Imaging orders by general practitioners in Australia 1999–00

GP Statistics and Classification Unit

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The General Practice Statistics and Classification Unit is a collaborating unit of the Australian Institute of Health and Welfare and the University of Sydney, situated within the Family Medicine Research Centre at Westmead Hospital. It fulfils the obligation of the Australian Institute of Health and Welfare to collect statistics regarding general practitioners, their patients and their patients' care.

Other related publications:

Britt H, Sayer GP, Miller GC, Charles J, Scahill S, Horn F, Bhasale A 1999. *BEACH,* Bettering the Evaluation And Care of Health. A study of general practice activity, six-month interim report. AIHW Cat. No. GEP 1. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 1).

Britt H, Sayer GP, Miller GC, Charles J, Scahill S, Horn F, Bhasale A, McGeechan K 1999. General practice activity in Australia 1998–99. AIHW Cat. No. GEP 2. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 2).

Sayer GP, Britt H, Horn F, Bhasale A, McGeechan K, Charles J, Miller GC, Hull B, Scahill S 2000. Measures of health and health care delivery in general practice in Australia. AIHW Cat. No. GEP 3. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 3).

Britt H, Miller GC, McGeechan K, Sayer GP 1999 [cited 30–10–2000]. Pathology ordering by general practitioners in Australia 1998. AIHW Cat. No. GEP 4. Canberra: Department of Health and Aged Care (General Practice Series No. 4). Available from Internet: http://www.health.gov.au:80/haf/docs/pathorder.htm

Britt H, Miller GC, Charles J, Knox S, Sayer GP, Valenti L, Henderson J, Kelly Z 2000. General practice activity in Australia 1999–2000. AIHW Cat. No. GEP 5. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 5).

General Practice Statistics and Classification Unit 2000 [cited 22–12–2000]. SAND abstracts from the *BEACH* program. Sydney: AIHW/University of Sydney. Available from Internet: http:/www.fmrc.org.au/beach.htm

Britt H, Miller GC, Valenti L 2001 'It's different in the bush': a comparison of general practice activity in metropolitan and rural areas of Australia 1998–2000. AIHW Cat. No. GEP 6. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 6).

GENERAL PRACTICE SERIES
Number 7

BEACH

Bettering the Evaluation and Care of Health

Imaging orders by general practitioners in Australia 1999–00

Helena Britt, Graeme C Miller, Stephanie Knox

July 2001

A joint report by the University of Sydney and the Australian Institute of Health and Welfare

AIHW Cat. No. GEP 7

This is the seventh publication of the General Practice Series, from the General Practice Statistics and Classification Unit, a collaborating unit of the University of Sydney and the Australian Institute of Health and Welfare. A complete list of the Institute's publications is available from the Publications Unit, Australian Institute of Health and Welfare, GPO Box 570, Canberra ACT 2601, or via the Institute's web site at http://www.aihw.gov.au.

ISBN 1 74024 126 6

ISSN 1442-3022

Suggested citation

Britt H, Miller GC, Knox S 2001. Imaging orders by general practitioners in Australia 1999–00. AIHW Cat. No. GEP 7. Canberra: Australian Institute of Health and Welfare (General Practice Series No. 7).

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Published by the Australian Institute of Health and Welfare

Printed by Panther Publishing and Printing

Foreword

Diagnostic imaging plays a critical role in medical practice by confirming clinical diagnosis, excluding the presence of disease, determining the severity or extent of known disease, establishing whether disease progression has occurred and monitoring response to treatment. Despite these considerations, high quality evidence in the literature on the effectiveness of diagnostic imaging, in terms of diagnostic accuracy, impact on clinical decision-making and influence on health outcomes, is often lacking. Comparisons between different diagnostic imaging modalities are rarer still.

Another area where data are lacking relates to the clinical utilisation of diagnostic imaging. While Australia has good aggregate data on diagnostic imaging services reimbursed through Medicare at the national and regional level, up to the present information has been unavailable on the clinical indications for diagnostic imaging services. This deficiency has been remedied, for general practice, in the current publication, which links presenting problem and clinical assessment to diagnostic imaging test requested. In addition, utilisation of diagnostic imaging is analysed according to patient and doctor characteristics.

Accurate information on diagnostic imaging utilisation underpins efforts to improve the quality of use of diagnostic imaging services. Quality use initiatives can be directed towards the judicious use of diagnostic imaging, the selection of the appropriate diagnostic imaging modality to use in a particular clinical situation and the effective use of diagnostic imaging results in clinical management. Such initiatives have the potential to improve the efficiency of healthcare and to promote better health outcomes.

The acquisition of these data can also enhance the understanding of the reporting radiologist of the decision making processes of the referrer, and indeed could act to facilitate improved referrer/provider liaison. Thus future discussions between the Commonwealth Department of Health and Aged Care and the providers of diagnostic imaging may also be enhanced by greater awareness of the role of the referrer.

We congratulate the authors of this report and anticipate that their findings will be of great use to researchers and policymakers.

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Background

Between 1994–95 and 1998–99 the number of diagnostic imaging services provided in Australia increased by 1.5 million, or 15%. About 60% of expenditure on imaging is for investigations initiated by GPs. Between 1991–92 and 1995–96 the value of imaging services ordered by 'non-specialists' rose from $349 million to $537 million per year, an increase of 54%. Data from the Health Insurance Commission (HIC) lack linkage to patient morbidity, limiting exploration of the reasons general practitioners (GPs) order imaging services.

Aims

This study aims to describe the patterns of imaging ordering by general practitioners in Australia, and investigate the relationship of orders to GP characteristics and patient characteristics and to the morbidity under management. It also aims to assess the relationships between GP behaviour, the available evidence and current guidelines.

Literature review

The literature regarding assessment of the value of diagnostic imaging is large and varied. However, the poor progress in radiology outcomes research makes the development of meaningful guidelines difficult. In light of the poor scientific evidence available for meta-analysis, the American College of Radiology (ACR) developed appropriateness criteria using a consensus process to complement the scientific data. In the absence of better evidence, the ACR Appropriateness Criteria™ probably represent the state-of-the-art advice on appropriateness of diagnostic imaging tests for the conditions that they cover.

The Royal Australian and New Zealand College of Radiologists (RANZCR) released the fourth edition of its imaging guidelines in April 2001. These guidelines use an algorithm approach to illustrate the diagnostic choices in a wide range of circumstances. Unlike the ACR criteria, no quantification of 'appropriateness' is provided in *Imaging Guidelines* (RANZCR 2001).

This report includes an appraisal of the relationship between the available guidelines and current GP practice for each of a series of specific imaging types and selected problems managed. The evidence on which to judge the appropriateness of GP ordering behaviour and to assess the impact of supplying imaging guidelines to GPs, is scanty and equivocal. Equally, the evidence base for the guidelines in terms of their applicability to general practice is sometimes open to question.

Methods

This study of general practitioner orders for imaging is a secondary analysis of data from the *BEACH* (Bettering the Evaluation and Care of Health) program, a continuous national study of general practice activity. *BEACH* relies on a random sample of approximately 1,000 recognised GPs per year. Each records details about 100 doctor–patient encounters of all types. The information is recorded on structured paper encounter forms. It is a rolling sample, about 20 GPs participating each week, 50 weeks a year.

This study utilises information about 104,700 GP–patient encounters from a random sample of 1,047 GPs who participated in the second year of the program, April 1999–March 2000. After post-stratification weighting there were 104,856 encounters in the final dataset.

Four care processes were defined for imaging tests ordered: investigative imaging, management imaging, monitoring imaging, and undefined imaging. Definitions were based on the status of the problem to the patient (new or old) and the level of diagnostic certainty represented by the label recorded by the GP to describe the tested problem.

Results

At least one imaging test was ordered by the GP at 6,979 (6.7%) of the 104,856 encounters. Tests were ordered at a rate of 7.6 per 100 encounters, or 5.1 per 100 problems managed. Extrapolated to the total GP–patient encounters across Australia, this suggests there were approximately eight million orders for imaging placed by GPs over the 12-month period.

At least one imaging order was placed in relation to 7,218 problems (4.7%). The mean number of imaging tests ordered was 6.9 tests per 100 encounters, with a standard deviation of 4.9 per 100. The ordering rates for the majority of GPs therefore fell between three and 11 tests with a minimum of no tests and a maximum of 62 per 100 encounters.

GP characteristics and imaging orders

The GPs were divided into three groups according to imaging order rate: the low ordering group (< three test orders per 100 encounters), the medium ordering group (3–11 tests per 100 encounters); and the high ordering group whose test rate was above this range.

GPs in the high ordering group were more likely to be female and more likely to work in small rural areas than those in the low ordering group. They were also less likely to be in solo practice. Those in the low ordering group were more likely to be male and to work in metropolitan areas and in solo practices.

Using analysis of variance and linear regression, the factors that affect GP imaging rates were explored. GPs from practices with 11–15 GPs had significantly higher imaging order rates than did solo GPs, and those from small rural/remote practices had higher rates than did urban GPs.

The strongest independent predictor of imaging order rates was the rate of encounters with new patients. Other significant predictors were:

- higher rates of management of musculoskeletal, urinary and female genital problems
- higher rates of problems described in symptomatic terms
- lower rates of patients aged 25–44
- lower rates of health card holders
- lower rates of management of psychological, skin and general/unspecified problems.

Characteristics of imaging encounters

The characteristics of the 6,979 imaging encounters were compared with those of the 97,878 non-imaging encounters. There were four significant differences between imaging encounters and non-imaging encounters. Imaging encounters were more likely than non-imaging encounters to be direct consultations (patient seen), and more likely to be charged to Medicare, less likely to be standard surgery consultations and more likely to be a long surgery consultation.

Patients at imaging encounters were more likely to be aged between 25 and 44 years and between 45 and 64 years than those at non-imaging encounters and far less likely to be children. There were no further significant differences between patients attending imaging encounters and those attending non-imaging encounters.

At imaging encounters there were significantly more patient reasons for encounter and more problems managed. Further, the problems were more likely to be new problems to the patient than those at non-imaging encounters. Orders for pathology tests were ordered at almost double the rate of non-imaging encounters

Imaging tests ordered by MBS groups

Diagnostic radiology tests numbered 5,042 and accounted for the majority of imaging tests ordered (63.7%). At least one was ordered by 96.1% of GPs. The most common were chest x-rays (21.0% of all imaging ordered); plain x-rays of the knee (7.9%); mammograms (7.2%); and plain x-rays of the lumbosacral region (5.3%), the ankle (4.2%) and shoulder (4.2%).

Orders for ultrasound numbered 2,035 and accounted for one-quarter (25.7%) of the total. More than three-quarters (78.5%) of the GPs ordered at least one. The most common were those of the pelvis (17.7% of all ultrasounds), the abdomen (12.5%), the breast (9.5%) and the shoulder (7.6%). However, obstetric ultrasounds (10.5%) took third place in this group.

The 674 computed tomography tests (CT scans) were ordered by less than half of the GPs. Seven tests accounted for 79.1% of all CT scans, including CTs of the brain, the head, the lumbosacral spine and the abdomen. There were only 24 magnetic resonance imaging tests ordered among 23 GPs and 16 nuclear medicine tests ordered among 16 GPs over the 12 months.

The distribution of the Health Insurance Commission imaging data across MBS major groups was similar to the distribution of the GP imaging test orders found in *BEACH*, with approximately two-thirds of the test falling onto the diagnostic radiology group. The gender distributions of the patients for whom the imaging tests were ordered/undertaken were also similar, as was the distribution by patient age group.

The imaging tests most often ordered

The top 30 individual test types ordered by GPs in *BEACH* accounted for almost two-thirds (61.9%) of all tests ordered. Chest x-rays were by far the most common, accounting for 13.3% of total imaging orders, followed by x-rays of the knee (5.1%). Mammography and pelvic ultrasound each accounted for 4.6% of imaging, and lumbosacral x-rays, 3.4%. Abdominal ultrasounds were slightly less common (3.2%) as were obstetric ultrasounds and plain x-rays of the ankle (each accounting for 2.7%).

Care process of imaging orders

More than one-third (35.6%) of all imaging orders were classed as investigative, 28.1% as management of new diagnoses, 30.7% as monitoring of old problems and 5.6% as undefined. The high proportion of investigative imaging is supported by the literature.

Imaging ordering by problem type

In the total dataset there were 153,857 problems managed, at an average rate of 147 per 100 encounters. About 5% of all problems managed generated an order for imaging.

Musculoskeletal problems accounted for the greatest proportion (40.4%) of imaging tests and were the problems most likely to be tested (16.0% generating at least one imaging test order). About one in 10 female genital problems were tested (9.4% of all imaging tests). While 7.2%

of urological problems generated an imaging test order these tests accounted for only 3.2% of all imaging tests ordered. A similar pattern was shown for pregnancy and family planning. Digestive and neurological problems came next in terms of the proportion of problems being tested (6.2%). However, digestive problems accounted for 8.9% of all imaging tests while neurological problems accounted for only 3.6%. Imaging test orders were most commonly associated with problems given a symptom/complaint label (7.5% being tested). Less than 5% of contacts with problems given a diagnosis/disease label generated imaging test orders.

The 20 specific morbidity types generating the most imaging orders accounted for 44.5% of all imaging ordered. Back pain, fractures, osteoarthritis and joint sprain/strain accounted for the highest number of test orders but varied in the extent they were tested.

The problems most likely to generate an order for one or more imaging tests were breast lump (56.4% of contacts tested), followed by symptoms of the hip (44.8%), fibrocystic disease of the breast (44.7%), urinary calculus (44.1%) and cholecystitis (40.3%).

Investigation of selected specific imaging test types

More specific examination was undertaken of eight selected imaging test types including: chest x-ray, mammography and breast ultrasound, imaging of the lower back, imaging of the shoulder, imaging of the pelvis, imaging of the brain/head, Doppler tests and imaging of the kidney.

Investigation of selected specific problems for which imaging was ordered

More detailed study of the pattern of imaging orders for selected problems was then undertaken. The topics include fractures, joint sprains and strains, back pain, osteoarthritis, abdominal pain, breast lump, shoulder syndrome, headache, head injuries, leg pain and peripheral vascular disease.

Conclusion

This study has demonstrated that GP ordering behaviour appears to follow the available guidelines in the majority of areas but that there could be improvements in both the guidelines and GP test selection in some areas. In some areas a reduction in ordering of specific imaging types may be possible without affecting outcomes. There are others in which the current system blocks improved performance.

The literature suggests that co-ownership of primary care and imaging facilities may result in higher test ordering and this study suggests a relationship between higher ordering rates and larger practice size. It could therefore be postulated that if corporatisation results in increases in both practice size and co-ownership of imaging facilities and general practices, higher imaging order rates might be expected in the future.

The review of available guidelines suggest the RANZCR guidelines could benefit from the inclusion of the evidence for each guideline, the introduction of the ACR scoring system, consideration of the systemic limitations on specific test ordering by GPs. They could also place more focus on testing of problems rather than use of specific test types, and address the lack of guidelines in some areas. The impact of guidelines on performance also needs further research. This report provides a baseline against which future practice can be compared and a means by which the impact of the recently distributed revised RANZCR guidelines can be tested in the future.

Acknowledgments

This study was made possible by a research grant from the Diagnostics and Technology Branch of the Commonwealth Department of Health and Aged Care.

The General Practice Statistics and Classification Unit wishes to thank the 1,047 general practitioners who participated in *BEACH* 1999–00, the data period on which this report is based. This report would not have been possible without their valued cooperation and effort in providing the data.

We also thank the following organisations for their financial support and their contribution to the ongoing development of the *BEACH* program between 1998 and 2000:

- Commonwealth Department of Health and Aged Care
- Commonwealth Department of Veterans' Affairs
- National Occupational Health and Safety Commission
- AstraZeneca (Australia)
- Aventis Pharma Pty Ltd and
- Roche Products Pty Ltd.

in addition to Janssen-Cilag Pty Ltd, a new contributor to *BEACH* in 2001–2002.

This is a secondary analysis of data collected in the *BEACH* program April 1999–March 2000. The authors recognise the large contribution to the data collection and data management process required to establish this dataset ready for analysis that was made by current members of the *BEACH* research team including Jan Charles, Joan Henderson, Lisa Valenti, Zoe Kelly, Matt Hou, and by past members of the team including Geoffrey P. Sayer, Fiona Horn, Sharon Scahill, Alice Bhasale and Kevin McGeechan. Special thanks to Zoe Kelly and Matt Hou for their work in the restructuring of imaging codes and recoding of the second year's imaging data.

We acknowledge the support of the Royal Australian College of General Practitioners, the Australian Medical Association, the Australian Divisions of General Practice and the Consumers Health Forum, and the contribution of their representatives to the *BEACH* Advisory Board.

We appreciate the time and advice provided by Dr Michael Jones of the Royal Australian and New Zealand College of Radiologists, Dr John Kramer and Dr Nick Demediuk of the Royal Australian College of General Practitioners and Dr John Primrose of the Commonwealth Department of Health and Aged Care in the planning of the analyses for this study. We also gratefully acknowledge the strong administrative support provided by Dulcie Bucksath and Gervaise Woods and the valuable contribution of the GP recruitment and data entry staff.

The cooperation of Carolynn Fredericks and Gordon Calcino of the General Practice Branch of the Commonwealth Department of Health and Aged Care in regularly supplying GP random samples and national Health Insurance Commission data is also appreciated. The data for general practitioner generated imaging tests from the Health Insurance Commission provided by the Diagnostics and Technology Branch of the department was also invaluable. At the Institute, Jenny Hargreaves assisted with the editing of the report and Amanda Nobbs coordinated the printing and publication process.

Ethics approval for the *BEACH* program was obtained from the Human Ethics Committee of the University of Sydney and the Health Ethics Committee of the Australian Institute of Health and Welfare.

1 Background

Between 1994–95 and 1998–99 the number of diagnostic imaging services provided in Australia increased by 1.5 million, or 15%. General practitioners (GPs) are among the largest requestors of imaging services with 61% of expenditure on imaging being for investigations initiated by GPs. Between 1991–92 and 1995–96 the value of imaging services ordered by 'non specialists' rose from $349,000,000 to $537,000,000 per year, an increase of 54%. The Australian Morbidity and Treatment Survey 1990–91 (Bridges-Webb et al. 1992), found that at least one imaging investigation was ordered at 5.7% of patient encounters. The *BEACH* report *General Practice Activity in Australia 1999–2000* (Britt et al. 2000) revealed that at least one imaging investigation was ordered at 6.3% of patient encounters, an increase of 17.5% since 1990–91.

While the Health Insurance Commission (HIC) data provide some insight into imaging services provided, the lack of linked data regarding patient morbidity does not allow exploration of the decision processes leading GPs to order imaging services. Data from the *BEACH* national general practice data collection program will allow the analysis of relationships between imaging ordered and problems managed by GPs. Other factors such as patient and doctor characteristics can also be taken into account in such analysis to provide greater insights into the factors affecting ordering decisions. The analysis can also provide a baseline measure against which changes in GP behaviours resulting from educational interventions can be measured.

The increasing emphasis in the medical profession on an evidence-based approach to clinical decision-making needs to broaden from the current concentration on patient management to the decision-making process involved in defining patient problems. Unfortunately, there is a gross deficiency in research into the effectiveness and cost–benefit of most diagnostic processes. Meta-analysis of research on imaging services is rare and the analytical principles of the Cochrane Collaboration have yet to be applied in this area. As a result, there is a paucity of evidence-based guidelines that might improve the quality of imaging ordering.

Reflecting growing interest in GP imaging orders, the Diagnostics and Technology Branch of the Department of Health and Aged Care (DHAC) provided a research grant to:

- conduct a full review of the imaging orders described in free text by the GPs in the second year of the program
- develop new ICPC–2 PLUS terms and codes to reflect the specificity provided by these recorded terms and map the newly developed imaging terms to the Medicare Benefits Schedule (MBS)
- analyse imaging data from *BEACH* 1999–00 using the new codes and report the results
- assess GP ordering behaviour in light of the evidence and of existing guidelines and
- comment on the existing guidelines in light of the results

The development of more specific ICPC–2 PLUS codes to reflect the terminology used by GPs when ordering diagnostic imaging was undertaken in preparation for the current study. This publication reports the results of the analyses of the resulting data and the assessment of the relationships between GP behaviour, the available evidence and the guidelines.

1.1 Literature review

A review of the literature on diagnostic imaging utilisation, interventions designed to alter ordering of diagnostic imaging, and articles on the effectiveness and cost–benefit of diagnostic imaging was undertaken. The MEDLINE, HEALTHStar and EMBASE databases were searched by crossing several subject headings (diagnostic imaging, physician's practice patterns, utilisation review, clinical guidelines, sensitivity and specificity, meta-analysis and quality assurance health care, plus various more specific imaging labels and problem labels). In addition, the references in the articles obtained were scanned to identify others of potential interest. Berry et al. have demonstrated that in the specific area of medical imaging, electronic databases, including MEDLINE, are reliable sources of articles (Berry et al. 2000). A total of 676 articles were retrieved of which 221 were of sufficient relevance to include in this literature review.

The literature regarding assessment of the value of diagnostic imaging is large and varied, particularly that from the United States. Blackmore et al. reviewed the radiology outcomes literature and found the methodological quality generally low (Blackmore et al. 1999). However, they found some studies with state-of-the-art methodologies and were optimistic about the improving quality of research in this area. Langlotz elucidated the methodological difficulties of assessing the outcomes of diagnostic testing because of the small magnitude of the outcome benefits attributable to diagnostic studies and the complex temporal and causal factors that intervene between diagnostic imaging and ultimate patient outcome (Langlotz 1999). Thornbury has suggested an approach using intermediate outcomes to solve some of the methodological problems of using patient outcomes to assess diagnostic imaging.

Stolberg et al. emphasised the need for organised data collection systems to underpin a statistically driven evaluative approach with methodological rigour (Stolberg et al. 1999).

Alternative approaches to radiology assessment have involved cost-effectiveness studies of which there are numerous examples (Alderson 1988; Baldor et al. 1993; Flamm 1999; Geitung et al. 1999; Hogstrom & Sverre 1996; Kahn, Jr. et al. 1993; Mushlin 1999; Roberts et al. 1998; Sartoris 1994; Southern et al. 1991). These have largely been driven by financial constraints and are less patient driven than outcome studies.

Revicki noted that the poor progress in radiology outcomes research made it difficult to develop meaningful guidelines (Revicki et al. 1999). Some progress had been made with studying the outcomes of screening procedures such as mammography but, in spite of extensive and high-quality studies the value of screening mammography was still equivocal (Kerlikowske 1997; Sjonell & Stahle 1999; Swedish Cancer Society and the Swedish National Board of Health and Welfare 1996). Revicki emphasised the need to focus assessment and guideline development on specific diseases or diagnostic problems rather than specific tests.

The American College of Radiology (ACR) approach of developing appropriateness criteria for imaging in various clinical conditions has been described by Cascade (Cascade 2000) and Vydareny (Vydareny 1997). Cascade commented that in most cases there are insufficient data available for meta-analysis and determination of a conclusion based on science alone. Therefore a broad-based consensus process was used to complement the scientific data. This utilised a modified Delphi technique. The ACR Appropriateness Criteria™ were first published in 1995 and are progressively updated.

Applicable ACR Appropriateness Criteria have been reviewed as part of this literature review, including those on a traumatic isolated headache (Masdeu et al. 2000), head trauma (Davis et al. 2000), chest radiography in uncomplicated hypertension (Westcott et al. 2000b), palpable and non-palpable breast masses (D'Orsi et al. 2000; Evans, III et al. 2000), and acute low back pain (Anderson et al. 2000).

The ACR criteria are published with a well-summarised literature review that allows assessment of the evidence used in the preparation of the criteria. In common with other literature on diagnostic testing, little of the evidence has been gathered in general/family practice where the circumstance of low prevalence makes the predictive value of tests much lower. The extent to which such guidelines are 'portable' to general practice in Australia is therefore open to question. In the absence of better evidence, however, the ACR criteria probably represent the state-of-the-art advice on appropriateness of diagnostic imaging tests for the conditions that they cover.

Guidelines have also been developed by the Royal College of Radiologists (RCR) under the title *Making the Best Use of a Department of Clinical Radiology – Guidelines for Doctors, 4th Edition* (RCR 1998a). A sample electronic version is available on the web and a full electronic version is available for purchase by hospitals (RCR 1998b). The RCR guidelines are not as clearly supported by documented evidence as the ACR Appropriateness Criteria. Polmear et al. found that the RCR guidelines for UTI imaging in children, which restricted GP access, were excessively restrictive and not optimal for patient care (Polmear et al. 1999).

The Royal Australian and New Zealand College of Radiologists has released the fourth edition of it's *Imaging Guidelines* (RANZCR 2001). The first edition was published in 1990 and has been regularly updated since. These guidelines use an algorithm approach to illustrate the diagnostic choices in a wide range of circumstances. Some of the algorithms are supported with a brief list of references. Reference to the ACR Appropriateness Criteria and its more comprehensive literature reviews is not uncommon. Unlike the ACR criteria, no quantification of 'appropriateness' is provided in *Imaging Guidelines*. The guidelines are also available on CD-ROM where they are complemented by example images and a quiz to test knowledge of the guidelines.

While there was no published literature on the effect of the release of the earlier editions of the Australian guidelines on the ordering behaviours of GPs, general conclusions regarding the effect of imaging guidelines can be drawn from research on other imaging guidelines in the United States, the United Kingdom and Canada.

The Royal College of Radiologists Working Party reported in 1992 a baseline audit of radiology referrals from hospital inpatient and outpatient sources which revealed high levels of variance in radiology ordering (Royal College of Radiologists Working Party 1992). It concluded that the data supported the proposition that at least 20% of radiology orders in the United Kingdom were unnecessary. A subsequent uncontrolled pre–post intervention study by the Working Party in 1989–90 to measure the effect of introduction of the RCR guidelines in general practice showed a fall in chest, spine, limb and skull radiography (Royal College of Radiologists Working Party 1993). A subsequent controlled study by Oakeshott et al. of the introduction of RCR guidelines showed a reduction of spinal x-ray orders and a higher proportion of requests that conformed to the guidelines in the intervention group (Oakeshott et al. 1994). A further study by the same group in 1995 using a combination of guidelines and feedback on radiology ordering, found a 20% reduction in spinal x-rays; however because of inter-practice variance, a trend to lower overall ordering by the intervention group failed to reach statistical significance (Kerry et al. 2000).

However, a study in a large group–model HMO in the United States found no benefit from the use of either guidelines alone or guidelines plus feedback in reducing the number of spinal x-rays. He concluded that the influence of practice and patient characteristics and of patient expectations needed to be identified and addressed (Freeborn et al. 1997; Shye et al. 1998).

This conclusion is supported by Wilson who found that patient attitude and expectation was a strong predictor of the ordering of spinal x-rays for low back pain (Wilson et al. 2001). On the other hand Gallagher found the introduction of guidelines successful in reducing lumbosacral spine x-rays in the controlled environment of a United States Emergency Department (Gallagher & Trotzky 1998).

Bearcroft in Cambridge, United Kingdom, found a 30% reduction in the small number of GP chest x-ray requests that were contrary to locally developed guidelines, but no overall reduction in the referral rate (Bearcroft et al. 1994).

Martin et al. undertook a study of the applicability of the ACR Appropriateness Criteria and found that they could be effectively applied in an internal medicine clinic situation (Martin et al. 1999). However, a Canadian study of the potential effect of introduction of the Agency for Health Care Policy and Research guidelines for the management of acute low back pain (which are very similar to the ACR guidelines) (Suarez-Almazor et al. 1997) showed that introduction of the guidelines in Alberta would result in a significantly increased utilisation of imaging without an increase in clinical utility. Little information is available in the literature on the use or impact of the ACR criteria in family practice in the United States.

While Kahn et al. have written extensively on the use of the ACR criteria in computerised decision support systems in the United States, there do not appear to have been any studies on the effectiveness of this method of using guidelines to change ordering behaviours (Kahn et al. 1998; Kahn, Jr. 1998; Tjahjono & Kahn, Jr. 1999).

Research into outcomes and cost effectiveness of GP imaging ordering is grossly inadequate in both quantity and quality. Therefore the evidence base on which to judge the appropriateness of GP ordering behaviours is extremely. Equally, the evidence base for the guidelines identified and reviewed as part of this literature review is poor in relation to general practice, and therefore their applicability in this area is open to question.

Evidence regarding the behavioural impact of supplying imaging guidelines to GPs is scanty and equivocal. What data there are indicate that additional interventions such as feedback and patient education are necessary to alter GP behaviour. Evidence from interventions to alter pathology ordering reported in the GPSCU report *Pathology Ordering by General Practitioners in Australia 1998* (Britt et al. 1999a) indicates that computerised decision support systems used at the time of ordering offer the most effective method of changing behaviours. No similar evidence exists for imaging ordering systems; however, such an approach may be worth evaluating.

1.2 Aims

This report aims to:

- describe the relationships between overall ordering rates, GP and patient characteristics
- describe the morbidity under management when diagnostic imaging is ordered
- describe the relationships between specific imaging types, GP and patient characteristics and problems under management
- consider these results in light of the international literature
- assess and comment on the existing guidelines set out in the RANZCR manual in light of the results for specific imaging types and selected problems, and
- identify areas where guidelines are not available.

2 Methods

This study is a secondary analysis of data from the *BEACH* (Bettering the Evaluation and Care of Health) program, a continuous study of general practice activity. The data period investigated is from April 1999 to March 2000 inclusive. The *BEACH* methods are summarised below. A more detailed description of the methods pertaining specifically to the analyses of orders for imaging is provided in Section 2.2.

2.1 The *BEACH* program

The methods adopted in the *BEACH* program have been described in detail elsewhere (Britt et al. 1999b; Britt et al. 1999c; Britt et al. 2000). In summary, each of the recognised GPs in a random sample of approximately 1,000 per year records details about 100 doctor–patient encounters of all types. The information is recorded on structured encounter forms (on paper). It is a rolling sample, being recruited approximately three weeks ahead. Approximately 20 GPs participate each week, 50 weeks a year.

Sampling methods

The source population includes all GPs who claimed a minimum of 375 general practice A1 Medicare items (items 1–51, 601, 602) in the most recently available three–month HIC data period. This equates with 1,500 Medicare claims a year and ensures inclusion of the majority of part-time GPs whilst excluding those who are not in private practice but claim for a few consultations a year. The General Practice Branch of the Commonwealth Department of Health and Aged Care (DHAC) draws a sample on a regular basis.

The sampling methods adopted by the General Practice Branch of the DHAC aim to provide a series of researchers with a random unbiased selection of GPs while minimising overlap with past samples. The method is a modification of Classic Synchronised Sampling and has been described in detail elsewhere (Britt et al. 2000; Calcino 1993).

Recruitment methods

The randomly selected GPs are approached initially by letter, then by telephone follow-up. GPs who agree to participate are set an agreed recording date approximately three to four weeks ahead. A research pack is sent to each participant about 10 days before their planned recording date. A telephone reminder is made to each participating GP in the first days of the agreed recording period. Non-returns are followed up by regular telephone calls.

Each participating GP earns 25 Clinical Audit points towards their quality assurance (QA) requirements. As part of this QA process, each receives an analysis of his or her results compared with those of nine other unidentified practitioners who recorded at approximately the same time. Comparisons with the national average and with targets relating to the National Health Priority Areas are also made. In addition, GPs receive some educational material related to the identification and management of patients who smoke or who consume alcohol at hazardous levels.

Statistical methods

The analysis of the *BEACH* database is conducted with SAS version 6.12 (SAS Institute Inc. 1996) and the encounter is the primary unit of analysis. Proportions (%) are only used when describing the distribution of an event that can arise only once at a consultation (e.g. age, sex or item numbers) or to describe the distribution of events within a class of events (e.g. problem *A* as a per cent of total problems).

Rates per 100 encounters are used when an event can occur more than once at the consultation (e.g. RFEs, problems managed or medications). Rates per 100 problems are also sometimes used when a management event can occur more than once per problem managed. In general, the following results present the number of observations *(n)*, rate per 100 encounters and the 95% confidence intervals.

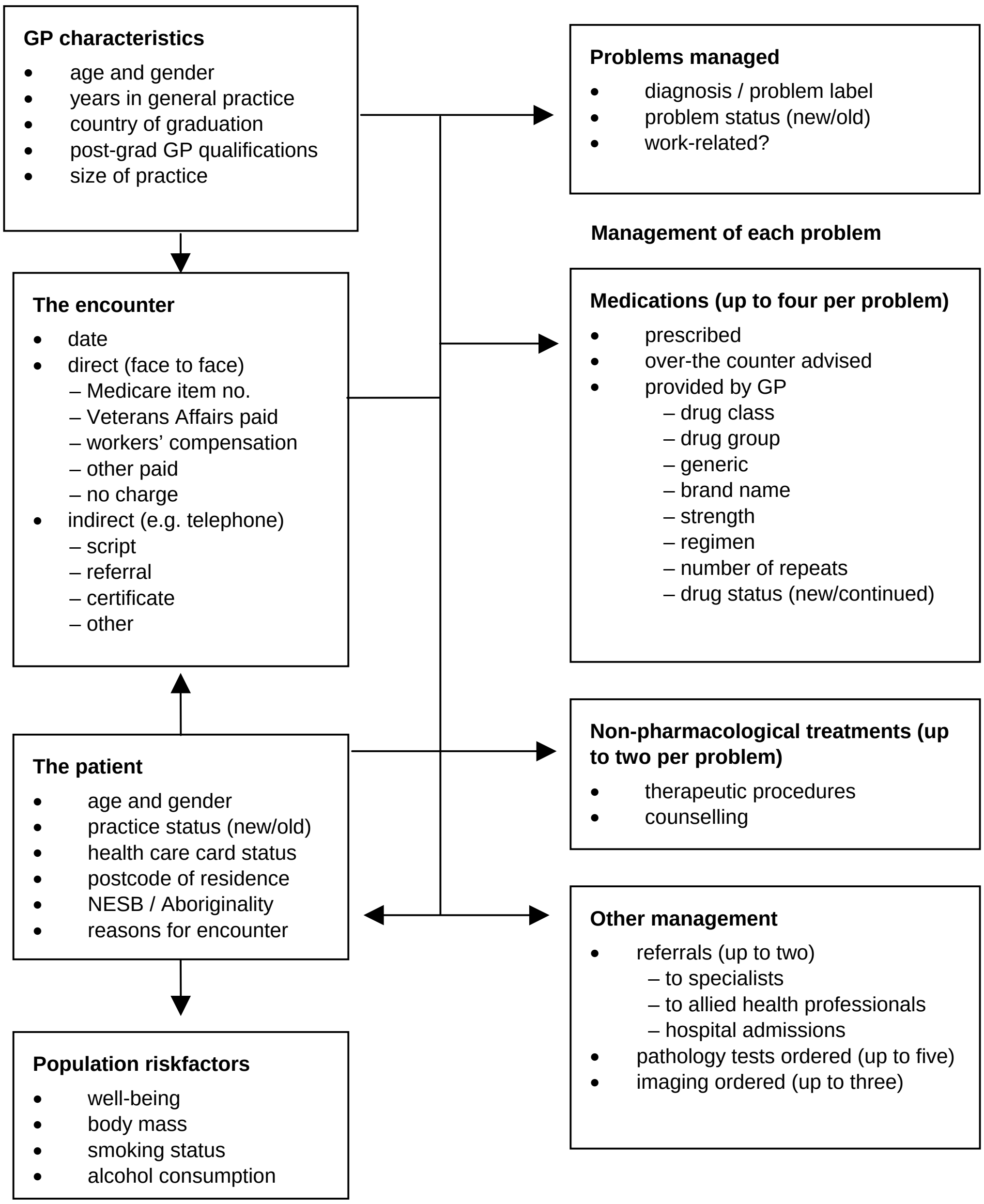


Figure 2.1: The *BEACH* relational database

The *BEACH* study is essentially a random sample of GPs, each providing data about a cluster of encounters. Cluster sampling study designs in general practice research violate the simple random sample (SRS) assumption because the probability of an encounter being included is a function of the probability of the GP being selected (Sayer 1999).

There is also a secondary probability function of particular encounters being included in the GP's cluster (associated with the characteristics of the GP or the type and place of the practice) and this increases the likelihood of sampling bias. In addition, there will be inherent relationships between encounters from the same cluster and this creates a potential statistical bias. The probability of gaining a representative sample of encounters is therefore reduced by the potential sampling and statistical bias, decreasing the accuracy of national estimates.

When a study design other than SRS is used, analytical techniques that consider the study design should be employed. In this report the standard error calculations used in the 95% confidence intervals accommodate both the single-stage clustered study design and sample weighting according to Kish's description of the formulae (Kish 1965). SAS 6.12 is limited in its capacity to calculate the standard error for the current study design, so additional programming was required to incorporate the formulas. Post-stratification weighting was also applied to the raw data before analysis (Britt et al. 2000).

The *BEACH* relational database

The *BEACH* relational database is described diagrammatically in Figure 2.1. Note that all variables can be directly related to GP and patient characteristics and to the encounter. Reasons for encounter have only an indirect relationship with problems managed. All types of management are directly related to the problem being treated.

Classification of data

The imaging tests ordered, patient reasons for encounter, problems managed, therapeutic procedures, other non-pharmacological treatments, referrals, pathology and imaging are coded using ICPC–2 PLUS (Britt 1997). This is an extended vocabulary of terms classified according to the International Classification of Primary Care (Version 2) (ICPC–2), a product of the World Organization of Family Doctors (WONCA) (Classification Committee of the World Organization of Family Doctors (WICC) 1997). The ICPC is regarded as the international standard for data classification in primary care.

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

- Component 1 includes symptoms and complaints.
- Component 7 covers diagnoses.

These are independent in each chapter and both can be used for patient reasons for encounter or for problems managed.

- Components 2 to 6 cover the process of care and are common throughout all chapters.

The processes of care, including referrals, non-pharmacological treatments and orders for pathology and imaging, are classified in these process components of ICPC–2. Component 2 (diagnostic screening and prevention) is also often applied in describing the problem managed (e.g. check-up, immunisation).

The ICPC–2 is an excellent epidemiological tool. The diagnostic and symptomatic rubrics have been selected for inclusion on the basis of their relative frequency in primary care settings or because of their relative importance in describing the health of the community. It has only about 1,370 rubrics and these are sufficient for meaningful analyses. However, reliability of data entry, using ICPC–2 alone, would require a thorough knowledge of the classification if correct classification of a concept were to be ensured. In 1995, recognising a need for a coding and classification system for general practice electronic health records, the Family Medicine Research Centre (then Unit) developed an extended vocabulary of terms classified according to the ICPC. These terms were derived from those recorded in more than half a million encounter forms by GPs participating in the quality assurance option mentioned earlier. The terms have developed further over the past six years in response to the use of terminology by GPs participating in the *BEACH* program and in response to requests from GPs using ICPC–2 PLUS in their electronic clinical systems. This allows far greater specificity in data entry and ensures high inter-coder reliability between staff. It also facilitates analyses of information about more specific problems when required (Britt 1997).

2.2 The study of imaging orders

This study is based on the imaging orders recorded on the encounter forms completed in the second year of the *BEACH* program. In that year a random sample of 1,047 GPs participated, providing details of 104,700 GP–patient encounters. After post-stratification weighting for GP age, sex and activity level, there were 104,856 encounters. An overview of these encounters is provided in Section 3.

An initial analysis of the relative rates of imaging orders for each GP was undertaken in order to identify low, medium and high ordering groups of GPs. The characteristics of the GPs in each group were compared and the results are reported in Chapter 4 (Section 4.4). The factors that affect the imaging order rates of GPs were investigated using analysis of variance and linear regression at both the univariate and multivariate levels (Section 4.5).

All encounter records that included a record of at least one order for an imaging test were identified, and a sub-file was created. An overview of the characteristics of the encounters at which imaging was ordered, and the patients for whom they were ordered is provided in Chapter 5. The remainder of the report investigating the types of imaging tests ordered by GPs and the problems for which they were ordered includes more detailed analyses of selected specific test types and selected problems.

Statistical reporting

This study uses the annual weighted *BEACH* data from the 1999–00 collection period. The weighting process (described earlier) leads to raw figures which are not round numbers. SAS generates the raw results to two decimal places. The raw figures in this report have been rounded for simplicity. This means that individual rounded frequencies do not always summate exactly to the reported total. Further, where results are reported in terms of rates, these have been calculated using the more specific two-decimal place raw data rather than the reported rounded frequencies. This may result in slight inconsistencies between results from different analyses.

Chapters 8 and 9 investigate the relationships between specific imaging test types and their related morbidity under management, or between selected morbidity and its related test order pattern. The reported rates are often based on the total number of 'problem-test combinations'. As there can be a many-to-one, one-to-many, many-to-many relationship between test orders and problems under management, each combination of a single test and a single problem is counted once. This means that the total number of problem-test combinations will only agree with the total number of tests ordered, and with the total number of tested problems, where there was always a one-to-one relationship between a single test order and a single problem under management.

In general, the results of this study are reported in rates per 100 encounters or rates per 100 problems managed. Where the relative frequency of an event is sufficient to provide statistical estimates of accuracy (such as in Section 5) the 95% confidence interval and relative standard errors are also provided. The rate is an estimate and its confidence limits suggest a 95% certainty that the true result lies between the reported upper and lower limits.

The relative standard error (RSE) is commonly used by the Australian Bureau of Statistics. It is a function of the standard error and the rate estimate and it provides a measure of reliability of the estimate. For general purposes a RSE of 0–15 indicates that the estimate is reliable, a RSE of 16–33 is slightly unreliable, one of 34–50 is extremely unreliable and a RSE of 51–100 suggests that the estimate should not be used.

In the more specific analyses of selected imaging types or selected problems, only the estimated relative frequency of the event is provided. While the relative standard errors would often suggest unreliability of the estimated ordering rates, in the absence of any Australian information about the relationship of test ordering to morbidity in general practice, the data are still useful in describing these trends. However, the size of the samples and the possible unreliability of the reported results must be kept in mind.

Coding and classifying imaging tests ordered

When the *BEACH* program began in April 1998, the coding and classification of imaging was less precise than that of morbidity managed. This is because in the first instance, ICPC–2 PLUS was developed on the basis of approximately 700,000 encounter records completed between 1990 and 1998 by GPs. However, in these encounter records, imaging orders were recorded only in terms of four tick box options: plain, contrast/special, ultrasound and other. Multiple boxes could be ticked where multiple test types were ordered. However, there was no opportunity to indicate multiple tests of a specific type (e.g. multiple plain x-rays of different sites) or to describe them in any specific way.

As a result GPs did not record the specific test label on the records. In the first year of *BEACH* a detailed terminology of test orders was therefore not available in ICPC–2 PLUS. During the first year the GPs were asked to record orders for imaging (in terms of whether they ordered a plain x-ray, US/CT/contrast, or other imaging), to nominate the body site of the test(s) and to elect the problem or problems for which the test was associated. This method provided no opportunity to define the terms usually used by GPs in describing their order for imaging for possible addition to ICPC–2 PLUS.

In response to government and the profession's interest in more detailed data on the orders placed for imaging, in the second year of the program the participants were asked to record the type of imaging test ordered (in their own words) as well as to specify the body site and the problem(s) for which each test was ordered. The free text was then classified according to the available ICPC–2 PLUS terms and codes.

This approach provided an opportunity to review the free text descriptors of the imaging orders and create more specific ICPC–2 PLUS codes to better reflect this free text and to better differentiate between different test types. In the second half of 2000 a research grant was received from the DHAC to conduct a full review of the imaging orders described in free text and further development of the ICPC–2 PLUS terms to reflect the higher specificity provided by these recorded terms.

In order to gain a timely view of the imaging ordered by GPs the newly created ICPC–2 PLUS codes for imaging orders were applied in a recoding of all imaging orders recorded in the second year of the *BEACH* program. This process was also funded by the DHAC.

Grouping codes for problems associated with imaging orders

In this report, some grouping of ICPC–2 codes and/or ICPC–2 PLUS codes has been made to overcome differences in the level of specificity recorded by GPs in ascribing problem labels. For example, we report imaging tests ordered for the problem label 'back pain'. This problem label includes all symptoms and complaints of the back (ICPC–2 codes L02) and those of the lower back (ICPC–2 code L03) together with sprains and strains of the back (which form part of ICPC–2 code L84) and selected back problems with radiating symptoms (which form part of ICPC–2 code L86).

Individual analysis of 'symptoms and complaints of the lower back' and 'hypertension with complications' and 'symptoms and complaints of the back' etc. may have meant that the relative frequencies of each were insufficient to report. Another example is osteoarthritis. There are multiple codes into which this problem may fall depending on its body location (i.e. osteoarthritis of the knee has a different ICPC–2 code from osteoarthritis of the shoulder). Osteoarthritis of the back is only a small part of a broader rubric. In this case the concept here reported as 'osteoarthritis' includes all the ICPC–2 PLUS terms associated with osteoarthritis rather than a number of ICPC–2 codes. All problem labels which include multiple codes from ICPC–2 are marked with an asterisk in the tables. Appendix 4 provides a full list of terms or rubrics that make up each problem label.

Grouping imaging order codes for analysis

Component 3 of the ICPC–2 provides for the classification of 'Diagnostic, Screening and Preventive Procedures'. This component includes a single rubric relating to imaging orders—'diagnostic radiology/imaging' (–41). Each of these can be applied across any one of the 17 chapters in ICPC–2 (see 'Classification of data' on page 8).

Imaging orders could be naturally grouped according to the ICPC–2 chapter (body system) to which they were applied. However, imaging data are more usually reported in Australia in terms of the groupings used in the Medicare Benefits Schedule (MBS) (DHAC 1998).

The newly developed ICPC–2 PLUS imaging terms were therefore mapped to the MBS. It had been hoped that the map would be from the ICPC–2 PLUS codes to the most specific (five-digit) MBS codes or at least to the MBS sub-group level (e.g. Group I1—Ultrasound, Sub-group 1). However, this was found to be an impossible task. The MBS classifies imaging tests for the purposes of costing and the classification bears little resemblance to clinical classifications. Some examples of the difficulties encountered in such mapping are provided below.

Matching at the MBS sub-group level

The ICPC–2 PLUS imaging order term 'x-ray; abdomen' recorded by the GP for 'abdominal pain' provides no indication of whether the cause of the pain is gynaecological, urological or gastrointestinal in nature. When the test order is received by the radiologist, s/he may use the clinical notes provided with the request to decide on the specific type of imaging to be undertaken. This allows the test to be suitably classified in the MBS. However, at the point of test order from the GP, the imaging test order of 'x-ray abdomen' could be classed in Diagnostic Radiology Sub-group 7 (Radiographic examination of urinary tract) or in Sub-group 8 (Radiographic examination of alimentary tract and biliary system).

Matching at the MBS individual (five-digit) item level

The map is even more complicated at the five-digit level. Where it is possible to allocate a specific ICPC–2 PLUS term to a single MBS sub-group, there can be multiple options for codes within that sub-group. For example, the ICPC–2 PLUS term 'breast ultrasound' could refer to a request for ultrasound of one or of both breasts. It therefore is not possible to map to the MBS at the five-digit level because there are two possible MBS items: one for a single breast ultrasound (item 55070) and another for ultrasound of both breasts (55079).

These items also provide an example of the limits placed on item selection. Many tests such as these are classified elsewhere in the MBS if they are associated with other specific test types. Further, there are many examples of a single MBS item representing combinations of other imaging tests, each of which already has a separate MBS item. If these limitations were to be considered in creating a map from ICPC–2 PLUS to the MBS, most of the PLUS terms would require multiple possible MBS maps depending on other tests ordered at the same encounter and with consideration of the problem under management.

Final map to the MBS

The ICPC–2 PLUS imaging order codes were therefore mapped to the MBS at the Group level only. These groups are:

- Group I1—Ultrasound
- Group I2—Computed tomography
- Group I3—Diagnostic radiology
- Group I4—Nuclear medicine imaging
- Group I5—Magnetic resonance imaging.

Care process

A specific interest of this study was the extent to which imaging was ordered for investigative/diagnostic purposes versus monitoring purposes. Each test was therefore classified into one of four groups depending on the status of the problem to the patient (new/old) and the level of diagnostic specificity inherent in the label assigned by the GP to the problem associated with the test order. Four care processes were designated for imaging tests ordered: investigative imaging, management imaging, monitoring imaging, and undefined imaging. The definitions applied to each care process are described in more detail in Section 7.2.

3 The *BEACH* database 1999–00

3.1 The GP sample

This study is based on data collected between 1 April 1999 and 31 March 2000. The final participating sample consisted of 1,047 practitioners who provided details pertaining to 104,700 encounters. These GPs represented 39.1% of those who were contacted and available, and 35.2% of those with whom contact was attempted. The following summary of the database is provided as a baseline for later comparison of specific groups of GPs or patients.

A comparison of characteristics of participating GPs (39.1% of those with whom contact was established) with those of the GPs from the random sample who declined to participate found no significant differences between the groups, with the exception of age group. Participants were significantly older and GPs aged less than 35 years were under-represented. The encounter data were weighted by GP age and sex to overcome the difference and ensure that the *BEACH* dataset was representative of Australian general practice. The weighting also incorporated the differential activity level of each GP to improve the national estimates.

3.2 GP characteristics

Of the 1,047 participants, 69.6% were male and 59.2% were 45 years of age or older. Three-quarters of the participants (75.4%) had been in general practice for more than 10 years and 15.3% could be regarded as practising part time, working fewer than six sessions per week. Almost one-fifth of participants were in solo practice (18.1%) and the majority (73.3%) had graduated in Australia. One in 10 respondents (10.6%) conducted more than half of his or her consultations in a language other than English (Table 3.1).

3.3 The patients

Approximately one in seven encounters were with children aged less than 15 years (14.8%), one in 10 were with young adults (10.4%), and approximately one in four with patients in each of the following age groups, 25–44 years (26.3%), 45–64 years (24.5%), and 65 years and older (24.1%).

The patient was new to the practice at 7.3% of encounters and patients who held a health care card accounted for 38.6% of all encounters. At 8.0% of encounters the patient was from a non-English-speaking background, and at 0.7% the patient indicated he or she was an Aboriginal person and/or a Torres Strait Islander (Table 3.2).

Table 3.1: Characteristics of participating GPs

GP characteristic	Number[(a)]	Per cent of GPs[(a)] (*n*=1,047)
Male	729	69.6
Age (missing=4)		
<35 years	88	8.4
35–44 years	338	32.4
45–54 years	338	32.4
55+ years	279	26.7
Years in general practice (missing=8)		
<5 years	90	8.7
6–10 years	166	15.9
11–19 years	331	31.9
20+ years	452	43.5
Sessions per week (missing=6)		
<6 per week	159	15.3
6–10 per week	691	66.0
>10 per week	191	18.3
Size of practice (missing=19)*[(b)]		
Solo	189	18.2
2–4 GPs	373	36.3
5–10 GPs	400	38.9
11+ GPs	68	6.6
Graduated in Australia (missing=2)	767	73.3
More than 50% of consultations in languages other than English	105	10.6

(a) Missing data removed.

Note: There was an error in Table 3.2 on page 12, *General Practice Activity in Australia 1999–2000* (Britt et al. 2000). The distribution reported here is correct.

3.4 The encounters

The distribution of encounter types shows the varied nature of general practice (Table 3.3). Direct consultations (where the patient was seen by the GP) represented 96.7% of all encounters. By far the majority of these were claimable on Medicare. Standard surgery consultations were most common, accounting for 78.1% of all recorded patient contacts. Workers' compensation claims represented 2.0% of all recorded encounters. Indirect consultations (patient not seen) represented 3.3 % of encounters.

Table 3.2: Characteristics of the patients at encounters

Patient variable	Number	Per cent of encounters (*n*=104,856)	95% LCL	95% UCL
Sex *(Missing)*	*(1,182)*	. .	. .	. .
Males	44,308	42.7	42.0	43.5
Female	59,366	57.3	56.5	58.0
Age group *(Missing)*	*(804)*	. .	. .	. .
<1 year	2,447	2.4	2.2	2.5
1–4 years	5,384	5.2	4.9	5.5
5–14 years	7,471	7.2	6.9	7.5
15–24 years	10,814	10.4	9.9	10.8
25–44 years	27,326	26.3	25.5	27.0
45–64 years	25,521	24.5	24.0	25.0
65–74 years	12,486	12.0	11.5	12.5
75+ years	12,603	12.1	11.4	12.9
New patient to practice	7,641	7.3	6.6	8.0
Health care card holder	40,452	38.6	37.0	40.2
Non-English-speaking background	8,356	8.0	4.8	11.1
Aboriginal and/or Torres Strait Islander	745	0.7	0.0	1.5

Note: UCL—upper confidence limit; LCL—lower confidence limit.

Table 3.3: Type of encounter

Variable	Number	Rate per 100 encounters[(a)]	95% LCL	95% UCL
General practitioners	1,048	. .	. .	. .
Direct consultations	97,436	96.7	96.3	97.0
No charge	1,345	1.3	0.9	1.7
Medicare-claimable	93,698	93.0	92.4	93.5
Standard surgery consultations	78,761	78.1	77.1	79.1
Workers' compensation claimable	2,005	2.0	1.7	2.3
Other paid (hospital, State, etc.)	1,236	1.2	0.0	2.8
Indirect consultations	3,367	3.3	2.8	3.8
Total encounters	**104,856**	**. .**	**. .**	**. .**

(a) Missing data for 4,054 encounters removed. Percentage base (n) = 100,802.

Note: UCL—upper confidence limit; LCL—lower confidence limit.

3.5 The content of the encounters

Using weighted data, there were 104,856 encounters from 1,048 GPs. An average of 149 patient reasons for encounter were described per 100 encounters. Of the 147 problems managed per 100 encounters, 45.3% were considered new problems to the patient. Problems regarded by the GP as likely to be work-related (irrespective of whether the encounter was covered by workers' compensation) occurred at a rate of 3.2 per 100 encounters.

Medications were prescribed, advised or supplied at a rate of 110.1 per 100 encounters. Non-pharmacological treatments were recorded less often than medications, with clinical non-procedural treatments (e.g. counselling, advice or psychotherapy) being recorded at a higher rate (33.5 per 100 encounters) than procedural treatments such as excisions and physical therapies (12.5 per 100 encounters). Approximately 11 referrals were made per 100 encounters. Orders for a pathology test (or batch of tests, e.g. FBC, HIV) were recorded more frequently (26.3 per 100 encounters) than were referrals. Orders for imaging (e.g. x-rays, scans) occurred at a rate of 7.5 per 100 encounters (Table 3.4).

Table 3.4: The content of the encounters

Variable	Number	Rate per 100 encounters	95% LCL	95% UCL	Rate per 100 problems	95% LCL	95% UCL
General practitioners	1,048	. .	. .	. .	. .	. .	. .
Encounters	104,856	. .	. .	. .	. .	. .	. .
Reasons for encounter	155,690	148.5	146.7	150.2	. .	. .	. .
Problems managed	153,857	146.7	144.9	148.6	. .	. .	. .
New problems	47,458	45.3	43.6	46.9	30.9	29.7	32.0
Old problems	106,399	101.5	99.0	103.9	69.2	68.0	70.3
Work-related	3,350	3.2	2.9	3.5	2.2	2.0	2.4
Medications	115,432	110.1	107.8	112.4	75.0	73.6	76.4
Clinical treatments	35,102	33.5	31.8	35.2	22.8	21.7	23.9
Procedural treatments	13,092	12.5	11.9	13.0	8.5	8.1	8.9
Referrals	11,760	11.2	10.8	11.7	7.6	7.4	7.9
Pathology tests ordered	27,613	26.3	25.2	27.5	18.0	17.2	18.7
Imaging test ordered	7,919	7.5	7.1	7.8	5.1	4.9	5.3

Note: UCL—upper confidence limit; LCL—lower confidence limit.

4 Overview of imaging orders by general practitioners

4.1 Overview of imaging order rates

At least one imaging test was ordered by the GP at 6,979 (6.7%) of the 104,856 encounters. Orders for imaging occurred at a rate of 7.6 per 100 encounters, or 5.1 per 100 problems managed. A total of 7,919 specific orders for imaging were recorded at a rate of 113.5 per 100 imaging encounters. That is, at encounters where an imaging order occurred, the average number of tests ordered was 1.14 or 114 per 100 imaging encounters (Table 4.1).

Extrapolated to the total number of GP–patient encounters across Australia, this suggests there were approximately 8 million orders for imaging placed by GPs over the 12-month period.

Table 4.1: Summary of imaging orders

	Number	Rate per 100 encounters (*n*=104,856)	Rate per 100 problems (*n*=153,857)
Number of encounters at least one imaging test ordered	6,979	6.7	. .
Total number of imaging tests ordered	7,919	7.6	5.1
Imaging tests ordered/100 imaging encounters	7,919	113.5	. .

Distribution of imaging orders across encounters

Table 4.2 describes the distribution of imaging test orders across encounters. It shows that no imaging tests were ordered at 97,878 (93.3%) consultations and one test was ordered at 6,104 (5.8%) of encounters. Orders for two or three imaging tests were rare, occurring at only 875 encounters (0.8%). However, the imaging tests ordered at these 875 encounters accounted for 22.9% of all imaging tests ordered.

Table 4.2: Distribution of imaging test orders across encounters

Number imaging tests ordered at encounter	Number of encounters	Per cent of total encounters (*n*=104,856)	Per cent of encounters at least one imaging (*n*=6,979)	Per cent total imaging tests ordered (*n*=7,919)
None	97,878	93.3	—	—
One	6,104	5.8	87.5	77.1
Two	810	0.8	11.6	20.5
Three	65	0.1	0.9	2.5

Relationship of imaging orders to problems managed

In Table 4.3 the problem under management is the unit of analysis. Of the 153,857 problems managed, no imaging was ordered for 146,639 (95.3%). At least one imaging order was placed in relation to the remaining 7,218 problems (4.7%) at 6,979 encounters. A single test type was most common, being ordered for 6,479 (4.2%) problems. Orders for multiple imaging tests for one problem were uncommon, occurring in the management of less than 1% of problems. However, the imaging ordered for these 739 problems represented almost 20% of all imaging tests ordered.

Table 4.3: Number of imaging tests for each problem

Number of imaging tests ordered per problem contact	Number of problems	Per cent of total problems (*n*=153,857)	Per cent of problems for which imaging ordered (*n*=7,218)	Per cent of total imaging tests ordered[(a)]
None	146,639	95.3	. .	.
One	6,479	4.2	89.8	81.8
Two	695	0.5	9.6	17.5
Three	44	*	0.6	1.7

(a) Column will not add to 100% because of the many-to-many relationship between problems and imaging test orders (see section 2.2).

* Less than 0.1%.

There can be a many-to-many relationship between imaging tests and problems. That is, while multiple imaging test types may be ordered for the management of one problem (see above), it is also possible that one imaging test order may be related to more than one problem under management. However, Table 4.4 suggests that 99.0% of all imaging test orders were related to a single problem being managed at the encounter.

Table 4.4: Number of problems for which a single test type was ordered

Number of problems to which each imaging test order was related	Number of imaging tests	Per cent total imaging tests ordered (*n*=7,919)
One	7,840	99.0
Two	74	0.9
Three or four	5	*

* Less than 0.1%.

4.2 Distribution of GPs by imaging order rates

The mean number of imaging tests ordered by the 1,047 participating GPs was 6.9 tests per 100 encounters, with a standard deviation of 4.9 per 100. The ordering rates for the majority of GPs therefore fell between 2 and 11.8 tests per 100. There was a minimum of no tests and a maximum of 62 tests per 100 encounters. Figure 4.1 demonstrates the distribution of the participating GPs across this range.

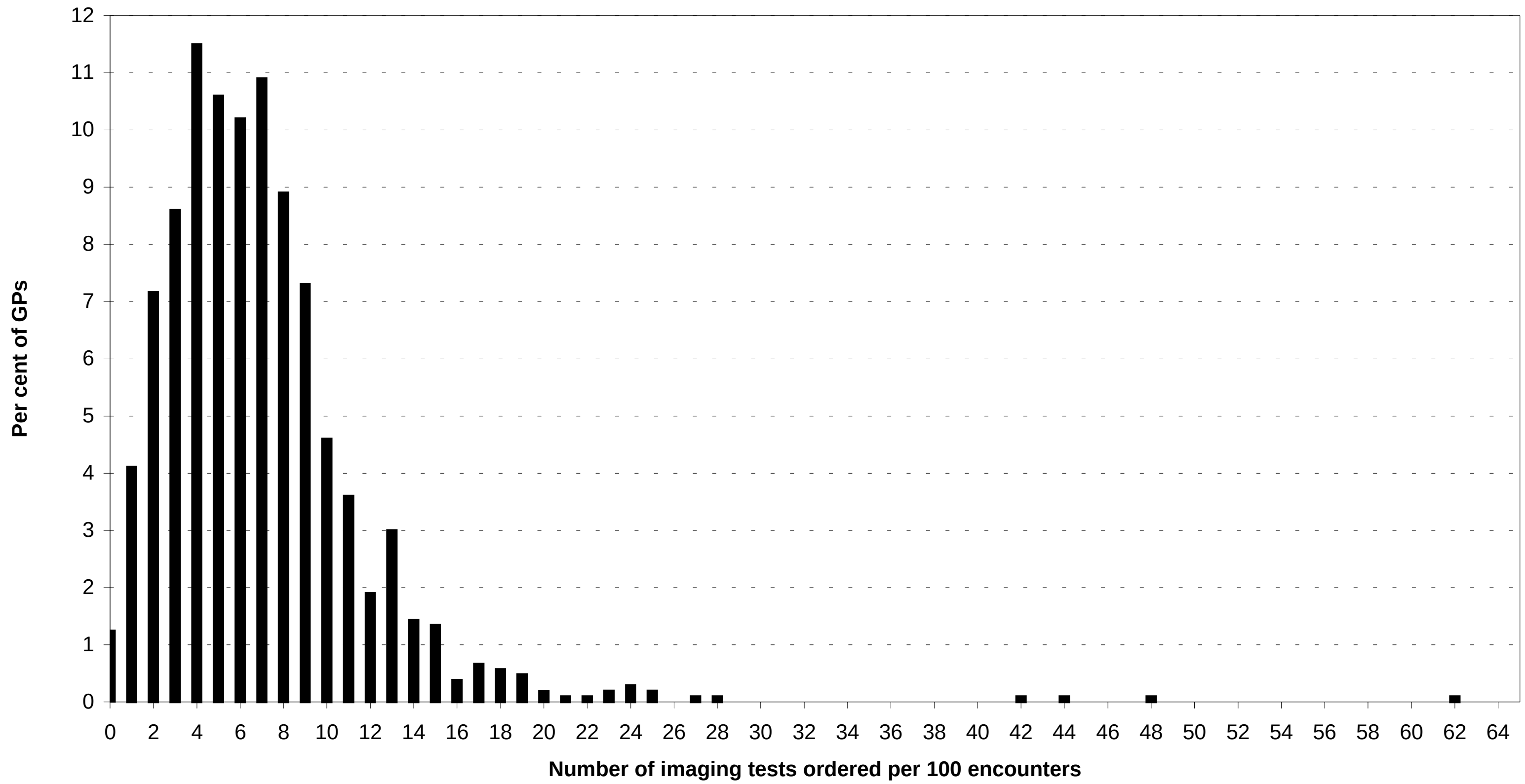


Figure 4.1: Distribution of GPs by imaging order rate

4.3 Imaging order rates by selected GP characteristics

The relative imaging order rates for particular groups of GPs are presented in Table 4.5.

Age and sex of GP

Female GPs ordered imaging tests at a rate of 8.6 per 100 encounters (95% CI: 7.8–9.3), a significantly higher rate than male GPs (7.3 per 100, 95% CI: 6.9–7.7). In contrast, the age group of the GP did not influence ordering rates, which ranged from 7.3 tests ordered per 100 encounters for GPs aged less than 35 years, to 6.6 per 100 encounters for those aged between 35 and 44 years.

Sessions per week

There were also no significant relationship between the number of sessions worked per week and the overall imaging order rates per 100 encounters. Imaging order rates ranged from 7.0 per 100 encounters for GPs working 11 or more sessions per week, to 7.8 per 100 for part-time GPs.

Size of practice

There was a definite trend for increasing order rates with increased size of practice. Solo practitioners placed imaging orders at a significantly lower rate of 6.4 per 100 encounters (95% CI: 5.6–7.1, than those in practices of 5–10 GPs (8.0 per 100, 95% CI: 7.4–8.5) or those in large group practices of 11 or more GPs (8.6 per 100, 95% CI: 7.1–10.1).

State

The State/Territory-specific ordering rates ranged from 5.2 per 100 encounters in South Australia to 8.6 per 100 in Western Australia. The South Australian rate was significantly lower that that of Victoria, New South Wales, Queensland and Western Australia. The smaller sample sizes in the Australian Capital Territory, Tasmania and the Northern Territory generated wide confidence intervals that rendered their rates not significantly higher than that of South Australia.

Rurality

Using grouped categories of the RRMA classification (Britt et al. 2001), the GPs were grouped according to their rurality. While the imaging order rate appeared to be slightly higher in small rural areas (8.4 per 100 encounters), when compared with that in the large rural stratum (7.1 per 100) and the metropolitan stratum (7.4 per 100), this difference was not statistically significant.

Table 4.5: Imaging order rates by selected GP characteristics

GP characteristic	Number of encounters (weighted)	Number of imaging tests ordered	Per cent of total imaging test orders (*n*=7,919)[(a)]	Imaging order rate per 100 encounters[(a)]	95% LCL	95% UCL
Sex						
Male	81,929	5,957	75.2	7.3	6.9	7.7
Female	22,927	1,963	24.8	8.6	7.8	9.3
Age (missing=363)						
<35 years	33,642	749	9.5	7.3	6.2	8.4
35–44 years	34,361	2,563	32.4	7.6	7.0	8.2
45–54 years	26,197	2,592	32.7	7.5	6.9	8.2
55+ years	10,293	1,966	24.8	7.5	6.8	8.2
Sessions per week (missing=472)						
<6 per week	9,835	768	9.7	7.8	7.0	8.6
6–10 per week	69,689	5,364	67.7	7.7	7.3	8.1
11+ per week	24,860	1,740	21.9	7.0	6.2	7.8
Size of practice (missing=1,532)						
Solo	20,699	1,321	16.7	6.4	5.6	7.1
2–4 GPs	36,603	2,757	34.8	7.5	6.9	8.2
5–10 GPs	39,021	3,107	39.2	8.0	7.4	8.5
11+ GPs	7,001	602	7.6	8.6	7.1	10.1
State						
New South Wales	39,205	3,064	38.7	7.8	7.2	8.4
Victoria	20,951	1,508	19.0	7.2	6.5	7.9
Queensland	23,331	1,900	24.0	8.1	7.2	9.1
South Australia	9,029	468	5.9	5.2	4.3	6.1
Western Australia	8,612	739	9.3	8.6	7.6	9.6
Tasmania	1,952	122	1.5	6.2	4.7	7.8
Australian Capital Territory	864	59	0.7	6.8	4.0	9.6
Northern Territory	911	60	0.8	6.6	3.1	10.1
RRMA category[(b)]						
Metropolitan	77,348	5,721	72.2	7.4	7.0	7.8
Large rural	8,368	594	7.5	7.1	5.7	8.5
Small rural	19,140	1,604	20.3	8.4	7.6	9.2
Total	**104,856**	**7,919**	**100.0**	**7.6**	**7.2**	**7.9**

(a) Missing data removed.

(b) Rural, Remote and Metropolitan Area classification: Metropolitan—RRMA groups 1 & 2; Large rural— RRMA groups 3 & 6; Small rural—RRMA groups 4, 5 & 7 (Britt et al. 2001)

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL—lower confidence limit

4.4 GP characteristics by ordering rate (univariate)

The GPs were divided into three groups according to their imaging order rate during their 100 recorded encounters. The low ordering group was defined as those whose order rate was less then three test orders per 100 encounters (i.e. the mean minus one standard deviation). The medium ordering group were those GPs whose order rate was within the range of the mean (6.9 per 100 encounters) plus or minus one standard deviation (i.e. 3–11 tests per 100 encounters). The high ordering group was defined as those GPs whose test rate was above this range.

The characteristics of the GPs falling into each of these imaging order groups are compared in Table 4.6. These data were drawn from the self-reported characteristics from each of the GPs in their GP profile questionnaire. A few differences between the groups emerged.

Age and sex of GPs

There was a significant difference in the gender distribution of GPs in the low and high ordering groups. In the high imaging order group there was a larger proportion of female GPs (39.5%) than in the low ordering group (22.9%). There were no significant differences in the age distribution of the GPs in the three ordering groups.

Sessions per week

Considering the high proportion of women in the high ordering group and the low proportion in the low ordering group, it might have been expected that a greater proportion of the high ordering group would be in part-time general practice. However, as demonstrated in Table 4.6, there were no significant differences in the proportion of part-time, full-time and 'busy' (at least 11 sessions per week) GPs in each of the ordering groups.

Size of practice and rurality

There was an overall trend for increased ordering level with increased size of practice, such that GPs from practices of five or more GPs represented 36.9% of the low ordering GPs, but 53.4% of the high ordering GPs. However, the single statistical difference was that the high ordering group was significantly less likely to be in solo practice (10.3%) than the low ordering group (30.8%), the difference between high and medium not reaching significance.

There was also an overall trend for increased imaging order rates with increased rurality of practice. Those practising in small rural areas represented a significantly larger proportion of the high ordering group (28.6%) than of the low ordering group (13.7%), while the reverse was true of metropolitan GPs who accounted for 78.6% of the low ordering group and 62.2% of the high.

Table 4.6: GP characteristics of the high, medium and low imaging order groups

GP variable		Low ordering GPs (*n*=131)				Medium ordering GPs (*n*=797)				High ordering GPs (*n*=119)			
		Number	Per cent	LCL	UCL	Number	Per cent	LCL	UCL	Number	Per cent	LCL	UCL
Gender	Male	101	77.1	69.9	84.3	556	69.8	66.6	73.0	72	60.5	51.7	69.3
	Female	30	22.9	15.7	30.1	241	30.2	27.0	33.4	47	39.5	30.7	48.3
Age	<35	12	9.2	4.3	14.1	67	8.4	6.5	10.3	9	7.6	2.8	12.4
	35–44	34	26	18.5	33.5	268	33.8	30.5	37.1	36	30.5	22.2	38.8
	45–54	42	32.1	24.1	40.1	259	32.6	29.3	35.9	37	31.4	23.0	39.8
	55+	43	32.8	24.8	40.8	200	25.2	22.2	28.2	36	30.5	22.2	38.8
Years in general practice	<2	1	0.8	0.0	2.3	5	0.6	0.1	1.1	1	0.9	0.0	2.6
	2–5	8	6.2	2.1	10.3	65	8.2	6.3	10.1	10	8.5	3.4	13.6
	6–10	22	16.9	10.5	23.3	127	16.0	13.4	18.6	17	14.5	8.1	20.9
	11–19	32	24.6	17.2	32.0	262	33.1	29.8	36.4	37	31.6	23.2	40.0
	20+	67	51.5	42.9	60.1	333	42.0	38.6	45.4	52	44.4	35.4	53.4
Sessions per week	<6	16	12.2	6.6	17.8	124	15.7	13.2	18.2	19	16.1	9.5	22.7
	6–10	87	66.4	58.3	74.5	523	66.0	62.7	69.3	80	67.8	59.4	76.2
	11+	28	21.4	14.4	28.4	145	18.3	15.6	21.0	19	16.1	9.5	22.7
Size of practice	Solo	40	30.8	22.9	38.7	135	17.3	14.6	20.0	12	10.3	4.8	15.8
	2–4	42	32.3	24.3	40.3	289	37.0	33.6	40.4	42	36.2	27.5	44.9
	5–10	39	30.0	22.1	37.9	314	40.2	36.8	43.6	47	40.5	31.6	49.4
	11+	9	6.9	2.5	11.3	44	5.6	4.0	7.2	15	12.9	6.8	19.0
Rurality	Metropolitan	103	78.6	71.6	85.6	583	73.1	70.0	76.2	74	62.2	53.5	70.9
	Large rural	10	7.6	3.1	12.1	63	7.9	6.0	9.8	11	9.2	4.0	14.4
	Small rural	18	13.7	7.8	19.6	151	18.9	16.2	21.6	34	28.6	20.5	36.7
Total		**131**	**100.0**	**. .**	**. .**	**797**	**100.0**	**. .**	**. .**	**119**	**100.0**	**. .**	**. .**

Note: UCL—upper confidence limit; LCL—lower confidence limit; shading indicates statistically significant differences between the groups.

Other GP characteristics

There were no significant differences between the groups in terms of their country of graduation, whether they were Fellows of the Royal Australian College of General Practitioners, or whether they conducted more than half their consultations in a language other than English (results not shown).

In summary, GPs in the high ordering group were more likely to be female and more likely to work in small rural areas than those in the low ordering group. They were also less likely to be in solo practice. Those in the low ordering group were more likely to be male and to work in metropolitan areas and in solo practices.

4.5 GP Characteristics by ordering rate: analysis of variance

The factors that affect GP imaging rates were explored using analysis of variance and linear regression. The variables of interest are listed below. Of the 1,047 GPs, 1,001 had data recorded for all variables of interest. The analysis of variance was restricted to these 1,001 GPs and was performed on unweighted data because the GP weighting variables (GP age and GP sex) were adjusted for in the analysis.

GP characteristics

- Number of MBS services per year
- Sex of GP
- Age of GP
- Years in practice
- Number of sessions per week
- Place of graduation (Australia, United Kingdom, other)

Practice characteristics

- Size of practice (Solo, 2–4, 5–10, 11–15, 15+)
- Location of practice (urban, large rural, small rural)

Patient characteristics

- Rate of male patients
- Rate of patients < 5
- Rate of patients 5–14
- Rate of patients 15–24

- Rate of patients 25–44
- Rate of patients 45–64 (The final group aged 65 years and over is excluded as it is a linear combination of the other five age groups).
- Rate of new patients
- Rate of patients with a health care card or Department of Veterans' Affairs card.

Problems managed

- Rate of problems in each of the ICPC–2 chapters
- Rate of problems in ICPC–2 component 1, Symptoms and Complaints (codes 1–29)
- Rate of problems in ICPC–2 components 3–6, Process components (codes 30–69)
- Rate of problems in ICPC–2 component 7, Diagnosis, disease (codes 70–99).

Univariate analysis

The proportion of variance in imaging rates explained by each variable alone was determined using simple linear regression. The results of the univariate analyses are summarised in Table 4.7.

Variables that were significant univariate predictors of imaging rates when fitted alone were:

- GP sex, practice location and size of practice
- sex of patients, rates of new patients, rates of health care/Veterans Affairs card holders
- management rates of musculoskeletal, psychological, respiratory, urinary, female genital problems and pregnancy were all significant univariate predictors of imaging rates
- relative rate of problems described as symptoms or complaints.

Multivariate analysis

General linear modelling was used to find the independent predictors of imaging order rates. When all variables of interest were entered, the model explained 17.8 per cent of the variance in imaging order rates. The full additive model explained a significant amount of the variance in imaging rates ($F(45, 955) = 4.58$, $p<0.0001$).

The model was reduced using backward elimination with predictor variables fitted in 'families' in the following order: 'GP demographics', 'practice', 'patient demographics', 'problems managed'. The model was reduced family by family.

Families were reduced in order, the variables most directly related to imaging rates (problem characteristics) being reduced first, after adjusting for all other families.

If a family was significant (global alpha = 0.1) when fitted last it was reduced further by fitting each individual variable last. Significant variables (alpha =0.05) or those that improved the fit of the model were kept. The reduced family was then fitted first and the next family fitted last. The final reduced model is summarised in Table 4.8.

Table 4.7: Univariate analysis of GP characteristics and imaging order rates

Variable	Regression coefficient	Effect size (standard Beta)	Per cent of variance explained	F-value	P-value
GP characteristics	**. .**	**. .**	**1.34**	**1.11**	**0.344**
GP sex	0.905	0.090	0.812	8.180	0.0043
GP age	. .	. .	0.132	0.440	0.7248
Annual A1 Medicare claims	–0.000	–0.059	0.348	3.489	0.0621
Place of graduation	. .	. .	0.125	0.627	0.5346
Years in practice	. .	. .	0.032	0.106	0.956
Sessions per week	. .	. .	0.133	0.665	0.515
Practice characteristics	. .	. .	2.74	4.66	<0.0001
Size of practice	. .	. .	1.565	3.958	0.0034
Location of practice	. .	. .	1.044	5.266	0.0053
Patient characteristics	**. .**	**. .**	**6.9**	**9.19**	**<0.0001**
Rate of male patients	–0.042	–0.112	1.257	12.716	0.0004
Rate of patients < 5	0.0047	0.006	0.000	0.850	0.853
Rate of patients 5–14	0.0012	0.001	0.000	0.001	0.972
Rate of patients 15–24	0.0350	0.050	0.250	2.470	0.116
Rate of patients 25–44	–0.0019	–0.005	0.100	0.020	0.887
Rate of patients 45–64	0.0360	0.060	0.270	3.663	0.0559
Rate of patients 65 +	–0.0132	–0.047	0.120	2.235	0.1353
Rate of card holders	–0.018	–0.089	0.793	7.986	0.0048
Rate of new patients	0.085	0.190	3.614	37.454	<.0001
Problems managed	**. .**	**. .**	**10.25**	**5.90**	**<0.0001**
Total problems managed	0.011	0.064	0.409	4.101	0.0432
Rate of new problems	0.005	0.026	0.069	0.694	0.4049
Rate of A chapter (General/unspecified)	–0.009	–0.016	0.025	0.251	0.6165
Rate of B chapter (Blood/blood forming)	0.002	0.001	0.000	0.001	0.9695
Rate of D chapter (Digestive)	0.003	0.003	0.001	0.008	0.9283
Rate of F chapter (Eye)	–0.023	–0.010	0.010	0.101	0.7504
Rate of H chapter (ear)	–0.024	–0.014	0.020	0.199	0.6556
Rate of K chapter (Circulatory)	–0.002	–0.005	0.003	0.026	0.8724
Rate of L chapter (Musculoskeletal)	0.070	0.127	1.613	16.386	0.0001
Rate of N chapter (Neurological)	0.034	0.019	0.038	0.376	0.5402
Rate of P chapter (Psychological)	–0.048	–0.103	1.052	10.621	0.0012
Rate of R chapter (Respiratory)	–0.036	–0.073	0.540	5.420	0.0201
Rate of S chapter (Skin)	–0.003	–0.005	0.003	0.027	0.8688
Rate of T chapter (Endocrine, metabolic)	0.038	0.052	0.273	2.729	0.0988
Rate of U chapter (Urinary)	0.306	0.138	1.895	19.298	0.0001
Rate of W chapter (Pregnancy/family plan)	0.100	0.106	1.132	11.438	0.0007
Rate of X chapter (Female genital)	0.116	0.191	3.661	37.958	0.0001
Rate of Y chapter (Male genital)	0.014	0.005	0.002	0.024	0.8768
Rate of Z chapter (Social)	–0.029	–0.016	0.026	0.262	0.6087
Rate of Component 1 (Symptoms/complaints)	0.031	0.091	0.828	8.341	0.004
Rate of Component 7 (Diagnosis/disease)	0.002	0.008	0.007	0.069	0.7932
Rate of Components 2–6 (Process)	0.008	0.023	0.050	0.547	0.4599

Note: Shading indicates variables significantly associated with imaging rates at the univariate level.

The results of this multivariate analysis indicated that:

- GPs from practices with 11–15 GPs had significantly higher imaging order rates than solo GPs, and
- GPs from small rural/remote practices had significantly higher imaging order rates than those from urban practices.

Significant predictors of higher rates of imaging order rates were:

- higher rates of new patients
- higher rates of management of musculoskeletal, urinary and female genital problems
- higher rates of problems described in symptomatic terms

and

- lower rates of patients aged 25–44
- lower rates of health card holders
- lower rates of management of psychological, skin and general/unspecified problems.

Together, the independent predictors explained 17.0 per cent of the variance in imaging rates ($F(16, 984) = 12.64$, $p < 0.001$). The strongest independent predictor of imaging order rates was the rate of encounters with new patients. This rate uniquely explained 3.7% of the variance and had the largest standardised effect size (Beta = 0.2).

Table 4.8: Final model of independent predictors of GP imaging order rates

Predictor (explanatory variable)		Regression coefficient [(a)]	Effect size (standard Beta) [(b)]	T-Value (F-partial)	P-value [(c)]	Per cent of Unique variance [(d)]
Rate of patients aged 25–44 years		–0.05	–0.11	–3.12	0.0018	0.82
Rate of health card holders		–0.02	–0.10	–2.76	0.0059	0.64
Rate of new patients		0.09	0.20	6.62	0.0001	3.69
Rate of A chapter (General/unspecified)		–0.06	–0.10	–3.02	0.0026	0.77
Rate of L chapter (Musculoskeletal)		0.08	0.15	4.69	0.0001	1.85
Rate of P chapter (Psychological)		–0.07	–0.15	–3.77	0.0002	1.20
Rate of S chapter (Skin)		–0.05	–0.07	–2.22	0.0268	0.41
Rate of U chapter (Urinary)		0.26	0.12	3.86	0.0001	1.25
Rate of X chapter (Female genital)		0.10	0.16	4.84	0.0001	1.97
Rate of symptoms/complaints		0.05	0.13	3.04	0.0024	0.78
Region of practice		. .	. .	(7.72)	0.0005	1.30
Versus urban	Large rural	0.17	0.01	0.33	0.7401	0.00
	Small rural	1.39	0.12	3.91	0.0001	0.00
Size of practice		. .	. .	(3.85)	0.0041	1.30
Versus solo	2–4 GPs	0.46	0.05	1.16	0.2466	. .
	5–10 GPs	0.82	0.09	2.05	0.0405	. .
	11–15 GPs	2.56	0.13	3.79	0.0002	. .
	16 + GPs	0.61	0.01	0.44	0.6595	. .

(a) Unit change in imaging rate for every unit change in the predictor variable. Units are original measurement units. Negative values represent a reduction in imaging rates with an increasing rate of the predictor.

(b) The standardised effect of the variable on imaging rates. Measured as standard deviation change in imaging rate for every standard deviation change in the predictor.

(c) Significance when all other variables in the model are held constant.

(d) The per cent of variance in imaging rates attributable uniquely to the variable, after taking into account the variance explained by all other variables in the model.

4.6 Discussion

The relationship between practice size and imaging ordering is not well documented in the published literature. A study by Njalsson et al. in Iceland found that ordering rates decreased with increasing practice size. However, the maximum practice size was five practitioners and this is below the size at which this study found increased ordering (Njalsson et al. 1995). Njalsson's study did, however, reveal much higher ordering rates in rural health centres which performed their imaging almost totally in the practice.

In reviewing imaging orders for gastrointestinal disorders in Germany, Busse et al. found that physicians (GPs and general internists) ordered imaging according to poor certainty of diagnosis and to severity of illness but the best predictor of imaging ordering was ownership of the imaging technology (Busse et al. 1999). Hillman et al. similarly found a significant correlation between ordering and practice ownership of the imaging process (Hillman et al. 1990). It would be useful in the Australian context to explore the imaging technology ownership of the large practices with high ordering revealed by this study.

Also consistent with this study, Rosen et al. found that in an outpatient setting female doctors were 40% more likely to order imaging (Rosen et al. 1997). Increasing feminisation of the GP workforce in Australia could therefore lead to higher overall imaging ordering.

5 Characteristics of imaging encounters and patients

5.1 Type of encounter

The characteristics of the 6,979 imaging encounters are compared with those of the 97,878 non-imaging encounters in Table 5.1. There were four statistically significant differences between imaging encounters and non-imaging encounters.

Table 5.1: Distribution of services for imaging and non-imaging encounters

	Imaging encounters (*n*=6,979)				Non-imaging encounters (*n*=97,878)			
Encounter type	***n***	**Rate per 100 encounters**	**95% LCL**	**95% UCL**	***n***	**Rate per 100 encounters**	**95% LCL**	**95% UCL**
General practitioners	1,036	. .	. .	. .	1,047	. .	. .	. .
Direct consultations	6,670	99.3	99.1	99.5	90,766	96.5	96.1	96.8
No charge	20	0.3	0.0	5.8	534	0.6	0.3	0.8
Medicare claimable	6,398	95.3	94.5	96.1	87,300	92.8	92.2	93.4
Short surgery	23	0.3	0.0	14.0	1,328	1.4	0.6	2.2
Standard surgery	4,982	74.2	72.4	76.0	73,779	78.4	77.4	79.4
Long surgery	1,067	15.9	13.6	18.2	7,071	7.5	6.9	8.1
Prolonged surgery	61	0.9	0.0	6.9	493	0.5	0.0	1.0
Home visits	52	0.8	0.0	5.6	1,349	1.4	0.9	2.0
Hospital	61	0.9	0.0	15.7	387	0.4	0.0	2.1
Nursing home	29	0.4	0.0	11.4	877	0.9	0.0	1.9
Other items	124	1.8	0.0	5.9	2,016	2.1	1.6	2.7
Workers' compensation	153	2.3	0.0	4.9	1,834	2.0	1.6	2.3
Other paid (hospital, State)	99	1.5	0.0	16.4	1,099	1.2	0.0	2.8
Indirect consults	46	0.7	0.0	5.1	3,321	3.5	3.0	4.1
Script	4	0.1	0.0	11.2	1,806	1.9	1.5	2.3
Referral	26	0.4	0.0	6.7	441	0.5	0.2	0.8
Certificate	0	. .	. .	. .	113	0.1	0.0	0.4
Other	18	0.3	0.0	6.3	1,076	1.1	0.7	1.6
Missing	264	. .	. .	. .	3,791	. .	. .	. .

Note: Shading indicates statistically significant differences between the groups. UCL—upper confidence limit; LCL—lower confidence limit.

- Imaging encounters were more likely to be direct consultations (99.3%) where the patient was seen face-to-face, than were non-imaging encounters (96.5%).
- Imaging encounters were more likely to be claimable on Medicare (95.3%) than were non-imaging encounters (92.8%).
- Imaging encounters were less likely to be charged as standard surgery consultations (74.2%) compared with non-imaging encounters (78.4%) and more likely to be charged as long surgery consultations (15.9% compared with 7.5%).

There were no other significant differences in the characteristics of the encounters where imaging was ordered when compared with those at which it was not. However, it should be noted that sample sizes for the remaining variables were very small and unlikely to produce statistically significant differences.

5.2 Patient characteristics

Table 5.2 provides a comparison of the characteristics of patients attending imaging encounters with the characteristics of those attending non-imaging encounters.

Table 5.2: Characteristics of patients at imaging and non-imaging encounters

		Imaging encounters (*n*=6,979)				Non-imaging encounters (*n*=97,878)			
Patient variable		**Number**	**Rate per 100 encounters(a)**	**95% LCL**	**95% UCL**	**Number**	**Rate per 100 encounters(a)**	**95% LCL**	**95% UCL**
Sex	Male	2,801	40.6	39.0	42.3	41,508	42.9	42.2	43.6
	Female	4,090	59.4	57.7	61.0	55,276	57.1	56.4	57.8
	Missing gender	(88)	. .	. .	. .	(1,094)	. .	. .	. .
Age	<15 years	550	7.9	6.3	9.5	14,752	15.2	14.5	15.8
	15–24 years	682	9.8	8.5	11.2	10,132	10.4	10.0	10.9
	25–44 years	1,985	28.6	27.0	30.2	25,341	26.1	25.4	26.8
	45–64 years	2,170	31.3	29.8	32.9	23,350	24.0	23.5	24.6
	65–74 years	798	11.5	10.0	13.0	11,687	12.0	11.5	12.6
	75+ years	747	10.8	9.0	12.5	11,856	12.2	11.5	13.0
	Missing age	(45)	. .	. .	. .	(759)	. .	. .	. .
New to practice		651	9.3	5.6	13.0	6,990	7.1	6.5	7.8
Health care card holder		2,569	36.8	34.7	38.9	37,883	38.7	37.1	40.3
Veterans' Affairs gold card		155	2.2	0.0	5.2	2,571	2.6	2.3	3.0
Veterans' Affairs white card		20	0.3	0.0	5.7	283	0.3	0.0	0.6
Non-English-speaking background		581	8.3	0.3	16.3	7,775	7.9	4.8	11.1
Aboriginal		57	0.8	0.0	9.9	638	0.7	0.0	1.5
Torres Strait Islander		3	*	0.0	10.7	54	0.1	0.0	0.7

(a) Missing data removed.

* Less than 0.05 per 100 encounters.

Note: UCL—upper confidence limit; LCL—lower confidence limit. Shading indicates statistically significant differences between patients at imaging and non-imaging encounters.

Patient sex and age group

While the patient was female at marginally more imaging encounters (59.4%) than at non-imaging encounters (57.1%), this difference failed to reach statistical significance.

Patients at imaging encounters were more likely to be aged between 25 and 44 years and between 45 and 64 years than those at non-imaging encounters and far less likely to be aged less than 15 years. There was no significant difference between the groups in the proportion of patients aged over 64 years.

Other patient characteristics

There were no further significant differences between patients attending imaging encounters and those attending non-imaging encounters in terms of their health care card status, Veterans' Affairs card status, Non-English speaking background, Aboriginality and Torres Strait Islander status, or status to the practice (new/seen before).

5.3 The content of the encounters

Table 5.3 provides a comparison of the overall content of imaging encounters and non-imaging encounters. At imaging encounters:

- there were significantly more patient reasons for encounter (157.3 per 100 encounters) than at non-imaging encounters (147.8)
- significantly more problems were managed (157.4 compared with 146.5 per 100 encounters), and
- the problems managed were significantly more likely to be new problems to the patient (40.1%) than those at non-imaging encounters (30.1% new).

Overview of management

A significantly lower proportion of imaging encounters generated at least one medication (prescribed, advised for over-the-counter purchase or supplied by the GP) (52.8%) than non-imaging encounters (69.6%). Problems managed at imaging encounters were also significantly less likely to be managed with medication (41.6% compared with 59.4%).

At least one non-pharmacological management was also less likely at imaging encounters (32.0% compared with 36.5% of non-imaging encounters) and significantly fewer problems were managed with other clinical or procedural techniques (23.4% of total problems) than at non-imaging encounters (28.4%).

At least one referral was provided at 14.3% of imaging encounters, for 9.6% of the problems managed. These were significantly higher referral rates than for non-imaging encounters, 10.1% of which generated a referral for 7.2% of problems managed (Table 5.3).

Table 5.3: Morbidity and management at imaging and non-imaging encounters

	Imaging encounters (*n*=6,979)							Non-imaging encounters (*n*=97,878)						
Data element	**Number**	**Rate per 100 encounters**	**95% LCL**	**95% UCL**	**Rate per 100 problems**	**95% LCL**	**95% UCL**	**Number**	**Rate per 100 encounters**	**95% LCL**	**95% UCL**	**Rate per 100 problems**	**95% LCL**	**95% UCL**
Reasons for encounter	11,007	157.7	154.9	160.5	. .	. .	. .	144,683	147.8	146.1	149.6	. .	. .	. .
Problems managed	10,985	157.4	154.4	160.4	. .	. .	. .	142,872	146.0	144.1	147.8	. .	. .	. .
New problems	4,399	63.0	60.4	65.7	40.1	38.4	41.7	43,059	44.0	42.3	45.6	30.1	28.9	31.3
Old problems	6,586	94.4	90.9	97.8	60.0	58.3	61.6	99,813	102.0	99.5	104.5	69.9	68.7	71.1
Work-related	261	3.7	1.1	6.4	2.4	0.6	4.1	3,088	3.2	2.8	3.5	2.2	1.9	2.4
Management														
At least one medication	3,685	52.8	50.9	54.7	41.6	39.8	43.3	68,096	69.6	68.7	70.4	59.4	58.5	60.3
At least one other treatment	2,233	32.0	30.0	34.1	23.4	21.7	25.1	35,728	36.5	35.3	37.7	28.4	27.4	29.3
At least one referral	996	14.3	12.5	16.1	9.6	8.4	10.9	9,930	10.1	9.8	10.5	7.2	7.0	7.5
Medications	5,859	84.0	79.4	88.5	53.3	50.6	56.1	109,573	112.0	109.6	114.30	76.7	75.3	78.1
Prescribed	5,065	72.6	68.1	77.1	46.1	43.4	48.9	93,307	95.3	93.0	97.7	65.3	63.8	66.8
Advised over-the-counter	510	7.3	4.4	10.2	4.7	2.8	6.5	9,332	9.5	8.7	10.4	6.5	5.9	7.1
GP supplied	283	4.1	0.0	9.4	2.6	0.0	5.6	6,934	7.1	6.0	8.2	4.9	4.1	5.6
Other treatments	2,967	42.5	39.2	45.8	27.0	24.8	29.2	45,227	46.2	44.4	48.0	31.7	30.5	32.8
Clinical	1,963	28.1	25.7	30.5	17.9	15.8	19.9	33,139	33.9	32.3	35.5	23.2	22.1	24.3
Procedural	1,003	14.4	13.1	15.7	9.1	7.7	10.6	12,088	12.4	11.8	12.9	8.5	8.1	8.8
Referrals	1,109	15.9	13.7	18.1	10.1	8.7	11.5	10,651	10.9	10.5	11.3	7.5	7.2	7.7
Emergency department	5	0.1	0.0	6.5	0.1	0.0	4.1	82	0.1	0.0	0.5	0.1	0.0	0.3
Hospital	97	1.4	0.0	6.7	0.9	0.0	4.3	647	0.7	0.5	0.8	0.5	0.3	0.6
Specialist	667	9.6	7.6	11.5	6.1	4.9	7.3	6,972	7.1	6.8	7.4	4.9	4.7	5.1
Allied health services	340	4.9	3.0	6.7	3.1	1.9	4.3	2,950	3.0	2.8	3.2	2.1	1.9	2.2
Pathology	3,525	50.0	45.8	55.2	32.1	29.2	35.0	24,088	24.6	23.5	25.7	16.9	16.2	17.6
Imaging	7,919	113.5	112.3	114.6	72.1	70.7	73.5	. .	. .	. .	. .	. .	. .	. .

Note: Shading indicates statistically significant differences between patients at imaging and non-imaging encounters; UCL—upper confidence limit; LCL—lower confidence limit.

Medications

Significantly fewer medications were prescribed, advised or supplied at imaging encounters (84.0 per 100 encounters and 53.3 per 100 problems managed) than at non-imaging encounters (112.0 per 100 encounters and 76.7 per 100 problems managed). However, this difference in overall rates was not significant for rates of advised over-the-counter medication nor in rates of GP-supplied medication. The difference was very much due to the prescribing rates, which were significantly lower at imaging encounters (72.6 per 100 encounters and 46.1 per 100 problems managed) than at non-imaging encounters (95.3 per 100 encounters and 65.3 per 100 problems managed).

Other non-pharmacological management

While there was no significant difference in the overall rate of other treatments per 100 encounters, imaging encounters included significantly less other treatments per 100 problems managed (27.0) than did non-imaging encounters (31.7).

There was a significantly lower rate of provision of clinical treatments (advice and counselling) at imaging encounters (28.1 per 100 encounters and 17.9 per 100 problems) than at non-imaging encounters (33.9 per 100 encounters and 23.2 per 100 problems managed).

In contrast there was a significantly higher rate of procedures at imaging encounters (14.4 per 100 encounters and 9.1 per 100 problems managed) than at non-imaging encounters (12.4 per 100 encounters and 8.5 per 100 problems managed) (Table 5.3).

Referrals

Counting each referral once, the relative rate of referral remained significantly higher at imaging encounters than at non-imaging encounters both on a rate per 100 encounters and a rate per 100 problems basis. However, this difference was not reflected in hospital admissions or in referral rates to emergency departments and allied health services. The difference in overall referral rates reflected referrals to specialists, which were significantly higher at imaging encounters (9.6 per 100 encounters and 6.1 per 100 problems managed) than at non-imaging encounters (7.1 per 100 encounters and 4.9 per 100 problems managed).

Pathology ordering

Orders for pathology tests were made at almost double the rate at imaging encounters (50.0 test orders per 100 encounters and 32.1 per 100 problems) than at non-imaging encounters (24.6 per 100 encounters and 16.9 per 100 problems managed).

6 Types of imaging tests ordered by general practitioners

6.1 Distribution of imaging tests ordered by Medicare Benefits Schedule groups

Table 6.1 provides a breakdown of the imaging tests ordered in terms of the five major groups used in the Medicare Benefits Schedule (MBS). Within each group the most frequent test types are listed.

- Column 1 gives an indication of the variance among GPs by providing the percentage of GPs who ordered at least one of this test type.
- Column 2 provides the number of test orders for that group or type of test.
- Column 3 gives the relative frequency (per cent) of the test within the MBS group.
- Column 4 gives an indication of the relative frequency of the group or type of imaging test in relation to the total imaging tests ordered.
- The next two columns provide the 95% confidence interval surrounding the estimate in Column 4.
- The last column gives the relative standard error (RSE) of the estimate.

Diagnostic radiology

Diagnostic radiology tests numbered 5,042 and accounted for the majority of imaging tests ordered (63.7%). At least one of these tests was ordered by 96.1% of the GPs. The six tests most often ordered from this group made up half of all diagnostic radiology orders. These included chest x-rays (21.0); plain x-rays of the knee (7.9%); mammograms (7.2%); and plain x-rays of the lumbosacral region (5.3%), the ankle (4.2%) and the shoulder (4.2%).

The relative standard errors indicated that the estimates of the frequency of diagnostic imaging test orders overall are highly reliable and that those for the frequency of orders for chest x-ray, knee x-ray and mammography are quite reliable. The remaining estimates are statistically unreliable.

Table 6.1: Distribution of imaging tests ordered by MBS groups

Imaging group (MBS)	Per cent of all GPs (*n*=1,047)	Number orders	Per cent of MBS group	Per cent of all imaging orders (*n*=7,919)	95% LCL	95% UCL	RSE
Diagnostic radiology	**96.1**	**5,042**	**100.0**	**63.7**	**62.0**	**65.1**	**1**
X-ray; chest	55.6	1,057	21.0	13.3	12.1	14.6	5
X-ray; knee	29.6	400	7.9	5.1	3.7	6.5	14
Mammography	27.6	365	7.2	4.6	3.0	6.2	17
X-ray; lumbosacral	17.6	266	5.3	3.4	1.1	5.6	34
X-ray; ankle	16.2	214	4.2	2.7	1.0	4.4	32
X-ray; shoulder	16.8	211	4.2	2.7	0.9	4.4	34
X-ray; foot/feet	15.8	191	3.8	2.4	0.7	4.1	37
X-ray; hip	15.1	168	3.8	2.1	0.1	4.1	48
X-ray; wrist	14.0	164	3.3	2.1	0.2	4	47
X-ray; spine; lumbar	9.5	139	2.8	1.8	0.0	5.3	100
X-ray; cervical	11.5	131	2.6	1.7	0	3.8	68
X-ray; hand	10.7	122	2.4	1.5	0	3.8	75
X-ray; finger(s)/thumb	11.5	114	2.3	1.4	0	3.5	73
Imaging other	5.5	107	2.1	1.4	0	10.9	100
X-ray; spinal	7.7	98	1.9	1.2	0	3.8	100
X-ray; abdomen	8.1	97	1.9	1.2	0	3.8	100
Test; bone densiometry	9.0	95	1.9	1.2	0	3.8	100
X-ray; neck	7.2	94	1.9	1.2	0	4.5	100
Scan; bone(s)	7.0	76	1.5	1.0	0	4.1	100
X-ray; elbow	6.6	73	1.4	0.9	0	3.2	100
Pyelogram; intravenous	4.8	70	1.4	0.9	0	4.7	100
X-ray; thoracic	5.7	65	1.3	0.8	0	3.5	100
X-ray; sinus	4.5	51	1.0	0.7	0	4	100
Barium meal	3.3	51	1.0	0.6	0	4.8	100
X-ray; ribs	4.1	47	0.9	0.6	0	4	100
X-ray; toe(s)	3.5	40	0.8	0.5	0	4.2	100
X-ray; heel	3.1	39	0.8	0.5	0	5.5	100
Barium enema	3.2	36	0.7	0.5	0	4.6	100
X-ray; pelvis	3.5	36	0.7	0.5	0	3.5	100
Sub-total	*. .*	*4,617*	*91.6*	*. .*	*. .*	*. .*	

(continued)

Table 6.1 (continued): Distribution of imaging tests ordered by Australian MBS groups

Imaging group (MBS)	Per cent of all GPs (*n*=1,047)	Number orders	Per cent of MBS group	Per cent of all imaging orders (*n*=7,919)	95% LCL	95% UCL	RSE
Ultrasound	**78.5**	**2,035**	**100.0**	**25.7**	**24.4**	**27.0**	3
Ultrasound; pelvis	27.9	361	17.7	4.6	2.9	6.3	19
Ultrasound; abdomen	20.4	253	12.5	3.2	1.6	4.8	25
Ultrasound; obstetric	15.2	214	10.5	2.7	0	5.6	54
Ultrasound; breast; F	18.3	194	9.5	2.5	0.7	4.2	36
Ultrasound; shoulder	12.6	155	7.6	2.0	0	4.1	55
Ultrasound; kidney	8.8	98	4.8	1.2	0	3.7	100
Test; Doppler	8.1	85	4.2	1.1	0	3.9	100
Ultrasound NOS	7.5	80	3.9	1.0	0	3.6	100
Ultrasound; abdomen upper	6.3	79	3.9	1.0	0	4.4	100
Ultrasound; thyroid	5.8	53	2.6	0.7	0	3.5	100
Ultrasound; scrotum	4.5	49	2.4	0.6	0	4.1	100
Echocardiography	3.6	47	2.3	0.6	0	4.5	100
Test; Doppler carotid	4.6	46	2.3	0.6	0	4.1	100
Ultrasound; renal tract	3.6	44	2.2	0.6	0	4.5	100
Ultrasound; gallbladder	3.2	38	1.9	0.5	0	6.2	100
Sub-total ultrasound	*. .*	*1,796*	*88.3*	*. .*	*. .*	*. .*	*. .*
Computed tomography	**39.5**	**674**	**100.0**	**8.5**	**7.1**	**9.9**	9
CT scan; brain	10.6	130	19.3	1.7	0	3.6	60
CT scan; head	9.3	107	15.9	1.4	0	4.0	100
CT scan; spine; lumbosacral	5.7	76	11.2	1.0	0	4.1	100
CT scan; abdomen	4.5	61	9.1	0.8	0	4.5	100
CT scan; spine; lumbar	4.8	60	8.9	0.8	0	4.7	100
CT scan; chest	3.9	52	7.7	0.7	0	5.1	100
CT scan; sinus	4.7	47	6.9	0.6	0	4.4	100
Sub-total CT scans	*. .*	*533*	*79.1*	*. .*	*. .*	*. .*	*. .*
Magnetic resonance imaging	**2.2**	**24**	**100.0**	**0.3**	**0.0**	**5.3**	**100**
Nuclear medicine imaging	**1.5**	**16**	**100.0**	**0.2**	**0.0**	**5.1**	**100**
Other NEC	**8.7**	**128**	**100.0**	**1.6**	**0.0**	**4.4**	**100**
Total imaging tests ordered	**98.7**	**7,919**	**. .**	**100.0**	**. .**	**. .**	**. .**

Note: UCL—upper confidence limit; LCL—lower confidence limit; RSE—relative standard error.

Ultrasound

Orders for ultrasound numbered 2,035 and accounted for one-quarter (25.7%) of the total. More than three-quarters (78.5%) of the GPs ordered at least one. The ultrasounds most often ordered were those of the pelvis (17.7% of all ultrasounds), the abdomen (12.5%), the breast (9.5%) and the shoulder (7.6%). However, it is notable that obstetric ultrasounds (10.5%) took third place in relative frequency in this group. These top five types of ultrasound made up almost 60% of all ultrasounds ordered and the estimates of ordering rates for only these five tests could be considered to have any acceptable level of statistical reliability according to the relative standard errors in the right hand column of Table 6.1.

Computed tomography

There were 674 CT scans ordered and the variety in types was far less than in the previous groups. Less than half the participating GPs ordered any computed tomography. Seven specific tests accounted for 79.1% of all CT scans and these included CTs of the brain, the head, the lumbosacral spine and the abdomen. Note that the relative standard errors for each of the specific tests listed in this group indicate that the estimates of ordering levels for each are not statistically reliable.

Magnetic resonance imaging

There were only 24 orders for MRIs and these were ordered by 23 GPs. This is not surprising because GPs cannot currently order an MRI under the Medical Benefits Scheme. These 24 cases therefore led to further investigation to assess the extent to which these were likely to have been ordered by GP/specialists (those who have dual registration) and the extent to which the costs are likely to have been covered by workers' compensation or other third party payments.

Due to the small sample of orders for MRIs, these are not investigated in further detail later in this report. However, a review of these orders demonstrated that they were associated with 24 different problem labels; that six of the 24 cases were associated with injuries; that six of the 24 were part of encounters claimable from Workers' Compensation Insurance and that four were at encounters claimable from other non-Medicare sources.

These data suggest that the 16 encounters at which an MRI was ordered that were claimable through Medicare were placed by GPs who had dual registration as a specialist or that these patients would be required to cover the costs of the MRI themselves.

Nuclear medicine imaging

There were only 16 tests of this type ordered among 16 GPs over the 12 months.

Other tests not elsewhere classifiable

There were 128 test orders that were not classifiable within the MBS groups due either to lack of information (for example, a tick that imaging had been done) or illegibility. These represented only 1.6% of total imaging ordered.

6.2 Comparison of *BEACH* and Health Insurance Commission data

Distribution of imaging ordered by MBS groups

The HIC imaging claims data related to all orders for imaging in the 1999–00 financial year were obtained from the HIC web site (HIC 2001). The DHAC also supplied the numbers of imaging tests undertaken from GP-generated requests for the same financial year. Earlier in this report the extrapolated *BEACH* data suggested there were approximately eight million imaging orders placed by GPs per year nationally. The total number of tests recorded as originating in a GP order in the MBS was 7.594 million for the 1999–00 financial year.

The distributions of these datasets across MBS diagnostic imaging groups are compared with the distribution of the imaging orders from *BEACH* in Table 6.2. No statistical tests of significance have been applied. Due to the sheer size of the HIC database, confidence intervals are very tight, ensuring that almost any comparison with a smaller database will generate significant differences.

It must be remembered that the HIC data report the number of tests claimed through the MBS. They do not include any tests paid for privately by the patient. Further, the radiologist has considerable professional freedom in deciding on the tests most suitable for the patient on any occasion so that the test order from the GP to the radiologist may not result in the same test as that ordered or may result in more tests being undertaken than were ordered by the GP. However, with these differences in mind these comparisons serve to provide a rough measure of the extent to which the *BEACH* data reflect the HIC claims data from radiologists.

As shown in Table 6.2 the distribution of the MBS imaging data across groups from all practitioners and those originating from general practice was remarkably similar to the distribution of the GP imaging test orders found in *BEACH*, with approximately two-thirds of the tests falling into the diagnostic radiology group.

Table 6.2: Comparison of distribution of MBS and *BEACH* imaging data

MBS group	MBS data Per cent of total imaging (*n*=10,967,698)[(a)]	MBS data Per cent of imaging ordered by GPs (*n*=7,594,538)[(b)]	BEACH Per cent of total imaging orders (*n*=7,791)[(c)]
Diagnostic radiology	64.2	62.4	64.8
Ultrasound	28.1	28.4	26.1
Computed tomography	4.4	7.8	8.7
Nuclear medicine	2.5	1.5	0.2
MRI	0.8	0.0	0.3
Total diagnostic imaging	**10,967,698**	**7,594,538**	**7,791**

(a) Source: Health Insurance Commission.

(b) Health Insurance Commission data by personal communication with DHAC.

(c) The 128 other tests that could not be classified in an MBS group were removed for the purposes of this comparison.

Note: MBS—Medical Benefits Schedule.

The comparison of *BEACH* with the HIC data for tests generated from GPs shows slight differences in the distribution. These differences (and that of the extrapolated total imaging order count) may be due to the inclusion in the *BEACH* data of all recorded orders for mammography, some of which would be referrals to BreastScreen Australia rather than to the private radiologists whose services are counted in the MBS (see Section 8.2). Further, a small proportion of diagnostic radiology ordered by the GP may not be followed up by the patient (i.e. the patient chooses not to present for the test). The slightly higher proportion of tests that fell into the diagnostic radiology group in *BEACH* has an effect on the proportion falling into the other MBS groups. The considerable difference in the relative rate of nuclear medicine tests between the MBS data (1.5%) and *BEACH* (0.3%) may reflect the small sample size in the *BEACH* program compared with the total MBS dataset.

MBS imaging groups by patient sex

The gender distribution of the patient (per cent male patients) associated with imaging tests from the major MBS groups are compared with those from *BEACH* in Table 6.3. Note that the MBS data in this case include all imaging tests, not only those that emanated from a GP order. Considering the inclusion of GPs orders for mammography to BreastScreen earlier mentioned, the gender distributions of the patients for whom the imaging tests were ordered/undertaken were remarkably similar, with approximately 40% of all tests being conducted for males.

Table 6.3: Major MBS imaging group by patient sex

	Patient gender—per cent male	
Imaging group	**MBS (*n*=10,967,698)[(a)]**	**BEACH (*n*=7,791)**
Diagnostic radiology	44.7	43.7
Ultrasound	26.3	29.7
CT	45.7	44.9
Total diagnostic imaging	39.5	40.3

(a) Source: Health Insurance Commission.

Note: MBS–Medical Benefits Schedule.

MBS imaging group by age distribution of patients

The age distributions from MBS data and *BEACH* data of the patients for whom each of the major MBS test groups was undertaken are compared in Table 6.4. The MBS data again include all patients for whom imaging tests were claimed rather than those generated by a GP. The overall distributions of total diagnostic imaging by age group were remarkably similar, approximately 13% of tests being undertaken for young people of less than 20 years, one-third being for those aged 20–44 years, one-third for those aged 45–64 years and about one-quarter for elderly people.

Table 6.4: Comparison of age distribution of patients for whom imaging ordered

		Age group of patient (per cent)			
Test group	**Dataset**	**<20**	**20–44**	**45–64**	**65+**
Diagnostic radiology	MBS[(a)]	17.1	27.0	30.4	25.5
	BEACH	15.8	27.7	31.5	25.1
Ultrasound	MBS[(a)]	7.7	45.6	27.1	19.6
	BEACH	9.0	44.5	30.1	16.4
CT	MBS[(a)]	6.1	28.3	36.0	29.5
	BEACH	7.2	29.4	37.0	26.4
Total diagnostic imaging	**MBS[(a)]**	**13.7**	**32.2**	**30.0**	**24.1**
	BEACH	**13.0**	**32.3**	**31.5**	**23.1**

(a) Source: Health Insurance Commission.

Note: MBS—Medical Benefits Schedule.

6.3 Individual imaging test types ordered most often

Table 6.5 provides a speedy overview of the results by listing the 30 most frequent imaging test types ordered, irrespective of their MBS group, in relative order of frequency. Note that the estimates are reliable only for about the top 10 test types ordered according to the relative standard error.

These top 30 tests accounted for almost two-thirds (61.9%) of all tests ordered. Chest x-rays were by far the most common, accounting for 13.3% of total imaging orders, at least one being ordered by more than half the participating GPs. These were followed by x-rays of the knee which were ordered on at least one occasion by 29.6% of the GPs and accounted for 5.1% of all imaging tests ordered.

Mammography and pelvic ultrasound were ordered at almost identical rates, each accounting for 4.6% of imaging orders and being ordered by the same proportion of the GP participants (27.6% and 27.9% respectively). These were followed by lumbosacral x-rays which accounted for 3.4% of imaging orders but were ordered by fewer individual GPs (17.6%). While abdominal ultrasounds were slightly less often ordered (3.2%), these test orders were spread widely across the GP sample, 30% of participants ordering at least one. Obstetric ultrasounds and plain x-rays of the ankle (each accounting for 2.7%) were ordered by one in seven GPs.

Table 6.5: Most frequent imaging test types ordered

Imaging test type	Per cent of GP with at least one order (*n*=1,047)	Number of orders	Per cent of all imaging tests ordered (*n*=7,919)	95% LCL	95% UCL	RSE
X-ray; chest	55.6	1,056.6	13.3	12.1	14.6	5
X-ray; knee	29.6	400.2	5.1	3.7	6.5	14
Mammography	27.6	365.2	4.6	3.0	6.2	17
Ultrasound; pelvis	27.9	360.8	4.6	2.9	6.3	19
X-ray; lumbosacral	17.6	266.6	3.4	1.1	5.6	34
Ultrasound; abdomen	30.0	253.3	3.2	1.6	4.8	25
X-ray; ankle	16.2	213.8	2.7	1.0	4.4	32
Ultrasound; obstetric	15.2	213.6	2.7	0.0	5.6	54
X-ray; shoulder	16.8	210.8	2.7	0.9	4.4	34
Ultrasound; breast	18.3	193.7	2.5	0.7	4.2	36
X-ray; foot/feet	15.8	190.6	2.4	0.7	4.1	37
X-ray; hip	15.1	167.7	2.1	0.1	4.1	48
X-ray; wrist	14.0	164.3	2.1	0.2	4.0	47
Ultrasound; shoulder	12.6	154.8	2.0	0.0	4.1	55
X-ray; spine; lumbar	9.5	139.1	1.8	0.0	5.3	100
X-ray; cervical	11.5	130.5	1.7	0.0	3.8	68
CT scan; brain	10.6	130.4	1.7	0.0	3.6	60
X-ray; hand	10.7	122.2	1.5	0.0	3.8	75
X-ray; finger(s)/thumb	11.5	113.6	1.4	0.0	3.5	73
CT scan; head	9.3	107.0	1.4	0.0	4.0	100
Other radiology NOS	5.5	106.8	1.4	0.0	3.7	100
Ultrasound kidney	8.8	98.5	1.2	0.0	3.7	100
x-ray spinal	7.7	98.2	1.2	0.0	3.8	100
x-ray; abdomen	8.1	96.6	1.2	0.0	3.8	100
Test; bone densiometry	9.0	94.6	1.2	0.0	3.8	100
x-ray; neck	7.2	94.3	1.2	0.0	4.5	100
Doppler test	8.1	85.2	1.1	0.0	3.9	100
Ultrasound NOS	7.5	80.3	1.0	0.0	3.6	100
Ultrasound upper abdomen	6.3	79.3	1.0	0.0	4.4	100
Bone scan	6.9	76.2	1.0	0.0	4.1	100
Sub-total top 30 tests	*. .*	*4,964.3*	*61.9*	*. .*	*. .*	*. .*
Total tests	**87.7**	**7.979**	**100.0**	**. .**	**. .**	**. .**

Note: LCL—upper confidence limit; UCL—upper confidence limit; RSE—relative standard error; NOS—not otherwise stated.

7 Problems managed with imaging test orders

This section investigates the problems to which the imaging tests ordered were related. As earlier stated, there can be a many-to-many relationship between morbidity and imaging tests. While a single test can be ordered for one problem under management at the encounter (a one-to-one relationship), it is also possible for one imaging test to be related to multiple problems under management, or more than one imaging test to be related to a single problem under management. The broad relationships between imaging tests and problems under management were reported in Chapter 4 (Tables 4.3 and 4.4). This many-to-many relationship means that while there were 7,919 imaging tests ordered, there were 7,218 problems (4.7%) managed with at least one imaging test.

7.1 Distribution of problems for which imaging was ordered

Distribution by ICPC–2 chapter of problem managed

In the total dataset there were 153,857 problems managed, at an average rate of 147 per 100 encounters. The distribution of these problems across ICPC–2 chapters is provided in the second column of Table 7.1. The third column gives the proportion of problems in each chapter that was associated with at least one imaging test order. The fourth column demonstrates the extent to which each morbidity chapter contributed to the total imaging orders. The last column states the relative test-ordering rate per 100 tested problems in each chapter.

Only 4.7% of all problems managed generated an order for one or more imaging tests. Musculoskeletal problems accounted for the greatest proportion (40.4%) of imaging tests and these types of problems were the most likely to be tested (16.0% generating at least one imaging test order). Female genital problems were second in the list of those most likely to have an imaging test order placed (9.8% having at least one) accounting for 9.4% of all imaging tests ordered. While 7.2% of urological problems generated an imaging test order these tests accounted for only 3.2% of all imaging tests ordered. A similar pattern was shown for the pregnancy and family planning chapter.

Digestive and neurological problems both came next in terms of the proportion of problems being tested (6.2%) but due to the difference in their overall relative frequency in general practice, accounted for very different proportions of total imaging. Digestive problems accounted for 8.9% of all imaging tests while neurological problems accounted for only 3.6%. Tests for the male genital system were less common (4.5% generating at least one) and they accounted for a very small proportion of total imaging.

The proportion of problems in each of the general, blood and skin chapters that were tested were similar (at about 2.5%) but, while the general and skin chapters each accounted for more than 5% of imaging, the problems associated with the blood generated less than 1% of total imaging.

Together problems associated with the digestive, musculoskeletal, respiratory and female genital systems accounted for almost 70% of all imaging tests ordered.

The chapter-specific imaging order rates demonstrated that while imaging was rarely ordered for eye problems (0.6% tested), multiple tests were most likely to be ordered when a decision for imaging tests was made (131.7 per 100 tested contacts). Problems associated with the blood and blood-forming organs were also likely to generate multiple tests (125.8 tests per 100 tested problems).

Table 7.1: Distribution of problems for which imaging ordered by ICPC–2 chapter

ICPC–2 chapter	Number of problems[(a)]	Per cent of problems with at least one imaging[(b)]	Per cent of total imaging orders (*n*=7,919)	Chapter-specific imaging order rate[(c)]
General and unspecified	14,622	2.7	5.6	113.4
Blood	1,781	2.6	0.7	125.8
Digestive	10,533	6.2	8.9	108.2
Eye	2,875	0.6	0.3	131.7
Ear	4,679	0.5	0.3	104.7
Cardiovascular	17,074	2.2	5.3	108.7
Musculoskeletal	17,766	16.0	40.4	112.6
Neurological	4,098	6.2	3.6	111.7
Psychological	11,025	0.6	0.9	109.7
Respiratory	25,375	3.0	9.9	104.7
Skin	17,865	2.3	5.8	114.1
Endocrine, nutritional, metabolic	9,572	1.7	2.1	104.2
Urological	3,185	7.2	3.2	108.9
Pregnancy and family planning	4,512	6.8	3.9	100.9
Female genital system	6,461	9.8	9.4	117.2
Male genital system	1,467	4.5	0.8	101.1
Social	968	0.5	0.1	100.0
Total	**153,857**	**4.7**	**100.0**	. .

(a) The number of problems in the total dataset that were classified in this chapter.

(b) The percentage of all problems in the chapter that generated at least one imaging test order.

(c) The number of imaging tests associated with problems in that chapter over the number of problems in that chapter for which at least one imaging test was ordered.

Imaging order rates by ICPC–2 component of problems under management

Examination of problems managed across ICPC–2 components provides an alternative way of viewing the types of matters dealt with at general practice consultations (Table 7.2).

GPs were instructed to record problems managed in the most specific terms possible at the time of the encounter. In an ideal world it could therefore be expected that problems managed should fall into three components of ICPC–2, namely the diagnosis/disease, symptoms and complaints, and diagnostic and preventive procedures (e.g. check-up). Although these components were the most frequently recorded, there were a small number of problems described in terms of a prescription, referral, test result or administrative procedure. In these circumstances, the lack of clinical description of the underlying problem required the label to be coded in terms of the process described (e.g. diagnosis was recorded as referral to dermatologist).

The majority of problems (65.5%) were described in terms of a diagnosis or disease (e.g. hypertension, depression, asthma). Problems described in terms of a symptom or complaint (e.g. febrile) represented almost one-quarter of all problems managed.

Imaging test orders were most commonly made for problems given a symptom/complaint label (7.5% being tested). Only 4.3% of problems with a diagnosis/disease label were associated with imaging tests. The component-specific ordering rate was around 110 tests per 100 problems in most components, the exception being problems with an administrative or referral label for which only one test was ordered for each tested problem.

Table 7.2: Imaging order rates by ICPC–2 component of problems under management

ICPC–2 component	Number of problems[(a)]	Per cent of problems at least one imaging[(b)]	Per cent of total imaging tests	Component-specific imaging order rate[(c)]
Symptoms & complaints	33,491	7.5	35.9	113.0
Diagnosis, diseases	100,788	4.3	59.4	109.9
Diagnostic & preventive procedures	13,700	2.6	4.8	107.2
Medications, treatments & therapeutics	3,257	0.5	0.4	105.3
Referral & other reasons for encounter	1,347	2.0	0.2	114.6
Results and administrative	1,272	1.6	0.3	100.0
Total problems	**153,857**	**100.0**	**7,919**	**. .**

(a) The number of problems in the total dataset that were classified in this chapter.

(b) The percentage of all problems in the chapter that generated at least one imaging test order.

(c) The number of imaging tests associated with problems in component over the number of problems in that component for which at least one imaging test was ordered.

7.2 Care process associated with imaging ordered

A specific interest of this study was the extent to which imaging was ordered for investigative/diagnostic purposes versus monitoring purposes.

Defining the care process involved in orders for imaging

The GPs were asked to indicate for each problem managed at the encounter whether it was a new problem to the patient. A new problem was defined as one that had not been managed for that patient by any medical practitioner or the first consultation for a new episode of an acute problem. The problem status was considered in combination with level of diagnostic certainty. Diagnostic certainty was defined in terms of the structure of the ICPC–2 classification, labels falling into the symptom component being seen as uncertain and those falling into the diagnostic component being regarded as problems already diagnosed. Problems labelled in a manner that placed them in the process components of ICPC–2 could not be defined in terms of symptoms or diagnoses and therefore could not be classified into a care process class.

Table 7.3 shows the relationship between problem status and component type for the 8,001 problems for which imaging was ordered. The problem was described in diagnostic terms in

58.8% of cases and almost half (47.0%) the problems were designated by the GP as new to the patient. The following care classes were then defined according to the status and component of the associated problem:

- *Investigative imaging:* tests ordered to assist in the diagnostic process: included all imaging ordered for problems that fell in ICPC–2 Component 1 (Symptoms and complaints) irrespective of problem status.
- *Management imaging:* tests ordered to assist in decisions about to how best to manage the problem that had already been defined in diagnostic terms by the clinician: included all imaging ordered for problems in ICPC–2 Component 7 (Diagnosis/disease) that were new to the patient.
- *Monitoring imaging:* tests ordered to monitor a patient in the ongoing care of a defined problem: included all imaging orders for problems in Component 7 (Diagnosis/Disease) at follow-up encounters for that problem.
- *Undefined imaging:* included all imaging ordered for problems in Components 2–6 (process codes) irrespective of the status of the problem to the patient

Table 7.3: Problem status by ICPC component of problems for which imaging is ordered.

	New problems[a]		Old problem follow-up		Total	
ICPC component	**Number**	**Per cent[b]**	**Number**	**Per cent[b]**	**Number**	**Per cent[b]**
Component 1—Symptoms and complaints	1,437	18.0	1,408	17.6	2,846	35.6
Component 7—Diagnoses, disease	2,248	28.1	2,457	30.7	4,705	58.8
Components 2–6—other[c]	79	1.0	371	4.6	450	5.6
Total	**3,764**	**47.0**	**4,237**	**53.0**	**8,001**	**100.0**

(a) The problem is new to the patient or this is the first contact with a medical practitioner for a new episode of an acute problem.

(b) Per cent of total combinations of imaging test orders and problems managed (n=8,001).

(c) Includes Diagnostic, screening and preventive procedures; Medications treatments, procedures; Test results; Administrative, Referrals and other reasons for encounter.

Imaging orders by care process

As shown in Table 7.3, 18.0% of all problem-imaging combinations were for new problems described in symptomatic terms and a further 17.6% were still described in symptomatic terms at the follow-up consultation. These two groups were combined and classed as investigative imaging.

Table 7.4 demonstrates that the problem types with the greatest likelihood of generating an imaging order were those associated with investigative imaging (those problems described in symptomatic terms), 7.5% of which resulted in a test order. These were followed by problems requiring management imaging tests (6.3% generating at least one order) and then by those requiring monitoring (3.3%).

- Investigative imaging accounted for 35.6% of all imaging orders.
- Management imaging tests for new diagnoses accounted for 28.1% of the problem-imaging combinations.
- Monitoring of old problems accounted for 30.7% of all problem-imaging combinations
- Undefined problem-imaging combinations accounted for 5.6% of the total.

The last column in Table 7.4 demonstrates that where a decision was made by the GP to order imaging, there was virtually no difference in the relative number of tests ordered between the imaging classes. The highest ordering rate was 113 tests per 100 tested problems for investigative imaging and the lowest, the tests classed as undefined which were ordered at a rate of 107 tested problems.

Table 7.4: Imaging orders by care process

Care process	Number problems	Number problems 1+ imaging[(a)]	Per cent of class[(b)]	Per cent of problems 1+ imaging (*n*=7,217)[(c)]	95% LCL	95% UCL	Per cent of tests (*n*=7,919)[(d)]	Test rate per 100 problems tested[(e)]
Diagnostic	33,491	2,518	7.5	34.9	33.2	36.6	35.6	113.0
Management	32,401	2,039	6.3	28.2	26.4	30.1	28.1	110.3
Monitoring	68,387	2,241	3.3	31.1	29.4	32.7	30.7	109.6
Undefined	19,578	420	2.1	5.8	3.7	7.9	5.6	107.4
Total	**153,857**	**7,217**	**4.7**	**100.0**	**. .**	**. .**	**100.0**	**110.9**

(a) The number of problems in each care process for which at least one imaging test was ordered.

(b) Percentage of problems in each care process with at least one imaging test.

(c) The distribution of problems for which imaging ordered across care processes.

(d) The percentage distribution of the test/problem combinations in each care process.

(e) The number of imaging tests ordered per 100 problems for which at least one test was ordered in each care process.

Discussion

The results of a German study by Busse et al. are consistent with the finding in this study that new problems, which are likely to have a higher uncertainty of diagnosis, result in higher levels of ordering (Busse et al. 1999). Klinkman found a higher level of general service utilisation associated with diagnostic uncertainty or non-specific diagnosis in patients with abdominal pain in a United States family practice (Klinkman 1996). These findings are not unexpected as GPs working in a 'diagnostic' mode could be expected to utilise more tests.

7.3 Most frequent individual problems for which imaging ordered

Table 7.5 provides a list of the most frequent problem labels (or groups of labels) for which imaging test orders were made, in decreasing order of frequency of imaging tests ordered. Column 2 provides the number of imaging tests ordered, while Column 3 describes the proportion of all imaging test orders accounted for by this problem label. Column 4 gives a proportion of total contacts with the selected problem that resulted in at least one order for imaging. Column 5 describes the relative number of imaging tests ordered in relation to the number of contacts with that problem that had at least one imaging order. Column 6 provides the relative number of imaging tests ordered per 100 contacts with a problem of this type.

These top 20 morbidity types listed in the table accounted for 44.5% of all imaging ordered. Back pain accounted for the highest number of imaging tests ordered (*n*=433) but only 15.2% of contacts with back pain resulted in at least one imaging test. Further, the number of tests per 100 problems, or 100 imaging contacts, was considerably less than for some other types of morbidity.

Fractures followed back pain in terms of the number of imaging tests ordered, and clinical contacts with fractures were more likely to result in an imaging order (38.0%) than did those for back pain. This resulted in a higher relative imaging order rate for contacts with fracture (41.4 per 100 contacts) than for back pain (17.3 per 100). Osteoarthritis was third in the list and this was followed by joint sprain/strain.

Table 7.5: Problems that generate the most imaging orders

Problem type	Number of imaging orders	Per cent of total imaging orders	Per cent of problems 1+ imaging[(a)]	Relative order rate per 100 imaging contacts[(b)]	Order rate per 100 problems[(c)]
Back pain*	433	5.5	15.2	114.1	17.3
Fracture*	424	5.4	38.0	109.0	41.4
Osteoarthritis*	326	4.1	12.6	110.0	13.9
Joint sprain/stain*	253	3.2	21.5	105.5	22.7
Injury musculoskeletal NOS	203	2.6	24.5	111.4	27.3
Abdominal pain*	192	2.4	27.7	111.5	30.9
Breast lump*	163	2.1	56.4	139.1	78.5
Other skin injury	159	2.0	23.5	107.5	25.2
Shoulder syndrome*	155	2.0	24.2	127.1	30.8
Acute bronchitis/bronchiolitis	146	1.8	4.4	100.5	4.4
Pre-postnatal check-up*	145	1.8	12.1	101.0	12.2
Bruise/contusion	121	1.5	18.2	128.3	23.3
Back syndrome with radiating pain	114	1.4	13.8	122.1	16.9
Pneumonia	114	1.4	34.4	100.0	34.4
Bursitis/tendonitis/synovitis NOS	112	1.4	13.5	111.5	15.0
Female genital check-up*	107	1.4	5.6	118.0	6.6
Neck syndrome*	100	1.3	16.4	107.3	17.6
Cholecystitis, cholelithiasis	92	1.2	40.3	103.7	41.7
Menstrual problems*	83	1.1	9.8	100.0	9.8
Chest pain NOS	82	1.0	21.5	128.3	27.5
Sub-total imaging tests for 20 problems types	*3,523*	*44.5*	*15.8*	*111.6*	*17.6*
Total imaging *(n)*	**7,919**	**100.0**	. .	. .	. .

(a) The percentage of total problems of each type for which at least one imaging test was ordered.

(b) The rate of imaging tests ordered per 100 problems for which at least one imaging test was ordered.

(c) The rate of imaging tests ordered per 100 problems of each type.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: NOS—not otherwise specified

The relative ordering rate for problems that resulted in at least one imaging order (Column 5) was lowest for pneumonia, where exactly 100 imaging tests were ordered for every 100 pneumonia cases tested (i.e. where a test was ordered in the management of pneumonia, a single test was always ordered). The highest rate was for breast lump where an average 1.4 tests were ordered per tested case (or 139.1 per 100). This was followed by bruise/contusion (128 tests per tested bruises/contusions and ill-defined chest pain (128.3 per 100).

7.4 Problems most likely to generate imaging orders

The problems most likely to generate an order for one or more imaging tests are presented in Table 7.6. Breast lump was the problem with the highest likelihood of imaging investigation (56.4% of contacts), followed by symptoms of the hip (44.8%), fibrocystic disease of the breast (44.7%), urinary calculus (44.1%) and cholecystitis (40.3%). In contrast (as shown in Table 7.5) an order for imaging was made at only 4.4% of contacts with acute bronchitis, 5.6% of female genital check-ups and at 9.8% of contacts with menstrual problems.

Table 7.6: Problems most likely to generate an imaging order

Problem type	Per cent of problems at least one imaging[(a)]	Number of imaging tests ordered	Per cent of total imaging orders	Relative order rate per 100 imaging contacts[(b)]	Relative order rate per 100 problems[(c)]
Breast lump*	56.4	163	2.1	139.1	78.5
Hip symptom/complaint	44.8	64	0.8	122.8	55.0
Fibrocystic disease breast	44.7	54	0.7	134.7	60.1
Urinary calculus	44.1	39	0.5	107.5	47.5
Cholecystitis, cholelithiasis	40.3	92	1.2	103.7	41.7
Fracture*	38.0	424	5.4	109.0	41.4
Spontaneous abortion	35.9	40	0.5	100.0	35.9
Goitre	34.4	36	0.5	101.6	34.9
Pneumonia	34.4	114	1.4	100.0	34.4
Haematuria	29.8	56	0.7	119.8	35.6
Abdominal pain*	27.7	192	2.4	111.5	30.9
Knee symptom/complaint	26.4	66	0.8	102.9	27.2
Injury musculoskeletal NOS	24.5	203	2.6	111.4	27.3
Shoulder syndrome	24.2	155	2.0	127.1	30.8
Acute internal damage to knee	23.7	69	0.9	109.6	26.1
Other skin injury	23.5	159	2.0	107.5	25.2
Shoulder symptom/complaint	23.0	62	0.8	123.3	28.3
Foot and toe symptom/complaint	22.9	50	0.6	110.5	25.4
Physical injury (excluding fracture; joint sprain/strain)	21.5	253	3.2	105.5	22.7
Sub-total imaging tests for 20 problems types	*15.8*	*3,523*	*44.5*	*111.6*	*17.6*
Total imaging *(n)*	**. .**	**7,919**	**100.0**	**. .**	**. .**

(a) The percentage of total problems of each type for which at least one imaging test was ordered.
(b) The rate of imaging tests ordered per 100 problems for which at least one imaging test was ordered.
(c) The rate of imaging tests ordered per 100 problems of each type.
* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).
Note: NOS—Not otherwise specified.

8 Analysis of selected test types

This section includes a more specific examination of eight selected imaging test types. These have been selected on the basis of their relative frequency in the dataset or for their intrinsic interest. For example, chest x-ray was chosen because of its high relative frequency in the dataset (*n*=1,057, 13.3% of all tests ordered), while Doppler tests were selected with the specific aim of establishing the morbidity for which a test was ordered. Some test types have been grouped under one topic heading (e.g. imaging of the breast) and comparisons made between the morbidity for which different specific types of tests (e.g. breast mammography and breast ultrasound) were ordered.

For each selected imaging type, the following data are provided:

- the sample size for each specific test type and the extrapolated estimate of total orders for this test by GPs per annum in Australia
- the age distribution of the patients for whom the tests were ordered (or, in further analyses the comparative age distribution of patients for whom different types of tests were ordered)
- the care process involved in the orders for this test type
- the most common problems for which the tests were ordered in decreasing order of frequency. In each case, this includes the morbidities that, together, accounted for approximately 75% of all problems associated with the selected test type. The proportion of total contacts with each problem that generated an order for the selected test is also reported.

Where appropriate, further analysis is presented regarding:

- the relationship between the test selected and the status of the problem, and/or
- the relationship between the test and the extent to which problems were work-related.

8.1 Chest x-ray

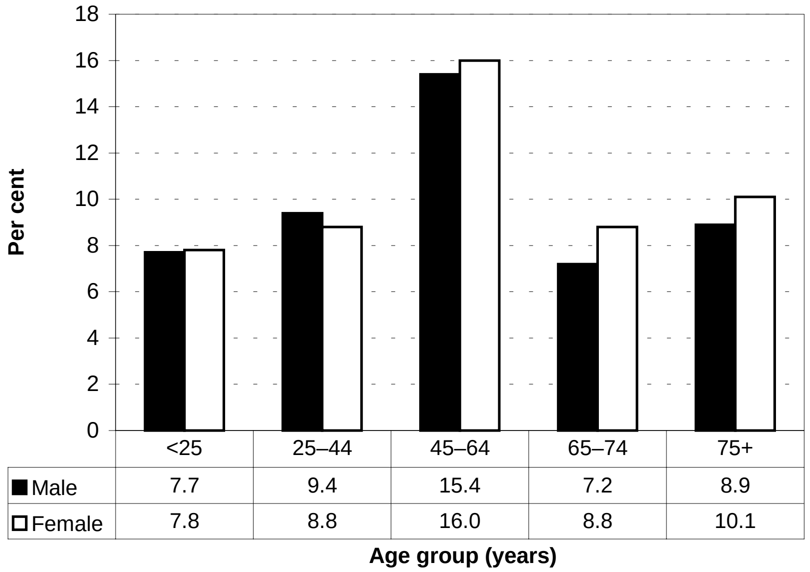
Chest x-ray includes ICPC–2 PLUS code A41002—Chest x-ray.

Chest x-rays were the most frequently ordered imaging test and more than half the participating GPs (55.6%) ordered at least one during their 100 recorded encounters. There were 1,057 orders for a chest x-ray and these accounted for 13.3% of all imaging ordered being ordered at a rate of 1.0 per 100 total encounters (Table 6.1). These orders occurred at 15.7% of imaging encounters. These results suggest there would be just over one million chest x-rays ordered nationally by GPs each year.

Age–sex distribution of patients

Orders for a chest x-ray were more likely to be for male patients than for female patients. The patient was male at 48.6% (95% CI: 44.9–52.2) of these encounters compared with 42.7% (95% CI: 42.0–43.5) of all encounters and 40.6% (95% CI: 39.0–42.3) of all imaging encounters.

Approximately one-third of patients for whom a chest x-ray was ordered were aged less than 45 years, one-third were between 45 and 64 years, and the remaining patients were 65 years or older (Figure 8.1).



	<25	25–44	45–64	65–74	75+
Male	7.7	9.4	15.4	7.2	8.9
Female	7.8	8.8	16.0	8.8	10.1

Figure 8.1: Age–sex distribution of patients for whom a chest x-ray was ordered

Care process

The chest x-rays were related to 1,083 problems under management, demonstrating an occasional one-to-many relationship between the chest x-ray and problems managed. The analysis of chest x-rays by class suggested a relatively even division between monitoring (35.6%), management (31.9%) and diagnostic testing (29.2%). Only 3.4% of these tests were associated with ill-defined problems labels such as check-up (Table 8.1).

Table 8.1: Care process involved in orders for chest x-rays

Care process	Number of problem-test combinations	Per cent of problem-test combinations	95% LCL	95% UCL
Diagnostic	316	29.2	23.5	34.9
Management	345	31.9	26.4	37.4
Monitoring	385	35.6	30.6	40.5
Undefined	37	3.4	0.0	21.0
Total	**1,083**	**100.0**	. .	. .

Note: UCL—upper confidence limit; LCL—lower confidence limit; Columns may not add to column total due to rounding.

Problems for which chest x-rays ordered

There was a wide range of problems associated with the orders for a chest x-ray but the top 19 problems accounted for almost three-quarters (72.3%) of the total. The top five most common problems related to an order for a chest x-ray were respiratory in nature. These included acute bronchitis (accounting for 13.3% of all chest x-ray orders), pneumonia (10.2%), asthma (6.6%), cough (5.8%) and chronic obstructive airways disease (4.8%). Together these five conditions accounted for 40.7% of total chest x-rays. There were other respiratory problems that fell into the top group of problems for which a chest x-ray was ordered, including shortness of breath and upper respiratory tract infection. The sixth most common problem associated with a chest x-ray was ill-defined chest pain, followed by heart failure.

The relative frequency of an order for a chest x-ray on a problem contact basis was highest for haemoptysis (51.1 chest x-rays per 100 contacts), shortness of breath/dyspnoea (36.7 per 100), pneumonia (33.6 per 100) and pleurisy/pleural effusion (29.7). While acute bronchitis/bronchiolitis was the most common problem associated with an order for a chest x-ray, the likelihood of such an order being placed for this problem was relatively small (4.3 orders per 100 contacts) as was the case with asthma (2.1 per 100) and chronic obstructive airways disease (6.0) (Table 8.2).

Table 8.2: Most common problems associated with an order for a chest x-ray

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Problem-specific test rate[(a)]
Acute bronchitis/bronchiolitis	144	13.3	4.3
Pneumonia	111	10.2	33.6
Asthma	71	6.6	2.1
Cough	63	5.8	11.8
Chronic obstructive airways disease	52	4.8	6.0
Chest pain NOS	47	4.4	15.9
Heart failure	40	3.7	4.5
Shortness of breath, dyspnoea	32	3.0	36.7
Upper respiratory tract infection	29	2.7	0.4
General check-up*	26	2.4	1.4
Ischaemic heart disease*	23	2.2	1.4
Pleurisy/pleural effusion	22	2.0	29.7
Fracture*	22	2.0	2.1
Chest symptom /complaint NOS	21	2.0	9.2
Hypertension*	20	1.9	0.2
Other respiratory disease	19	1.7	12.1
Weakness/tiredness	15	1.4	2.1
Haemoptysis	14	1.3	51.1
Tobacco abuse	13	1.2	6.1
Sub-total	*784*	*72.6*	. .
Total	**1,083**	**100.0**	**. .**

(a) The rate of chest x-rays ordered per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: NOS—Not otherwise specified; Columns may not add to column total due to rounding.

Discussion

A literature review by the American College of Radiology (ACR) Expert Panel on Thoracic Imaging indicated that there was a generally poor return on chest x-ray examinations in patients with acute respiratory illness in the absence of age>40, dementia, a positive physical examination, haemoptysis, hypoxaemia, leucocytosis, or other significant risk factors such as cardiovascular disease (Westcott et al. 2000a).

In this study, 75% of all patients for whom chest x-rays were ordered were aged 45 years or more. The acute respiratory illnesses with the highest problem-specific test rate were those where the diagnosis could be reasonably expected to have a foundation in abnormal physical findings such as haemoptysis, pneumonia, dyspnoea and pleurisy/pleural effusion. The low rate (0.4 per 100 problems) at which patients with upper respiratory tract infection had chest x-rays ordered seems consistent with the ACR and RANZCR guidelines. Acute bronchitis/bronchiolitis, while the commonest cause of chest x-ray, also had a low problem-specific rate of 4.3 orders per 100 problems managed. Also consistent with the guidelines were a low rate of ordering of chest x-ray for asthma (2.1) and chronic obstructive airways disease (6.0). Non-specific diagnoses such as cough (11.8), chest pain NOS (15.9), chest symptom/complaint (9.2) and other respiratory disease (12.1) attracted a higher rate of testing and this was consistent with the previously described tendency for higher testing rates associated with diagnostic uncertainty.

The ACR guidelines suggest that chest x-ray is not useful in uncomplicated hypertension and should be reserved for those with cardio-respiratory symptoms. In these patients echocardiography is more sensitive, specific and accurate (Westcott et al. 2000b). In this study, patients with hypertension had a chest x-ray ordered at a rate of 2 per 1,000 problem contacts.

In spite of the above guidelines, heart failure was the seventh ranking reason for the ordering of a chest x-ray. The ordering of echocardiography by GPs for heart failure in both Australia and the United Kingdom is much lower than ideal, with significant under-treatment of patients with this condition (Clarke et al. 1994; Horowitz & Stewart 2001; Krum et al. 2001). Perhaps because their members do not carry out the relevant investigation, the ACR and RANZCR do not produce guidelines for the investigation of heart failure. GP access to echocardiography in Australia is through cardiologists' rooms. Krum suggests that a combination of access, the cost of the test to Medicare and the lack of knowledge about the test and its interpretation leads GPs to avoid echocardiography and rely on chest x-rays, an (inferior) alternative. These factors may limit application of the recently published National Heart Foundation – Cardiac Society guidelines (Krum 2001).

8.2 Mammography and breast ultrasound

There were 365 orders for mammography. They accounted for 4.6% of all imaging ordered (Table 6.1) and occurred at a rate of 5.2 per 100 imaging encounters, or at a rate of 0.35 per 100 total encounters (3.5 per 1,000 encounters). There was a one-to-one relationship between an order for a mammogram and a single problem under management. One in four GPs (27.6%) ordered at least one mammography during their 100 recorded encounters.

Orders for breast ultrasound were less common. In almost all cases only one problem was being managed with this order. The 194 orders placed for breast ultrasounds accounted for 2.5% of all imaging ordered (Table 6.1). They occurred at a rate of 2.8 per 100 imaging encounters and an overall rate of 0.185 per 100 encounters (or 1.85 per 1,000 encounters). These results suggest that, nationally, GPs would order approximately 360,000 mammographies and 190,000 breast ultrasounds per year.

Age–sex distribution of patients

There were few mammograms or breast ultrasounds ordered at encounters with males, but these made up 1.8% of the total orders. Exactly half the patients for whom a mammography or breast ultrasound was ordered were aged between 45 and 64 years and a further 36.0% were between 25 and 44 years. Such tests were rarely ordered for the young or for the elderly (Figure 8.2.).

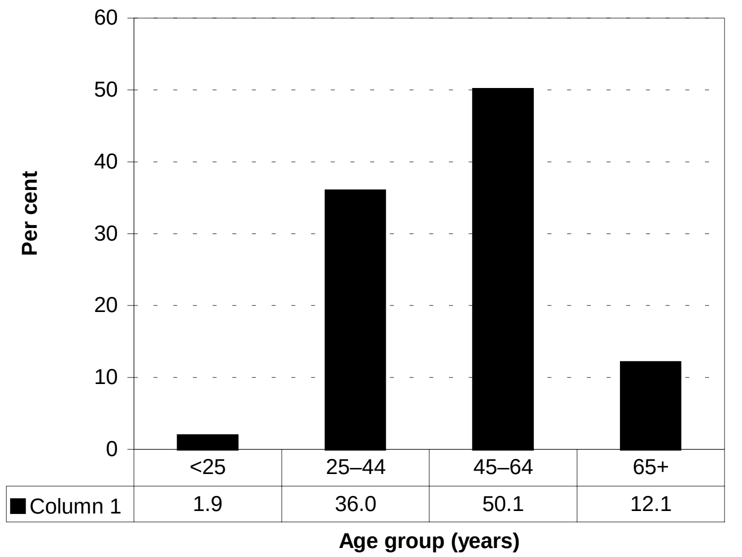
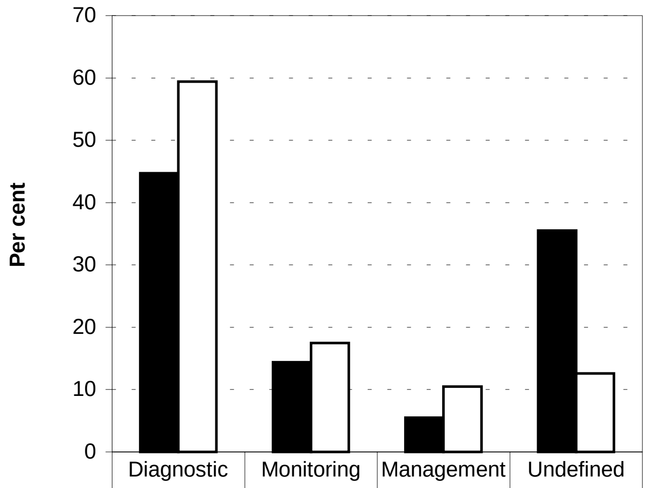


Figure 8.2.: Age distribution of patients for whom a mammography or breast ultrasound was ordered

Care process

Figure 8.3 compares the distribution of problem-test combinations by care process. Both mammography and breast ultrasound were most likely to be ordered for diagnostic purposes, but the proportion of breast ultrasounds classed as diagnostic was somewhat higher (59.4%) than for mammography (44.7%). More than one in three (35.5%) mammographies were classed as undefined. In the majority, these would be related to check-ups and could possibly be regarded as being ordered for screening purposes. The proportion of ultrasounds classed as undefined was far smaller (12.6%).



	Diagnostic	Monitoring	Management	Undefined
■ Mammography	44.7	14.4	5.5	35.5
□ Breast ultrasound	59.4	17.5	10.5	12.6

Care process

Figure 8.3: Distribution of mammography and breast ultrasound by care process

Problems for which mammography or breast ultrasound ordered

The relationship of mammography to check-ups (and possibly screening) suggested by Figure 8.2 is supported by the list of the most common problems related to an order for mammography in Table 8.3. The single most common problem under management when a mammography was ordered was a breast lump (22.9%). Fibrocystic disease (6.7%), breast pain (5.2%) and other symptoms and complaints of the breast (3.1%) also fell in the top list of problems associated with a mammography order. The tests for these problems would be diagnostic in nature. Female genital check-up was the second most common problem associated with mammography, and general check-up was the seventh. Together, these accounted for 24.8% of all mammography orders.

The test itself was used as the problem label in a further 7.0% of cases, and these are also likely to be of a screening rather than a diagnostic nature since no underlying symptom or diagnosis was described. Patients sent for mammography because they had an underlying risk factor for breast disease (e.g. a family history) accounted for a further 2.8% of mammograms.

The problem profile associated with orders for a breast ultrasound was somewhat different, more than half (56.1%) of the problems being related to breast lump (40.8%) or fibrocystic disease (15.3%). Only a small proportion of problem labels (check-up—9.1% and diagnostic radiology genital—2.2%) suggested that the ultrasound might have been ordered for screening purposes (Table 8.4).

Table 8.3: Most common problems associated with orders for mammography

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Relative order rate per 100 problem contacts[(a)]
Breast lump*	84	22.9	40.3
Female genital check-up*	78	21.5	4.8
Diagnostic radiology genital	26	7.0	63.0
Fibrocystic disease breast	25	6.7	27.2
Menopausal symptom/complaint	23	6.3	1.6
Breast pain	19	5.2	19.8
General check-up*	13	3.6	0.7
Breast symptom/complaint	11	3.1	14.2
Risk-factor NOS	10	2.8	4.1
Malignant neoplasm breast	10	2.8	6.4
Benign neoplasm breast	7	1.9	25.9
Sub-total	*306*	*82.2*	*. .*
Total	**365**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

The relative test order rates for mammography and breast ultrasound (Column 4 in Tables 8.3 and 8.4) demonstrated that 40.3% of contacts with breast lump generated an order for mammography and 38.2% generated an order for a breast ultrasound. In the management of fibrocystic disease, a mammogram was ordered at 27.2% of contacts and an ultrasound ordered at 32.9%. Contacts with breast pain were equally as likely to result in an order for a mammogram (19.8%) or an ultrasound (19.1%).

Table 8.4: Most common problems associated with orders for breast ultrasound

Problem type	Number of imaging orders	Per cent of problem-test combinations	Problem-specific test rate[(a)]
Breast lump*	79	40.8	38.2
Fibrocystic disease breast	30	15.3	32.9
Female genital check-up*	18	9.1	1.1
Breast pain	18	9.4	19.1
Benign neoplasm breast	13	6.5	27.5
Breast symptom/complaint	5	2.6	6.3
Diagnostic radiology genital	4	2.2	10.3
Malignant neoplasm breast (female)	3	1.7	2.1
Sub-total	*170*	*87.6*	*. .*
Total	**194**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Test choice and problem status

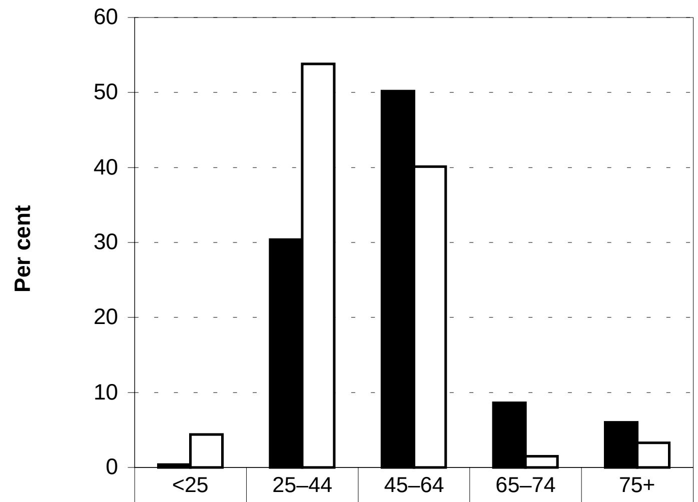
Whether the problem was new to the patient or the subject of a follow-up consultation had little influence on the imaging test selected by the GP. Table 8.5 shows that where mammography and/or breast ultrasound were ordered for a new problem, breast ultrasound accounted for more than two-thirds of the orders, and mammograms, one-third. Two-thirds of the mammographies were ordered for old problems. The proportion of breast ultrasounds accounted for by follow-up of old problems was only slightly less.

Table 8.5: Imaging order type by problem status

Problem status	Mammography per cent	Breast ultrasound per cent
New problem	32.4	42.1
Old problem (follow-up)	67.6	57.9
Total problem-test combinations	**365**	**626**

Test choice and patient age

There appeared to be some relationship between the choice of imaging test to be ordered and the age of the patient. While over 80% of mammograms and over 90% of ultrasounds were ordered for patients aged between 25 and 64 years, Figure 8.4 suggests that GPs may have a slight preference for mammography for older patients and for ultrasound for younger patients. However, the small sample sizes involved must be kept in mind in this comparison.



	<25	25–44	45–64	65–74	75+
■ Mammography	0.4	30.4	50.2	8.6	6.0
□ Breast ultrasound	4.4	53.8	40.1	1.5	3.3

Age group (years)

Figure 8.4: Comparison of age distribution of patients for whom mammography and breast ultrasound ordered

Discussion

The vast mass of current literature on mammography concerns screening for breast cancer in asymptomatic women. In Australia, screening mammography is carried out mainly on the basis of self-referral or recall to the free BreastScreen Australia program. However, a proportion of the over 700,000 mammograms performed annually by BreastScreen (AIHW 2000) are referred by GPs. Previously published *BEACH* data indicates that 69.5% of women in the 50–69 age group attending GPs have had screening mammography, a higher percentage than for the general population in this age group (AIHW 2000; Sayer et al. 2000). Problem labels suggestive of screening were associated with 116 mammography orders. This would extrapolate to approximately 116,000 mammograms annually which may have been referred by GPs to BreastScreen. The rate of mammograms ordered in the June quarter of 1999 by full-time recognised GPs for which Medicare rebates were paid, reported in *General Practice in Australia 2000*, was 0.23 per 100 patient encounters (DHAC 2000). This extrapolates to approximately 230,000 mammograms per year. The 365 mammography orders recorded by GPs in the 1999–00 *BEACH* year equates to 365,000 mammogram orders per year. It can be concluded that about one-third of the mammograms ordered by GPs are referrals to BreastScreen for screening. These data suggest that GPs are making a significant contribution to breast screening in Australia. Appropriately, much smaller numbers of ultrasound examinations of the breast were associated with problems suggestive of screening.

The imaging guidelines for the management of breast masses by both the American College of Radiology and the Australian New Zealand College of Radiologists recommend the use of x-ray mammography for the primary diagnosis of breast masses and the use of ultrasound to differentiate between cysts and solid masses and to further define the nature of the mass (D'Orsi et al. 2000; Evans, III et al. 2000; RANZCR 2001). Ultrasound is the preferred investigation for patients under 30 years of age where the incidence of malignancy is extremely low. These recommendations are well supported by the literature (Finlayson & MacDermott 2000; Garcia et al. 2000; Lee et al. 1995; Perre et al. 1993; Schelling et al. 1997).

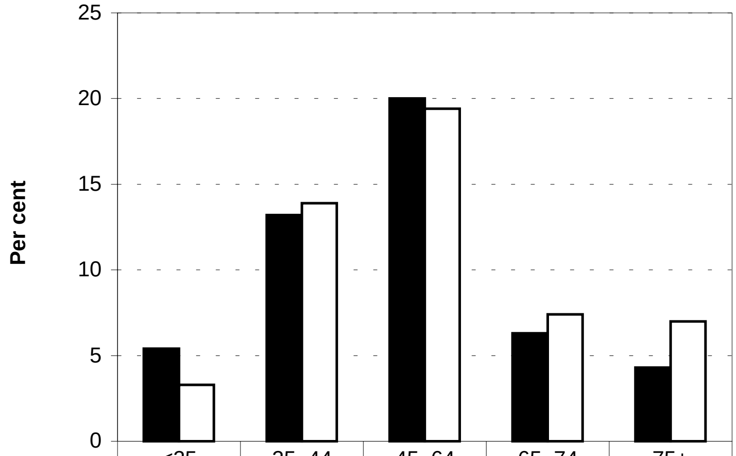
The results of this analysis suggest that GPs use both mammography and ultrasound in the diagnostic mode, in line with the recommendations, and that they use ultrasound almost exclusively in the under 25 years age group.

8.3 Imaging of the lower back

This section investigates the ordering of plain x-rays of the lower back and low back CT scans. Overall, the former test was the more popular choice (*n*=522) than the latter (*n*=165).

Age–sex distribution of patients

The patient was more likely to be male at encounters generating an order for imaging of the lower back (49.1%, 95% CI: 43.4–54.8) than in all imaging encounters (40.6%, 95% CI: 39.0–42.3). Females were significantly under-represented at these encounters. Almost 40% of these tests were ordered for people of middle age (45–64 years) and a further 27% for young adults (aged 25–44 years). While elderly patients accounted for one in four of these imaging orders, women made up a greater proportion of these elderly patients than did men (Figure 8.5).



	<25	25–44	45–64	65–74	75+
■ Male	5.4	13.2	20.0	6.3	4.3
□ Female	3.3	13.9	19.4	7.4	7.0

Age group (years)

Figure 8.5: Age–sex distribution of patients for whom imaging of the lower back was ordered

Plain x-rays of the lower back

Plain x-rays of the lower back included the following ICPC–2 PLUS codes and rubrics:

- L41021—X-ray; spine; lumbosacral (*n*=266)
- L41033—X-ray spine; lumbar (*n*=139)
- L41024—X-ray spine (*n*=98)
- L41034—X-ray spine; sacrum (*n*=3)
- L41062—X-ray; thoracolumbar (*n*=16).

The 522 orders for plain x-rays of the lower back accounted for 6.6% of all imaging ordered (Table 6.1). They occurred at a rate of 7.5 per 100 imaging encounters, or at a rate of 0.50 per 100 total encounters (5.0 per 1,000). This suggests that GPs order approximately half a million x-rays of this type nationally per year. There was almost a one-to-one relationship between an order for an x-ray of the lower back and a single problem under management, the total problems associated with an order for a plain x-ray of the lower back being 523.

Care process

The care process involved in these orders varied considerably, two in five orders being diagnostic in nature, a third being for monitoring purposes and 27.9% being related to management decisions (Table 8.6).

Table 8.6: Care process involved in orders for a plain x-ray of the lower back

Care process	Number of problem-test combinations	Per cent of problem-test combinations	95% LCL	95% UCL
Diagnostic	202	38.5	30.5	46.5
Management	146	27.9	19.9	36.0
Monitoring	170	32.6	23.2	41.9
Undefined	5	1.0	0.0	60.0
Total	**523**	**100.0**	**. .**	**. .**

Note: UCL—upper confidence limit; LCL—lower confidence limit; Columns may not add to column total due to rounding.

Problems associated with an order for a plain x-ray of the lower back

Back pain accounted for almost half (43.1%) of all orders for plain x-rays of the lower back, and back syndrome with (8.7%) or without (5.9%) radiating pain was also among the top problems associated with this type of imaging order. Osteoarthritis was also a relatively common problem under management (9.3%). However, as demonstrated in Table 8.7, the problem-specific test rate was less than one in 10 orders for a plain x-ray of the low back per 100 problem contacts in all areas of associated morbidity.

Table 8.7: Most common problems associated with a plain x-ray of the lower back

Problem type	Number of imaging orders	Per cent of problem-test combinations	Problem-specific test rate(a)
Back pain	226	43.1	9.0
Osteoarthritis*	48	9.3	2.1
Back syndrome with radiating pain	45	8.7	6.7
Back syndrome without radiating pain	31	5.9	9.1
Sprain/strain*	31	5.9	2.8
Osteoporosis	17	3.2	3.1
Sub-total	*398*	*76.0*	. .
Total	**523**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Low back CT scans

Low back CT scans include five imaging order types. Their ICPC–2 PLUS code, the term and its frequency are listed below.

- L41054—CT scan spine (*n*=23)
- L41057—CT scan spine; lumbar (*n*=60)
- L41058—CT scan spine; lumbosacral (*n*=76)
- L41059—CT scan spine; sacrum (*n*=1)
- L41069—CT scan spine; thoracolumbar (*n*=5).

The 165 low back CT scans were associated with 162 problems under management. There were 166 problem-imaging combinations, indicating an almost one-to-one relationship between problems under management and the CT scan order.

These 165 tests accounted for 2.1% of all imaging tests ordered and they were ordered at a rate of 2.4 per 100 imaging encounters or a rate of 0.157 per 100 total encounters (or 157 per 100,000). This suggests that GPs order approximately 160,000 CT scans per year nationally.

Care process

The distribution of the low back CT scans by care process was almost identical to that of the low back plain x-rays (Table 8.8). This suggests that the purpose of the test does not influence the GP's decision to order a plain x-ray or a CT scan.

Table 8.8: Care process involved in orders for low back CT scans

Care process	Number of problem-test combinations	Per cent of problem-test combinations	95% LCL	95% UCL
Monitoring	65	39.1	20.5	57.6
Diagnostic	51	32.5	14.3	50.8
Management	46	27.8	3.9	51.8
Undefined	1	0.6	*	*
Total	**166**	**100.0**	. .	. .

* 95% confidence intervals could not be calculated due to the small sample size.

Note: Columns may not add to column total due to rounding.

Problems associated with orders for a low back CT scan

The types of problems associated with CT scans of the lower back were also remarkably similar to those for which the plain x-rays were ordered, though osteoarthritis no longer appeared in the list of most common problems managed. Back pain, and back syndromes, accounted for over 80% of the problems associated with an imaging order of this type. However, the relative order rate of CT scans for each of these problems was very low, ranging from 2.9 orders per 100 problem contacts to 6.3 per 100 (Table 8.9).

Table 8.9: Most common problems associated with an order for a low back CT scan

Problem type	Number of imaging orders	Per cent of problem-test combinations	Problem-specific test rate[(a)]
Back pain*	81	48.6	3.2
Back syndrome with radiating pain	43	25.7	6.3
Back syndrome without radiating pain	10	6.0	2.9
Sub-total	*134*	*80.7*	. .
Total	**166**	**100.0**	. .

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

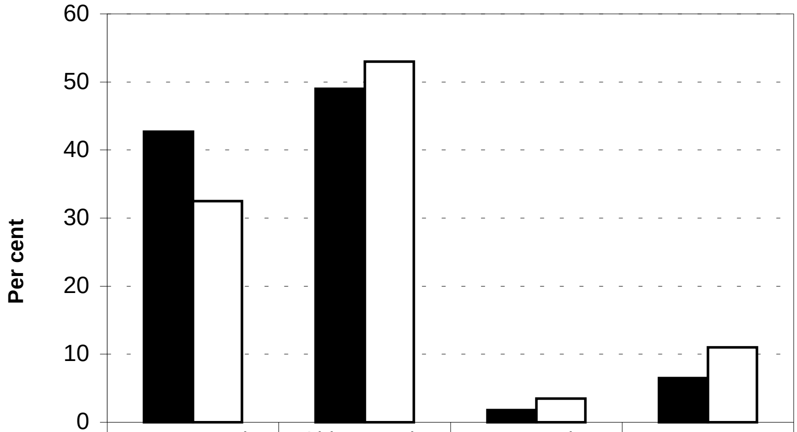
* Includes multiple ICPC–2 and/or multiple ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Test choice and problem status

The majority of both plain x-rays (55.5%) and CT scans of the lower back (64.0%) were ordered at follow-up encounters for the problem under management rather than at first consultations for new problems (Figure 8.6).

Whereas problems thought by the GP to be work-related made up only 2.2% of all problems in the total dataset (Britt et al. 2000), 8.3% of problems associated with orders for plain x-rays of the lower back and 14.5% of those associated with low back CT scans were thought to be work-related. Figure 8.6 demonstrates a slight trend for GPs to choose a CT scan rather then a plain x-ray when the problem was thought to be work-related. However, again the small sample sizes involved must be kept in mind.



	New not work-related	Old not work-related	New work-related	Old work-related
■ Plain x-ray	42.7	49.0	1.8	6.5
□ CT scan	32.5	53.0	3.5	11.0

Problem status

Figure 8.6 : Comparison of problem status and work-related status of problems managed with plain x-rays and CT scans of lower back

Discussion

Three imaging modalities are commonly used for the evaluation of spinal problem—plain x-ray, CT scan and MRI. However, in Australia, Medicare rebates are not available to patients for MRI examinations ordered by GPs. Thus, only very small numbers of MRIs are recorded in the *BEACH* dataset. Patients may undergo MRI for back problems following referral to a specialist. In the United Kingdom, studies of direct access by GPs to MRI studies have demonstrated generally appropriate use of this form of imaging (Apthorp et al. 1998; Chawda et al. 1997; Robling et al. 1998). In this study, there is evidence of the use of CT scan in situations where an MRI would have been preferable under ACR or RANZCR guidelines, for example in the investigation of back syndrome with radiating pain (Anderson et al. 2000; RANZCR 2001). The systemic limitation of access may therefore be influencing the GP choice of imaging type.

8.4 Imaging of the shoulder

Imaging of the shoulder includes the following ICPC–2 PLUS codes and rubrics:

- L41020—Plain x-ray; shoulder (*n*=211)
- L41048—Ultrasound; shoulder (*n*=155).

Imaging of the shoulder was more often ordered as a plain x-ray than as an ultrasound. At least one plain x-ray of the shoulder was ordered by 16.8% of the participating GPs. The 211 test orders accounted for 2.7% of all imaging tests ordered and they were ordered at a rate of 3.0 per 100 imaging encounters (Table 6.1) or a rate of 0.20 per 100 total encounters (or 2.0 per 1000). This suggests that GPs order a total of 206,000 plain x-rays of the shoulder per year nationally. There were 213 problem-x-ray combinations.

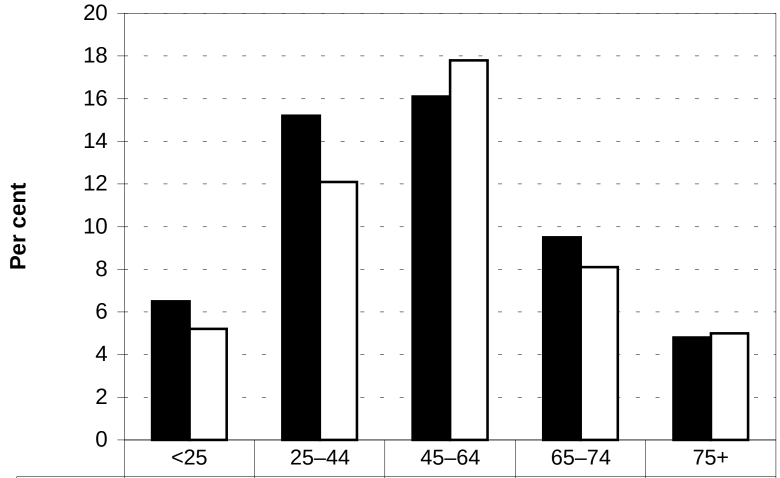
There were 155 shoulder ultrasounds ordered and 156 problem-imaging combinations. At least one of these tests was ordered by 12.6% of participating GPs. These 155 tests accounted for 2.0% of all imaging tests ordered (Table 6.1) and they were ordered at a rate of 2.3 per 100 imaging encounters or a rate of 0.15 per 100 total encounters (or 155,000 per year nationally. In 56 cases both an ultrasound and a plain x-ray of the shoulder were ordered.

Age–sex distribution of patients

Male patients were over-represented at encounters which generated an order for imaging of the shoulder (51.9%, 95% CI: 42.9–60.9) when compared with the patients at all imaging encounters (40.6%, 95% CI: 39.0–42.3). This suggests that where imaging is ordered at the encounter, an order for imaging of the shoulder is more likely for male patients than for female patients. Figure 8.7 demonstrates that the patients for whom imaging of the shoulder was ordered were usually between the ages of 25 and 64 years, though one in four of these tests was ordered for elderly patients. There were few tests of this type requested for younger patients.

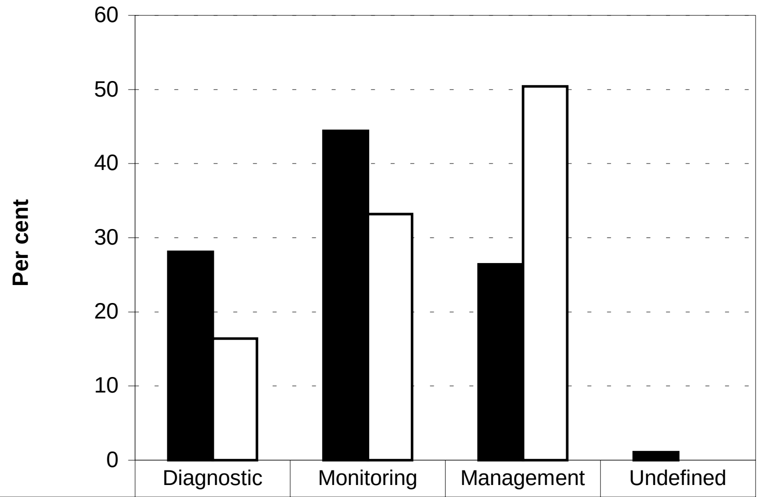
Care process

Figure 8.7 demonstrates the different care process involved with these two test types. Plain shoulder x-rays were more likely to be ordered for monitoring purposes (44.4%) while ultrasounds were commonly classified as being ordered for management decisions (50.4%).



	<25	25–44	45–64	65–74	75+
Male	6.5	15.2	16.1	9.5	4.8
Female	5.2	12.1	17.8	8.1	5.0

Figure 8.7: Age–sex distribution of patients for whom imaging of the shoulder was ordered



	Diagnostic	Monitoring	Management	Undefined
Plain x-ray	28.1	44.4	26.4	1.1
Ultrasound	16.4	33.2	50.4	0.0

Figure 8.8: Distribution of plain x-ray of shoulder and ultrasound of shoulder by care process

Problems associated with imaging of the shoulder

These results align with the profile of the problems associated with orders for a shoulder x-ray (Table 8.10) and for an ultrasound (Table 8.11). Together, these tables suggest that, in managing shoulder syndrome, GPs are likely to order a plain x-ray of the shoulder and an ultrasound of the shoulder at approximately equivalent rates of one in seven encounters.

While shoulder syndrome accounted for one-third of problem-shoulder x-ray combinations it accounted for half of the shoulder ultrasounds. Shoulder symptoms and complaints accounted for 15.7% of the plain x-rays and 11.8% of the shoulder ultrasounds. However, plain x-rays were ordered at a rate of 15.3 and ultrasounds at a rate of 8.4 per 100 presentations of such symptoms.

Table 8.10: Most common problems associated with a plain x-ray of the shoulder

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Problem-specific test rate[(a)]
Shoulder syndrome*	68	32.0	13.5
Shoulder symptom/complaint	34	15.7	15.3
Musculoskeletal injury NOS	20	9.2	2.6
Sprain/strain*	20	9.1	1.8
Osteoarthritis*	14	6.6	0.6
Other skin injury	13	6.3	2.1
Sub-total	*169*	*79.0*	. .
Total	**214**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: NOS—Not otherwise specified; Columns may not add to column total due to rounding.

Table 8.11: Most common problems associated with an ultrasound of shoulder

Problem type	Number of imaging orders	Per cent of problem-test combinations	Problem-specific test rate[(a)]
Shoulder syndrome*	79	50.3	15.6
Musculoskeletal injury NEC	21	13.5	2.8
Sprain, strain*	19	12.0	1.7
Shoulder symptom/complaint	18	11.8	8.4
Sub-total	*137*	*87.8*	. .
Total	**156**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: NEC—Not elsewhere classified; Columns may not add to column total due to rounding.

Discussion

The RANZCR guidelines and some of the literature suggest that plain x-ray of the shoulder is the first investigation of choice in patients with shoulder pain (Peh 1998; The Royal RANZCR 2001). While plain x-ray accurately depicts bone damage following trauma, it does not provide accurate information regarding soft tissue injury (King & Healy 1999). On the other hand, ultrasound has a high predictive value for soft tissue injury, similar to that for MRI when both are judged against the 'gold standard' of arthroscopy (Swen et al. 1999; Teefey et al. 1999; Teefey et al. 2000). GPs in this study used both these modalities in the imaging of shoulder problems. They tended to select ultrasound more frequently in problem labels associated with soft tissue abnormalities. In 56 instances, being one-third of shoulder ultrasound examinations and one-quarter of shoulder x-ray examinations, the two tests were ordered simultaneously. MRI examinations of the shoulder are rarely ordered by GPs, possibly because of the lack of Medicare rebates for MRI examinations ordered by GPs.

8.5 Imaging of the pelvis

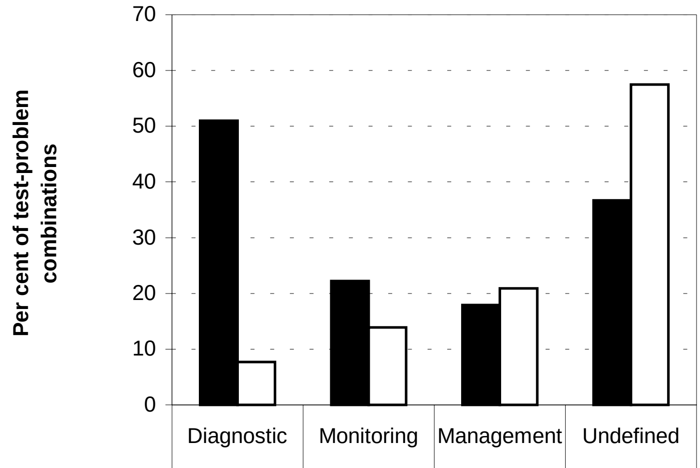
Pelvic imaging tests investigated in this section include the following ICPC–2 PLUS codes and rubrics:

- L41 019—X-ray; pelvis (*n*=36)
- L41047—Ultrasound; pelvis (*n*=361)
- X41011—Ultrasound; uterus not pregnant (*n*=17)
- W41004—Ultrasound; obstetrics (*n*=214).

The imaging tests of the pelvis were divided into two groups: those not specified as obstetric and those specifically described as obstetric ultrasounds.

Care process

The care process involved in orders for non-obstetric pelvic imaging was most commonly diagnostic in nature (51.0%), although a further 36.7% of these tests could not be defined by care process. This suggests that approximately one-third of these tests were ordered as part of a check-up. In contrast, over 57.5% of obstetric ultrasounds were classed as undefined. This is likely to reflect the fact that check-ups (including pre and postnatal care) are neither symptoms nor diagnoses (Figure 8.9).



	Diagnostic	Monitoring	Management	Undefined
■ Non-obstetric pelvis	51.0	22.2	17.9	36.7
□ Obstetric pelvis	7.7	13.9	20.9	57.5

Care process

Figure 8.9: Comparative distribution of the care process for non-obstetric and obstetric ultrasound test orders

Imaging of the pelvis—non-obstetric

Non-obstetric pelvic imaging occurred at almost twice the rate (*n*=414) of obstetric ultrasounds (*n*=214). Non-obstetric pelvic imaging tests accounted for 5.2% of total imaging ordered and obstetric imaging for further 2.7%. Together, there were 628 pelvic imaging tests ordered, accounting for 7.9% of all imaging tests ordered (Table 6.1), and occurring at a rate of 8.9 per 100 imaging encounters and at a rate of 0.6 per 100 total encounters. The extrapolated frequency of GP orders for these tests across the country over one year was 620,000.

Problems associated with orders for non-obstetric pelvic imaging

As shown in Table 8.12, non-obstetric imaging of the pelvis was most frequently ordered for menstrual problems (18.1% of problem-test combinations). Other symptoms for which these tests were ordered included abdominal pain and female genital pain. However, included in the problems most commonly associated with imaging of the pelvis (not specified as obstetric) were pre and postnatal care, pregnancy and spontaneous abortion.

Some problems associated with these tests demonstrated very high test frequency in terms of the number of contacts resulting in a test of this type. The GP ordered such a test in 40.6% of contacts with female genital pain, 35.1% of contacts with benign/uncertain female genital neoplasms and 22.9% of contacts with pelvic inflammatory disease.

Table 8.12: Most common problems associated with non-obstetric imaging of the pelvis.

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Relative order rate per 100 problem contacts[(a)]
Menstrual problems*	75	18.1	8.9
Benign neoplasm genital (female)	25	6.1	35.1
Abdominal pain*	25	6.1	4.1
Pain, genital (female)	25	6.1	40.6
Pre/postnatal check-up*	24	5.8	2.0
Pregnancy*	22	5.2	2.8
Abortion, spontaneous	20	4.9	18.1
Pelvic inflammatory disease	15	3.5	22.9
Genital symptom/complaint	12	2.9	15.6
Endocrine/metabolic disease, other	12	2.8	2.6
Menopausal symptom*	11	2.5	0.7
Sub-total	*266*	*74.1*	. .
Total	**413**	**100.0**	. .

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Imaging of the pelvis — obstetric

As suggested by Figure 8.9, the most common problems associated with orders for obstetric pelvic imaging were pre/postnatal care, pregnancy and spontaneous abortion. Together these accounted for 90% of all problem-imaging combinations. (Table 8.13).

Problems associated with orders for obstetric pelvic imaging

The most common problems for which obstetric imaging was ordered are listed in order of frequency in Table 8.13. Comparing these results with those for non-obstetric pelvic imaging (Table 8.12), it is apparent that imaging of the pelvis (not specified as obstetric) was ordered at only 2.0% of pre/postnatal checks, whereas obstetric imaging was ordered at 9.6%.

Table 8.13: Most common problems associated with obstetric pelvic imaging orders

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Relative order rate per 100 problem contacts[(a)]
Pre/postnatal check-up*	115	53.7	9.6
Pregnancy*	56	26.0	7.2
Abortion, spontaneous	19	9.1	17.4
Sub-total	*190*	*88.8*	. .
Total	**214**	**100.0**	**. .**

(a) The rate of orders for this test per 100 problems of each type managed in the total dataset.

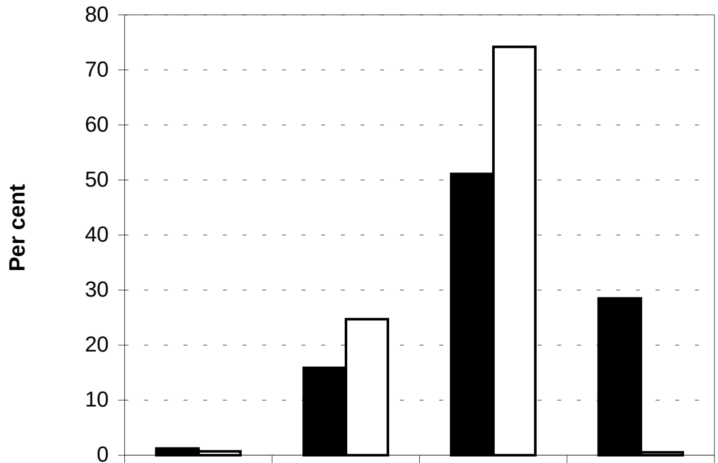
* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

For pregnancies, obstetric ultrasound was ordered at 7.2% of contacts, while other pelvic imaging was ordered at only 2.8%. Contacts with the problem of spontaneous abortion had equal chance of an order for obstetric ultrasound (17.4%) or for other pelvic imaging (18.1%).

Comparative age distribution of patients

Considering these results, the question arose as to whether the age of the patient may influence the GP's decision as to the type of imaging to be ordered. Figure 8.10 provides a comparison of the age distribution of the patients for whom each test type was ordered. The age distribution of patients for whom obstetric ultrasounds were ordered reflected the female reproductive years, with 98.9% of patients being aged between 15 and 44 years. In contrast, the age distribution of those for whom other pelvic tests were ordered demonstrated that while 67.0% were in these age groups, more than one-quarter of these patients (28.5%) were 45 years or older.



	<15	15–24	25–44	45 +
■ Non-obstetric	1.2	15.9	51.1	28.5
□ Obstetric	0.7	24.7	74.2	0.5

Age group (years)

Figure 8.10: Comparative age distribution of patients for non-obstetric and obstetric imaging tests of the pelvis

Discussion

For almost all purposes, ultrasound is the modality of choice recommended for the examination of the gravid or non-gravid female pelvis (Bohm-Velez et al. 2000; Laing et al. 2000; RANZCR 2001; Thurmond et al. 2000). The recommendations of the American College of Radiology are well supported by the literature reviewed in the College's published Appropriateness Criteria. The small number of studies of GP ordering of pelvic ultrasound generally demonstrate appropriate use (McIlvenny & O'Kane 1995; Skillern & Pearce 1993). Everett demonstrated the value of ultrasound in assessing bleeding in the first 20 weeks of pregnancy in a general practice clinic and Brunader has shown that the psychomotor skills to undertake ultrasonography are readily imparted to family practice residents in the United States (Brunader 1996; Everett & Preece 1996). The pattern of ultrasound ordering by Australian GPs appears consistent with ACR and RANZCR guidelines.

8.6 CT scans of the brain/head

CT scan of the brain and head includes the following ICPC–2 PLUS codes and rubrics:

- N41006—CT scan brain (*n*=130)
- N41008—CT scan head (*n*=107).

There were 237 orders for a CT scan of the head or brain. These were made up of 130 orders for a CT scan of the brain from 97 GPs and 107 CT scans of the head from 94 GPs. Together, these tests accounted for 3.9% of all imaging tests ordered (Table 6.1). They occurred at a rate of 3.5 per 100 imaging encounters and at an overall rate of 0.23 per 100 encounters (or 2.3 per 1,000).

Age–sex distribution of patients

Of all CT scans ordered of the brain, 63.1% were ordered for female patients. Women in young adulthood, middle age and in older age groups accounted for a consistently higher proportion of these CT scan tests than their male counterparts. However, the largest proportion of these tests (almost one-third) were ordered for patients between 45 and 64 years of age (Figure 8.11).

Care process

There were 240 problem-test combinations demonstrating an occasional one-to-many relationship between the test and problems managed. The analysis of these CT scans by care process suggested that almost half (43.6%) of these tests were ordered for diagnostic purposes with the remaining being evenly divided between management and monitoring purposes (Table 8.6.1).

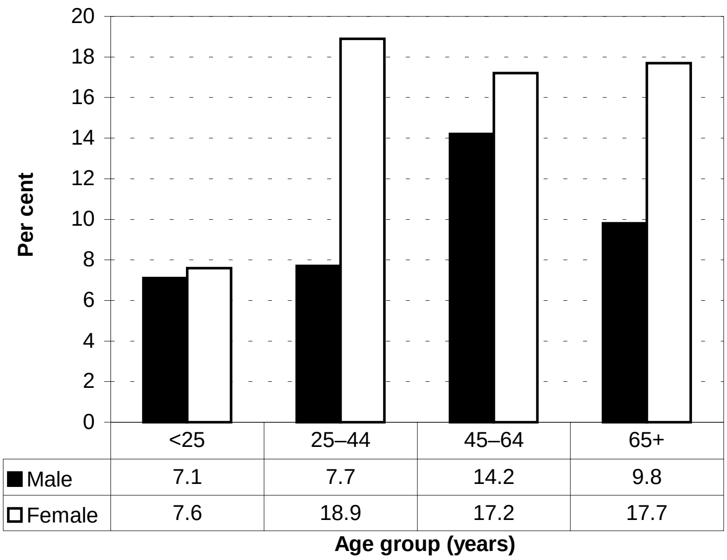


Figure 8.11: Age–sex distribution of patients for whom a CT scan of the brain/head was ordered

Table 8.14: Care process involved in orders for CT scan of the brain/head

Care process	Number of problem-test combinations	Per cent of problem-test combinations	95% LCL	95% UCL
Diagnostic	105	43.6	32.9	54.4
Management	63	27.3	11.0	41.5
Monitoring	68	28.3	11.3	45.4
Undefined	4	1.8	26.3	11.0
Total	**240**	**100.0**	. .	. .

Note: UCL—upper confidence limit; LCL—lower confidence limit; Columns may not add to column total due to rounding.

Problems associated with CT scan of the brain/head

There was a wide range of problems associated with tests of this type. Headaches accounted for almost one in five of these tests and migraine accounted for a further 8.9%. Tension headaches also rated in the most frequent problems under management when a CT scan of the head/brain was ordered (3.2%). Together, these three problems therefore accounted for one-third of the ordered CT scans of the head or brain. Other symptoms under management included vertigo and vertiginous syndrome and fainting/syncope. However, head injuries were the third most common problem under management when tests of this type were ordered (6.9%) and diagnostic labels of stroke (4.1%) dementia (3.7%), sinusitis (3.2%) and epilepsy (2.2%) were not uncommon (Table 8.15).

The problems most likely to generate CT scans of the head/brain were benign neoplasms of the nervous system (13.6% of contacts), convulsions/seizures (not diagnosed as epilepsy) (10.5%), head injuries (11.7%), fainting/syncope (11.3%) and headaches (9.6%). The rate of orders for other problems associated with imaging of this type was otherwise relatively low.

Table 8.15: Most common problems associated with a CT scan test of the brain/head

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Problem-specific test rate[(a)]
Headache*	46	19.2	9.6
Migraine	21	8.9	2.3
Head injury*	17	6.9	11.7
Vertigo/dizziness	16	6.5	4.4
Vertiginous syndrome	10	4.1	2.4
Stroke/cerebrovascular accident	10	4.1	5.3
Fainting/syncope	10	4.0	11.3
Tension headache	9	3.9	3.2
Dementia	9	3.7	2.2
Sinusitis	8	3.2	0.5
Other neurological disease NEC	6	2.3	2.1
Epilepsy	5	2.2	1.4
Neurological symptom/complaint NEC	5	2.1	5.5
Transient cerebral ischaemia	5	2.1	3.0
Convulsions/seizures	3	1.4	10.5
Benign neoplasm nervous system	3	1.3	13.6
Sub-total	*183*	*76.3*	. .
Total	**240**	**100.0**	**. .**

(a) The rate of tests ordered per 100 problems of each type in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: NEC—Not elsewhere classified; Columns may not add to column total due to rounding.

Problem status

Approximately half the problems for which a CT scan of the brain/head was ordered were problems that were new to the patient and half of the tests were ordered at follow-up consultations for problems managed before. Only 1.2% of these problems managed with an order for a CT scan of the brain/head were thought by the GP to be work-related (Table 8.16) and this proportion is less than in the total dataset. This suggests that there is no relationship between ordering rates and work-related status of these problems.

Table 8.16: Relationship between problem status and CT scan of the brain/head

GP work-related view	New problem Per cent of total (*n*=241)	Old problem Per cent of total (*n*=241)	Total Per cent (*n*=241)
Work-related	0.3	0.9	1.2
Not work-related	48.1	50.8	98.8
Total	**48.4**	**51.6**	100.0

Discussion

The use of CT scans in headache and head injury are discussed in sections 9.8 and 9.9 respectively.

Problem labels associated with cerebrovascular disease (vertigo/dizziness, vertiginous syndrome, stroke/cerebrovascular accident, fainting/syncope, and transient cerebral ischaemia) account for over 20% of CT scans of the brain/head. Half of these studies are directed at problem labels suggestive of problems related to vertebrobasilar blood flow. For vertebrobasilar problems, both the ACR and RANZCR guidelines suggest that MRI or MR angiography is the modality of choice (Masaryk et al. 2000; RANZCR 2001). CT scan is an appropriate substitute (rating 6 versus 8 for MRA in the ACR guidelines) in situations where MR imaging is unavailable or inaccessible. For the remaining problem labels CT scan is the usual imaging technique advised when brain imaging is required.

8.7 Doppler tests

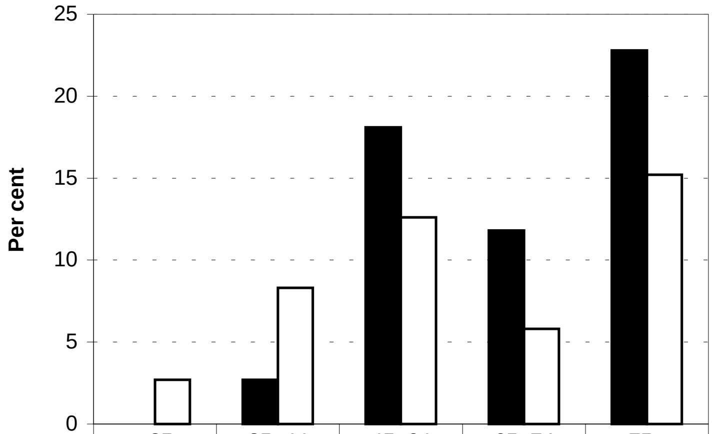
This group includes the following ICPC–2 PLUS codes and rubrics:

- K43003—Test; Doppler (*n*=85)
- K43005—Scan; duplex (*n*=10)
- K43004—Test; Doppler carotid (*n*=46).

There were 141 orders for tests in this group (Table 6.1) and these accounted for only 1.8% of all imaging tests, being ordered at a rate of 2.1 per 100 imaging encounters and at a rate of 0.13 per 100 total encounters. Through extrapolation, it would be expected that nationally there would be about 135,000 Doppler tests ordered by GPs per year. There were 143 problem-test combinations.

Age and sex distribution of patients

Men were over-represented in the patients for whom a Doppler test was ordered. They accounted for 55.4% of these tests (95% CI: 44.7–66.0) compared with 40.6% (95% CI: 39.0–42.4) of all imaging tests. Such tests were more frequently ordered for patients aged between 45 and 64 years and for the elderly, particularly for males in each of these age groups (Figure 8.12).



	<25	25–44	45–64	65–74	75+
■ Male	0.0	2.7	18.1	11.8	22.8
□ Female	2.7	8.3	12.6	5.8	15.2

Age group (years)

Figure 8.12: Age–sex distribution of patients for whom a Doppler test was ordered

Care process

Half the Doppler tests were classed as management orders and a further third were classed as being for monitoring purposes. Only 15.4% were diagnostic in nature (Table 8.17).

Table 8.17: Care process involved in orders for Doppler tests

Care process	Number of problem-test combinations	Per cent of problem-test combinations	95% LCL	95% UCL
Diagnostic	22	15.4	0.0	38.7
Management	71	49.6	37.7	61.4
Monitoring	47	33.1	19.1	47.1
Undefined	3	1.9	0.0	76.3
Total	**143**	**100.0**	..	..

Note: UCL—upper confidence limit; LCL—lower confidence limit; Columns may not add to column total due to rounding.

Problems associated with orders for a Doppler test

As shown in Table 8.18, most of Doppler tests were ordered in the management of three problems, phlebitis/thrombophlebitis (23.4%), transient cerebral ischaemia (17.5%) and peripheral vascular disease (12.6%). The problem-specific rates of Doppler orders were highest for transient cerebral ischaemia (15.2% of contacts resulting in an order for a Doppler test), phlebitis/thrombophlebitis (13.7%) and atherosclerosis (13.5%).

Table 8.18: Most common problems associated with an order for a Doppler test

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Problem-specific test rate[(a)]
Phlebitis and thrombophlebitis	33	23.4	13.7
Transient cerebral ischaemia	25	17.5	15.2
Peripheral vascular disease	18	12.6	8.7
Atherosclerosis	11	7.5	13.5
Swollen ankles/oedema	5	3.3	3.2
Varicose veins of leg	5	3.2	5.3
Cerebrovascular disease	3	2.2	10.9
Stroke/cerebrovascular accident	3	2.1	1.5
Sub-total	*103*	*73.0*	. .
Total	**141**	**100.0**	**. .**

(a) The rate of tests ordered per 100 problems of each type in the total dataset.
Note: Columns may not add to column total due to rounding.

Patient reasons for encounter at Doppler encounters

The earlier mentioned discussions with members of the professional bodies and the DHAC in the formulation of the list of imaging tests of interest had raised the question of the patients' reasons for encounter at consultations generating a Doppler test order.

There was a wide range of patient reasons recorded and many of these would not be associated directly with the morbidity for which the Doppler was ordered.

The top 10 patient reasons for encounter listed in Table 8.7.3 accounted for one-third of the total. Pain and swelling of the legs, together with pain and other symptoms of the feet made up almost 20% of all RFEs for these encounters.

Discussion

Arterial occlusive vascular disease has a strong tendency to occur at multiple sites and to be associated with high levels of mortality even when presenting initially as peripheral vascular disease of the lower limb (Balkau et al. 1994; Criqui et al. 1997; Marsland et al. 1980; Tonelli et al. 1993). Carotid artery disease often manifests as stroke with high mortality and major functional disability in many of the survivors (Williams et al. 1999; Williams & Jiang 2000). Untreated deep vein thrombosis will result in embolism in 50% of untreated patients, 30% of whom will not survive (Needleman et al. 2000). Accurate diagnosis of these diseases is therefore important in terms of management and secondary prevention of sequelae. Non-invasive investigation such as Doppler and duplex scanning are the tests of choice for both diagnosis and follow-up (Barnes 1991; Bettmann et al. 2000; Masaryk et al. 2000; Needleman et al. 2000; RANZCR 2001).

Table 8.19: Most common patient reasons for encounter where a Doppler test ordered

Problem type	Number of RFEs	Per cent of RFEs at Doppler encounters
Pain; leg	24	10.1
Swollen; leg	12	5.3
Check-up; blood pressure	8	3.6
Dizziness	7	3.0
Pain; foot/feet	5	2.3
Transient ischaemic attack	5	2.3
Foot/feet symptom/complaint	5	2.0
Check-up	4	1.9
Disturbed balance	4	1.7
Ulcer; leg	4	1.7
Sub-total	*78*	*33.1*
Total	**236**	**100.0**

Note: RFE—patient reasons for encounter; Columns may not add to column total due to rounding.

8.8 Imaging of the kidney

Included in this group were intravenous pyelograms (IVPs) and ultrasounds of the kidney.

IVPs include only one ICPC–2 PLUS code: U41001 (*n*=70).

Ultrasounds of the kidney include the following ICPC–2 PLUS codes and rubrics:

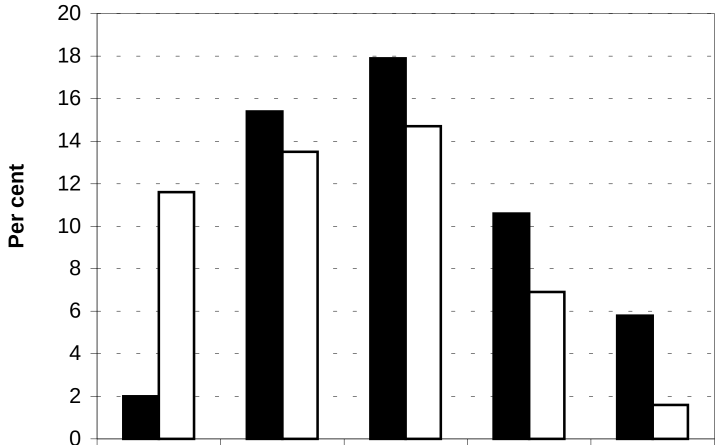
- U41009—Ultrasound; renal tract (*n*=44)
- U41010—Ultrasound; kidney (*n*=98).

There were 70 orders for an IVP and these tests accounted for 0.9% of all imaging tests ordered (Table 6.1). They occurred at a rate of 1.0 per 100 imaging encounters and at an overall rate of 0.07 per 100 encounters. This suggests that nationally GPs order approximately 68,000 IVPs per year for their patients. There were 75 problem-test combinations demonstrating there were a few cases in which the test was related to more than one problem under management.

There were 142 orders for ultrasounds of the kidney and these tests accounted for 1.8% of all imaging tests ordered. They occurred at a rate of 2.1 per 100 imaging encounters and at an overall rate of 0.14 per 100 encounters. Extrapolation of these figures suggests that ultrasounds of the kidney are ordered by GPs on about 140,000 occasions nationally per year. There were 144 problem-test combinations, which suggest an almost one-to-one relationship with the order for ultrasounds of the kidney and a single problem under management. Renal tract ultrasounds were ordered on at least one occasion by only 3.6% of the participating GPs, while 8.8% ordered at least one kidney ultrasound (Table 6.1).

Age–sex distribution

Half the patients (51.7%) for whom imaging of the kidney was ordered were male. While young males of less than 25 years were rarely sent for imaging of the kidney, 11.6% of those tested were women in this age group. However, one-third of the tested patients were middle aged (45–64 years) (Figure 8.13).



	<25	25–44	45–64	65–74	75+
■ Male	2.0	15.4	17.9	10.6	5.8
□ Female	11.6	13.5	14.7	6.9	1.6

Age group (years)

Figure 8.13: Age–sex distribution of patients for whom imaging of the kidney was ordered

Care process

The care processes associated with these two test types were similar, with about half the tests being ordered for diagnostic purposes, about one-third for monitoring and one in five for management purposes (Table 8.20).

Table 8.20: Care process for intravenous pyelogram and ultrasounds of the kidney

	Intravenous pyelogram				Ultrasounds of the kidney			
Care process	**Number of problem-test combinations**	**Per cent of problem-test combinations**	**95% LCL**	**95% UCL**	**Number of problem-test combinations**	**Per cent of problem-test combinations**	**95% LCL**	**95% UCL**
Diagnostic	37	50.0	31.6	67.3	63	43.5	29.3	57.7
Management	15	20.1	0.0	90.2	33	23.0	0.0	48.1
Monitoring	23	30.4	0.0	69.7	44	30.2	11.9	48.6
Undefined	0	. .	. .	. .	4	3.3	0.0	71.2
Total	**75**	**100.0**	**. .**	**. .**	**144**	**100.0**	**. .**	**. .**

Note: UCL—upper confidence limit; LCL—lower confidence limit; Columns may not add to column total due to rounding.

Most common problems managed with imaging of the kidney

Urinary calculus was the problem most often associated with an IVP order (27.7% of problem-IVP combinations), followed by haematuria (24.4%), symptoms and complaints of the kidney (16.4%) and urinary tract infections (16.3%). These four diagnostic labels accounted for three-quarters of all problem-IVP combinations (Table 8.21).

There was a wider range of problems associated with ultrasounds of the kidney, the eight most common problems together accounting for three-quarters of all problems associated with these tests. Urinary tract infections (23.7%), haematuria (14.0%) and symptoms of the kidney (8.7%) were the problems most commonly under management. It is notable that these tests were used in the management of hypertension in 7.1% of cases (Table 8.22).

Viewing both tables together, it is apparent that the relative likelihood of ordering an IVP or an ultrasound of the kidney for the management of urinary tract infections was extremely low.

In the management of urinary calculus, the test most often chosen was an IVP (at 25.4% of contacts with this problem), rather than an ultrasound (11.5%). In the management of haematuria and kidney symptoms and complaints, orders for IVPs and ultrasounds of the kidney were equally likely at about one in seven contacts with both problem types.

Table 8.21: Most common problems associated with an order for an IVP

Problem type	Number of imaging orders	Per cent of total problem-test combinations	Problem-specific test rate[(a)]
Urinary calculus	21	27.7	25.4
Haematuria	18	24.4	11.8
Kidney symptom/complaint	12	16.4	14.0
Urinary tract infection*	4	16.3	0.7
Sub-total	*55*	*75.8*	. .
Total	**75**	**100.0**	**. .**

(a) The rate of tests ordered per 100 problems of each type in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Table 8.22: Most common problems associated with an order for ultrasound of the kidney

Problem type	Number of imaging orders	Per cent of total problem-imaging of kidney combinations	Problem-specific test rate[(a)]
Urinary tract infection*	34	23.7	1.9
Haematuria	20	14.0	13.0
Kidney symptom/complaint NEC	13	8.7	14.3
Hypertension*	10	7.1	0.1
Urinary calculus	9	6.5	11.5
Other urinary disease NEC	9	6.0	11.5
Abnormal test results*	6	4.2	1.1
Prostate symptom/complaint	5	3.5	4.1
Sub total	*106*	*73.6*	. .
Total	**144**	**100.0**	**. .**

(a) The rate of tests ordered per 100 problems of each type in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Note: Columns may not add to column total due to rounding.

Discussion

American College of Radiology guidelines suggest that imaging is rarely required in adult lower urinary tract infection and contributes little to management (Segal et al. 2000). Imaging may contribute to the management of pyelonephritis in diabetic or immuno-compromised patients and those who do not respond to appropriate therapy within 72 hours. In these cases CT scan or ultrasound plus kidneys, ureter and bladder x-ray may be indicated (Sandler et al. 2000). The very low levels of ordering of IVP by Australian GPs and the very modest orders for ultrasound are consistent with these guidelines.

IVP is still the investigation of choice for urinary calculus, with ultrasound and kidneys, ureter and bladder x-ray an alternative for patients with sensitivity to contrast media or where there are reasons to avoid or minimise radiation exposure (Fritzsche et al. 2000). Australian GP usage is consistent with these guidelines also.

There is some division of opinion in the literature reported in the ACR guidelines for imaging in patients with haematuria (Newhouse et al. 2000). Australian use reflects the validity of using IVP and ultrasound as almost equal alternatives in this situation.

9 Analysis of imaging orders for selected problems

This section investigates the pattern of imaging orders for selected problems. The problems were selected on the basis of:

- the relatively high number of imaging orders associated with its management (e.g. fracture, joint sprains and strains), or
- the high proportion of contacts with that problem that generate a pathology test order (e.g. breast lump, shoulder syndrome and abdominal pain), or
- for their intrinsic interest after the discussions with professional bodies and government earlier mentioned (peripheral vascular disease/leg pain, headaches and head injury).

For each selected problem type, the following data are provided:

- the codes, terms and rubrics included in the problem group and their relative frequency within the total dataset
- the number and relative rate of imaging tests ordered for this problem type
- the age and sex distribution of the patients at encounters where this problem type was managed
- the age–sex-specific imaging order rate for this problem type
- the distribution of imaging tests ordered by MBS group for this problem type, and
- the most common individual imaging test types ordered for this problem type.

Where appropriate further analyses are provided to investigate the relationship between test ordering and problem status (new/old) and/or the extent to which the tested problems were thought work-related by the GP.

9.1 Fracture

This group excludes fractures of the head and skull. There were 1,026 fractures managed at 1,009 encounters. The fracture problem group includes the following ICPC–2 codes and rubrics:

- L72—Fracture; radius/ulna (*n*=180)
- L73—Fracture: tibia/fibula (*n*=104)
- L74—Fracture; hand/foot bone (*n*=300)
- L75—Fracture: femur (*n*=35)
- L76—Fracture: other (*n*=399)

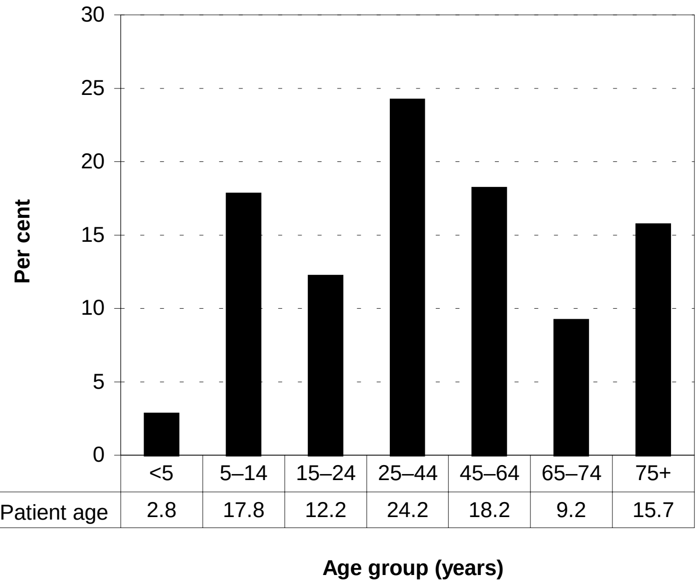
and the following ICPC–2 PLUS codes and rubrics:

- L99017—Fracture: non-union (*n*=1)
- L99018—Fracture: pathological (*n*=5)
- L99019—Fracture: malunion (*n*=2).

For 389 fractures (38.0%) at least one imaging test was ordered. In total 424 tests were ordered, accounting for 5.4% of total imaging, being placed at a rate of 109 per 100 tested fractures (Table 7.5).

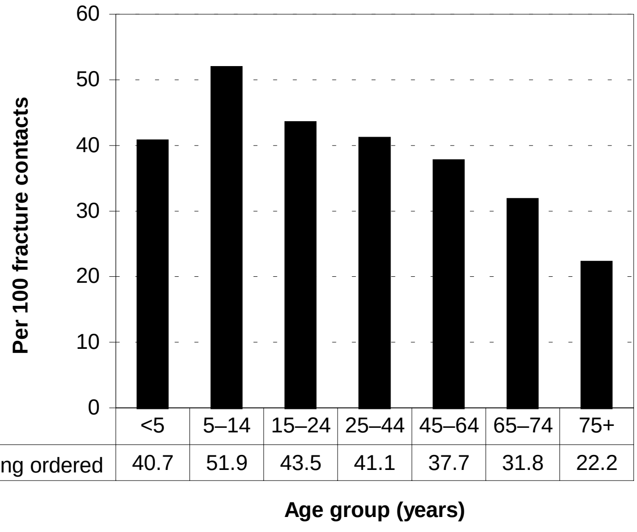
Age- and sex-specific imaging order rates for fracture

At half the encounters involving fracture, the patient was male. An imaging order was placed at only 40.7% of the encounters with male patients compared with 36.5% of those with females. These rates were not statistically different



	<5	5–14	15–24	25–44	45–64	65–74	75+
■ Patient age	2.8	17.8	12.2	24.2	18.2	9.2	15.7

Figure 9.1: Age distribution of patients at fracture encounters



	<5	5–14	15–24	25–44	45–64	65–74	75+
■ Imaging ordered	40.7	51.9	43.5	41.1	37.7	31.8	22.2

Figure 9.2: Age-specific imaging order rates for fractures

The age distribution of the patients at fracture encounters is provided in Figure 9.1, which demonstrates that one in four were aged between 25 and 44 years and a further 18% were between 45 and 64 years old.

The age-specific rates of imaging orders are presented graphically in Figure 9.2. The likelihood of having an imaging test ordered for fracture was highest for children aged 5–14 years (51.9%) and decreased steadily with age to 22.2% for the elderly.

Imaging tests ordered for fracture by MBS group

Almost all (97.7%) of the imaging tests ordered for fracture fell into the diagnostic radiology MBS group. Computed tomography accounted for a further 1.6% of tests for fracture (Table 9.1).

Table 9.1: Distribution of imaging tests ordered for fracture by MBS group

MBS imaging group	Number of tests	Per cent of tests for fracture
Diagnostic radiology	414	97.7
Computed tomography	7	1.6
Ultrasound	1	0.3
Magnetic resonance imaging	1	0.3
Other	1	0.5
Total	**424**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging test order rates by problem status of fracture

New presentations of fracture made up one-third of the total contacts and an imaging test order was far more likely in these cases. Tests were ordered at a rate of 61.5 per 100 contacts with new fractures compared with a rate of 31.2 tests per 100 old fracture encounters (Table 9.2).

Table 9.2: Imaging order rate by problem status of fracture

Problem status	Number of problem contacts[(a)]	Per cent	Number of imaging tests ordered	Imaging order rate per 100 problems
New fracture problems	343	33.4	211	61.5
Old fracture problems	683	66.6	213	31.2
Total	**1,026**	**100.0**	**424**	52.1

(a) Total contacts with this problem in the full dataset.

Most common imaging tests ordered for fracture

The tests most commonly ordered in the management of fracture were plain x-rays of specific body parts. X-rays of the wrist accounted for 14.8% of imaging ordered for fractures, followed by those of the hand (9.8%), the foot/feet (9.2%) and the finger(s) or thumb (7.8%) (Table 9.3).

Table 9.3: Most common imaging tests ordered for fracture

Test type ordered	Number of tests	Per cent of tests for fracture	Per cent of tests for new fractures (*n*=211)	Per cent of tests for old fractures (*n*=213)
X-ray; wrist	63	14.8	*12.2*	*17.3*
X-ray; hand	42	9.8	*11.2*	*8.4*
X-ray; foot/feet	39	9.2	*8.0*	*10.3*
X-ray; finger(s)/thumb	33	7.8	*8.6*	*6.9*
X-ray; ankle	25	5.9	*4.9*	*6.8*
X-ray; chest	22	5.1	*4.9*	*5.3*
Scan; bone(s)	18	4.2	4.4	3.9
X-ray; forearm	14	3.3	2.8	3.9
X-ray; toe(s)	14	3.2	2.8	3.7
X-ray; elbow	14	3.2	3.0	3.4
X-ray; ribs	14	3.2	3.8	2.6
X-ray; arm	13	3.0	4.3	1.7
x-ray; clavicle	11	2.6	0.6	4.6
Test; bone marrow density	11	2.6	3.1	2.0
X-ray; nose	10	2.4	3.6	1.3
X-ray; knee	7	1.7	2.3	1.0
X-ray; shoulder	7	1.6	2.3	1.0
Sub-total	*357*	*84.2*	*82.8*	*84.1*
Total	**424**	**100.0**	100.0	100.0

Note: Columns may not add to column total due to rounding.

Discussion

The results described in this section are discussed in association with those for sprains and strains (see 'Discussion') in Section 9.2.

9.2 Joint sprain and strain

This group includes the following ICPC–2 codes and rubrics:

- L77—Sprains and strains of ankle (*n*=220)
- L78—Sprains and strains of knee (*n*=64)
- L79—Sprains and strains of other joints (*n*=830).

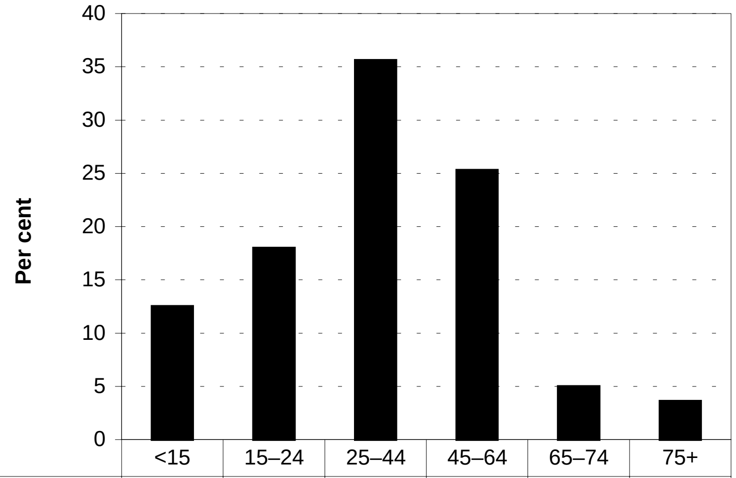
There were 1,114 joint sprains and strains managed at 1,009 encounters. For 239 joint sprains and strains (21.5%) at least one imaging test was ordered. In total 253 tests were ordered and these accounted for 3.2% of total imaging. These orders were placed at a rate of 106 per 100 tested joint sprains and strains.

Age- and sex-specific imaging order rates for joint sprain and strain

At half the encounters involving joint sprains and strains, the patient was male. The likelihood of imaging orders for joint sprain or strain did not differ significantly between the sexes, imaging being ordered at 19.2% of encounters with males and 24.0% of those with females.

The age distribution of the patients at joint sprain and strain encounters is provided in Figure 9.3, which demonstrates that one in three were aged between 25 and 44 years and a further 25% were between 45 and 64 years old. The management of joint sprains and strains was relatively infrequent at encounters with elderly patients and young children.

The age-specific rates of imaging orders are presented graphically in Figure 9.4. The likelihood of having an imaging test ordered for joint sprains and strains was highest for children aged less than 15 years (31.0%) and decreased with age to 8.5% for the elderly. The small sample sizes involved rendered the differences between the age-specific rates not statistically significant.



	<15	15–24	25–44	45–64	65–74	75+
Patient age	12.5	18	35.6	25.3	5.0	3.6

Figure 9.3: Age distribution of patients at sprain and strain encounters

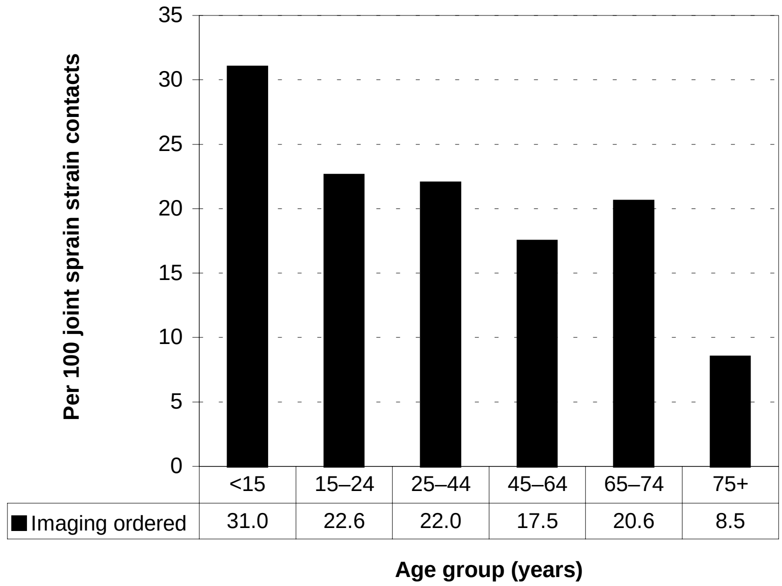


Figure 9.4: Age–specific imaging order rates for sprains and strains

Imaging tests ordered for joint sprains and strains by MBS group

By far the majority (87.9%) of the imaging tests ordered for joint sprains and strains fell into the diagnostic radiology MBS group. However, there were 24 ultrasounds ordered for these problems, accounting for almost 10% of imaging orders for these problems (Table 9.4).

Table 9.4: Distribution of imaging tests ordered for joint sprain and strain by MBS group

Imaging class	Number of tests	Per cent of tests for joint sprains and strains
Diagnostic radiology	222	87.9
Ultrasound	24	9.6
Computed tomography	5	1.9
Other	2	0.7
Total	**253**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging test order rates by problem status of joint sprains and strains

New presentations of joints sprains and strains accounted for 45% of all joint sprains and strains managed. As shown in Table 9.5 imaging was ordered for one in four new cases and at one in five follow-up consultations for this problem type.

Table 9.5: Imaging order rates by problem status of joint strain and sprain

Problem status	Number of problem contacts[(a)]	Number of imaging tests ordered	Imaging order rate per 100 problems
New joint sprains and strains	503	129	25.6
Old joint sprains and strains	611	124	20.2
Total	**1,114**	**253**	**22.7**

(a) Number of contacts with this problem in the total dataset.

Most common imaging ordered for joint sprains and strains

The tests most commonly ordered in the management of joint sprains and strains were plain x-rays of specific body parts. X-rays of the ankle were most common, accounting for almost one-third (32.8%) of the imaging orders, followed by those of the knee (10.8%), the wrist (8.5%) and the shoulder (7.7%). Orders for an ultrasound of the shoulder (7.5%) were as frequent as orders for plain x-rays of this site (7.7%) where the problem was described as a joint sprain or strain (Table 9.6).

The tests most often ordered at follow-up encounters for the problem were x-rays of the ankle (37.5%) and of the knee (12.7%), which, together, made up more than half of all tests ordered. Where imaging was ordered for new presentations of a joint sprain or strain the most common was also x-ray of the ankle (28.2%). This was followed by x-ray of the knee (9.1%), the wrist and the shoulder.

Table 9.6: Most common imaging tests ordered for joint sprain and strain

Test type ordered	Number of tests	Per cent of tests	Per cent of tests for new sprains/strains (*n*=129)	Per cent of tests for old sprains/strains (*n*=124)
X-ray; ankle	83	32.8	28.2	37.5
X-ray; knee	27	10.8	9.1	12.7
X-ray; wrist	22	8.5	10.7	6.3
X-ray; shoulder	20	7.7	10.7	4.7
Ultrasound; shoulder	19	7.5	7.9	7.0
X-ray; foot/feet	16	6.3	8.7	3.8
X-ray; spine; lumbar	14	5.4	5.8	5.0
X-ray; lumbosacral	12	4.7	4.4	5.0
Sub-total	*213*	*84.2*	*85.5*	*82.0*
Total	**253**	**100.0**	**100.0**	**100.0**

Note: Columns may not add to column total due to rounding.

Rates of testing for selected fractures and sprains/strains

The difference in relative rates of imaging orders for fractures (52.1 orders per 100 contacts, Table 9.2) and for joint sprains and strains (22.7 per 100 contacts, Table 9.5) led to an investigation of the extent to which this difference in ordering rates was apparent in the more frequent specific fractures and sprains/strains. The fractures managed most frequently in general practice are those of the wrist/arm (*n*=180 contacts in this *BEACH* data year) and the ankle (*n*=56).

The parallel frequencies for sprain/strain were 220 contacts with sprain/strain of the ankle and 86 for sprain/strain of the wrist. Sprains and strains of the knee were also relatively common (*n*=65).

GPs ordered imaging at a rate of 44.8 per 100 contacts with fractured ankle and 37.7 per 100 contacts with sprain/strain of the ankle. For fractured wrist, they placed 42.2 orders per 100 contacts but where the problem was labelled as strain/sprain of the wrist the ordering rate was somewhat lower (25.6 per 100 contacts). Sprains and strains of the knee generated a somewhat higher imaging order rate of 41.9 tests per 100 contacts (results not presented).

Discussion

Problem labels of fracture and sprain/strain are both applied to the results of blunt trauma to joints and may reflect different levels of certainty regarding the diagnosis in patients referred for imaging studies. Overall, 61.5 imaging tests were ordered per 100 new fracture contacts (Table 9.2) but for new problems labelled as sprain/strain, the order rate was 25.6 (Table 9.5). Presumably these tests were ordered to exclude fracture.

In the case of ankle injury, the well-validated Ottawa decision rules for imaging have been adopted by the American College of Radiology as appropriate guidelines for the diagnosis of fracture (Anis et al. 1995; Dalinka et al. 2000; Pigman et al. 1994; Stiell et al. 1992c; Stiell et al. 1992a; Stiell et al. 1992b; Stiell et al. 1993; Stiell et al. 1994; Stiell et al. 1995a; Verbeek et al. 1997). Stiell et al. reported that more than 92% of ankle injuries were x-rayed in an Emergency Department setting. As indicated above, in this study GPs ordered at the rate of 44.8 per 100 problems labelled as fractured ankle and at the rate of 37.7 per 100 problems labelled as sprain/strain. This difference is not statistically significant. Although GPs order x-ray of the ankle at a lower rate than Emergency Department staff, it may still be appropriate to familiarise GPs with the Ottawa guidelines. The RANZCR guidelines do not provide any guidance on the selection of patients for x-ray for suspected fracture of the ankle.

X-ray of the wrist/arm was the most common x-ray for fracture and occurred at 42.2 per 100 contacts with problems labelled as fracture and 25.6 per 100 contacts for sprain/strain. ACR and RANZCR guidelines both suggest plain x-ray as the investigation of choice for fracture to the hand and wrist but make no comment on patient selection except for suspected scaphoid fracture. No literature on guidelines for patient selection for imaging to detect wrist fracture was found.

In a study of knee injuries managed in Emergency Departments in Canada, Stiel et al. found that 74.5% of patients had an x-ray and 5.2% had fractures. Knee x-rays have the lowest yield for diagnosing clinical significant fractures (Stiell et al. 1995c). The ACR Appropriateness Criteria for acute trauma to the knee synthesises the research of several developers of decision rules for knee imaging including Stiell, Seberg and Bauer (Bauer et al. 1995; Nichol et al. 1999; Seaberg et al. 1998; Seaberg & Jackson 1994; Stiell et al. 1995b; Stiell et al. 1996; Stiell et al. 1997). If the criteria were applied in the Australian context they have the potential to significantly reduce the need for knee radiology without losing sensitivity of fracture detection. The current level of 41.9 knee x-rays per 100 problem contacts for sprain/strain of knee, while well below North American Emergency Department levels, could probably be significantly reduced.

9.3 Back pain

This group contains the following ICPC–2 codes and rubrics:

- L02—Back symptom complaint (*n*=1,029)
- L03—Low back symptom/complaint (*n*=804)

and the following ICPC–2 PLUS codes and rubrics:

- L84020—Strain; back (*n*=252)
- L84021—Sprain; back (*n*=49)
- L86002—Lesion; intervertabral disc; lumbosacral (*n*=24)
- L86003—Neuritis; lumbosacral (*n*=2)
- L86009—Sciatica (*n*=336)
- L86036—Backpain; radiating; lumbosacral (*n*=7).

There were 2,502 GP contacts with back pain and 379 of these (15.2%) generated an order for imaging. In total 433 imaging test orders were placed. For every 100 contacts with back pain, GPs ordered 17.3 tests, and when they did order there were 114 tests per 100 contacts (Table 7.5).

Age- and sex-specific imaging order rates for back pain

Half the back pain contacts were with male patients. There was no significant difference in the relative frequency of imaging orders for back pain by patient sex, tests being ordered at a rate of 15.9 per 100 male back pain contacts and 14.7 per 100 female back pain contacts.

By far the majority of patients for whom back pain was managed were aged between 25 and 64 years, with 18.4% being 65 years or more and 10.0% aged less than 25 years (Figure 9.5).

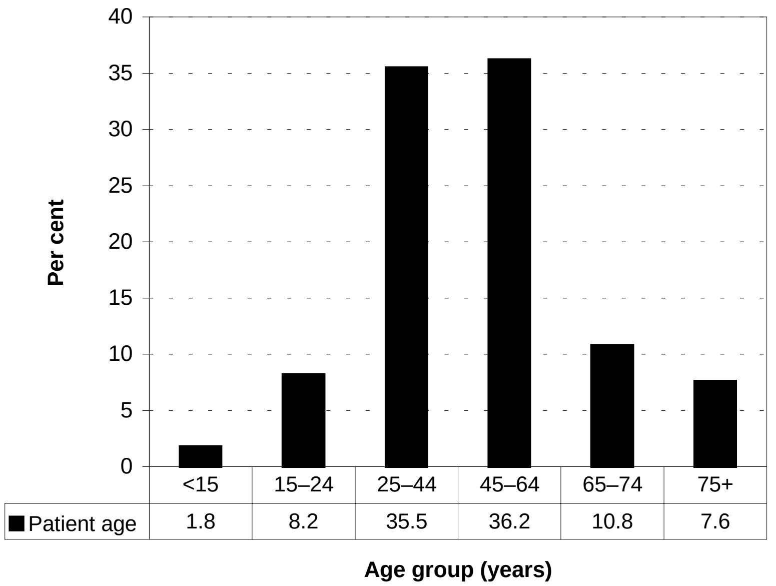


Figure 9.5: Age distribution of patients at back pain encounters

The age-specific rate of imaging orders is presented graphically in Figure 9.6. It demonstrates little variance in imaging order rates across age groups. The lowest ordering rate was 14.3 orders per 100 back pain contacts with patients aged 45–64 years, and the highest, 17.5 per 100 back pain contacts with patients aged 75 years or more.

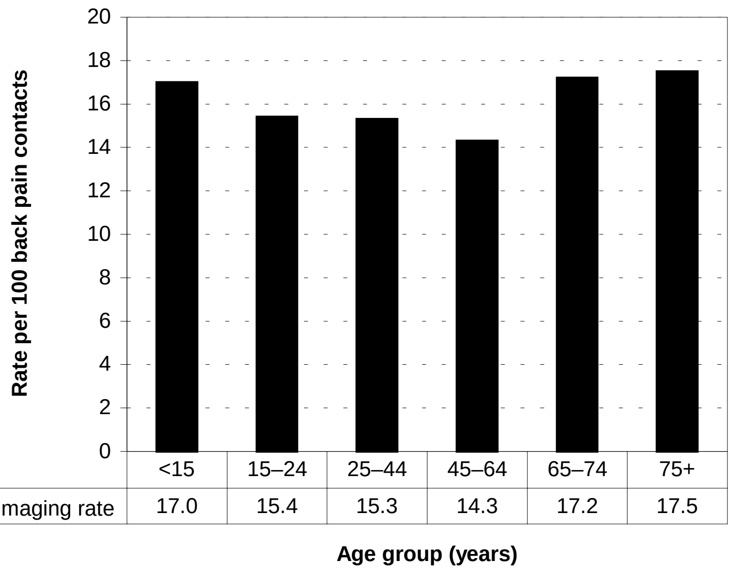


Figure 9.6: Age-specific imaging order rates for back pain

Imaging tests ordered for back pain by MBS groups

Almost three-quarters (73.8%) of all imaging tests ordered for back pain were classified as diagnostic radiology and most of the remainder (21.4%) were classed as computed tomography. Ultrasounds were rarely ordered (3.7%), as were magnetic resonance imaging tests (1.1%) (Table 9.7).

Table 9.7: Distribution of imaging tests for back pain by MBS groups

Imaging class	Number of tests	Per cent of tests for back pain
Diagnostic radiology	319	73.8
Computed tomography	92	21.4
Ultrasound	16	3.7
Magnetic resonance imaging	5	1.1
Total	**433**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging test order rates by problem status of back pain

Almost three-quarters of the GP contacts with back pain were follow-up consultations. However, the relative rate of imaging orders for this problem was greater at first presentations of back pain (28.7% of contacts generating an order) than at follow-up consultations (13.3%) (Table 9.8).

Table 9.8: Imaging order rates by status of back pain problem

Problem status	Number of problem contacts[(a)]	Per cent	Number of imaging tests ordered	Imaging order rate per 100 problems
New back pain problems	656	26.2	188	28.7
Old back pain problems	1,846	73.8	245	13.2
Total	**2,502**	**100.0**	**433**	**17.3**

(a) The number of contacts with this problem in the total dataset.

Most common imaging tests ordered for back pain

The imaging tests most frequently ordered for back pain are listed in Table 9.9, which also presents the distribution of tests ordered for new and old back pain problems. Lumbosacral x-rays were the preferred option, accounting for 28.6% of all imaging ordered for back pain. X-rays of the lumbar spine accounted for a further 15.0% of all imaging ordered, and spinal x-rays another 8.0%. The most common types of CT scans were those of the lumbosacral spine (9.6%) and the lumbar spine (5.4%). The major difference in the distribution of test types for new and old problems was that lumbosacral x-rays were the more popular choice for new presentations (37.4%) than for old problems (21.9%).

Table 9.9: Most frequent imaging tests ordered for back pain

Test type ordered	Number of tests	Per cent of tests for back pain	Per cent of tests for new back pain (*n*=188)	Per cent of tests for old back pain (*n*=245)
X-ray; lumbosacral	124	28.6	37.4	21.9
X-ray; spine; lumbar	65	15.0	16.6	13.8
CT scan; spine; lumbosacral	42	9.6	9.9	9.3
X-ray; spinal	35	8.0	5.7	9.8
CT scan; spine; lumbar	23	5.4	4.9	5.8
X-ray; thoracic	16	3.7	2.7	4.5
X-ray; back	15	3.6	3.4	3.7
CT scan; spine	12	2.8	2.4	3.1
X-ray; back lower	10	2.2	0.9	3.2
Sub-total	342	79.2	83.9	75.1
Total	**432**	**100.0**	**100.0**	**100.0**

Note: Columns may not add to column total due to rounding.

Discussion

A comprehensive analysis of the scientific literature regarding low back pain by the Quebec Task Force on Spinal Disorders in 1987 revealed that, on the evidence, spinal x-ray was contraindicated within seven days of onset of uncomplicated back pain with or without radiation. There was no scientific evidence to support the use of x-ray short of seven weeks from onset and even then the return was poor (Quebec Task Force on Spinal Disorders 1987). Subsequently developed guidelines all support the proposition that uncomplicated low back pain without ‘red flags’ (such as > 70 years old, osteoporosis, weight loss, malignancy, fever, IV drug use or immunosuppression) will settle within 6–12 weeks in 90% of cases without investigation and with little more than supportive therapy (Agency for Health Care Policy and Research 1994; Anderson et al. 2000; RANZCR 2001).

In this study, GPs ordered spinal imaging at the rate of 28.7 per 100 new back pain problems seen and 13.2 per 100 old back problems. While some of the patients with new back problems may have had symptoms for some time before presentation, these data suggest that an appropriate intervention could reduce the spine x-ray rate without decreasing the quality of patient care.

There is evidence in the literature that the supply of guidelines, when combined with feedback to the clinician, can reduce spinal x-ray use by GPs (Kerry et al. 2000; Oakeshott et al. 1994). However, a Canadian study found that some guidelines had the potential to increase usage if they were not sufficiently rigorous (Suarez-Almazor et al. 1997).

Wilson et al. studied the effect of patient factors on the use of radiology in rural practice in the United States and found a significant correlation between patient preference and ordering. They suggest that these patient factors need to be addressed in any strategy to reduce ordering of spinal x-rays (Wilson et al. 2001).

9.4 Osteoarthritis

This group includes the following ICPC–2 codes and rubrics:

- L83011—Osteoarthritis; spine; cervical (*n*=48)
- L84009—Osteoarthritis; spine; thoracic (*n*=7)
- L84010—Osteoarthritis spine; lumbar (*n*=74)
- L84011—Osteoarthritis; lumbosacral (*n*=31)
- L84012—Osteoarthritis; sacroiliac (*n*=1)
- L89001—Osteoarthritis; hip (*n*=186)
- L90001—Osteoarthritis; knee (*n*=527)
- L91001—Osteoarthritis; degenerative (*n*=6)
- L91003—Osteoarthritis (*n*=1,270)
- L92007—Osteoarthritis; shoulder (*n*=59).

There were 2,346 cases of osteoarthritis managed at 2,332 encounters. For 296 osteoarthritis contacts (12.6%), at least one imaging test was ordered. In total, 326 tests were ordered and these accounted for 4.1% of total imaging. These orders were placed at a rate of 110 per 100 tested cases of osteoarthritis or 10 per 100 contacts with osteoarthritis (Table 7.5).

Age- and sex-specific imaging order rates for osteoarthritis

Women accounted for the majority (59.0%) of osteoarthritis contacts. However, the likelihood of an imaging order being placed in the management of osteoarthritis was almost identical for men (13.0%) and women (12.5%).

The age distribution of the patients at osteoarthritis encounters is provided in Figure 9.7. Elderly patients (65 years and over) accounted for 59.6% of the GP contacts with osteoarthritis and those aged less than 45 years, 7.9% of contacts.

The age-specific rates of imaging orders are presented graphically in Figure 9.8. The likelihood of having an imaging test ordered at an osteoarthritis, contact was highest at 18.1% for patients aged less than 45 years and then decreased with patient age group to 9.2 per 100 osteoarthritis contacts in patients aged 75 years or more. However, the small sample sizes rendered the differences between the age–specific rates not statistically significant.

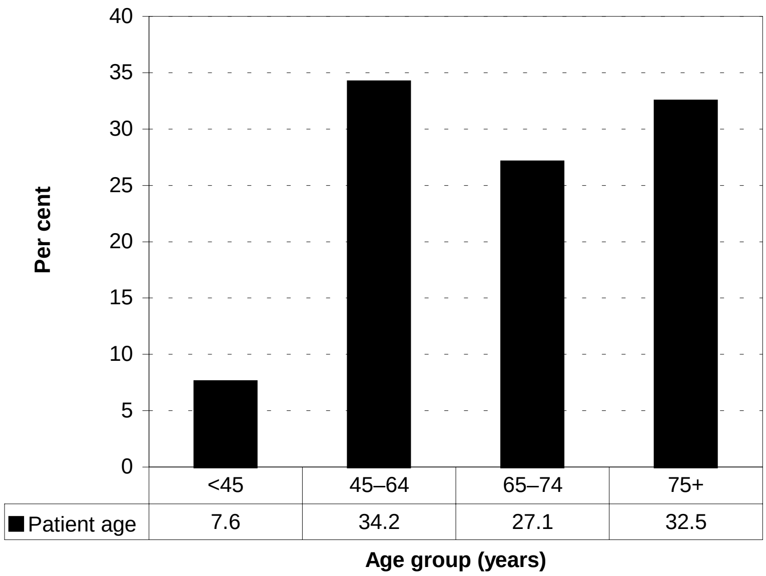


Figure 9.7: Age distribution of patients at osteoarthritis encounters

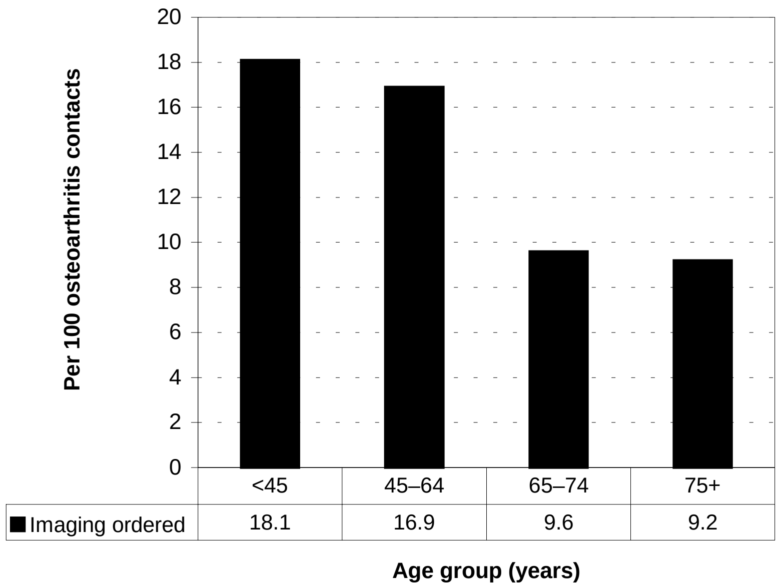


Figure 9.8: Age–specific imaging order rates for osteoarthritis

Imaging tests ordered for osteoarthritis by MBS group

Diagnostic radiology accounted for almost all the imaging tests ordered by the GPs for osteoarthritis. There were only nine ultrasounds ordered (2.7%) (Table 9.10).

Table 9.10: Distribution of imaging tests ordered for osteoarthritis by MBS group

Imaging class	Number of tests	Per cent of tests for osteoarthritis
Diagnostic radiology	312	95.7
Ultrasound	9	2.7
Computed tomography	4	1.2
Magnetic resonance imaging	1	0.4
Total	**326**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging test order rates by problem status of osteoarthritis

Table 9.11 demonstrates that the vast majority of contacts with osteoarthritis were follow-up consultations (84.3%), reflecting the ongoing nature of its management in general practice. However, the relative rate of imaging test orders was three times higher at new contacts with osteoarthritis (33.4 tests per 100 contacts) than at follow-up consultations (10.3 per 100). However, the distribution of test types for new and old cases of osteoarthritis was very similar (Table 9.12).

Table 9.11: Imaging order rates by status of osteoarthritis

Problem status	Number of problem contacts[(a)]	Per cent	Number of imaging tests ordered	Imaging order rate per 100 problems
New osteoarthritis problems	369	15.7	123	33.4
Old osteoarthritis problems	1,977	84.3	203	10.3
Total	**2,346**	**100.0**	**326**	**13.9**

(a) Number of contacts with this problem in the total dataset.

Most common imaging tests ordered for osteoarthritis

The tests most commonly ordered in the management of osteoarthritis were plain x-rays of specific body parts. X-rays of the knee were most common, accounting for almost one-third (32.5%) of the imaging orders, followed by those of the hip (13.7%) and the lumbosacral region (7.7%). Each of the remaining test types ordered for osteoarthritis accounted for less than 5% of the total tests ordered (Table 9.12). The shoulder was the most likely site for an order for an ultrasound, accounting for 1.1% of all tests for osteoarthritis.

Table 9.12: Most common imaging tests ordered for osteoarthritis

Test type ordered	Number of tests	Per cent of tests for osteoarthritis	Per cent of imaging tests ordered for new osteoarthritis	Per cent of imaging tests ordered for old osteoarthritis
X-ray; knee	106	32.5	34.1	31.5
X-ray; hip	45	13.7	15.3	12.8
X-ray; lumbosacral	25	7.7	4.2	9.8
X-ray; hand	16	4.9	6.2	4.1
X-ray; spine; lumbar	15	4.7	6.8	3.4
X-ray; shoulder	14	4.3	5.9	3.4
X-ray; foot/feet	13	4.1	7.9	1.8
X-ray; neck	12	3.6	3.9	3.3
X-ray; ankle	11	3.5	0.2	5.5
X-ray; cervical	10	3.2	1.5	4.2
X-ray; spinal	8	2.3	2.0	2.5
Sub-total	*275*	*84.4*	88.0	82.3
Total	**326**	**100.0**	**100.0**	**100.0**

Note: Columns may not add to column total due to rounding.

Discussion

Osteoarthritis is a common disease in Australia and costs between 1–2.5% of gross national product (March & Bachmeier 1997). Osteoarthritis is the third most common problem for which imaging is ordered by GPs although the frequency of ordering per 100 problems is relatively low at 13.9 per 100 problem encounters. While diagnostic guidelines exist for painful hips and knees, there are few reports of research into the use of radiology to measure progress and outcomes of this condition. There is a perceived need for randomised controlled trials of osteoarthritis imaging in general practice to better assess therapeutic effect of interventions and outcomes in this common condition (Balint et al. 1998). Osteoarthritis is a very heterogeneous condition and therefore the development of guidelines is a complex process. There is also evidence in the literature of variance in the management of osteoarthritis by GPs (Bierma-Zeinstra et al. 2000; Saag 1997). American College of Rheumatology guidelines for the assessment of patients with musculoskeletal pain indicate that plain x-ray of the affected joint may reveal evidence of osteoarthritis; however, they may be negative in the presence of disease (American College of Rheumatology Ad Hoc Committee on Clinical Guidelines 1996). Considerable research has been undertaken to develop more accurate quantitative assessment of joint changes in osteoarthritis, particularly in relation to assessment of the benefit of non-steroid anti-inflammatory drugs in clinical trials (Bellamy 1995; Bellamy 1999; Dougados 1995; Hart & Spector 1995; Hochberg 1996; Ravaud 1996; Vignon et al. 1999; Watt 2000). These latter guidelines do not assist the decision process of GPs monitoring the progress or control of patients in the practice setting as access to these very specialised research techniques is very limited.

9.5 Abdominal pain

Abdominal pain is the twelfth most common patient reasons for encounter in general practice. Many of these presentations result in a defined diagnostic label but many also remain ill-defined at the end of the consultation. As a result, it was decided that the investigation of imaging associated with abdominal pain should centre both on those encounters at which it was presented as a reason for encounter and those at which the problem was labelled by the GP in this manner.

Abdominal pain as a patient reason for encounter

A reason for encounter (RFE) was classified as 'abdominal pain' if the patient described his or her reason for the encounter in terms of any of the labels classified under the ICPC–2 rubric D01 (Pain/cramps, abdominal general) or D06 (Pain, abdominal localised, other). In ICPC–2 PLUS these rubrics include a number of more specific symptom and complaint codes such as 'cramps; abdominal' and 'intestinal colic'**.** As multiple ICPC–2 PLUS codes fall into the general abdominal pain group, in cases where a patient used more than one of these terms at an encounter, the RFE would have been counted twice.

Abdominal pain was described on 2,172 occasions, represented 1.4% of all RFEs and occurred at a rate of 2.1 per 100 encounters. Encounters involving at least one RFE of this type numbered 2,168 (2.1% of all encounters).

Figure 9.9 illustrates the relationship of an RFE of abdominal pain with other information collected at that general practice encounter. The RFE of abdominal pain can be directly linked to patient characteristics such as age and sex (solid arrows). However, RFEs can only be indirectly linked (dotted arrows) to the problems and their management, including the imaging tests ordered at these encounters.

Age and sex distribution of patients presenting with an RFE of abdominal pain

Over two-thirds of these 2,168 encounters were with female patients. Patients presenting with abdominal pain tended to be somewhat younger than the total sample. Only 16% of these patients were aged 65 years and over (compared with about 24% of patients at all encounters).

Other reasons for encounter

A total of 1,518 other RFEs were described at these encounters. At one in 10 diarrhoea was concurrently described with the abdominal pain, while some patients described nausea (5.7 per 100 abdominal pain encounters) and/or vomiting (5.6 per 100). Other symptoms described included throat complaints, cough, fever and flatulence. Requests for a prescription and for test results were also relatively common (Figure 9.9).

Problems managed

Multiple problems could be managed at an encounter, some of which may have been unrelated to the RFE of abdominal pain. However, while there is not a direct link between a single RFE and a single diagnosis, certain diagnostic groups stand out at these encounters and a relationship between the demand for care and the diagnostic label can be generally assumed (Britt 1994).

There were 3,195 problems managed at these encounters and the most common were described in the same symptomatic terms. That is, at 461 encounter (21.3%) no further definition of the underlying problem could yet be determined. Problems with more specific labels included gastroenteritis (12.1 per 100 encounters), irritable bowel syndrome (6.3) and constipation (5.1).

ABDOMINAL PAIN[(a)*]
N=2,172 RFEs of abdominal pain 1.4% of total RFEs, at 2,168 encounters

The patients[(a)]	
Sex (n=2,143)	
Males	35.3%
Females	64.7%
Age group (n=2,154)	
<15	14.5%
15–24	14.4%
25–44	31.0%
45–64	23.7%
65–74	7.6%
75+	8.8%

Other RFEs at these encounters (n=1,518) [(a)]	
Diarrhoea	10.1
Nausea	5.7
Vomiting	5.6
Back complaint*	3.5
Prescription—all*	3.1
Test results*	2.9
Throat complaint	2.5
Cough	2.4
Fever	2.3
Flatulence	2.3

Referrals (n=407)[(a)]	
Specialist	12.8
Allied health	1.9
Hospital	3.3
Emergency dep't	0.8

Pathology tests (n=1,094)[(a)]	
Chemistry	15.0
Microbiology	13.5
Haematology	11.9
Other NEC	6.9

Imaging ordered (n=546)[(a)]	**Rate/100**	**% imaging[(b)]**
Ultrasound; abdomen	6.3	24.9
Ultrasound; pelvis	3.2	12.9
X-ray; abdomen	2.7	10.7
Ultrasound; upper abdomen	1.6	6.5
Ultrasound; gallbladder	1.2	4.9
Ct scan; abdomen	1.0	3.9
x-ray; chest	1.0	3.8
Barium enema	0.9	3.6
Barium meal	0.7	2.8
Ultrasound; obstetric	0.5	2.0

Drugs prescribed (n=1,983)[(a)]	
Antispasmodics	10.4
Anti-ulcerants	8.9
Simple analgesic	8.9
Anti-emetic/antinausea	5.7
Laxatives	5.4
Compound analgesics	5.1
Antiviral	4.6
Narcotic analgesics	3.1
Penicillin	3.1
Broad spectrum penicillin	3.0

Problems managed at abdominal pain encounters (n=3,195)[(a)]	
Abdominal pain*	21.3
Gastroenteritis	12.1
Irritable bowel syndrome	6.3
Constipation	5.1
UTI*	4.8
Diverticular disease	4.6
Gallbladder problems	4.6
Reflux/oesophagus disease	3.8
Stomach function disorder	3.4

Other treatments (n=1,057)[(a)]	
Clinical treatments	**44.5**
Counsel/advice—nutrition/weight	12.8
Advice/education—treatment	10.4
Advice/education	5.0
Counselling—problem	4.4
Advice/education—medication	2.4
Reassure/support	2.0
Counselling—psychological	1.7
Procedures	**4.3**

Figure 9.9: Inter-relationship of RFEs of abdominal pain with other variables

(a) Expressed as rates per 100 encounters at which abdominal pain was given as an RFE (N=2,168).

(b) The percentage of total imaging tests ordered at encounters which included an RFE of abdominal pain.

* Includes multiple ICPC–2 or ICPC–2 PLUS codes (see Appendix 3).

Note: UTI—urinary tract infection, NEC—not elsewhere classified, US—ultrasound, CT—computed tomography.

Prescriptions, other treatments and referrals

Medications were prescribed at these encounters at a rate of 91.5 per 100 encounters, a similar rate to the average for all encounters (93.8 per 100). Clinical treatments were recorded at a rate of 44.5 per 100 encounters, a higher rate than in the total dataset (33.5 per 100). Procedures were rarely undertaken. Referrals (18.8 per 100 abdominal pain encounters) were made at almost double the overall average rate (7.3 per 100 encounters) and over two-thirds of these were to specialists.

Pathology tests ordered

Encounters involving an RFE of abdominal pain generated relatively high pathology test ordering rates. There were 1,094 pathology test orders (or groups of tests such as FBC) at these encounters, a rate of 50.5 per 100 encounters. This compares with an overall rate of 26.3 orders per 100 encounters.

Most frequent imaging tests ordered at encounters involving an RFE of abdominal pain

Orders for imaging were made at a rate of 25.2 per 100 encounters (compared with the overall rate of 7.5 per 100). There were 57 different imaging test types ordered and some would be associated with co-morbidity presented rather than to a problem associated with the presenting abdominal pain. The inclusion of chest x-rays in the top 10 imaging test types is likely to be a result of the high rate of chest x-rays in the total sample rather than a result of the presenting abdominal pain. The 10 imaging tests most frequently ordered at encounters involving an RFE of abdominal pain are presented in Figure 9.9. Together they made up 76.0% of all imaging ordered at these encounters. Abdominal ultrasounds were most often ordered and these accounted for one-quarter of all imaging at these encounters. They were followed by pelvic ultrasounds (12.9%) and abdominal x-rays (10.7%) and ultrasounds of the upper abdomen (6.5%).

Abdominal pain as a problem under management

This problem group includes the following ICPC–2 rubrics

- D01—Abdominal pain/cramps, general (*n*=509)
- D06—Abdominal pain, localised NEC (*n*=111).

There were 620 encounters at which abdominal pain was recorded as the problem under management (0.6 cases per 100 encounters). From the RFE data described above, it can be deduced that at 461 of these (74.4%) the patient described the abdominal pain as one of the reasons for attending the GP. At the remaining 159 they did not.

At least one imaging test was ordered for 172 of these cases (27.7%). A total of 192 separate tests were ordered at a rate of 116 per 100 tested abdominal pain contacts and an overall rate of 31.0 tests per 100 contacts with the problem abdominal pain (Table 7.5).

Age- and sex-specific imaging order rates for abdominal pain

Female patients made up 65.1% of those for whom abdominal pain was managed. There was no significant difference in the relative rate of imaging orders for males (28.2 per 100 contacts) and females (27.7 per 100).

Thirty per cent of the patients at abdominal pain encounters were aged between 25 and 44 years. A further 23.8% were 45–64 years old (Figure 9.10). However, the extent to which GPs ordered imaging tests for this problem was heavily influenced by the age of the patient.

Figure 9.11 demonstrates a steady increase in age-specific imaging order rates from 11 tests per 100 abdominal pain contacts with children to a peak of 35 tests per 100 contacts with patients of 45–64 years. There was a slight decrease in ordering rates for older patients.

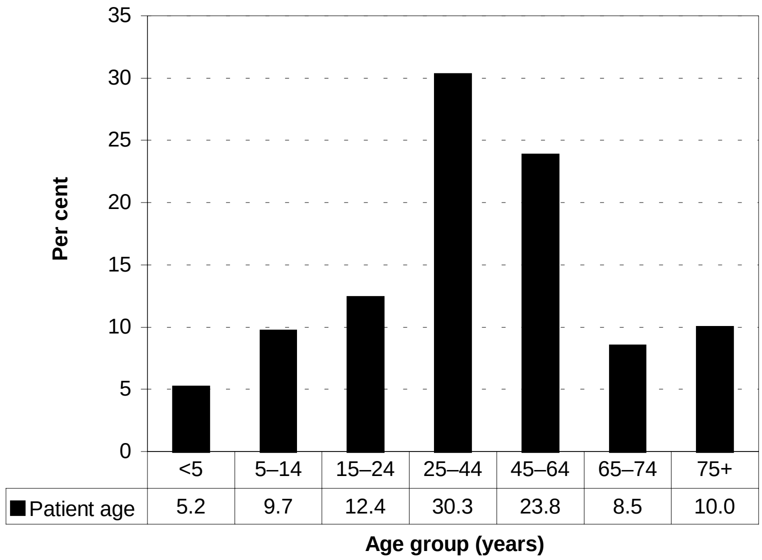


Figure 9.10: Age distribution of patient at abdominal pain encounters

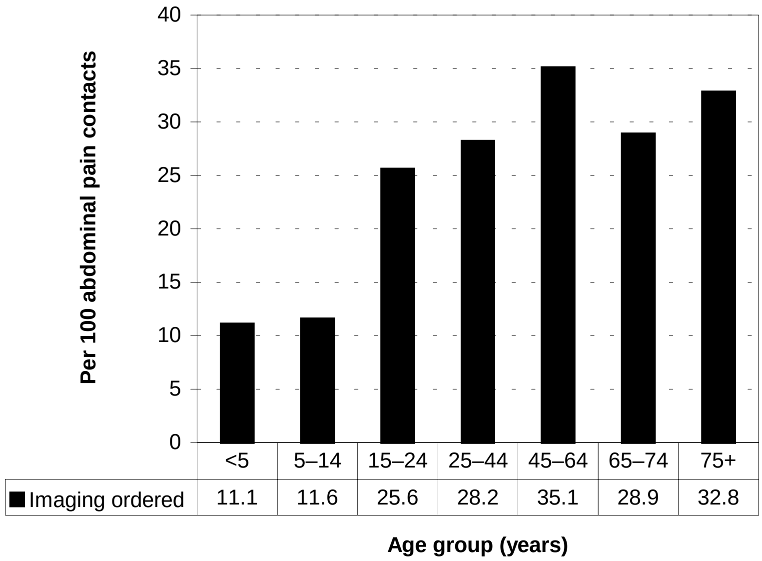


Figure 9.11: Age–specific imaging order rates for abdominal pain

Imaging tests ordered for the problem abdominal pain by MBS group

The test types ordered for the problem of abdominal pain differed markedly from the pattern in earlier subjects of interest. Ultrasounds accounted for over two-thirds (67.5%) of all imaging ordered for this problem, followed by diagnostic radiology which accounted for a further 25.1% of all imaging ordered (Table 9.13).

Table 9.13: Distribution of imaging tests ordered for abdominal pain by MBS group

Imaging class	Number of tests	Per cent of tests for abdominal pain
Diagnostic radiology	48	25.1
Ultrasound	129	67.5
Computed tomography	13	7.0
Other	1	0.5
Total	**192**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging order rates by problem status of abdominal pain

More than half (57.3%) of these abdominal pain contacts were follow-up encounters and 42.7% were new presentations. The test ordering rate was somewhat higher for new presentations (39.1 tests per 100 contacts) than at follow-ups (24.7 per 100) (Table 9.14). The distribution of test types ordered for abdominal pain was similar for new and old problems though there was a trend for increased use of ultrasounds and decreased use of plain x-rays at follow-up consultations when compared with first presentations (Table 9.15).

Table 9.14: Imaging order rates by status of abdominal pain

Problem status	Number of problem contacts[(a)]	Per cent of total problems	Number of imaging tests ordered	Imaging order rate per 100 problems
New abdominal pain* problems	265	42.7	104	39.1
Old abdominal pain* problems	355	57.3	88	24.7
Total	**620**	**100.0**	**192**	**31.0**

(a) The number of contacts with this problem in the total dataset.

* Includes multiple ICPC–2 and/or ICPC–2 PLUS codes (see Appendix 4).

Most common imaging tests ordered for abdominal pain

Ultrasound of the abdomen was the test most often ordered for abdominal pain, accounting for 36.0% of all tests. These could be considered in combination with orders for ultrasounds of the upper abdomen (8.0%) and, together, these two test types accounted for half of all tests ordered. This was followed by pelvic ultrasounds (13.2%) and plain abdominal x-rays (10.1%). Abdominal CT scan was the single test that accounted for almost all CT scans ordered for this problem.

Table 9.15: Most common imaging tests ordered for abdominal pain

Test type ordered	Number of tests	Per cent of tests for abdominal pain	Per cent of tests for new abdominal pain *(n=104)*	Per cent of tests for old abdominal pain *(n=88)*
Ultrasound; abdomen	69	36.0	33.9	38.6
Ultrasound; pelvis	25	13.2	11.0	15.8
X-ray; abdomen	19	10.1	12.3	7.6
Ultrasound; abdomen; upper	15	8.0	6.3	10.0
CT scan abdomen	12	6.5	4.3	9.0
Barium enema	8	4.1	4.6	3.4
Barium meal	5	2.6	1.9	3.5
Sub-total	*153*	*79.7*	*86.8*	*92.3*
Total	**192**	**100.0**	**100.0**	**100.0**

Note: Columns may not add to column total due to rounding.

Discussion

Both the RANZCR and the ACR guidelines advocate the use of ultrasound in elucidating the diagnosis in right upper and lower abdominal pain. Additional imaging is indicated when a negative examination is accompanied by high clinical suspicion. The common cause in left lower abdominal pain in older patients is diverticulitis and CT is the most discriminating investigation. In women of child-bearing age, gynaecological causes are the most common cause of left lower abdominal pain and ultrasound is the investigation of choice (Balfe et al. 2000; Bree et al. 2000; Ralls et al. 2000; RANZCR 2001).

The limited literature on ultrasound orders for abdominal pain by GPs indicates reasonable discrimination in ordering and high appreciation of the value of the test in patient management (Charlesworth & Sampson 1994; Geitung et al. 1998).

The results of this study indicate that an appropriate range of modalities appear to be used by Australian GPs.

9.6 Breast lump

The problem breast lump includes the following ICPC–2 and ICPC–2 PLUS codes and rubrics:

- X19—Breast lump/mass (*n*=178)
- Y16001—Mass; breast; male (*n*=12)
- Y16009—Gynaecomastia (*n*=17).

There were 207 contacts for breast lump and, for the majority of these contacts (85.9%), the patient was female. Females managed for a breast lump were far more likely to have imaging ordered (63.3% of breast lump contacts) than males (16.5%). More than half (56.8%) of all contacts with breast lump generated at least one imaging test order. There were a total of 163 tests ordered at a rate of 139 per 100 tested breast lump contacts (data not presented).

Age- and sex-specific imaging order rates for breast lumps

The patient was male at 2.4% of the breast lump contacts. Patients at encounters at which breast lump was managed were most often aged between 25 and 44 years (41.5%) or between 45 and 64 years (37.3%). Only about one in 10 of these patients was less than 25 years old, or over 64 years old (Figure 9.12). As shown in Figure 9.13, the relative rate of tests ordered for breast lump was highest for patients in the middle ages (60.3 to 65.9 per 100 contacts) and far lower for younger patients (27.2 per 100).

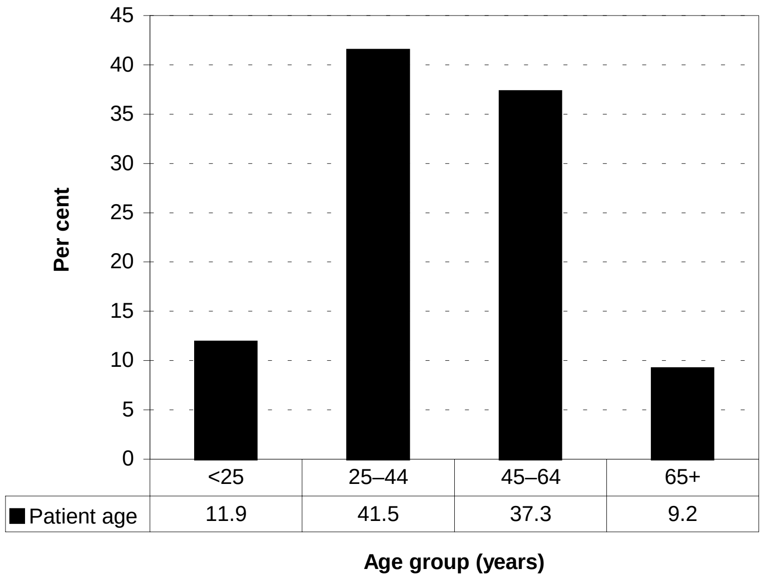


Figure 9.12: Age distribution of patient at breast lump encounters

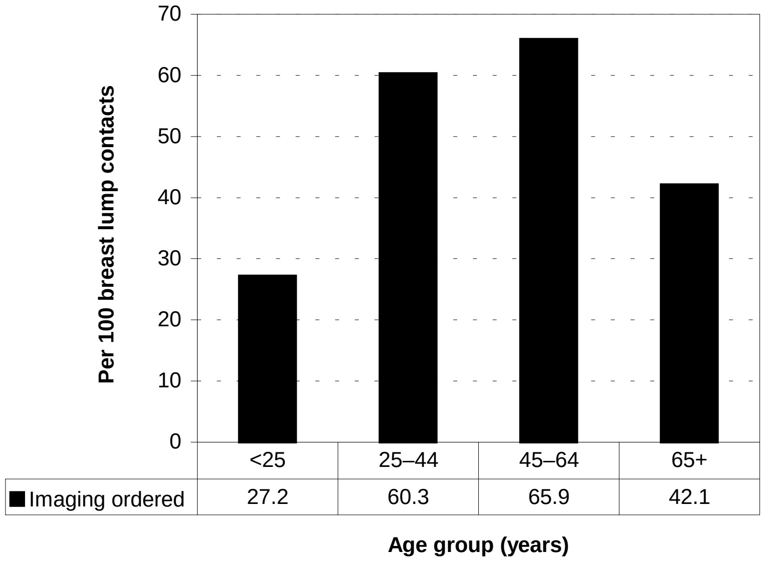


Figure 9.13: Age–specific imaging order rates for breast lump

Imaging tests ordered for breast lump

Approximately half the imaging tests ordered for breast lump were mammographies (51.4%) and half were ultrasound (48.6%) (Table 9.16).

As shown in Table 9.17, contacts with breast lumps were more commonly follow-up consultations (*n*=112, 54.1%). The imaging order rate was very high for all breast lump contacts (78.7 per 100 problem contacts) but particularly high at new presentations of this problem (92.6 per 100). The status of the problem had little influence on the choice of imaging test to be done although there was a trend for GPs to select mammography in the first instance (54.9% of tests for new presentations) and to select ultrasound (52.8% of tests ordered) at follow-up.

Table 9.16: Distribution of imaging tests ordered for breast lump

MBS Imaging class	Most common test type	Number of tests	Per cent of tests for breast lump
Diagnostic radiology:	Mammography	84	51.4
Ultrasound:	Ultrasound breast	79	48.6
Total		**163**	**100.0**

Table 9.17: Imaging order rates and type by problem status

Problem status	Number of problems	Number of tests	Imaging order rate	Mammographies per 100 contacts (*n*=84)	Breast ultrasounds per 100 contacts (*n*=79)
New cases of breast lump	95	88	92.6	50.5	36.8
Old cases of breast lump	112	75	66.5	35.7	35.7
Total	**207**	**163**	**78.7**	**92.6**	**70.0**

Table 9.18: Breast imaging for breast lump by problem status

	New problems (*n*=64)		Old problems (follow-up) (*n*=53)		Total problems	
Problem status	Number	Per cent of new problems	Number	Per cent of old problems	Number	Per cent
No imaging	31	32.6	**59**	**52.6**	**90**	**43.5**
Mammography only	24	25.3	14	12.5	38	18.4
Ultrasound only	16	16.8	17	15.2	33	15.9
Both mammography and ultrasound	24	25.3	22	19.6	46	22.2
Total (row per cent)	**95**	**45.9**	**112**	**54.1**	**207**	**100.0**

Note: Columns may not add to column total due to rounding.

However, Table 9.18 demonstrates that at almost one in four contacts with breast lumps the GP chose to order both a mammography and an ultrasound. At one in five, the mammography was ordered alone and in the remaining 15.9% the patient was sent for an ultrasound but not for a mammography. There was a very slight trend for GPs to rely only on mammography in new cases of breast lump and to order both tests at follow-up consultations for an old breast lump problem when deciding to test at follow-up.

Discussion

Overall imaging of the breast is discussed in detail in Section 8.2.

The imaging guidelines for the management of breast masses by both the American College of Radiology and the Royal Australian New Zealand College of Radiologists recommend the use of x-ray mammography for the primary diagnosis of breast masses and the use of ultrasound to differentiate between cysts and solid masses and to further define the nature of the mass (D'Orsi et al. 2000; Evans, III et al. 2000; RANZCR 2001).

In approximately 40% of problem contacts with breast lump both x-ray and ultrasound were ordered. There is a trend for this combination to be used more frequently in the assessment of previously managed breast lumps.

Assessment of breast lumps by Australian general practitioners appears consistent with these guidelines.

9.7 Shoulder syndrome

Shoulder syndrome includes most of the ICPC–2 PLUS terms classified in the ICPC–2 rubric L92—shoulder syndrome, with the exception of arthritis and osteoarthritis of the shoulder, which have been included in other groupings. The following ICPC–2 PLUS codes and terms therefore make up the shoulder syndrome group:

- L92001—Bursitis; shoulder (*n*=23)
- L92002—Fibrositis; shoulder (*n*=1)
- L92003—Rotator cuff syndrome (*n*=157)
- L92004—Shoulder syndrome (*n*=26)
- L92005—Synovitis; shoulder (*n*=1)
- L92008—Capsulitis; adhesive (*n*=10)
- L92009—Capsulitis; shoulder (*n*=41)
- L92010—Frozen shoulder (*n*=42)
- L92011—Humeroscapular periarthritis (*n*=1)
- L92012—Rheumatism; shoulder (*n*=2)
- L92013—Tendonitis; shoulder (*n*=104)
- L92014—Epicondylitis; shoulder (*n*=10)
- L92016—Tendonitis; supraspinatus (*n*=86).

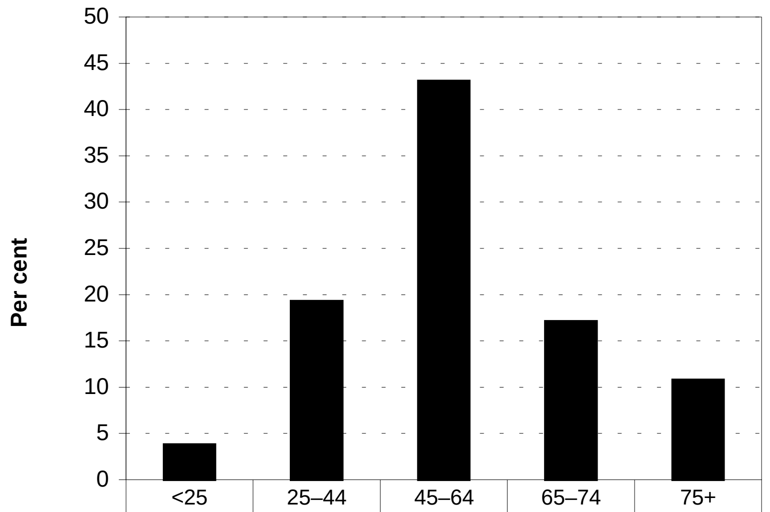
There were 504 contacts with shoulder syndrome and 122 of these (24.2%) generated at least one imaging order. In total, 155 imaging tests were ordered at a rate of 30.8 per 100 contacts with shoulder syndrome and a rate of 127 per 100 tested shoulder syndrome contacts. These tests represented 2.0% of all imaging tests ordered (Table 7.5).

Age- and sex-specific imaging order rates for shoulder syndrome

At about half (48.9%) of the 503 encounters at which shoulder syndrome was ordered, the patient was male. Imaging was ordered in the management of 23.4% of these male encounters and at 25% of female encounters with shoulder syndrome.

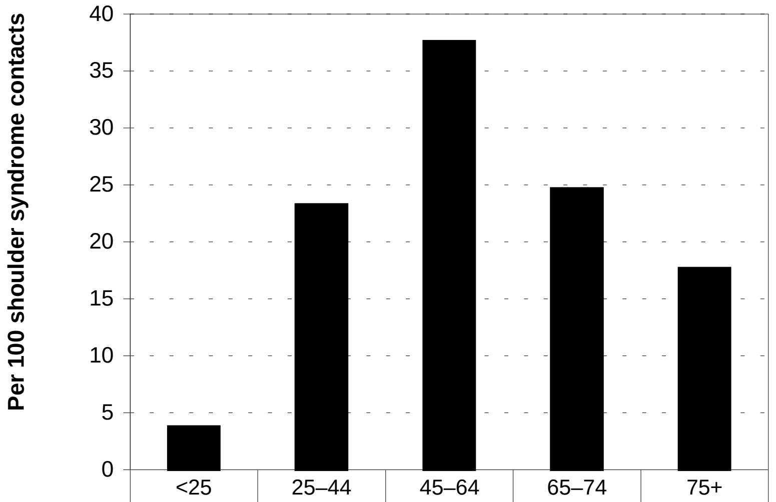
At almost half (43.1%) these encounters the patient was aged between 45 and 64 years. A further 19.3% were aged between 25 and 44 years and 27.9% were elderly (65+ years) (Figure 9.14).

As demonstrated in Figure 9.15, imaging orders associated with shoulder syndrome were most likely in the 45–64 years age range, where more than one-third (37.6%) of contacts generated such an order. In the 25–44 and 65–74 age groups, about one in four shoulder syndrome contacts resulted in an imaging order. The relative likelihood of ordering was less for those over 75 years and rare for young people.



	<25	25–44	45–64	65–74	75+
■ Patient age	3.8	19.3	43.1	17.1	10.8

Figure 9.14: Age distribution of patients at shoulder syndrome encounters



	<25	25–44	45–64	65–74	75+
■ Patient age	3.8	23.3	37.6	24.7	17.7

Figure 9.15: Age–specific imaging order rates for shoulder syndrome

Imaging tests ordered for shoulder syndrome by MBS group

Of the 155 imaging tests ordered for shoulder syndrome, about half (51.4%) fell into the MBS group diagnostic radiology and half (48.4%) into ultrasounds (Table 9.19).

Table 9.19: Distribution of imaging tests ordered for shoulder syndrome by MBS group

Imaging class	Number of tests	Per cent of tests for shoulder syndrome
Diagnostic radiology	75	48.4
Ultrasound	80	51.4
Computed tomography	1	0.1
Total	**155**	**100.0**

Note: Columns may not add to column total due to rounding.

Imaging order rates by problem status of shoulder syndrome

New cases/diagnoses of shoulder syndrome represented about one-third of the total, and these new presentations generated a far higher number of imaging test orders (50.3 per 100 encounters) than did follow-up consultations (19.4 per 100) (Table 9.20).

Table 9.20: Imaging order rates by problem status of shoulder syndrome

Problem status	Number of problem contacts[(a)]	Number of imaging tests ordered	Imaging order rate per 100 problems
New shoulder syndrome problems	186	93	50.3
Old shoulder syndrome problems	319	62	19.4
Total	**505**	**155**	**30.7**

(a) The number of contacts with this problem in the total dataset.

Most common imaging tests ordered for shoulder syndrome

The variance in tests selected for some of the earlier problems investigated was not apparent in the management of shoulder syndrome. Half the test orders were for an ultrasound of the shoulder and 44.0% were for a plain x-ray of the shoulder (Table 9.21).

Table 9.21: Most common imaging tests ordered for shoulder syndrome

Test type ordered	Number of tests	Per cent of tests for shoulder syndrome	Per cent of tests for new shoulder syndrome (*n*=93)	Per cent of imaging tests for old shoulder syndrome (*n*=62)
Ultrasound; shoulder	79	51.0	52.4	48.2
X-ray; shoulder	68	43.8	43.6	44.6
Sub-total	*147*	*94.8*	*96.0*	*92.8*
Total	**155**	**100.0**	**100**	**100**

Discussion

The RANZCR guidelines and some of the literature suggest that plain x-ray of the shoulder is the first investigation of choice in patients with shoulder pain (Peh 1998; RANZCR 2001). While plain x-ray accurately depicts bone damage following trauma, it does not provide accurate information regarding soft tissue injury (King & Healy 1999). On the other hand, ultrasound has a high predictive value for soft tissue injury, similar to that for MRI when both are judged against the 'gold standard' of arthroscopy (Swen et al. 1999; Teefey et al. 1999; Teefey et al. 2000). GPs in this study used both these modalities in the imaging of shoulder syndrome. They tended to select ultrasound more frequently. The test rate of 127 per 100 tested problem contacts indicates that ultrasound and x-ray are sometimes ordered together.

These data indicate broad compliance with the published guidelines for the selection of imaging modalities.

9.8 Headache

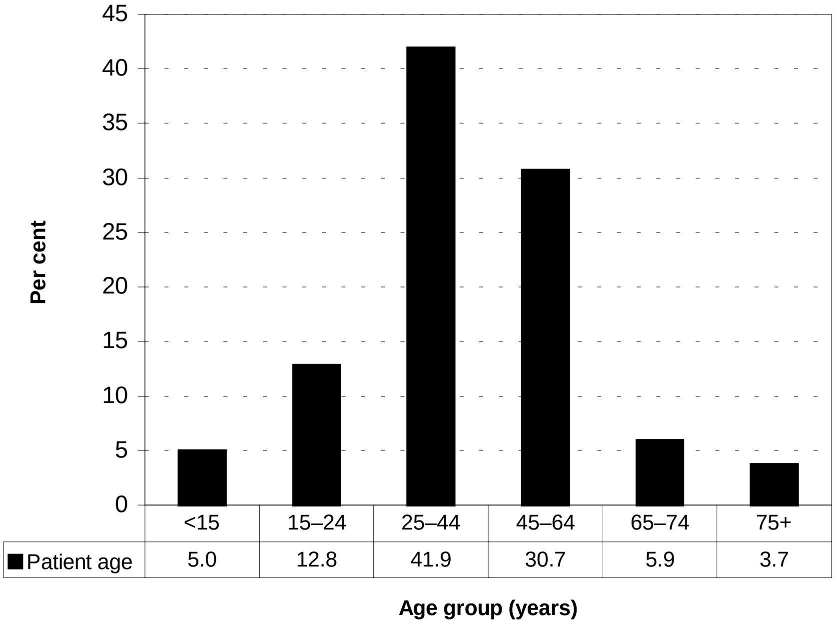
This problem label includes the following ICPC–2 codes:

- N01—Headache (*n*=480)
- N89—Migraine (*n*=917)
- N90—Cluster headache (*n*=20)
- N95—Tension headache (*n*=291).

There were 1,708 contacts with headache. A total of 103 imaging tests were ordered at 97 encounters, a rate of 106 per 100 tested headaches. The overall test rate was 6.0 imaging tests per 100 headache contacts (Table 7.5).

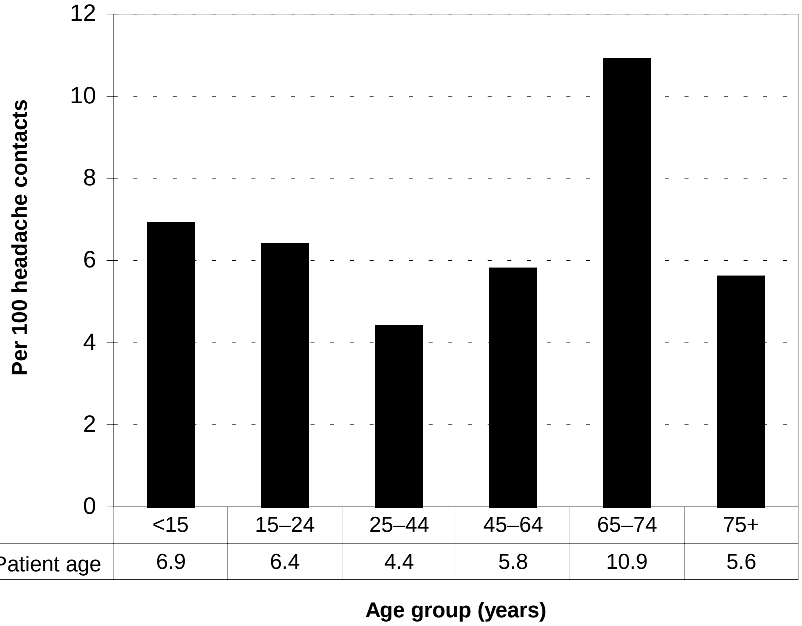
Age- and sex-specific imaging order rates for headache

More than two-thirds (70.4%) of patients for whom headache was managed at the encounter were female. The largest proportion were aged between 25 and 44 years (41.9%) with a further 30.7% being 45–64 years old. Together, these age groups accounted for over 70% of all patients seen for headache (Figure9.16). Imaging was most likely to be ordered for patients aged between 65 and 74 years (10.9 tests per 100 encounters) and least likely for those aged 25–44 years (4.4 per 100). In the remaining age groups, approximately six imaging tests were ordered per 100 contacts (Figure 9.17).



	<15	15–24	25–44	45–64	65–74	75+
Patient age	5.0	12.8	41.9	30.7	5.9	3.7

Figure 9.16: Age distribution of patients managed for headache



	<15	15–24	25–44	45–64	65–74	75+
Patient age	6.9	6.4	4.4	5.8	10.9	5.6

Figure 9.17: Age–specific imaging order rates for headache

Imaging tests ordered for headache by MBS group

Computed tomography accounted for 78.6% of all imaging tests ordered for headache. A further 14.6% of tests were diagnostic radiology and 6.8% were ultrasounds (Table 9.22). CT scans of the brain and the head were the most frequently ordered imaging tests, together making up three-quarters (74.6%) of all tests ordered (Table 9.23).

Table 9.22: Distribution of imaging tests ordered for headache by MBS group

Imaging class	Number of tests	Per cent of tests for headache
Diagnostic radiology	15	14.6
Ultrasound	7	6.8
Computed tomography	81	78.6
Total	**103**	**100.0**

Most common tests ordered by problem status of headache

The vast majority of headache contacts were follow-up consultations (*n*=1,276, 74.8%). The test ordering rate was higher for new problems (11.0 per 100 contacts) than for old (4.4 per 100). However, Table 9.23 demonstrates that orders for CT scans of the brain made up a somewhat larger proportion of the tests ordered for old cases of headache than for new presentations.

Table 9.23: Most common imaging tests ordered for headache

Test type ordered	Number of tests	Per cent of tests for headache	Per cent of tests for new headache (*n*=47)	Per cent of tests for old headache (*n*=56)
CT scan; brain	46	44.8	36.6	51.8
CT scan; head	31	29.8	32.7	27.3
X-ray; cervical	7	6.8	9.5	4.4
Sub-total	*84*	*81.6*	*78.8*	*83.5*
Total	**103**	**100.0**	**100**	**100**

Discussion

The well-researched Appropriateness Criteria on when to image a traumatic isolated headache, indicate that the yield of CT scans of the brain in these patients in the absence of neurological signs, altered mental state, nausea or vomiting, or other 'at risk' features such as HIV infection, is between 0.4 and 0.5% (Masdeu et al. 2000). Clinical discrimination by Family Physicians in the United States resulted in higher yields from a mixed group of patients (Becker et al. 1993a; Becker et al. 1993b). Imaging was ordered at the rate of 11 per 100 headache problem contacts, the large majority being CT scans. The guidelines suggest that for other than suspected intracranial bleeding, MRI is the modality of choice for investigating suspected underlying pathology. The previously mentioned lack of access by GPs to MRI may be causing substitution of a less satisfactory method.

The possibility of 'missed' sub-arachnoid haemorrhage needs to be placed in the perspective of the low incidence of this condition. If the United States' yearly incidence of 9 per 100,000 population (Masdeu et al. 2000) applies in Australia, and assuming all were seen in general practice rather than in emergency departments, only 13.5% of Australia's 23,000 GPs could expect to see a case in any one year. Many GPs will not see a case in their professional lifetime. The positive predictive value of a CT scan in this circumstance is virtually zero. The findings of a recent Dutch study challenge the concept of a 'warning leak' causing headache in patients who have a subsequent sub-arachnoid haemorrhage (Linn et al. 2000). The ACR criteria are possibly just as applicable for 'thunderclap' headache as for other headaches in the particular circumstances of general practice. An English study demonstrated the criteria have 100% sensitivity in an Emergency Department population.

9.9 Head injury

The ICPC–2 rubrics included in this group were:

- N79—Concussion (*n*=36)
- N80—Head injury, other (*n*=106).

There were 142 contacts with head injury and 22 of these (15.5%) generated an order for an imaging test. Only one test was ordered in each case (Table 7.5). CT scans were most common (16 of the 22), plain x-rays being few (3 of the 22) (Table 9.24).

Types of imaging tests ordered for head injuries

The order was placed as 'CT scan of the brain' in 12 of these cases and as 'CT scan of the head' in a further 4 cases.

Table 9.24: Most common imaging tests ordered for head injury

Test type ordered	Number of tests	Per cent of tests for head injury
CT scan; brain	12	54.5
CT scan; head	4	18.2
x-ray skull	3	13.6
Other	3	13.6
Total	**22**	**100.0**

Discussion

Head injuries present infrequently to general practitioners, only 142 contacts with patients with head injury occurred in the 1999–00 *BEACH* year. In 22 cases, imaging was ordered and in 16 cases the test ordered was a CT scan. Skull x-ray was ordered in only three cases. A literature review by Hofman et al. concluded that there was little value in the use of plain skull x-ray in mild head injury (Hofman et al. 2000).

The literature review for the ACR Appropriateness Criteria on Head Trauma supports the use of CT scanning as the modality of choice in most circumstances for head injury, a conclusion also supported in the RANZCR guidelines (Davis et al. 2000; RANZCR 2001).

Both these guidelines and those produced by the American Academy of Family Physicians and the American Academy of Paediatrics suggest that, on occasions, it may be appropriate to use CT scan to triage head injury in emergency departments and to use a negative CT scan as a substitute for observation in hospital.

While the numbers are small, the practice of Australian GPs appears consistent with established guidelines.

9.10 Leg pain and peripheral vascular disease

Leg pain

There were 79 contacts with undiagnosed leg pain (ICPC–2 PLUS code L14006) and 15 of these (18.9%) generated an imaging test order (Table 7.5). Only one test was ordered in each case. The majority of leg pain contacts (75.9%) were follow-up consultations. Test orders were less likely at these contacts (12.9 per 100) than at new presentations of leg pain (41.6 test orders per 100 contacts). Thirteen different imaging tests were ordered across the 15 problem contacts. No pattern of GP behaviour emerged in this small sample.

Peripheral vascular disease

This problem includes ICPC–2 PLUS codes

- K92003—Disease; peripheral vascular (*n*=170)
- K92017—Claudication; intermittent (*n*=36).

There were 206 occasions on which peripheral vascular disease was managed and these contacts generated only 23 imaging test orders (11.2 per 100 contacts). Where imaging was ordered, only one test was ordered in every case.

Age- and sex-specific imaging order rates for peripheral vascular disease

The patient was male at 63.9% of encounters in which peripheral vascular disease was managed. Only two patients were aged less than 45 years, with one in five being aged between 65 and 74 years and the majority (59.4%) being 75 years of age or older (Figure 9.18). Imaging test orders were most likely for patients of 75 years or more (12.9 per 100 encounters) than for those 65–74 years old (5.9 per 100) or the younger age group (7.9 per 100) (Figure 9.19).

Types of imaging tests ordered for PVD

Ultrasounds made up more than 80% of the tests ordered by GPs for peripheral vascular disease while almost all of the remaining tests ordered were classed as diagnostic radiology (Table 9.25). Doppler test orders accounted for 16 of the 19 ultrasounds ordered.

Discussion

The use of Doppler imaging in peripheral vascular disease was discussed in Section 8.7. Although the numbers are small, this analysis from a problem perspective supports the conclusion that the ordering pattern is consistent with established guidelines.

Table 9.25: Distribution of imaging tests for peripheral vascular disease by MBS group

Imaging class	Number of tests	Per cent of tests for PVD
Diagnostic radiology	3	13.3
Ultrasound	19	82.4
Computed tomography	1	4.4
Total	**23**	**100.0**

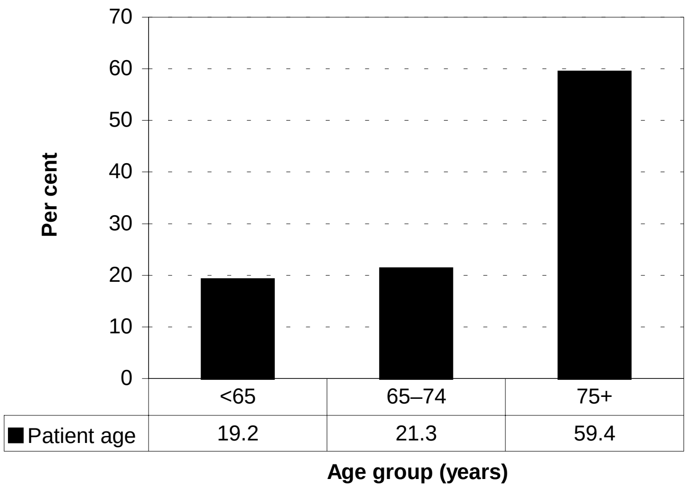


Figure 9.18: Age distribution of patients managed for peripheral vascular disease

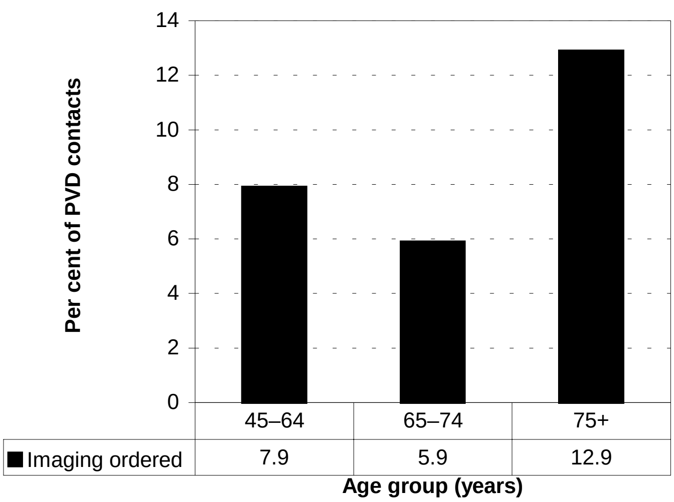


Figure 9.19: Age-specific imaging order rates for peripheral vascular disease

10 Discussion

This study is the first of its type in Australia and no comparable research was identified in the international literature. It provides the first insight into the imaging orders placed by GPs, into the variance in ordering between GPs and into the relationship of tests ordered to the GP and patient characteristics and morbidity under management. These ordering patterns have been evaluated in light of the literature. The extent to which the current guidelines for imaging testing are followed by practising GPs and the extent to which they may be useful to them in deciding on the most appropriate tests have also been examined.

At least one imaging order was initiated by the GP at 6.7% of all encounters, an increase of 17.5% (from 5.7% of encounters) in 1990–91 (Bridges-Webb et al. 1992). The 17.5% increase over the last decade in the proportion of encounters generating at least one imaging order suggests a national increase of about 2.2 million encounters, from 4.7 million per year in 1990–91, to 6.9 million encounters in 1999–00.

GPs currently order, on average, seven imaging tests per 100 GP–patient encounters, with a standard deviation of 4.9 and the majority order between three and 11 tests per 100. However, the wide variance in ordering rates among the GP participants is notable, the range being zero to 62 tests per 100 encounters. The literature review provided a basis on which to assess the appropriateness of these ordering rates for the quality care of patients. However, as demonstrated in Chapter 4, several outliers with very high ordering rates should raise some question of appropriateness in these few cases. It is, however, possible that these outliers have specialised practices dealing with problems requiring radiological investigation.

For most problems managed by GPs, no imaging tests are ordered. For the 4.7% of problems for which they are ordered, there are 113 tests ordered per 100 tested problems (Section 4.1). This indicates that in by far the majority of cases only one imaging test was ordered per problem. In Section 4.1 it was demonstrated that for almost 90% of tested problems only one test was ordered but that the remaining 10% of tested problems accounted for almost 20% of total orders. One of the major exceptions to the one-test order pattern was in the management of breast lumps where both mammography and ultrasound were ordered for nearly 40% of tested cases.

The extrapolated estimate of eight million test orders from general practice across Australia includes some orders for mammography, many of which would not be counted in the MBS data because they would go through BreastScreen Australia. The data suggest that GPs are playing an active role in encouraging their patients to attend BreastScreen even though there is free, unreferred access to this service. GP provision of a referral to BreastScreen may have a positive impact on patient attendance.

The Health Insurance Commission data suggest there were 7.6 million radiology tests claimed through the MBS in approximately the same year. Considering there are about 103 million GP–patient encounters across the country per year, this ordering rate does not seem excessive. However, the data considered in this report suggest there are some areas in which increased use of a specific test might improve the quality of care, and other areas in which a decrease in testing would be unlikely to affect quality of care.

The extent to which the HIC data (drawn from the Medical Benefits record of payment to radiologists for tests instigated by GPs) reflect the pattern of tests actually ordered by the GPs was tested in this study at a very broad level. The comparison demonstrated very similar patterns in terms of the distribution of tests across major MBS groups, with slightly higher proportions of diagnostic radiology and computed tomography in the *BEACH* data and slightly lower proportion of ultrasounds. The extent to which these small differences reflect radiologists' decisions to conduct a test not ordered by the GP is not known.

However, in both datasets, diagnostic radiology accounted for by far the greatest proportion of all imaging tests (64.8% in *BEACH* and 62.4% in the MBS), followed by ultrasounds (26.1% and 28.4% respectively) and computed tomography (8.7% and 7.8% respectively). The very few MRIs and nuclear medicine tests recorded by, the GPs in *BEACH* may reflect those few cases in which the patient was covered by workers' compensation or some other insurance payment source, or where the patient chose to pay all costs for these tests, for they are not covered by the MBS when ordered by a GP. It is unlikely that these came from procedural GPs for these were spread across almost as many practitioners as there were tests ordered.

The relationship between ordering rates and GP characteristics was investigated at three levels. Initial analysis concentrated on mean ordering rates for specific GP groups. This suggested that female GPs order imaging tests at a significantly higher rate than their male counterparts and that ordering rates increase with practice size. The GPs were then divided according to their ordering rate into three groups—low, medium and high orderers. Female GPs and those practising in small rural and remote areas were over-represented in the high ordering groups while solo practitioners were less likely to be classed as high ordering GPs. The gender difference is supported by Rosen's findings that, in an outpatient setting female doctors were 40% more likely to order imaging than their male counterparts (Rosen et al. 1997).

In the analysis of variance, the factors that were significantly associated with ordering level were identified. These were GP sex, rurality and size of practice, sex of patients, rates of new patients and number of health care card holders seen, management rates of specific groups of morbidity, and the relative rate of management of problems described in symptomatic or ill-defined terms.

The subsequent multivariate analysis used general linear modelling to identify the best independent predictors of imaging order rates. The results indicated a significant relationship between high imaging order rates and practice size of 11–15 GPs and between high ordering and small rural or remote practice location (earlier noted in the descriptive analysis). Higher rates of new patient presentations and of the management of musculoskeletal, urinary and female genital problems, together with those described in symptomatic terms, were also significant predictors of high ordering rates in general practice.

The number of health care card holders seen by the GPs, the number of patients aged 25 to 44 years and the management rate of psychological, skin and general problems had an inverse relationship with imaging order rates. Note that GP gender earlier had disappeared from the model, having been overtaken by the better predictive value of the variables listed above. This suggests that while differences do exist in test ordering rates of male and female GPs these differences are better explained by other factors associated with the GP's practice that weave in with gender, rather than the gender factor itself.

The finding of a relationship between solo practice and low ordering rates is contrary to that of Njalsson et al. who found that ordering rates decreased with increase in practice size in Iceland (Njalsson et al. 1995). However, the Njalson study also revealed higher ordering rates in rural areas where clinicians often performed their own imaging within the practice. The higher ordering rates in rural areas of Australia demonstrated in the current study are likely to result from a combination of some rural GPs performing their own x-rays and GPs going through more detailed investigation prior to referral where access to specialists is poor.

These results suggest that the GPs most likely to be high orderers of imaging are those who practise in small rural and remote areas and those in large practices of 11–15 GPs, particularly those who see large numbers of new patients not holding a health care card and who manage large numbers of the problems of the type listed above. Together with Njalson's findings, these indicate that if corporatisation results in increased co-ownership of imaging facilities and general practices, higher imaging order rates could be expected in the future. In a situation of capped radiology rebates this may affect the distribution of available revenue among radiologists. Health planners need to keep this in mind in the development of future policy.

The finding of a relationship between the rate of problems that are described in symptomatic terms and the rate of imaging orders is supported by Klinkman, who found a higher level of general practice resource utilisation associated with diagnostic uncertainty or non-specific diagnosis in patients with abdominal pain in a United States family practice (Klinkman 1996, 75). This suggests that in many cases GPs rely on imaging together with other secondary services to assist them in reaching a diagnosis.

When imaging was ordered by the GP there were far less medications prescribed but significantly more therapeutic procedures undertaken, pathology tests ordered and referrals made to specialists. Secondary costs associated with imaging encounters would clearly be considerably higher than those of non-imaging encounters, above and beyond the cost of the imaging test itself. These results also align with Klinkman's findings (Klinkman 1996).

The extent to which GPs use imaging to assist in the diagnostic process was considered in respect of each specific morbidity group investigated in Chapter 8. The problem under management and its status to the patients were used to define whether the test was investigative in nature, used to assist management decisions or used to monitor the care of the patients. The differences in extent to which each test type reflected investigation rather than the other modes varied considerably. Whereas 60% of breast ultrasounds and 51% of non-obstetric pelvic imaging were investigative in nature as defined in this report, only 16% of ultrasounds of the shoulder were classed in this group.

The patients at encounters generating imaging orders differed from those attending non-imaging encounters only in their age distribution, there being a significantly higher proportion aged between 25 and 44 years and a significantly lower proportion of children. However, the multivariate investigation of the relationship between various GP characteristics, patient characteristics and morbidity managed to the number of imaging orders demonstrated an inverse relationship between ordering rates and the number of 25–44 year old patients seen during the recording period, after adjustment for the other factors in the model, including morbidity patterns. This suggests that when these younger adults do attend the GP they are more likely to be managed for musculoskeletal, psychological, skin, urinary and female genital problems but that when these problems are managed they are less likely to have imaging ordered than people in other age groups who have such problems.

While the proportion of health care card holding status of patients did not differ at imaging and non-imaging encounters, the multivariate analysis demonstrated an inverse relationship between the number of patients seen who held a health care card and the GP imaging order rate. That is, high imaging ordering rates were less likely the more health care cardholders the GP saw, probably due to the nature of the health problems of the population holding a health care card.

The literature review reported in this document demonstrated that, as with pathology, there is a great deficiency of high-quality research into the value of imaging, particularly in the general practice setting. Further, meta-analysis of the benefit of imaging tests is virtually non-existent. The currently available guidelines have been developed using a combination of the little available evidence and consensus of radiologists with an apparent lack of general practice input. There is little research into patient outcomes with or without the use of imaging. The little that is available is either based on the technical side of imaging or on patient selection. The latter work attempts to build predictive models of sensitivity and specificity of test results to give guidance on the selection of patients for whom the test should be undertaken. However, the majority of this research has been conducted either in hospitals or emergency settings with a different population base to that found in general practice. Revicki's suggestion that there is a need for focused assessment and guideline development on specific diseases or diagnostic problems rather than on the use of specific tests (Revicki et al. 1999) should be heeded.

While guidelines have successfully been developed in other areas, particularly in the area of therapeutic interventions, in light of the paucity of outcome-based research in the area of imaging tests, it is far harder to link the outcome of diagnostic investigation with patient outcome.

Two sets of guidelines have been used extensively in this report, those developed by the American College of Radiology (ACR) and the recently released revised edition of the RANZCR guidelines. Neither set of guidelines assist the clinician in deciding when not to use imaging. Rather they aim to assist the clinician in the selection of patients who should have imaging undertaken and/or guide in the selection of the appropriate imaging to be ordered in certain circumstances.

The ACR criteria are published with a well-summarised literature review that allows assessment of the evidence used in the preparation of the criteria. In common with other literature on diagnostic testing, little of the evidence has been gathered in general/family practice where the circumstance of low prevalence makes the predictive value of tests much lower. The extent to which such guidelines are 'portable' to general practice in Australia is therefore open to question. In the absence of better evidence, however, the ACR criteria probably represent the state-of-the-art advice on appropriateness of diagnostic imaging tests for the conditions that they cover.

The ACR guidelines are based on a mixture of consensus and scientific evidence. The philosophy of evidence-based practice is well supported by inclusion of a well-constructed literature review and references for each of the guidelines. They attempt to address the deficiencies in evidence by at least presenting the evidence that is available in a readable format. They then present a series of scenarios for each guideline and these are likely to be very effective as a learning tool. They also include flags, which aid the clinician in patient selection for a specific course of action. This is supported by a scoring system that allows the reader to weigh up alternative approaches in each individual circumstance.

The RANZC guidelines use an algorithm approach to illustrate the diagnostic choices in a wide range of circumstances. Some of the algorithms are supported with a brief list of references. Reference to the American College of Radiology Appropriateness Criteria and its more comprehensive literature reviews is not uncommon. In an era where GPs are being encouraged to learn and apply critical review techniques it would seem more appropriate to include the evidence rather than references only. For example, in imaging of the shoulder, selection of the patient is just as important as selection of modality and in this area both the ACR and RANZCR guidelines are quite good. However, in other areas, such as x-ray of ankle injuries, the ACR guidelines rely heavily on the Ottowa rules to guide in the selection of patients for whom imaging is appropriate. In contrast, the RANZCR guidelines choose to ignore these rules.

Unlike the ACR criteria, no quantification of 'appropriateness' is provided to allow clinicians to consider the weighted alternatives. Instead, they provide simple branching algorithms to guide decision-making. Unfortunately, without the evidence and without the scoring system, the clinician is left with little to allow thoughtful discriminatory decision-making between alternative options for an individual patient. An example of this is in the investigation of back pain with radiculopathy where the ARC guidelines suggest that an MRI is the best choice. However, Medicare does not cover MRIs ordered directly by GPs. The ARC guidelines demonstrate that while the MRI is the preferred option (with a score of 8) the use of CTs is still acceptable with a score of 6. This information is extremely valuable. If the CT had received a score of zero for the investigation of this problem, the balance of choice for the GP would be completely different and the selection of the CT totally inappropriate.

This study suggests that the next revision of the RANZCR guidelines could benefit from the inclusion of evidence for each guideline. Consideration should also be given to the development of a scoring system similar to that used in the ACR Appropriateness Criteria. However, care must be taken to ensure that any advice to GPs is in line with the system limitations placed on GP ordering. Currently, the guidelines appear to have little input from general practitioners, yet they are the end users of the product. Inclusion of GPs on the editorial panel in future could be of benefit in the development of the most usable set of guidelines. Future revisions should also consider the need for more focused attention on specific diseases or diagnostic problems and guideline development rather than on the use of specific tests.

The evidence on which to judge the appropriateness of GP ordering behaviour and the impact of supplying imaging guidelines to GPs is scanty and equivocal. There was no published literature on the effect of the release of the earlier editions of the Australian guidelines on the ordering behaviours of GPs, but general conclusions regarding the effect of imaging guidelines can be drawn from research on those used in the United States, the United Kingdom and Canada. It would appear from some studies that the introduction of guidelines can effect a decrease in selected undesirable ordering behaviours. Other research suggests that guidelines alone are ineffective in changing behaviour and that guidelines need to be combined with feedback of individual behaviour in order to be effective. Other studies suggest that such interventions cannot overrule the important influence of patient expectations on GP behaviour.

If guidelines were to be combined with GP feedback about their ordering behaviour in an attempt to affect ordering patterns, the use of the HIC radiology data for feedback would be likely to have little impact. The current report and review of the guidelines demonstrate the importance of the relationship between morbidity and ordering.

Overall rates of ordering for all tests, or for a selected imaging test, fail to consider the age of patients being seen and their morbidity patterns—both factors which have been shown to have a strong predictive relationship to the level of testing undertaken by an individual GP.

More research needs to be undertaken into the impact of guidelines on performance, prior to any large investment in decision support systems in this area. There is a lack of evidence that their introduction will have any more impact on imaging ordering than currently available guidelines. Further, linking quality improvement in diagnostic imaging with more general quality improvement initiatives may be productive. The 'Building on Quality' project currently being undertaken by a consortium of six Divisions of General Practice with funding from the DHAC is an example of such initiatives.

In the majority of areas investigated, GPs appear to be ordering imaging in a manner that is consistent with the available guidelines. These include the ordering of chest x-rays, mammographies, breast ultrasounds and Dopplers, imaging of the kidney, imaging undertaken for abdominal pain, assessment of breast lumps, imaging of the shoulder, and management of head injuries. However, in some areas a lack of guidelines makes it difficult to assess the appropriateness of GP ordering behaviour. Consideration should be given to the development of guidelines in some problem groups where there are no guidelines currently available, such as osteoarthritis.

There are some areas investigated in this report in which there are systemic blocks to improvement in performance.

Echocardiography is the most sensitive, specific and accurate test for patients with cardio-respiratory symptoms, yet heart failure was ranked seventh in the morbidity associated with orders for plain chest x-ray. The literature clearly demonstrates that the rate of echocardiography in patients with congestive cardiac failure is well below optimum levels. There were 308,000 echocardiograms claimed against Medicare in 1999–00. This equates to a total of 16 tests per 1,000 population per year. A study in the United Kingdom suggests the appropriate level should be about 22 per 1,000. From the *BEACH* dataset in that year, the extrapolated estimate for the total echocardiograms ordered by GPs for congestive heart failure was 47,000. The remainder of the 308,000 tests would presumably have been ordered by cardiologists. Krum suggests that about 30% of patients with congestive cardiac failure managed in general practice in Australia have had an echocardiogram (Krum et al. 2001). Together, these data suggest that the quality of care provided to general practice patients could be improved with increased use of echocardiography.

GP access to echocardiography in Australia is usually through cardiologists' rooms. Krum suggests that a combination of access, the cost of the test to Medicare and a lack of knowledge about the test and its interpretation lead GPs to avoid echocardiography and rely on chest x-rays. These factors may limit application of the recently published National Heart Foundation – Cardiac Society guidelines (Krum 2001).

Mair demonstrated that the importance of early diagnoses and treatment of congestive heart failure is not fully appreciated by GPs (Mair et al. 1996). There may be insufficient education in selection of diagnostic interventions at both the undergraduate and postgraduate levels of medical training. Improved training of GPs in the early detection and treatment and the interpretation of echocardiographs may be of benefit. A greater understanding of the balance of costs between echocardiography and that of hospitalisation resulting from late diagnosis of the disease may also assist in improving the testing of congestive cardiac failure. Khunti et al. are currently conducting a randomised control trial of the cost-effectiveness of use of guidelines in improving the use of echocardiography in general practice (Khunti et al. 2000). Their results should be watched with interest.

The system limitations of the Australian health care system must also always be considered in the development of guidelines. For example, in several topics investigated in this report (e.g. suspected soft tissue injury of the shoulder and back problems) the guidelines and/or the literature suggested MRI was the appropriate modality. However, within the Australian health care system, the GP must refer to a specialist in order for MRI to be rebatable under the MBS. This blocking of direct access to MRIs means that the GP who does not feel a specialist referral to be appropriate at this stage is limited to investigations less appropriate than the MRI.

A further example is GP ordering of CT scans in the investigation of headache and head injury where a neurological cause is suspected. Both the ACR and RANZCR guidelines suggest that where vertebrobasilar problems are involved, MR angiography is the modality of choice. Since MRIs are barred to the GP, the use of CT scans is probably an appropriate substitution according to the guidelines, though only in situations where MR imaging is unavailable or inaccessible.

In the United Kingdom, studies of direct access by GPs to MRI studies have demonstrated generally appropriate use of this form of imaging (Apthorp et al. 1998; Chawda et al. 1997; Robling et al. 1998). We therefore conclude that removal of the system block for direct GP ordering of MRI, MR angiography and echocardiography should be considered for selected problems.

There are three areas in which the results of this study suggest that a decrease in imaging orders could be possible without having a negative impact on quality of care. The current level of 41.9 knee x-rays per 100 problem contacts for sprain/strain of the knee, while well below North American Emergency Department levels, could probably be significantly reduced. In the investigation of knee injury, plain x-rays have the lowest yield for diagnosing clinical significant fractures. The ACR Appropriateness Criteria for acute trauma to the knee synthesise the research into the use of decision rules for knee imaging (Stiell et al. 1995c). Introduction of these criteria in Australia has the potential to significantly reduce orders for knee radiology without losing sensitivity of fracture detection.

The evidence suggests that spinal x-ray is contraindicated within 14 days of onset of uncomplicated back pain with or without radiation. There is no scientific evidence to support the use of x-ray short of seven weeks from onset and even then the return was poor (Quebec Task Force on Spinal Disorders 1987). The guidelines all support the proposition that uncomplicated low back pain without 'red flags' will settle within 6–12 weeks in 90% of cases without investigation and with little more than supportive therapy (Agency for Health Care Policy and Research 1994; Anderson et al. 2000; RANZCR 2001). In this study, GPs ordered spinal imaging at the rate of 28.7 per 100 new back pain problems seen and 13.2 per 100 old back problems. While some of the patients with new back problems may have had symptoms for some time before presentation, these data suggest that an appropriate intervention could reduce the spine x-ray rate without decreasing the quality of patient care.

In this study GPs ordered imaging at a rate of 44.8 per 100 problems labelled as fractured ankle and at the rate of 37.7 per 100 problems labelled as ankle sprain/strain. In the case of ankle injury, the well-validated Ottawa decision rules for imaging adopted by the ACR as appropriate guidelines for the diagnosis of fracture. The RANZCR guidelines do not provide any guidance on the selection of patients for x-ray for suspected fracture of the ankle. Providing GPs in Australia with the Ottawa guidelines has the potential to decrease the x-ray level in this area.

This study has provided new insight into the relationship between GP characteristics and ordering behaviour, and between orders for specific imaging test types, the patients for whom the orders were placed and the problems under investigation. It has demonstrated that in the majority of areas GP ordering behaviour follows the available guidelines. However, it has also highlighted some areas in which improvement would be desirable in both the guidelines and in GP test selection.

This report provides a baseline against which future practice can be compared so that changes over time in imaging order behaviour can be documented. It further provides a pre-measure of ordering patterns on which to test the impact of the new RANZCR guidelines on ordering behaviour of general practitioners in the future.

11 Conclusion

This is the first study of its type in Australia and a review of the literature suggests it is possibly the first in the world. It has provided an overview of the extent to which GPs order imaging and the relationship between characteristics of the GPs, their patients and the morbidity under management, to the rates of orders placed. It has demonstrated that the best predictors of high rates of ordering are the number of new problems presented to the GP, the size of the practice, the geographic location of the practice and the type of morbidity managed. However, other influences on ordering rates are apparent, including the gender of the GP and the State/Territory of the practice. In turn, this has allowed an evaluation of the guidelines currently available to GPs on this subject, in light of the results and the broader literature.

The study suggests that the next revision of the RANZCR guidelines could benefit from the inclusion of evidence for each guideline. Consideration should also be given to the development of a scoring system similar to that used in the ACR Appropriateness Criteria. However, care must be taken to ensure that any advice to GPs is in line with the systemic limitations placed on GP ordering. Revision should also consider the need for more focused attention on specific diseases or diagnostic problems and guideline development rather than on the use of specific tests. The absence of guidelines in some diseases commonly managed in general practice (such as osteoarthritis) should also be addressed.

Currently, the guidelines appear to have little input from general practice, yet they are the end users of the product. Inclusion of GPs on the editorial panel in future could be of benefit in the development of the most usable set of guidelines.

Further research also needs to be undertaken into the impact of guidelines on performance, prior to larger investment in decision support systems in this area. Linking quality improvement in diagnostic imaging with more general quality improvement initiatives may be productive. The 'Building on Quality' project currently being undertaken by a consortium of six Divisions of General Practice with funding from the DHAC is an example of such initiatives.

The results indicate that in the majority of areas of investigated performance GPs are ordering imaging in a manner which is consistent with the available guidelines. These areas include the use of chest x-rays, mammographies, breast ultrasounds and Dopplers, and their selection of tests to be undertaken for abdominal pain, the assessment of breast lumps, imaging of the shoulder, and in the management of head injuries

However, there are some areas where a reduction in ordering of specific imaging types would be unlikely to have a negative impact on the quality of care. These include the ordering of spinal x-rays and x-rays of the ankle. A decrease in ordering of imaging of the knee might also be accomplished by distribution to GPs of the ACR Appropriateness criteria for the use of knee radiology.

There are some areas in which there are systemic blocks to improving performance and these include the system block on GP ordering of MRIs and MRAs and echocardiography. These blocks sometimes lead the GP to order a less suitable investigation. In light of overseas research which indicates satisfactory selectivity by GPs in the use of such tests when given the freedom to order them, consideration should be given to removing these blocks to GPs either fully, or for selected problems under investigation.

The possible need for further education of GPs about echocargiography tests and interpretation of the results, should also be considered.

Health planners and policy makers should note the apparent relationship between practice size and ordering rates and should consider the overseas research findings of a relationship between ownership of radiology facilities and ordering rates. It could be postulated that if corporatisation of general practice leads to increases in both the number of large practices and in co-ownership of imaging facilities and general practices, imaging order rates might be expected to rise in the future. In a situation of capped radiology rebates, this may distort the distribution of available revenue among radiologists.

This study has provided new insight into the relationship between GP characteristics and ordering behaviour, and between orders for specific imaging test types, the patients for whom the orders were placed and the problems under investigation. It has demonstrated that GP ordering behaviour follows the available guidelines in the majority of areas. However, it has also served to highlight some areas in which improvement would be desirable in both the guidelines themselves and in GP test selection.

This report provides a baseline against which future practice can be compared and a means by which the impact of the new RANZCR guidelines, recently distributed to all GPs in Australia, can be tested in the future.

12 Current status of *BEACH* and access to data

The *BEACH* program is now early in its fourth year. The database for the first three years includes data pertaining to approximately 300,000 GP–patient encounters from more than 3,000 GPs. This report provides one example of the use of the database for secondary analyses of a selected topic or for a specific research question. Each year the GPSCU publishes an annual report of *BEACH* results through the Australian Institute of Health and Welfare in which the results from the previous *BEACH* data year are reported on a national basis for the more common events.

However, the full database also allows investigation of less frequent events or study of selected populations or geographic locations. Those interested in encounters at which the patient is referred to an emergency department would find that while such referrals only occur at a rate of 1 per 1,000 encounters, there would be approximately 250 cases in the current database. This would be sufficient to provide an overview of the types of patients and the pattern of problems referred to an emergency department. The same concept applies to those morbidities that are relatively rare and to medications prescribed on an infrequent basis.

Others who are interested in the health of the population at a State or Territory level will find sufficient sample size already available for the more populated States to allow state based reporting. For example, there are approximately 100,000 encounter records available for New South Wales to date.

12.1 Public domain

In line with standard Australian Institute of Health and Welfare practice, an annual publication will provide a comprehensive view of general practice activity in Australia.

Abstracts of results for sub-studies conducted in the second year of the program and not reported in earlier documents are available through the web site of the Family Medicine Research Centre (of which the GPSCU is a part) at http://www.fmrc.org.au. These include: patient employment status and occupation; prevalence, severity and management of asthma; influenza and absenteeism; chronicity; length of consultation; co-morbidity not managed; point prevalence and management of depression; prevalence and management of cardiovascular disease; passive smoking; prevalence of anxiety-stress; education and employment status; self perceived stress levels among patients.

12.2 Participating organisations

Organisations providing funding for the *BEACH* program receive summary reports of the encounter data quarterly and standard reports about their subjects of interest. Analysis of the data is a complex task. The General Practice Statistics and Classification Unit has therefore designed standard report formats that cover most aspects of the subject under investigation. Individual data analyses are conducted where the specific research question is not adequately answered through standard reports.

12.3 External purchasers of standard reports

Non-contributing organisations may purchase standard reports or other ad hoc analyses. Charges are available on request. The General Practice Statistics and Classification Unit should be contacted for further information. Contact details are provided at the front of this publication.

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Glossary

A1 Medicare items: Medicare item numbers 1–51, 601, 602

Aboriginal: The patient identifies himself or herself as an Aboriginal person.

Activity level: The number of general practice A1 Medicare items claimed during the previous three months by a participating GP**.**

Allied health services: Those who provide clinical and other specialised services in the management of patients, including physiotherapists, occupational therapists, dieticians and pharmacists.

Care process: Each imaging test order was classified into one of four groups depending on the status of the problem to the patient and the level of diagnostic specificity inherent in the label assigned by the GP to the problem associated with the test order. Four care processes were designated for imaging tests ordered:

- *Investigative imaging.* Tests ordered to assist in the diagnostic process: included all imaging ordered for problems that fell in ICPC–2 Component 1 (Symptoms and complaints) irrespective of problem status.
- *Management imaging.* Tests ordered to assist in decisions about to how best to manage the problem that had already been defined in diagnostic terms by the clinician: included all imaging ordered for problems in ICPC–2 Component 7 (Diagnosis/disease) that were new to the patient.
- *Monitoring imaging.* Tests ordered to monitor a patient in the ongoing care of a defined problem: included all imaging orders for problems in Component 7 (Diagnosis/Disease) at follow-up encounters for that problem.
- *Undefined imaging.* Included all imaging ordered for problems in Components 2-6 (process codes) irrespective of the status of the problem to the patient

Chapters (ICPC–2): The main divisions within ICPC–2 PLUS; there are 17 chapters primarily representing the body systems.

Complaint: A symptom or disorder expressed by the patient when seeking care.

Component (ICPC–2): In ICPC–PLUS there are seven components which act as a second axis across all chapters.

Consultation: See *Encounter (enc.).*

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

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

Encounter (enc.): Any professional interchange between a patient and a GP.

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

Direct encounters can be further divided into:

(a) Medicare-claimable

– A1 items of service: MBS item numbers 1–51, 601, 602

– *surgery consultations:* encounters identified by any one of MBS item numbers 3, 23, 36, 44

– *home visits:* encounters identified by any one of MBS item numbers 4, 24, 37, 47

– *hospital encounters:* encounters identified by any one of MBS item numbers 19, 33, 40, 50

– *nursing home visits:* encounters identified by any one of MBS item numbers 20, 35, 43, 51

– *other institutional visits:* encounters identified by any one of MBS item numbers 13, 25, 38, 40

– *other MBS encounters:* encounters identified by an MBS item number that does not identify place of encounter

(b) Workers' compensation: encounters paid by workers' compensation insurance

(c) Other paid: encounters paid from another source (e.g. State).

General practitioner (GP): 'A medical practitioner who provides primary comprehensive and continuing care to patients and their families within the community' (Royal Australian College of General Practitioners).

ICPC–2: The International Classification of Primary Care (Version 2).

ICPC–2 PLUS: An extended vocabulary of terms classified according to the ICPC–2.

Medication: Medication that is prescribed, advised for over-the-counter purchase or provided by the GP at the encounter.

Metropolitan stratum: See *Strata*

Morbidity: Any departure, subjective or objective, from a state of physiological well-being. In this sense, sickness, illness and morbid conditions are synonymous.

Patient status: The status of the patient to the practice

- *new patient:* The patient has not been seen before in the practice.
- *old patient:* The patient has attended the practice before.

Problem managed: See *Diagnosis/problem*

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

Reasons for encounter (RFEs): The subjective reasons given by the patient for seeing or contacting the general practitioner. These can be expressed in terms of symptoms, diagnoses or the need for a service.

Recognised GP: A medical practitioner who is:

- vocationally recognised under Section 3F of the *Health Insurance Act*, ***or***
- a holder of the Fellowship of the Royal Australian College of General Practitioners who participates in, and meets the requirements for, quality assurance and continuing medical education as defined in the Royal Australian College of General Practitioners' (RACGP) Quality Assurance and Continuing Medical Education Program, ***or***
- undertaking an approved placement in general practice as part of a training program for general practice leading to the award of the Fellowship of the Royal Australian College of General Practitioners or undertaking an approved placement in general practice as part of some other training program recognised by the RACGP as being of equivalent standard. (Medicare Benefits Schedule book, 1 November 1998).

Referral: The process by which the responsibility for part or all of the care of a patient is temporarily transferred to another health care provider. Only new referrals to specialists, allied health professionals, and for hospital and nursing home admissions arising at a recorded encounter are included. Continuation referrals are not included. Multiple referrals can be recorded at any one encounter.

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

Rural strata: See *Strata.*

Strata: Categories created for this report by grouping RRMA categories.

- *Metropolitan stratum:* A grouping of RRMA categories 1 and 2.
- *Large rural stratum:* A grouping of RRMA categories 3 and 6.
- *Small rural stratum*: A grouping of RRMA categories 4, 5 and 7.

Torres Strait Islander: The patient identifies himself or herself as a Torres Strait Islander.

Abbreviations

ACR	American College of Radiology
BEACH	Bettering the Evaluation and Care of Health, a national survey of GP activity
CAPS	Coding Atlas for Pharmaceutical Substances
CI	Confidence interval (in this report 95% CIs are reported)
CT	Computed tomography
DHAC	Commonwealth Department of Health and Aged Care
enc(s)	Encounter(s)
FMRC	Family Medicine Research Centre, University of Sydney
GP	General practitioner
GPSCU	AIHW General Practice Statistics and Classification Unit, University of Sydney
HIC	Health Insurance Commission
HMO	Health maintenance organisations
ICPC–2	International Classification of Primary Care (Version 2)
IVP	Intravenous pyelograms
LCL	Lower confidence limit (in this report the 95% LCL is used)
MBS	Medicare Benefits Schedule
MRI	Magnetic resonance imaging
MR	Magnetic resonance
NEC	Not elsewhere classified
NSAIDS	Non-steroidal anti-inflammatory drugs
NOS	Not otherwise stated
RACGP	Royal Australian College of General Practitioners
RANZCR	Royal Australian and New Zealand College of Radiologists
RCR	Royal College of Radiologists
RFE(s)	Patient reason(s) for encounter
RRMA	Rural, Remote and Metropolitan Area classification
RSE	Relative standard error
SRS	Simple random sample
STD	Sexually transmitted disease
UCL	Upper confidence limit (in this report the 95% UCL is used)
WONCA	World Organization of Family Doctors

Appendix 1: Example of a *BEACH* encounter recording form 1999–00

BEACH (Bettering the Evaluation And Care of Health) - Morbidity and Treatment Survey - National

DOCID

Encounter Number

Date of encounter	Date of Birth	Sex	Patient Postcode
___/___/___	___/___/___	M ☐ F ☐	

Patient Reasons for Encounter	
	1.
	2.
	3.

New patient..................... ☐
Health Care Card holder.. ☐
NESB............................. ☐
Aboriginal....................... ☐
Torres Strait Islander....... ☐
Veterans Affairs Card
White card............ ☐
Gold card.............. ☐

PATIENT SEEN
Item No
MBS/Vet.Affairs
VA paid.............................. ☐
Workers comp paid............. ☐
State/Other paid.................. ☐
No charge/Unpaid.............. ☐

PATIENT NOT SEEN
Script................. ☐
Referral............... ☐
Certificate........... ☐
Other.................. ☐

1. Diagnosis/problem	**New problem** ☐		**Work related** ☐			
Medications/vaccines for this problem	Strength	Regimen	No. of Rpts	? OTC	GP Supply	New Drug
1.						
2.						
3.						
4.						
Procedures, other treatment, counselling this consult	New referrals, admissions					
1.	1.					
2.	2.					

2. Diagnosis/problem	**New problem** ☐		**Work related** ☐			
Medications/vaccines for this problem	Strength	Regimen	No. of Rpts	? OTC	GP Supply	New Drug
1.						
2.						
3.						
4.						
Procedures, other treatment, counselling this consult	New referrals, admissions					
1.	1.					
2.	2.					

3. Diagnosis/problem	**New problem** ☐		**Work related** ☐			
Medications/vaccines for this problem	Strength	Regimen	No. of Rpts	? OTC	GP Supply	New Drug
1.						
2.						
3.						
4.						
Procedures, other treatment, counselling this consult	New referrals, admissions					
1.	1.					
2.	2.					

4. Diagnosis/problem	**New problem** ☐		**Work related** ☐			
Medications/vaccines for this problem	Strength	Regimen	No. of Rpts	? OTC	GP Supply	New Drug
1.						
2.						
3.						
4.						
Procedures, other treatment, counselling this consult	New referrals, admissions					
1.	1.					
2.	2.					

Pathology For problem(s)
1 .... 1 2 3 4
2 .... 1 2 3 4
3 .... 1 2 3 4
4 .... 1 2 3 4
5 .... 1 2 3 4

Imaging & other tests (+Body site) Problem(s)
1 .... 1 2 3 4
....
2 .... 1 2 3 4
....
3 .... 1 2 3 4

To the patient:
In general would you say your health is:
Excellent............. ☐
Very good............ ☐
Good.................. ☐
Fair..................... ☐
Poor.................... ☐

Patient's
Height: cm
Weight:

To the patient if 18+:
How often do you have a drink containing alcohol?
Never......................... ☐
Monthly or less............ ☐
Once a week............... ☐
2-4 times a week.......... ☐
5+ times a week........... ☐

How many standard drinks do you have on a typical day when you are drinking?

How often do you have 6 or more standard drinks on one occasion?
Never.............................. ☐
Monthly or less................ ☐
Once a week.................... ☐
2-4 times a week.............. ☐
5+ times a week............... ☐

BA

Appendix 2: GP profile questionnaire 1999–00

The University of Sydney
at Westmead Hospital

General Practice Statistics and Classification Unit
Family Medicine Research Centre
Department of General Practice

a collaborating unit of the
Australian Institute of Health and Welfare
AIHW

Please fill in boxes or circle answers where appropriate

[ ][ ][ ][ ] Doctor Identification Number

1. Sex: .... **Male / Female**
2. Age .... [ ]
3. How many years have you spent in general practice? .... [ ]
4. Number of general practice sessions you usually work per week? .... [ ]
5. How many **full-time** (>5 sessions per week) general practitioners work with you at this practice? (Practice= shared medical records) .... [ ]
6. How many **part-time** (<6 sessions per week) general practitioners work with you at this practice? (Practice = shared medical records) .... [ ]
7. Do you conduct more than **50%** of consultations in a language other than English? .... **Yes / No**
8. What is the postcode of your major practice address? .... [ ][ ][ ][ ]
9. Country of graduation: .... **Aust** **NZ** **Asia** **UK** **Other:(specify)** ....
10. General Practice training status (CSCT or RACGP training programme)? .... **Presently training** **Completed training** **Not Applicable**
11. Do you hold FRACGP? .... **Yes / No**
12. Are you a member of any of the following organisations? **AMA** **RACGP** **RDAA**
13. How do you <u>routinely</u> instruct pharmacists on the substitution of generic drugs? **No substitute allowed** **Substitute allowed**
14. To what extent are computers used at your major practice address? *(Circle as many as apply)*
    Not at all **Billing** **Prescribing** **Medical Records** **Internet / Email** **Other Admin**
15. Is this practice accredited ? .... **Yes / No**
16. What are the normal after-hours arrangements for your practice?
    Practice does its own **Co-operative with oth. practices** **Deputising service** **Referral to other service (eg A&E)** **Other** **None**
17. Do you have your own *on-site* NATA accredited pathology lab? .... **Yes / No**
18. Which external pathology provider does your practice normally use? **Name of provider**.......... **Provider's Postcode** [ ][ ][ ][ ]

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Appendix 3: Australian MBS imaging groups and their ICPC–2 PLUS codes and terms

Imaging group (MBS)	ICPC–2 PLUS code	ICPC–2 PLUS term
Diagnostic radiology	A41001	Radiology;diagnostic
	A41002	X-ray;chest
	A41006	X-ray;abdomen
	A41007	Imaging other
	A41010	Radiology
	A41014	Test;imaging;contrast/special
	B41001	Radiology;diagnostic;blood
	D41001	GI series
	D41003	Radiology;diagnostic;digestive
	D41006	X-ray;oesophagus
	D41007	X-ray;biliary ducts
	D41008	X-ray;digestive tract
	D41009	X-ray;mouth
	D41012	X-ray;dental
	D41015	Barium enema
	D41016	Barium meal
	D41017	Barium swallow
	F41001	Radiology;diagnostic;eye
	F41002	X-ray;eye
	H41001	Radiology;diagnostic;ear
	H41002	X-ray;ear
	K41002	Radiology;diagnostic;cardiovas
	K41003	Cardiogram
	K41005	Angiography;coronary
	K41006	Angiography;femoral
	K41007	Angiography;cerebral
	K41011	Angiogram
	K41012	Angiogram;coronary
	K41013	Angiogram;cerebral
	K41014	Angiogram;femoral
	L41001	Arthrogram
	L41002	Scan;bone(s)
	L41003	X-ray;bone(s)
	L41004	Plain x-ray;bone(s)
	L41005	Radiology;diagnostic;musculo
	L41013	X-ray;elbow
	L41014	X-ray;hand
	L41015	X-ray;wrist
	L41016	X-ray;knee

(continued)

Appendix 3 (continued): Australian MBS imaging groups and their ICPC–2 PLUS codes and terms

Imaging group (MBS)	ICPC–2 PLUS code	ICPC–2 PLUS term
	L41017	X-ray;hip
	L41018	X-ray;neck
	L41019	X-ray;pelvis
	L41020	X-ray;shoulder
	L41021	X-ray;lumbosacral
	L41022	X-ray;cervical
	L41023	X-ray;thoracic
	L41024	X-ray;spinal
	L41025	X-ray;joint(s)
	L41026	X-ray;foot/feet
	L41027	X-ray;ankle
	L41028	X-ray;leg
	L41029	X-ray;ribs
	L41030	X-ray;face
	L41032	X-ray;arm
	L41033	X-ray;spine;lumbar
	L41034	X-ray;spine;sacrum
	L41035	X-ray;spine;coccyx
	L41036	X-ray;finger(s)/thumb
	L41037	X-ray;toe(s)
	L41038	X-ray;heel
	L41039	X-ray;tibia/fibula
	L41040	X-ray;femur
	L41041	X-ray;radius/ulna
	L41042	X-ray;clavicle
	L41043	X-ray;humerus
	L41044	X-ray;jaw
	L41045	X-ray;temporomandibular joint
	L41060	X-ray;spine;cervicothoracic
	L41061	X-ray;spine;sacrococcygeal
	L41062	X-ray;spine;thoracolumbar
	L41063	X-ray;back
	L41064	X-ray;back lower
	L41065	X-ray;forearm
	L41066	X-ray;leg lower
	L41067	X-ray;metacarpal
	L41068	X-ray;metatarsal
	L43003	Test;bone marrow density
	N41001	Radiology;diagnostic;neurolog
	N41004	X-ray;skull
	P41001	Radiology;diagnostic;psychol
	R41001	Radiology;diagnostic;respirat

(continued)

Appendix 3 (continued): Australian MBS imaging groups and their ICPC–2 PLUS codes and terms

Imaging group (MBS)	ICPC–2 PLUS code	ICPC–2 PLUS term
	R41002	X-ray;sinus
	R41003	X-ray;nose
	S41001	Radiology;diagnostic;skin
	T41001	Radiology;diagnostic;endo/meta
	T41003	X-ray;endo/metabolic
	U41001	Pyelogram;intravenous
	U41002	Pyelogram;retrograde
	U41005	Radiology;diagnostic;urology
	U41007	X-ray;urinary tract
	U41008	X-ray;kidney/ureter/bladder
	W41002	Radiology;diagnostic;reprod
	W41003	X-ray;uterus
	X41001	Mammography;female
	X41002	Mammography;request;female
	X41003	Thermography;breast
	X41005	Radiology;diagnostic;genital;female
	X41007	X-ray;breast;female
	Y41001	Radiology;diagnostic;genital;male
Ultrasound	A41012	Ultrasound
	A41015	Ultrasound;abdomen
	A41017	Ultrasound;chest
	A41021	Ultrasound;inguinal
	A41022	Ultrasound;abdomen;upper
	A41023	Ultrasound;abdomen;lower
	B41002	Ultrasound;spleen
	D41013	Ultrasound;gallbladder
	D41014	Ultrasound;liver
	K41001	Echocardiography
	K41016	Ultrasound;cardiac
	K43003	Test;Doppler
	K43004	Test;Doppler carotid
	K43005	Scan;duplex
	L41046	Ultrasound;neck
	L41047	Ultrasound;pelvis
	L41048	Ultrasound;shoulder
	L41049	Ultrasound;spine
	L41050	Ultrasound;knee
	L41051	Ultrasound;elbow
	L41070	Ultrasound;wrist
	L41071	Ultrasound;ankle
	L41072	Ultrasound;groin
	L41073	Ultrasound;back
	L41074	Ultrasound;back lower
	L41075	Ultrasound;hand/finger(s)
	L41076	Ultrasound;foot/toe(s)

(continued)

Appendix 3 (continued): Australian MBS imaging groups and their ICPC–2 PLUS codes and terms

Imaging group (MBS)	ICPC–2 PLUS code	ICPC–2 PLUS term
	L41078	Ultrasound;arm
	L41079	Ultrasound;leg
	N41005	Ultrasound;brain
	N41007	Ultrasound;head
	T41004	Ultrasound;thyroid
	U41009	Ultrasound;renal tract
	U41010	Ultrasound;kidney
	W41004	Ultrasound;obstetric
	X41009	Ultrasound;breast;female
	X41011	Ultrasound;uterus (not preg)
	Y41005	Ultrasound;prostate
	Y41006	Ultrasound;scrotum
Computed tomography	A41013	CT scan
	A41016	CT scan;abdomen
	A41018	CT scan;chest
	A41019	CT scan;abdomen;upper
	A41020	CT scan;abdomen;lower
	D41018	CT scan;liver
	K41017	CT scan;cardiac
	L41052	CT scan;neck
	L41053	CT scan;pelvis
	L41054	CT scan;spine
	L41055	CT scan;spine;cervical
	L41056	CT scan;spine;thoracic
	L41057	CT scan;spine;lumbar
	L41058	CT scan;spine;lumbosacral
	L41059	CT scan;spine;sacrum
	L41069	CT scan;spine;thoracolumbar
	L41077	CT scan;spine;cervicothoracic
	N41006	CT scan;brain
	N41008	CT scan;head
	R41004	CT scan;sinus
	X41010	CT scan;breast;female
	Y41007	CT scan;breast;male
Nuclear medicine	A41009	Nuclear medicine
	A41011	Isotope scan
	K41015	Scan;thallium heart
	R41005	Scan;VQ (lung)
Magnetic resonance imaging	A41008	MRI

Appendix 4: Problem/problem group labels and the ICPC–2 PLUS codes and terms

Problem label	ICPC–2 codes	ICPC–2 PLUS codes
Abdominal pain	D01, D06	—
Abnormal test results	A91, B84, U98, X86	—
Anaemia	B80, B81, B82	—
Anxiety	P01, P74	—
Arthritis (excluding osteoarthritis)	—	L81003,L70010, L70009 L83010, L84003, L84023, L84024, L84025, L84026, L89004, L90004, L91009, L91010, L91011, L91012, L92006, S91002, T99063
Back pain	L02, L03	L84020, L84021, L86002, L86003, L86005, L86009, L86036, L86044
Breast lump	X19	Y16001, Y16005, Y16009
Check-up	–30, –31, X37	—
General check-up	A30, A31	—
Blood check-up	B30, B31	—
Digestive check-up	D30, D31	—
Eye check-up	F30, F31	—
Ear check-up	H30, H31	—
Cardiac check-up	K30, K31	—
Musculoskeletal check-up	L30. L31	—
Neurological check-up	N30, N31	—
Psychological check-up	P30, P31	—
Respiratory check-up	R30, R31	—
Skin check-up	S30, S31	—
Endocrinology check-up	T30, T31	—
Urolology check-up	U30, U31	—
Pre/post natal check-up	W30, W31	—
Female genital check-up	X30, X31, X37	—
Male genital check-up	Y30, Y31	—
Depression	P03, P76	—
Diabetes	T89, T90, W85	—
Fracture –excluding head	L72, L73, L74, L75, L76	L99017, L99018, L99019
Head injury	N79, N80	—

(continued)

Appendix 4 (continued): Problem/problem group labels and the ICPC–2 PLUS codes and terms

Problem label	ICPC–2 codes	ICPC–2 PLUS codes
Headache	N01, N89, N90, N95	—
Hypertension	K86, K87, W81	—
Immunisation all	A44, D44, N44, R44	—
Ischaemic heart disease	K74, K76	—
Leg pain	—	L14006
Menstrual problems	X02, X03, X05, X06, X07, X08, X09, X10	—
Oral contraception	W10, W11	—
Osteoarthritis	—	L83011, L84004, L84009, L84010, L84011, L84012, L89001, L90001, L91001, L91003, L92007
Peripheral vascular disease	—	K92003, K92017
Pregnancy	W01, W78, W79	—
Prescription all	–50	—
Rash	S06, S07	—
Rheumatoid arthritis	L88	—
Shoulder syndrome (excluding arthritis or osteoarthritis of shoulder)	—	L92001, L92002, L92003, L92004, L92005, L92008, L92009, L92010, L92011, L92012, L92013, L92014, L92016
Sprain/stain	L77, L78, L79	—
Swelling	S04, S05	—
Tonsillitis	R76, R90	—
UTI	U70, U71	—

Note: All codes starting with a dash can be equally applied to any chapter so that each of these codes has 17 possible ICPC–2 codes attached.