AN INVESTIGATION OF THE IMPACTS OF EXCESS ALCOHOL CONSUMPTION ON CHRONIC DISEASE MANAGEMENT IN A REGIONAL SETTING

PhD Thesis

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Statement of the contribution of candidate

Dr Julie Kay Mudd, was the primary person responsible for this research, including the: original idea and design of the research, coordination of the project, study design and drafting of research protocols, data management and data analysis, drafting thesis and component manuscripts, submitting of manuscripts and revision of manuscripts and the thesis.

Statement of the contribution of others

Prof Kerrianne Watt	Primary supervisor. KW advised on appropriateness of study design, advised on statistical analysis of the papers in chapter 4 &5, read and suggested revisions for manuscripts for chapters 2, 4 &5, and read and suggested revisions for the overall thesis
Prof Sarah Larkins	Secondary supervisor. SL advised on appropriateness of study design, advised on qualitative analysis of the paper in chapter 3, read and suggested revisions for manuscripts for chapters 2, 3,4 &5, and read and suggested revisions for the overall thesis
Dr Robyn Preston	Cohort program mentor. RP advised on qualitative analysis of the paper in chapter 3 and provided cross-coding for validity on this paper.
Kian Lotter	KL undertook a brief paid research assistant position to clean the chart audit database for chapter 5, finding duplicates, fixing typos and classifying medications to drug class as per a protocol written by JM.

Declarations

Ethics

The research presented and reported in this thesis has been conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research. This research was assessed and approved by the JCU Human Research Ethics committee (approvals: H5335, H6281 and H6279).

Copyright

The work reported in this thesis is the original work of the candidate, Dr Julie Mudd. Any work conducted by others that is referred to has been appropriately cited and the contributions of other authors to submitted manuscripts has been explained.

Every reasonable effort has been made to gain permission and acknowledge the owners of copyright material. I would be pleased to hear from any copyright owner who has been omitted or incorrectly acknowledged.

Conflicts of interest

Nil conflicts of interest identified.

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Publications

Chapter	Manuscript Details	Status
2	Mudd, J., Larkins, S., Watt, K. The effect of alcohol consumption on the management of chronic disease: a systematic review. PLOS one. Submitted Feb 2020.	under review (revisions on hold due to pandemic)
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Abstract

Background

Alcohol consumption is almost ubiquitous in Australian society, being regularly consumed by approximately 80% of the population. Current Australian guidelines state that individuals should: 1) consume no more than two standard drinks daily to avoid chronic impacts; and 2) have a maximum of four on any single occasion to avoid acute impacts, with a standard drink defined as containing 10g of alcohol. However, alcohol is consumed in excess of Australian guidelines by a significant proportion of the community including those who have pre-existing chronic health conditions. Chronic disease places an ever-increasing burden on health systems with one in two Australians reporting at least one chronic health condition. Despite this, the existing guidelines for health professionals provide limited guidance on alcohol consumption in the presence of chronic disease. This limited information is compounded in regional areas by a greater burden of disease, higher rates of alcohol consumption and limited specialist drug and alcohol facilities. This study examines the impact of alcohol consumption by people with chronic diseases on the management of their disease in a regional setting.

Methods

Building on the foundation of a systematic literature review of the impact of alcohol on chronic disease management, from both a clinical and public health perspective, this thesis presents a multi-methods study undertaken in a primary practice environment in Townsville, a regional Australian city of fewer than 200,000 people in north Queensland. It begins with a qualitative study exploring the practices and perceptions of health practitioners working in multiple primary care practices utilising 18 brief semi-structured interviews. The interviews were analysed by line by line analysis utilising abductive coding to data saturation. This is then complemented with a cross-sectional study of 68 people living with chronic disease, using a custom designed survey to better understand their alcohol consumption habits, the impact that alcohol has had on the management of their chronic disease and their perceptions about how much can be safely consumed without negatively impacting management of their chronic disease. The survey analysis included qualitative line by line analysis of free text fields and descriptive statistical analysis compared between high and low alcohol consumption categories.

Finally, in the largest sub-study of the thesis, a retrospective chart audit of 482 patient records was undertaken. The audit aimed to provide a comprehensive examination of the impact of

alcohol consumption above guidelines on chronic disease management, outcomes and health utilisation of individuals with diagnosed chronic disease in a regional context. Three common chronic diseases with clear management guidelines for primary care were chosen as indicator conditions; chronic kidney disease, type two diabetes mellitus and chronic obstructive pulmonary disease. Chronic disease management was measured against the primary care guideline. The outcomes measured were: estimated glomerular filtration rate for chronic kidney disease; forced expiratory volume in one second as a percent of normal for chronic obstructive pulmonary disease and haemoglobin fraction A1c level for type two diabetes. Both attainment of management targets and primary disease outcomes were standardised to allow different chronic diseases to be compared. Health use information collected was the number of prescriptions, the number of practice visits, the total practice billings per individual, emergency department attendance, hospital admissions and length of stay for admitted patients. Associated costs were then calculated and analysed. All outcomes were analysed utilising statistical software using the appropriate descriptive and comparative statistical methods.

Results

Health practitioners working in primary care found working with people with chronic disease who continued to drink alcohol above Australian guidelines challenging and a significant burden. They reported a lack of resources, training and referral options in the alcohol management space. Practices undertook a multidisciplinary approach, however, role confusion with regards to who was addressing the alcohol issue was common across practices. The cultural role and pervasiveness of alcohol was highlighted as an important factor for both patient and practitioner attitudes and practices. Practitioner comfort in dealing with these patients was predominantly associated with years of professional experience and the most experienced practitioners reported the central role of the patient in their own care.

Approximately 20% of participants with chronic disease were drinking in excess of the Australian Guidelines and 14% reported having personally experienced an impact on their chronic disease as a result of alcohol consumption. Overall, the patient group perceived a safe drinking level that was comparable to the guidelines, however, when subdivided by AUDIT-C screen for potential alcohol dependence, those that screened negative (AUDIT-C score <4) gave significantly lower estimations of safe consumption compared to those that screened positive (chronic drinking: 0 *cf* 4 standard drinks; acute drinking 2 *cf* 6 standard drinks, Mann-Whitney p<0.001). Two people expected that drinking above the Australian guidelines would have a positive effect on their health. Seven did not know what impact alcohol consumption

would have (six of these people were non-drinkers). Two-thirds of participants reported that they expected negative consequences on their own health if they were to drink above the Australian guidelines, with hypertension and hyperglycaemia most reported.

Alcohol consumption at high-risk levels (AUDIT-C scores over nine or more) significantly reduced the ability of people to reach the management targets outlined in the relevant chronic disease guideline for general practice ($F_{[3,453]}=3.68$; $p=0.012$); this effect remained significant after adjustment for gender and diagnosis ($p=0.025$). In addition, alcohol consumption at high risk levels significantly worsened standardised primary disease outcome ($F_{[3,403]}=2.86$; $p=0.037$), an effect that remained after adjustment for gender and current smoking status ($p=0.040$).

Despite inability to reach management targets and worsening disease outcomes, excess alcohol consumption was associated with a decrease in health care utilisation, as evidenced by a decline in primary care attendance ($X^2_{[1]}=6.93$; $p=0.009$), fewer prescriptions per person ($F_{[3,453]}=3.22$; $p=0.023$) and therefore an overall decrease in primary care costs ($F_{[3,453]}=4.06$; $p=0.007$). Overall, 35% of individuals attended hospital during the year (20% attended the emergency department without an associated admission, and 22% with an admission). The relationship between alcohol consumption and hospital attendance approximated an asymmetric U-shape with the lowest utilisation observed in those who scored AUDIT-C 5-8, and equal highest in those who scored AUDIT-C 0 and AUDIT-C 9+. Relative to those scoring in the AUDIT-C 5-8 category, participants who scored in the AUDIT-C 9+ category showed higher relative risk of attending the emergency department (RR:2.6; 95%CI:1.1-6.0; $p=0.03$) and having a hospital encounter (RR:1.8; 95%CI:1.0-3.1; $p=0.04$), with a non-significant effect on hospital admission rate (RR:1.5; 95%CI: 0.7-3.3; $p=0.32$). Rates of hospital use were higher in smokers, but the small sample size limited further elucidation of alcohol's impact. However, after accounting for smoking, there was a significant association between AUDIT-C and emergency department costs ($F_{[3,101]}=5.25$; $p=0.02$), total hospital costs ($F_{[3,112]}=2.92$; $p=0.037$) with an equivocal effect on admission costs ($F_{[3,114]}=2.68$, $p=0.05$). This was associated with a paradoxical decrease in length of hospital stay ($F_{[3,352]}=2.77$; $p=0.04$) for higher AUDIT-C categories.

Conclusion

Alcohol consumption in people living with chronic disease poses a significant challenge for health professionals. This burden is increased in regional areas where referral services are

more limited. Overall, staff in primary care felt under-trained and under-resourced to adequately manage this group of patients.

People living with chronic disease were generally aware of the potential harmful impacts of alcohol on their chronic disease, however 20% still drank in excess of guidelines. While as an overall group the perception of what was safe reflected the guidelines, current drinking behaviour impacted on the perception of how much was safe to drink.

High consumption of alcohol by people living with chronic disease was associated with a reduction in their ability to attain chronic disease management targets and a decrease in the standard primary outcome of their chronic condition. Despite this apparent worsening of the outcomes of chronic disease, this was also associated with an overall decrease in engagement with health services, especially primary care services and shift towards the use of hospitals in the highest alcohol consumption category.

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Tables and Figures

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Abbreviations

AAF	Alcohol attributable fraction
ACR	Albumin creatinine ratio
ALT	Alanine aminotransferase
AMI	Acute myocardial infarction
ANOVA	Analysis of variance
AST	Aspartate aminotransferase
ATODS	Alcohol, tobacco and other drug service
AUD	Alcohol use disorder
AUDIT	Alcohol use disorders identification test
AUDIT-C	Alcohol use disorders identification test-consumption
BMI	Body mass index
BP	Blood pressure
CAD	Coronary artery disease
CAGE	AUD screen acronym (cut down, annoyed, guilty, eye-opener)
CDT	Carbohydrate deficient transferrin
CHF	Chronic heart failure
CKD	Chronic kidney disease
COPD	Chronic obstructive pulmonary disease
CVD	Cardiovascular disease
DSM (4, 5)	Diagnostic and statistical manual of mental disorders (version 4 or 5)
ED	Emergency department
eGFR	Estimated glomerular filtration rate
FBG	Fasting blood glucose
FEV1%	Forced expiratory volume in one second, % of predicted
GDP	Gross domestic product
GGT	Gamma-glutamyl transferase
GP	General practitioner
HbA1c	Haemoglobin glycated fraction A1c
HDL	High density lipoprotein
HIV	Human immunodeficiency virus
HTN	Hypertension
ICD-(9,10,11)	International statistical classification of diseases and related health problems (version)
LDL	Low density lipoprotein
LFT	Liver function test(s)
MCV	Mean corpuscular volume
NQPHN	North Queensland primary health network
OR	Odds ratio
PCR	Protein creatinine ratio
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
PTSD	Post-traumatic stress disorder
PVD	Peripheral vascular disease
RACGP	Royal Australian college of general practitioners
RR	Risk ratio
SUD	Substance use disorder
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus

Chapter 1 Introduction to Thesis

1.1 Rationale

This research was born while I was working as the Senior Medical Officer in addiction medicine at a regional Alcohol Tobacco and Other Drug Service (ATODS). I became aware that people with existing chronic disease were a challenging cohort of patients for whom to arrange management. Due to the complexity of their comorbidities they often experienced adverse events that led to them presenting earlier to addiction services than those using the same substance who were otherwise physically healthy. Due to the earlier presentation they were less likely to have become physically dependent on alcohol (or have a diagnosis of alcohol use disorder (AUD; 1). ATODS was oriented toward managing AUD and other substance use disorders, and as a result of this the approaches available were not a good fit for these clients. Even in those whose presentation did meet AUD criteria, our rehabilitation options were limited as most residential rehabilitation facilities would not accept people with pre-existing physical comorbidities as they did not have sufficient medical and nursing cover to manage health emergencies and they were uncomfortable with clients bringing medications into the rehabilitation environment. The service had 'dual-diagnosis' arrangements for those with mental health comorbidities but no such arrangements for physical disease comorbidities. This issue became increasingly difficult as the service transitioned from being organisationally positioned under Community Health within the health service to being under mental health. As this transition occurred most of the medical staff cover shifted from addiction medicine specialists to addiction psychiatry specialists who, in general terms, were less comfortable managing physical chronic disease comorbidities.

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This meant that these people were often being primarily managed by their General Practitioners (GPs) many of whom expressed concern about adequate management of complex clients. So, in summary, I realised that some of our potentially most at-risk clients in terms of adverse events were also the most difficult for whom to secure specialised help and that there was an expectation for GPs to manage these complex and medically at-risk clients.

1.2 Background

1.2.1 Why Alcohol?

Alcohol is consumed by most of the Australian population. Approximately 90% of Australians have tried alcohol and the most recent figures suggest that 77% have consumed it in the last 12 months (2). Alcohol plays a complex role in society with integration into many daily social activities and functions, however, it remains a potentially dangerous substance that can cause substantial harms. While many people consume alcohol in a manner that is unlikely to result in harm, the alcohol use of a significant number of Australians has the potential for acute or chronic harm or both. The Australian Guidelines to reduce health risks from drinking alcohol current at the time of conducting this research (Australian Alcohol Guidelines, Box 1; 3) were designed to limit the lifetime risk of death as a result of consumption to 1%. Consumption is described in terms of a standard drink defined as containing 10g of ethanol. The first two guidelines are most relevant to this thesis, particularly the first. The first guideline is routinely referred to as the chronic use guideline and the second as the acute use guideline.

Box 1: Australian Alcohol Guidelines 2009

1. For healthy men and women, drinking no more than two standard drinks on any day to reduce the lifetime risk of harm from alcohol-related disease or injury
2. For healthy men and women, drinking no more than four standard drinks on a single occasion to reduce the risk of alcohol-related injury
3. For people under 18 years of age, not drinking alcohol is the safest option.
4. For women who are pregnant, planning a pregnancy or breastfeeding not drinking is the safest option.

Source: Australian guidelines to reduce health risks from drinking alcohol (3)

1.2.2 Why Chronic Disease?

Approximately half of all Australians have a chronic disease and this rate is increasing (4). The Australian Government monitors specified chronic diseases that contribute significantly to disease burden; arthritis, asthma, back pain and problems, cancer, cardiovascular disease, chronic obstructive pulmonary disease (COPD), diabetes (particularly Type 2 diabetes mellitus; T2DM), and mental health conditions (5). In Australia, chronic diseases as a group are responsible for 87% of deaths, 37% of hospitalisations and 61% of the burden of disease (5). With increasing incidence but decreasing mortality they are an ever-increasing contributor to overall disease burden (5). The impact of alcohol on chronic disease is covered in more detail in the background of the literature review presented in Chapter 2.

1.2.3 Alcohol and Chronic Disease

It is worth noting that the guidelines in Box 1 are designed for otherwise healthy individuals, with the full guideline recognising the potential for increased harm in those with pre-existing health conditions (3). However, the guideline stops short on giving advice about drinking for those with chronic disease, instead suggesting they seek

medical advice. The fact that individuals may need to curtail their drinking if they have chronic disease is not contained in the public facing webpage explaining safe drinking or the summary version of the guidelines and no information is provided to health practitioners to guide their advice to patients.

"Drinking leads to poorer outcomes for people with certain diseases and conditions, including alcohol-related diseases. Anyone having treatment for any of these conditions, or any other problem that might be made worse or affected by alcohol, should discuss their alcohol intake with a health professional. In many instances, temporary or permanent abstinence may be necessary"

Australian Alcohol Guidelines 2009 Appendix 1, p 94 (3)

While rates of excess alcohol consumption are trending downwards in younger people (18-24 year olds) for both guideline one and two, there has been no change in older age groups where chronic disease is more prevalent (5). Evidence available in the literature at the time the project commenced suggested that people with chronic disease consumed alcohol at similar rates and patterns to those without chronic disease (6) despite being at increased risk from alcohol use. However, there was limited evidence in this space and assessing and advising about alcohol consumption was not prioritised in the literature or the guidelines for chronic disease management. Given the rates of chronic disease and alcohol consumption in excess of guidelines, it is estimated that between 10-15% of the population is potentially in this increased risk group. Therefore, the focus of this research in examining the impacts of alcohol consumption in people with chronic disease is justified.

1.3 Context

1.3.1 Location

Townsville is an outer regional city located on the north-eastern Queensland coast of Australia, in the dry tropics. The population is approximately 190 000 and it is located 1337km north of Brisbane, the nearest capital city. This distance creates a need for independent service provision for the population. The region has slightly lower socioeconomic status, lower educational attainment, higher rates of government housing, and higher overcrowding than Queensland as a whole (7). The proportion of residents who identify as Aboriginal and/or Torres Strait Islander (7.6%) is more than double the Queensland average (3.6%) and nearly three times the national average (2.8%; 7).

1.3.2 Health Profile of Townsville

Health status in Townsville is similar, or fractionally worse, than overall health status for Queensland (7). The prevalence of health risk factors and indicators are shown in Table 1.

Alcohol consumption by both men and women in Townsville is slightly higher than the Queensland average, in relation to both Guideline 1 and Guideline 2 (7) which is, in turn, higher than the average for Australia (2) (Table 1).

Table 1 Prevalence of Risk Factors and Chronic Disease in Townsville, Queensland and Australia

	Townsville (%)	Queensland (%)	Australia (%)
Diabetes	4.9	4.5	4.4
COPD	3.1	2.9	2.6
CVD	4.8	4.7	4.8
CKD*	7.0	10.0	10.0
Alcohol consumption			
Exceeding Guideline 1 (>2SD/day)	24.2	17.3	16.1
Exceeding Guideline 2 (>4SD at least monthly)	34.5	31.8	26.0
Daily smoking rate	14.6	14.0	13.8

*represents biochemical evidence of kidney disease, only 10% of these people self-identify as CKD and low regional/ remote rates may reflect limited pathology access. Source: Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016 (2) and Northern Queensland PHN Health Needs Assessment 2016 (7)

1.3.3 Services Available

Townsville has a wide variety of primary care practices. In 2018, 80% of the population in the North Queensland Primary Health Network (NQPHN) region accessed a GP, however 14.7% wanted to see a GP but could not, and 20% felt they waited an unacceptably long time for their appointment (10), suggesting a degree of unmet need. Overall access to GP services was considered adequate by the NQPHN (7).

ATODS are considered an area of workforce need by the NQPHN (7). A 2017 comprehensive needs assessment in the alcohol and other drugs sector for the region undertaken by the NQPHN (8) identified that despite an increased need for service, driven by increased use, there was a significant gap in service provision in relation to ATODS. Currently Townsville has one public ATODS clinic that provides counselling,

medical services and day detoxification services. There are two main residential rehabilitation providers, both of which are operated by non-governmental organisations and there is a substantial gap for residential services for women and young people (8). Recommendations made in the NQPHN needs assessment of the alcohol and other drugs sector included: improved access to residential rehabilitation services; increased detoxification services; improved services for people transitioning from prison or rehabilitation to the community; stronger primary health care capacity in this sector and improved evaluation. While the report specifically considered dual diagnosis in terms of mental health and the need to strengthen services for these clients, there was no consideration of dual diagnosis with physical chronic disease (8).

1.3.4 Scope

Given the identified local need, the aim of this thesis is to examine the use of alcohol in people with diagnosed chronic disease, focusing on the impacts of at-risk alcohol consumption on their health outcomes and health care utilisation. At-risk alcohol consumption is defined as drinking in excess of the current Australian Alcohol Guidelines (3).

The scope of chronic diseases included is outlined in the methodology of each chapter. In general, the focus is on those conditions that have been highlighted as priorities by the Australian Government: arthritis, asthma, back pain, cancer, cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), diabetes and mental health conditions (11). Later in the thesis (Chapter 5) the focus narrows to three chosen indicator conditions: T2DM, CKD and COPD. These were selected as they are common and have clear management guidelines for primary care.

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1.4 Research Questions

The overall aim of the thesis is addressed by four research questions.

1. What is already known about the impact of alcohol consumption on chronic disease and what gaps exist in our understanding?

2. How do health practitioners currently manage excess alcohol consumption in patients with chronic disease?

3. What do people with chronic disease think about the impact of alcohol on their disease management?

4. Does excess alcohol consumption impact on chronic disease outcomes in terms of:

    a. Clinical management?

    b. Disease outcome?

    c. Health service utilisation?

1.5 Overview of Methodology and Thesis Outline

The programme of research was undertaken using a multi-methods approach to enable triangulation of data and gain a complete and nuanced understanding of the impact of at-risk alcohol consumption on people with chronic disease in Townsville. Techniques were selected to best fit the research question for each sub-study with a mixture of qualitative and quantitative approaches. The thesis is by publication, and while every attempt has been made to minimise repetition, some overlap is unavoidable. The

methodology is outlined below, and specific details are provided in the appropriate section of the relevant manuscript in each chapter. Each of the sub-studies is presented in the form of a manuscript, thus each chapter is self-contained and includes its own reference section, Figures and Tables (rather than one reference section for the entire thesis and continual numbering of Figures and Tables). The manuscripts are presented in their final submission form in terms of content; however, a consistent format has been applied rather than the journal specific style to improve the readability. The findings of the four individual studies are consolidated in Chapters 7 and 8 for the discussion, recommendations, conclusions and implications of the research. The thesis structure is shown in Figure 1. This figure is repeated at the beginning of each chapter, to orient the chapter in the context of the thesis.
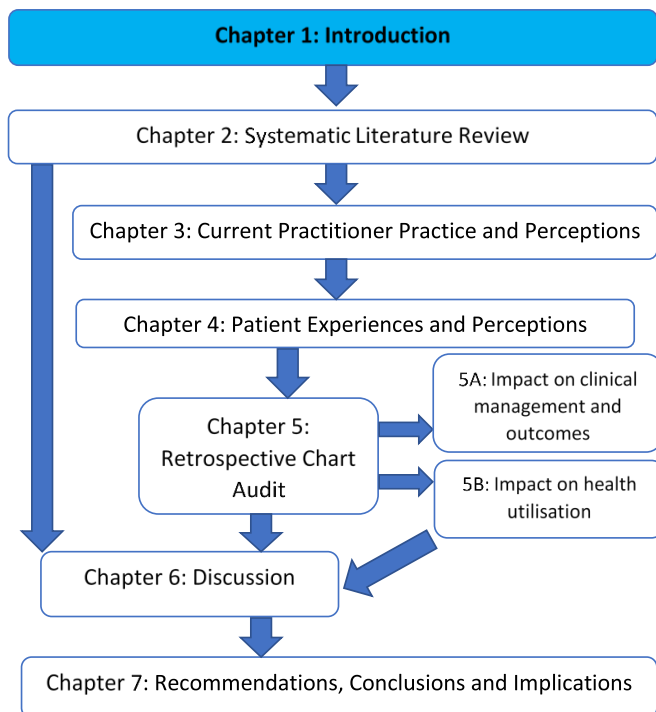
Figure 1 Thesis Structure

Chapter 2 comprises a systematic literature review of the impact of alcohol consumption on chronic disease management. This chapter addresses research question 1 of the thesis and presents a broad interpretation of management with a scope that covers self-care management, individual clinical management through to studies of community level management examining issues such as hospitalisation rates all the way to national studies looking at alcohol attributable fractions of disease burden. This manuscript has been submitted for peer review with PLOS One (2020).

Chapter 3 presents the findings of a qualitative study examining the practice and perceptions of health practitioners who work in general practices about the management of chronic disease patients with at-risk alcohol consumption. Semi-structured interviews were conducted with healthcare providers. Chapter 3 addresses research question 2 and is presented in the form of a manuscript that has been accepted for publication in the Australian Journal of Primary Health (2020).

Chapter 4 comprises a cross-sectional survey on the experiences and perceptions of alcohol consumption in people with chronic disease. Patients self-completed a survey with mostly quantitative and some qualitative questions. Chapter 4 addresses research question 3 of the thesis and is presented in the format of a manuscript which has been submitted for publication to The Health Promotion Journal of Australia and is currently under review (2020).

Chapter 5 is the largest sub-study in the thesis. This chapter addresses research question 4 and is an examination of the outcomes of people with chronic disease

relative to their measured alcohol consumption. This is a quantitative study using a retrospective chart audit of 482 records across two large primary care practices, to examine recorded alcohol consumption and its association with chronic disease outcomes. This work is presented as two separate manuscripts , the first looking at clinical outcomes of chronic disease and the second presenting health care utilisation data. These manuscripts have been accepted for publication in the Australian and New Zealand Journal of Public Health.

Chapter 6 presents the thesis discussion integrating the preceding data chapters, centred on the four overarching research questions, in the context of the relevant literature, and strengths and limitations of the programme of research.

Chapter 7 begins with a summary of the findings before presenting the recommendations, conclusions and implications for policy, practice and further research.

1.5.1 Ethics

Human ethics approval was granted for the project and each of the sub-studies within the thesis from the JCU Human Research Ethics Committee. The approval numbers are provided in the relevant methods sections of each of the manuscripts, and in the thesis ethics declaration at the beginning of the thesis.

1.6 Reflexivity

In addition to the previous work in addiction medicine outlined earlier in this chapter (1.1) that generated the original rationale for the research project, I have lived with chronic disease for many years. While my own disease is not one of those focused on

in this study and it was my choice not to complicate my management by consuming alcohol, it did demonstrate to me several important points that fed into my understanding of the issue under examination.

1.   Managing chronic disease is a complex and continuous process from the patient perspective and much of the burden of day to day activity falls to the individual rather than the health practitioner. In my case I have the health literacy to negotiate my needs and the health system and to actively participate in my care, however, I often wonder how those with lower health literacy manage their care.

2.   Maintaining one's health in the presence of a chronic disease requires substantial motivation and self-care, features that are often lost with chronic alcohol consumption.

3.   Chronic disease can be an expensive process. Many general practices in Townsville do not bulk bill, resulting in out of pocket expenses for each visit. Medication expenses add up quickly and this is increased if other management aids are required such as continuous positive airway pressure machines or glucometers for example. Even with a general practice chronic disease care plan, allied health input often accrues bills in the hundreds of dollars, especially in regional centres where limited service availability limits competition. Alcohol use often impacts adversely on finances which may compound this problem.

4.   Chronic disease often carries a degree of social stigma and isolation which are both also features of excess alcohol use and therefore the combination risks a downward spiral effect.

Throughout the process of this research I have continually reflected on my own experiences, both as an individual living with chronic disease and as a health care provider in the field, and how they impact on my understanding and interpretation of the research and on how the research has also informed my own experience and choices. While such overlap between experience and research can be a double-edged sword, through this process of reflection on the issues overall, I feel that far from being detrimental, the outcome of the reflexive approach has strengthened the research findings.

1.7 A Note on Terminology

Words are important and I acknowledge that some of the terms used in this thesis have been associated with stigma and discrimination. Regarding alcohol use, the terms alcohol dependence, alcohol addiction, alcoholism and alcohol use disorder are considered here as synonymous. Throughout this thesis, the more current and less stigmatised phrase alcohol use disorder is preferred where appropriate or at-risk drinking for those whose consumption is above guidelines but not consistent with a diagnosis. Where existing literature presented an alternative term such as alcoholism, it has on occasion been discussed in the framework of the literature as definitions and diagnostic criteria do vary slightly. Alternative terms are also present in reference lists as required.

In respect to the ongoing debate about the use of the term patient as opposed to person, both terms have been used in this thesis. The advantage of the term person is it encourages a more holistic consideration of the individual, however it sometimes risks failing to acknowledge the existing power imbalance that exists in many health care

systems and structures and the knowledge discrepancies that may come into play. In addition, there are at times practical considerations regarding distinguishing a sample of individuals who are included in the study from others in the practice such as staff or from the general population. I have attempted to reserve the use of the term patient to where the interaction between the individual and the health system is in play and refer the rest of the time to people living with a chronic disease.

1.8 Chapter 1 References

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Chapter 2 Systematic Literature Review

2.1 Introduction

Chapter 1 established the rationale for the programme of research and outlined the approach. Chapter 2 presents a systematic literature review, performed and reported using preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines, examining the first research question of the thesis: "What is the impact of alcohol on chronic disease management?" A broad definition of management was taken to reflect the nature of the research and ensure adequate theoretical coverage of the content. The articles included in the review were subsequently subdivided into clinical management and public health management. The Chapter is presented in the form of a manuscript however, a consistent format has been applied rather than the journal specific style to improve the readability.

2.2 Declarations

Publication Status: **Mudd, J., Larkins, S., Watt, K. The effect of alcohol consumption on the management of chronic disease: a systematic review. PLOS one. Submitted Feb 2020.**

Authors' contributions: JM designed devised the research, undertook the search, analysed the data and wrote the manuscript. KW and SL advised on the appropriateness of the approach and reviewed the quality analysis and revision of the manuscript. All authors read and approved the final manuscript.
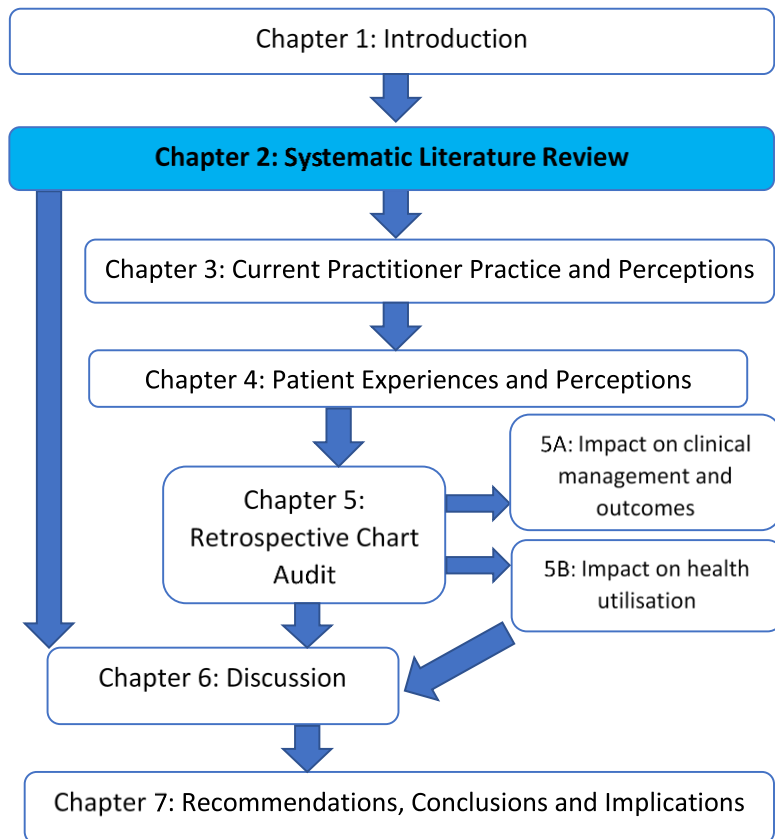
Figure 1 Position in Thesis Structure

2.3 Manuscript: The Effect of Alcohol Consumption on the Management of Chronic Disease: A Systematic Review.

Introduction

Globally, alcohol is consumed by a high proportion of the world's population; 52% of those over 15 years have consumed alcohol at some point in their life, although patterns and amounts vary by country and region (1). Australia has similar drinking patterns to the USA and most of Europe, where around 80% of the population consume alcohol and it plays an important role in cultural and social identity (1). Alcohol contributes to over 200 types of disease and injury that in combination account for over 3.3 million deaths each year worldwide; more than the global mortality from Human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (1). As a result of this high disease burden, most nations have legislation and/or guidelines regarding alcohol consumption. In Australia these guidelines, which are based on a 1% lifetime risk of death due to alcohol consumption, suggest no more than two standard drinks per day on average and no more than four standard drinks on any one occasion, with a standard drink defined as containing 10g of alcohol (2). The first guideline is most relevant to alcohol's contribution to chronic disease; the second guideline is more relevant to acute incidents and injury. Analysis of the National Health Survey for 2014-2015 shows 17% of adult Australians exceeded the first guideline and 45% exceeded the second guideline on at least one occasion in the preceding year (3).

Chronic diseases, defined here as conditions which have a prolonged course, do not spontaneously resolve and are without likelihood of cure (4), are the most prevalent cause of death and disability in Australia (3) and across the globe (5). Given their prolonged course and increasing prevalence they are also a major and increasing

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component of health care service utilisation and expenditure and overall disease burden (4). This review focusses on diabetes mellitus, chronic cardiovascular disease, chronic obstructive pulmonary disease and chronic kidney disease as exemplar chronic conditions.

Alcohol use contributes to chronic disease in three broad ways: 1) alcohol dependence can be conceptualised as a chronic disease in its own right (6); 2) alcohol is classified by the World Health Organisation as the third most harmful risk factor for chronic disease (7) and 3) alcohol consumption can impact on the management efficacy and prognosis of chronic diseases (2). It is this third interaction between alcohol and chronic disease that is being investigated in this review.

Previous studies have shown similar rates of at-risk drinking in individuals living with chronic disease to rates seen in the general community (8). This may be because many chronic diseases have an onset in adulthood or middle age and drinking behaviours are firmly established at this point. There is evidence to suggest that excess alcohol consumption is often not detected in at-risk individuals in a community setting (9).

Management of chronic disease is significantly different to the mangement of acute disease in that it is long term, focussed on secondary prevention of complications, occurs predominantly in the community and usually is interdependent with the patient's engagement in self care. Thus, the issues involved in management of chronic disease cover a wide scope from modifying or influencing the ability of an individual patient to adhere to recommended self-care activities such as blood glucose monitoring, through community programs designed to prevent complications or hospitalisation, to adequate provision of tertiary hospital facilities to manage acute exacerbations and complications.

Therefore, in this review, management is considered from both a broad community, or public health, perspective and from a more individual clinical management perspective. This review examines how alcohol consumption affects the public health management and clinical management of chronic disease.

Methods

A systematic literature review was undertaken consistent with the PRISMA guidelines (10). Medline, CINAHL, PsychInfo, Informit, Cochrane and Scopus were searched in combination (via Ovid SP) or individually as required for MESH terms and keywords (allowing for truncation) under searches in the three categories of alcohol use, chronic disease and management, as below.

Alcohol use: *alcoholism, alcohol-related disorders, alcohol intoxication, alcohol drinking, alcoholic beverages*

Chronic disease: *Chronic Disease, Diabetes Mellitus, Type 1, Type 2, Diabetes Complications, Renal insufficiency, chronic kidney failure, renal dialysis, renal replacement therapy, kidney diseases, kidney failure chronic, kidney failure, haemodialysis, kidney artificial, pulmonary disease chronic obstructive*

Management: *patient care management, disease management, therapeutics, clinical protocols, patient care, hospitalisation and self-care*

Searches for these three categories were conducted separately, then combined with "and". For databases that do not use MESH terms, the terms included in the MESH terms definition were searched as keywords in addition to the main term keyword search. Results were then limited to English language and post-1992, 25 years prior to

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the completion of the review. Grey literature such as government reports and guidelines were utilised for background data. The combined database results (2148), underwent an initial title and abstract screen for relevance and duplicates were removed, reducing the pool of articles to 246 which were retrieved for further analysis (Figure 1). Inclusion criteria were: alcohol use and chronic disease are included as independent and dependent variables (respectively), and not confounders; the focus was on management of chronic disease (not prevention) and primary studies. These articles were read in full to ascertain relevance to the specific review question with the same inclusion criteria applied. Hence, articles that focused on the role of alcohol in the development of chronic disease were excluded.

The remaining 42 articles were assessed for quality, using the Quality Assessment Tool for Quantitative Studies recommended by the National Collaborating Centre for Methods and Tools recommended (11) (quantitative studies); or the qualitative appraisal guidelines by Jeanfreau *et al.* (qualitative studies; 12). Articles that rated moderate or higher were included – 7 articles were excluded.

The 35 included articles were split into two groups, based on whether the studies considered the management of the chronic disease from a community or public health perspective (n=22), such as hospitalisation rates or health care costs; or from an individual patient perspective (n=13), such as detection of at-risk drinking in primary care or effects on self-care behaviours.

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│ Psych Info, SCOPUS,         │◄─────────│ Bibliographic    │
│ Cochrane), Databases        │          │ searching        │
│ MESH and keyword, [limited  │          │                  │
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│ retrieved for full text │        │ for relevance, duplicates    │
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│ N=35 articles included  │
│ (Table 1 and Table 2)   │
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Figure 1 PRISMA Search Strategy

Results

The findings of the 22 articles included in the systematic review in relation to the impact of alcohol consumption on the public health management of chronic diseases are outlined in Table 1, together with the quality assessment. Twenty-two articles considered the effect of alcohol consumption on: chronic heart disease (four articles); diabetes mellitus (four articles); chronic obstructive pulmonary disease/asthma (three articles); and one article each for chronic kidney disease and depression; nine articles considered multiple chronic conditions. A wide variety of management issues were

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investigated, including mortality rates, health service utilisation, health care costs, social costs, predictors of problem drinking, hospitalisation and retention in treatment.

The impact of alcohol on the clinical or individual management of chronic diseases is outlined in thirteen articles (Table 2). Chronic diseases considered here were diabetes, hypertension or multiple diseases. Within the clinical care category, the management issues examined were: self-care behaviours; primary care interventions; the qualitative experience of people; the effect of alcohol consumption on disease activity markers; the prevalence of at risk drinking; predictors of at risk drinking in a chronic disease population; and health behaviour changes after diagnosis with a chronic disease.

The majority (over 80%) of studies included were observational, with cross sectional and cohort designs being the most common, particularly in the public health management category. Experimental designs were more common in the clinical management category, making up one third of the studies. More than half of the studies were performed in the United States of America (22/35) with the remaining articles from Australia, England, Japan, Canada, Israel, Ireland, Italy and Singapore. The setting was predominantly in cities with only one article specifically examining regional or remote populations (13).

Most of the articles reviewed in both broad management categories (Table 1 and 2) considered varying levels of alcohol consumption, however, some exclusively looked at individuals with a diagnosis of alcoholism (alcohol use disorder, alcohol dependency or alcoholism) who had comorbid chronic diseases and their management in this context. One article looked at the change in consumption over time as the grouping mechanism and one was an experimental design where previous abstainers were randomised to

either alcohol consumption or placebo. There was considerable variation in the categories of alcohol consumption, reflecting variations in international classification methods for a "standard drink", and definitions of safe drinking levels. Similarly, there is variation in the terminology of alcohol use disorders between regions and over time. For this review, within tables and in direct discussion of articles the term utilised within the article are used. When comparing articles, these terms were considered as synonymous and where definitions allowed, articles were grouped according to consumption levels that were interpreted to reflect Australian Guidelines of at-risk drinking (2).

Discussion

The impact of alcohol consumption on public health management of chronic disease

Effect on mortality

As reviewed elsewhere, there is a controversial though widely reported U or J shaped curve for the relationship between long term alcohol consumption and risk of cardiovascular disease mortality (14, 15), with the greatest risk for abstinence and for heavy alcohol consumption. This was supported by the large prospective cohort study undertaken by Harriss et al. (16) for women, but not for men where no significant change was seen apart from a higher risk with former drinkers compared to lifetime abstainers. Associations between CVD and alcohol are less pronounced when former drinkers are separated from life-time abstainers as former drinkers have a particularly poor prognosis, possibly because this group includes people who have ceased drinking due to worsening health. Adding further weight to concerns that the moderate protective

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effect previously reported for alcohol on CVD has limited functional impact, the robust analysis by Yedlapati et al. of the nationwide (USA) inpatient sample showed increased mortality due to myocardial infarction in people with an alcohol-related diagnosis (17). While this was seen with all alcohol-related diagnoses, sub-analysis revealed that it predominantly results from chronic alcohol diagnoses which are likely to represent levels of alcohol consumption greater than six standard drinks per day. Patients with alcohol-related diagnoses were also more likely to have additional chronic diseases, more likely to die as a result of their myocardial infarction, had longer lengths of stay but received fewer cardiac interventions. Of concern, this study also revealed an increasing trend in alcohol related diagnoses (17).

The cardiovascular studies described above (14-16) have focused on lifetime drinking habits in the general population and generalised cardiovascular risk. In their cross-sectional study, Gargiulo *et al.* (18) reported an observed a protective effect on mortality of alcohol consumption in people who did not have chronic heart failure (CHF), but was increased mortality in people who had CHF. This effect was seen even at their lowest consumption level (which approximated to 2.5 standard drinks of wine per day or less) which overlaps with current Australian guidelines for safe drinking. However, this study has limitations as it only examined wine consumption and was specific to older drinkers. Further investigation is required to see if these findings can be replicated in a more generalised population or if re-analysis of previous studies, stratifying for the presence of CHF, alter the established findings.

A multinational global burden of disease study by Griswald *et al. (2018)*, the largest of its kind, concluded that the level of alcohol consumption that minimised harm was zero

(0-0.8 drinks per week) (19). The authors' explanation for the protective effect reported elsewhere is artefact resulting from confounders in the zero-consumption group. While this study did not specifically look at chronic disease, the findings are highly relevant to the systematic review findings and support significant caution in interpreting effects of alcohol in reference to a non-drinking cohort.

Alcohol attributable mortality

In addressing alcohol attributable mortality, Rehm *et al.* (20) reviewed five meta-analyses to determine the alcohol attributable fractions for varying chronic diseases which assisted in analysing the alcohol attributable deaths in Canada in 2002. This analysis supported a net alcohol attributable death rate of 2.4%, which the authors identified as a conservative estimate because they limited it to conditions with accepted associations that are consistent and dose responsive (20). This analysis was not well described in the paper but drew on previous published work of the author group which elucidated their methodology in more detail (15) and was well-referenced with other sources. It reported a net protective effect of moderate alcohol use only for T2DM and ischaemic heart disease (20). Within the cardiovascular disease category, only ischaemic heart disease showed a protective effect from moderate alcohol use, with hypertensive disease, cardiac arrhythmias and alcoholic cardiomyopathy all having detrimental associations with alcohol consumption (20). Cerebrovascular disease protection was lost for men over two standard drinks per day and for women over four standard drinks per day and there was no protective effect with regards to haemorrhagic stroke in men (20). The study proposed a net protective effect on mortality of alcohol in the moderate drinking category, defined as less than two standard drinks per day for

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women and less than four standard drinks per day for men. Above this level, alcohol consumption had a net alcohol attributable death rate of 2.7% of all deaths in Canada in people aged 69 years or younger in 2002 (20), equating to 1836 deaths, with 150 lives saved in the moderate alcohol consumption category. In total, across all age groups, there were more deaths attributable to alcohol then there were lives potentially saved by alcohol consumption (20).

The findings of these papers suggest that the more complex the patient, the more likely excess alcohol is to have a detrimental effect on the prognosis. They also suggest that even in complex clients if drinking status can be modified there can be significant improvement in outcomes.

Alcohol related morbidity and hospitalisations

A large, population-based cross-sectional study of over 6000 individuals in Singapore, findings supported alcohol being one of the major contributing factors to people having multiple (as opposed to single or none) chronic disease diagnoses (21). Multiple comorbidity increases the likelihood of hospitalisation and poor outcomes.

Similarly, looking at hospitalisation rates rather than mortality, Klatsky and colleagues (22) reported that alcohol consumption in individuals with CHF (associated with coronary artery disease and to a lesser extent associated with diabetes mellitus), was strongly protective against hospitalisation at levels from one drink per day to over six drinks per day. There was no significant dose-effect improvement in protection above the one to two drinks per day level. However, when CHF not associated with coronary artery disease was considered, alcohol consumption over three drinks per day

increased risk of hospitalisation, becoming statistically significant over six drinks per day. When diabetes mellitus was removed from the non-CAD group the association strengthened. This large observational study with sound methodology, suggests that drinking at current Australian guidelines (no more than two standard drinks per day; 2) should be safe for people with CHF. However, the safety of any consumption above this level may vary by sub-type of CHF which is often difficult to determine.

Similar to cardiovascular disease, low to moderate consumption of alcohol appears to decrease the incidence of diabetes mellitus (specifically Type 2 Diabetes mellitus: T2DM) and to protect against cardiovascular disease in established T2DM (15, 23). The articles reviewed here showed little measurable impact of alcohol consumption on hospitalisation rates in people with diabetes, however there was a reduced length of stay in the lower level consumption group in Burke's study (13). This study was difficult to compare with other studies as the alcohol consumption groups were lifelong abstainers, ex-drinkers and then above or below 150g/day (15 standard drinks) for men or 100g/day (10 standard drinks) for women; a much higher cut-off than all the other studies. Of interest however, when Yokoyama *et al.* (24) conducted their methodologically rigorous cohort study in people with diagnosed alcoholism (by DSM-IIIR criteria) combining alcohol and diabetes significantly reduced the survival over the study period (approximately four years) from 73% to 26% (p<0.0005). In those clients who ceased drinking over the study period, survival was not significantly associated with diabetes status (94% vs 90%). This suggests that at the alcohol dependent level there may be significant impacts on the prognosis of diabetes that are not elucidated by the other studies. Spangler *et al.* (8), utilised survey data with linkage to medical records for

validation, in their cross-sectional study of predictors of problem drinking in people with diabetes (either Type 1 Diabetes mellitus (T1DM) or T2DM). There were some methodological limitations in this study, such as the grouping of Type 1 and Type 2 diabetes together when some of their outcome measures are utilised differently between the groups, making interpretation of the outcomes challenging.

Greene *et al.*'s (25) large rigorous prospective cohort study of chronic obstructive pulmonary disease (COPD) management utilised screening tools for at-risk drinking either CAGE (a four question screen-named as an acronym for cut-down, angry, guilty and eye-opener) and the alcohol use disorders identification test (AUDIT). The study demonstrated a statistically significant increased rates of exacerbations, requiring health service utilisation, in the AUDIT 0 category (non-drinkers) and in the higher AUDIT categories 6-7 and 7-8 when compared to the AUDIT 1-3 (low risk drinking) category. They showed similar findings when using CAGE score greater than two compared to less than two or a positive binge drinking question alone (in AUDIT) when compared to a negative answer. However, these findings were no longer statistically significant when smoking was considered as a confounder. In a US analysis of over 135 000 hospitalisations over ten years (26), alcohol abuse was found to increase the likelihood of re-admission in COPD patients, however smoking was not considered as a confounder. Similarly, Sumino et al. (27) found increased all-cause mortality and hospitalisation in comorbid asthma and alcoholism in their large observational study. Once again, the role of smoking was not considered.

Only one study (28) in this group considered CKD review criteria. The sample comprised homeless and alcoholic patients, hence the findings may not be

generalisable to all CKD patients. The authors observed that homelessness worsened outcomes of CKD, adding substance abuse worsened those impacts further, and alcoholism was more common in homeless CKD patients than in housed CKD patients. A major limitation of this study was the way in which substance use was analysed, making it difficult to separate the effect of alcohol compared with other co-existing substance use.

When examining hospitalisation characteristics for people with depression, Sacco *et al.* (29) did not show an increase in health costs associated with alcohol comorbidity in depression. Their study revealed that comorbid alcohol use was likely to lead to admission at lower severity, higher rates of suicidality, shorter lengths of stay and reduced rates of discharge to a post-care facility. Like Yedlapati in CVD (16), these findings show that the comorbid group received less health care intervention despite having higher rates of suicidality; this may represent healthcare system bias against individuals with alcohol related diagnoses.

Rehm *et al.* (20) also examined hospitalisation rates and identified 91,970 net hospital admissions for chronic disease as a result of alcohol consumption. Martin *et al.* (30) undertook a similar study in Ireland focused on alcohol attributable hospitalisation. They found a net 8.7% bed days of admissions attributable to alcohol and 95% of these were due to chronic conditions (30). In this study they reported a lower protective effect of alcohol in cardiovascular disease then seen elsewhere, which they attributed to the higher binge pattern of alcohol consumption within their population, which is less likely to have cardioprotective benefits (30). Increased hospitalisation was also seen in the more recent large studies in England by Green *et al.* (31) and by Schoepf and Heun

(32) with the later also showing longer hospital stays, higher hospital-based mortality and younger deaths. Overall alcohol-related hospital admissions in England increased (31) similar to the increase in admissions and mortality seen in the USA (17).

The net protective effect of alcohol on diabetes mellitus hospitalisations elucidated by Rehm *et al.* (20) is supported by the other studies already discussed for people with diabetes not complicated by other factors (13, 33). However, in more complex clients with homelessness or alcoholism or both (34), high levels of alcohol consumption (13) may result in increased health care utilisation.

Effects on cost of care

In their Irish study, Martin *et al.* (30) reported a net attributable cost due to alcohol of just over eight million Irish Pounds. This equates to 15% of the total hospital costs in the study period, or 0.7% of Gross Domestic Product (GDP). Willenbring *et al.* (35), in their randomised controlled trial of 500 veterans, outlined integrated outpatient treatment of medically ill alcoholic men that did not alter symptoms of alcohol dependence, quality of life or life problems, but saved approximately $US1100 per patient per year. Similarly, Dillie *et al.*(8) in a multiple model analysis of existing studies, showed cost savings to the extent of $212-$353 per patient depending on the model used, as a result of improved detection of at-risk drinking in chronic disease patients utilising carbohydrate deficient transferrin (CDT) with assumed subsequent earlier intervention.

The impact of alcohol consumption on clinical management of chronic disease

Impact on self-care behaviours

All the studies that investigated self-care behaviours were undertaken in people with diabetes mellitus. The range of self-care behaviours tested varied between the studies. All considered self-monitoring of blood glucose (36-38), three of the four examined adherence to diet and exercise recommendations (36, 37), three of the four HbA1c monitoring (36-38), two considered attendance at follow-up appointments (38), two medication adherence, two smoking status (36, 37), two foot inspection (37, 38), one examined maintenance of normal blood glucose levels (37) and one considered dilated eye examination (38). While direct comparisons between the studies cannot be made due to different self-care behaviours being studied and different alcohol categorisation, all showed a dose-dependent trend towards decreased adherence with self-care behaviours and increasing alcohol consumption. The exception was smoking which showed poor correlation with alcohol consumption levels or other self-care behaviours, however, there were higher rates of smoking in the higher drinking categories (36-38); a finding replicated in other studies (25). In a cross-sectional study by Thomas *et al.* (37) there was a swing back towards adherence in the highest alcohol consumption category with those monitoring tasks that were health practitioner initiated such as HbA1c measurement. This may represent opportunistic checking during a presentation for another reason in a client perceived to be high risk.

Reif et al. (39) utilised cross-sectional secondary data analysis derived from an existing randomised controlled trial to examine how engagement in drug and alcohol treatment, which is considered a key indicator for successful management of alcohol use

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disorders, was affected by chronic disease. They reported no significant difference between clients with and without chronic disease in terms of engagement suggesting that having a chronic disease should not be a barrier to addressing alcohol use above recommendations, even at dependent levels. The main limitation of this study was the grouping of chronic diseases which limited the ability to see potential differences between disease types.

Impact on biochemical markers

Shai *et al.* (40) undertook an experimental study, randomising people with T2DM who were previously abstainers from alcohol, to either continue zero alcohol or 13g per day (approximately one and a half standard drinks). They then investigated fasting blood glucose, 2-hour post prandial glucose and HbA1c. While they saw no change in the post prandial glucose or HBA1c, their findings supported a statistically significant reduction in fasting blood glucose in the alcohol group. This finding of improved glycaemic control is consistent with other studies showing a potentially beneficial effect of low consumption of alcohol. Though given the lack of impact on post-prandial glucose or HbA1c, which gives an indication of overall glycaemic control, the significance of the findings appears limited.

Impact on patient experience

Two of the studies investigated the qualitative experience in people with diabetes who were drinking above recommendations (41) or had self-reported alcoholism (42). Kobayashi *et al.'s* (41) study utilised complementary interviews in addition to their cross-sectional survey to compare the reasons for behaviour change in those who were and

were not able to reduce their alcohol intake. They found minimal concordance in people's experiences, with the only two recurrent themes that were associated with positive behaviour change being an awareness of diabetic retinopathy and having a more acute onset of disease (41). They also identified potential issues with recall bias given the time elapsed between event and interview for some of the participants. Inman *et al.'s* (42) thematic analysis considered the lived experience of concurrent alcoholism and diabetes. They identified nine themes: disease process management, rationalising, process perspective, familial inheritance, quality of life, consequences, support, self-motivation and advice. In general, the patients were more focused on their alcoholism than diabetes which the authors attributed to living with alcoholism for longer (42). The importance of self-efficacy and self-motivation were very prominent in the perceptions of those interviewed. The study had a limited theoretical basis and a small sample size that showed little evidence of having reached saturation of the views expressed. It did highlight the complexities of living with both conditions and further supports the notion of poorer outcomes in dual diagnosis clients. A more rigorous study in this area may help to establish new research areas that could improve the management of complex patients.

Intervention study Outcomes

A large and rigorously designed study by Fleming *et al.* (43), randomised people with diabetes mellitus (with or without hypertension) to brief intervention or standard care in a primary care setting. They incorporated the use of CDT testing to improve detection rates of at-risk drinkers. The included people were either drinking more than 30 standard drinks per month for men (25 drinks per month for women) or were having five

or more drinks per occasion (four or more for women). In the intervention group there were significant reductions in the percentage of people drinking above the guidelines in the regular drinkers but no change in the single occasion binge drinking category (43).

In another, even larger, multi-practice intervention study, Rose *et al.* (44) investigated people with hypertension as their primary diagnosis who screened positive for at-risk drinking, through multiple screening methods (see Table 2), for a brief practice-based intervention. Their study suggested significant improvement in screening rates in targeted practices as well as reductions in both systolic and diastolic blood pressure in the treatment group (44). The final intervention study in this review was a small randomised controlled trial that utilised the Flinders™ chronic disease management program to target clients who had at least one or more chronic disease diagnoses and an AUDIT score of eight or more (high risk drinking likely) (45). The Flinders™ chronic disease management program is an intensive approach to chronic disease management that integrates self-management with cognitive behavioural principles. The control group in this study was usual care. Significant reductions in AUDIT scores, anxiety and depression scores, and symptom scores for Post-traumatic stress disorder (PTSD) as well as increases in quality of life scores were observed in the intervention group compared to the standard care group at 18 months (45). The relative importance of connectivity to a primary care provider is supported by the 2012 analysis by Cook *et al.* (46) of the existing National Health Interview Cross-sectional Survey in the USA, that showed a protective effect against heavy drinking with attending regular practice or with frequent primary care attendance.

These intervention studies are more significant when considered in the light of the findings of Newsom *et al.* (47) which examined longitudinal survey data of people before and after the onset of a chronic disease to see how health behaviours changed post diagnosis. In the absence of specific interventions, they observed minimal measurable health behaviour change. The only significant changes in alcohol consumption occurred in women with occasional excessive drinking and in moderate drinkers (47), where there may have been health benefits if they had continued. This suggests that people struggle to change established health behaviours without targeted assistance and that the health care messages regarding alcohol that patients are receiving may not be accurate in terms of the potential impact of low-moderate alcohol consumption, particularly in some diseases such as diabetes mellitus and ischaemic heart disease (18, 20). The potential for inaccurate advice also was highlighted by Satre *et al.* (48), who reported that predictors of successful drinking cessation were lower educational attainment, worse self-reported health and diabetes. For men, race and depression were also predictors, and in women, cardiac problems. Once again, the two conditions that were most likely to benefit from alcohol consumption (18, 20) were also the only conditions that were likely to result in a decision to abstain, even when the level of drinking was in the moderate category (48).

The increased likelihood of drinking cessation with worse self-reported health was also demonstrated by Ryan *et al.* (49), who observed associations between lower alcohol consumption and increased numbers of comorbidities and decreased functional status. This may be due to the strong social associations of alcohol consumption and an inability to partake as fully in social gatherings as functionality decreases, a perception

on the part of the individual patients that ceasing drinking may be of benefit to them or a marker of financial strain associated with poorer health.

Conclusion

Alcohol consumption at current Australian guideline levels (two or fewer standard drinks per day on average or a maximum of four standard drinks on any one occasion for both men and women), does not appear to negatively impact management of the majority of chronic diseases either in terms of clinical management or public health management. This may not hold true for all types of chronic heart failure, but more work is needed to determine what recommendations are best in the sub-categories. Once alcohol guidelines are exceeded there is an increase in issues with regards to chronic disease management which is largely dose-dependent and predominantly seen in the highest drinking categories. This effect is amplified by comorbidities or social confounders such as homelessness. The effects seen on the clinical management of chronic disease, such as lower adherence to self-care behaviours, do not necessarily cross over to measurable public health management issues such as hospitalisation or mortality rates. The reasons for this are unclear and studies to elucidate this would be beneficial in targeting the aspects of care that could best improve public health management of chronic disease. More recent studies are more likely to demonstrate increased hospitalisation due to alcohol, which may suggest that consideration of the issue, or recording of alcohol use in hospitals has improved over time. Interventions that address high-risk drinking currently appear to have the greatest impact on health service utilisation. However, at the clinical level, interventions targeting risky drinking show significant improvement in disease outcomes and it may be easier to target potentially

problematic drinking earlier rather than once excessive drinking patterns are established. More rigorous qualitative studies that elucidate the reasons for patient and practitioner behaviours may help to target research areas more effectively. More work is needed in tracking health service utilisation in patients who are undergoing clinical management interventions to help bridge the gap and better understand how the overall burden of chronic disease management in the community can be reduced.

Table 1:Studies of Impact of Alcohol on Chronic Disease Management from a Community or Public Health Perspective

Study Context Design	Quality Rating (10)	Chronic Disease [definition]	Management Issue	Alcohol Categories	Finding; [CI 95%], p value
Harriss *et al.* (16) Australia Cohort	Strong	CVD and CHD [ICD-9 and ICD-10 codes]	Mortality	6 categories: Life-time abstainer; former drinker; occasional, 3 levels of regular.	Women 1 category (>20g/d) OR 0.43 Total [0.19,0.95], Wine [0.23,0.78] Men Former drinkers OR 2.58 [1.51,4.41] NS at other categories
Gargiulo *et al.* (18) Italy Cross-sectional	Strong	CHF [age>65:self-report with medical verification]	Mortality, Drinking advice	None (ref) < 250mL wine per day; >250mL/day; >500mL/day	WITHOUT CHF Protective of mortality RR=0.79[0.66,0.95], p<0.01 WITH CHF Predictive of mortality RR= 1.29[1.05,1.97], p<0.05
Klatsky *et al.* (22) USA Cross-sectional	Moderate	CAD-HF and nonCAD-HF DM related nonCAD-HF [discharge codes + record review]	Hospitalisation	Lifelong abstainer Ex drinker <1 drink/month <1drink/day 1-2 drinks/day 3-5 drinks/day 6 or more drinks/day	RR hospitalisation for CHF (ref abstainer) CAD-CHF nonCAD CHF 1.2, ns 1.0, ns 0.9, ns 0.9, ns 0.7[0.6,0.8], p<0.001 0.8, ns 0.6[0.5,0.7], p<0.001 1.0, ns 0.6[0.5,0.8], p<0.001 1.2, ns 0.5[0.3,0.8], p<0.01 1.7[1.1,2.6], p<0.05 DM related nonCAD CHF behaves more like CAD related CHF in relation to alcohol
Yedlapati *et al.* (17) USA Cross-sectional	Moderate	CAD [hospital investigated]	Hospitalisation for acute exacerbation	Alcohol-related diagnosis or not Acute alcohol vs chronic alcohol [based on hospital ICD-9 code]	Alcohol related diagnosis vs none More likely to have comorbidity (except for PVD or arrhythmia); p<0.001 More likely to die from AMI OR1.5, p<0.001 Longer length of stay OR 1.5, p<0.001 Fewer procedures OR 0.6, p<0.001
Singh *et al.* (26) USA Cohort	Strong	COPD [hospital ICD-9 code]	Re-admission	+/- Alcohol abuse by hospital ICD-9 code	Readmission rate 17.8% without alcohol abuse vs 26.5% with alcohol abuse; p<0.001

Greene et al. (25) USA Cohort	Strong	COPD [self-report and physician examination & investigations]	Exacerbations (health care utilisation)	CAGE<2; ≥2CAGE 2; AUDIT C: 0, 1-3,4-5, 6-7, 8-12 Binge drinking only (>6 drinks)	Age adjusted analysis shows increases exacerbations in AUDIT-C categories 0, 6-7 and 7-8 compared to 1-3. Similar findings were shown for CAGE >2 or binge drinking All these findings lost statistical significance when corrected for concurrent smoking.
Sumino et al. (27) USA Cross-sectional	Moderate	Asthma [primary or secondary diagnosis by ICD-9 code]	Mortality and morbidity	Alcoholism by ICD-9 or not	All-cause mortality was higher in <65yr olds with asthma and alcoholism (OR 3.5[2.01,6.09] age 18-45;1.65[1.14,2.39] age 46-64) Hospitalisation higher <65 yrs with asthma and alcoholism (OR1.56[1.26,1.9] age 18-45;1.64[1.40,1.93] age 46-64) Asthma related hospitalisation higher <65y (OR 1.49[1.14,1.95] age 18-45; OR1.64[1.32,2.02] age 46-64)
Moss et al. (33) USA Cohort	Moderate	DM- divided by age onset [medical record age cut-off 30 years at diagnosis]	Hospitalisation	None <5g/day 5-23.5g <day >23.5g/d	No significant association found between alcohol consumption and rates of hospitalisation
Burke et al. (13) Australia Cohort	Moderate	T2DM (Australian Aboriginal cohort) [hospital codes]	Hospitalisation	Lifelong abstainers Ex-drinkers <150g/d (M) or 100g/d (F) >150g/d (M) or 100g/d(F)	No statistical difference in number of admissions or interval between admissions <150/100g/day associated with shorter length of stay OR=0.61[0.40,0.92], p<0.02
Yokoyama et al. (24) Japan Cohort	Strong	diabetes/ liver cirrhosis [WHO criteria (1980)]	Survival rates	Alcoholics (DSM-IIIR criteria)	Combined DM + alcoholism lowers 4.4yr survival from 73% to 26% with continued drinking, p<0.0005 If drinking ceases survival is similar 94% to 90%

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Spangler *et al.* (8) **USA** **Cross-sectional**	Moderate	diabetes [T1DM or T2DM, WHO criteria (1980)]	Predictors of problem drinking	Problematic or non-problematic, defined by 2 Q screen.	Drinking problem predicted by negative affect; OR 8.42 [2.41,29.4] Drinking problem predicted by male gender; OR 3.8[1.66,8.69] Fasting glucose and perceived glycaemic control; ns
Hall *et al.* (28) **USA** **Cohort**	Strong	CKD stage 3-5	Homelessness; morbidity and mortality, health care costs	Self-report or coding alcoholism	Homelessness worsens outcomes CKD; p<0.001 Substance abuse worsens impact of homelessness; p<0.001 Alcoholism more common in homeless CKD than housed; p<0.001
Sacco *et al.* (29) **USA** **Cross-sectional**	Strong	Depression [hospital primary ICD-9]	Hospital outcome	Alcohol comorbidity by ICD-9	Alcohol comorbidity vs none Shorter length of stay; p<0.001 Admitted at lower severity Equal severity and comorbidity; ns
Podymow *et al.* (34) **Canada** **Cohort**	Strong	multiple [self-report and hospital coding]	ED visits, admissions, police encounters	Self-reported alcoholism	Pre and during intervention (number /month) Decreased Ambulance Calls; ns Decreased ED visits; p<0.005 Reduced Hospital stay; ns Reduced Police reports; p<0.02
Willenbring *et al.* (35) **USA** **RCT**	Moderate	Multiple [self-report and hospital coding]	Integrated management; health care utilisation	Self-reported alcoholism	Increased engagement in treatment; p<0.001 Decreased hospital use; ns Increased abstinence rate; p<0.02 Decreased death rate; ns
Reif *et al.* (39) **USA** **RCT**	Moderate	Multiple [self-report]	Engagement in alcohol treatment	Self-reported alcoholism	Addiction treatment utilisation; ns
Schoepf *et al.* (32) **England** **Cohort**	Strong	Multiple [hospital ICD-10 codes]	Hospital based mortality	Alcohol dependence verified ICD-10	Alcohol dependent vs not More likely to be admitted as emergency (90.4%vs52.7%); p<0.001 Longer stay (5.7d vs 2.9 d); p<0.001 More hospitalisations (15.5 vs 10.8); p<0.001 Higher hospital-based mortality (20.4%vs8.3%); not done Died younger (54.4y vs 62.0 y); p<0.001

Dillie *et al.* (9) **USA** **Cost benefit analysis**	Moderate	Multiple [identified by treating practice]	Cost benefit of biomarker	Moderate to light (<60 drinks per month for females, <90 drinks per month males) Heavy (> 60/90 drinks per month)	CDT had greater sensitivity than self-report (45-75% cv 30-50%) but marginally lower specificity (85-95% cv 90-100%) Using CDT increased the number of cases of heavy drinking detected Net cost saving calculated of $118 per patient
Rehm *et al.* (20) **Canada**	Moderate	Multiple [coding data, national survey data]	Deaths, Hospitalisations	AAF	In terms of mortality and diagnosis rates: Net beneficial effect for CVD and Diabetes Net detrimental effect for Cancer, Dependence, mental disorders and digestive diseases
Martin *et al.* (30) **Ireland**	Moderate	Multiple [coding data, national survey data]	Hospitalisations, health care costs	AAF	Net 8.7% bed-days due to alcohol 96% of these bed days were due to chronic conditions associated with alcohol
Subramaniam *et al.* (21) **Singapore** **Cross-sectional**	Strong	Multiple [self-report questionnaire]	Multiple comorbidity as a marker of complexity	Alcohol use disorder or not [as determined by WMH-CIDIv3.0]	Alcohol use disorder increased likelihood of having multiple chronic conditions (24.2% vs 16%), p<0.05
Green *et al.* (31) **England** **Cross-sectional**	Moderate	Multiple [hospital ICD-10]	hospitalisation	Alcohol related admissions [ICD-10]	From 2002/03-2013/14 Acute conditions wholly attributable to alcohol increased 2.26-fold Acute conditions partially attributable increased 1.43-fold Chronic conditions wholly attributable to alcohol increased 1.47-fold Chronic conditions partially attributable to alcohol increased 1.38-fold Acute intoxication admissions increased 2.22-fold Intentional self-poisoning with alcohol increased 2.61-fold Overall alcohol related admissions increased 1.51-fold

CHF: chronic heart failure; CAD: coronary artery disease; PVD: peripheral vascular disease; RCT: randomised controlled trial; T2DM: type 2 diabetes mellitus; HTN: hypertension; COPD: chronic obstructive pulmonary disease; CVD: cardiovascular disease; AAF: alcohol attributable fraction; CKD: chronic kidney disease; AUDIT: alcohol use disorders identification test; AUDIT-C: alcohol use disorders identification test-consumption; QoL: quality of Lilfe; CDT: carbohydrate deficient transferrin; HbA1c: haemoglobin A1c blood test; ED: emergency department; CAGE: alcohol screening test (acronym for cut down, annoyed, guilty, eye-opener) ; WMH-CIDI: world mental health-composite international diagnostic interview; ns:not significant

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Table 2:Studies of Impact of Alcohol on Chronic Disease Management from an Individual Perspective

Study Context Design	Quality Rating (10)	Chronic Disease [definition]	Management Issue	Alcohol Categories	Finding; [CI 95%], p value
Ahmed *et al.* (36) USA Cross-sectional	Moderate	diabetes [national registry, type 1 and 2 separate recommendations]	Self-care behaviours [self-monitoring of BG, HbA1c testing, medication adherence, smoking, diet and exercise]	Never (ref) Former <1 std drink /day 1-2 std drinks/day 2-3 std drinks/day >3 std drinks/day	Gradient of increasing nonadherence to recommended self-care with increasing alcohol consumption; p<0.001
Thomas *et al.* (37) USA Cross-sectional	Moderate	diabetes [self-report, type unspecified]	Self-care behaviours [self-monitoring of BG, HbA1c testing, smoking, diet, exercise, maintaining normal BG levels and foot inspection]	AUDIT-C 0 (Ref) AUDIT-C 1-3 AUDIT-C 4-5 AUDIT-C 6-7 AUDIT-C 8-12	Less likely to follow meal plan, more likely to smoke, more likely to have checked HbA1c in last year; p<0.05
Chew *et al.* (38) USA Cross-sectional	Moderate	diabetes [self-report, type unspecified]	Self-care behaviours [self-monitoring of BG, HbA1c testing, foot examination, eye examination, diabetes education and at least one visit to health care provider per year]	Non-drinker Moderate drinker: less than 2 std drinks per day for males, 1 for females Heavy drinker: >2/1 std drinks per day	Increasing alcohol consumption was associated with: No daily glucose monitoring; p<0.001 No annual foot exam; p<0.001 No annual provider visit; p<0.001 Heavy drinkers more likely to not adhere to recommended care; OR 2.0[1.1,3.2]
Kobayashi *et al.* (41) Japan Cross-sectional	Moderate	diabetes [patients of diabetes clinic]	Reasons for behaviour change	Change in alcohol consumption from diagnosis to study	Awareness of diabetic retinopathy; p<0.01 More acute onset; p<0.05

Inman and Kornegay (42) USA Qualitative; phenomenology	Suitable#	diabetes [self-report]	Interaction of patient and health practitioner, lived experience	Self-reported alcoholism	Qualitative thematic analysis: 9 themes identified, more focus on alcoholism, self-efficacy/self-motivation prominent
Shai _et al._ (40) Israel RCT	Strong	T2DM [physician diagnosis]	Ability of alcohol to improve glycaemic control	0g alcohol vs 13g/d alcohol (experimental design in previous abstainers)	Alcohol vs no alcohol FBG 118.0 +/-32.5mg/dL vs 138.6 +/- 27.8 mg/dL; p<0.02 2h post prandial glucose or HbA1c (ns)
Fleming _et al._ (43) USA RCT	Strong	diabetes +/- HTN [record coding]	BI in primary care, use of CDT	% men who consumed >30 std drinks in previous 30 days (>25 std drinks for women) % men who consumed 5 or more drinks per occasion (4 or more for women)	BI group had greater reductions in % of drinkers above guideline; p<0.05 NS change
Cook _et al._ (46) USA Cross-sectional	Moderate	diabetes+HTN [not defined]	Health care access	Non-drinker; current drinker; heavy drinker [heavy defined as >14 drinks per week males;>7 drinks per week females]	A regular primary care place for HTN; OR 0.47[0.27,0.82] or regular attendance at primary care HTN; OR 0.55[0.32,0.97]: diabetes; OR 0.23[0.06,0.92] were protective against heavy drinking
Rose _et al._ (44) USA RCT	Strong	HTN [physician records]	rates of screening, and response to positive screens in primary care settings Improvement in BP	Aimed at at-risk drinking not specific intake categories. AUDIT-C, CAGE or history-based screening assessment	Intervention Practices vs Control Practices Likelihood of screening OR 8.1[1.7,38.2], p<0.0087 Likelihood of receiving counselling if positive assessment at-risk drinking OR 5.5[1.3,23.3], p<0.0205 Treatment vs no treatment Systolic BP decline 8.3 vs 1.0; p<0.05 Diastolic BP decline 3.6 vs 0.8; p<0.006
Battersby _et al._ (45) Australia RCT	Strong	Multiple [verified self-report]	Flinders™ Program	AUDIT 8 or more (in clients with at least 1 chronic disease)	Flinders™ vs usual care AUDIT scores reduced more in Flinders™ gp at 9 months; p<0.001
Ryan _et al._ (49) USA Cross-sectional	Moderate	Multiple [Medicare item numbers]	Prevalence at risk drinking	Non drinkers Within guidelines At –risk drinkers	As comorbidity increased alcohol consumption decreased; p<0.01 As functional impairment increased alcohol consumption decreased; p<0.05

Satre *et al.* (47) **USA** **Cross-sectional**	Moderate	Multiple [self-report]	Predictors at risk drinking	Frequency/amount questions Never >12 months abstinent Moderate Over-limit	Predictors of having quit drinking that were significant: Men: race, p<0.01; less education, p<0.001; diabetes, p<0.01; worse self-reported health, p<0.001; depression, p<0.05 Women: less education, p<0.001; heart problems, p<0.01; diabetes, p<0.001; worse self-reported health, p<0.001
Newsome *et al.* (46) **USA** **Cohort**	Strong	Multiple [longitudinal survey, self-report]	Health behaviour change	Less than moderate (never-<1/wk.) Moderate (1/wk-1/day or 2/day for men) Excessive (>1/d women, >2/d men) Occasionally excessive (<1/2 per day on average but >4 per day at some point in last 3 mth)	Minimal measurable behaviour changes post diagnosis, women were more likely to change than men- particularly regarding occasionally excessive drinking; p<0.05-p<0.001 Moderate drinkers more likely to decrease than excessive drinkers

CHF: chronic heart failure; CAD: coronary artery disease; RCT: randomised controlled trial; T2DM: type 2 diabetes mellitus; HTN: hypertension; COPD: chronic obstructive pulmonary disease; CVD: cardiovascular disease; AAF: alcohol attributable fraction; CKD: chronic kidney disease; AUDIT: alcohol use disorders identification test; AUDIT-C: alcohol use disorders identification test-consumption; QoL: quality of life; CDT: carbohydrate deficient transferrin; HbA1c: haemoglobin A1c blood test; ED: emergency department; CAGE: alcohol screening test (acronym for cut down, annoyed, guilty, eye-opener), #:qualitative article assessed separately (11)

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2.4 Chapter 2 Summary

The systematic literature review suggests a potential impact of alcohol on both clinical management of chronic disease as well as on the public health management of chronic disease. However, two significant gaps were identified in the existing literature. Firstly, only two studies were based outside of urban settings, resulting in an absence of information about alcohol related issues in chronic disease in regional settings. Secondly there was a significant discrepancy between the findings in primary care, hospital level care and national or health system level data, with the hospital setting frequently failing to demonstrate the same level of impact of alcohol demonstrated in the other two contexts. There was little to no information about the interaction between the primary care space and the hospital system.

In order to best address these gaps, the subsequent chapters in this thesis explore the impact of excess alcohol consumption on chronic disease management in people attending primary care in Townsville, a regional setting. There is a specific attempt to examine the hospital utilisation of established primary care clients in order to gather more information about the interaction between health utilisation at primary and hospital level.

In Chapter 3, the current practice and perceptions of health practitioners in primary care practices in the Townsville area is explored.

Chapter 3 Perceptions of Health Practitioners

3.1 Introduction to Chapter 3

Chapter 2 established the gap in understanding of how alcohol affects the clinical management of chronic disease and discrepancy between information at the primary care level, where the impact was frequently seen and the hospital or health system level, where often no impact of alcohol was identified. It is theorised that this may in part be due to failure to recognise and/or code alcohol related presentations at hospitals. This body of research has therefore been positioned in primary practice where the patient is known, their lifestyle habits are more likely to be explored and where records of emergency department encounters, or admissions are sent in an effort to capture both levels of health utilisation.

As the first step in this investigation, this study examines the current practice and perceptions of staff in three private primary practices in Townsville regarding the management of people with chronic disease who are drinking alcohol above recommended guidelines. This chapter addresses research question 2 of the thesis. It utilises a descriptive qualitative methodology and is presented in the format of a manuscript. The manuscript is presented in its final accepted form in terms of content; however, a consistent format has been applied rather than the journal specific style to improve the readability.
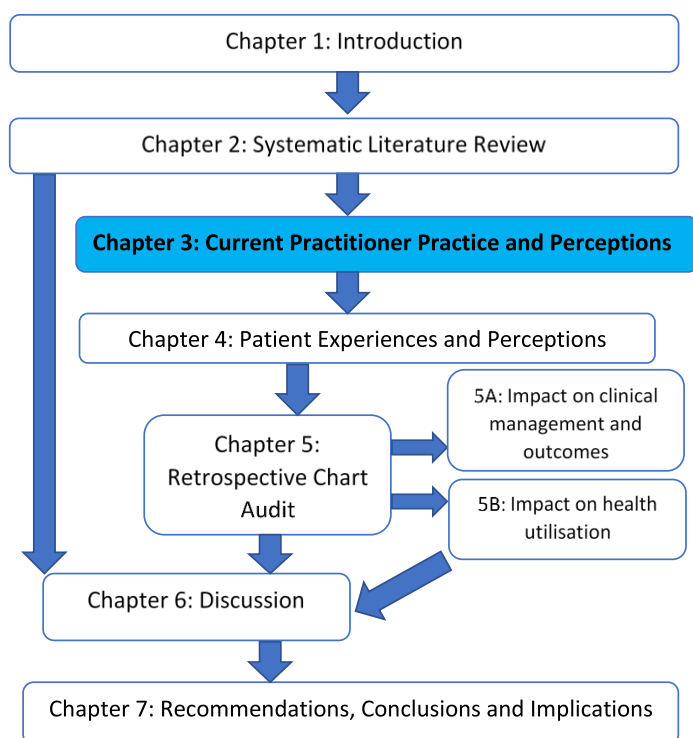
Figure 1 Position in Thesis Structure

3.2 Declarations

Ethics: Ethics approval for the study was obtained from James Cook University Human Research Ethics Committee (H5335)

Consent for Publication: no identifiable information is included. All participants were provided with information sheets and signed consent forms that included intent to publish.

Availability of data and materials: The datasets generated and/or analysed during the current study are not publicly available due to potential identifiability of participants in the raw data, but more information is available from the corresponding author on reasonable request

Conflicts of Interests: nil

Authors' contributions JM designed the research, undertook the interviews, analysed the data and wrote the manuscript. RP assisted with cross coding in analysis and discussion of themes to add depth to the interpretation and revision of the manuscript. SL supervised the design, assisted with interpretation and revision of the manuscript. All authors read and approved the final manuscript.

3.3 Manuscript: A qualitative exploration of barriers to alcohol management in patients with chronic disease in a regional setting.

Abstract:

Background: Chronic diseases are a major contributor to the burden of disease in Australia. Alcohol consumption occurs at similar rates in people with chronic disease to the general public and may contribute to management challenges. In regional Australia, there are limited options for the management of excess alcohol consumption so most of this burden falls to general practitioners. This research explores how staff in general practices are managing alcohol in patients with chronic disease with a view to determining what additional services may be appropriate.

Methods: Brief interviews were conducted with doctors, nurse and allied health practitioners across three general practices in a regional centre. Interviews were analysed using abductive thematic techniques to elicit broad themes.

Results: A total of 18 interviews were conducted. All interviewees found the management of patients with chronic disease who were drinking in excess of guidelines to be challenging. The complexity of patients, in terms of health needs and social circumstances, impacted on management and self-care. Australian drinking cultural norms also influenced patients and practitioners' behaviour. Multidisciplinary care was highlighted by all health professionals; however, there were challenges maintaining staff motivation; a lack of training in alcohol management and a lack of referral or assistance services. Experienced practitioners identified that the patient was the key stakeholder who needed to take ownership of their health.

Conclusions: The combined burden of excess alcohol consumption and chronic disease is a common management challenge faced by staff in general practice. While there was evidence of awareness of the issue and a concerted effort to address the problem; most staff felt they had inadequate training, skills and resources to address it. More undergraduate or postgraduate training in alcohol management and more resources are required to support general practitioners in this area.

Background

Chronic diseases, defined as conditions that are both long lasting and have persistent effects (1), are amongst the most prevalent causes of death and disability in Australia (2) and are an increasing component of health care service utilisation, expenditure and overall disease burden (1). General practice is the backbone of chronic disease management in Australia with over half (53.3%) of all general practice encounters attributable to chronic disease (3); this equates to 76.2 million encounters per year.

Alcohol consumption has been shown to be associated with increased rates of breast and colon cancer, osteoporosis, stroke and poorer oral health (1). However, it can also impact on the management efficacy and prognosis of chronic diseases (4). Previous studies have suggested that individuals living with some chronic diseases have alcohol consumption patterns comparable to those seen in the general community (5, 6). However, this varies between chronic diseases with people with diabetes found in one recent study to have.lower rates of alcohol consumption, while those with chronic mental health conditions had higher rates of consumption than those without a chronic disease (6).

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Alcohol is consumed by nearly 80% of the adult Australian population and plays a complex and significant role in social and societal functioning (2). Alcohol guidelines vary considerably around the world both in terms of how consumption is defined and the frequency and amount of alcohol that is recommended. In Australia, these guidelines, based on a 1% lifetime risk of death, suggest no more than two standard drinks per day on average and no more than four standard drinks on any one occasion, with a standard drink being defined as containing 10g of alcohol (4). The first guideline is most relevant to its contribution to chronic disease; the second guideline is more relevant to acute incidents and injury. The Australian National Health Survey for 2017-2018 shows that 16% of people exceeded the first guideline and 42% of people exceeded the second guideline on at least one occasion in the preceding year (2).

Alcohol and other drug specialist services across Australia saw 42 880 people with alcohol related problems in the 2015-2016 financial year (7), whilst general practitioners saw 572 000 people for alcohol conselling in the same timeframe (3). The National Health Survey data above (2) suggests there are nearly 10 million Australians who exceed alcohol drinking guidelines and may therefore potentially benefit from counselling about their alcohol useage.

Previous research has identified that general practitioners are often reluctant to manage patients with alcohol and other drug problems (8, 9). These studies have been conducted in cities, where there is better access to alternative options for alcohol and other drug treatment. Regional and rural areas are more reliant on general practitioners to manage alcohol and other drug issues due to limited referral options.

Given the apparent burden that alcohol and chronic disease place on primary health care, we investigated how what clinical staff working in general practices thought about the impact of alcohol on chronic disease management and how they are currently coping with these issues in a regional setting. This research aims to understand current practice in terms of managing comorbidities of alcohol use and chronic disease and the perceptions of the health practitioners who are providing the care. This will allow the identification of strategies to assist practices to manage the impact of alcohol and chronic disease in an effective and sustainable way.

Methods

This descriptive qualitative study is part of a larger study investigating the role of alcohol in the management of chronic disease in a regional setting, Townsville, more than 1500km from the nearest capital city, with a population of approximately 190 000 (10). In order to consider perspectives across a broad range of primary care, three practices were purposively selected to cover a range of locations (inner city, mid suburban and urban fringe), billing type and configuration (solo practice and group practice). Consent was obtained at the practice level and the option to be interviewed offered to all medical, nursing and allied health staff. Ethics approval for the study was obtained from James Cook University Human Research Ethics Committee (H5335).

Brief, semi-structured interviews were designed to have minimal impact on the workloads of the practice. The aim was for the interviews to take between 15 and 20 minutes. The questions (Box 1) were pilot tested with two practitioners of different professional backgrounds. Interviews continued until data saturation was achieved as determined by two subsequent interviews with the same practitioner group without identification of new code themes. As a result of this approach, 100% of total

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clinical staff at practice one were interviewed; at practice two 100% of allied health

and nursing staff and 57% of medical staff were interviewed; and at practice three,

33% of allied health and nursing staff and 56% of medical staff were interviewed. No

interviews were excluded from the analysis.

Box 1: Interview Questions

1. What approach does the practice take to chronic disease management?
2. How is alcohol consumption assessed in patients with chronic disease?
3. How often is alcohol consumption checked in clients with chronic disease?
4. If alcohol consumption is above recommendations, how is this managed?
5. Based on your experiences in your practice, in what ways do you think alcohol consumption affects chronic disease management?
6. What is your impression of the effectiveness of your practice's approach to excess alcohol consumption in chronic disease patients?
7. What would help you?
8. Why do you think some practitioners are reluctant to ask about alcohol or to address excess consumption?

Individual interviews were conducted after obtaining informed consent. Audio

recordings were professionally transcribed verbatim and de-identified; and

underwent line by line analysis using abductive thematic techniques (11, 12). NVivo

software (13) was used for the coding process. The set interview questions were

used as the deductive nodes with simultaneous creation of inductive nodes. This

was repeated by constant comparison until no new codes were identified (11). The

data were also analysed by practitioner type and length of practice. A third of the

transcripts were randomly selected and independently coded by an experienced

qualitative researcher (RP) and the coding density and spread compared. De-

identified themes were discussed with a selection of participants and practice

managers to check if they accurately reflected the experience of the practice as

respondent validation (11, 12).

Results

Of the three participating practices, one was a solo doctor practice that was bulk billing (services provided free of charge to the patient and billed to Medicare). The remaining two practices were multi-doctor practices with allied health support. These practices utilised what is known as mixed billing, with bulk billing to those clients with socioeconomic need and the remainder of patients paying a subsidy

A total of 18 interviews were conducted. The characteristics of the interviewees are outlined in Table 1. The average duration of interviews was 13 minutes (range 7-20 minutes).

Table 1: Interview Characteristics

Professional Group	
Doctor	9
Nurse	5^
Allied Health	5^
Experience in Profession (years)	
<5	6
5-10	3
>10	9
Gender	
Male	4
Female	14
Practice Type where employed	
Bulk Billing	2
Mixed Billing	16

^one participant was qualified as both RN and allied health

All participants agreed that alcohol use complicated management of their patients with chronic disease. Seven broad themes emerged as outlined below.

Patient complexity: "alcohol is a symptom of the complex problems"

Participants identified that many patients had more than one comorbid chronic disease as well as their alcohol consumption to manage.

"It becomes a bit impenetrable because it's usually their complicated personal lives, historical factors, economic, pain…things that I don't really often have a solution for" (GP9)

Impacts on chronic disease management identified included adherence to medication; reduced medication effectiveness; maintenance of drivers for chronic disease e.g. weight; poorer motivation to address health issues; and poorer insight into their health.

Patients with complex/chronic alcohol use sometimes lost vital family support due to their addiction; impairing their ability to lead healthy lives.

"…we know he won't take his medicine around that time because he's always too drunk but he will wake up and be hungry at this time so we'll put all his tablets then" (GP1)

General practitioners and more experienced nurses were more likely to identify specific chronic health impacts of alcohol use such as liver disease, kidney disease and pancreatitis as well as less motivation and self-care. By comparison, allied health and less experienced nurses identified acute intoxication related health impacts such as inebriation, "not listening" and "losing medication".

Culture of Drinking: "*there's always alcohol*"

Participants discussed multiple social factors that promoted the consumption of alcohol. Societal attitudes to alcohol consumption also make alteration of drinking behaviours challenging for many people.

> *"I think that comes back to the culture of drinking in Australia…, you know, it's integrated into all sorts of things …, good things and bad things… celebrations and commiserations – there's always alcohol"*
>
> *(GP9)*

Some practitioners identified that the drinking habits of the health practitioner or their cultural expectations around drinking, may impact on their interpretation of how much alcohol is too much.

> *"If you come – like certainly me - I come from [names home country]. We drank a lot. It's more you drink from a young age and you consider it as normal or not…[and this will] influence on the lifestyle or the disease management."(GP6)*

Multidisciplinary Care: "we've tried to cover it all here"

Most practitioners identified the need for multidisciplinary and/or holistic care as essential in the management of these patients. Patients were generally seen first by a practice nurse, then by a doctor with add-on care from allied health or specialists as deemed appropriate. The practices all had some additional allied health service arrangements, within or nearby the practice to facilitate this care.

"…so many people… have a hand in on that. You know, like a diabetic,

you'd have a podiatrist, optometrist, you'd have a nutritionist, a

dietician, an exercise physio, so there's so many people that are

involved in that one person's – but we've tried to cover it all

here."(AH1)

Most care was being delivered via individualised care plans with alcohol included in the plan set up. The practitioners mostly reported using 'direct questioning' to determine alcohol consumption and most were unaware of tools to assist with the collection of this information. The practice software at all practices utilised the AUDIT-C (14) tool which was guiding the questions asked, however staff appeared unaware of this and how to interpret it.

"I tend to just ask… I don't use a formal tool…but I am aware that you

don't always get an honest answer so it's something that I will explore

more thoroughly if I'm concerned." (GP7).

Many participants were unclear how often alcohol consumption was rechecked. Where answers were specific the responses varied from never asking to asking every visit. The most common response was that they expected it would happen with each care plan review, generally quarterly. Doctors who were interviewed seemed less clear about review frequency than nurses, who often reported it would happen each time.

"Well every time they've come in for a care plan I review that again. I'll

review their alcohol status, I review their smoking status, exercise and

nutrition status" (AH1)

Management of patients who drank alcohol above guidelines was reported as multidisciplinary, holistic or integrated. However, the specific management options mentioned usually were regarding the chronic disease (for example, diabetes mellitus) more than for the alcohol consumption.

"… [our practice is] quite proactive and I would say fairly holistic… they can access allied health services and also therefore sort of formalising their regular review and follow up to make sure that they are seen as required for bloods and their checkups and all that kind of thing."(GP3)

Practices were extremely well set up for managing chronic disease and this included measurement of alcohol intake, however management of excess alcohol consumption was a more elusive concept. Most interviewees agreed that alcohol consumption should be managed but many felt that this was very challenging. There was considerable discussion about what was tried, "*counselling*", "*motivational interviewing*", "*lifescripts*" (15) without any clear successful strategy elucidated. Some management approaches were considered too complex;

"*…We also looked at the Flinders program but we felt that even though it's been adapted for Indigenous people, it's still too bulky and too labour intensive. And someone with a chronic disease doesn't want to have to spend two hours talking to make a plan…They just want simple take home messages.*" (GP1)

The consensus was that all practices and all practitioners try very hard to address this complex issue with limited and at best mixed success.

"*I think…–we try our hardest but it's not always successful. We try to encourage people to stop drinking or to certainly decrease their*

drinking habits but you know… sometimes you're fighting a losing

battle. They don't really want to." (RN2)

One of the key findings regarding multidisciplinary care was role confusion. Within

practices, teams demonstrated a shared vision of what the practice aims were, as

demonstrated by the repetition of key phrases and themes by many individuals in a

practice. However, the role each person played was less clear. Many nurses and

allied health workers noted that they felt that management was a "*doctor's role*" and

that their role was to record the patients' consumption.

"…with me as the nurse is not going to be treating that person, so it's

developing a rapport with the patient so that they feel free to answer

the questions and whatever is said about wanting to quit, I make a note

that, the doctor will read that" (RN1)

The doctors generally stated that it was a multidisciplinary approach and felt the

nurses managed it well.

Interviewee: "the doctor refers back to us then we do some education"

Interviewer: "And how comfortable do you feel giving education around

alcohol?

Interviewee: "No, not really" (AH3)

Staff motivation: "I feel a bit helpless"

Motivation to deal with alcohol consumption varied. Many expressed frustrations,

concerns regarding health cost burden and a sense of being helpless. Others

suggested they found the occasional wins rewarding. This variability existed across

professional disciplines.

"Especially if … I'm sure it's going well and then they start drinking again and it just spirals out of control again. Then I get probably quite … demotivated" (GP2)

"Non-conformity, you know, people who are just non-compliant…it's very frustrating when you go to all this work." (RN2)

In general, motivation to address alcohol discussion or to actively discuss it with the patient was more closely linked to experience, with more experienced practitioners more likely to address the issue of alcohol consumption and less fearful of adverse outcomes such as lost rapport. This was seen across all three professional groups. As expressed by this GP with more than 10 years' experience:

"…I think people are reluctant to ask because they don't want to damage their relationship they've got with a patient...in fact it probably strengthens it… I've learnt over time. I used to be reluctant. I am much less so now because you need to have that honesty there." (GP9)

This contrasts with the following quote from a recently graduated allied health worker:

"…it feels almost as though it's like a bit of a moral dilemma because you feel as though it's offensive to the patient to be reporting on them without their knowledge I suppose… that rapport can be affected if I report anything" (AH2)

Patient as Key Stakeholder: **"at the end of the day, it's up to that client to want to change"**

Experienced practitioners frequently referred to the concept that the patient was the key stakeholder in their health. Amongst less experienced practitioners nobody

identified this concept and the focus tended to be on the practitioners' own skills or actions in moving the patient towards more self-efficacy.

"Put a bit more effort into explaining why that it does this to your body …putting it back on the patients to take a bit more responsibility" (AH2)

Staff knowledge and training: "I get stuck and I'm not too sure what to do"

Across professional disciplines there were concerns raised about a lack of training in alcohol management, both in terms of undergraduate training, on the job training or continuing professional development. This suggests alcohol management is learned in a self-directed way whilst working and is consistent with the number of themes that were more closely linked to years of experience than professional background or job designation.

"I think it's the … resistant ones –the ones that just don't care…that's where I get stuck and I'm not too sure what to do" (GP5)

"Well I don't know what tools are really available." (GP8)

Referral and Assistance: "Where do you refer them to anyway?"

All but one practitioner requested more assistance: *"more training and more help and more resources"*. Referral services were perceived to be only available for those patients with the highest levels of alcohol consumption and the effectiveness of such interventions so late was considered a problem. These referral services were also deemed to be unlikely to cope with the medical needs of complex chronic disease. Communication with referral services was also raised as an issue as it was felt that once you referred the patient the treated doctor was "*out of the loop*".

"Where do you refer them to anyway? I don't really know. Because once you start bringing in…ATODS or something like that, the patients start to get very defensive–there's one patient I haven't seen for the last 6 months. She got admitted to ATODS and haven't seen her again, so I don't know." (GP6)

Certain types of patients; those with psychiatric problems, complex problems or "*people who don't see themselves as addicts*", were felt to be difficult to refer. There was a sense that there was no in-between option from management by the GP alone and specialist ATODS facilities.

"…well there's obviously…ATODS but I do wonder whether for many people that is seen as an extreme. You know, people don't see themselves as addicts when it comes to alcohol and therefore perhaps don't feel that that service is for them. So, in that regard, maybe some other sort of support which doesn't perhaps carry the stigma would be helpful." (GP7)

Discussion

The interviews revealed a high degree of motivation to undertake integrated multidisciplinary care of patients with chronic disease that includes management of their alcohol consumption. However, there was an over-arching sense of systematic barriers to the effectiveness and feasibility of this care.

There was recurrent use of the same key words and phrases between practitioner groups and between practices, such as *"holistic care"*, *"integrated"* and *"we try our best"*. This was highly suggestive of a shared insight or vision of what they were trying to achieve, in managing a very complex group of patients.

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Given how commonly alcohol is imbedded in social functions in Australian society (4) it is not surprising that the theme of the pervasive culture of drinking arose consistently throughout the interviews. It was believed to impact in terms establishing and maintaining drinking habits and be a factor in failure of practitioners to recognise excess consumption. Rarely, it was a protective factor. While these cultural factors may be largely non-modifiable by primary health care providers there are many aspects where improved services and outcomes could be achieved. The impact of a practitioner's own alcohol consumption, beliefs and cultural influences is well known and has been systematically reviewed elsewhere (16).

General practitioners are managing these patients holistically and need to balance a complex set of needs. They must manage the chronic disease(s), the alcohol use, the interplay between these factors and, the underlying contributors to both. Many clients will also have mental health diagnoses and/or social issues that further complicate their management. Participants reported that when they refer these patients to a specialist alcohol service only the alcohol component is considered, meaning many clients are not seen as needing specialist help, or are unsuited to the type of help on offer. This is consistent with findings from Allan's (15) 2010 study in regional NSW examining the perceptions of specialist versus generalist clinicians working with patients with substance abuse issues. Our clientele of interest, with co-morbid chronic disease, are even more complex and supported generalist management is more likely to be the preferred sustainable model.

The role confusion in teams suggests a lack of clarity when establishing care plans in terms of what is going to be done by whom. This may also suggest that lead practitioners are unaware of the pre-existing knowledge and skills and training requirements of the members of the treating team.

All disciplines report that they lacked adequate drug and alcohol training in their undergraduate programs and that most of their knowledge has been learned from on the job experience with some coming from postgraduate training, professional development training or self-directed learning. This is consistent with the literature regarding alcohol coverage in undergraduate curricula (17, 18) and the effectiveness of brief training programs for new graduates (19) This largely explains the strong correlation with years of experience for motivation and understanding of the patient's role. Less experienced practitioners were more likely to feel that the responsibility was all their own and feel demotivated by perceived treatment failures. More experienced practitioners can draw on previous positive patient results to offset these experiences and maintain their motivation. This also highlights the potential importance of mentoring of less experienced practitioners by their professionally senior colleagues to reassure them of the need for, and value of, alcohol interventions.

There was an over-emphasis on measuring alcohol consumption coupled with a lack of clarity about what management of excess alcohol consumption would consist of. This is consistent with data about undergraduate training which largely covers recognition of alcohol problems rather than counseling skills or other approaches (17).

Lack of appropriate referral services and the poor interagency communication are of concern, especially when coupled with the lack of confidence in managing excess alcohol consumption and a perceived lack of resources that also potentially suggests unawareness of the many alcohol resources available to practitioners online. Solving this is complex and requires improving the appropriateness of available referral services to manage patients with chronic disease and offering skills based training

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such as brief intervention options (20) for general practice staff. In addition, ensuring that existing resources (such as the RACGP SNAP guidelines (21)) are, available to providers and meet the perceived needs of primary care practitioners, and potentially developing a support liaison service may be important. One such service is the Drug and Alcohol Brief Intervention Team (22) that has been successful in emergency department environments, and modified may be a realistic option for supporting general practices.

Samet and colleagues (23) approached the gap between primary health and specialist drug and alcohol services from the other direction, by co-locating primary health at drug and alcohol facilities to improve uptake in primary care in this hard to reach group. They did manage to achieve a greater uptake in primary care although the contact was not necessarily maintained. This approach may be less useful in a regional center where throughput in specialist centers is lower. Co-location does not address the issue of sustained integrated primary health care and therefore may not be suitable for a cohort with chronic disease co-morbidity.

This research was specifically designed to inform service delivery in the regional context in which it was undertaken. Whilst possibly a limitation, the findings are consistent with regional contexts in other areas of Australia (15) and with findings in an urban setting in the United States (10) suggesting that practitioners across a broad spectrum of contexts are grappling with similar service challenges. The interviews were designed to be brief to limit negative impact on the service delivery of the practice, this may have limited the ability to build rapport and explore the depth of practitioners' perceptions. However, there was remarkable consistency in the challenges expressed and iterative analysis demonstrated saturation with the data that was acquired.

Conclusions

All participating practices demonstrated a proactive multidisciplinary approach to the management of chronic disease in general. There was evidence of a clear shared vision of what the practice was trying to achieve in terms of care. There was a high level of awareness that alcohol consumption above national guidelines would have an adverse impact on the management and outcomes of chronic disease.

This issue of what to do when excess alcohol was detected was more problematic with many practitioners feeling uncomfortable with management of the issue due to a lack of formal training and a perceived lack of resources available to assist them. Role confusion within practices is common and a clear discussion of who is doing what should be encouraged.

There is clear evidence that increased training is required in the management of alcohol use disorders, both at the undergraduate level across all health disciplines and at the level of continuing professional development. Consideration should be given to strengthening referral services that are more integrated with primary care practices with a well-defined supportive role and more transparent communication with practices.

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3.4 Chapter 3 Summary

Using a qualitative approach, Chapter 3 establishes that management of alcohol use in people with chronic disease is seen by health professionals in Townsville primary care as a significant issue. Practitioners felt under-trained and under-resourced to manage what was perceived as a complex and challenging group of patients. The importance of multidisciplinary care was highlighted, and a discrepancy picked up regarding role clarification that potentially results in staff not discussing alcohol use with patients. The role of the patient was also seen as developing self-efficacy in dealing with their alcohol use and chronic disease, especially by more experienced health staff.

In the next chapter, the understanding of the person living with chronic disease will be explored to better understand how their understanding of the impact of alcohol use on management of their chronic disease fits into their role in integrated patient centred care.

Chapter 4 Patient Perceptions

4.1 Introduction to Chapter 4

Chronic disease management is a collaboration between health practitioners and the patient. Having established the current practice and experiences of the health practitioners in Chapter 3, this chapter examines the impact of alcohol on chronic disease from the perspective of the patient, thereby addressing research question 3 of the thesis.

This study took place in two of the three practices that participated in the chapter 3 study, with one practice no longer in business. The chapter describes responses to a survey designed to examine the current drinking habits and explore the experiences and perceptions of patients attending the practice who have chronic disease. The chapter comprises a manuscript that has been submitted for review in a peer-reviewed journal however the formatting has been standardised to improve readability.

4.2 Declarations

Ethics: Ethics approval for the study was obtained from James Cook University Human Research Ethics Committee (H6281)

Consent for Publication: no identifiable information is included. All participants were provided with information sheets and signed consent forms that included intent to publish.

Competing Interests: nil

Funding: this research was funded by minimum resource funding available through the College of Public Health, Medical and Veterinary Sciences at James Cook University as part of PhD studies.

Publication status: **Mudd, J., Watt, K, Larkins, S. Experiences and perceptions of impacts of alcohol consumption in patients with chronic disease. Health Promotion Journal of Australia (2020, under review)**

Authors' contributions: JM designed the research, designed the surveys, analysed the data and wrote the manuscript. SL and KW supervised the design, assisted with interpretation and revision of the manuscript. All authors read and approved the final manuscript.

Figure 1: Position in Thesis Structure

4.3 Manuscript: Impact of alcohol consumption on chronic disease-experiences and perceptions of patients

Background

Chronic disease is one of the greatest contributors to the burden of disease in Australia (1) and across the world. Collaboration between health practitioners and patients is essential for effective chronic disease management (2) and therefore understanding patients' experiences and perceptions is an important part of the therapeutic alliance. Most people managing chronic disease are diagnosed in adulthood when their lifestyle behaviours are well established.

A significant proportion of Australian adults drink alcohol in excess of the national guidelines (3). These guidelines suggest that to reduce the risk of chronic harm from alcohol, no more than two standard drinks (defined as containing 10g of alcohol) should be consumed daily. Similarly, the guidelines state that to reduce the risk of acute harm, no more than four standard drinks should be consumed on any occasion (3). However, the guidelines are designated as being for healthy individuals and in the case of people living with a chronic disease the onus is put back onto the treating clinician to advise on the appropriate level of consumption (3). This is particularly complex for health practitioners as most chronic disease guidelines refer to the Australian alcohol guidelines for advice on alcohol consumption, leaving practitioners with minimal information to assist them with patient's questions.

Given the likelihood of established behavioural patterns and the potential for alcohol consumption to impact on disease management it is helpful for practitioners to understand patients' experiences of alcohol related harm and their expectations to

inform discussions with patients about safer drinking in the presence of their chronic disease.

This article is part of a larger study designed to address the impacts of alcohol on chronic disease management, particularly in regional settings. The larger study demonstrates that alcohol consumption, in excess of guidelines, can negatively impact on the management of chronic diseases (4). The study presented here aims to answer the question, what do patients with chronic disease think about the impact of alcohol on their chronic disease management?

Method
Study design and setting.

A cross-sectional survey was completed by people with chronic diseases in Townsville, a regional city in north Queensland, Australia. The survey was administered at two large group practices with a combined client base of 19 704, or 9% of the city's population (229 031; 5). These practices were purposively selected as they had a large client base and cut a geographical wedge across the town, covering a variety of socioeconomic and demographic areas. Ethics was approved by the JCU Human Research Ethics Committee [H6281]. Practice consent was obtained from the practice principal and the practice manager.

Survey development

The survey questions were a mix of qualitative and quantitative questions (Box 1) and were designed to assess: current drinking behaviours, any harms related to their chronic disease attributed by patients to alcohol consumption, how much alcohol can be consumed without harm, and what harms could occur if too much alcohol is consumed. AUDIT-C was used as the measure of current drinking behaviour as a

validated and well accepted screening tool in a primary practice setting (6). A

screening cut-off score of 4 was selected for good sensitivity, noting that this is

applied as a screening process not a diagnostic approach. Standard drinks were

defined as containing 10g of alcohol (3) and a pictorial representation was included

in the survey. The free text field for alcohol consumption was used to validate the

interpretation of standard drinks for the AUDIT-C score.

Box 1: Survey Questions

1) Age (categorical, by decade)
2) Gender
3) Diagnosis (tick box and other field)
4) AUDIT-C question 1 How often do you have a drink containing alcohol?
5) AUDIT-C question 2 How many drinks containing alcohol do you have on a typical day?
6) AUDIT C question 3 How often do you have six or more drinks containing alcohol on one occasion?
7) When you drink alcohol, what do you usually drink? (free text)
8) Since you have been diagnosed with a chronic disease have you ever experienced a problem with your health that you thought was caused by your consumption of alcohol? (free text)
9) How many standard drinks do you think you could drink in a six-hour period without it being bad for your chronic disease(s)?
10) How many standard drinks do you think you could drink each day on average without it being bad for your chronic disease(s)?
11) In what ways do you think alcohol consumption might impact on your chronic disease? (free text)

Sample and survey administration

Data were collected across 2016-2017 at each practice sequentially, for two months

in the first practice and for five months in the second practice, in an attempt to

increase the responses received. Eligible patients were active patients attending the

practice during the data collection period with a diagnosed chronic disease. A

convenience sample of patients who were seeing the chronic disease nurse were

handed a survey and offered the opportunity to complete it; additional surveys were available from reception and in the waiting room for patients who wished to complete the survey.

The survey was completed in paper format. An information sheet outlining the project was attached to the survey with consent implied through completion of the survey. All surveys were anonymous, with completed surveys being placed into a sealed box that was collected and replaced intermittently by the principal investigator (first author).

Data management and analysis

The surveys were created in SurveyMonkey[TM] (7). Variables were analysed with statistical package for social sciences software (SPSS version 25; 8) by descriptive statistics (chi-square tests for categorical variables and Mann-Whitney tests due to non-parametric distribution for numerical variables). Medians and inter-quartile ranges [IQR] are reported where relevant. Paired data were analysed via a Wilcoxon signed rank test.

Free text fields underwent content analysis as well as being grouped as negative, positive, or neutral impact.

Results

A total of 68 surveys were collected from the two practices (30 & 38 respectively). While 150 surveys were printed, it is not known how many were handed to patients as not all unused surveys were returned making a response rate impossible to calculate. Two surveys were blank, leaving 66 valid surveys. The sample characteristics are summarised in Table 1. The chronic diseases reported were diverse with 17 different conditions being listed. The most common were: Diabetes

mellitus (predominantly Type 2, T2DM), chronic obstructive pulmonary disease (COPD)/asthma, cardiovascular disease (CVD), chronic kidney disease (CKD) with others including arthritis, depression, cancer, coeliac disease, fibromyalgia, diverticulosis, Parkinson's disease, chronic liver disease, hypertension and hyperlipidaemia. Two or more conditions were reported by 35% of respondents (median 1, IQR 1-2) Seven respondents did not know what their chronic disease was and were included in the 'other' category.

Table 1: Sample Characteristics (N=66)

	n (%)
Age	
<40yrs	2 (3%)
40-49 yrs	5 (7%)
50-59 yrs	13 (20%)
60+ yrs	46 (70%)
Gender M/F	27 (41%)/39 (59%)
Diagnosis[i]	
Diabetes	27 (4%)
COPD/asthma	14 (22%)
CVD	23 (35%)
CKD	5 (8%)
Other	34 (52%)
AUDIT-C Category	
0	22 (33%)
1-3	23 (35%)
4-7	11 (17%)
8+	10 (15%)
AUDIT-C score, n=65	**Median [IQR]**
Reported AUDIT-C score	1 [0-5]
Validated AUDIT-C score	2 [0-6]
Perceived Safe Drinking Limit (standard drinks), median [IQR], n=45[ii]	
Single Occasion	3 [1-5.5]
Lifetime use	1 [0-3]

Notes i: disease categories tally to over 100% due to multiple diagnoses; ii: twenty-one missing responses

The free text description of drinking was used to validate the AUDIT-C score results. Two-thirds of respondents had the same score on validation. Of those participants where the validated AUDIT-C score was different from the reported AUDIT-C score, the difference was one point (20/66) or two points (3/66), with one outlier whose reported AUDIT-C score was lower by 5 points. Reported AUDIT-C score was not higher than validated score for any participants. The median [IQR] was 1 [0-5] for actual score and 2 [0-6] for validated score which were statistically significantly different (z=-3.516, p<0.001).

Utilising the free text field alongside the AUDIT-C questions revealed that of those who consumed alcohol (44/66), a quarter (11/44) drank less than two standard drinks per session on average as suggested by the Australian guidelines for reduced risks from alcohol (3). There were 22 drinkers (50%) with a zero score to question 3 (no more than six on any occasion).

Experience of impact on chronic disease with current level of drinking

Nine of the respondents (seven of whom were males) reported having experienced a negative impact on their chronic disease as a result of their current level of drinking. The AUDIT-C scores for these participants ranged from 0-12. Two of the respondents with a low AUDIT-C score (0 & 1) specified that their previous negative experience had resulted in their current lower level of drinking.

The reported impact varied considerably from generic responses such as "*compounded my ill health*", to contributing to intermediary causes (for example weight gain) to specific examples of adverse effect for example *"liver damage, high blood pressure, onset of mental illness all are in remission since stopping drinking for 15 mths"*. The most commonly reported adverse effects were increased blood

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pressure and increased blood sugar. One respondent gave a relatively detailed account of the relative impacts of different alcohol types on their sugar levels.

No impact was reported in 41/66 surveys including one respondent who specified they modify their alcohol intake to reflect the activity of their chronic disease, drinking less when unwell. One respondent stated they did not know if they had experienced an adverse event attributable to alcohol. There were 15 missing responses to this item. Most people who did not respond to the question were in the non-drinking group (11/15).

Table 2: Perceived Drinking Capacity Without Harm Relative to AUDIT-C Screen

Current Drinking	Perceived Drinking Capacity Without Harm			
AUDIT-C Score	Single occasion: Std Drinks per 6 hrs median [IQR][i]	n	Lifetime drinking: Std drinks per day median [IQR][ii]	n
Screen negative (Score 0-3)	2[1-3]	29	1[0-2]	28
Screen Positive (Score 4-12)	6[1-8]	19	4[2-6]	17
p-value	<0.001		0.001	

Note: [i] 18 participants did not respond to this item; [ii] 21 participants did not respond to this item

As perceptions of drinking are likely to be impacted by current drinking patterns, particularly dependence on alcohol, AUDIT-C dependence screen results were also considered. Perceived median standard drinks that can be consumed without harm were significantly lower in participants who screened negative to AUDIT-C (0-3) than participants who screened positive (4-12). This was true for both single occasion use, and lifetime use (Table 2).

There were also significant gender differences. Median AUDIT-C score was higher in males (4.0, [1-6.75]) than females: (1.0 [0-1], p <0.001). Median perceived safe

drinking amounts were also higher in males for both single occasion (4 [2-7.5] *cf* 1 [0-2.75], p=0.002) and lifetime use (2 [0.5-5.5] *cf* 0 [0-1], p=0.001).

Perceived effects of "too much" alcohol on chronic disease

Thirty of the respondents (45%) reported a perceived negative impact of alcohol if they were to drink above the levels outlined in Table 2. Two respondents reported an expectation of a positive effect on their health (*"makes me happy"* and *"helped my problems"*). Six anticipated no impact on their health while seven stated that they *"do not know"* what would happen if they drank too much. Twenty-one participants declined to answer. Except for those reporting unknown effects which was predominantly seen in the AUDIT-C 0-3 group (6/7), the other responses were evenly distributed across the two groups.

Expected issues that would arise from increased consumption included: liver problems (n=6), weight gain (n=6), kidney damage (n=5), difficulty with sugar control (n=5), dehydration (n=3), worsening pain (n=3), interference with medication (n=2), heart damage (n=2), stomach pain (n=1), increased smoking (n=1), poorer mental health (n=1), dizziness/tiredness (n=1) and higher blood pressure (n=1). One patient reported different responses based on alcohol type *"drank 1 full bottle of rum and pepsi max next morning blood sugar 6.2 if drink beer sugar goes up lots"*. Some responses were non-specific but still indicated an expectation of a negative impact, for example *"if I was still drinking I'd say it would not be effective to my health"*.

Discussion

This article describes real-world impacts of alcohol on people with chronic disease, their perceptions of how much alcohol is safe to consume and their beliefs about what might happen if they drank too much. Importantly, it shows a significant impact of current alcohol consumption on risk perception.

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The abstinence rate, at 30%, is higher than the rate of non-drinkers in Australia (23%) reported by the National Drug Survey for the corresponding timeframe (9). For those that consume alcohol, 25% were within the chronic alcohol use Australian guideline (3) somewhat higher than the national level for 2016 of 17% (9). Due to the difference in cut-off for single occasion drinking a comparison to the national single use guideline cannot be made (3). Comparison of the current study respondents to participants in another recent Australian study that included primary practice AUDIT-C results, showed lower rates of abstainers, higher overall rates of people with an AUDIT-C of <3, lower rates of moderately at-risk people (AUDIT-C 4-7) and higher rates of severely at-risk people (AUDIT-C 8+) (10).

While the overall group reported values similar to the guidelines, the current drinking status by AUDIT-C screen was associated with the perception of how much alcohol was safe to consume. The differences between the two AUDIT-C screen groups seen in this study has also been demonstrated in general community cohorts (11) and can be reconciled by the potential impact of dependence on decision making via physiological adaptation and psychological craving (12). Additionally, there is a tendency to normalise one's own behaviour and underestimate personal risk relative to perceived risk to others (13) which may explain the varied rates of perceived harm to reports of alcohol related harm to the individual.

The majority of the respondents were over 50 years (and 70% were over 60yrs) and it should be noted that while the National Drinking Guidelines have been in place for ten years, the previous version of the guideline was gender specific (3) and allowed for higher single-occasion cut-off values. The previous guideline suggested that four drinks per day or six drinks per occasion were suitable for males. As most of these respondents would have long term established drinking habits the gender difference

and increased overall alcohol consumption may reflect a failure to have been taught or to accept the more recent guidelines. A 2012 survey by Livingston suggested only minor shift in risk perception following the new guidelines (11), however the possibility that ten years later this information has still not reached people is of potential concern.

The issues raised as concerns by participants in this study match known potential effects of alcohol relatively well, with established concerns in the literature such as medication interference, hypertension and sugar management (14, 15). There were some impacts that are reported in the literature such as cognitive issues or falls (14, 15), that were not identified by any participants in this survey. No-one identified increased cancer risk which, whilst well established in the literature, has variable levels of acceptance by the public globally (16). In Australia, previous studies have suggested approximately half of Australians are aware of this link (17), however, this awareness is not reflected in this study. This is important, as understanding of cancer risk has been previously associated with higher likelihood of compliance with drinking guidelines (18, 19), especially when this association is established by their healthcare team.

Strengths and limitations

While this study is limited by sample size it enabled participants to freely express impacts, whether positive or negative, and statistically significant differences between AUDIT-C screen categories were demonstrated. There was potential for selection and self-report bias (including memory) due to the sampling strategy however alcohol consumption rates were comparable to larger general Australian community samples in the literature. In addition, the design of this study does not

allow interpretation regarding the direction of observed associations, so inferences about causality are not possible.

Conclusion

This study reveals that patients' perceptions of how much is safe to drink is linked to their current alcohol consumption and that AUDIT-C screening, a simple three question tool, can assist in identifying patients for whom more alcohol education may be warranted. It also demonstrates that there are gaps in the understanding of patients regarding the potential impacts of alcohol consumption on their chronic disease. Areas for improvement include education about potential acute alcohol risks such as hypoglycaemia in people with diabetes, cancer risk, and risks such as decreased cognition and increased falls.

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4.4 Chapter 4 Summary

In Chapter 4, a survey was used to explore the experiences and perceptions about alcohol amongst people living with chronic disease. This establishes that while some people living with chronic disease have personally experienced an adverse impact on the management of their condition as a result of alcohol consumption, most were able to describe potential negative impacts of alcohol, although two people did suggest that alcohol would improve their quality of life. The perception of how much was safe to drink was strongly associated with current drinking behaviour. Those who screened negative for alcohol dependence by AUDIT-C suggested safe drinking levels in line with the Australian Guidelines, and those who screened positive for alcohol dependence suggested safe drinking levels that were significantly higher.

The next chapter builds on these findings and explores the impact of alcohol consumption on measurable outcomes of chronic disease and health care utilisation.

Chapter 5 Retrospective Chart Audit

5.1 Introduction to Chapter 5

Having explored the perceptions and experiences of both the health practitioners

and the patients, Chapter 5 seeks to provide objective evidence of the impact of

alcohol consumption on chronic disease management. Chapter 5 addresses

research question 4 of the thesis.

This chapter is based on the largest sub-study in the thesis, a chart audit performed

at the same two large group practices where the survey in Chapter 4 was

undertaken. The chapter is divided into two separate manuscripts. Overall, the

chapter presents the findings of 482 patient records looking at three outcomes. The

first manuscript describes the impact of alcohol on the ability of people to reach their

chronic disease management targets and the impact of alcohol on the primary

chronic disease outcome. The second manuscript describes the impact of alcohol on

health system utilisation (primary care and hospital based). Both manuscripts are

presented in the final accepted form in terms of content, but the formatting has been

standardised to improve readability.

5.2 Declarations

Ethics: Ethics approval for the study was obtained from James Cook University
Human Research Ethics Committee (H6279)

Consent for Publication: no identifiable information is included. Practice level
consents were obtained and all patients in the practice were aware that the data
collection was taking place.

Conflict of Interests: nil

Funding: this research was funded by minimum resource funding available through
the College of Public Health, Medical and Veterinary Sciences at James Cook
University as part of PhD studies.

Publication status: 1) **Mudd, J., Larkins, S., Watt, K. The effect of excess alcohol consumption on chronic disease clinical outcomes in a regional general practice setting- a retrospective chart audit. Australian and New Zealand Journal of Public Health. Accepted June 11 2020**

2) **Mudd, J., Larkins, S., Watt, K. The effect of excess alcohol consumption on health utilisation in regional patients with chronic disease - a retrospective chart audit. Australian and New Zealand Journal of Public Health. Accepted June 21 2020**

Figure 1 Position in Thesis Structure

5.3 Manuscript: The effect of excess alcohol consumption on chronic disease clinical outcomes in a regional general practice setting- a retrospective chart audit

Abstract

Objective

To better understand the impact of alcohol consumption on the clinical management of chronic diseases in a regional general practice setting.

Methods

A retrospective chart audit was undertaken of individual patient records at two large group general practices in Townsville, a regional Australian city. Three common indicator chronic diseases were selected that have clear management guidelines for general practice: type 2 diabetes, chronic obstructive pulmonary disease, and chronic kidney disease. The audits were analysed using SPSS software to examine the association between alcohol consumption on acquisition of clinical management targets and primary disease intermediate outcomes (haemoglobin A1c fraction, percent of normal forced expiratory volume at one second and estimated glomerular filtration rate).

Results

A total of 457 records were audited. Higher-risk alcohol consumption is associated with reduced ability of patients to reach management targets ($F_{[3,453]}=3.68$; $p=0.012$) and decreased standardised primary disease outcome ($F_{[3,403]}=2.86$; $p=0.037$).

Conclusion

Higher-risk alcohol consumption is associated with reduced attainment of chronic disease management targets and worse chronic disease outcomes.

Implications for Public Health

Alcohol consumption should be assessed frequently in people with chronic disease, especially when there is difficulty acquiring management targets or worsening of disease outcomes without a clear explanation. Better education about the potential associations between alcohol use and chronic disease would benefit those managing these complex conditions, both clinicians and patients.

Background

In Australia, alcohol is consumed by nearly 80% of the population (1) and is responsible for 4.6% of the burden of disease (2). The Australian guidelines to reduce harms from alcohol suggest that to prevent chronic harm from alcohol consumption intake should be restricted to no more than two standard drinks per day on average; and to prevent acute harms, no more than four drinks on any single occasion, with a standard drink being defined as containing 10g of alcohol (3). However, in the most recent national health survey, 16% of Australians reported that they exceeded the first chronic harm guideline in the preceding year (1). Previous studies have suggested that alcohol is consumed by people with diagnosed chronic disease at similar rates to the general population (4). Given that chronic disease is identified as the major contributor to disease burden in Australia (2), the intersection of these two prevalent sources of morbidity is potentially important.

In Townsville, a regional city of Queensland, Australia, general practitioners have identified concerns about managing excess alcohol consumption in patients with

chronic disease (5). This is complicated by higher rates of alcohol consumption than the national average (6), limited specialist drug and alcohol services (5, 7) and perceived lack of resources and referral options (5). This concern has been echoed by general practitioners elsewhere (8), suggesting that it may be an issue for practitioners more widely.

Chronic disease management requires close collaboration between the health practitioner and the patient to successfully prevent complications and slow progression of the disease (9). This essential collaboration between patient and health practitioner is potentially inhibited by alcohol consumption which has been associated with poorer adherence to chronic disease related self-care behaviours (10, 11) as well as decreased practitioner motivation to engage with patients who are drinking to excess (5, 8). While there are limited studies on the reasons for this decrease in self-care and health related behaviours and awareness, it has been demonstrated across a wide range of demographics in those with and without chronic disease (12, 13).

While both acute and chronic consumption of alcohol can be harmful (3), the focus of this study was on chronic consumption above Australian guidelines as this was felt to be most likely to reflect on chronic disease clinical outcomes, which are the accumulation of small gains or losses over extended time periods (14). Alcohol consumption has the potential to affect both the behavioural and physiological factors contributing to chronic disease (12, 14), both directly and via contributions to mental health challenges (15). This research investigates the association between alcohol on the attainment of clinical practice guideline-based management goals and clinical outcomes of chronic disease in the general practice setting where concerns about the issue have been raised (5), in regional north Queensland.

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Methods

A retrospective chart audit was conducted at two large group general practices in Townsville, purposively selected to cover a broad geographical and demographic section and to maximize the sampling of potential clients. The collection period was twelve months (1/1/2015-31/12/2015) with data extraction undertaken between February 2016 and February 2017. Three indicator chronic diseases were chosen that were common and had clear evidence based management guidelines for general practice: Type 2 Diabetes Mellitus (T2DM, 16), Chronic Obstructive Pulmonary Disease (COPD, 17) and Chronic Kidney Disease (CKD, 18).

Ethics approval was obtained from James Cook University Human Research Ethics Committee [H6279]. Informed consent was obtained at the practice level with advertisements placed in the practice to allow people the option to request that their records not be included in the study. This was in addition to existing practice level consent for the use of records for quality improvement and clinical auditing purposes. Information sheets were made available through the chronic disease nurse for people who wanted further information and the chronic disease nurses, and the general practitioners (GPs) also discussed the project with any client they felt may have been unable to read or interpret the information.

The chart audit was undertaken by a registered medical practitioner (JM), who did not work at either clinical practice, using a minimally intrusive approach. All records accessed were electronic. The key word and function searches within the software were used to find data to avoid unnecessary reading of patient consultation details. The eligible case list was cross-checked with the chronic disease nurse's database of active chronic disease patients to check completeness and maximise the number

of eligible records. No identifying details were collected. A temporary record number was included to enable identification of duplicate records and deleted on completion of collection. To generate the patient list at each practice the electronic software was searched, as diagnosis and keyword, for the three indicator chronic diseases (T2DM, COPD and CKD), looking for records active (at least one visit) in the retrospective collection timeframe (2015). The generated list was verified by the chronic disease nurse at each practice. Patient lists were kept secured at the practice during collection and were destroyed at the completion of collection. No identifiable information left the practice.

Data (Box 1) from every second record was collected for T2DM and COPD, and due to lower patient numbers, all CKD records were considered. Records were first checked for exclusion criteria: no information regarding alcohol consumption; no evidence to support the presence of the chronic disease; evidence of the patient transferring into or out of the practice during the collection timeframe; no attendances recorded in the allotted timeframe or on ethical grounds (patient was known to the researcher). All records that had were excluded due to no alcohol consumption data were incomplete, most commonly a single visit from a person from out of area.

Box 1: Data Points Collected

All conditions	Diagnosis, age, sex, Indigenous identification, medications, number of doctor visits, alcohol use (frequency, amount, frequency of >6 drinks), smoking status, and current influenza vaccination.
T2DM	Body mass index (BMI), last podiatry recorded, last optometry recorded, glycated haemoglobin fraction (HbA1c), total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), last recorded systolic blood pressure (BP)
COPD	Date of last spirometry, forced expiratory volume-one second % predicted (FEV1 %), disease severity as determined by specialist (if unable to complete spirometry)
CKD	BMI, albumin creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), haemoglobin (Hb), TC, LDL, HDL, systolic BP

Management targets

The management targets for each disease were derived from the relevant guideline (16-18). The number of targets acquired was divided by the total number of targets for that disease and expressed as a percentage to enable comparisons between diseases.

COPD: no smoking, spirometry within 12 months, influenza vaccination within 12 months, four or more visits per year

T2DM: BMI<25 kg/m^2, HbA1c< 53 mmol/mol, lipids in range (TC<4 mol/L, HDL>1 mol/L ,LDL<2 mol/L), systolic BP<140 mmHg, influenza vaccination within 12 months, four or more visits per year, allied health involvement in 12 months, no smoking

CKD: Lipids in range, systolic BP<130 mmHg, ACR or PCR within 12 months, Hb >100 g/L, influenza vaccination within 12 months, four or more visits per year.

Classification of severity

COPD: assigned by spirometry (FEV1 % predicted) or specialist determination if unable to do spirometry.

Mild: 60+% predicted.

Moderate: 41-59% predicted.

Severe: <40% predicted.

CKD: assigned by eGFR or formal GFR measurement where available.

Mild: eGFR > 60 + microalbuminuria or eGFR 45-59.

Moderate: eGFR 30-59+ microalbuminuria or eGFR 30-44 with no albuminuria.

Severe: eGFR < 30 or macroalbuminuria.

T2DM: severity was assigned by a combination of number of medications and HbA1c as per Box 2.

Box 2: Assignment of Severity for T2DM

Number T2DM Medications	HbA1c (mmol/mol)		
	<53	54-85	>86
0-1	Mild	Mild	Severe
2	Moderate	Moderate	Severe
3+	Moderate	Severe	Severe
Insulin	Severe	Severe	Severe

Assessment of alcohol consumption

Alcohol consumption was assessed using the Alcohol use disorders identification test-consumption (AUDIT-C) tool (19) (Box 3), as this was embedded into the practice software used at both practices and was therefore the most consistent and reliable method of measuring alcohol consumption. For each patient this was

confirmed by utilising a keyword search to look for evidence of alcohol assessment in the written notes.

Box 3: AUDIT-C

Q1: How often do you have a drink containing alcohol?				
Never (0)	≤ monthly (1)	2-4 /month (2)	2-3 / week (3)	4+ / week (4)
Q2: How many standard drinks do you have on a typical drinking day?				
1-2 (0)	3-4 (1)	5-6 (2)	7-9 (3)	10+ (4)
Q3: How often do you have 6 or more standard drinks?				
Never (0)	≤ monthly (1)	Monthly (2)	Weekly (3)	Almost daily (4)

As the AUDIT-C was being used as a proxy for consumption rather than a screening tool for dependence, five categories were considered to give the broadest range of potential results: score 0 (non-drinkers), score 1-4 (low risk drinkers), score 5-8 (moderate risk drinkers) and score 9+ (higher risk drinkers). A small number of people (n=10) who had an episodic-only heavy alcohol consumption pattern in the absence of regular consumption (less than monthly consumption of more than 6 drinks) and those with insufficient information to generate an AUDIT-C score (n=15) were excluded from the analysis leaving 457 records.

Assessment of smoking

While the practice records recorded current, past (amount, duration and length of abstinence) or never smoked, due to the low group numbers only current smoking (yes/no) could be assessed and is reported in Table 2.

Disease outcomes

The study used widely accepted markers of disease activity for the individual diseases; eGFR for CKD, FEV1% for COPD and HbA1c for T2DM. To increase the

available sample size sufficiently to consider the impact of co-variables, the primary outcome was expressed as a percent of the value obtained in an unaffected individual. The value that would be considered non-diagnostic (100% for FEV1%, 90 for eGFR and 31mmol/mol for HbA1c) was set as 100% and the worst outcome measure obtained was set at 0%. This value was termed % standard outcome.

Analysis

Statistical analyses were completed using SPSS Statistics 25 (20). Between group comparisons of the AUDIT-C categories were made using independent samples t-tests or ANOVA for numerical variables. Where ANOVA was used, Bonferroni post-hoc analyses were also completed. Categorical variables were analysed with Chi-square tests, and Fisher's Exact tests where assumptions were violated. Analysis of covariance was then undertaken to assess the association between AUDIT-C score on each outcome measure (mean percent management targets reached, mean percent standardised disease outcome), adjusting for potential confounders: age, sex, Indigenous identification status, diagnosis, disease severity category and current smoking status. Those demographic factors that were identified to be associated with both AUDIT-C score and the disease outcome measures were included as covariates.

Results

Data collection

Records were obtained from two large group practices with a combined client base of 19 704 or 11% of the total Townsville population, with 63% (12 377) of the client pool having been seen during the collection period. From these records, 482 patients were audited from a pool of 1179 patients identified with T2DM, COPD or CKD

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(combined practice prevalence of 9.5%; Table 1). The data collected are summarised in Table 2.

Table 1: Records Collected and Exclusions

	T2DM	COPD	CKD	All
Number of records identified	644	385	150	1179
Exclusions				
Record incomplete	86	32	41	159
Disease evidence lacking	30	40	47	117
Ethical	1	0	1	2
Total exclusions	117	72	89	278
Total eligible	**527**	**313**	**61**	**901**
Sampling method	1 in 2	1 in 2	All valid	
Records collected	**263**	**158**	**61**	**482**
Post collection exclusion (insufficient alcohol data)	17	4	4	25
Final record count	**246**	**154**	**57**	**457**

Alcohol consumption: relationship to sample demographics

The associations between alcohol consumption as measured by AUDIT-C score and sample characteristics are shown in Table 2. Two demographic factors were significantly associated with AUDIT-C score category: sex ($X^2(3)=28.40$; $p<0.001$) and current smoking status ($X^2(3)=32.19$; $p<0.001$). AUDIT-C score category was not associated with chronic disease diagnosis ($X^2(6)=9.03$; $p=0.172$), age ($X^2(6)=4.21$; $p=0.650$), Indigenous identification ($X^2(3)=7.52$; $p=0.057$) or disease severity ($X^2(6)=8.30$; $p=0.217$).

Table 2: Demographics and Clinical Outcome Data by AUDIT-C Score

Variable	AUDIT-C Score				All
	0	**1-4**	**5-8**	**9+**	
Number of records	198	158	58	43	457
Age in years, n (%)					
<50	15 (41%)	14 (38%)	6 (16%)	2 (5%)	37 (100%)
50-75	127 (44%)	95 (33%)	40 (14%)	27 (9%)	289 (100%)
>75	56 (42%)	49 (37%)	12 (9%)	14 (11%)	131 (100%)
Sex, n (%)					
Male	77 (33%)	80 (35%)	40 (17%)	32 (14%)	229 (100%)
Female	121 (53%)	78 (34%)	18 (8%)	11 (5%)	228 (100%)
Identification, n (%)					
Aboriginal &/or Torres Strait Islander	48 (57%)	21 (25%)	7 (8%)	8 (10%)	84 (100%)
Non-Indigenous	151 (42%)	133 (37%)	46 (37%)	31 (9%)	361 (100%)
Missing n=12					
Current smoking, n (%)					
Yes	41 (41%)	20 (20%)	18 (18%)	22 (22%)	101 (100%)
No	157 (44%)	138 (39%)	40 (11%)	21 (6%)	356 (100%)
Diagnosis, n (%)					
T2DM	110 (45%)	87 (35%)	30 (12%)	19 (8%)	246 (100%)
COPD	61 (40%)	47 (30%)	24 (16%)	22 (14%)	154 (100%)
CKD	27 (47%)	24 (42%)	4 (7%)	2 (4%)	57 (100%)
Severity category, n (%)					
Mild	79 (40%)	70 (35%)	29 (15%)	20 (10%)	198 (100%)
Moderate	78 (44%)	63 (36%)	23 (13%)	12 (7%)	176 (100%)
Severe	41 (49%)	25 (30%)	6 (7%)	11 (13%)	83 (100%)

The association between alcohol consumption and management targets

As shown in Figure 1, the mean percentage of management targets reached differed by AUDIT-C category (F[3,453]=3.68; p=0.012). Specifically, mean percentage of management targets reached was significantly lower in participants who scored AUDIT-C 9+ than in participants who scored AUDIT-C 5-8 (p=0.03), AUDIT-C 1-4 (p=0.01) and AUDIT-C 0 (p=0.04). As expected, attainment of management targets was positively correlated with standardised outcome (r=0.29; p=0.01).
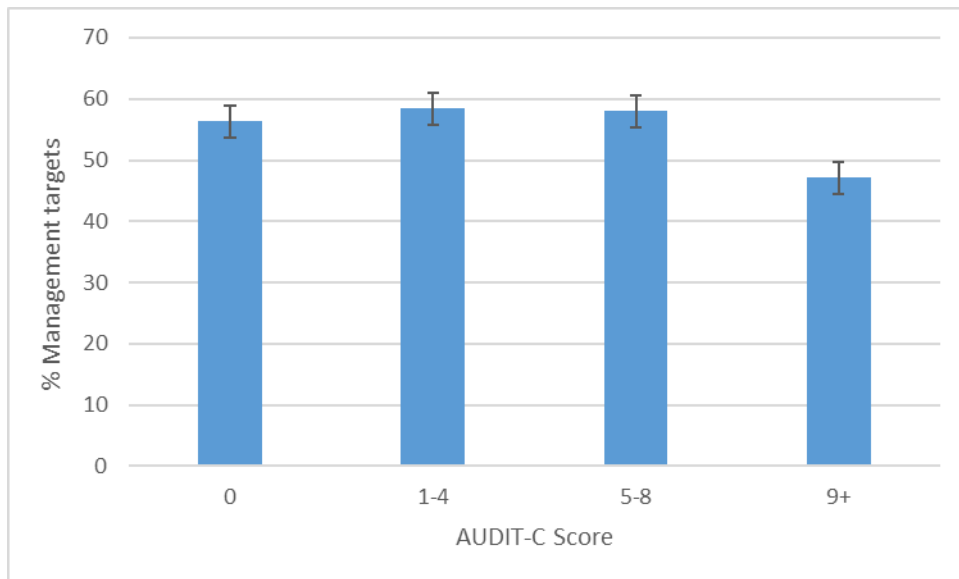
Figure 1: Alcohol Association with Management Targets (mean percentage)

Having established an association between alcohol consumption and management targets, analysis of covariance was performed to investigate contributing effects. Smoking could not be assessed as a covariate as non-smoking was a management target for all three chronic diseases, therefore the only variable adjusted for was sex. Differences between AUDIT-C groups and mean percentage management targets achieved remained after adjustment for sex ($F(3, 453)=3.14$; $p=0.025$).

The association between alcohol consumption and disease outcomes

Mean standardised disease outcome percentage differed significantly by AUDIT-C category ($F(3,403)=2.86$; $p=0.037$; see Figure 2). There were no significant between group differences in post- hoc analysis, likely due to the low number of observations in some categories; but participants in the AUDIT-C 9+ category had the lowest mean standardised disease outcome (62.2), and the highest was in the AUDIT-C 1-4 category (72.6). The association remained after adjusting for sex and current smoking status ($F(3, 403)=2.87$; $p=0.04$).
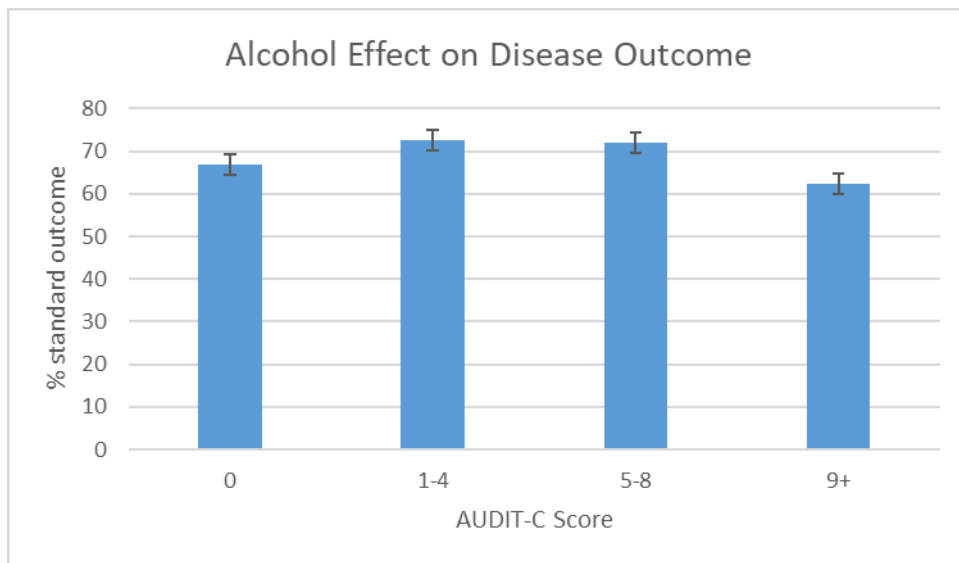
Figure 2: Alcohol Association with Standardised Disease Outcome (mean standardised %)

Discussion

Overall, alcohol had a measurable association with the management of chronic disease across both domains studied (reaching management targets and standardised primary outcome). In general, increased alcohol use was associated with reduced mean percent of management targets reached and worse standardised primary disease outcomes.

Alcohol consumption patterns

AUDIT-C was originally intended and verified as a screening tool for alcohol dependence and alcohol related harm, rather than as a stand alone measure of consumption, however it performs well in detecting hazardous drinking (21). All AUDIT-C scores were verified by checking the written notes. Consumption in participants who scored nine or more ranged from 5-6 drinks, 4+ days/week with 6 or more weekly to 10+ drinks per day. AUDIT–C scores over five are consistent with

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drinking in excess of Australian alcohol consumption guidelines, with scores of four equivocal. Using a cutoff of five, rather than the more commonly used four, lowers the sensitivity for detecting hazardous alcohol consumption but raises the specificity (21). Furthermore, it better aligns with the Australian guidelines that were in use at the time of the data collection as many participants who scored four reported daily drinking of 1-2 standard drinks. Based on this, 30% of the patients in this study were drinking above the regular consumption guideline, compared with 17% of the general Australian population in 2015 (1). This rate was higher in patients with COPD (39%). Abstinence rates of the sample were 40% which is substantially higher than the general Australian population (19.4%; 1). The reason for the higher abstinence rate cannot be definitively determined from this sample but likely reflects alteration in risk behaviours as a result of their chronic disease diagnosis on the recommendation of their doctor (14). This sample also contains a high proportion of people with T2DM, which has been associated with higher than normal alcohol abstinence rates in some studies (22).

Generalisability of the findings

The overall proportion of people with COPD and T2DM reflects the proportions in the Australian population (1). The proportion for CKD is substantially lower than anticipated by national rates, especially in the mild range. It is possible that a proportion of the excluded CKD records, where insufficient evidence was available to support the diagnosis (47/150) would have met mild CKD criteria but in the absence of overt clinical illness this was not being closely monitored at the time and hence there was no evidence in the patient's record.

The total patient pool in this study was over 12000, which equates to 7% of the population in Townsville. Hence, this sample is likely to be representative of the

Townsville chronic disease population who seek medical treatment. Comparison of the demographics of the T2DM sample with a national diabetes audit sample of over 5000 people showed similar means and overlapping ranges for age, sex distribution, blood pressure readings, lipid levels and HbA1c (23), suggesting that the findings are likely to be generalisable to the Australian chronic disease population with respect to these characteristics. The Townsville sample had a higher representation of people who identified as Aboriginal or Torres Strait Islander, a reflection of higher than national average percentage locally (6). The national audit sample, while very comprehensive in many regards, did not include information about alcohol consumption (23).

Alcohol association with management targets

The key finding of decreased attainment of management targets associated with increased alcohol consumption is consistent with other literature looking at the relationship between alcohol on self-care behaviours (10, 24). The ability to meet management targets is a complex interplay between physician or practice led initiatives and individual health behaviours, including the persons self-efficacy to initiate changes. While self-care behaviours are integral to chronic disease management, there is also evidence that clinicians are less inclined to engage with people who are drinking to excess (5, 8). This study does not distinguish the stage or stages of the management pathway that are being impacted. It does, however, suggest that if a patient is not meeting management targets, alcohol consumption is one of the areas that may need to be more thoroughly assessed.

The impact of smoking could not be independently assessed as 'not smoking' was a management target for all three chronic diseases.

Association of alcohol consumption with disease outcomes

As chronic diseases are generally progressive in nature there are many things that impact on disease outcome. Throughout the literature, evidence of the impact of alcohol on disease outcomes varies considerably and is complicated by data collection and coding issues. In this study there was a small but measurable association between alcohol consumption and disease outcomes above and beyond the effects of demographics with independent associations with both outcome variables. Due to the small effect, demonstrating the difference within single disease cohorts was more problematic and may well be the domain of large national audits.

This study used a primary disease outcome that was readily available in most records and reflected guidance to GPs about monitoring of that disease. FEV1 % predicted and GFR are well established markers of disease progression. HbA1c monitors glucose control over a 3-month period and is therefore a less sensitive measure of progression of disease. However, it is well associated with adverse outcomes of diabetes and is widely used and accepted in the literature (25). More accurate markers for diabetes, such as HbA1c trends or disease complications were not able to be consistently obtained from the records without overly obtrusive inspection.

Limitations

Practice data are designed for clinical care of individuals, not for research. Not all data that would have been useful for this study were available or searchable. For example, letters stored as scanned documents are not generally searchable. The data were collected as entered in the practice records, however where possible verification was sought from the consultation notes. These limitations are offset by

clear inclusion criteria, consistency of collection and a sample size that exceeded the minimum 360 records suggested by sample size calculations.

While the data come from only two practices in one regional city in north Queensland, Australia, the sample covers the practice of over twenty doctors and seven percent of the population of that city. The pool of patients from which the sample is collected is socioeconomically and geographically distributed across the town increasing the likelihood that it is representative. Similarity in demographic and clinical data with large national samples increases the generalisability of the findings.

Alcohol consumption is measured by AUDIT-C which is collected at a point-in-time. Unlike smoking status, which is routinely recorded as current, ex- or never smoked, alcohol consumption was routinely recorded in the software as a single entry. Not all records distinguished between recent ex-drinkers, long-term ex-drinkers or those who never drank alcohol. Recent substantial changes in alcohol consumption may not be reflected. This means that the AUDIT-C 0 category needs to be interpreted with caution.

Conclusions

In this study, increased alcohol consumption was associated with reduced ability to meet management targets for chronic disease and poorer disease outcomes. It is recommended that clear advice on alcohol assessment and management should be included in all chronic disease management guidelines. Higher-risk alcohol consumption should be routinely further explored in patients living with chronic disease who demonstrate an inability to meet targets in management guidelines and as a potential contributor to unexplained poor outcomes. Modification of practice software to better monitor alcohol use over time might assist GPs in this task.

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5.4 Manuscript: The impact of excess alcohol consumption on health care utilisation in regional patients with chronic disease - a retrospective chart audit

Abstract

Objective

To understand the impact of alcohol consumption on the health utilisation of people with chronic diseases.

Methods

A retrospective chart audit was undertaken in two primary care settings in a regional Australian city. Three indicator conditions were selected: type 2 diabetes, chronic obstructive pulmonary disease and chronic kidney disease. The audits were analysed to examine the impact of alcohol consumption on primary care and hospital-based health utilisation.

Results

A total of 457 records were audited. Alcohol consumption decreased engagement in the primary care setting, with fewer visits, prescriptions and lower primary care costs. There was a U-shaped association between alcohol consumption and hospital attendance rates and costs. Admission rates were unchanged but a decrease in length of stay was observed in non-smokers in the highest alcohol consumption category.

Conclusion

Excess alcohol consumption decreases engagement in primary care and results in increased emergency department attendance but not admissions to hospital. In those who are admitted to hospital, alcohol is associated with a decreased length of stay.

Implications for Public Health

Alcohol consumption should be considered as a potential cause of decreased engagement in primary care. Follow-up and recall of patients may reduce shifting of care to the hospital environment.

Background

Alcohol consumption in Australia costs the economy in excess of $14 billion per year with $1.686 billion attributed to healthcare costs (1) and is responsible for 4.6% of the disease burden (2). Chronic disease is the major contributor to disease burden in Australia and previous studies have demonstrated that alcohol consumption in people with chronic disease is similar to the general public (3).

The Australian safe drinking guidelines current at the time of this study suggest no more than two standard drinks per day to prevent chronic harm from alcohol consumption, with a standard drink being defined as containing 10g of alcohol (4). However, 17% of Australians report exceeding this guideline in the preceding year (5).

General practitioners (GPs) are at the forefront of management of chronic disease and alcohol misuse (6), especially in regional settings where specialist services may be less available. Over half (53.3%) of all general practice encounters are attributable to management of chronic disease (6); this equates to 76.2 million encounters per year. Similarly, general practice encounters for specified alcohol counseling exceed 500 000 per year (6), ten-fold higher than alcohol consultations in specialist facilities (7).

Rates of alcohol consumption are higher than the national average in regional areas of Australia such as Townsville in north Queensland, where this study was

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undertaken; (8); specialist alcohol and drug services are also limited in these areas. In addition, remoteness is associated with an excess of burden of disease in outer regional areas compared with major cities (2). This research follows from earlier work which established that excess alcohol consumption was associated with lower attainment of chronic disease management targets and poorer chronic disease outcomes (9). The article addresses a gap in the existing literature by exploring the association between alcohol and the health system utilisation of chronic disease patients in a general practice setting in a regional center.

Methods

A retrospective chart audit of 12 months was undertaken by the primary author (also a registered medical practitioner) at two large, geographically separated multi-doctor primary care practices in Townsville. Type 2 Diabetes Mellitus (T2DM) (10), Chronic Obstructive Pulmonary Disease (COPD) (11), and Chronic Kidney Disease (CKD) (12) were chosen as three indicator chronic diseases because they are common and have clear management guidelines for general practice.

To generate the patient list at each practice the electronic software was searched for records active (at least one visit) in the collection timeframe using the three indicator chronic diseases (T2DM, COPD and CKD) as diagnosis and keywords. No identifying details were collected. Patient lists were kept secured at the practice during collection and were destroyed at the completion of collection.

All CKD records and every second T2DM and COPD record were extracted. Exclusion criteria were: no information regarding alcohol consumption; no evidence to support the presence of the chronic disease; evidence of the patient transferring into or out of the practice during the collection timeframe; no attendances recorded in

the allotted timeframe; or on ethical grounds (patient was known to the researcher).

Data points collected relevant to health utilisation are reported in Box 1, additional data collection on disease outcomes has been presented previously (9).

Ethics approval was obtained from James Cook University Human Research Ethics Committee [H6279]. Informed consent was obtained at the practice level.

Box 1: Data Points Collected

Diagnosis, age, gender, Indigenous identification, medications, number of doctor visits, number of nurse visits, Emergency Department (ED) presentations, hospital admissions, length of stay in hospital, alcohol use (frequency, amount, frequency of >6 drinks), glycated haemoglobin fraction (HbA1c; T2DM only), forced expiratory volume-one second % predicted (FEV1 %; COPD only), estimated Glomerular Filtration Rate (eGFR; CKD only), gamma-glutamyl transferase (GGT), alanine aminotransferase (ALT), aspartate aminotransferase (AST), mean corpuscular volume (MCV), smoking status, and total practice billings for that patient.

Assessment of alcohol consumption

Alcohol consumption was assessed using the Alcohol Use Disorders Identification Tool-Consumption (AUDIT-C) (13), which was embedded into the practice software and therefore the most consistent and reliable. For each patient the recorded AUDIT-C score was confirmed by utilising a keyword search to look for evidence of alcohol assessment in the written notes.

In this study, the AUDIT-C was used as a proxy for consumption, with a high specificity cut-off selected due to the retrospective nature of the study. The score was categorised as follows: score 0 (no consumption in last 12 months), score 1-4 (low risk drinkers), score 5-8 (moderate range drinkers) and score 9+ (high risk drinkers). Patients identified as having a binge only pattern in the absence of any

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regular consumption (n=10) and patients with insufficient information to generate an

AUDIT-C score (n=15) were excluded from the primary analysis.

Classification of severity

COPD: assigned by spirometry FEV1 % predicted or specialist determination if

unable to do spirometry.

Mild: 60+% predicted;

Moderate: 41-59% predicted;

Severe: <40% predicted.

CKD: assigned by eGFR or formal GFR measurement where available.

Mild: eGFR > 60 + microalbuminuria or eGFR 45-59;

Moderate: eGFR 30-59+ microalbuminuria or eGFR 30-44 with no

albuminuria;

Severe: eGFR < 30 or macroalbuminuria.

T2DM: severity was assigned by a combination of number of medications and

HbA1c as described previously (9).

Cost calculations for health system utilisation

Prescription costs were estimated using the average dispensed price for 2015-16:

$45.00 per script (14). Practice billings were collected from the practice software, to

the nearest dollar, for each individual patient. Emergency Department and

hospitalisation costs were derived from the Independent Hospital Pricing Authority

(15) and set at $660/ED presentation and $2236/day for admissions.

Analysis

Unless otherwise stated, statistical analyses were completed using SPSS 25 (16). Differences between AUDIT-C groups in mean costs, prescription numbers and primary practice visits were compared using ANOVA if more than two groups, with Bonferroni post-hoc analysis where relevant. Where ANOVA homogeneity of variance conditions were not met, Welch tests with Games-Howell post-hoc analyses are reported. Where there were only two groups being analysed, independent samples t-tests were used. Data with small group sizes, outliers or that were not normally distributed were analysed using nonparametric tests (Kruskal-Wallis test for 3 groups or more, and Mann-Whitney U test for 2 groups). Analysis of variance was performed for either single or groups of covariates that were independently associated with AUDIT-C score and the outcome measure, as specified in each result.

Hospital admissions, emergency department attendance and hospital encounters (defined as an ED presentation and/or an admission) are presented as rate percentages (the number of people who experienced the encounter within the collection period as a percentage of the number of patients within the AUDIT-C category group). Groups were compared using relative risks with 95% confidence intervals calculated using the online version of MedCalc[TM] software (17). Comparisons of proportions were tested with Chi-squared test of independence or Fisher's exact test where assumptions were violated. Where categorical variables were ordinal, chi-square test for trend was used.

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Results

Data collection

The combined client base of the two large group practices was 19 704 or 11% of the total Townsville population; 63% (12 377) of these patients were seen during the collection period. From these records, 1179 patients were identified as having T2DM (n=644), COPD (n=385) or CKD (n=150), and 482 of these records were audited.

This resulted in 457 records after exclusions, as described in more detail elsewhere (9). Briefly, mean age was 66yrs (± 12yrs), and the sample was predominantly non-Indigenous, non-smoking, and equally distributed between males and females. T2DM was the most frequent chronic disease (54%), followed by COPD (34%), and CKD 12%). Only sex and current smoking status were significantly associated with AUDIT-C category (9). Table 1 shows health utilisation data by AUDIT-C scores of participants.

The impact of alcohol consumption on health care utilisation

Primary practice-based care

The care of people living with chronic disease within the primary practice environment was examined in terms of visits to the practice, prescription provision, and practice billings. These were also used to derive a total primary care cost as outlined in the methods.

Primary care encounters include visits to the doctor or nurse. The data contained some extreme outliers with six individuals having more than 60 visits per year, four of whom were in the AUDIT-C 0 category, one in the AUDIT-C 1-3 category and one in the AUDIT C 9+ category. These six individuals came from all three diagnostic

groups, CKD (3), T2DM (2) and COPD (1). Therefore, practice visits were divided into categories (<4 (quarterly), 5-12 (up to monthly), 13-26 (up to fortnightly), 27+ (more than fortnightly)) to limit the impact of outliers. An inverse association was observed between practice attendance and AUDIT-C score (X^2=6.93; df=1; p=0.009, Table 1). Two percent of patients who scored in the AUDIT-C 0 category had 4 or less annual practice visits compared with 9% of those scoring in the AUDIT-C 9+ category. Conversely, almost three-quarters (74%) of patients scoring in the AUDIT-C 0 category had more than 13 practice visits, compared with approximately half (48%) of those in the AUDIT-C 9+category. A similar pattern was observed for prescription provision (F[3, 453]=3.22; p=0.023), though the only significant post-hoc differences were between AUDIT-C 0 and AUDIT-C 9+ categories (p=0.042). Analysis of variance models remained significant after adjustment for age (F[3, 455]=3.02; p=0.029).

Total primary care costs (Table 1) declined with increasing AUDIT-C score category (F[3, 453]=4.06; p=0.007); mean costs were only significantly higher in the AUDIT-C 0 than in AUDIT-C 9+ categories (p=0.013) in post-hoc analyses. The association between total primary care costs and AUDIT-C score remained significant after adjustment for age, gender, diagnosis, and current smoking status (F[3, 453]=3.31; p=0.020). The same pattern was observed for prescription costs (F[3, 453]=3.33; p=0.020) with mean prescription costs also significantly higher in AUDIT-C 0 than AUDIT-C 9+ categories (p=0.033) in post-hoc analyses. The association between PBS costs and AUDIT-C score remained significant after adjustment for age, gender, diagnosis, and current smoking status (F[3, 453]=2.95; p=0.033). While the same pattern was observed for practice billing, this was not significant (F[3, 453]=2.08; p=0.102).

Hospital-based care

Overall, 35% (n=162) of participants used the hospital at least once in the year. Twenty percent (n=93) visited the emergency department (without being admitted), and 22% were admitted to hospital at least once (Table 1). There were no significant gender differences in the proportion of admissions (both 21%), emergency department attendances (females 23%, males 16%; X^2 =3.46, df=1; p=0.063) or hospital attendance (females 36%, males 33%; X^2 =0.44; df=1; p=0.507). There was no association between Indigenous status and emergency department attendance (X^2 =1.52, df=1; p=0.218) or overall hospital encounters (X^2 =3.02; df=1; p=0.082), but there was an increased frequency of admissions in Indigenous people (28%) compared with non-indigenous people (19%) (X^2 =4.85; df=1; p=0.03). There was no association between smoking and emergency department attendance (X^2 =1.19; df=1; p=0.275) or hospital encounters (X^2 =2.16; df=1; p=0.141), but a higher proportion of smokers were admitted (29%) than non-smokers (19%; X^2 =4.59; df=1; p=0.032).

The association between AUDIT-C score and hospital use approximated an asymmetric U-shaped curve (Figure 1, panel A), a pattern also seen for emergency department attendance (Figure 1, panel B), and admissions (Figure 1, panel C). The highest attendances were observed in those who scored in the 0 category, lowest costs occurred in the 5-8 category, and costs increased again in the 9+ category. Rates for total hospital encounters, emergency department encounters, and admissions are presented in Table 1.

Table 1: Health Utilisation by AUDIT-C Category

Variable	AUDIT-C Score				All
	0	**1-4**	**5-8**	**9+**	
Number of records	198	158	58	43	457
Males, n (%)	77 (39%)	80 (51%)	40 (69%)	32 (74%)	229 (50%)
Current Non-Smoker, n (%)	157 (79%)	138 (87%)	40 (69%)	21 (49%)	356 (78%)
Severity Category, n (%)					
Mild	79 (40%)	70 (44%)	29 (50%)	20 (47%)	198 (43%)
Moderate	78 (39%)	63 (40%)	23 (40%)	12 (28%)	176 (39%)
Severe	41 (21%)	25 (16%)	6 (10%)	11 (25%)	83 (18%)
Number of Medications, mean (SEM)	6.9(0.3)	6.3(0.5)	6.0 (0.9)	5.3 (0.5)	6.4 (0.2)
Practice encounters, n (%)					
≤4	3 (2%)	1 (1%)	1 (2%)	4 (9%)	9 (2%)
5-12	48 (25%)	43 (27%)	20 (33%)	20 (43%)	131 (29%)
13-26	90 (47%)	76 (48%)	23 (37%)	13 (28%)	202 (44%)
≥27	51 (27%)	38 (24%)	17 (28%)	9 (20%)	115 (25%)
Practice Billings, $, mean (SEM)	1144 (51)	1029 (49)	992 (130)	915 (140)	1062 (31)
Total Primary Care Costs, $, mean (SEM)	5920 (222)	4998 (192)	5563 (242)	4500 (686)	5399 (123)
Number attended ED, n (%)	41 (24%)	33 (21%)	7 (12%)	12 (28%)	93 (20%)
ED costs $, mean (SEM)	295 (85)	221 (44)	76 (32)	215 (60)	227 (40)
Number admitted, n (%)	46 (23%)	34 (21%)	10 (18%)	10 (23%)	100 (22%)
Admission Costs, $, mean (SEM)	4620 (1091)	2062 (514)	1743 (807)	2558 (1551)	3065 (525)
Number with hospital encounter, n (%)	72 (36%)	57 (36%)	15 (26%)	18 (42%)	162 (35%)
Total Hospital Costs, $ mean (SEM)	4939 (1100)	2283 (526)	1819 (814)	2773 (1565)	3258 (526)

For each separate type of encounter, relative risks and 95%CI were calculated comparing each AUDIT category with every other AUDIT category. Only rates that were significantly different from each other are reported here. The relative risk was higher in the AUDIT-C 9+ group than in the AUDIT-C 5-8 group for attending the emergency department (RR:2.6; 95%CI: 1.1-6.0; p=0.03), having a hospital encounter (RR:1.8; 95%CI: 1.0-3.1; p=0.04), but not for admissions (RR:1.5; 95%CI: 0.7-3.3; p=0.32).

To account for the impact of multiple attendances by individuals, mean costs in each group were compared. Total hospital costs (Figure 1, panel A), emergency department costs (Figure 1, panel B) and admission costs (Figure 1, panel C) follow

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the same approximate asymmetric U-shape as encounters. Emergency department costs differed significantly by AUDIT-C category (F [3,179]=4.10; p=0.008), with mean costs in patients in the AUDIT-C 5-8 category significantly lower than in the 1-4 category (p=0.036), and also lower than patients in the AUDIT-C 9+ category, though this difference was not significant (p=0.16) – most likely due to sample size. There were no differences in admission costs (F=1.69; df= 3, 146; p=0.17) or total hospital costs (F=1.88; df=3, 147; p=0.135) according to AUDIT-C score.
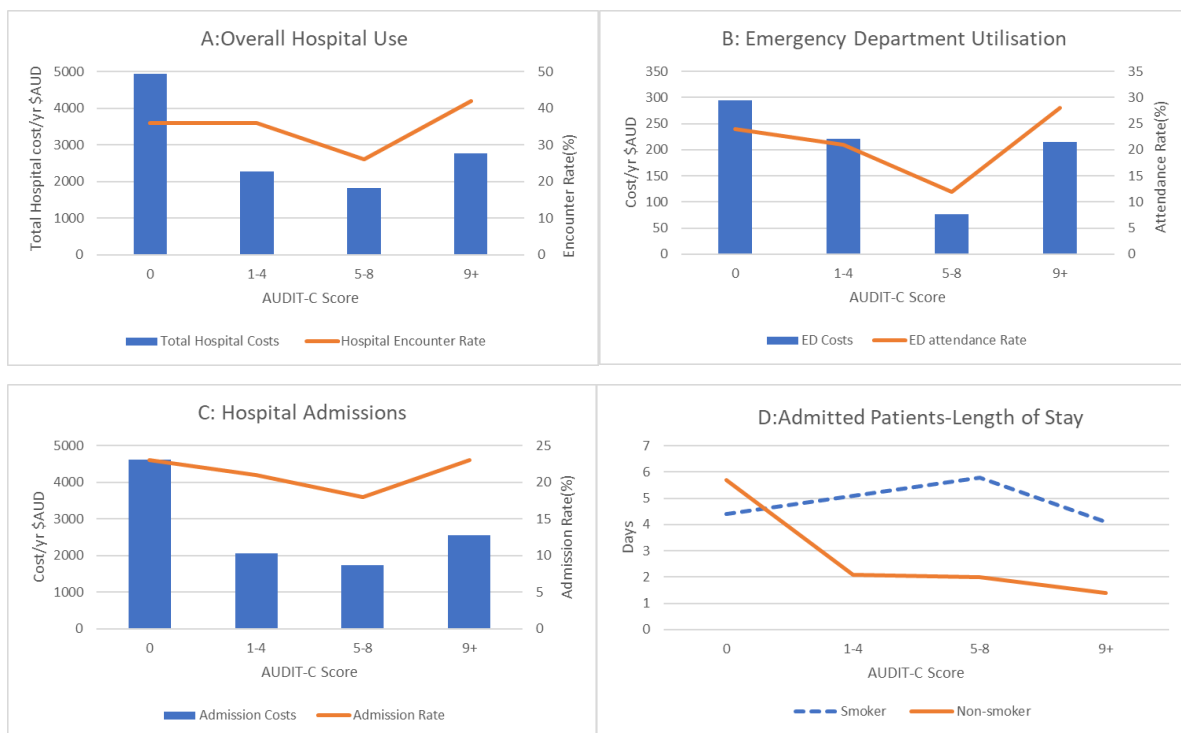
Figure 1: The Impact of AUDIT-C Category on (A) Mean overall hospital use; (B) Mean Emergency Department Utilisation; (C) Hospital Admissions and (D) Length of Stay (smokers/non-smokers)

As admission rates differed by Indigenous status and current smoking status (see hospital-based care above), analyses of the association between AUDIT-C and admission costs, total hospital costs and length of stay were then stratified by Indigenous status and smoking status. Adjusting for Indigenous status did not alter the findings described above, except for length of stay which reflected the smoking

effect described below, most likely due to an overrepresentation of smokers in the Indigenous 9+ category. There was an effect from current smoking status. In non-smokers there was a significant association between AUDIT-C and emergency department costs (F=5.25; df=3,101; p=0.02), total hospital costs (F=2.92, df=3, 112; p=0.037), and an equivocal effect on admission costs (F=2.68, df=3, 114; p=0.05). For each of these costs, the asymmetric U-shape was approximated and the most pronounced decline in costs as evidenced through post-hoc analyses was observed from the AUDIT-C 1-4 category to the 5-8 category. In hospitalised patients, length of stay was also statistically different (F=2.77; df=3, 352; p=0.04) –length of stay was highest in AUDIT-C category 0 and lower in both the AUDIT-C 5-8 (p=0.042) and 9+ category (p=0.035, Figure 1, panel D). In smokers, there was no association between total hospital costs (F=0.16; df=3, 97; p=0.92), admission costs (F=0.15; df=3, 97; p=0.93) or length of stay (F=0.15; df=3, 97; p=0.93) and AUDIT-C category, potentially the result of a substantially lower sample size.

Discussion

Overall alcohol had a measurable impact on the health care utilisation of people living with chronic disease as measured through primary practice and hospital visits.

Alcohol consumption patterns

AUDIT-C is verified as a screening tool for alcohol dependence but has been used previously as a proxy for consumption (13). As identified previously (9), AUDIT–C scores over five are consistent with drinking in excess of Australian safe drinking guidelines, with scores of four equivocal, suggesting 30% of the people with chronic disease in this study were drinking in excess of guidelines, compared with 17% of

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the general Australian population in 2015 (5). Abstinence rates, at 40%, were also higher than the general population (19.4%; 5).

Validity of the sample

The overall proportion of people with COPD and T2DM reflects the proportions in the Australian population (5). The proportion for CKD is substantially lower than anticipated by national rates, especially in the mild range. It is likely that many of the excluded CKD records, where insufficient evidence was available to support the diagnosis (47/150) were mild CKD with pre-existing evidence that was unavailable.

As previously reported (9), the large total patient pool, geographically dispersed, increases the likelihood that the sample is representative of the Townsville population with chronic disease. Comparison of the demographics of the T2DM sample with a national diabetes audit sample of over 5000 people showed similar demographics, blood pressure readings, lipid levels and HbA1c ranges (18). This provides some evidence for generalisability of the observed results to the wider Australian population living with chronic disease. However, the national diabetes audit did not report on alcohol consumption (18).

Impact of alcohol consumption on health costs

Despite evidence of worsening disease outcomes with increased alcohol consumption, these results consistently demonstrate a trend towards decreased health care utilisation at higher levels of alcohol consumption. This was observed for general practice visits, prescription numbers, practice billings and total costs. The exception is costs from hospital attendances, for which there is an approximate U-shaped curve and increasing hospital encounters, ED visits and a trend towards increasing admissions (albeit non-significant), in the highest consumption category

relative to moderate drinking. U-shaped or J-shaped associations in response to alcohol abound in the literature, and are frequently attributed to a protective effect of low levels of drinking. However, a 195 nation global burden of disease study by Griswald *et al. (2018)*, the largest of its kind, demonstrated that the level of alcohol consumption that minimised harm was zero with an uncertainty interval of 0-0.8 drinks per week (19). In the Griswald study, the apparent protective effect reported elsewhere is attributed to an artefact due to confounders in the zero consumption group. In the current study, it is likely that many former drinkers had ceased alcohol use due to their chronic health condition, increasing the variability seen in the zero consumption category.

When the analyses were stratified by smoking, the association was significant for non-smokers. This suggests that people with higher alcohol consumption are missing out on regular preventive care, thus having more acute presentations. As hospital costs per encounter are more expensive than primary care costs, this suggests that more active follow-up of disengaged patients and consideration of alcohol consumption as a potential contributing factor could potentially prevent hospital attendances.

This phenomenon is seen elsewhere in the literature. Sacco et al 2015 (20), showed that while alcohol consumption did not increase overall health costs in patients with depression, it was associated with a different admission pattern. Patients were more likely to be admitted but had shorter length of stay. Similarly, in the current study, there was no significant change to the number of annual presentations to hospital, but there was a decrease in length of stay in non-smokers consuming alcohol. The reasons for the observed reduced health care utilisation cannot be explained using the data available in this study, but are likely to be a complex interplay between the

physiological impacts of chronic excess alcohol consumption on chronic disease progression, the behavioral implications of the potential impairment from alcohol consumption and stigma that may impair help seeking. Interestingly, the observed decrease in length of stay represents an average discharge in the AUDIT-C 9+ group of 32 hours, which approximates the onset of phase two alcohol withdrawal (21). This raises the possibility that early discharge in these patients could potentially be related to withdrawal syndromes, either as self-discharge due to unrecognised withdrawal or deliberate discharge before the onset of withdrawal. A large prospective cohort study of emergency department attendances and hospital admission relative to alcohol consumption would better elucidate the impact of alcohol consumption on hospitalisation patterns in people with chronic disease, and would also allow investigation into factors affecting repeat presentations. However, such a study would be contingent on adequate and detailed coding of alcohol consumption at presentation to hospital.

Limitations

The limitations of the overarching study have been discussed previously (9), but include challenges associated with practice data that are designed for clinical management not research, and the inability to distinguish recent ex-drinkers from long term ex-drinkers or those who have never drunk alcohol. Of most relevance to this paper is the fact that hospital attendance data are derived from the practice data and will potentially not reflect attendances where the patient has not specified the correct GP practice or where the hospital has failed to provide discharge summaries. This limitation was mitigated by the delayed retrospective access of practice data by the researcher, which gave time for discharge summaries to have been incorporated into the record.

These limitations are offset by the benefits of using primary care data as recorded for usual care, clear inclusion criteria, consistency of collection and a sample size that exceeded the minimum 360 records suggested by sample size calculations. In addition, the sample is socioeconomically and demographically diverse and comparable to large national samples which increases the generalisabiltiy of the findings.

Conclusions

Increasing alcohol consumption as recorded in practice records was associated with a decreased utilisation of health services in people with chronic diseases. This consisted of a decreased use of primary care and medications, an increase in emergency department attendances, no change in admission rates and a decrease in length of stay in non-smokers.

It is recommended that staff in primary care consider alcohol consumption when patients are disengaging with health services. Additionally, improved coding of alcohol use in hospitals would assist in determining the reasons for altered admission patterns in people consuming excess alcohol.

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5.5 Chapter 5 Summary

Chapter 5 establishes that excess alcohol consumption impacts on chronic disease in terms of the ability to attain clinical management targets, disease outcome and health service utilisation. This chapter addresses the final research question of the thesis in two separate manuscripts.

The first manuscript presented demonstrates that patients with AUDIT-C scores of more than nine had significantly reduced ability to reach clinical management targets specific to their underlying chronic disease compared with those with AUDIT-C scores of 0 or 1-4. In addition, patients with AUDIT-C scores 9+ had reduced standardised primary outcomes, lower eGFR for CKD, higher HbA1c for T2DM and lower FEV1% for COPD, compared with patients with AUDIT-C scores of 1-4.

The second manuscript reveals that despite this evidence of worsening clinical outcomes there was an overall decline in health care utilisation. This consisted of a relatively linear decline in primary care attendance, prescriptions and billing and an approximate asymmetric U-shaped association in hospital encounter rates, ED attendance rates and associated costs. Admission rates were not significantly changed and, in non-smokers but not smokers, length of stay was reduced in response to higher alcohol consumption also resulting in lower admission costs.

In Chapter 6, the work presented in Chapters 3, 4 and 5 is consolidated and discussed in relation to the four research questions of this thesis.

Chapter 6 Discussion

6.1 Introduction to Chapter 6

The research presented in this thesis supports the original viewpoint that, at least this sample of people living with a chronic disease in north Queensland, are frequently consuming alcohol in excess of current Australian guidelines. The evidence presented here suggests that 21-24% of this study population are drinking at risky levels. Alcohol abstinence rates were also higher than in the general population, likely due to increased numbers of people who have ceased consumption due to their health problems. Given the prevalence of chronic disease in Townsville, and indeed similar rates of chronic disease and alcohol consumption Australia wide, this equates to more than 10% of the population potentially falling in this co-morbidity group of at-risk drinking and chronic disease, with approximately 5% of the population in the highest alcohol consumption risk group. Therefore, a more thorough understanding of the approach, management and impacts of alcohol consumption in people with chronic disease is likely to be highly relevant to improving outcomes and reducing health care costs. This chapter will first discuss a couple of methodological issues of relevance in interpreting the findings, then discuss the findings in more detail in terms of each of the research questions in turn, comparing and contrasting with what has been previously reported. This is followed by a discussion of the strengths and limitations of this work. Then Chapter 7 will present recommendations arising from this work.

6.2 Alcohol consumption categories

6.2.1 The complexity of non-drinking designations

Decisions regarding the appropriate categories for alcohol consumption are complex. In particular, the non-drinking group is problematic in studies of all sizes as it is a diverse category. While superficially non-consumption appears to be easily definable grouping, this includes those who have never drunk alcohol, those who have drunk intermittent small amounts but not recently or consider their consumption as negligible, those who normally drink moderately but have ceased for a specific reason like pregnancy, possibly those who do not feel comfortable discussing their alcohol consumption with their health practitioners, and those who previously drank large amounts but have ceased. Even within each of these categories there are relevant subgroups such as those who have ceased drinking due to adverse health events or those who do not drink for very precise reasons such as religious exclusions that may also be associated with other behavioural differences to the general population. Therefore, confounders are a frequent issue within the non-drinking group, and it is often difficult to account for these confounders within the limits of available data, particularly in smaller studies (1). Furthermore, comparison may need to be made between low-risk and high risk-drinking rather than against abstinence. Where there is sufficient information to subdivide the zero category, it often comes at the cost of sample size.

The practical implication of this is that U-shaped or J-shaped curves often seen in alcohol studies, including in many of the results in Chapter 5 of this thesis, have two potential interpretations. The first is that low level drinking is protective, but this protection is lost at higher consumption levels. This is often reported, including in studies included in the literature review in Chapter 2, and in large systematic reviews

and even meta-analyses particularly in regard to cardiovascular disease (2).

However, more recently a 195 nation global burden of disease study by Griswald *et al. (2018)*, the largest of its kind, showed that the level of alcohol consumption that minimised harm was zero with an uncertainty interval of 0-0.8 drinks per week (1) and attributes the apparent protective effect reported elsewhere as an artefact due to confounders in the zero consumption group.

For this reason, non-drinking is considered as a separate group wherever possible throughout these studies and the results within this group are interpreted with caution.

6.2.2 Validating Alcohol Use

While AUDIT-C is an established and well validated measure of alcohol use, including being validated by biochemical transdermal alcohol measurement (3), multiple additional verification methods were used in this study. In Chapter 4 free text descriptions were utilised in patient surveys to verify the AUDIT-C answers, particularly regarding the individual's interpretation of the term 'standard drink'. In Chapter 5, two additional verification strategies were used. Firstly, free-text searches of the patient notes aimed to look for verification or contradiction of the recorded AUDIT-C score as assessed by their regular medical practitioner. This allowed for differences in reporting due to level of rapport and added clinical judgement to the interpretation of the recorded score. The distribution across alcohol categories was closely reflected in both the survey method in Chapter 4 and the chart audit method in Chapter 5.

6.2.3 New Alcohol Guidelines

In December of 2019, the first draft of new Australian alcohol guidelines was released for stakeholder consultation (7). As these are still in draft form and were not

the guidelines in use during data collection, the 2009 guidelines (8) have been used throughout the thesis.

In brief, the new guidelines propose a further reduction in alcohol consumption with a simplified statement "to reduce risks of harm from alcohol it is recommended to drink less than ten standard drinks per week and no more than two on any occasion", page 1 (7). The guidelines in pregnancy and for minors have not changed. There is also expanded advice regarding chronic disease.

Therefore, the draft guidelines are broadly in concordance with the findings of this research.

6.3 Addressing the Research Questions

6.3.1 Research Question 1: What is already known about the impact of alcohol consumption on chronic disease and what gaps exist in our understanding of the issue?

In Chapter 2, a broad systematic literature review established the current evidence base in this field. It raised an interesting pattern in the overarching literature findings that showed a clear impact of alcohol on the management of chronic diseases at the level of individual patient care and at the national study level, that was often inapparent in hospital or community based settings. The initial proposal was that this may be due to poor coding of alcohol as a contributing factor at the hospital level, and this is likely to be at least a contributing factor. As a result of this the research design was centred in primary care, where it was hoped that the better rapport with a patient and longitudinal nature of the relationship between the health practitioners

and the person living with chronic disease would lead to a more accurate representation of drinking behaviour.

A recent robust systematic literature review, published during the thesis revision process, demonstrated the limited research base in addressing alcohol consumption in the primary care environment (9). This need for research evidence is even more pressing in the chronic disease space, where evidence suggests alcohol consumption above recommended levels may have a more pronounced effect on the individual and by extension the health care system (7).

The three subsequent research questions, and the research methodology to investigate these were generated from these literature findings and are discussed in detail below.

6.3.2: Research Question 2: How do healthcare practitioners manage excess alcohol consumption in patients with chronic disease?

Chapter 3 demonstrates how a patient centred multidisciplinary approach was utilised by primary care practices in attempting to manage excess alcohol consumption in people with chronic disease. Health care providers from all three primary care practices included in this study acknowledged the complexity of this patient group and expressed how challenging comorbid alcohol use and chronic disease was to manage. Poorer outcomes for complex clientele who are consuming alcohol was also noted as a finding in the literature review in Chapter 2.

Most health practitioners interviewed reported feeling under-prepared to manage alcohol consumption in these complex patients. Reluctance to address alcohol or concerns regarding level of training are commonly reported amongst health professionals (10, 11). Inadequacy of alcohol curricula in some undergraduate health

education, particularly in regard to management rather than recognition, has been raised as an issue in nursing (12), medicine (11), occupational therapy (13) and physical therapy (14). Some success has been noted in embedding addiction training into postgraduate medical residency (15, 16) with even a brief training program enhancing skills (15). This is encouraging as an option for the general practice environment, either at registrar training level or for qualified general practitioners.

In the absence of existing training, most practitioners rely heavily on evidence-based guidelines to direct their practice. Table 1 outlines the advice provided by commonly accepted chronic disease guidelines regarding alcohol consumption. It is worth noting that most of these guidelines direct doctors back to the Australian Alcohol Consumption Guidelines (8), however as outlined in the introduction these guidelines are specified to be for healthy individuals and direct people with pre-existing or chronic conditions to their medical practitioner for advice. Therefore, even in combination the guidelines often provide limited information to assist health practitioners in this area.

If there is inadequate advice in expert guidelines, health practitioners will fall back on 'first principles', personal and professional experience. This is reflected in the findings in Chapter 3 that show practitioner experience as a major factor in perceived management ability. 'First principles' is the concept in medicine that in the absence of specific information or guidance a health practitioner or scientist can infer what to do based on a solid understanding of the science, for example, the physiological impacts of alcohol. While most audits of university curricula in medicine or nursing suggest alcohol management training is lacking, information about the pharmacology and physiology of alcohol are usually considered adequate (12, 17). This may aid in

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recognition of an alcohol related health issue; however, it is unlikely to guide management or be sufficient for early intervention. Relying on experience alone is problematic as this is impacted by the quality and range of professional experience (11). Additionally, when relying on experience it is likely to be influenced heavily by personal views, practices and beliefs about alcohol consumption (18). With experience, practitioners showed an increased understanding of the role of the patient in their own care and the importance of patient self-efficacy. The central role of self-efficacy is well established in the literature (19-21) and the impact that alcohol can have on this behaviour domain was specifically studied by Stein and colleagues in 2012 (21). More recently, medical programs have begun to try and integrate this knowledge into their programs (22) however the fact that recent medical graduates still struggled with this concept suggests this is not necessarily translating into clinical practice at this point in time.

The use of multidisciplinary teams in primary care has been established as improving outcomes for patients (23) but can also pose challenges in team dynamics with risk of role confusion (24). The findings presented in this thesis highlight a clear shared vision of both intent and approach, which is one of the key aspects of establishing a successful team (24). Doctors who were interviewed praised the abilities of the nurses working within the team to identify and discuss alcohol.

Table 1 Guideline Advice Regarding Alcohol in Common Chronic Diseases

Guideline	Advice regarding alcohol and chronic disease
General Practice Guidelines for T2DM (25)	Refer to the Australian Alcohol Consumption Guidelines 2009 (8) Drink as for those without diabetes Note increased risk of hypoglycaemia, decreased hypoglycaemic awareness and potential for weight gain.
COPD-X concise guideline (40 page) (26)	No mention of alcohol
COPD-X complete guideline (235 page) (27)	No advice regarding amount of consumption Notes that excess alcohol may exacerbate reduced PO_2 with sleep, suggests abstinence from alcohol may be necessary with combined obstructive sleep apnoea and COPD. Notes on potential drug interactions with alcohol.
Chronic Kidney Disease Management in General Practice (28)	Refer to the Australian Alcohol Consumption Guidelines 2009 (8)
Guidelines to the management of absolute cardiovascular risk (29)	All adults should be advised to follow the Australian Alcohol Consumption Guidelines 2009 (8) Notes lowest risk seen in 1-2 drinks per day group; moderate consumption may reduce risks in those with hypertension [i]

[i] see 'Alcohol consumption categories and the complexity of non-drinkers' section 6.2

However, when the nurses were interviewed, they nearly all specified that while they were comfortable asking about alcohol consumption and recording the response, they felt it was the doctors' role to interpret and manage any excess consumption. The implication of this is that neither the nurses nor the doctors were routinely discussing alcohol consumption with patients as they assume this has been undertaken by other staff. The most cited reason for not wishing to discuss alcohol consumption was potential loss of rapport with the patient, which is identified as a major concern of practitioners elsewhere in the literature (30). Allied health professionals, in general, had the lowest levels of confidence in addressing alcohol

which probably reflect the limited undergraduate training about alcohol as already discussed.

The only overt discrepancy in the studies that comprise the whole programme of research described in this thesis was between the interviews presented in Chapter 3 and the chart audit presented in Chapter 5. In the interviews, multiple practitioners stated that they were either unaware of the AUDIT-C tool or they were aware but did not use it in their practice, and no one identified common or routine use of AUDIT or AUDIT-C. However, when the chart audits were conducted in these same facilities, 95% of the records included a current AUDIT-C score as it was built into the practice software. The fact that practitioners were unaware of this suggests that while the tool was in use it was likely that it was under-utilised in the management of patients.

In summary, in primary care practices in Townsville, despite the significant need and the challenges posed by lack of referral services and training, health practitioners are attempting to provide multidisciplinary patient centred care to people with chronic disease who are drinking alcohol in excess of recommended guidelines. This appears to be placing a substantial, though under-recognised, burden on practices and practitioners.

6.3.3: Research Question 3: What do patients with chronic disease think about the impact of alcohol on their chronic disease management?

Jordon and colleagues, in 2008, discussed the need for integration of care to improve chronic disease management, both in terms of the team approach as well as enhanced patient engagement (31). As chronic disease care frequently involves ongoing monitoring, medication and lifestyle modifications that occur outside of the traditional healthcare environment, the role of the patient in management is pivotal.

Therefore, understanding patient perceptions is vitally important in establishing current practice and areas for improvement.

This research question is predominantly addressed by the cross-sectional study presented in Chapter 4. The main limitation of this study was the low survey return rate, which may have been limited by self-stigmatisation and/or concerns about disclosing alcohol consumption. Measurement bias due to the self-report nature of the survey is also a possibility. Such concerns commonly complicate health seeking in the presence of alcohol or drug use (32). However, if either of these biases were present, it would be expected that survey respondents would have lower rates of drinking than the chart audit group, and this is not the case. Given how common concerns about stigmatisation are, the likelihood of a low return rate was anticipated, and steps taken to improve return rates by ensuring anonymity. However, the sample size only allowed for consideration of responses as a whole group or by AUDIT-C screen result (positive/negative) rather than by AUDIT-C category as presented elsewhere in the thesis. One third of respondents underestimated the standard drinks consumed resulting in a median difference of one AUDIT-C score point between reported and validated scores. This level of discrepancy did not impact on the overall findings.

Whilst limited by sample size, the overall AUDIT-C category results were comparable to those found in the chart audit carried out in the same practices (Chapter 5) with a slightly lower rate of alcohol abstinence reported. This is likely explained by the fact that a patient who does not drink alcohol is less likely to fill out a survey titled 'Alcohol perceptions in patients living with chronic disease'. Similarly, missing data in the surveys were predominantly in those who did not report drinking. Alternatively, it may reflect a group of patients who are reporting abstinence to their health

practitioners out of self-stigmatisation or concerns regarding discrimination if they disclose their drinking habits (32).

Nine respondents (14%) reported experiencing an adverse health event as a result of their drinking. Interestingly, these individuals were spread across the spectrum of AUDIT-C scores, with evidence supplied in the free text answers supporting reduction in alcohol consumption as a result of these adverse experiences in the low scoring individuals. This supports the challenge of measurement of point-in-time alcohol consumption, especially in categorised non-drinkers, as already discussed.

The adverse events reported were, broadly speaking, consistent with evidence of alcohol impacts as reported in the literature with the exception of the effect on sugar levels (8, 25). Patients predominantly reported the risk as hyperglycaemia, which can occur depending on the type of alcohol consumed, when the more acutely dangerous effect is the risk of hypoglycaemia coupled with hypoglycaemic unawareness (25). One respondent accurately outlined the differential effects of alcohol types on their sugar levels but interpreted this as meaning they should consume spirits as this dropped their sugar level and was therefore deemed by the patient as preferable. This suggests that the relevant risks had not been understood by the patient, with hypoglycaemia associated with an increased risk of cardiovascular events (33), falls (34), hospitalisation (35) and overall health economic costs (36). This also complicates measurement of outcomes for diabetes, as discussed in the next section.

While the overall perceptions of how much alcohol was safe aligned well with the current guidelines and previous reports from larger general population surveys (8, 37), this was heavily influenced by current drinking behaviour. This impact was also seen in Livingston's (2012) perceptions survey, but the differential between the low

risk drinkers and high-risk drinkers was even more pronounced in the sample living with chronic disease investigated in this thesis (38). The difference seen in drinking behaviour and perceptions between men and women may reflect previous alcohol guidelines that were gendered (8, 38, 39), particularly as the cohort surveyed were predominantly over 50 and would have established their drinking behaviours in the era of the various previous guidelines.

One of the most interesting findings in this study was the perceptions of people living with chronic disease regarding what would happen if they drank too much. While two people reported that they thought it would have a positive impact, the answers were somewhat vague in terms of how alcohol would achieve this outcome. Six specified that they thought there would be no effect on their condition and seven stated that they did not know what the impact would be. Not knowing what impacts there could be was strongly associated with non-drinking behaviours, probably as this has not been discussed or considered in those who do not drink and do not plan to do so. Overall, approximately half of the respondents, and two-thirds of those that answered the question, suggested at least one negative impact likely to occur if they drank more than what they deemed as safe. Overall, the potential impacts reported were once again broadly compatible with available evidence except for an underestimation of the risk of hypoglycaemia and no mention of cancer risk. Increased cancer risk associated with alcohol consumption is an established effect with an ever-growing body of evidence for more types of cancer (40). Understanding of cancer risk is better associated with behaviour change than other alcohol-related risks (41, 42).

The range of issues raised by people who participated in the survey suggests a reasonable level of knowledge about the risks of alcohol consumption, especially in

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those who were consuming alcohol. Areas for improvement could be coverage of the topic with those who may drink infrequently and, in this sample, appear relatively oblivious of potential harms and better coverage of topics such as hypoglycaemia and cancer risk. These discussions would be better informed by clearer guidance for practitioners around potential harms in those people living with chronic disease. This could be further enhanced by open discussions of the role of the person living with chronic disease as part of the healthcare team, and the potential limitation that alcohol consumption could have on these behaviours.

In summary, people living with chronic disease were broadly aware of the potential risks of alcohol on their chronic disease. Some reported personal experience of harm but three times as many were able to accurately report on at least some potential harms of alcohol consumption. Their overall perception of how much was too much aligned well with national guidelines and general community surveys, but this was heavily influenced by current drinking behaviour, with those screening positive for potential AUD reporting significantly higher levels of perceived safe drinking.

6.3.4: Research Question 4: Does excess alcohol consumption impact on chronic disease outcomes?

This research question is addressed by the largest study in the thesis, a chart audit of patients with one of three specific chronic diseases across two large group practices in Townsville (Chapter 5). Three key outcomes were investigated: the ability of patients to meet management targets; the primary disease outcome: and use of health services. Findings from each of these are discussed in turn below.

Data related to three specified chronic diseases were collected; COPD, CKD and T2DM. These conditions were chosen because they are common, contribute significantly to disease burden, are managed principally from primary care and have clear and well accepted guidelines for management. Originally it was intended that data from patients with chronic heart failure would also be collected, however there was considerable inconsistency of information recorded, especially regarding the type of heart failure, and this made data collection challenging and inaccurate. Management of CHF is in part decided by the underlying cause and determining the gold standard management of patients without this information would be problematic. Additionally, it turned out that most of the initial group of patients whose data was identified in this category was duplicated in the other datasets. For these reasons it was decided that CHF would not be included in the chart audit.

Alcohol's impact on management targets

The management targets, specific to each disease and determined by their relevant guideline, are outlined in the methods of the manuscript presented in Chapter 5.3. The basis of these management targets is the intention that they improve outcomes (25, 27, 28, 37, 43). The findings presented in Chapter 5 demonstrate that attainment of management targets is associated with improved primary disease outcomes, albeit with substantial variability. Achieving many of the management targets requires input from both the health practitioner and the patient as many of the factors are lifestyle based (31, 34) whilst others are practitioner-led such as ordering of repeat pathology and selection of stage-appropriate therapy (25, 27). A systematic review of chronic disease by Simmons *et*.al (2014) (44), highlights the fact that patient engagement is not only preferred in current chronic disease management approaches but is actually required for the functioning of integrated care models.

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This is particularly relevant as increased alcohol use may be associated with reduced capacity for self-care and engagement (45, 46). This is reflected in the findings regarding health care utilisation in this thesis (Chapter 5.4). There may be less motivation or effort put into management by health practitioners when a patient is drinking to excess due to concerns about effectiveness or stigma (47, 48) as also demonstrated in Chapter 3 regarding loss of staff motivation. In addition, the ability to meet management targets may decline with progression of disease as once a patient is severely impaired the ability to attend multiple appointments may be more difficult and some long-term preventive strategies are less useful. To account for this, the impact of alcohol was examined in mild disease versus moderate-severe disease and a decrease in management targets was demonstrated over and above the decline seen due to disease progression.

Alcohol's impact on disease outcome

The choice of outcome measures is always controversial. The nature of chronic disease is different to acute conditions and the goals of therapy are generally to slow progression, limit complications and maximise function, rather than cure the illness (49). The reality of population level disease monitoring is that quantifiable targets are easier to report and compare than more subjective measures such as functionality and quality of life. So, while established quantitative outcome measures were chosen for this thesis as recommended by the appropriate guidelines, it is recognised that these values do not tell the whole story of the care and circumstances of the individuals whose data is used in this thesis study. Ideally, patient reported outcome measure would have been included, but this was not possible due to the retrospective study design. For COPD the primary outcome used was FEV1%. This is the most commonly used outcome for COPD in the literature and most closely

associated with mortality (50) however it is well recognised that it is not the only or necessarily the best measure for current function (51). It is used by the guidelines to direct therapy (26). This measure is already expressed as a percent of normal and is therefore not altered when standardised to compare with the other two diseases. For CKD the measure used was eGFR which is utilised in the guidelines to determine stage of disease and appropriate treatment (28). There are some limitations to eGFR at the individual patient level (for example variation with high/low body mass, high/low protein consumption and pregnancy), however it does perform well at a population level (43). The 'normal' value for an eGFR is greater than 90mmol/L with lower values indicating loss of kidney function and therefore there was minimal manipulation of the raw data to standardise for comparison to the other conditions.

The use of HbA1c to reflect disease status or progression in T2DM is more complex. This is a very well-established outcome measure that is widely used, including by the guidelines to recommend therapy changes (25) and associated with disease complications and mortality (52). However, unlike the other two outcome measures that attempt to measure residual organ function, HbA1c attempts to estimate the glycaemic state over the preceding three months (53). Therefore, this outcome measure does not necessarily reflect disease progression. Additionally, both low and high HbA1c values have been associated with worsening outcomes (52) due to hypoglycaemia being an independent risk in diabetes in addition to the risk of chronic hyperglycaemia. As higher values are generally considered to be less favourable, these values were mathematically transformed in order to standardise outcomes across the three diseases, utilising the cut-off diagnostic value as the 100% and deviation from this to establish the standardised outcome value. The raw data and standardised data were overlaid for the T2DM only group to ensure the data trends

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were consistent. Despite the potential limitation of use of HbA1c, it has been used in this study as there is no other regularly recorded and accepted measure for disease status.

The pattern of alcohol consumption is important in risk determination with regular consumption being most closely associated with chronic disease (8). Most individuals who binge drink also consume alcohol regularly or intermittently at a lower level. There were a small number (10/483) who had an unusual pattern of consumption that was infrequent binge only. These individuals had AUDIT-C scores that were composed completely of the binge component (Q3) with no regular consumption (even at low risk levels). They were therefore excluded from the main analysis and considered separately. The binge only group tended to demonstrate similar patterns to those who drank at low risk in terms of outcomes and health use but their drinking showed the same impact on acquisition of management targets as those in the high-risk drinking group. Those with missing alcohol data demonstrated health outcome results that most closely reflected this binge-only group.

Attributing changes in chronic disease outcome to any individual factor is challenging as, due to the prolonged pathological progression, there are many potential factors impacting on the disease. Past alcohol consumption is not recorded consistently in the records which risks underestimating the effects. Factors that were analysed for independent associations with AUDIT score and standardised outcome were gender, Indigenous status, disease severity, diagnosis and smoking. Smoking was not considered as a predictor of management targets as not smoking is one of the targets collected. While smoking was identified as a potential confounder, with smokers having a mean AUDIT-C score of four compared to non-smokers who scored two, the relatively small number of smokers in the study sample limited

exploration of the interaction between smoking and alcohol on outcomes. The sample size was insufficient for a detailed multivariate analysis and this would likely require a national audit size sample to accurately account for all potential confounders. The impact on outcomes observed in this study is consistent with the findings reported in the systematic review presented in Chapter 2. This includes the fact that throughout the available literature it is easier to demonstrate statistically significant impacts on proximal markers such as self-care practices or, as shown here, on management targets, than it is to demonstrate the more distal markers such as actual primary disease outcome.

Alcohol's impact on utilisation of health care

Overall health care utilisation for the study group was substantially higher than for the general population, with 13.1 GP attendances per year versus the populations average attendances of 5.5 per year for our region (54), reflecting the health burden of chronic disease. With decreased ability to reach management outcomes and worse primary disease outcomes, it was expected that an increase in overall health costs in the high-risk alcohol group would be observed, relative to those who drank at lower levels. However, overall health care utilisation decreased. This is driven predominantly by a decrease in attendances, billings and script provision in the primary care environment.

In terms of hospital-based care, a decrease in utilisation was seen in those who drank at higher levels compared to lower levels, until the highest alcohol consumption group (AUDIT-C of 9+) where attendances and length of stay increased again. However, this increase seems to be largely driven by smokers, with non-smokers in this study who were drinking at higher levels having no change in ED attendances or admission rates but a statistically significant decrease in length of

stay. This is very similar to the pattern seen by Jackson *et al.* (1995) in people with depression who were drinking alcohol (55). While the cause for this decrease in length of admission cannot be elucidated further in this thesis, possible explanations include a patient incentive to leave hospital before alcohol withdrawal becomes severe or alcohol cravings become unmanageable, and clinician bias regarding the likelihood of successful treatment (56).

The systematic literature review (Chapter 2) revealed a gap in understanding in the progression of alcohol impacts from the initial primary care clinical interface, through the hospital system to the national burden of disease studies. The working hypothesis for the lack of overt alcohol impact at hospital or community level was that there was poor coding of alcohol related illness resulting in an underestimation. The methodological design for the study presented in chapter 5, utilising hospital data recorded in the primary care records, was intended to remove this issue as the practice would have more information about the alcohol consumption even if it had not been recorded in the hospital. However, the findings of this study suggest that the issue is more complex. It is possible that not all attendances to hospital resulted in a discharge summary being sent, however local rates of return on discharge summaries are quite high, if a little slow. The retrospective nature of the collection should have allowed ample time for even the slowest discharge summaries to be included.

The new hypothesis is that alcohol causes decreased engagement of individuals with their health care, resulting in fewer primary care attendances, less medications and lower attainment of management targets. This is compounded by reluctance or lack of resources for health practitioners to actively manage excess alcohol consumption and a sense of treatment futility. This in turn results in an overall

decline in the management of their chronic disease. However, as the engagement is poorer the extent and outcome of this decline may not be seen by either primary care or hospitals in the short term. Eventually, for some clients the decline becomes so severe that the individual can no longer continue drinking and at this point, due to the point in time questioning about alcohol consumption, the linkage to alcohol may be missed at this level. In addition, the decline in engagement with health services is partially offset by the increase in utilisation of the hospital in the highest AUDIT-C category, making it challenging to demonstrate the overall increase in health costs established with the larger sample sizes in national burden of disease studies.

When questioning people about smoking, clinicians have for many years routinely asked: 1) Do you smoke?; 2) If so, how much and for how long?; 3) If no, did you ever smoke?; and 4) If so, when did you quit and how much for how long was smoked prior to ceasing? However, for alcohol, routine questioning is usually only about current drinking and even the most commonly used tools to measure consumption (AUDIT and its derivatives) ask about the preceding 12 months. The routine adoption of a similar line of questioning regarding alcohol to that which is routinely used for smoking would greatly improve data capture and make monitoring the impacts of alcohol significantly easier.

In summary, results suggest excess alcohol consumption in patients with chronic disease are associated with decreased ability to reach management targets and worsened standardised disease outcomes. This appears to be associated with a decrease in utilisation of health services, particularly in terms of accessing primary care.

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6.4 Strengths and limitations of the research

6.4.1 Strengths

The main strength of this research is that it was carried out in the context where the potential problem was identified - regional primary care practice. The research was undertaken by a content expert and informed by the key stakeholders, who were staff of general practices and their patients. Therefore, the likelihood of the findings being useful to general practitioners in regional Australia is high.

The multi-methods approach assists in obtaining a more complete picture of alcohol use by people with chronic disease by allowing for triangulation of findings obtained by different means to create a more nuanced multi-dimensional understanding of the issue.

The advisory team had the necessary skills and experience to add valuable insights and guidance regarding methodology and analysis. The author of the thesis had extensive insider knowledge of the drug and alcohol field and clinical and personal knowledge of the challenging nature of chronic disease management. This knowledge allowed for in depth interpretation of the findings and an understanding of how they could apply to health practitioners in the field, thereby increasing the ability to translate the research into practice.

While there is substantial evidence in the literature about alcohol use and chronic disease as solo entities, there is limited evidence available about alcohol use and impact in people living with chronic disease. This means that health staff working in primary care have limited information to inform their practice. This research is therefore novel, in that it adds a significant body of evidence to the dual diagnosis of

chronic disease and excess alcohol consumption that can be used to better inform guidelines for primary care.

The key issues identified by the North Queensland Primary Health Network needs assessment of the drugs and alcohol sector (57) in 2017 reflect the core issues that sparked this research, suggesting that despite the prolonged timeframe the findings remain highly pertinent to the region.

6.4.2 Limitations

The private practice context

The research was carried out in private practices which are independent businesses that bill in a time-dependent manner. It was crucial to take this into account to minimise disruption to patient services. In practice this meant that the interviews conducted for the study presented in chapter three were deliberately brief; that the data collection occurred over a prolonged period when there was a room available and that re-entering the practices to extend data collection was not feasible.

In addition, the data collected for the studies presented in chapter 5 comprised what was available in the electronic record without being overly intrusive, that is with minimal reading of the free text notes. There was no way to confirm the recorded data, although also no reason to doubt its validity. The practices were all accredited and the findings were consistent with literature and national audit data.

Sample size

The sample size calculated for the cross-sectional study in Chapter 4 was 100-150, but it was only possible to achieve a sample of 66. This limited the ability to further characterise the alcohol consumption into categories but worked adequately using a

screening result approach. The limited sample may have impacted the diversity of responses in the free text fields.

The retrospective chart audit study (Chapter 5) achieved its target sample size of 450-500 records. However, the unanticipated higher rate of abstinence in the cohort and the higher than expected variability in responses limited multivariate analysis and consideration of results in subcategories, for example by individual disease.

The CKD group was under-represented relative to expected rates and this is reflected in the very low percentage of 'mild' CKD patients. This is likely due to the way in which the practices coded these stage 1 patients, for example they may have been described as under monitoring for potential kidney issues rather than have a diagnosis of kidney disease.

Retrospective data

While a prospective observational study would have been optimal, this was not feasible within the timelines and resources available for a PhD study. Advantages of the retrospective study were that it allowed for the same time frame to be considered at different practices with a single researcher and prevented interaction with the practices (for example by doing interviews) from impacting on the results of the chart audit.

Generalisability

While the context was a match for the research rationale the specific nature of the research context has the potential to limit the generalisability of findings. The literature suggests that the challenges and findings are comparable across regions (48), albeit with fewer alternative services in regional areas, and the sample in the chart audit is comparable with national audit samples in terms of demographics and

biomarkers (37). The facilities studied are accredited by a national body and their practices aligned with national guidelines. It is therefore likely that the research findings will be applicable across a broad range of regional settings and services in Australia and based on the literature review in Chapter 2 the issues here are similar to those of many other countries.

Prior knowledge

The author possessed substantial prior clinical knowledge of the research content having worked in Townsville as an addiction specialist for five years and living with a chronic disease. Prior knowledge can be a double-edged sword when it comes to research objectivity (58, 59). Any potential negative impacts were mitigated by taking a reflexive approach and utilising the research team to balance the research perspective.

6.5 Chapter Summary

This novel, multi-phase study utilising a range of both qualitative and quantitative methods has demonstrated that health care practitioners, particularly in regional centres, feel ill equipped to manage alcohol consumption in people with chronic disease. This is compounded by limited undergraduate and postgraduate training in alcohol management and limited specialist services. Patients living with chronic disease overall had an adequate understanding of the potential for harm from alcohol consumption and many had personal experiences with adverse events arising from alcohol relating to their chronic disease. Their perceptions of how much was safe to consume was clearly influenced by their current drinking behaviours.

Alcohol consumption was shown to impair the ability of patients to meet chronic disease management targets and this was also associated with worsening disease outcomes. Despite the worsening clinical management associated with excess alcohol consumption, there was a decrease in health care utilisation which was seen most strongly in terms of disengagement with primary care, an increase in emergency department attendances and, in non-smokers, a decrease in admission length.

The research is methodologically robust and undertaken by an author with solid knowledge of the field and supervised by well-established researchers with complementary skill sets. It is undertaken in the very environment where the central issue was identified, increasing the probability of translation into practice.

Despite some challenges with the private practice environment and variability that impacted sample size, and therefore multivariate analysis, this novel research adds to the body of literature by filling gaps regarding the impact of alcohol on chronic disease management and the primary care of these complex patients in the context of regional primary care practice.

The conclusion of the thesis is presented in the next and final chapter, which includes recommendations and implications for research, policy and practice.

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Chapter 7 Recommendations, Implications and Conclusion

7.1 Summary of findings

What was known previously?

The systematic review of the literature demonstrates that alcohol clearly has some impacts on the individual clinical management of chronic disease and shows a clear contribution to overall disease burden. However, there is limited evidence of impact at the hospital or community level. There are limited studies in regional settings and limited exploration of the experience of patients or practitioners in this area.

What does this study contribute?

Health practitioner perspectives

Management of patients with chronic disease who consume alcohol in excess constitutes a significant ongoing challenge for general practice. While health care providers in these practices were aware of the issue and work in a multidisciplinary way to address the health needs of this group, most staff felt under-resourced to manage these complex patients. Furthermore, there were concerns about a lack of referral options to support primary care. This challenge is underpinned by the heavy reliance on self-care in chronic disease management which is likely to be significantly impacted by alcohol consumption. As changing behaviours takes time, staff found maintaining motivation difficult, both for themselves and the patient. Role confusion was an issue within multidisciplinary teams, highlighting the need for clear

communication and definition in this space. Health practitioners largely relied on professional experience to guide their practice and the most experienced practitioners were likely to recognize the pivotal role of the patient in their own care.

Perspectives of patients with chronic disease

Approximately 20% of the patients surveyed were drinking in excess of the Australian guidelines, with 14% reporting they had experienced an adverse impact on their chronic disease management as a result of their alcohol consumption. Patients reported a range of issues with difficulty with blood sugar control and blood pressure control being the most commonly reported.

Overall the surveyed patients suggested safe drinking levels that were in keeping with the Australian guidelines. However, when subdivided by AUDIT-C screen result those who screened negative for potential alcohol dependence reported safe levels significantly lower than the guidelines and those that screened positive reported levels significantly higher.

Only two people reported a potentially positive impact of their drinking on their health, with two-thirds of the respondents to the question reporting perceived negative impacts if they were to drink more than their specified safe level. Overall, the perceived negative impacts are consistent with those previously reported in the literature suggesting adequate knowledge of potential harms except for an underestimation of the risks of hypoglycaemia and cancer.

The association between alcohol and clinical management of chronic disease

Alcohol consumption at high-risk levels was associated with significantly reduced likelihood that people had reached their clinical management targets. Additionally,

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alcohol consumption in the AUDIT-C 9+ category was associated with a statistically significant decrease in primary disease outcome. The outcome measured was eGFR for CKD, FEV1% for COPD and HbA1c for T2DM.

The association between alcohol and health utilisation of patients with chronic disease

Despite an apparent reduction in the ability to reach management targets and worsening disease outcomes, excess alcohol consumption was associated with a decrease in health care utilisation. This was most evident in a decline in primary care attendance and associated with fewer prescriptions per person. There was an apparent approximate U-shaped response in hospital-based care with the lowest utilisation in the AUDIT-C 5-8 group and highest in the AUDIT-C 0 and AUDIT-C 9+ groups.

7.2 Proposals for improved management of people living with chronic disease who are drinking in excess of Australian guidelines.

Improve alcohol management within the primary care practice

General practitioners and the nurse and allied health staff in their practices are the experts at management of chronic disease. Evidence suggests that even a short course in addiction can upskill postgraduate staff sufficiently to increase confidence managing drug and alcohol problems (1, 2) and therefore this is likely to be the most productive path to follow. There is sufficient evidence that brief intervention programs in the primary care space can improve outcomes for people with AUD or substance

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use disorder (3-5). Given the spectrum of alcohol use that could potentially have impacts for patients with chronic disease, a short course that focused on broader aspects of lifestyle modification approaches as well as AUD management would be of the greatest benefit.

Connectedness and rapport are known to be critical factors in successful addiction treatment (6) and therefore expanding the existing therapeutic relationship to cover alcohol consumption would be better for the majority of clients than fragmenting the care. This could be supported by a GP alcohol and drug liaison role or expansion of the role of the current mental health GP liaison officers, to provide specific individual advice as required to support practitioners. Utilisation of the HealthPathways (7) scheme, which provides expert assessed online management summaries with links to literature, resources and localised referral pathways, could assist GPs in obtaining expert advice and knowledge as required.

Recent evidence (8), suggest that embedding alcohol assessment into practice continuous quality improvement processes may assist in establishing better approaches, although evidence for improvement in outcomes from this approach is still limited.

There are existing clinical advisory services for alcohol and other drugs available in Australia, as explained and outlined by Conigrave and colleagues (9), that were not raised/discussed by the practitioners in this study. Further promotion of such services may provide additional support to primary care.

Improve management of chronic disease within the drug and alcohol specialist sector

Improving the awareness and management of chronic disease within the drug and alcohol sector would go some way to improving the care of individuals with both chronic disease and high alcohol consumption. Currently the most common dual diagnosis discussion in the sector is around patients with dual addiction and mental health problems rather than this additional group who have other comorbidities. This would not, however, solve the access issues as it would likely prolong care times by increasing the amount of work per patient and therefore make wait times to care even longer. It would also not solve the 'threshold' effect - when there is limited specialist availability the triaging system tends to raise the bar for specialist treatment higher and higher as those with the most severe presentations are seen first. Additionally, the public drug and alcohol sector in our region comes under Mental Health and is predominantly medically staffed by psychiatrists, many of whom have not worked with physical comorbidities for a considerable amount of time and would require substantial upskilling across a wide and varied range of conditions.

Where this approach would enhance services is in terms of better access and care in the residential rehabilitation space for people living with chronic disease. A better understanding of physical health needs would facilitate options for people with chronic disease who are currently being excluded. One option may be utilising the holistic management skills of general practitioners through implementing paid GP time within the drug and alcohol sector to assist staff with making plans for patients that are consistent with their physical health needs.

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Improve health practitioner undergraduate training in drugs and alcohol management

Lack of adequate training was identified as a potential issue across all the professional backgrounds, and this is echoed in the literature (1, 2, 10-12). Improving the coverage of drug and alcohol topics in undergraduate and postgraduate training, especially with a focus on management rather than just recognition, is vital. However, changing curriculum at that level will take substantial amounts of time to translate into improved outcomes for patients. It is also unlikely to be successful in isolation and would need to be part of an integrated solution. In the meantime, implementing flexible online training modules providing micro-credentialing in aspects of alcohol and other drug treatment, and managing dual diagnoses with chronic diseases would fill an important gap.

7.3 Implications for primary care practice

- When making use of multidisciplinary teams in primary care there should be a clear definition of roles and checking to ensure all those involved feel adequately trained and equipped to carry out that role.

- We need to ensure that all practitioners are aware of the existence and location of available guidelines for behaviour change around alcohol use – for example the RACGP SNAP guidelines (13).

- Recording of alcohol consumption should be done along the same lines as is currently done for smoking: 1) Do they currently drink?; 2)If so, how much?; 3) If not, did they use to drink?; and 4) If so, how much and for how long?

- All those with chronic disease, even those who do not drink, or drink very rarely, should be educated about the potential impact of alcohol, particularly

the risk of hypoglycaemia with diabetes or interference with medications. The literature suggests that discussion of alcohol's role in cancer is associated with greater behaviour change and this should be explicitly included in risk discussions (14).

- Alcohol consumption should be considered as a potential cause or contributor in patients who are not meeting chronic disease management targets or whose attendance is declining.

7.4 Implications for policy

- More guidance is needed in chronic disease guidelines regarding evidence for the interaction between that specific disease and alcohol. Currently there is an information loop. The chronic disease guidelines predominantly advise to use the Australian Alcohol Guidelines and the alcohol guidelines state they are for healthy individuals and giving limited advice on those with comorbidities.

- University health student curricula need to reflect recognition, management and implications of alcohol across all groups - the general public, those with physical comorbidities and those with co-existing mental health diagnoses.

- Post-graduate training for health professionals should reinforce and extend training in management of alcohol related issues.

- The drug and alcohol sector needs to extend its focus on dual diagnosis to reflect comorbidity with chronic disease as well as mental health diagnoses. This includes ensuring public services and residential services can cater adequately for the needs of those with chronic disease.

- Hospitals need to examine the way in which alcohol consumption data are recorded to allow for better responsiveness to potential alcohol-related harms. This will lead to better inpatient outcomes, may prevent early unintended discharge due to withdrawal symptoms and ensure that people who consume alcohol are not being discriminated against in the provision of services.
- A public media campaign focused on the dangers of alcohol consumption in the presence of chronic disease may assist in raising awareness of this important issue.

7.5 Implications for research

- The primary area for further research arising from this study is to explore the reason for the decline in primary care health service utilisation with high-risk alcohol consumption. This could be patient driven due to poor health literacy, disinterest, self-stigmatisation, social stigma, previous unpleasant experiences or fear of the response of health practitioners. Alternatively, it may be practitioner driven as a result of decreased motivation and assumptions about poor treatment outcome. Likely, it is a mixture of factors from both practitioner and patient. Depending on the outcome, strategies could be explored to combat the issue.
- Given the difficulty in determining statistically significant changes in outcomes, large data sources such as national chronic disease audits should include alcohol consumption data to enable a large data set for greater statistical power allowing for more robust multivariate analysis.
- A large prospective cohort study investigating emergency department attendances and hospital admission relative to alcohol consumption would

usefully inform the impact of alcohol consumption on hospitalisation patterns in people with chronic disease. However, such a study would be contingent on adequate and detailed coding of alcohol consumption at presentation to hospital.

7.6 Conclusion

The aim of this thesis was to examine the use of alcohol in people with diagnosed chronic disease, focusing on the impacts of at-risk alcohol consumption on their health outcomes and health care utilisation. Four research questions were addressed in this thesis, which was conducted using a multi-methods approach in a large, regional town in North Queensland, Australia. This facilitated a more complete and nuanced understanding of the impact of at-risk alcohol consumption on people with chronic disease in Townsville than would otherwise have been possible.

Alcohol consumption in people living with chronic disease poses a significant challenge for general practitioners. This burden is increased in regional areas where referral services are more limited. Overall, those staff in primary care interviewed felt under-trained and under-resourced to adequately manage this group of patients.

Patients with chronic disease in general were aware of the potential harmful impacts of alcohol on their chronic disease, however 20% still drank in excess of guidelines. While as an overall group the perception of what was safe reflected the guidelines, current drinking behaviour impacted on the perception of how much was safe to drink.

In people with chronic disease, alcohol consumption was associated with decreased likelihood of meeting chronic disease clinical management targets and worse chronic

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disease outcomes. Despite this apparent worsening of chronic disease outcomes, alcohol consumption is associated with a decrease in engagement with primary care health services, an increase in emergency department presentations, no change in rate of admissions but a decreased length of stay in hospital.

Overall, the thesis presents novel and compelling findings that have advanced the evidence in this field and will usefully inform practice, policy and research relating to those with chronic disease who drink alcohol.

7.7 Chapter 7 References

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