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Variations in access, uptake and equity: Radiology services

Dave Worthington, Ruth Kowalczyk, Malcolm Dalziel and Peter Robinson

The Department of Management Science
Lancaster University Management School
Lancaster LA1 4YX
UK

VARIATIONS IN ACCESS, UPTAKE AND EQUITY: RADIOLOGY SERVICES.

FINAL REPORT
TO
THE NATIONAL HEALTH SERVICE EXECUTIVE
NORTH WEST

Grant RDO/12/19/3

Dr. Dave Worthington and Mrs Ruth Kowalczyk,
Department of Management Science and Institute for Health Research,
Lancaster University.

Dr. Malcolm Dalziel and Mr. Peter Robinson,
Morecambe Bay Acute Hospitals Trust.

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The research reported is part of a coherent programme entitled "**Health Services Provision: Access, Need, Equity and Management"**, funded by the NHS Executive (North West) over the period 1996-99. This research programme involves researchers from several University Departments and is in collaboration with health professionals in the northern part of the Region.

For further details about the work of the Institute please contact:

Professor A.C. Gatrell

Institute for Health Research
Bowland Annexe
Alexandra Square
Lancaster University
Lancaster LA1 4YT

Tel: 01524 593754
FAX: 01524 592401
Email: a.gatrell@lancaster.ac.uk

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EXECUTIVE SUMMARY

Background

There are many examples of substantial variations in access to health services. RAWP and its successors demonstrated and sought to correct major resource inequalities between health regions. Numerous studies have consistently demonstrated three or fourfold variations in GP referral rates to hospitals after allowance has been made for all the obvious factors such as population needs, GP's knowledge etc.

The NHS recognises that it "..... must accept that there are limits to the acceptable range of variation. It is one thing to justify variations on the grounds that local practitioners have developed a new approach to a pressing problem, or that the needs and wishes of local people require a different pattern of provision. It is something quite different to tolerate differences in the quality of health care which arise simply out of historical accident or professional conservatism."

Research Aims

The objectives of the research at the outset were:

- To improve understanding of the reasons for variations in the uptake of a specific service, namely a radiology service.
- To investigate and evaluate possible ways in which Purchasers, Providers and health care professionals could beneficially influence the uptake of services.
- To recommend ways in which Purchasers, Providers and health care professionals could beneficially influence the uptake of services.
- To contribute to a general methodology for undertaking this process elsewhere and for other services.

Research Methods

As is often the case with health services research, the researchers needed to recognise that they were investigating a 'moving target'. In particular during the two year duration of the project there have been massive changes in the health service at both the national and local levels. Overall the research has adopted and been guided by an Action Research methodology. This approach has enabled issues to be studied at macro and micro levels

as opportunities arose, data became available and issues became relevant.
Specific research methods used have included:

- Literature reviews
- Data-mining of available radiology service databases from three hospitals,
- Calculation of age-specific and age-standardised rates using demographic information relating to geographic areas and GP practices,
- Statistical analyses of age-standardised rates to separate real effects from chance variations,
- Presentations to stakeholders and follow-up discussions,
- Semi-structured interviews with a wide range of stakeholders,
- Postal questionnaires to referring GPs,
- Modelling of possible service developments.

Understanding Radiology Referral Rates

The research has shown that ***statistical analyses of available data*** (standardised for age when appropriate) are capable of shedding light on levels of access and uptake of services, to the point where apparently high (or low) referring GP practices or consultants or localities can be identified, and a profile of their referral patterns can be compared against those of other similar referring sources.

Geographical ward and parish based analyses of ***aggregate referral rates*** show significant effects of geodemographic factors with distance and deprivation having a significant combined effect on ***referrals from all sources***. Distance and deprivation combined have similar significant effects on ***referrals from outpatients*** and ***referrals from A&E***. For ***inpatient referrals*** the best explanatory factor is deprivation, whereas for ***GP referrals*** any simple effects of either distance or deprivation were masked by the stronger effect of 'local hospital'. When 'local hospital' was allowed for, there is evidence that distance and deprivation affect referrals.

Whilst the results above offer important insights, it is equally important to note that there is ***considerably more variation in the referral rates than is explained*** by these factors

alongside simple annual random variation.

Consultant ***inpatient and outpatient referral rates*** vary massively between specialities, and comparisons that make no allowance for specialty are virtually useless. However there is some evidence of significant shifts in referral patterns over time, mainly an increase in outpatient rates and a decrease in inpatient rates. There is also some evidence of significant variation between consultants within specialities.

When looked at in further detail ***GP practice referral rates*** were found to vary massively, but often in different ways for different examinations. Statistical analyses revealed that distance, local hospital and the ratio of female to male GPs in a practice all had significant effects for some of examinations. However substantial unexplained variations still remained.

Routes to Beneficial Change

Change management is crucial to the continuing development of health services, including radiology services, and a range of processes that might be adopted have been reviewed. Ways forward investigated in this research have mainly hinged around the intelligent analysis of available information to provide health care professionals and managers with a sound basis for discussion of their current patterns of referral and service delivery, and hence a firm basis for identifying and evaluating opportunities for beneficial change.

GP practices responded well to ***tailored reports and questionnaires*** about their use of radiology services. All responses indicated that they were interested to receive reports and in many cases that they were using or could envisage using the information to constructively review their practices. Looking forward to the responsibilities of ***Primary Care Groups*** (PCGs) to become involved in ***clinical governance and health improvement programmes***, reports of this sort that provide a sound basis for comparing practices could provide an essential catalyst in reasoned discussion and beneficial change.

Consultant teams also responded well to ***reports tailored to their specialties***, and to

presentations and discussion of results. Standardisation for casemix would have strengthened the analyses, and reduced the scope for referrers to "pull the wool" over each others eyes – knowingly or not. However the experience of the research was that presentation of results (for example in an audit setting) led to serious consideration, reflection and professional debate. As with GP referrals, this approach again provides a sound basis for comparing practices relevant to ***clinical governance and health improvement.***

Guidelines and protocols also offer routes to improved referral patterns. However some referrers are clearly much more influenced by this sort of information than others. Localised, problem-specific guidance rather than examination specific is generally thought more likely to influence local practice. Informal communications about specific local issues are much valued by referrers and there is scope for using analyses of local data to target formal and informal communications.

Service developments will have a direct impact on the distance that patients need to travel for those services and hence convenience of access. In addition, distance can also have a ***serious impact on uptake of services***. The scale of such impacts will typically be much larger in rural areas such as Morecambe Bay than in more urban settings. It is important that any evaluation of the likely impact of service developments takes proper account of the effects of distance. Service developments evaluated as beneficial in urban settings may require substantial re-evaluation for rural settings. ***Patient flow modelling*** can be used to illuminate the consequences of possible schemes.

Generalisations

This study of radiology services has provided one concrete example of important issues associated with Access, Uptake and Equity. It is postulated that ***many of the findings of this research would be more or less duplicated in many respects by similar studies of other services***.

Whilst the existence of ***PCGs*** and their role in ***clinical governance and health improvement programmes*** were not foreseen at the start of this research, many of the

approaches developed in this research could ***play a very important role in enabling health care professionals and managers to undertake these new responsibilities***. In particular combinations of quantitative and qualitative investigations will be valuable in enabling health care professionals and managers to come to a common understanding of the issues involved, as well as acting as a catalyst in the generation and evaluation of ideas for service development.

1. Introduction

There are many examples of substantial variations in access to health services. RAWP [1] and its successors demonstrated and sought to correct major resource inequalities between health regions. Numerous studies have consistently demonstrated three or fourfold variations in GP referral rates to hospitals after allowance has been made for all the obvious factors such as population needs, GP's knowledge etc. [2].

The NHS recognises [3] that it "..... must accept that there are limits to the acceptable range of variation. It is one thing to justify variations on the grounds that local practitioners have developed a new approach to a pressing problem, or that the needs and wishes of local people require a different pattern of provision. It is something quite different to tolerate differences in the quality of health care which arise simply out of historical accident or professional conservatism."

NHS commitment to the overall objective of reducing inequalities has been further emphasised in the recent Green paper 'Our Healthier Nation' [4] in which the Government states two key aims:

- To improve the health of the population as a whole by increasing the length of people's lives and the number of years people spend free from illness.
- To improve the health of the worst off in society and to narrow the health gap.

Whilst these twin problems have a long history within the NHS, recent research has emphasised the importance of the latter by highlighting the extent of inequalities in health and access, see for example [5] for the North West; by starting to improve understanding of factors which contribute to inequalities, for example by the ESRC Health Variations Programme co-ordinated by Professor Hilary Graham at Lancaster University; and by experimenting with measures that might be taken to reduce inequalities, for example via Health Action Zones.

The overall aim of this research project is to contribute to understanding of the variations that exist in access, uptake and equity of one particular service, namely radiology, and to investigate opportunities for beneficial change.

Considerable literature exists on the effects of distance on the uptake of services [6-9] and on variations in referral rates [2, 10] all leading to the conclusion that significant reductions in variations will involve the appropriate location of services and improved communications between referrers and specialist departments.

In the context of radiology services the Royal College of Radiologists published a set of guidelines for doctors in 1990, updated to a third edition [11] in 1995 (and a fourth

edition in 1998), intended for use by hospital doctors and general practitioners alike. They have been subject to numerous evaluations, see for example [12-16], which have indicated varying degrees of success.

The original design of this research project was to study the radiology service provided by the Lancaster Acute Hospitals Trust in some depth, making comparisons and contrasts with the service provided by the Furness Hospitals NHS Trust insofar as the Furness radiology database allowed. This work has been undertaken successfully. In addition, as is often the case with health services research, the researchers needed to recognise that they were investigating a 'moving target'. In particular during the two year duration of the project there have been massive changes in the health service at both the national and local levels.

At the National level there has been a change of government; a White Paper [17] on the future of the Health Service which dismantled one of the main levers for service development and management, i.e. the Purchaser Provider split, and replaced it with a structure built upon Primary Care Groups. The White Paper details a number of functions for which the new Primary Care Groups will be responsible:

- To contribute to the Health Authority's Health Improvement Programme and to ensure that this plan reflects local need;
- To promote the health of the local population, working in conjunction with other agencies;
- To commission health services for their populations from NHS Trusts, ensuring quality and efficiency;
- To monitor performance against service agreements;
- To develop primary care through joint working across practices, including developing the new approach to clinical governance, and influencing the deployment of resources for general practice locally;
- To better integrate primary and community health services and work more closely with social services on both planning and delivery.

At the local level the three acute hospital trusts that provided radiology services in Morecambe Bay have been merged into one new trust, Morecambe Bay Acute Hospitals Trust, which is currently in the early stages of reviewing the services it provides, including radiology. Also three new Primary Care Groups (PCGs) have been established for Morecambe Bay, each of which will need to develop working relationships with the Health Authority, Morecambe Bay Acute Hospitals Trust, each other, and other

organisations to review and develop services, including radiology.

By adopting an overall Action Research methodology to guide the research it has been possible to keep up with these changes and indeed to study issues as opportunities arose, data became available and the issues became relevant. For example the quantitative and qualitative analyses undertaken have been strengthened considerably by the inclusion of data from the Westmorland Acute Hospitals Trust, which became possible when it was clear that the acute trusts were going to merge and would no longer be in competition. Also a range of practical opportunities for beneficial changes have arisen during the project, including:

- the location of an ultrasound service in Morecambe,
- the siting of a fixed MRI Scanner somewhere in Morecambe Bay,
- guidelines and/or protocols for back pain and pregnancy ultrasound and
- the requirement that PCGs become involved in clinical governance and health improvement programmes.

Discussion and/or evaluation of these opportunities have therefore been included within the research.

2. Aims, Objectives and Outline.

The objectives of the research at the outset were:

> To improve understanding of the reasons for variations in the uptake of a specific service, namely a radiology service.
>
> To investigate and evaluate possible ways in which Purchasers, Providers and health care professionals could beneficially influence the uptake of services.
>
> To recommend ways in which Purchasers, Providers and health care professionals could beneficially influence the uptake of services.
>
> To contribute to a general methodology for undertaking this process elsewhere and for other services.

As noted in the previous section, during the course of this research the context has changed, but the underlying issues remain. In particular the stated objectives of this research only need modifying by replacing the phrase “Purchasers, Providers and health care professionals” by “ Primary Care Groups, Health Authorities, Trusts and health care professionals”

The remainder of this report is organised as follows. The methodology adopted in the research is outlined in section 3. The main results arising directly from the research are described in sections 4 to 9. Section 4 describes the quantitative data used in the research together with results of a comparison of the radiology workloads of the three trusts that existed at the start of the study. Electoral ward-based analyses of referral patterns are also presented. Section 5 focuses on GP referred examinations, using the quantitative data and qualitative information gathered directly from GPs. Section 6 focuses on hospital-based referrals, using available quantitative data followed by qualitative information gathered from referrers.

Whilst sections 4 to 6 concentrate on the issue of understanding referral patterns as a necessary precursor to considering beneficial change, sections 7 to 9 address processes to instigate change. Section 7 considers guidelines and protocols as instruments intended to influence referrers’ behaviour directly; whereas section 8 considers service developments as an indirect way in which the NHS can influence access and uptake. Section 9 draws on the previous sections and other research, providing an overview of change management with respect to radiology services.

Finally section 10 discusses and summarises the main findings of this research.

3. Methodology

Overall the research has adopted and been guided by an Action Research methodology. This approach has enabled issues to be studied at macro and micro levels as opportunities arose, data became available and issues became relevant.

One guiding premise acknowledged at the outset of the research has been the need to see issues from the points of view of both the referrers to the radiology service, who in part also reflect the patients' viewpoints, and the providers of that service. Whilst both sides may have strong opinions about problems and possible solutions, neither has the full picture. In addition both parties will need to work together to maximise the chance of any proposed solutions succeeding. Hence the research has sought to improve understanding of issues in a number of ways, in the expectation that implementable service improvements will emerge.

Specific research methods used have included:

- Literature reviews,
- Data-mining of available radiology service databases from three hospitals,
- Calculation of age-specific and age-standardised rates using demographic information relating to geographic areas and GP practices,
- Statistical analyses of age-standardised rates, to separate real effects from chance variations,
- Presentations to stakeholders and follow-up discussions,
- Semi-structured interviews with a wide range of stakeholders,
- Postal questionnaires to referring GPs,
- Modelling of possible service developments.

4. Statistical Overview of the Radiology Services

An initial overview of the radiology service in Morecambe Bay and factors affecting uptake are presented in this chapter. The sources of data are described and then used to provide a comparison of the radiology services at the three trusts that served the area at the start of the project. The concepts of age-specific and age-adjusted referral rates are introduced and used in electoral ward-based analyses for those wards served mainly by the Lancaster and Westmorland trusts for which comparable computerised data was available. The effects of geodemographic factors, 'local hospital' and possible substitution of routes to radiology examinations are also investigated.

4.1 Data

The core data utilised within the project came from the following sources:

- Lancaster Acute Hospitals Trust Radiology Database for the financial years 1994-5, 1995-6 and 1996-7 and Westmorland General Hospital's Radiology Database for the financial year 1996-7. The databases contain records of every examination carried out by the respective departments. In particular details of the examination carried out (date, description and Korner group), the source of referral (Inpatient, Outpatient, GP or A & E), the referring clinician's specialty (or in the case of GPs, the referring Practice), the patient's date of birth and postcode.
- Printouts of radiology data from the Furness Hospitals Trust for 1996/7. This consisted of printed data which was produced on a monthly basis. The numbers of each different examination are recorded for the Barrow and Ulverston Hospitals. Also, for each hospital, a cross-tabulation of the examinations by Körner Group and referral source (A&E, GP, inpatient or outpatient) was produced.
- P.A.S. data from the Royal Lancaster Infirmary provided the inpatient and outpatient activity used in analysis of internal referrals.
- Morecambe Bay Health Authority records of Practice list sizes, broken down by sex and into nine age categories.
- 1991 Census Data on population numbers of the 89 electoral wards in Morecambe Bay, broken down into 10 age categories.
- Census data on population density and deprivation (Carstairs, Jarman and Townsend indices) for the wards. Post Office data linking patients' postcodes to electoral wards and Ordnance Survey co-ordinates.

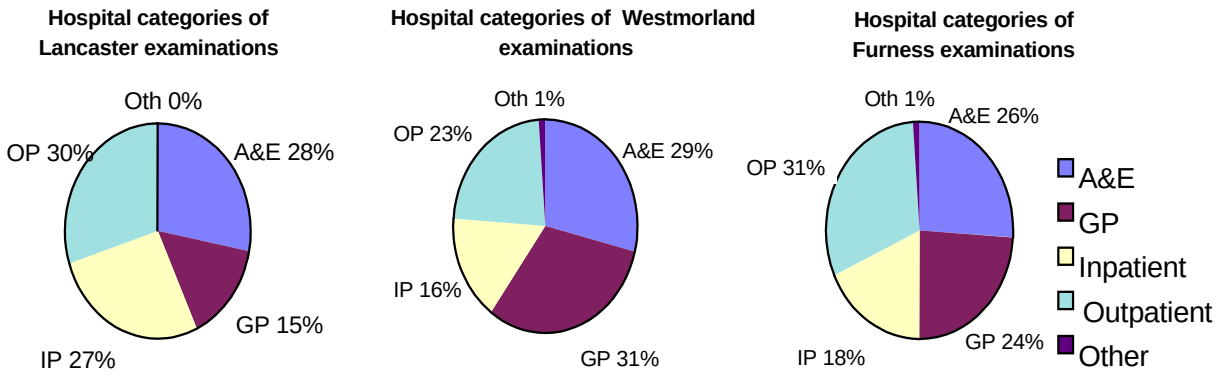
4.2 Comparison of Hospital Activity Levels

Data for the financial year 1996-97 were used to compare the radiology workloads at Lancaster, Furness and Westmorland hospitals. In particular, the source of referrals to the radiology departments, Körner Groups and a number of individual examinations were studied. The following conclusions were drawn:

- In the Lancaster Trust approximately 69,000 examinations took place as compared to 55,000 and 30,000 at Furness and Westmorland hospitals respectively.
- GP referrals to Westmorland accounted for 31% of the total number of examinations (7% and 16% more than Furness and Lancaster respectively).
- Accident and Emergency referral percentages to the three hospitals did not differ significantly.
- Inpatient referrals to both Furness and Westmorland were 10% lower than to Lancaster.

These differences can be seen in figure 4.1.

Figure 4.1 Sources of Radiology Referrals 1996/7

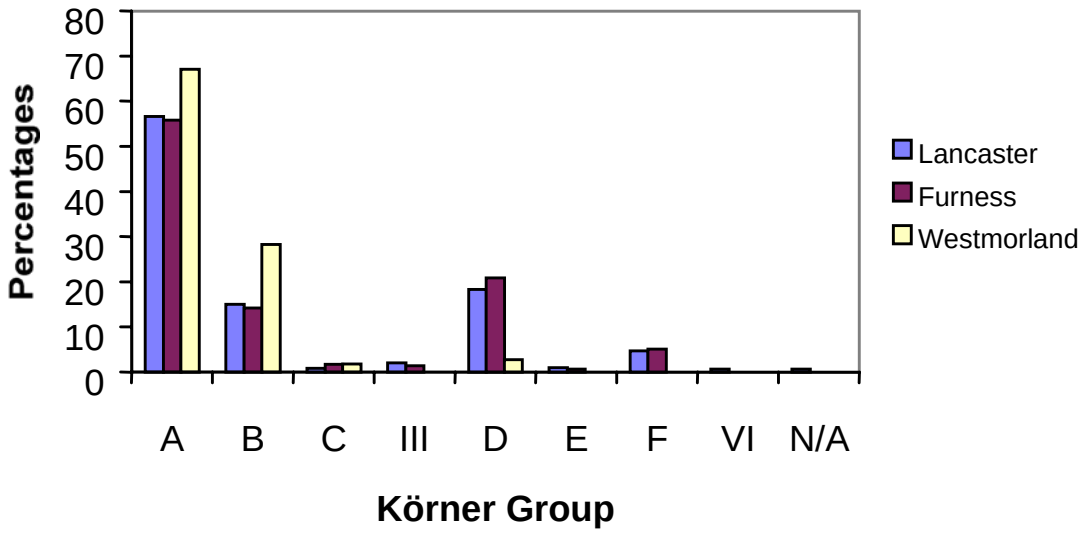


These variations in the hospitals' workloads reflect in part differences in each hospital's operations, characteristics and catchment populations. For example, whilst all three hospitals have similar proportions of A&E work, the high proportion of inpatient referrals to Lancaster in comparison to Westmorland hospital is consistent with its larger range of inpatient facilities leading to a higher proportion of patients being hospitalised in Lancaster. However, this does not explain the 9% difference in inpatient referrals between the Lancaster and Furness hospitals as they each serve fairly distinct catchment populations for a wide range of services. Neither does it explain the wide variations in the

proportions of GP referred patients.

Differences in the composition of the Lancaster, Furness and Westmorland workloads by Körner Group is shown in figure 4.2.

Figure 4.2: Comparison of Korner Groups for the three hospitals.



Although differences were detected between Lancaster and Furness when referrals were broken down by source, the division of referrals into Körner Groups is more or less identical. However, in contrast, the proportion of examinations carried out at Westmorland that fall into Körner Groups A and B is much greater, representing 95% of the hospital's total workload. For example 32% of examinations are chest or spinal x rays at Westmorland, whereas at Furness and Lancaster the corresponding figures are 27% and 22%.

The above level of comparison of hospitals is relatively crude. It is useful for setting the scene, and within the scope of the project led to better informed discussions between staff of the three departments about issues such as the use of open access gastroscopy as an alternative to barium meals.

However levels of access can only be judged properly if the uptake of services is related to the relevant catchment population in reasonable detail. This led to the next stage of the study, making use in particular of the computerised radiology databases in place at Lancaster and Westmorland hospitals.

4.3 Age-specific usage rates.

The combined service provided by Lancaster and Westmorland can be mapped onto electoral wards and onto practice populations.

Although there are 89 electoral wards in the Morecambe Bay area, see figure 4.3, 29 wards refer the majority of residents to the Radiology Departments at Barrow and Ulverston. These were therefore eliminated from the analysis because of the unsuitability of the Furness data for computer analysis. The remaining 60 ‘core’ wards account for 87% of all referrals to Royal Lancaster Infirmary (RLI) and Westmorland General Hospital (WGH).

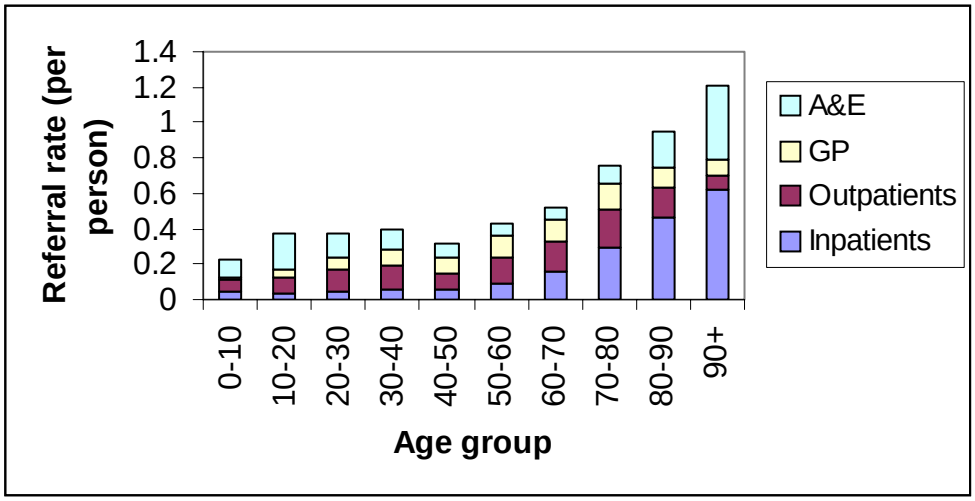
Figure 4.3 Morecambe Bay HA, showing 'core' electoral wards.

Whilst the Westmorland hospital patients were virtually 100% postcoded, about 40% of Lancaster records were missing postcodes. As there was some evidence that different age groups had differing propensities to have their postcodes recorded, the numbers of examinations requested from different electoral wards were scaled up allowing for the

age structure of the ward, for further details see [18]. After scaling, the proportions of inpatient, outpatient and GP referred examinations attributable to residents of the core wards were 87%, 92% and 88% respectively. On the other hand the proportion of referrals from A&E was only 80%. However given the thousands of visitors every year to the Morecambe Bay area a substantial proportion of A&E referrals to Radiology from outside the core wards is to be expected.

Comparing the total referrals from the core wards by age of patients with the overall age structure of the same wards enabled 'local' average age-specific referral rates to be calculated. These are summarised in figure 4.4 and clearly highlight the danger of not adjusting for age profile in any comparison of radiology uptakes.

Figure 4.4 Age-specific Radiology Referral Rates, by Source of Referral.



4.4 Ward-based statistical analyses

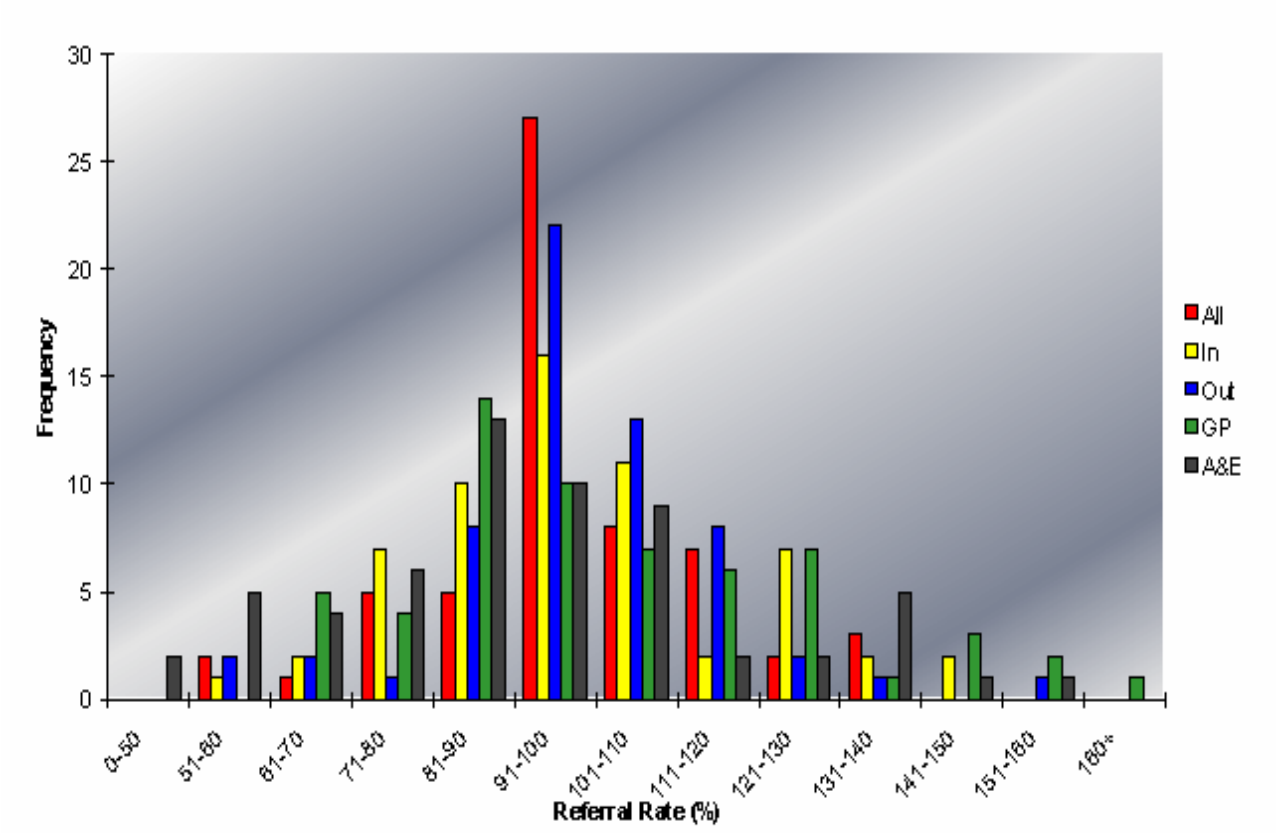
Age standardised rates were therefore computed from Census data for all referrals and the four referral sources; Inpatient, Outpatient, GP and A&E. Rates are presented as percentages, with 100% indicating the average rate and 120% indicating that the actual rate is 20% higher than the average, etc. However there is no implication that 100% is necessarily 'right'. Rates proving to be statistically high or low after taking into account random variation that one would normally expect were highlighted. Details of this process are described in [19]. Results are shown in table 4.1, with significantly high rates highlighted in grey (darker) and significantly low rates highlighted in green (lighter).

Table 4.1 Age-standardised Radiology Referral Rates for 60 wards in Morecambe Bay.

Ward Name	Code	All	In	Out	GP	A&E
Arnside	16UGFA	75%	72%	81%	90%	58%
Beetham	16UGFB	76%	75%	84%	82%	59%
Burneside	16UGFD	94%	85%	85%	127%	87%
Burton And Holme	16UGFE	90%	92%	97%	87%	83%
Endmoor	16UGFL	81%	98%	86%	86%	57%
Hutton	16UGFQ	98%	95%	87%	126%	93%
Kendal Castle	16UGFR	69%	80%	68%	75%	55%
Kendal Far Cross	16UGFS	98%	98%	93%	99%	104%
Kendal Fell	16UGFT	92%	99%	86%	99%	85%
Kendal Glebelands	16UGFU	139%	140%	139%	151%	132%
Kendal Heron Hill	16UGFW	93%	97%	93%	115%	74%
Kendal Highgate	16UGFX	109%	143%	91%	103%	100%
Kendal Mintsfeet	16UGFY	114%	129%	103%	142%	96%
Kendal Nether	16UGFZ	116%	121%	125%	122%	94%
Kendal Oxenholme	16UGGA	109%	87%	106%	141%	104%
Kendal Stonecross	16UGGB	120%	129%	118%	126%	108%
Kendal Strickland	16UGGC	94%	114%	92%	85%	89%
Kendal Underley	16UGGD	139%	103%	152%	163%	139%
Kirkby Lonsdale	16UGGE	90%	95%	93%	90%	82%
Lakes Ambleside	16UGGF	88%	93%	81%	109%	74%
Lakes Grasmere	16UGGG	57%	66%	58%	68%	41%
Levens	16UGGH	74%	75%	75%	92%	57%
Lyth Valley	16UGGK	78%	72%	62%	100%	87%
Milnthorpe	16UGGL	103%	104%	106%	118%	86%
Sedbergh	16UGGN	107%	106%	103%	155%	76%
Staveley-In-Westmo	16UGGP	99%	82%	96%	142%	83%
Whinfell	16UGGW	97%	104%	95%	124%	78%
Windermere Appleth	16UGGX	55%	54%	52%	72%	44%
Windermere Bownes	16UGGY	97%	91%	101%	134%	70%
Windermere Bownes	16UGGZ	97%	108%	88%	127%	78%
Windermere Town	16UGHA	93%	102%	91%	122%	68%
Alexandra	30UHFA	97%	104%	102%	80%	98%
Arkholme	30UHFB	87%	93%	96%	86%	67%
Bolton-le-Sands	30UHFC	88%	84%	95%	86%	83%
Bulk	30UHFD	112%	94%	103%	116%	138%
Carnforth	30UHFE	107%	133%	110%	80%	104%
Castle	30UHFF	113%	106%	106%	102%	133%
Caton	30UHFG	91%	84%	94%	99%	89%
Ellel	30UHFH	92%	80%	99%	88%	94%
Halton-with-Aughton	30UHFJ	90%	84%	112%	64%	88%
Harbour	30UHFK	116%	129%	111%	104%	121%
Heysham Central	30UHFL	97%	99%	95%	90%	105%
Heysham North	30UHFM	96%	78%	101%	86%	113%
Heysham South	30UHFN	101%	98%	102%	94%	108%
Hornby	30UHFP	90%	86%	114%	89%	63%
John OGaunt'	30UHFQ	112%	109%	106%	116%	121%
Kellet	30UHFR	93%	85%	120%	67%	81%
Overton	30UHFS	109%	122%	106%	102%	107%
Parks	30UHFT	88%	96%	93%	72%	85%
Poulton	30UHFU	92%	89%	98%	84%	95%
Scotforth East	30UHFW	101%	101%	96%	110%	100%
Scotforth West	30UHFX	100%	99%	93%	94%	111%
Silverdale	30UHFY	79%	67%	100%	70%	72%
Skerton Central	30UHFZ	135%	127%	125%	117%	165%
Skerton East	30UHGA	129%	144%	118%	107%	144%
Skerton West	30UHGB	121%	123%	111%	111%	138%
Slyne-With-Hest	30UHGC	97%	94%	111%	85%	91%
Torrisholme	30UHGD	93%	89%	97%	93%	92%
Victoria	30UHGE	99%	104%	98%	84%	107%
Warton	30UHGF	97%	119%	95%	70%	100%

Figure 4.5 emphasises the variations in referral rates that exist amongst the electoral wards. Whilst the overall referral rates are more concentrated around the 100% mark, there is still substantial variation amongst the wards. For referrals from the separate sources the variation is more marked, especially for A&E and GPs.

Figure 4.5: Histogram of Age-Standardised Ward Referral Rates



Geodemographic Factors

Previous research, for example see [20] for an extensive review and [8] for a description of the use of gravity models, has suggested that geographical and socio-economic factors influence the uptake of many health services. In particular:

- Distance is often found to have a deterrent effect;
- The age structure of the population can have a large effect on the uptake of services, as already noted in figure 4.4.
- Levels of social deprivation often increase, (although sometimes decrease), the level of uptake.

In an attempt to investigate the extent to which these factors explain the variations in referral rates that are clearly visible in figure 4.5, regression analyses were performed using the statistical package SPSS. Note that the effect of age structure has already been allowed for by age-standardising the rates, so the analysis that follows concentrates on the effects of distance and social factors. The following variables were used:

- *AllDistance, InDistance, OutDistance, GPDistance* and *A&EDistance*; for each source (All, Inpatient etc.), the Euclidean distance (in km) from the centre of the ward to the hospital (WGH or RLI) serving the majority of that ward for that service.
- *Townsend*, *Jarman* and *Carstairs*; deprivation scores, see appendix A for details.
- *Density*; population per square mile.
- *Localhosp*; indicator variable which takes the value 1 if wards look 'naturally' to Westmorland hospital, 0 if look 'naturally' to Lancaster.

The Distance variables employed depended on the referral source e.g. regression was performed on Inpatient Referral Rates using InDistance. This was because the proportions of examinations referred to each hospital vary substantially according to the referral source. In particular, the majority of Inpatient examinations were linked to RLI rather than to WGH and hence the distances used were mainly those from the ward centre to RLI. (Weighted distance variables that reflected these proportions were also used as an alternative measure of Euclidean distance but did not appear to alter the results.)

Each deprivation score and density was considered in turn for the five referral sources. All significant results are given in table 4.2. The percentage of variation explained by the regression equation is given in brackets. Where deprivation indices have been used, the range of variation explained by the three indices is given. The Carstairs index consistently provided the greatest explanation of variation followed by Townsend and then Jarman.

Table 4.2 Effects of geodemographic factors on Referral Rates.

Source	*Distance (from ward centre to main hospital)*	*Deprivation*	*Density*	*Distance & Deprivation Combined*	*Distance & Density Combined*
All	Significant (30%)	Significant (15-33%)	Significant (23%)	Significant (36-43%)	Significant (35%)
Inpatient	Not Significant	Significant (16-26%)	Significant (21%)	Not Significant*	Not Significant*

Outpatient	Significant (15%)	Significant (9-16%)	Significant (14%)	Significant (22%)	Not Significant*
GP	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
A&E	Significant (40%)	Significant (27-51%)	Significant (34%)	Significant (52-63%)	Significant (49%)

*Note: An asterisk means that SPSS rejected the regression equation containing both variables on the grounds that the variation was better explained by an individual variable. The underlines indicate the relationship that is statistically 'best' for each source of referral.

As can be seen, A&E referral rates are largely influenced by both Distance and Deprivation. Electoral wards isolated from the hospital and/or wards with low levels of deprivation appear to have lower A&E referral rates.

Referral rates from Outpatient Clinics are also affected by Distance and Deprivation in a similar manner to those from A&E, although not as marked, in this case only explaining 22% of the variation.

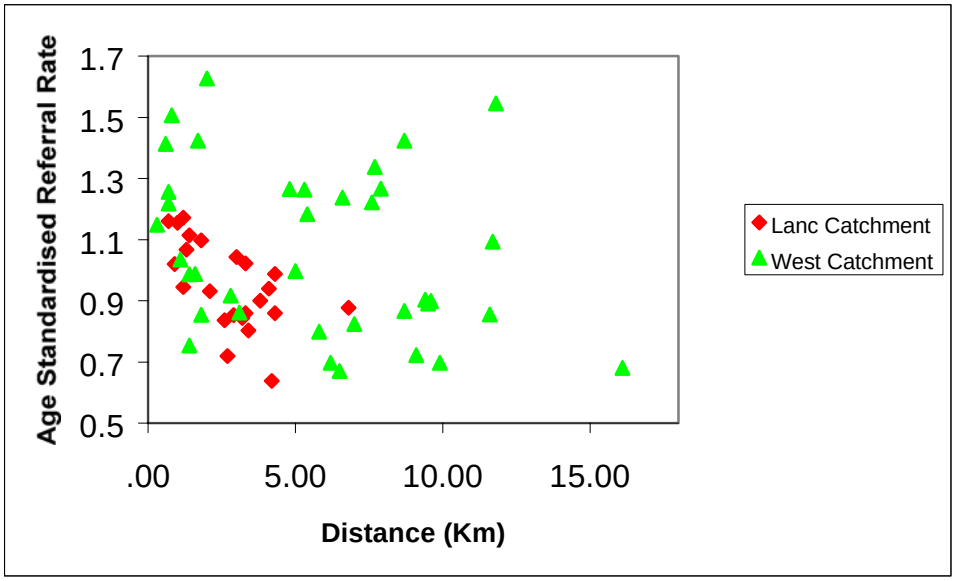
Higher levels of Deprivation also seem to lead to higher referral rates from inpatient care, but Distance does not have a significant effect.

Surprisingly, none of the geodemographic variables seem to be affecting GP referral rates. This could mean that they really do not have any effects, or alternatively they may have effects which are masked by the effects of other factors. Subsequent analyses, reported next, suggest the latter is the case.

'Local hospital' effect

A closer examination of GP referral rates sheds further light on this issue. For example figure 4.6 shows that whilst overall there is no significant pattern between GP referral rate and distance from hospital, for each of the two hospitals separately there is some evidence of an effect.

Figure 4.6: Age-standardised GP Referral Rates, by Distance and by 'Local Hospital'.



Regression analysis confirms this impression, showing that Distance and catchment area individually and combined have significant effects. The regression equation fitted is:

Referral rate = 1.01 – 0.023 x Distance + 0.18 [if in Westmorland Catchment]

Whilst this model only explains 15% of the variation in the data, it nevertheless implies that on average (standardised) referral rates decrease by 0.023 for every extra Km an electoral ward is distant from the hospital, and that wards in the catchment area of Westmorland refer on average 18% more patients. A possible explanation of the 'local hospital' effect is the existence of an open access radiology service at Westmorland General Hospital.

There was also some evidence that increased levels of deprivation measured using Carstairs index (see [19] for details) led to higher GP referral rates, but this result was only significant at the 11% level.

Substitution Between Referral Sources

One issue that arose during the course of the project concerned possible 'trade-offs' in referral numbers between Outpatient Clinics, General Practices and A&E Departments. It was suggested that:

- Patients living in more rural areas may choose to visit their local GP for treatment as opposed to the A&E Department of the nearest hospital.
- Some GPs prefer to send a patient directly to an Outpatient Clinic rather than obtain a preliminary report from the Radiology Department.

The statistical evaluation of these hypotheses is complicated. Unfortunately the Radiology databases do not identify the GP practices of patients referred by Outpatient Clinics or A&E Departments and thus no direct comparisons can be made. However by continuing to analyse the GP, outpatient and A&E referral rates at the ward level (allowing for the effects of distance and catchment area), there was a strong ***positive*** relationship between GP referral rates and referral rates from A&E and from outpatients, implying that substitution of sources was not an explanation of the observed variations.

In fact referral rates from A&E and outpatients turned out to be better explanatory variables than distance for GP referral rates, implying that there were perhaps other characteristics of wards that had a general effect on the uptake of radiology services by all three routes.

5. GP Referred Radiology Examinations

This chapter seeks to better understand the high degree of variation in GP referral rates identified in chapter 4. Practice-based referral rates are calculated and analysed to allow quantitative comparisons of practices; and are then used to provide a spring-board for a more in-depth qualitative investigation of some issues.

5.1 Practice-based analysis of GP referrals

The previous chapter has provided some explanations of the variation in GP referral rates amongst the core electoral wards. A further method of analysing GP referral rates is by individual practices. Practices who referred the majority of their patients to Barrow and Ulverston were removed and attention was focused on 33 core practices who were main referrers to RLI and WGH (referring 93% of total GP referrals). For the analyses it was assumed that no core practice referred significant numbers of patients to other hospitals.

Age standardised referral rates were calculated for 9 frequently requested radiology investigations: Chest, Lumbar Vertebrae, Cervical Vertebrae, Other Spine (e.g. thoracic), Knee and Hip x-rays and Pelvic, Pregnancy and Gallbladder Ultrasound examinations. Rates proving to be statistically high or low after taking into account random variation one would normally expect were highlighted. A Poisson distribution rather than a Normal distribution was assigned to those examinations for which the referral numbers were very low (less than 10). Details of the age standardisation process and statistical tests can be found in [19]. The results are shown in table 5.1. As in section 4.4, the average for any examination is 100% and 120% indicates that the actual rate is 20% higher than the average, etc. However again note that there is no implication that 100% is ‘right’.

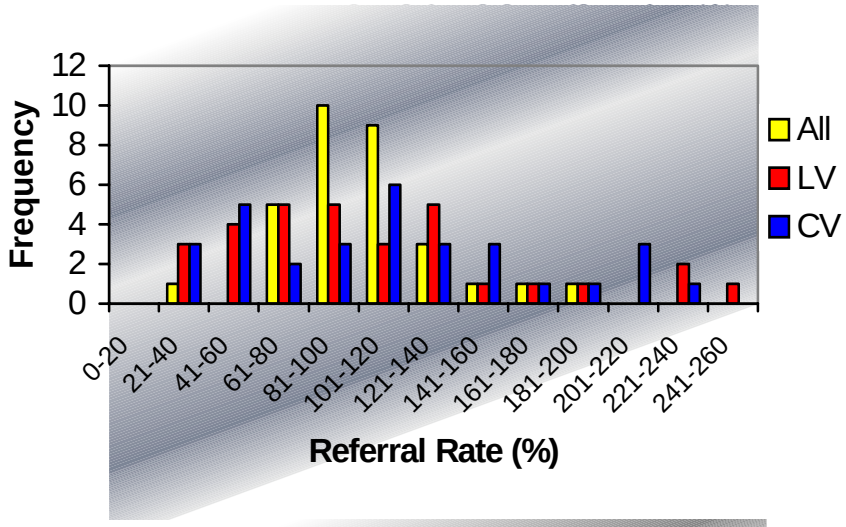
Table 5.1 Age standardised referral rates for Practices in MBHA.

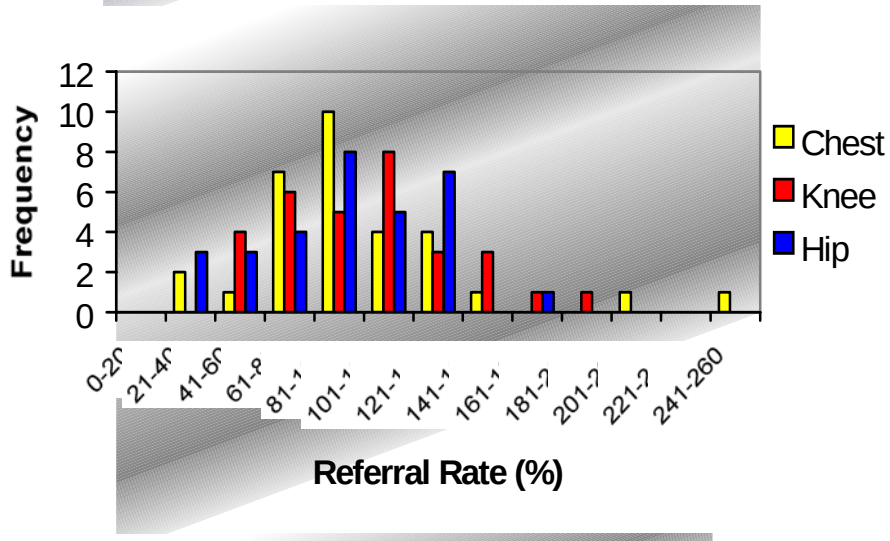
Practice	All	Chest	Lumb verte	Cerv verte	Other Spine	Knee	Hip	Usnd Gall Bldr	Usnd Pelvis	Usnd Preg
1	93%	101%	135%	120%	57%	111%	70%	29%	96%	26%
2	99%	99%	107%	108%	76%	111%	88%	148%	129%	97%
3	143%	131%	249%	144%	76%	133%	177%	125%	200%	158%
4	123%	134%	138%	116%	93%	176%	113%	33%	59%	102%
5	87%	62%	126%	90%	115%	114%	84%	75%	100%	72%
6	104%	71%	120%	113%	81%	127%	100%	127%	121%	126%
7	111%	87%	100%	220%	64%	110%	107%	155%	145%	64%
8	131%	150%	190%	213%	68%	147%	85%	111%	107%	73%
9	30%	34%	58%	30%	13%	30%	5%	13%	8%	0%
10	122%	78%	174%	203%	95%	153%	126%	124%	117%	64%
11	88%	97%	82%	115%	30%	78%	43%	133%	29%	160%
12	192%	211%	238%	191%	243%	85%	22%	171%	286%	200%
13	92%	91%	73%	129%	20%	189%	43%	0%	20%	0%
14	282%	175%	350%	600%	500%	100%	300%	100%	0%	0%
15	166%	244%	233%	155%	114%	146%	133%	114%	113%	22%
16	99%	38%	156%	233%	150%	100%	83%	100%	25%	0%
17	94%	60%	133%	114%	60%	80%	25%	80%	100%	100%
18	72%	87%	30%	40%	60%	41%	84%	73%	50%	70%
19	108%	93%	33%	57%	105%	111%	71%	130%	100%	157%
20	114%	125%	76%	47%	123%	100%	121%	132%	102%	116%
21	69%	64%	62%	44%	78%	60%	83%	80%	79%	66%
22	115%	117%	116%	131%	210%	111%	136%	81%	53%	171%
23	107%	100%	24%	64%	122%	69%	90%	91%	106%	236%
24	76%	66%	69%	98%	70%	110%	138%	50%	59%	31%
25	106%	85%	74%	57%	131%	102%	129%	208%	185%	217%
26	102%	127%	58%	59%	119%	94%	76%	150%	133%	127%
27	66%	72%	58%	26%	44%	47%	43%	100%	80%	126%
28	115%	83%	113%	154%	224%	140%	133%	140%	188%	163%
29	75%	74%	91%	163%	238%	93%	114%	25%	0%	56%
30	37%	40%	50%	40%	0%	43%	33%	75%	33%	0%
31	98%	109%	81%	125%	79%	73%	107%	115%	111%	117%
32	84%	113%	58%	80%	33%	53%	78%	106%	116%	95%
33	92%	90%	91%	93%	140%	65%	104%	40%	125%	70%

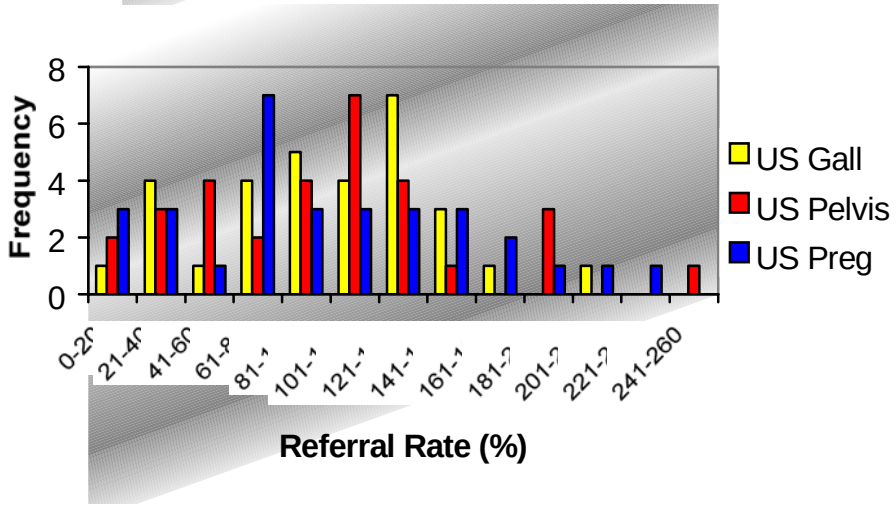
Statistically high and low referrers are shaded grey (darker) and green (lighter) respectively.
Practices 1-17 (excluding 5 and 11) refer the majority of patients to WGH. Practices 5, 11, 21 and 27 refer patients to both RLI and WGH. The remainder mainly refer to the RLI.

Figures 5.1(a), (b) & (c) emphasise the large variation in referral rates amongst practices. At first sight some of these variations are massive. However, whilst they are indeed large, natural statistical variation tends to exaggerate the impression and it would be unsound to quote the maximum variations observed as real variations, particularly for infrequently requested examinations.

Figures 5.1(a), (b) & (c): Histograms of age-standardised GP referral rates overall and for individual examinations.







As in section 4.4 the notion that geographical and socio-economic factors affect radiology uptake in the Morecambe Bay area led to a regression analysis of referral rates for the core practices. In addition to considering the effects of distance, deprivation and 'local hospital' on GP referrals, additional factors unique to practices were included in the analysis in a further attempt to understand the variation. A summary of results is presented in table 5.2, where the variables used in this case are:

- *Patient ratio*: The ratio of female to male patients on the practice list.
- *FemaleGP:Females*: Ratio of female GPs to female patients in the practice. This variable was only employed for Pelvic and Pregnancy Ultrasound examinations.
- *GP ratio*: Ratio of female to male GPs in the practice.
- *GP:Patient*: Ratio of GPs to patients in a practice.
- *Distance*: Euclidean distance (in km) to the hospital (WGH or RLI) receiving the majority of the Practice's referrals.
- *Fundholder*: Dummy variable representing practices that were fundholders at the time.
- *Jarman,Townsend, Carstairs*: Weighted deprivation scores for the practices calculated from the scores for each electoral ward and the proportion of patients from each ward.
- *Localhosp*: indicator variable which takes the value 1 if practices look 'naturally' to Westmorland hospital, 0 if look 'naturally' to Lancaster.

Several conclusions can be drawn from these analyses. First the results for "All (GP) referrals" are very similar to those obtained from the earlier electoral ward-based analysis. In particular the only two significant effects were a tendency for rates to decrease as distance increases and for practices looking 'naturally' to Westmorland Hospital to tend to have higher rates than the others.

Table 5.2: Significant results of regression analyses to explain GP referral rates.

Examination	*Significant effects*	*% of Variation Explained*
All Referrals	Distance, Localhosp	23
Lumbar Vertebrae	Localhosp	43
Cervical Vertebrae	Localhosp, Townsend	43
Other spine	Nothing significant	
Chest	GP ratio*	12
Hip	Distance	20
Knee	Distance, Localhosp	34
Gallbladder Ultrasound*	GP ratio, Distance	21
Pelvic Ultrasound	GP ratio	15
Pregnancy Ultrasound	GP ratio, Distance	36

[*These results were less significant than the others, falling fractionally outside the 5% significance level used otherwise.]

However the 'local hospital' effect does not seem to apply to the same extent across all examinations. Lumbar Vertebrae, Cervical Vertebrae and Knee x-ray referral rates all tend to increase if the local hospital is Westmorland, whereas there is no evidence of a 'local hospital' effect for any of the other examinations. These results support the hypothesis that the higher referral rates are in part due to the open access service at Westmorland General Hospital, as those examinations showing a 'local hospital' effect are available through open access, whereas those not available through open access (e.g. ultrasound examinations) do not show the same effect.

Similarly distance only has a significant deterrent effect for Knee x-ray, Hip x-ray, Gallbladder Ultrasound and Pregnancy Ultrasound. In fact some analyses also suggested that fundholding practices were higher referrers. However this was probably the effect of distance as the fundholding practices tended to be closer to the radiology departments.

In addition the practice-based analysis has also identified a significant effect of GP ratio, i.e. ratio of female to male GPs in the practice. For chest x-ray, Gallbladder Ultrasound, Pelvic Ultrasound and Pregnancy Ultrasound there is a tendency for practices with higher proportions of female doctors to have higher referral rates.

Though the above analyses have highlighted several factors influencing GP referral rates, they only offer limited reasons as to why. The next section attempts to explain this referral behaviour further by approaching the GPs themselves.

5.2 Qualitative Analysis of GP Referral Rates

There were two primary motives for the qualitative study of practice referral rates:

– To improve understanding of the reasons for variation in radiology uptake.

– To provide the practices with a sound basis for discussion of their own referral patterns, and to see whether or not they found the exercise itself to be of value.

Experience from individual interviews with GPs earlier in the study suggested that they were interested in their own referral patterns, and that questions concerning them led to informative answers. Hence postal questionnaires were designed around individualised practice-based reports together with some practice-specific and some general questions. The tailored questionnaires were addressed to the senior partner in each practice and the covering letter encouraged any GP within the practice to reply on behalf of the practice (see appendix B for an example letter and questionnaire).

The questionnaires were in four sections. Section 1 identified significantly high or low referral rates for particular examinations and age groups, asking GPs to suggest possible reasons. Section 2 presented a brief description of the results of the statistical analyses in section 5.1 plus information on referral flows to Lancaster and Westmorland trusts for those practices that made substantial use of both, asking GPs to offer their own insights. Section 3 provided a brief description of the referral profiles of the main wards served by the practice, again asking GPs to offer insights. Section 4 was a set of more general questions concerning for example Radiology guidelines, the local radiology departments and the usefulness of the report itself.

Responses to the Reports

Of the 31 reports sent out, 14 questionnaires were completed. There was concern that practices with significantly high referral rates would be less inclined to respond (and hence 'biasing' the results), but this did not appear to be the case. Of the nine practices that were significantly high referrers, four replied whereas three of the eight significantly low referrers responded.

<u>Comments on Section 1</u>

- Three practices had comments to make on their *high overall referral rates*. Practice 3 attributed the high rates to an elderly deprived population, Practice 22 put it down to good clinical management whereas Practice 4 said that outreach clinics generated

GP-referred x-rays (which might otherwise appear as outpatient clinic referred examinations). Similarly, two practices gave reasons for their *low overall referral rates*. Both Practice 5 and 27 cited distance as a major factor and Practice 27 went on to suggest the rates were due to a healthier and less demanding population.

- Practice 26 attributed a *high chest x-ray referral rate* to one of its partners but also stated that deprived areas and low socio-economic class were factors, whereas Practice 4 again attributed them to the effects of outreach clinics. Practice 5 suggested that a lower incidence of respiratory conditions was the cause of its *low chest x-ray referral rate* whilst Practice 6 felt that chest x-rays were not a useful investigation and may explain why its referral rate was significantly low.
- Practice 4 attributed high *referral rates for spinal x-rays* to the effects of outreach clinics. There were various explanations of low rates; Practice 29 stated that it conformed to Royal College of Radiologists guidelines. Practices 19 and 20 tried not to refer patients for lumbar and cervical vertebrae x-rays as they were of little use for patient management. Practice 26 commented that deprived areas had lower referral rates. Finally, Practice 11 did not consider other spinal x-rays (e.g. thoracic vertebrae) to be useful other than for excluding malignancy.
- Practice 11 ascribed its *low hip referral rate* to its diagnosis of osteoarthrosis being based on loss of function rather than x-ray appearance alone. Practice 4 attributed high *referral rates for knee x-rays* to the effects of outreach clinics.
- Practice 19 suggested that its *high Pregnancy Ultrasound rates* might be explained by a female partner referring a large number of patients. Practice 22 attributed its high Pregnancy Ultrasound rate to the patient population not knowing when they had their last period and hence requiring dating scans. It attributed its *low Pelvic Ultrasound rate* to the belief that if a patient requires the examination she also requires gynaecological referral/opinion. Practice 4 used an inhouse ultrasound service which had reduced its referrals elsewhere.
- With respect to *age group referral rates*, Practice 24 perceived limited use of x-rays for conditions affecting persons under 35 years of age, Practice 11 only referred patients over 75 if it was imperative to diagnosis and Practice 26 attributed its high referral rate amongst 55-64 year olds to a high incidence of morbidity.
- The question posed on *variation amongst individual GPs within a practice* was met with a mixed response. Eight practices did not feel there was any variation and one practice felt it was difficult to assess. The remaining practices felt that substantial

variation existed; Practice 5 suggested that some partners were more confident about relying on their clinical judgement; Practice 19 commented that one partner used a lot of x-rays and ultrasound often in response to patients' requests; Practice 27 suggested that awareness of cost was a factor; and Practice 2 offered several insights into the variation (e.g. female GPs referring for gynaecological examinations, individual behaviour and specialisation of caseloads).

Comments on Section 2

a) *Practices with a higher ratio of female to male GPs tended to refer more patients for Pelvic Ultrasound examinations.* Reasons given were; higher levels of gynaecological investigations and treatments done by female GPs; female patients were more inclined to mention problems to a female GP; these practices perhaps attract more female patients and female GPs were more cautious/sympathetic.

b) *Pregnancy Ultrasound referral rates were affected by distance and the ratio of male to female GPs*. Reasons given were as in (a) above, patients' dislike of travel and over-enthusiasm on behalf of the female GP!

c) Practice 27 *referred more patients to WGH* as results were obtained quicker and it had open access 5 days a week.

d) Practice 5 *referred more patients to RLI for Pregnancy Ultrasound* as full facilities were available (including emergency admissions) and hence all 'problem pregnancies' were sent there.

Comments on Section 3

Reasons suggested for the variation in ward-based referral rates were distance, deprivation (and other socio-economic factors) and use of GPs replacing A&E in more rural areas. One practice believed that its fundholding status had affected is use of radiology services and hence also the referral profile of the wards it served.

Comments on Section 4

- Ten of the responding practices had copies of the *Royal College of Radiologists Guidelines* but only one practice believed that they were often referred to by GPs. Seven practices felt that they were helpful. Of these, one practice remarked that they

were not really written for GPs and several practices qualified their comments, saying that they were mainly useful in their general explanations (for example radiation doses and uses of Chest and Lumbar Vertebrae examinations in younger age groups).

- There were conflicting responses as to whether GPs should be allowed to *refer for CT Scans, MRI and Barium Studies*. Eight practices felt that there were no examinations for which they shouldn't be allowed to refer and several practices commented that they should be allowed to refer for Carotid Ultrasound and IVP within strict guidelines.
- The practices were generally satisfied with the *level of communication* with the radiology departments. A number of additional comments and suggestions were made:

  - Waiting times for certain investigations (e.g. Ultrasound) could be circulated amongst GPs on a regular basis.

  - Consultants should send locally prepared guidelines to practices.

  - Waiting lists for Ultrasound are unduly long.

  - The comment "Report not verified" was not always understood.

  - Practices should receive Radiology reports on their patients who are referred by other sources e.g. as inpatients.

  - Feedback on appropriateness of tests would be useful.

  - Some consultants are easier to discuss problems with than others.

  - A list of Consultants' special interests and when best to phone would be very helpful as they are sometimes difficult to get hold of to discuss x-rays etc.

- All practices *found the tailored analyses to be of interest and would be interested in receiving further information*.
- All but one of the practices would see value in *presenting their practice results alongside other practices* and circulated to all co-operating practices. The exception was Practice 4 which felt they were not directly comparable because of the outreach clinic effect. Just under half wanted practices to be identified.

In Summary

The prime motive of this qualitative part of the study was to improve understanding of the variations in GP referral rates. The comments received do provide various practical explanations for the substantial variations in referral rates amongst practices, and the majority of the responses support the hypothesis that differences in referral rates are a result of differences in GP behaviour. In some cases they also provide cogent arguments for effects for their particular practices, e.g. substitution, which cannot be detected across all practices from the statistical data available.

The second objective was to provide the practices with a basis for discussion and to gauge their reactions to it. In addition to the positive answers to specific questions above concerning interest in the current and future analyses, there was considerable evidence in the replies to suggest that the exercise had been viewed positively, for example:

- Practice 23 was surprised at the high incidence of referrals amongst particular age groups and remarked that they would look into the matter.
- Practice 24 commented that further presentations incorporating RCR guidelines would be of value in changing referral patterns.
- Practice 2 would be interested in the presentation of similar results with individual GPs identified.
- Several respondents felt that the practice referral rate for certain examinations did not correspond to their own personal view of their appropriateness for patient management.
- A number of the reports had been completed by several Partners within the practice.
- Practices were contacted by phone to confirm that they had received the reports and of the two GPs spoken to directly, both said that the analyses had been passed round the practice and discussed at a practice meeting.

In addition, there were indications that some practices had independently taken an active role in the consideration of their referrals to Radiology;

- Practice 2 had audited the usage of x-ray and ultrasound examinations by its GPs and altered its referral behaviour as a result.
- Practice 20 had investigated referrals for Chest x-rays amongst its GPs and whether they complied with RCR guidelines.

6. In-hospital Referred Radiology Examinations

This chapter seeks to identify and better understand variations in in-hospital referral patterns. First specialty-based referral rates are calculated and analysed to allow some quantitative comparisons of consultants. As with GP referrals, these results were then made the basis for more qualitative discussions with referrers. Insights from presenting and discussing these results, often in an audit setting, are reported.

6.1 Consultant-based analyses of Inpatient and Outpatient referrals

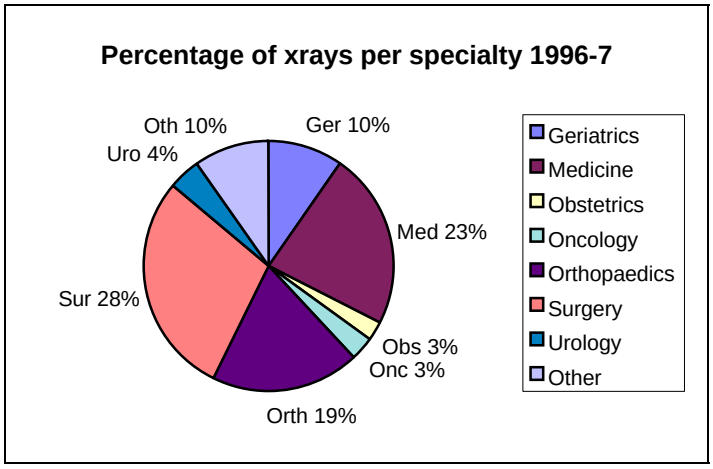
This section of the analysis was based on patients referred by hospital consultant teams to the radiology department at the Lancaster trust during the year 1996/7.

An initial look at the available data confirmed that it was inappropriate to compare the practices of consultants from different specialties, since their case-mix was so disparate. Accident & Emergency referrals were analysed separately. Seven other specialties were selected for further analysis. Between them these seven specialties accounted for 90% of Inpatient, see figure 6.1, and 75% of Outpatient referrals. These specialties were selected for one of three reasons: -

- the specialty makes a large contribution to radiology workload,
- the specialty refers for a limited range of investigations suggesting that the data would be amenable to analysis, or
- the radiology department expressed a particular interest in a specialty's referrals.

The seven specialties selected were Geriatrics, Medicine, Obstetrics, Oncology, Orthopaedics, Surgery and Urology.

Figure 6.1 : Distribution of inpatient x-rays by specialty.



One ***recent trend*** that emerged is shown in table 6.1. For each specialty, inpatient and outpatient referrals, standardised for workload, were compared with the previous year's referrals. In the majority of specialties, the average number of x-rays per patient episode for inpatients can be seen to have decreased, while the average number of x-rays per patient visit for outpatients can be seen to have increased.

Table 6.1: Comparing in-hospital referral profile in 1995/6 and 1996/7

Specialty	Average x-rays per inpatient		Average x-rays per outpatient visit	
	1995/6	1996/7	1995/6	1996/7
Geriatrics	1.02	0.98	0.21	0.21
Medicine	1	0.83	0.22	0.21
Obstetrics	0.26	0.21	0.3	0.39
Oncology	0.33	0.28	0.6	0.78
Orthopaedics	1.1	1.05	0.21	0.23
Surgery	0.81	0.8	0.23	0.23
Urology	0.41	0.56	0.49	0.55
All Referrals	**0.56**	**0.51**	**0.17**	**0.18**

Statistical tests used in this analysis have used a 5 % significance level. Those referral rates which are significantly higher than the previous year are highlighted in grey (darker), while those which are significantly lower are highlighted in green (lighter).

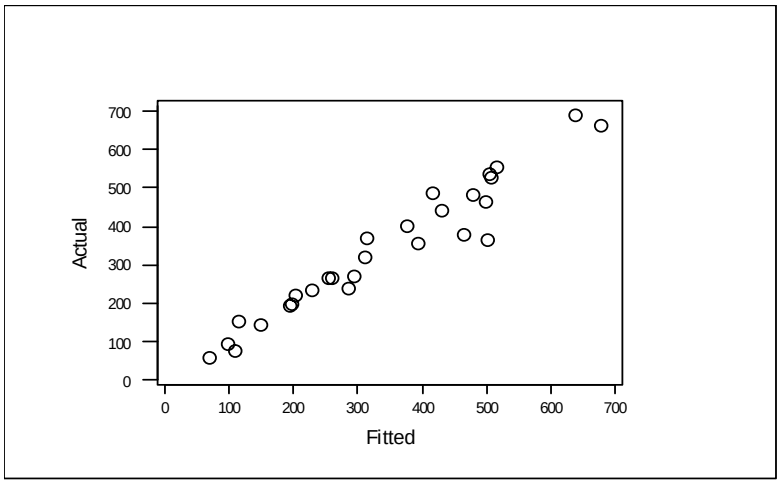
Since the data has been standardised to take changes in workload into account, this result represents a change in practice. Patients are now receiving a higher proportion of investigations as outpatients and a lower proportion of investigations as inpatients. This may be related to shorter lengths of stay. Patients may be 'worked up' prior to admission or receive follow-up x-rays after discharge. This suggestion is supported by the lesser evidence of change within General Surgery, since this specialty was already using day care quite extensively prior to this analysis.

Another interesting result concerns ***A&E referrals*** for radiology exams. The number of radiology referrals from each electoral ward was found, see section 4.4, to be positively correlated with the ward's deprivation score and negatively correlated with distance from the hospital. For referrals to the Lancaster Trust from its natural catchment area this relationship between use of Accident & Emergency services, deprivation and distance from the hospital can be represented mathematically by the following equation:-

Standardised Referral rate = 1.07 + 0.0458 Deprivation score - 0.0236 Distance

Whilst the nature of this relationship may be unsurprising, its strength is quite striking with 73.4% of the variation being explained by these two factors. The accuracy of this equation and hence its ability to explain Accident & Emergency referrals is shown in figure 6.2 by the approximate straight line that can be passed through the origin and the data.

Figure 6.2 : Actual versus expected referrals from A&E



There are two implications of this result. First, patients from more deprived areas on average are more likely to receive a radiology examination via A&E, which may well in part reflect a greater propensity to have conditions requiring A&E services, including x-rays. Second, patients from further away are on average less likely than those living closer to receive a radiology examination via A&E. As the A&E doctor's decision to refer for an x-ray is unlikely to be affected by this distance, this provides further evidence of the deterrence effect of distance on patients' decision to use a service, in this case A&E.

Table 6.2 provides a more detailed analysis of ***standardised in-hospital referrals***. It shows the referral rates for each specialty and each consultant within that specialty, standardised for workload (in terms of number of cases but not casemix). Inpatient and outpatient workloads ere analysed separately. Statistical comparisons compare consultants with the average referral rate for their specialty. The table shows statistically significant differences between consultants in most specialties.

To investigate these differences further, the ***most common investigations*** for each specialty were also identified. Consultant's referral rates for each investigation were

compared with the average referral rate of the specialty, see [21] for details. In some instances, the differences now identified could be attributed to casemix by the researchers, but in most cases discussions with the consultants involved were required. Typical analyses and the process of discussing them with consultant teams are described next.

Table 6.2: Referral rates for individual consultants

Specialty	Average exams per patient seen				
Accident & Emergency	0.49				
	Average exams per inpatient episode	Average exams per outpatient visit	Consultant	Average exams per inpatient episode	Average exams per outpatient visit
Geriatrics	0.93	0.2	Consultant 1	0.9	0.15
			Consultant 2	0.97	0.25
			Consultant 3 *	3.66	0.32
Medicine	0.83	0.21	Consultant 1	1.11	0.16
			Consultant 2	0.57	0.2
			Consultant 3	0.59	0.18
			Consultant 4	1.02	0.12
			Consultant 5	1.02	0.31
Obstetrics	0.21	0.39	Consultant 1	0.45	0.67
			Consultant 2	0.14	0.34
			Consultant 3	0.25	0.4
			Consultant 4	0.21	0.36
Oncology	0.29	0.78	Consultant 1	0.29	0.78
Orthopaedics	1.05	0.23	Consultant 1	1	0.24
			Consultant 2	0.93	0.19
			Consultant 3	1.27	0.3
			Consultant 4	1.05	0.2
			Consultant 5 *	1.09	0.5
Surgery	0.8	0.23	Consultant 1	0.79	0.33
			Consultant 2	1.4	0.11
			Consultant 3	0.72	0.14
			Consultant 4	0.54	0.23
			Consultant 5	1.01	0.32
Urology	0.56	0.55	Consultant 1 *	1.09	0.22
			Consultant 2	0.55	0.56

1. * These consultants are not directly comparable with the rest of their specialty because of a significant difference in areas of specialisation.
2. Statistical tests used in this analysis have used a 5 % significance level. Those referral rates which are significantly higher than the overall average for their specialty are highlighted in grey (darker), while those which are significantly lower are highlighted in green (lighter).

6.2 Consultant referrals: Presentations and Interviews

As with GPs it was hoped that discussion of results with referring consultants would serve two purposes:

– to improve our understanding of reasons for variations,
– to feed back results of the analysis to the referrers allowing them to compare their own practice with that of their colleagues and address any anomalies.

This process involved preparation of reports which were specific to each specialty, presentations of the reports to referrers in their own places of work and then interviews with referrers or questionnaires to ascertain reasons for variations in referral practices. For each specialty, the data was tailored to produce an individual report including analysis for both inpatients and outpatients of:

- the contribution of the specialty to Radiology workload,
- comparison of the three year's data,
- comparison of consultant referral patterns,
- distribution by Körner group,
- the most common investigations,
- analyses concerning lumbar vertebrae x-rays and pelvic ultrasound examinations were also included where appropriate as examinations of especial interest,
- seasonal variations.

The presentations were tailored in similar ways, and were structured to enable the referrers to see what factors had been allowed for and the variation that remained. For example figure 6.3 shows the proportion of medical outpatient workload attributable to each consultant in the specialty. Consultant 5 can be seen to account for 45% of referrals. This may mean he is a higher referrer or that his workload is higher or both.

Figure 6.3: Distribution of radiology exams for Medical Outpatients by referrer

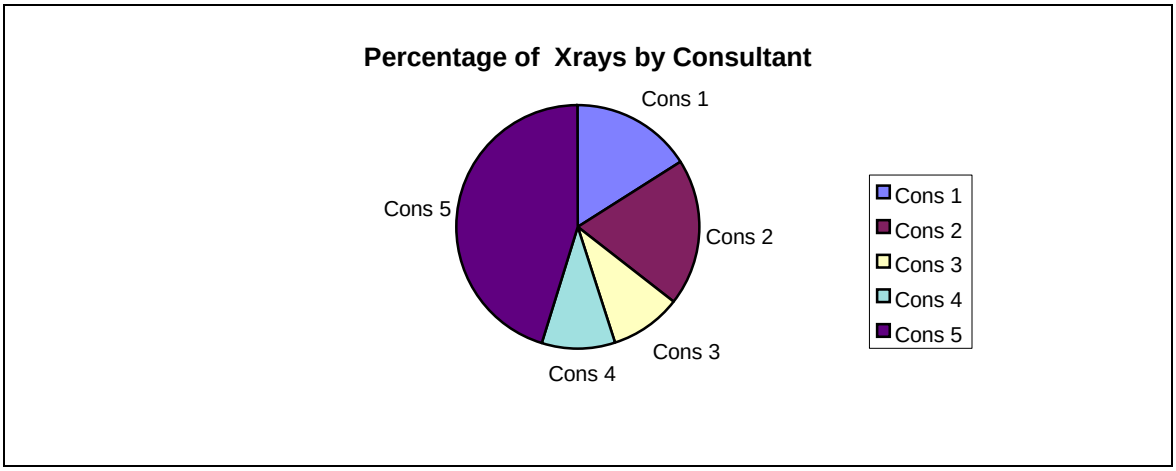


Table 6.3 shows that Consultant 5 remains a high referrer after adjustment for workload but also that his workload was higher to start with. To find out why, consultant referral rates are then compared for the most common investigations for Medical outpatients.

Table 6.3: Comparison of medical outpatient Consultant Referral Rates

Consultant	Average x-rays per outpatient seen
Specialty average	0.21
Consultant 1	0.16
Consultant 2	0.2
Consultant 3	0.18
Consultant 4	0.12
Consultant 5	0.31

Those referral rates which are significantly higher than the specialty average are highlighted in grey (darker), while those which are significantly lower are highlighted in green (lighter).

Table 6.4 shows that Consultant 5 is a high referrer for chest x-rays. Discussion with consultants then revealed whether this is because he is a respiratory specialist (for example) with many chronically ill patients who are reviewed regularly as outpatients, or whether it is due to important differences in his referral criteria.

Table 6.4: Referral rates for Most Common Investigations for Medical Ops

Examination	Cons 1	Cons 2	Cons 3	Cons 4	Cons 5	Average no. of x-rays per outpatient
Chest	0.07	0.047	0.053	0.029	0.197	0.095
CT Head	0.012	0.043	0.013	0.012	0.006	0.016
LV Ejection Fraction	0.023	0.006	0.002	0.006	0.006	0.009
US Doppler	0.014	0.003	0.004	0.008	0.002	0.006
CT Abdomen c Contrast	0.001	0.002	0.004	0.002	0.015	0.006

Those referral rates which are significantly higher than the specialty average are highlighted in grey (darker), while those which are significantly lower are highlighted in green (lighter).

For most of those specialties where comparisons between consultants were possible, presentations to a specialty audit meeting were arranged. These included Geriatrics, Medicine, Orthopaedics and Surgery. Feedback to the researchers was provided by the consultants both at the audit meeting and through follow-up questionnaires. In the case of the other specialties - Accident & Emergency, Obstetrics, Oncology and Urology - individual reports were sent to the specialty and feedback was obtained either through interviews or questionnaires.

There were a number of examples where casemix was found to play an important part. For example two geriatricians explained how similarities in their referral patterns were probably due to teamwork and similarity of casemix as well as sharing the same philosophy and training in geriatric care. In contrast the third member of the team, a geriatrician who specialised in younger rehabilitation patients, had a very different referral profile.

Audit proved to be a useful venue for presentation for two reasons. Most consultants attend their specialty's audit meeting. Secondly, there were strong similarities between the research we were doing and the audit process. However, as audit usually compares what is with what should be, in the absence of national figures for comparison an audit would not normally have been undertaken. Nevertheless our results provided an understandable basis for comparison as well as a possible baseline for future audits. Whilst the value of this exercise was noted, some referrers felt that it is difficult to change practice unless practitioners know the appropriateness of the x-rays done and so suggested that a prospective audit of clinical usefulness would also be valuable.

In Summary the qualitative part of this study has demonstrated that whilst the standardised comparisons of referral rates do not allow for casemix, they can nevertheless provide a sound basis for informed discussion within specialties.

As was the case with GP referrals, the research process again seems to offer an important catalyst for change. Presentations and discussions in an audit setting together with follow-up interviews and questionnaires have led to serious consideration, reflection and professional debate. Consultants within specialties were encouraged to compare their practices, and constructive feedback on the radiology service was generated for the radiology department. For example one orthopaedic consultant chose to change his practice concerning hip x rays following hip replacement.

However we also note that the process would have been considerably strengthened if referral rates had been standardised for casemix. Whilst not possible in this project, it would clearly be a major benefit of linking a radiology department database with inpatient and outpatient systems.

7 Guidelines and Protocols

Guidelines and Protocols provide two possible approaches for reducing variation in the uptake of services by ***attempting to influence referrers' behaviour directly***. In a health service context Guidelines and Protocols have two main objectives: improving clinical management of a condition and facilitating more cost-effective use of limited resources. Their introduction relies on three vital stages - *development*, *dissemination* and *implementation* [22]. Three issues appear to influence whether the development of guidelines is successful - how they are developed, by whom and in what style. Methods used to develop guidelines include literature reviews, discussions amongst small groups and consensus conferences. Dissemination may be achieved through publication in professional journals, mailing to targeted clinicians or seminars. Implementation strategies are generally in the form of reminders or feedback.

Making the Best Use of a Department of Clinical Radiology - Guidelines for Doctors [11] is a pocket sized booklet produced by the Royal College of Radiologists comprising a short introduction on the necessity and philosophy of guidelines and the need for their planned implementation and audit. There are sections on the medico-legal position, the pregnant patient and minimising radiation dose. The main content is devoted to 278 individual guidelines, detailing the investigation, guideline and comment. The stated primary objective of the guidelines is to improve clinical practice and they are intended to be used by hospital and general practitioners alike. Studies have shown that many requests for radiological examinations fall outside these guidelines. Hence, if all doctors adhered to them the number of unnecessary referrals could be reduced. The guidelines

have been recommended by both the NHS Executive and the Audit Commission. The guidelines have been most recently updated in 1998, and further updates are planned.

The table in Appendix C summarises five distinctive studies [23-27] undertaken to evaluate the effectiveness of the RCR guidelines both prior to and following their first publication in 1990. It is not a comprehensive list, but it gives an indication of the range of audits that have been carried out and the varying degrees of success achieved by the guidelines.

Although the studies suggest that the guidelines can and do improve clinical management, it appears that they have been more successful at a specialist rather than a GP level.

At the local level views on the effectiveness of RCR guidelines amongst practices in the Bay area have come from interviews with GPs and from the questionnaires, see section 5.2 and [19] for further details. At present whilst dissemination had occurred in the sense that most practices were aware that they had received a copy, no implementation strategy has been planned. The comments reported in section 5.2 suggest that the guidelines can provide useful information on the appropriateness of referrals, but on the whole it appears that they have yet to make an impact on GP referral behaviour.

One issue that arose during the course of the project was the need for guidelines or protocols that went beyond the RCR guidelines. Three examinations were therefore selected for an investigation of the scope for and approaches to the development of guidelines and protocols: lumbar vertebrae x-rays, pelvic ultrasound and pregnancy ultrasound examinations.

The idea of protocols for pelvic ultrasound scans and spinal x-rays was proposed to David Burch (consultant in obstetrics and gynaecology) and Wendy Dodds (consultant rheumatologist) at Lancaster. Despite the fact that they work in distinct specialties, the response was the same; "*Don't refer patients for radiological examinations on the basis of pain*". The consensus was that protocols were unnecessary in the sense that the fundamental point to get across to GPs was not to refer patients suffering from acute pelvic or back pain.

A recent audit carried out by David Burch highlights this view - of 72 ***pelvic ultrasound scans*** requested on account of the patient complaining of painful periods, only 6 were diagnosed as abnormal. In the majority of cases, long-term menstrual discomfort is not associated with any serious medical problems.

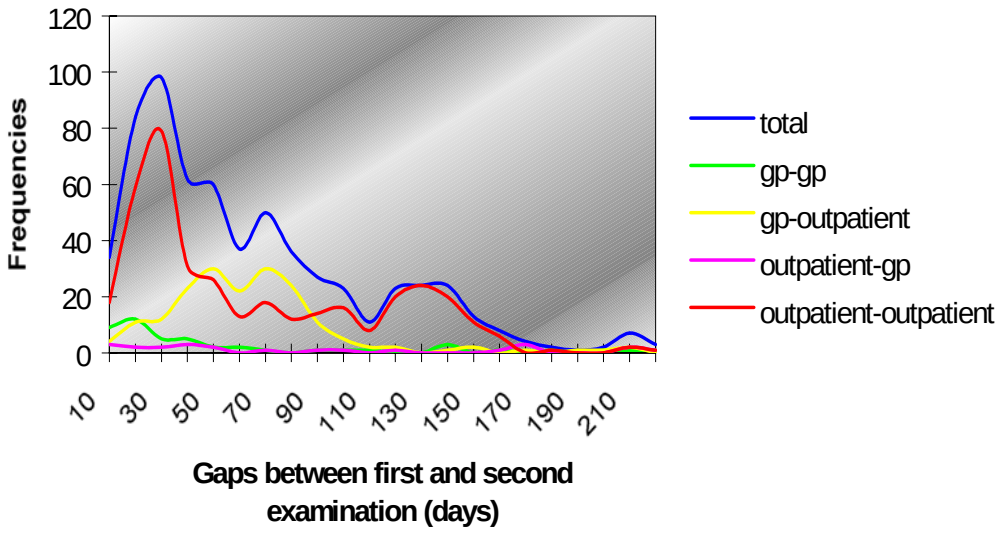
The case of ***spinal x-rays*** reinforced comments arising from our earlier questionnaire responses from GPs. In particular the view was expressed that the RCR guidelines needed further tailoring to be useful to GPs and to the local setting. Guidelines that concentrate on specific areas of clinical management but that are also relevant to radiology, particularly if developed locally, may be more useful to GPs than RCR guidelines. An excellent example of this is a "Back Pains Guideline" pack produced by East Lancashire Health Authority [28]. The project was undertaken after concern was expressed over the ineffectiveness of GPs' treatment for acute back pain. A pack was developed by GPs, physiotherapists and other professionals from ELHA. It contained guidelines for management of back pain, a desktop reminder card, patient education leaflets and a poster display. The packs were disseminated through the post, medical education sessions and practice visits. An audit the following year showed, amongst other evidence, a 27% decrease in lumbar spine x-rays. A similar project concerned with back pain guidelines has recently been completed by Morecambe Bay HA. Simple advice targeted at patients included:

- X-rays for simple back pain are usually not necessary
- Don't think of rest as a cure.

Pregnancy Ultrasound examinations offered the opportunity for a different approach to be investigated. In particular the available information on pregnancy ultrasound examinations undertaken at the Royal Lancaster Infirmary was used to identify potential problems areas where experts might target their guidance and expertise.

In this case the project work [19] showed how a systematic data-mining exercise could be used to identify mothers receiving high numbers of scans and/or scans surprisingly close together, and to trace them back to the referring GP or consultant. In addition the referral profiles of patients according to source of referrals, see for example figure 7.1, or referring GP or consultant could be compared with one another to generate an informed discussion of professional practice. Such a discussion is currently ongoing at the Royal Lancaster Infirmary.

Figure 7.1: Distribution of intervals between first two examinations according to source of first two referrals.



In Summary, whilst protocols and guidelines can provide successful routes to improved referral patterns, they do need to be tailored to the prevailing circumstances. There is clearly scope for using locally gathered data to target protocols, guidelines and indeed less formal communications.

8 Evaluating possible Service Developments

In contrast to the direct influence on referrers' behaviour that is the intention of protocols and guidelines, service developments provide an indirect way by which the NHS can influence access and uptake. During the course of this research three opportunities arose to consider possible service developments, as described in the next three sections.

8.1 Extension of Ultrasound service

One service development that was considered during the course of this action research project was the provision of an ultrasound service in Morecambe, possibly in a new Primary Health Centre. One reason for the proposal was the deterrent effect of distance on the uptake of ultrasound examinations, e.g. as shown in section 5.1 for GP referred patients, which on average resulted in patients living in Morecambe receiving a lower level of this service than those living in Lancaster.

The data and methods described earlier in this report were therefore used to project some of the likely consequences of such a development, see [18] for further details of methods. The results are summarised in table 8.1.

Table 8.1 Projected referrals to New Ultrasound service in Morecambe

(i) GP referred patients (at current referral levels)	892
(ii) GP referred patients (low referrers brought up to average)	1015
(iii) GP referred patients (all referrers brought up to highest)	1437
Morecambe obstetric patients	683
Outpatient examinations from the Morecambe area for Gall Bladder, Kidney and Pelvic ultrasounds	353
Total number of patients referred (GPs at level (i))	**1928**
Total number of patients referred (GPs at level (ii))	**2051**
Total number of patients referred (GPs at level (iii))	**2437**

These projections are estimated to be equivalent to between three and five sessions per week and are helping decision makers to evaluate the likely costs and service benefits of a new service being introduced.

8.2 Magnetic Resonance Imaging

The provision of MRI in the UK was discussed by the Royal College of Radiologists in 1992 [29], and more recently in 1995 by an Audit Commission Report [30]. Both documents highlight the under-provision of MRI in the UK and the high and low extremes of provision. The Audit Commission did not recommend a specific level of provision but found it “difficult to explain and defend both the high and the low extremes of provision” whereas the Royal College report recommended an immediate target level of four MRI units per million population.

Presently there is no static MRI service in the Morecambe Bay area. A mobile unit visits Furness General Hospital fortnightly and Royal Lancaster Infirmary on a monthly basis. Patients are otherwise referred to Preston, Manchester Children’s Hospital Trust, Central Manchester Healthcare NHS Trust, North Manchester General Hospital or Alexander Hospital. The creation of the new Morecambe Bay Acute Hospitals Trust during the course of this project has encouraged thinking in terms of a static unit somewhere in the area.

A Business Case for the provision of a static MRI unit in the Morecambe Bay area presents two major issues; the *need* for a static scanner and consequently its *location*.

The population of the area covered by MBHA is approximately 300,000 and hence, according to the target set by the Royal College of Radiologists, necessitates a MRI unit. This may be seen as a simplistic view, treating Health Authorities as separate entities when in fact services are purchased and provided across ‘borders’, but it does support the case for the acquisition of a static unit in the Morecambe Bay area.

Estimation of annual need cannot be undertaken in the same way as for ultrasound services as outlined in section 8.1 because there is no part of the area which is currently receiving a full MRI service. Whilst immediate annual need, based on current annual usage, can be estimated at 1800 scans, see [19] for details, it is difficult to assess the long-term potential of a MRI service. Not only is the above figure heavily constrained by the current limited facilities but it is also generally felt that once available locally MRI creates its own workload. For example MRI will replace many invasive investigational procedures, e.g. arthroscopy, and specialties such as oncology will rely increasingly on MRI for patient management. The suggestion that MRI could replace 40-60% of the CT workload translates into at least 1100 additional scans yearly at RLI alone, although some would argue that MRI will complement CT scans rather than replace them.

The issue of location of a static MRI unit poses a number of questions. The most appropriate location will be superior in one or several of the following criteria according to their relative importance:

- ***Accessibility***. The location of the static unit is likely to influence the uptake of the service by residents in Morecambe Bay. An appropriate method of examining the effects on the population is a flow modelling approach. Projected patient numbers would be estimated and the benefits of locating the unit in a particular hospital measured in different ways e.g. total or average travel distance for patients, maximum distance from the service location or distance travelled according to mobility levels, likely variation in uptake from different areas.
- ***Location of specialties***. It may be necessary to locate the unit in the vicinity of particular specialties that are or will be frequent users of MRI.
- ***Alternative sources of patients***. There may be scope for referrals from Health Authorities outside Morecambe Bay. The issues of access and estimates of patient numbers arise again but in this case the interest is specifically in projected cross-border patient flows.
- ***Suitable Staffing***. Additional staff will have to be employed and training will be needed.
- ***Infrastructure to support a unit***. Appropriate electrical distribution facilities are necessary and further building work may be required to accommodate the scanner.

The issue of accessibility, outlined above for MRI, is particularly important in rural areas such as Morecambe Bay and is relevant not just to MRI, or to radiology, but to many other services as well. As such it is considered in further depth next.

8.3 Service Location

The amalgamation of three acute trusts into one during the course of the research has naturally started to lead towards questions of the location of services associated with specialties, including radiology. Of particular relevance here are the earlier findings of this research on the important effects of distance, as well as ‘local hospital’, on the uptake of services.

In a more urban population than Morecambe Bay a similar sized population might well be served from just one location for many specialties. However withdrawal of services

from any one of the three sites in Morecambe Bay would typically cause substantial numbers of people to travel 25 or more miles for services. In addition to this decrease in convenience, distance has already been shown to have a significant deterrent effect on the uptake of services. This marked dual effect is characteristic of rural areas, and as argued in [9] should lead health service managers to challenge models of specialty definition and treatment delivery that have been developed to be appropriate in urban settings.

As in due course questions of location emerge for radiology services, including for instance a static MRI unit, the radiology data of the type gathered in this study should be analysed to identify existing patient flows, and incorporated into a patient flow model along the lines described in [9]. Such an approach would enable health service planners to compare alternative scenarios in terms of the likely consequences for patient convenience and uptake of services. In areas such as Morecambe Bay solutions tailored to a rural setting may well be best.

9. Change Management

A fundamental issue exemplified by much of this research is that of ‘change management’. In the past, research has concentrated on analysing the effectiveness of different interventions and, as Mays [31] comments:

> “Until recently, it tended to be assumed that health care professionals, particularly doctors, practiced scientifically and that advances in knowledge would automatically and quickly be assimilated into their day-to-day practice.”

However, this has not proved to be the case.

> “There are numerous topical examples of delay or failure to apply new knowledge in clinical practice.” (Mays [31]).

Ways of improving the transfer of research into practice are now high on the research agenda.

This action research project provided an excellent opportunity to discuss and reflect upon these change management issues in the context of radiology services. Much of this section draws upon the earlier parts of this research, during which various possible ways of encouraging change have been considered, discussed with stakeholders and sometimes tried. In addition further interviews, specific to change management, were undertaken with a range of stakeholders not previously involved in the research, (for example other radiologists responsible for training and audit; contract, audit and business managers; medical advisor to health authority) together with additional meetings with some of those involved earlier.

The remainder of this section therefore discusses “change management” in the light of previous research and recent organisational changes in the NHS.

In a review of the most effective ways of disseminating change in a clinical setting, Oxman [32] grouped the various approaches into the following ten groups:

- Educational materials, e.g. guidelines;
- Conferences / lectures;
- Outreach visits / academic detailing, i.e. visits to the healthcare professional in their workplace to provide information & sometimes feedback on performance;
- Local opinion leaders, i.e. the use of an individual nominated as “influential” by their colleagues;
- Patient-mediated intervention, e.g. advice and educational material targeted at patients;

- Audit & feedback;
- Reminders / decision aids, i.e. written / computerised prompts to action;
- Marketing, i.e. assessment of the barriers & incentives to change in an individual or group to inform the choice of a subsequent intervention;
- Local consensus approaches, i.e. involving local health professionals in identifying priorities and guidelines for change;
- Financial / regulatory incentives.

Oxman included an eleventh group - a multi-faceted approach, i.e. using more than one of the above, and found this to be more effective than simple approaches. Each of these types of approach and its relevance to radiology will now be considered.

Sibbald and Roland [33] suggested that research showed that "the simple distribution of educational materials or guidelines is a poor method of changing clinical behaviour". Other research as well as evidence from our project would support this view. An audit of GP-requested lumbar vertebrae x-rays at one hospital [34] showed that more than half of these did not comply with guidelines. The radiology department at Lancaster sent out a copy of the national guidelines to each GP practice. Of those GPs who remembered seeing the guidelines, they rarely claimed to have used them. From a radiologist's viewpoint the national guidelines are evidence-based and represent the best practice of their profession. However many GPs suggested that local guidelines might be more relevant to their practice. In particular they suggested that guidelines for the treatment of a specific condition would be more useful than guidelines which were only for the use of radiology services. Recent development of local guidelines for the treatment of patients with back pain, see section 7, and for the use of the endoscopy service were highlighted. While national guidelines provide the greatest accuracy, the development of local guidelines can help generate ownership and commitment. Whether guidelines are produced nationally or locally, all guidelines should be presented in a digestible form and need training and support to go with them.

National and local journals were widely cited as a useful form of educational material. To provide an example of beneficial change stimulated by a local journal, a newly appointed paediatrician noticed that GPs were not investigating children who had urinary tract infections. He wrote an article on this in the journal which resulted in an increase in referrals for renal investigations in children. However, one study [35] commented that "the present readership and publication patterns of professional journals may not facilitate effective and rapid information dissemination about innovations to a broad

spectrum of clinicians." For example, any articles published in radiology journals are likely only to be read by radiologists, and not by referrers to radiology.

The effectiveness of conferences/lectures varies. National specialty-based radiology conferences, as with radiology journals, are of little use in disseminating information to referrers since they are outside the target audience for such conferences. The post-graduate education programme is a good forum for dissemination of ideas, but radiology is not a high profile specialty and will usually be low on a GP's list of priorities. Similarly, one radiologist had attempted to present a lecture on the service to GPs and found that only two GPs turned up. The radiologist responsible for the education of junior doctors regarding use of radiology suggested that they are keen to learn, but could find themselves trying to balance the wishes of their consultant with the desire to reduce radiation doses to patients.

Outreach visits / academic detailing have taken place during the project. The project involved preparation of reports which included feedback on the referrer's use of the radiology service, presentation of these reports to referrers in their own place of work and interviews with referrers to ascertain reasons for variations in referral practices. Some effect on changing practice has been seen as referrers become more aware of any anomalies. Other examples of this kind of dissemination include meetings with GPs regarding inappropriate xrays or high referral rates. A particularly productive example might be the attendance of the Clinical Director and the Directorate Manager at a GP forum on any occasion that radiology is to be discussed. In Morecambe Bay this has recently led to joint working with regard to ultrasound services.

Many of those interviewed identified peer pressure as being one of the more effective ways to change practice. This may occur within practices/departments or between the radiology department and its referrers. One radiologist commented that discussion socially with a GP had affected the practice referral rate for lumbar vertebrae x-rays. Informal methods of communication were seen to be effective in changing practice.

Two aspects of patient intervention were commented on. The increase in patient demand for services, particularly since the introduction of the Patient's Charter, has had a negative effect in relation to radiology services. GPs have found it even more difficult to refuse a test to a demanding patient despite feeling the x-ray may not be appropriate. One radiologist expressed surprise at the limited response from the public to a recent Panorama programme which had highlighted (or maybe exaggerated) the dangers of radiation and x-rays.

As a way of stimulating change, audit received a mixed response. While most interviewees felt that it ought to be a useful mechanism for change, inadequacy of time, support and funding were seen to limit its usefulness. Lack of follow-up was highlighted by a few interviewees as a problem with audit. The increasing focus on evidence-based practice may improve the use of audit. GPs suggested that it would be useful if the Trust provided information for practice's audit or sent GPs any departmental audits relevant to them.

Radiologists felt that the time needed to produce reminders or decision aids, alongside the fact that they are yet more pieces of paper, make these less effective options. In contrast, GPs said they would find reminders useful. They read a circular produced by pathology, which provides updates on antibiotics, and find it useful. On the subject of decision aids, one interviewee suggested altering the request card, so that the referrer was forced to consider other options and so the decision process became explicit. This idea had been tried in Huddersfield and had resulted in a reduction in x-rays.

Oxman [32] suggests the use of marketing tools such as surveys, interviewing and focus groups "to elicit professional opinion concerning important clinical difficulties and barriers to overcoming them". As part of this research project, many referrers were interviewed and clinical difficulties as well as barriers to overcoming them were discussed. For example, an increased need for carotid ultrasound was identified. The decision to develop this service had financial benefits for the radiology department since the referrers were willing to provide additional funding for the service. It also enabled the department to maintain a strong relationship with the GPs. GPs gained improved accessibility to the service for their patients as well as strengthening their relationship with the department. However, there were also major barriers to this change relating to the fact that this investigation is time-consuming and so requires the department to change its work practices.

The development of a carotid ultrasound service also demonstrates the effective use of a local consensus approach. Once the need for the service had been identified by the GPs and the department as a priority, the department was able to develop the service. One suggestion made both by radiologists and referrers relates closely to this type of approach in that it involves joint working between the department and its' referrers. The suggestion is that referrers could refer a patient with a specific problem to the radiology department, allowing the department to decide on the appropriate radiological investigation, so utilising the radiologist's expertise and avoiding inappropriate x-rays and duplication of work. However issues relating to autonomy as well as cost of investigations were thought

to be problematic. A ‘triangular’ development of this same approach, is the joint creation between the department, GPs and hospital consultants of specific protocols for particular conditions, allowing each party to refer the patient directly to the appropriate next party.

Sibbald and Roland [33] comment that “Financial incentives and regulatory change can be powerful drivers for altering behaviour, but are relatively blunt instruments capable of provoking perverse change.” Following the 1991 reforms, the effects of GP fundholding and contracting can be seen in the Radiology department. Communication between GPs and the Radiology department had increased dramatically since the advent of fundholding. The Trust itself developed more lines of communication with fundholders, which had been used to some benefit by both parties. However, the department had found that decisions were not necessarily passed on by GPs to their colleagues. Communication between GPs, and hence the dissemination of ideas, had been affected in two opposing ways by fundholding. It encouraged the sharing of ideas within the fundholding group but discouraged interaction between groups, since they were, to some extent, the competition.

Contracting has also had some impact on the radiology service. As a small part of much larger block contracts, radiology’s contract was not specific enough and clinicians were not directly involved in contracting. This led to the production of a “wish-list” and promises to purchasers that could not be delivered. Because inter-directorate charging was not introduced for radiology services, the concept of money following the patient did not become a reality for the radiology service. The radiology budget was decided within the Trust and savings made were not seen at the department level. Within the hospital, a directorate’s use of the radiology service is not limited and so cost is not an incentive for reviewing the investigations that patients receive. On the other hand inter-directorate charging for radiology services was seen to have problems as well as advantages. Referrers could decide to spend their budget elsewhere and so affect radiology’s core funding. On the more positive side some negotiations with fundholding practices have led to some new developments in the radiology service, for example the carotid ultrasound service described earlier.

Other regulatory incentives mentioned by the radiology department, some of which are currently in use and some of which they feel might be beneficial include limiting access to certain services, the use of national or local policies, the ability of the department to refuse any request they do not feel is suitable, and the use of waiting lists as a disincentive.

In Summary in this section the various factors which affect clinical change and the effectiveness of different mechanisms for implementing change in relation to radiology services have been discussed. Clearly different measures will be appropriate in different circumstances. Choices between them should be made in the light of their known strengths and weaknesses, and the greatest benefits may well be achieved by using a multi-faceted approach.

In addition the latest NHS reforms [17] appear to be more supportive of change. The development of a National Institute for Clinical Excellence suggests an increasing focus on disseminating good practice, while Primary Care Groups with their responsibilities towards health improvement programmes and clinical governance should encourage greater cohesion in decision-making, greater interaction between colleagues and new opportunities for beneficial change.

10 Discussion and Conclusions

Results from this action research project have taken a variety of forms in the earlier sections of this report. In this section they are discussed and summarised under three main headings which reflect the overall aims of the research to:

- improve understanding of variations in radiology referral rates (section 10.1);
- investigate, evaluate and recommend opportunities for beneficial change (section 10.2);
- produce generalisable results (section 10.3).

10.1 Understanding Radiology Referral Rates

The factors that lead to relatively high or low uptakes of radiology services are complex. As a result the consequences of actions taken to modify uptakes could well be lost amidst the consequences of factors not so easily controlled. Nevertheless there is value in trying to understand the situation, to use that understanding to generate ideas for beneficial change and to evaluate their likely consequences.

Statistical analyses of available data are capable of shedding light on levels of access and uptake of services, to the point where apparently high (or low) referring GP practices or consultants or localities can be identified, and a profile of their referral patterns can be compared against those of other similar referring sources.

However age-specific usage rates vary massively, so that any comparison of referral profiles must be performed in terms of age-standardised rates. This can be achieved by combining databases of referrals which contain patient's age, postcode, GP (or GP practice) and referring consultant with age-grouped census and GP (or practice) list data.

Ward based analyses of ***aggregate referral rates*** show significant effects of geodemographic factors, with distance and deprivation having a significant combined effect on ***referrals from all sources*** (R^2 value of 43%). Distance and deprivation combined have similar significant effects on ***referrals from outpatients*** (R^2 value of 22%) and ***referrals from A&E*** (R^2 value of 63%). For ***inpatient referrals*** the best explanatory factor is deprivation (R^2 value of 26%), whereas for ***GP referrals*** any simple effects of either distance or deprivation were masked by the stronger effect of 'local hospital'. When 'local hospital' was allowed for, there was then some evidence that distance and deprivation affected referrals (R^2 value of 15%).

Whilst the results above offer important insights, it is equally important to note that there

is considerably more variation in the referral rates than is explained by these factors plus simple annual random variation. Hence there are clearly other factors at work.

Whilst some substitution between referral routes must occur, it was not detectable in the data and does not explain much of the overall variation in the referral rates. A thorough study of this issue would only be feasible if patient's GP practice and/or GP were recorded whenever they were referred for a radiology examination, whether their referral was directly by their GP, or by a hospital doctor.

When looked at in further detail ***GP practice referral rates*** were found to vary massively, but often in different ways for different examinations. For example a practice might be a significantly high referrer for some back x-ray examinations and a significantly low referrer for some ultrasound examinations. Statistical analyses revealed that distance, 'local hospital' and the ratio of female to male GPs all had significant effects for some of examinations (see table 5.2 for a summary). However substantial unexplained variations still remained.

GPs responded well to ***reports and questionnaires tailored to their individual practices***. Their explanations of these variations included geodemographic reasons, belief that there is a high/low incidence of problems, and a number of examples of explicit and implicit practice policies. In-house services, hospital outreach clinics and open access were all identified as potential causes in some cases, as were significant variations in the practices of individual GPs, see section 5.2 for details.

Consultant ***inpatient and outpatient referral rates*** vary massively between specialities, and comparisons that make no allowance for specialty are virtually useless. However there is some evidence of significant shifts in referral patterns over time, mainly an increase in outpatient rates and a decrease in inpatient rates. There is also some evidence of significant variation between consultants within specialities. As standardisation for casemix was not possible in this study, the real significance of variations needed to be interpreted in the light of the professional judgement of the consultants involved. This was possible by presenting results to consultant groups via reports tailored to their specialty or presentations, often as part of an audit meeting.

Referral rates from A&E showed by far the strongest geodemographic effects with distance and deprivation explaining much of the total variation in rates. However this is expected to be due to how these two factors affect attendance of patients at A&E rather than any effect on the propensity to refer to radiology once the patients have arrived in A&E.

10.2 Routes to Beneficial Change.

Change management is crucial to the continuing development of health services and a range of processes that might be adopted are reviewed in section 9. Ways forward considered in some detail in this research have mainly hinged around the intelligent analysis of available information to give health care professionals and managers a sound basis for discussion of their current patterns of referral and service delivery, and hence a firm basis for identifying and evaluating opportunities for beneficial change.

GP practices responded well to ***tailored reports and questionnaires*** about their use of radiology services. All responses indicated that they were interested in receiving reports and in many cases that they were using or could envisage using the information to constructively review their practices. Looking forward to the responsibilities of PCGs to become involved in clinical governance and health improvement programmes, reports of this sort that provide a sound basis for comparing practices could provide an essential catalyst in reasoned discussion and beneficial change.

Consultant teams also responded well to reports tailored to their specialties, and to presentations and discussion of results. Whilst casemix remains an important cause of variations there is in theory scope for referrers to "pull the wool" over each other's eyes – knowingly or not. However the experience of the research was that presentation of results (for example in an audit setting) led to serious consideration, reflection and professional debate. This approach again provides a sound basis for comparing practices relevant to clinical governance and health improvement and could provide an essential catalyst for reasoned discussion and beneficial change.

Guidelines and protocols also offer routes to improved referral patterns. However some referrers are clearly much more influenced by this sort of information than others. Localised and problem-specific guidance rather than examination specific, (e.g. back pain rather than lumbar vertebrae x-ray) is generally thought more likely to influence local practice. Indeed informal communications about specific local issues are much valued by referrers. There is scope for using analyses of local data to target formal and informal communications.

Many ***service developments*** will have a direct impact on the distance that patients need to travel for those services and hence convenience of access. In addition, as demonstrated in section 4.4, distance can also have a serious impact on uptake of services with little evidence of substitution with alternative services.

For example, at a fairly localised level, a new ultrasound service in Morecambe would

improve the service to Morecambe residents in terms of closeness and convenience, but also would be very likely to increase the average level of uptake substantially amongst Morecambe residents. Similarly at a health authority level additions or reductions in many services will impact on access, uptake and equity. The scale of such impacts will typically be much larger in rural areas such as Morecambe Bay than in more urban settings. As such it is important that any evaluations of the likely impacts of service developments takes ***proper account of the effects of distance***. In addition it should be expected that service developments evaluated as beneficial in urban settings may require substantial re-evaluation for rural settings. Indeed those involved in developing services in more rural settings may need to be very innovatory in their approaches. Patient flow modelling can be used to illuminate the consequences of possible schemes.

10.3 Generalisations

Whilst the focus of this research has been on radiology services, it was acknowledged at the outset that in terms of the overall issues of Access, Uptake and Equity, radiology was just one example service. As the research has progressed the researchers have been aware that many of the issues that have arisen could equally well have emerged in a similar study of other services. Hence whilst the research has clearly not shown the above conclusions to be true of other services, they have been phrased in terms that could be applied to other services. Furthermore ***it is postulated*** by the researchers that they would indeed be ***moreorless duplicated in many respects by similar studies of other services.***

The existence of ***PCGs and their role in clinical governance and health improvement programmes*** were not foreseen at the start of this research. However it has become clear as the research has progressed and the latest reforms have started to take shape, that many of the approaches developed in this research could play a very important role in enabling health care professionals and managers to undertake their new responsibilities with respect to a whole range of services, of which radiology is just one example. In particular the combination of quantitative and qualitative investigations would be very valuable in enabling health care professionals and managers to come to a common understanding of the issues involved, and would act as an essential catalyst in the joint generation and evaluation of ideas for service development.

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Appendix A: Deprivation scores

In all three indexes a large positive score implies an area associated with high deprivation.

Jarman Underprivileged Area Index (1984)

Composite score based on eight variables: -

i. Unemployment
ii. Overcrowding
iii. Lone Pensioners
iv. Single Parents
v. Born in New Commonwealth
vi. Children aged under 5
vii. Low Social Class
viii. One Year Migrants.

The arcsine of the square root of each variable is used and the standardised scores are summed according to their weightings. Variables are weighted differently – iii & vi in particular have greater influence on the final score.

Townsend Material Deprivation Index (1988)

Composite score based on 4 variables: -

i. Unemployment
ii. Overcrowding
iii. Non Car Ownership
iv. Non Home Ownership

Unemployment and overcrowding variables are transformed using the natural log transformation and standardised scores are summed without weighting.

Carstairs Index (1991)

Composite score based on four variables: -

i. Unemployment
ii. Overcrowding
iii. Non Car Ownership
iv. Low Social Class

All four variables are standardised and these are summed without weighting.

Appendix B:
Sample letter to GP practices, individualised report and questionnaire.

Sample letter

Dear Dr.,

The report included with this letter is part of a wider project titled "Variations in Access, Uptake and Equity: Radiology Services". The project is funded by the NHS Executive (North West) and has the following objectives:

- To improve understanding of the reasons for variations in the uptake of the radiology service.
- To investigate and evaluate possible ways in which Purchasers, Providers and health care professionals could beneficially influence the uptake of services in the light of
  - new services that are becoming available
  - existing guidelines and local expertise on the use of radiology services
  - available effectiveness and cost-effectiveness information
  - the desire for equity.
- To contribute to a general methodology for undertaking this process elsewhere and for other services.

Areas of investigation have included within hospital referrals to radiology by consultants, direct referrals to radiology by GPs and Ultrasound services.
The results in the attached report compare the radiology referrals made by your practice to the average of all practices referring predominantly to Lancaster Royal Infirmary and Westmorland General. We hope that they are of some interest to you and your colleagues. All results including the analyses in the report will be treated as confidential. The report consists of three sections; the first section (Analysis I) relates specifically to your Practice whereas the second and third sections (Analyses II & III) are concerned with overall GP referrals and the uptake of radiology by wards respectively. Copies of the analyses are included for you to keep.
It would be greatly appreciated if you or one of your colleagues could fill in and return to us the brief questionnaires on pages 1 & 2 by Tuesday 18th August (please find enclosed an S.A.E. for this purpose). Additionally, if you were able to spare the extra few minutes there are further questions on Pages 3 & 4 to which we would value your answers.
We would like to thank you for taking the time to read this report and we look forward to your response. If you require any further information about this study, please do not hesitate to call (01524 593872) or email (d.worthington@lancaster.ac.uk).

Yours sincerely,

Dave Worthington

Sample Individualised Report and Questionnaire

Analysis I *(referred to as section 1 in write-up)*

Data has been provided by Westmorland General and Lancaster Royal Infirmary on all radiology examinations occurring between April 1996 and March 1997. During this period 96,000 examinations took place, of which 19% were GP referred.

Of the 59 GP practices (including branches) in the Morecambe Bay Health Authority, 33 have been selected as referring the majority of their patients to either of the two hospitals mentioned above. As it was felt that the age-mix of patients within a practice would be a significant factor in determining uptake, age standardised referral rates have been produced. Referral rates for 9 of the most frequently requested examinations have also been calculated. These are Chest, Lumbar Vertebrae, Cervical Vertebrae, Other Spine, Knee and Hip x-rays and Gallbladder, Pelvic and Pregnancy Ultrasound examinations.

Those rates that have statistically proved to be significantly higher or lower than the 100% average referral rate for the area are highlighted. It should be pointed out that the term 'average' does not imply desirable.

Age Standardised Referral Rates for Practice X:

Exam	*All*	*Chest*	*LV*	*CV*	*Other V*	*Knee*	*Hip*	*US Gall*	*US Pelv*	*US Preg*
Actual	526	147	70	42	13	50	21	7	25	7
Expected	568	146	52	35	23	45	30	24	26	27
Rate	93%	101%	135%	120%	57%	111%	70%	29%	96%	26%

Age Group	*0 to 4*	*5 to 14*	*15 to 24*	*25 to 34*	*35 to 44*	*45 to 54*	*55 to 64*	*65 to 74*	*75 plus*
Actual	11	18	32	64	65	86	91	100	59
Expected	3	8	45	71	53	72	157	93	66
Rate	367%	225%	71%	90%	123%	119%	58%	108%	89%

Can you think of any possible reasons for the significantly high referral rates for Lumbar Vertebrae x-rays and significantly low referral rates for Other Spinal x-rays (in comparison to the area average) within your practice?

Can you think of any possible reasons for the significantly low number of Pregnancy and Gallbladder Ultrasound examinations within your practice?

Can you think of any possible reasons for the significantly high number of radiology examinations amongst 0-4 and 5-14 year olds within your practice?

Would you say that there is substantial variation in referral rates amongst GPs within your practice? If so, can you offer any insights into reasons for them?

General *(referred to as section 4 in write-up)*

Does your practice have a copy of the Royal College of Radiologists Guidelines? When was it first acquired?

Do you think that they are often referred to by GP's within your practice?

Do you find them to be useful? Please give reasons.

Are there any examinations for which you think GPs should be allowed to refer but are not at present?

Conversely, are there any examinations for which you think GPs shouldn't be allowed to refer?

Are you satisfied with the level of communication between GPs and the radiology departments? Are there any changes you would like to see made?

Have you found the attached analyses to be of interest?

Would you be interested in receiving further information of this kind?

Would you see value in presenting your practice results for Analyses I & III alongside other practices and circulated to all co-operating practices with practices identified, not identified or not at all?

Analysis II *(referred to as section 2 in write-up)*

Following this study, regression analyses were performed on the results to determine whether issues such as distance and deprivation had any overall influence on the levels of GP referrals to radiology. Amongst the factors included were distance to nearest hospital, deprivation, ratio of GPs to patients and ratio of female to male GPs within a practice.

It was inferred that:

a) Deprivation had a significant effect on lumbar vertebrae and cervical vertebrae referral rates; practices serving more deprived areas tended to refer fewer patients. This factor explained approximately 20% of the variation.

b) The ratio of female to male GPs within a practice had a significant effect on Pelvic Ultrasound referral rates; a greater proportion of female GPs within a practice was usually accompanied by higher referral rates. This explained 15% of the variation.

c) Pregnancy Ultrasound referral rates were affected by two factors; distance and the ratio of female to male GPs. Lower referral rates were associated with greater distances and fewer female GPs. These factors explained approximately 35% of the variation.

Based on your experience, Can you offer any practical reasons for the above results?

Analysis III *(referred to as section 3 in write-up)*

Whereas Analyses I & II focussed on patients referred directly by GPs, this analysis concentrates on radiology referrals according to the patients' wards. Of the 89 wards within the Morecambe Bay area, 60 were selected as referring the majority of their residents to either Lancaster Royal Infirmary or Westmorland General. Age standardised referral rates have been produced using the same technique as in Analysis I for Inpatient, Outpatient, GP, A&E and 'All' examinations.

The table below provides a profile of the level of usage of radiology services by patients living in wards served by your practice. The '*estimated coverage'* column gives the proportion of patients from a particular ward that were referred directly by your practice. All referral rates statistically different from the 100% average rate have been highlighted.

Ward	*Estimated coverage of ward by your practice*	*Number of records*	*All*	*Inpatient*	*Outpatient*	*GP*	*A & E*
Ward A	89%	290	88%	93%	81%	109%	74%
Ward B	96%	90	57%	66%	58%	68%	41%

To what extent do you think that this profile can be explained by policies or procedures of your practice or other practices nearby?
To what extent do you think that this profile can be explained by other factors?

Appendix C: Five Studies to Evaluate RCR Guidelines

Period of study	Authors	Outline of study	Method of implementing/disseminating guidelines	Outcome
1. Jan - Dec 1985	F. Fowkes et al	Conducted in five major hospitals in the UK. RCR guidelines on the use of pre-operative chest x-rays were implemented for one year under four different strategies (the fifth hospital was a control).	The four strategies were: A) the appointment of a utilisation review committee and display of guidelines in wards B) getting feedback on use to consultants C) the introduction of a new chest x-ray request form D) the reviewing of x-ray requests by the radiology department.	A) Rates fell in the first six months and dropped further after guidelines were displayed (16% reduction at best). B) Rates decreased consistently over the year (12% at best). C) Rates remained more or less constant (8% at best). D) Rates decreased overall (15% at best).
2. Jan 1987 - Dec 1990	Royal College of Radiologists Working Party	Data collected from five district general hospitals and one district health authority on referral numbers before and after radiology guidelines were introduced.	Booklets were distributed to staff and review committees intervened if specialties were deemed as high referrers. Intervention ranged from informal discussions with consultants to formal presentations to all medical staff.	Overall, inpatient and outpatient referrals were reduced by 7.7% and 8.9% respectively.
3. Jan 1989 - Dec 1990	Royal College of Radiologists Working Party	Referral data was collected from 22 practices. Guidelines were introduced after one year.	Guidelines and the study were explained to Practices. No reinforcement of the guidelines took place.	Overall, referral rates were reduced by 13% .
4. April 1992 - Aug 1992	P. Oakeshott et al.	Referral numbers for 62 practices were collected for a period of 7 weeks prior to the introduction of guidelines and 9 weeks following the introduction of the guidelines to 30 of the practices.	Guidelines and an introductory letter were sent out to each GP.	Practices who had received guidelines requested significantly fewer examinations for the spine and made a significantly higher number of requests that conformed to the guidelines. There was no significant reduction in requests for chest, limbs or joints x-rays, nor in the overall referral rates.
5. Aug 1994 - Nov 1995	B. Morgan et al.	Involved analysing the radiology reports of 1153 referrals by 150 Practices for knee x-rays over a 9-month period, and following up each result with a questionnaire on reasons for referral.	Results of the analysis and questionnaire were sent to GPs along with current RCR guidelines. GPs were invited to give their comments on the results.	Only 50% of referrals fell within RCR guidelines. Despite GPs being informed of the results and guidelines, the audit did not alter their referral rates.