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Evaluation of pathology ordering by general practitioners in Australia

CLARE FRANCES BAYRAM

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Sydney School of Public Health
Sydney Medical School
University of Sydney

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Abstract

This thesis describes and evaluates ordering of pathology tests by general practitioners (GPs) in Australia. Over the past decade the volume and cost of pathology services generated by GP orders have grown markedly, raising questions about reasons for, and appropriateness of, orders contributing to the increase.

This study uses data collected between 2000 and 2010 in the Bettering the Evaluation and Care of Health (BEACH) program, from 9,842 randomly sampled GPs about 984,200 encounters and 1,490,194 pathology tests/batteries of tests.

Multiple factors contributed to the total increase in volume of GP pathology orders from 2000–02 to 2006–08: increased likelihood of GPs' deciding to order test(s), increased number of tests ordered by GPs per episode, increased number of problems managed at GP–patient encounters, and increased population attendance rates. Just 22 health problems accounted for 59% of the growth in testing.

Significant independent predictors of the volume of pathology ordered by GPs, included some GP and practice characteristics, but the principal explanatory variable was the type of problem being managed.

For six common problems with high pathology test ordering rates, appropriateness of ordering was assessed, by measuring alignment of GPs' ordering with guidance documents. Alignment was good for: hypertension, Type 2 diabetes, lipid disorders and weakness/tiredness; and poor for 'health checks' and overweight/obesity.

Of the six problems investigated, overall increases in pathology ordering were seen for both 'appropriate' and 'inappropriate' tests. However, only a small proportion of tests were deemed inappropriate. I found no evidence to support concerns raised in the literature about assumed widespread inappropriate ordering, or assertions that increases in ordering reflect disproportionate increases in inappropriate ordering

For the ongoing management of chronic problems, pathology testing guidance was poor. Australia has an ageing population and therefore chronic problem management and the testing associated with it will inevitably increase. Improved guidance regarding pathology testing in chronic problem management could help support GPs' appropriate ordering in this high growth area.

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Contents

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Abbreviations

AACE	American Association of Clinical Endocrinologists
ABS	Australian Bureau of Statistics
ACE	angiotensin converting enzymes
ACRRM	Australian College of Rural and Remote Medicine
ADA	American Diabetes Association
AMTS	Australian Morbidity and Treatment Survey
ASGC	Australian Standard Geographical Classification
ATC	Anatomical Therapeutic Chemical [classification]
BEACH	Bettering the Evaluation And Care of Health
BMI	body mass index
bpac	Best practice advocacy centre
CDA	Canadian Diabetes Association
CHEP	Canadian Hypertension Education Program
CI	confidence interval [in this thesis 95% CI is used]
CK	creatine kinase
CRP	C reactive protein
CSANZ	Cardiac Society of Australia and New Zealand
CTFPHC	Canadian Task Force on Preventive Health Care
DA	Diabetes Australia
DAGDC	Diabetes Australia Guideline Development Consortium
DCGP	Dutch College of General Practitioners
DoHA	[Australian Government] Department of Health and Ageing
DVA	[Australian Government] Department of Veterans' Affairs
ESC	European Society of Cardiology
ESH	European Society of Hypertension
ESR	erythrocyte sedimentation rate
eTG	electronic Therapeutic Guidelines
EUC	electrolytes, urea and creatinine

FBC	full blood count
FMRC	Family Medicine Research Centre
FOBT	faecal occult blood test
FRACGP	Fellowship of the Royal Australian College of General Practitioners
FTE	full-time equivalent
GP	general practitioner
HbA1c	haemoglobin, type A1c
HDL	high density lipoprotein
HIV	human immunodeficiency virus
ICPC-2	International Classification of Primary Care (Version 2)
ICPC-2 PLUS	a clinical terminology classified according to ICPC-2
ICSI	Institute for Clinical Systems Improvement
IDF	International Diabetes Federation
IHD	ischaemic heart disease
ISH	International Society of Hypertension
JNC 7	Joint National Committee [seventh report of the committee]
LCL	lower confidence limit [in this thesis, this refers to the 95% LCL]
LDL	low density lipoprotein
LFT	liver function test
M,C&S	microscopy, culture and sensitivity
MBA	multibiochemical analysis
MBS	Medicare Benefits Schedule
MoH	[Singapore] Ministry of Health
MoU	Memorandum of Understanding
N/A	not applicable
NCEP	National Cholesterol Education Program
NEC	not elsewhere classified
NHF	National Heart Foundation
NHLBI	National Heart, Lung, and Blood Institute
NHMRC	National Health and Medical Research Council
NICE	National Institute for Health and Clinical Excellence

NICE NHS	NICE guideline designed for the National Health Service
NLASSA	National Lipid Association Statin Safety Assessment
NOF	National Obesity Forum
NOS	not otherwise specified
OCCPG	Obesity Canada Clinical Practice Guidelines
OECD	Organization for Economic Co-operation and Development
Pap smear	Papanicolaou smear
PBS	Pharmaceutical Benefits Scheme
PSA	prostate specific antigen
PST	Pathology Services Table [Category 6 of the MBS]
RACGP	Royal Australian College of General Practitioners
RCPA	Royal College of Pathologists of Australasia
SAND	Supplementary Analysis of Nominated Data
SAS	Statistical Analysis System
SIGN	Scottish Intercollegiate Guidelines Network
STI	sexually transmitted infection
T2D	Type 2 diabetes
TFT	thyroid function test
UCL	upper confidence limit [in this thesis, this refers to the 95% UCL]
UK	United Kingdom
US	United States [of America]
USPSTF	United States Preventive Services Task Force
USyd	University of Sydney
WHO	World Health Organization

Symbols

‡	indicates that the term is defined in the Glossary
🡅/🡇	indicates a statistically significant linear change
↑/↓	indicates a marginally significant linear change
—	indicates no change
<	less than
>	more than
≥	greater than or equal to
≤	less than or equal to
n	number
. .	indicates that the table category/data item does not apply

Glossary

Throughout this thesis terms that are defined in the glossary are marked with the symbol ‘‡’. Terms are only marked the first time they are used in the text.

Accreditation: Indicates that the practice is accredited against the Royal Australian College for General Practitioner’s ‘Standards for general practices’.

Activity level: The number of MBS GP consultation service items claimed during the previous 3 months by a participating GP.

Analyte: A chemical substance (in a fluid or other specimen from the body) that a laboratory test aims to detect. A single pathology test or battery of tests may include multiple analytes.

Battery of tests: A standard group of related tests (sometimes called a ‘test profile’) that are ordered together and referred to as a group. For example, a ‘full blood count’ is a battery of tests that examine different parts of the blood, and often includes: white blood cell count, red blood cell count, haemoglobin, and platelets.

Diagnosis/problem: A statement of the provider’s understanding of a health problem presented by a patient, family or community. GPs are instructed to record at the most specific level possible from the information available at the time. It may be limited to the level of symptoms.

- **New problem:** The first presentation of a problem, including the first presentation of a recurrence of a previously resolved problem, but excluding the presentation of a problem first assessed by another provider.
- **Old problem:** A previously assessed problem that requires ongoing care, including follow-up for a problem or an initial presentation of a problem previously assessed by another provider.

Encounter: Any professional interchange between a patient and a GP.

- **Indirect:** Encounter where there is no face-to-face meeting between the patient and the GP but a service is provided (for example, prescription, referral).

- **Direct:** Encounter where there is a face-to-face meeting of the patient and the GP.

Episode coning rule: The MBS payment rule that restricts (to a maximum of three per ordering episode) the number of MBS pathology items that can be claimed by the pathologist for pathology tests ordered by GPs for non-hospitalised patients. Payment is made for the three items with the highest rebate amount.

General practitioner (GP): A medical practitioner who provides primary, comprehensive and continuing care to patients and their families within the community.

Health concession card: Patients holding a Health care/benefit card and/or a Repatriation health card.

Health care/benefit card: A card entitling the holder to a higher level of Government subsidy for health services (for example, reduced-cost medicines under the Pharmaceutical Benefits Scheme). Examples of patients who may be eligible include pensioners, unemployed, low-income earners.

ICPC-2 chapters: The main divisions within ICPC-2. There are 17 chapters primarily representing the body systems.

Iso-resource group: A group of pathology tests that each use a similar amount of resources. The reimbursement and structure of some MBS pathology items are based on iso-resource groups of tests.

Medicare Benefits Schedule (MBS) item: Each item number identifies a service funded through Medicare. The MBS lists all the Medicare services subsidised by the Australian Government, their schedule fees and conditions for use.

- **MBS GP consultation service items:** Includes GP services provided under the MBS professional services category including MBS items classed as A1, A2, A5, A6, A7, A14, A17, A18, A19, A20, A22 and selected items provided by GPs classified in A11, A15 and A27.
  - **Level A items:** MBS item numbers 3, 4, 13, 19, 20. A ‘Level A’ item will be used for obvious and straightforward cases and this should be reflected in the practitioner’s records. In this context, the practitioner should undertake the necessary examination of the affected part if required, and note the action taken.

- **Level B items:** MBS item numbers 23, 24, 25, 33, 35. A ‘Level B’ item will be used for a consultation lasting less than 20 minutes for cases that are not obvious or straightforward in relation to one or more health related issues. The medical practitioner may undertake all or some of the following tasks (as clinically relevant): taking a detailed history, a clinical examination, arranging any necessary investigations, implementing a management plan, and providing appropriate care.
- **Level C items:** MBS item numbers 36, 37, 38, 40, 43. A ‘Level C’ item will be used for a consultation lasting at least 20 minutes for cases in relation to one or more health related issues. The medical practitioner may undertake all or some of the following tasks (as clinically relevant): taking a detailed history, a clinical examination, arranging any necessary investigations, implementing a management plan, and providing appropriate care.
- **Level D items:** MBS item numbers 44, 47, 48, 50, 51. A ‘Level D’ item will be used for a consultation lasting at least 40 minutes for cases in relation to one or more health related issues. The medical practitioner may undertake all or some of the following tasks (as clinically relevant): taking a detailed history, a clinical examination, arranging any necessary investigations, implementing a management plan and providing appropriate care.

- **MBS pathology item:** Each pathology item number identifies a pathology service that is funded through Medicare. The MBS pathology items are listed in the Pathology Services Table of the MBS.

Pathology ordering: The ordering of pathology tests or batteries of tests by GPs or other clinicians. Primarily in this thesis it refers to GPs’ ordering of pathology tests or batteries of tests.

Patient status: The status of the patient to the practice.

- **New patient:** The patient has not been seen before in the practice.
- **Old patient:** The patient has attended the practice before.

Problem managed: *See Diagnosis/problem*.

Problem–pathology link: The link between the pathology test (or battery) and the problem under management at the encounter. Each test must be linked to at least one problem, and up to four problems per encounter. There are more problem–pathology links than numbers of tests recorded at encounters.

Provider: A person to whom a patient has access when contacting the health care system.

Recognised GP: A medical practitioner who is:

- vocationally recognised under Section 3F of the *Health Insurance Act*, *or*
- a holder of the Fellowship of the Royal Australian College of General Practitioners who participates in, and meets the requirements for, quality improvement and continuing medical education as defined in the Royal Australian College of General Practitioner's Quality Improvement & Continuing Professional Development Program, *or*
- undertaking an approved placement in general practice as part of a training program for general practice leading to the award of the Fellowship of the Royal Australian College of General Practitioners, or undertaking an approved placement in general practice as part of some other training program recognised by the Royal Australian College of General Practitioners as being of equivalent standard.

Repatriation health card: An entitlement card provided by the Department of Veterans' Affairs that entitles the holder to access a range of Repatriation health care benefits, including access to prescription and other medications under the Pharmaceutical Benefits Scheme.

Rubric: The title of an individual code in ICPC-2.

Significant: This term is used to refer to a statistically significant result. Statistical significance is measured at the 95% confidence level in this report.

1 Aims and candidate's contribution

1.1 Aims

This thesis aims to assess general practitioners' (GPs) pathology test ordering and the changes in their ordering patterns; evaluate the quality of this ordering in terms of the variance among GPs, and its alignment with guidelines; and predict future ordering for an increasing and ageing population. More specifically, the aims are:

- to describe GPs' pathology test ordering, and growth over time in this ordering, in terms of the types of tests ordered, and the types of problems for which tests were ordered.
- to identify the tests and problems that accounted for high growth in the volume of GPs' pathology ordering over time, and the factors that contributed to this growth.
- to determine the appropriateness of GPs' pathology test ordering for selected problems in terms of its alignment with recommendations for pathology testing made in guidelines and other sources of guidance.
- to determine the variance among GPs in their pathology test ordering rates and identify factors that may explain this variance.
- to estimate the growth in volume of GPs' pathology ordering to 2050, as a result of the projected growth and ageing of Australia's population.

1.2 Candidate's contribution

The candidate was fully involved in all aspects of the research reported in this thesis, including the conceptualisation, design, planning and conduct of the research. The candidate undertook an extensive literature review involving selection of databases, libraries and other sources of information including published guidelines and guidance documents.

In this thesis I present a series of studies, all of which utilise data collected in the BEACH (Bettering the Evaluation and Care of Health) program. The candidate's involvement in the BEACH program, at the Family Medicine Research Centre (FMRC), University of Sydney, is described below.

The study measuring the appropriateness of GPs' pathology test ordering (reported in Chapter 5) was funded through a competitive grant from the Quality Use of Pathology Program, Australian Government Department of Health and Ageing. The candidate assumed full responsibility for conduct of the study, research design (including selection of problems for investigation, identification and review of guidance documents) and preparation of reports. Professors Helena Britt and Graeme Miller prepared the initial funding application, nominating the candidate as the responsible researcher.

The candidate conceptualised, designed and initiated the SAND (Supplementary Analysis of Nominated Data) study (reported in Chapter 6). This included conceptualising and designing the questionnaire form and instructions, and obtaining ethics approval for the study from the Ethics Committee of the Australian Institute of Health and Welfare, and the Human Research Ethics Committee of the University of Sydney. The candidate prepared the specifications for the electronic data entry form which was implemented by the Centre's IT manager, Mr Tim Chambers. The candidate also oversaw the data entry undertaken by trained casual staff.

Data cleaning and checking were performed by the candidate and assisted by Ms Lisa Valenti, under instruction from the candidate. Statistical analyses for the results reported in Chapters 4 to 8 were specified by the candidate with the assistance of her supervisors Professors Helena Britt and Graeme Miller. The candidate independently performed the analyses for the extrapolations presented in Chapter 4. Under the candidate's close instruction, senior analysts in the research team at the FMRC undertook the remaining analyses: Ms Lisa Valenti conducted the analyses for Chapters 4 to 7; and Mr Christopher Harrison conducted the analysis for Chapter 8.

The preparation and creation of this manuscript, the literature review, reporting and interpretation of results, the discussion and conclusions made, are solely the work of the candidate.

A list of publications and presentations arising from this thesis is provided in Appendix 1. Two publications of which the candidate is lead author have emanated from this work. The research presented in Chapter 4 was published as a peer-reviewed chapter in the report *General practice in Australia, health priorities and policies 1998–2008.*[1] The final report of the work conducted for the Quality Use of

Pathology Program grant (reported in Chapter 5) was published by the Australian Government Department of Health and Ageing online: *Evidence-practice gap in GP pathology test ordering: a comparison of BEACH pathology data and recommended testing*.[2] As a result of this work, the Australian Government Department of Health and Ageing invited the candidate to become a member of the (pathology) Demand Management Advisory Committee (established in late 2011). Her involvement with this committee is ongoing.

Candidate's involvement in the BEACH study

The research reported in this thesis uses data collected in the BEACH program, a continuous national study of general practice activity. BEACH commenced in April 1998 and in April 2012 started its fifteenth year of data collection.

The BEACH study was established two years prior to the candidate joining the research team at the FMRC. The candidate was initially employed at the FMRC in 2000 while an undergraduate student as a casual data entry staff member. She completed her Honours thesis using BEACH data (Male consultations in general practice[3]) in 2001, and has been employed on a full-time basis since this time. Over the years the candidate has been involved in every aspect of the BEACH study including recruitment, data entry, training data entry staff, data checking, form design, planning and overseeing analysis for specific topics, producing and editing reports, preparing papers and presenting results at conferences.

The candidate's current primary work role is to update and design the BEACH recording forms. This includes annual updates of the standard BEACH data collection forms as required, co-ordination and design of the SAND substudies (in collaboration with external stakeholders), submission of forms for ethics approval, and preparing the forms for printing. The candidate is also responsible for co-ordinating the publication of the General Practice Series BEACH books, involving timeline management, editing and liaising with the publisher.

2 Introduction

Pathology is defined as "the branch of medicine that studies the essential nature of disease, especially the structural, biochemical, and functional changes in the cells, tissues and organs of the body that cause or are caused by disease".[4] Pathology tests are critical in modern medical practice, and are essential for disease prevention, diagnosis and monitoring.

In Australia, the use and cost of pathology testing has increased over past decades across multiple health sectors.[5,6] A similar pattern has occurred in most developed countries, despite differences in how the various health systems are managed and pathology services funded.[7-12]

This growth has raised concerns, in Australia and internationally, about what is driving the increased use of pathology testing, the viability of the increased costs, and whether this expenditure represents appropriate health care spending.[6-9] Despite these concerns being expressed and investigated over decades, the use and cost of pathology tests have continued to increase.

In Australia, over the decade 2000 to 2010, the cost of pathology services funded by the Australian Government through the national insurance scheme, Medicare, increased by 78.0%: from $1.2 billion in the 2000–01 financial year to $2.0 billion in 2009–10.[5] Similarly the volume of pathology services increased, from 62.1 million claimed (3.2 per capita) in 2000–01 to 103.7 million (4.7 per capita) in 2009–10, a 67.0% increase in the number of claimed services and a 46.9% increase in the number of services per capita.[5,13]

These pathology services represent those ordered by general practitioners‡ (GPs) and other medical specialists for non-hospitalised patients, and 68–70% of Medicare pathology outlays over the decade (E Wilson, personal communication, March 2011) were generated by GPs' pathology ordering‡. The focus of this thesis is pathology ordering by GPs, as it accounts for the majority of the Government-funded pathology services in Australia.

The structure of the Australian health care system is complex, as are the arrangements for Government funding of pathology services within the system. An

understanding of both is required to understand the context of the research presented in this thesis.

A brief overview of the Australian health care system

Governance of the Australian health care system is shared between the Federal, and the State and Territory Governments. The health care system is funded through a mixture of public and private sources including governments, health insurers and individual Australians.

The Federal Government is responsible for national health policy, and controlling and managing the national health insurance scheme, Medicare. Through Medicare, the Australian population have access to free or subsidised treatment provided by a variety of health professionals. The Medicare Benefits Schedule (MBS) lists the health services for which Medicare benefits are available, the rebates for these services and the conditions for use. The health care system provides free treatment to Australian residents using public hospitals, and free or subsidised treatment by GPs and other medical specialists. Individual clinicians determine whether or not their services are charged directly to Government at the Medicare rebate level and are free to patients (referred to as bulk-billing). When not bulk-billed, the patient pays the fee set by the provider[‡] and seeks reimbursement of the appropriate Medicare rebate, with the patient covering any difference between the fee and rebate. The Federal Government is also responsible for the Pharmaceutical Benefits Scheme (PBS), which subsidises the cost of prescribed medications. Private health insurance is optional in Australia, and its cost to an individual is subsidised through taxation rebates provided by the Federal Government. Private health insurance does not cover services provided by GPs or the pathology tests ordered by GPs, when such services/tests are covered by Medicare.

As set out in the Australian Health Care Agreements, Federal and State/Territory Governments jointly fund public hospitals. The State and Territory Governments are responsible for the management of public hospitals and community care services.

Australia's health expenditure in 2009–10 was $121.4 billion, and accounted for 9.4% of gross domestic product. Governments funded 70% of this expenditure and other non-government sources including patients, funded the remaining 30%.[14]

In June 2010, the population of Australia was estimated to be 22.3 million people.[15]

General practitioners

GPs are usually the first point of contact in the Australian health care system. In 2009–10, about 83% of the Australian population had at least one GP visit funded by Medicare (Department of Health and Ageing [DoHA], personal communication, June 2010). Payment for GP visits is largely on a fee-for-service basis, there being no compulsory patient lists or registration. People are free to see multiple GPs and visit multiple practices of their choice.

GPs have a gatekeeper role in the health care system. GP 'referral' is needed in order for patients to access Medicare benefits for many health services including pathology tests, imaging tests and medical specialist care. GP referral is the most common way by which the population accesses Medicare-subsidised pathology services. Patients may also access these services through medical specialist referral. Similarly access to PBS-subsidised medications requires a prescription from a medical practitioner.

In Australia, there were 24,029 practising primary care practitioners (vocationally recognised GPs[‡] and other medical practitioners) in 2008, making up 23,188 full-time equivalents (based on a 40 hour week), or 107.9 per 100,000 people.[16]

The vast majority of GP services are funded through Medicare.[17] In 2009–10 there were 116.6 million Medicare-funded GP encounters, an average of 5.2 per person in Australia, and the majority (79.5%) were bulk-billed.[5,13] The Medicare cost for these GP encounters was about $4.9 billion.[5]

The number of Medicare-funded GP services has increased over the decade 2000 to 2010, from 100.6 million encounters in 2000–01 to 116.6 million in 2009–10.[5] The number of services per person and the proportion of services that were bulk-billed were similar in 2000 and 2010. However there was a decline in both during the mid 2000's: the number of GP visits per person fell to a low of 4.8 per capita in 2003–04 compared with 5.2 in 2000 and 2010;[13] and the proportion of services bulk-billed fell to 68.2% in 2003–04 compared with 78–80% in 2000 and 2010.[5] These falls prompted concerns about patient access to care and in response the Government introduced several 'Strengthening Medicare' initiatives in 2004[18] which were successful in increasing access to GP services.

Pathology funding arrangements

The pathology sector comprises private and public laboratories. Public laboratories are primarily based in public hospitals and private laboratories are based in the

community. The private sector is dominated by a few large private pathology companies. The way pathology services are funded and the type of laboratory conducting the testing varies based on the health setting in which pathology tests are ordered and the type of clinician ordering the test.

Pathology ordered for patients of public hospitals is conducted in public laboratories and funded under the Australian Health Care Agreements. Pathology ordered by GPs and other medical specialists for non-hospitalised patients is funded through Medicare as set out in the MBS Pathology Services Table (PST), and mostly undertaken in laboratories owned by private pathology companies. The PST outlines the tests that are funded through MBS pathology items[‡], their rebates and conditions of use.

All MBS pathology services must be ordered (or 'referred') by GPs or other medical specialists. Pathologists claim for MBS pathology items for tests ordered on a fee-for-service basis and can elect whether to bulk-bill patients for these services. A high proportion of pathology services are bulk-billed (i.e. free to the patient). Across the period 2000 to 2010, an average of 85.0% of MBS pathology services were bulk-billed.

While bulk-billing has remained high, the average rebate for MBS pathology items has decreased. In real terms the average rebate per MBS pathology item in 2008–09 was below what it was when Medicare began in 1984.[19] This has been achieved through amalgamation and centralisation of pathology laboratories in Australia and increased automation of testing. Therefore, while the total number and cost of Medicare-funded tests continues to increase, the proportion of total Medicare benefits accounted for by pathology services is decreasing. In 2000–01 pathology services accounted for 15.8% of Medicare benefits and in 2009–10 they accounted for 13.0%.[5]

In funding MBS pathology services the Australian Government acts as the sole purchaser, setting the regulatory framework, and managing the PST.[20] These structures and rules ensure high quality pathology services, and facilitate management of outlays. To some extent they have evolved in response to allegations during the 1980's and 1990's of fraud (such as inducements and 'kickbacks') and overservicing in Australia.[21]

The vast majority of pathology tests ordered by GPs are included in the MBS and funded through Medicare. However, there are some exclusions. For example, point of care tests, while available to GPs, are not currently funded by Medicare. In part this is due to poor cost-effectiveness.[22]

This thesis is concerned with tests ordered by GPs that are funded through Medicare. Theoretically the data held by the Federal Government of the MBS pathology items claimed should provide a picture of the ordering behaviour of GPs. However, there are MBS structure and payment rules that mean the Medicare data cannot provide an exact reflection of pathology requested by GPs. The two main factors are the episode coning rule‡ and the structure of some MBS pathology items.

The episode coning rule restricts the number of MBS pathology item numbers that can be claimed by the pathologist per episode of ordering for pathology tests requested by GPs for non-hospitalised patients. This rule means that a maximum of three MBS pathology items can be claimed per episode of ordering, payment being made for the three items with the highest rebate amount (i.e. highest cost). Some MBS pathology item numbers are exempt from the coning rule, such as Papanicolaou (Pap) smear items.[23]

Each MBS pathology item number can either represent a single pathology test or multiple pathology tests. Item numbers that include multiple tests usually reflect iso-resource‡ groupings, and for some of these items, the amount paid for such items is based on the number of tests ordered from within the group (referred to as ladder items). For example, one test from the group, two tests from the group, and so on, to a maximum of five tests from the group.[23]

In addition to the MBS payment rules outlined in the PST, outlays for pathology services were capped through a series of Memoranda of Understanding (MoU) (up to 2009) between the Australian Government and the pathology industry and profession. The first was introduced in 1996, and in 2008, at the commencement of the research for this thesis, the third MoU was in place. It covered 1 July 2004 to 30 June 2009, and aimed to contain growth in outlays to an average of 5.3% per annum.[24]

At the completion of the third MoU, the MBS pathology funding arrangements were reviewed.[20] Following this review, the MBS funding arrangements remain largely unchanged, and a new 5-year funding agreement was introduced in July 2011.[25] The

review was partially prompted by the 2008 audit of the MoU, undertaken to investigate why the financial objectives of the MoU were not being met. Over the 2004–08 period, the annual growth in pathology outlays covered by the MoU was 7%, rather than the projected 5%, following the Government's introduction of national policy initiatives that produced an unanticipated increase in demand for pathology services. In addition to policy influences, the audit reported several factors that were thought to be associated with increased demand for pathology testing. The audit revealed that there was limited Government understanding of the drivers of demand and recommended that this be improved as it is essential for management of future pathology outlays.[26]

Why is pathology testing increasing?

Over the years, the increases in pathology testing have been attributed to numerous factors, including: the ageing population;[9,26,27] defensive testing due to practitioner concerns about medicolegal implications of not testing;[9,26,28] increasing patient demand for testing;[26,28,29] increased disease awareness (e.g. due to educational campaigns) and disease prevalence, leading to increased diagnostic and/or management rates;[27] changes in the management of established disease;[9,27] increased availability of tests;[9,26] improvements in testing technologies;[29] increased use of computers for ordering tests;[29,30] and policy initiatives.[26,27,29]

In Australia, policy initiatives that have been associated with increases include those that aim to improve patient access to medical services (such as the Strengthening Medicare initiatives), improve provision of preventive care, and facilitate better management of diseases (such as MBS items‡ for health assessments and chronic disease management).[26,27] Similar influence of policy initiatives on test ordering is seen internationally, for example the introduction of Quality and Outcomes Framework indicators that incorporated pathology test indicators in the United Kingdom (UK).[29]

Another factor linked to increased use of pathology services is a lack of economic signal. In Australia, due to the structure of MBS pathology funding and the high rate of bulk-billing, the patient and the referring clinician do not pay for, and are unaware of, the costs of pathology tests. This funding situation is called the 'third party payer problem' and has been referred to as a "fundamental market flaw".[31]

These factors are used to explain increases in pathology ordering by all clinicians, including that by GPs. The increased volume of pathology tests generated by GPs can be attributed to these factors working on the mechanisms of increasing GP workload, and/or changes in GPs' pathology ordering behaviour. The latter can be characterised by changes in the GPs' decision to initiate ordering, and the type and/or number of pathology tests ordered when the decision to order is made.

The relationship between these factors and the increases in GPs' ordering of pathology tests is not always proven. For example, while patient demand for testing is high (14–39% expect pathology or imaging tests when they visit the GP[32-35]) and GPs report this as a reason for ordering pathology,[36,37] there is no evidence that patient demand has increased. Similarly the increased use of computers by GPs was thought to increase the ease with which pathology tests could be ordered and therefore contribute to increased GP demand.[30] However, two studies found no independent effect of computer use on GPs' pathology ordering.[30,38] In contrast, the association of other factors is much stronger. For example the effect of Australia's ageing population on increased demand for pathology tests can be established, as the use of pathology services increases with age.[27] Similarly some national policy initiatives were determined to have increased the demand for pathology testing, and this resulted in adjustments to the third MoU.[26]

With the numerous factors linked to increased demand for pathology testing, and the likely overlap between them,[39] it is no wonder that understanding what is driving the increased demand for pathology testing has proved difficult. Further, it is reasonable to assume that the factors associated with increased demand would not equally affect all circumstances in which pathology tests were ordered.

Notably absent in the literature that discusses increases in pathology testing, is information about the tests and clinical problems for which GPs' pathology testing has increased.

Why are pathology tests ordered?

Two recent reviews investigated the reasons tests are ordered by clinicians.[40,41] Both reviews took a very focussed approach: Whiting et al. concentrated on reasons tests were ordered for patients with undiagnosed symptoms,[40] and Sood et al. only on variables that were related to the physician and were 'non-evidence-based'.[41] The focus taken by these reviews largely excluded the accepted clinical reasons for

pathology test ordering: to diagnose, monitor, assess prognosis, assess severity, or to screen for diseases.[8,30,37,42]

Further, the extent to which results of the reviews can be generalised to describe the reasons that GPs' order pathology tests is limited due to their narrow focus and the heterogeneity of the reviewed studies. Differences between the studies include: the types of tests investigated (i.e. a mixture of pathology, imaging and other diagnostic tests); the methodology used (including qualitative, quantitative and mixed methods); and the context of the study (i.e. the health settings, the types of clinicians ordering tests and the specific disease or test investigated).[40,41]

Whiting et al. identified more than 30 reasons for ordering tests for undiagnosed symptoms and categorised these into five interrelated groups.[40] Reasons classified as: diagnostic (e.g. to modify pretest probability of disease, rule disease 'in' or 'out'); and therapeutic and prognostic (e.g. decide on appropriate treatment) could be considered evidence-based reasons for testing. However, the same could not be said for many of the: patient-related (e.g. patient preference); doctor-related (e.g. clinical experience and confidence in clinical judgement, speciality); and policy and organisational factors (e.g. practice size, test availability).[40]

In their review, Sood et al. divided 'non-evidence-based' physician variables associated with ordering into those that could be modified and those that could not. Non-modifiable factors included geographic location, practice setting, age and sex, and clinical setting. Modifiable factors included experience and knowledge, belief systems, medicolegal concerns, financial incentives/awareness of cost of testing, and provision of feedback/education.[41] It is somewhat inflammatory to label all of these factors as non-evidence-based. In particular, the provision of feedback and education, which is cited as being very successful in reducing test ordering and the "best-studied modifiable variable", often involves the introduction of evidence through feedback and education. To label it as non-evidence-based is misleading.

Despite the limited applicability of the reviews to general practice, Van der Weijden et al.[36] found GPs in a small Dutch qualitative study reported similar reasons for ordering pathology testing in diagnostic uncertainty as those reported by Whiting et al.[40] for undiagnosed symptoms. Variables most often linked by others to GPs' pathology ordering are those related to the GP and the practice, and would be considered 'non-evidence-based' according to Sood's review. GP variables linked to

testing include age,[43-45] sex,[43,46-48] geographic location and number of GPs working in the practice.[43,45-47,49-51]

The bulk of the literature discussing reasons for pathology ordering focuses on the non-clinical reasons for testing, excluding the crucial fact that pathology is ordered in a clinical interaction between a patient and a clinician primarily for a clinical purpose. I believe the focus on non-evidence-based factors has occurred because they can be considered inappropriate and are potentially a modifiable area to target in the context of increasing testing. However, while they exist, a small study by Enno et al. demonstrated that they were not the primary reasons that GPs in Australia ordered pathology tests. The main reasons for ordering 3,419 pathology tests were: to establish a diagnosis (31.6% of 3,840 reasons for ordering), to monitor illness (29.1%), for screening (15.1%), or to monitor drug therapy (11.5%). GPs nominated non-evidence-based patient-related (3.7%) and doctor-related reasons (3.2%) far less frequently.[37]

Inappropriate testing and outcomes

The question of whether pathology tests are ordered appropriately has become an important issue due to the continuing increase in pathology ordering, and our inability to completely determine what is driving this increase.[9,42,52-54]

Determining what testing is inappropriate and how much pathology testing is ordered inappropriately is difficult. In their review of 44 studies, Van Walraven and Naylor found that 5-95% of tests were reported as inappropriate, the majority of studies reporting that 10-50% of tests were inappropriate.[52] They found that the level of evidence in studies evaluating the appropriateness was poor. The studies were heterogeneous in terms of the health setting investigated, the clinicians involved, the clinical problem investigated, and the tests investigated. In addition, the criteria used to judge appropriateness were found to be diverse and flawed. Part of the problem with assessing appropriate test use is the dearth of high-level evidence demonstrating the clinical value of pathology tests and the optimal way in which they should be used.[39,52,55-57]

Despite the poor evidence, and Van Walraven and Naylor's conclusion that "allusions to extensive inappropriate use should not be made without appropriate qualifiers",[52] these statements are common within the literature.[8,9,28,29,58,59] It is reasonable on the basis of the available evidence to say that some pathology ordered

in selected circumstances is inappropriate and/or that some tests are ordered inappropriately. But to conclude that inappropriate test ordering is widespread, overstates the available evidence.

Another statement repeated in the literature is that the increase in pathology ordering is due (either totally or partly) to increases in inappropriate pathology ordering.[12,58] However when you trace the origins of references used to support these statements the evidence is not there or is decades old. It appears that two true separate statements [(i) that pathology ordering is increasing, and (ii) that some of this testing is inappropriate] have merged to become a single unsubstantiated concept.

Some have proposed that the appropriateness of pathology testing can be evaluated by whether it improves the patient's or public's health outcomes.[60,61] This has given rise to the argument that the increased use of pathology testing has not corresponded with improved health outcomes or health status,[9,31,61] the inference being that the increased use of testing is unjustified.

This argument is extremely hard to prove or disprove as measuring outcomes associated with pathology ordering is notoriously difficult and studies that evaluate outcomes are rare.[52,61,62] Partly this is because it is not the use of a pathology test in isolation that affects outcomes, it is the clinician's actions (or lack thereof) in response to test results that affect outcomes. Further, numerous outcome measures can be used.[61,63] There are examples in the literature where: use of pathology tests has resulted in improved outcomes;[64,65] reduction in the use of tests has not adversely affected outcomes;[66-68] and use of tests have contributed to adverse patient outcomes.[69] Such studies are usually conducted in confined clinical settings (e.g. patients in hospital) where the association between testing and a specific outcome can be measured.

There is no conclusive evidence to support the broad assertion that the increased use of pathology tests has not improved patient outcomes. The lack of quality evidence to measure outcomes has resulted in the call for an outcomes research agenda for pathology testing.[42,57] The development of methods to assess such outcomes is a current area of research.[70]

While these issues are important, the extrapolation of flawed evidence to make broad statements about the appropriateness (or lack thereof) of all pathology testing, paints the whole issue in an unnecessarily negative light. These general perceptions are

applied to all pathology ordered in all settings. As GPs in Australia order the majority of Medicare-funded pathology tests, the negative perception is often applied to their ordering behaviour, even though many of the studies of appropriateness and outcomes were not conducted in general practice.

Criteria used to assess the quality of GPs' pathology ordering behaviour often include the appropriateness of their ordering in selected clinical situations (e.g. for a specific disease) and the variance among GPs in their use of pathology tests. The presence of inter-GP variance is well established. Studies have found this variance is only partially explained by GP, practice and patient characteristics.[43-51,71-73] However, investigation of this variance often excludes consideration of the contribution of the clinical problem (or purpose) for ordering as these data are not routinely available. When included, the clinical problem being managed has been found to explain the largest proportion of variance.[45,73]

Studies introducing interventions to improve appropriateness of GPs' pathology ordering are used in the literature to demonstrate the presence of inappropriate ordering. Change, usually a reduction, achieved following interventions is used to 'prove' that appropriateness of ordering can be improved. However, these studies rarely assess the appropriateness of these changes. Success is measured purely on test ordering rates without linked clinical data (such as the problem for which testing was ordered). Hence, while the intervention makes recommendations about appropriate pathology ordering in a given clinical situation using clinical data available to GPs at the time of ordering, such clinical data are not available in the assessment of the impact of the intervention. In the absence of such data, a measured change in the ordering rate of the related pathology tests is assumed to be due to improved appropriateness of ordering.

I found two studies that directly assessed appropriateness of change following interventions targeting a limited number of pathology and diagnostic tests.[74,75] The authors reported that this assessment was laborious and that appropriateness was only improved for selected tests. Both studies were randomised control trials. In one study, Verstappen et al. found that improvement in appropriateness aligned with reduction in use of tests.[74] This was not the case for Winkens et al.[75] who found that for one group of tests, GPs' testing rates did not change but appropriateness of ordering improved, and for a second group of tests, GPs' testing decreased

significantly but there was no change in the proportion of tests that were appropriate.[75] It was hypothesised that this unusual finding was due to a high level of appropriate use of testing in the second group at baseline (prior to the intervention).

Some authors acknowledge the limitation of being unable to assess appropriateness of change, but argue that such change can be assumed to be due to improved appropriateness because this is the basis of the intervention.[76-79] I believe that this is a fair assumption in cases where testing is known (or likely) to be inappropriate at baseline. Most studies meet this requirement, interventions having been targeted to 'problem' areas of pathology ordering. This approach is logical from the perspective that limited funds are available for interventions, and targeted interventions are likely to be cost-effective. However, in relation to the broader discussion of appropriateness of GP ordering, it is problematic.

First, the need for cost effectiveness means that interventions are almost exclusively targeted to areas where a reduction in testing is anticipated. As summarised by Winkens and Dinant "ideal interventions would improve the rationality of ordering of investigations while at the same time leading to fewer requests being made."[9] Consequently areas in which improved appropriateness of testing may lead to increases in testing are excluded.

Second, targeting problem areas means that most interventional studies are conducted in very focussed clinical situations targeting a limited number of pathology tests[58,80-84] or pathology testing for a limited number of clinical problems.[11,75,77,85-87] While we know that a minority of problems and tests account for the majority of pathology ordered by GPs,[45,79,82,88,89] this is not the basis for the selection of tests and problems. Therefore these studies do not provide an overall impression of the appropriateness of GPs pathology ordering behaviour.

While these interventional studies can be used to demonstrate that there are areas of inappropriate ordering by GPs, they cannot be used to give an accurate evaluation of the extent of this inappropriate ordering.

Interventions in pathology ordering

Numerous interventions have been used in an attempt to modify clinicians' pathology test ordering behaviour. In her 1991 review, Leese categorised interventions as involving: education; feedback; participation (i.e. involving clinicians in the need for, and development of an intervention); peer review; financial

incentives; and administrative changes (i.e. changes that control or direct choices regarding testing, such as policy change).[90] Others have used similar categories to describe interventions.[91-94]

Reviews of interventional studies found that success of the interventions was limited and the methodological quality of the studies was poor.[91-94] For example, many studies lacked a control group or used a historical control group when evaluating interventions, and many lacked follow-up to determine whether the effect of interventions was sustained.[93] The most recent review was conducted by Solomon et al. in 1998. Of the 49 studies reviewed that involved interventions to improve clinicians use of diagnostic tests, 76% reported favourable change in the clinicians use of tests. Despite the poor methodology and diversity of the studies, Solomon et al. found that those targeting multiple behavioural factors were more successful than those that targeted a single behavioural factor.[91]

The extent to which results of these reviews can be applied to the general practice setting is limited due to the heterogeneity of the included studies. They included multiple types of tests (pathology and imaging), clinicians, health settings, and patient groups. Most of the reviewed studies were not conducted in general practice. For example of the 49 studies reviewed by Solomon et al. only 8 were conducted in general practice.[91]

Several studies have reported interventions in general practice. Since 1990 results of 19 intervention strategies have been published.[11,58,74-77,79-87,95-100] Each 'strategy' often incorporated more than one intervention and some strategies were used in multiple studies. Types of interventions used include: changes to the laboratory order form (either paper-based[11,80,83,97,99] or computer-based order form[79,81,100]), education (such as educational materials and meetings),[11,58,74,75,77,82-85,95,100] feedback,[58,74,75,77,82,85,95,96] decision support,[76,79,86,87] and changes to funding rules or arrangements.[98,99] Guidelines were the basis for many of these interventions.[74-77,83,85-87,95]

Almost all of the published studies reported success in achieving all or some of the desired change (most often a decrease) in GPs' pathology ordering rates, which may represent an element of publication bias. Only two reported no success in changing clinician behaviour.[82,86]

In Australia in the past 15 years, no studies were published that reported the effect of interventions targeting GPs' pathology ordering behaviour. However, the Australian Government Quality Use of Pathology Program (established in 1999) supports quality ordering of pathology services and provision of quality services by funding projects that promote quality use of services.[101] Other educational programs (such as the Common Sense Pathology series produced by the Royal College of Pathologists of Australasia [RCPA][102]) and administrative interventions have also been introduced. To date, most national interventions have been administrative and reflect efforts to contain pathology outlays. These were primarily supply-based controls acting on the pathology industry through the MoUs and the MBS structures and rules.

Few national initiatives have sought to modify demand for pathology services by referring GPs. Those that do have been largely incorporated into MBS rules, including indication and frequency restrictions for selected MBS pathology items.[23] For example, the MBS 'HbA1c test' item is only claimable for patients with established diabetes and can be claimed a maximum of four times within a 12 month period. Additionally, paper-based laboratory order forms are regulated to ensure that no 'tick box' lists of tests are provided, although the high level of GPs' use of clinical software[17] which allows 'tick box' pathology ordering may negate this measure.

The Government's ability to introduce interventions targeting GPs' pathology ordering is hampered by the limitations of the Medicare data in describing the GPs' pathology 'referral' behaviour. The Medicare data do not accurately reflect of the types of tests ordered by GPs due to the structure of the MBS items and the episode coning rule. In 2010, it was estimated that approximately 30% of MBS pathology items generated by GP orders were not eligible for funding due to coning.[19] Further the Medicare data do not include any information about the clinical problems for which pathology tests were ordered. Such data are required to evaluate the appropriateness of GPs' ordering and identify areas in which interventions may be needed. This evaluation step is missing in much of the international literature due to the lack of availability of clinical data (particularly the patient problem under management) related to GPs' pathology ordering. This has led to judgements of

appropriateness based on limited evidence, and has hampered investigation of the clinical problems contributing to the increases in GPs' pathology ordering.

In Australia, data describing GPs' pathology ordering behaviour are collected in the BEACH (Bettering the Evaluation and Care of Health) program. BEACH is a continuous cross-sectional national study of general practice activity, and is the only national source of data that allows analysis of the relationships between pathology ordered and problems managed[‡] by GPs. Other factors such as the characteristics of the patient and the GP are also available for such analyses. For these reasons the BEACH data are used in this thesis.

Two previous studies investigating GPs' pathology ordering have been conducted using BEACH data.[45,89] The first, conducted on 9 months of data collected in 1998, provided the first comprehensive national snapshot of GPs' pathology ordering unaffected by the limitations of the Medicare data. It described GP characteristics associated with test ordering, the most common tests ordered, and the clinical problems for which pathology tests were ordered.[89] The second was conducted using data from 1998 to 2001 and investigated increases in GPs' pathology ordering with a focus on the GP characteristics associated with this increase.[45] Since publication of these reports, upper level BEACH data summarising GPs' pathology ordering (published annually) have demonstrated statistically significant increases in the likelihood and rate of GPs' pathology ordering in Australia.[103]

The ongoing increases in GPs' pathology ordering evident in the BEACH and Medicare data are placing increasing pressure on Australia's health budget. Many assumptions are made in the literature about why these increases are occurring and the appropriateness of GPs' ordering. There is an underlying leaning that more testing represents poor quality, but with very little supporting evidence that measured increases in testing represent either 'good' or 'bad' change. This is partially due to a lack of clinical data describing the clinical context (e.g. clinical problems) of increases in pathology ordering. Such data are required to evaluate appropriateness of GPs' pathology ordering.

Framework for this thesis

In this thesis I seek to address some of these issues. The overall aims are presented in Chapter 1, and topic-specific aims are included in the chapters in which they are investigated. In Chapter 3, I describe the methods used in this thesis. In Chapter 4, I

examine the changes in GPs' pathology ordering patterns over time, and the pathology tests and the clinical problems contributing to the increase. For each of the identified clinical problems, I investigate the contribution of changes in GPs' workload and GPs' pathology ordering behaviour to the growth in pathology ordering. In Chapter 5, I evaluate the appropriateness of GPs' pathology ordering for selected problems based on the extent to which GPs' ordering aligns with pathology test recommendations made in clinical guidance for these problems. In Chapter 6, I investigate the use of the two most commonly ordered pathology test types by Australian GPs, the full blood count and lipid tests. Chapter 7 examines the extent to which the variance in GPs pathology ordering rates can be explained by GP, practice, and patient characteristics, the clinical problem under management, and the type of encounter. Chapter 8 considers the impact of the expected growth and ageing of the Australian population on GPs' future pathology ordering. Discussion and conclusions are presented in Chapters 9 and 10.

3 Method

In this thesis I use data collected in an ongoing research program called the BEACH (Bettering the Evaluation and Care of Health) study. The methods of the BEACH study are described in detail below.

Throughout the thesis, additional methods have been designed and applied, and different data periods used for specific topics—these are described in detail in the method section of each chapter. Broadly the chapters rely on data that were collected at some point between April 2000 and March 2010.

The description of BEACH and its methods provided in this chapter are drawn from previously published BEACH reports. The candidate has been a co-author of these reports since 2002. Each section is referenced to the report(s) from which it was sourced.

3.1 An overview of the BEACH study

The BEACH study is a continuous national study of general practice activity in Australia that commenced in April 1998 and began its fifteenth year of continuous operation in April 2012. The study was conducted by the Australian General Practice Statistics and Classification Centre, a collaboration between the Family Medicine Research Centre (FMRC) of the University of Sydney and the Australian Institute of Health and Welfare. This collaboration ceased in 2011 (after the data used in this thesis were collected), and the study has since been conducted by the FMRC alone.

The BEACH study is supported by multiple stakeholders, including the Australian Government DoHA, pharmaceutical companies, not-for-profit organisations and other organisations that require general practice data (recognised in Acknowledgements). The program is overseen by an Advisory Board that is made up of representatives of each stakeholder organisation and representatives of the Royal Australian College of General Practitioners (RACGP), Australian College of Rural and Remote Medicine (ACRRM), Australian Medical Association, Australian General Practice Network and the Consumer Health Forum.[104]

Ethics approval

For each year, ethics approval for the BEACH study was obtained from the Human Research Ethics Committee of the University of Sydney. From 1998 to 2011 ethics approval was also obtained from the Ethics Committee of the Australian Institute of Health and Welfare.

Aims of the study

The BEACH study has three primary aims:

- to provide a reliable and valid data-collection process for general practice which is responsive to the ever-changing needs of information users,
- to establish an ongoing database of GP–patient encounter information,
- to assess patient risk factors and health states and the relationship these factors have with health service activity.[104]

3.2 The BEACH method

The core BEACH methodology, and data elements collected, did not change over the data years used in this thesis (2000 to 2010). While there have been minor changes over time (such as changes to questions on the GP profile), these do not affect the data elements used in this thesis. The example forms and instructions included as Appendices 2 to 5 reflect those used in the 2007–08 recording period.

BEACH involves an ever-changing random sample of approximately 1,000 GPs per year. The study is paper-based. Each GP records details for 100 doctor–patient encounters[‡] and each GP also completes a questionnaire about themselves and their practice.[104]

The BEACH methods were developed from those used in the 1990–91 Australian Morbidity and Treatment Survey (AMTS) undertaken by the Department of General Practice at the University of Sydney.[105]

While the BEACH study is ongoing, its methods are described throughout this chapter in past tense to describe how the BEACH data used in this study were collected.

3.2.1 Sample size

Using data from the AMTS, Meza et al. developed sample size models for national general practice surveys.[106] They found that a sample size of 1,000 GPs, each recording data about 100 patient encounters, provided reliable estimates of the most common problems managed and medications prescribed.[106]

3.2.2 The sample

In each year, the GP sample frame included all recognised GPs who had claimed at least 375 MBS general practice consultation service items[‡] in the most recently available Medicare data quarter. The use of this cut-off meant that the vast majority of full-time and part-time GPs who were currently practising were included, but those who were very part-time or were not currently practising (e.g. on maternity leave) were excluded.

Random samples for recruitment were drawn by DoHA. The samples included the GP's: name, contact details at their major practice (address and telephone number), age, sex, and activity level[‡] (that is, number of MBS general practice consultation service items[‡] claimed in the previous quarter and in the previous 12 months).[104]

3.2.3 GP recruitment

The randomly sampled GPs were sent a letter describing the study, detailing what participation involved and inviting them to participate.[104] An average of 60 GPs were sent letters each week.

In order to retain their vocational registration, Australian GPs are required to participate in professional development programs conducted by the RACGP or the ACRRM. Registered GPs are required to participate in activities in the program to earn a specific number of points in each triennium (3 year period). BEACH is classified as a clinical audit, and participation earns GPs these points.

Approximately ten days after the approach letter was sent, the GP was contacted via telephone by a trained recruiter to ask whether they would like to participate. When a GP agreed to participate, they were entered into the GP participant database, assigned an identification number and a starting date was arranged. A participating sample of 25 GPs per week (with a target completion rate of 20 GPs per week) was recruited for 50 weeks each year. This created a rolling ever-changing sample.

3.2.4 Data collection

A research pack was posted to each GP 10 days before the start date. Each research pack contained:

- a pad of 105 (to allow for error) paper encounter forms. An example of the encounter form is included as Appendix 2.
- a one page questionnaire about the GP and their practice called the 'GP Profile'. An example is included as Appendix 3.
- a cover letter
- a set of instructions about how to complete the encounter form and a sample of a completed form (Appendix 4)
- two copies of the patient information card (Appendix 5).
- height and weight conversion charts (imperial to metric) used to record details of the patients height and weight for conversion to body mass index
- an alcoholic drinks chart providing information on 'standard' drinks.

The patient information card was intended to inform patients that their GP was participating in the study. GPs were instructed to ensure that all patients were given the card to read. The card instructed the patients to advise their GP if they did (or did not) want unidentified details of their encounter recorded. Consent was obtained as per the ethics requirements: from 1998–99 to 2004–05 only verbal consent was required; from 2005–06 onward, GPs were required to include a note in the patient's medical record that she/he had agreed to take part.

A member of the research team telephoned each GP on their agreed starting date to remind the GP to commence recording, and to answer any questions the GP might have.

GPs were instructed to record details for 102 patient encounters, in a consecutive manner (or as consecutive as possible where patient consent enabled this). The first 100 encounter forms that were completed were used in the study. Each GP returned their completed pad and their GP profile using the reply paid envelope provided.

3.2.5 Data elements

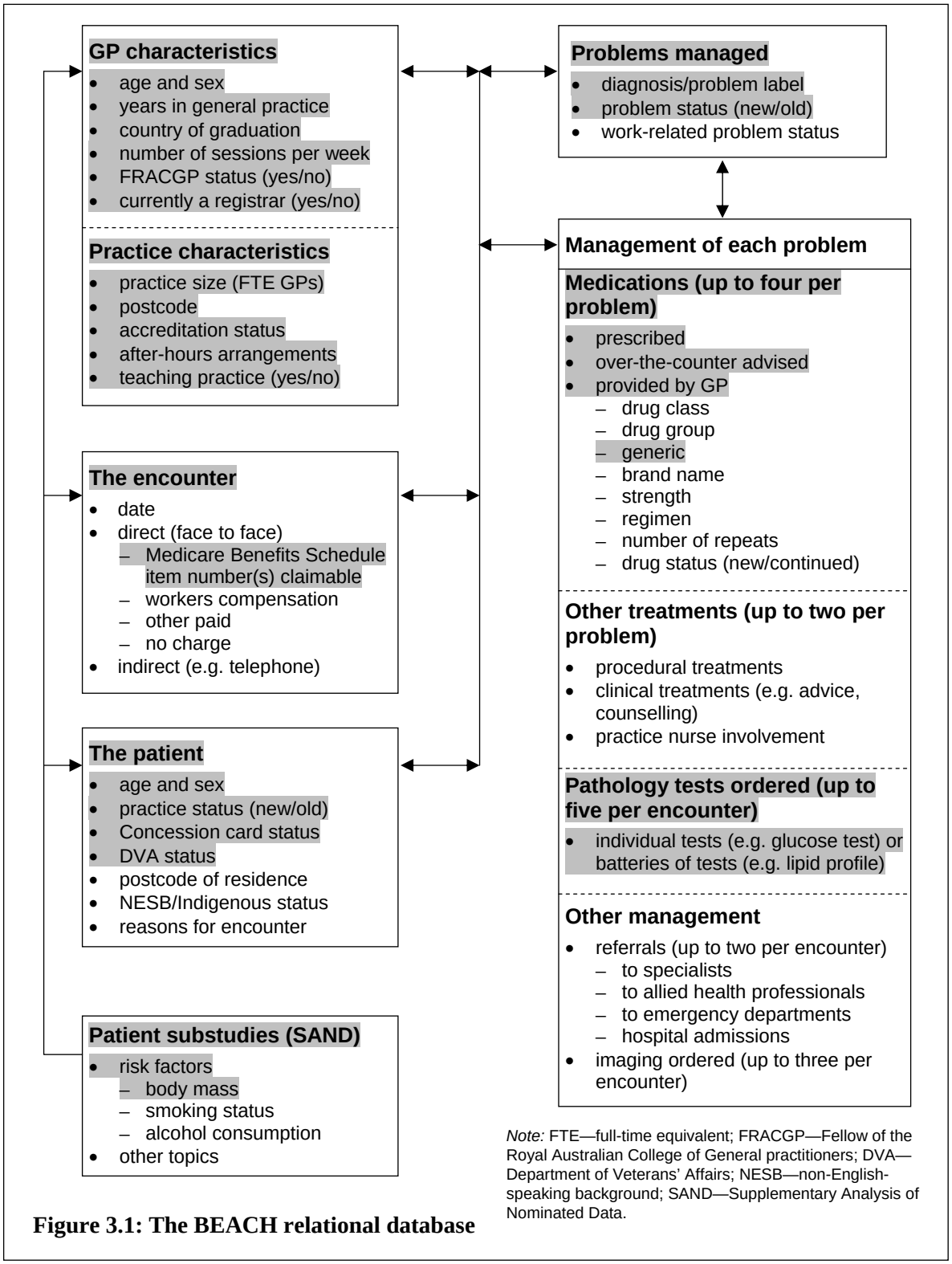
Three interrelated sets of data were collected in BEACH: encounter data; GP and practice data; and substudies of various topics. The substudies, referred to as SAND (Supplementary Analysis of Nominated Data), are described in Section 3.2.6.

Figure 3.1 describes the relationships between the BEACH data elements diagrammatically. All variables can be directly related to GP and patient characteristics and to the encounter. All types of management (including pathology tests) are directly related to one or more problems being managed at the encounter. The data used in this thesis are highlighted in Figure 3.1, and defined below.

Encounter data

In BEACH, the encounter was defined as any professional interchange between a patient and a GP. Encounters can be 'direct'[‡] involving face-to-face meeting between the GP and patient or 'indirect'[‡] where there was no face-to-face contact but a service was provided (e.g. a prescription or referral arranged by telephone).

Encounter data elements were collected on the encounter form (Appendix 2) and included details about the encounter itself, the patient, the problems that were managed and the management provided. The encounter data were cross-sectional. Therefore, the problems managed and the management provided reflect the encounter activity.



Note: FTE—full-time equivalent; FRACGP—Fellow of the Royal Australian College of General practitioners; DVA—Department of Veterans' Affairs; NESB—non-English-speaking background; SAND—Supplementary Analysis of Nominated Data.

Figure 3.1: The BEACH relational database

Encounter details

The only data element describing the encounter that is used in this thesis, is the MBS item number (Box 3.1). It is used to classify the encounter as level A, B, C or D‡ (where applicable) based on the type of GP–patient consultation. These MBS levels are defined in the glossary.

Box 3.1: Encounter data elements

Element	Definition and format
Medicare Benefits Schedule item number‡	Item number recorded as claimable for the encounter. Up to 3 item numbers per encounter (Free text number)

‡ Definition of term is included in glossary.

The patient

Data elements about the patient used in this thesis are described in Box 3.2. The 'Health concession card'‡ variable used in Chapter 7 is a binary variable that was created using the health care/benefits card‡ and Repatriation health card‡ data elements. A patient with either of these cards was classed as having a health concession card.

Box 3.2: Patient data elements

Element	Definition and format
Age	Day (2 digit number), month (2 digit number) and year (4 digit number) of the patient's date of birth
Sex	Male, Female (Tick box)
New patient status‡	Indicates whether this is the patient's first visit to the practice (Yes/No tick box)
Health care/benefits card‡	Patient holds a card entitling them to a higher level of Government subsidy for health services. Examples of patients who may be eligible include pensioners, unemployed, low income earners (Yes/No tick box)
Repatriation health card‡	Patient holds a card from the Department of Veteran's Affairs entitling them to a range of Repatriation health care benefits (Yes/No tick box)

‡ Definition of term is included in glossary.

The problems managed

Data elements collected about a problem under management at the encounter that are used in this thesis, are described in Box 3.3.

Box 3.3: Data elements about the problems managed

Element	Definition and format
Diagnosis/problem‡	A statement of the provider's understanding of a health problem presented by a patient, family or community. GPs are instructed to record at the highest diagnostic level possible from the information available at the time. It can be recorded as a symptom, morbidity or process of care. At least one and up to four problems can be recorded per encounter. Free text
Problem status, either 'New'‡ or 'Old'‡	New problem is defined as the first presentation of a problem, including the first presentation of a recurrence of a previously resolved problem, but excluding the presentation of a problem first assessed by another provider. Old problem is defined as a previously assessed problem that requires ongoing care, including follow-up for a problem or an initial presentation of a problem previously assessed by another provider. New/Old tick box for each problem.

‡ Definition of term is included in glossary

Pathology tests ordered and other management provided

In BEACH, several types of management actions could be recorded, and all of these management activities were linked by the GP to the problem (or problems) for which they were given.

In this thesis, pathology data are the main type of management data used. GPs recorded each pathology test in free text as either a single test (such as fasting glucose test) or a battery of tests‡ (such as a lipid profile) (Box 3.4). Up to five pathology tests or batteries of tests can be recorded per encounter. Each pathology test or battery must be linked to at least one problem but could be linked to up to four problems managed (the maximum recorded per encounter). This means that there can be a one-to-one, one-to-many or many-to-one relationship between pathology tests/batteries and problems managed.

The medication 'name' data element was also used in Chapter 5 (Box 3.4).

Box 3.4: Data elements about pathology tests and other management of problems at the encounter

Element	Definition and format
Pathology Single test (e.g. fasting glucose test) Battery of tests‡ (e.g. lipid profile)	Pathology tests/batteries of tests ordered by the GP at the encounter. Up to five pathology tests or batteries of tests could be recorded per encounter. Each test or battery of tests was linked by the GP to the related problem or problems managed at the encounter for which the test was ordered. Free text, and circle the problem number(s) to which the test related.
Medication Details collected include: name, form (where required), strength, regimen.	Includes medications prescribed, supplied by the GP and advised for over-the-counter purchase. Up to 4 medications could be recorded per problem, and a maximum of 16 medications could be recorded per encounter. Tick boxes for GP-supply, and over-the-counter status. Free text for other medication data variables.

‡ Definition of term is included in glossary

GP and practice data

In BEACH, a single page questionnaire was used to gather data about each participating GP and their practice (Appendix 3). As it is possible for a GP to work at multiple practices, GPs were instructed to provide details about their major practice.

The GP and practice data elements used in this thesis are described in Box 3.5. In Chapter 7, the practice postcode was used to assign the relevant Australian State or Territory of the practice location, and to classify the rurality of the practice location using the Australian Standard Geographical Classification (ASGC) remoteness areas.[107]

Box 3.5: Data elements about the participating GPs and their practice

Element	Definition and format
Age	GP's age. Free text (number).
Sex	GP's sex. Circle 'male' or 'female'.
Years in general practice	Number of years spent in general practice. Free text (number).
Fellowship of the Royal Australian College of General Practitioners (FRACGP)	Status of the GP as a fellow of the Royal Australian College of General Practitioner. Circle 'yes' or 'no'.
Country of graduation	Country where the GP's primary medical degree was obtained. Circle number to indicate one of the listed countries or record (in free text) an 'other' country.
Year of graduation	Year in which primary medical degree was obtained. Free text (number).
Sessions per week/Workload	Number of general practice sessions usually worked by the GP per week. A session is defined as approximately 4 hours e.g. a morning session. Free text (number).
Practice postcode	Postcode of the major practice address. Free text (number).
Size of practice (number of full-time equivalent [FTE] GPs)	Number of FTE GPs, including the participating GP, who work at the major practice. Free text (number).
Accreditation‡ status	Whether the major practice is accredited according to the Royal Australian College of General Practitioner standards. Circle 'yes' or 'no'.
Status as a teaching practice	Whether the major practice provides training for undergraduate medical students and/or GP registrars. Circle a number(s) to indicate training provided.

‡ Definition of term is included in glossary.

3.2.6 SAND substudy data

Each recording form had a section at the bottom that was used to investigate additional topics not covered in the encounter-based data. These additional investigations are referred to as SAND substudies.[108]

In each GP's recording pad of 100 forms there were three 'sets' of SAND forms: one set of 40 forms and two sets of 30 forms. Each set represented a separate topic.

The set of 40 forms were the same in every pad and covered selected patient risk factors: alcohol intake, smoking status and self-reported height and weight (for calculation of body mass index [BMI] using the World Health Organization's BMI classification[109]). Start and finish times were also recorded for calculation of the length of the encounter. The encounter form attached as Appendix 2 includes this set of SAND questions.

The questions on the two sets of 30 forms varied throughout each year. Each BEACH data year was divided into 10 five-week periods. In each five-week period

information was collected from about 100 GPs (20 recording per week), with a potential sample size of about 3,000 patient encounters on each topic. New studies were introduced at the beginning of each five-week period. It was possible to repeat topics over two or more different periods to increase the sample size.

The order of SAND sections in the GP recording pack was rotated, so that the set of 40 forms may have appeared first, second or third in the pad. Rotation of the forms minimised order effect on the data collected.

SAND data are used in two places in this thesis.

- The patient BMI data are used in Chapter 5, Section 5.9 to describe prevalence of overweight and obesity.
- A SAND study was designed for this thesis to investigate GP ordering of full blood counts and lipid tests (see Chapter 6).

3.2.7 Data entry and classification

Data from the BEACH study were entered into a Microsoft Access database designed for the study. The Access database was designed to enable efficient accurate data entry (for example picklists that automatically classified the selected term). Data were entered by trained secondary coders.

Most data elements collected in BEACH were classified according to the International Classification of Primary Care—Version 2 (ICPC-2), a product of the World Organization of Family Doctors (Wonca).[110] ICPC-2 is accepted by the World Health Organization (WHO) in the WHO Family of International Classifications,[111] and is the recommended Australian standard for classification of data from general practice.[112]

In this thesis, the data elements classified to ICPC-2 are problems managed, and pathology tests ordered. These elements were coded using ICPC-2 PLUS (see below) and classified to ICPC-2.

International Classification of Primary Care

The ICPC-2 has a biaxial structure, with 17 chapters on one axis (each with an alphabetic code) and seven components on the other (numeric codes) (Figure 3.2). Chapters are based on body systems, with additional chapters for psychological and

social problems. Component 1 includes symptoms and complaints and component 7 covers diagnoses.

Component 2 (diagnostic, screening and prevention) is often applied in describing the problem managed (for example, check-up, immunisation). Components 3 to 6 cover other processes of care, including referrals, other treatments and orders for pathology and imaging. The components are standard and independent throughout all chapters.[110]

Components	A	B	D	F	H	K	L	N	P	R	S	T	U	W	X	Y	Z
1. Symptoms, complaints																	
2. Diagnostic, screening, prevention																	
3. Treatment, procedures, medication																	
4. Test results																	
5. Administrative																	
6. Other																	
7. Diagnoses, disease																	

A General and unspecified
B Blood and blood-forming organs
D Digestive
F Eye
H Ear
K Circulatory
L Musculoskeletal
N Neurological
P Psychological
R Respiratory
S Skin
T Endocrine, metabolic and nutritional
U Urological
W Pregnancy and family planning
X Female genital
Y Male genital
Z Social

Figure 3.2: The structure of the International Classification of Primary Care, Version 2 (ICPC-2)

ICPC-2 PLUS

In 1995, recognising a need for a coding and classification system for general practice electronic health records, the Family Medicine Research Centre (then Unit) developed a clinical terminology classified according to the ICPC-2, called ICPC-2 PLUS.[113] It was based on the free text terms recorded by GPs in studies such as the AMTS.[105] Approximately 800,000 encounter records were used in the development of the terminology,[104] and it is regularly updated using the terms recorded in BEACH (approximately 1.2 million encounters from 1998 to 2010)[17] and input from GPs using ICPC-2 PLUS in their electronic health records.

All free text data elements were coded using ICPC-2 PLUS. This ensured high coder reliability, and automatic classification of the concept. It also enabled analysis of the data at the classification level or (where required) at the more specific terminology level.

Presentation of data classified in ICPC-2

In this thesis, data coded in ICPC-2 PLUS are reported at the ICPC-2 classification level. However, there are some circumstances where this was not meaningful, and it was necessary to group concepts.

Problems managed

Where problems managed are grouped in this thesis they are marked with an asterisk in the tables and listed in Appendix 6 with the associated codes.

Concepts may need to be grouped 'above' the classification level. This involves grouping multiple ICPC-2 codes. For example, two ICPC-2 codes K86 (hypertension, uncomplicated) and K87 (hypertension, complicated) were grouped together and reported as 'Hypertension (non-gestational)*'.

Concepts are also grouped across the classification by grouping multiple ICPC-2 PLUS terms. For example, multiple PLUS terms that describe checks-ups were grouped together and reported as 'health check*'.

Grouping of pathology data

Pathology tests are classified in ICPC-2 in component 2, 'Diagnostic, screening and prevention'. There are seven rubrics[‡] within this component that relate to pathology tests. These rubrics can be applied in 16 of the 17 ICPC-2 chapters[‡]. They cannot be applied in the Social chapter of ICPC-2. The rubrics are:

- –32 Sensitivity
- –33 Microbiological/immunological test
- –34 Blood test
- –35 Urine test
- –36 Faeces test
- –37 Histological/exfoliative cytology
- –38 Other laboratory test not elsewhere classified.

This means there are 112 rubrics available to classify pathology tests in ICPC-2. While it is possible to analyse and report the pathology data using ICPC-2, it is too broad for meaningful interpretation. For example, a fasting glucose test is classified in T34—Blood test associated with the Metabolic, endocrine, nutritional system.

In Australia, pathology data are often reported using the groupings from the MBS PST in which pathology tests are grouped by pathology discipline. These groupings are more meaningful in the Australian setting so all pathology ICPC-2 PLUS codes are grouped to align with the MBS standard pathology groups. Some of the terms I have used to refer to these groups differ slightly from those used by the MBS, as I have used terminology that is common in general practice. The pathology groups analysed and reported in this thesis are:

- Haematology
- Chemistry (referred to as 'Chemical' in the MBS)
- Microbiology
- Immunology
- Histopathology (referred to as 'Tissue pathology' in the MBS)
- Cytopathology (referred to as 'Cytology' in the MBS)
- Infertility and pregnancy tests
- Simple basic tests
- Other tests not elsewhere classified (NEC). This group includes pathology tests not included in any of the above groups (such as, the 'Genetics' MBS group).

Each of these pathology groups with its associated ICPC-2 PLUS pathology codes is listed in Appendix 7.

Individual pathology tests and batteries of tests are also grouped together to form logical reporting entities (for example, the 'Glucose/glucose tolerance' test group includes all types of serum glucose tests). All pathology tests/batteries of tests that include multiple ICPC-2 PLUS codes are marked with an asterisk in the tables and listed in Appendix 7 with the associated PLUS codes.

Classification of pharmaceuticals

Pharmaceuticals that are prescribed, provided by the GP or advised for over-the-counter purchase are coded and classified according to the Anatomical Therapeutic Chemical (ATC)[114] classification, which is the international standard for classifying

medications for drug utilisation studies.[115] The ATC has a hierarchical structure with five levels. For example:

- Level 1: C—Cardiovascular system
- Level 2: C10—Serum lipid reducing agents
- Level 3: C10A—Cholesterol and triglyceride reducers
- Level 4: C10AA—HMG CoA reductase inhibitors
- Level 5: C10AA01—Simvastatin (the generic drug).

3.2.8 Quality assurance

A quality assurance program was applied to ensure reliability of data entry. This included ongoing development and application of computer-aided error checks and 'locks' at the data entry stage (such as preventing female-specific problems being coded for male patients), and a series of logical data checks (e.g. medication dose outliers) to identify encounters where the coded data should be checked against the original recording form. All forms entered by new data entry staff were checked against the original form, and as staff became more experienced a sample of forms (e.g. one-in-ten) were checked by senior research staff. This ongoing process identified areas where further training was required.[108]

3.2.9 Validity and reliability

In the development of a database such as BEACH, data gathering moves through specific stages: GP sample selection, cluster sampling around each GP, GP data recording, secondary coding and data entry. At each stage the data can be invalidated by the application of inappropriate methods. The methods adopted to ensure maximum reliability of coding and data entry have been described above. The statistical techniques adopted to ensure valid analysis and reporting of recorded data are described in Section 3.2.11. Previous work has demonstrated the extent to which a random sample of GPs recording information about a cluster of patients, represents all GPs and all patients attending GPs.[116] Other studies have reported the degree to which GP-reported patient reasons for encounter and problems managed accurately reflect those recalled by the patient,[117] and the reliability of secondary coding of reasons for encounter[118] and problems managed.[105] The validity of ICPC as a tool with which to classify the data has also been investigated in earlier work.[119]

3.2.10 Representativeness

The extent to which data drawn from a sample can be generalised is a function of the ability of the sample to represent the population from which it is drawn. Random sampling of GPs improves the likelihood that a study will be representative, as each GP has equal probability of being selected. Even with random sampling, it is possible to end up with under-representation and/or over-representation of some groups within the final sample.[108]

Sample weights can be calculated to improve the representativeness of the sample and adjust for any identified under-representation or over-representation within the sample. Weights were assigned by comparing the distribution of the sample against the distribution in the benchmark population for those characteristics that may influence the final results (e.g. GP age group and sex). Weights are calculated as the proportion of each subgroup in the population divided by the proportion in the sample. Over-representation results in a weight less than one, under-representation in a weight greater than one.[108]

The BEACH study aims to gain a representative sample of GP–patient encounters. Representativeness of the GP sample is used to weight the encounters, based on the assumption that the characteristics of the patient encounter are related to the characteristics of the GP. Therefore to weight the encounters the representativeness of the GP sample needs to be determined. This is done by comparing the sample of participating GPs with GPs in the national sample frame (using MBS data supplied by DoHA). GP weights were calculated for the participants to match the age-sex distribution of all GPs in the total sample frame, correcting for any measured under-representation or over-representation. Weightings for GP age were stratified by GP sex.

The BEACH process requires that each GP provides details of 100 consecutive encounters. The assumption (based on earlier research) is that 100 encounters provide a reliable sample of the GP's patients and practice style.[106] However, there is considerable variation in the number of services provided by different GPs in a given year. This may have an impact on the reliability of any estimate due to the differences in the sampling fraction for each GP—a GP who provides 6,000 services in a given year should make a greater contribution to any national estimate of a selected activity than a GP who provides 3,000 services. Encounters were therefore

assigned an additional weight that was directly proportional to the activity level of the GP who recorded the encounter, based on the number of MBS general practice consultation service items claimed in the previous 12 months.

The final annual weighted encounter data set was created by multiplying raw rates by the GP age-sex weight and the GP activity weight. However, weights can only be applied to each single annual sample of BEACH data because the MBS data supplied by DoHA (on which weighting is based) are only provided for the specific BEACH 12 month data period (April to March).

In this thesis, weighted annual data are used in Chapter 8. In all other results chapters (Chapters 4–7), it is not methodologically sound to apply weighting for various reasons.

- In Chapters 4 and 5, multiple years of data are combined in the analysis, and it is not possible to apply weighting. However, combining multiple years of data increases the statistical power of the analysis.
- In Chapter 6, a SAND substudy is analysed, and as this uses a subsample of the total BEACH sample, weighting cannot be applied.
- In Chapter 7, it was not appropriate to weight the data because the variables used for weighting (GP age and GP sex) were adjusted for in the analysis.

The representativeness of the each of the annual GP samples and samples of encounter data (both unweighted and weighted) used in this thesis, 2000–01 to 2009–10, have been investigated and published elsewhere.[17,120-128] This thesis centres on pathology testing ordered at encounters, therefore, the representativeness of the sampled encounters needs to be considered to determine whether the results can be generalised.

Briefly, the representativeness of each annual encounter sample was assessed by comparing the age-sex distribution of patients at BEACH encounters where MBS general practice consultation service items were recorded as claimable with the age-sex distribution of patients at all encounters claimed in Australia as MBS general practice consultation service items (data provided by DoHA). To aid this comparison, precision ratios were created by dividing the proportion of BEACH encounters by the proportion of Australian MBS encounters in each age-sex group.[121,125] In determining whether any estimate is reliable, power calculations use a precision of 0.2 or 20% of the true proportion (or value). Therefore the BEACH

encounters are considered a reliable representation of MBS encounters when the range of precision is 0.8–1.2.

In each of the years of data used in this thesis (2000–01 to 2009–10), there was an excellent fit of the MBS and BEACH age and sex distribution both with and without weighting, with no age–sex category varying by more than 20% from the population distribution, with one exception. In 2008–09 one unweighted age–sex category (males aged 1–4 years) varied by 23% from the population distribution (based on raw data). After weighting, this ratio improved to within 20%.[17,120-128] The fact that raw precision ratios (unweighted data) rarely varied by more than 20% indicates that each of the annual BEACH encounter samples is a good representation of Australian GP–patient encounters. Therefore the unweighted data used in Chapters 4–7 can be considered a reliable representation of GP–patient encounters in Australia.

3.2.11 Statistical methods

The analysis of BEACH data was conducted with Statistical Analysis System (SAS) version 9.1.3.[129] The primary unit of inference in the BEACH study is the encounter. Rates per 100 encounters are used when an event can occur more than once at the consultation (for example, problems managed or medications). Rates per 100 problems are also used when a management event (such as pathology tests ordered) can occur more than once per problem managed.[45,108]

Proportions (%) are used when describing the distribution of an event that can arise only once per encounter (for example, patient age, sex) or once per problem (for example, new problem), or to describe the distribution of events within a class of events (for example, problem A as a percentage of total problems).[45,108]

In general, the results presented include: the number of observations (*n*), the rate per 100 encounters or the rate per 100 problems managed, and the 95% confidence interval (CI).

It is possible to report the rate of pathology test ordering as a rate per 100 encounters and as a rate per 100 problems managed. When presented as a rate per 100 encounters, the number of pathology tests/batteries of tests at the encounter are analysed. When presented as a rate per 100 problems the analysis can be based on the number of pathology tests/batteries or the number of problem–pathology links.[‡] The problem–pathology links must be used in analyses investigating GPs' pathology

ordering behaviour for specific problems. In most cases, data presented as a rate per 100 problems are based on the number of problem–pathology links. It is possible to link each test/battery to more than one problem; therefore there are more problem–pathology links than numbers of tests recorded at encounters. This is discussed further in Chapter 4.

BEACH is a single-stage cluster sample study design. The randomly sampled GPs each provide data about a cluster of 100 encounters. Studies with a cluster sample design violate the simple random sample (SRS) assumption because the probability of an encounter being included is a function of the probability of the GP being selected. There is also a secondary probability function of particular encounters being included in each GP's cluster (e.g. associated with characteristics of the location or type of the practice) and this increases the likelihood of sampling bias. In cluster samples, variance needs to be adjusted to account for the correlation between observations within clusters.[45,108]

When a study design other than SRS is used, analytical techniques that consider the study design should be used. In this thesis, survey procedures in SAS version 9.1.3 were used to adjust the standard error used in calculating the 95% CIs, to accommodate the single-staged cluster sample study design.[129]

Statistically significant differences

In this thesis, a statistically significant difference between two results was assessed by comparing the 95% CI around each result. Non-overlapping 95% CIs indicate a statistically significant difference between the results. The magnitude of this difference can be described as at least $p < 0.05$; however, non-overlapping CIs are known to be a conservative measure of significance.[130-132] By using this measure I am increasing the specificity while reducing the sensitivity, thus decreasing the chance of false positive and increasing the chance of false negative results. Due to the number of comparisons made in this thesis, and the large sample size of the BEACH study, I believe it is more appropriate to reduce the chance of false positive results.

Cumming and Finch stated that when comparing results from independent random samples, non-overlapping 95% CIs are more likely to represent a confidence level of approximately $p < 0.01$ than $p < 0.05$.[131] Each annual sample of BEACH data is an

independent random sample. Therefore, in Chapters 4, 5 and 8, statistically significant changes over time measured using data from separate independent random samples, indicate a confidence level of $p < 0.01$.

The following gives an example of non-overlapping 95% CIs:

> Result A: 11.5 per 100 problems (95% CI: 11.3–11.7) is significantly less than Result B: 11.9 per 100 problems (95% CI: 11.8–12.0).

When comparing results, if the two sets of CIs butt together the difference is regarded as marginal. For example:

> Result A: 11.5 per 100 problems (95% CI: 11.3–11.7) is marginally lower than Result B: 11.9 per 100 (95% CI: 11.7–12.1).

If the CIs overlap, then no difference has been demonstrated.

In measuring changes in pathology ordering over time in Chapters 4 and 5, results from April 2000 to March 2002 (referred to as 2000–02), are compared with those from April 2006 to March 2008 (2006–08). Grey shading in tables indicates changes between 2000–02 and 2006–08, darker shading indicates a statistically significant change and lighter shading indicates a marginal change. The direction and type of change is indicated for each result in the far right column of the tables:

- ↑/↓ indicates a statistically significant linear change
- ↑/↓ indicates a marginally significant linear change
- — indicates there was no change.

3.2.12 Extrapolated national estimates

Extrapolations can be used to estimate the number of occurrences of a selected event at GP encounters in Australia at a single time point or to estimate the total national effect of measured change. In this thesis, extrapolations are made to estimate the number of encounters in Australia involving the management of selected problems and the number involving pathology ordering.

The extrapolation method described in this section is the standard method used throughout this thesis. Extensions of this method are used in Chapters 4 and 8, and are described in the methods section of these chapters.

Extrapolations are calculated using the total number of MBS general practice consultation service items claimed in Australia in each financial year, rounded to the

nearest 100,000.[5] These are listed for each year (2000–01 to 2009–10) in Table 3.1. Throughout this thesis, the number of MBS general practice consultation service items claimed in Australia is referred to as the number of national MBS GP–patient encounters.

Table 3.1: Number of general practice professional services claimed from Medicare Australia each financial year, 2000–01 to 2009–10

Financial year	Number of GP MBS items	Rounded number of GP MBS items
2000–01	100,645,000	100,600,000
2001–02	99,921,000	99,900,000
2002–03	96,919,000	96,900,000
2003–04	96,330,000	96,300,000
2004–05	98,180,000	98,200,000
2005–06	101,095,000	101,100,000
2006–07	103,433,000	103,400,000
2007–08	109,518,000	109,500,000
2008–09	113,045,000	113,000,000
2009–10	116,646,000	116,600,000

Note: MBS – Medicare Benefits Schedule.

Source: Medicare statistics.[5]

When an extrapolation is based on data from multiple years, the average number of national MBS GP–patient encounters (rounded to the nearest 100,000) is used for the extrapolation and the extrapolation is interpreted as the average 'per annum' estimate in those years. Chapters 4 and 5 include extrapolations that are based on data from multiple years. These chapters use data collected over the period April 2000 to March 2008 (referred to as 2000–08); and changes over time are measured by comparing results from the first two years of the study period (2000–02) with those from the last two years (2006–08). For 2000–08 data, the number of national MBS GP–patient encounters used for extrapolation is 100.8 million. For 2000–02 data, the number of national MBS GP–patient encounters used is 100.3 million, and for 2006–08 data, it is 106.5 million.

The method used to calculate extrapolations is described below. The national number of encounters from 2000–02 is used in the example to describe the method, but it can be applied for other periods. To calculate the number of encounters involving the management of a specific problem:

- divide the BEACH management rate of each problem i.e. the 'rate per 100 encounters' for 2000–02 by 100, and then multiply by the total number of MBS

general practice consultation service items in 2000–02, 100.3 million (rounded to the nearest 100,000) to give the estimated number of GP encounters at which the problem was managed nationally per year in 2000–02.

As an example the management rate of hypertension is extrapolated. In BEACH, hypertension was managed at a rate of 9.1 per 100 encounters in 2000–02. To extrapolate: (9.1/100) x 100.3 million = an estimated 9.1 million encounters where hypertension was managed in general practice per year in 2000–02.

The above extrapolation is used most commonly throughout this thesis. All extrapolation estimates made are average annual estimates. For example, the number of encounters at which hypertension is managed by GPs was estimated to be 9.1 million encounters per annum in 2000–02.

Analysis of some problem data (and the related pathology testing data) are restricted by patient age. For example, overweight/obesity problems are investigated in patients aged 18 years and over. When data pertaining to these problems are extrapolated the number of GP–patient encounters is adjusted based on the proportion of encounters in the selected age group. For example, in 2000–02, 84.1% of encounters were with patients aged 18 years and over, therefore the number of GP–patient encounters used in extrapolations related to overweight/obesity data was 84.4 million (84.4% of 100.3 million).

Extrapolation estimates are rounded to the nearest 100,000 if more than a million, to the nearest 10,000 if between 100,000 and a million, and to the nearest 5,000 if less than 100,000.

4 Overview of pathology ordering

4.1 Background

As in most developed countries, the volume and cost of pathology tests ordered by GPs in Australia has increased over the past decades.[5,6] In the literature, this increase is usually described in terms of the overall increase in and/or cost of pathology tests. Rarely are the clinical problems or pathology tests that contribute to this increase described.

It would be expected that data about tests contributing to the increase may be available in Australia from sources such as Medicare claims data or from laboratories that perform testing ordered by GPs. However, this is not the case because of limitations of these data sources. MBS payment structure and rules, in particular the episode coning rule and the structure of MBS pathology items (as described in Chapter 2), mean that Medicare data do not provide an accurate view of the tests ordered by GPs.

The private pathology laboratories that conduct the bulk of GP-ordered pathology testing have data on the tests ordered by GPs. As private companies own these laboratories, the data are not readily accessible and the extent of data recorded is unclear. Further, accessing a representative sample of GP ordering from laboratories is logistically difficult.

In order to describe the clinical problems contributing to the increase in GPs' pathology ordering, data about the problem must be linked to the pathology tests ordered by GPs. This type of data is rarely available. The BEACH study collects this data for all pathology tests recorded by participating GPs.

In the absence of knowledge about the causes of increases in pathology ordering many assumptions have been made in the literature. This chapter seeks to examine the influence of GP workload and pathology ordering behaviour on the national increase in pathology ordering.

4.2 Objectives

- To describe the extent to which general practice encounters involve pathology ordering, and the changes over time in GPs' pathology ordering behaviour.

- To investigate the types of pathology tests and batteries of tests ordered by GPs and what changes have occurred.
- To identify problems that generate the majority of GPs' pathology ordering, and to determine whether the management rate of these problems has changed (i.e. change in GP's clinical workload) and/or whether GPs' ordering behaviour in the management of these problems has changed.
- To identify problems for which GPs' pathology ordering behaviour has changed, and specifically those where assessment of appropriateness of GPs' pathology ordering may be indicated.

4.3 Method

Data used in this chapter were recorded in the BEACH study over eight years, from April 2000 to March 2008, inclusive (labelled as 2000–08). Changes in pathology ordering behaviour are measured using two 2-year data points: April 2000 – March 2002 and April 2006 – March 2008 inclusive (labelled respectively as 2000–02 and 2006–08).

The majority of analysis in this chapter uses unweighted data from multiple years. When data years are combined the data cannot be weighted (see Section 3.2.10). Weighted data is only used in this chapter for Figure 4.1 where single year data are presented.

Investigation of GP pathology ordering for all problems (Section 4.4.1) is based on the number of tests/batteries recorded at GP–patient encounters. As it is not based on problem–pathology links, each test/battery is counted only once per encounter. However, investigations of pathology ordering behaviour of GPs for specific problems and calculation of extrapolations (Section 4.4.2) are based on the number of problem–pathology links. It is possible for a test/battery to be linked by the GP to more than one problem; therefore there are more problem–pathology links than number of tests recorded (see Section 3.2.11).

The most common individual pathology tests/batteries, each accounting for at least 1% of pathology tests in either 2000–08, 2000–02 or 2006–08 are described and changes from 2000–02 to 2006–08 investigated.

Individual problems each generating at least 1% of total problem–pathology links in either 2000–08, 2000–02 or 2006–08 are described and changes from 2000–02 to 2006–08 investigated to determine whether there were changes in: the management rate of the problem; the likelihood of pathology being ordered in the management of the problem; the number of pathology tests/batteries ordered for that problem. Investigation of pathology ordering for these selected problems is based on the pathology linked by the GP to the selected problem.

4.3.1 Extrapolation

Three types of extrapolations are made in this chapter, the first using the method described in Section 3.2.12, and the second and third using an extension of this method. These extrapolations are used to demonstrate the magnitude of national change from 2000–02 to 2006–08. Extrapolation estimates made in this chapter are rounded to the nearest 10,000.

In this chapter extrapolations are based on data from multiple years; therefore, the average number of MBS GP–patient encounters over the period is used for each data point (2000–02 and 2006–08), and this is interpreted as the average 'per annum' estimate in those years. The number of national GP encounters used for extrapolation of 2000–02 data is 100.3 million and for 2006–08 data is 106.5 million.

The first type of extrapolation is used to estimate the number of encounters involving the management of a specific problem per year nationally (see Section 3.2.12).

The second and third types of extrapolations are based on the problem–pathology links for each problem. The second type of extrapolation estimates the number of contacts with the selected problem at which at least one pathology test/battery was ordered at GP encounters per year. The calculation was:

- for each problem divide the number of problems involving at least one pathology test by the number of BEACH encounters in 2000–02, and multiply by the total number of MBS general practice consultation service items in 2000–02
- repeat the process using data for 2006–08.

The difference between the two estimates gives the estimated national change between 2000–02 and 2006–08 in the number of problem contacts where at least one pathology test/battery was ordered.

The third type of extrapolation estimates the number of pathology tests/batteries ordered for each specific problem per year. The calculation was:

- for each problem divide the number of pathology tests/batteries of tests linked to the problem by the number of BEACH encounters in 2000–02, and multiply by the total number of MBS general practice consultation service items in 2000–02
- repeat the process using data for 2006–08.

The difference between the two estimates gives the estimated national change between 2000–02 and 2006–08 in the number of pathology tests/batteries ordered for each specific problem.

4.4 Results

4.4.1 Overview of data set

From April 2000 to March 2008, 7,843 GPs participated in BEACH, and provided data about 784,300 encounters involving the management of 1,174,893 problems. At these encounters GPs ordered 307,013 pathology tests/batteries of tests. In 2000–02, there were 198,200 encounters recorded and 64,389 pathology tests/batteries ordered by 1,982 GPs, and in 2006–08 there were 188,300 encounters recorded and 87,444 pathology tests/batteries ordered by 1,883 GPs (Table 4.1).

In BEACH, each pathology test/battery was linked to at least one and up to four problems per encounter. There were more problem–pathology links than tests/batteries: in 2000–08, there were 3.1% more links than tests (*n* = 316,572 problem–pathology links); in 2000–02, there were 3.2% more links than tests (*n* = 66,429 problem–pathology links); in 2006–08, there were 3.8% more links than tests (*n* = 90,753 problem–pathology links) (results not tabled).

Pathology ordered

In 2000–08, pathology tests/batteries were ordered at a rate of 39.1 tests/batteries per 100 encounters, and 26.1 per 100 problems. At least one pathology test/battery was ordered at 16.8% of encounters and for 12.8% of problems managed (Table 4.1).

Figure 4.1 presents the annual rate of pathology ordered by GPs at encounters and in the management of problems over the eight years of the study. From 2000 to 2008 there was a significant[‡] linear increase in the rate of pathology ordered by GPs per

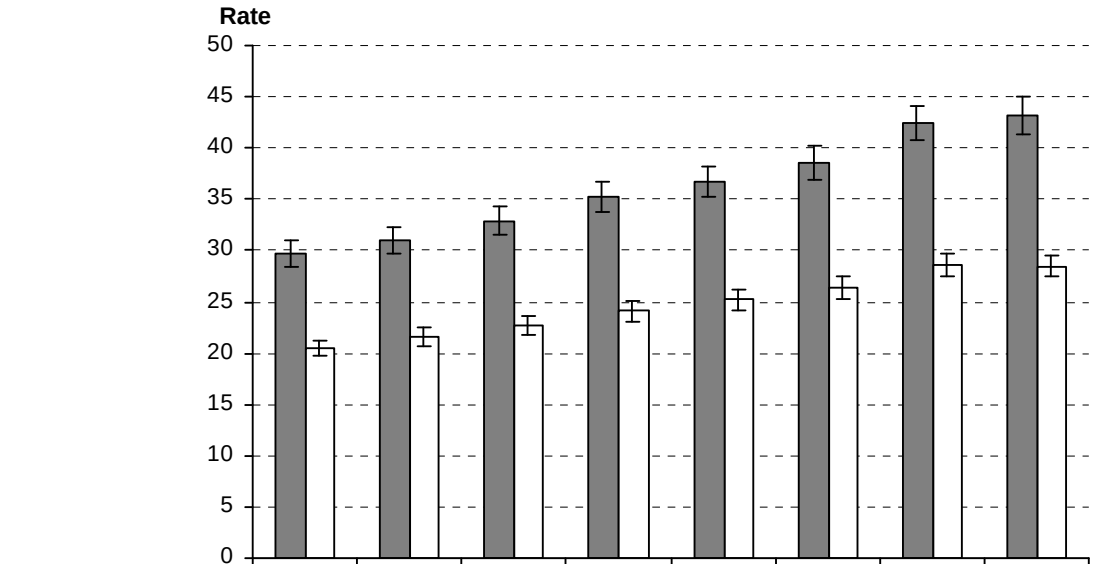
100 encounters, and per 100 problems managed (Figure 4.1), supporting the validity of measuring changes over time by comparing data from 2000–02 with that from 2006–08.

The rate of pathology tests/batteries ordered per 100 encounters increased significantly from 32.6 per 100 encounters in 2000–02 to 46.4 per 100 in 2006–08. This was due to significant increases in:

- the likelihood of at least one pathology test/battery being ordered at encounters (14.9% of encounters in 2000–02 and 18.7% in 2006–08)
- the number of pathology tests ordered per encounter once the decision to order was made (217.8 per 100 tested encounters in 2000–02 and 247.8 in 2006–08) (Table 4.1).

The number of problems managed per GP encounter also increased significantly from 147.3 per 100 encounters in 2000–02 to 153.3 per 100 in 2006–08. As this indicates an increase in the volume of clinical work undertaken per encounter, it is important to measure the rate of pathology per 100 problems managed. The rate of pathology tests/batteries ordered per 100 problems managed significantly increased from 22.2 per 100 in 2000–02 to 30.3 in 2006–08. This was due to significant increases in:

- the likelihood of at least one pathology test/battery being ordered in the management of problems (11.4% of problems in 2000–02 and 14.2% in 2006–08)
- the number of pathology tests ordered per problem once the decision to order was made (200.1 per 100 tested problems in 2000–02 and 221.3 in 2006–08) (Table 4.1).



	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08
Rate per 100 encs	29.7	31.0	32.9	35.2	36.7	38.6	42.4	43.2
Rate per 100 probs	20.5	21.6	22.7	24.1	25.2	26.4	28.6	28.5

Note: encs – encounters; probs – problems.

BEACH year

Figure 4.1: Rate of pathology test/battery orders per 100 encounters and per 100 problems managed, 2000–01 to 2007–08 (95% confidence intervals)

Table 4.1: Overview of data set and summary of pathology ordering, 2000–08, 2000–02 and 2006–08

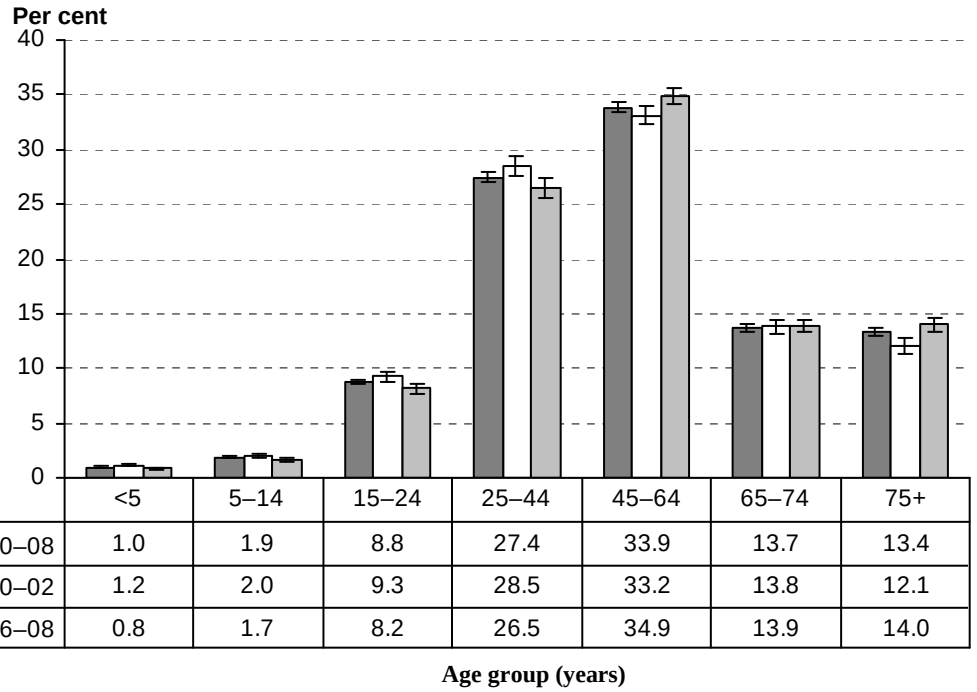
	2000–08				2000–02				2006–08				
	Number	Rate/ Per cent	95% LCL	95% UCL	Number	Rate/ Per cent	95% LCL	95% UCL	Number	Rate/ Per cent	95% LCL	95% UCL	Change
General practitioners	7,843	. .	. .	. .	1,982	. .	. .	. .	1,883	. .	. .	. .	. .
Number of encounters	784,300	. .	. .	. .	198,200	. .	. .	. .	188,300	. .	. .	. .	. .
Problem management rate per 100 encounters	1,174,893	149.8	149.2	150.4	291,890	147.3	146.1	148.4	288,610	153.3	151.9	154.7	↑
Pathology order rate per 100 encounters	307,013	39.1	38.6	39.7	64,389	32.6	31.7	33.5	87,444	46.4	45.2	47.7	↑
At least one pathology order per encounter (Per cent of all encounters)	131,586	16.8	16.6	17.0	29,559	14.9	14.6	15.3	35,284	18.7	18.3	19.2	↑
Pathology order rate per 100 tested encounters	. .	233.1	231.6	234.7	. .	217.8	214.9	220.6	. .	247.8	244.6	251.1	↑
Pathology order rate per 100 problems managed	307,013	26.1	25.8	26.5	64,389	22.2	21.6	22.7	87,444	30.3	29.6	31.0	↑
At least one pathology order per problem (Per cent of all problems managed)	150,187	12.8	12.6	12.9	33,196	11.4	11.1	11.6	41,019	14.2	13.9	14.5	↑
Pathology order rate per 100 tested problems	. .	210.8	209.5	212.1	. .	200.1	197.6	202.6	. .	221.3	218.5	224.0	↑

Note: Pathology data reported in this table are based on the number of pathology tests/batteries. The number of problem–pathology links is not used in the problem-based analyses reported in this table (see Section 3.2.11 and Section 4.4.1). Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change. LCL – lower confidence limit; UCL – upper confidence limit.

Figure 4.2 shows the distribution of the volume of pathology tests/batteries by patient age groups in 2000–08, 2000–02 and 2006–08. The patient age groups accounting for the highest volume of pathology tests/batteries ordered in 2000–08 were the 45–64 year age group (33.9% of tests/batteries) and the 25–44 year age group (27.4% of tests/batteries) (Figure 4.2).

The pattern of distribution was similar in 2000–02 and 2006–08. However, there were statistically significant changes over time in the proportion of testing accounted for by some age groups. Between 2000–02 and 2006–08, there was a significant decrease in the proportion of tests/batteries ordered for patients aged less than 45 years (41.0% in 2000–02 and 37.2% in 2006–08), and significant increases in the proportion ordered for patients aged 45–64 years (33.2% in 2000–02 and 34.9% in 2006–08) and for those aged 75 years and over (12.1% in 2000–02 and 14.0% in 2006–08) (Figure 4.2).

The distribution of likelihood of testing at encounters (i.e. at least one pathology test/battery ordered) across patient age groups is not presented in this thesis because it showed the same pattern of overall age distribution and changes over time as that presented in Figure 4.2 for volume of pathology.

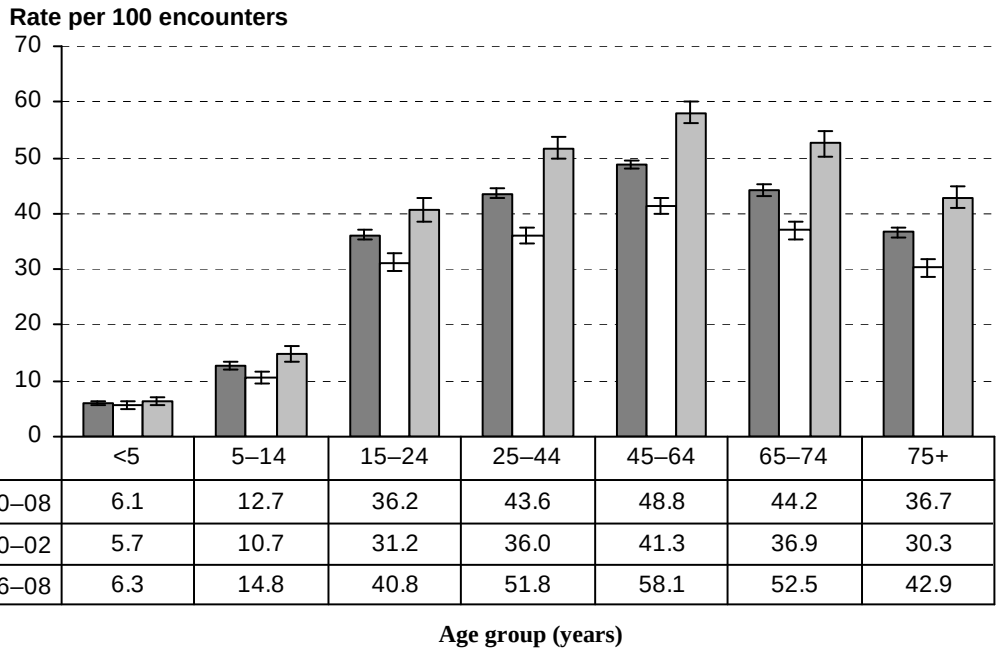


	<5	5–14	15–24	25–44	45–64	65–74	75+
2000–08	1.0	1.9	8.8	27.4	33.9	13.7	13.4
2000–02	1.2	2.0	9.3	28.5	33.2	13.8	12.1
2006–08	0.8	1.7	8.2	26.5	34.9	13.9	14.0

Figure 4.2: Distribution of volume of pathology ordered across patient age groups, 2000–08, 2000–02 and 2006–08 (95% confidence intervals)

Figure 4.3 shows the age-specific rates of pathology ordering at encounters. In 2000–08, the rate of testing was highest at encounters with patients aged 45–64 years (48.8 pathology tests/batteries per 100 encounters with patients in this age group), followed by those with patients aged 65–74 years (44.2 per 100) and 25–44 years (43.6 per 100) (Figure 4.3).

Between 2000–02 and 2006–08, there were significant increases in the age-specific rates of pathology ordering at encounters with all patient age groups except at those with children aged less than 5 years. Patients aged 25 to 74 years had the highest age-specific rates of pathology testing, and these age groups also had the largest age-specific increases in pathology ordering rates from 2000–02 to 2006–08 (Figure 4.3).



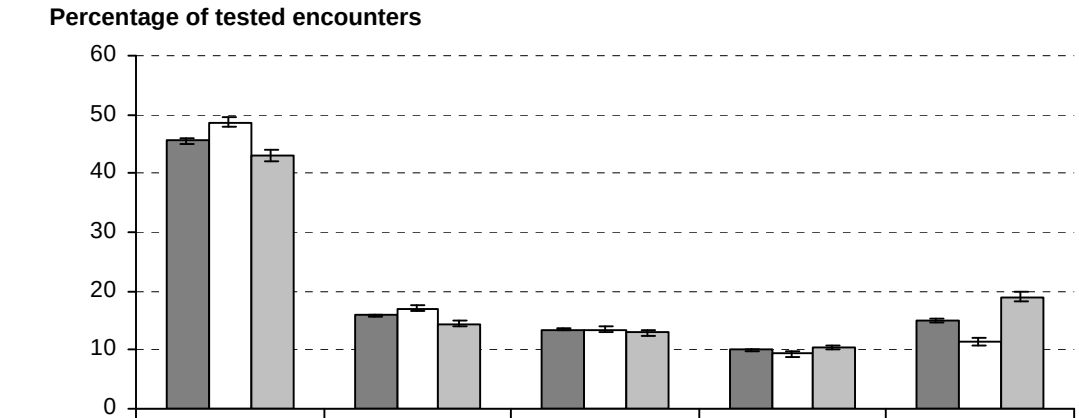
	<5	5–14	15–24	25–44	45–64	65–74	75+
2000–08	6.1	12.7	36.2	43.6	48.8	44.2	36.7
2000–02	5.7	10.7	31.2	36.0	41.3	36.9	30.3
2006–08	6.3	14.8	40.8	51.8	58.1	52.5	42.9

Figure 4.3: Patient age-specific rate of pathology test orders per 100 encounters, 2000–08, 2000–02 and 2006–08 (95% confidence intervals)

The number of pathology tests ordered per encounter when at least one pathology test was ordered is presented in Figure 4.4. At encounters where pathology testing was ordered (tested encounters), GPs most commonly ordered one or two pathology tests/batteries (45.6% and 15.9% of tested encounters respectively in 2000–08). Over time there was a significant decrease in the proportion of tested encounters with one or two tests/batteries ordered: in 2000–02, 48.7% of tested encounters had one test and 17.0% had two, while in 2006–08, 43.1% had one test and 14.5% had two tests.

Simultaneously, there was a significant increase in the proportion with four or five tests/batteries ordered at tested encounters (Figure 4.4).

The distribution of number of tests per tested problem is not presented in this thesis as it showed the same pattern of overall distribution and changes over time as that presented in Figure 4.4 for number of tests per tested encounter.



	1 test	2 tests	3 tests	4 tests	5 tests
2000–08	45.6	15.9	13.5	10.0	15.1
2000–02	48.7	17.0	13.5	9.3	11.5
2006–08	43.1	14.5	13.0	10.5	19.0

Figure 4.4: Distribution of the number of pathology tests/batteries ordered per encounter when at least one test was ordered, 2000–08, 2000–02 and 2006–08 (95% confidence intervals)

Types of pathology tests ordered

Table 4.2 describes the pathology orders made for all problems by MBS pathology groups and the most common individual pathology tests, in the total data period 2000–08, and changes measured from 2000–02 to 2006–08. Pathology data are reported as rates per 100 problems as the number of problems managed per encounter increased over the study period.

At the MBS pathology group level, chemistry tests were the tests most commonly ordered by GPs in 2000–08 (14.3 per 100 problems managed), followed by those classified as haematology (4.9 per 100), microbiology (3.9) and cytopathology (1.5). Between 2000–02 and 2006–08, there were statistically significantly increases in the order rates of chemistry, haematology, microbiology and cytopathology tests; and

marginal significant increases in histopathology and immunology test order rates (Table 4.2).

The most common individual tests or batteries of tests ordered by GPs in 2000–08 were full blood counts (FBC) (3.5 per 100 problems), lipid tests (2.5 per 100), electrolytes, urea and creatinine (EUC) tests (1.8), liver function tests (LFT) (1.7), and glucose tests (1.6). The 22 most common tests/batteries accounted for 85.7% of all pathology tests recorded by GP participants in 2000–08 (Table 4.2).

Between 2000–02 and 2006–08, there were significant increases in the ordering rate (per 100 total problems) of almost all frequently ordered individual tests. There were statistically significant increases in the order rate of FBC, lipid tests, EUC tests, LFT, glucose tests, thyroid function tests (TFT), multibiochemical analysis (MBA), ferritin, 'other chemistry' tests, HbA1c, 'other microbiology' tests, prostate specific antigen (PSA), histology skin tests, C reactive protein (CRP) and vitamin B12 tests. There were also marginal increases in the rates of Pap smears, urine microscopy, culture and sensitivity (M,C&S), coagulation tests, and vaginal swab M,C&S (Table 4.2).

Table 4.2: Distribution of pathology orders across MBS pathology groups and most frequent individual test orders for all problems, 2000–08, 2000–02 and 2006–08

	2000–08				2000–02				2006–08				
Pathology test ordered	Number (%)	Rate per 100 problems[(a)]	95% LCL	95% UCL	Number (%)	Rate per 100 problems[(a)]	95% LCL	95% UCL	Number (%)	Rate per 100 problems[(a)]	95% LCL	95% UCL	Change
MBS pathology groups													
Chemistry	167,676 (54.6)	14.3	14.0	14.5	33,843 (52.6)	11.6	11.2	12.0	49,681 (56.8)	17.2	16.7	17.7	↑
Haematology	57,594 (18.8)	4.9	4.8	5.0	12,636 (19.6)	4.3	4.2	4.5	15,743 (18.0)	5.5	5.3	5.6	↑
Microbiology	45,604 (14.9)	3.9	3.8	4.0	10,098 (15.7)	3.5	3.3	3.6	12,186 (13.9)	4.2	4.0	4.4	↑
Cytopathology	17,152 (5.6)	1.5	1.5	1.5	3,931 (6.1)	1.4	1.3	1.4	4,534 (5.2)	1.6	1.5	1.7	↑
Other tests NEC	6,285 (2.0)	0.5	0.5	0.6	1,492 (2.3)	0.5	0.5	0.6	1,741 (2.0)	0.6	0.5	0.7	—
Histopathology	5,218 (1.7)	0.4	0.4	0.5	978 (1.5)	0.3	0.3	0.4	1,456 (1.7)	0.5	0.4	0.6	↑
Immunology	4,540 (1.5)	0.4	0.4	0.4	970 (1.5)	0.3	0.3	0.4	1,369 (1.6)	0.5	0.4	0.5	↑
Infertility and pregnancy tests	1,841 (0.6)	0.7	0.2	0.2	502 (0.8)	0.2	0.1	0.2	374 (0.4)	0.1	0.1	0.1	—
Simple basic tests	1,103 (0.4)	0.1	0.1	0.1	193 (0.3)	0.1	0.1	0.1	360 (0.4)	0.1	0.1	0.1	—
Individual pathology tests/batteries													
Full blood count	40,882 (13.3)	3.5	3.4	3.5	8,629 (13.4)	3.0	2.8	3.1	11,696 (13.4)	4.1	3.9	4.2	↑
Lipids*	29,578 (9.6)	2.5	2.5	2.6	6,627 (10.3)	2.3	2.2	2.4	8,410 (9.6)	2.9	2.8	3.0	↑
Electrolytes, urea and creatinine*	21,037 (6.9)	1.8	1.7	1.8	4,234 (6.6)	1.5	1.4	1.5	6,175 (7.1)	2.1	2.0	2.3	↑
Liver function*	20,183 (6.6)	1.7	1.7	1.8	4,201 (6.5)	1.4	1.4	1.5	6,067 (6.9)	2.1	2.0	2.2	↑
Glucose/glucose tolerance*	18,615 (6.1)	1.6	1.5	1.6	4,215 (6.5)	1.4	1.4	1.5	5,170 (5.9)	1.8	1.7	1.9	↑
Thyroid function*	17,225 (5.6)	1.5	1.4	1.5	3,335 (5.2)	1.1	1.1	1.2	5,034 (5.8)	1.7	1.7	1.8	↑
Pap smear*	16,818 (5.5)	1.4	1.4	1.5	3,844 (6.0)	1.3	1.2	1.4	4,449 (5.1)	1.5	1.4	1.6	↑
Urine M,C&S*	14,243 (4.6)	1.2	1.2	1.2	3,371 (5.2)	1.2	1.1	1.2	3,613 (4.1)	1.3	1.2	1.3	↑

(continued)

Table 4.2 (continued): Distribution of pathology orders across MBS pathology groups and most frequent individual test orders for all problems, 2000–08, 2000–02 and 2006–08

	2000–08				2000–02				2006–08				
Pathology test ordered	**Number (%)**	**Rate per 100 problems[(a)]**	**95% LCL**	**95% UCL**	**Number (%)**	**Rate per 100 problems[(a)]**	**95% LCL**	**95% UCL**	**Number (%)**	**Rate per 100 problems[(a)]**	**95% LCL**	**95% UCL**	**Change**
Individual pathology tests/batteries (continued)													
Multibiochemical analysis*	12,094 (3.9)	1.0	1.0	1.1	2,181 (3.4)	0.8	0.7	0.8	3,615 (4.1)	1.3	1.1	1.4	↑
Erythrocyte sedimentation rate	8,018 (2.6)	0.7	0.7	0.7	1,974 (3.1)	0.7	0.7	0.7	1,908 (2.2)	0.7	0.6	0.7	—
Ferritin*	7,780 (2.5)	0.7	0.6	0.7	1,463 (2.3)	0.5	0.5	0.5	2,540 (2.9)	0.9	0.8	0.9	↑
Other chemistry*	7,467 (2.4)	0.6	0.6	0.7	1,035 (1.6)	0.4	0.4	0.4	2,594 (3.0)	0.9	0.8	1.0	↑
Hormone assay*	7,118 (2.3)	0.6	0.6	0.6	1,663 (2.6)	0.6	0.5	0.6	1,739 (2.0)	0.6	0.5	0.7	—
HbA1c*	6,901 (2.2)	0.6	0.6	0.6	1,330 (2.1)	0.5	0.5	0.5	1,959 (2.2)	0.7	0.6	0.7	↑
Coagulation*	6,201 (2.0)	0.5	0.5	0.5	1,447 (2.2)	0.5	0.5	0.5	1,539 (1.8)	0.5	0.5	0.6	↑
Other microbiology*	5,872 (1.9)	0.5	0.5	0.5	1,089 (1.7)	0.4	0.4	0.4	1,702 (1.9)	0.6	0.5	0.6	↑
Hepatitis serology*	4,697 (1.5)	0.4	0.4	0.4	1,191 (1.8)	0.4	0.4	0.4	1,116 (1.3)	0.4	0.3	0.4	—
Prostate specific antigen*	4,656 (1.5)	0.4	0.4	0.4	893 (1.4)	0.3	0.3	0.3	1,514 (1.7)	0.5	0.5	0.6	↑
Histology; skin	4,603 (1.5)	0.4	0.4	0.4	790 (1.2)	0.3	0.3	0.3	1,328 (1.5)	0.5	0.4	0.5	↑
C reactive protein	3,522 (1.1)	0.3	0.3	0.3	472 (0.7)	0.2	0.1	0.2	1,288 (1.5)	0.5	0.4	0.5	↑
Vaginal swab M,C&S	3,091 (1.0)	0.3	0.2	0.3	741 (1.2)	0.3	0.2	0.3	830 (0.9)	0.3	0.3	0.3	↑
Vitamin B12*	2,482 (0.8)	0.2	0.2	0.2	400 (0.6)	0.1	0.1	0.2	847 (1.0)	0.3	0.3	0.3	↑
Subtotal	*263,083 (85.7)*	*. .*	*. .*	*. .*	*55,125 (85.6)*	*. .*	*. .*	*. .*	*75,133 (85.9)*	*. .*	*. .*	*. .*	*. .*
Total pathology tests	**307,013 (100.0)**	**26.1**	**25.8**	**26.5**	**64,643 (100.0)**	**22.2**	**21.6**	**22.7**	**87,444 (100.0)**	**30.3**	**29.6**	**31.0**	↑

(a) The rate at which the pathology test was ordered, expressed as a rate per 100 problems managed. Based on the number of pathology tests/batteries (not problem–pathology links) (see Section 3.2.11 and Section 4.4.1). For the number of problems in each data period see Table 4.1.

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the pathology tests/batteries accounting for more than 1% of all tests/batteries in any of the three data periods are included. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change (darker shading), ↑/↓ indicates a marginal change (lighter shading), and — indicates no change. LCL – lower confidence limit; UCL – upper confidence limit; NEC – not elsewhere classified; M,C & S – microscopy, culture and sensitivity.

4.4.2 Problems generating high volumes of pathology orders

There were 22 problems that each accounted for 1% or more of problem–pathology links recorded by GPs in BEACH. These problems accounted for more than half of problem–pathology links in each period (53.4% in 2000–08, 52.5% in 2000–02 and 54.8% in 2006–08) (Table 4.3).

Table 4.3 presents for each data period and for each problem: (i) the number of times it was recorded as a problem managed in the data set; (ii) the GP clinical workload it accounted for (management rate per 100 encounters); and (iii) the volume of pathology orders it generated (per cent of problem–pathology links).

Table 4.4 reports for 2000–02 and 2006–08 GP pathology ordering behaviour in the management of each problem, that is, the likelihood of testing (per cent of problem contacts involving at least one pathology test order) and the number of tests/batteries ordered (per 100 tested contacts with the problem).

Problems in Tables 4.3 and 4.4 are listed in decreasing order according to the proportion of total problem–pathology links accounted for by each problem in 2006–08 (Table 4.3).

For each problem, Table 4.5 reports the extrapolated estimates for 2000–02 and 2006–08 of: (i) the number of national encounters involving its management; (ii) the number of national encounters involving at least one pathology order; (iii) the number of pathology tests/batteries of tests ordered in its management in Australia. It also describes the amount of national change from 2000–02 to 2006–08 attributed to each problem. Problems in Table 4.5 are listed in decreasing order according to the proportion of national change accounted for by each problem.

Tables 4.3, 4.4 and 4.5, that are referred to throughout this section, are located on pages 67–72.

When the total rates of pathology ordering for 2000–02 and 2006–08 are extrapolated to the GP encounters claimed through Medicare (100.3 million per year in 2000–02 and 106.5 million per year in 2006–08), these data suggest that compared with 2000–02, in 2006–08 there were:

- 6.4 million additional problems per year for which the GP ordered at least one pathology test/battery of tests (23.2 million per year in 2006–08 compared with 16.8 million per year in 2000–02)
- 17.7 million additional tests/batteries of tests ordered per year by GPs (51.3 million per year in 2006–08 compared with 33.6 million per year in 2000–02) (Table 4.5).

GP pathology ordering behaviour did not change in the management of seven of the 22 problems investigated. These problems were sexually transmitted infections, urinary tract infection, pregnancy, arthritis, anaemia, hypothyroidism, and atrial fibrillation (Table 4.4). Pathology tests/batteries ordered for these seven problems accounted for a considerable proportion of total pathology ordering (12.1% of total problem–pathology links in 2000–02 and 11.7% in 2006–08) (Table 4.3). However there was no change in GPs' pathology ordering behaviour (i.e. decision of whether to test and number of tests per order) in the management of these problems. Any contribution to national change made by these problems was due to the increase in the total number of GP encounters claimed through Medicare with or without a simultaneous change in the management rate of the problem between 2000–02 and 2006–08 (Table 4.5). Therefore, these problems are not described in further detail in this chapter.

GP pathology ordering increased significantly in the management of 15 of the 22 problems investigated, from 2000–02 to 2006–08. These were: hypertension, Type 2 diabetes, lipid disorders, female genital check-ups, health checks (in patients aged 15 years and over), weakness/tiredness, 'blood test', 'abnormal test results', depression, menstrual problems, ischaemic heart disease, abdominal pain, overweight/obesity (in patients aged 18 years and over), menopause and viral illness (Table 4.4). The changes in GPs' pathology ordering in the management of these 15 problems are described in greater detail below.

Hypertension

The management rate of hypertension in general practice in Australia did not differ significantly between 2000–02 and 2006–08 (9.1 per 100 encounters in 2000–02 and 9.5 per 100 in 2006–08). Pathology ordered for hypertension problems accounted for

5.9% of all problem–pathology links recorded in 2000–02 and 6.3% in 2006–08 (Table 4.3).

The rate of pathology ordering per 100 hypertension contacts increased significantly, from 21.6 per 100 contracts in 2000–02 to 32.3 per 100 in 2006–08. This increase was due to significant increases in the likelihood of pathology being ordered in the management of hypertension (8.7% of hypertension contacts in 2000–02 compared with 11.9% in 2006–08), and increased number of pathology tests/batteries ordered per tested hypertension problem (248.2 per 100 tested contacts in 2000–02 compared with 270.4 per 100 in 2006–08) (Table 4.4).

When these data were extrapolated to the number of GP encounters claimed through Medicare nationally, I estimated there were about:

- 950,000 more encounters involving the management of hypertension problems in 2006–08 (10.1 million per year) than in 2000–02 (9.1 million per year)
- 410,000 additional hypertension contacts that involved the ordering of at least one pathology test/battery (tested contacts) in 2006–08 (1.2 million per year) compared with 2000–02 (790,000 per year)
- 1.3 million additional pathology tests/batteries ordered for hypertension in 2006–08 (3.2 million per year) than in 2000–02 (2.0 million per year). Pathology ordered in the management of hypertension accounted for 7.2% of the total national increase in pathology ordering that occurred between 2000–02 and 2006–08 (Table 4.5).

Type 2 diabetes

The management rate of Type 2 diabetes (T2D) increased significantly from 2.6 per 100 encounters in 2000–02 to 3.3 per 100 in 2006–08. Pathology ordered for T2D problems accounted for 5.0% of all problem–pathology links recorded in 2000–02 and 6.0% in 2006–08 (Table 4.3).

The rate of pathology ordering increased significantly from 63.6 tests/batteries ordered in 2000–02 per 100 contacts with T2D to 88.4 per 100 in 2006–08. This was due to significant increases in both the likelihood of pathology testing being ordered for T2D (27.3% in 2000–02 to 31.6% in 2006–08 of T2D problems), and the number of tests ordered once the decision to order tests was made (232.9 per 100 tested T2D contacts in 2000–02 and 280.2 in 2006–08) (Table 4.4).

When these data were extrapolated to the number of GP encounters claimed through Medicare nationally, I estimated there were about:

- 850,000 more encounters involving the management of T2D in 2006–08 (3.5 million per year) than in 2000–02 (2.6 million per year)
- 380,000 additional T2D contacts that involved the ordering of at least one pathology test/battery (tested contacts) in 2006–08 (1.1 million per year) than in 2000–02 (720,000 per year)
- 1.4 million additional pathology tests/batteries ordered for T2D in 2006–08 (3.1 million per year) than in 2000–02 (1.7 million per year). T2D accounted for 8% of the national increase in pathology ordering that occurred between 2000–02 and 2006–08 (Table 4.5).

Lipid disorders

From 2000–02 to 2006–08, there was a significant increase in the management rate of lipid disorders, from 2.9 per 100 encounters to 3.5 per 100. Pathology ordered for lipid problems accounted for 5.1% of all problem–pathology links recorded in 2000–02 and 4.9% in 2006–08 (Table 4.3).

The rate of pathology ordering increased from 58.2 per 100 contacts with lipid disorders in 2000–02 to 66.5 per 100 in 2006–08. This was due to a significant increase in the number of tests ordered per tested lipid problem (191.4 tests/ batteries per 100 tested contacts in 2000–02 compared with 219.4 per 100 in 2006–08). There was no change in the likelihood of pathology tests being ordered in the management of lipid disorders (30.4% of lipid disorder contacts in 2000–02 and 30.3% in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 820,000 more encounters involving the management of lipid disorders
- 250,000 more lipid disorder problems for which pathology was ordered
- 790,000 more tests/batteries ordered for lipid disorders (accounting for 4.5% of the national increase in pathology tests/batteries) (Table 4.5).

Female genital check-ups/Pap smears

The management rate of female genital check-ups/Pap smears increased significantly from 2.0 per 100 encounters in 2000–02 to 2.4 in 2006–08. Pathology ordered for

female genital check-ups/Pap smears accounted for 4.7% of all problem–pathology links recorded in 2000–02 and 4.6% in 2006–08 (Table 4.3).

The rate of pathology ordering increased from 79.1 per 100 contacts with female genital check-ups/Pap smears in 2000–02 to 93.1 per 100 in 2006–08. This was due to an increased likelihood of pathology tests being ordered (70.1% of female genital check-up/Pap smear contacts in 2000–02 to 77.9% in 2006–08), and an increased number of tests being ordered once the decision to order had been made (112.9 per 100 tested contacts in 2000–02 to 119.5 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 530,000 more encounters involving management of female genital check-ups/Pap smears
- 580,000 more female genital check-up/Pap smear problems for which pathology was ordered
- 790,000 more tests/batteries ordered for female genital check-ups/Pap smears (accounting for 4.4% of the national increase in pathology tests/batteries) (Table 4.5).

Health checks

The management rate of health checks in patients aged 15 years and over increased significantly from 1.1 per 100 encounters in 2000–02 to 1.5 in 2006–08. Pathology ordered for health checks accounted for 3.4% of all problem–pathology links recorded in 2000–02 and 4.9% in 2006–08 (Table 4.3).

The rate of pathology ordering increased significantly from 122.0 tests/batteries in 2000–02 per 100 health check contacts to 178.9 per 100 in 2006–08. This was due to a significant increase in the number of tests for health checks ordered, once the decision to order tests was made (250.1 per 100 tested health check contacts in 2000–02 to 334.1 in 2006–08). There was no significant change in the likelihood that GPs would order pathology in the management of health checks (48.8% of contacts in 2000–02 and 53.5% in 2006–08) (Table 4.4).

When these data were extrapolated to the number of GP encounters claimed through Medicare nationally, I estimated there were about:

- 460,000 more encounters involving the management of health checks in 2006–08 (1.4 million per year) than in 2000–02 (930,000 per year)
- 290,000 additional health check contacts that involved the ordering of at least one pathology test/battery (tested contacts) in 2006–08 (750,000 per year) than in 2000–02 (460,000 per year)
- 1.4 million additional pathology tests/batteries ordered in the management of health checks in 2006–08 (2.5 million per year) than in 2000–02 (1.1 million per year). The proportion of the national increase in pathology tests/batteries ordered by GPs between 2000–02 and 2006–08 attributable to health checks was 7.6% (Table 4.5).

Weakness and tiredness

There was no change in the management rate of weakness/tiredness (0.8 per 100 encounters in 2000–02 and 0.7 in 2006–08) over the study period. Pathology ordered for weakness/tiredness problems accounted for 4.0% of all problem–pathology links recorded in 2000–02 and 3.5% in 2006–08 (Table 4.3).

The rate of pathology ordered for weakness/tiredness increased significantly (177.9 per 100 contacts in 2000–02 to 233.0 in 2006–08), due to an increased likelihood of pathology tests being ordered (50.3% of contacts in 2000–02 to 62.2 in 2006–08). The data also suggests a trend toward increased numbers of tests ordered per tested weakness/tiredness problem, but this did not reach statistical significance (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 10,000 more encounters involving management of weakness/tiredness
- 100,000 more weakness/tiredness problems for which pathology was ordered
- 450,000 more tests/batteries ordered for weakness/tiredness (accounting for 2.5% of the national increase in pathology tests/batteries) (Table 4.5).

‘Blood test’ problems

Problems labelled as ‘blood tests’ were managed at a significantly higher rate in 2006–08 (0.8 per 100 encounters) than in 2000–02 (0.6 per 100). Pathology ordered for ‘blood test’ problems accounted for 2.5% of all problem–pathology links recorded in 2000–02 and 3.3% in 2006–08 (Table 4.3).

The rate of pathology tests/batteries for ‘blood test’ problems increased significantly (from 147.6 to 199.1 per 100 ‘blood test’ contacts), due to an increased likelihood of pathology tests being ordered (68.8% of blood test contacts in 2000–02 to 75.0% in 2006–08), and increased numbers of tests ordered per tested problem (214.7 tests/batteries per 100 tested contacts in 2000–02 to 265.4 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 290,000 more encounters involving management of ‘blood test’ problems
- 250,000 more ‘blood test’ problems for which pathology was ordered
- 870,000 more tests/batteries ordered for ‘blood test’ problems (accounting for 4.9% of the national increase in pathology tests/batteries) (Table 4.5).

‘Abnormal test result’ problems

The management rate of problems labelled as ‘abnormal test results’ increased significantly from 0.7 per 100 encounters in 2000–02 to 1.1 per 100 in 2006–08. Pathology ordered for ‘abnormal test result’ problems accounted for 1.4% of all problem–pathology links recorded in 2000–02 and 2.0% in 2006–08 (Table 4.3).

The rate of pathology tests/batteries ordered for ‘abnormal test result’ problems increased from 68.6 per 100 ‘abnormal test result’ contacts to 88.5 in 2006–08, due to an increased likelihood of pathology tests being ordered (42.3% of contacts in 2000–02 to 52.5% in 2006–08). There was no change in the number of tests ordered per 100 tested contacts (162.9 per 100 tested contacts in 2000–02 and 168.6 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 430,000 more encounters involving management of ‘abnormal test results’
- 300,000 more ‘abnormal test result’ problems for which pathology was ordered
- 530,000 more tests/batteries ordered for ‘abnormal test result’ problems (3.0% of the national increase in pathology tests/batteries) (Table 4.5).

Depression

There was a marginally significant increase in the management rate of depression between 2000–02 (3.9 per 100 encounters) and 2006–08 (4.2 per 100). Pathology

ordered for depression problems accounted for 1.1% of all problem–pathology links recorded in 2000–02 and 1.3% in 2006–08 (Table 4.3).

There was a significant increase in the ordering of pathology tests in the management of depression, from 9.8 per 100 contacts in 2000–02 to 14.7 per 100 in 2006–08. This was due to a significant increase in the likelihood of pathology tests/batteries being ordered for depression problems (from 3.3% of depression problems in 2000–02 to 4.6% in 2006–08). There was no change in the number of tests/batteries ordered per tested problem (299.6 per 100 tested depression problems in 2000–02 and 322.4 per 100 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 590,000 more encounters involving the management of depression problems
- 80,000 more depression problems involving at least one pathology request
- 280,000 more tests/batteries ordered for depression problems (1.6% of the national increase in pathology tests) (Table 4.5).

Menstrual problems

The management rate of menstrual problems did not change, remaining at 0.8 per 100 encounters in 2000–02 and 2006–08. Pathology ordered for menstrual problems accounted for 1.4% of all problem–pathology links recorded in 2000–02 and 1.3% in 2006–08 (Table 4.3).

There was a significant increase in the rate of pathology ordered in the management of menstrual problems (60.6 per 100 contacts in 2000–02 to 80.2 in 2006–08), due to increased numbers of tests ordered per tested problem (209.3 per 100 tested menstrual problem contacts in 2000–02 compared with 252.3 in 2006–08). There was no change in the likelihood of pathology being ordered in the management of menstrual problems (28.9% in 2000–02 and 31.8% in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 50,000 more encounters involving the management of menstrual problems
- 40,000 more menstrual problems involving at least one pathology request
- 190,000 more tests/batteries ordered for menstrual problems (1.1% of the national increase in pathology tests) (Table 4.5).

Ischaemic heart disease

There was a marginal decrease in the management rate of ischaemic heart disease (IHD) from 1.4 per 100 encounters in 2000–02 to 1.2 per 100 in 2006–08. Pathology ordered for IHD problems accounted for 1.4% of all problem–pathology links recorded in 2000–02 and 1.2% in 2006–08 (Table 4.3).

The pathology test order rate per 100 contacts with IHD increased significantly, from 33.3 per 100 IHD contacts in 2000–02 to 46.7 in 2006–08. This was due to a significant increase in the number of tests/batteries ordered for IHD problems once the decision to order had been made (231.3 tests/batteries per 100 tested IHD problems in 2000–02 compared with 272.6 tests per 100 in 2006–08). However, there was no change in the likelihood of pathology ordering being involved in the management of IHD problems (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 90,000 fewer encounters involving the management of IHD problems
- 20,000 more encounters with IHD problems for which pathology was requested
- 140,000 more tests/batteries ordered for IHD problems (0.8% of the total national increase in pathology tests) (Table 4.5).

Abdominal pain

There was no change in the management rate of abdominal pain over the study period, staying at 0.6 per 100 encounters. Pathology ordering in the management of abdominal pain accounted for 1.1% of all problem–pathology links recorded in 2000–02 and 1.0% in 2006–08 (Table 4.3).

The rate of pathology tests/batteries ordered for abdominal pain increased from 57.5 per 100 contacts in 2000–02 to 79.1 in 2006–08. This was due to a significant increase in the number of tests/batteries ordered for abdominal pain problems once the decision to order had been made (224.8 per 100 tested abdominal pain contacts in 2000–02 compared with 283.1 in 2006–08). There was no change in the likelihood that pathology would be ordered in the management of abdominal pain (25.6% of contacts in 2000–02 and 27.9 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 60,000 more encounters involving the management of abdominal pain problems
- 30,000 more encounters with abdominal pain problems for which pathology was requested
- 180,000 more tests/batteries ordered for abdominal pain problems (1.0% of the total national increase in pathology tests) (Table 4.5).

Overweight/obesity

The overweight/obesity analysis in this section includes problems managed that were labelled by the GP as obesity or overweight at encounters with patients aged 18 years and over. From 2000–02 to 2006–08, there was no significant change in the management rate of overweight/obesity, remaining at 1.2 per 100 adult encounters. Pathology ordered for overweight/obesity problems accounted for 0.9% of all problem–pathology links recorded in 2000–02 and 1.0% in 2006–08 (Table 4.3).

The rate of pathology tests ordered in the management of overweight/obesity among adult patients increased between 2000–02 and 2006–08 by more than 50% (30.6 to 47.1 per 100 overweight/obesity contacts). This increase was due to an increased likelihood that at least one test/battery was ordered (11.7% of contacts for overweight/obesity in 2000–02 and 16.5% in 2006–08). The number of tests ordered per tested problem did not change significantly (262.3 per 100 tested contacts in 2000–02 and 285.9 per 100 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there were about:

- 100,000 more encounters involving the management of overweight/obesity (1 million per year in 2000–02 and 1.1 million per year in 2006–08)
- 60,000 additional tested overweight/obesity contacts (120,000 per year in 2000–02 and 180,000 per year in 2006–08)
- 210,000 additional tests/batteries requested for overweight/obesity (310,000 per year in 2000–02 and 520,000 per year in 2006–08). Of the total national increase in pathology tests/batteries, 1.2% was attributable to pathology ordered in the management of overweight/obesity (Table 4.5).

Menopausal complaint

The management rate of menopausal symptoms and complaints decreased significantly from 1.6 per 100 encounters in 2000–02 to 1.0 in 2006–08. Pathology ordered for menopausal complaint problems accounted for 1.5% of all problem–pathology links recorded in 2000–02 and 0.9% in 2006–08 (Table 4.3).

There was a significant increase in the order rate of pathology tests/batteries for menopausal complaints (33.0 per 100 contacts in 2000–02 and 44.5 in 2006–08), due to increased likelihood of pathology tests being ordered from 13.4% of menopausal complaint contacts in 2000–02 to 19.6 in 2006–08. The number of tests ordered per tested problem did not change significantly (247.0 per 100 tested contacts in 2000–02 and 227.7 per 100 in 2006–08) (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there:

- were about 480,000 fewer encounters involving the management of menopausal complaint problems
- was no change in the number of menopausal contacts involving at least one pathology test
- were about 30,000 fewer tests/batteries requested for menopausal complaints. The proportion of the national change in pathology tests/batteries ordered by GPs in 2006–08, compared with 2000–02, attributable to menopausal complaints was –0.2% (Table 4.5). The decrease in the management rate outweighed the effect of

the increased pathology ordering of the GPs, creating a net decrease in pathology ordering attributable to menopausal complaints.

Viral illness

There was a significant decrease in the management rate of viral illness from 1.4 per 100 encounters in 2000–02 to 1.1 in 2006–08. Pathology ordered for viral illness problems accounted for 1.1% of all problem–pathology links recorded in 2000–02 and 0.9% in 2006–08 (Table 4.3).

There was a significant increase in the order rate of pathology tests/batteries for viral illness, increasing from 26.7 per 100 contacts in 2000–02 to 37.4 in 2006–08. There was a trend toward increased likelihood of tests being ordered for viral illness, but this did not reach statistical significance. There was also no change in the number of tests ordered per tested contact over the study period for viral illness (Table 4.4).

When these data were extrapolated to national GP Medicare encounters, I estimated that, compared with 2000–02, in 2006–08 there:

- were about 260,000 fewer encounters involving the management of viral illness
- was no change in the number of viral illness contacts involving at least one pathology test
- were about 60,000 more tests/batteries requested for viral illness. The proportion of the national change in pathology tests/batteries ordered by GPs in 2006–08, compared with 2000–02, attributable to viral illness was 0.3% (Table 4.5).

Table 4.3: Overview of problems that accounted for at least 1% of total problem–pathology links, 2000–08, 2000–02 and 2006–08

	Number of problems managed			Management rate per 100 encounters[a] (95% CI)			[b]	Number of pathology tests linked to the problem (% of total links)[c]		
Problem	**2000–08**	**2000–02**	**2006–08**	**2000–08**	**2000–02**	**2006–08**		**2000–08**	**2000–02**	**2006–08**
Hypertension (non-gestational)*	72,171	18,007	17,793	9.2 (9.0–9.4)	9.1 (8.8–9.4)	9.5 (9.1–9.8)	—	18,889 (6.0)	3,884 (5.9)	5,744 (6.3)
Type 2 diabetes	22,938	5,211	6,172	2.9 (2.9–3.0)	2.6 (2.5–2.8)	3.3 (3.1–3.4)	↑	17,709 (5.6)	3,314 (5.0)	5,459 (6.0)
Lipid disorders	25,248	5,782	6,629	3.2 (3.2–3.3)	2.9 (2.8–3.0)	3.5 (3.4–3.7)	↑	15,777 (5.0)	3,363 (5.1)	4,410 (4.9)
Female genital check-up/Pap smear*	17,416	3,920	4,471	2.2 (2.1–2.3)	2.0 (1.8–2.1)	2.4 (2.2–2.6)	↑	14,778 (4.7)	3,100 (4.7)	4,163 (4.6)
Health check (15+ years)*	8,120	1,846	2,464	1.2 (1.1–1.2)	1.1 (1.0–1.2)	1.5 (1.4–1.6)	↑	12,008 (3.8)	2,252 (3.4)	4,407 (4.9)
Weakness/tiredness	5,627	1,509	1,373	0.7 (0.7–0.8)	0.8 (0.7–0.8)	0.7 (0.7–0.8)	—	11,559 (3.7)	2,684 (4.0)	3,199 (3.5)
Blood test – all*	5,222	1,121	1,516	0.7 (0.6–07)	0.6 (0.5–0.6)	0.8 (0.7–0.9)	↑	9,444 (3.0)	1,655 (2.5)	3,018 (3.3)
Sexually transmitted infection*	5,999	1,141	1,830	0.8 (0.7–0.8)	0.6 (0.5–0.6)	1.0 (0.8–1.1)	↑	7,128 (2.3)	1,198 (1.8)	2,292 (2.5)
Urinary tract infection*	13,283	3,253	3,152	1.7 (1.7–1.7)	1.6 (1.6–1.7)	1.7 (1.6–1.7)	—	8,201 (2.6)	2,003 (3.0)	2,026 (2.2)
Pregnancy*	8,077	1,799	2,730	1.0 (1.0–1.1)	0.9 (0.8–1.0)	1.5 (1.3–1.6)	↑	6,030 (1.9)	1,197 (1.8)	2,022 (2.2)
Abnormal test result*	6,955	1,389	2,022	0.9 (0.9–0.9)	0.7 (0.7–0.8)	1.1 (1.0–1.1)	↑	5,462 (1.7)	953 (1.4)	1,790 (2.0)
Arthritis – all*	29,755	7,788	6,703	3.8 (3.7–3.9)	3.9 (3.8–4.1)	3.6 (3.4–3.7)	↓	5,577 (1.8)	1,277 (1.9)	1,345 (1.5)
Depression*	31,309	7,658	7,898	4.0 (3.9–4.1)	3.9 (3.7–4.0)	4.2 (4.0–4.4)	↑	3,943 (1.2)	749 (1.1)	1,164 (1.3)
Menstrual problems*	5,961	1,489	1,419	0.8 (0.7–0.8)	0.8 (0.7–0.8)	0.8 (0.7–0.8)	—	4,247 (1.3)	902 (1.4)	1,138 (1.3)

(continued)

Table 4.3 (continued): Overview of problems that accounted for at least 1% of total problem–pathology links, 2000–08, 2000–02 and 2006–08

	Number of problems managed			Management rate per 100 encounters[a] (95% CI)			[b]	Number of pathology tests linked to the problem (% of total links)[c]		
Problem	**2000–08**	**2000–02**	**2006–08**	**2000–08**	**2000–02**	**2006–08**		**2000–08**	**2000–02**	**2006–08**
Anaemia*	5,129	1,271	1,188	0.7 (0.6–0.7)	0.6 (0.6–0.7)	0.6 (0.6–0.7)	—	4,363 (1.4)	1,007 (1.5)	1,077 (1.2)
Ischaemic heart disease*	10,048	2,707	2,261	1.3 (1.2–1.3)	1.4 (1.3–1.5)	1.2 (1.1–1.3)	↓	3,959 (1.3)	902 (1.4)	1,055 (1.2)
Hypothyroidism	4,990	1,057	1,397	0.6 (0.6–0.7)	0.5 (0.5–0.6)	0.7 (0.7–0.8)	↑	3,541 (1.1)	728 (1.1)	1,036 (1.1)
Abdominal pain*	4,803	1,215	1,185	0.6 (0.6–0.6)	0.6 (0.6–0.7)	0.6 (0.6–0.7)	—	3,389 (1.1)	699 (1.1)	937 (1.0)
Overweight/obesity (adults)*	7,797	1,975	1,935	1.2 (1.1–1.2)	1.2 (1.1–1.3)	1.2 (1.1–1.3)	—	2,916 (0.9)	605 (0.9)	912 (1.0)
Atrial fibrillation	6,334	1,323	1,813	0.8 (0.8–0.8)	0.7 (0.6–0.7)	1.0 (0.9–1.0)	↑	3,251 (1.0)	642 (1.0)	900 (1.0)
Menopausal complaint	10,044	3,093	1,923	1.3 (1.2–1.3)	1.6 (1.5–1.7)	1.0 (0.9–1.1)	↓	3,687 (1.2)	1,020 (1.5)	856 (0.9)
Viral illness	9,814	2,847	2,086	1.3 (1.2–1.3)	1.4 (1.3–1.5)	1.1 (1.0–1.2)	↓	3,174 (1.0)	760 (1.1)	780 (0.9)
Subtotal	*317,040*	*77,401*	*79,960*	*. .*	*. .*	*. .*		*169,033 (53.4)*	*34,894 (52.5)*	*49,730 (54.8)*
Total	**1,174,893**	**291,890**	**288,610**	**149.8 (149.2–150.4)**	**147.3 (146.1–148.4)**	**153.3 (151.9–154.7)**	↑	**316,549 (100.0)**	**66,429 (100.0)**	**90,753 (100.0)**

(a) Management rate of the problem, expressed as a rate per 100 encounters. For the number of problems in each data period see Table 4.1. Shading indicates a change between 2000–02 and 2006–08, darker shading indicates a statistically significant change and lighter shading indicates a marginal change.

(b) The direction and type of statistically significant change is indicated for each measure between 2000–02 and 2006–08: ↑/↓ indicates a statistically significant change, ↑/↓ indicates a marginal change, and — indicates no change.

(c) The number and proportion of pathology tests/batteries of tests linked to each problem. It is possible for a single pathology test/battery to be linked to more than one problem (see Section 3.2.11 and Section 4.4.1).

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: Problems that account for at least 1% of problem–pathology links in any of the three data periods are included in this table. CI – confidence interval.

Table 4.4: Changes in pathology ordering for problems that accounted for at least 1% of problem–pathology links, 2000–02 compared with 2006–08

Problem	Pathology per 100 problem contacts[a] (95% CI)		↑↓[b]	Per cent of problem contacts with at least 1 test[c] (95% CI)		↑↓[b]	Pathology per 100 tested problems[d] (95% CI)		↑↓[b]
	2000–02	2006–08		2000–02	2006–08		2000–02	2006–08	
Hypertension (non-gestational)*	21.6 (20.0–23.2)	32.3 (30.3–34.2)	↑	8.7 (8.1–9.3)	11.9 (11.3–12.6)	↑	248.2 (239.5–257.0)	270.4 (262.5–278.4)	↑
Type 2 diabetes	63.6 (59.6–67.6)	88.4 (83.7–93.2)	↑	27.3 (25.8–28.8)	31.6 (30.1–33.0)	↑	232.9 (224.8–241.0)	280.2 (272.4–288.1)	↑
Lipid disorders	58.2 (54.7–61.6)	66.5 (62.5–70.6)	↑	30.4 (28.9–31.9)	30.3 (28.9–31.8)	—	191.4 (184.6–198.2)	219.4 (211.6–227.3)	↑
Female genital check-up/Pap smear*	79.1 (76.4–81.8)	93.1 (90.2–96.0)	↑	70.1 (62.2–72.0)	77.9 (76.2–79.7)	↑	112.9 (110.7–115.1)	119.5 (116.7–122.2)	↑
Health check (15+ years)*	122.0 (110.7–133.3)	178.9 (167.3–190.4)	↑	48.8 (45.1–52.5)	53.5 (50.7–56.3)	—	250.1 (236.1–264.2)	334.1 (322.8–345.4)	↑
Weakness/tiredness	177.9 (164.0–191.8)	233.0 (217.3–248.7)	↑	50.3 (46.7–53.9)	62.2 (58.5–65.9)	↑	353.6 (343.2–364.0)	374.6 (363.5–385.7)	—
Blood test – all*	147.6 (136.3–159.0)	199.1 (186.4–211.8)	↑	68.8 (65.7–71.8)	75.0 (72.2–77.8)	↑	214.7 (201.6–227.8)	265.4 (253.1–277.8)	↑
Sexually transmitted infection*	105.0 (95.3–115.7)	125.2 (115.3–135.2)	—	42.6 (39.3–45.9)	46.6 (43.9–49.3)	—	246.5 (231.4–261.6)	268.7 (251.2–286.2)	—
Urinary tract infection*	61.6 (58.9–64.3)	64.3 (61.4–67.1)	—	53.4 (51.4–55.4)	55.7 (53.7–57.7)	—	115.3 (112.5–118.0)	115.4 (112.6–118.2)	—
Pregnancy*	66.5 (60.5–72.6)	74.1 (68.6–79.6)	—	34.5 (31.9–37.1)	35.0 (33.0–37.0)	—	192.8 (180.6–240.9)	211.7 (200.8–222.6)	—
Abnormal test result*	68.6 (62.7–74.5)	88.5 (83.2–93.9)	↑	42.3 (39.4–45.1)	52.5 (50.2–54.9)	↑	162.9 (154.1–171.7)	168.6 (161.6–175.6)	—
Arthritis – all*	16.4 (14.6–18.2)	20.1 (18.0–22.1)	—	5.5 (5.0–6.1)	6.5 (5.9–7.1)	—	296.3 (283.7–308.9)	308.5 (294.2–322.8)	—
Depression*	9.8 (8.4–11.2)	14.7 (12.8–16.7)	↑	3.3 (2.8–3.7)	4.6 (3.9–5.2)	↑	299.6 (280.2–319.0)	322.4 (300.6–344.3)	—
Menstrual problems*	60.6 (54.3–66.9)	80.2 (72.2–88.2)	↑	28.9 (26.5–31.4)	31.8 (29.1–34.5)	—	209.3 (196.1–222.4)	252.3 (238.4–266.2)	↑

(continued)

Table 4.4 (continued): Changes in pathology ordering for problems that accounted for at least 1% of problem–pathology links, 2000–02 compared with 2006–08

Problem	Pathology per 100 problem contacts[a] (95% CI)		[b]	Per cent of problem contacts with at least 1 test[c] (95% CI)		[b]	Pathology per 100 tested problems[d] (95% CI)		[b]
	2000–02	2006–08		2000–02	2006–08		2000–02	2006–08	
Anaemia*	79.2 (71.8–86.6)	90.7 (82.3–99.0)	—	34.9 (32.2–37.7)	37.3 (34.4–40.2)	—	226.8 (215.4–238.2)	243.1 (230.4–255.8)	—
Ischaemic heart disease*	33.3 (29.2–37.5)	46.7 (41.3–52.1)	↑	14.4 (12.9–15.9)	17.1 (15.4–18.8)	—	231.3 (216.3–246.3)	272.6 (257.5–287.8)	↑
Hypothyroidism	68.9 (62.3–75.5)	74.2 (68.2–80.1)	—	43.0 (39.7–46.2)	44.4 (41.5–47.2)	—	160.4 (150.7–170.1)	167.1 (158.2–176.0)	—
Abdominal pain*	57.5 (50.8–64.3)	79.1 (70.4–87.8)	↑	25.6 (23.0–28.2)	27.9 (25.3–30.6)	—	224.8 (210.0–239.6)	283.1 (265.7–300.5)	↑
Overweight/obesity (adults)*	30.6 (24.6–36.7)	47.1 (39.9–54.4)	↑	11.7 (9.7–13.7)	16.5 (14.1–18.9)	↑	262.3 (241.4–283.3)	285.9 (268.2–303.6)	—
Atrial fibrillation	48.5 (43.9–53.1)	49.6 (45.3–54.0)	—	37.4 (34.4–40.5)	37.4 (34.6–40.2)	—	129.7 (121.8–137.6)	132.7 (125.6–139.9)	—
Menopausal complaint	33.0 (28.9–37.0)	44.5 (37.9–51.1)	↑	13.4 (12.0–14.7)	19.6 (15.2–23.9)	↑	247.0 (231.4–262.5)	227.7 (191.1–264.2)	—
Viral illness	26.7 (22.8–30.6)	37.4 (32.0–42.7)	↑	10.6 (9.3–12.0)	13.4 (11.7–15.1)	—	250.8 (232.9–268.8)	279.6 (261.2–298.0)	—
Total problems	**22.8 (22.2–23.4)**	**31.4 (30.7–32.2)**	↑	**11.4 (11.1–11.6)**	**14.2 (13.9–14.5)**	↑	**200.1 (197.6–202.6)**	**221.3 (218.5–224.0)**	↑

(a) The rate at which pathology tests/batteries of tests were ordered for each problem (based on the number of problem–pathology links), expressed as a rate per 100 specified problems. For details on the number of cases and pathology tests for each problem see Table 4.3.

(b) The direction and type of change is indicated for each measure between 2000–02 and 2006–08: ↑/↓ indicates a statistically significant change, ↑/↓ indicates a marginal change, and — indicates no change.

(c) The proportion of contacts with each problem where at least one pathology test/battery was ordered.

(d) The number of pathology tests/batteries per 100 tested contacts with each problem.

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: Problems that account for at least 1% of problem–pathology links in either 2000–08, 2000–02 or 2006–08 are included in this table. Shading indicates a statistically significant change between 2000–02 and 2006–08. CI – confidence interval.

Table 4.5: Extrapolated national estimated number (thousands) of management and pathology ordered for problems that accounted for at least 1% of problem–pathology links, changes from 2000–02 to 2006–08[a]

	Number of encounters with each problem			Number of problem contacts involving pathology[b]			Number of pathology tests for each problem[b]			Per cent of the change due to each problem[d]
Problem	**2000–02**	**2006–08**	**Change[c]**	**2000–02**	**2006–08**	**Change[c]**	**2000–02**	**2006–08**	**Change[c]**	
Type 2 diabetes	2,640	3,490	850	720	1,100	380	1,680	3,090	1,410	8.0
Health check (15+ years)*	930	1,390	460	460	750	290	1,140	2,490	1,350	7.6
Hypertension (non-gestational)*	9,110	10,060	950	790	1,200	410	1,970	3,250	1,280	7.2
Blood test – all*	560	850	290	390	640	250	840	1,710	870	4.9
Lipid disorders	2,920	3,750	820	890	1,140	250	1,700	2,490	790	4.5
Female genital check-up/ Pap smear*	1,860	2,390	530	1,390	1,970	580	1,570	2,350	790	4.4
Sexually transmitted infection*	570	1,000	430	250	480	240	610	1,300	690	3.9
Pregnancy*	910	1,540	630	310	540	230	610	1,140	540	3.0
Abnormal test result*	690	1,120	430	300	600	300	480	1,010	530	3.0
Weakness/tiredness	760	780	10	380	480	100	1,360	1,810	450	2.5
Depression*	3,870	4,470	590	130	200	80	380	660	280	1.6
Hypothyroidism	530	790	260	230	350	120	370	590	220	1.2
Overweight/obesity (adults)*	1,000	1,090	100	120	180	60	310	520	210	1.2
Menstrual problems*	750	800	50	220	260	40	460	640	190	1.1
Atrial fibrillation	670	1,030	360	250	380	130	320	510	180	1.0

(continued)

Table 4.5 (continued): Extrapolated national estimated number (thousands) of management and pathology ordered for problems that accounted for at least 1% of problem–pathology links, changes from 2000–02 to 2006–08[a]

	Number of encounters with each problem			Number of problem contacts involving pathology[b]			Number of pathology tests for each problem[b]			Per cent of the change due to each problem[d]
Problem	**2000–02**	**2006–08**	**Change[c]**	**2000–02**	**2006–08**	**Change[c]**	**2000–02**	**2006–08**	**Change[c]**	
Abdominal pain*	610	670	60	160	190	30	350	530	180	1.0
Ischaemic heart disease*	1,360	1,280	-90	200	220	20	460	600	140	0.8
Urinary tract infection*	1,640	1,780	140	880	990	110	1,010	1,150	130	0.7
Arthritis – all*	3,910	3,770	-140	220	250	30	650	760	110	0.6
Anaemia*	640	670	30	220	250	30	510	610	100	0.6
Viral illness	1,440	1,180	-260	150	160	0	380	440	60	0.3
Menopausal complaint	1,560	1,080	-480	210	210	0	520	480	-30	-0.2
Total	**100,300**	**106,500**	**6,200**	**16,800**	**23,200**	**6,400**	**33,620**	**51,330**	**17,710**	**100.0**

(a) Extrapolations are presented in thousands and are rounded to the nearest 10,000.

(b) Calculations are based on the number of problem–pathology linkages. There are more problem–pathology linkages than pathology tests recorded as each pathology test can be linked to more than one problem (see Section 3.2.11 and Section 4.4.1).

(c) Calculations of change were made prior to rounding to the nearest 10,000. Due to the rounding, calculating change using the 2000–02 and 2006–08 data presented in the table above may produce a different result to that reported in the 'Change' column.

(d) The proportion of the total extrapolated national increase in pathology tests/batteries (*n* = 17.7 million) that was attributable to each problem.

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: Problems that account for at least 1% of problem–pathology links in either 2000–08, 2000–02 or 2006–08 are included in this table.

4.5 Discussion

This chapter has provided a comprehensive overview of GPs' pathology ordering in Australia in 2000–08. It described the total increase in GPs' pathology ordering that occurred between 2000–02 and 2006–08, and identified the most common individual tests and clinical problems contributing to the measured increase in pathology ordering.

Three factors (each of which can operate independently) contributed to the total increase in the volume of pathology tests/batteries of tests ordered by GPs between 2000–02 and 2006–08: an increase in the number of national GP encounters in the country (reflecting an increase in total GP workload); a statistically significant increase in the number of problems managed per encounter (reflecting a change in GPs' encounter workload); and a statistically significant increase in GPs' pathology ordering in the management of these problems (reflecting change in GPs' pathology ordering behaviour). The latter was measured as an increase in the rate of pathology ordering due to increases in the likelihood of GPs' initiating pathology ordering in the management of problems, and the number of tests ordered per occasion of testing.

These findings differ considerably from those of the earlier BEACH study that investigated change in GPs' pathology ordering between 1998 and 2001, which found that GPs' ordering increased due to an increase in the number of tests ordered per tested problem, without any change in likelihood of testing.[45] The other two factors did not contribute to the national increase in total volume of pathology ordered in general practice from 1998 to 2001. This suggests that the behaviour of increased likelihood of ordering pathology tests has occurred since that time.

From the perspective of managing financial outlays associated with pathology testing, the increase in occasions of testing has a greater impact than the number of tests ordered on each occasion of testing.[133] This is because the majority of the costs associated with laboratory testing are labour costs. Each additional test ordered on a single occasion contributes a relatively small additional cost burden due to the high use of automated machinery in the pathology sector.[134]

The extrapolations used in this chapter incorporate the increases in the three factors to estimate the national effect of change. When extrapolated, the BEACH data

suggest that in 2006–08, compared with 2000–02, there was a national increase of about 53% in the volume of tests/batteries ordered by GPs. In contrast, the volume of Medicare-funded pathology items increased by 54% from 2000–01 to 2007–08.[5] However, this does not accurately reflect changes in GP pathology ordering behaviour, as only 70% of the MBS pathology items are generated by GPs (E Wilson, personal communication, March 2011). Further, only three pathology item numbers can be claimed per episode of ordering (due to episode coning), and multiple tests may be included in each MBS item.[23] While BEACH data reflect actual GP orders for pathology tests, it is likely that it under-estimates the true number of pathology tests/batteries ordered, as there is only space for up to five tests/batteries to be recorded per encounter (see 'strengths and limitations' below).

Individual tests ordered by GPs

The majority of pathology ordered by GPs' was generated by a relatively small number of tests—the 22 most common tests accounted for 86% of all GP-ordered tests in 2000–08. This finding aligns with that reported in earlier studies: the 20 most common tests accounted for 80% of all pathology ordered by GPs in Australia in 1998[89] and in the Netherlands in 1996–97;[79] and, similarly, in the UK in 1997–98 the 28 most common test types accounted for 95% of GPs' pathology ordering activity.[82] In the current study, there were significant increases between 2000–02 and 2006–08 in GPs' ordering rates for the majority of the commonly ordered individual tests; only three individual tests showing no change. The size of the increase varied considerably between the individual tests, from a marginal increase of 8% in the ordering rate of urine M,C&S tests to an increase of 200% in the order rate of vitamin B12 tests. GPs' ordering rate of the five most commonly ordered tests increased by between 26% and 55%. Despite these increases, the types of tests ordered by GPs stayed relatively constant between 2000–02 and 2006–08 and they accounted for a similar proportion of total pathology ordered over time, suggesting that the majority of the increase in GPs' pathology ordering reflected an increase in the ordering of common tests rather than the emergence of new tests.

The problems generating the highest volume of tests

GPs' management of a relatively small group of clinical problems accounted for the majority of pathology ordered by GPs. The 22 problems investigated in this study accounted for 53.4% of all problem–pathology links.

The most common problems for which GPs ordered pathology tests stayed relatively constant from 2000–02 to 2006–08. However, GPs' pathology ordering for these 22 problems increased. Extrapolation suggests they accounted for 59% of the national increase in pathology ordered in general practice. This national increase was due to: increases in GPs' pathology ordering in the management of the problems; changes in the GP workload accounted for by these problems; and the increase in number of GP encounters nationally.

It is important to consider the influence of GP workload in combination with GPs' pathology ordering behaviour. The example of 'menopausal complaint' demonstrates why these aspects must be considered together. GPs' pathology ordering in the management of menopausal problems increased significantly. Specifically GPs were more likely to initiate pathology testing for 'menopausal complaint' in 2006–08 than in 2000–02. In isolation this result would suggest that there would be an increase in the volume of pathology associated with the management of menopausal complaints. However, due to a significant decrease in the management rate of menopausal complaint problems, the opposite was true.

The change in management rate was likely triggered by the 2002 publication of results from the Women's Health Initiative study that indicated adverse effects were associated with use of hormone replacement therapy (HRT).[135] Following this finding, use of HRT declined. As HRT was the principal method of managing menopausal complaints, this led to the decrease in management rate of menopausal complaints at GP–patient encounters. The total decrease in the management rate of menopausal complaints was a greater influence than the increase in likelihood of GPs' ordering pathology. This is a good example of how a change in evidence influences volume of pathology ordered in general practice.

Menopausal complaint was the only problem for which a decrease in pathology ordering was found. Generally speaking in the absence of a change in GPs' ordering behaviour, there was an increase in volume of tests generated by each problem due to the national increase in GP workload (as demonstrated by the increased number of encounters over time) with or without a contributing increase in GPs management rate of the individual problem. Hence for each of the seven problems for which GPs' pathology ordering behaviour did not change, there was still a national increase in total number of tests ordered.

I have described the increasing volume of pathology tests/batteries ordered by GPs as being related to changes within three factors (total GP workload, management rates of problems and GPs' pathology ordering behaviour in the management of these problems). Many potential causes for these changes are discussed in the literature, and the influence of some of these causes may be seen in the results of this chapter. Some causes of change will be beyond the control of GPs, while others may contribute to changes in GPs' pathology ordering behaviour. The quality or appropriateness of a change also varies, it may reflect 'good' clinical practice (for example, in response to new evidence) or 'bad' (for example, defensive testing). Examples of causes of change in GPs' pathology ordering are given below.

The publication of new guidelines or changes to existing guideline recommendations relating to pathology testing have the potential to change GPs' pathology ordering. Such changes are often made in response to emergence of new evidence.

The increase in the number of national GP encounters is largely beyond the control of GPs. Australia's ageing population will have contributed to the past increase in number of GP encounters, as rates of attendance increase with age.[136] Over the period of 2000 to 2008 the proportion of the population aged 65 years or more increased from 12.4% to 13.2%,[15] and this is expected to continue. By 2050 it is projected to be 22-24%.[137] The influence of population ageing on future growth in pathology ordering is investigated in Chapter 8.

Health policy initiatives have been associated with an increased volume of pathology tests.[26,27,29] Depending on their content and design, these initiatives have the potential to influence pathology ordering by changing GP workload and/or GPs' pathology ordering behaviour. How such initiatives are targeted (e.g. to the GP, or to the patient) will also influence whether GPs have any control over the changes in pathology that may be generated by the initiatives. For example, the 'Strengthening Medicare' package introduced in 2004–05 is a population-based initiative that aimed (among other things) to improve access to GP services.[18] It was regarded as successful in achieving this aim and contributed to the increase in GP workload over the period investigated in this study. The content of the initiative was unlikely to have caused any change in GPs' pathology ordering behaviour, but the growth in workload it generated was accepted by the Government as contributing to growth in Medicare pathology outlays between 2004 and 2009.[26]

The Practice Incentives Program (PIP) is a national initiative that provides a series of financial incentives for specific activity in general practice. PIP incentives were introduced for diabetes (in late 2001) and cervical screening (in late 2000). These incentive payments were made for specific outcomes which required pathology testing and recall systems within general practice to meet these targets.[138] These may have contributed to both the increased management rate and the increased pathology ordering for these problems that were reported in this study.

The broad range of problems for which GPs ordered pathology tests, illustrates the different clinical purposes for which GPs order pathology tests. For example, the majority of pathology ordered in the management of chronic problems such as hypertension and T2D is likely to be for monitoring purposes, whereas testing in the management of weakness/tiredness problems is likely to be for diagnostic purposes, and that ordered in the management of health checks and female genital check-ups for screening purposes.

Most of the problems I have investigated in this chapter reflect diseases or symptoms. Two notable exceptions are problems labelled as 'blood test' and 'abnormal test results'. Increases in workload and pathology ordering related to management of these problems may represent a change in GPs' process of care when ordering tests and giving results at GP–patient encounters. This study spans a period of workforce crisis and financial stress in general practice.[139] Discontent with level of Medicare rebates led to falls in bulk-billing rates in the early 2000's.[5] It is possible that GPs changed their process of managing blood tests and results to increase income from this management by always seeing the patient to prepare the blood test order and provide results.

Also occurring at around the same time was the December 2001 introduction of privacy legislation that covered, for the first time, patient information collected, used and communicated by GPs.[140] The legislation stated the need to ensure the identity of the patient prior to communicating any sensitive information. Telephone communication may make this difficult. It is now not uncommon for general practices to have policies precluding communication of test results over the telephone. Almost half of Australians surveyed in the 2008–09 Patient Experience Survey who had had a pathology test, received the test results at a follow-up appointment.[141]

The increase in the management rate of abnormal test results may reflect an increase in the number of false positive test results. False positive results are a function of the reference range used to determine whether a result is 'normal'. When a 95% reference range is used to test a normal sample, there is a 95% chance that the result will be normal and a 5% chance that the result will be inappropriately reported as abnormal.[142-144] The current study demonstrates that the number of tests ordered on each occasion of testing is increasing. As the number of tests ordered increases, so too does the probability that at least one false positive result will be reported. Most GPs are aware of the likelihood of false positive results and manage these intuitively. However, it is possible that medicolegal concerns may be contributing to the change in GPs' pathology ordering behaviour in the management of abnormal test results.

GPs' awareness of medicolegal issues was high throughout the period of this study due to the political and media coverage of the 'medical indemnity crisis' which followed the collapse of the general insurer HIH in 2001 and the 2002 voluntary liquidation of Australia's largest medical defence organisation. The causes of the crisis were complex, and involved poor regulation of defence organisations, insufficiencies in their financial arrangements, and an increased number of medicolegal claims.[145,146] National data on medicolegal claims involving GPs are only readily available from 2007–08 onward. Of the new claims initiated in 2007–08, general practice was the speciality that generated the highest proportion (21%). This is due to the high number of services provided by GPs. The most common type of claim made regarding GPs was related to 'diagnosis' (26.4% of all claims against GPs) which includes missed, delayed or incorrect diagnosis. As pathology testing is frequently involved in the diagnostic process, it is conceivable that some of the change observed in GPs management of abnormal test results may be due to defensive behaviour. Further, medicolegal concerns have been frequently described as a reason for ordering pathology tests.[9,26,28,36,147]

The management rate and GPs' pathology ordering increased for both 'blood test' and 'abnormal test results' problems over the study period. Some of the many external factors that may have contributed to these changes have been discussed above.

Strengths and limitations

The strength of the investigation of pathology ordering associated with individual problems, is that the analytical approach used enabled separation of the influence of (a) the GP workload associated with the management of each problem and (b) the GPs' pathology ordering behaviour in the management of each problem. These data, together with national Medicare claims data for GP encounters have been used in the extrapolations to estimate the national increase in pathology ordering attributed to each problem.

There are limitations that should be considered when interpreting the extrapolations. Extrapolations are only estimates and are likely to provide an underestimate of the true 'GP workload' because they are made to Medicare-claimed GP services, not to the total number of GP encounters per year (which include those not charged for, and those paid by sources other than Medicare, for example, state governments, WorkCover, employers). Approximately 5% of GP encounters are funded by sources other than Medicare.[121]

Further the extrapolated estimates of pathology ordering are based on the problem–pathology links. Each test may be linked (by the GP) to more than one problem being managed at the encounter. Therefore, it is possible for a single pathology test/battery to be linked to more than one problem. In each of the data periods used in this chapter there were 3–4% more links than tests. Therefore the extrapolations may overestimate the number of tests attributed to the problem.

In BEACH there was also an increase over time in the number of encounters where the maximum number of pathology tests/batteries (five) were recorded, suggesting that the number of tests/batteries missed may be increasing due to lack of space on the recording form. Therefore, extrapolations may under-represent the number of tests ordered by GPs and the amount of change that has occurred.

Despite these limitations, the extrapolations provide an estimate of the contribution of each problem to the increase in the national volume of pathology generated from GP orders. This is the first time that such analyses have been attempted.

Conclusion

This chapter highlights the influence of increases in GP workload and change in GPs' pathology ordering behaviour on the total volume of pathology ordering. This study provides, for the first time, information on the problems under management

that contribute to the growth in GPs' pathology ordering. It also demonstrates that change in GPs' pathology ordering behaviour is not always a contributing factor to the total volume of pathology associated with an individual problem. Further, even when present, changes in GPs' pathology ordering behaviour are not the sole factor contributing to national increases.

GPs' ordering rates of 22 pathology tests, and testing in the management of 22 problems, generated the majority of the volume and growth in GPs' pathology ordering between 2000–02 and 2006–08.

The findings of this chapter are used as the basis for selection of problems for the evaluation of the appropriateness of GPs' pathology ordering in the next chapter. The criteria used to select problems consuming increasing amounts of pathology resources were: (a) contribution to a high volume of total pathology ordering; (b) GPs' management has been characterised by changes in their pathology ordering behaviour. Hence, of the 22 problems investigated in this chapter, 10 were identified priorities for investigation of appropriateness. These were: hypertension, T2D, lipid disorders, health checks, weakness/tiredness, overweight/obesity, depression, menstrual problems, IHD, and abdominal pain (see Chapter 5).

The increases in GPs' pathology ordering described in this chapter do not provide any indication of the appropriateness of this ordering, and are likely to reflect both 'good' and 'bad' behaviours. The investigation of appropriateness of GPs' pathology ordering is the focus of Chapter 5.

5 GP pathology testing versus recommended testing

The results of the previous chapter confirmed that GPs' pathology ordering in the management of all problems increased significantly over time. However, investigation of the problems generating the highest volume of pathology ordering, demonstrated that GPs pathology ordering behaviour did not change for all problems. Further, for the problems where GPs' ordering increased, the type of ordering behaviour that changed differed across problems. While discerning whether GPs' pathology ordering behaviour changed, the research described in Chapter 4 did not investigate the types of tests nor the appropriateness of tests ordered in the management of each of these problems.

5.1 Objectives

In this chapter I will investigate the types of tests ordered by GPs for selected problems and evaluate the extent to which GPs' pathology ordering for these selected problems aligns with recommendations for pathology testing made in national and international guidelines and other sources of guidance for the management of selected problems. Secondary objectives are:

- to identify whether any changes over time that occurred in pathology ordered for selected problems reflect a change to be 'more' or 'less' in line with recommendations.
- to evaluate the quality of guidance for pathology testing available and identify areas in which guidance needs to be improved (such as areas where guidance is lacking or inconsistent).

5.2 Background

The increased rate of pathology testing and associated cost increases has stimulated much research and debate into the reasons for the increased demand. Numerous factors have been described in the literature as contributing to the increase.[9,26-30] One of the aspects of the debate is whether these factors are contributing to increases in appropriate or inappropriate pathology ordering.

Several authors have implied that inappropriate pathology testing is widespread, and that the continued increase in pathology testing reflects inappropriate ordering.[8,9,12,28,29,58,59] The Carter report (investigating pathology ordering in the UK) noted that several 'witnesses' reported widespread unnecessary testing but found there were "no robust studies which verify this statement."[8] However, it is relatively safe to conclude from the published literature that there is a degree of inappropriate or unnecessary pathology ordering by GPs and other clinicians.[11,52,76,85,96]

Concern about appropriate ordering is not new, having been discussed for several decades.[28,42,148-150] What is unclear is the proportion of pathology testing that is inappropriate, and whether inappropriate testing is increasing.

Defining and measuring appropriateness of pathology ordering is difficult. In their review, van Walraven and Naylor[52] found huge variability in the volume (5–95%) of tests ordered that were deemed 'inappropriate' in studies. This variation was due to the different clinical scenarios in the studies reviewed, and the diverse and often flawed methods used to evaluate appropriateness. Although most of the reviewed studies were not conducted in general practice, the review highlights the difficulty of defining appropriateness. This is echoed by Smellie, who noted that the appropriateness of pathology tests "depends on the clinical context of the patient, the severity of the disorder, administrative necessities and many other factors."[54]

To date there have been no large studies attempting to define the amount of inappropriate pathology testing in general practice. Much of the evidence used to support the presence of inappropriate pathology ordering by GPs is drawn from studies reporting results of interventions that aim to improve appropriateness of their pathology ordering.[11,58,74-77,79-87,95-97] Guidelines are usually the basis of these interventions. However, as discussed in Chapter 2, these studies are often targeted to 'problem' areas of pathology ordering where the intervention is most likely to be cost-effective by achieving a reduction in use of pathology testing. As such they are conducted in very focussed clinical situations targeting a limited number of pathology tests[58,80-84] or pathology testing for a limited number of clinical problems.[11,75,77,85-87] Only a handful of interventions target groups of tests and/or problems that reflect the breadth of clinical situations in which GPs' order pathology tests.[76,79,82,88,95]

Success of these intervention studies is usually judged on the basis of a reduction in pathology testing following the intervention. The assumption is made that the reduction is a reduction in inappropriate tests. However most studies do not assess the appropriateness of the reduction in testing. A reduction (even when only inappropriate tests are reduced) does not enumerate the proportion of tests that are inappropriate as there may be situations where the test was used inappropriately but the intervention was not successful. This is illustrated by van Wijk et al. who introduced a decision support tool to support appropriate pathology ordering by GPs,[79] and then assessed the appropriateness of GPs' ordering after the intervention.[88] The intervention reduced ordering,[79] but the subsequent assessment demonstrated that only 40% of pathology ordering sets for 12 indications were compliant with guidelines.[88] Van Wijk et al. did not measure whether the reduction in ordering represented improved appropriateness, but the subsequent assessment demonstrates that there is potential for further improvement in GPs' ordering for the 12 indications investigated. Thus a 'successful' intervention is not a reflection of the underlying appropriateness of GPs' ordering.

The extent to which results of these studies can be generalised is limited by the diversity of the circumstances being investigated. Other authors have misinterpreted findings of such studies extrapolating them beyond the context of the clinical situation in which the study was designed, resulting in statements such as "between 25 and 40% of all tests sent to the laboratory are unnecessary".[28]

There is currently insufficient evidence to determine the proportion of GP-ordered pathology tests that could be considered inappropriate in Australia. However, it is important to establish whether inappropriate pathology ordering is an issue, and if it is, the extent of this inappropriate ordering, before investing resources in interventions to improve pathology ordering. Whether such interventions should be targeted to specific clinical problems, types of tests or other areas of testing (such as, purpose of testing e.g. diagnostic versus monitoring) also needs to be determined. This chapter aims to evaluate the proportion of the tests ordered by GPs that are appropriate, for each of a subset of clinical problems that are generating a high volume of pathology ordering in general practice.

5.3 Method

5.3.1 General practice data

The data used in this chapter were collected in the BEACH study over 8 years from April 2000 to March 2008 (referred to as 2000–08). Changes over time were measured by comparing results from the first two years of the study period (April 2000 to March 2002) with those from the last two years (April 2006 to March 2008) (referred to as 2000–02 and 2006–08 respectively).

In BEACH, all pathology tests recorded are linked (by the GP) to the specific problem(s) for which they were ordered. The analysis of pathology ordering in this chapter is based on these problem–pathology links (see Section 3.2.11). I used unweighted data in the analysis because multiple data years were combined (see Section 3.2.10).

5.3.2 Selecting the problems for investigation

A problem was considered for investigation if GPs' pathology ordering had increased for that problem between 2000–02 and 2006–08, and if:

- it was considered a National Health Priority Area, and/or
- the problem generated a high volume of total pathology ordering, and/or
- pathology ordering was commonly used by GPs in the management of the problem.

The eight National Health Priority Areas in Australia (in 2008) were: arthritis and musculoskeletal conditions, asthma, cancer control, cardiovascular health, diabetes mellitus, injury prevention and control, mental health, and obesity.[151]

A total of 22 problems generating high volumes of pathology ordering by GPs were identified in Chapter 4. Of these, I identified 10 as priorities for investigation based on the criteria above. These were: hypertension, Type 2 diabetes, lipid disorders, health checks, weakness/tiredness, overweight/obesity, depression, menstrual problems, ischaemic heart disease, and abdominal pain. The first six problems from this list were investigated because they generated the highest volume of pathology tests ordered by GPs and/or were areas of current policy interest.

Defining the problems

The six problems investigated are defined below. The list of ICPC-2 or ICPC-2 PLUS codes included for each problem is provided in Appendix 6.

Hypertension

Hypertension includes problems recorded by GPs that were classified as uncomplicated or complicated hypertension in ICPC-2 (codes K86 and K87). It excludes hypertension in pregnancy (pre-eclampsia) because this condition is not managed in the same way.

Type 2 diabetes

Type 2 diabetes includes problems recorded by GPs that were classified as 'non-insulin dependent diabetes' (ICPC-2 code T90). In line with ICPC-2 inclusion criteria, this includes diabetes mellitus not specified by the GP as Type 1 or Type 2.

Lipid disorder

Lipid disorder includes problems recorded by GPs that were classified as 'lipid disorder' in ICPC-2 code T93.

Health check

'Health check' was investigated when recorded as a clinical problem at encounters with patients aged 15 years or more. 'Health check' problems are a group of ICPC-2 PLUS (terminology) codes classified as check-ups in the general and unspecified chapter of ICPC-2 (codes A30 and A31). The 'health check' problems can be considered preventive in nature but whether each is for primary, secondary or tertiary prevention is not recorded in the BEACH data set. The age limit (of 15 years and over) was selected because check-ups for children rarely involve pathology testing.

Check-ups that were likely to be privately funded (such as employment check-ups) were excluded because any pathology generated in the management of these checks would also be privately funded. This is one of the few areas in general practice that generates a substantial amount of privately funded pathology. The majority of pathology ordered by GPs is publicly funded through the MBS and this is the focus of this thesis.

Check-ups related to a specific health condition were also excluded because presence of this condition would affect pathology test selection and the resources GPs use to guide their test selection. In addition, the specific condition usually indicated that the check-up was not preventive.

Weakness/tiredness

Weakness/tiredness was investigated when recorded by the GP as the clinical problem under management. It includes problems classified as 'weakness/tiredness' in ICPC-2 (code A04). This does not include all patient presentations of weakness/tiredness. In many cases GPs were able to assign a presentation of weakness/tiredness to a more specific diagnosis based on other information (e.g. patient history). The problem label of weakness/tiredness indicates that a more precise diagnostic label could not be assigned to the problem at the time of the encounter.

Overweight/obesity

Overweight/obesity includes problems labelled by the GP as 'obesity' or 'overweight' (ICPC-2 codes T82 and T83) at encounters with adult patients (aged 18 years and over). This does not represent all encounters with overweight/obese adult patients, only those at which overweight or obesity was managed as a specific problem at the encounter. It also does not include GP management of overweight/obesity as part of the management of other morbidity (e.g. weight/diet advice in the management of hypertension).

The method(s) used by the GP to define the problem as obesity or overweight is not known. It may be clinical opinion, calculation of BMI, waist measurement, weight measurement, or a combination of the above indications.

Overweight and obesity were combined to provide a larger sample with greater statistical power than obesity alone. In addition, many of the available guidance documents were for overweight/obesity. If a patient is overweight they are at considerable risk of progressing to obesity. Hence the WHO regards overweight as preobesity.[109]

The analysis of pathology ordering for overweight and obesity was limited to adults because guidance provided for management of overweight/obesity in children and adolescents differed from that for adults. Further, most encounters (95.1%) involving the management of overweight/obesity were with adult patients.

5.3.3 Identifying the guidelines and other sources of guidance

National and international guidelines, and other published guidance documents for the management of each selected problem were identified using literature searches in Medline and internet-based search engines and databases (e.g. Google, National Guideline Clearinghouse, TRIP Database). The most recently available international and national guidelines and other Australian sources of GP guidance for each selected problem published prior to May 2009 were reviewed.

Search terms used included *disease management* and *practice guidelines* and terms related to the specific problem. For example, for overweight/obesity search terms included *overweight*, *obesity*, and *body weight*. Additional websites and databases were found by consulting 'related links' on websites and 'related articles' links within electronic databases.

Peak bodies that develop and disseminate guidelines were identified, and their published guidelines examined for any relating to the selected problems. Reference lists in documents were also reviewed to find other relevant publications.

Any guidelines or guidance documents that were largely based on another guidance document were excluded, and the source guidance document reviewed. Only guidance published in English or with an English translation available was included.

The guidance documents reviewed in this study included guidelines and other types of published guidance documents (such as the pathology manual produced by the RCPA). All types of guidance documents were reviewed because GPs use multiple sources when looking for clinical information, including guidelines and other published guidance documents.[152] The review also sought to evaluate the extent to which pathology test recommendations were consistent among guidance documents. Therefore it was considered appropriate to review all published sources of guidance available to GPs.

Some guideline authors have also produced abbreviated GP guides and fact sheets in an effort to overcome identified barriers to guideline use by GPs (e.g. length of guidelines).[153] These guides were compared with the matching guidelines to identify mismatches (e.g. differences in level of recommendations, and omissions).

Throughout the remainder of this chapter the term ‘guidance documents’ is used to refer to both guidelines and other sources of guidance.

5.3.4 Determining recommended pathology testing

Guidance documents were reviewed to identify pathology tests recommended in the management of the specific problems. Level of support was determined for each pathology test/battery of tests that accounted for at least 1% of pathology tests ordered for the selected problem.

When there were differences among guidance document recommendations for an individual test, the level of support for the test was determined by agreement in the majority of guidance documents.

Tests were classified as:

- **supported**: those that the guidance documents indicated have a role in any phase of management of the problem. For example, tests only recommended for diagnosis were considered supported. In addition tests that were recommended for a large specific group of patients were considered supported (e.g. all female patients).
- having **conditional support**: guidance documents indicated the test has a role in the management of the problem in certain circumstances (such as the presence of a risk factor).
- **unsupported**: tests that the guidance documents specifically stated should not be performed or tests not mentioned by guidance documents as having a role in the management of the problem.
- support **unable to be determined**: level of support in guidance documents was unclear for two groups of tests—multibiochemical analysis (MBA) and ‘other chemistry’ tests.

  The MBA group includes two tests: the MBA test and the electrolytes and liver function test (E&LFT) (see Appendix 7). The MBA group potentially includes a large number of biochemical analytes[‡]. The MBS chemical analysis pathology item 66500 gives an example of the range of biochemical tests that could be included in a MBA.[23] The specific analytes measured in response to a GP’s order for a MBA or E&LFT test varied between laboratories, therefore it was not possible to determine the exact tests included in the MBA group. When a

guidance document recommended one or more biochemical tests that could be considered part of the MBA group (but did not mention the MBA or E&LFT tests) this is discussed in the relevant section.

The ‘other chemistry’ group includes a large number of individual chemistry tests that are not frequently ordered in general practice. The included tests are listed in Appendix 7. Where an individual test within the group accounted for more than 1% of pathology tests for an investigated problem it was evaluated and discussed in the relevant section.

5.4 Hypertension

5.4.1 Background

Hypertension is the most common cardiovascular condition in the population.[154] Cardiovascular disease was made a National Health Priority Area in 1996 due its' high burden of morbidity and mortality.[155] High blood pressure accounted for 7.6% of the burden of disease in Australia (in 2003).[156] In 1999–00, the prevalence of hypertension was 29% of Australians aged 25 years and over, and prevalence increased with age.[157]

A 2005 SAND substudy of 9,156 patients estimated the prevalence of hypertension to be 23.3% of patients at encounters in general practice. After adjusting for frequency of attendance, the prevalence was 17.6% of the general practice patient population (i.e. patients who attend general practice at least once).[158]

Hypertension is identified and managed because of the cardiovascular risk associated with high blood pressure.[159-162] Pathology testing does not have a role in the diagnosis of hypertension, but does have a role in identifying causes of secondary hypertension and detecting cardiovascular risk factors and disease.

5.4.2 Management rate in Australian general practice

In BEACH, hypertension was managed at 72,169 encounters by 7,489 GPs in 2000–08, at a rate of 9.2 per 100 encounters (Table 5.1). This equates to an estimated 9.3 million GP encounters per year where hypertension was managed in Australia.

The vast majority (99.9%) of hypertension managed was uncomplicated hypertension (results not tabled), and there was no change in the management rate of hypertension between 2000–02 and 2006–08 (Chapter 4). In contrast, the management rate of 'new' hypertension problems increased significantly (by 24%), from 0.48 per 100 encounters in 2000–02 to 0.60 in 2006–08 (Table 5.1), indicating an increase in its diagnosis or detection rate.

Table 5.1: Summary of hypertension data set, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Rate per 100 encounters (95% CI) (*n* = 784,300)	Number	Rate per 100 encounters (95% CI) (*n* = 198,200)	Number	Rate per 100 encounters (95% CI) (*n* = 188,300)	Change
General practitioners	7,489	. .	1,900	. .	1,810	. .	. .
Hypertension encounters	72,169	. .	18,007	. .	17,792	. .	. .
Hypertension problems managed	72,171	9.2 (9.0–9.4)	18,007	9.1 (8.8–9.4)	17,793	9.5 (9.1–9.8)	—
New hypertension problems	4,237	0.54 (0.52–0.56)	958	0.48 (0.44–0.52)	1,131	0.60 (0.56–0.64)	↑

Note: Data about hypertension problems managed are drawn from Chapter 4, Table 4.3. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

5.4.3 Pathology ordered for hypertension

Pathology was ordered at a rate of 26.2 tests/batteries of tests per 100 hypertension contacts in 2000–08. One in ten hypertension problem contacts (10.2%) resulted in at least one pathology order. Once the decision to order pathology was made GPs ordered on average 2.56 tests/batteries per tested problem (Table 5.2).

As described in Chapter 4, the rate of pathology ordering per 100 hypertension contacts increased significantly between 2000–02 and 2006–08. This was due to significant increases in both the likelihood of pathology being ordered in the management of hypertension and the number of tests ordered per tested hypertension problem (Table 5.2).

Table 5.2: Summary of pathology ordering for hypertension, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Per cent / Rate of hypertension problems (95% CI) (*n* = 22,938)	Number	Per cent / Rate of hypertension problems (95% CI) (*n* = 18,007)	Number	Per cent / Rate of hypertension problems (95% CI) (*n* = 17,793)	Change
Pathology (Rate per 100 hypertension problems)	18,889	26.2 (25.3–27.1)	3,884	21.6 (20.0–23.2)	5,744	32.3 (30.3–34.2)	↑
At least one pathology order (Per cent of hypertension problems)	7,377	10.2 (9.9–10.6)	1,565	8.7 (8.1–9.3)	2,124	11.9 (11.3–12.6)	↑
Number of tests/ batteries per 100 tested hypertension problems	. .	256.1 (251.8–260.4)	. .	248.2 (239.5–257.0)	. .	270.4 (262.5–278.4)	↑

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.4. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

Types of pathology tests/batteries ordered

Table 5.3 shows the rate of pathology tests/batteries ordered for hypertension in 2000–08 by MBS groups and the most common individual types of tests ordered.

Chemistry tests were the group most often ordered (21.0 per 100 hypertension contacts) and the most common were:

- lipid tests (5.8 per 100 hypertension contacts)
- EUC tests (5.3 per 100 contacts)
- glucose/glucose tolerance tests (2.9 per 100)
- LFTs (2.3) (Table 5.3).

Haematology tests (4.0 per 100 contacts), in particular FBC tests (3.6), were also commonly ordered in the management of hypertension (Table 5.3).

One-eighth (16.4%) of pathology tests were ordered for ‘new’ cases of hypertension. While the rate of pathology ordering for new cases was significantly higher than the average rate, the majority of tests ordered by GPs were for the ongoing management or monitoring of hypertension (Table 5.3).

Table 5.3: Rate of pathology test orders for hypertension by MBS pathology groups and most frequent individual test orders within each group, 2000–08

	All hypertension problems		New hypertension problems		
Pathology test	Number	Rate per 100 hypertension problems (95% CI) (*n* = 22,938)	Number	Per cent of test	Rate per 100 new hypertension problems (95% CI) (*n* = 1,421)
Chemistry	**15,148**	**21.0 (20.2–21.7)**	**2,387**	**15.8**	**56.3 (52.6–60.0)**
Lipids*	4,203	5.8 (5.6–6.1)	644	15.3	15.2 (13.9–16.5)
EUC*	3,836	5.3 (5.1–5.6)	528	13.8	12.5 (11.4–13.6)
Glucose/glucose tolerance*	2,119	2.9 (2.8–3.1)	348	16.4	8.2 (7.3–9.1)
LFT*	1,624	2.3 (2.1–2.4)	281	17.3	6.6 (5.8–7.4)
MBA*	1,237	1.7 (1.6–1.9)	207	16.7	4.9 (4.2–5.6)
TFT*	768	1.1 (1.0–1.1)	179	23.3	4.2 (3.6–4.8)
Other chemistry*	456	0.6 (0.5–0.7)	78	17.1	1.8 (1.4–2.3)
PSA*	270	0.4 (0.3–0.4)	45	16.7	1.1 (0.8–1.4)
HbA1c*	182	0.3 (0.2–0.3)	14	7.7	0.3 (0.2–0.5)
Haematology	**2,917**	**4.0 (3.8–4.2)**	**528**	**18.1**	**12.5 (11.3–13.6)**
FBC	2,564	3.6 (3.4–3.7)	480	18.7	11.3 (10.3–12.3)
ESR	261	0.4 (0.3–0.4)	40	15.3	0.9 (0.7–1.2)
Other tests NEC	**462**	**0.6 (0.6–0.7)**	**74**	**16.0**	**1.8 (1.3–2.2)**
Blood test	197	0.3 (0.2–0.3)	30	15.2	0.7 (0.4–1.0)
Microbiology	**293**	**0.4 (0.4–0.5)**	**107**	**36.5**	**2.5 (2.0–3.0)**
Urine M,C&S*	274	0.4 (0.3–0.4)	100	36.5	2.4 (1.9–2.9)
Other pathology groups	**69**	**. .**	**7**	**10.1**	**. .**
Total pathology tests	**18,889**	**26.2 (25.3–27.1)**	**3,103**	**16.4**	**73.2 (68.6–77.9)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; EUC – Electrolytes, urea and creatinine; MBA – multibiochemical analysis; TFT – thyroid function tests; PSA – Prostate specific antigen; FBC – full blood count; ESR – erythrocyte sedimentation rate; M,C&S – microscopy, culture and sensitivity; NEC – not elsewhere classified.

Changes in the types of pathology tests/batteries ordered

Table 5.4 shows the most common pathology tests/batteries ordered for hypertension in 2000–02 and 2006–08. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- lipid tests—28% increase
- EUC tests—36% increase
- FBCs—64% increase
- glucose/glucose tolerance tests—35% increase

- LFTs—71% increase
- MBA tests—109% increase
- TFTs—75% increase
- PSA tests—200% increase
- 'other chemistry' tests—400% increase (Table 5.4). This was mostly due to increases in the rate of urinary albumin and albumin:creatinine ratio tests that are grouped within the 'other chemistry' group.

Table 5.4: Rate of pathology test orders for hypertension by MBS pathology groups and most frequent individual test orders within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test	**Number**	**Rate per 100 hypertension problems (95% CI) (*n* = 18,007)**	**Number**	**Rate per 100 hypertension problems (95% CI) (*n* = 17,793)**	**Change**
Chemistry	**3,105**	**17.2 (15.9–18.6)**	**4,615**	**25.9 (24.3–27.6)**	↑
Lipids*	970	5.4 (4.8–6.0)	1,220	6.9 (6.4–7.3)	↑
EUC*	816	4.5 (4.1–5.0)	1,084	6.1 (5.5–6.6)	↑
Glucose/glucose tolerance*	462	2.6 (2.3–2.9)	616	3.5 (3.1–3.8)	↑
LFT*	306	1.7 (1.5–1.9)	524	2.9 (2.6–3.3)	↑
MBA*	199	1.1 (0.9–1.3)	407	2.3 (2.0–2.6)	↑
TFT*	141	0.8 (0.6–0.9)	254	1.4 (1.2–1.6)	↑
Other chemistry*	39	0.2 (0.1–0.3)	174	1.0 (0.8–1.2)	↑
PSA*	39	0.2 (0.1–0.3)	110	0.6 (0.5–0.7)	↑
HbA1c*	36	0.2 (0.1–0.3)	55	0.3 (0.2–0.4)	—
Haematology	**588**	**3.3 (2.9–3.6)**	**900**	**5.1 (4.6–5.5)**	↑
FBC	501	2.8 (2.5–3.1)	811	4.6 (4.2–5.0)	↑
ESR	65	0.4 (0.3–0.5)	71	0.4 (0.3–0.5)	—
Other tests NEC	**97**	**0.5 (0.4–0.7)**	**135**	**0.8 (0.6–0.9)**	**—**
Blood test	39	0.2 (0.1–0.3)	64	0.4 (0.2–0.5)	—
Microbiology	**74**	**0.4 (0.3–0.5)**	**78**	**0.4 (0.3–0.6)**	**—**
Urine M,C&S*	67	0.4 (0.3–0.5)	72	0.4 (0.3–0.5)	—
Other pathology groups	**20**	**. .**	**16**	**. .**	
Total pathology tests	**3,884**	**21.6 (20.0–23.2)**	**5,744**	**32.3 (30.3–34.2)**	↑

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and— indicates no change

5.4.4 Guidance documents for hypertension

Eleven guidance documents were reviewed for hypertension (Box 5.1).

Box 5.1: Guidance documents reviewed for hypertension

Title	Year	Author	Abbreviated to
Guide to management of hypertension 2008: assessing and managing raised blood pressure in adults[163]	2008	National Heart Foundation (NHF) of Australia	NHF
Hypertension: management of hypertension in adults in primary care[164]	2006	National Collaborating Centre for Chronic Conditions and the British Hypertension Society. *National Institute for Health and Clinical Excellence (NICE) guideline* [United Kingdom]	NICE
Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood pressure (JNC 7)[165]	2004	United States Department of Health and Human Services, National Institutes of Health	JNC 7
Hypertension in older people[166]	2001	Scottish Intercollegiate Guidelines Network (SIGN)	SIGN
Statement on management of hypertension[167]	2003	World Health Organization (WHO) and International Society of Hypertension (ISH)	WHO & ISH
Guidelines for the management of arterial hypertension[168]	2007	European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC)	ESH & ESC
Health care guideline: hypertension diagnosis and treatment[169]	2006	Schwartz G, Canzanello V, Woolley A, Miller T, O'Connor P, Klein D et al. *Institute for Clinical Systems Improvement (ICSI) guideline* [United States of America]	ICSI
Canadian Hypertension Education Program recommendations for the management of hypertension: parts 1[170] and 2[171]	2007	Canadian Hypertension Education Program (CHEP)	CHEP
RCPA manual, hypertension section[172]	2004	The Royal College of Pathologists of Australasia (RCPA)	RCPA
Murtagh's general practice, hypertension chapter[173]	2007	Murtagh J [Australia]	Murtagh
Patient presentations in general practice: blood pressure check up and hypertension review sections[174]	1999	Steven I [Australia]	Steven

5.4.5 Extent of alignment between GP testing and guidance documents

In Table 5.5, the frequently ordered pathology tests/batteries for hypertension are categorised by level of support in the guidance documents listed in Box 5.1. The key explaining the colours used in the table is provided before Table 5.5.

Supported tests

The four types of tests that were recommended in the majority of guidance documents were lipids, EUC, FBC and glucose/glucose tolerance (Table 5.5). Together these four tests accounted for 67.4% of tests/batteries ordered by GPs for hypertension (Table 5.6). The order rate of these tests increased significantly between 2000–02 and 2006–08 (Table 5.4).

Lipid and glucose testing were almost unanimously recommended (Table 5.5), most often as part of the initial assessment of newly diagnosed hypertension. The reason for testing lipids was to determine patient's cardiovascular risk profile, and for glucose testing it was to detect undiagnosed diabetes. Ongoing testing was recommended in three guidance documents (JNC 7,[165] Steven,[174] CHEP[170,171]) and in one other it was referred to in a footnote of a flowchart (NHF[163]).

There was unanimous agreement among guidance documents for EUC testing (predominately creatinine, potassium and sodium testing), primarily to assess kidney function both as end (or target) organ damage (in ongoing management) and kidney disease as a cause of secondary hypertension (in the initial assessment). EUC was also recommended in the monitoring of response to medications, specifically potassium monitoring in the management of diuretics, and sodium and creatinine in the monitoring of angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers/angiotensin II receptor antagonists (see medication monitoring discussion in Section 5.4.6).

The FBC (also referred to as a 'complete blood picture' or 'full blood evaluation') is a battery of tests. GPs routinely order a FBC rather than the individual analytes or components within it. Most of the hypertension guidance documents reviewed recommended that one or more of the analytes in a FBC should be tested (Table 5.5).

Haematocrit and/or haemoglobulin tests (two analytes within a FBC) were commonly recommended, but the rationale for ordering these tests was not given.[163,165,168,169,173] In contrast, the CHEP guideline specifically recommended against the use of these tests as they did not aid in investigation or monitoring of hypertension.[170]

The SIGN guideline recommended FBC testing because the mean cell volume (one part of a FBC) may indicate excess alcohol consumption, and such consumption is associated with resistance to antihypertensive therapy and to risk of stroke.[166]

Alcoholism/excess alcohol consumption was also mentioned as a potential cause of secondary hypertension in other guidance documents.[164,165,169-172] However, with the exception of SIGN, no other guidance documents recommended pathology tests to identify excess alcohol consumption.

In all guidance documents, when FBC testing was recommended it was only as part of the initial assessment.

Tests with conditional support

There were four types of tests that had conditional support or mixed levels of support: LFT, TFT, urine M,C&S, and albumin (urinary albumin or albumin:creatinine ratio) tests (Table 5.5) and together they accounted for 15.3% of tests ordered by GPs for hypertension (Table 5.6). Between 2000–02 and 2006–08 there were significant increases in the order rate of LFT, TFT and 'other chemistry' tests (which includes albumin tests) and no change in the rate of urine M,C&S (Table 5.4)

LFT was recommended in two guidance documents (Table 5.5). The NHF guideline recommended LFT as part of the investigations of a newly diagnosed patient, but the reason for testing was not given.[163] The SIGN guideline recommended testing of Gamma glutamyl transpeptidase (one part of LFT) as a possible indicator of alcoholism/excess alcohol intake.[166] As discussed above, many guidelines discussed alcoholism/excess alcohol intake as a cause of secondary hypertension.[164,165,169-172]

Thyroid disease was mentioned as a possible cause of secondary hypertension in six guidance documents (Table 5.5). Testing was only recommended if thyroid disease was suspected (e.g. clinical suspicion or abnormal physical examination) as part of the initial assessment.

Two guidance documents recommended urine M,C&S in initial investigation of newly diagnosed hypertension to identify possible urinary tract infection.[168,174] NHF recommended it as a follow-up test if urinalysis was abnormal.[163] RCPA recommended it as part of 'further investigation' if necessary.[172]

Testing for microalbuminuria (using urine albumin or albumin:creatinine ratio tests) was recommended in the majority of guidance documents but for different reasons. Some recommended testing as part of the routine initial assessment,[164,166,167,174] while others recommended it if the patient had an abnormal urinalysis test[163,168,169] or the

patient had diabetes.[170,171,173] JNC 7 stated that urine albumin or albumin:creatinine ratio tests were optional unless diabetes or kidney disease is present, in which case it was recommended annually.[165]

Support unable to be determined

It was not possible to determine whether MBA and 'other chemistry' tests (excluding urine albumin tests) were recommended in the guidance documents (see Section 5.3.4). These two tests accounted for 7.8% of pathology ordered for hypertension (Table 5.6).

With the exception of urinary albumin and albumin:creatinine (split from the 'other chemistry' group and discussed above), the remainder of the 'other chemistry' group was classified as having unclear guidance.

The MBA test was not recommended in any guidance documents. However, some tests that may be considered part of the MBA, such as EUC and LFT, were partially or completely supported in the management of hypertension (as discussed above).

Unsupported tests

The guidance documents did not recommend testing of PSA, erythrocyte sedimentation rate (ESR), HbA1c and unspecified 'blood tests' (Table 5.5). These four tests together accounted for 4.8% of pathology ordered by GPs in the management of hypertension (Table 5.6). PSA was the only test within this group to increase significantly between 2000–02 and 2006–08 (Table 5.4).

Other tests mentioned in the guidance documents

Other tests mentioned in guidance documents were urinalysis, uric acid, calcium and CRP. These were ordered rarely, each accounting for less than 1% of pathology ordered for hypertension.

Urinalysis was recommended in nine of the eleven guidance documents as part of the initial investigations for hypertension to assess kidney function.[163,165,166,168-174]

Uric acid and calcium testing were rarely ordered as individual tests. However it is possible that they would be tested as part of a MBA. Testing urate/uric acid was recommended in four guidance sources. It was recommended as a measure of kidney function,[168,173] as part of the initial assessment[163] or as a baseline when initiating a diuretic.[166] Calcium testing was recommended as part of the initial review in three guidance documents as an indicator for hyperparathyroidism.[165,166,169]

The CRP, a non-specific measure of inflammation[175] was recommended in Murtagh.[173] The rationale for ordering this test was not provided. While CRP was rarely ordered, GPs did order the ESR (an alternative test to the CRP). ESR was not recommended in guidance documents (see above) (Table 5.5).

Key to Table 5.5

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.5: Summary of guidance recommendations by most frequent individual test orders for hypertension, 2000–08

Pathology test	Per cent of hypertension pathology (*n* = 18,889)	NHF[163]	NICE[164]	JNC 7[165]	SIGN[166]	WHO & ISH[167]	ESH & ESC[168]	ICSI[169]	CHEP[170,171]	RCPA[172]	Murtagh[173]	Steven[174]
Lipids*	22.3											
EUC*	20.3											
FBC	13.6	Hb		Haematocrit			Hb & haematocrit	Haematocrit			Hb & haematocrit	
Glucose/glucose tolerance*	11.2											
LFT*	8.6				Gamma GT							
MBA*	6.6											
TFT*	4.1											
Urine M,C&S*	1.5	If abnormal urinalysis										
PSA*	1.4											
ESR	1.4											
Other chemistry (excluding urinary albumin/ albumin:creatinine ratio)	1.3											
Urinary albumin/ albumin:creatinine ratio	1.1	If abnormal urinalysis					If abnormal urinalysis	If abnormal urinalysis	Diabetes		Diabetes	
HbA1c*	1.0											
Blood test	1.0											

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Hb – haemoglobulin; also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.4.5.

Evaluation of GP pathology ordering against guidance documents

Table 5.6 provides a summary of the individual tests recorded in BEACH and the level of support provided in the guidance documents for each. Of the tests/batteries ordered by GPs for hypertension in 2000–08:

- 67.4% were supported
- 24.2% had conditional support or support could not be determined
- 4.8% were not supported by the guidance documents.

The individual tests/batteries listed in Table 5.6 accounted for 96.3% of pathology ordered for hypertension because only the most commonly ordered tests were evaluated.

Table 5.6: Summary of support for GP pathology ordering for the most frequent individual test orders for hypertension, 2000–08

Pathology test supported by guidance	Number	% of all pathology for hypertension
Supported	**12,722**	**67.4**
Lipids*	4,203	22.3
EUC*	3,836	20.3
FBC	2,564	13.6
Glucose/glucose tolerance*	2,119	11.2
Conditional/unclear support	**4,567**	**24.2**
LFT*	1,624	8.6
MBA*	1,237	6.5
TFT*	768	4.1
Other chemistry* (excluding urine albumin/albumin:creatinine ratio)	248	1.3
Urinary albumin/Albumin:creatinine ratio	208	1.1
Urine M,C&S*	274	1.5
Unsupported	**910**	**4.8**
PSA*	270	1.4
HbA1c*	182	1.0
ESR	261	1.4
Blood test	197	1.0
Subtotal (n, % of total tests)	*18,199*	*96.3*
Total pathology tests	**18,889**	**100.0**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered supported pathology tests at a rate of 17.6 tests/batteries per 100 hypertension problems, followed by tests with conditional support (6.0 per 100),

and unsupported tests (1.3). Tests ordered for hypertension but not evaluated were ordered at a rate of 1.3 per 100 hypertension problems. The rate at which GPs ordered tests in all 'level of support' groups increased significantly over time (Table 5.7).

Table 5.7: Rate of pathology ordering for hypertension by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 hypertension problems (95% CI) (*n* = 72,171)	Rate per 100 hypertension problems (95% CI) (*n* = 18,007)	Rate per 100 hypertension problems (95% CI) (*n* = 17,793)	Change
Supported	17.6 (17.0–18.3)	15.3 (14.0–16.5)	21.0 (19.6–22.3)	↑
Conditional/unclear support	6.0 (5.7–6.3)	4.2 (3.8–4.6)	8.0 (7.4–8.6)	↑
Unsupported	1.3 (1.2–1.4)	1.0 (0.8–1.2)	1.7 (1.4–1.9)	↑
Not evaluated	1.3 (1.2–1.4)	1.1 (0.9–1.3)	1.6 (1.4–1.9)	↑

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

GPs ordered only pathology tests that were supported or conditionally supported at 8.7% (95% CI: 8.4–9.0) of hypertension problems in 2000–08. A further 1.2% (95% CI: 1.1–1.3) of hypertension problems involved at least one unsupported test, and 90.1% (95% CI: 89.7–90.4) of problems involved either no pathology tests (89.8%) or tests that were not evaluated (0.3%) (results not tabled).

Between 2000–02 and 2006–08 there were significant increases in the proportion of hypertension problems that involved GP orders for:

- only completely or partially supported tests, 7.5% (95% CI: 6.9–8.0) in 2000–02 and 10.1% (95% CI: 9.4–10.7) in 2006–08.
- at least one unsupported test 1.0% (95% CI: 0.8–1.1) in 2000–02 and 1.6% (95% CI: 1.4–1.9) in 2006–08 (results not tabled).

When GPs ordered unsupported tests, they were usually accompanied by one or more supported/partially-supported tests (75% of occasions). Unsupported tests were ordered alone at the remaining 25%. GPs ordered only unsupported pathology tests at 0.3% of hypertension problems in 2000–08. This did not change significantly over time, 0.2% (95% CI: 0.1–0.3) in 2000–02 and 0.4% (95% CI: 0.2–0.5) in 2006–08 (results not tabled).

5.4.6 Discussion

Pathology testing was recommended in the management of hypertension in all guidance documents, and the majority (> 90%) of tests ordered by GPs were recommended (with either partial or complete support) in this guidance.

The statistically significant increase in the rate of GPs' total pathology ordering for hypertension between 2000–02 and 2006–08 was reflected in significant increases in the rate of tests that were supported, partially supported, and unsupported in guidance documents. The largest increase was in the rate of partially supported tests.

Due to the increase in total rate of pathology ordering, the correlation between GPs' ordering and level of support, as a proportion of total tests should be considered. Supported tests decreased as a proportion of total tests between 2000–02 and 2006–08, counteracted by an increase in partially supported tests. The proportion of total pathology tests that were unsupported stayed stable. Overall this suggests that the increase in GPs ordering did not result in testing being 'more' or 'less' in line with recommendations. However this disguises a shift in GPs' ordering, from supported to partially supported tests that warrants investigation.

Pathology testing in the initial assessment

The majority of pathology recommendations made in guidance documents were for the initial assessment of newly diagnosed hypertension. An initial assessment was recommended for all patients to detect cardiovascular risk and end organ damage (usually kidney damage).

Guidance documents also recommended investigation of secondary causes of hypertension (as part of the assessment of hypertension) if initial testing was abnormal or other clinical indicators suggested that secondary hypertension was likely. The causes of secondary hypertension that involve pathology ordering in their diagnosis are listed with the relevant recommended test(s) (as defined by the guidance):

- kidney disease—EUC, albumin, albumin:creatinine ratio
- aldosteronism—aldosterone, renin
- Cushing's syndrome—cortisol
- phaeochromocytoma—catecholamines, methylated amines
- parathyroid disease—parathyroid hormone, calcium

- thyroid disease—thyroid-stimulating hormone, T4 (i.e. TFT)

Only kidney disease and thyroid disease were tested for by GPs in the management of hypertension. The tests for the rare diseases that cause secondary hypertension (aldosteronism, Cushing's syndrome, phaeochromocytoma) were ordered very infrequently, accounting for less than 1% of pathology tests for hypertension. This reflects appropriate pathology ordering by GPs based on the low probability of these diseases.

It is possible that GPs ordered pathology tests/batteries for the initial assessment of hypertension at the time of its 'diagnosis' as a new clinical problem, explaining the higher pathology order rate at these new cases compared with the average for hypertension problems. There was a significant increase in the management rate of new cases of hypertension (between 2000–02 and 2006–08), suggesting an increase in the number of new cases, which contributed to the increase in the total rate of pathology ordered for hypertension. Despite this increase, new cases accounted for a small proportion of hypertension contacts and total pathology ordered for hypertension (6% and 16% respectively).

There are limitations to linking pathology testing to new cases as a way of defining the initial assessment. A new case indicates that the patient was diagnosed at that consultation. But GPs may order pathology tests for the initial assessment after the diagnosis (e.g. at the second or third consultation). While this may occur, the chronic nature of the disease suggests that a large proportion of tests recommended as part of the initial investigation were ordered in ongoing management.

As tests were considered 'supported' if recommended at any phase of management, it is important to establish whether tests recommended only for the initial assessment have a role in the ongoing management of hypertension.

Pathology testing in long-term management

Hypertension usually requires life long management. Guidance documents highlighted this fact and often included a section on long-term management, with recommendations for frequency of review and intensifying therapy. However, most did not provide guidance about the need for pathology testing in long-term management. This is alarming because the majority of contacts (94%) and pathology tests (84%) ordered by GPs were for the long-term management of hypertension.

The guidance documents that did discuss pathology tests for monitoring did so in relation to: reassessing cardiovascular risk; monitoring (or detecting) end organ kidney damage; and monitoring medications.

Reassessing cardiovascular risk (involving lipid and glucose testing) was recommended in four guidance documents. Steven[174] recommended annual testing and was the only one to specify interval between monitoring. CHEP referred to a diabetes guideline for assessment of 'incident' diabetes (i.e. the development of diabetes) and recommended lipid testing 'with a frequency reflecting the clinical situation'.[170,171] JNC 7 recommended that cardiovascular risk should be monitored.[165] Similarly, NHF recommended reassessing cardiovascular risk 'regularly' but this was only mentioned in a footnote to a management flowchart.[163]

Presence of end organ kidney damage is also considered a cardiovascular risk in patients with hypertension. JNC 7[165] and CHEP[170,171] specifically recommended monitoring of electrolytes and creatinine for all patients; only JNC 7[165] specified an interval (1–2 times per year). The SIGN guideline recommended annual testing for proteinuria.

When guidance was given, specific information about the interval between testing was often omitted. Information from other sources would need to be used by GPs if they wanted to know about interval between monitoring. For example, the cardiovascular risk guideline recommended reassessment based on risk level (every 2 years in low risk, 6–12 monthly in medium, and based on clinical situation in high risk);[176] and the RACGP recommended annual testing for diabetes in patients aged 45 years and over with hypertension.[177]

It should not be necessary for GPs to reference multiple sources to find this information. Producers of hypertension guidance should improve recommendations on reassessment of cardiovascular risk in long-term care, including the specific pathology testing required and interval between testing.

Medication monitoring

Pathology tests related to medication use were discussed in most guidance documents, but specific recommendations about testing and frequency of tests were often not provided. Some guidance documents listed the common side effects of medications (including hypo/hyperkalaemia, hyponatraemia, hyperglycaemia, worsening renal function) without recommending the testing needed to identify side

effects.[165,167-171,173,178] Others did not specifically mention the side effects.[164,172,174] It is possible that some of the guidance documents may have considered the monitoring of adverse medication effects outside the scope of the guidance.

When guidance was provided for medication monitoring, potassium and/or creatinine testing was recommended (dependent on the medication used) but no recommendation for frequency of testing was given. Some examples are given below.

- Testing potassium in use of thiazide diuretics. The SIGN guideline recommended testing within 4–6 weeks of initiation but monitoring was not discussed.[166] Steven recommended annual testing of sodium and potassium for patients taking diuretics without discussing the side effects of its use.[174] The NHF guideline recommended action if potassium levels were below the reference range in patients taking thiazide but the recommendation to test and the interval to monitor was not given.[163] The NHF also listed hyperglycaemia, gout, and hyponatraemia as possible adverse effects of thiazide use 'to be considered' but whether these should be tested for was not clear.[163]
- Monitoring serum creatinine and potassium in use of ACE inhibitor or angiotensin receptor blocker. SIGN recommended testing creatinine and potassium within 1–2 weeks of therapy initiation.[166] NHF and NICE discussed the possibility of an initial rise in creatinine at initiation of these medications without specifically mentioning the need to test creatinine.[163,164] NHF recommended 'monitoring of kidney function' when combination therapy of ACE inhibitor and angiotensin receptor blocker was used but no information on the monitoring interval or the specific test was given.[163]

In monitoring medications, GPs may have used other sources such as the electronic Therapeutic Guidelines (eTG) (an Australian resource for medication guidance). It recommended testing electrolytes (i.e. potassium) and creatinine prior to initiation of ACE inhibitors or angiotensin receptor blockers and one to two weeks after initiation or dose adjustments. However clear guidance on adverse effect monitoring was not provided for thiazide diuretics or loop diuretics—the common adverse effects were listed but testing was not mentioned.[179]

Information about the role of pathology testing in monitoring adverse effects of medication was poor. Guidance documents need to provide clearer recommendations

about whether testing for adverse effects of hypertension medications is required, the interval between tests and the duration that monitoring needs to persist. Alternatively, if not considered within the scope of the guidance, this should be clearly stated and appropriate resources referenced. Further, the completeness of recommendations for pathology testing in these alternative resources should be checked (as demonstrated by the example of diuretics in the eTG).

The discussion in this section demonstrates that guidance documents either lacked guidance or provided incomplete guidance about pathology testing in the long-term management of hypertension. Despite this, the guidance available did suggest that lipid, glucose, electrolyte and kidney function tests had a role in its ongoing management. These tests accounted for about half of pathology ordered for hypertension, and their order rate increased significantly between 2000–02 and 2006–08. This suggests that GPs are acting in accordance with the limited guidance available.

GPs' use of these tests is further supported by research that shows that hypertension rarely occurs in isolation. In 80% of people it is clustered with metabolic conditions (dyslipidaemia, insulin resistance, glucose intolerance and obesity).[162] While test recommendations in guidance documents for the initial assessment of hypertension reflect these comorbidities, they are not necessarily present at the time of diagnosis. The underlying prevalence of these diseases and the fact that they may develop over the longer term in patients with hypertension further supports GPs' continued ordering of these tests.

The lack of guidance about the required interval between monitoring is concerning. However, even if guidance was provided, I would not have been able to assess this using the cross-sectional BEACH data. This assessment would require quality longitudinal data (which may be available from the pathology industry) but such investigation was outside the scope of this thesis.

Tests for which guidance was lacking

There was a significant discord between guidance documents' recommendations and GPs' ordering for hypertension for four tests: FBC, LFT, TFT and MBA. For three of these (FBC, LFT and TFT), guidance documents only recommended their use in the initial assessment of hypertension, but GPs usually ordered them in ongoing management (more than three-quarters of occasions), suggesting their level of

support may be over-estimated. The fourth test, the MBA, was not recommended in any guidance documents. Despite this lack of guidance, GPs' ordering of these tests increased significantly between 2000–02 and 2006–08, and they accounted for one-third of total tests ordered for hypertension in 2000–08.

The rationale for recommending FBC and LFT in the initial assessment was provided by only one guideline (to identify excess alcohol consumption).[166] However, no recommendations were made for ongoing management.

The lack of rationale is more concerning for FBC (than for LFT) because it was frequently recommended (6 out of 11 documents) and commonly ordered by GPs. It raises questions about what clinical purpose the FBC fulfils for GPs in hypertension management, and on what guidance authors based their recommendations. For example, was evidence found that supported FBC use? Were recommendations consensus-based or based on the guidance authors' clinical experience? GPs' have reported in qualitative research that clinical experience influences their pathology ordering.[36] However, the fact that one guideline specifically recommended against FBC use (because it did not aid either initial investigation or monitoring of hypertension) adds weight to the argument that guidance authors should revisit the FBC recommendation. Future guidance should include the rationale for the test (to aid in its clinical interpretation) and its role (if any) in monitoring, and if applicable, the frequency of testing required.

GPs' ordering of LFTs may be associated with the management of lipid levels, in particular, monitoring side effects of lipid-lowering medications such as statins (see Section 5.6.6). While guidance documents did not recommend monitoring of LFT for this purpose, they did recommend assessment and management of lipid levels.

Thyroid disease was discussed as a cause of secondary hypertension, suggesting that most TFTs would be ordered in initial testing, but GPs usually ordered them in ongoing care. Information on whether there is a need to reassess TFT when initial results are clinically insignificant is needed in guidance documents. For example, are there certain patient groups for whom reassessing thyroid function is valid (such as, older patients, if incidence increases with age) and what is the interval at which patients should be reassessed if it is valid to do so? The RACGP's guideline on preventive activities in general practice states that there is unproven benefit in screening for thyroid disease in adults.[177] Although this guidance is not specific to

hypertension, GPs' clinical experience may suggest that there is value in reassessing TFT when managing hypertension. However, the question about the validity of reassessing TFT should be investigated further and the findings incorporated into future hypertension guidance.

The increase in the proportion of GP-ordered tests classified as 'partially supported' (mentioned earlier in this discussion) was mainly due to increases in the rate of LFT, TFT and MBA tests. These tests were classified as partially supported because either very few guidance documents recommended the test (in the case of MBA and LFT) or guidance suggested their use should be confined to a specific clinical situation (for TFT).

The four tests for which guidance was unclear are likely to represent the greatest opportunity to decrease the volume of pathology ordered by GPs for hypertension. Reducing their use would require investigation of whether the tests are clinically useful in the management of hypertension at any stage (including for ongoing monitoring). The results of this investigation should be used to improve guidance documents, and this guidance promoted to GPs to improve test ordering (if necessary).

Summary

GPs' selection of appropriate pathology tests in the management of hypertension was excellent, the vast majority being recommended in guidance documents. However, the lack of recommendations provided in guidance documents about pathology testing in long-term management of hypertension is alarming given the majority (84%) of pathology ordered by GPs was for ongoing care. Guidance needs to be improved in this area, specifying the tests required and the recommended interval between monitoring tests. Future research is needed to investigate whether deficiencies identified in guidance also represent areas in which GP pathology ordering could be improved.

The lack of guidance about the testing interval required for monitoring tests may provide an opportunity to decrease the number of testing occasions (where at least one pathology test was ordered) for hypertension, which increased over the study period. If further investigation reveals that the recommended testing interval is less frequent than current GP practice there would be potential for decrease. However, the reverse may be found, that current practice is less frequent than recommended

testing, which would suggest an increase in the number of testing occasions is needed.

Targeting a reduction in unsupported tests will achieve modest reductions in volume of pathology (as they accounted for only 5% of pathology ordered for hypertension), and would be unlikely to reduce the number of testing occasions, because GPs usually ordered unsupported tests with supported tests.

Hypertension was the problem that generated the highest volume of pathology tests in Australian general practice. Further, the ageing population is expected to lead to an increase in the prevalence of hypertension, which in turn would generate more management of hypertension in general practice and increased associated pathology ordering. Therefore, achieving a reduction (even a modest reduction) in GPs' pathology test (volumes or occasions of testing) ordering by reducing unnecessary tests would be worthwhile.

5.5 Type 2 diabetes

5.5.1 Background

The prevalence of diabetes in Australia has doubled over the last 20 to 30 years,[180,181] and is expected to continue to increase,[180-182] a situation that is occurring in many countries.[182,183] The expected increase is linked to increases in population, ageing of population, and increasing obesity.[180-183]

Diabetes was made a National Health Priority Area in 1996 due to the burden it places on the health system.[184] In 2003, diabetes was responsible for 5.5% of the total burden of disease and injury in Australia.[156]

The majority of diabetes in Australia is Type 2 diabetes (T2D).[154,181,185] The self-reported prevalence of diagnosed T2D in the population was 3.5% in 2007–08.[154] However, measured prevalence is far higher—7.1% of adults aged 25 years and over in 1999–00—because it includes diagnosed and undiagnosed T2D (approximately half was undiagnosed).[181]

There have been numerous national and state-based policies and initiatives introduced to identify undiagnosed diabetes, improve the care of people with diabetes, and prevent diabetes in those at risk in Australia. Examples of initiatives implemented in general practice include, the National Integrated Diabetes Program[186] (which included the MBS diabetes annual cycle of care items), the National Chronic Disease Strategy,[187] the MBS Chronic Disease Management items,[188] the Prevention of Type 2 Diabetes Program,[189] and the Australian Primary Care Collaboratives Program.[190]

General practice has been the focus of many initiatives because GPs hold the primary role in the diagnosis and management of T2D. For the majority of patients they are the health professional most often seen and they coordinate multidisciplinary care, through referrals and through the MBS multidisciplinary care plans. Diabetes is one of the most commonly managed problems in general practice.[17] A 2009 SAND substudy of 3,021 patients estimated the prevalence of T2D to be 9.0% of patients at encounters in general practice.[191] Pathology testing is used by GPs to diagnose T2D, to monitor glycaemic control and to identify morbidities associated with diabetes.

5.5.2 Management rate in Australian general practice

In BEACH, T2D was managed at 22,935 patient encounters by 6,451 GPs in 2000–08, at a rate of 2.9 per 100 encounters (Table 5.8). This equates to about 3.2 million encounters per year where T2D was managed by GPs in Australia.

As described in Chapter 4, the management rate of T2D increased significantly between 2000–02 and 2006–08. There was no change in the diagnosis or detection rate of new cases of T2D between 2000–02 and 2006–08 (Table 5.8). This indicates that the increased management rate largely reflected an increase in monitoring encounters for T2D rather than an increase in its detection or diagnosis rate.

Table 5.8: Summary of T2D data set, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Rate per 100 encounters (95% CI) (*n* = 784,300)	Number	Rate per 100 encounters (95% CI) (*n* = 198,200)	Number	Rate per 100 encounters (95% CI) (*n* = 188,300)	Change
General practitioners	6,451	. .	1,573	. .	864	. .	. .
T2D encounters	22,935	. .	5,211	. .	6,171	. .	. .
T2D problems managed	22,938	2.9 (2.9–3.0)	5,211	2.6 (2.5–2.8)	6,172	3.3 (3.1–3.4)	↑
New T2D problems	1,421	0.2 (0.2–0.2)	325	0.2 (0.1–0.2)	369	0.2 (0.2–0.2)	—

Note: Data about T2D problems managed are drawn from Chapter 4, Table 4.3. T2D – Type 2 diabetes; CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

5.5.3 Pathology ordered for T2D

Pathology was ordered at a rate of 77.2 per 100 T2D problems in 2000–08. At almost one-third of T2D problem contacts (29.7%) at least one pathology test/battery was ordered by the GPs. Once the decision to order pathology was made, GPs ordered an average 2.59 tests/batteries per tested T2D problem (Table 5.9).

As reported in Chapter 4, the rate of pathology ordering for T2D increased significantly between 2000–02 and 2006–08. This was due to significant increases in both the likelihood of pathology being ordered for T2D, and the number of tests ordered once the decision to order pathology was made (Table 5.9).

Table 5.9: Summary of pathology ordering for T2D, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Per cent / Rate of T2D problems (95% CI) (*n* = 22,938)	Number	Per cent / Rate of T2D problems (95% CI) (*n* = 5,211)	Number	Per cent / Rate of T2D problems (95% CI) (*n* = 6,172)	Change
Pathology (Rate per 100 T2D problems)	17,709	77.2 (75.0–79.5)	3,314	63.6 (59.6–67.6)	5,459	88.4 (83.7–93.2)	↑
At least one pathology order (Per cent of T2D problems)	6,818	29.7 (29.0–30.5)	1,423	27.3 (25.8–28.8)	1,948	31.6 (30.1–33.0)	↑
Number of tests/ batteries per 100 tested T2D problems	. .	259.8 (255.7–263.8)	. .	232.9 (224.8–241.0)	. .	280.2 (272.4–288.1)	↑

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.4. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

Types of pathology tests/batteries ordered

Table 5.10 shows the rate of pathology tests/batteries ordered for T2D in 2000–08 by MBS groups and the most common individual types of tests ordered.

Chemistry tests were the group most often ordered (68.5 per 100 T2D contacts) and the most common were:

- HbA1c tests (23.0 per 100 T2D contacts)
- lipid tests (11.7 per 100 contacts)
- glucose/glucose tolerance tests (10.0)
- EUC tests (7.2)
- 'other chemistry' tests (6.2)—90% of this group were urine albumin tests
- LFTs (4.5) (Table 5.10).

Haematology tests (6.1 per 100 contacts), in particular FBCs (5.5 per 100), were also commonly ordered in the management of T2D (Table 5.10).

Only 7% of pathology tests/batteries were ordered in the management of 'new' cases of T2D, the vast majority being ordered for ongoing management (Table 5.10).

Table 5.10: Rate of pathology test orders for T2D by MBS pathology groups and most frequent individual test orders within each group, 2000–08

	All T2D problems		New T2D problems		
Pathology test	Number	Rate per 100 T2D problems (95% CI) (*n* = 22,938)	Number	Per cent of test	Rate per 100 new T2D problems (95% CI) (*n* = 1,421)
Chemistry	**15,718**	**68.5 (66.5–70.6)**	**1,051**	**6.7**	**74.0 (67.6–80.3)**
HbA1c*	5,271	23 (22.3–23.7)	257	4.9	18.1 (16.0–20.1)
Lipids*	2,681	11.7 (11.2–12.2)	124	4.6	8.7 (7.2–10.2)
Glucose/glucose tolerance*	2,299	10.0 (9.5–10.5)	287	12.5	20.2 (18.1–22.3)
EUC*	1,657	7.2 (6.8–7.6)	89	5.4	6.3 (4.9–7.6)
Other chemistry*	1,418	6.2 (5.8–6.6)	110	7.8	7.7 (6.3–9.2)
LFT*	1,040	4.5 (4.2–4.9)	60	5.8	4.2 (3.2–5.3)
MBA*	803	3.5 (3.2–3.8)	46	5.7	3.2 (2.3–4.2)
TFT*	235	1.0 (0.9–1.2)	47	20.0	3.3 (2.3–4.3)
Haematology	**1,402**	**6.1 (5.7–6.5)**	**116**	**8.3**	**8.2 (6.6–9.7)**
FBC	1,266	5.5 (5.2–5.9)	106	8.4	7.5 (6.1–8.9)
Other tests NEC	**401**	**1.8 (1.5–2.0)**	**31**	**7.7**	**2.2 (1.4–3.0)**
Microbiology	**164**	**0.7 (0.6–0.8)**	**23**	**14.0**	**1.6 (0.9–2.3)**
Other pathology groups	**24**	**. .**	**3**	**12.5**	**. .**
Total pathology tests	**17,710**	**77.2 (75.0–79.5)**	**1,224**	**6.9**	**86.1 (78.7–93.6)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations.

Changes in the types of pathology tests/batteries ordered

The pathology tests/batteries ordered for T2D problems in 2000–02 and 2006–08 are shown in Table 5.11. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- HbA1c tests—33% increase
- lipid tests—53% increase
- EUC tests—48% increase
- 'other chemistry' tests—135% increase (due to a 125% rise in urine albumin tests)
- LFTs—79% increase
- MBA tests—83% increase
- FBCs—89% increase (Table 5.11).

There was also a significant 28% decrease in the order rate of glucose/glucose tolerance tests between 2000–02 and 2006–08 (Table 5.11).

Table 5.11: Rate of pathology test orders for T2D by MBS pathology groups and most frequent individual test orders within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test ordered	**Number**	**Rate per 100 T2D problems (95% CI) (*n* = 5,211)**	**Number**	**Rate per 100 T2D problems (95% CI) (*n* = 6,172)**	**Change**
Chemistry	**2,951**	**56.6 (53.0–60.2)**	**4,828**	**78.2 (73.9–82.5)**	↑
HbA1c*	994	19.1 (17.7–20.4)	1,566	25.4 (23.9–26.8)	↑
Glucose/glucose tolerance*	641	12.3 (11.1–13.5)	550	8.9 (7.9–9.9)	↓
Lipids*	478	9.2 (8.2–10.1)	869	14.1 (13.0–15.2)	↑
EUC*	289	5.6 (4.8–6.3)	510	8.3 (7.4–9.1)	↑
Other chemistry*	176	3.4 (2.8–4.0)	492	8.0 (7.1–8.8)	↑
LFT*	170	3.3 (2.7–3.8)	363	5.9 (5.1–6.6)	↑
MBA*	121	2.3 (1.8–2.9)	258	4.2 (3.5–4.9)	↑
TFT*	43	0.8 (0.6–1.1)	69	1.1 (0.8–1.4)	—
Haematology	**226**	**4.3 (3.7–5.0)**	**462**	**7.5 (6.6–8.4)**	↑
FBC	190	3.7 (3.1–4.2)	433	7.0 (6.2–7.8)	↑
Other tests NEC	**94**	**1.8 (1.3–2.3)**	**123**	**2.0 (1.5–2.5)**	—
Other test NEC*	34	0.7 (0.4–0.9)	51	0.8 (0.5–1.1)	—
Microbiology	**35**	**0.7 (0.4–0.9)**	**41**	**0.7 (0.5–0.9)**	—
Other pathology groups	**8**	**. .**	**5**	**. .**	
Total pathology tests	**3,314**	**63.6 (59.6–67.6)**	**5,459**	**88.4 (83.7–93.2)**	↑

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

Medications prescribed for T2D

As pathology test recommendations often relate to the medications prescribed in the management of T2D, the most common prescribed medications for T2D are listed in Table 5.12.

Between 2000–02 and 2006–08, there were significant increases in prescribing of the hypoglycaemic agents: thiazolinediones (glitazones), combination oral blood glucose lowering drugs, and long-acting insulin. There were simultaneous decreases in the prescribing rates of sulfonamides and fast acting insulins.

The prescribing rates of statins, ACE inhibitors and aspirin also increased significantly between 2000–02 and 2006–08 (Table 5.12).

Table 5.12: Prescribed medications for T2D by Anatomical Therapeutic Chemical classification levels 3 and 4, 2000–02 and 2006–08

	2000–02		2006–08		
ATC levels 3 and 4	**Number**	**Rate per 100 T2D problems (95% CI) (*n* = 5,211)**	**Number**	**Rate per 100 T2D problems (95% CI) (*n* = 6,172)**	**Change**
Blood glucose lowering drugs, excluding insulins	3,058	56.7 (55.7–61.6)	3,207	52.0 (49.4–54.5)	↓
Biguanides (e.g. metformin)	1,528	29.3 (27.6–31.0)	1,779	28.8 (27.3–30.3)	—
Sulfonamides, urea derivatives	1,480	28.4 (26.6–30.2)	1,088	17.6 (16.4–18.9)	↓
Thiazolidinediones (i.e. glitazones)	8	0.2 (0.0–0.3)	245	4.0 (3.4–4.5)	↑
Combination oral blood glucose lowering drugs	0†	0†	75	1.2 (0.8–1.6)	↑
Insulins and analogues	297	5.7 (4.7–6.7)	395	6.4 (5.6–7.2)	—
Intermediate combined with fast-acting	186	3.6 (2.9–4.2)	269	4.4 (3.8–5.0)	—
Long-acting	19	0.4 (0.2–0.5)	71	1.2 (0.8–1.5)	↑
Fast-acting	92	1.8 (1.3–2.2)	55	0.9 (0.6–1.1)	↓
Lipid modifying agents, plain	59	1.1 (0.8–1.5)	260	4.2 (3.6–4.8)	↑
HMG CoA reductase inhibitors (i.e. statins)	54	1.0 (0.7–1.3)	242	3.9 (3.4–4.5)	↑
ACE inhibitors, plain	51	1.0 (0.7–1.3)	110	1.8 (1.4–2.1)	↑
Other analgesics and antipyretics (e.g. aspirin)	27	0.5 (0.3–0.7)	111	1.8 (1.3–2.3)	↑
Total prescribed medications	**3,749**	**71.9 (68.7–75.2)**	**4,440**	**71.9 (68.7–75.2)**	**—**

† Medication was not available in 2000–02.

Note: Only the medications accounting for > 1% of prescribed medications in either of the data periods are included. ATC – Anatomical Therapeutic Chemical classification; CI – confidence interval; ACE – angiotensin converting enzyme. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

5.5.4 Guidance documents for T2D

Twelve guidance documents were reviewed for T2D (Box 5.2).

Box 5.2: Guidance documents reviewed for T2D

Title	Year	Author	Abbreviated to
Diabetes management in general practice: guidelines for Type 2 diabetes 2008–09[192]	2008	Diabetes Australia (DA) and Royal Australian College of General Practitioners (RACGP)	DA & RACGP
National evidence based guidelines for the management of Type 2 diabetes mellitus[193]	2005	Diabetes Australia Guideline Development Consortium (DAGDC)	DAGDC
Clinical practice guidelines for the prevention and management of diabetes in Canada[194]	2008	Canadian Diabetes Association (CDA)	CDA
Type 2 diabetes: national clinical guideline for management in primary and secondary care[195]	2008	National Collaborating Centre for Chronic Conditions, Royal College of Physicians. *National Institute for Health and Clinical Excellence (NICE) guideline* [United Kingdom]	NICE
Management of diabetes: a national clinical guideline[196]	2001	Scottish Intercollegiate Guidelines Network (SIGN)	SIGN
Standards of medical care in Diabetes[197]	2008	American Diabetes Association (ADA)	ADA
Clinical practice guidelines: Diabetes mellitus[198]	2006	Ministry of Health (MoH) [Singapore]	MoH
Medical guidelines for clinical practice for the management of diabetes mellitus[199]	2007	American Association of Clinical Endocrinologists (AACE)	AACE
Global guideline for Type 2 diabetes[200]	2005	International Diabetes Federation (IDF)	IDF
RCPA manual, diabetes mellitus section[172]	2004	The Royal College of Pathologists of Australasia (RCPA)	RCPA
Murtagh's general practice, diabetes mellitus diagnosis and management chapters[173]	2007	Murtagh J [Australia]	Murtagh
Patient presentations in general practice, 'diabetes mellitus' and 'diabetes check-up'[174]	1999	Steven I [Australia]	Steven

5.5.5 Extent of alignment between GP testing and guidance documents

In Table 5.13, the frequently ordered pathology tests/batteries for T2D are categorised by level of support in the guidance documents listed in Box 5.2.

Supported tests

The five tests recommended in the majority of guidance documents were HbA1c, lipids, glucose/glucose tolerance, EUC, and urinary albumin or albumin:creatinine

(Table 5.13). Together these five tests accounted for 74.4% of tests/batteries ordered by GPs for T2D (Table 5.14). The rate at which supported tests were ordered for T2D increased significantly between 2000–02 and 2006–08 (Table 5.15). However individually, the rate of glucose/glucose tolerance tests decreased significantly while the other tests increased (Table 5.11).

There was strong agreement among guidance documents for monitoring glycaemic control using the HbA1c test. Frequency of recommended testing was specified in the majority of guidance documents. However, three guidelines did not explicitly recommend testing of HbA1c.[193,196,199]

Fasting glucose tests and oral glucose tolerance tests were recommended for the diagnosis of T2D by all guidance documents that provided diagnostic guidance. Only three documents[194,195,200] recommended annual fasting plasma glucose testing to check the accuracy of the patient's self-monitoring blood glucose machine.

There was strong agreement among guidance documents for assessment of lipid levels. Frequency of testing and targets were provided in the majority of guidance documents. However, three guidance documents[172,196,199] did not provide clear guidance on lipid testing.

Annual assessment of kidney function was recommended in all documents with the exception of the DAGDC guideline. Serum creatinine (for calculation of estimated glomerular filtration rate) and urine albumin (albumin:creatinine ratio) were the tests specifically recommended. Annual testing of urea was also recommended in two documents.[173,174]

Renal function was also often discussed in the context of medications. However, the DAGDC guideline only discussed renal function in the context of medications and blood pressure target—it did not discuss monitoring of creatinine or urine albumin to detect diabetic nephropathy.[193]

Tests with conditional support

LFT was classified as having conditional support (Table 5.13). LFT accounted for 5.9% of tests ordered for T2D (Table 5.14) and their ordering increased significantly between 2000–02 and 2006–08 (Table 5.11).

When LFT was mentioned in guidance documents it was most often in the context of medications, specifically in regard to monitoring glitazone use.[192,198,199] In two

guidance documents liver function was discussed as a consideration in prescribing metformin but specific testing was not recommended.[194,195] In contrast, NICE recommended against LFT testing when statins were prescribed.[195]

Two documents recommended LFT as part of the initial assessment of T2D[174,197] and one of these also recommended annual testing.[174]

Support unable to be determined

It was not possible to determine whether MBA and 'other chemistry' tests (excluding urine albumin tests) were recommended in the guidance documents (see Section 5.3.4). Together these two tests accounted for 5.3% of pathology ordered for T2D (Table 5.14).

With the exception of urinary albumin and albumin:creatinine (split from the 'other chemistry' group and discussed above), the remainder of the 'other chemistry' group was classified as having unclear guidance.

The MBA test was not recommended in any guidance documents. However, some tests that may be considered part of the MBA, such as EUC and LFT, were partially or completely supported in the management of T2D (as discussed above).

Unsupported tests

The majority of guidance documents did not recommend testing of FBC and TFT (Table 5.13). These tests accounted for 8.5% of pathology ordered for T2D (Table 5.14). The order rate of FBC increased significantly between 2000–02 and 2006–08 (Table 5.11).

FBC monitoring was mentioned in two documents as a check for anaemia when chronic kidney disease was present.[199,200]

TFT was not mentioned in the majority of guidance documents. Two documents did recommend TFT: DA & RACGP[192] recommended it as part of the initial assessment if there was a family history or clinical suspicion of thyroid disease; and ADA[197] recommended TFT as part of the initial assessment if dyslipidaemia was present or the patient was female and over 50 years of age.

Other tests mentioned in the guidance documents

Other tests were mentioned in the guidance documents but each of these accounted for less than 1% of tests recorded by GPs for T2D.

Urinalysis was recommended as part of the initial investigations in two sources.[174,192]

Urine M,C&S was recommended by DA & RACGP if risk of urine infection was high[192] and was mentioned in RCPA in relation to diabetic nephropathy but the specific purpose of testing (whether to identify or monitor nephropathy) was not stated.[172]

Parathyroid function tests were recommended in the presence of kidney disease by AACE.[199]

Two guidance documents specifically recommended that routine monitoring of blood ketones[198] and creatine kinase (CK) [195] should not be done.

Key to Table 5.13

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.13: Summary of guidance recommendations by most frequent individual test orders for T2D, 2000–08

Pathology test	Per cent of T2D path (*n* = 17,710)	DA & RACGP[192]	DAGDC[193]	CDA[194]	NICE[195]	SIGN[196]	ADA[197]	MoH[198]	AACE[199]	IDF[200]	RCPA[172]	Murtagh[173]	Steven[174]
HbA1c*	29.8		Implied			Implied			Implied				
Lipids*	15.1					Implied			Implied		Implied		
Glucose (excluding tolerance tests)	12.1	Diagnosis	Diagnosis	Diagnosis & annual	Annual	Diagnosis	Diagnosis	Diagnosis	Diagnosis	Diagnosis & annual	Diagnosis	Diagnosis	N/A
EUC*	9.4		Implied										
Urine albumin/ albumin:creatinine ratio	7.2		Implied										
FBC	7.2								Kidney disease	Kidney disease			
LFT*	5.9	Meds		Meds	Statins Meds		Diagnosis	Meds	Meds				
MBA*	4.5												
TFT*	1.3	Diagnosis (Family Hx or symptoms)					Diagnosis (dyslipidaemia or F > 50 years)						
Glucose tolerance	0.9	Diagnosis	Diagnosis	Diagnosis	N/A	Diagnosis	Diagnosis	Diagnosis	Diagnosis	Diagnosis	Diagnosis	Diagnosis	N/A
Other chemistry* (excluding urine albumin/ albumin:creatinine ratio)	0.8												

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: T2D – Type 2 diabetes; path – pathology; N/A – not applicable; Meds – medications; Hx – history; F – female; also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.5.5, briefly: implied – indicates the use of the test is implied; Diagnosis – Test recommended at diagnosis; Meds – test recommended when specific medications are taken.

Evaluation of GP pathology ordering against guidance documents

Table 5.14 provides a summary of the individual tests recorded in BEACH and the level of support provided in the guidance documents for each. Of the tests/batteries ordered for T2D in 2000–08:

- 74.4% were supported
- 11.2% had conditional support or support could not be determined
- 8.5% were not supported (Table 5.14).

The tests/batteries listed in Table 5.14 account for 94.1% of pathology ordered for T2D because only the most commonly ordered tests for T2D were evaluated.

Table 5.14: Summary of support for GP pathology ordering for the most frequent individual test orders for T2D, 2000–08

Pathology test	Number	Per cent of all pathology for T2D
Supported	**13,184**	**74.4**
HbA1c*	5,271	29.8
Lipids*	2,681	15.1
Glucose/glucose tolerance*	2,299	13.0
EUC*	1,657	9.4
Urine albumin/albumin:creatinine ratio	1,276	7.2
Conditional/unclear support	**1,985**	**11.2**
LFT*	1,040	5.9
MBA*	803	4.5
Other chemistry*[(a)] (excluding urine albumin/albumin:creatinine ratio)	142	0.8
Unsupported	**1,501**	**8.5**
FBC	1,266	7.1
TFT*	235	1.3
Subtotal (n, % of total tests)	*16,671*	*94.1*
Total pathology tests	**17,710**	**100.0**

(a) 'Other chemistry' after excluding albumin tests accounts for < 1% of total tests in 2000–08 but in 2006–08 it accounted for 1.6% of tests. It is included because as a whole group it accounted for ≥ 1% of tests for T2D.

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered supported pathology tests at a rate of 57.5 tests/batteries per 100 T2D problems, followed by tests with conditional support (8.6 per 100), and unsupported tests (6.5). Tests ordered for T2D but not evaluated were ordered at a rate of 4.6 per 100 T2D problems. The rate at which GPs ordered tests in all 'level of support' groups increased significantly over time (Table 5.15).

Table 5.15: Rate of pathology ordering for T2D by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 T2D problems (95% CI) (*n* = 22,938)	Rate per 100 T2D problems (95% CI) (*n* = 5,211)	Rate per 100 T2D problems (95% CI) (*n* = 6,172)	Change
Supported	57.5 (55.7–59.2)	49.1 (45.9–52.3)	63.7 (60.1–67.3)	↑
Conditional/unclear support	8.6 (8.2–9.1)	6.0 (5.2–6.7)	11.0 (10.0–12.0)	↑
Unsupported	6.5 (6.1–7.0)	4.5 (3.8–5.1)	8.1 (7.2–9.1)	↑
Not evaluated	4.6 (4.2–4.9)	4.1 (3.4–4.7)	5.7 (4.9–6.4)	↑

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

GPs ordered only pathology tests that were supported or conditionally supported at 22.6% (95% CI: 21.9–23.3) of T2D problems in 2000–08. A further 6.0% (95% CI: 5.6–6.3) of T2D problems involved at least one unsupported test, and 71.4% (95% CI: 70.7–72.2) of problems involved either no pathology tests (70.3%) or tests that were not evaluated (1.1%) (results not tabled).

There was no change in the proportion of T2D problems that involved supported testing between 2000–02 (22.2%, 95% CI: 20.7–23.6) and 2006–08 (22.7%, 95% CI: 21.4–24.1). However the proportion involving at least one unsupported test increased significantly over this time, from 4.1% (95% CI: 3.5–4.7) to 7.4% (95% CI: 6.6–8.2) (results not tabled).

When GPs ordered unsupported tests, the vast majority (98%) were accompanied by one or more supported/partially-supported tests. Unsupported tests were ordered alone at the remaining 2%. GPs ordered only tests that were unsupported at 0.1% of T2D problems in 2000–08, and this did not change over time (0.1% in 2000–02 and 2006–08) (results not tabled).

5.5.6 Discussion

More than 85% of pathology tests ordered by GPs in the management of T2D were recommended (with either partial or complete support) by guidance documents. The statistically significant increase in the rate of GPs total pathology ordering for T2D between 2000–02 and 2006–08 was reflected in significant increases in the rate of tests that were supported, partially supported, and unsupported in guidance documents. The largest increases were in the rate of partially supported and unsupported tests.

Due to the increase in total rate of pathology ordering, the correlation between GPs' ordering and level of support, as a proportion of total tests should be considered. Supported tests accounted for the largest proportion of total tests, but they accounted for a smaller proportion of total tests in 2006–08 than in 2000–02. Concomitantly there were small increases in the proportion of both the partially supported and unsupported tests. Overall the increase in total tests ordered by GPs for T2D suggested a small shift (approximately 2% of total pathology) to be 'less' in line with guidance recommendations.

Comments on selected guidance documents

The DAGDC, SIGN and AACE guidelines lacked clear recommendations for testing in (at least one of) three crucial aspects of T2D management: glycaemic control, lipid testing and renal function.

Regular monitoring of glycaemic control (using the HbA1c test) was not recommended in any of these guidelines. SIGN and AACE both discussed the HbA1c target but specific recommendations for monitoring HbA1c were not given.[196,199] The DAGDC guideline was published as seven stand-alone sections (each section focused on an aspect of T2D management), but there was no section on glycaemic control. It was only mentioned in the lipid section of the guideline in the context of the beneficial effect of glycaemic control on lipids, and specific test recommendations for HbA1c were not given.[193]

Lipid test recommendations were lacking in the SIGN and AACE guidelines. SIGN discussed dyslipidaemia as a cardiovascular risk factor,[196] and AACE provided the target for lipid levels,[199] but neither included testing or monitoring recommendations.

The DAGDC guideline did not include a section on diabetic nephropathy. Renal function was only discussed as a consideration in choice of therapy and monitoring of medication side effects.[193]

Since work for this chapter was completed, new SIGN and DAGDC guidelines have been published that supersede those reviewed in this study, and an additional AACE guideline about developing a diabetes care plan has been published (but this does not supersede the existing guidance). The new SIGN guideline does not correct the omissions noted above. In contrast, the new DAGDC guideline corrects the noted omissions, but it is worth mentioning that the structure of separate sections persists in the new version. Publishing the guideline in multiple sections makes it difficult to search for information and creates a very long guideline (the length of the 2005 guideline reviewed in this chapter was more than 750 pages, easily the longest of the reviewed documents) making it difficult to use as a guidance document.

Monitoring of T2D

As T2D is a chronic condition, the majority of management provided and pathology ordered by GPs, was for its ongoing management. In most guidance documents there were clear recommendations on the use and frequency of tests to monitor glycaemic control, lipid levels and renal function in the ongoing management of T2D. However the role of fasting glucose tests, FBC and LFT in long-term management was not clear.

The fasting glucose test was unanimously recommended to diagnose T2D, suggesting the majority would be associated with ‘new’ cases of T2D. However, BEACH data showed that most (87%) were ordered after the diagnosis of T2D. Glucose testing accounted for 12% of testing for T2D. While the order rate of fasting glucose tests did decrease between 2000–02 and 2006–08, the high proportion ordered for ongoing care suggests that GPs routinely use this test for ongoing management. Only three guidance documents recommended glucose testing in ongoing management, to annually assess the accuracy of the patient’s home glucose monitor. GPs’ rationale for ongoing use may reflect this recommendation or may be due to other reasons. Considering the volume of glucose testing, guidance on the role of fasting glucose testing in ongoing care of T2D should be clarified in future guidance documents.

FBC testing was classified as unsupported in this study because only two guidance documents suggested it had a role in the management of T2D. However, GPs commonly ordered FBC for T2D (7% of total tests in 2000–08), and the order rate almost doubled between 2000–02 and 2006–08. This test was responsible for the small shift in GPs ordering being 'less' in line with guidance recommendations.

Two guidance documents recommended FBC testing to check for anaemia when chronic kidney disease was present. The presence of chronic kidney disease as a comorbidity in T2D was not recorded in BEACH. Therefore whether the rate of FBC testing ordered by GPs reflects monitoring of kidney disease cannot be determined. However, the lack of guidance for the test, its increased ordering rate and the high proportion of tests it accounted for, suggest that the role of FBC in ongoing management of T2D needs to be clarified.

Assessment of liver function was most often mentioned in regard to medications in guidance documents, either to identify liver dysfunction or to monitor potential adverse effects of medications. However, frequency and duration of monitoring were not specified, with one exception—Steven[174] recommended annual monitoring. In the management of T2D, the order rate of LFTs increased significantly between 2000–02 and 2006–08, as did the prescribing rate for medications for which LFT monitoring was recommended (statins and glitazones). Given these increases, the required frequency and duration of LFT for monitoring adverse effects of medications needs to be clarified (see 'medication monitoring' discussion below).

For fasting glucose tests, FBC and LFT, in addition to the issues discussed above, there was a lack of guidance about interpretation of test results in the context of monitoring, even among tests with an established role in monitoring. While the target and testing interval were discussed, guidance was not provided on what represents a true change in repeated testing results. This is known as the 'critical difference' and incorporates the expected analytical and intra-individual variation of a test.[201] An understanding of critical difference is necessary when making treatment decisions (e.g. titrating medications) as it determines the level at which a change in results represents a true change versus a chance finding.

Previous studies have demonstrated that there is large variation in GPs estimation of critical difference[201,202] and that there is limited guidance available to users of pathology testing about interpreting repeated results.[201-203] As providing guidance

about critical difference is complex (due to the number of factors involved), disease-specific guidelines may not be the best place to disseminate this information for monitoring tests. Nevertheless, authors of guidance should consider including at least some information about interpretation of the primary monitoring tests on which major treatment decisions for T2D are based (such as HbA1c).

Medication monitoring

The amount of information about pathology tests required when selecting medication (e.g. presence of impaired renal function) and identifying adverse effects, varied considerably among guidance documents. Some documents stated that medication information was outside the scope of the guidance and referred the reader to the relevant product information.[194,195] In contrast, the AACE guideline provided a summary table for oral hypoglycaemic medications that described the monitoring required to determine medication response and presence of side effects, with information on time interval to test.[199]

Recommendations regarding testing to measure response to therapy were clear in the guidance. However, the testing required to identify contraindications and to monitor adverse effects was not clear and these are discussed below.

For metformin, renal impairment and liver disease were considerations in the appropriateness of the medication.[179,192,194,198,199] Despite this, most guidance did not recommend testing prior to initiation of metformin. Based on pathology test recommendations in other parts of the guidance documents, GPs should have been aware of renal impairment as it would be tested in routine assessment of T2D, but this is not the case for liver function. As metformin is the first line medication recommended for T2D and the most commonly prescribed medication for T2D in this study, the high rate of LFTs ordered by GPs may be partially due to the need to assess presence of liver disease in these patients. Guidance about the need for testing prior to initiation of metformin should be clarified.

In the use of glitazones, liver dysfunction/disease was stated as a consideration and monitoring of liver enzymes was recommended.[192,198,199] The frequency of monitoring of liver enzymes was often not specified. In contrast, the Australian medication guideline, eTG, recommended LFT prior to initiation of glitazone, followed by 2-monthly monitoring for the first year of therapy and periodically thereafter.[179] The prescribing rate of glitazones increased significantly between

2000–02 and 2006–08 and this may have contributed to the significant increase in LFT testing.

Most T2D guidance documents included recommendations about the management of lipid levels and blood pressure. For the blood pressure medications—ACE inhibitors, angiotensin receptor blockers and diuretics—testing of electrolytes and creatinine were recommended.[192,196-199]

Statins were the lipid lowering medication most often discussed in T2D guidance. The NICE guideline and a paper by the American Physicians Association specifically stated monitoring of liver function in statin use for T2D was not necessary.[195,204] In contrast, the majority of guidance for management of lipid disorders reviewed in Section 5.6 recommended monitoring LFT in statin use. The eTG also recommended monitoring liver function after 4 weeks of statin use, but information on ongoing monitoring was not provided.[179] In the management of T2D the prescribing rate of statins and ACE inhibitors increased significantly over the duration of this study (2000–02 to 2006–08) and this may have contributed to the significant increase in LFT and kidney function testing.

In summary, pathology testing related to medication use may have contributed to increases in the rates of LFT, electrolyte and kidney function testing. Guidance documents need to provide clearer recommendations about when testing is required, whether monitoring of adverse effects is required, the interval between tests and the duration of monitoring needed.

Other factors contributing to the increased management rate of T2D

The recommended management of T2D has changed as our understanding of cardiovascular disease risk has improved. Guidance documents' recommendations are based on evidence about the combined influence of multiple risk factors (such as lipid levels and blood pressure) on cardiovascular disease risk. GPs' management of T2D recorded in BEACH suggests they manage the multiple risk factors (such as blood pressure and lipids) as part of T2D rather than as separate clinical problems, probably because the threshold at which they become a cardiovascular risk is lower than the level required for clinical diagnosis.

As awareness of the threshold of risk (the level at which a factor contributes to risk) improved, the targets for a number of observable findings were changed in guidance documents (for example, lower HbA1c, low density lipoprotein [LDL] cholesterol

and blood pressure, and increased high density lipoprotein [HDL] cholesterol) for certain 'at risk' patients. Changes in these targets may have influenced GPs' management rate of T2D and pathology ordering rates because these targets are potentially harder and take longer to achieve. Pathology testing to measure response is more frequent while actively trying to achieve a target (titrating medications, monitoring adverse-effects of medications). While the guidance documents acknowledge that targets should be adjusted to the individual patient, it is likely that a change in targets that requires intensifying management will result in increased testing rates.

Basing treatment recommendations on multiple factors is likely to increase the number of patients requiring active treatment. For example, using conventional targets, a single risk factor in a patient with T2D may not need treatment—such as, a LDL level of 2.4 mmol/L, where the target is < 2.5mmol/L. However, it may require treatment when other risk factors are considered—such as, presence of coronary heart disease which lowers the recommended LDL target to < 2.0 mmol/L,[192] presence of other risk factors (age > 60 years, microalbuminuria) which require lipid-lowering treatment regardless of lipid levels.[176]

Management of cardiovascular disease risk factors in patients with T2D may have contributed to the increased management rate and pathology rate seen in this study. While these changes may increase the resources required to manage T2D they represent an increase in high quality evidence-based care.

Past health initiatives aiming to improve detection of diabetes and care of patients with diabetes are also likely to have contributed to the increased management rate and pathology ordering rate for T2D in general practice. These initiatives provide funding for evidence-based clinical activities. For example the diabetes cycle of care (introduced as part of the National Integrated Diabetes Program[186] in 2006) required patients to see the GP at least twice (in a 11–13 month period) and have HbA1c, lipids and microalbuminuria assessed at least once in the cycle.[186] The success of these initiatives may have had an impact on the management rate and pathology ordering rate for T2D in a positive way – as they are evidence-based, the recommended activities reflect best practice in the management of T2D.

Summary

The majority of tests ordered by GPs in the management of T2D were recommended in guidance documents. It can be concluded that much of the increase in the management rate and testing rate seen in BEACH was related to best practice management of T2D and has been stimulated through numerous evidence-based initiatives. The prevalence of T2D is expected to increase in the future due to the ageing population and increasing obesity prevalence.[180-182] This would cause a concomitant increase in the management rate of T2D in general practice, and a corresponding increase in pathology ordering based on the current pattern of GPs' pathology ordering for T2D. This study suggests that most of this ordering would be supported by guidance documents.

These finding suggest that the main opportunity to reduce unsupported testing ordered for T2D lies in clarification of whether FBC has a role in T2D management. Monitoring recommendations should also be improved to clarify: the role (if any) of fasting glucose and LFT in long-term management of T2D; and testing required to monitor adverse effects of medications. The majority of T2D management and pathology ordered by GPs for T2D is for monitoring, reinforcing the need for clarity in recommendations regarding pathology testing in long-term management.

5.6 Lipid disorders

5.6.1 Background

Lipid disorder is national priority because it is a risk factor for cardiovascular disease.[151] In 2003, 'high blood cholesterol' was responsible for 6.2% of the total burden of disease and injury in Australia.[156]

The prevalence of measured elevated total cholesterol (> 5.5 mmol/L) was 51.2% of adults aged 25 years and over in 1999–00.[157] The National Health Survey estimated the prevalence of self-reported high cholesterol to be 6% of the Australian population in 2007–08.[154]

The link between lipid levels and cardiovascular disease has been known for many decades.[205,206] However the management strategy has changed over time. Lipid levels are now assessed and managed in the context of the patient's absolute cardiovascular risk.[207] This incorporates multiple risk factors and allows identification of the patients who will benefit most from treatment rather than basing treatment decisions on lipid levels alone.[178] In this context, the criteria for subsidised lipid-lowering medications (through the PBS) in Australia were broadened in October 2006 to allow access on the basis of cardiovascular risk rather than measured lipid levels alone.[208]

Lipid disorder is one of the most commonly managed problems in general practice.[17] A SAND substudy of 2,960 patients estimated that 22% of patients at general practice encounters had diagnosed dyslipidaemia, and a further 5% had their lipid levels managed for other reasons (such as cardiovascular risk).[209] Pathology tests are required for the diagnosis and monitoring of lipid disorders, and for the assessment of cardiovascular risk.

5.6.2 Management rate in Australian general practice

In BEACH, lipid disorder was managed at 25,231 patient encounters by 6,480 GPs, at a rate of 3.2 per 100 encounters in 2000–08 (Table 5.16). This equates to approximately 3.2 million encounters per year where lipid disorder was managed by GPs in Australia.

As discussed in Chapter 4, the management rate of lipid disorders increased significantly between 2000–02 and 2006–08 (Table 5.16). There was a significant

increase in the diagnosis or detection rate of new cases of lipid disorder, from 0.35 per 100 encounters in 2000–02 to 0.48 in 2006–08 (Table 5.16). This suggests that the increased management rate reflects increases in both detection and monitoring encounters for lipid disorders.

Table 5.16: Summary of lipid disorders data set, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Rate per 100 encounters (95% CI) (*n* = 784,300)	Number	Rate per 100 encounters (95% CI) (*n* = 198,200)	Number	Rate per 100 encounters (95% CI) (*n* = 188,300)	Change
General practitioners	6,480	. .	1,629	. .	1,602	. .	. .
Lipid encounters	25,231	. .	5,780	. .	6,624	. .	. .
Lipid problems managed	25,248	3.2 (3.2–3.3)	5,782	2.9 (2.8–3.0)	6,629	3.5 (3.4–3.7)	↑
New lipid problems	3,169	0.40 (0.39–0.42)	699	0.35 (0.32–0.38)	902	0.48 (0.44–0.52)	↑

Note: Data about lipid disorder problems managed are drawn from Chapter 4, Table 4.3. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

5.6.3 Pathology ordered for lipid disorders

Pathology was ordered at a rate of 62.5 per 100 lipid disorder problems managed in 2000–08. Almost one-third of lipid disorder problem contacts (30.5%) resulted in at least one test/battery being ordered by GPs. Once the decision to order pathology was made, GPs ordered on average 2.05 tests/batteries per tested lipid problem (Table 5.17).

As reported in Chapter 4, the rate of pathology ordering for lipid disorders increased significantly between 2000–02 and 2006–08. This was due to a significant increase in the number of tests ordered once the decision to order pathology was made. There was no change in the likelihood of pathology being ordered in the management of lipid disorders (Table 5.17).

Table 5.17: Summary of pathology ordering for lipid disorder, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Per cent / Rate of lipid problems (95%CI) (*n* = 25,248)	Number	Per cent / Rate of lipid problems (95%CI) (*n* = 5,782)	Number	Per cent / Rate of lipid problems (95%CI) (*n* = 6,629)	Change
Pathology (Rate per 100 lipid problems)	15,777	62.5 (60.6–64.4)	3,363	58.2 (54.7–61.6)	4,410	66.5 (62.5–70.6)	↑
At least one pathology order (% of lipid problems)	7,704	30.5 (29.8–31.3)	1,758	30.4 (28.9–31.9)	2,010	30.3 (28.9–31.8)	—
Number of tests/ batteries per 100 tested lipid problems	. .	204.8 (201.2–208.4)	. .	191.4 (184.6–198.2)	. .	219.4 (211.6–227.3)	↑

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.4. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

Types of pathology tests/batteries ordered

Table 5.18 shows the rate of pathology ordered for lipid disorders in 2000–08 by MBS groups and the most common individual types of tests ordered.

Chemistry tests were the group most often ordered (57.1 per 100 lipid disorder contacts) and the most common were:

- lipid tests (31.4 per 100 lipid disorder contacts)
- LFTs (7.8)
- glucose/glucose tolerance tests (6.0)
- EUC tests (3.2).

Haematology tests (4.3 per 100 contacts), in particular FBCs (3.8), were also commonly ordered in the management of lipid disorders.

Only 7.6% of pathology tests were ordered in the management of ‘new’ cases of lipid disorders, the vast majority being ordered for ongoing management (Table 5.18).

Table 5.18: Rate of pathology test orders for lipid disorder by MBS pathology groups and most frequent individual test orders within each group, 2000–08

	All lipid disorder problems		New lipid disorder problems		
Pathology test	Number	Rate per 100 lipid problems (95% CI) (*n* = 22,938)	Number	Per cent of test	Rate per 100 new lipid problems (95% CI) (*n* = 1,421)
Chemistry	**14,414**	**57.1 (55.4–58.8)**	**1,104**	**7.7**	**34.8 (31.9–37.8)**
Lipids*	7,919	31.4 (30.5–32.3)	704	8.9	22.2 (20.4–24.0)
LFT*	1,961	7.8 (7.3–8.2)	106	5.4	3.3 (2.7–4.0)
Glucose/glucose tolerance*	1,520	6.0 (5.7–6.4)	107	7.0	3.4 (2.7–4.0)
EUC*	801	3.2 (2.9–3.5)	42	5.2	1.3 (0.9–1.7)
MBA*	683	2.7 (2.4–3.0)	37	5.4	1.2 (0.8–1.6)
CK	671	2.7 (2.4–2.9)	44	6.6	1.4 (1.0–1.8)
TFT*	318	1.3 (1.1–1.4)	27	8.5	0.9 (0.5–1.2)
PSA*	157	0.6 (0.5–0.7)	4	2.5	0.1 (0.0–0.2)
Haematology	**1,076**	**4.3 (3.9–4.6)**	**55**	**5.1**	**1.7 (1.2–2.2)**
FBC	949	3.8 (3.5–4.1)	48	5.1	1.5 (1.1–1.9)
Other tests NEC	**210**	**0.8 (0.7–1.0)**	**16**	**7.6**	**0.5 (0.2–0.8)**
Other pathology groups	**77**	**. .**	**18**	**23.4**	**. .**
Total pathology tests	**15,777**	**62.5 (60.6–64.4)**	**1,193**	**7.6**	**37.7 (34.5–40.8)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations.

Changes in the types of pathology tests/batteries ordered

Table 5.19 shows the most common tests/batteries ordered for lipid disorders in 2000–02 and 2006–08. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- FBCs—85% increase
- EUC tests—110% increase
- MBA tests—68% increase
- CK tests—94% increase
- TFTs—70% increase
- PSA tests (a marginal increase)—60% increase (Table 5.19).

In contrast, there was a significant 12% decrease in the order rate of lipid tests (Table 5.19).

Table 5.19: Rate of pathology test orders for lipid disorder by MBS pathology groups and most frequent individual test orders within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test	Number	Rate per 100 lipid problems (95% CI) (*n* = 5,782)	Number	Rate per 100 lipid problems (95% CI) (*n* = 6,629)	Change
Chemistry	**3,124**	**54.0 (50.8–57.3)**	**3,954**	**59.7 (56.1–63.2)**	—
Lipids*	1,932	33.4 (31.5–35.4)	1,957	29.5 (27.9–31.1)	↓
LFT*	408	7.1 (6.1–8.0)	550	8.3 (7.4–9.2)	—
Glucose/glucose tolerance*	305	5.3 (4.6–6.0)	417	6.3 (5.5–7.0)	—
EUC*	121	2.1 (1.6–2.5)	294	4.4 (3.8–5.1)	↑
MBA*	112	1.9 (1.4–2.4)	211	3.2 (2.6–3.8)	↑
CK	101	1.8 (1.2–2.3)	232	3.5 (2.9–4.1)	↑
TFT*	56	1.0 (0.7–1.2)	112	1.7 (1.3–2.1)	↑
PSA*	26	0.5 (0.3–0.6)	55	0.8 (0.6–1.1)	↑
Haematology	**185**	**3.2 (2.6–3.8)**	**361**	**5.5 (4.7–6.2)**	↑
FBC	156	2.7 (2.2–3.2)	333	5.0 (4.3–5.8)	↑
Other tests NEC	**35**	**0.6 (0.4–0.8)**	**71**	**1.1 (0.7–1.4)**	—
Other pathology groups	**19**	**. .**	**24**	**. .**	
Total pathology tests	**3,363**	**58.2 (54.7–61.6)**	**4,410**	**66.5 (62.5–70.6)**	↑

Note: CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change (darker shading), ↑/↓ indicates a marginal change (lighter shading), and — indicates no change.

Medications prescribed for lipid disorders

Lipid lowering agents (plain and combination) accounted for more than 97% of medications prescribed in the management of lipid disorders, in 2000–08. Most of these were plain statins (91% of all prescribed medications for lipid disorders).

There was a marginal increase in the rate of prescribed medications between 2000–02 and 2006–08, from 63.0 per 100 contacts with lipid disorders (95% CI: 61.1–64.8) to 66.5 per 100 (95% CI: 64.8–68.2). This increase was due GPs' prescribing of ezetimibe and statin/ezetimibe medications, which were not available for purchase in 2000–02 and were prescribed at a rate of 4.0 per 100 lipid disorder contacts in 2006–08. There was no change between 2000–02 and 2006–08 in the prescribing rate of: statins; fibrates; and other lipid-lowering medications (results not tabled).

5.6.4 Guidance documents for lipid disorder

Guidance documents for the management of lipid disorder and the lipid section of cardiovascular disease prevention guidelines were considered in this study. Twelve guidance documents were reviewed for lipid disorder (Box 5.3).

Box 5.3: Guidance documents reviewed for lipid disorders

Title	Year	Author	Abbreviated to
Position Statement on Lipid Management[178]	2005	National Heart Foundation (NHF) of Australia and the Cardiac Society of Australia and New Zealand (CSANZ)	NHF & CSANZ
Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults - Adult Treatment Panel[210] and the 2004 update: Implications of recent clinical trials[211]	2002 (2004)	National Cholesterol Education Program (NCEP) Expert Panel [United States of America]	NCEP
Clinical Guidelines and Evidence Review for Lipid Modification: cardiovascular risk assessment and the primary and secondary prevention of cardiovascular disease[212]	2008	National Collaborating Centre for Primary Care and Royal College of General Practitioners. *National Institute for Health and Clinical Excellence (NICE) guideline* [United Kingdom]	NICE
Risk estimation and the prevention of cardiovascular disease[213]	2007	Scottish Intercollegiate Guidelines Network (SIGN)	SIGN
Medical Guidelines for Clinical Practice for the Diagnosis and Treatment of Dyslipidemia and Prevention of Atherogenesis[214]	2002	American Association of Clinical Endocrinologists (AACE)	AACE
European guidelines on cardiovascular disease prevention in clinical practice[215]	2007	European Society of Cardiology (ESC)	ESC
Screening and Management of Lipids[216]	2009	Barrie WE, Harrison RV, Khanderia UB, Kiningham RB, Rosenson RS University of Michigan [United States of America]	Barrie et al.
Recommendations for the management of dyslipidemia and the prevention of cardiovascular disease[217,218]	2003	Genest J, Frohlich J, Fodor G, McPherson R. Working Group on Hypercholesterolemia and Other Dyslipidemias [Canada]	Genest et al.
Clinical practice guidelines: Lipids[219]	2006	Ministry of Health (MoH) [Singapore]	MoH
Health Care Guideline: Lipid Management in Adults[220]	2007	Woolley A, Kopecky S, Kottke T, O'Connor P, Hanson S, Conroy W et al. *Institute for Clinical Systems Improvement (ICSI) guideline* [United States of America]	ICSI
RCPA manual, hyperlipidaemia section[172]	2004	The Royal College of Pathologists of Australasia (RCPA)	RCPA
Murtagh's general practice, dyslipidaemia chapter[173]	2007	Murtagh J [Australia]	Murtagh

5.6.5 Extent of alignment between GP testing and guidance documents

In Table 5.20, the frequently ordered tests/batteries for lipid disorder are categorised by level of support in the guidance documents listed in Box 5.3.

Supported tests

The five types of tests recommended in the majority of guidance documents were Lipid tests, LFT, glucose/glucose tolerance, EUC and TFT (Table 5.20). Together these tests accounted for 79.3% of pathology ordered by GPs for lipid disorder (Table 5.21). Between 2000–02 and 2006–08 the order rate of EUC and TFT increased significantly while the order rate of lipid tests decreased (Table 5.19). The latter represents a change in how GPs record the lipid test rather than a change in lipid ordering behaviour. GPs were more likely to record the specific lipid subfractions in 2000–02 (counted as multiple tests) whereas in 2006–08 they were more likely to record the lipid profile test (counted as a single test) (results not tabled).

Lipid tests were unanimously recommended, including the need to test lipid subfractions (i.e. total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides).

Liver function testing was also recommended in all guidance documents to: determine presence of liver dysfunction as a cause of secondary lipid disorders,[172,210-212,214,216,219,220] as a consideration in medication selection and safety,[173,178,210-213,215,216,219,220] and/or in the monitoring of statin medications and selected other medications (e.g. combination therapy).[173,210-214,216-220]

Glucose testing was recommended in most guidance documents to determine the presence of diabetes as a cause of secondary lipid disorder.[172,173,210-214,216,219,220] Diabetes was also discussed in regard to cardiovascular risk as its presence increases the patient's risk and affects which lipid target is appropriate for the patient.[178,210,211,213-220]

Assessment of renal function (EUC test) was recommended in most guidance documents to determine the presence of renal impairment as a cause of secondary lipid disorder.[172,173,210-212,214,216,219,220] Renal function was also discussed as a consideration in medication selection,[178,210-213,216-220] and in regard to cardiovascular

risk[178,210,211,213,215,217,218] as this affects which lipid target is appropriate for the patient.

Assessment of thyroid function was recommended in most guidance documents to determine the presence of hypothyroidism as a cause of secondary lipid disorder,[172,173,210-212,214,216,219,220] and prior to initiating a statin.[220]

Tests with conditional support

The CK test was classified as having conditional support (Table 5.20). CK accounted for 4.3% of tests ordered for lipid disorders (Table 5.21) and increased significantly between 2000–02 and 2006–08 (Table 5.19).

CK testing was discussed in regard to medication (primarily statin) use to detect myopathy. Most guidance stated that routine CK monitoring was not necessary, but CK testing was recommended in patients with muscle symptoms[178,210-213,216,219,220] and some guidance documents recommended taking a baseline measure prior to starting statins (or combination statin therapy) for future comparison in all patients[173,178,210,211,220] or for high risk patients.[213]

A few guidance documents recommended routine monitoring in certain high risk patients (e.g. renal disease, high dose statins, statin combination therapy).[173,178,217-219] In documents where guidance about CK testing was not given, the potential for myopathy as an adverse effect of statin use was discussed.[214,215]

Support unable to be determined

It was not possible to determine whether MBA were recommended in the guidance documents (see Section 5.3.4). MBA accounted for 4.3% of pathology ordered for lipid disorder (Table 5.21) and increased significantly over time (Table 5.19).

The MBA test itself was not recommended in any guidance documents. However, some tests that may be considered part of the MBA, such as EUC and LFT, were partially or completely supported in the management of lipid disorder (as discussed above).

Unsupported tests

The guidance documents did not mention FBC and PSA testing (Table 5.20). These tests accounted for 7.0% of pathology ordered for lipid disorders (Table 5.21) and the order rate of both tests increased significantly between 2000–02 and 2006–08 (Table 5.19). It may be possible that GPs ordered the FBC to assess the presence of

systemic lupus erythematosus,[221] a possible cause of secondary lipid disorders (mentioned in two guidance documents[214,220]).

Key to Table 5.20

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.20: Summary of guidance recommendations by most frequent individual test orders for lipid disorder, 2000–08

Pathology test	Per cent of lipid disorders pathology (*n* = 15,777)	NHF & CSANZ[178]	NCEP[210,211]	NICE[212]	SIGN[213]	AACE[214]	ESC[215]	Barrie et al.[216]	Genest et al.[217,218]	MoH[219]	ICSI[220]	RCPA[172]	Murtagh[173]
Lipids*	50.2												
LFT*	12.4	Medication safety					Medication safety		Medication				Medication
Glucose/glucose tolerance*	9.6	CV risk			CV risk				CV risk				
FBC	6.0					SLE					SLE		
EUC*	5.1	CV risk and medication							CV risk and meds				
MBA*	4.3												
CK	4.3	Baseline & muscle sx	Baseline & muscle sx	Muscle sx	Muscle sx & high risk pts	Implied	Medication safety	Muscle sx	High risk medication	High risk medication	Baseline & muscle sx		Monitor in statin use
TFT*	2.0												
PSA*	1.0												

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: CV risk – cardiovascular risk; SLE – systemic lupus erythematosus; sx – symptom; pts – patients. Also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.6.5.

Evaluation of GP pathology ordering against guidance documents

Table 5.21 provides a summary of the individual tests recorded in BEACH and the level of support provided in the guidance documents for each. Of the tests/batteries ordered for lipid disorder in 2000–08:

- 79.3% were supported
- 8.6% had conditional support or support could not be determined
- 7.0% were not supported by the guidance documents.

The individual tests/batteries listed in Table 5.21 account for 94.9% of pathology ordered for lipid disorders because only the most commonly ordered tests for lipid disorder were evaluated.

Table 5.21: Summary of support for GP pathology ordering for the most frequent individual test orders for lipid disorder, 2000–08

Pathology test	Number	Per cent of all pathology for lipid disorders
Supported	**12,519**	**79.3**
Lipids*	7,919	50.2
LFT*	1,961	12.4
Glucose/glucose tolerance*	1,520	9.6
EUC*	801	5.1
TFT*	318	2.0
Conditional/unclear support	**1,354**	**8.6**
MBA*	683	4.3
CK	671	4.3
Unsupported	**1,106**	**7.0**
FBC	949	6.0
PSA*	157	1.0
Subtotal (n, % of total tests)	*14,980*	*94.9*
Total pathology tests	**15,777**	**100.0**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered supported pathology tests at a rate of 49.6 tests/batteries per 100 lipid disorder problems, followed by tests with conditional support (5.4 per 100), and unsupported tests (4.4). Tests ordered for lipid disorder but not evaluated were ordered at a rate of 3.2 per 100 problems. The rate at which GPs ordered tests that were conditionally supported, unsupported and not evaluated increased significantly over time (Table 5.22).

Table 5.22: Rate of pathology ordering for lipid disorder by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 lipid disorder problems (95% CI) (*n* = 25,248)	Rate per 100 lipid disorder problems (95% CI) (*n* = 5,782)	Rate per 100 lipid disorder problems (95% CI) (*n* = 6,629)	Change
Supported	49.6 (48.1–51.1)	48.8 (45.9–51.7)	50.3 (47.3–53.3)	—
Conditional/unclear support	5.4 (5.0–5.8)	3.7 (3.0–4.4)	6.7 (5.8–7.6)	↑
Unsupported	4.4 (4.0–4.7)	3.1 (2.6–3.7)	5.9 (5.0–6.7)	↑
Not evaluated	3.2 (2.9–3.4)	2.5 (2.0–3.0)	3.8 (3.1–4.4)	↑

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

GPs ordered only pathology tests that were supported or conditionally supported at 25.6% (95% CI: 24.9–26.3) of lipid disorder problems in 2000–08. A further 4.1% (95% CI: 3.8–4.4) of problems involved at least one unsupported test, and 70.3% (95% CI: 69.5–71.0) involved either no pathology tests (69.5%) or tests that were not evaluated (0.8%) (results not tabled).

There was no significant change in the proportion of lipid disorder problems that involved supported testing between 2000–02 (26.8%, 95% CI: 25.3–28.2) and 2006–08 (24.1%, 95% CI: 22.7–25.4). However the proportion of problems involving at least one unsupported test increased significantly over this time, from 3.0% (95% CI: 2.5–3.5) to 5.4% (95% CI: 4.6–6.2) (results not tabled).

When GPs ordered unsupported tests, the vast majority (98%) were accompanied by one or more supported/partially-supported tests. Unsupported tests were ordered alone at the remaining 2%. GPs ordered only tests that were unsupported at 0.1% of lipid disorder problems managed in 2000–08. This did not change over time (0.1% in 2000–02 and 2006–08) (results not tabled).

5.6.6 Discussion

GPs' pathology testing aligned well with that recommended in guidance documents, with 88% of tests ordered by GPs in the management of lipid disorders being recommended (with either partial or complete support). The statistically significant increase in the rate of GPs total pathology ordering for lipid disorders between 2000–02 and 2006–08 was reflected in the increased rate of tests that were partially supported, and unsupported in guidance documents. There was no change in the rate of supported tests.

Due to the increase in total rate of pathology ordering, the correlation between GPs' ordering and level of support, as a proportion of total tests should be considered. Supported tests decreased as a proportion of total tests between 2000–02 and 2006–08, and was counteracted by increases in partially supported and unsupported tests. Overall this suggests that the increase in GPs ordering resulted in testing being 'less' in line with recommendations.

Part of the decrease in the proportion of supported tests was due to a change in the way GPs' recorded lipid tests on the BEACH encounter forms. In 2000–02, GPs were more likely to record the specific lipid subfractions (counted as multiple tests) whereas in 2006–08 they were more likely to record the lipid profile test (counted as a single test). This may reflect the recommendation to test the entire lipid profile so that treatment decisions are based on all lipid subfractions. In the past, treatment recommendations were based on the total cholesterol level alone.[178,222]

Criteria for funding may also contribute to changes in the pattern of lipid components being recorded by GPs in BEACH. Prior to November 2001, the MBS only funded HDL tests if the total cholesterol was found to be abnormal,[223] suggesting that GPs ordered a HDL test separately after obtaining an abnormal total cholesterol result. Further, the limit of five pathology tests per BEACH recording form (see Section 5.10) may have an influence on recording. For example, as the number of tests recorded per problem has increased (see Chapter 4), GPs may record a lipid profile (one test) rather than specifying all the lipid subfractions (multiple tests) in order to have space available to record other tests.

Monitoring lipid levels

The treat-to-target approach to managing lipid levels was recommended (usually with LDL cholesterol targets) in most guidance documents.[173,178,210,211,214-220]

Recommendations for monitoring lipid levels were based on the phase of management: an 'active' phase of management while trying to achieve targets and a monitoring phase.

In the active phase of managing lipid levels (response to diet and exercise and/or medications), most guidance documents recommended an interval of between 4 and 12 weeks for measuring response (i.e. retesting lipid levels) until the recommended target lipid levels were achieved.[210,211,214,216-218,220]

The NICE and SIGN guidelines did not adopt the usual treat-to-target approach to managing lipids. The NICE guideline recommended that patients taking statins for primary prevention of cardiovascular disease should not have their lipid levels measured in response to statin use unless clinical judgement or patient preference indicate the need to review the lipid profile. For secondary prevention of cardiovascular disease, the authors provided 'desirable' total cholesterol and LDL levels to guide the intensification of treatment rather than as targets.[212]

The SIGN guideline authors found there was insufficient evidence to support recommending lipid targets. Instead they recommended "intensive lipid lowering therapy" for high-risk patients taking lipid-lowering therapy for secondary prevention and "lifetime treatment with simvastatin 40mg" for those taking it for primary prevention. The authors advocated the same total cholesterol target as recommended by the National Health Service for Scotland as a minimum standard of care.[213]

In their review of available evidence, Smellie et al. recommended an interval of 8 weeks (+/- 4 weeks) for monitoring lipid levels in the active phase of management, concluding that differences between guideline recommendations were unlikely to influence long-term outcomes.[224] However, Bell et al. questioned the need to monitor patients taking lipid-lowering medications where randomised control trial data are available to give an indication of whether target will be achieved based on initial lipid levels.[225] This approach assumes high levels of medication adherence and similarities between patients in everyday clinical settings and trial participants. There is concern that clinical trial data may not reflect the 'real world' clinical setting as trial participants are highly selected and levels of medication adherence are higher than in the general patient population. Smellie et al. concluded that further evidence

is needed before recommending changes in monitoring practices on the basis of clinical trial evidence.[224]

The recommended interval for testing in the long-term monitoring phase varied between the guidance documents. For patients whose lipid levels were being managed (i.e. those on lipid-lowering medications or at high cardiovascular risk), the recommended monitoring interval ranged from 3 to 12 monthly, with individual guidance documents often suggesting a range for retesting such as 4–6 monthly, 6–12 monthly.[178,210,211,213,214,216-220]

Smellie et al., after reviewing available guidelines, recommended annual lipid tests for long-term monitoring. They also noted that most recommendations on testing intervals were consensus-based.[224] In the guidance documents reviewed the level of evidence behind the recommended testing interval (for either the active or monitoring phase of management) was not stated.

Although there were differences among the guidance documents, the most commonly recommended interval for long-term monitoring of lipid levels was 6–12 months. However, recent evidence suggests that in patients for whom lipid levels are stable (within 0.5 mmol/L of target) the interval for monitoring should be every 3–5 years because more frequent testing is more likely to reflect measurement error than true change.[226]

This measurement error is a product of the analytical and intra-individual variation in lipid testing. Most of the guidance documents reviewed did not discuss intra-individual and analytical variation of lipid testing. Only two guidance documents[212,216] discussed the level of expected variance in lipid measurements and the need for at least two tests before starting therapy. The NICE guideline highlighted that repeated measurement improves precision of the lipid testing, and was the only guideline to mention this in the context of monitoring, stating that monitoring is often based on one measurement, multiple testing being impractical in practice. Murtagh, AACE and NCEP also stated the need for at least two tests before starting therapy but the reason for this was not provided.[173,210,211,214]

The only time authors of guidance documents appear to consider precision is at the time of initial assessment of lipid levels before therapy is started. Although it is important to establish an accurate baseline measurement of lipid levels (because lipid lowering therapy is life-long), the recommendation to initiate lipid-lowering therapy

in guidance documents was usually based on a patient's cardiovascular disease risk which incorporates multiple factors, lipid levels being just one of these factors. This puts less importance on the precision of the lipid measurement at initiation. However, in monitoring the response to therapy, lipid levels are usually the sole indicator.

Further, the majority of management of lipid disorders in general practice, and lipid tests ordered in their management, are for monitoring. Therefore, information on variation in lipid levels is arguably of most importance in monitoring. The amount of intra-individual and analytical variation in monitoring lipid levels has been discussed by other authors,[224,226-229] but not incorporated into guidance documents. More information on the degree of variation is needed in guidance documents to inform GPs of the likelihood of measurement error when monitoring lipid levels.

Glaziou et al.'s (2008) finding that interval for monitoring lipid levels should be 3–5 yearly[226] is too recent to have been incorporated into the reviewed guidance documents or to be reflected in the lipid test order rate observed in this study. This evidence may be incorporated in future guidance. However, further investigation of the impact of a longer monitoring interval may be needed – particularly the impact on patient adherence as some guideline authors discussed frequent monitoring of lipid levels as a tool to aid improvement in patient adherence to therapy.[178,220]

Monitoring statin use

The majority of lipid-lowering medications prescribed in the management of lipid disorders in the current study were plain statins (91% of medications for lipid disorders). The guidance documents reviewed primarily referred to monitoring in relation to statin therapy.

Liver function

There was reasonable agreement among guidance documents on the need to test LFT before initiating statins, after commencing and after increasing dose. However, guidance varied on the need for ongoing monitoring.

Other authors have published recommendations about testing in the context of statin use. The United States (US) National Lipid Association Statin Safety Assessment (NLASSA) taskforce recommended ongoing monitoring but noted there was little evidence to support it.[230] Recognition of the lack of evidence for long-term monitoring was echoed by others.[212,224,227]

The NICE guideline provided a consensus recommendation that LFT testing was needed pre-treatment, within 3 months of starting medication, and a year after that. Further monitoring was not recommended unless clinically indicated.

The majority of guidance documents recommended monitoring of LFT but offered no comment on frequency or duration of monitoring.[173,178,214,220] This was also the case in the Australian medication guideline 'eTG'.[179]

The order rate of LFT did not change over the period of this study, suggesting GPs have not changed their behaviour in regard to monitoring LFTs in the management of lipid disorders.

Creatine kinase

CK testing was not recommended in routine monitoring of statin use in most guidance documents. The exception was Murtagh, who recommended ongoing monitoring of CK in statin use.[173]

Other authors provided more detail. Smellie et al recommended a baseline CK test prior to initiating a statin for two reasons: if baseline CK is elevated statin should not be started, and if CK testing is indicated in the future (e.g. muscle symptoms develop) results can be compared with baseline.[224,227] The NLASSA taskforce stated that baseline testing in patients at high risk for muscle toxicity may be considered but routine baseline testing for all patients commencing a statin was not recommended.[230]

In the reviewed guidance documents, CK testing was commonly recommended in patients who develop muscle symptoms. The NLASSA taskforce stated that muscle symptoms or increased CK were likely to be caused by other aetiologies and should be investigated by health professionals.[230] If rhabdomyolysis is suspected serum creatinine should also be measured.

GPs ordering of CK increased significantly between 2000–02 and 2006–08, even though the vast majority of guidance recommended against routine monitoring of CK.

Causes of secondary dyslipidaemia

Testing for causes of secondary dyslipidaemia was recommended in most guidance documents prior to starting lipid-lowering therapy. The exceptions were: the Australian NHF & CSANZ guideline;[178] and the cardiovascular prevention

guidelines from ESC[215] and SIGN.[213] The SIGN guideline recommended that clinicians 'consider secondary causes of dyslipidaemia' but details of these secondary causes were not listed.[213] For the two cardiovascular prevention guidelines[213,215] this omission is possibly because they did not solely provide guidance on the management of lipid disorder, but included all aspects of cardiovascular prevention (e.g. blood pressure, antiplatelet therapy).

The conditions commonly listed as secondary causes that involved pathology tests were hypothyroidism, renal disease, liver disease and diabetes. Testing to identify causes of secondary dyslipidaemia were mentioned as part of the initial evaluation of the patient. In contrast, the majority (> 90%) of tests used to identify these conditions were ordered by GPs for ongoing management.

Of the tests related to secondary causes of lipid disorders, the rate of thyroid and kidney function testing (TFT and EUC) increased significantly. The proportion of lipid problems that were newly diagnosed increased between 2000–02 and 2006–08 and this may have contributed to some of the increased rates of EUC, and TFT as these were recommended as part of the initial investigations. However, this is unlikely to account for the entire increase in these tests.

No guidance was provided on whether there is a need to periodically retest for these secondary causes of lipid disorders in the future. However, liver function testing was recommended in monitoring of medication use; and ongoing testing for diabetes or kidney disease may be undertaken as part of reassessment of cardiovascular risk (as these conditions increase cardiovascular risk) although the need to test glucose and kidney function was not explicitly stated. Kidney function testing, specifically creatinine levels were mentioned in guidance documents for diagnosis of rhabdomyolysis as a rare adverse effect of statin therapy. But the NLASSA taskforce stated that it is not necessary to monitor serum creatinine or proteinuria routinely during statin therapy.[230]

Most guidance documents recommended thyroid testing in all patients regardless of initial lipid levels. In contrast, Smellie et al. recommended thyroid testing only if the initial total cholesterol level was > 8.0 mmol/L.[231] The need to reassess thyroid function was not mentioned in any of the guidance documents.

Authors of guidance documents should consider incorporating information on whether these conditions, particularly thyroid disease, are likely to occur in the future

(e.g. increasing prevalence with age) and whether subsequent diagnosis of the condition is likely to affect management of lipid disorders, to inform whether repeated testing is needed for patients without thyroid disease at initial assessment.

Tests for which guidance was lacking

The significant increases in GPs' ordering rates of FBC and MBA tests and marginal increase in PSA tests are not directly related to guidance provided in the management of lipid disorders. It is unclear why the rates of these tests increased over the period of this study. GPs' increased use of FBC and MBA tests are discussed further in Section 5.10.

Other factors contributing to the increased management rate of lipid disorder

The guideline documents recommended initiating lipid therapy and management of lipid levels in the context of the patient's absolute cardiovascular risk.

Lipid targets have become lower over time as knowledge about cardiovascular risk improved. The majority of guidance documents recommended LDL targets, with lower targets recommended for patients with higher cardiovascular risk. Lower targets may have influenced GPs' management rate of lipid disorder problems and pathology ordering rates because they are potentially harder, and may take longer, to achieve. More frequent visits and pathology testing were recommended while actively trying to achieve a target (titrating medications). While the guidance documents acknowledged that targets may not be achievable in all patients and should be adjusted to the individual patient, it is likely that a change in target that requires intensifying treatment will result in increased management and testing rates.

Changes in policies are also likely to have contributed to the increased management rate of lipid disorders seen in this study. In particular, the decision to broaden the PBS criteria for subsidised lipid-lowering medications in October 2006 to allow access on the basis of cardiovascular risk rather than measured lipid levels alone,[208] and the introduction of the MBS item for health checks in patients aged 45–49 years in February 2006 to prevent or delay the onset of chronic disease[232] may have contributed to the increased management rate of lipid disorders.

The increased focus on total cardiovascular risk does not appear to have altered GPs' pathology ordering behaviour in the management of lipid disorders. The data suggest that GPs have not changed the rate at which they monitor lipids in response to

therapy. GPs have also not changed the rate of glucose testing (e.g. assessing presence of diabetes/impaired glucose tolerance) or liver function testing (i.e. presence of liver disorder/monitoring side effect of statin) when managing lipid disorder. Of the individual tests that increased (FBC, EUC, MBA, CK, TFT and PSA) for lipid disorder problems, only EUC (kidney function) may be associated with assessment or management of cardiovascular risk.

Summary

The majority of tests ordered by GPs in the management of lipid disorders were recommended in guidance documents. However, the increased rate of pathology tests ordered for lipid disorders reflected GPs' increased use of tests that were partially supported and unsupported in guidance documents. This highlights the importance of targeting a reduction in unsupported tests, even if the absolute reduction in testing would be modest.

5.7 Health check

5.7.1 Background

Prevention is one of the cornerstones of Australian general practice. Promoting the prevention of disease was one of the founding objectives of the Australian College of General Practitioners (now the RACGP) in 1958.[233]

Primary care is the health sector with the most contact with the population and the most opportunity to provide preventive care. In 2009–10, 83% of the population visited a GP at least once (DoHA, personal communication, June 2010) and per head of population there were an average 5.2 GP visits funded by Medicare Australia.[13]

Through activities such as vaccination, health promotion, and risk management (identification and reduction) GPs have the opportunity to prevent disease, and to detect disease in its early stages. Therefore they are involved in all types of preventive care.

In Australia, the recent focus of preventive care has been the prevention of chronic diseases because our ageing population is expected to increase the burden on the health system.[234] Recent initiatives include the National Chronic Disease Strategy[187] (2005) and the National Preventative Health Strategy[235] (2009), both acknowledged the role of primary health care in preventive care and provided funding to support GPs in preventing, detecting and managing chronic disease.[187,235]

MBS item numbers for health assessments in general practice have been introduced to encourage preventive action in target population groups. Examples include: the annual health assessment in patients aged 75 years and over (1999);[236] the health assessment for people aged 45–49 years who are at risk of developing chronic disease (2006);[232] the assessment of people aged 40–49 years with a high risk of T2D (2008).[18] Pathology tests are used by GPs in preventive activities to identify risk factors, and to diagnose and monitor disease.

5.7.2 Management rate in Australian general practice

In this section 'health check' problems include those labelled as unspecified health check-ups in patients aged 15 years and over.

In BEACH, ‘heath check’ was managed at 8,113 encounters by 3,707 GPs in 2000–08, at a rate of 1.2 per 100 encounters (Table 5.23). This equates to approximately 1.0 million encounters per year with patients aged 15 years or more where health checks were managed by GPs in Australia.

As reported in Chapter 4, there was a significant increase in the management rate of health checks, between 2000–02 and 2006–08 (Table 5.23).

Table 5.23: Summary of health check data set in patients aged 15+ years, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Rate per 100 encounters (95% CI) (*n* = 682,932)	Number	Rate per 100 encounters (95% CI) (*n* = 171,136)	Number	Rate per 100 encounters (95% CI) (*n* = 165,439)	Change
General practitioners	3,707	. .	872	. .	1,028	. .	. .
Health check encounters	8,113	. .	1,845	. .	2,463	. .	. .
Health check problems managed	8,120	1.2 (1.1–1.2)	1,846	1.1 (1.0–1.2)	2,464	1.5 (1.4–1.6)	↑

Note: Data about health check problems managed are drawn from Chapter 4, Table 4.3. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

5.7.3 Pathology ordered for health check

Pathology was ordered at a rate of 147.9 tests/batteries per 100 ‘health check’ contacts with patients aged 15 years and over in 2000–08. Almost half of the contacts (49.5%) resulted in at least one pathology order. Once the decision to order pathology was made the GP ordered on average 2.99 tests/batteries per tested ‘health check’ contact (Table 5.24).

The increase in the rate of pathology ordering between 2000–02 and 2006–08 was due to a significant increase in the number of tests ordered once the decision to order tests was made (as reported in Chapter 4). There was no change in the likelihood that at least one pathology test would be ordered in the management of health check problems (Table 5.24).

Table 5.24: Summary of pathology ordering for health check (patients 15+ years), 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Per cent / Rate of health check problems (95%CI) (*n* = 8,120)	Number	Per cent / Rate of health check problems (95%CI) (*n* = 1,846)	Number	Per cent / Rate of health check problems (95%CI) (*n* = 2,464)	Change
Pathology (Rate per 100 health check problems)	12,008	147.9 (142.2–153.6)	2,252	122.0 (110.7–133.3)	4,407	178.9 (167.3–190.4)	↑
At least one pathology order (% health check problems)	4,023	49.5 (48.0–51.1)	900	48.8 (45.1–52.5)	1,319	53.5 (50.7–56.3)	—
Number of tests/ batteries per 100 tested health check problems	. .	298.5 (291.6–305.3)	. .	250.1 (236.1–264.2)	. .	334.1 (322.8–345.4)	↑

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.4. CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

Types of pathology tests/batteries ordered

Table 5.25 shows the rate of pathology tests/batteries ordered for 'health check' problems in patients aged 15 years and over in 2000–08 by MBS groups and the most common individual types of tests ordered.

Chemistry tests were the group most often ordered (102.2 per 100 health check contacts) and the most common were:

- lipid tests (29.7 per 100 'health check' contacts)
- glucose/glucose tolerance tests (18.5)
- LFTs (11.7)
- EUC tests (10.3)
- MBA tests (8.7).

Haematology tests (25.3 per 100 contacts), in particular FBC (22.7), and cytopathology tests (9.2), in particular Pap smear (9.1), were commonly ordered as part of the management of 'health check' (Table 5.25).

Table 5.25: Rate of pathology test orders for health check (patients 15+ years) by MBS groups and most frequent individual tests within each group, 2000–08

Pathology test	Number	Rate per 100 health check problems (95% CI) (*n* = 8,120)
Chemistry	**8,301**	**102.2 (97.8–106.6)**
Lipids*	2,413	29.7 (28.4–31.1)
Glucose/glucose tolerance*	1,500	18.5 (17.3–19.6)
LFT*	952	11.7 (10.7–12.7)
EUC*	839	10.3 (9.5–11.2)
MBA*	705	8.7 (7.8–9.6)
PSA*	663	8.2 (7.5–8.9)
TFT*	583	7.2 (6.5–7.9)
Ferritin*	203	2.5 (2.1–2.9)
Other chemistry*	144	1.8 (1.2–2.3)
Haematology	**2,055**	**25.3 (23.9–26.7)**
FBC	1,839	22.7 (21.4–23.9)
ESR	153	1.9 (1.5–2.2)
Cytopathology	**745**	**9.2 (8.0–10.4)**
Pap smear*	740	9.1 (7.9–10.3)
Microbiology	**574**	**7.1 (5.8–8.4)**
Hepatitis serology*	161	2.0 (1.5–2.5)
Other tests NEC	**199**	**2.5 (2.0–2.9)**
Other pathology groups	**134**	**. .**
Total pathology tests	**12,008**	**147.9 (142.2–153.6)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations.

Changes in types of pathology tests/batteries ordered

Table 5.26 shows the most common pathology tests/batteries ordered for health check in 2000–02 and in 2006–08. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- lipid tests—36% increase
- FBCs—72% increase
- glucose/glucose tolerance—40% increase
- LFTs—100% increase
- EUC tests—128% increase
- MBA tests—60% increase

- TFTs—121% increase
- PSA tests—95% increase
- 'other chemistry' tests—233% increase
- occult blood tests—280% increase (Table 5.26).

There was also a significant 58% decrease in the order rate of Pap smears as part of health checks between 2000–02 and 2006–08 (Table 5.26).

Table 5.26: Rate of pathology test orders for health check (patients 15+ years) by MBS groups and most frequent individual tests within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test	**Number**	**Rate per 100 health check problems (95% CI) (*n* = 1,846)**	**Number**	**Rate per 100 health check problems (95% CI) (*n* = 2,464)**	**Change**
Chemistry	**1,423**	**77.1 (68.9–85.3)**	**3,182**	**129.1 (120.3–138)**	↑
Lipids*	484	26.2 (23.4–29.1)	877	35.6 (33.1–38.1)	↑
Glucose/glucose tolerance*	278	15.1 (12.6–17.5)	519	21.1 (18.8–23.3)	↑
LFT*	149	8.1 (6.1–10.0)	399	16.2 (14.0–18.4)	↑
EUC*	107	5.8 (4.5–7.1)	324	13.2 (11.4–14.9)	↑
MBA*	124	6.7 (5.0–8.4)	264	10.7 (8.9–12.5)	↑
PSA*	101	5.5 (4.1–6.8)	263	10.7 (9.2–12.1)	↑
TFT*	86	4.7 (3.2–6.1)	255	10.4 (8.8–11.9)	↑
Ferritin*	33	1.8 (1.0–2.5)	82	3.3 (2.4–4.3)	—
Other chemistry*	17	0.9 (0.4–1.4)	74	3.0 (1.5–4.5)	↑
Haematology	**369**	**20.0 (17.1–22.9)**	**779**	**31.6 (28.8–34.4)**	↑
FBC	312	16.9 (14.4–19.4)	716	29.1 (26.4–31.7)	↑
ESR	41	2.2 (1.5–2.9)	42	1.7 (1.0–2.4)	—
Microbiology	**130**	**7.0 (4.5–9.6)**	**161**	**6.5 (4.4–8.6)**	—
Hepatitis serology*	37	2.0 (1.1–2.9)	49	2.0 (0.9–3.1)	—
Cytopathology	**270**	**14.6 (11.4–17.8)**	**149**	**6.1 (4.3–7.8)**	↓
Pap smear*	270	14.6 (11.4–17.8)	149	6.1 (4.3–7.8)	↓
Other tests NEC	**42**	**2.3 (1.4–3.2)**	**78**	**3.2 (2.1–4.2)**	—
Simple basic tests	**10**	**0.5 (0.2–0.9)**	**46**	**1.9 (1.2–2.5)**	↑
Occult blood test	10	0.5 (0.2–0.9)	46	1.9 (1.2–2.5)	↑
Other pathology groups	**18**	**. .**	**58**	**. .**	
Total pathology tests	**2,252**	**122.0 (110.7–133.3)**	**4,407**	**178.9 (167.3–190.4)**	↑

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change. The direction and type of change is indicated for each measure between 2000–02 and 2006–08: ↑/↓ indicates a statistically significant change, and — indicates no change.

5.7.4 Guidance documents for health check

The five preventive health guidance documents reviewed for health check are listed in Box 5.4.

Box 5.4: Guidance documents reviewed for health checks

Title	Year	Author	Abbreviated to
Guidelines for preventive activities in general practice (The Red Book)[177]	2009	Royal Australian College of General Practitioners (RACGP)	RACGP
US Preventive Services Task Force recommendations[237]	2008	United States Preventive Services Task Force (USPSTF)	USPSTF
Health Care Guidelines: Preventive services for adults[238]	2008	Grenz K, Mortinsen R, Pine D, Solberg L, Wilkinson JM, Harvey L et al. *Institute for Clinical Systems Improvement (ICSI) guideline* [United States of America]	ICSI
Canadian Task Force on Preventive Health Care recommendations[239]	1994–2005	Canadian Task Force on Preventive Health Care (CTFPHC)	CTFPHC
Health Screening[240]	2004	Health Promotion Board, Ministry of Health (MoH) [Singapore]	MoH

5.7.5 Extent of alignment between GP testing and guidance documents

In Table 5.27, the frequently ordered pathology tests/batteries for health check are categorised by level of support in the guidance documents listed in Box 5.4.

Supported tests

The three tests that were recommended in the majority of guidance documents were lipids, Pap smears and faecal occult blood tests (Table 5.27). Together these tests accounted for 26.3% of tests/batteries ordered by GPs for health checks (Table 5.28). Between 2000–02 and 2006–08, the order rate of lipid and faecal occult tests increased significantly, but the order rate of Pap smears for health check problems decreased (Table 5.26). While the rate of Pap smears decreased for health checks, the total rate of Pap smears (for all problems) increased between 2000–02 and 2006–08 (see Chapter 4).

There was strong agreement among the guidance documents that lipids should be measured in selected patients. Recommendations were made on the basis of identifying patients who are at increased risk of cardiovascular disease and are therefore most likely to benefit from testing. The evidence for screening in male patients is stronger than for females.[177,237] Recommendations for screening intervals

were made in three guidance documents.[177,237,240] The RACGP and USPSTF recommended intervals based on risk, 5 yearly for the lower risk group and 1–2 yearly for the higher risk groups.[177,237] The MoH guideline recommended an interval of 3 years if lipid levels were within the 'desirable' range.[240]

The CTFPHC[239] was the only document to conclude that there was insufficient evidence to recommend lipid testing. However, this guideline was released in 1994 and considering the new evidence and new pharmacological treatments now available, can be considered out of date.

There was unanimous agreement among guidance documents that cervical cancer screening should be routinely undertaken in all sexually active females until the age of 65 or 69 years. Testing older women was recommended if patients were not previously screened[177,237] or they had a new sexual partner.[238] Frequency of recommended Pap smear testing varied based on risk. For average risk patients testing every 2 years[177] or 3 years[237-240] was recommended.

Guidance documents also unanimously recommended that colorectal cancer screening should be routinely undertaken in patients aged 50 years and over and earlier for those at increased risk. The faecal occult blood test (FOBT) was the only pathology test that GPs could order for colorectal screening. Other screening options given in guidance documents were sigmoidoscopy or colonoscopy. The type, frequency, and age of onset of screening depended on the patient's risk of colorectal cancer. For patients at average risk, all guidance documents recommended FOBT from the age of 50 years either annually[237-240] or biannually.[177,237,239] Alternatively sigmoidoscopy or colonoscopy were also recommended.[237-239] For patients at higher risk (e.g. family history of bowel cancer) the primary screening tools were colonoscopy or sigmoidoscopy.[177,237,239] In high risk patients the potential need for genetic testing was discussed in two guidance documents.[177,237]

Tests with conditional support

There were three types of tests that had conditional support or mixed levels of support in the guidance documents: glucose/glucose tolerance, hepatitis tests and tests for other sexually transmitted infections (STI) (Table 5.27). Together these tests accounted for 15.4% of the tests ordered for health checks (Table 5.28). Over the period of this study, the order rate of glucose/glucose tolerance tests increased

significantly, and the rate of hepatitis testing (Table 5.26) and other STI tests did not change significantly (results not tabled).

Testing for diabetes mellitus (using glucose testing) was recommended for selected high risk patients in three guidance documents.[177,237,239] MoH provided stronger support, recommending screening for all patients from the age of 40 years and for patients with known risk factors from 30 years.[240] In contrast, ICSI stated that testing was not recommended in asymptomatic patients but did not provide further guidance.[238]

Screening for STIs (including chlamydia, HIV, and hepatitis) was recommended in most guidance documents for high risk patients.[177,237-240] Most also recommended chlamydia testing for all females aged less than 25 years in addition to other high risk groups.[177,237-239] The USPSTF recommended against routine screening for Hepatitis B or C. For Hepatitis B this was because screening strategies have poor predictive value due to difficulty in accurately identify at risk individuals, and for Hepatitis C there was insufficient evidence to recommend screening.[238]

Support unable to be determined

It was not possible to determine whether MBA and 'other chemistry' tests were recommended in the guidance documents (see Section 5.3.4). Together these two tests accounted for 7.1% of GP pathology ordered for health checks (Table 5.28). Both increased significantly between 2000–02 and 2006–08 (Table 5.26).

The ICSI guideline specifically recommended against use of routine laboratory testing (including blood chemistry panels) without clinical suspicion of disease.[238]

Unsupported tests

The guidance documents did not recommend testing of FBC, LFT, EUC, PSA, TFT, ferritin and ESR (Table 5.27). These tests accounted for 43.6% of pathology ordered by GPs in the management of health check (Table 5.28). Between 2000–02 and 2006–08, the order rate of most of these tests increased significantly (with the exception of ferritin and ESR tests).

All guidance documents recommended against routine testing of PSA to detect prostate cancer.[177,237-240] RACGP recommended against the test but stated that men should be informed of risks and benefits to make an informed choice.[177] Both USPSTF and RACGP highlighted that PSA testing was not recommended in men

aged 75 years and over,[177,237] and USPSTF stated that there was insufficient evidence to make a recommendation in men aged less than 75 years.[237] MoH recommended screening in high risk men aged more than 50 years who have had close relatives diagnosed with prostate cancer when aged less than 60 years.[240]

EUC tests were supported in only one document, the RACGP recommending annual screening using the estimated glomerular filtration rate for high risk patients. High risk patients were defined as those with hypertension, obesity, diabetes, family history of kidney disease, and Indigenous patients aged more than 35 years.[177] The other guidelines did not discuss EUC testing nor kidney disease with one exception. The 1993 CTFPHC recommended against screening asymptomatic adults using a dipstick to identify chronic renal failure because there was no efficacious, non harmful treatment available for early stages of the disease course.[239]

Screening for thyroid disease was not supported in most guidance. RACGP specifically recommended against the use of TFT as a screening test.[177] USPSTF, CTFPHC and ICSI stated that there was insufficient evidence to make a recommendation for or against screening in asymptomatic adults.[237-239]

LFT, ferritin and ESR were not mentioned in any of the guidance documents. FBC was also not directly mentioned in any document. However, ICSI recommended against use of routine laboratory testing (including "haemoglobulin and haematocrit screening") without clinical suspicion of disease.[238] These would be considered part of the FBC in Australia, suggesting that ICSI did not support routine use of the FBC.

Key to Table 5.27

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.27: Summary of guidance recommendations by most frequent individual test orders for health check, 2000–08

Pathology test	Per cent of path (*n* = 12,008)	RACGP[177]	USPSTF[237]	ICSI[238]	CTFPHC[239]	MoH[240]
Lipids*	20.1	> 45 yrs or high risk	Not in F without CHD risk	M > 34 yrs & F > 45 yrs	Insufficient evidence (1994)	> 40 yrs or high risk
FBC	15.3			Not as screening		
Glucose/glucose tolerance*	12.5	Patients at increased risk	Yes in HT. Consider for CVD and dyslipidaemia Not in asymptomatic pts	Not recommended in asymptomatic pts	Yes in HT and dyslipidaemia (2005)	> 40 yrs or > 30 yrs and risk factors
LFT*	7.9					
EUC*	7.0	High risk pts				
Pap smear*	6.2	Sexually active until 69 yrs	Sexually active until 69 yrs	21 to 64 yrs & 65+ if new sexual partner	Sexually active until 65 yrs (1994)	F > 25 yrs
MBA*	5.9			Not as screening		
PSA*	5.5	Not recommended. Pt choice (50–75 yrs) informed of risk & benefit.	Insufficient evidence in M<75 yrs and NO in M>75 yrs	Not recommended	Not recommended (1994)	FHx onset < 60 yrs
TFT*	4.9	Low prevalence even with FHx	Insufficient evidence	Insufficient evidence	Insufficient evidence (1994)	
Ferritin*	1.7					
STI tests (excluding hepatitis)[(a)]	1.6	High risk pts and Chlamydia in F < 25 yrs	High risk pts and Chlamydia in F < 25 yrs	High risk pts and Chlamydia in F < 25 yrs	High risk pts (1994) and Chlamydia in F < 25 yrs (1996)	High risk pts
Hepatitis serology*	1.3	High risk / request STI check	Only in pregnant women	High risk pts		
ESR	1.3					
Other chemistry*	1.2					
Occult blood test[(b)]	0.9	> 50 to 75 yrs or > 25 yrs in high risk pts	> 50 to 75 yrs	> 50 yrs or > 45 yrs in high risk pts	> 50 yrs or earlier in high risk pts (2001)	> 50 yrs

(a) STI tests include tests for chlamydia, HIV, and 'STI screen'. Hepatitis is excluded because it is listed separately.
(b) Occult blood tests accounted for < 1% of pathology in 2000–08. It is included because the order rate increased significantly between 2000–02 and 2006–08. In 2006–08 it accounted for 1.0% of pathology.
* Includes multiple ICPC-2 PLUS codes (see Appendix 7).
Note: Path – pathology; M – male; F – female; yrs – years; pts – patients; HT – hypertension; CVD – cardiovascular disease; FHx – family history; STI – sexually transmitted infection**;** also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.7.5.

Evaluation of GP pathology ordering against guidance documents

Table 5.28 provides a summary of the individual tests and the level of support provided in the guidance for each. Of the tests/batteries ordered by GPs for health check in 2000–08:

- 26.3% were supported
- 22.5% had conditional support or support could not be determined
- 43.6% were not supported by the guidance documents (Table 5.28).

The individual tests/batteries listed in Table 5.28 account for 93.2% of pathology ordered by GPs for health checks because only the most common tests ordered for health checks were evaluated.

Table 5.28: Summary of support for GP pathology ordering for the most frequent individual test orders for health check (patients aged 15+ years), 2000–08

Pathology test	Number	Per cent of pathology for health check
Supported	**3,152**	**26.3**
Lipids*	2,413	20.1
Pap smear*	740	6.2
Occult blood test[(a)]	104	0.9
Conditional/unclear support	**2,707**	**22.5**
Glucose/glucose tolerance*	1,500	12.5
MBA*	705	5.9
Other STI testing (including Chlamydia, HIV, STI screen)	197	1.6
Hepatitis serology*	161	1.3
Other chemistry*	144	1.2
Unsupported	**5,232**	**43.6**
FBC	1,839	15.3
LFT*	952	7.9
EUC*	839	7.0
PSA*	663	5.5
TFT*	583	4.9
Ferritin*	203	1.7
ESR	153	1.3
Subtotal (n, % of total tests)	*11,196*	*93.2*
Total pathology tests	**12,008**	**100.0**

(a) Occult blood tests accounted for < 1% of pathology in 2000–08. It is included because the order rate increased significantly between 2000–02 and 2006–08. In 2006–08 it accounted for 1.0% of pathology.

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered unsupported pathology tests at a rate of 64.5 tests/batteries per 100 health check problems, followed by supported tests (40.1 per 100), and tests with conditional support (33.4). Tests ordered for health check but not evaluated were ordered at a rate of 10.1 per 100 problems. The rate at which GPs ordered unsupported and conditionally supported tests increased significantly over time (Table 5.29).

Table 5.29: Rate of pathology ordering for health check by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 health check problems (95% CI) (*n* = 8,120)	Rate per 100 health check problems (95% CI) (*n* = 1,846)	Rate per 100 health check problems (95% CI) (*n* = 2,464)	Change
Supported	40.1 (38.3–41.9)	41.4 (37.1–45.6)	43.5 (40.4–46.6)	—
Conditional/unclear support	33.4 (31.5–35.2)	26.4 (23.3–29.6)	39.1 (35.7–42.6)	↑
Unsupported	64.5 (61.1–67.9)	44.9 (38.4–51.4)	84.5 (77.4–91.6)	↑
Not evaluated	10.1 (9.0–11.1)	9.3 (7.0–11.6)	11.8 (9.8–13.9)	—

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

GPs ordered only pathology tests that were supported or conditionally supported at 17.1% (95% CI: 15.8–18.3) of health check problems in 2000–08. A further 30.2% (95% CI: 28.8–31.5) of health check problems involved at least one unsupported test, and 52.8% (95% CI: 51.2–54.4) involved either no pathology tests (50.4%) or tests that were not evaluated (2.4%) (results not tabled).

The proportion of health check problems that involved supported testing decreased significantly from 23.9% (95% CI: 20.9–26.9) in 2000–02 to 12.6% (95% CI: 10.8–14.5) in 2006–08. In parallel, the proportion of problems involving at least one unsupported test increased from 22.3 % (95% CI: 19.6–25.0) to 38.5% (95% CI: 35.7–41.2) (results not tabled).

When GPs ordered unsupported tests, the majority (89%) were accompanied by one or more supported/partially supported tests. Unsupported tests were ordered alone at the remaining 11%. GPs ordered only tests that were unsupported at 3.3% of health check problems in 2000–08. This did not change significantly over time 2.7% (95% CI: 1.9–3.5) in 2000–02 and 3.4% (95% CI: 2.6–4.2) in 2006–08 (results not tabled).

5.7.6 Discussion

GPs' pathology testing did not align well with that recommended in guidance documents, only about half of tests ordered by GPs for health checks (in patients aged 15 years and over) being partially or completely supported. The statistically significant increase in the rate of GPs' total pathology ordering for health checks between 2000–02 and 2006–08 was reflected in the increased rate of tests that were partially supported, and those that were unsupported in guidance documents. There was no change in the order rate of supported tests.

Due to the increase in total rate of pathology ordering, the relationship between GPs' ordering and level of support, as a proportion of total tests should be considered. Supported tests decreased as a proportion of total tests between 2000–02 and 2006–08, and was counteracted by an increase in unsupported tests. Overall this suggests that the increase in GPs' ordering resulted in testing being 'less' in line with recommendations.

Comments on guidance documents

There were relatively few guidance documents for preventive health care available for review. Further, of the five guidance documents reviewed, two[239,240] would be considered out of date.

The CTFPHC[239] guideline recommendations dated from 1994, 1996, 2001 and 2005. The year of each recommendation is provided in Table 5.27, and those from the earlier years were out of date (although not formally withdrawn). Despite this, the CTFPHC recommendations were extensively referenced throughout the literature.

MoH guidelines are withdrawn after 5 years (unless updated), as the MoH guideline[240] (published in June 2004) was not updated it was withdrawn in June 2009.

Unsupported pathology tests in guidance documents

Prostate cancer screening

Screening for prostate cancer (involving the PSA test) in the general male population was not recommended in any of the reviewed guidance documents (including the Australian RACGP guideline[177]). Since these documents were released, interim results from two clinical trials on prostate cancer screening outcomes have been

published (in 2009 and 2012). The US and European studies provided inconclusive evidence of whether screening for prostate cancer was worthwhile.

In 2009, the European study reported after an average 9-year follow-up that screening reduced deaths from cancer by 20% (2.94 deaths per 1,000 in the screened men compared with 3.65 per 1,000 in the control group). However, there was a high rate of over-diagnosis: 1,410 patients would need to be screened and 48 patients treated, in order to save one life.[241] In contrast, the US study reported no difference in mortality from prostate cancer was seen in the screened group compared with the control group after a 7–9 year follow-up.[242] The differences in the results of the two studies are partially explained by differences in the screening protocol used (PSA was tested annually in the US study and every 4 years in the European study), and the proportion of the control group who received PSA testing as part of 'usual care', which was higher in the US study.

In early 2012, results from both the above European and US studies were published using data after a longer follow-up period—both reported no significant change from the results reported in 2009.[243,244] Independent reviews of the 2009 and 2012 publications concluded that the results were unlikely to change recommendations for prostate cancer screening, nor current practice.[245-247]

Authors of the guidance documents reviewed in the current study have not changed their recommendations in response to these publications. Similarly other organisations (e.g. Cancer Council of Australia,[248] international governments) still recommend against routine screening for prostate cancer.[249] Despite this, the media coverage of prostate screening often incorrectly reports the evidence[250] and encourages screening.[251]

Further, there are organisations that support prostate cancer screening. For example, the Prostate Cancer Foundation of Australia recommends annual screening (PSA test and digital rectal exam) in all men commencing at 50 years of age for those with no family history or at 40 years of age with a family history.[252] The RCPA and others have recommended use of the PSA test to predict long-term risk in men, first testing around the age of 45 years[253,254] and using the result to guide the frequency of future PSA monitoring. This approach has been criticised.[255] However, the purpose of the RCPA recommendation was to provide guidance on the 'optimal use of PSA testing', accepting that there is existing widespread use of the PSA test.[254,256]

The current study confirms this, demonstrating that GPs commonly order PSA testing during health checks. Further, use of the test increased significantly between 2000–02 and 2006–08. In fact, total PSA testing (for all problems) increased significantly over the duration of this study (see Chapter 4, Table 4.2). This increase occurred without change in the guidance documents' recommendations. Contributing factors may include: increased patient requests for testing; 'pro-screening' media coverage;[251] and increased number of men in the population aged 50–75 years.[15] Further, increased incidence of prostate cancer may also play a role. As incidence in the population increases,[257] the number of men with a family history of the disease also increases. As family history increases the risk of prostate cancer,[177,240] it may influence the patient's decision to request PSA testing. However, the increased number of men being tested has contributed to increased incidence of prostate cancer,[249] creating the potential for perpetuating the 'screening–diagnosis' cycle.

Thyroid function test

The majority of guidelines reviewed in this study stated that there was insufficient evidence to make a recommendation regarding screening of thyroid function in asymptomatic patients. The RACGP guideline recommended against the testing of thyroid function in asymptomatic adults (regardless of family history) due to low prevalence and lack of evidence of benefit.[177]

Other reviews/authors have recommended that opportunistic thyroid testing is not supported in the healthy population.[258-262] However, as thyroid disease is most prevalent in older women[263] some guidance suggested that screening in menopausal women may be cost-effective.[258,261,262,264] The American Thyroid Association guidelines for detection of thyroid dysfunction was the only guideline to recommend routine screening (every 5 years, using the thyroid-stimulating hormone test) in all adults from the age of 35 years.[265]

Despite this lack of support or evidence the BEACH data demonstrated a significant increase in the rate of TFTs. Between 2000–02 and 2006–08, the order rate increased significantly both in the management of health checks and in the management of all problems (see Chapter 4, Table 4.2).

Pathology tests not referenced in guidance documents

Most guidance documents did not mention the use of FBC, MBA, LFT, EUC, ferritin and ESR tests for health checks or screening, which together accounted for 39% of

tests. Despite this lack of guidance, GPs' order rate of FBC, MBA, LFT, and EUC increased significantly in the management of health checks.

It is important to note that GPs may use the 'health check' label to refer to preventive checks done in a diverse range of clinical situations. While health checks ordered for a specific disease were excluded in this study, it is possible that some tests were appropriate for the patient's individual clinical circumstance but were not recommended in guidance documents. This is discussed in more detail in Section 5.10 (see 'Prevention'), and may explain why GPs order tests not referenced in guidance documents.

The FBC was the second most commonly ordered test for health checks (15% of tests). A FBC is often requested as a routine screening blood test in general practice.[221] However, the guidance documents did not mention FBC testing.

Screening for kidney disease was only recommended in the Australian RACGP guideline. Annual screening of glomerular filtration rate estimated from serum creatinine was recommended for high risk patients. The prevalence among high risk patients may have increased, as the prevalence of conditions associated with high risk have increased (e.g. diabetes,[180,181] obesity[154]). This in turn may have contributed to increased rates of EUC testing.

The ICSI guideline provided a consensus recommendation against ordering routine testing in preventive health care, particularly the use of blood chemistry panels, haemoglobulin/haematocrit screening and urinalysis without clinical suspicion of an underlying condition.[238] This suggests that routine ordering of MBA and FBC tests were not supported by the ICSI.

The high proportion of tests ordered by GPs for health checks but not mentioned in guidance documents is concerning. Investigation of the clinical usefulness of these pathology tests for health checks is needed. The results of this investigation should be used to improve guidance documents, and this guidance promoted to GPs to improve test ordering (if necessary).

Changes in order rate of tests that were supported

The reduction in the rate of Pap smears ordered for health checks reflects a change in the problem label recorded by GPs (from 'check-up' to 'well woman check-up', the latter was not included in the analysis for this chapter) rather than a reduction in

cervical cancer screening. The pathology ordering data for all problems (Chapter 4) showed that the total rate of Pap smear testing increased significantly over the duration of this study (2000–02 to 2006–08).

In addition to being supported for health checks, lipid and glucose testing were supported in guidelines for the assessment of cardiovascular risk[176,213,215] (see Section 5.6). GPs might consider assessment of cardiovascular risk as part of the health check. Contributing factors to the increased ordering rate of these tests when doing health checks include the increasing number of patients in the target age group for screening due to Australia's ageing population,[15] and the increase in the proportion of patients with known risk factors for lipid disorders or diabetes (e.g. hypertension,[157] metabolic syndrome,[266] chronic kidney disease[267]) particularly if the diagnosed prevalence of risk factors increases with age.

The increase in the rate of occult blood tests between 2000–02 and 2006–08 may be partially attributed to the introduction of the National Bowel Cancer Screening program in August 2006.[268] Tests conducted in the screening program do not require GPs to order FOBTs (as test packs are supplied directly to screening participants). However, the program has been introduced slowly and currently provides a 'one-off' test per person turning either 50, 55 or 65 years of age, far less often than the biannual screening recommendation in the Australian guideline for people aged 50 to 75 years.[177] The increased rate of FOBTs may reflect GPs' biannual testing (as per the guideline recommendation) for patients not targeted in the screening program. Another contributor may be the increased number of people in the target age group for screening due to Australia's ageing population.[15]

Other factors contributing to the increased management rate of health checks

Check-ups are an important preventive activity and the community is encouraged to have a regular check-up with a GP.[269] To a large extent, the increased management rate of health checks was due to the introduction and subsequent uptake of MBS items funding specific age or risk-based health assessments.[18,232,236]

Australia's ageing population may have contributed to the increased rate of health checks provided by GPs. Over the decade 2000 to 2010, the proportion of the population aged 40 years and above increased.[15] These older adults are the age-group in whom routine disease screening (e.g. colorectal cancer, diabetes, lipid disorders) was recommended (commencing at 40–50 years) and for whom many of the MBS

health assessments were designed.[18,232,236] It can be assumed that the increased number of older Australians may have contributed to the past growth in the rate of health checks provided by GPs. It may also contribute to future growth in rates of health checks, as the growth in the older population is expected to continue over the coming decades.[137] A corresponding increase in volume of GPs' pathology ordering (based on the current pattern of pathology test ordering) would be likely.

Summary

Less than half the pathology tests ordered by GPs for health checks were supported by the guidance documents. Further, the increased rate of pathology tests ordered for health checks primarily reflected GPs' increased use of tests that were unsupported in guidance documents. Of particular importance is the need to determine the role of tests commonly ordered by GPs but not referenced in guidance documents. There is significant discord between guidance recommendations and GPs' ordering practice for health checks that should be investigated further.

5.8 Weakness / tiredness

5.8.1 Background

Tiredness or fatigue is a common presentation in general practice. Studies have reported its prevalence as a presenting symptom in 6–14% of general practice patients,[270-272] and as a secondary symptom in 19% of patients.[270]

In BEACH, patients presented with weakness/tiredness as a reason for encounter at a rate of 1.4 per 100 encounters in 2006–08,[273] and it was managed as a clinical problem at a rate of 0.7 per 100 encounters (Chapter 4, Table 4.3). The difference between the presentation and management rates indicates that at the encounter GPs were able to apply a more specific diagnostic label to about half of the weakness/tiredness presentations.

Tiredness or fatigue has been described as the most common medically unexplained condition managed in general practice.[274] It represents a diagnostic challenge for GPs due to the broad range of conditions for which it may be a symptom, including psychological disorders, sleep problems, chronic disorders and serious disease.[271,272,275-279] Pathology testing is often ordered by GPs in an attempt to identify the underlying cause (and/or exclude serious disease as the cause) of tiredness.

5.8.2 Management rate in Australian general practice

In BEACH, weakness/tiredness problems were managed at 5,624 patient encounters with 3,279 GPs in 2000–08, at a rate of 0.7 per 100 encounters (Table 5.30). This equates to approximately 710,000 encounters per year where weakness/tiredness problems are managed by GPs in Australia.

As described in Chapter 4, there was no change in the management rate of weakness/tiredness between 2000–02 and 2006–08. There was also no significant change in the rate of new cases per 100 encounters (Table 5.30).

Table 5.30: Summary of weakness/tiredness data set, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08	
Variable	Number	Rate per 100 encounters (*n* = 784,300)	Number	Rate per 100 encounters (*n* = 198,200)	Number	Rate per 100 encounters (*n* = 188,300)
General practitioners	3,279	. .	853	. .	788	. .
Weakness/tiredness encounters	5,624	. .	1,507	. .	1,372	. .
Weakness/tiredness problems managed	5,627	0.7 (0.7–0.8)	1,509	0.8 (0.7–0.8)	1,373	0.7 (0.7–0.8)
New weakness/ tiredness problems	2,456	0.31 (0.30–0.33)	597	0.30 (0.27–0.33)	657	0.35 (0.32–0.38)

Note: Data about the weakness/tiredness problems managed are drawn from Chapter 4, Table 4.3. CI – confidence interval.

5.8.3 Pathology ordering for weakness/tiredness

Pathology was ordered at a rate of 205.4 tests/batteries per 100 weakness/tiredness contacts in 2000–08, and more than half of contacts (56.6%) resulted in at least one pathology order. Once the decision to order pathology was made, the GP ordered on average 3.63 tests/batteries per tested contact (Table 5.31).

As described in Chapter 4, the rate of pathology ordering increased significantly between 2000–02 and 2006–08. This was due to a significant increase in the likelihood of pathology being ordered in the management of weakness/tiredness problems. There was no statistically significant change in the number of tests ordered once the decision to order tests was made (Table 5.31).

Table 5.31: Summary of pathology ordering for weakness/tiredness, 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
Variable	Number	Per cent / Rate of weak/tired problems (95%CI) (*n* = 5,627)	Number	Per cent / Rate of weak/tired problems (95%CI) (*n* = 1,509)	Number	Per cent / Rate of weak/tired problems (95%CI) (*n* = 1,373)	Change
Pathology (Rate per 100 weak/tired problems)	11,559	205.4 (197.2–213.6)	2,684	177.9 (164.0–191.8)	3,199	233.0 (217.3–248.7)	↑
At least one pathology order (% of weak/tired problems)	3,187	56.6 (54.7–58.6)	759	50.3 (46.7–53.9)	854	62.2 (58.5–65.9)	↑
Number of tests/ batteries per 100 tested weak/tired problems	. .	362.7 (357.0–368.3)	. .	353.6 (343.2–364.0)	. .	374.6 (363.5–385.7)	—

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.4. Weak/tired – weakness/ tiredness; CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

Types of pathology tests/batteries ordered

Table 5.32 shows the distribution of pathology tests/batteries ordered for weakness/tiredness in 2000–08 by MBS groups and the most common individual types of tests ordered.

Chemistry tests were the group most often ordered (135.7 per 100 weakness/ tiredness contacts) and the most common were:

- TFTs (32.3 per 100 contacts)
- ferritin tests (21.0)
- LFTs (17.4)
- EUC tests (15.5)
- MBA tests (11.6)
- glucose/glucose tolerance tests (11.5) (Table 5.32).

Haematology tests (53.9 per 100 contacts), in particular FBCs (45.7), and microbiology tests (9.7) were also commonly ordered in the management of weakness/tiredness (Table 5.32).

Almost 60% of pathology tests were ordered by GPs for ‘new’ cases of weakness/ tiredness and the order rate for ‘new’ problems was significantly higher than average (Table 5.32). The likelihood of pathology being ordered at new weakness/tiredness

contacts was high, with at least one pathology test ordered for 74.3% (95% CI: 72.4–76.1) of new cases (results not tabled).

Table 5.32: Rate of pathology test orders for weakness/tiredness by MBS groups and most frequent individual tests within each group, 2000–08

	All weakness/tiredness problems		New weakness/tiredness problems		
Pathology test	**Number**	**Rate per 100 weak/tired problems (95%CI) (*n* = 5,624)**	**Number**	**Per cent of test**	**Rate per 100 new weak/tired problems (95%CI) (*n* = 2,456)**
Chemistry	**7,636**	**135.7 (130.0–141.5)**	**4,558**	**59.7**	**185.6 (178.9–192.3)**
TFT*	1,819	32.3 (30.5–34.1)	1,113	61.2	45.3 (43.1–47.5)
Ferritin*	1,183	21.0 (19.6–22.5)	727	61.5	29.6 (27.6–31.6)
LFT*	979	17.4 (16.1–18.7)	589	60.2	24.0 (22.1–25.8)
EUC*	872	15.5 (14.3–16.7)	510	58.5	20.8 (18.9–22.6)
MBA*	650	11.6 (10.5–12.6)	405	62.3	16.5 (14.8–18.2)
Glucose/glucose tolerance*	647	11.5 (10.5–12.5)	391	60.4	15.9 (14.3–17.6)
Lipids*	329	5.9 (5.1–6.6)	184	55.9	7.5 (6.4–8.6)
Vitamin B12*	311	5.5 (4.8–6.2)	171	55.0	7.0 (5.9–8.1)
Other chemistry*	213	3.8 (3.0–4.6)	99	46.5	4.0 (3.0–5.0)
Hormone assay*	197	3.5 (2.7–4.3)	117	59.4	4.8 (3.4–6.1)
CRP	147	2.6 (2.1–3.1)	91	61.9	3.7 (2.9–4.5)
Haematology	**3,034**	**53.9 (51.5–56.3)**	**1,832**	**60.4**	**74.6 (71.9–77.3)**
FBC	2,572	45.7 (43.7–47.7)	1,561	60.7	63.6 (61.5–65.7)
ESR	430	7.6 (6.9–8.4)	250	58.1	10.2 (8.9–11.4)
Microbiology	**543**	**9.7 (8.6–10.7)**	**311**	**57.3**	**12.7 (11–14.3)**
Monospot*	153	2.7 (2.2–3.2)	95	62.1	3.9 (3.1–4.7)
Urine M,C&S*	127	2.3 (1.8–2.7)	79	62.2	3.2 (2.5–3.9)
Other tests NEC	**181**	**3.2 (2.6–3.8)**	**100**	**55.2**	**4.1 (3.1–5.1)**
Immunology	**147**	**2.6 (2.1–3.1)**	**74**	**50.3**	**3.0 (2.2–3.8)**
Other pathology groups	**18**	**. .**	**10**	**55.6**	**. .**
Total pathology tests	**11,559**	**205.4 (197.2–213.6)**	**6,885**	**59.6**	**280.3 (271.6–289.0)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations.

Changes in types of pathology tests/batteries ordered

The most common pathology tests/batteries ordered for weakness/tiredness in 2000–02 and 2006–08 are shown in Table 5.33. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- FBCs—20% increase
- TFTs—35% increase
- ferritin tests—64% increase
- LFTs—33% increase
- vitamin B12 tests—105% increase
- CRP tests—281% increase (there was trend for a corresponding decrease in the order rate of ESR tests but this trend did not reach statistical significance)
- 'other immunology' tests—600% increase, due to an increased number of immunoglobulin and anti-endomysial antibody tests (Table 5.33).

Table 5.33: Rate of pathology test orders for weakness/tiredness by MBS groups and most frequent individual tests within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test	Number	Rate per 100 weak/tired problems (95% CI) (*n* = 1,509)	Number	Rate per 100 weak/tired problems (95% CI) (*n* = 1,373)	Change
Chemistry	**1,696**	**112.4 (102.9–121.9)**	**2,163**	**157.5 (146.1–168.9)**	↑
TFT*	406	26.9 (24.1–29.7)	498	36.3 (32.9–39.7)	↑
Ferritin*	245	16.2 (13.9–18.5)	365	26.6 (23.6–29.5)	↑
LFT*	232	15.4 (13.2–17.6)	282	20.5 (17.9–23.2)	↑
EUC*	199	13.2 (10.9–15.5)	221	16.1 (13.8–18.4)	—
MBA*	154	10.2 (8.3–12.1)	167	12.2 (10.0–14.3)	—
Glucose/glucose tolerance*	174	11.5 (9.6–13.4)	154	11.2 (9.1–13.3)	—
Vitamin B12*	59	3.9 (2.8–5.0)	110	8.0 (6.3–9.7)	↑
Lipids*	65	4.3 (3.2–5.4)	91	6.6 (5.1–8.2)	—
Other chemistry*	47	3.1 (2.0–4.2)	76	5.5 (3.7–7.4)	—
CRP	17	1.1 (0.6–1.7)	58	4.2 (2.9–5.5)	↑
Hormone assay*	45	3.0 (1.8–4.2)	46	3.4 (2.0–4.7)	—
Haematology	**778**	**51.6 (47.3–55.9)**	**782**	**57.0 (52.5–61.4)**	**—**
FBC	629	41.7 (38.3–45.1)	689	50.2 (46.4–53.9)	↑
ESR	138	9.2 (7.5–10.8)	85	6.2 (4.8–7.6)	—
Microbiology	**135**	**9.0 (6.9–11.0)**	**131**	**9.5 (7.5–11.6)**	**—**
Monospot*	37	2.5 (1.6–3.4)	44	3.2 (2.2–4.2)	—
Urine M,C&S*	33	2.2 (1.4–3.0)	30	2.2 (1.4–3.0)	—
Immunology	**18**	**1.2 (0.6–1.8)**	**69**	**5.0 (3.5–6.6)**	↑
Other immunology*	6	0.4 (0.1–0.7)	38	2.8 (1.6–3.9)	↑
Other tests NEC	**56**	**3.7 (2.4–5.0)**	**47**	**3.4 (2.1–4.7)**	**—**
Blood test	29	1.9 (1.0–2.8)	29	2.1 (1.1–3.2)	—
Other pathology groups	**1**	**. .**	**7**	**. .**	
Total pathology tests	**2,684**	**177.9 (164.0–191.8)**	**3,199**	**233.0 (217.3–248.7)**	↑

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Weak/tired – weakness/tiredness; CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change, the direction and type of change is indicated for each measure between 2000–02 and 2006–08: ↑/↓ indicates a statistically significant change, and — indicates no change.

5.8.4 Guidance for weakness/ tiredness

Guidance documents for the management of tiredness and fatigue were reviewed in this study, but guidance for chronic fatigue syndrome was excluded.

The Dutch College of General Practitioners (DCGP) guideline for blood testing in 'medically unexplained' complaints was also reviewed because fatigue is the most common unexplained complaint managed in general practice.[274] Medically unexplained complaints were defined as 'those complaints for which a GP, after clarifying the reason for the encounter, taking the patient's history, and performing a physical examination, is unable to establish a diagnosis.'[280] There were no guidance documents that specifically addressed management of 'weakness', but it was covered in the DCGP guideline.

In total eight guidance documents were reviewed (Box 5.5). However there was some duplication as two authors produced two guidance documents each. These documents (written by the same author) were independent of each other and were therefore reviewed.

Box 5.5: Guidelines and guidance documents reviewed for weakness/tiredness

Title	Year	Author	Abbreviated to
Investigating fatigue of less than 6 months' duration: Guidelines for family physicians[276]	1999	Godwin M, Delva D, Miller K, Molson J, Hobbs N, MacDonald S et al. [Canada]	Godwin et al.
Dutch College of General Practitioners guideline for blood testing in medically unexplained complaints[281]	1994 (2009)	Dutch College of General Practitioners (DCGP), cited in Koch et al. because the original guideline is published in Dutch [The Netherlands]	DCGP
Fatigue – a general diagnostic approach[282]	2003	Murtagh J [Australia]	Murtagh 2003
Murtagh's general practice, tiredness chapter[173]	2007	Murtagh J [Australia]	Murtagh
Patient presentations in general practice, 'I feel tired'[174]	1999	Steven I [Australia]	Steven
Laboratory investigation of tiredness[283]	2006	bpac (Best practice advocacy centre) [New Zealand]	bpac
ABC of psychological medicine: Fatigue[284]	2002	Sharpe M and Wilks D [United Kingdom]	Sharpe & Wilks
RCPA manual, chronic fatigue section[172]	2004	The Royal College of Pathologists of Australasia (RCPA)	RCPA
There must be something wrong'—primary presentation in the scenario is fatigue of a chronic duration > 6 months[285] (RCPA case scenario)	2003	The Royal College of Pathologists of Australasia (RCPA) and The University of Sydney (USyd) Department of Medical Education	RCPA & USyd

5.8.5 Extent of alignment between GP testing and guidance documents

In Table 5.34, the frequently ordered pathology tests/batteries for weakness/tiredness are categorised by level of support in the guidance documents listed in Box 5.5.

Overview

Some guidance documents consistently referred to the same clinical situation or conditions when recommending pathology testing. These conditions are summarised here and referred to in the next sections.

Godwin et al.,[276] Steven[174] and DCGP[281] only provided conditional support for the use of any pathology tests in the management or investigation of tiredness. Each document consistently recommended testing in the following circumstances:

- if indicated by the physical examination (Godwin et al.)[276]
- 'if felt to be required' by the GP (Steven)[174]
- tests should be postponed until 4 weeks after the first presentation of the unexplained complaint (of which fatigue is the most common) (DCGP).[281]

In the bpac guidance, test recommendations were based on patient age, sex, presence of risk factors and/or duration of tiredness. After relevant clinical review, specific tests were recommended:

- for all patients (after relevant clinical review)
- if the duration of tiredness was longer than 1 month or the patient was aged more than 50 years, or
- for those patients aged less than 50 years who had additional risk factors for a specific disease.[283]

In the following text when Godwin et al.,[276] Steven[174] DCGP[281] and bpac[283] are mentioned as giving conditional support, the conditions refer to those listed above.

Supported tests

The tests that were recommended in the majority of guidance documents were FBC, TFT, ferritin, LFT, EUC, glucose/glucose tolerance and ESR (Table 5.34). Together these tests accounted for 73.6% of tests/batteries ordered by GPs for weakness/tiredness (Table 5.35). The order rate of FBC, TFT, ferritin, and LFT increased significantly between 2000–02 and 2006–08 (Table 5.33).

FBC testing was recommended in all guidance documents. Godwin et al.,[276] DCGP[281] and Steven[174] provided conditional support (as described above), but the DCGP[281] only recommended the haemoglobin test, a component of the FBC battery in Australia, rather than the full battery.

TFT was also supported in all guidance documents. Though four documents provided conditional support—as described above for Godwin et al.,[276] DCGP,[281] Steven,[174] and in bpac for patients at risk of thyroid problems.[283]

Ferritin testing was recommended to identify iron deficiency anaemia in five of the guidance documents and not mentioned in the other four documents—of these four, two discussed anaemia as a common cause of tiredness/fatigue[276,284] but did not recommend ferritin testing.

LFT was supported in the majority of guidance documents. Conditional support was provided by Steven[174] and in bpac for patients at risk of liver dysfunction.[283]

EUC was recommended in seven guidance documents. Three of these provided conditional support: Godwin et al.,[276] Steven,[174] and in bpac for patients at risk of renal problems.[283]

Glucose testing was recommended in most guidance documents. Conditional support was provided in Godwin et al.[276] and DCGP,[281] and in bpac for patients at risk of diabetes.[283]

ESR testing was recommended in the majority of guidance documents. Godwin et al.,[276] DCGP[281] and Steven[174] gave conditional support.

Tests with conditional support

There were two tests that had conditional support or mixed levels of support in the guidance documents: Monospot and CRP (Table 5.34). Together these tests accounted for 2.6% of tests ordered for weakness/tiredness (Table 5.35). Between 2000–02 and 2006–08 the rate of CRP increased significantly but the order rate for Monospot tests did not change (Table 5.33)

CRP was recommended in four guidance documents,[172,173,283,284] two of which recommended use of either CRP or ESR.[173,284] The bpac guidance recommended CRP testing if the patient was over 50 years of age or tiredness had lasted longer than a month.[283]

Epstein Barr Virus (Monospot testing) was mentioned in most guidance documents as a possible cause of tiredness. The limitations of the test in diagnosing the condition were also discussed. RCPA and USyd recommended testing only if there was recent infection because approximately 90% of patients will have positive results due to previous infection,[285] and bpac specifically recommended against testing.[283]

Support unable to be determined

It was not possible to determine whether MBA and 'other chemistry' tests were recommended in the guidance documents (see Section 5.3.4). Together these two tests accounted for 7.4% of pathology ordered for weakness/tiredness (Table 5.35). Their order rate did not change between 2000–02 and 2006–08 (Table 5.33).

The MBA test itself was not recommended in any guidance documents. However, some tests that may be considered part of the MBA, such as EUC and LFT, were partially or completely supported in the management of weakness/tiredness (as discussed above).

Unsupported tests

Most guidance documents did not recommend testing of lipids, vitamin B12, hormone assay and Urine M,C&S (Table 5.34). These four tests accounted for 8.3% of pathology ordered for weakness/tiredness (Table 5.35). Vitamin B12 was the only test within this group to increase significantly between 2000–02 and 2006–08 (Table 5.33).

Lipid tests were not mentioned by any of the guidance documents in the management of weakness/tiredness.

Vitamin B12 testing was only recommended by Steven[174] if anaemia was suspected. Other documents discussed anaemia as a cause of tiredness/fatigue, but did not mention vitamin B12 testing even though vitamin B12 deficiency is one possible cause of anaemia.

The 'hormone assay' test group in BEACH represented orders for sex hormones in > 90% of cases. Testing sex hormones was not mentioned in any of the guidance documents, but testing the cortisol hormone was mentioned in four documents if Cushing's syndrome was suspected (a rare disease that may cause tiredness). However, because cortisol was rarely ordered and 'hormone assay' largely reflected sex hormone testing, this test group was classified as unsupported.

Urine M,C & S test was recommended in the two Murtagh documents; however, it was not mentioned in any of the other guidance documents.

Other tests mentioned in the guidance documents

Other tests were mentioned in the guidance documents but each of these accounted for less than 1% of tests recorded by GPs for weakness/tiredness.

Urinalysis was recommended in six documents,[174,276,282-285] three[174,276,283] of which gave conditional support.

Calcium testing was commonly recommended[173,174,282,283] often with magnesium[173,282] or phosphate testing.[283]

Other recommendations included testing for autoimmune diseases (e.g. antinuclear antibody test),[173,283,285] testing for chronic infections (e.g. HIV, hepatitis),[173,174,283] muscle enzymes (e.g. CK)[173,284,285] and cancer antigens.[173]

Key to Table 5.34

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.34: Summary of guideline/guidance recommendations by most frequent individual test orders for weakness/ tiredness, 2000–08

Pathology test	Per cent of weak/tired pathology (*n* = 11,559)	Fatigue/tiredness							Chronic fatigue (> 6 months)	
		Godwin et al.[276]	DCGP[281]	Murtagh 2003[282]	Murtagh[173]	Steven[174]	bpac[283]	Sharpe & Wilks[284]	RCPA[172]	RCPA & USyd[285]
FBC	22.3		Wait 4 weeks Hb only							
TFT*	15.7		Wait 4 weeks				At risk/ > 50 yrs/ 1+month			
Ferritin*	10.2					Anaemia				
LFT*	8.5						At risk/ > 50 yrs/ 1+month			
EUC*	7.5						At risk/ > 50 yrs/ 1+month			
MBA*	5.6									
Glucose/glucose tolerance*	5.6		Wait 4 weeks				At risk/ > 50 yrs/ 1+month			
ESR	3.7		Wait 4 weeks		or CRP			or CRP		
Lipids*	2.9									
Vitamin B12*	2.7					Anaemia				
Other chemistry*	1.8									
Hormone assay*	1.7			Cortisol	Cortisol	Cortisol				Cortisol
Monospot*	1.3						Not in diagnosis			Recent infection
CRP	1.3				or ESR		> 50 yrs/ 1+month	or ESR		
Urine M,C&S*	1.1									

* Includes multiple ICPC-2 PLUS terms (see Appendix 7)

Note: Weak/tired – weakness/tiredness; Hb – haemoglobulin; > 50 yrs – aged more than 50 years; 1+ month – duration of one month or more; also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.8.5. Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included.

Evaluation of GP pathology ordering against guidelines/guidance

Table 5.35 provides a summary of the individual tests and the level of support provided in the guidance for each. Of the tests/batteries ordered by GPs for weakness/tiredness in 2000–08:

- 73.6% were supported
- 10.1% had conditional support or support could not be determined
- 8.3% were not supported by the guidance documents (Table 5.35).

The individual tests/batteries listed in Table 5.35 account for 92.0% of pathology tests/batteries ordered for weakness/tiredness because only the most commonly ordered were evaluated.

Table 5.35: Summary of support for GP pathology ordering for the most frequent individual test orders for weakness/tiredness, 2000–08

Pathology test	Number	Per cent of all pathology for weakness/tiredness
Supported	**8,502**	**73.6**
FBC	2,572	22.3
TFT*	1,819	15.7
Ferritin*	1,183	10.2
LFT*	979	8.5
EUC*	872	7.5
Glucose/glucose tolerance*	647	5.6
ESR	430	3.7
Conditional/unclear support	**1,163**	**10.1**
MBA*	650	5.6
Other chemistry*	213	1.8
Monospot*	153	1.3
CRP	147	1.3
Unsupported	**964**	**8.3**
Lipids*	329	2.9
Vitamin B12*	311	2.7
Hormone assay*	197	1.7
Urine M,C&S*	127	1.1
Subtotal (n, % of total tests)	*10,629*	*92.0*
Total pathology tests	**11,559**	**100.0**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered supported pathology tests at a rate of 151.0 tests/batteries per 100 weakness/tiredness problems, followed by tests with conditional support (20.5 per 100), and unsupported tests (17.0). Tests ordered for weakness/tiredness but not evaluated were ordered at a rate of 16.9 per 100 problems. The rate at which GPs ordered tests in all 'level of support' groups increased significantly over time (Table 5.36).

Table 5.36: Rate of pathology ordering for weakness/tiredness by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 weak/tired problems (95%CI) (*n* = 5,627)	Rate per 100 weak/tired problems (95% CI) (*n* = 1,509)	Rate per 100 weak/tired problems (95% CI) (*n* = 1,373)	Change
Supported	151.0 (144.5–157.5)	134.1 (122.7–145.6)	166.8 (153.9–179.7)	↑
Conditional/unclear support	20.5 (19.2–21.9)	16.9 (14.3–19.4)	24.9 (21.8–28.0)	↑
Unsupported	17.0 (15.6–18.5)	13.3 (11.1–15.6)	20.0 (17.0–23.0)	↑
Not evaluated	16.9 (15.3–18.4)	13.5 (11.2–15.7)	21.4 (17.9–24.8)	↑

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change.

GPs ordered only pathology tests that were supported or conditionally supported at 38.5% (95% CI: 37.0–40.1) of weakness/tiredness problems in 2000–08. A further 15.4% (95% CI: 14.1–16.6) of problems involved at least one unsupported test, and 46.1% (95% CI: 44.2–48.0) involved either no pathology tests (43.3%) or tests that were not evaluated (2.8%) (results not tabled).

There was no change in the proportion of weakness/tiredness problems that involved supported testing, 36.2% (95% CI: 33.1–39.4) in 2000–02 and 40.5% (95% CI: 37.4–43.7) in 2006–08. However the proportion of problems involving at least one unsupported test increased significantly over this time, from 11.8% (95% CI: 9.9–13.6) to 18.3% (95% CI: 15.6–21.0) (results not tabled).

When GPs ordered unsupported tests, the vast majority (95%) were accompanied by one or more supported/partially supported tests, unsupported tests being ordered alone at the remaining 5%. GPs ordered only tests that were unsupported for 0.8% of weakness/tiredness problems in 2000–08. This did not change significantly over time 0.7% (95% CI: 0.3–1.1) in 2000–02 and 1.2% (95% CI: 0.2–2.1) in 2006–08 (results not tabled).

5.8.6 Discussion

GPs pathology testing aligned well with that recommended in guidance documents, with approximately 85% of tests ordered by GPs in the management of weakness/tiredness being recommended (with either partial or complete support). The statistically significant increase in the rate of GPs total pathology ordering for weakness/tiredness between 2000–02 and 2006–08 was reflected in significant increases in the rate of tests that were supported, partially supported, and unsupported in guidance documents.

As a proportion of total tests ordered there was very little change in the proportion that were supported (either completely or partially) or unsupported for weakness/tiredness, indicating that the increase in GPs' testing did not reflect a change to be 'more' or 'less' in line with guidance recommendations.

This study includes weakness/tiredness when recorded as a problem under management by GPs. It does not reflect all patient presentations of weakness/tiredness, as GPs at encounters were able to apply a more specific diagnostic label to about half of these presentations.[273] In BEACH, GPs were instructed to record the problem at the highest diagnostic level possible with the information available at the encounter. Therefore the management of weakness/tiredness represents either: a diagnostic process (i.e. a symptom under investigation), or an undifferentiated problem (i.e. following investigation a 'diagnosis' is unable to be determined).

Pathology tests would be considered part of the diagnostic process. Guidance documents discussed them in the context of the entire diagnostic process, that is, in combination with an appropriate medical history and physical examination. This was also emphasized in the literature, Cornuz et al. stated that 'in the absence of positive history or physical examination laboratory tests are rarely helpful'.[286] This approach was recommended to focus testing because of the broad range of conditions linked to tiredness.

In this study, only guidance documents for fatigue and tiredness were reviewed for weakness/tiredness because no guidance documents were found for weakness. This is unlikely to impact significantly on the results of the study because the majority of problems classified to the ICPC-2 'weakness/tiredness' group were recorded by GPs as tiredness or related synonyms such as fatigue or malaise.

In the guidance documents reviewed, pathology recommendations were consensus-based rather than evidence-based because there is very little evidence available. Recommendations were based on the conditions in general practice that commonly involve fatigue/tiredness as a symptom, and on the likelihood of underlying disease.

Underlying disease

Prevalence of underlying disease in general practice patients with fatigue is low. Three prospective studies investigating outcomes of fatigue in general practice patients reported diagnosis of a somatic disease as the (known or likely) cause of fatigue in 8% of patients.[275,278,281] Two of these studies specifically linked diagnosis of somatic diseases to pathology tests.[275,281] An Australian retrospective study examined medical records where tiredness was recorded as a symptom or diagnosis, and identified a 'significant diagnosis' as the likely cause of tiredness in 9% of patients, but only 4% of patients were diagnosed as a result of pathology testing.[287]

While three of the studies linked the diagnosis of somatic diseases to pathology tests,[275,281,287] only two recommended the most useful tests in making these diagnoses.[281,287] Koch et al.[281] compared the tests recommended in the DCGP's guideline with a separate panel of tests developed by expert consensus, and concluded that the four blood tests in the DCGP's guideline (FBC, TFT, glucose and ESR) were most useful. In contrast Gialamas et al. in their retrospective study concluded that the most useful tests were FBC, glucose and EUC.[287] The five tests (from these two studies) were evaluated as supported in this study, but only represent a subset of the supported tests (74% of the supported tests ordered by GPs, 55% of total tests ordered). The results of these studies suggest authors of future guidance documents should consider a more focussed approach to pathology testing than is currently recommended.

Abnormal results and false positive results

The low prior probability of underlying disease in patients with weakness/tiredness and high rates of pathology testing ordered by GPs are likely to generate high rates of abnormal test results, many of which will be false positive test results. This is demonstrated in results of the three studies that investigated the role of pathology tests in diagnosing somatic diseases in general practice.[275,281,287]

In the retrospective study, 14% of 1,046 tests had abnormal results, but 90% of these were not clinically significant.[287] In the British prospective study, 33% of patients

had an abnormal test result, but for 72% of these patients the abnormal result was not clinically relevant.[275] In the Dutch prospective study, at least one false positive result was recorded for 23% of 192 patients with medically unexplained fatigue with the limited DCGP set of tests and for 56% of patients with the expanded test panel.[281] The issue of abnormal results and false positive results is discussed in greater depth in Section 5.10.

Delaying testing

The desire to reduce false positive test results, the low probability of underlying disease and the self-limiting nature of most medically unexplained complaints such as fatigue led the DCGP to recommend a limited set of tests and to delay testing until 4 weeks after first presentation of the complaint. The study by Koch et al. designed to test the DCGP recommendation, could not assess the impact of delaying pathology testing in patients with medically unexplained fatigue, because most patients randomised to wait 4 weeks did not return for a follow-up consultation – 78% (of 111 patients) did not return. An additional 27 patients were excluded because GPs were unable to delay testing. Whether this was due to patient or GP factors was not investigated.[281] Even though there was insufficient follow-up data, Koch et al. concluded there was value in delaying pathology testing, on the basis of similar rates of somatic diseases in the delayed versus immediate testing groups.[281]

It is possible that the low level of follow-up consultations in Koch et al.'s study could indicate that these patients experienced a self-limiting episode of fatigue that resolved within 4 weeks, making a follow-up visit and testing unnecessary. The likelihood of patients requiring multiple visits for management of weakness/tiredness may be relatively low regardless of the pathology testing strategy used. The retrospective study of medical records conducted by Gialamas et al. reported that the majority of patients (55%) required only one GP visit to manage tiredness.[287] The current study also supports this: the high proportion of new weakness/tiredness contacts (44%) suggests that the rate of follow-up contacts was relatively low (when compared with the chronic diseases investigated in this chapter). However, because this study used cross-sectional data, I was not able to assess the number of GP consultations patients required to manage weakness/tiredness.

Even though each episode of tiredness may not require many GP visits, pathology tests are frequently initiated at the first visit. In this study, three-quarters of new

weakness/tiredness problems had at least one pathology test ordered. Similarly, in a small study of medically unexplained complaints, 83% of 59 patients with fatigue had tests initiated at the first GP visit,[288] and in the study by Gialamas et al. likelihood of ordering at the first contact was not reported but 67% of test orders were initiated at the first contact.[287] This suggests that application of a recommendation to 'delay testing' would require a significant change in GPs' current pathology ordering behaviour for weakness/tiredness.

The DCGP was the only guideline to recommend delaying testing at the first GP visit. However, duration of tiredness was mentioned as a component of medical history to be considered prior to ordering pathology testing in many guidance documents.[172,173,276,281,283-285] It may be that GPs incorporate patients' duration of tiredness in their decision to order pathology testing, and patients' duration of symptoms at their first GP visit was sufficient to warrant pathology testing.

Given that over the period of this study the likelihood of ordering pathology increased and likelihood of ordering was high for new cases of weakness/tiredness, delaying pathology testing as per the DCGP's recommendation may achieve a reduction in the likelihood of testing. Delaying testing has been found not to have an impact on patient satisfaction and anxiety levels when compared with immediate testing for medically unexplained complaints.[289] However, further research needs to be conducted to determine the clinical outcomes of patients in whom testing is delayed. Such research would also need to compare cost effectiveness of delaying testing versus immediate testing, for example, the cost of pathology tests, GP visits required, and the time taken to explain the reasons for delaying testing.

Summary

The majority of tests ordered by GPs for weakness/tiredness were recommended in guidance documents. The measured increase in pathology testing was due to an increased likelihood that GPs would initiate testing in the management of weakness/tiredness. There was no contributing increase in the management rate of weakness/tiredness and no clear cause for the increase in likelihood of testing. But importantly the extent to which GPs' testing aligned with recommendations did not change.

Results from some small studies have suggested that limiting the number of pathology tests ordered, at least initially, for weakness/tiredness may have a role in

reducing clinically insignificant abnormal test results. It has also been recommended that GPs should delay testing in patients with tiredness. Both of these suggestions may reduce pathology testing for weakness/tiredness, but the level of evidence is weak. Further research is needed to increase the evidence base and to ensure recommendations to delay testing would not adversely affect patient outcomes, and that any associated change in clinical practise is cost-effective.

The evidence-base available to support recommendations for pathology ordering in the management of weakness/tiredness is weak. Consequently many of the recommendations in guidance documents were consensus-based. Increasing the research in this area could improve the robustness of future guidance documents for weakness/tiredness.

5.9 Overweight/obesity

5.9.1 Background

In most developed countries, including Australia, the high and increasing prevalence of overweight and obesity has a significant economic and health impact.[109] Recognising the burden of chronic disease caused by obesity, it was named a National Health Priority Area in April 2008[290] and is targeted in the current National Preventative Health Strategy.[235]

The 2007–08 National Health Survey, estimated that 61.3% of Australian adults were overweight/obese (measured BMI ≥ 25). Prevalence was higher among males (68%) than females (55%), and had increased from 56.3% in 1995.[154] In a SAND substudy of adult patients (aged 18 years and over) attending general practice, prevalence of overweight/obesity (calculated BMI from self-reported height and weight) increased from 54.3% in 2000–01 to 59.3% in 2007–08.[273]

In 2003, high body mass was responsible for 7.5% of total burden of disease and injury in Australia.[156] In 2005, the direct cost (health care and non-health care costs) of overweight and obesity (in adults aged 30 years and over) was $21 billion, $6.5 billion for overweight and $14.5 billion for obesity.[291] Three-quarters of these direct costs were health care costs.

Obesity and overweight are associated with many diseases including T2D, cancer and cardiovascular diseases.[292] Research suggests that about two-thirds of overweight/obese patients seen in general practice have at least one obesity-related cardiovascular comorbidity,[293] and likelihood of comorbidities increases with increasing BMI.[293,294]

Pathology testing has a role in the diagnosis, assessment and management of many of these associated diseases and is one small component of the health cost burden attributed to overweight/obesity. GPs' management of overweight/obesity generated the smallest amount of pathology of the six problems investigated in this study (see Chapter 4). It was prioritised for investigation because it is the focus of much current public health policy. There have been several national and state-based programs that aim to reduce the prevalence of overweight and obesity. Recent national examples include the 'Measure Up' campaign[295] and the 'Swap it' campaign.[296] With

increasing public awareness it is likely that the management rate of overweight and obesity in general practice will increase. If this occurs it would create a corresponding increase in pathology orders.

5.9.2 Management rate in Australian general practice

In BEACH, obesity or overweight was managed at 7,797 encounters with adult patients (aged 18 years and over) by 3,677 GPs in 2000–08, at a rate of 1.2 per 100 adult encounters (Table 5.37). This equates to approximately 1.0 million adult encounters nationally per year where overweight/obesity was managed by GPs. Obesity accounted for 71.8% of overweight/obesity problems managed and overweight for the remaining 28.2% (Table 5.37).

As discussed in Chapter 4, there was no significant change in the management rate of overweight/obesity between 2000–02 and 2006–08. There was also no change in the diagnosis or detection rate of new cases of overweight/obesity (Table 5.37).

Table 5.37: Summary of overweight/obesity data set (adult patients), 2000–08, 2000–02 and 2006–08

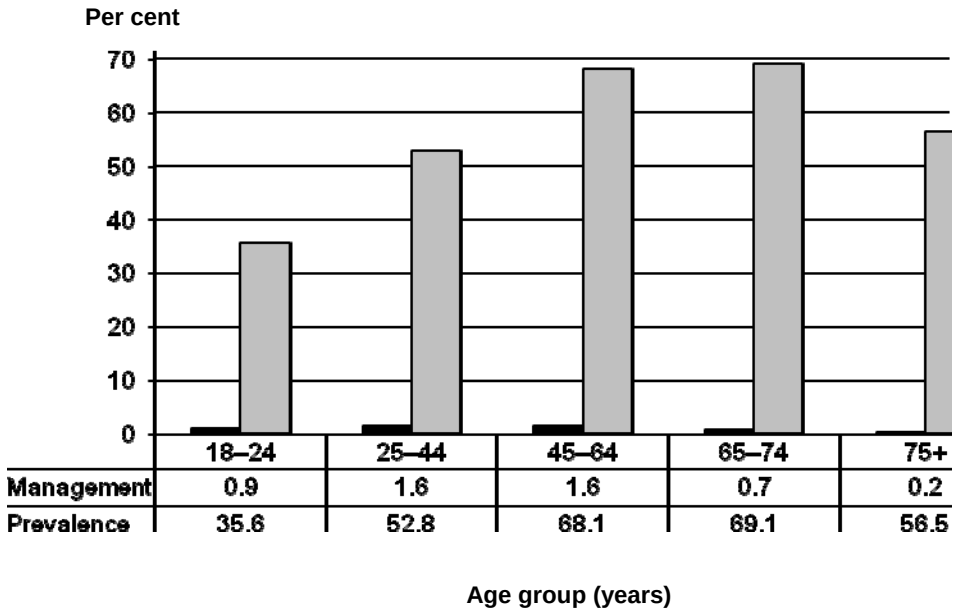
	2000–08		2000–02		2006–08	
Variable	Number	Rate per 100 adult encounters (95% CI) (*n* = 666,135)	Number	Rate per 100 adult encounters (95% CI) (*n* = 166,770)	Number	Rate per 100 adult encounters (95% CI) (*n* = 161,571)
General practitioners	3,677	. .	954	. .	864	. .
Overweight/obesity encounters	7,797	. .	1,975	. .	1,935	. .
Overweight/obesity problems managed	7,797	1.2 (1.1–1.2)	1,975	1.2 (1.1–1.3)	1,935	1.2 (1.1–1.3)
Obesity	5,598	0.8 (0.8–0.9)	1,458	0.9 (0.8–1.0)	1,418	0.9 (0.8–1.0)
Overweight	2,199	0.3 (0.3–0.4)	517	0.3 (0.3–0.4)	517	0.3 (0.3–0.4)
New overweight/ obesity problems	1,141	0.17 (0.16–0.18)	292	0.18 (0.15–0.20)	242	0.15 (0.12–0.18)

Note: Data about overweight/obesity problems managed are drawn from Chapter 4, Table 4.3. CI – confidence interval.

Figure 5.1 compares the age-specific rates of management of overweight/obesity among adult patients and the age-specific prevalence of overweight/obesity among patients encountered in general practice. The latter uses calculated BMI from self-reported height and weight drawn from a subsample of 31,062 patients at BEACH encounters in 2007–08 (see Section 3.2.6).

Figure 5.1 should be interpreted as follows—for patients aged 45–64 years, 1.6% had obesity or overweight managed as a clinical problem at the encounter, whereas 68.1% of patients attending in this age group were obese or overweight.

There is a huge gap between the proportion of patients who are overweight/obese and the management rate of overweight/obesity. The combination of prevalence and encounter data suggests there were 51 overweight/obese adult patients seen by GPs per 1 management encounter for overweight/obesity. This illustrates that there is huge scope for an increase in the management rate of overweight/obesity.



Note: Management is the per cent of encounters with patients in each age group involving management of overweight or obesity. Prevalence is the per cent of patients in the subsample surveyed who are overweight/obese (BMI ≥ 25, *n* = 31,062).

Figure 5.1: Age-specific rate of management of overweight/obesity (2000–08) and age-specific prevalence of overweight/obesity (2007–08) in adult patients

5.9.3 Pathology ordering for overweight/obesity

Pathology was ordered at a rate of 37.4 per 100 overweight/obesity problems in 2000–08 for adult patients. More than one in ten overweight/obesity problem contacts (13.6%) resulted in at least one pathology order. Once the decision to order was made the GP ordered on average 2.75 tests per tested problem (Table 5.38).

As reported in Chapter 4, the rate of pathology ordering for overweight/obesity increased significantly between 2000–02 and 2006–08, due to an increase in the

likelihood of at least one test/battery being ordered. There was no significant change in the number of tests ordered per tested overweight/obesity problem (Table 5.38).

Table 5.38: Summary of pathology ordering for overweight/obesity (adult patients), 2000–08, 2000–02 and 2006–08

	2000–08		2000–02		2006–08		
	Number	Per cent / Rate of ov/ob problems (95% CI) (*n* = 7,797)	Number	Per cent / Rate of ov/ob problems (95% CI) (*n* = 1,975)	Number	Per cent / Rate of ov/ob problems (95% CI) (*n* = 1,935)	Change
Pathology (Rate per 100 ov/ob problems)	2,916	37.4 (34.4–40.4)	605	30.6 (24.6–36.7)	912	47.1 (39.9–54.4)	↑
At least one pathology order (% of ov/ob problems)	1,062	13.6 (12.6–14.6)	231	11.7 (9.7–13.7)	319	16.5 (14.1–18.9)	↑
Number of tests/ batteries per 100 tested ov/ob problems	. .	274.7 (265.5–283.8)	. .	262.3 (241.4–283.3)	. .	285.9 (268.2–303.6)	—

Note: Pathology ordering data from 2000–02 and 2006–08 are drawn from Chapter 4, Table 4.3. Ov/ob – overweight/ obesity; CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

Types of pathology tests/batteries ordered

Table 5.39 shows the rate of pathology tests/batteries ordered for overweight/obesity in 2000–08 by MBS groups and the most common individual types of pathology tests ordered. Chemistry tests were the group most often ordered (30.9 per 100 overweight/obesity management contacts) and the most common were:

- lipid tests (8.7 per 100)
- glucose/glucose tolerance tests (7.1 per 100)
- TFTs (5.0) (Table 5.39).

Haematology tests (5.2 per 100 contacts), in particular FBCs (4.7), were also commonly ordered in the management of overweight/obesity (Table 5.39).

One-quarter of pathology tests (26.5%) were ordered for ‘new’ cases of overweight/obesity. Tests were ordered at a higher rate for ‘new’ overweight/obesity problems (67.7 per 100 new problems) than average for all overweight/obesity problems (37.4 per 100 problems). However, the majority of pathology tests ordered were for ongoing management or monitoring of overweight/obesity (Table 5.39).

Table 5.39: Rate of pathology test orders for overweight/obesity by MBS pathology groups and most frequent individual test orders within each group, 2000–08

	All overweight/obesity problems		New overweight/obesity problems		
Pathology test	Number	Rate per 100 overweight/obesity problems (95% CI) (*n* = 7,797)	Number	Per cent of test	Rate per 100 new overweight/obesity problems (95% CI) (*n* = 1,141)
Chemistry	**2,411**	**30.9 (28.4–33.5)**	**643**	**26.7**	**56.4 (48.5–64.2)**
Lipids*	676	8.7 (7.8–9.5)	178	26.3	15.6 (13.1–18.1)
Glucose/glucose tolerance*	550	7.1 (6.3–7.8)	144	26.2	12.6 (10.1–15.1)
TFT*	392	5.0 (4.5–5.6)	119	30.4	10.4 (8.5–12.3)
LFT*	248	3.2 (2.7–3.6)	70	28.2	6.1 (4.5–7.7)
EUC*	197	2.5 (2.1–2.9)	47	23.9	4.1 (2.9–5.4)
MBA*	149	1.9 (1.6–2.3)	47	31.5	4.1 (2.9–5.4)
Hormone assay*	53	0.7 (0.4–0.9)	16	30.2	1.4 (0.6–2.2)
Other chemistry*	46	0.6 (0.4–0.8)	8	17.4	0.7 (0.2–1.2)
Ferritin*	30	0.4 (0.2–0.6)	3	10.0	0.3 (0.0–0.6)
Haematology	**408**	**5.2 (4.6–5.8)**	**112**	**27.5**	**9.8 (7.8–11.8)**
FBC	369	4.7 (4.2–5.3)	101	27.4	8.9 (7.1–10.6)
ESR	30	0.4 (0.2–0.5)	9	30.0	0.8 (0.3–1.3)
Other tests NEC	**53**	**0.7 (0.5–0.9)**	**10**	**18.9**	**0.9 (0.3–1.4)**
Other pathology groups	**44**	**. .**	**7**	**15.9**	**. .**
Total pathology tests	**2,916**	**37.4 (34.4–40.4)**	**772**	**26.5**	**67.7 (58.6–76.7)**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included.

Changes in the types of pathology tests/batteries ordered

Table 5.40 shows the most common pathology tests/batteries ordered for overweight/obesity in 2000–02 and 2006–08. Listed below are the tests for which significant change in GPs' order rate occurred between 2000–02 and 2006–08 (listed in decreasing test rate order). There were significant increases in the order rate of:

- TFTs—70% increase
- FBCs—68% increase
- 'other chemistry' tests—450% increase.

There was also a marginal increase in the order rate of MBA (Table 5.40).

Table 5.40: Rate of pathology test orders for overweight/obesity by MBS pathology groups and most frequent individual test orders within each group, 2000–02 compared with 2006–08

	2000–02		2006–08		
Pathology test	**Number**	**Rate per 100 ov/ob problems (95% CI) (*n* = 1,975)**	**Number**	**Rate per 100 ov/ob problems (95% CI) (*n* = 1,935)**	**Change**
Chemistry	**498**	**25.2 (20.2–30.2)**	**754**	**39.0 (32.7–45.2)**	↑
Lipids*	153	7.8 (6.0–9.5)	208	10.8 (8.8–12.7)	—
Glucose/glucose tolerance*	127	6.4 (4.8–8.0)	164	8.5 (6.7–10.3)	—
TFT*	72	3.7 (2.7–4.6)	122	6.3 (5.0–7.6)	↑
LFT*	45	2.3 (1.3–3.2)	78	4.0 (2.9–5.1)	—
EUC*	38	1.9 (1.3–2.6)	63	3.3 (2.3–4.2)	—
MBA*	25	1.3 (0.7–1.8)	50	2.6 (1.8–3.4)	↑
Other chemistry*	4	0.2 (0.0–0.4)	21	1.1 (0.6–1.6)	↑
Hormone assay*	13	0.7 (0.2–1.1)	14	0.7 (0.3–1.2)	—
Ferritin*	8	0.4 (0.1–0.7)	12	0.6 (0.1–1.1)	—
PSA*	6	0.3 (0.0–0.6)	9	0.5 (0.2–0.8)	—
Haematology	**83**	**4.2 (3.0–5.4)**	**135**	**7.0 (5.6–8.4)**	↑
FBC	75	3.8 (2.7–4.9)	123	6.4 (5.1–7.6)	↑
ESR	6	0.3 (0.1–0.5)	11	0.6 (0.2–0.9)	—
Other tests NEC	**17**	**0.9 (0.3–1.4)**	**17**	**0.9 (0.5–1.3)**	—
Other test NEC*	5	0.3 (0.0–0.5)	12	0.6 (0.3–1.0)	—
Blood test	10	0.5 (0.1–0.9)	4	0.2 (0.0–0.4)	—
Other pathology groups	**7**	**. .**	**6**	**. .**	
Total pathology tests	**605**	**30.6 (24.6–36.7)**	**912**	**47.1 (39.9–54.4)**	↑

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Ov/ob – overweight/obesity; CI – confidence interval; NEC – not elsewhere classified; also see Abbreviations. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change (darker shading), ↑/↓ indicates a marginal change (lighter shading), and — indicates no change.

5.9.4 Guidance documents for overweight/obesity

Eleven guidance documents were reviewed for overweight/obesity (Box 5.6). Only documents for overweight and/or obesity in adults were included.

Box 5.6: Guidance documents reviewed for overweight/obesity

Title	Year	Author	Abbreviated to
Clinical practice guidelines for the management of overweight and obesity in adults[297]	2004	National Health and Medical Research Council (NHMRC) [Australia]	NHMRC
Overweight and obesity in adults: a guide for general practitioners (GP)[298]	2004	NHMRC [Australia]	NHMRC GP
Canadian clinical practice guidelines on the management and prevention of obesity in adults and children[299]	2006	Obesity Canada Clinical Practice Guidelines (OCCPG) Expert Panel	OCCPG
Guidelines on management of adult obesity and overweight in primary care[300]	2006	National obesity forum (NOF) [United Kingdom]	NOF
In depth assessment resource for health professionals[301]	2004	NOF [United Kingdom]	NOF assess
Obesity: guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children[302]	2006	National Collaborating Centre for Primary Care & the Centre for Public Health Excellence at National Institute for Health and Clinical Excellence (NICE) [United Kingdom]	NICE
Quick reference guide 2 for the National Health Service (NHS)[303]	2006	National Collaborating Centre for Primary Care & the Centre for Public Health Excellence at NICE [United Kingdom]	NICE NHS
The practical guide to the identification, evaluation, and treatment of overweight and obesity in adults[304]	2000	National Heart, Lung, and Blood Institute (NHLBI) Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults [United States of America]	NHLBI
RCPA manual, obesity section[172]	2004	The Royal College of Pathologists of Australasia (RCPA)	RCPA
Murtagh's general practice, weight gain chapter[173]	2007	Murtagh J [Australia]	Murtagh
Patient presentations in general practice, 'management of overweight'[174]	1999	Steven I [Australia]	Steven

5.9.5 Extent of alignment between GP testing and guidance documents

In Table 5.41, the frequently ordered pathology tests/batteries for overweight/obesity are categorised by level of support in the guidance documents listed in Box 5.6.

Supported tests

The four types of tests that were recommended in the majority of guidance documents were lipids, glucose/glucose tolerance, LFT and hormone assay (Table 5.41). Together these four tests accounted for 52.4% of tests/batteries ordered by GPs for overweight/obesity (Table 5.42). The order rate of these tests did not change between 2000–02 and 2006–08 (Table 5.40).

Guidance documents unanimously recommended lipid testing to identify lipid disorders and glucose testing to identify diabetes or impaired glucose tolerance.

Liver function testing was recommended in six guidance documents, four documents[173,297-299] recommended testing all patients and two indicated it could be considered.[300,304] When provided, the rationale for LFT was to identify non-alcoholic fatty liver disease and other liver disorders.[297-299,304]

Of the 'hormone assay' test group for overweight/obesity, sex hormones accounted for about 80% and cortisol tests for the remaining 20%. Three documents recommended testing sex hormones for all female patients,[297-299] and two listed it as a test to consider.[173,300] The rationale for testing was to identify polycystic ovary syndrome and infertility problems. In five documents, cortisol testing was recommended if symptoms of Cushing's syndrome were present.[172-174,300,301]

Tests with conditional support

There was mixed support for TFT in the management of overweight/obesity (Table 5.41). TFT accounted for 13.4% of tests ordered (Table 5.42) and the ordering rate increased significantly between 2000–02 and 2006–08 (Table 5.40).

Thyroid disease was discussed in guidance as a possible cause of overweight/obesity in seven guidance documents.[172-174,298,300,301,304] Only two guidance documents recommended routine thyroid testing in the assessment of overweight/obesity, one of which recommended ordering TFT,[174] and the other recommended the thyroid-stimulating hormone test.[301] There were two occasions where guidance documents produced by the same authors (the NHMRC guideline and GP guide,[297,298] and the

NOF guideline and assessment document[300,301]) provided inconsistent recommendations for thyroid function assessment. This is discussed in more detail in Section 5.9.6.

Support unable to be determined

It was not possible to determine whether MBA and 'other chemistry' tests were recommended in the guidance documents (see Section 5.3.4). Together these two tests accounted for 6.7% of pathology ordered for overweight/obesity (Table 5.42). Between 2000–02 and 2006–08, the rate of MBA increased marginally and the rate of 'other chemistry' tests increased significantly (Table 5.40).

The MBA test itself was not recommended in any guidance documents. However, some tests that may be considered part of the MBA, such as LFT, were partially or completely supported in the management of overweight/obesity (as discussed above).

Unsupported tests

The guidance documents did not recommend testing of FBC, EUC, ferritin and ESR (Table 5.41). Together these tests accounted for 21.4% of all pathology ordered by GPs in the management of overweight/obesity (Table 5.42). FBC was the only test within this group to increase significantly between 2000–02 and 2006–08 (Table 5.40).

EUC testing or assessment of kidney function was not mentioned in most guidance documents. Murtagh[173] recommended testing kidney function in all patients and NOF[300] and NHLBI[304] listed it as a consideration.

The FBC, ferritin and ESR tests were not mentioned in most of the guidance documents, with the exception of the NHLBI guideline, that stated that FBC should be considered.[304]

Other tests mentioned in the guidance documents

Other tests were mentioned in the guidance documents but each of these accounted for less than 1% of tests recorded by GPs for overweight/obesity.

Urinalysis was recommended in two sources,[299,300] and two documents recommended testing for gout/hyperuricaemia.[297-299] The most common test for gout is urate/uric acid. While it was not among the most common individual tests, it may have been a part of the MBA test.

Key to Table 5.41

Colour	Description
	The document specifically recommended this test. Any notes within the cell indicate further detail. For example, a specific disease to test for within subset of patients; a specific test within a group.
	The document stated that this test should be considered. Any notes within the cell indicate further detail (e.g. a specific test to consider)
	Unable to determine guidance (see Section 5.3.4).
	The document specifically stated not to do this test. Additional information is supplied if certain conditions apply (e.g. specific clinical situations).
	Guidance document does not mention this test

Table 5.41: Summary of guidance recommendations by most frequent individual test orders for overweight/obesity, 2000–08

Pathology test	Per cent of ov/ob path (*n* = 2,917)	NHMRC[297]	NHMRC GP[298]	OCCPG[299]	NOF[300]	NOF assess[301]	NICE[302]	NICE NHS[303]	NHLBI[304]	RCPA[172]	Murtagh[173]	Steven[174]
Lipids*	23.2											
Glucose/glucose tolerance*	18.9											
TFT*	13.4			Only if clinically indicated		Thyroid-stimulating hormone						
FBC	12.7											
LFT*	8.5											
EUC*	6.8											
MBA*	5.1											
Hormone assay*	1.8	Polycystic ovary and fertility	Polycystic ovary and fertility	Polycystic ovary	Cortisol and sex hormones	Cortisol				Cortisol	Cortisol and sex hormones	Cortisol
Other chemistry*	1.6											
Ferritin*	1.0											
ESR	1.0											

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Ov/ob – overweight/obesity; also see Abbreviations. Any notes within the coloured cells are described in detail in Section 5.9.5. Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included.

Evaluation of GP pathology ordering against guidance documents

Table 5.42 provides a summary of the individual tests ordered for overweight/obesity and the level of support provided in the guidance for each. Of the tests ordered by GPs in 2000–08:

- 52.4% were supported
- 20.1% had conditional support or support could not be determined
- 21.4 were not supported by the guidance documents (Table 5.42).

The individual tests/batteries listed in Table 5.42 account for 93.9% of pathology tests/batteries ordered for overweight/obesity because only the most commonly ordered tests for overweight/obesity were evaluated.

Table 5.42: Summary of support for GP pathology ordering for the most frequent individual test orders for overweight/obesity, 2000–08

Pathology test supported by guidance	Number	Per cent of all pathology tests for overweight/obesity
Supported	**1,527**	**52.4**
Lipids*	676	23.2
Glucose/glucose tolerance*	550	18.9
LFT*	248	8.5
Hormone assay*	53	1.8
Conditional/unclear support	**587**	**20.1**
TFT*	392	13.4
MBA*	149	5.1
Other chemistry*	46	1.6
Unsupported	**625**	**21.4**
FBC	369	12.7
EUC*	196	6.8
Ferritin*	30	1.0
ESR	30	1.0
Subtotal (n, % of total tests)	*2,739*	*93.9*
Total pathology tests	**2,916**	**100.0**

* Includes multiple ICPC-2 PLUS codes (see Appendix 7).

Note: Only the groups of tests/individual tests accounting for ≥ 1% of all pathology tests for the selected problem are included. See Abbreviations.

In 2000–08, GPs ordered supported pathology tests at a rate of 19.6 tests/batteries per 100 overweight/obesity problems, followed by unsupported tests (8.0) and those with conditional support (7.5). Tests ordered for overweight/obesity but not evaluated

were ordered at a rate of 2.3 per 100 problems. The rate at which GPs ordered unsupported and conditionally supported tests increased significantly over time (Table 5.43).

Table 5.43: Rate of pathology ordering for overweight/obesity by level of support, 2000–08, 2000–02 and 2006–08

	2000–08	2000–02	2006–08	
Level of support	Rate per 100 overweight/obesity problems (95%CI) (*n* = 7,797)	Rate per 100 overweight/obesity problems (95%CI) (*n* = 1,975)	Rate per 100 overweight/obesity problems (95%CI) (*n* = 1,935)	Change
Supported	19.6 (17.7–21.4)	17.1 (13.2–21.0)	24.0 (19.4–28.6)	—
Conditional/unclear support	7.5 (6.7–8.3)	5.1 (3.9–6.4)	9.8 (8.0–11.7)	↑
Unsupported	8.0 (7.1–8.9)	6.4 (4.7–8.2)	10.8 (8.6–13.0)	↑
Not evaluated	2.3 (2.0–2.7)	2.0 (1.3–2.7)	2.5 (1.8–3.3)	—

Note: CI – confidence interval. Shading indicates a statistically significant change between 2000–02 and 2006–08. The direction and type of change is indicated for each measure: ↑/↓ indicates a statistically significant change, and — indicates no change.

GPs ordered only pathology tests that were supported or conditionally supported at 7.1% (95% CI: 6.4–7.9) of overweight/obesity problems in 2000–08. A further 5.9% (95% CI: 5.2–6.5) of problems involved at least one unsupported test, and 87.0% (95% CI: 86.1–88.0) of problems involved either no pathology tests (86.4%) or tests that were not evaluated (0.6%) (results not tabled).

Between 2000–02 and 2006–08 there was no change in the proportion of overweight/obesity problems that involved supported testing, 6.1% (95% CI: 4.8–7.4) in 2000–02 and 8.1% (95% CI: 6.2–9.9) in 2006–08. However the proportion of problems involving at least one unsupported test increased significantly over this time, from 4.8% (95% CI: 3.5–6.0) to 7.7% (95% CI: 6.3–9.2) (results not tabled).

When GPs ordered unsupported tests, the vast majority were accompanied by one or more supported/partially supported tests (96.6% of occasions). Unsupported tests were ordered alone at the remaining 3.4%. GPs ordered only tests that were unsupported at 0.2% of overweight/obesity problems in 2000–08, and this did not change over time (0.1% in both 2000–02 and 2006–08) (results not tabled).

5.9.6 Discussion

GPs' pathology test ordering for overweight/obesity problems (in adult patients) aligned moderately well with that recommended in guidance documents, with 72% of tests partially or completely supported. The statistically significant increase in the rate of GPs total pathology ordering for overweight/obesity problems between 2000–02 and 2006–08 was reflected in the increased rate of tests that were partially supported, and in those unsupported in guidance documents. There was no change in the rate of supported tests.

Due to the increase in total rate of pathology ordering, the correlation between GPs' ordering and level of support, as a proportion of total tests should be considered. Supported tests accounted for the largest proportion of total tests, but they accounted for a smaller proportion of total tests in 2006–08 than in 2000–02. Concomitantly there was an increase in the proportion of partially supported tests and a small increase in unsupported tests. Overall the increase in total tests ordered by GPs for overweight/obesity suggested a small shift (less than 2% of total pathology) towards being 'less' in line with guidance recommendations. However, there was a more pronounced shift in GPs' ordering, from supported to partially supported tests that warrants further investigation.

Comments on guidance documents

Guidance documents for management of overweight/obesity logically followed the 'normal' management pathway from identification, to assessment, to management, to monitoring.

Most documents had no clear section for recommended pathology tests. Mixed terminology was used to refer to testing e.g. 'diagnostic testing', 'laboratory investigations', 'diagnostic investigations', 'assessment', the specific test name, or the disease to be tested for—making identification of recommended testing within the lengthy documents (often over 200 pages) difficult. The Australian NHMRC guideline (and related GP guide) did not specifically recommend any pathology tests, conditions associated with obesity being listed by relative risk of developing the condition with the statement 'standard procedures are used to test for these'.[297,298]

Contradictory statements

Recognising that size, complexity and structure of guidance documents was a barrier to them being utilised, some authors created an abbreviated guidance document. However, there were inconsistencies between the full and abbreviated guidance. There were also conflicting statements made within the same guidance document.

The Australian NHMRC guideline and the related GP guide provided contradictory advice for thyroid disease. In the full guideline thyroid disease was not mentioned as a disease to consider in assessment. However, hypothyroidism was mentioned in two other places in the guideline: as a condition that places people at risk of obesity with the statement that it generally shows up earlier in life; and, in the alternative treatment section it was noted that it caused "very few cases" of obesity.[297] These comments suggest that the authors of the full guideline do not consider thyroid disease testing to be a routine part of the assessment of overweight/obesity. In contrast, the GP guide stated "Medical conditions: Certain medical conditions, for example, hypothyroidism, are known causes of overweight" and goes on to recommend that these medical conditions should be assessed by clinicians.[298] This suggests support for thyroid testing in the GP guide, though not in the full guideline.

The recommended pathology tests in the NOF guideline and separate 'full assessment' did not align. In the NOF guideline[300] a number of blood tests were listed 'if appropriate', suggesting they would not be necessary in all patients. In contrast, the assessment document recommended a smaller number of tests for all patients.[301]

Authors of two guidance documents made inconsistent recommendations within the document. The NHLBI guideline listed the lipids and glucose tests as recommended tests in one section of the guideline and as tests to be considered in another section.[304] The NHRMC GP guide listed conditions to test for in the assessment phase using "standard testing", but also included as an appendix a Weight Management Plan, which prompted for specific test results. These were: triglycerides, cholesterol, insulin, glucose, LFT, and endocrine tests. However, insulin is not a recommended standard pathology test to use for testing any of the conditions.

Testing for phase of management

Pathology tests were, in the main, only recommended in the assessment phase of management (i.e. prior to starting treatment) to identify the presence/absence of other morbidities associated with overweight/obesity, and/or possible medical causes for overweight/obesity. It is likely that GPs ordered pathology tests/batteries for the assessment of overweight/obesity at the time of its 'diagnosis' as a new clinical problem, which explains the higher pathology order rate at these new cases than the average rate for overweight/obesity problems.

Multiple guidance documents acknowledged the chronic nature of overweight/obesity and the need for long-term management.[297-299,302-304] The majority of GP-patient contacts for overweight/obesity management (85%) were for its ongoing management, as were the majority of pathology tests/batteries ordered (74%). However, only one guidance document made a recommendation about pathology testing in ongoing management: the Canadian guideline made a consensus recommendation to retest glucose and lipid levels 'at regular intervals'.[299]

There was a lack of guidance about whether there is a need for pathology testing in ongoing management to reassess the absence or presence of associated morbidities. As the majority of contacts and pathology testing were provided by GPs for ongoing management of overweight/obesity this is an area authors of future guidance documents should improve.

Tests for which guidance was lacking

There was a significant discord between guidance documents' recommendations and GPs' ordering for overweight/obesity for three tests: FBC, TFT and MBA.

FBC was only mentioned in one guidance document, as a possible inclusion in initial assessment, and the MBA was not recommended in any guidance documents. Only TFT was commonly mentioned in guidance documents. However, due to the variation between recommendations in guidance documents TFT was judged as 'partially supported' in this study. However, when it was recommended it was only in the initial assessment of overweight/obesity, but GPs usually ordered it in ongoing management (70% of occasions). The increase in the proportion of GP-ordered tests classified as 'partially supported' (mentioned earlier in this discussion) was mainly due to increases in the rate of TFT and MBA tests.

The three tests (FBC, TFT and MBA) accounted for one-third of total tests ordered for overweight/obesity in 2000–08. GPs' ordering of these tests increased significantly between 2000–02 and 2006–08, and the increases in order rates of TFT and FBC were the main contributors to the total increase in GPs' pathology ordering for overweight/obesity.

Investigation of whether the FBC and TFT tests are clinically useful in the management of overweight/obesity and at which stage of management (including for ongoing monitoring) is needed. The results of this investigation should be used to improve guidance documents, and this guidance promoted to GPs to improve test ordering.

Evidence base for overweight

A lot of the available evidence, on which recommendations in the documents were based, was for obesity only. For example, the studies referenced in guidance documents that identified links to associated morbidities and causative conditions/diseases were among obese patients, not in the overweight. However, recommendations were made for overweight and obese patients based on this evidence though the causative links may be less clear in overweight patients.

Factors influencing the future management rate of overweight /obesity

The prevalence of overweight/obesity is high and increased over the period of this study (between 2000 and 2008) in the Australian population,[154] and in the Australian general practice patient population.[273] However, there was no change in the management rate of overweight/obesity as a clinical problem in general practice. It remained very low. In 2000–08, on average, GPs saw 51 overweight/obese patients for every one management occasion.

Multiple studies have similarly noted the discord between prevalence of obesity and its management in primary care. The proportion of obese patients who recall receiving weight management or have it documented in the record varies from 19% to 49%.[305-308] GPs acknowledge the importance of management of overweight and obesity and most report feeling well prepared to manage it.[309] However, they also perceive that they are unlikely to be very effective in influencing the factors driving obesity in patients,[310,311] despite evidence that patients who receive weight loss counselling are more likely to attempt weight loss.[305]

As the current management rate is low, the amount of total pathology accounted for by overweight/obesity is also small. However, with public awareness campaigns underway to address overweight/obesity at a population level it is likely that its management rate in general practice will increase as it is the usual first point of contact Australians have with the health care system. The potential for increased management is huge and would create a corresponding increase in pathology, which would occur without any change in GPs' current pathology ordering behaviour. However, GP's pathology ordering for overweight/obesity has increased and may continue to do so, which would further increase future pathology test rates for overweight/obesity.

The inclusion of obesity as a National Health Priority Area[290] and as part of the National Preventative Health Strategy[235] reflects the urgency and scale of the overweight/obesity problem. The Strategy's Obesity Working Group recommendation to 'strengthen, skill and support primary healthcare and public health workforce to support people in making healthy choices'[235] is timely.

The Australian NHMRC guideline and GP guide were created seven years ago and are overdue for revision, providing an opportunity to improve the overweight/obesity guidance available to GPs addressing the deficiencies highlighted in this study. It is clear from the Working Group' recommendation that primary care workers will continue to have a role key in the management of obesity in the future.

Summary

More than 70% of pathology ordered by GPs in the management of overweight/obesity were recommended in guidance documents. Based on the current prevalence-management pattern and increases in GP's pathology ordering for overweight/obesity there is potential for future growth in pathology ordering associated with overweight/obesity. Future guidance developed for GPs should address the gaps and limitations highlighted in this study, particularly in long-term management. Addressing the appropriateness of GP test ordering in management of overweight/obesity may decrease some future costs associated with its management.

5.10 Discussion

GP adherence to guidance documents

Pathology tests/batteries ordered by GPs in the management of hypertension, T2D, lipid disorders and weakness/tiredness aligned well with those recommended in guidance documents, with at least 85% of tests ordered for these problems being completely or partially supported. This was not the case for 'health check' and overweight/obesity problems, with 50% and 70% of tests, respectively, being completely or partially supported in guidance documents.

Although only six problems were investigated in this chapter, they accounted for one-quarter (25%) of the total pathology tests/batteries recorded by GPs in 2000–08. When viewed as one group, 66% of the pathology ordered for the six conditions were supported in guidance documents, 15% were partially supported, 13% were unsupported and 6% were not evaluated. When described in terms of the total volume of pathology ordered 17% of tests were supported for the six problems, 4% were partially supported, and 3% were unsupported.

Over the period of this study, GPs' pathology ordering for the six problems increased, and this represented a shift to be 'less' in line with recommendations in guidance documents. The proportion of tests ordered by GPs that were supported decreased (from 70% in 2000–02 to 61% in 2006–08), counteracted by increases in the proportion that were partially supported (13% to 17%) and unsupported (11% to 16%). The proportion of tests that were not evaluated in this study remained constant (6% in 2000–02 and 2006–08). Although the proportion of unsupported tests increased, it is important to note that the increase of 5% was relatively modest over the 8 years of the study. Inappropriate pathology ordering was not the major contributor to the increased rates of GPs' pathology ordering, as increases occurred in all 'level of support' groups.

The results in Chapter 4 suggest that 13.6 million tests/batteries were ordered for the six problems in 2006–08 in Australia. This is the extrapolated number of pathology tests ordered across the country and incorporates GPs pathology ordering for the problems, the management rate of the problems and the number of national GP encounters. Of these tests, 10.7 million (78.2%) were completely or partially

supported in guidance documents, 2.1 million (16.6%) were not supported and 850,000 (6.2%) were not evaluated in this study.

It is interesting to note that most of the pathology tests evaluated as unsupported in the current study were not mentioned in the guidance documents, rather than being specifically recommended against. In other words, guidance documents were prescriptive in encouraging the necessary pathology tests and rarely proscriptive in recommending against use of pathology tests.

It may be that some of the tests not mentioned in guidance documents, and therefore evaluated as unsupported, have a role in the management of the clinical problem. Prior to implementing interventions to curb these 'unsupported' tests, further investigation of the clinical value of such tests may be needed.

When GPs ordered unsupported tests this was primarily in addition to ordering supported tests. It was rare that an order for pathology for any of the six problems included only unsupported tests. This aligns with the study by van Wijk et al.[79] that found the most common cause of 'non-compliant' pathology ordering by GPs was the addition of tests. However, it was also found that half of the tests considered 'non-compliant' were subsequently recommended in the revised guidelines, leading van Wijk et al. to conclude that GPs were early adopters of new evidence.[79] This does not appear to be the case in the current study. The eight years of data evaluated and the range of publication dates of the reviewed guidance documents suggest that if GPs' ordering of unsupported tests was pre-empting changes in guidance this would have been noted.

The fact that unsupported tests were rarely ordered alone has significant implications in the context of the current MBS funding structure of pathology tests ordered by GPs in Australia. In studies evaluating the cost-effectiveness of implementing pathology interventions in other countries, cost-effectiveness was favourable on the basis of the saved testing costs.[76,78,312] However, because of the coning structure in the current funding arrangement, only the three most expensive MBS pathology item numbers per testing episode are funded by the Australian Government. This means that reducing the ordering of inappropriate tests may not achieve a reduction in cost of the tests at an episode, unless they fall in the three most expensive pathology items ordered on that occasion.

Limitations

Essentially this study assesses the appropriateness of GPs' pathology test selection in the management of the six investigated problems, with appropriateness judged on recommendations for testing provided in guidance documents. It was not the purpose of this study to determine whether GPs performed all the recommended tests for each problem. There are circumstances where GPs' use of appropriate tests may be suboptimal.

There were a few occasions where guidance documents recommended pathology tests that GPs did not order. These tests were not strongly recommended, that is, there was not consensus among guidance documents for these tests. The only exception was the urinalysis test, which was supported in guidance documents for hypertension and weakness/tiredness. It is likely that urinalysis was not recorded by GPs participating in BEACH because GPs are instructed not to record dipstick tests. Urinalysis includes a dipstick and microbiology test. Therefore, low rates of urinalysis may reflect a limitation of the BEACH pathology data. However, in general, GPs' failure to order tests that were not strongly supported in guidance document is not likely to be a concern.

There are limitations related to the type of data available in this study. The cross-sectional and encounter-based nature of the data meant some clinical information (e.g. presence of clinical signs, comorbidities, test results, interval between repeated tests) was not known. When a guidance document recommended a test in a selected clinical circumstance, GPs' ordering of the test was evaluated as 'supported' in the current study. This is a somewhat lenient approach to assessing the appropriateness of testing. It is possible that a test that was evaluated as supported in this study may not be appropriate in the circumstances of the individual patient. It is also possible that a test not recommended in guidance may be appropriate in the circumstances of the individual patient.

The measure used to assess 'appropriateness' in this study, is just one possible measure. Others have used different measures (such as unnecessary repetition of tests[313]) although most of these have been applied in settings other than general practice.[52]

There are also limitations to the pathology data recorded in the BEACH study. As discussed in Chapter 3, there are a maximum of five pathology tests/batteries of tests that can be recorded per encounter. Each test may relate to more than one problem being managed and the analysis in this chapter is based on these problem–pathology linkages. It was possible for a single pathology test/battery to be linked to more than one problem, and therefore evaluated in this study for more than one problem, but this was rare.

Some of the guidance documents reviewed in this study were published subsequent to the data being recorded. However, the relative consistency of recommendations between guidance documents and consistency in the types of tests ordered by GPs for each problem suggest that differences in publication dates of the guidance documents would not have affected the conclusions of this study.

Guidance documents

Guidance documents, in particular guidelines, have been shown to be successful in improving care when produced, disseminated and implemented successfully.[11,85,314] However uptake of guidance is often poor for a variety of reasons. Barriers to guideline adherence may relate to the individual patient, clinicians attitudes to guidelines, the characteristics of the guidance (e.g. the source, evidence base and practical features such as length), and characteristics of the individual recommendations.[153,315-323] In this study, while acknowledging that these barriers exist, guidance documents are viewed as summaries of the best available evidence and reflect the guidance available to GPs for pathology testing.

As a whole, the quality of the guidance documents reviewed in this study was highly variable. For example, it is likely that some of the guidelines reviewed would not meet the indicators for high quality using the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument.[324] However, it was not the purpose of this study to assess the quality of the guidance documents in this respect. Nor was it within the scope of this thesis to determine the accuracy or appropriateness of the pathology recommendations made by authors of guidance documents (e.g. that the evidence was correctly interpreted). Instead guidance documents were viewed to determine what is available to GPs in terms of guidance about pathology testing.

I may not have identified and reviewed all the relevant guidance documents available for the six problems investigated in this study. Also as the study was limited to guidance documents available in English, most of the Dutch College of General Practitioners guidelines could not be evaluated, despite being widely referenced in the literature.[76,79,86,88,95,281]

Locating relevant Australian guidelines and other guidance documents was not straightforward as several organisations produce guidance documents.[325] At the time this study was conducted there was no central listing of Australian guidelines or other guidance documents. In contrast, other countries had organisations responsible for guideline creation and dissemination (such as NICE in the UK) and/or central listings of guidelines (e.g. the US National guideline clearinghouse). Since this study was completed, a web-based 'National clinical practice guidelines portal' has been launched[326] which should facilitate locating guidelines in the future.

The guidance documents reviewed, commonly guidelines, were usually not designed for GPs. Many of the documents were lengthy (frequently 200+ pages) in order to include all the evidence. The size and number of guidelines applicable to diseases commonly managed in general practice has been acknowledged as a barrier to their use by GPs.[153,319,322,323]

In addition, locating information about recommended pathology testing in the guidance documents was often difficult. There was mixed terminology used to refer to testing e.g. 'diagnostic testing', 'laboratory investigations', 'diagnostic investigations', 'assessment', and the specific test name, or the disease that testing aims to identify or exclude. Implementing common terminology to refer to pathology tests in guidance documents would be one easy way to help clinicians identify relevant recommendations in these lengthy documents.

This study identified quite a few inconsistencies in pathology recommendations both within and between guidance documents for equivalent clinical situations. Incomplete pathology test recommendations were also identified, particularly in the context of long-term management (this is discussed in more detail below in 'Chronic conditions').

I found one other study that investigated the quality of blood test recommendations in guidelines. Van Wijk et al.[327] reported only a few instances of incomplete blood

test recommendations in the guidelines of the Dutch College of General Practitioners. Van Wijk's study suggests a better quality of recommendations in the Dutch guidelines than found in the current study. This is probably because the guidelines reviewed were all from one source. Additionally these guidelines have been extensively used in studies to improve GPs' pathology ordering in the Netherlands[76,79,86,88,95,281] over several decades and it is likely that any inconsistencies have been corrected over time.

The problems investigated

The six problems included in this study can be considered to represent three broad groups: chronic conditions, diagnostic problems and preventive care. Lipid disorders, T2D, hypertension, and overweight/obesity are chronic conditions. Health check, as a problem under management, represents a preventive process of care and the management of weakness/tiredness problems represents a diagnostic process. There were different issues raised in this study that were common to each of these three broad groups.

Chronic conditions

The study highlights that the majority of GP management and pathology tests/batteries ordered (70–90% of pathology) for the four chronic conditions were for the long-term management of the conditions. Despite this, recommendations regarding pathology testing in long-term management of conditions were frequently omitted or incomplete in guidance documents.

Guidance documents often included recommendations about monitoring the key indicator(s) for the disease (e.g. lipid levels for lipid disorders, HbA1c for diabetes). However, recommendations regarding the monitoring of other factors including medication side effects were frequently omitted or incomplete. For example, guidance documents recommended monitoring liver function in the use of statin medications but gave no advice on the frequency and duration of monitoring.

For hypertension, lipid disorders and overweight/obesity a number of pathology tests were only recommended as part of the initial assessment of new cases of disease (e.g. those recommended to identify possible underlying causes of the disease). In this study, the level of support may be over-estimated for such tests.

GPs continued to order these pathology tests in the ongoing management of the problems, that is, beyond the initial assessment. No guidance was provided on the need (or not) to periodically reorder tests recommended in the initial assessment. For example, guidance is needed on whether the secondary causes of disease (recommended for testing in the initial assessment) are likely to occur in the future (e.g. increasing prevalence with age), and therefore whether these secondary causes need to be reassessed. Such guidance should inform GPs whether subsequent diagnosis of the condition is likely to affect management of the disease and whether repeated testing is needed.

In addition to incomplete guidance about pathology tests needed for monitoring chronic conditions, there was also a lack of information on interpretation of repeated testing. Even among tests with an established role in monitoring chronic conditions, the expected variation of test results (i.e. the expected analytical and intra-individual variation in repeated test results) was not discussed in guidance documents. Knowledge of this variance is essential for GPs to accurately interpret results, to determine the level at which clinical intervention (e.g. increase medication dose) is required to maintain 'control' and avoid progression of disease.[328]

Lipid testing is a good example to highlight the issues around recommendations for monitoring. In this study lipid testing was supported for the four chronic conditions, but the level of detail provided in guidance documents about reassessing or monitoring lipid levels varied. No guidance documents discussed interpretation of repeated lipid results (i.e. expected variation of results), although its variability is well studied.[224,226-229] Recommendations to monitor lipid levels and the interval between repeated testing were usually complete in guidance documents for lipid disorders and T2D. However this was not the case for hypertension and overweight/obesity. On the few occasions where recommendations for repeated lipid testing were made, they were vague, such as reassess 'regularly' or 'at regular intervals'. GPs' ordering of lipid tests is further investigated in a substudy in Chapter 6.

The current study suggests that there is scope for improvement in pathology ordering guidance in the long-term management of chronic diseases. Complete guidance is needed on tests required in ongoing management particularly beyond the primary

monitoring test(s) for conditions. These improvements should include whether other tests have an ongoing role in the long-term management of the condition (such as those recommended in the initial management) and monitoring of medication side effects. Specifically these recommendations should be complete and include the recommended interval between tests and the duration that testing should persist.

It has been said that monitoring practices are understudied,[328] and that quality evidence in monitoring protocols in health care is lacking.[56,329] This may explain why the monitoring recommendations in guidance documents are not ideal. Improving recommendations about the testing interval for monitoring is not straightforward because frequency may depend on the phase of management.[328,329] Never-the-less making improvements in recommendations for monitoring tests (including interval and interpretation) is worthwhile considering the volume of testing generated by monitoring chronic disease in general practice.

Multiple morbidity

Managing patients with multiple chronic problems has become part of everyday practice for GPs.[330,331] Prevalence of multimorbidity increases with age[330,331] and as the Australian population ages the proportion of people with multiple chronic morbidities will increase.

Both guidance documents and this study are disease-specific. This is necessary because much of the evidence is disease-specific. However disease-specific guidance documents do not reflect the real world experience of managing patients with multiple diseases in general practice.[153,332,333] A similar limitation applies in this study when comparing disease-specific recommended testing with actual clinical practice.

There is a need for improved guidance for pathology testing in patients with multiple morbidities. As many individual chronic diseases require pathology testing in their ongoing management, producing guidance relating to appropriate pathology in multiple morbidity situations may benefit GPs. However, since the number of possible combinations of chronic diseases is almost innumerable, realistically such guidelines should concentrate on the most prevalent combinations of disease.

Testing for a diagnostic purpose

Pathology tests are usually ordered by GPs for diagnostic purposes in the management of weakness/tiredness. The low prior probability of disease in these patients and the high rates of pathology ordering mean that the likelihood of receiving false positive or false negative tests results is common.

Even though GPs' test selection aligned well with that recommended in guidance documents, most of these recommendations were based on consensus because there is little available evidence. The few studies conducted suggest that limiting the number of tests (so that fewer than that currently recommended in guidance documents are ordered) may reduce the likelihood of false positive results with no change in the diagnostic yield of pathology testing for fatigue.[281,287] However, the study by Koch et al.[281] suggested that even with a limited set of pathology tests, the chances of false positive results are relatively high. Increasing the number of tests ordered per testing occasion and the characteristics of tests ordered (such as sensitivity) contribute to the likelihood of false positive results.

In the current study, the odds of false positive test results are not likely to have increased over the study period, as the number of tests ordered per testing occasion and the types of tests ordered for weakness/tiredness did not change significantly between 2000–02 and 2006–08. Therefore, the odds of false positive results are unlikely to have contributed to the increased rate of pathology testing for weakness/tiredness. The increase rate of GPs' pathology ordering in the management weakness/tiredness was due to an increased likelihood that GPs would initiate pathology testing (i.e. an increased proportion of patients with weakness/tiredness problems were being tested).

Increasing the number of patients being tested may create a cascade of effects that contribute to more pathology testing. For example, assuming that the odds of receiving false positive results stay the same and GPs react to these abnormal results in the same way (with the same rate of follow-up pathology tests), an increase in the volume of patients being tested will flow on to an increased volume of patients experiencing false positive results and receiving follow-up testing. This is not to suggest that this is clinically inappropriate testing – but simply demonstrating the cascade that may be triggered by increasing GP likelihood of testing.

Based on the low probability of disease and high rates of testing (as described above), it can be assumed that receiving false positive results or clinically insignificant abnormal results is a common occurrence in general practice for weakness/tiredness. It may be that GPs' management of abnormal results in the management of weakness/tiredness changed and this contributed to increased rates of pathology testing. Certainly the management rate of abnormal tests results (as a clinical problem) in Australian general practice has increased, so too has GPs' pathology ordering in managing these abnormal results (as described in Chapter 4).

A high probability of clinically insignificant abnormal test results in diagnostic situations is not unique to weakness/tiredness—GPs deal with similar situations on a regular basis. Authors have discussed the potential harms of clinically insignificant abnormal test results, such as cascades of investigations and testing, unnecessary procedures and patient anxiety.[9,53,144,334] However, Houben et al. found that in diagnostic situations where probability of disease is low (as is the case for tiredness) GPs interpreted most abnormal tests results as 'normal' or clinically insignificant,[335] and cascades of unnecessary investigations, referrals and treatments were uncommon.[336] The small sample of GPs (n = < 90) in these studies may limit the generalisability of the results, particularly as other studies have reported considerable variation in GPs' pathology ordering behaviour.[43-51,71-73,337]

Patient experiences of abnormal results are not well understood, but it is likely that they will also be highly variable. An interesting contradiction is apparent when you consider that one of the motivations cited by GPs[36,37,338] for ordering pathology tests (and cited by patients for wanting to be tested[33,339]) in diagnostic situations is to reassure, but abnormal results may achieve the opposite effect, leading to patient anxiety—a conundrum considering that clinically insignificant abnormal results are a common occurrence in these diagnostic situations.[338] Future investigation of the flow-on effects of abnormal pathology results in Australian general practice for weakness/tiredness, or similar diagnostic problems, would identify the frequency of the discussed 'harms' and whether interventions (such as education) either for GPs, patients or both are needed.

Prevention

Health checks are considered a valuable tool in providing preventive care. Their use has been shown to improve use of cholesterol tests, Pap smears and faecal occult blood testing.[340] However, there is a significant amount of literature that shows performance of preventive health activities in primary care is suboptimal.[92,341-343] The Australian Government has introduced several MBS items for health assessments[18,232,236] among other initiatives to "ensure that we encourage GPs to deliver quality preventative health."[344]

Health checks had the poorest alignment between GPs' pathology ordering and guidance recommendations of the six problems investigated. This may be partially due to the diverse range of clinical situations that GPs may face when using the 'health check' label. For example, MBS items were introduced to encourage preventive care in a range of selected high risk patient groups, such as older patients aged 75 years and over,[236] patients at risk of chronic disease,[232] and patients at risk of T2D.[18] While the definition of health checks used in this study excludes those related to established disease, it is possible that the patient's individual clinical circumstances call for different pathology tests than those recommended in guidance documents. As discussed in the limitations section above, the cross-sectional encounter-based nature of this study meant that some data about the patient's individual clinical circumstance was not available. Therefore a conservative approach was used; all pathology tests recommended in guidance documents for preventive care were included as supported tests. However, as discussed below, the difference between tests required for an individual patient's clinical situation and tests recommended in preventive care guidance documents may be more pronounced than for the other 5 problems evaluated in this study.

In considering appropriateness of pathology ordering Lundberg states that we need to consider the effect of the test in terms of whether "it was useful for the patient or for the public's health".[42] Of course a test may be useful to both the patient and the public. However, the concept of individual benefit versus public benefit may partially explain the discord between pathology tests ordered by GP's for health checks and those recommended in preventive care guidelines.

Prevention is a core population health strategy, and as such guidelines for preventive care have their basis in public health benefit. By contrast the interaction between a

GP and patient is primarily about the patient's individual benefit. Beaulieu et al. found that both physicians and patients were as concerned with usefulness of a preventive intervention to the individual as to the general population.[341] The lack of applicability of guidelines to the individual patient has been identified as a barrier to guideline adherence particularly for GPs.[153,316,317,319-321] Potentially this may be more pronounced for guidelines based on population benefit (such as preventive care) than those created for a specific morbidity.

Over the study period, there was an increase in the number of tests ordered by GPs per ordering occasion for health checks. This may have increased the likelihood of false positive results, particularly among well patients.[142-144]

One of the limitations of the cross-sectional data is that we don't know the nature of the 'health check' being provided (e.g. presence of other risk factors or morbidities) and cannot determine the type of preventive care likely to be represented.

The RACGP guideline states that health checks must "involve preventive interventions for which there is clear evidence of their effectiveness."[177] It appears that the Government's initiatives to increase the number of health checks were successful but this has also increased the rates of both supported and unsupported pathology tests for preventive care.

Only a few guidance documents were available for preventive care and the tests that were unsupported for health checks were usually not mentioned in guidance documents rather than specifically recommended against. This suggests that further research is needed to determine whether there is evidence to support the pathology tests that were unsupported in this study but commonly ordered by GPs for health checks.

Specific tests of interest

There were a few tests identified in this study which were commonly ordered in management of the six problems, but for which GPs ordering and recommendations in guidance documents frequently did not align. These tests were FBC, TFT and MBA.

These tests are highlighted because the GP ordering rate increased significantly, they account for a significant proportion of pathology ordered for these six conditions but guidance documents frequently did not support use of the tests.

Further investigation is needed to determine the clinical indications for ordering FBC, TFT and MBA tests, particularly to investigate their role in the long-term monitoring of the chronic conditions. GPs' ordering of FBCs are investigated in a separate study in Chapter 6.

Conclusion

The majority of pathology ordered for the six problems were supported in guidance documents. The significant increases in GPs' rates of pathology ordering for these problems were reflected in significant increases in tests at all levels of support. Thus GPs' pathology ordering in these six problems does not reflect significant amounts of inappropriate tests, nor does it support the assertion that increases in pathology ordering are caused by disproportionate increases in unsupported tests.

As a proportion of total tests, there was an increase in the proportion of unsupported tests over time, suggesting a shift toward GPs' pathology ordering being less in line with recommendations over time. However, this was a modest change in the context of the increases in total pathology rates.

There is scope for improvements in GPs' pathology ordering for the six problems investigated. However there are considerable differences between the problems. GPs' pathology test ordering aligned well with recommendations for pathology testing in guidance documents for hypertension, T2D, lipid disorders and weakness/tiredness. However, due to the lack of guidance on pathology testing in ongoing management, the level of support for some tests may be over-estimated, particularly for hypertension and lipid disorders. Pathology tests/batteries ordered by GPs for 'health checks' and overweight/obesity problems did not align well with recommended testing.

Pathology recommendations in guidance documents could be improved in multiple ways. Removing inconsistent pathology test recommendations, and standardising terminology used to refer to pathology testing would help GPs locate relevant information within the lengthy guidance documents. The most important improvements needed are for guidance in the long-term monitoring of chronic problems. Guidance documents need to include detail about: which tests need to be monitored, the frequency and duration of monitoring required; and the interpretation of results of repeated tests.

6 Investigation of FBC and lipid testing

6.1 Background

In previous chapters of this thesis, the focus of the research has been the problems for which GPs order high volumes of pathology tests and, for a selection of these problems, the extent to which GPs' test selection represents that recommended in evidence-based guidelines and guidance documents. In contrast, the focus in this chapter is the pathology test. Specifically the study investigated the use of the two most commonly ordered pathology test types in Australian general practice as previously identified in Chapter 4: the FBC and the lipid test.

The FBC test (also known as a 'complete blood count') and lipid tests are 'low cost, high volume' pathology tests. Despite the high volume at which they are ordered,[37] they are not the most commonly funded MBS pathology items.[345] This is due to the effect of the MBS payment structure: the iso-resource item numbers, and the coning rule which limits MBS funding to the three most expensive MBS items from each episode of GP-ordered pathology tests (as described in Chapter 2).

The extent of 'coned out' or missing MBS data was investigated in 2010, using data from pathology laboratories. Of the FBCs ordered by GPs only 45–55% were charged to the MBS, the remainder being 'coned out'. For lipid tests, HDL was the only lipid component that could be investigated (because it has its own MBS item number) and just 20–30% of these were charged to the MBS.[19,346] It was not possible to investigate the effect of coning on the remaining lipid components because these are in MBS items that are structured as iso-resource chemistry groups, and the specific tests ordered cannot be identified. This study demonstrated that MBS data do not reflect GPs actual pathology ordering patterns for FBC and lipid tests.

GPs' rate of FBC and lipid test ordering increased significantly between 2000–02 and 2006–08 (see Chapter 4). These tests were among the most commonly ordered tests for the six problems investigated in Chapter 5, although the extent to which their use was supported varied. While lipid tests were generally supported for the investigated problems, this was not the case for FBC tests.

The purpose of this chapter is to investigate issues raised in the literature review and during research undertaken in previous chapters that could not be investigated using the cross-sectional BEACH encounter data. These issues and the objectives for this study are summarised below.

Who initiates the tests

The literature suggests that general practice patients frequently wish to have their blood tested.[33-35] Not all patients communicate a request for testing,[347] but when they do, GPs have described this as a contributing factor in their decision to order pathology tests.[36,37] However, few studies have quantified the proportion of tests perceived by GPs to be generated by patient request. A SAND substudy conducted in 2002, found that 15.1% of pathology tests ordered at general practice encounters were initiated by patient requests for testing.[348]

Purpose of tests

While the clinical problem for which a pathology test was ordered was recorded in the BEACH data set, the specific clinical purpose of the test (whether for monitoring, diagnostic or preventive purposes) was not requested. However, as discussed in Chapter 5, this has a bearing on the appropriateness of ordering specific tests and the interpretation of the result.

Interval between repeat testing

The cross-sectional nature of the BEACH encounter data meant that the interval between testing was not known. The review of guidance documents undertaken in Chapter 5 revealed that recommendations on the ideal interval between tests were often lacking, particularly when tests were used for monitoring purposes and, the majority of lipid and FBC tests were ordered by GPs for the long-term management of the chronic conditions. For monitoring of lipid levels, there has also been debate as to whether the commonly recommended monitoring interval of 6–12 months should be lengthened or whether there is a need for monitoring at all.[224-226,349]

Status of FBC testing

The clinical purpose for GP ordering of FBCs was unclear for most of the six problems investigated in Chapter 5. They appeared to be ordered opportunistically or routinely when GPs ordered pathology tests in the management of the problems

investigated. Others have described clinician's use of the FBC as 'indiscriminate', 'reflexive' or 'routine' in various inpatient and outpatient health settings.[350-354]

Even though the FBC was the most commonly ordered pathology test in general practice, it has not been the subject of much 'independent' discussion in the literature. In contrast, there is a wealth of literature about lipid testing in primary care.[83,226-228,355,356]

The use of FBC tests has been discussed in the outpatient[352-354] (including the emergency department[357,358]) and inpatient health settings.[67] Outcomes of these studies suggest that FBC tests either were not supported in the specific setting studied[67,352,353] or that improved appropriateness of ordering would reduce the number of FBCs.[357,358] Only one study recommended the routine use of FBCs in ambulatory care because they 'contributed to the wellbeing of the population'.[354]

I could find only one small study discussing use of FBCs in general practice and it was conducted more than 20 years ago.[350] This study introduced an intervention to improve appropriateness of ordering that reduced use of FBCs and improved appropriateness of their use.[350] Other studies in general practice would have included evaluation of GPs' use of FBC tests in the context of a broader intervention, [76,82,86,88,281] but these publications did not report information specifically about FBC ordering.

While GPs' use of FBC tests is rarely discussed in the literature, there is no shortage of articles recommending GPs use the test, most frequently for diagnostic purposes for a range of problems (such as, fatigue,[276,282,284] unexplained complaints,[281,359] nausea and vomiting[360]) and for the diagnosis and management of haematological diseases (such as anaemia[173,361]).

Medication status and morbidity profile of patients with lipid tests

The cardiovascular risk associated with lipid levels means that testing lipids and management of lipid levels is recommended for prevention and secondary prevention of cardiovascular disease in the management of related chronic diseases (see Chapter 5). The BEACH encounter data set provides a snapshot of the characteristics of patients and the details of the clinical problems for which lipid tests are ordered. However, this snapshot does not provide a complete profile of the morbidities that the patient has nor information about whether the patient currently takes lipid-

lowering medication. Both of these factors may influence the decision to order lipid tests. In this chapter I aim to fill the gaps in the available information highlighted above.

6.2 Objectives

The objectives of this study were:

- to measure the extent to which FBC and lipid tests are initiated by patients
- to investigate the purpose of ordering FBC and lipid tests for all problems, and specifically for the six problems investigated in Chapter 5
- to describe the interval between repeated FBC and lipid tests, and specifically the interval between these tests when used for monitoring purposes.

Additional objectives that are unique to either FBC or lipid tests are:

- to describe the differential diagnosis or diagnoses investigated by GPs when FBC tests were ordered for diagnostic purposes
- to investigate the morbidity profile, and lipid lowering medication use among patients for whom lipid tests were ordered.

6.3 Method

This study used the SAND method as described in Section 3.2.6. Ethics approval for this SAND study was obtained from the Ethics Committee of the Australian Institute of Health and Welfare, and the Human Research Ethics Committee of the University of Sydney. Data in this study were collected over two periods: July–August 2008 (Sample A), and September–October 2009 (Sample B).

At each encounter where the GP had ordered a FBC or lipid test they were asked a series of questions. I designed these questions to elicit information for each test on: who initiated the test; the clinical purpose of the test; whether the patient had been tested in the past, and (where applicable) the time since previous testing. Box 6.1 shows the SAND form designed for this study. These questions were attached to the bottom of the BEACH encounter form (see Appendix 2) and the SAND data collected can be linked to data (such as patient age and sex) recorded in the

encounter form. Additionally the linkages between the FBC and lipid test and the problem(s) for which they were ordered were drawn from the encounter form.

The 'purpose of test' categories were based on a previous study conducted in 2002 that defined tests as investigative, monitoring and/or preventive.[348] The preventive category was further broken down into tests for primary and secondary prevention. The purpose of tests were defined as:

- investigative or diagnostic for a new condition
- monitoring of an existing diagnosed condition
- primary prevention, i.e. screening in an otherwise healthy patient (e.g. following RACGP red book guidelines[177] for preventive activities)
- secondary prevention, i.e. screening in a patient with established risk factors for a condition but without the condition (Box 6.1).

GPs were also asked whether ordering the FBC or lipid test was 'opportunistic', i.e. the test was added to the pathology order once the decision to order another test had already been made.

In circumstances where FBC tests were ordered for investigative purposes, GPs were asked to specify the differential diagnosis or diagnoses for which the FBC was ordered. Selecting a differential diagnosis was defined as 'the process of weighing the probability of one disease versus that of other diseases possibly accounting for a patient's illness'.[362] These differential diagnoses were recorded by the GPs as free text and coded using ICPC-2 PLUS.[113]

When lipid tests were ordered, GPs were asked whether the patient was currently taking lipid lowering medication, and to indicate which conditions the patient had from a short list of conditions or risk factors (tick boxes). The listed conditions/risk factors were: dyslipidaemia, family history of dyslipidaemia, obesity, diabetes, hypertension and 'other cardiovascular disease' (Box 6.1).

Box 6.1: Example of SAND form completed by participating GPs (with instructions)

PLEASE READ CAREFULLY

The shaded section of the following forms asks questions about **SELECTED PATHOLOGY TESTS.**

You may tear out this page as a guide to completing the following section of forms.

INSTRUCTIONS

Ask **ALL** of the **next 30 PATIENTS** the following questions **in the order in which the patients are seen.**

Please **DO NOT select patients** to suit the topic being investigated.

Please ensure you complete details of all pathology tests ordered at today's encounter in the main section of the form before completing the questions in the shaded section below.

Selected pathology tests

Please advise whether you ordered a **lipid test** and/or a **full blood count (FBC)** for this patient **at this encounter**.

Lipid test includes total cholesterol, HDL, LDL and triglycerides.

If you **did not order** a lipid test or full blood count at this encounter please tick the box labelled '**neither of the above**' and **end the questions here** for this patient.

Initiation of tests

Under each heading (lipid or FBC) please use the tick boxes to indicate **who suggested each test—you, the patient** or **another health professional** (e.g. specialist).

Please **tick only one option per test** using the tick boxes in the appropriate column 'Lipid' or 'FBC'.

Purpose of test

Please use the tick boxes to indicate for each test whether the test was:

- **investigative** or diagnostic for a new condition
- **monitoring** of an existing condition
- **primary prevention****/screening in an otherwise healthy patient (e.g. following RACGP red book guidelines for preventive activities)
- **secondary prevention****/screening in a patient with established risk factors for a condition but without the condition
- **opportunistic**** - the test was added to the pathology order once the decision to order another test was already made.

Tick as many as apply for each test.

Previous testing

Please indicate whether this patient has had a lipid/FBC test on **any previous occasion**.

If you do not know if the patient has previously been tested please tick the box labelled '**don't know'.**

Time since last test

If 'yes' to either test please advise **how long** it has been **since the patient last had a lipid/FBC test**.

If you do not know when the last test was ordered please tick the box labelled '**don't know**'.

Investigative FBC test

If a **FBC** was **ordered today for investigative purposes** please write your **differential diagnosis(es)** in the space provided. Please **rank multiple differential diagnoses**, 1. being the most probable to 3. the least probable.

If you **do not have** a differential diagnosis please write '**none**'.

A differential diagnosis is defined as '*the process of weighing the probability of one disease versus that of other diseases possibly accounting for a patient's illness*'.

Source: www.medterms.com, accessed 27/5/08

Lipid medication and other conditions

For patients who have a **lipid test ordered today** please indicate whether the patient:

- is **currently taking a lipid lowering medication**
- has any of the **listed conditions or risk factors**.

At today's encounter did you order a:	Who suggested the test(s)? (Please tick one option per test)	Today's test(s) is/are: (Tick all that apply)	Has this patient had this test before?	The test was last ordered:	For FBC test:	For LIPID tests:	Does this patient have:
☐ Lipid test ☐ Full blood count ☐ Neither of the above → **End questions**	Lipid FBC GP ☐ ☐ Patient ☐ ☐ Other health professional ☐ ☐	Lipid FBC Investigative ☐ ☐ Monitoring ☐ ☐ Preventive (primary)** ☐ ☐ Preventive (secondary - pt has known risk)** ☐ ☐ Opportunistic** ☐ ☐ **See definitions on green sheet	Lipid FBC Yes ☐ ☐ No ☐ ☐ Don't know ☐ ☐	Lipid FBC <3 mnth ago ☐ ☐ 3-6 mnth ☐ ☐ 7-12 mnth ☐ ☐ >12 mnth ☐ ☐ Don't know ☐ ☐	If '**investigative**' what is/are your differential diagnosis(es)? 1. 2. 3.	**Is this patient currently taking lipid lowering medication?** ☐ Yes ☐ No ☐ Don't know	☐ Dyslipidaemia ☐ Family Hx dyslipidaemia ☐ Obesity ☐ Diabetes ☐ Hypertension ☐ Other CVD ☐ None of the above

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6.4 Results

6.4.1 The sample

Table 6.1 shows the age and sex distributions of patients in: each of the two samples (A and B) included in this study; the combined sample (A + B); and, all encounters recorded in BEACH in 2008–09.[122]

There was no statistically significant difference in the patient age and sex distributions in samples A and B did not differ significantly, indicating that the samples were homogenous (Table 6.1). Therefore, the samples were combined for the remaining analysis. In the combined sample, 193 GPs recorded details of FBC and lipid testing for 5,629 patients who visited them when participating in this study.

The patients in this study were a subsample of all patients in the BEACH study. The age-sex distribution of the combined SAND sample was compared with that of all patients in the BEACH study (Table 6.1). There was no difference in the sex distribution, but there were significant differences in the age distribution. Significantly more patients were aged 1–4 years, and fewer were aged 75 years and over, in the SAND sample than in the total BEACH sample (Table 6.1).

Table 6.1: Characteristics of patients in the FBC and lipid study sample

	Sample A	Sample B	Combined sample	BEACH 2008–09[122]
Variable	**Per cent[(a)] (95% CI) (*n* = 2,940)**	**Per cent[(a)] (95% CI) (*n* = 2,689)**	**Per cent[(a)] (95% CI) (*n* = 5,629)**	**Per cent[(a)] (95% CI) (*n* = 101,000)**
Sex (missing *n*)	(14)	(16)	(30)	(781)
Male	41.8 (38.6–45.0)	41.2 (38.5–43.9)	41.5 (39.4–43.6)	41.5 (40.7–42.3)
Female	58.2 (55.0–61.4)	58.8 (56.1–61.5)	58.5 (56.4–60.6)	58.5 (57.7–59.4)
Age (missing *n*)	(19)	(15)	(34)	(626)
< 1 years	2.1 (1.6–2.7)	2.6 (1.8–3.4)	2.3 (1.9–2.8)	1.9 (1.8–2.0)
1–4 years	4.8 (3.7–5.8)	6.4 (5.1–7.8)	5.6 (4.7–6.4)	4.0 (3.8–4.2)
5–14 years	5.8 (4.6–7.0)	4.8 (3.9–5.7)	5.3 (4.6–6.1)	5.1 (4.8–5.3)
15–24 years	8.0 (6.7–9.4)	9.6 (8.1–11.0)	8.8 (7.8–9.8)	8.1 (7.7–8.4)
25–44 years	22.2 (19.9–24.5)	23.8 (21.0–26.6)	23.0 (21.2–24.7)	20.7 (20.1–21.3)
45–64 years	29.0 (27.0–30.9)	28.0 (25.6–30.5)	28.5 (27.0–30.1)	29.1 (28.5–29.6)
65–74 years	13.3 (11.5–15.1)	11.1 (9.2–13.0)	12.3 (11.0–13.6)	13.8 (13.4–14.2)
75+ years	14.8 (12.4–17.1)	13.6 (10.8–16.5)	14.2 (12.4–16.1)	17.5 (16.7–18.3)

(a) Missing data removed.

Note: FBC – full blood count; CI – confidence interval.

6.4.2 FBC testing

GPs ordered a FBC test for 9.4% (95% CI: 8.4–10.5) of sampled patients. This equates to an estimated 10.6 million FBC tests ordered by GPs at the 113 million MBS paid GP encounters that occurred in Australia in 2008–09. There was no statistical difference in the order rate of FBC tests by patient sex: 9.6% (95% CI: 8.1–11.0) of males and 9.3% (95% CI: 8.0–10.5) of female patients (results not tabled).

The age-specific rate of FBC testing is shown in Figure 6.1. The likelihood of GPs ordering a FBC was constant across age groups for patients aged 15 years and over, approximately 10% of patients in each adult age group receiving an order for a FBC test. Ordering FBC tests for children aged less than 15 years was uncommon (Figure 6.1).

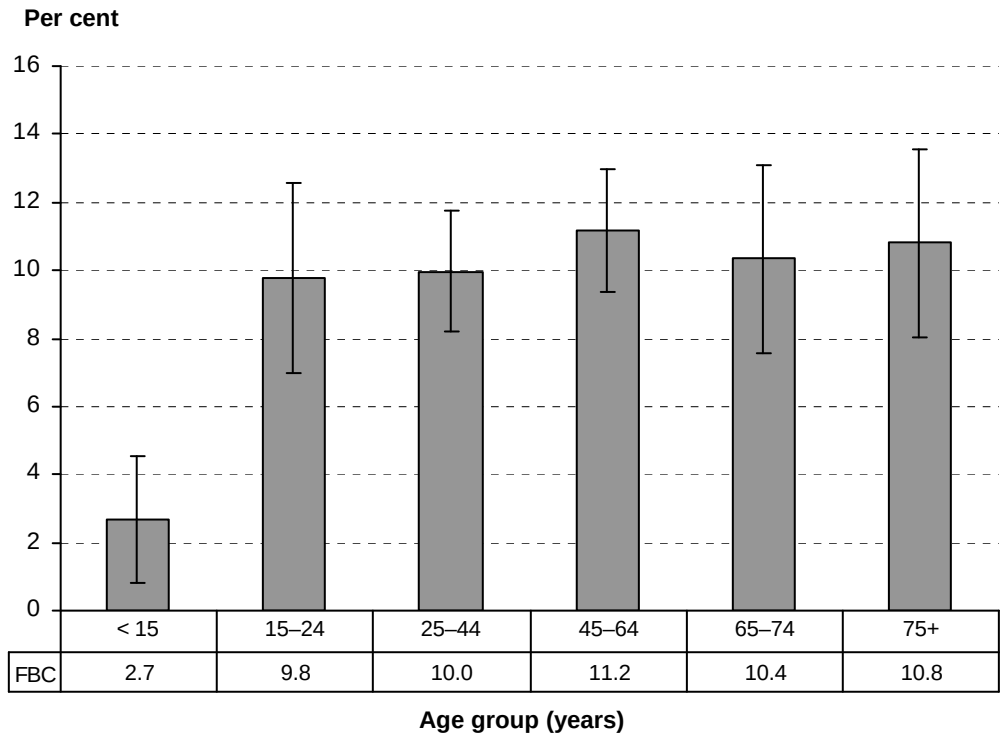

Figure 6.1: Patient age-specific rate of FBC orders (95% confidence intervals)

Test initiation

Of the 530 patients for whom GPs ordered a FBC test, responses to who initiated or suggested the test were recorded for 486. In most cases the GP initiated the FBC test (92.2%), but the patient initiated 6.0% and an 'other health professional' 1.9% (Table 6.2).

Purpose of test

It was possible to record multiple reasons for ordering FBC tests and at least one reason was recorded for 500 patients. In most cases (94.4% of patients) GPs listed only one reason. Two reasons were recorded for 4.8% of patients, and three reasons for 0.8% of patients (results not tabled).

An investigative or diagnostic purpose was the most common reason for ordering FBC tests, indicated for 48.0% of patients for whom a FBC was ordered. Monitoring was a recorded reason for 35.0% of patients, opportunistic testing (i.e. adding the test to a pathology order once the decision to order was already made) for 10.6%, primary prevention (i.e. screening in an otherwise healthy patient) for 8.0%, secondary prevention (i.e. screening in a patient with known risk factors) for 4.8% (Table 6.2).

Previous testing and interval between repeat testing

Most patients with a FBC test ordered at the recorded encounter had previously had a FBC test (80.6%), 12.4% were tested for the first time at the recorded encounter, and for 7.0% of patients previous testing status was not known (Table 6.2).

The time since the last test was ordered was recorded for 396 of the 404 patients who had a previous FBC test. The last test was ordered > 12 months ago for 39.7% of patients, 7–12 months ago for 22.2%, 3–6 months ago for 19.7%, < 3 months ago for 16.4%, and was not known for 2.0% of patients (Table 6.2).

Table 6.2: FBC testing in general practice patients

Variable	Number	Per cent[a] (*n* = 530)	95% LCL	95% UCL
Initiation of testing (missing)	(44)			
GP	448	92.2	89.8	94.6
Patient	29	6.0	3.9	8.0
Other health professional	9	1.9	0.7	3.0
Purpose of ordering[b] (missing)	(30)			
Investigative	240	48.0	42.8	53.2
Monitoring	175	35.0	29.4	40.6
Primary prevention	40	8.0	5.3	10.7
Secondary prevention	24	4.8	2.6	7.0
Opportunistic	53	10.6	6.7	14.5
Prior testing status (missing)	(29)			
Previously tested	404	80.6	76.6	84.7
Never tested	62	12.4	8.9	15.8
Unknown	35	7.0	4.6	9.3
Time since previous test[c] (missing)	(8)			
< 3 months	65	16.4	12.0	20.9
3–6 months	78	19.7	14.8	24.6
7–12 months	88	22.2	18.1	26.4
> 12 months	157	39.7	34.2	45.1
Unknown	8	2.0	0.5	3.5

(a) Missing data removed.
(b) Multiple responses allowed.
(c) Proportion of patients who had been tested previously.
Note: FBC – full blood count; LCL – lower confidence limit; UCL – upper confidence limit.

The interval since the previous FBC test was recorded for 170 of the 175 patients who had a FBC ordered for monitoring purposes. Almost half (48.3%) of those patients with a monitoring FBC had been tested in the previous six months. When compared with FBC tests ordered for non-monitoring purposes, monitoring FBC tests were significantly more likely to have been ordered within the previous 12 months (Table 6.3).

Table 6.3: Time since previous FBC test when ordered for monitoring versus other purposes

	Monitoring FBC test				FBC test for other purposes			
Time since previous test	Number	Per cent[(a)] (*n* = 170)	95% LCL	95% UCL	Number	Per cent[(a)] (*n* = 218)	95% LCL	95% UCL
< 3 months	37	21.8	14.8	28.8	25	11.5	6.3	16.6
3–6 months	45	26.5	18.6	34.4	33	15.1	9.5	20.8
7–12 months	47	27.6	20.4	34.9	40	18.3	13.4	23.3
> 12 months	41	24.1	17.4	30.8	112	51.4	44.0	58.8
Unknown	0	. .	. .	. .	8	3.7	1.0	6.4

(a) Missing data removed. Of the 404 patients with a previous FBC test data were missing for 16 patients.
Note: FBC – full blood count; LCL – lower confidence limit; UCL – upper confidence limit.

Problems for which FBC tests were ordered

The SAND data were linked to the data recorded on the encounter form to investigate the problems for which GPs ordered FBC tests. The problem or problems for which the test was ordered were linked for 466 of the 530 patients for whom a FBC was ordered. There were 64 patients for whom the FBC test was not linked to a problem on the encounter form. Where the FBC test and problem(s) was linked, GPs indicated that the 466 tests were ordered in the management of 492 problems (Table 6.4).

There was a broad range of problems for which FBC tests were ordered by GPs. The most common problems were hypertension (8.5%), weakness/tiredness (6.1%), health checks (4.9%), Type 2 diabetes (4.9%), pregnancy (3.5%), problems described as blood tests (3.0%), and lipid disorders (2.8%) (Table 6.4). The 23 problems listed in Table 6.4 accounted for 57% of all problems linked to FBC and the three most common problems accounted for less than 20%.

Table 6.4: Most common problems for which GPs ordered a FBC test

Problem managed	Number	Per cent of problem–FBC test links (*n* = 492)	95% LCL	95% UCL
Hypertension (non-gestational)*	42	8.5	6.1	11.0
Weakness/tiredness	30	6.1	3.7	8.5
Health check (15+ years)*	24	4.9	2.8	6.9
Type 2 diabetes	24	4.9	2.8	6.9
Pregnancy*	17	3.5	1.8	5.1
Blood test – all*	15	3.0	1.2	4.9
Lipid disorders	14	2.8	1.4	4.3
Anaemia*	13	2.6	1.3	4.0
Vitamin/nutritional deficiency	10	2.0	0.7	3.4
Menstrual problems*	9	1.8	0.5	3.1
Anxiety*	8	1.6	0.4	2.9
HIV infection/AIDS	7	1.4	0.0	4.2
Abdominal pain*	7	1.4	0.4	2.5
Depression*	7	1.4	0.3	2.6
Rheumatoid arthritis	7	1.4	0.4	2.5
Upper respiratory tract infection	7	1.4	0.1	2.7
Abnormal test results*	6	1.2	0.3	2.2
Ischaemic heart disease*	6	1.2	0.3	2.2
Cough	6	1.2	0.1	2.3
Urinary disease, other	6	1.2	0.3	2.2
Back complaint*	5	1.0	0.2	1.9
Vertigo/dizziness	5	1.0	0.1	1.9
Acute bronchitis/bronchiolitis	5	1.0	0.1	1.9
Subtotal	*280*	*56.9*	*. .*	*. .*
Total	**492**	**100.0**	**. .**	**. .**

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: Only problems accounting for > 1% of problem–FBC test links. FBC – full blood count; LCL – lower confidence limit; UCL – upper confidence limit; HIV – human immunodeficiency virus; AIDS – acquired immune deficiency syndrome.

Differential diagnoses of investigative FBC tests

When FBC tests were ordered for investigative purposes, GPs were asked to describe the differential diagnosis/diagnoses. Of the 240 FBC test ordered for investigative purposes, GPs recorded differential diagnoses for 230 patients. More than one differential diagnosis could be recorded per patient and a total of 349 diagnoses were recorded: 60% of patients had one differential diagnosis recorded, 28.3% had two and 11.7% had three recorded (results not tabled).

There was a wide range of problems listed as differential diagnoses. The most common were:

- anaemia (29.2% of diagnoses)
- infectious disease (8.0%), which was primarily expressed by GPs as 'infection'
- vitamin/nutritional deficiency (4.0%), primarily expressed as 'iron deficiency'
- viral disease (3.7%), primarily expressed as 'viral illness'
- infectious mononucleosis (2.9%)
- other disease of the digestive system, recorded by GPs as coeliac disease, colitis or pancreatitis (2.3%) (Table 6.5).

Table 6.5: Most common differential diagnoses for investigative FBC tests

Differential diagnoses	Number	Per cent (*n* = 349)
Anaemia*	102	29.2
Infectious disease, other/NOS	28	8.0
Vitamin/nutritional deficiency	14	4.0
Viral disease, other/NOS	13	3.7
Infectious mononucleosis	10	2.9
Other disease of the digestive system	8	2.3
Pneumonia	7	2.0
Purpura/coagulation defect	7	2.0
Abnormal test results*	6	1.7
Acute bronchitis/bronchiolitis	6	1.7
Subtotal	*201*	*57.6*
Total	**349**	**100.0**

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: FBC – full blood count; NOS – not otherwise specified.

Purpose of FBC test when ordered for selected problems

Table 6.6 reports the purpose of FBC tests ordered for each of the six problems investigated in Chapter 5. It was possible for multiple purposes to be recorded for each problem.

The majority of FBCs ordered for hypertension, Type 2 diabetes and lipid disorders were ordered for monitoring (Table 6.6). These three chronic conditions accounted for almost one-third (31.4%) of the monitoring FBCs ordered (results not tabled).

There were insufficient numbers of cases where GPs ordered FBCs for overweight/obesity to draw conclusions about the purpose of testing (Table 6.6).

FBCs for weakness/tiredness were almost exclusively ordered for investigative purposes (Table 6.6). It was the clinical problem for which GPs most often ordered investigative FBCs (11.7% of investigative FBC tests) (results not tabled). For the 28 patients with an investigative FBC ordered for weakness/tiredness, GPs listed 45 differential diagnoses for weakness/tiredness (12.9% of all differential diagnoses). The most common were anaemia (n = 22), infectious diseases (n = 6), and vitamin/nutritional deficiency (n = 4) (results not tabled).

When FBCs were ordered as part of the health check, the three main purposes were monitoring (27.3%), primary prevention (27.3%) and investigative (22.7%). There was no primary purpose for which GPs ordered FBCs for health checks (Table 6.6).

Table 6.6: Purpose of ordering FBC tests for selected problems

Problem managed[(a)]	Purpose of FBC	Number	Per cent of problem-specific FBC test links	95% LCL	95% UCL
Hypertension (non-gestational)*	Investigative	7	17.1	4.5	29.6
	Monitoring	24	58.5	42.4	74.6
	Primary prevention	5	12.2	0.0	24.4
	Secondary prevention	4	9.8	0.3	19.2
	Opportunistic	6	14.6	3.6	25.7
Weakness/tiredness	Investigative	28	96.6	89.3	100.0
	Monitoring	1	3.4	0.0	10.7
	Primary prevention	0	. .	. .	. .
	Secondary prevention	0	. .	. .	. .
	Opportunistic	0	. .	. .	. .
Type 2 diabetes	Investigative	2	8.3	0.0	20.5
	Monitoring	20	83.3	67.5	99.2
	Primary prevention	1	4.2	0.0	12.9
	Secondary prevention	4	16.7	0.0	36.2
	Opportunistic	1	4.2	0.0	12.9
Health check (15+ years)*	Investigative	5	22.7	3.0	42.4
	Monitoring	6	27.3	6.2	48.3
	Primary prevention	6	27.3	7.5	47.1
	Secondary prevention	2	9.1	0.0	21.7
	Opportunistic	3	13.6	0.0	27.8
Lipid disorders	Investigative	0	. .	. .	. .
	Monitoring	11	91.7	72.9	100.0
	Primary prevention	0	. .	. .	. .
	Secondary prevention	0	. .	. .	. .
	Opportunistic	1	8.3	0.0	27.1
Overweight/obesity (adults)*	Investigative	2	66.7	0.0	100.0
	Monitoring	1	33.3	0.0	100.0
	Primary prevention	0	. .	. .	. .
	Secondary prevention	0	. .	. .	. .
	Opportunistic	0	. .	. .	. .

(a) Multiple purposes for ordering FBC tests could be ordered per problem. There were cases where the purpose of the FBC was missing for the problem. The purpose of FBC was known for: 41 hypertension problems (missing *n* = 1); 29 weakness/tiredness problems (missing *n* = 1); 24 Type 2 diabetes problems (missing *n* = 0); 22 health check problems (missing *n* = 2); 12 lipid disorder problems (missing *n* = 2); 3 overweight/obesity problems (missing *n* = 0).

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: FBC – full blood count; LCL – lower confidence limit; UCL – upper confidence limit.

6.4.3 Lipid testing

GPs ordered a lipid test for 8.3% (95% CI: 7.3–9.2) of sampled patients. This equates to an estimated 9.4 million lipid tests ordered at GP encounters in Australia in 2008–09. GPs were more likely to order lipid tests for male patients (9.9%, 95% CI: 8.4–11.4) than for female patients (7.0%, 95% CI: 5.9–8.1) (results not tabled).

The age-specific rate of lipid testing is shown in Figure 6.2. Lipid tests were most likely to be ordered for patients aged 45–64 years (14.2%), followed by patients aged 65–74 years (10.5%), and those aged 75 years and over (8.2%). GPs rarely ordered lipid tests for patients aged less than 25 years of age (Figure 6.2).

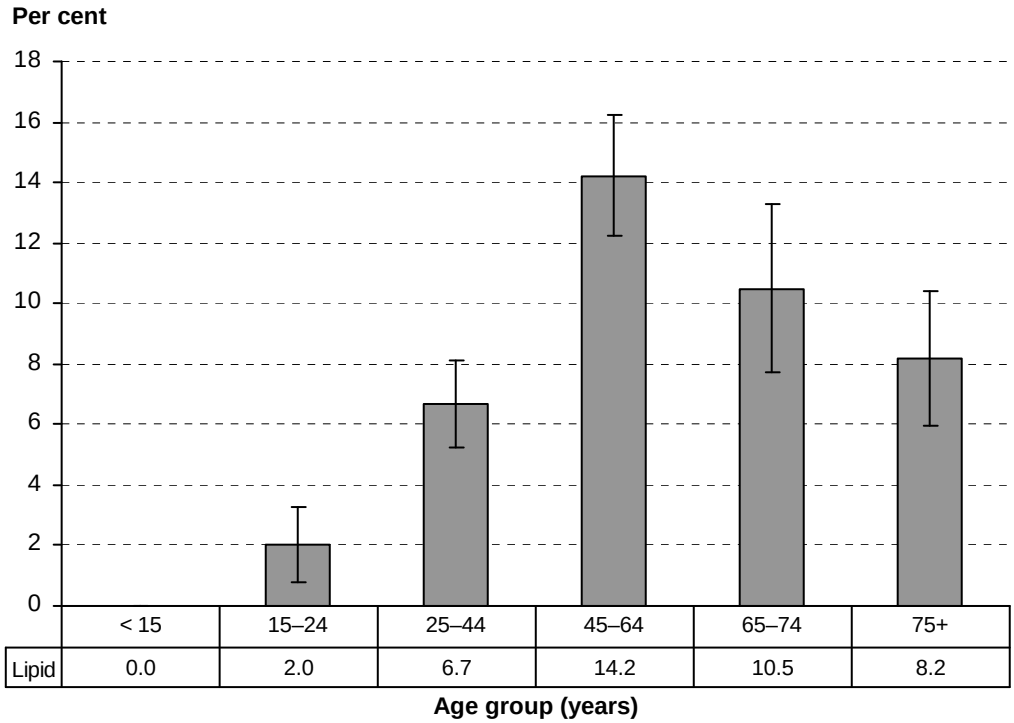

Figure 6.2: Patient age-specific rate of lipid orders (95% confidence intervals)

Test initiation

Of the 465 patients for whom GPs ordered a lipid test, the person who initiated or suggested the test was recorded for 456 patients. In most cases the GP initiated the lipid test (87.1%), followed by the patient (11.2%), and an 'other health professional' (1.8%) (Table 6.7).

Purpose of test

The purpose(s) of the test was provided for 455 patients. It was possible to record multiple reasons for ordering lipid tests. However, in most cases (83.7% of patients) GPs recorded only one reason for ordering lipid tests. Two reasons were recorded for 13.4% of patients, and three reasons for 2.9% of patients.

The most common purpose was monitoring (58.5% of patients). Prevention was recorded as the purpose for 35.8% of patients: 18.0% being for primary prevention (i.e. screening in an otherwise healthy patient), and 17.8% for secondary prevention (i.e. screening in a patient with known risk factors). An investigative or diagnostic purpose was recorded for 18.2% of patients, and the lipid test was opportunistic (i.e. adding the test to a pathology order once the decision to order was already made) for 7.3% (Table 6.7).

The most common combinations of indications were: monitoring and secondary prevention (5.9%), monitoring and primary prevention (2.9%), and investigative and primary prevention (1.3%) (results not tabled).

Previous testing and interval between repeat testing

Most patients with a lipid test ordered at the recorded encounter had previously had their lipid levels assessed (86.0% of 458 respondents), 10.5% were tested for the first time today, and for 3.5%, previous testing status was not known (Table 6.7).

Of the 394 patients who had previously had their lipid levels assessed, the time since the last test was ordered was recorded for 391 patients. The last test was ordered > 12 months ago for 42.2% of patients, 7–12 months ago for 26.6% of patients, 3–6 months ago for 22.0%, < 3 months ago for 7.4%, and was not known for 1.8% of patients (Table 6.7).

Table 6.8 shows the interval since the previous lipid test, recorded for 259 of the 266 patients who had a lipid test ordered for monitoring purposes. The last test was ordered more than 12 months ago for 31.3% of patients, 7–12 months ago for 30.1% of patients, 3–6 months ago for 29.3%, and < 3 months ago for 8.5% of patients. When compared with lipid tests ordered for non-monitoring purposes, monitoring lipid tests were significantly more likely to have been ordered within the previous 12 months (Table 6.8).

Medication status and morbidity profile

Current lipid lowering medication status was specified for 447 patients for whom lipid tests were ordered and almost 40% were currently taking a lipid lowering medication (Table 6.7). Of the 174 patients taking a lipid lowering medication, 80.4% had dyslipidaemia (with or without any of the other listed conditions). The remaining 19.6% of patients had at least one of the other listed cardiovascular diseases or risk factors (results not tabled).

Details on the presence/absence of the listed morbidities and risk factors were provided for 452 patients: 43.8% had dyslipidaemia, 43.1% had hypertension, 25.7% were obese, 18.8% had diabetes, 18.8% had a family history of dyslipidaemia, and 12.2% had an 'other cardiovascular disease' (Table 6.7).

At least one of these morbidities/risk factors was present in 84.3% (95% CI: 80.7–87.9) of patients who had a lipid test ordered and multiple morbidities/risk factors were common (44.5% of patients with lipid tests). Of the 381 patients with at least one of the listed morbidities/risk factors, 47.2% had only one, 24.9% had two, 18.6% had three morbidities and 9.2% had four or more. The most common morbidities/risk factors and combinations were: dyslipidaemia alone (13.6%, 95% CI: 9.6–17.7 of patients with morbidities/risk factors), hypertension alone (10.0%, 95% CI: 6.7–13.3), family history of dyslipidaemia alone (8.9%, 95% CI: 5.9–12.0), dyslipidaemia + hypertension (7.3%, 95% CI: 4.4–10.3), obesity only (7.1%, 95% CI: 4.5–9.7), dyslipidaemia + diabetes + hypertension (5.0%, 95% CI: 2.8–7.2), and diabetes alone (4.7%, 95% CI: 2.2–7.1) (results not tabled).

Of the 198 patients with dyslipidaemia who had a lipid test ordered, 73.7% (95% CI: 66.5–81.0) had at least one of the other listed morbidities/risk factors, and 71.4% were taking a lipid lowering medication. Of patients with dyslipidaemia: 55.1% (95% CI: 47.0–63.1) had hypertension; 28.3% (95% CI: 20.9–35.6) obesity; 24.2% (95% CI: 17.7–30.8) diabetes; 17.7% (95% CI: 10.6–24.8) family history of dyslipidaemia; 16.2% (95% CI: 11.3–21.0) other cardiovascular disease, and 26.3% had none of the other listed morbidities/risk factors (results not tabled).

There were 183 patients (40.5% of those with a lipid test ordered at the current encounter) with at least one of the listed morbidities or risk factors who did not have dyslipidaemia. Of these patients: 47.0% (95% CI: 39.0–55.0) had hypertension;

32.8% (95% CI: 24.6–41.0) obesity; 27.3% (95% CI: 19.6–35.0) family history of dyslipidaemia; 20.2% (95% CI: 13.9–26.6) diabetes; and 12.6% (95% CI: 7.5–17.6) had an other cardiovascular disease (results not tabled).

Table 6.7: Lipid testing in general practice patients

Variable	Number	Per cent[(a)] (*n* = 465)	95% LCL	95% UCL
Initiation of testing (missing)	(9)			
GP	397	87.1	83.6	90.6
Patient	51	11.2	7.9	14.4
Other health professional	8	1.8	0.6	3.0
Purpose of ordering[(b)] (missing)	(10)			
Monitoring	266	58.5	53.5	63.5
Investigative	83	18.2	13.9	22.6
Primary prevention	82	18.0	13.5	22.5
Secondary prevention	81	17.8	13.0	22.6
Opportunistic	33	7.3	4.3	10.2
Prior testing status (missing)	(7)			
Previously tested	394	86.0	82.6	89.4
Never tested	48	10.5	7.4	13.6
Unknown	16	3.5	1.9	5.1
Time since previous test[(c)] (missing)	(3)			
< 3 months	29	7.4	4.4	10.5
3–6 months	86	22.0	17.1	26.9
7–12 months	104	26.6	21.9	31.3
> 12 months	165	42.2	36.6	47.8
Unknown	7	1.8	0.5	3.1
Medication status (missing)	(18)			
Taking lipid lowering medication	174	38.9	33.9	43.9
Presence of associated morbidities[(b)] (missing)	(13)			
Dyslipidaemia	198	43.8	38.9	48.8
Hypertension	195	43.1	37.6	48.7
Obesity	116	25.7	21.0	30.4
Diabetes	85	18.8	15.0	22.6
Family history of dyslipidaemia	85	18.8	14.0	23.6
Other cardiovascular disease	55	12.2	9.0	15.3

(a) Missing data removed.
(b) Multiple responses allowed.
(c) Proportion of patients who had been tested previously.
Note: LCL – lower confidence limit; UCL – upper confidence limit.

Table 6.8: Time since previous lipid test when ordered for monitoring versus other purposes

	Monitoring lipid test				Lipid test for other purposes			
Time since previous test	Number	Per cent[(a)] (*n* = 259)	95% LCL	95% UCL	Number	Per cent[(a)] (*n* = 128)	95% LCL	95% UCL
< 3 months	22	8.5	4.7	12.3	6	4.7	1.0	8.3
3–6 months	76	29.3	22.9	35.8	9	7.0	2.4	11.7
7–12 months	78	30.1	24.1	36.2	26	20.3	12.8	27.8
> 12 months	81	31.3	24.8	37.7	82	64.1	54.9	73.2
Unknown	2	0.8	0.0	1.8	5	3.9	0.6	7.3

(a) Missing data removed. Of the 394 patients with a previous lipid test data were missing for 7 patients.
Note: LCL – lower confidence limit; UCL – upper confidence limit.

Problems for which lipid tests were ordered

The SAND data were linked to the data recorded on the encounter form to investigate the problems for which GPs ordered lipid tests. Of the 465 patients for whom a lipid test was ordered, the problem or problems for which the test was ordered were linked for 401 patients. There were 64 patients where the lipid test was not linked to a problem on the encounter form. Where the lipid test and problem(s) was linked, GPs indicated that the 401 tests were ordered in the management of 427 problems (Table 6.9).

The most common problems for which GPs ordered lipid tests were lipid disorders (20.8%), hypertension (15.9%), Type 2 diabetes (11.9%), health checks (6.9%) and problems labelled as blood tests (5.9%). Approximately half of all lipid test-problem linkages were accounted for in the three most common problems: lipid disorders, hypertension and diabetes (Table 6.9).

Table 6.9: Most common problems managed with a lipid test

Problem managed	Number	Per cent of problem–lipid test links (*n* = 427)	95% LCL	95% UCL
Lipid disorders	89	20.8	16.7	25.0
Hypertension (non-gestational)*	68	15.9	12.2	19.7
Type 2 diabetes	51	11.9	8.6	15.3
Health check (15+ years)*	29	6.9	4.1	9.7
Blood test – all*	25	5.9	3.1	8.6
Ischaemic heart disease*	13	3.0	1.4	4.7
Weakness/tiredness	11	2.6	0.8	4.4
Overweight/obesity (adults)*	11	2.6	1.0	4.2
Risk factor NOS	8	1.9	0.6	3.1
Prescription – all*	7	1.6	0.4	2.8
Abnormal test results*	7	1.6	0.4	2.8
Cardiovascular check-up*	6	1.4	0.3	2.5
HIV infection/AIDS	5	1.2	0.0	3.5
Subtotal	*330*	*77.3*	*. .*	*. .*
Total	**427**	**100.0**	**. .**	**. .**

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

Note: Only problems accounting for > 1% of problem–lipid test links. LCL – lower confidence limit; UCL – upper confidence limit; NOS – not otherwise specified; HIV – human immunodeficiency virus; AIDS – acquired immune deficiency syndrome.

Purpose of lipid test for selected problems

Table 6.10 reports the purpose of lipid tests ordered for the six problems investigated in Chapter 5. It was possible for multiple purposes to be recorded for each problem.

The majority of the lipid tests ordered for hypertension, Type 2 diabetes and lipid disorders were ordered for monitoring (Table 6.10). These three chronic conditions accounted for 60.5% of the monitoring lipids ordered (results not tabled).

Secondary prevention was also a common reason for ordering lipid tests for hypertension, Type 2 diabetes and overweight/obesity. When lipid tests were ordered as part of the health check, the main purposes were primary prevention (42.9%), and monitoring (35.7%) (Table 6.10).

Table 6.10: Purpose of ordering lipid tests for selected problems

Problem managed[(a)]	Purpose of lipid test	Number	Per cent of problem-specific lipid test links	95% LCL	95% UCL
Lipid disorders	Monitoring	78	87.6	79.1	96.2
	Investigative	3	3.4	0.0	7.3
	Primary prevention	10	11.2	3.2	19.3
	Secondary prevention	12	13.5	4.8	22.2
	Opportunistic	3	3.4	0.0	7.3
Hypertension (non-gestational)*	Monitoring	40	60.6	47.4	73.8
	Investigative	9	13.6	2.8	24.5
	Primary prevention	7	10.6	2.0	19.2
	Secondary prevention	17	25.8	14.1	37.4
	Opportunistic	2	3.0	0.0	7.3
Type 2 diabetes	Monitoring	43	89.6	80.5	98.6
	Investigative	4	8.3	0.4	16.3
	Primary prevention	3	6.3	0.0	15.5
	Secondary prevention	15	31.3	15.3	47.2
	Opportunistic	0	. .	. .	. .
Health check (15+ years)*	Monitoring	10	35.7	16.8	54.6
	Investigative	5	17.9	2.0	33.7
	Primary prevention	12	42.9	20.6	65.1
	Secondary prevention	2	7.1	0.0	17.2
	Opportunistic	2	7.1	0.0	16.8
Weakness/tiredness	Monitoring	4	36.4	1.7	71.0
	Investigative	6	54.5	20.6	88.5
	Primary prevention	0	. .	. .	. .
	Secondary prevention	0	. .	. .	. .
	Opportunistic	1	9.1	0.0	30.9
Overweight/obesity (adults)*	Monitoring	3	27.3	0.0	60.4
	Investigative	4	36.4	0.0	72.7
	Primary prevention	3	7.3	0.0	60.4
	Secondary prevention	5	45.5	5.9	85.0
	Opportunistic	1	9.1	0.0	27.8

(a) Multiple purposes for ordering lipid tests could be ordered per problem. There were cases where the purpose of the lipid was missing for the problem. The purpose of lipid testing was known for: 89 lipid disorder problems (missing *n* = 0); 66 hypertension problems (missing *n* = 2); 48 Type 2 diabetes problems (missing *n* = 3); 28 health check problems (missing *n* = 1); 11 weakness/tiredness problems (missing *n* = 0); 11 overweight/obesity problems (missing *n* = 0).

* Includes multiple ICPC-2 PLUS codes (see Appendix 6).

6.5 Discussion

FBC tests were widely ordered by GPs for a broad range of problems, most often for investigative or diagnostic purposes. The results suggest GPs generate an estimated 10.6 million FBC tests in Australia annually. Lipid tests were predominately ordered for a small number of chronic problems, usually for the purposes of monitoring lipid levels, and in total GPs' orders for lipid tests generate an estimated 9.4 million tests per annum in Australia.

Initiation of testing

FBC and lipid testing was primarily initiated by the GP. While patient desire to have pathology tests has been described as a factor influencing GPs' pathology ordering,[36,37] GPs perceived patients as initiating FBC and/or lipid testing at relatively few encounters (5% of FBC orders and 11% of lipids). There was no statistically significant difference between the proportion of FBC and lipid tests that were patient-initiated. However, when compared with an earlier SAND study conducted in 2002, the proportion of patient-initiated FBC tests was significantly smaller than the average for all pathology tests (15.1%).[348] This suggests that the decision to order FBC tests was more likely to be initiated by the GP than average for all tests, but this was not the case for lipid tests.

If an intervention or policy regarding FBC and/or lipid testing was to be introduced, then GPs should be the primary focus of the intervention or policy as the majority of testing is initiated by them.

Patient demand for testing has been described as one of the possible factors contributing to the increased use of pathology testing.[28,29,363] Comparison of the results of the current study with the 2002 BEACH study suggests that there has been no increase over time in the proportion of testing that was initiated by patient requests. However, the current study measures 'successful' communicated requests for testing, not the total patient demand for testing.

Demand for testing has been assessed as expectations of testing[32-35] and communicated requests to be tested.[347,364,365] Other studies report that 14–39% of patients in general practice have an expectation of pathology or imaging testing being ordered at their visit.[32-35] But only 7.5–9.4% of patients in outpatient settings

actually requested tests,[364,365] a smaller proportion than those expecting to be tested.[347] Both the proportions of patients expecting and requesting tests are larger than those whose request for testing is successful (as measured here).

The fact that a low proportion of patients in this study initiated pathology testing, together with the finding from other studies that fulfilment of expected or requested tests does not affect patient satisfaction,[32,35,347] suggests that patient demand for testing is managed successfully by GPs.

Full blood count

Pattern of use of FBC tests

GPs' use of the FBC test was widespread, with GPs ordering FBCs for one-in-ten contacts with all patients aged 15 years and over, regardless of patient sex. There was a wide range of problems for which FBCs were ordered, reflecting the distribution of ordering across patient age groups.

Other authors have described clinician's ordering of FBCs as 'indiscriminate', 'reflexive' or 'routine' on the basis of patterns of ordering.[350-354] The increased rate of GPs' FBC ordering over time for all problems (see Chapter 4), and specifically for the six problems investigated in Chapter 5, also raised concerns about GPs patterns of use of FBC tests.

The breadth and frequency of FBC testing in this study may be suggestive of routine ordering, but the purposes recorded by GPs for ordering FBC tests do not support this conclusion. GPs were able to describe a clinical purpose for 90% of FBCs ordered, the remainder being ordered 'opportunistically'. A FBC was described as 'opportunistic' if it was added to the pathology order after the decision to order was made. It is possible these opportunistic tests represent occasions of 'routine' or 'reflexive' ordering.

Investigative/diagnostic FBC tests

GPs indicated that the most common purpose for ordering FBCs was investigative/diagnostic, accounting for half of FBC testing in this study. GPs recorded the differential diagnoses being assessed with these investigative FBCs. The differential diagnoses were most commonly haematological disorders (e.g. anaemia) and infections, which aligns with FBC test ordering recommendations in the literature.[173,276,281,282,284,359-361,366] Weakness/tiredness was the most common problem

investigated with an FBC, but it accounted for only 12% of the investigative tests, reflecting the breadth of problems for which investigative FBC was ordered. The purpose of ordering FBC for weakness/tiredness was almost exclusively investigative, and the differential diagnoses recorded by GPs reflected those for which FBC testing was recommended in guidance documents (see Chapter 5).

Monitoring FBC tests

Monitoring was the second most common reason GPs ordered FBC tests, 35% of them being ordered for this purpose. The need to monitor the FBC in management of diseases where the result of the test directly reflects the disease status (e.g. anaemia, infections[231,366]) is logical. In contrast, the reason for monitoring FBC in the management of hypertension, Type 2 diabetes and lipid disorders is unclear because the FBC result is unlikely to monitor variables directly related to these diseases. GPs indicated the main purpose of ordering FBCs for these conditions was monitoring, confirming the hypothesis I made in Chapter 5, that GPs' use of FBC tests for these conditions was for monitoring.

Monitoring tests for these three problems accounted for one-third of all monitoring FBCs. As discussed in Chapter 5, guidelines for these conditions do not recommend FBC monitoring. It is possible that for patients with chronic conditions, GPs' ordered FBC tests opportunistically. For example, if patients have comorbidities (such as anaemia) which require FBC testing, that were not managed at the current encounter, GPs may have ordered the test opportunistically when ordering other pathology tests for the condition under management. However, this may well not be the case. Further investigation is needed to gain a better understanding of the reasons GPs order FBC tests.

FBCs were ordered frequently when ordered for monitoring, patients being monitored were significantly more likely to have been tested within the previous 12 months (76%) than those ordered for other purposes (45%). It is unclear whether or not this represents an ideal monitoring interval because no general information is available to Australian GPs about use of FBC tests for monitoring.

I could find only one document giving GPs guidance on the use of the FBC test and the follow-up of abnormal FBC results.[366] This New Zealand document provided consensus-based guidance on interpretation and follow-up of minor abnormal results

of the components of the FBC, because this was an area in which GPs indicated they needed guidance. As such, the guidance it contains is more relevant to FBCs ordered for investigative/diagnostic purposes than those ordered for monitoring.

It may be too difficult to provide general recommendations about FBC monitoring because the ideal frequency of monitoring will be influenced by the characteristics of the individual patient, the problem being monitored, and the expected variation of the test.[366] Data on ideal monitoring intervals and interpretation of repeated FBC testing may be included in the guidance documents for the individual problems for which monitoring FBCs were ordered rather than in the general literature. However, as discussed above, this was not the case for hypertension, Type 2 diabetes and lipid disorders.

Given the volume of FBC tests ordered by GPs for monitoring it is of concern that there is no published guidance available to GPs on what constitutes the best monitoring strategy. There is also limited guidance available on the interpretation of monitoring FBC tests. As such, GPs would be guided by their clinical experience when ordering and interpreting FBCs used for monitoring. There is a need for guidance on the use of FBCs for monitoring, particularly for chronic disease.

Preventive FBC tests

GPs reported a purpose of primary or secondary prevention for 13% of FBCs ordered in this study, a proportion small enough to challenge the assumption that FBCs are usually used as a screening test.[221,352,353] The use of FBCs for primary or secondary prevention was not supported in guidelines for preventive care (see Section 5.7). Similarly, studies investigating routine use of the FBC for case finding (i.e. primary prevention) in outpatient care recommended against the use of the FBC for this purpose because it generates a very low diagnostic yield (less than 1% of tests identified new cases of disease).[352,353] Given this lack of support for FBC as a preventive test it is reassuring that it was not the main reason for GPs' use of the FBC test. However it represents an area in which FBC ordering may be inappropriate.

The 'health check' in general practice is considered a preventive care activity. Therefore, it was expected that FBCs ordered for 'health check' patients would be ordered for preventive purposes. While this was the case for 36% of FBC tests

(primary prevention 27%, secondary prevention 9%), GPs also frequently reported monitoring (27%) and investigation (23%) as the purpose(s) of ordering FBCs for health checks.

The variety of purposes given for ordering FBCs for health check problems may indicate that the patients receiving health checks were not 'well' patients. They may have had symptoms requiring investigation with a FBC test or a disease (or history of disease) for which monitoring with a FBC was indicated. Caution is needed in interpreting the purpose of FBCs ordered for health checks as there were small numbers of health checks recorded in this study. However, the results demonstrate that the reason for ordering a test for a problem that is considered preventive cannot be assumed to be for prevention. If an intervention was implemented to discourage GPs from using FBC tests for preventive purposes, then targeting preventive health problems (such as the health check) to deliver this intervention would not be an effective strategy.

Due to the high volume of FBC tests ordered by GPs, the 13% ordered for prevention equated to approximately 1.4 million FBC tests ordered in Australia in 2008–09, a considerable volume of tests nationally that were not supported by current evidence-based guidelines.

Reducing the ordering of FBCs for prevention has the potential to substantially decrease the volume of FBC tests. But this will not necessarily translate directly into reduced cost of FBC tests funded through Medicare because of the coning funding rule (approximately 45–55% of FBCs ordered by GPs were 'coned out' and therefore were not Medicare-funded[19,346]). It is unclear whether a similar proportion of FBCs ordered for prevention would be coned out. The argument about effectiveness of any future intervention aiming to reduce inappropriate FBC ordering must be based on the ability of the intervention to improve quality of ordering rather than cost-effectiveness. The cost-effectiveness argument does not hold in this instance due to the coning effect. However, reduction of FBC ordering for prevention represents an opportunity to improve the quality of pathology ordering and has the potential to generate savings in terms of resource use and manpower required for this testing.

Lipid testing

Pattern of use of lipid tests

GPs ordered lipid tests most frequently at encounters with adult patients aged 45–64 years, followed by those aged 65–74 years and 75 years and over. The peak in testing in middle age reflects the age group in which lipid levels in the population are at their highest;[367] and the age from which lipid screening is recommended for cardiovascular risk assessment.[176,177] It also reflects the age group targeted by MBS items for health assessments in patients at risk of chronic disease.[18,232]

GPs ordered lipid testing more often at encounters with male patients than at those with females. This may be due to the increased risk of cardiovascular disease[177,237] and mortality in males in the population compared with females.[368] However, there were no corresponding sex-specific differences in the prevalence of dyslipidaemia or other conditions requiring management of lipid levels in patients attending general practice.[209] This suggests that the difference seen in this study was not due to differences in the sex-specific prevalence of disease requiring lipid management.

However, differences in sex-specific attendance patterns in general practice may explain some of the difference in rates of lipid testing. Men visit GPs less frequently than women,[369] and so to maintain a comparable level (by sex) of lipid screening in the patient population, GPs would have to test males at a higher proportion of their attendances than females. The data imply that GPs are being proactive in ensuring male patients have their lipid levels tested rather than suggesting that females are being tested at a lower rate, and it is therefore unlikely that the difference is of concern.

GPs ordered lipid tests for a relatively focussed group of problems compared with the breadth seen for FBC tests. Lipid disorders, hypertension, Type 2 diabetes, and health checks accounted for 55% of lipid testing, and the majority of these tests were ordered for monitoring. This is not surprising as guidelines recommended that the best practice management of each of these problems requires assessment of lipid levels and, if necessary, their subsequent management and monitoring (see Sections 5.4–5.7).

The most common reason for testing lipid levels was for monitoring of an existing disease, recorded for almost 60% of lipid tests. Other purposes for ordering lipid tests

were also commonly recorded: an investigative/diagnostic purpose was recorded for 18% of lipid tests; primary prevention for 18%, and secondary prevention 18%. It was possible for GPs to record multiple purposes, and this occurred most often when testing for secondary prevention, with half also having 'monitoring' recorded as a reason for ordering.

Monitoring of lipids

GPs ordered lipid tests for monitoring more frequently than for other purposes, and generated approximately 5.6 million orders for monitoring lipid tests in 2008–09. The majority (59%) of lipid monitoring by GPs in the current study was repeated at an interval of 3–6 or 7–12 months, indicating that GPs are following current guideline recommendations that advocate 6–12 monthly monitoring (see Section 5.6).

Recent evidence from two studies suggests that monitoring lipid levels at an interval of less than 3 years is likely to represent measurement error, rather than true change, because the signal-to-noise ratio in cholesterol testing is weak.[226,349] In other words, the amount of short-term biological and analytical variation (noise) makes it difficult to detect small changes in cholesterol levels (signal) when tests are repeated too frequently.

Only one of the above studies was published prior to the conduct of the current study. Glasziou et al. used data from the 'LIPID' clinical trial, and recommended that among patients in whom lipid levels are stable (within 0.5 mmol/L of target) the interval for monitoring should be every 3–5 years.[226] A move toward such a testing interval would represent a major change to GPs' current lipid monitoring practices. The fact that this represents a change to GPs' existing behaviour is of itself a barrier to the adoption of the new evidence.[321]

One of the commonly stated barriers to adoption of guideline recommendations is disagreement with the evidence or lack of applicability of the evidence to the patient population.[153,316-319,321] This includes the perception that clinical trial evidence does not reflect the real world clinical setting. This 'barrier' can be applied to the LIPID trial: it included patients had a history of acute coronary syndrome, who were taking pravastatin and had high total cholesterol.[226] Using the first criteria alone—acute coronary syndrome—would represent (at most) 12% of general practice patients in

the current study, assuming that all patients who had an 'other cardiovascular disease' had an acute coronary syndrome. GPs may be hesitant to adopt this new evidence, perceiving that the study findings would be relevant to a small minority of their patients.

The second study that recommended an interval of at least 3 years between repeated lipid measures was conducted in Japan and published in 2010. Takahashi et al.[349] investigated the signal-to-noise ratio of lipid measures taken in adults receiving an annual health check-up (excluding those who were taking a lipid lowering medication), and provided further evidence supporting the recommendation for a longer interval between repeated lipid measures in a broader group of patients.[349] GPs' may accept this 'real world' evidence more readily than the clinical trial data from the earlier study. Takahashi's study was published after my research was completed, therefore I could not measure its subsequent impact (if any) on GPs' ordering behaviour. GPs have been shown to adopt new evidence in their pathology ordering behaviour quickly (before it is incorporated in guidelines).[88] However, to do so they need to trust the evidence itself, and its applicability to their patients.[153,316,317,319-321]

Another factor is that GPs may believe that monitoring lipid levels has an effect on patient behaviour. The outcomes of testing in terms of patients' emotional, social, cognitive and behavioural responses to testing are not well studied.[63] It is possible that these outcomes could be beneficial to the patient (such as, improved adherence to medication, reassurance) or detrimental (such as increased anxiety).[63]

Numerous studies have shown that patient adherence to lipid lowering medications, particularly statins, is poor and decreases over time.[370-372] For example, non-adherence of statins in patients aged 65 years and over were 38%, 42% and 56% after 1 year, 2 years and 5 years respectively.[371] Patient adherence is important to ensure the health benefits of lipid lowering medication are realised and cost-effectiveness is maintained.[370,373,374]

Thus patient adherence to medication is a valid concern for GPs, but it is unclear whether monitoring lipids will improve adherence. A few studies have shown an association between lipid testing (monitoring) and improved adherence to lipid medication, but the causality of this relationship is unproven.[375] The results of

monitoring lipid tests have been found to have only limited ability to detect patients' lipid medication adherence.[355] Hence it appears that the action of monitoring may have an effect on patient adherence even though the results of these tests may not accurately measure adherence.

Despite the lack of robust evidence, guidelines for the management of lipid disorders recommend frequent monitoring of lipid levels as a tool to improve patient adherence to therapy.[178,220] GPs may be guided by these recommendations and their clinical experience of whether or not testing has a desirable impact on patient adherence.

The extent to which a change in the lipid testing interval would influence the volume of lipid tests analysed in laboratories can be seen in a UK study. Doll et al. found that if lipids were tested only once every 3 years then 79% of the lipid tests ordered in primary and secondary care in 2005–07 would not have been needed. Alternatively if lipid levels were tested once per year, as recommended for high risk patients in guidelines, then 42% of lipid tests would not have been needed.[367] The current study shows that most patients (84%) for whom GPs ordered lipid tests had cardiovascular conditions or risk factors for which current guidelines recommend annual testing. Therefore the lower estimate is likely to be a closer reflection of the amount of lipid testing that may be surplus in general practice based on current guideline recommendations.

The study by Doll et al. is likely to overestimate the amount of lipid testing that was 'unnecessary' by applying a simple measure of repeat testing to all patients. Further details about these patients (such as their diseases, risk factors or the reason for ordering a lipid test) were not available, yet may have an influence on the ideal interval between repeated testing. The longer interval of 3-5 yearly testing was not recommended for all patients.[226,349] It would only apply to patients being monitored, and the current study shows that only 60% of lipid tests were ordered for monitoring. Recommendations for a long interval between repeated testing would be applicable to only a subset of patients. Further research is needed to identify the subset of patients for whom GPs could implement a longer monitoring interval.

Lipid tests ordered by GPs generate a substantial volume of testing—an estimated 9.4 million lipid tests were ordered at GP encounters in Australia in 2008–09. Of these, 5.5 million were ordered for monitoring purposes. A change in monitoring

practices has the potential to substantially reduce the volume of lipid testing ordered by GPs. Further research is needed to determine: whether a lengthening in monitoring interval is acceptable to GPs and patients, for which subset patients this would be applicable, and whether it would adversely affect patient outcomes. While a reduction in volume of lipid testing generated by GP orders would generate savings in terms of resources required for testing, the extent of cost savings to the MBS is not known because of the current iso-resource items and coning funding model.

Limitations

The lipid and FBC testing activity for patients aged 75 years and over may not be accurately assessed in the study due to an under-representation of patients in this age group.

In this study, the definition of secondary prevention provided to participating GPs was 'screening in a patient with established risk factors for a condition but without the condition' and was based on the definition of the US Preventive Task Force that states "*secondary preventive measures* identify and treat *asymptomatic* persons who have already developed risk factors or preclinical disease but in whom the condition has not become clinically apparent."[101] The definition used in this study should have stated that the patient had not already been diagnosed with disease rather than stating that the patient did not have the disease. There is some contention around the definition of secondary prevention throughout the literature and confusion about the application of these definitions.[376,377] Therefore, readers may wish to combine primary and secondary prevention and view results as being indicative of FBC and lipid tests ordered for preventive purposes.

The interval between FBC and lipid tests is a single measure of the time between the patient's current and most recent FBC or lipid test. When the purpose of the test is monitoring this interval between FBC or lipid tests has been interpreted as the usual monitoring interval, but this may not reflect the patient's regular pattern of testing.

The FBC is a battery of tests which includes multiple components that are ordered together for convenience but have different clinical uses. The components of interest will vary based on the clinical situation. For example, when investigating anaemia the red cell count and red cell morphology are the components of interest. As such

the GPs' purpose for ordering the FBC test may reflect only part of the included tests.

Conclusion

FBC is the most commonly ordered test in general practice, yet there was a surprising lack of data and guidance available about the use of the test. This study partially fills this gap by providing data about GPs' use of FBC tests. GPs regularly ordered FBC tests for adult patients, for a broad range of problems, and most tests were ordered for investigative/diagnostic or monitoring purposes. Patients initiated only a small proportion of FBC tests, most of this testing being generated by the GPs' judgement that testing was needed.

There is a need for further research on the use of the FBC test for monitoring, including the situations in which it needs to be monitored, and the appropriate monitoring strategy. In contrast, FBC tests ordered for prevention represent a clinical use that is not supported in evidence-based guidelines. Prevention was not a major reason that GPs ordered FBCs, but due to the large volume of FBC tests ordered it represents a considerable number of tests that are potentially unnecessary, and is an area in which interventions could be targeted. Further, given the breadth of problems for which GPs' ordered the FBC, it would be better to target an intervention at the test and purpose (e.g. FBC tests used for prevention) than at the use of the test for a particular problem.

This chapter also describes GPs' ordering of lipid tests, the second most frequently ordered test in general practice. Most lipid testing was generated by the GPs' judgement that testing was needed. Lipid tests were ordered primarily for chronic problems, and most tests were ordered for monitoring purposes. New evidence suggests GPs may order monitoring tests more frequently than is needed. Introducing a longer interval between monitoring tests has the potential to significantly reduce the volume of lipid tests ordered by GPs. However, further research is needed to determine for which general practice patients this change in monitoring strategy could be applied, and to ensure it would not result in adverse outcomes for patients.

7 Predictors of GPs' pathology ordering

7.1 Background

The increasing use and cost of pathology services in general practice in Australia,[5] and internationally,[8-10] have prompted concern about the quality of GPs' pathology ordering. In Chapter 5, I assessed quality of ordering by measuring the appropriateness of GP pathology ordering for selected morbidities. In this chapter I investigate factors that contribute to variance in GPs' pathology ordering rates because the presence of variance among GPs is often regarded as an indicator of poor quality.

The presence of considerable variance among GPs in their use of pathology testing services has been established in Australia and internationally.[43-51,71-73,337] There is a huge range of reasons for which clinicians (including GPs) order pathology tests, including: diagnostic factors; therapeutic and prognostic factors; to monitor illness and drug therapy; for screening; patient-related factors; doctor-related factors; and policy and organisational factors.[36,37,40,41] All of these factors have the potential to account for variance among GPs' in terms of their pathology ordering and multiple factors may simultaneously influence this variance. Therefore studies seeking to investigate the variance among GPs' ordering of pathology tests aim to determine the independent predictors of the variance, using multivariate analysis.[43-51,71-73]

The most common factors investigated to identify the independent causes of variation are doctor-related factors or policy and organisational factors, followed by factors related to the patients. Other studies have found behavioural factors (such as GP attitude to risk and malpractice claims,[378,379] and communication style[380]) independently influenced GPs' pathology ordering behaviour, but these cannot be addressed through methods adopted in this thesis. The non-behavioural variables found to be independently associated with GPs' pathology ordering are summarised below.

Studies that found an association between GP sex and pathology testing reported that female GPs ordered more tests.[43,46-48] In other studies there was a univariate

association between GP sex and pathology testing[45,49,51] but with modelling this relationship disappeared[44,45,49] or was unclear.[51] Other studies did not test the influence of GP sex.[50,71]

Increased GP age or more years of experience were found to be independent predictors of lower rates of pathology ordering in some studies.[43-45] Others found a non-linear relationship between years of experience and testing in young GPs.[46,48] In other cases no effect of GPs' age or experience has been shown[47,49] or it was not tested.[50,71]

Country of graduation was found be a factor in some studies[43,46,47] but not others.[45] An effect related to education was found in one study in which variation was related to the training hospital attended by young GPs,[48] but 'medical school attended' did not have an effect in a separate study.[49] This suggests a possible effect of training, but the consistency of this result is affected by the health system of the country being studied.

Geographic location of the practice appeared to have an independent relationship with pathology ordering but the results were inconsistent as were the variables assessed. Rural areas were associated with lower[47,49] and higher[43,45] rates of testing. A relationship between increased distance to laboratory and lower rates of testing was found in one study[46] but not another.[50] Associations with size of the local population,[46] geographic region[50] and country[51] have also been found.

The number of GPs working at a practice was associated with higher[45] and lower[50] rates of pathology ordering. A number of other GP variables were found to be independently associated with testing. Examples include: involvement with guideline development,[50] number of auxiliary staff,[46] and use of problem orientated order forms.[50] These were not frequently investigated in studies and may reflect associations unique to the study population.

In some studies, the type of work or workload associated with pathology ordering was assessed at an aggregated level and related to the GP. Factors associated with increased testing were high frequency of visits per patient,[44] high proportion of (age-adjusted) patients,[47] higher proportion of services performed in the office (versus the hospital),[49] lower rates of psychotherapy services,[49] and higher rates of

long (Level C) Medicare consultations.[45] These variables may reflect differences in pathology testing based on the types of patients seen by GPs.

Most authors incorporated patient age and sex in their studies but only a small number measured the effect of this on variation in GPs' pathology ordering. Patient age was incorporated in most,[43-47,49,51,72,73] but not all[50,71] studies. Older patients were independently associated with more testing,[43,46] as was management of patients aged 15–64 years.[45] Hartley et al. found age a predictor of pathology testing but did not describe the nature of the relationship.[73]

Similarly, patient sex was incorporated in most,[43-46,49,51,72,73] but not all[47,50,71] studies. Management of female patients was independently associated with higher testing levels in some studies[43,46] and had no effect in others.[45,73]

Ferrier et al. incorporated the proportion of female patients aged 15–49 years in their study and found this group of patients were independently associated with higher rates of testing. Two studies adjusted the outcome measure of the study (rate of pathology testing) by patient age and sex.[44,51]

Adjustment for patient morbidity was only made in three studies.[45,72,73] In one of these studies the amount of variation explained by morbidity was not stated.[72] However, in the other two, it was the variable that accounted for the greatest proportion of variation in GPs' pathology ordering.[45,73] In many studies it is possible that data about patient morbidity was not available. Despite this lack of data, some authors have assumed that casemix has little effect and variability is due to the individual GPs' clinical requesting practices.[50]

Some of the studies investigating variation in GPs' pathology ordering did not specify the variables that were significant predictors or did not describe the nature of the relationship, instead stating that a relationship existed.[44,51,72,73] In another study the multivariate model did not identify any statistically significant predictors of GPs' pathology ordering.[71]

There is some inconsistency between studies in the variables found to be independently associated with GPs' pathology ordering. There are several possible causes for this inconsistency. The outcome variable used in the studies varied. Outcomes used include: total pathology ordering per GP; [43-46,71,73] rates of pathology adjusted by patient age-sex;[51] ordering rates of a selected group of the most common

individual tests;[47,50] a mixture of pathology and imaging tests;[46,50,72] ratio of pathology services to all services claimed by the GP;[48] quintiles of GPs' testing from low to high;[47] number and cost of tests per patient;[49] and presence or absence of testing (i.e. a binary variable).[72] To some extent these outcome measures were due to differences in the data sources used, such as laboratory data,[47,50,71] billing data,[43,48,49] and data collected at the GP encounter.[44-46,51,72,73]

Further, the number of variables included in multivariate analyses differed considerably and this also may be due, in part, to the source data. In particular, the lack of inclusion of morbidity or casemix variables in the studies may reflect data limitations.

Authors often had a narrow objective or specific hypothesis that the study was designed to address (e.g. to assess the effect of attending medical schools of different universities[49]), in terms of determining whether a specific variable was an independent predictor of pathology ordering.[46,48-50] In some cases this led to authors choosing a limited number of variables to include in the multivariate models, but the basis for selection was not provided.[49,50] Consequently variables were omitted that others had found were independent predictors of variation (such as GPs' sex[50]) even when these variables were available in the data set.[50] This calls into question the quality of some of the models used.

Several studies involved a local sample[44,46,48,49,71-73] and/or were not representative of the GP population within the respective country.[46,48-51,72] In addition, the majority of studies were either published more than 10 years ago, or, though published more recently, used data more than 10 years old,[43,44,46,48-51,71-73] and can be considered out of date. The limitations of previous studies, including inconsistent methodology, poor quality of the multivariate models, lack of representativeness and age of the data severely limit their reliability.

Only two studies included data that were collected since 2000 from nationally representative samples.[45,47] The most recent of these was conducted by Vinker et al. in Israel in 2003 using laboratory data for 16 common pathology tests ordered by primary care physicians.[47] The limited number of tests, lack of data on morbidity and differences in health systems between Israel and Australia meant that this study

could not provide a reliable indication of factors likely to account for variation in GPs' pathology ordering in Australia.

The second study used data collected in the BEACH study (the same study as used in this thesis) from a representative Australian sample in 1998–2001 to investigate variation in GPs' pathology ordering.[45] This previous BEACH study is relevant and relatively contemporary. However, there has been significant growth in the rate of GPs' pathology ordering since the study was done—it increased by 31%, from 29.7 tests/batteries of tests per 100 encounters in 2000–01 to 43.2 in 2007–08.[273] Due to this growth, and the limitations of previous research, I have investigated predictors of GP pathology ordering in this thesis. Identifying factors that are independent predictors of pathology ordering has the potential to inform future patterns of pathology ordering, particularly if these predictors relate to expected changes in the characteristics of the GP workforce and population characteristics.

7.2 Objective

This chapter investigates the extent to which the variance in GPs' pathology ordering rates can be explained by a number of factors including GP, practice, and patient characteristics, the clinical problem under management, and the type of encounter.

7.3 Method

The simple and multiple regression analyses were performed on data collected in BEACH from April 2007 to March 2008. In these analyses the GP was the unit of analysis and the outcome variable was total number of pathology tests/batteries of tests ordered per GP—referred to as rate of GP pathology ordering throughout this chapter. The statistical software package SAS 9.1.3[129] was used for univariate and multivariate analyses.

The data were unweighted because the variables used for weighting (GP age and GP sex) were adjusted for in the analyses (see Section 3.2.10).

In BEACH, problems under management and pathology tests ordered are coded at the GP terminology level using ICPC-2 PLUS and classified to the ICPC-2 (see Section 3.2.7). In this chapter problems managed were analysed at the classification chapter level using the 17 ICPC-2 chapters. As the analysis conduced in this chapter

investigates GPs' total pathology ordering, the types of pathology tests ordered by GPs were not investigated.

Simple linear regression was used to determine the proportion of variance in GP pathology ordering rates explained by each individual variable. Explanatory variables investigated are listed by 'family' in Box 7.1.

Variables listed in Box 7.1 were included in both the univariate and multivariate analysis, except where variables were highly correlated. This was the case for GP age and years in general practice, hence only GP age was fitted in the multivariate analysis.

In the analysis of variance, most variables were assigned a reference group. This group (or category) is clearly labelled for each variable in the results, and results are interpreted in relation to the reference group. However, a static reference group was not assigned for three variables: proportion of encounters by patient age, rate of problems managed in each ICPC-2 chapter, and the proportion of encounters with MBS item consultations classified as level A, B, C and D. Instead, for these categorical variables, each category was compared with the remainder of the categories in that variable. In effect the 'remainder of the categories' becomes the reference group to the category being examined. For example, when investigating the variance explained by MBS consultation levels: level A MBS consultations are compared with, as one group, level B, C and D consultations; level B MBS consultations are compared with level A, C and D consultations, and so on.

Multiple regression using stepwise (backward) elimination was used to find the independent predictors of GP pathology ordering rates. Predictor variables were fitted into the model in 'families' in the following order: GP demographics, practice characteristics, consultation type, patient demographics, and problems managed. The model was reduced by each family in turn, starting with problems managed, adjusting for all other families. Variables within problems managed were kept if significant (alpha=0.05) or improved the fit of the model. The next family (patient demographics) was then reduced, and so on, until all retained variables are (to some degree) significant.[381]

Box 7.1: Variables included in univariate and multivariate analysis

- GP characteristics
  - Sex
  - Age
  - Years in general practice
  - Fellowship of the Royal Australian College of General Practitioners (FRACGP) (yes/no)[(a)]
  - Workload (number of sessions worked per week)[(a)]
  - Country of graduation (international medical graduates)[(a)]
- Practice characteristics
  - Size of practice (number of full-time [FTE] equivalent GPs)[(a)]
  - State or Territory of practice location
  - Rurality of practice location using the Australian Standard Geographical Classification (ASGC) remoteness areas[(a)]
  - Accreditation‡ status (yes/no)
  - Teaching status (undergraduate or registrar training) (yes/no)[(a)]
- Patient characteristics
  - Proportion of encounters by patient sex
  - Proportion of encounters by patient age
  - Proportion of encounters with new patients‡
  - Proportion of encounters with patients with a health concession card‡ (Health care card‡ or Repatriation health card‡)
- Problems managed
  - Rate of problems managed in each ICPC-2 chapter‡
- Consultation type
  - Proportion of encounters with MBS GP consultation service items classified as level A, B, C and D.‡

(a) These variables are described in the data elements section of the method (Section 3.2.5).

‡ Definition of term is included in glossary.

7.4 Results

7.4.1 The sample

A total of 953 randomly sampled GPs participated in BEACH in 2007–08 and recorded data about 95,300 encounters.

The representativeness of the GPs and encounters sampled in 2007–08 has been demonstrated and published elsewhere.[121] The assessment of representativeness of all annual BEACH samples included in this thesis are discussed in detail in Section 3.2.10. In summary, in 2007–08, the sampled GPs were representative of Australian GPs in the sample frame in terms of their sex, age, and distribution across states. However, participants who graduated in a country other than Australia were slightly under-represented (26.5%) when compared with the total sample (30.2%) ($\chi^2 = 5.72$, $p = 0.017$).[121]

The age-sex distribution of patients at BEACH encounters where MBS general practice consultation service items were recorded as claimable was compared with that of patients at all Australian encounters claimed as MBS general practice consultation service items in the 2007–08 study period. There is an excellent fit of the MBS and BEACH age-sex distribution, with no age-sex category varying by more than 15% from the population distribution. The range of precision ratios (0.91–1.14) indicates that the BEACH sample of encounters is a good representation of Australian GP–patient encounters.[121]

GPs who participated in BEACH in 2007–08 ordered 45,597 pathology tests/batteries. An average of 47.8 pathology tests/batteries were ordered per GP per 100 encounters (standard deviation: 29.6), and 95% of GPs ordered between 9 and 97 pathology tests/batteries per 100 encounters (Table 7.1). The outcome variable (rate of GP pathology ordering) showed a normal distribution (results not shown).

Table 7.1: Description of pathology ordering per 100 encounters with GPs

Variable	Number of pathology tests per 100 encounters from each GP (*n* = 45,597 tests/batteries of tests)
Mean (standard deviation)	47.8 (29.6)
Range	0–263
Percentile of distribution	
5%	9
25%–1st quartile	27
50%–Median	43
75%–3rd quartile	64
95%	97

7.4.2 Univariate analysis

The results of the univariate analysis are shown in Table 7.2. The number of GPs analysed for each variable differs due to the removal of missing data, and the number used in the analysis of each variable is specified. Of the 17 variables investigated, 15 were found to be significant univariate predictors of GP pathology ordering rates when fitted alone.

GP characteristics

Female GPs had significantly higher pathology ordering rates than male GPs. Similarly those with Fellowship of the Royal Australian College of General Practitioners (FRACGP) had higher pathology ordering rates than their non-FRACGP colleagues (Table 7.2).

The rate of ordering decreased significantly with increasing age, GPs aged 55 years and over having the lowest ordering rates. Correspondingly, GPs with more than 20 years experience in general practice had the lowest ordering rates. Lower rates of ordering were also generated by GPs with a high workload (more than 10 sessions per week) compared with GPs who worked 1–5 sessions per week, and those who obtained their primary medical degree in Asia compared with Australian graduates (Table 7.2).

Practice characteristics

Compared with GPs in small practices with less than 2.0 full-time equivalent (FTE) GPs, those in moderately sized practices (with 2.0–4.9 and 5.0–9.9 FTE GPs) had

higher rates of pathology ordering. GPs in practices that were accredited and in those that provided undergraduate and registrar training also had higher rates of ordering than their counterparts in non-accredited, and in non-teaching practices (Table 7.2).

Location of practice by rurality was significantly associated with ordering rates. In particular, GPs in major cities had lower rates of ordering than GPs in inner and outer regional areas. The state or territory in which the GPs' practice was located showed a statistically significant association with pathology ordering rates ($p = 0.045$), but this association was not reflected in any individual state or territory (Table 7.2).

Patient characteristics

Higher ordering rates were associated with management of female patients, and of patients aged 45–64 years compared with patients in all other age groups. In contrast, management of children (aged less than 15 years) was associated with lower ordering rates of pathology (Table 7.2).

Problems under management

Higher rates of ordering were associated with management of problems classified in the following ICPC-2 chapters (in order of predictive value): female genital; endocrine, metabolic and nutritional; general and unspecified; urological; blood and blood-forming organs; pregnancy and family planning; psychological; circulatory; digestive; male genital; and social. Management of problems classified as respiratory was associated with lower pathology ordering rates (Table 7.2).

Types of consultations

General practice consultations claimable as standard (level B) were associated with lower ordering rates, whereas those claimable as long (level C) or prolonged (level D) were associated with higher ordering rates (Table 7.2).

Table 7.2: Univariate analysis of GP pathology ordering[(a)]

Variable	Regression Coefficient	Effect size (standard Beta)	Per cent of variance explained (R^2*100)	*P* value
GP characteristics				
Sex (*n* = 945) (reference = Male)	. .	. .	10.86	<0.001
Female	20.18	0.33	. .	
Age (*n* = 953) (reference = < 35 years)	. .	. .	5.44	<0.001
35–44 years	-8.07	-0.11	. .	0.039
45–54 years	-9.83	-0.16	. .	0.008
55+ years	-21.72	-0.35	. .	<0.001
Years in general practice (*n* = 946) (reference = 1–4 years)	. .	. .	2.59	<0.001
5–9 years	-1.65	-0.02	. .	0.675
10–19 years	-2.48	-0.03	. .	0.490
20+ years	-11.14	-0.19	. .	0.001
FRACGP (*n* = 948) (reference = FRACGP)	. .	. .	0.81	0.006
Not FRACGP	-5.32	-0.09	. .	
Workload (*n* = 944) (reference = 1–5 sessions per week)	. .	. .	1.65	<0.001
6–10 sessions per week	-6.55	-0.10	. .	0.015
11+ sessions per week	-15.07	-0.16	. .	<0.001
International medical graduate (*n* = 950) (reference = Australian graduates)	. .	. .	2.49	<0.001
UK / Ireland / New Zealand	-5.21	-0.05	. .	0.136
Asia	-15.52	-0.16	. .	<0.001
Other	-1.91	-0.02	. .	0.577
Practice characteristics				
Size of practice (number FTE GPs) (*n* = 930) (reference < 2 FTE GPs)	. .	. .	3.54	<0.001
2.0–4.9	9.36	0.16	. .	0.001
5.0–9.9	14.87	0.23	. .	<0.001
10+	0.93	0.01	. .	0.811

(continued)

Table 7.2 (continued): Univariate analysis of GP pathology ordering[(a)]

Variable	Regression Coefficient	Effect size (standard Beta)	Per cent of variance explained (R^2*100)	*P* value
Location by state/territory (*n* = 952) (reference = Australian Capital Territory)	. .	. .	1.51	0.045
New South Wales	8.25	0.13	. .	0.323
Victoria	10.55	0.16	. .	0.209
Queensland	16.72	0.22	. .	0.049
South Australia	10.27	0.10	. .	0.239
Western Australia	16.52	0.15	. .	0.063
Tasmania	11.22	0.07	. .	0.254
Northern Territory	18.60	0.08	. .	0.101
Rurality of practice by ASGC (*n* = 952) (reference = Major cities)	. .	. .	1.04	0.007
Inner/outer regional	6.70	0.10	. .	0.002
Remote/very remote	6.90	0.03	. .	0.340
Accreditation (*n* = 948) (reference = accredited practice)	. .	. .	1.27	0.001
Not accredited	-9.71	-0.11	. .	. .
Teaching practice (*n* = 948) (reference = teaching practice)	. .	. .	1.80	<0.001
Not a teaching practice	-7.99	-0.13	. .	. .
Patient characteristics				
Sex (*n* = 953) (reference = Female)	. .	. .	11.87	<0.001
Male patients	-0.75	-0.34	. .	. .
Age (*n* = 953)				
Patients < 5 years	-0.49	-0.09	0.85	0.004
Patients 5–14 years	-1.46	-0.20	4.07	<0.001
Patients 15–24 years	-0.23	-0.05	0.25	0.123
Patients 25–44 years	0.06	0.02	0.04	0.524
Patients 45–64 years	0.40	0.11	1.25	0.001
Patients 65+ years	0.05	0.03	0.09	0.352
Health concession card (*n* = 940) (reference = no card)	. .	. .	0.39	0.054
Health concession card holders	-0.08	-0.06	. .	. .
New patient (*n* = 953) (reference = not new patient)	. .	. .	0.16	0.222
New patients	-0.10	-0.04	. .	. .

(continued)

Table 7.2 (continued): Univariate analysis of GP pathology ordering[(a)]

Variable	Regression Coefficient	Effect size (standard Beta)	Per cent of variance explained (R^2*100)	*P* value
Rate of problems managed (ICPC-2 chapter) (*n* = 953)				
General and unspecified (A chapter)	0.90	0.31	9.56	<0.001
Blood and blood-forming organs (B chapter)	3.11	0.23	5.13	<0.001
Digestive (D chapter)	1.07	0.16	2.68	<0.001
Eye (F chapter)	0.47	0.03	0.08	0.385
Hearing (H chapter)	-0.35	-0.03	0.08	0.372
Circulatory (K chapter)	0.45	0.17	2.77	<0.001
Musculoskeletal (L chapter)	0.06	0.02	0.04	0.562
Neurological (N chapter)	1.27	0.10	1.01	0.002
Psychological (P chapter)	0.62	0.19	3.43	<0.001
Respiratory (R chapter)	-0.57	-0.17	2.98	<0.001
Skin (S chapter)	0.11	0.04	0.18	0.185
Endocrine, metabolic and nutritional (T chapter)	1.42	0.41	16.6	<0.001
Urological (U chapter)	3.13	0.23	5.35	<0.001
Pregnancy and family planning (W chapter)	1.18	0.20	4.00	<0.001
Female genital (X chapter)	1.57	0.44	18.96	<0.001
Male genital (Y chapter)	2.55	0.15	2.20	<0.001
Social (Z chapter)	2.33	0.11	1.28	0.001
MBS item[(b)] (*n* = 942)				
Level A – short	-0.02	-0.00	0.00	0.959
Level B – standard	-0.25	-0.17	2.85	<0.001
Level C – long	0.93	0.36	12.78	<0.001
Level D – prolonged	2.76	0.25	6.42	<0.001

(a) Missing data were removed from the analysis. There were 953 GPs in the total sample and the numbers available for each variable are specified next to the variable label.

(b) The MBS items are content-based GP consultation descriptors ranging from Level A (attendance for an obvious problem, no time specifications) to D (exhaustive consultation, minimum of 40 minutes) see glossary.

Note: FRACGP – Fellowship of the Royal Australian College of General Practitioners; ASGC – Australian Standard Geographical Classification; ICPC-2 – International Classification of Primary Care, Version 2; MBS – Medicare Benefits Schedule. Also see glossary.

7.4.3 Multivariate analysis

The independent predictors of pathology ordering rates are shown in Table 7.3. The final model explained 50.4% ($F_{21,880}$=42.65, p <0.001) of the variance in GPs' pathology ordering. This model included data from 902 GPs (94.6% of the original sample), for whom all data variables were complete. Of the 16 variables investigated, nine were found to be significant multivariate predictors of GP pathology ordering rates, results for which are described below.

GP characteristics

The association with GP sex and age seen in the univariate analysis persisted after adjusting for all other variables in the model. After adjustment, female GPs had significantly higher pathology ordering rates than their male counterparts, whereas GPs aged 45 years and over (particularly those aged 55 years and over) had lower ordering rates relative to GPs aged less than 35 years. In contrast, the association with workload and country of graduation found in the univariate analysis did not persist after adjustment (Table 7.3).

Practice characteristics

The effect of practice size and rurality persisted after adjustment. GPs in moderately sized practices with 5 to 10 FTE GPs had higher rates of ordering than those in practices with less than 2 FTE GPs. GPs in practices located in inner and outer regional areas had higher order rates than those in major city practices. However, the effect of state/territory of practice location, and medium practice size (2.0–4.9 FTE GPs) were no longer significant after adjustment (Table 7.3).

Patient characteristics

Although not significant in the univariate analysis, after adjustment, management of new patients was associated with higher ordering; and management of patients with a health concession card was associated with lower ordering. This suggests the effect of each of these variables on pathology ordering was associated with other variables in the model (Table 7.3).

Both before and after adjustment, management of patients aged less than 5 years was associated with lower ordering rates. The effect of the proportion of female patients and patients aged 45–64 years did not persist in the multivariate analysis (Table 7.3).

Problems under management

In the multivariate analysis, higher rates of ordering were associated with management of problems classified in the following ICPC-2 chapters: (in order of predictive value) endocrine, metabolic and nutritional; male genital; general and unspecified; female genital; urological; and blood and blood-forming organs (Table 7.3).

The effects of the management of problems classified as pregnancy and family planning, circulatory, respiratory, psychological and social, identified in the univariate analysis were not significant after adjustment (Table 7.3).

Types of consultations

General practice consultations claimable as long (Medicare level C) and to a lesser extent those claimable as standard (level B) were independently associated with higher rates of pathology ordering. The effect of the proportion of prolonged (level D) consultations did not persist after adjustment (Table 7.3).

Table 7.3: Final multivariate model of independent predictors of GP pathology ordering[(a)]

Predictor variables	Regression coefficient	T-Value (F-partial)	*P* value	Effect size (standard Beta)	Unique variance (per cent)
GP characteristics					
GP sex (reference = Male)					
Female	5.86	2.92	0.004	0.10	0.48
GP age (reference = < 35 years)					
35–44 years	-4.43	-1.52	0.129	-0.06	0.13
45–54 years	-6.22	-2.23	0.026	-0.10	0.28
55+ years	-13.37	-4.49	<0.001	-0.22	1.14
Practice characteristics					
Practice size (reference = < 2 FTE GPs)					
2.0–4.9	3.79	1.86	0.064	0.06	0.19
5.0–9.9	7.90	3.68	<0.001	0.13	0.76
10+	1.54	0.53	0.594	0.02	0.02
Rurality of practice by ASGC (reference = Major cities)					
Inner/outer regional	6.22	3.73	<0.001	0.09	0.78
Remote/very remote	5.16	0.91	0.363	0.02	0.05
Patient characteristics					
Patients < 5 years	-0.40	-2.88	0.004	-0.08	0.47
Health concession card holders	-0.09	-2.81	0.005	-0.08	0.44
New patients	0.19	3.02	0.003	0.08	0.52
Rate of problems managed (ICPC-2 chapter)					
General and unspecified (A chapter)	0.53	6.96	<0.001	0.18	2.73
Blood and blood-forming organs (B chapter)	1.18	3.54	<0.001	0.09	0.71
Endocrine, metabolic and nutritional (T chapter)	1.10	11.23	<0.001	0.32	7.10
Urological (U chapter)	1.21	3.63	<0.001	0.09	0.74
Female genital (X chapter)	0.72	6.36	<0.001	0.20	2.28
Male genital (Y chapter)	3.11	7.09	<0.001	0.19	2.83
MBS item[(b)]					
Medicare level B – standard	0.11	2.56	0.011	0.07	0.37
Medicare level C – long	0.35	4.18	<0.001	0.13	0.98

(a) Missing data were removed from the analysis. 902 GPs had all data variables available and were included in the final multivariate data.

(b) The MBS items are content-based GP consultation descriptors ranging from Level A (attendance for an obvious problem, no time specifications) to D (exhaustive consultation, minimum of 40 minutes) see glossary.

Note: ASGC – Australian Standard Geographical Classification; ICPC-2 – International Classification of Primary Care, Version 2; MBS – Medicare Benefits Schedule. Also see glossary.

7.5 Discussion

This study demonstrated that there was considerable variation among GPs in their use of pathology tests, with 95% of GPs ordering between 9 and 97 tests/batteries per 100 encounters. This variation is consistent with that reported in other studies.[44,46,47,50,51,72,82,337] The multivariate model used in this study explained just over half of the variance in the rate of GPs' pathology ordering. A number of variables were found to be independent explanatory predictors of pathology ordering. The strongest was the type of problem under management, followed by variables related to the GP, the practice, the patients and the types of consultations.

This study investigated variables that were independent predictors of the volume of GPs' pathology ordering in Australia. While these variables do not explain the increase in GPs' pathology ordering seen in recent years,[5] comparison of results with those of previous studies can inform whether these independent predictors have changed over time or new predictors emerged that may have contributed to the increase. In addition, the significant predictors identified in the current study can be viewed in the context of expected changes in the characteristics of the Australian GP workforce and population to predict likely future pressures on the utilisation of health resources for pathology testing.

GP characteristics

GP sex and age were the only GP characteristics associated with pathology ordering after adjustment in this study. Female GPs were found to order significantly more pathology tests than their male counterparts. Previous studies have either found a similar result,[43,46-48] or no independent association with GP sex.[44,45,49] Reasons for this discrepancy are unclear, but differences in the models used in each of the studies may have contributed—particularly the extent to which patient characteristics and problems managed by GPs were included. For example, compared with male GPs, Australian female GPs manage significantly more encounters with female patients and consequently manage more female-specific problems, such as female genital checks for Pap smears.[382] These factors are not independent of each other. Therefore, interpreting the effect of GP sex on pathology ordering reported in these studies after adjustment requires consideration of which variables were included in the multivariate model.

Of the four studies that found female GPs ordered more tests than male GPs, only two included adjustment for patient sex,[43,46] and none adjusted for morbidity.[43,46-48] Three earlier studies found no association of pathology ordering with GP sex, all three included patient sex,[44,45,49] and two also included morbidity in the multivariate models.[44,45] Consequently, the only two earlier studies that adjusted for patient sex and morbidity (one of which was the previous study using BEACH data from 1998–2001), as I did in this study, did not support the finding that female GPs ordered more pathology tests. However, a recent study investigating sex-specific differences in GPs' practising style, using BEACH data from 2009–10, found that female GPs ordered more pathology tests after adjustment for patient sex and morbidity.[382] This supports the findings of the current study, and suggests that a relationship between GP sex and ordering may have developed over time.

GP age and years of experience are commonly related to GPs' pathology ordering rates. Increasing age could be assumed to be synonymous with increasing experience. In this study age and experience were highly correlated, therefore only GP age was analysed—and found to be inversely associated, as age increased the rate of testing decreased. This supports the findings of three previous studies,[43-45] two of which were representative Australian studies.[43,45] In contrast, one representative international study found no effect of GP age or years since graduation on pathology testing.[47] Other small studies either reported a non-linear independent effect[46,48] or no effect[49] of GP age on pathology testing after adjustment.

In the context of the Australian GP workforce the relationship of GP sex and age to pathology ordering raises potential concerns. The GP workforce has become increasingly feminised and is ageing.[16] In 2008, one-third of GPs were aged 55 years and over and 38.4% were female.[16] There have been considerable efforts to increase the number of medical graduates entering general practice[383] to replace the ageing workforce, and the majority (62% in 2008) of GP registrars (i.e. medical graduates currently training to become GPs) are female.[383] The results of this study suggest this group of young female GPs could be expected to order disproportionately more pathology tests. Therefore, the focus on identifying gaps in GP registrars' education about quality use of pathology services[384] is timely.

Practice variables

This study showed that GPs practising in rural locations classified as inner and outer regional areas ordered more tests than those in urban areas. This finding is consistent with two earlier Australian studies: one used BEACH data;[45] and the other used MBS pathology billing data.[43]

However, this finding was not echoed in international studies. In two of these, the opposite effect was found, with pathology ordering being higher in urban areas;[47,49] and in another, no association between rurality of practice and pathology ordering was found.[50] The small geographic size of the country or region(s) investigated in these studies may explain differences in the effect of rurality on pathology ordering between the studies and compared with the current study.[47,49,50] Some international studies assessed whether geographic location of the practice had an independent effect of pathology ordering using variables other than rurality (e.g. distance to laboratory from practice location), but a consistent effect did not emerge.[46,50,51]

The effect of rural location in the current and past Australian studies[43,45] is likely to be related to the frequency of GP–patient attendance in these areas. In 2006–07, fewer GP services per person were claimed through Medicare with increasing geographic remoteness,[385] possibly related to lack of access in the more rural areas. The three Australian studies that reported higher ordering in rural areas (after adjustment) all used encounter-based data about GPs' pathology ordering, and were therefore affected by attendance patterns (e.g. in encounter-based studies, the lower the rate of attendance the lower the likelihood of being sampled). A population group which attends less frequently (such as those living in rural areas), assuming a similar need for pathology, would be more likely to have pathology ordered because they have fewer GP visits in which the opportunity to order can arise. Therefore, it is unlikely the higher rate of pathology of GPs in rural locations seen in this study is a concern. However, this could be tested in future studies by adjusting for attendance patterns of patients in different rural areas or by using data not affected by attendance patterns.

Australian GPs' practising in larger practices had higher rates of pathology ordering than those in small practices in the current and past studies using BEACH data.[45] In contrast, Verstappen et al.[50] found that GPs in the Netherlands who worked in group

practices (> 2 GPs) ordered fewer tests than those in solo practice. No other studies investigated practice size as a predictor of pathology ordering.

Verstappen et al.[50] hypothesized that lower ordering in group practices was due to clinical support provided by the opportunity to discuss a case with colleagues. It is conceivable that the behaviour of peers could influence GPs' pathology ordering behaviour. Several studies have used feedback comparing GPs' test utilisation with their peers as part of interventions to improve quality of pathology ordering.[82,92,96,386] Often these interventions achieve a reduction in pathology ordering.[92,96,386] However, it is possible that peer influence may be multi-directional, depending on the behaviour of peers. In the current study, GPs practicing in larger practices ordered more tests than those in smaller practices, and this may reflect exposure to colleagues with higher rates of pathology ordering behaviour.

Another possible explanation for the effect of practice size is corporate ownership of general practices within Australia. General practices owned by corporations tend to be large and incorporate other health services (such as pathology and imaging services) which are also commonly owned by the corporation, in one medical centre.[387,388] Since the mid 1990's corporate ownership of general practices in Australia has increased, raising concerns about the potential for influence on GPs' use of health services in which corporations have a shared interest.[387-391] Catchlove acknowledged this risk, but argued there was no evidence that GPs' service use had been unduly influenced by corporation status.[388] Instead he believed that simply by locating health services together, the proximity would provide the opportunity for the corporations to profit from GP referrals without the need for inducements.[388]

Studdert et al.[392] sought to investigate whether proximity to the pathology industry as indicated by presence of pathology collection centres in or adjacent to the practice influenced GPs pathology ordering in Australia. During the data period for this study (2000–09) the number and distribution of these collection centres was regulated.[393] Due to this restriction they were commonly located in larger practices due to the high volume of patients. Studdert et al. found no independent effect of practice proximity to collection centres (in Sydney and Melbourne) on GP pathology ordering.[392] While no evidence has emerged of inducements in regard to GPs' pathology ordering, the concern about the potential[390,391] for such led the Australian Government to

strengthen the legislation on activities that are (and are not) acceptable between requesters (such as GPs) and providers of pathology services to ensure no inducements are made in regard to pathology services.[394]

Defining 'corporate ownership' in Australian general practice is difficult as there is a wide range of possible ownership models, and so the extent to which practice size represents corporate ownership is uncertain. If the higher pathology rate at larger practices represents higher rates of testing at practices that are corporate owned, this may be a concern. It must be kept in mind that this higher testing does not provide any measure of the quality of the pathology testing. It may be that larger practices, whether corporately owned or not, have more resources available to them to ensure that patients are tested appropriately (e.g. through patient recall for monitoring or preventive care). It is unclear why GPs in larger practices order more pathology tests. Further investigation is needed to determine what causes this effect and whether it represents a cause for concern.

Characteristics of GP workload

Variables related to the patient, the types of problems managed and types of consultations are all indicators of the GPs clinical workload.

In the current study, after adjustment, GPs' pathology ordering was not associated with management of patients of a particular sex, and only management of young patients (aged less than 5 years) was associated with lower rates of testing. This suggests that the significant effect of patient age and sex reported in the univariate analysis was counteracted by other variables in the multivariate model. In particular, there is likely to be an interaction between patient age, sex and problems that generate high volumes of pathology testing. For example, the management of sex-specific problems classified to the female genital (such as Pap smear) and male genital (such as prostate problems) ICPC-2 chapters, together explained 5% of the variance in this study. The inclusion of sex-specific morbidities is likely to have contributed to negating any independent effect of patient sex on GPs pathology ordering. Therefore the fact that many studies did not incorporate patient and casemix characteristics, other than age and sex into multivariate models used to investigate independent predictors of pathology ordering should be borne in mind when comparing results of studies.

The results of the current study, when compared with those of past studies using a similar method and multivariate model (incorporating patient age, sex and morbidity variables, among others), support earlier findings that patient sex is not an independent predictor of GPs' pathology ordering.[45,73] However, there were not similar findings for patient age. The current study found management of young patients resulted in fewer tests and no age groups were associated with higher testing. In contrast, Britt et al. reported higher ordering associated with management of patients aged 15–64 years.[45] Hartley et al.[73] stated that patient age explained 3.3% of variation in British GPs' pathology ordering but not which age groups explained the variation.

Adjustment for patient age and/or sex was made in several other studies,[43,44,46,47,49,51,72] but the effect of these variables was only reported in two of these.[43,46] Kristiansen et al.[46] and Calcino[43] both reported that management of older patients and female patients were each independently associated with increased rates of pathology testing, but neither study incorporated morbidity in their analysis.

In the current study the types of problems managed by GPs were the strongest predictor of GPs pathology ordering. Very few studies adjusted for patient morbidity in their investigation of independent predictors of pathology ordering. Yet the two past studies that did, also found that it was the strongest independent explanatory predictor of GPs' rates of pathology ordering.[45,73]

Management of problems related to the endocrine system, those of a general and unspecified nature, and those related to the male and female genital systems were the strongest problem predictors of higher pathology ordering rates. Management of problems classified to these four chapters explained almost 15% of the variance in GPs' testing rates.

The individual conditions in Chapter 4 that contributed to the majority of pathology tests ordered by GPs may provide some insight into the conditions within these chapters which have the greatest potential to explain the variation. For example, the conditions classified in the general and unspecified chapter include health check-ups, weakness/tiredness, abnormal test results and viral illness. The endocrine and metabolic conditions include diabetes, lipid disorders, overweight/obesity, and thyroid problems. The chronic endocrine and metabolic conditions are perhaps an

area of concern in the context of Australia's ageing population[395] as many of these conditions are more prevalent in older patients.[154]

The higher rate of pathology associated with level C Medicare consultations may reflect increased complexity and length of the consultation. In order to qualify for level C reimbursement the consultation must be a minimum of 20 minutes and may involve taking a detailed history, a clinical examination, arranging any necessary investigations and/or implementing a management plan in relation to one or more problems.[23] The number of problems managed at general practice encounters and the proportion of encounters with older patients is increasing.[103] In the context of an ageing population,[395] it might be expected that GP workload will become more complex involving more older patients with multiple chronic conditions—the management of which is likely to require pathology testing. The future impact of Australia's ageing population on the volume of pathology ordered by GPs is investigated in Chapter 8 of this thesis.

New patients were significantly more likely to receive pathology testing in the current study. Kravitz et al.[365] found that new patients were independently more likely to directly request imaging and pathology tests from their physician and also to receive tests. Establishing a thorough medical history for a new patient is accepted practice and this often involves pathology tests. Lack of access to previous pathology results may also be a factor. In our current health system, GPs would usually only have access to previous records and test results if a new patient brought a copy to their first encounter.

Lower rates of pathology testing were associated with management of patients holding health concession cards. Concession cards incorporate: health care cards, which give access to health care through a higher Government subsidy level for those on lower incomes; and Repatriation health cards for returned servicemen and women and their families. The lower rate of GPs' ordering could be due to higher attendance patterns in this group, or to physicians' or patients' perception of affordability. Patients with a lower socio-economic index attend general practice more often[396] and therefore (as discussed above) in an encounter sample they would have a higher chance of being included in the sample and a lower chance of having pathology recorded at the sampled encounter (because they have more opportunities to be

tested). Lower rates of pathology in health concession card holders may also indicate an access problem to pathology services. If patients or physicians perceive barrier(s) to ordering pathology (e.g. cost) at an encounter this may influence the decision to order testing. However the high rates of bulk-billing of Medicare pathology services (86.1% of pathology services were bulk-billed in 2007–08[5]) mean that cost is unlikely to be a barrier to the majority of patients.

Amount of variance explained

The final predictive model explained 50% of the variance in GPs' pathology ordering. This is a larger proportion of variance than that explained by previous studies with a similar method (i.e. models including GP and patient characteristics, and morbidity data collected at patient encounters).[45,72] One of these studies used BEACH data and was able to explain 33% of the variance in pathology ordering in 1998–2001.[45] Davis et al.[72] were able to explain 21% of the variance in New Zealand GPs' pathology and imaging ordering, but did not describe the specific variables contributing to this variation.

Another three studies that primarily investigated GP and practice variables reported markedly different amounts of explained variation in multivariate analysis: 10%,[46] 30%[50] and 49%.[51] The first two studies investigated GPs' ordering of both pathology and imaging and neither had representative GP samples.[46,50] The study that was able to explain 49% of the variance, investigated blood tests ordered by GPs in eight European countries, and the main contributor was the country variable, accounting for 45% of the variation.[51] Several authors did not describe the proportion of variance explained in the final multivariate models used in their studies. Of the studies that did, only the current and previous study using BEACH data had a representative sample.

Factors found elsewhere to independently GPs' pathology ordering behaviour (e.g. GP attitude to risk and malpractice claims,[378,379] and communication style[380]) were not measured in this study. The extent to which they are applicable in the Australian general practice setting is not known, and further research in this area could determine the effect of these factors in the Australian setting.

Conclusion

This study has demonstrated that much of the variation in GPs' pathology ordering is due to the GPs' workload, particularly the types of problems managed. The observation by Smellie et al. that "clinical practice is often assumed to account for differences in the use of pathology tests, but there is little published evidence to support this" is pertinent.[337] This study provides this evidence, and demonstrates that the key factor within 'clinical practice' is differences in the types of clinical problems dealt with by individual GPs. The problems that are prevalent in older patients are likely to place the greatest pressure on future use of pathology services as the Australian population ages.

There were some GP and practice characteristics independently associated with use of pathology services. These accounted for a much smaller amount of the variation, but the finding that young GPs, and female GPs, had higher pathology rates has implications for future pathology utilisation, due to expected increases in the number of trainee GPs (registrars) and continued feminisation of the workforce.

8 Pathology generated by GP orders in the future

The previous chapters of this thesis have investigated the historical growth in GPs' pathology ordering, the morbidities that contributed to the increase and some of the explanatory factors contributing to variance in their pathology ordering. This chapter considers likely future growth in GPs' pathology ordering based on the expected growth in, and ageing of, the Australian population.

8.1 Objective

The objective of this work is to assess the effect of the projected population growth and ageing on GP's future pathology ordering in Australia.

8.2 Background

In the past, growth in the volume of pathology tests ordered in Australia has been associated with the ageing population (i.e. growth in the proportion of the population in older age groups).[26,27] Population projections indicate continued increases in the number of people in older age groups.[137] As the use of pathology services increases with age,[27] it is likely this will continue to be a contributing factor to future growth in pathology ordering.

The Australian Government has described the ageing population as a major challenge facing the future of the country because of its associated fiscal pressure.[234] Health care costs are described as the major contributor to this fiscal pressure, contributing two-thirds of the expected increase in Government spending from 2010 to 2050.[234]

The population projections published by the Australian Bureau of Statistics (ABS) demonstrate both the expected ageing of the population and population growth.[137] In June 2010, Australia's population was 22.3 million and 13.6% of people were aged 65 years and over.[15] The ABS have made three population projections based on different assumptions about fertility rates, longevity and migration rates. In 2050 the population is projected to be between 30.2 million and 39.6 million, with 22.2% to 24.3% aged 65 years and over. In all three projections the proportion of the

population accounted for by older people aged 65 years and over from 2010 to 2050 grows faster than does the total population.[137]

Australia is not the only country facing fiscal pressure from an ageing population. A number of developed countries face similar pressures and the associated burden of expected increases in public health expenditure. Per capita health service use (including pathology[27] and GP service[136] use) and cost increase with age.[234,397] Growth will be driven by demographic trends and technological advances, including, new drugs, tests and medical interventions,[234,397] leading the Organization for Economic Co-operation and Development (OECD) to describe the pressure for increasing health spending in the future to be "unrelenting, fuelled by technological changes, population expectations and ageing."[397]

Factors contributing to ageing populations include declining fertility rates and increased life expectancy. Many countries will experience pronounced increases in the proportion of the population that is aged 65 years and over due to the baby boom following World War II. Much of this increase is expected to occur over the next 3 decades as the 'baby boomers' age.[398] In Australia, the resulting population age structure is expected to persist to (at least) 2050 (assuming fertility rates and longevity do not change significantly),[395] carrying with it the ongoing fiscal challenge of an increased dependency ratio (i.e. fewer working people per older people in the population). The long-term nature of the change in population age structure and dependency ratio translates to ongoing health expenditure pressures as outlined by the Australian Government and other OECD nations.[234,397]

All areas of Australia's health budget will face scrutiny as the Government prepares to meet the fiscal challenges caused by ageing to ensure that "spending on health is sustainable, affordable and provides maximum benefit to the greatest number of people."[20] Public expenditure on pathology services is one important aspect of the public health budget. In 2009–10, Medicare outlays on pathology services were $2 billion, 13% of total Medicare outlays.[5] At the time the research for this chapter was conceptualised and analysis undertaken, the Australian Government was in the process of reviewing Medicare funding arrangements for MBS pathology services. One of the primary tasks of the review, which commenced in mid 2009 (and was completed in 2011), was to identify suitable alternate funding models.[20,399]

Regardless of the outcome of this review, demographic changes in the population will contribute to growth in the volume and cost of pathology services. This chapter attempts to estimate the amount of pathology that will be ordered by GPs for the Australian population in the future, based on recent rates of GP pathology ordering and recent patterns of GP service use, in combination with projected estimates of the future population.

8.3 Method

Patient age-sex patterns of GP pathology ordering and GP service use are used to estimate the future number of GP contacts involving pathology testing, and volume of pathology testing generated by GP orders for the Australian population. National data from three sources are used to calculate projected estimates for 2015 to 2050, using data from 2005–06 and 2009–10.

Data sources

The three types of national data used are: (i) the population of Australia; (ii) the number of GP services in Australia; and (iii) GPs' pathology ordering rates (summarised in Box 8.1).

Box 8.1: Summary of source data

	2005–06	2009–10
Number of people in the Australian population[(a)]	20.4 million	22.0 million
Number of GP services[(b)]	107.7 million	120.0 million
BEACH[(c)]		
Number of participating GPs	1,017	988
Number of GP–patient encounters recorded	101,933	101,349
Number of pathology tests/batteries of tests recorded by GPs	39,358	45,594

Sources:

(a) Australian Bureau of Statistics published estimated resident population for 2005 and 2009.[15]

(b) General practice services funded by Medicare Benefits Schedule and Department of Veterans' Affairs. Data supplied by the Australian Government Department of Health and Ageing, and the Australian Government Department of Veterans' Affairs.

(c) The BEACH study annual data set published in General practice activity in Australia 2005–06[123] and General practice activity in Australia 2009–10.[17]

Population data

Australian population data were sourced from the ABS and are based on census data. Population estimates are formally updated each year,[15] and population projections to 2101 are also produced.[137] Data on the number of people by age (single year) and sex are published by the ABS for population estimates and projections.[15,137]

The estimated resident population from 30th June 2005[15], 30th June 2009[15], and the projected estimated population for 30th June for each 5th year from 2015 to 2050[137] are used.

The estimated number of residents in the Australian population was 20.4 million in 2005 and 22.0 million in 2009 (Box 8.1). The 2005 estimate was based on the 2001 census data, adjusted for births, deaths and migration in subsequent years, and further adjusted following the 2006 census.[15] The 2009 population estimate was based on 2006 census data, adjusted for births, deaths and migration in subsequent years.[15]

Three series of future projections of the Australian population are produced by the ABS: Series A, B and C.[137] These series are based on past trends and on different assumptions about future fertility rates, life expectancy and migration.[137] The projected estimates used in this chapter are summarised in Box 8.2. Series A projections predict the greatest growth in the population and Series C the lowest growth.

Box 8.2: Australian projected population 2015 to 2050 (millions)

	2015	2020	2025	2030	2035	2040	2045	2050
Series A	24.0	26.1	28.3	30.5	32.7	35.0	37.3	36.6
Series B	23.6	25.3	26.9	28.5	30.0	31.3	32.7	34.0
Series C	23.3	24.5	25.7	26.9	27.8	28.7	29.5	30.2

Source: Australian Bureau of Statistics population projections.[137]

General practice services data

The numbers of GP services provided to the Australian population were estimated using claims data. These data were provided by DoHA and the Department of Veterans' Affairs (DVA); the two Australian Government organisations that fund the majority (95%[17]) of GP services in Australia. Each GP service is defined as a single GP-patient-date combination in the claims data. There were approximately 107.7 million GP services in 2005–06 and 120.0 million in 2009–10 (Box 8.1). GP

services data were supplied by patient age (single year) and sex. These data are not publicly available with the required patient age and sex specificity and were provided directly by DoHA (DoHA, personal communication, June 2010) and DVA (DVA, personal communication, September 2009).

DoHA provided the number of Medicare-funded GP services funded for two 12 month time periods—April 2005 to March 2006, and April 2009 to March 2010. The majority of Australia's GP services were funded by Medicare (100.6 million in 2005–06 and 112.8 million in 2009–10).

DVA provided the number of GP services funded via the Veterans' Entitlements Act for Repatriation health card holders (including veterans and eligible dependents) for the 12 month period, April 2005 to March 2006. However, the April 2009 to March 2010 data were not available from DVA. Therefore the 2005–06 DVA data (7.1 million GP services) were applied in the calculations that use 2009–10 data.

GPs' pathology ordering

GPs' pathology ordering data were drawn from the BEACH study. Annual weighted data are used for two 12 month time periods—April 2005 to March 2006, and April 2009 to March 2010. As discussed in Section 3.2.10, the representativeness of these two annual data sets has been assessed, both before and after weighting, and the application of weighting marginally improved the precision of the encounter data set.[17,123] Weighting is applied to ensure the estimates are based on nationally representative data.

In the BEACH study, there were a total of 101,993 encounters recorded by 1,017 participating GPs in 2005–06, and 101,349 encounters recorded by 988 GPs in 2009–10. Details about 39,358 pathology tests/batteries were recorded at these encounters in 2005–06 and 45,594 tests/batteries in 2009–10 (Box 8.1).

Two measures of GP pathology ordering are used—the rate of pathology tests/batteries ordered at GP–patient encounters, and the proportion of encounters that involve at least one pathology test/battery. For each measure the point estimate and 95% confidence limits were calculated. These measures can be analysed by patient age (single year) and sex groups as needed.

Calculation of national estimates

This section describes how data from the three national sources described above are used to calculate:

- the number of pathology tests/batteries of tests that were, and in the future are estimated to be, ordered by GPs for the total Australian population.
- the number of GP contacts that involved, and in the future are estimated to involve, at least one pathology test/battery of tests for the total population.

To ensure calculations were robust, patient or population data from each source were grouped:

- 5-year age-sex groups were created for patients/people aged 0 to 84 years (e.g. males aged 0–4 years, females aged 0–4 years, males 5–9 years, females aged 5–9 years)
- two age-sex groups were created for patients/people aged 85 years and over (males aged ≥ 85 years, females aged ≥ 85 years).

Data where age or sex was missing were excluded from the analysis.

The method used to calculate the number of tests/batteries in the population is described in detail below. The same method was used to calculate the number of GP contacts that involve pathology testing—by using the proportion of encounters with at least one pathology test/battery in steps 2 to 4 instead of the rate of pathology ordering.

Box 8.3 provides a worked example of the method applied to both measures of GP pathology ordering for one age-sex group, female patients aged 40–44 years.

Step 1: The average number of GP contacts per person in the population

The average number of GP contacts per person is calculated by dividing the number of GP services in each age-sex cohort by the number of people in the population in the corresponding age-sex group. This is repeated using data from 2005–06 and 2009–10. Referring to the example in Box 8.3 the average number of GP encounters per female head of population aged 40–44 years in 2005–06 was 5.0, and in 2009–10 it was 5.4.

Step 2: The average number of pathology tests/batteries ordered by GPs per person in the population

The average number of pathology tests/batteries per person is calculated by multiplying the rate of GPs' pathology tests/batteries ordered per encounter (the rate per 100 encounters divided by 100) by the number of GP contacts per person (as calculated in step 1) in each age-sex cohort. This calculation was repeated using data from 2005–06 and 2009–10, and repeated for each time point using the lower and upper 95% confidence limits of the rate of pathology tests/batteries per encounter. For example, per woman aged 40–44 years, GPs ordered (on average) 2.4 tests/ batteries (95% CI: 2.2–2.7) in 2005–06, and 3.2 (95% CI: 2.9–3.5) in 2009–10 (Box 8.3).

Step 3: The total number of pathology tests/batteries ordered by GPs for the population

The total number of pathology tests/batteries ordered by GPs for the population is calculated by multiplying the number of people in the population by the average number of tests/batteries per person (as calculated in step 2) in each age-sex cohort. This calculation was repeated using data from 2005–06 and 2009–10, and repeated using the lower and upper 95% confidence limits (calculated in step 2). Referring to the example in Box 8.3, there were approximately 1.88 million (95% CI: 1.70 million–2.06 million) tests/batteries ordered by GPs for females aged 40–44 years in 2005–06, and 2.46 million (95% CI: 2.25 million–2.68 million) in 2009–10.

Adding the estimates for all age-sex cohorts provides the total number of pathology tests/batteries ordered by GPs for the total Australian population in 2005–06 and 2009–10.

Step 4: The total number of pathology tests/batteries ordered by GPs for the projected population 2015 to 2050

The total number of pathology tests/batteries ordered by GPs for the projected population is calculated by multiplying the expected number of people in the population in each age-sex cohort by the average number of tests/batteries per person (as calculated in Step 2).

The number of pathology tests/batteries ordered by GPs was calculated for the projected population at 5 yearly intervals from 2015 to 2050 (that is, 2015, 2020, 2025… etc). For each of the projected estimates of the annual population used (2015

to 2050) there are two estimates of the average number of tests/batteries per person (one based on 2005–06 data and a second based on 2009–10 data) applied to each series of population projections at each time point. Applying the three series of population projections (A, B and C) to the 2005–06 and 2009–10 data gives six estimates (each with 95% CI) of the projected total number of pathology tests/batteries ordered by GPs for each age-sex cohort, and (when the age-sex cohorts are added) for the total Australian population in each year used in the calculations.

The projections based on 2005–06 data assume that in the future the population continues to have the same average number of GP contacts (per person in the 5-year age-sex cohorts) as they did in 2005–06, and that GPs continue to order pathology tests/batteries at the same rate at GP encounters (for patients in the 5-year age-sex cohorts) as they did in 2005–06. Similarly the projections based on 2009–10 data repeat these two assumptions, on the basis of 2009–10 GP contact and ordering rates.

The example in Box 8.3 uses the estimated number of females aged 40–44 years in the population in 2020 to illustrate the method for Step 4. There are three 2005–06-based estimates of the number of tests/batteries ordered by GPs for females aged 40–44 years in 2020:

- Series A: 2.02 million (95% CI: 1.83 million–2.22 million)
- Series B: 1.97 million (95% CI: 1.78 million–2.16 million)
- Series C: 1.92 million (95% CI: 1.73 million–2.11 million).

Similarly there are three 2009–10-based estimates:

- Series A: 2.68 million (95% CI: 2.44 million–2.91 million)
- Series B: 2.61 million (95% CI: 2.38 million–2.84 million)
- Series C: 2.54 million (95% CI: 2.32 million–2.76 million).

Box 8.3 Calculation example of GP ordered pathology (number of tests/batteries and GP contacts involving testing) for females aged 40–44 years

Source data (females aged 40–44 years)	**2005–06**	**2009–10**
Number of people in the population	776,908	769,345
Number of GP services	3,881,819	4,127,491
Rate of pathology tests/batteries ordered by GPs per 100 encounters (95% CI)	48.39 (43.68–53.10)	59.66 (54.44–64.87)
Per cent of encounters with at least 1 pathology test/battery ordered by GPs (95% CI)	21.75 (19.87–23.62)	23.73 (22.01–25.46)

Step 1:	**2005–06**	**2009–10**
Average number of GP contacts per person	5.00	5.36

Number of pathology tests ordered by GPs in the population

Step 2:	**2005–06**	**2009–10**
Average number of pathology tests/batteries per person (95% CI)	2.42 (2.18–2.65)	3.20 (2.92–3.48)

Step 3:	**2005–06**	**2009–10**
Number (millions) of pathology tests/batteries for the population (95% CI)	1.88 (1.70–2.06)	2.46 (2.25–2.68)

Step 4:	**Series**	**2005–06**	**2009–10**
Number (millions) of pathology tests/batteries of tests ordered by GPs for the population in 2020 (95% CI)	**A:**	2.02 (1.83–2.22)	2.68 (2.44–2.91)
	B:	1.97 (1.78–2.16)	2.61 (2.38–2.84)
	C:	1.92 (1.73–2.11)	2.54 (2.32–2.76)

Number of GP contacts with at least one pathology test ordered in the population

Step 2:	**2005–06**	**2009–10**
Average number of GP contacts with at least one pathology test/battery per person (95% CI)	1.09 (0.99–1.18)	1.27 (1.18–1.37)

Step 3:	**2005–06**	**2009–10**
Number ('000's) of GP contacts with at least one pathology test/battery for the population (95% CI)	844 (771–917)	980 (909–1,051)

Step 4:	**Series**	**2005–06**	**2009–10**
Number ('000's) of GP contacts with at least one pathology test/battery for the population in 2020 (95% CI)	**A:**	909 (831–987)	1,065 (988–1,142)
	B:	886 (810–962)	1,038 (963–1,113)
	C:	863 (789–938)	1,011 (938–1,085)

Note: Figures are rounded to two decimal points for presentation (Calculations were made with the total number). CI – confidence interval.

8.4 Results

In the BEACH data set there were 100,566 GP–patient encounters recorded in 2005–06 and 99,843 encounters in 2009–10 for which patient's age and/or sex were known (Table 8.1). The total rate of pathology ordered by GPs increased significantly from 36.6 tests/batteries per 100 encounters in 2005–06 to 45.1 per 100 in 2009–10. Similarly the proportion of encounters that involved at least one pathology test/battery increased from 16.4% in 2005–06 to 17.8% in 2009–10 (Table 8.1).

Table 8.1: Overview of pathology ordering data from the BEACH study 2005–06 and 2009–10

Data element	2005–06	2009–10
Number of GP–patient encounters[(a)]	100,566	99,843
Number of pathology tests/batteries of tests[(a)]	38,855	45,062
Rate of pathology tests/batteries of tests ordered per 100 encounters (95% confidence interval)	36.6 (36.9–40.4)	45.1 (43.3–47.0)
Per cent of encounters with at least 1 pathology test/battery of tests ordered (95% confidence interval)	16.4 (15.8–17.0)	17.8 (17.2–18.4)

(a) Data for which patient's age and/or sex were not known were excluded. Therefore data do not match that reported in Box 8.1.

In 2005–06, there were an estimated 41.0 million pathology tests/batteries ordered by GPs for the Australian population. This increased significantly to 53.3 million tests/batteries in 2009–10 (Table 8.2). The growth between 2005–06 and 2009–10 in the number of pathology tests/batteries ordered by GPs for the population was due to increases in both the rate at which GPs order pathology tests (as described above) and the number of GP contacts per head of population (4.9 per person in 2005–06 and 5.2 in 2009–10[13]).

At least one pathology test/battery was ordered by GPs at 17.5 million GP contacts in 2005–06, and at 21.1 million GP contacts in 2009–10 (Table 8.3). This was not a statistically significant change. Although there was a statistically significant increase in the proportion of encounters with at least one pathology test/battery recorded in BEACH, when the age-sex specific rates of GP service use were included in the calculation no population-based change was apparent between 2005–06 and 2009–10.

Table 8.2: Total number of pathology tests/batteries of tests ordered by GPs for the Australian population

Time period	Number pathology tests/batteries	95% LCL	95% UCL
2005–06	40,990,000	35,950,000	46,030,000
2009–10	53,310,000	47,160,000	59,460,000

Note: LCL – lower confidence limit; UCL – upper confidence limit.

Table 8.3: Number of GP contacts involving the ordering of at least one pathology test/battery of tests in the Australian population

Time period	Number of GP contacts with at least one pathology test/battery	95% LCL	95% UCL
2005–06	17,460,000	15,650,000	19,270,000
2009–10	21,100,000	19,040,000	23,160,000

Note: LCL – lower confidence limit; UCL – upper confidence limit.

The average number of tests/batteries ordered by GPs per person in each 5-year age-sex cohort in 2005–06 is shown in Figure 8.1, and in 2009–10 in Figure 8.2. The age-sex specific average number of GP contacts per person involving at least one pathology test/battery in 2005–06 and 2009–10 are shown in Figures 8.3 and 8.4, respectively.

The average number of tests/batteries ordered by GPs per head of population increased with age in 2005–06 and 2009–10. Australians aged less than 15 years had an average of < 1 test/battery per person, and those aged 75 years and over had an average of 5.5 to 7.2 tests/batteries per person. There were also significant differences between males and females in the number of tests/batteries per person. GPs ordered significantly more tests for females aged between 15 and 54 years than for males, in both 2005–06 and 2009–10 (Figures 8.1 and 8.2).

The statistically significant increase in number of tests ordered for the entire population from 2005–06 to 2009–10 was not reflected in all age-sex groups. For people aged 75 years and over, the average number of tests/batteries ordered by GPs increased significantly, from 2005–06 to 2009–10: for females from 5.5 (95% CI 5.0–6.0) to 6.5 (95% CI: 6.1–7.1); and for males from 6.0 (95% CI: 5.5–6.5) to 7.2 (95% CI: 6.6–7.8). There was also a marginal increase for people aged 50–54 years: for females from 2.9 (95% CI: 2.7–3.2) to 3.6 (95% CI: 3.2–3.9); and for males from 2.1 (95% CI: 1.9–2.4) to 2.7 (95% CI: 2.4–3.0). Further, for females aged 40–44 and 45–49 years the number of tests per head increased from 2.4 (95% CI: 2.2–2.7) in

both age groups in 2005–06 to: 3.2 (95% CI: 2.9–3.5) for those aged 40–44 years; and 3.1 (95% CI: 2.8–3.3) for those aged 45–49 years in 2009–10. For females aged 5–9 years the number of tests per head increased marginally from 0.3 (95% CI: 0.2–0.4) to 0.6 (95% CI: 0.4–0.7) (results not tabled).

The average number of GP contacts per person involving at least one pathology test/battery also increased with age in 2005–06 and 2009–10 (Figures 8.3 and 8.4). Australians aged less than 20 years had an average of < 1 GP contact that involved pathology testing, and those aged 75 years and over had an average of 2.4 to 2.9 GP contacts per person that involved at least one pathology tests/battery. Between the ages of 15 and 50 years, females had more GP contacts per person that involved pathology testing than did males, in both 2005–06 and 2009–10 (Figures 8.3 and 8.4).

As reported earlier, there was no statistically significant increase in the number of GP contacts that involved at least one pathology order for the total population from 2005–06 to 2009–10. However there was an increase (between these years) in the number of GP contacts per person that involved pathology for females aged 5–9 years (0.2, 95% CI: 0.2–0.2 compared with 0.3, 95% CI: 0.3–0.4), and a marginal increase for females aged 40–44 years (1.1, 95% CI: 1.0–1.2 in 2005–06 compared with 1.3 95% CI: 1.2–1.4 in 2009–10) (results not tabled).

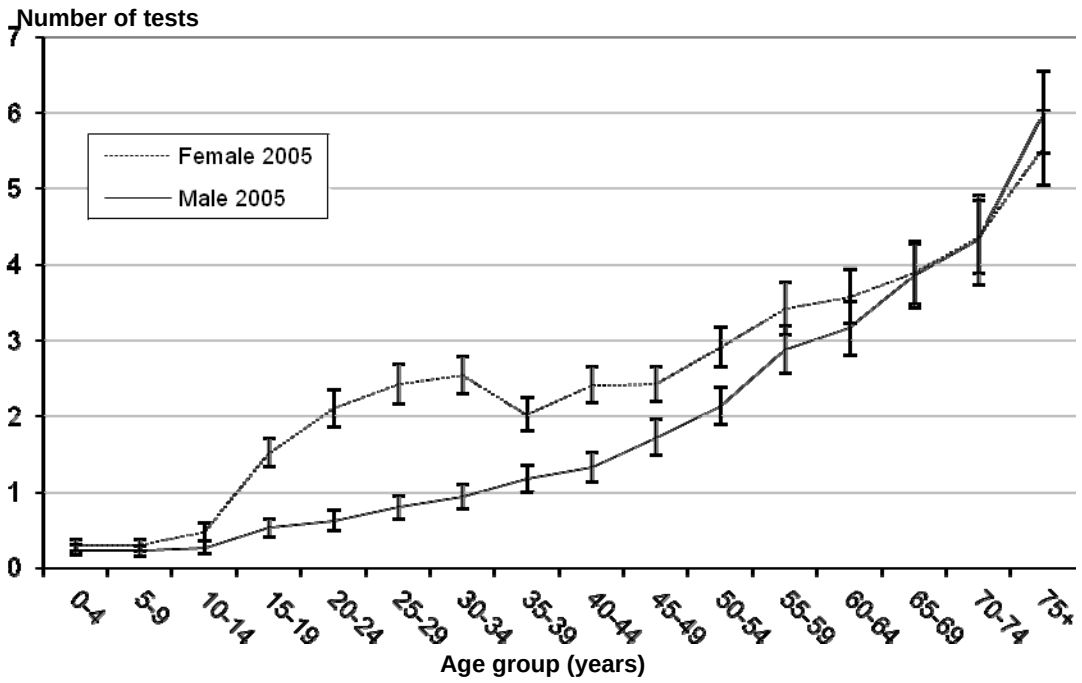

Figure 8.1: Age-sex–specific average number of pathology tests/batteries of tests ordered by GPs per person in the Australian population in 2005–06 (95% confidence intervals)

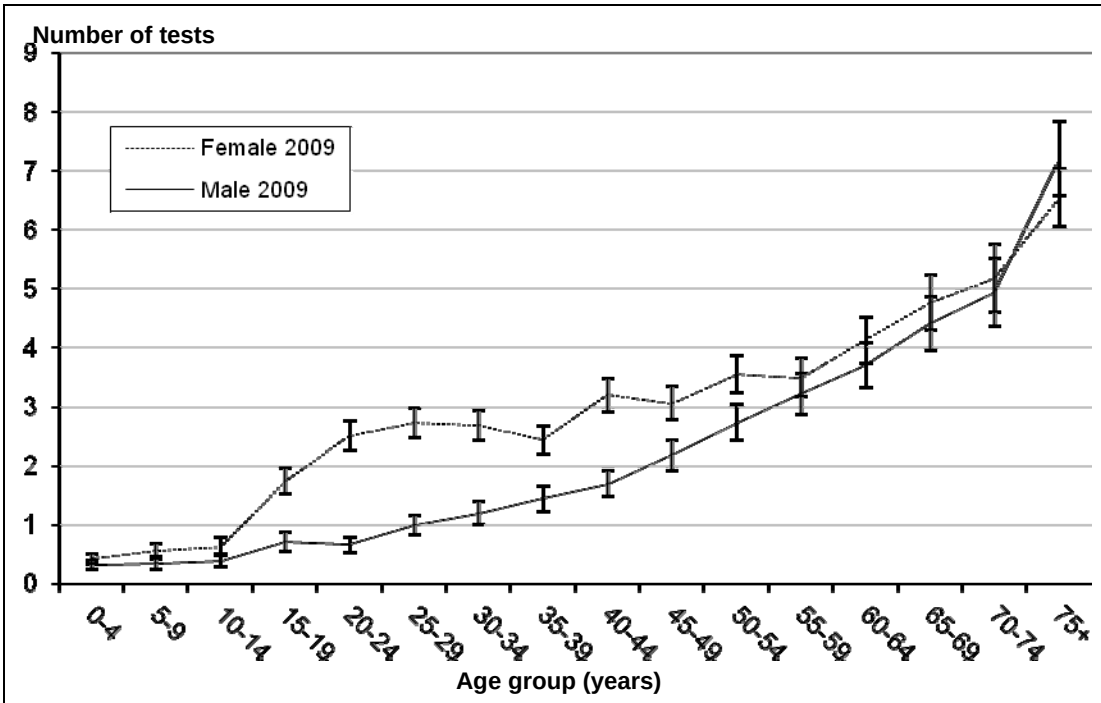

Figure 8.2: Age-sex–specific average number of pathology tests/batteries of tests ordered by GPs per person in the Australian population in 2009–10 (95% confidence intervals)

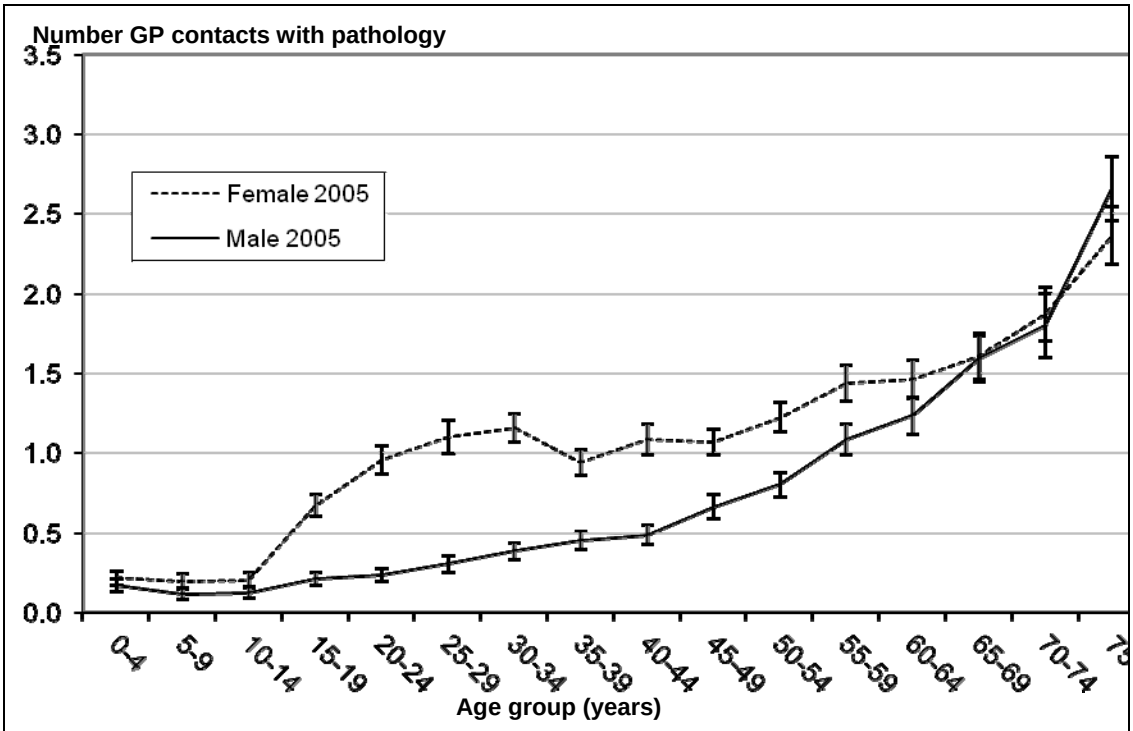

Figure 8.3: Age-sex–specific average number of GP contacts involving at least one pathology test/battery of tests per person in the Australian population in 2005–06 (95% confidence intervals)

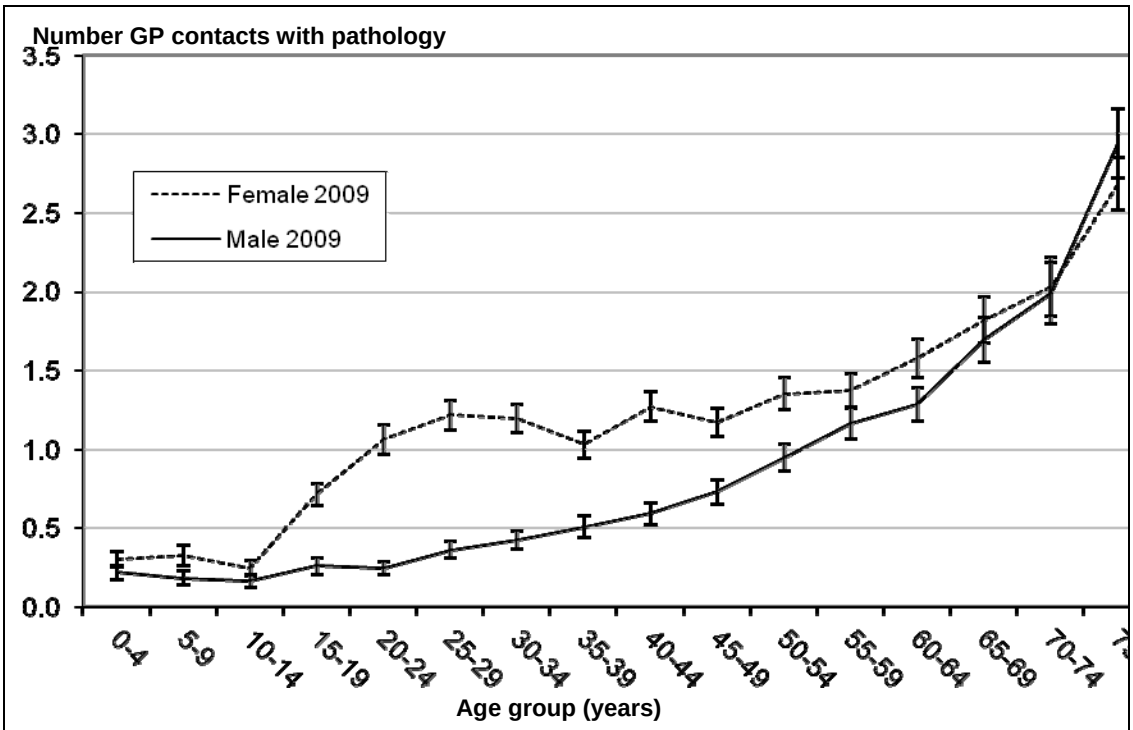

Figure 8.4: Age-sex–specific average number of GP contacts involving at least one pathology test/battery of tests per person in the Australian population in 2009–10 (95% confidence intervals)

The projected estimated number of pathology tests/batteries that will be ordered by GPs and the estimated number of GP contacts that will involve at least one pathology order for the Australian population in the coming decades are shown in Figures 8.5 and 8.6. In each figure there are six estimates for each projected population time point.

The first two column blocks in Figure 8.5 show estimated numbers of pathology tests/batteries based on the Series A population projections. The first column block is based on 2005–06 data (referred to as 2005-based) about GP pathology ordering per person and the second column block is based on 2009–10 data (referred to as 2009-based). Series A estimates have the highest number of people in the Australian population, therefore they produce the highest estimates of future pathology ordering. From 2015 to 2050 the 2005-based Series A calculations suggest an increase of 91.0%—from 50.3 million tests/batteries ordered by GPs in 2015 to 96.2 million in 2050. Over the same period, the 2009-based Series A estimate increased by 89.0% from 59.9 million tests/batteries ordered by GPs in 2015 to 113.2 million in 2050 (Figure 8.5).

The middle two column blocks are based on the Series B population projections, the intermediate estimates of population growth. From 2015 to 2050 the 2005-based Series B calculations suggest an increase of 63.4%—from 49.9 million tests/batteries ordered by GPs in 2015 to 81.5 million in 2050. Over the same period, the 2009-based Series B estimate increased by 62.6%, from 59.3 million tests/batteries ordered by GPs in 2015 to 96.5 million in 2050 (Figure 8.5).

The last two column blocks are based on the Series C population projections, the lowest estimates of population growth. From 2015 to 2050 the 2005-based Series C calculations suggest an increase of 53.6%—from 49.5 million tests/batteries ordered by GPs in 2015 to 76.0 million in 2050. Over the same period, the 2009-based Series C estimate increased by 52.6% from 58.9 million tests/batteries ordered by GPs in 2015 to 89.8 million in 2050 (Figure 8.5).

The estimated numbers of GP contacts that involve at least one pathology test/battery in the future are shown in Figure 8.6. From 2015 to 2050 the 2005-based Series A calculations suggest an increase of 91.7%—from 21.4 million GP contacts involving at least one pathology test/battery in 2015 to 41.1 million in 2050. Over the same

period, the 2009-based Series A estimate increased by 90.6% from 23.7 million GP contacts involving at least one pathology test/battery in 2015 to 45.2 million in 2050 (Figure 8.6).

From 2015 to 2050 the 2005-based Series B calculations suggest an increase of 63.7%—from 21.2 million GP contacts involving at least one pathology test/battery in 2015 to 34.7 million in 2050. Over the same period, the 2009-based Series B estimate increased by 63.2%, from 23.5 million GP contacts involving at least one pathology test/battery in 2015 to 38.3 million in 2050 (Figure 8.6).

From 2015 to 2050 the 2005-based Series C calculations suggest an increase of 53.7%—from 21.0 million GP contacts involving at least one pathology test/battery in 2015 to 32.3 million in 2050. Over the same period, the 2009-based Series C estimate increased by 53.1% from 23.3 million GP contacts involving at least one pathology test/battery in 2015 to 35.6 million in 2050 (Figure 8.6).

When comparing the 2005-based and 2009-based results presented in Figures 8.5 and 8.6, there were no statistically significant differences between projections when comparing equivalent time points. For example, the projections for 2015 of the estimated number of pathology tests/batteries that will be ordered and the estimated number of GP contacts that will involve at least one pathology order, based on 2005–06 data were not significantly different to those based on 2009–10 data.

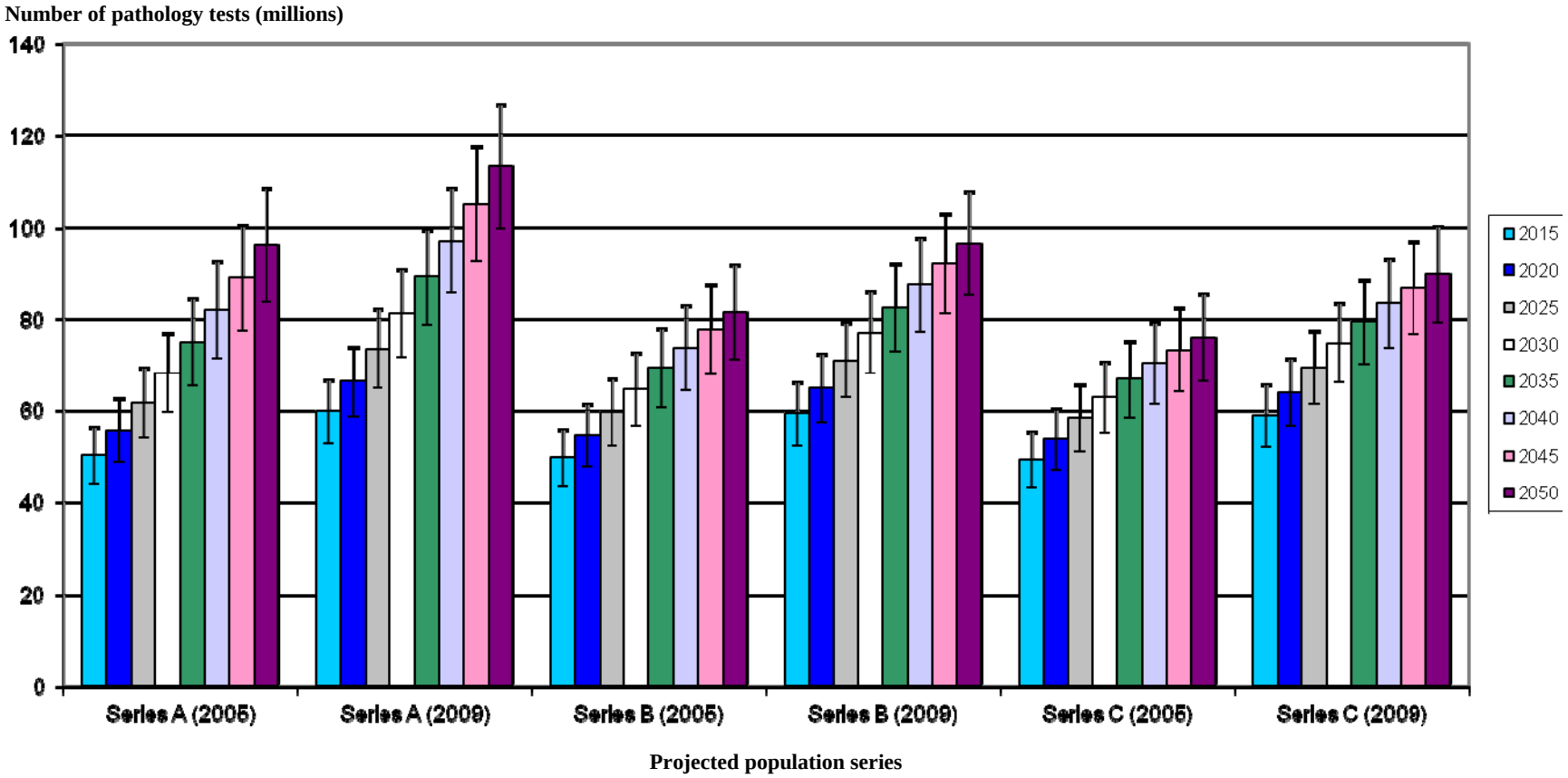

Figure 8.5: Estimated number (millions) of pathology tests/batteries of tests ordered by GPs for the projected Australian population 2015 to 2050 based on per head GP service use and GPs' pathology ordering in 2005–06 and 2009–10 (95% confidence intervals)

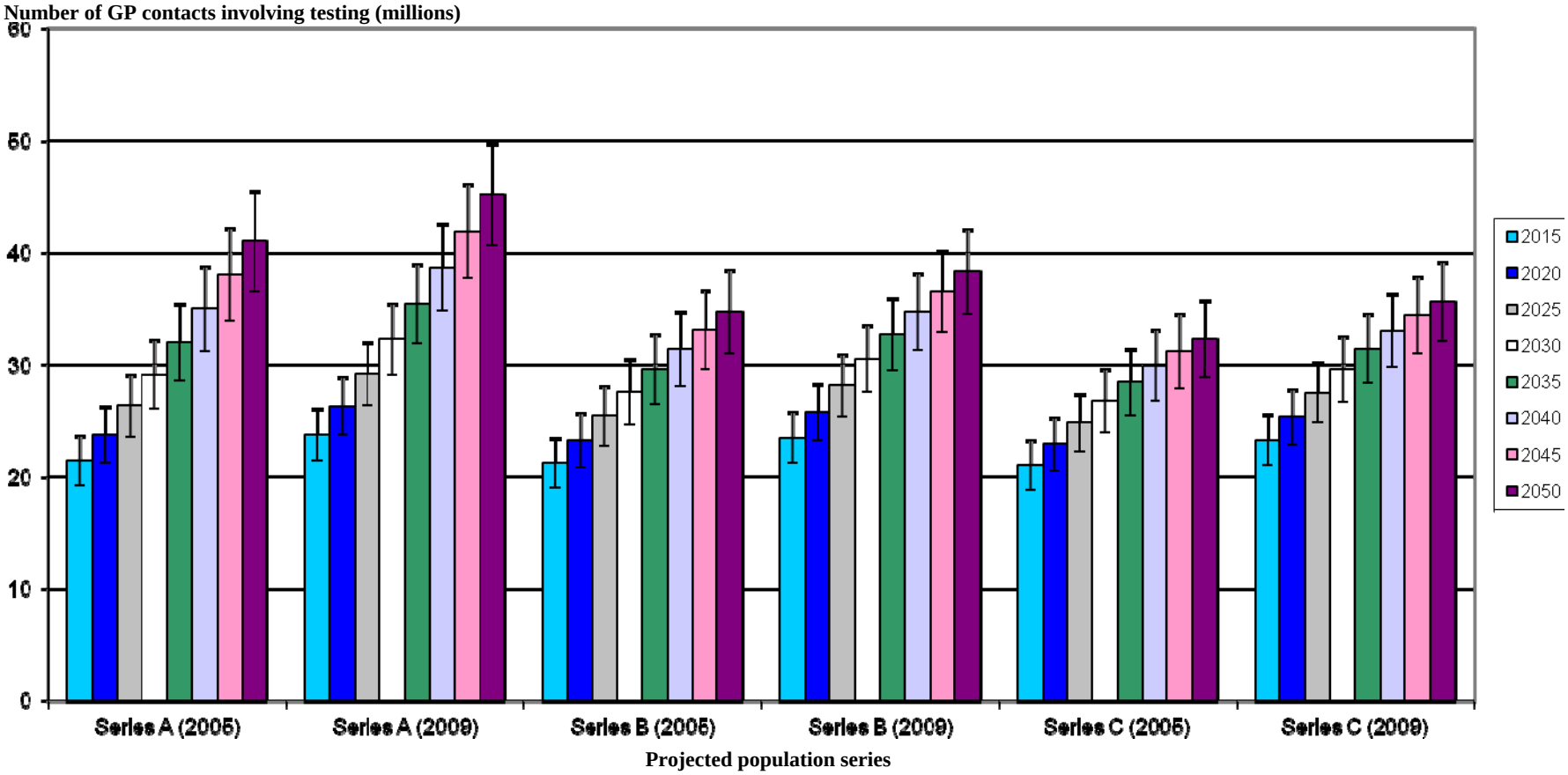

Figure 8.6: Estimated number (millions) of GP contacts involving at least one pathology test/battery of tests for the projected Australian population 2015 to 2050 based on per head GP service use and GPs' pathology ordering in 2005–06 and 2009–10 (95% confidence intervals)

8.5 Discussion

The results presented in this chapter demonstrate that per capita, pathology generated by GP orders increases with age in the Australian population. This echoes the pattern of increased per capita health resource use, and total pathology service use associated with increased age.[27,234,397]

The volume of pathology generated by GP orders and the number of occasions of testing for the population are projected to grow faster than would be expected with population growth alone. The same result is found for all series of projections and regardless of whether the calculations are based on 2005–06 or 2009–10 rates of GP pathology ordering and GP utilisation. This is because the proportion of older people in the population is projected to increase[137] and, as age increases, so too does per capita GP pathology ordering. Therefore the excess growth (above that generated by population growth) is due to the effect of the ageing population.

There are limitations that need to be kept in mind when considering the long-term projections made in this chapter. The projections of GPs' pathology ordering are reliant on the robustness of the three types of national data (population projections, GPs' pathology ordering and GP services) used.

There is inherent uncertainty in estimating population projections. Projections were made by the ABS based on assumptions about life expectancy, fertility rates and migration rates. An unanticipated change in any of these factors would render the population projections unreliable. This uncertainty is why three series of population projections are published and why I have used these three series to project GPs' pathology ordering.

The number of pathology tests/batteries recorded in the BEACH study is limited by the space available on the recording form. A maximum of five tests/batteries can be recorded per encounter. This cap may lead to an underestimation in the projections of the number of pathology tests/batteries that will be ordered by GPs. This limitation does not affect the projected number of GP contacts that involve at least one pathology order because it is based on the proportion of encounters that involve at least one pathology test/battery, not on a count of tests/batteries.

Pathology ordering recorded by GPs (in BEACH) reflects their intention that the patient will be tested. Inevitably a proportion of pathology ordered by GPs will never

be conducted, because the patient chooses not to be tested. Therefore the projections made in this chapter may overestimate the pathology testing that will be performed in the population in response to GPs' ordering.

The number of GP services provided to the community in 2005–06 and 2009–10 were based on services funded through Medicare and the DVA. As the 2009–10 DVA data were not available, the 2005–06 DVA data and 2009–10 Medicare data were combined to calculate the number of GP services per person in 2009–10. The number of GP services funded through Medicare (per capita) increased over the period of this investigation (2005–06 to 2009–10).[13] As the total per capita use of DVA funded medical services (including GP, specialist and dental services) increased over this period,[400,401] it is likely that DVA funded GP services (when viewed alone) also increased. Given these increases, the lack of 2009–10 DVA data may cause an underestimation of the number of GP services per person in 2009–10, particularly as most DVA funded GP services are for veterans' aged 80 years and over and GP service use increases with age.[136] In turn this means that the pathology projections based on 2009–10 data may be underestimated.

The projections created in this chapter were based on 2005–06 and 2009–10 data because over this time there were significant increases in: the number of GP services per capita;[13] the rate of GPs' pathology ordering at encounters; and the proportion of GP encounters that involved at least one pathology test. Despite these increases, when the projections were calculated there were no statistically significant differences in the pathology projections based on 2005–06 data versus those based on 2009–10 data (when comparing equivalent projection time points). Theoretically it would be more reliable to use the 2005–06 based estimates because of the lack of 2009–10 DVA data. However the pathology projections based on 2009–10 were consistently above those based on 2005–06 data and (while not statistically significant) this has economic ramifications for funding pathology services. Therefore the 2009–10 projections are the focus of the discussion below.

The estimated projected number of pathology tests/batteries that will be ordered by GPs for the Australian population (based on 2009–10 data) was 58.9–59.9 million tests/batteries in 2015 and 89.8–113.2 million in 2050—an increase of 53–89% from 2015 to 2050. The estimated number of GP contacts that will involve at least

one pathology order for the Australian population (based on 2009–10 data) was 23.3–23.7 million in 2015 and 35.6–45.2 million in 2050—an increase of 53–91% over this period.

These projections assume that per head in each age-sex group the number of GP visits stays constant and the rate and likelihood of GPs' ordering pathology stays constant. For example (referring to Box 8.3), these assumptions mean that an average 40–44 year old female would have the same number of GP visits (5.4 per head), pathology tests/batteries (3.2) and GP visits involving pathology testing (1.3) in 2009–10, as a 40–44 year old female will have in 2015, 2020…and so on to 2050.

The current age-sex–specific pattern of pathology ordered by GPs for the population has potential to change considerably over the coming decades. In order for pathology rates to stay constant in the age-sex cohorts of the population in the future and therefore for the projections of future pathology ordering to be correct, the use of GP services, and GPs' pathology ordering within the age–sex groups would need to stay constant. At a minimum, this would require prevalence of diseases and patterns of multiple morbidities in any one age-sex cohort of the population to remain constant in the future. Knowledge, guidance and rules about the role of pathology testing in the management of these morbidities would also need to be constant. However, in reality, changes within these variables will be inevitable over the coming decades because there are many factors that could create change. Some examples are given below.

The prevalence of overweight/obesity may change and consequently generate changes in GP service use and GPs' pathology ordering. The proportion of Australian adults who are overweight/obese has increased from 54% in 2004–05 to 62% in 2007–08.[154,402] High body mass is a risk factor for a number of chronic conditions including (but not limited to) dyslipidaemia and diabetes mellitus. Both of these conditions are usually managed by GPs and require pathology for diagnosis and monitoring. If the proportion of the population who are overweight/obese were to increase (as suggested by the historical trend) it is likely that this would generate a subsequent increase in pathology ordered by GPs. Alternatively if the ongoing public health initiatives[295,296] that aim to reduce the prevalence of overweight/obesity are successful it is likely that there would be a subsequent reduction in pathology testing.

Significant changes in the extent to which GPs used pathology tests in the management of selected conditions were demonstrated from 2000–02 to 2006–08 in Chapter 4. Changes in what we know about a condition, and the best way to treat it (such as, new scientific knowledge, technological developments including new tests, and new medications), contribute to changes in the role of pathology in its management. These changes have the potential to change the management of conditions and are considered by both the OECD and the Australian Government to be a likely source of future growth in health costs.[234,397] For example, genetic testing has been highlighted as a potential area of growth during the Government's recent review of pathology funding, due to the rapid developments occurring in the genetics discipline.[399]

Alternatively technological advances may reduce the need for pathology testing in the future. An example is the development of a vaccine for the human papillomavirus (HPV) and the subsequent vaccination program that was implemented in Australia in 2007.[403] The vaccine prevents the types of HPV that cause 70% of cervical cancer[403] and therefore it is likely to reduce the incidence of cervical cancer. Australia's comprehensive national program for cervical cancer screening currently recommends screening with a Pap smear every 2 years for women aged 18 to 70 years, but this screening protocol is under review due to the introduction of the HPV vaccine, availability of new tests for screening, and emergence of evidence about the screening age and interval.[404] It is expected that the screening interval will be increased and the age-groups covered in the program reduced.[404] Consequently, the ordering of Pap smears, one of the most common tests ordered by GPs (see Chapter 4), may decrease.

If the likelihood and rate of GPs' pathology ordering stay constant, projected population growth and ageing will produce substantial future growth in the number of pathology tests/batteries and number of GP contacts involving pathology in the population. However, if the historic growth in the likelihood and rate of GPs' pathology ordering continued in the future, then any projected estimates (based on 2009–10 data) of GP-ordered pathology in the population would be too low.

Governments internationally face uncertainties in estimating future health costs as changes in population, the prevalence of conditions and technological advances are

difficult to accurately predict. While it has limitations, basing projections on past patterns of health resource use is the best tool available to plan for future requirements. The projections of pathology in this chapter were made to 2050 as the growth in the proportion of the population in older age groups is expected to continue over the next four decades.[395] In addition, the sustainability of health spending to 2050 is the Australian Government's current focus.[234]

The Australian Government has estimated that public health spending will increase by 77.5%, from 4.0% of gross domestic product in 2009–10 to 7.0% in 2049–50.[234] Forty per cent of this expected growth is due to population growth and ageing (i.e. demographic changes).[234] The population projection used by the Government to predict this growth lies between the Series A and Series B population projections published by the ABS. In this chapter, the estimated growth in the volume of pathology tests/batteries ordered by GPs and the GP contacts that involve pathology from 2009 to 2050 is approximately 80% based on Series B population projections and 110% based on Series A projections. These pathology projections are based only on demographic changes (i.e. population growth and ageing). In contrast, the Government's estimate of future health spending also incorporates growth in non-demographic health spending (such as increased use of doctors, tests and medicines).[234]

In this chapter, even without attempting to estimate the affect of non-demographic factors, growth in GPs' projected pathology ordering is considerably larger that the Government's expected growth in total health spending over the same timeframe. Comparing these estimates suggests that pathology generated by GP orders is likely to grow faster than total health care spending. Whether this means that the cost of pathology (ordered by GPs) will grow at the same rate as the projected pathology ordering is another matter. As the majority of GPs' pathology ordering is funded through Medicare, the magnitude of cost growth will be affected by the Medicare funding rules, in particular the episode coning rule which restricts payment to the three most expensive pathology items (as described in Chapter 2). Therefore the Medicare cost of funding pathology tests ordered by GPs only partially reflects the tests ordered by GPs. It is not possible to replicate the effect of the episode cone using the data presented in this chapter. However, it is reasonable to conclude that projected growth in GPs pathology ordering is likely to produce growth in Medicare

pathology outlays, but under the current Medicare funding structure the growth in cost and growth in GPs' ordering will not be equivalent.

The review of Medicare funding arrangements for MBS pathology services, undertaken by the Australian Government (underway when the study in this chapter was conceptualised and data analysed), was completed in early 2011. The outcome was that the funding arrangements remained largely unchanged. A new funding agreement between the pathology industry and the Australian Government covering July 2011 to June 2016 was introduced. This covered Medicare outlays and growth in these outlays from pathology services ordered by all requestors (i.e. GPs and other specialist doctors),[25] in a similar arrangement to the three previous MoUs that were in operation from 1996 to 2009 (the Government chose not to renew the previous MoU pending the outcome of this review). The new funding agreement includes a fixed annual range of funding growth, between a minimum of 4.4% and maximum of 5.2% each year (subject to review).[25]

During the period of the Government's review, a pathology industry group, the Australian Association of Pathology Practices (AAPP) commissioned an analysis of the expected future growth in outlays for MBS pathology services. This analysis estimated an average annual growth rate in outlays of 6.2% (a range of 3.1% to 7.0%) over the five years 2010–11 to 2014–15, based on historical growth in per person pathology usage, costs of services, and projected growth and ageing of the population.[27] The annual growth in outlays attributed to the population was 1.4–1.5%. In comparison, I estimated a growth of between 2.1% and 2.5% per annum in the volume of pathology tests/batteries generated by GPs' orders, and number of GP contacts that involve pathology testing over the 5 years from 2009–10 to 2015 based on population changes. The AAPP-commissioned report differs from the current study as it focussed on the growth in cost of pathology services generated by orders from GP and other medical specialists whereas I estimated the growth in volume and occasions of pathology testing generated from GP orders. However, my study may indicate a greater influence of population changes than suggested in the AAPP-commissioned report.

It is likely that due to demographic changes alone there will be upward pressure on Medicare outlays for pathology services generated by GPs' pathology ordering,

suggesting that the Australian Government's concern about future growth in the cost of pathology services is justified. Based only on the expected demographic changes in the population, future growth in GPs' pathology ordering is inevitable. However if the historical trends of increased per capita use of GP services and increased number and likelihood of GP pathology ordering continue, they will compound the impact of these demographic changes. Together these factors will put significant upward pressure on future costs of pathology services.

9 Discussion

Major findings

This research provides a detailed picture of GPs' pathology ordering and how it has changed from 2000 to 2008. The total increase in volume of GPs' pathology ordering between 2000–02 and 2006–08 was influenced by increases in three factors, each of which can operate independently: the rate of pathology ordered in the management of clinical problems (due to increased likelihood of ordering and increased number of tests ordered per testing occasion), the number of problems managed at GP–patient encounters, and the total number of encounters provided to the Australian population. The majority of the volume and growth in GPs' pathology ordering was attributable to a relatively small group of pathology tests and clinical problems. Just 22 problems accounted for 59% of the growth in testing between 2000–02 and 2006–08.

Variance among GPs' in the volume of pathology ordered is often used as an indicator of poor quality. In investigating factors that contribute to variance, I was able to explain 50% of the variance in GPs' testing rates. Significant independent predictors of volume included some GP and practice characteristics, but the strongest determinate was the type of problem being managed.

In this thesis, appropriateness of GPs' pathology ordering for six selected problems was assessed by measuring alignment with recommendations in guidance documents. Overall GPs' ordering aligned well, and increases in ordering over time for the six problems reflected increases in both 'appropriate' and 'inappropriate' ordering. I found no evidence to support concerns raised in the literature about widespread inappropriate ordering, or assertions that increases in ordering reflect disproportionate increases in inappropriate ordering.

Based on the growth and ageing of the population alone, future growth in the volume of GPs' pathology ordering is inevitable. The ageing of the population will increase the prevalence of diagnosed chronic disease and therefore increase its management and associated pathology testing. During my review of guidance documents I found that pathology test recommendations for long-term monitoring of chronic diseases were poor. Improving this guidance would support GPs in the appropriate ordering of pathology tests in this high growth area.

Limitations

As with all observational studies there are limitations in the studies described here. The BEACH data used in this thesis are cross-sectional and encounter-based. As such, they are affected by the frequency with which patients see their GP. I have no way of knowing how often individual patients at the sampled encounters return to see a GP. Attendance patterns vary according to patient age and sex.[136,369] Distance from care and the GP:population ratio which affects availability of GP appointments also have a bearing, as the management provided by GPs may be affected by the patient's access to care. For example, the likelihood of a GP ordering pathology at an encounter may be higher for a patient who has not seen a GP for some time than for one who is seen regularly.

The encounter data presented in this thesis will be affected by attendance patterns but the extent of this affect varies. In Chapters 4–6 there is minimal impact on the conclusions drawn as the encounter-based data are used to describe the grouped clinical activity of GPs. However, attendance patterns have an influence when activity is compared for individual GPs as in the investigation of variance in GPs' pathology ordering (Chapter 7). For example, the finding that GPs in rural areas ordered more pathology than their urban counterparts is likely to reflect differences in attendance patterns and a need to go further down the diagnostic pathway before referring the patient to specialist care as access to care is more limited.

The study predicting future growth in GPs' pathology ordering (Chapter 8) is the only work in this thesis that incorporates the affect of attendance patterns. However, this was done using population age-sex-specific average attendance rates, as data about individual attendance patterns were not available.

There are many factors for which I lacked information that may have a bearing on a GP's decision to order pathology testing. These include: presence and duration of symptoms, presence of comorbidities not managed at the encounter, past medical history, family history, social circumstances, previous test results, and risk factors. As discussed in Chapter 5, the presence of these factors may have an influence on the accuracy of my assessment of appropriateness of GPs' pathology ordering. My assessment was based on the pathology test linked to the problem under management at the encounter for only six selected problems. Even if more detailed data were available, it would be very difficult to design an exact measure of appropriateness

that reflects the complexity of GPs' decision-making processes. The data set used in this thesis is one of few that links GPs' test selection to the clinical problem for which it was ordered. So while there are some limitations to the method I have adopted to assess the appropriateness of GPs' pathology ordering, my study is one of the few that incorporates the clinical problem.

The variables available in the study also have a bearing on the study of inter-GP variance in rates of pathology ordering (Chapter 7). I adjusted for the available GP, patient and encounter variables, but there may be other factors that have a bearing on this variance for which I have no measure.

As discussed in Chapter 4, the maximum of five pathology tests/batteries of tests that can be recorded per encounter has implications for the results presented in this thesis. Over time the proportion of encounters where the maximum number of pathology tests was recorded increased, suggesting that the proportion being missed may have increased over the years investigated.

Further, the maximum of five tests/batteries may have a greater bearing on some types of clinical problems managed at encounters. For example, a problem for which many tests are usually required on an occasion of testing is more likely to have missing data than a problem for which only a single test is required. This selection bias has implications for some of my results. In the study assessing the appropriateness of GPs' ordering, I could only make a judgement based on the tests recorded for each problem.

The large number of comparisons made in this thesis (in particular when investigating changes over time) provides the potential for reporting a difference between groups when none exist (i.e. a Type 1 error). There may be occasions where a statistically significant difference has been detected by chance rather than because it exists in reality. However, I used non-overlapping 95% CIs as the primary measure of significance (which is considered a conservative approach[130-132]) to reduce the likelihood of such error.

Appropriateness of GPs′ pathology ordering

There is a negative narrative present throughout the literature regarding clinicians' pathology testing, whereby authors link (implicitly or explicitly) the increasing rates of pathology testing with inappropriate ordering, leading to a prevailing opinion that

the quality of clinicians ordering is poor or could be improved considerably. There is limited evidence to support this assumption. The landmark review of appropriateness of pathology ordering by van Walraven and Naylor found a wide range of 'inappropriate' ordering but suggested that the results were not generalisable (most studies having been conducted in inpatient settings) and that "allusions to extensive inappropriate ordering should not be made without appropriate qualifiers."[52] While there has been some evaluation of clinician's pathology ordering in other health settings, there has been virtually none in general practice, and yet the same negative perceptions exist.

In the research reported in this thesis, I evaluated the appropriateness of GPs' pathology ordering for six problems: hypertension, Type 2 diabetes, lipid disorders, weakness/tiredness and health checks. Together these problems generated a quarter of pathology ordered at GP–patient encounters, and of the tests ordered 81% were appropriate, 13% were inappropriate and 6% could not be evaluated. GPs' ordering for these problems increased over time, and this was reflected in increases in tests in all levels of appropriateness (i.e. appropriate, inappropriate and unevaluated tests). These six problems were used as indicator conditions for the quality of GPs' pathology ordering, and suggest that GPs in Australia are not ordering a large proportion of pathology tests inappropriately, and that the increases were not driven by increases in inappropriate ordering, despite conjecture throughout the literature.

When making reference to GPs' inappropriate ordering, other authors often refer to studies that report interventions aiming to improve appropriateness of GPs' pathology ordering. As I discussed in Chapter 2, the use of interventional studies to describe appropriateness is flawed because such studies demonstrate the success (or failure) of the interventions, rather than the appropriateness of GPs' ordering. These studies are designed to improve the appropriateness of ordering in a specific area in which GPs' pathology ordering is known or likely to be inappropriate. It is implied that preceding the intervention, an evaluation step of some kind identified the area to be targeted on the basis of the need for improvement. Unfortunately such evaluation is rarely reported.

Further, the success of an intervention (usually measured as a reduction in testing) is frequently assumed to reflect an improvement in the appropriateness of GPs'

ordering but this is rarely assessed. In many cases a lack of clinical data linked to testing data prevents assessment of appropriateness. I therefore conclude that interventional studies cannot act as a proxy for evaluation of appropriateness of GPs' pathology ordering.

The approach I took in this thesis to evaluate appropriateness of GPs pathology, is fundamentally different. The six problems for which GPs' test ordering was evaluated were selected on the basis of past increases in GPs' ordering in their management, and the high volume of pathology testing generated by the management of these problems in general practice. I made no prior assumption about the need for improvement in the ordering of pathology. This approach enabled me to conclude that (in the majority of cases) GPs' selection of tests in the investigated problems reflected appropriate pathology ordering. This is a substantially different conclusion to that reached by other authors. To the best of my knowledge, this study is the first to provide an assessment not influenced by the presence of a concomitant intervention, of the appropriateness of GPs' pathology test selection in the management of the selected problems.

While overall the majority of ordering was appropriate, there were differences among the six problems investigated. For four problems alignment was very high, with at least 85% of tests deemed appropriate, for overweight/obesity problems (in adult patients) alignment was moderate (72% of tests supported), but for 'health check' problems (in patients aged 15 years and above) alignment was poor, with only half the tests ordered being supported.

GPs' ordering for 'health checks' was assessed against guidance for preventive care. As discussed in Chapter 5, some of the discord between GPs' activity and recommended testing may be due to GPs' responding to the needs of the individual patient. Recommendations in preventive care guidance may reflect population health benefit, whereas GPs' provision of health checks will be adapted to the individual patient's benefit. Further research is needed to determine whether the lower level of alignment in GPs' management of 'health check' reflects appropriate individualised care or inappropriate ordering. This is particularly important if the Government continues to use incentives to encourage GPs' to provide specific health assessments, as it has done in the past.[18,232,236] These types of assessments (often labelled by GPs

as health checks) are one way in which the Government aimed to "encourage GPs to deliver quality preventative health"[344] and in particular were targeted to prevent and detect chronic disease. Their use continues to be advocated by some peak bodies and researchers.[405,406] My work suggests that GPs' may need further support regarding the selection of appropriate pathology tests when performing health checks.

Pathology recommendations in guidance documents

My evaluation of the appropriateness of GPs' pathology ordering was based on recommendations for pathology testing in guidance documents. In reviewing these documents I found that the accessibility of pathology recommendations and the content of recommendations need considerable improvement.

Accessibility issues related to accessing pathology recommendations within documents, and included: the sheer size of documents, many of which were not designed for GPs; lack of a central body in Australia responsible for creating and structuring guidelines in a consistent format; and mixed terminology used to refer to testing (e.g. 'diagnostic testing', 'laboratory investigations', 'assessment', the specific test name, the disease that testing aims to identify or exclude). I believe the international adoption of standardised terminology to refer to pathology testing in guidelines could have considerable impact on accessibility. It could be achieved with minimal effort and is worthwhile promoting.

Content issues identified in guidelines pertain to missing or incomplete guidance. Primarily these deficiencies related to recommendations for testing in long-term management of chronic disease, including incomplete guidance about what tests were needed for monitoring and the recommended interval between repeated testing, and lack of guidance about the interpretation of repeated test results. The latter refers to the critical difference between results, and describes the expected analytical and intra-individual variance in test results.[201] Such knowledge is essential for GPs to correctly interpret results to determine the level at which clinical intervention is required to maintain 'control' and avoid progression of disease.[328]

The majority of pathology recommendations in guidance documents refer to the decision to order testing and the types of tests ordered and so support GPs' decisions in the pre-analytical phase of testing. In contrast, guidance regarding test results in the post-analytical phase of testing relates primarily to the diagnosis of differentiated

disease. There is considerable scope for improvements in guidance for this phase of testing in regard to interpretation of abnormal results in undifferentiated disease and interpretation of monitoring tests. As I discussed in Chapter 5, providing guidance about interpretation of monitoring results is complex as critical difference may vary between patients. This is an area in which pathologists give ongoing high quality support to GPs and other referring clinicians for individual patients, but it could be supplemented by producing guidance for interpretation of common monitoring tests.

As discussed in Chapter 5, the poor quality of recommendations in guidance documents for monitoring may also be due to the lack of evidence about ideal monitoring protocols in health care.[56,329] Despite this, the volume of monitoring undertaken by GPs for chronic disease, and the expected increase in prevalence and management of these diseases due to our ageing population, leads me to recommend that monitoring guidance be improved. A pragmatic approach incorporating consensus views may be needed where evidence is not available.

Developing guidance about monitoring (as I have recommended) and supporting GPs' in applying recommended monitoring protocols may, or may not, change GPs' current monitoring practices. There are limited data about these monitoring practices. The study reported in Chapter 6 gives some preliminary information about GPs' monitoring of lipid tests, but further research is needed to understand GPs' current monitoring intervals and interpretation of repeated results. Such research should evaluate whether monitoring influences patients' social, cognitive or behavioural responses[63] (for example, whether monitoring affects medication adherence) as these factors will contribute to a GP's decision to order testing. Even if no change is needed to current practise, supporting GPs through improved guidance is still valuable as it supports quality of care.

Two recent national programs have the potential to address the accessibility and content issues I identified in the existing guidance. The first of these is the National Prescribing Service medical test program announced in the 2009–10 budget to promote evidence-based ordering of imaging and pathology tests. At the time this thesis was submitted (March 2013), programs had been initiated for only a small number of topic areas involving pathology testing. This program will primarily

involve education-based interventions, and at the time of the submission of this thesis there were no results available from the outcomes of the program.

The second national program is the development of pathology guidelines for GPs to be implemented as decision support tools within clinical software (announced as part of the new funding agreement between Government and the pathology industry, July 2011[25]). There are potential benefits and pitfalls of this approach that bear discussion in regard to the results presented in this thesis.

It appears that this approach will result in the development of 'stand alone' pathology guidelines. GPs have previously indicated that they do not want pathology guidance to be produced in isolation as this does not assist the integration of pathology ordering and interpretation of results in their clinical management of problems.[407] For example, the diagnostic process of undifferentiated disease involves more than the selection of appropriate pathology tests. Gialamas et al. suggested that a decision support tool for the management of presentations of tiredness would need to incorporate: patient age, sex, a psychological evaluation (to assess presence of depression), a physical examination (e.g. to assess presence of anaemia) as well as advice about appropriate tests.[408] Other authors have suggested additional factors (such as the patient's medical history, duration of symptoms) that may also have a bearing on the decision.[281,283,285] Therefore, the role of pathology testing in relation to other factors associated with the diagnostic process needs to be considered. The way in which the guidelines are implemented into a decision support tool and the associated level of integration may address this concern.

It is unclear how the proposed Australian decision support tools will be designed and integrated, but results of the few international examples of similar decision support tools,[76,79,86] suggest these factors will have an impact on the efficacy of the tool. For example, existing pathology decision support tools are 'launched' once the GP opens the pathology ordering section of the electronic medical record, and provide guidance on test selection at this point. Such an approach is unlikely to affect the decision to (or not to) order because GPs' have already decided to order before any advice is presented. I have demonstrated that the increase in occasions of testing was a feature of past growth in GPs' pathology ordering (see discussion below). This type of decision support design would only support appropriate test selection in GPs'

clinical management—only one aspect of GPs' pathology testing behaviour. Further my results show the appropriateness of GPs' ordering is already high. Therefore, there may be little or no reduction in volume or cost of pathology testing achieved through introduction of this type of decision support tool.

Volume and growth of GPs′ pathology ordering

The data presented in this thesis provides the first in-depth picture of GPs' pathology ordering in Australia in more than a decade. Other national pathology data (such as that collected by laboratories and Medicare Australia) cannot provide the same level of detail about GPs' ordering as that collected in the BEACH study. In particular, the complex Medicare funding structure (including the episode coning rule that restricts payment to the three most expensive MBS pathology items per episode of GP ordering, and the iso-resource grouping of some items) limits the ability of Medicare data to accurately reflect GPs' pathology ordering.

My investigation of growth in the total volume of GPs' pathology ordering from 2000–02 to 2006–08 demonstrated that three factors contributed to the growth, each of which can operate as a separate mechanism and all of which increased over the study period. These were: increased number of national GP encounters provided to the population; increased number of problems managed at GP–patient encounters; and increased rate of GPs' pathology ordering in the management of problems. The latter was due to significant increases in the likelihood of at least one pathology test being ordered (i.e. more occasions of testing), and the number of pathology tests ordered per problem once the decision to order was made (i.e. more tests per order) —these increases reflect change in the GPs' pathology ordering behaviour.

As I discussed in Chapter 4, there are many potential drivers of change in these three factors and each driver can act on one or more of the factors. Examples include: changes in the population demographics (primarily the ageing population); introduction of population health policies and initiatives; publication of new guidelines or changes to existing recommendations in guidelines; change in disease prevalence; and emergence of new evidence. In addition to their potential to influence one or more factors, they also interact among themselves. For example, new evidence may have an affect on guidelines and health policy, and the ageing

population may influence health policy and changing disease prevalence. This illustrates the complexity underlying growth, as discussed by several authors.[9,26-30]

Describing the growth in GPs' ordering in terms of the three factors highlighted in my research takes a somewhat reductionist approach. However its strength is that it demonstrates that change in GPs' ordering behaviour is only partially responsible for the total growth in GPs' pathology ordering—a finding that is crucial in the context of much of the conjecture and discussion in the literature. There is a perception that the increase in pathology ordering reflects a deliberate management action by GPs to order more pathology testing. In reality the 'choice' to order as represented by change in ordering behaviour is just one factor.

Similarly, in the context of an individual clinical problem, change in GPs' pathology ordering behaviour is only one possible factor generating growth in the volume of pathology ordered for its management. Therefore, growth can still occur without change in GPs' ordering behaviour. Further, where change occurs, it may be an increase in only one of the two measures of behaviour change—occasions of testing or tests per order. It is important to distinguish these as there may be different factors contributing to growth in each type of ordering behaviour. Also an increase in occasions of testing represents a higher cost burden than a decision to order additional tests.[133,134]

While the discussion above largely focuses on factors contributing to growth over time, the same construct can be applied to demonstrate that GPs' pathology ordering at a single time point is only partially determined by GPs' pathology ordering behaviour. This holds true whether investigating the total volume of pathology generated by GPs' orders or the pathology generated in GPs' management of an individual clinical problem.

Demonstrating the separate contribution of GPs' ordering behaviour to the overall volume and growth of pathology testing has a bearing on the discussion of the appropriateness of ordering. This is because the judgement of whether a clinician's ordering is 'appropriate' or 'inappropriate' can only be a reflection of the appropriateness of their behaviour in terms of making the 'correct' decisions in initiating testing and/or ordering certain types of tests. Therefore, when inappropriate

ordering is present and there is potential to 'correct' this ordering it will only have an impact on the proportion of ordering that is driven by GPs' ordering behaviour.

I found that the majority of the volume of GPs' pathology testing is confined to a relatively small group of tests and clinical problems. Other authors have previously noted this concentration of ordering.[79,82,89] In investigating growth in GPs' ordering over time, I also demonstrated that these same tests and problems contribute to most of the growth that has occurred. In theory, targeting these tests and/or problems with interventions has the potential to have a significant impact on the volume of pathology tests ordered by GPs. However, my research suggests that there are not many situations where the quality of GPs' ordering is measurably poor, and therefore not many situations that could be targeted. One of the few examples is FBC testing in preventive care.

FBC tests are not recommended in preventive care guidelines (Chapter 5), but GPs' indicated that 8% of those ordered were for primary prevention (Chapter 6). The introduction of a successful intervention aiming to reduce this testing has the potential to have a significant impact on the volume of testing. Even if only a minor reduction in the ordering rate is achieved the impact on test ordering would still be significant because FBC tests account for the highest volume of tests ordered by GPs.

Hypothetically this type of intervention would be worthwhile, however the potential benefits in terms of quality of care and cost-benefit also need to be considered. For example, determining whether reducing FBC testing for prevention will improve quality of care is difficult. There is no evidence for its use in primary prevention, but FBC testing is unlikely to generate harm to patients and the benefit of testing to an individual patient's care is not known. Therefore, GPs' may not perceive a reduction of testing as of benefit to patient care, yet this perception is an important element in achieving change in testing behaviour.[409]

Further, the current Medicare rules (in particular the coning rule) for funding GP-ordered tests mean that a reduction in volume of testing may not translate into a reduction in the cost to Medicare. Due to coning, only 45–55% of GP-ordered FBCs performed by pathologists were funded by Medicare,[19,346] so reducing the volume of GPs' FBC ordering (as discussed in the example above) may not achieve any cost

reduction. For tests that are 'coned out' and therefore do not attract Medicare reimbursement, reducing testing will generate economic savings in terms of cost of reagents, labour etc., although these savings will not be reflected in public spending. It therefore seems that any interventions that aim to improve quality of GPs' pathology ordering and at the same time to reduce cost are unlikely to be successful under the current funding structure.

The growth in volume and cost of pathology testing has meant that the focus of governments and researchers has been on understanding the growth and managing the demand. As a result, the quality of GPs' pathology ordering as a whole has not been evaluated, including areas of overuse and underuse of pathology testing. A review of pathology services in England suggested that a significant proportion of testing (estimated as up to 25%) was inappropriate or unnecessary but that there was probably a similar amount of under-requesting.[410] This statement was based on the opinions of participants in the review about testing across the entire health sector rather than on quantitative evidence, yet it does highlight the possibility of significant amounts of under-utilisation. In my assessment of appropriateness of ordering, there were few recommended tests that were not ordered by GPs. However, this reflects a grouped measure of test appropriateness. In many cases under-utilisation may relate to patient-based measures such as inadequate monitoring of HbA1c over time in patients with diabetes. Further research to evaluate the extent of under-utilisation of GP pathology testing in individual patient care is needed.

The need to contain the increasing cost of pathology testing is understandable. Health budgets are limited and there is pressure to ensure maximum benefit for each dollar spent (or as the Australian Government describes it) ensuring that "spending on health is sustainable, affordable and provides maximum benefit to the greatest number of people."[20] This reflects the need for efficient health spending and implies the need to consider health care spending as a whole, but there is a tendency (due to 'siloing' of health budgets) to consider the pathology budget in isolation. While quality use of pathology services by ordering physicians has been and remains a core objective of the Australian Government (as reflected in the maintenance of the Quality Use of Pathology Program, and recently funded programs to promote evidence-based ordering and development of decision support tools), national policies have not attempted to reduce demand by ordering clinicians. Historically, the

Government has contained the pathology budget administratively through funding mechanisms, which has resulted in the current complex funding system.

There is an inherent conflict between population health strategies introduced by the Government and the objective of containing pathology spending. Many public health initiatives represent efficient health spending, as they have a net benefit to the community. However they can have a cost in terms of pathology testing. For example, the finding of the population-based AusDiab study that one in two Australians with diabetes were undiagnosed,[157] prompted many health initiatives to improve detection of diabetes, and therefore increased testing costs associated with its diagnosis and monitoring. It is thought that the health benefits of such initiatives (e.g. early detection of chronic disease, prevention of complications) more than outweigh the cost.[405] While there are situations where logical links between pathology testing 'costs' and outcomes can be made, there are many more where evidence between pathology testing and outcomes is lacking. This has prompted the call for an outcomes-based research agenda.[42,57] However, producing evidence linking testing to outcomes is complex and the development of methodology to do so is an area of current research.[70] While linking testing to outcomes would be ideal, in reality such evidence is many years away. It will be an ongoing challenge to find the optimal level of testing because while not enough testing will result in more 'flow on' costs in other sectors of the health system, there is a point at which too much testing will have no additional benefit.

Variance in GPs' ordering

The presence of considerable variance among GPs' in their use of pathology testing has been noted by several authors.[43-51,71-73,82,337] This variance is discussed as an indicator of poor quality, the rationale being that in the same clinical situation, clinicians should be homogeneous in their use of pathology testing, and this would result in low levels of variation. I similarly found variance among GPs in their pathology ordering at encounters. However, my investigation of this variance suggests that it is not a good indicator of quality of GPs' pathology ordering.

The amount of variance I was able to explain in the analysis (50%) was much higher than that explained by other researchers (10–30%). This is partially because (in most cases) others did not have information about the clinical problems for which GPs

ordered pathology tests and therefore were limited in their ability to assess the influence of the clinical situation on the variance. The GP's clinical workload, in particular the type of clinical problem under management at GP encounters, was the strongest determinate of pathology testing. However, I may have underestimated the influence of the clinical problem on variance as I used the ICPC-2 chapter to represent the clinical problem in the modelling. This chapter represents the body system that the clinical problem is classified to; for example, diabetes and lipid disorders are both classified to the 'endocrine, metabolic and nutritional' chapter. If the multivariate analysis had included the individual clinical problems (not just its ICPC-2 chapter), more variance may have been explained.

A number of other GP, practice and patient variables were found to be independent predictors of pathology ordering. These accounted for far less of the variance than did clinical problems. Some are not surprising such as lower testing for young patients aged < 5 years, and higher testing for new patients. However, others such as the higher ordering rates of young GPs and female GPs raise concerns (as discussed later) and may need to be further investigated.

Variation in response to patient-centred care represents higher quality care.[411-414] Therefore, the finding that the clinical problem under management was the primary factor driving variance can be considered an indicator of good quality care. The variables available in my analysis (i.e. those recorded in the BEACH study) only 'scratch the surface' in terms of describing the clinical situation that may generate 'appropriate' variance. GPs provide holistic care to their patients and their decision to order pathology in the management of the patient will incorporate consideration of biomedical and psychosocial factors. These types of drivers of patient-centred care are difficult to measure.

As discussed in Chapter 7, the inability of other researchers to incorporate the clinical problem in their models limits their ability to adequately assess 'appropriate variance'. Without adequate data to differentiate, researchers are effectively assuming that GPs' are homogeneous in the type of patients they see and care they provide to patients—we know this is not the case.[382] However, there may be specific clinical circumstances in which variance among GPs' pathology ordering reflects poor quality. Assessment of variance in such circumstances should reflect a specific

subset of pathology data; rather than variation in GPs' total ordering—the main measure used to date. I believe it is reasonable to conclude that a large proportion of the variance in GPs' total pathology ordering reflects patient-centred care and therefore quality care. It is misleading to assess variance of GPs' ordering without adjusting for the clinical workload of the GP, particularly the problem under management. I conclude that variance in total volume of pathology ordering is too blunt to be considered a useful measure of the quality of GPs' pathology ordering.

Predicted future growth in GPs′ ordering

My research confirms that the growth and ageing of Australia's population will contribute to ongoing growth in volume of pathology tests ordered by GPs to at least 2050. Over the 5 years from 2009–10 to 2015, I estimated that the volume of GPs' pathology ordering will grow between 2.1% and 2.5% per annum purely because of these expected demographic changes.

The three factors (discussed earlier) that contributed to past growth in GPs' ordering behaviour were held steady in these projections. Therefore, future growth can be expected even if no change occurs in GPs' ordering behaviour, the number of problems managed by GPs' per encounter or the number of encounters per person. However, it is inevitable that there will be further changes in these three factors. In addition to demographic changes, governments cite technological advancements (including new tests) as an expected driver of increased future health spending.[234,397] Other potential contributors include the many drivers linked to past growth, such as changes in disease prevalence, emergence of new evidence and new technologies, changes in health policy etc., and there are likely to be many more that emerge over time.

My research suggests that workforce factors may also influence the future growth of GPs' pathology ordering. For example, the finding that young GPs and female GPs ordered more pathology tests after adjustment than their older and male counterparts (as discussed in Chapter 7), may contribute to growth as the number of trainee GPs and the proportion of female GPs in the workforce are increasing.[383]

As I discussed in Chapter 8, under the current Medicare funding structure, the future increases in volume of GPs' pathology testing will only be partially reflected in increases in Medicare outlays. Nevertheless, the projected increases in volume of

GP-ordered tests will place ongoing pressure on the pathology budget, one of many areas of the health budget that will be under pressure as a result of the ageing population.

The ageing of the population is expected to increase the prevalence of diagnosed chronic disease and therefore its management in general practice. Pathology testing is integral to this management, and to the initiatives introduced by the Government to support GPs' prevention, detection and management of chronic disease.[187,235] As discussed earlier, some of these initiatives have encouraged GPs' use of health checks to prevent (through identification of risk factors) and detect chronic disease. Early detection is encouraged, as the sooner chronic disease is diagnosed the greater the potential for preventing disease progression and complications.

Once diagnosed, chronic disease management frequently requires long-term (often life-long) monitoring to determine disease progress, presence of complications, effectiveness of drug therapy and/or presence of side effects related to drug therapy. Pathology ordered for this monitoring already accounts for the majority of pathology testing ordered by GPs.[415] If diagnosed chronic disease prevalence increases as expected there will be significant growth in the associated pathology testing. Early detection may compound this further, particularly if life expectancy in the population continues to increase, because if people are living longer and chronic disease is diagnosed earlier, there will be a longer duration of monitoring required. Therefore, the associated growth in pathology ordering may be exponential. The expected increases in this area underscore the importance of improving the poor monitoring guidance in guidelines, and supporting GPs in the quality use of pathology testing in long-term chronic disease management.

Suggestions for future research

Further investigation of the appropriateness of GPs' pathology ordering for clinical presentations beyond the six problems investigated in this thesis, would provide a more comprehensive evaluation of the appropriateness of GPs' pathology ordering. Such evaluation could be undertaken with BEACH data, using similar methods to those used in the study described in Chapter 5. This research would provide an assessment of the availability and quality of guidance documents for other clinical

presentations and highlight areas for future interventions where it was found that GPs' ordering and/or guidance could be improved.

Future research will be needed to evaluate the impact of recent national programs that aim to introduce decision support tools for GPs, and to promote evidence-based testing. These programs are likely to implement educational interventions targeting GPs' pathology ordering behaviour in regard to specific tests or clinical problems. Such interventions will need to be evaluated. The results of this thesis indicate that any future evaluation will need to measure the impact of the intervention on GPs' ordering behaviour (including the likelihood of ordering, and the number and types of tests ordered), as well as changes in GP workload related to management of the targeted clinical problem or area. It is also important to collect sufficient variables to assess the appropriateness of pathology ordering in the targeted clinical area, at baseline and after the intervention. A simple measure of the number of tests ordered will not provide sufficient detail to determine success of an intervention or the appropriateness of any measured change. Ideally such evaluations would be conducted as randomised controlled trials.

In this thesis, the need for further research has been highlighted in several other areas, not covered in the research proposed above. Examples include: the need to describe and assess the appropriateness of GPs' pathology ordering in selected clinical situations (that could not assessed in this cross-sectional study); the need for research to establish the role of selected pathology tests in the investigation or monitoring of a condition/presentation; and the need for evidence about outcomes associated with different testing practices.

Establishing a patient-based longitudinal study has the potential to fill these gaps. Experience from the research presented in this thesis suggests that the variables required for future pathology research include the clinical presentation, details about patients and their medical history (e.g. test results, presence of diagnosed morbidities, risk factors, use of selected medications, family history, and social circumstances), pathology tests ordered, and outcome measures (e.g. hospitalisations, measures of disease severity, and patients' responses to testing such as psychosocial, cognitive and behavioural responses).

There are numerous ways in which data collected in this type of longitudinal patient-based study could be utilised. For example, it would be possible to measure patient health outcomes associated with GPs' adherence to pathology monitoring protocols in the management of specific diseases. It would also be possible to use the additional variables collected in this research (as listed above) to identify factors associated with the unexplained variance among GPs in their pathology ordering behaviour. Establishing a general practice patient-based longitudinal research project would create a data set that contains pathology test ordering and results data in the broader clinical context of the patient.

10 Conclusion

Considerable growth in pathology services generated by GP orders has led to concerns about appropriateness of this ordering. In this thesis I investigated three aspects of GPs' pathology: the reasons for GPs' pathology ordering; how these reasons contribute to growth in pathology ordering; and the appropriateness of this ordering. This body of work provides the first clear picture in over a decade of GPs' pathology ordering and how it has changed over time.

Factors contributing to the increase in pathology ordering include: increasing likelihood of ordering pathology tests; increasing number of tests ordered per episode; increasing number of problems managed at GP–patient encounters; increasing total volume of GP services provided to the Australian population. A small number of tests and problems account for the majority of pathology tests ordered by Australian GPs, and the majority of growth. Therefore, targeting interventions to these tests and/or problems may have a significant impact on the volume of pathology ordered by GPs.

The volume of pathology tests related to an individual problem is only partially determined by GPs' pathology ordering behaviour in the management of the problem. This has implications for interventions that target GPs' pathology ordering behaviour because if successful such interventions will only partially affect the associated volume of pathology tests ordered. With recent national programs being funded to develop interventions to support GPs' in the area of pathology ordering, an evaluation strategy that measures the impact of these interventions is needed. Such evaluation needs to determine the impact of the intervention on the volume of pathology testing that can be attributed to GP ordering behaviour, and the appropriateness of any change in ordering behaviour.

Variance among GPs in their volume of pathology ordering is used in the literature as an indicator of poor quality of GPs' ordering. I found that the foremost factor in explaining variance is the clinical problem being managed by the GP, which suggests patient-centred care is the main driver for variance. As such variance is appropriate, I

conclude that variation in total rates of pathology ordering is not a reasonable measure of the quality of GPs' ordering.

The good alignment with guidance documents of GPs' test selection in the management of six problems, and the fact that the increased ordering for these problems did not reflect a change in appropriateness of ordering, lead me to conclude that concerns about widespread inappropriateness of GPs pathology ordering are not substantiated, and that growth in testing does not equate with an increase in inappropriate ordering.

The expected ageing and growth in Australia's population will generate future growth in volume of pathology ordering irrespective of changes to GPs' clinical workload or GPs' pathology ordering behaviour. In particular, the ageing population will generate increased management of chronic diseases and along with it pathology testing associated with its management. The majority of this testing will be ordered for monitoring, however, recommendations for monitoring in guidelines were poor. Guidance needs to incorporate monitoring protocols detailing the pathology tests that have a role in ongoing monitoring, and the intervals at which these tests are required. Further research is needed to investigate and evaluate the monitoring protocols used by GPs. Ideally such research would be undertaken in a patient-based longitudinal research project that allows evaluation of patient health outcomes associated with GPs' adherence to pathology monitoring protocols. Improving the evidence base and guidance for pathology testing in long-term management of chronic disease will support GPs' in their quality use of pathology testing in this high growth area.

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Appendices

Appendix 1: Publications and presentations from this thesis

Reports:

Bayram C, Britt H, Miller G, Valenti L. Evidence-practice gap in GP pathology test ordering: a comparison of BEACH pathology data and recommended testing. Sydney: The University of Sydney. 2009. Viewed 7 March 2013, available at www.health.gov.au/internet/main/Publishing.nsf/Content/9B6B7B4EAAC0383DCA256F180048CCBD/$File/BEACH_QUPP%20report_FINAL_050609.pdf

Bayram C & Valenti L. GP pathology ordering. In: Britt H & Miller GC (eds). General practice in Australia, health priorities and policies 1998–2008. General practice series no. 24. Cat. no. GEP 24. Canberra: Australian Institute of Health and Welfare, 2009;57–86.

Presentations:

Bayram C. Quality of pathology ordering in Australian general practice. Presented at the Research Presentation Day: School of Public Health, University of Sydney June 2008 Sydney.

Bayram C, Valenti L, Britt H, Miller G. GP pathology ordering in Australia 2000–02 to 2006–08. Presented at the 2009 General Practice & Primary Health Care Research Conference, Melbourne. Primary Health Care Research & Information Service, July 2009.

Bayram C, Britt H, Miller G, Valenti L. The value of pathology to healthcare - Pathology ordering by general practitioners in Australia. Presented to the Business of Pathology meeting, Melbourne. Australasian Association of Clinical Biochemists & The Dark Report, November 2009.

Bayram C, Britt H, Miller G, Valenti L. Evidence-practice gap in GP pathology test ordering: a comparison of BEACH GP pathology ordering data and recommended testing. Presented at the 2010 Primary Health Care Research Conference, Darwin. Primary Health Care Research & Information Service, June 2010.

Bayram C, Britt H, Miller G, Valenti L. Evidence-practice gap in FP pathology ordering: A comparison of BEACH pathology data and recommended testing. Presented at the 38th NAPCRG Annual Meeting, Seattle. North American Primary Care Research Group, November 2010.

Bayram C, Harrison C, Britt H, Miller G. Pathology testing in 2020: the projected growth of family physician pathology test ordering. Presented at the 38th NAPCRG Annual Meeting, Seattle. North American Primary Care Research Group, November 2010.

Bayram C. Evidence-practice gap in GP pathology ordering: a comparison of BEACH pathology data and recommended testing. Presented at the Research Presentation Day: School of Public Health, University of Sydney, November 2010 Sydney.

Britt H, Bayram C, Miller G, Valenti L, Harrison C. GP-initiated pathology testing, data from the BEACH program. Presented at the Pathology Update 2011 conference, Melbourne. Royal College of Pathologists of Australasia, March 2011.

Appendix 2: Example of a 2007–08 BEACH recording form

BEACH (Bettering the Evaluation And Care of Health) - Morbidity and Treatment Survey - National DOC ID

Encounter Number	Date of encounter ____/____/____	Date of Birth ____/____/_ _ _ _	Sex M ☐ F ☐	Patient Postcode

START Time : AM / PM (please circle)	Patient Reasons for Encounter 1. 2. 3.

	Yes / No
New Patient	☐ ☐
Health Care/Benefits Card	☐ ☐
Veterans Affairs Card	☐ ☐
NESB	☐ ☐
Aboriginal	☐ ☐
Torres Strait Islander	☐ ☐

PATIENT SEEN BY GP ☐
PATIENT NOT SEEN BY GP ☐

Medicare Item Nos: (if applicable)
1. ____
2. ____
3. ____

Workers comp paid ☐
State Govt/Other paid ☐
No charge ☐

Diagnosis/ Problem ① : **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ② : **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ③ : **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ④ : **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Prac Nurse? ☐ 2. Prac Nurse? ☐

NEW REFERRALS, ADMISSIONS — Problem(s)
1. ____ 1 2 3 4
2. ____ 1 2 3 4

IMAGING/Other tests — Body site — Problem(s)
1. ____ - ____ 1 2 3 4
2. ____ - ____ 1 2 3 4

PATHOLOGY — Problem(s)
1. ____ 1 2 3 4
2. ____ 1 2 3 4
3. ____ 1 2 3 4

PATHOLOGY (cont) — Problem(s)
4. ____ 1 2 3 4
5. ____ 1 2 3 4

Patient reported
Height: ____ cm
Weight: ____ kg

To the patient if 18+:
Which best describes your smoking status?
- Smoke daily ☐
- Smoke occasionally ☐
- Previous smoker ☐
- Never smoked ☐

To the patient if 18+:
How often do you have a drink containing alcohol?
- Never ☐
- Monthly or less ☐
- Once a week/fortnight ☐
- 2-3 times a week ☐
- 4+ times a week ☐

How many 'standard' drinks do you have on a typical day when you are drinking? ____

How often do you have 6 or more standard drinks on one occasion?
- Never ☐
- Less than monthly ☐
- Monthly ☐
- Weekly ☐
- Daily or almost daily ☐

FINISH Time : AM / PM (please circle)

BA10

Appendix 3: GP characteristics questionnaire, 2007–08

The University of Sydney
at Westmead Hospital

Australian General Practice Statistics and Classification Centre

a collaborating unit of the
Australian Institute of Health and Welfare

Doctor Identification Number

Please fill in boxes or circle answers

1. Sex .....**Male / Female** *(please circle)*

2. Age.....

3. How many years have you spent in general practice?.....

4. How many GPs (full time equivalents) work at this practice (including yourself)?
(Practice = shared medical records)

5. Postcode of major practice address ..

6. In which GP Division is this practice

_____

7. Year of graduation .....

8. Place of graduation *(primary medical degree)*:

Aust 1
NZ 2
Asia 3
UK / Ireland..... 4
Other: (specify) 5

9. Do you conduct any of your consultations in a language other than English?

No..... 1
Yes - <25%..... 2
Yes - 25 to 50%..... 3
Yes - >50%..... 4

10. Are you a GP registrar (i.e. in training)?... **Yes / No**

11. Do you hold FRACGP ?..... **Yes / No**

12. Is your major practice accredited ?..... **Yes / No**

13. Is there a practice nurse at your major practice address ?..... **Yes / No**
If yes, how many full time equivalents?

14. Number of general practice sessions you usually work per week?
(1 session = ~4 hrs eg a morning session) ....

15. Direct patient care hours worked per week?
(Include hours of direct patient care, instructions, counselling etc and other services such as referrals, prescriptions, phone calls etc.) .....

16. Over the past four weeks have you provided any patient care ....*(Circle all that apply)*

As a locum 1
In a deputising service 2
In a residential aged care facility 3
As a salaried/sessional hospital medical officer..... 4
None of the above 5

17. What are the normal after-hours arrangements for your practice? *(Circle all that apply)*

Practice does its own.....1
Co-operative with other practices 2
Deputising service.....3
Referral to other service (eg A&E) 4
Other 5
None 6

18. Do you bulk bill ALL patients?.....**Yes / No**

If No, which groups are bulk billed?

(Tick those that apply)	**All**	**Some**
Pensioner/Healthcare Card holders ...	☐	☐
Children <16 years.....	☐	☐
Selected other patients		☐

19. To what extent are computers used -

(i) at your major practice?	(ii) by you (at work)?
Not at all 1	Not at all 1
Billing.....2	Test ordering 2
Prescribing.....3	Prescribing 3
Medical Records.....4	Medical Records 4
Other Admin.....5	Internet 5
Internet / Email.....6	Email 6

(iii) Prescribing / Health record software used is —

_____

20. Is your major practice site a teaching practice?
(Circle all that apply)

for undergraduates..... 1
for GP registrars..... 2
No..... 3

21. Did any of your BEACH consultations take place in an Aboriginal Community Controlled Health Service (ACCHS)?

No.....1
Yes - all.....2
Yes - some (which dates?) _____ 3

*Thank you for participating in the **BEACH PROGRAM**.*

AGPSCC, Acacia House, Westmead Hospital, WESTMEAD, 2145.
Ph: 02 98458151 fax: 02 98458155 email: janc@med.usyd.edu.au Web http://www.fmrc.org.au

Appendix 4: Instructions for participating GPs

B E A C H - Bettering the Evaluation And Care of Health

NATIONAL MORBIDITY AND TREATMENT STUDY

INSTRUCTIONS FOR PARTICIPATING DOCTORS

USING THESE INSTRUCTIONS

Use these instructions as a resource to complete the forms. While they may look daunting, most of the form is self-explanatory. The instructions contain:

- an example consultation scenario
- a completed form for the example scenario
- detailed explanations for each question on the form.

Reading these instructions will:

- show you how to fill out the forms
- **ultimately save you time**
- decrease the variation among practitioners in their recording techniques.

When to complete the forms

Complete the forms during the course of the consultation as

- some information needs to be asked of the patient
- it will be faster and more accurate than going back to your records at the end of the day. **To show the full range of your clinical activity it is vital that you take the pad with you to all hospital, home and nursing home visits.**

Informing patients

In your research pack there are two copies of a gloss board notice which tells patients about the study and of their right to refuse to allow inclusion of their unidentified data. Please ask your reception staff to **ensure your patients read the notice**. Patients who consult with you in another language should be made aware of their options regarding the study. For patients not seen, nursing home visits and palliative care, please use your professional discretion in this matter. The Human Research Ethics Committee of the University now requires that a mark be placed in the medical record of each patient who agrees to allow their data to be included in BEACH. Please record B ✓ or Beach Y (for yes) in the medical record. This action could be performed by any authorised staff member.

Patient information questions at the bottom of the form

These vary and are presented in blocks within the pad, so please read carefully the instructions relating to these questions. When the questions change in the pad, a green instruction sheet gives you instructions for the next block of forms.

EXAMPLE OF ONE TYPE OF RECORDED ENCOUNTER

This is a description of the data recorded on the sample recording form that follows.

On April 30th 2009, Mr A comes to the surgery. He has read the patient information card while in the waiting room and agrees to be included in the study. The consultation starts at 9.10 am. From the medical record you note Mr A's date of birth is 13/3/1947, his postcode is 2145 and that he carries a Health Care Card. You ask if he is from a Non English-Speaking Background or identifies himself as an Aboriginal or Torres Strait Islander and he answers no. You use the tick boxes to show his responses.

He is a regular patient suffering from hypertension and says he has almost run out of Cardizem and requests a script. After examination you feel Mr A is not responding to medication and you refer him to a cardiologist but also provide him with the required script for Cardizem CD 180mg tablets to be taken once a day with two repeats. You also recommend he try to lose weight, advise a low-fat diet and send him for cholesterol screening.

Mr A then complains about his ribs. He says he slipped and bumped himself at his part-time job the day before and his ribs are hurting. You send him for an x-ray and advise him to take Panadol for the pain.

Finally, Mr A asks for his annual flu injection. You tell Mr A that you will arrange for the practice nurse to give him a FluVax injection from your practice supply.

You tell him you have to ask him a couple of extra questions for the study. He says that he is 170 centimetres tall and weighs about 90 kilos. He says he no longer smokes and has a drink most nights but never more than one or two. You show him the 'standard drinks' card and he confirms one or two standard drinks.

This has been a standard surgery consultation in the Item 23 category, with an Item 10993 for the practice nurse, which finishes at 9.28 am.

BEACH (Bettering the Evaluation And Care of Health) - Morbidity and Treatment Survey - National DOC ID

Encounter Number

Date of encounter	Date of Birth	Sex	Patient Postcode
30 / 04 / 09	13 / 03 / 1947	M ☑ F ☐	2145

	Yes	No
New Patient	☐	☑
Health Care/Benefits Card	☑	☐
Veterans Affairs Card	☐	☑
NESB	☐	☑
Aboriginal	☐	☑
Torres Strait Islander	☐	☑

PATIENT SEEN BY GP ☑
PATIENT NOT SEEN BY GP ☐

Medicare Item Nos: (if applicable)
1. 23
2. 10993
3.

Workers comp paid ☐
State Govt/Other paid ☐
No charge ☐

START Time 9 : 10 (AM) / PM (please circle)

Patient Reasons for Encounter
1. Script for hypertension tablets
2. Sore ribs
3. Flu shot

Diagnosis/ Problem ①: Hypertension — Problem Status: New ☐ Old ☑ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Cardizem CD tablets	180mg	1 tab	1 daily	2				✓
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Dietary advice — Prac Nurse? ☐ 2. — Prac Nurse? ☐

Diagnosis/ Problem ②: Injury - ribs — Problem Status: New ☑ Old ☐ Work related ☑

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Panadol tablets	500mg	2 tabs	qid		✓		✓	
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. — Prac Nurse? ☐ 2. — Prac Nurse? ☐

Diagnosis/ Problem ③: Immunisation — Problem Status: New ☐ Old ☑ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. FluVax injection	0.5 ml	1 inj	stat	0		✓		✓
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. Injection given — Prac Nurse? ☑ 2. — Prac Nurse? ☐

Diagnosis/ Problem ④: — Problem Status: New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem
1. — Prac Nurse? ☐ 2. — Prac Nurse? ☐

NEW REFERRALS, ADMISSIONS

	Problem(s)
1. Cardiologist	(1) 2 3 4
2.	1 2 3 4

IMAGING/Other tests

	Body site	Problem(s)
1. X-ray	Ribs	1 (2) 3 4
2.		1 2 3 4
3.		1 2 3 4

PATHOLOGY

	Problem(s)
1. Lipid screen	(1) 2 3 4
2.	1 2 3 4
3.	1 2 3 4

PATHOLOGY (cont)

	Problem(s)
4.	1 2 3 4
5.	1 2 3 4

Patient reported
Height: 170 cm
Weight: 90 kg

To the patient if 18+: Which best describes your smoking status?
- Smoke daily ☐
- Smoke occasionally ☐
- Previous smoker ☑
- Never smoked ☐

To the patient if 18+: How often do you have a drink containing alcohol?
- Never ☐
- Monthly or less ☐
- Once a week/fortnight ☐
- 2-3 times a week ☐
- 4+ times a week ☑

How many 'standard' drinks do you have on a typical day when you are drinking? 2

How often do you have 6 or more standard drinks on one occasion?
- Never ☑
- Less than monthly ☐
- Monthly ☐
- Weekly ☐
- Daily or almost daily ☐

FINISH Time 9 : 28 (AM) / PM (please circle)

BA11

BEACH (Bettering the Evaluation And Care of Health) - Morbidity and Treatment Survey - National

DOC ID

Encounter Number

Date of encounter	Date of Birth	Sex	Patient Postcode
30 / 04 / 09	13 / 03 / 1947	M ☑ F ☐	2145

	Yes	No
New Patient	☐	☑
Health Care/Benefits Card	☑	☐
Veterans Affairs Card	☐	☑
NESB	☐	☑
Aboriginal	☐	☑
Torres Strait Islander	☐	☑

PATIENT SEEN BY GP ☑
PATIENT NOT SEEN BY GP ☐

Medicare Item Nos: (if applicable)
1. 23
2. 10993
3.

Workers comp paid ☐
State Govt/Other paid ☐
No charge ☐

DATE: Enter day, month and year of encounter.

BIRTH: Enter day, month and FULL YEAR of patient's birth.

SEX: Tick box for sex of patient.

PATIENT POSTCODE: Postcode of patient's home address.

ENCOUNTER NUMBER:
Pre-stamped with consecutive encounter number 001-105. A few extra forms allow for error - please complete up to 102.

This is not a patient identification number. If you see the same patient more than once during the recording period, complete a new form for each encounter. No linking of forms is required.

Ask the patient the following questions and tick either 'Yes' or 'No' for each item.

- **New Patient:** If this is the patient's first visit to your practice, tick the 'New' box. If the patient has been seen previously at this practice by you or one of your associates, tick the 'Old' box.
- **Health Care / Benefits Card Holder:** eg unemployed, pensioner, low income earner.
- **Veterans' Affairs Card holder:** Indicate whether the patient has a Veterans' Card. Patients may hold both Veterans' and Health Care cards.
- **NESB:** Non-English Speaking Background i.e. primary language spoken at home is NOT English.
- **Aboriginal / Torres Strait Islander:** Ask the patient "Are you of Aboriginal or Torres Strait Islander origin?" The patient may answer "Yes" to either or both. If both, tick both 'Yes' boxes. Otherwise, tick 'Yes' to whichever option the patient nominates and 'No' to the other, or tick 'No' for both options if that is the patient's response.**

PATIENT SEEN / NOT SEEN.

Tick 'PATIENT SEEN' if this is a face-to-face encounter

Tick 'PATIENT NOT SEEN' if a service is provided where your clinical action results in entry of information into the patient's record but the patient is not seen e.g. referrals, renewals for prescription/ certificates, case conferences/EPC items, where the patient is not seen face-to-face.

NB - Informed consent must be obtained from the patient or their carer prior to inclusion in the study, either by telephone or in person.

** This question was formally adopted in 1995 by the Australian Bureau of Statistics as the standard for measuring membership of the Indigenous population.

McLennan, W. & Madden, R. (1999) The health and welfare of Australia's Aboriginal and Torres Strait Islander Peoples ABS 4704.0 p.149

These items ask about the type of renumeration claimable for the encounter.

Medicare Encounters

Item No:

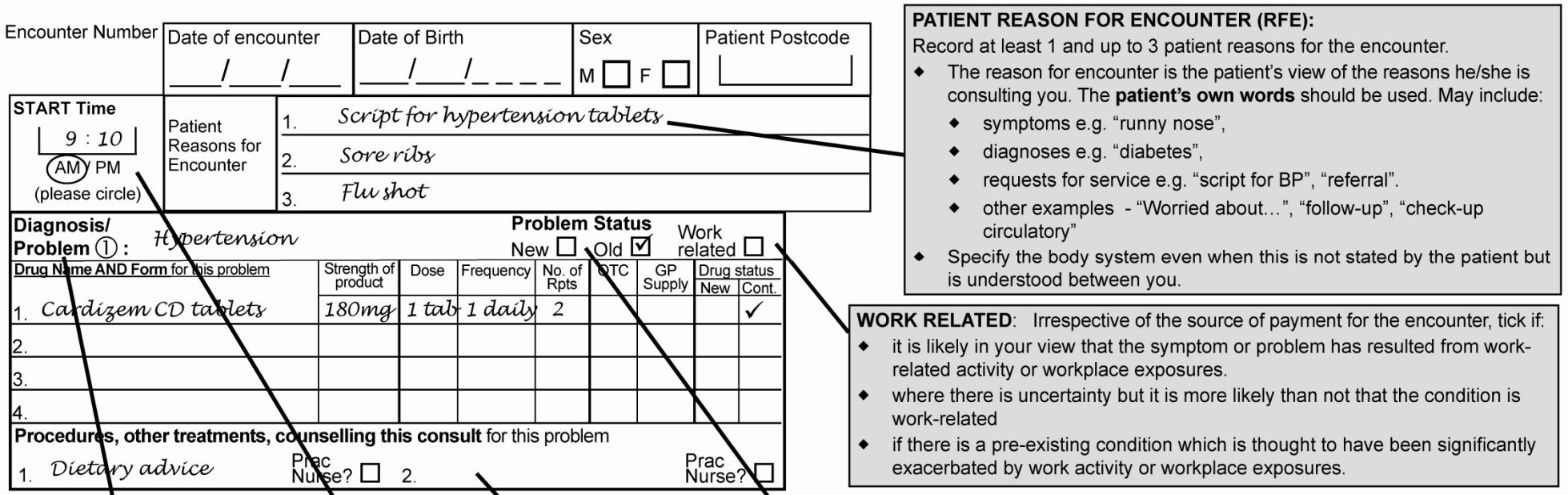
- Write the item number/s when there is a charge through Medicare, **bulk-billed or otherwise**.
- When multiple item numbers are involved, record the **consultation item**, e.g. 23 **and up to 2 others**.
- If unsure of item number, please provide type and level of consultation e.g. NHV-B (nursing home visit - level B) or diabetes care plan - C.
- Include item numbers (when applicable) for services when the patient is not seen e.g. case conferences, enhanced primary care (EPC) items.

Non-Medicare

Workers Compensation paid: For consultations claimable through workers compensation.

State Govt / Other paid: If the encounter is being paid for by a state government (e.g. hospital or other state agency), insurance company or other source. DOES NOT include additional cash payments made by patients charged through Medicare, but would include 'cash only' patients e.g. overseas travellers.

No charge: For services you provide free - with no payment from **ANY** source.



PATIENT REASON FOR ENCOUNTER (RFE):

Record at least 1 and up to 3 patient reasons for the encounter.

- The reason for encounter is the patient's view of the reasons he/she is consulting you. The **patient's own words** should be used. May include:
  - symptoms e.g. "runny nose",
  - diagnoses e.g. "diabetes",
  - requests for service e.g. "script for BP", "referral".
  - other examples - "Worried about…", "follow-up", "check-up circulatory"
- Specify the body system even when this is not stated by the patient but is understood between you.

WORK RELATED: Irrespective of the source of payment for the encounter, tick if:

- it is likely in your view that the symptom or problem has resulted from work-related activity or workplace exposures.
- where there is uncertainty but it is more likely than not that the condition is work-related
- if there is a pre-existing condition which is thought to have been significantly exacerbated by work activity or workplace exposures.

PROBLEM STATUS:

Tick '**New**' if:

- this is a new problem to the patient, or
- this is a new episode of a recurrent problem (e.g. URTI), or
- the patient has not been treated for that problem by any medical practitioner before.

Tick '**Old**' if the patient has been seen before by ANY medical practitioner for this chronic problem or this episode of an acute problem.

START TIME

Record the time the consultation STARTED in hours and mins and circle whether the time was AM or PM.

eg. 9 : 10 AM PM

DIAGNOSIS/PROBLEM: Record at least one and up to four problems.

- Use one Diagnosis/problem box for each diagnosis/problem
- Only record problems actually dealt with at this encounter
- Include ill-defined conditions (e.g. "cough"), preventive care (e.g. "pap smear", "contraception", "immunisation" or "checkup"), and social problems (e.g. "problems with spouse").
- Diagnose at the highest level possible with the information available (e.g. for diabetes, differentiate between IDDM/NIDDM/Type 1/Type 2 etc.)
- The order in which you record the problems is not significant - they do not have to match the order of the RFEs.
- If more than four problems are managed at the consultation, record the four problems that best describe the breadth of the consultation.

PROCEDURES, OTHER TREATMENTS, COUNSELLING:

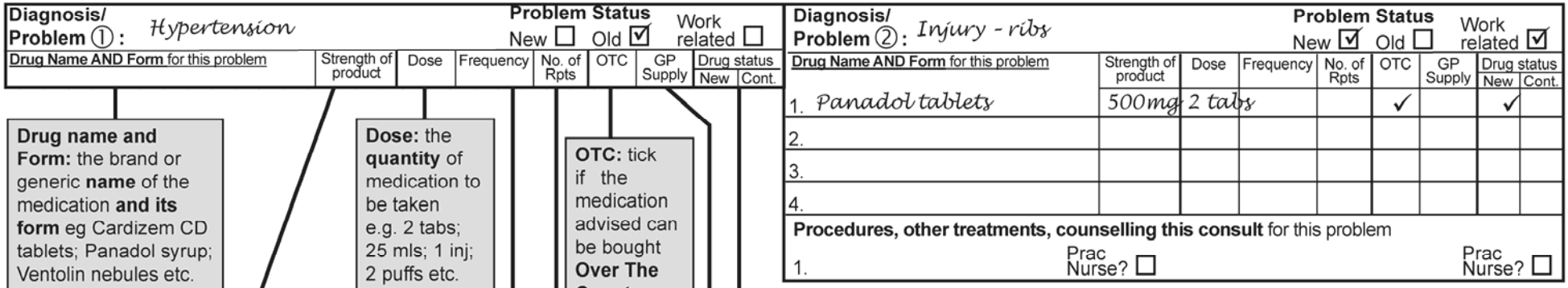
For each problem:

- Record up to two procedures, other treatments or counselling.
- Only include those ACTUALLY PROVIDED at the encounter.
- **Include in this section actions such as**
  - pap smears, injections, excisions, ear syringe
  - psychosocial counselling
  - diet and exercise advice
  - medical certificates
- **Do NOT include in this section:**
  - history
  - routine physical examinations e.g. blood pressure checks
  - discussion
  - referrals, imaging, or pathology ordered (there are sections for these).

NB - If a **practice nurse performs the procedure**, please **tick the box** marked 'Prac Nurse?'

MEDICATIONS: **NB** - **ONLY** record medications that were prescribed / advised / supplied **at this encounter**
Record medications when

- a prescription is written at this encounter,
- you recommend that the patient take an "over the counter" (OTC) medication.
- you administer or supply a medication/vaccine. eg. If 'Immunisation' is the problem managed, please enter drugs administered at this encounter, (e.g. CDT, DTP) or any drug samples you provide.



Diagnosis/ Problem ①: *Hypertension* — **Problem Status** New ☐ Old ☑ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.

Diagnosis/ Problem ②: *Injury - ribs* — **Problem Status** New ☑ Old ☐ Work related ☑

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. *Panadol tablets*	*500mg*	*2 tabs*			✓		✓	
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem

1. Prac Nurse? ☐ Prac Nurse? ☐

Drug name and Form: the brand or generic **name** of the medication **and its form** eg Cardizem CD tablets; Panadol syrup; Ventolin nebules etc.

Strength of product: Please specify the **strength** of the product you are prescribing/ supplying/advising.
We are attempting to differentiate between product strengths, e.g. 250mg or 500mg of the same product.

Dose: the **quantity** of medication to be taken e.g. 2 tabs; 25 mls; 1 inj; 2 puffs etc.

Frequency:

- **how often** the dose is to be taken.
- record in accepted abbreviations e.g. "bd", "tds", etc.
- if drug is to be taken "as required", write PRN.

No. of Rpts: for all **prescriptions** please specify the **number of repeats** ordered. If no repeats are given, please write '0' or ' - '. **Please do not leave blank**.

OTC: tick if the medication advised can be bought **Over The Counter** i.e. an S2 or S3 product. **Otherwise leave blank**.

GP supply: tick box if medication is from the **practice supplies** eg drug sample or vaccine. **Otherwise, leave blank**.

DO NOT TICK IF YOU HAVE PROVIDED A PRESCRIPTION, ONLY IF YOU HAVE PROVIDED A MEDICATION.

Drug status: If the medication is being used for the management of this problem for the **first time** then tick the '**New**' box. If it is a **continuation** or repeat of previous therapy then tick the '**Cont**.' box.

PLEASE RECORD INFORMATION IN AS MUCH DETAIL AS YOU WOULD WRITE ON A PRESCRIPTION.

For OTCs, provide as much detail as the patient would need to buy the medication over the counter.

OTHER MEDICATION EXAMPLES

ALWAYS SPECIFY

NAME and FORM,

STRENGTH,

DOSE and

Syrups
Dose may be written in "mg" or "ml" but strength must be specified.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Amoxil syrup	250mg/5ml	2.5ml	tds	0			✓	
2. Panadol syrup	120mg/5ml	10ml	4 hrly		✓		✓	

Creams
Specify the name, form, strength and no. of applications per day. There is no need to specify pack size.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Aristocort cream	0.02%		tds	-			✓	

Multiple strengths of same drug
If prescribing multiple strengths of the same drug to achieve a particular dose, specify both.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Warfarin tablets	1mg	1 tab	mane	2				✓
2. Warfarin tablets	2mg	1 tab	mane	2				✓

Injections
Tick GP supply only if you have provided the vaccine / medication yourself.
NB Please write '**injection given**' in the "Procedures, other treatments ..." section if you have given the injection at this encounter.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Fluvax inject	0.5ml	1 inj	stat	0			✓	
2. Engerix B Adult inject	20mcg/ml	1 inj	stat	0		✓	✓	

Insulin
Specify the number of units prescribed.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Mixtard 30/70 injection	100iu/ml	20units	mane	1				✓
2. Mixtard 30/70 injection	100iu/ml	12units	nocte	1				✓

Inhaled medications
Specify the mode of delivery, e.g. inhaler, turbuhaler, nebules, etc. and the strength.

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1. Pulmicort turbuhaler	400mcg	2 puffs	bd	1			✓	
2. Prednisone tablets	25mg	½ tab	1 daily	0			✓	
3. Ventolin inhaler	100mcg	2 puffs	4/24 prn			✓		✓

NEW REFERRALS / ADMISSIONS:

- Specify the type of specialist(s) or allied health professional(s) to whom the referral has been made, e.g. dermatologist, physiotherapist, hospital emergency department etc.
- Record new referrals only. Do not include continuation referrals.
- Indicate the problem or problems for which the referral was made by circling the appropriate problem number.
- Include referrals for clinical measurements such as spirometry and ECG

IMAGING/Other tests (+ Body site):

Imaging

- write the name of the imaging (e.g. x-ray) and body site
- circle the number(s) of the Diagnosis/problem which is being investigated

Other tests

- specify the type of test
- circle the relevant Diagnosis/problem number(s)

Lateralization is not required.

PATHOLOGY:

- Give details of up to five pathology tests ordered at the encounter. Document one test per line.
- Circle the associated Diagnosis/problem number(s).
- For single tests, write the test name (e.g. *HBA1C, pap smear*). If ordering a set of tests such as a FBC or LFT or lipids or thyroid function, record them in this grouped form. You don't need to list each of the individual tests incorporated in the set.
- Do not record simple urine dip stick tests.

NEW REFERRALS, ADMISSIONS	Problem(s)
1. Cardiologist	(1) 2 3 4
2. _____	1 2 3 4

IMAGING/Other tests	Body site	Problem(s)
1. X-ray	Ribs	1 (2) 3 4
2. _____	_____	1 2 3 4
3. _____	_____	1 2 3 4

PATHOLOGY	Problem(s)
1. Lipid screen	(1) 2 3 4
2. _____	1 2 3 4
3. _____	1 2 3 4

PATHOLOGY (cont)	Problem(s)
4. _____	1 2 3 4
5. _____	1 2 3 4

Appendix 5: Patient information card

The University of Sydney
School of Public Health

Australian General Practice Statistics and Classification Centre
Family Medicine Research Centre

a collaborating unit of the
Australian Institute of Health and Welfare

INFORMATION FOR PATIENTS

The BEACH © Project

Today your doctor is taking part in a National Survey of general practice called BEACH © *(Bettering the Evaluation and Care of Health).* This study is being done by the Australian General Practice Statistics and Classification Centre, University of Sydney, with the Australian Institute of Health and Welfare.

Your Doctor will be recording information about each patient he/she sees (age, gender etc), the problems that you see the Doctor about and the treatments given to you. **There are no names on the forms so you cannot be identified.** The information about today's visit to the doctor will be one record in a set of 100,000 records collected in general practices across Australia over the year.

This information will be used by researchers to describe what happens in general practice and to look at different aspects of health care; by government departments to help them plan for our future health; and by pharmaceutical companies to gain a picture of the people who use their drugs and of the problems being treated with the drugs they produce.

Remember: your name will not be on the form and no information will ever be released which could possibly let anyone know who you are. However, if you do not wish your doctor to record any unidentified information about you or your visit **please tell your Doctor as soon as you go in**. Such a decision will not affect the care your doctor is providing in any way.

SEE OVER FOR PROJECT DETAILS

AGPSCC, Acacia House, Westmead Hospital, PO Box 533,WENTWORTHVILLE, 2145.
Ph: 02 98458151 fax: 02 98458155 email: janc@med.usyd.edu.au Web http://www.fmrc.org.au

BEACH © Program Details

This program has been approved by the Ethics Committees of the University of Sydney and the Australian Institute of Health and Welfare (AIHW). The data are being collected under the AIHW ACT 1987 and in accordance with the Privacy Act 1988 (Amended 2001).

Organisations contributing financially to the conduct of this study in 2009–2010 are:

- ✦ The Australian Institute of Health and Welfare
- ✦ The Australian Government Department of Health and Ageing
- ✦ AstraZeneca Pty Ltd (Australia)
- ✦ Janssen-Cilag Pty Ltd
- ✦ Merck Sharp & Dohme (Aust) Pty Ltd
- ✦ Pfizer Australia Pty Ltd
- ✦ Abbott Australasia Pty Ltd
- ✦ Wyeth Australia Pty Ltd
- ✦ Sanofi-Aventis Australia Pty Ltd

BEACH is endorsed by the Royal Australian College of General Practitioners

BEACH is endorsed by the Australian Medical Association

AMA

FURTHER INFORMATION:

Australian General Practice
Statistics and Classification Centre
The University of Sydney
Acacia House, Westmead Hospital
Westmead 2145

Phone: (02) 9845 8151
Fax: (02) 9845 8155
Email: janc@med.usyd.edu.au
Web: http://www.fmrc.org.au

Any person with concerns or complaints about the conduct of this study can contact the Senior Ethics Officer, Ethics Administration, University of Sydney on (02) 9351 4811 (Telephone); (02) 9351 6706 (Facsimile) or gbriody@mail.usyd.edu.au (Email)

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Appendix 6: ICPC-2 and ICPC-2 PLUS code groups used for analysis of problems managed

Table A6.1: Code groups from ICPC-2 and ICPC-2 PLUS

Problem managed	ICPC-2 rubric	ICPC-2 PLUS code	ICPC-2/ICPC-2 PLUS label
Abdominal pain	D01		Pain/cramps; abdominal general
	D06		Pain; abdominal localised; other
Abnormal test results	A91		Abnormal result investigations NOS
	B84		Unexplained abnormal white cells
	U98		Abnormal urine test NOS
	X86		Abnormal cervix smear
Anaemia	B80		Iron deficiency anaemia
	B81		Anaemia; vitamin B12/folate deficiency
	B82		Anaemia; other/unspecified
		B78002	Anaemia; sickle cell
		B78003	Anaemia; hereditary haemolytic
		B79001	Anaemia; congenital
		B79004	Anaemia; hereditary
Arthritis – all	L88		Rheumatoid/seropositive arthritis
	L89		Osteoarthrosis of hip
	L90		Osteoarthrosis of knee
	L91		Osteoarthrosis, other
		L70009	Arthritis; pyogenic
		L70010	Arthritis; viral
		L70021	Arthritis;septic
		L81003	Arthritis; traumatic
		L81015	Haemarthrosis
		L83010	Arthritis; spine cervical
		L83011	Osteoarthritis;spine;cervical
		L84003	Arthritis; spine
		L84004	Osteoarthritis;spine
		L84009	Osteoarthritis;spine;thoracic
		L84010	Osteoarthritis;spine;lumbar
		L84011	Osteoarthritis;lumbosacral
		L84012	Osteoarthritis;sacroiliac
		L92006	Arthritis; shoulder
		L92007	Osteoarthritis;shoulder
		L92011	Humeroscapular periarthritis

(continued)

Table A6.1 (continued): Code groups from ICPC-2 and ICPC-2 PLUS

Problem managed	ICPC-2 rubric	ICPC-2 PLUS code	ICPC-2/ICPC-2 PLUS label
Arthritis – all (continued)		S91002	Arthritis; psoriatic
		T99063	Arthritis; crystal (excl. gout)
Back complaint	L02		Back symptom/complaint
	L03		Low back symptom/complaint
	L86		Back syndrome with radiating pain
Blood test – all[(a)]	–34		Blood test
Cardiovascular check-up	K30		Medical examination/health evaluation, complete, cardiovascular system
	K31		Medical examination/health evaluation, partial, cardiovascular system
Depression	P03		Feeling depressed
	P76		Depressive disorder
Female genital check-up/Pap smear	X30		Complete medical examination/health evaluation, female genital
	X31		Partial medical examination/health evaluation, female genital
	X37		Histological / exfoliative cytology, female genital
Health check (15+ years)[(b)]		A30001	Health evaluation; complete
		A30002	Exam; complete
		A30011	Check up; complete
		A30010	Exam; complete; physical
		A30017	Medical exam; complete
		A30028	Health assessment
		A30029	Check up; adult health; complete
		A31001	Health evaluation; partial
		A31003	Assessment; normal growth
		A31004	Exam; partial; physical
		A31005	Check up; partial
		A31006	Exam; partial
		A31008	Health screening
		A31012	Check up
		A31013	Medical exam
		A31017	Assessment; aged care
		A31025	Check up; adult health; partial
		A31026	Health surveillance; partial
		A31027	Assessment; physical fitness
		A31030	Check up; height/weight

(continued)

Table A6.1 (continued): Code groups from ICPC-2 and ICPC-2 PLUS

Problem managed	ICPC-2 rubric	ICPC-2 PLUS code	ICPC-2/ICPC-2 PLUS label
Hypertension (non-gestational)	K86		Hypertension; uncomplicated
	K87		Hypertension; complicated
Ischaemic heart disease	K74		Ischaemic heart disease with angina
	K75		Acute myocardial infarction
	K76		Ischaemic heart disease without angina
Lipid disorders	T93		Lipid disorders
Menstrual problems	X02		Pain; menstrual
	X03		Pain; intermenstrual
	X05		Menstruation; absent/scanty
	X06		Menstruation; excessive
	X07		Menstruation; irregular/frequent
	X08		Intermenstrual bleeding
	X09		Premenstrual symptom/complaint
	X10		Postponement of menstruation
Overweight/obesity (adults)[(c)]	T82		Obesity
	T83		Overweight
Pregnancy	W01		Question of pregnancy
	W78		Pregnancy
	W79		Unwanted pregnancy
Prescription – all[(d)]	–50		Medication prescription/request/ renewal/injection
Sexually transmitted infection	B90		HIV infection/AIDS
	X70		Syphilis; female
	X71		Gonorrhoea; female
	X73		Genital trichomoniasis; female
	X74		Pelvic inflammatory disease
	X90		Genital herpes; female
	X91		Condylomata acuminata; female
	X92		Chlamydia infection, genital; female
	Y03		Urethral discharge; male
	Y70		Syphilis; male
	Y71		Gonorrhoea; male
	Y72		Genital herpes; male
	Y76		Condylomata acuminata; male
		A78011	Disease; sexually transmitted
		A78053	Disease; venereal
		D72003	Hepatitis B

(continued)

Table A6.1 (continued): Code groups from ICPC-2 and ICPC-2 PLUS

Problem managed	ICPC-2 rubric	ICPC-2 PLUS code	ICPC-2/ICPC-2 PLUS label
Sexually transmitted infection (continued)		D72008	Hepatitis C
		U72003	Urethral syndrome
		U72005	Urethritis
		U72006	Urethritis; non-gonococcal; female
		U72007	Urethritis; non-gonococcal; male
		U72008	Urethritis; non specific; female
		U72009	Urethritis; non specific; male
		U72010	Urethritis; chlamydial
		Y73002	Prostatitis
		Y99018	Chlamydia; male
		Y99020	Donovanosis; male
Type 2 diabetes	T90		Diabetes; non-insulin-dependent
Urinary tract infection	U70		Pyelonephritis/pyelitis
	U71		Cystitis/urinary infection other
Weakness/tiredness	A04		Weakness/tiredness, general

(a) The ICPC-2 rubric '–34' signifies that the concept 'blood test – all' includes all of the blood test rubrics across all chapters of ICPC-2 (excluding the social chapter).

(b) Analysis of health check problems was limited to patients aged 15 years and over.

(c) Analysis of overweight/obesity problems was limited to adult patients aged 18 years and over.

(d) The ICPC-2 rubric '–50' signifies that the concept 'prescription – all' includes all of the prescription rubrics across all chapters of ICPC-2 (excluding the social chapter).

Note: NOS – not otherwise specified; HIV – human immunodeficiency virus; AIDS – acquired immune deficiency syndrome.

Appendix 7: ICPC-2 PLUS code groups used for analysis of pathology tests

Table A7.1: Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Chemistry		
Amylase	D34004	Test; amylase
C reactive protein (CRP)	A34005	Test; C reactive protein
Calcium/phosphate	A34006	Test; calcium
	A34013	Test; phosphate
	A34024	Test; calcium phosphate
Creatine kinase (CK)	K34004	Test; creatine kinase
Drug screen	A34002	Drug assay
	A34026	Blood drug screen
	A34027	Blood screen
	A35003	Drug screen
	A35005	Urine drug screen
	K34005	Test; digoxin
	N34003	Test; phenytoin
	N34004	Test; valproate
	N34005	Test; carbamazepine
	P34002	Test; lithium
Electrolytes, urea and creatinine (EUC)	A34007	Test; chloride
	A34008	Test; electrolytes
	A34010	Test; electrolytes, urea and creatinine (EUC)
	A34014	Test; potassium
	A34017	Test; sodium
	A34029	Test; urea and electrolytes
	A34034	Test; electrolytes and creatinine
	U34002	Test; creatinine
	U34003	Test; urea
HbA1c	T34010	Test; HbA1c
	T34017	Test; fructosamine
	T34022	Test; HBA1
Ferritin	B34016	Test; ferritin
	B34019	Test; iron studies

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Folic acid	B34017	Test; folic acid
	B34024	Test; folate
Glucose/glucose tolerance	T34005	Test; glucose
	T34009	Test; glucose tolerance
	T34023	Test; glucose (fasting/random)
	T34025	Test; glucose; fasting
	T34026	Test; glucose; random
Hormone assay	A34003	Hormone assay
	D33015	Test; Anti gliadin antibody
	T34007	Test; cortisol
	T34034	Test; adrenocorticotropic hormone
	W34005	Test; HCG
	W34006	Test; B HCG level (titre/quant)
	X34002	Test; luteinising hormone
	X34003	Test; progesterone
	X34004	Test; oestradiol
	X34005	Test; follicle stimulating hormone
	X34006	Test; SHBG; female
	X34007	Test; free androgen index; female
	Y34004	Test; SHBG; male
	Y34005	Test; free androgen index; male
Lactose intolerance	D38002	Test; lactose intolerance
Lipids	T34001	Check up; cholesterol
	T34004	Test; lipids profile
	T34006	Test; cholesterol
	T34011	Test; cholesterol high-density lipoprotein (HDL)
	T34013	Test; cholesterol low-density lipoprotein (LDL)
	T34016	Test; triglycerides
	T34020	Test; free fatty acids
	T34024	Test; chol/trig
Liver function test (LFT)	A34004	Test; albumin
	D34003	Test; alkaline phosphatase
	D34006	Test; bilirubin
	D34007	Test; gamma-glutamyl transferase
	D34008	Test; liver function
	T34012	Test; lactate dehydrogenase

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Multi-biochemical analysis (MBA)	A34012	Test; multi-biochemical analysis (MBA)
	A34021	Test; electrolytes & liver function test (E & LFT)
Other chemistry	A33023	Test; alpha fetoprotein
	A33026	Test; cancer antigen 125
	A33027	Test; cancer antigen 15.3
	A33028	Test; cancer antigen 19.9
	A33029	Test; carcinoembryonic antigen
	A33041	Test; cancer antigen
	A34015	Test; protein
	A34018	Vitamin assay
	A34019	Test; lead
	A34020	Test; blood gas analysis
	A34022	Test; mineral
	A34023	Test; zinc
	A34025	Test; dehydroepiandrosterone sulfate
	A34030	Test; biochemistry
	A34031	Test; blood alcohol
	A34032	Test; prolactin
	A34033	Test; testosterone
	A34037	Test; Glutathione S-transferase
	A34038	Test; magnesium
	A34040	Test; renin
	A35004	Test; urine sodium
	A35007	Test; urine; albumin
	A35008	Test; albumin creatine ratio
	B34023	Test; transferrin
	D34002	Test; alanine aminotransferase
	D35002	Test; 5-hydroxyindoleacetic acid
	K34001	Test; blood; digitalis
	K34006	Test; amino acids
	K34007	Test; troponin
	N34001	Test; blood; phenylhydantoin
	P34003	Test; methadone
	T34018	Test; androgens
	T34019	Test; insulin
	T34021	Test; C peptide

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Other chemistry (continued)	T34029	Test; aldosterone
	T34030	Test; parathyroid hormone
	T34035	Test; lipase
	T35002	Test; catecholamines
	W34008	Test; pregnancy associated plasma protein A
	W38002	Amniocentesis
Prostate specific antigen	Y34002	Test; acid phosphatase
	Y34003	Test; prostate specific antigen
Thyroid function (TFT)	T34015	Test; thyroid function
	T34027	Test; thyroxine
	T34028	Test; thyroid stimulating hormone
Urate/uric acid	U34004	Test; urate/uric acid
Vitamin B12	B34015	Test; B12
	D34009	Test; Schillings
Cytopathology		
Cytology	A37002	Test; cytology
	B37003	Test; cytology; blood
	D37002	Test; cytology; digestive
	F37002	Test; cytology; eye
	H37002	Test; cytology; ear
	K37002	Test; cytology; cardiovascular
	L37002	Test; cytology; musculoskeletal
	N37002	Test; cytology; neurological
	R37002	Test; cytology; respiratory
	R37003	Test; sputum cytology
	S37002	Test; cytology; skin
	T37002	Test; cytology; endocrine/metabolic
	U37002	Test; cytology; urology
	W37002	Test; cytology; reproduction
	Y37002	Test; cytology; genital; male
Pap smear	X37001	Pap smear
	X37003	Test; cytology; genital; female
	X37004	Vault smear
	X37005	Pap smear; thin prep

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Haematology		
Blood grouping & typing	B33001	Test; Coombs
	B33002	Test; blood grouping & typing
	B33009	Test; blood group
	B33013	Test; blood; cross match
Coagulation	B34003	Test; coagulation time
	B34006	Test; part thromboplastin time
	B34009	Test; prothrombin time
	B34014	Test; activated partial thromboplastin time
	B34022	Test; thrombin time
	B34025	Test; international normalised ratio (INR)
	B34026	Test; fibrinogen
	B34028	Test; bleeding time
	B34029	Test; coagulation screen
	K34008	Test; D-Dimer
Erythrocyte sedimentation rate (ESR)	A34009	Test; Erythrocyte sedimentation rate (ESR)
Full blood count (FBC)	A34011	Test; full blood count
Haemoglobin	B34018	Test; haemoglobin
Other blood	A33042	Test; lymphocyte type & count
	A34035	Test; blood film
	A34036	Test; blood thick film
	B33003	RH; antibody titer
	B34005	Test; blood; platelets
	B34007	Test; blood; sickle cell
	B34021	Test; reticulocyte count
	B34031	Test; haemoglobin epg
	B34032	Test; packed cell volume
	B34033	Test; blood; blood
	B37001	Exam; bone marrow
Histopathology (Tissue pathology)		
Histology; skin	S37001	Test; histopathology; skin
Other histology	A37001	Test; histopathology
	B37002	Test; histopathology; blood
	D37001	Test; histopathology; digestive
	F37001	Test; histopathology; eye

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Other histology (continued)	H37001	Test; histopathology; ear
	K37001	Test; histopathology; cardiovascular
	L37001	Test; histopathology; musculoskeletal
	N37001	Test; histopathology; neurological
	R37001	Test; histopathology; respiratory
	T37001	Test; histopathology; endocrine/metabolic
	U37001	Test; histopathology; urology
	W37001	Test; histopathology; reproductive
	X37002	Test; histopathology; genital; female
	Y37001	Test; histopathology; genital; male
Immunology		
Anti-nuclear antibodies	L33004	Test; anti-nuclear antibodies
Other immunology	A32001	Test; sensitivity
	A33005	Test; immunology
	A33011	Test; human leucocyte antigen
	A33024	Test; bone marrow surface mark
	A33025	Test; serum electrophoresis
	A33051	Test; immune status
	A33052	Test; skin patch
	A38004	Test; deoxyribonucleic acid
	B33005	Test; immunology; blood
	B33007	Test; immunoglobulins
	B33011	Test; immunoglobulin E
	B34027	Test; FBC for surface markers
	B34030	Test; intrinsic factor
	D32001	Test; sensitivity; digestive
	D33004	Test; immunology; digestive
	D33014	Test; endomysial antibody
	D33028	Test; mitochondrial antibodies
	D33031	Test; anti-tissue transglutaminase
	D34010	Test; transglutamase
	F33002	Test; immunology; eye
	H33002	Test; immunology; ear
	K33002	Test; immunology; cardiovascular
	K33003	Test; antineutrophil cytoplasmic antibodies
	L33003	Test; immunology; musculoskeletal

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Other immunology (continued)	L34001	Test; lupus erythematosus; cell prep
	N33002	Test; immunology; neurological
	R32004	Test; sensitivity; respiratory
	R33004	Test; immunology; respiratory
	S32001	Test; sensitivity; skin
	S33002	Test; immunology; skin
	T33002	Test; immunology; endocrine/metabolic
	U33003	Test; immunology; urology
	W33007	Test; immunology; reproductive
	X33002	Test; immunology; genital; female
	Y33002	Test; immunology; genital; male
Radioallergosorbent test (RAST)	A34016	Test; RAST
Rheumatoid factor	L33001	Test; rheumatoid factor
Infertility and pregnancy tests	W33002	Test; pregnancy
	W34002	Test; blood; pregnancy
	W34003	Test; antenatal
	W34007	Test; pregnancy screen
	Y38002	Test; sperm count
	Y38003	Test; semen examination
Microbiology		
Antibody	A33003	Test; antibody
Cervical swab	X33004	Test; cervical swab M,C&S
Chlamydia	A33006	Test; chlamydia
	A33034	Test; chlamydia direct immunofl
	X33006	Test; viral culture; genital; female
Ear swab and M,C&S	H33003	Test; ear swab M,C&S
Faeces M,C&S	D33002	Stool(s); culture
	D33008	Test; faeces M,C&S
	D36001	Test; faeces; cyst/ova/parasite
Fungal ID/sensitivity	A33008	Test; fungal ID/sensitivity
	A33030	Test; skin scraping fungal M,C&S
Hepatitis serology	D33005	Test; hepatitis A serology
	D33006	Test; hepatitis B serology
	D33007	Test; hepatitis C serology
	D33010	Test; hepatitis D serology
	D33011	Test; hepatitis E serology

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Hepatitis serology (continued)	D33013	Test; hepatitis serology
	D33016	Test; hepatitis C antibody
	D33017	Test; hepatitis B antigen
	D33018	Test; hepatitis A antibody
	D33019	Test; hepatitis B antibody
	D33020	Test; hepatitis D antibody
	D33021	Test; hepatitis E antibody
	D33022	Test; hepatitis A antigen
	D33023	Test; hepatitis C antigen
	D33024	Test; hepatitis D antigen
	D33025	Test; hepatitis E antigen
	D33026	Test; hepatitis antibody
	D33027	Test; hepatitis antigen
HIV	A33021	Test; cytomegalovirus serology
	B33006	Test; HIV
	B33008	Test; AIDS screen
	B33012	Test; HIV viral load
H pylori	D33009	Test; H Pylori
Other microbiology	A33004	Test; microbiology
	A33007	Test; culture and sensitivity
	A33012	Test; mycoplasma serology
	A33013	Test; parvovirus serology
	A33015	Test; Barmah forest virus
	A33016	Test; Antistreptolysin O Titre
	A33017	Test; herpes simplex culture
	A33019	Test; herpes simplex serology
	A33020	Test; toxoplasmosis serology
	A33033	Test; swab M,C&S
	A33035	Test; serology
	A33036	Antibodies screen
	A33038	Test; rapid plasma regain
	A33039	Test; viral swab M,C&S
	A33040	Test; viral serology
	A33043	Test; human papilloma virus (HPV)
	A33044	Test; Brucella
	A33045	Test; fungal M,C&S

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Other microbiology (continued)	A33046	Test; measles virus antibodies
	A33047	Test; Rickettsial serology
	A33053	Test; Bartonella
	A33054	Test; M,C&S
	A34028	Test; blood culture
	A34039	Test; Q fever
	B33004	Test; microbiology; blood
	B33010	Test; serum immunoglobulins
	D33003	Test; microbiology; digestive
	D33012	Test; rotavirus
	F33001	Test; microbiology; eye
	F33003	Test; eye swab M,C&S
	H33001	Test; microbiology; ear
	K33001	Test; microbiology; cardiovascular
	L33002	Test; microbiology; musculoskeletal
	N33001	Test; microbiology; neurological
	R33001	Culture; tuberculosis
	R33002	Culture; throat
	R33003	Test; microbiology; respiratory
	R33009	Test; influenza serology
	R33010	Test; Legionnaires antibodies
	R33011	Test; respiratory syncytial virus
	S33001	Test; microbiology; skin
	S33005	Test; varicella zoster serology
	S33006	Test; varicella zoster culture
	S33007	Test; nail M,C&S
	T33001	Test; microbiology; endocrine/metabolic
	U33002	Test; microbiology; urology
	W34004	Test; antenatal serology
	W33006	Test; microbiology; reproductive
	X33001	Test; microbiology; genital; female
	X33003	Culture; gonococcal; female
	Y33001	Test; microbiology; genital; male
	Y33003	Culture; gonococcal; male
	Y33004	Test; viral culture; genital; male
	Y33005	Test; urethral/penile swab

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Monospot	A33002	Test; monospot
	A33014	Test; Paul Bunnell
	A33031	Test; Epstein Barr virus serology
	A33032	Test; Epstein Barr virus
Nose swab M,C&S	R33008	Test; nose swab M,C&S
Pertussis	R33007	Test; pertussis
Ross River fever	A33009	Test; Ross River Fever
Rubella	A33001	Test; rubella
Skin swab M,C&S	S33003	Test; skin swab M,C&S
Sputum M,C&S	R33005	Test; sputum M,C&S
Throat swab M,C&S	R33006	Test; throat swab M,C&S
Urine M,C&S	U33001	Test; culture; urine
	U33004	Test; urine M,C&S
Vaginal swab and M,C&S	X33005	Test; vaginal swab M,C&S
Sexually transmitted infection (STI) screen	A33010	Test; venereal disease
	A33022	Test; syphilis serology
	A33057	STI screen
Simple basic tests		
Occult blood test	D36003	Test; occult blood
Other simple basic tests	B35001	Test; urine; blood
	R32001	Test; Mantoux
	R32002	Test; tuberculin
	W33001	Test; urine; pregnancy
	W35003	Test; urine; HCG
Other tests NEC		
Blood test	A34001	Test; blood
Urine test	A35001	Test; urine
Urinalysis	A35002	Urinalysis
Faeces test	A36001	Test; faeces
Other test NEC	A35006	Test; urine; full ward test
	A38001	Test; other lab
	A38002	Pathology
	A38003	Test; genetic
	A38005	Test; disease screen
	B38001	Test; other lab; blood
	D34001	Test; blood; digestive
	D35001	Test; urine; digestive

(continued)

Table A7.1 (continued): Pathology code groups for MBS groups and individual tests/batteries

Pathology test orders	ICPC-2 PLUS code	ICPC-2 PLUS label
Other test NEC (continued)	D36002	Test; faeces; digestive
	D38001	Test; other lab; digestive
	F34001	Test; blood; eye
	F38001	Test; other lab; eye
	H34001	Test; blood; ear
	H38001	Test; other lab; ear
	K34002	Test; blood; cardiovascular
	K38001	Test; other lab; cardiovascular
	L34003	Test; blood; musculoskeletal
	L38001	Test; other lab; musculoskeletal
	N34002	Test; blood; neurological
	N38001	Test; other lab; neurological
	P34001	Test; blood; psychological
	P35001	Test; urine; psychological
	P38001	Test; other lab; psychological
	R34001	Test; blood; respiratory
	R38001	Test; other lab; respiratory
	S34001	Test; blood; skin
	S38001	Test; other lab; skin
	T34002	Test; blood; endocrine/metabolic
	T35001	Test; urine; endocrine/metabolic
	T38001	Test; other lab; endocrine/metabolic
	U34001	Test; blood; urology
	U35002	Test; urine; urology
	U38001	Test; other lab; urology
	W34001	Test; blood; reproductive
	W35001	Test; urine; reproductive
	W38001	Test; other lab; reproductive
	X34001	Test; blood; genital; female
	X35001	Test; urine; genital; female
	X38001	Test; other lab; genital; female
	Y34001	Test; blood; genital; male
	Y35001	Test; urine; genital; male
	Y38001	Test; other lab; genital; male
	Z38001	Test; other lab; social

Note: AIDS – acquired immune deficiency syndrome; FBC – full blood count; H Pylori – Helicobacter pylori; HbA1 – haemoglobin alpha 1; HbA1c – haemoglobin A1c; HCG – human chorionic gonadotropin; HIV – human immunodeficiency virus; ID – identification; M,C&S – microscopy, culture and sensitivity; NEC – not elsewhere classified; SHBG – sex hormone binding globulin.