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2002–03 to 2011–12

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Evaluation of imaging ordering by general practitioners in Australia, 2002–03 to 2011–12

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Bettering the Evaluation and Care of Health

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Summary

This report describes changes in general practitioners' (GPs) ordering of imaging tests in Australia over the decade 2002–03 to 2011–12 and an evaluation of the quality of GP imaging ordering against the available guidelines. This project was funded by a grant from the Diagnostic Imaging Quality Program, through the Australian Government Department of Health.

This study uses data collected from the BEACH program (Bettering the Evaluation and Care of Health), a continuous national study of GP clinical activity in Australia. Over the decade 2002–12, 9,802 GPs participated in BEACH, providing details of 980,200 GP–patient encounters. Changes in GP ordering behaviour were assessed by comparing data from two 3-year data periods: Period 1, April 2002–March 2005 inclusive; and Period 2, April 2009–March 2012 inclusive. Assessment of alignment between recommendations in guidelines and GPs' imaging test ordering behaviour was made on the basis of recent GP test ordering behaviour in Period 2.

This report is divided into three sections. Section 1 discusses GPs' overall imaging ordering patterns and changes over time. Section 2 includes detailed investigation of GPs' imaging ordering in the management of specific problems. Section 3 investigates GPs' ordering of selected imaging types.

SECTION 1

There was significant growth over the decade in the total number of imaging services funded through the Medicare Benefits Schedule (MBS). The following factors influence the total number of imaging tests ordered by GPs:

- the number of GP–patient encounters claimed through the MBS nationally
- the number of problems managed at encounters
- the rate of GPs' imaging test ordering in the management of problems at encounters. This rate is a function of two factors:
  - the likelihood of testing the problems being managed
  - the number of tests ordered for the problem once the decision to test is made.

Over time (from Period 1 to Period 2), there were statistically significant increases in almost all of these factors. The only factor to remain steady was the number of tests ordered once the decision to test was made.

The average number of GP encounters across the country (measured using number of MBS GP services claimed) increased by approximately 23 million, from about 97 million per year in Period 1, to 120 million per year in Period 2.

The number of problems GPs managed at encounters significantly increased from an average of 149.1 per 100 encounters in Period 1, to 157.6 in Period 2.

The rate of imaging tests ordered significantly increased from 8.7 per 100 encounters in Period 1, to 10.2 per 100 in Period 2. Extrapolation of this result suggests an average 8.45 million imaging tests ordered by GPs per year in Period 1 and 12.23 million per year in Period 2, an increase of 44.7%, equating to approximately 3.78 million more orders per year over the 3 years in Period 2 than in the years of Period 1.

The likelihood of an imaging order being placed in the management of problems increased significantly from 5.3% to 5.8%. The average number of imaging tests ordered per 100 tested problems remained steady (111.0 per 100 tested problems in Period 1 and 112.1 in Period 2).

Therefore the increased number of test orders in Period 2 reflected increases in three factors: number of GP encounters, number of problems managed, and the likelihood of ordering imaging for a problem being managed.

Independent predictors

The strongest predictors of imaging test orders (by multiple regression) were:

- Problems managed—number of problems: each additional problem increased the chance of testing by 41%. Type of problem managed: management of musculoskeletal problems (odds ratio, OR: 3.72); female genital problems (OR: 1.97); pregnancy and family planning (OR: 1.60); male genital problems (OR: 1.36); urinary problems (OR: 1.32), neurological problems (OR: 1.33), and digestive problems (OR: 1.18).
- Patient characteristics—female (OR: 1.04); in age groups from 45 years and up (OR range: 1.77–1.94); new to the practice (OR: 1.40).
- GP characteristics—sex female (OR: 1.12); age 35–44 years (OR: 1.10), in solo practice (OR: 1.10); in practice with co-located imaging service (OR: 1.10).

Types of imaging tests

In both data periods, orders for diagnostic radiology accounted for the majority of test orders, followed by ultrasound, and computerised tomography (CT) scans. Orders for magnetic resonance imaging (MRI), nuclear medicine, and other tests were relatively rare. However, between Period 1 and Period 2 there was a significant decrease in the order rate of diagnostic radiology, and significant increases in orders for ultrasound, CT scan and MRI.

SECTION 2

Eight problems accounting for high volumes of GPs' imaging orders are investigated in detail in chapters 5 to 8. These are: back problems; osteoarthritis, shoulder problems; sprains/strains; bursitis/tendonitis/synovitis; abdominal pain; knee problems; other musculoskeletal injuries. Guidelines for imaging tests in the management of these problems were identified, and the extent of alignment between guideline recommendations and GP ordering behaviour assessed. Results for each problem are summarised, describing recent practice (Period 2, 2009–12), changes over time (from Period 1 to Period 2), and alignment with guidelines.

Back problems (Chapter 5)

In recent practice, back problems were managed at a rate of 3.6 per 100 encounters, and imaging was ordered at a rate of 16.8 per 100 back problem contacts. New cases accounted for one-quarter of all cases, but generated 54% of total imaging ordered because new cases were twice as likely to result in testing than old cases. Diagnostic radiology was most frequently ordered (54%), followed by CT scan (36%), MRI (5%) and ultrasound (3%).

There was no change over time in the management rate or likelihood of testing. However, there were changes in the types of tests: there was a marginal decrease in diagnostic radiology (i.e. plain radiography of the spine) and small but significant increases in CT scan and MRI imaging orders. Although small, this change is consistent with changes in the guidelines favouring MRI investigation of complex back problems. The lack of MBS cover for GP-ordered MRI probably explains the greater increase in orders for CT scans.

The high rate of imaging at initial encounters for these problems is inconsistent with all established guidelines for the management of back problems.

Osteoarthritis (Chapter 6)

Osteoarthritis was managed at a rate of 2.8 per 100 encounters. New cases accounted for one-fifth of all osteoarthritis contacts, but were four times more likely to result in an imaging order than old cases (accounting for 47% of all tests). Diagnostic radiology accounted for almost 90% of imaging ordered, followed by ultrasound (6%), CT scan (2%) and MRI (2%). On those occasions where ultrasound, CT scan or MRI were ordered, there was no difference in the order rate for new presentations or in continuing care.

Over time there was a marginal decrease in the management rate of all osteoarthritis, but an increased proportion were new cases; the likelihood of testing significantly increased for all cases, new and old, leading to increased imaging order rates per 100 problems. Orders for diagnostic radiology increased over time. Ultrasound and MRI also increased, but numbers were small.

Ordering of imaging for osteoarthritis by GPs appears consistent with existing guidelines.

Shoulder problems (Chapter 7)

Shoulder problems were managed at a rate of 0.9 per 100 encounters. Shoulder syndromes were managed at a far higher rate than shoulder symptoms/complaints. Ultrasound (65%) and diagnostic radiology (32%) were the most commonly ordered tests.

The management rate of shoulder problems increased, with increased likelihood of testing, resulting in increased imaging orders per 100 cases, but this was only reflected in the management of shoulder syndromes, not in management of symptoms/complaints. There was a move away from diagnostic radiology toward ultrasound in test ordering for shoulder problems.

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

Sprains/strains (Chapter 8)

Sprains/strains were managed at a rate of 1.0 per 100 encounters. New cases accounted for nearly two-thirds of all sprain/strain problems, and these presentations were more likely to involve orders for imaging than previously managed sprains/strains. Diagnostic radiology accounted for 61% of imaging ordered, followed by ultrasound (35%). Order rates for CT and MRI were low and did not differ between new and old cases.

While there was a marginal decrease in the management rate over time, the likelihood of testing increased, resulting in an increased number of tests ordered per 100 sprain/strain problems managed. There was a move away from diagnostic radiology, although there was a singular increase in x-rays for sprain/strain of the shoulder. There was a general increase in ultrasound and MRI orders, although each remained infrequent.

Compliance with published guidelines was assessed based on the site of the sprain/strain.

- Ankle: the investigation of new ankle sprain/strain frequently involved orders for ultrasound, and ordering of x-ray and ultrasound together was common. Neither the Australian guidelines nor the American College of Radiology Appropriateness Criteria suggest use of ultrasound in investigation of ankle sprain/strain. There is considerable room for improvement in this area.
- Shoulder: test ordering patterns for sprain/strain paralleled those for shoulder syndrome, and similarly we conclude they were consistent with published guidelines, taking into consideration the lack of MBS coverage of MRIs for these problems.

- Knee: guidelines for imaging for knee sprain/strain are complex, but rely heavily on the Ottawa knee rules. Encouraging use of the Ottawa rules by GPs may assist improved test selection for these problems.
- Wrist: the current ordering of x-ray for wrist sprain/strain is consistent with guidelines.

Bursitis/tendonitis/synovitis (Chapter 9)

Bursitis problems were managed at a rate of 1.1 per 100 encounters, and almost one-quarter of presentations resulted in a test order. New cases were managed more often than old cases, and were more likely to have imaging ordered. Ultrasound accounted for 63% of tests, followed by diagnostic radiology (34%), and both were ordered more often for new cases.

Over time there was an increase in the management rate of bursitis, and a 51% increase in the likelihood of testing. This resulted in an increased test order rate per 100 problems. Orders for ultrasound more than doubled over time and has become the most commonly ordered type of imaging test for bursitis problems in recent practice. Diagnostic radiology significantly decreased as a proportion of all imaging ordered for bursitis problems, but the order rate did not change.

The range of investigation is consistent with the current guidelines. CT scan and MRI were infrequently ordered by GPs for these problems.

Abdominal pain (Chapter 10)

Abdominal pain was managed by GPs at a rate of 0.7 per 100 encounters, and one-third of presentations resulted in an imaging test order. Ultrasound was the most frequently ordered test (70%), followed by CT scans (18%) and diagnostic radiology (12%). New problems accounted for 52% of all cases, and generated 61% of tests. Likelihood of ordering was higher for new problems than for old, with CT scans and ultrasounds the most common tests ordered.

There was no change over time in the management rate of abdominal pain, but there was an increase in likelihood of testing. This resulted in an increased number of tests ordered per 100 abdominal pain problems managed. Ultrasound remained the most frequently ordered test over both data periods, but the order rate of CT scan significantly increased.

An appropriate range of modalities appear to be used by Australian GPs for these problems. Ultrasound remains the imaging of choice for GPs, and there has been a move away from plain x-ray to CT scan. These findings are consistent with the guidelines. However, due to the low yield of imaging investigations demonstrated in the literature, advice to GPs regarding use of 'red flag' symptoms and signs to guide ordering may decrease unnecessary imaging. Advice for a sequential approach to imaging orders should be considered in revisions of guidelines.

Knee problems (Chapter 11)

Knee problems were managed at a rate of 0.6 per 100 encounters. Knee syndrome and knee symptom/complaint each accounted for half of all knee problems. GPs were far more likely to order imaging at new presentations of knee problems than at follow-up consultations. The test order rate was significantly higher for knee symptom/complaint than for knee syndrome, and in both, far higher for new cases than for those previously managed.

The majority of tests for all knee problems were diagnostic radiology (73% of tests), followed by MRI (13%). MRI ranked second in test choice for both new and old problems, but ultrasound was the second choice when testing new knee symptoms/complaints.

For all knee problems the management rate and likelihood of testing increased, largely due to increases in follow-up consultations for old problems rather than new cases. There was a

move away from diagnostic radiology toward MRI, but the former remained the predominant test group.

If the Ottawa knee rules were applied in the Australian context they have the potential to significantly reduce the need for diagnostic radiology (i.e. plain x-rays) without losing sensitivity of fracture detection.

Ultrasound and CT scan were ordered infrequently, and this is consistent with guidelines.

Use of MRI for knee syndrome is consistent with guidelines. MRI ordering increased over the study period, even though during this time, MRI ordered by GPs were not covered by the MBS. With the recent inclusion of GP-ordered knee MRI under the MBS, use of MRI is likely to continue to rise.

Other musculoskeletal injuries (Chapter 12)

Other musculoskeletal injuries (OMI) were managed at a rate of 0.5 per 100 encounters, and at least one test was ordered at 38% of contacts. The likelihood of ordering for new cases (49%) was double that for old cases (23%). Diagnostic radiology was ordered most frequently (67% of tests), followed by ultrasound (26%).

There was no change in the management rate of OMI, but the likelihood of testing increased. Diagnostic radiology remained the most commonly ordered test type over time, but there were increases in the rate of ultrasound and MRI orders.

The rise in orders for ultrasound is consistent with the increasing use of ultrasound in soft tissue injuries as recommended in site-specific guidelines.

SECTION 3

Section 3 of this report centres on the use of each of the four types of tests: diagnostic radiology, ultrasound, CT, and MRI. Over time there was a statistically significant decrease in the order rate of diagnostic radiology, and statistically significant increases in the order rates of ultrasound, CT scan and MRI. For each test group, we report the problems for which tests were most often ordered, and the extent to which management of each problem involved imaging from that test group.

The problems for which diagnostic radiology were most commonly ordered were osteoarthritis, back problems, fracture, and sprain/strain, which together accounted for 28% of diagnostic radiology in Period 2.

Ultrasound was ordered most commonly by GPs in the management of pregnancy and pregnancy-related check-ups, abdominal pain, and shoulder problems. Together these problems accounted for 24% of all ultrasound in Period 2.

CT scan was commonly ordered in the management of back problems, headache, sinusitis, abdominal pain, and neck syndrome, which together accounted for 36% of CT scans ordered.

The most common problems generating orders for MRI tests were: back problems, knee problems, osteoarthritis, sprain/strains, and other musculoskeletal injuries. These problems accounted for 52% of MRI orders.

This section demonstrates that the changes in GPs' ordering of the selected test types are due to the combined effect of the frequency of management for selected problems and the likelihood of testing in the management of problems. For example, a low test order rate for a very frequently managed problem usually results in a greater number of test orders than a very infrequently managed problem with a high test order rate.

Summary of the review of the guidelines

Following review of available diagnostic imaging guidelines in Australia and other countries, it appears that the Diagnostic Imaging Pathways (DIP) guidelines produced under the sponsorship of the Government of Western Australia Department of Health are the most appropriate and useful guidance for GPs in Australia. DIP is described as "an evidence-based and consensus-based educational and decision support resource for clinicians, to guide them in their choice of the most appropriate diagnostic examinations in the correct sequence for a range of clinical cases"‡. There were no reported studies found in the literature of the effect of the DIP guidelines on GP imaging ordering behaviour.

Promulgation of diagnostic imaging guidelines to GPs has not been demonstrated in the literature to significantly change behaviour in the ordering of imaging. Electronic decision support tied to electronic ordering of imaging also has limited effect. Financial barriers, such as restriction of insurance benefits to patients for certain tests, do have a demonstrated effect, but unless carefully designed may lead to a reduction in appropriate tests as well as inappropriate tests.

Broad interventions to improve clinical performance through education, training and clinical audit, combined with peer review processes have been shown to be effective in other dimensions of clinical care. These may be more effective than interventions addressed specifically toward ordering of imaging by GPs.

Summary of compliance with diagnostic imaging guidelines

In general this report shows that Australian GPs select appropriate diagnostic imaging modalities for specific clinical problems given the restraint imposed by restriction of MBS rebates for MRIs ordered by GPs.

Imaging ordering behaviour suggests broad compliance with published guidelines in the management of: osteoarthritis, bursitis/tendonitis/synovitis, sprain/strain of the wrist, and other musculoskeletal injuries.

Current ordering patterns for shoulder sprains/strains, knee problems, and knee sprains/strains, have potential for improvement. If the Ottawa knee rules were applied, significant reduction in diagnostic radiology of the knee could be gained without losing sensitivity of fracture detection.

Considering the lack of MBS coverage of MRI ordered by GPs for shoulder sprains and strains, current ordering patterns are appropriate. The same can be said for back problems overall. However the order rate for new presentations of back problems is inconsistent with all established guidelines for the management of back problems.

Order patterns for abdominal pain may benefit from increased GP use of 'red flag' symptoms and signs to guide ordering, and added guidance in any future revision of the guidelines, to take a sequential approach in ordering.

Some possibly unnecessary ordering is evident in both time periods of this study as it was in the previous Family Medicine Research Centre report on imaging ordering by GPs. The perceived unnecessary ordering occurs in situations such as back and joint imaging where the literature indicates that careful clinical assessment, derived from clinical history and physical examination, can improve the specificity of imaging examinations without reducing the sensitivity in the detection of abnormalities. The use of the Ottawa rules, for example, has been shown to result in improved cost-effectiveness of imaging examinations of the knee and ankle.

‡ Healthdirect Australia. Diagnostic Imaging Pathways. 2012. Viewed 7 May 2014, www.healthdirect.gov.au/partner/diagnostic-imaging-pathways.

Section 1

Background, method and overview of GPs' imaging ordering

1 Introduction

This is the final report for the project titled: '*Evaluation of imaging ordering by general practitioners in Australia, 2002–03 to 2011–12*' funded by a grant from the Diagnostic Imaging Quality Program through the Australian Government Department of Health (ITA455, 2012).

This project aimed to assess changes in the imaging test ordering behaviour of general practitioners (GPs) since the last published report on this subject in 2001,[1] and to evaluate the appropriateness of recent test ordering behaviour, in terms of its level of alignment with guidelines for GPs.

This study relies on analyses of data from the BEACH (Bettering the Evaluation and Care of Health) program, a continuous national study of general practice activity in Australia. The BEACH program began in April 1998 and was the culmination of about 20 years research and development work at the University of Sydney. BEACH is currently supported financially by government and private industry (see Acknowledgments).

BEACH is the only continuous randomised study of general practice activity in the world, and the only national program that provides direct linkage of management actions (such as imaging test orders) to the problem under management. In March 2014, the BEACH database included information pertaining to almost 1.6 million encounters from about 16,000 GP participants, who together represent about 10,000 individuals.

1.1 Background

In June 2012, the population of Australia was estimated to be 22.7 million people.[2] Australia's health expenditure in 2010–11 was $130.3 billion, an average $5,796 per head of population, and accounted for 9.3% of GDP. Governments funded 69.9%, with the remainder (30.1%) being paid by the non-government sector.[3] Government expenditure on general practice services (including those of practice nurses) was almost $5.6 billion dollars in the 2011–12 financial year.[4]

GPs are usually the first port of call in the Australian healthcare system, as they act as gate-keepers to secondary and tertiary services. Payment for GP visits is largely on a fee-for-service system, and there are no compulsory patient lists or registration. People are free to see multiple practitioners and visit multiple practices of their choice. There is a universal medical insurance scheme (called the Medicare Benefits Schedule [MBS], managed by Medicare Australia), which covers all or most of an individual's cost for a GP visit, and all or some of MBS approved imaging tests ordered by GPs from radiologists.[4]

In the 2002–03 financial period, there were 96.3 million claims made to Medicare for GPs items of service. In the last year of the data period used in this report (2011–12), there were 122.5 million such claims. This demonstrates that over the decade 2002–03 to 2011–12, the annual attendance rate to GPs increased by more than one visit per head of population.

In Australia in 2011, there were 25,056 practising GPs (medical practitioners self-identifying as GPs), and in the April 2012 to March 2013 year, about 85% of the Australian population claimed at least one GP service from Medicare (personal communication, Department of Health, June 2013). In the 2012–13 period, Medicare paid rebates for about 126.8 million claimed GP service items,[5] at an average of about 5.6 GP visits per head of population. This equates to about 2.4 million GP–patient encounters per week.

In 2002–03, MBS paid benefits for 13.23 million imaging tests (ordered by all types of medical practitioners) at a cost of $1.17 billion. In 2011–12, the number of imaging tests to which Medicare contributed had increased by about 50% to 20.33 million, but the cost had more than doubled to $2.53 billion, or about $111 per head of population.

Previously published data from the BEACH study demonstrate that GPs' ordering of imaging tests increased significantly over the decade 2002–03 to 2011–12. The proportion of all problems managed for which imaging was ordered rose from 5.3% to 5.8%. Further, the number of imaging tests ordered increased from 5.9 tests per 100 problems managed to 6.6 per 100 in 2011–12.[6]

In the context of the increasing resources associated with this testing, it is important to understand the types of imaging tests ordered by GPs and the indications (i.e. patient problems) for which these tests are ordered, the tests and indications contributing to growth, and to evaluate the quality of GPs' ordering.

The imaging data in MBS reflect the imaging undertaken by radiologists and billed to Medicare. The data include all imaging billed to Medicare, irrespective of the type of medical practitioner ordering the test from the radiologist. Further, when a radiologist receives a request for a specific test from a medical practitioner, they can decide whether the test ordered is the most suitable and may decide a different test should be undertaken, and whether to undertake other tests of their choosing.

Further, when claims are made for imaging tests undertaken by the radiologist, the claim is made for a specific MBS item number. These item numbers often represent iso-resource groups, rather than individual tests. For example: "Item 58115: Ultrasound of the spine, three examinations of the kind mentioned in items 58100, 58103, 58106 and 58109".[7]

The MBS data therefore reflect the tests that are actually undertaken by the radiologist, in response to a request from a medical practitioner, and possibly after doing additional tests or selecting an alternative test to that requested, then claimed from Medicare as an item number. These items may represent an iso-resource group, rather than an individual test.

The data cannot tell us what GPs actually requested to be done from the radiologist, nor about the indications for which tests were ordered. MBS data therefore cannot be used to assess the extent to which GP test ordering follows available guidelines for testing of specific health problems. The BEACH program fills this gap.

This study uses BEACH data to describe GPs' imaging ordering and the changes in this ordering. The appropriateness of GPs' imaging ordering is evaluated for selected imaging tests and/or indications of interest, though comparisons of GPs' ordering (as measured in BEACH) with current practice guidelines to determine areas in which quality improvement is needed. Highlighting these areas will provide a direction for those involved in educational programs and interventions to improve the quality of test ordering by GPs. It will also identify areas where guidelines may warrant improvement.

Objectives

The objectives of this study are to:

- describe recent patterns of general practitioner ordering for diagnostic imaging in Australia, the indications for which imaging tests are ordered, and how GP test ordering patterns have changed over the decade 2002–03 to 2011–12
- determine areas where intervention may be beneficial, and where guidelines may warrant improvement, through comparison of GP ordering behaviour with current practice guidelines.

1.2 Literature review

The literature review in this report builds on that undertaken for the 2001 publication on imaging orders by GPs produced by the Family Medicine Research Centre (FMRC) and published by the Australian Institute of Health and Welfare (AIHW).[1] Parts of the original review are included in this current updated review.

The FMRC undertook an extensive review of guidelines for diagnostic imaging using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

The final group of guidelines considered for this report were:

- Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways.[8-18] These guidelines could be considered as the successor of the now obsolete Royal Australian and New Zealand College of Radiologists (RANZCR) Imaging Guidelines 2001,[19] and are endorsed by the RANZCR
- the American College of Radiology Appropriateness Criteria™ (ACRAC)[20-28]
- the New Zealand Accident Compensation Corporation guidelines endorsed by the New Zealand Guidelines Group (NZGG)[29-32]
- the NHMRC guidelines distributed by the Royal Australian College of General Practitioners.[33,34]

The FMRC was unsuccessful in obtaining agreement from the Royal College of Radiologists for access to the iRefer guidelines used in the National Health Service (NHS) in the United Kingdom.

An additional review of the literature over the past 10 years regarding the use of imaging guidelines was undertaken using Medline. The Medline databases were searched by crossing several subject headings (diagnostic imaging, family practice, 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). A total of 1,413 articles were retrieved, of which 24 were of sufficient relevance and quality to be included in this review in addition to those retrieved for the previous report. Berry et al. have demonstrated that in the specific area of medical imaging, electronic databases, including Medline, are reliable sources of articles.[35]

Articles pertaining to individual diagnostic imaging tests, patient problems or anatomical sites are cited in those sections of the report.

Bairstow et al. outlined the development of the Government of Western Australia Department of Health sponsored Diagnostic Imaging Pathways.[36] The Australian Government Healthdirect website states:

> *The Diagnostic Imaging Pathways Group produces, updates and maintains the content of the Diagnostic Imaging Pathways (DIP) web-site. DIP is an evidence-based and consensus-based educational and decision support resource for clinicians, to guide them in their choice of the most appropriate diagnostic examinations in the correct sequence for a range of clinical cases.*[37]

The Australasian College for Emergency Medicine has adapted the Diagnostic Imaging Pathways for use in emergency departments.[38] The Diagnostic Imaging Pathways have also been adapted for use on electronic tablets.[39] There were no reported studies found in the literature of the effect of the Diagnostic Imaging Pathways on GP imaging ordering behaviour.

The Royal Australian and New Zealand College of Radiologists produced the fourth edition of *Imaging Guidelines*.[19] The first edition was published in 1990. These guidelines, like the Pathways, used 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 ACRAC and its more comprehensive literature reviews is not uncommon. Unlike the ACRAC, no quantification of 'appropriateness' is provided in Imaging Guidelines nor in the Pathways. The Imaging Guidelines are now out of print although electronic versions are still available on the Web.

The American College of Radiology (ACR) approach of developing appropriateness criteria for imaging in various clinical conditions has been described by Cascade[40] and Vydareny.[41] 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 ACRAC were first published in 1995 and have been progressively updated. Blackmore and Medina expressed concern that after 10 years of use, substantial improvements to the criteria were needed if they are to meet standards for evidence-based medicine.[42] The ACR has defended the development process as being a good synthesis of evidence and expert opinion.[43]

The ACRAC 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. However, in the absence of better evidence, the ACRAC 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 iRefer.[44] These are available free to all clinicians in the NHS in the United Kingdom, and on subscription to other clinicians. Unfortunately, a request for access to these guidelines for this project remains unanswered.

The New Zealand Accident Compensation Corporation guidelines are clinical guides for the management of patients covered by the New Zealand universal accident compensation scheme. They are endorsed by a joint clinical colleges group, the NZGG. While they have some wider applicability, they are primarily designed for accident victims.

While there was no published literature on the effect of the release of the earlier editions of 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.

In 1992, the Royal College of Radiologists Working Party reported a baseline audit of radiology referrals from hospital inpatient and outpatient sources which revealed high levels of variance in radiology ordering.[45] 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.[46] 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.[47] 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.[48]

However, studies by Shye et al. 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.[49,50]

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.[51] 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.[52]

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.[53]

Martin et al. undertook a study of the applicability of the ACRAC and found that they could be effectively applied in an internal medicine clinic situation.[54] 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 ACRAC)[55] 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 ACRAC in family practice in the United States.

Curry and Reed, and Bowen et al. have shown that electronic decision support for diagnostic imaging ordering had limited support and success in a clinical primary care setting.[56,57] While Kahn et al. have written extensively on the use of the ACRAC 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 these guidelines in changing ordering behaviours.[58-60]

2 Methods

This study relies on analyses of data from the Bettering the Evaluation and Care of Health (BEACH) program, a continuous cross-sectional national study that began in April 1998. The BEACH database now includes information for almost 1.6 million encounters from nearly 16,000 participants.

The BEACH methods are summarised in this chapter. Detailed BEACH methods have been published in *A decade of general practice activity 2002–03 to 2011–12*.[6] This chapter also provides the methods used in this particular analysis of imaging test ordering by GPs.

2.1 The BEACH program

Each year about 1,000 ever changing, randomly selected GPs, each records details of 100 consecutive encounters on structured paper recording forms, and provides information about themselves and their practice.

BEACH is the only continuous randomised study of general practice activity in the world, and the only national program that provides direct linkage of management actions such as orders for imaging tests, to the problem under management.

Data elements used in this report

The 2011–12 GP Profile (information about the GP and their practice) is shown in Appendix 1. The GP and practice data elements collected that pertain to this report are as follows.

- **GP characteristics:** age; sex; years in general practice; country of graduation (analysed in this report as Australia/other); Fellowship of the Royal Australian College of General Practitioners (RACGP) (Yes/No).
- **Characteristics of major practice:** number of individual GPs; number of GPs working in the practice; geographic status of practice (metropolitan/rural, using ASGC – Australian Standard Geographical Classification);[61] co-located imaging service (Yes/No).

The 2011–12 BEACH encounter form is provided as Appendix 2. The data elements drawn from the encounter record that pertain to this study are as follows.

- **Patient characteristics:** date of birth (reported as age group); sex; status of the patient to the practice (new/seen before); concession cardholder status (including Commonwealth and/or Department of Veterans' Affairs repatriation) (Yes/No); non-English-speaking background (patient self-report – a language other than English is the primary language at home) (Yes/No); Aboriginal person (self-identification) and/or Torres Strait Islander person (self-identification) (Yes/No).
- **The problems managed** at encounter (at least one and up to four per encounter); status of the problem to the patient (new/old).
- **Imaging tests ordered at the encounter**, and body site specified (all recorded in free text), and designation of the problem or problems managed at this encounter for which each test was ordered.

The Patient Information Sheet, provided to participating GPs for their patients is shown in Appendix 3.

Sampling methods

The source population includes all vocationally registered GPs and all general practice registrars who claimed a minimum of 375 Medicare general practice items of service in the most recently available 3-month Medicare data period (which equates to 1,500 such claims in a year). The Medical Benefits Division of the Department of Health (DoH) updates the sample frame quarterly from Medicare claims data, removes from the sample frame any GPs already randomly sampled in the current quality improvement triennium, and draws a new sample from those remaining. This ensures the timely addition of new entries to the profession, and timely exclusion of those GPs who have stopped practising, or have been previously approached in the current triennium.

Recruitment methods

- The randomly selected GPs are sent a letter, posted to the address provided by DoH.
- The GPs are then telephoned in the order they were approached and, referring to the letter, asked whether they will participate.
- GPs who agree to participate are set an agreed recording date several weeks ahead.
- A research pack is sent to each participant before the planned start date.
- Non-returns are followed up by regular telephone calls for 3 months.
- Participating GPs earn clinical audit points toward their Quality Improvement and Continuing Professional Development (QI & CPD) requirements through the RACGP and/or the Australian College of Rural and Remote Medicine (ACRRM).

Ethics approval and informed patient consent

Ethics approval for the BEACH program in 2011–12 was obtained from the Human Ethics Committee of the University of Sydney.

Although the data collected by the GPs is not sufficient to identify an individual patient, informed consent for GP recording of the encounter details is required from each patient. GPs are provided with a Patient Information Card (Appendix 3) and are instructed to ask the patient if they are happy for their data to be included. If the patient refuses, details of the encounter are not recorded. This is in accordance with the ethics requirements for the BEACH program.

Classification of data

Imaging test orders and problems managed are classified according to the International Classification of Primary Care – Version 2 (ICPC-2), a product of the World Organization of Family Doctors (Wonca).[62]

The ICPC-2 has a biaxial structure, with 17 chapters on one axis (each with an alphabetic code) and seven components on the other (numeric codes) (Figure 1). Chapters are based on body systems, with additional chapters for psychological and social problems.

The ICPC-2 is an excellent epidemiological tool. The diagnostic and symptom 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. ICPC-2 has about 1,370 rubrics and these are sufficient for meaningful analyses.

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

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

Figure 2.1: The structure of the International Classification of Primary Care – Version 2 (ICPC-2)

When the free-text data are received from the GPs, trained secondary coders code the data in more specific terms using ICPC-2 PLUS.[63,64] This is an interface terminology, developed from all the terms used by GPs in about 2.5 million encounter records. Readers interested in seeing how coding works can download the ICPC-2 PLUS Demonstrator at <sydney.edu.au/medicine/fmrc/icpc-2-plus/demonstrator/index.php>.

All the imaging tests recorded by GPs are coded very specifically in ICPC-2 PLUS, but ICPC-2 classifies imaging tests very broadly (for example, a CT scan of the lumbar spine is classified as L41 – Diagnostic radiology/imaging of the musculoskeletal system). In Australia, the Medicare Benefits Schedule (MBS) classifies imaging tests in groups that are relatively well recognised. We therefore re-classified all ICPC-2 PLUS codes for imaging orders into MBS standard groups, and report imaging test orders using these groups. Inclusions are provided in Appendix 5, Table A5.3.

BEACH data and imaging data from the MBS

The imaging data from the MBS and that from BEACH are very different.

The imaging tests recorded by GPs in the BEACH program reflect the GP's intent that the patient should have the test undertaken. Two steps affect the extent to which this test order results in a claim from the MBS:

- the patient may choose not to have the test done, or
- the patient has the test done, but the test is not covered by the MBS if it is ordered by a GP, so again no claim is made through the MBS for this action.

An example of the latter is GP orders for MRI. At the time the data were collected for this study, the costs of a MRI ordered by a GP directly (rather than through referral to a specialist with a request for a MRI) were not claimable from the MBS.

Imaging data in the MBS reflect the imaging undertaken by radiologists and billed to Medicare. The data include all private radiology billed to Medicare, irrespective of the type

of medical practitioner ordering the test from the radiologist. Further, when a radiologist receives a request for a specific test from a medical practitioner, they can decide whether the test ordered is the most suitable and may decide a different test should be undertaken, and whether to undertake other tests of their choosing.

The MBS data therefore reflect the tests that are actually undertaken by the radiologist in response to a request from a medical practitioner, possibly after doing additional tests or selecting an alternative test to that requested.

Further, when claims are made for imaging tests undertaken by the radiologist the claim is made for a specific MBS item number. These item numbers are often iso-resource groups, for example: "Item 58115: Ultrasound of the spine, three examinations of the kind mentioned in items 58100, 58103, 58106 and 58109".[7]

2.2 Methods specifically adopted for this project

To assess how GP test ordering patterns changed over the decade, we first undertook descriptive analyses of BEACH data for each year from 2002–03 to 2011–12 inclusive. From this we determined the patterns of GPs' diagnostic imaging ordering, the most frequent imaging tests ordered by GPs, and changes over time in GPs' ordering. This allowed us to assess the consistency of the data over time and identify any period in which dramatic change in behaviour occurred.

These initial analyses of annual data demonstrated linear growth in imaging ordering over the decade. However, the statistical power of each individual year of data was relatively low, particularly when investigating GPs' ordering of specific imaging tests and detailed imaging ordering for specific health problems.

Further, as the growth was relatively slow and linear in nature we decided to use two groups of three BEACH data years, to measure change in behaviour over the decade:

- Period 1: data collected between 1 April 2002 and 31 March 2005 inclusive
- Period 2: data collected in between 1 April 2009 and 31 March 2012 inclusive.

Those readers wishing to view the annual results by year for the period 2002–03 to 2011–12, should see Appendix 4.

The initial search for guidelines demonstrated that they were largely problem-based, and site-based. For example, the guidelines for imaging in the management of sprains and strains, were site-based. Further, in the site-specific guidelines there was often different advice for diagnosed problems (which we refer to in this report as 'syndromes') than for undiagnosed conditions, which we refer to in this report as 'symptoms/complaints'. Test ordering for syndromes could be considered as more likely to be monitoring of the problem, while test ordering for symptoms/complaints should be considered part of the diagnostic process.

Further, guidance was often specifically aimed at imaging testing of new presentations of conditions. Therefore test ordering for new problems (those not previously managed by a medical practitioner for this patient, or the first visit for a new episode of a recurrent condition), was investigated separately.

We initially went through a process of creating problem groups (some of which differed from those usually used in BEACH reporting), that aligned with the problem subjects addressed by each group of guidelines. This facilitated the comparison of GP practise with guidelines and with published evidence. In areas of morbidity for which guidelines differed

for 'syndromes' and for 'symptoms/complaints', groups of problems were also created for these two aspects of the problem area.

All ICPC-2 and/or ICPC-2 PLUS codes for each problem group and subgroup (where applicable) investigated in detail in this report, are listed in Appendix 5.

We then identified problems/indications for which imaging was frequently ordered by GPs. Problems that accounted for at least 1.0% of problem–imaging links in 2009–12 were identified. The top 17 problems accounted for more than 45% of problem–imaging links in 2009–12.

The ten problems/indications each generating >2% of problem-imaging links in 2009–12 were identified as priority areas. As explained in the introduction to Section 2 of this report, two of these were rejected, leaving eight individual problem types for further investigation.

Statistical methods

The analysis of BEACH data for this report was conducted with Statistical Analysis System (SAS) version 9.3,[65] and the encounter is the unit of analysis. Proportions are used when describing the distribution of an event that can arise only once at a consultation (for example, patient or GP age and sex), or to describe the distribution of events within a class of events (for example, imaging test type A as a percentage of all imaging tests in that MBS group of tests). Due to rounding, proportions may not always add to exactly 100%.

Rates per 100 encounters are used when an event can occur more than once at the consultation (for example, problems managed or imaging test orders). These rates are used as the basis of extrapolations for estimates of national annual occurrence of a selected event, because the extrapolation to the estimated number of encounters at which an event occurred in any given period must be based on the total claims from Medicare for GP items of service in that period.

Rates per 100 or 1,000 problems are also used when a management event can occur more than once per problem managed. In general, the results present the number of observations (*n*), and (in the case of management actions) the rate per 100 problems managed, and the 95% confidence interval. These figures are used for comparison between Period 1 and 2, because the calculation takes account of the greater number of problems managed at encounters in Period 2 than in Period 1.

BEACH is a single stage cluster sample study design, with each 100 encounters forming a cluster around each GP participant. In cluster samples, variance needs to be adjusted to account for the correlation between observations within clusters. Procedures in SAS version 9.3 were used to calculate the intra-cluster correlation, and adjust the confidence intervals accordingly, to create robust 95% confidence intervals.[65]

Chi-squares are provided in tables comparing GP characteristics and patient characteristics, but 95% confidence intervals are also presented (and these are the results described in the body of the report), because the chi-square statistic cannot adjust for the cluster sample study design of BEACH.

Significance of differences in rates is judged by non-overlapping 95% confidence intervals of the results being compared. The magnitude of this difference can be described as $p < 0.005$.[66] Assessment using non-overlapping 95% confidence intervals (CIs) is a conservative measure of significance,[67-69] particularly when differences are assessed by comparing results from independent random samples, as is the case when changes over time are investigated using

BEACH data. Due to the number of comparisons made in this report, we believe this conservative approach is warranted.

- Changes over time in the frequency of these events are judged significant (that is, a real change has occurred) if the two sets of confidence intervals do not overlap. For example, Result A: 11.5 per 100 problems (95% CI: 11.3–11.7) is significantly less than Result B: 11.9 per 100 problems (95% CI: 11.8–12.0).
- If the two sets of confidence intervals butt together the difference is regarded as marginal. For example, Result A: 11.5 per 100 problems (95% CI: 11.3–11.7) is marginally lower than Result B: 11.9 (95% CI: 11.7–12.1).
- In this report, highlighting in tables indicates a significant (or marginal) difference between Period 1 and Period 2.
- If the two sets of 95% confidence intervals overlap, then no change was measured.

Regression analyses

In the investigation of the predictors of imaging test ordering by GPs, we used logistic regression to identify at the univariate level (i.e. unadjusted), those factors which appeared to significantly influence the likelihood of imaging being ordered at a GP–patient encounter. Descriptive univariate analyses were performed using SAS V9.3,[65] adjusting for the cluster sample study design. Stata version 11[70] was used for univariate and multivariate logistic regression, adjusting for the cluster sample study design. Variables were regarded as significant at $p < 0.05$.

In this analysis, logistic regression was used with 'at least one imaging test ordered at the encounter' (No = 0, Yes = 1) as the outcome variable, with the following independent (explanatory) groups:

- GP/practice characteristics
- patient characteristics
- encounter characteristics.

Multiple regression analysis was then conducted. To select the best regression model for each group of characteristics, all predictor variables were fitted into the model, and the model was reduced using stepwise backward elimination, whereby non-significant variables were eliminated in turn (starting with the least significant variable), and the model refitted. The process ended when all the retained variables were significant.

These results are expressed as odds ratios with one group as the reference group. If the 95% confidence intervals do not include 1.0, the difference between the group under investigation and the reference group is statistically significant. An odds ratio of 1.0 implies that the event is equally likely in both groups.

For example, in investigating the extent to which the sex of the GP affects GP imaging test ordering at the univariate level, male GPs are used as the reference group, and the odds ratio for female (versus males) was OR: 1.12 (95% CI: 1.07–1.17). Strictly speaking, this is interpreted as: the odds of a female GP ordering imaging at an encounter are 12% higher than the odds of a male GP ordering imaging. However, in practice it is reasonable to say *'female GPs are 12% more likely to order imaging at encounters than male GPs'* when the outcome is not a very frequent event (as is the case with imaging test orders).

Extrapolated national estimates

In most chapters of this report, changes that have occurred between two data periods (2002–05 and 2009–12) are highlighted. Where the results demonstrate a significant change, the estimated national change across total GP Medicare items of services is calculated for each period, to demonstrate the impact of this finding on national GP imaging order activity. Note that extrapolations are always based on the rate per 100 encounters rather than the rate per 100 problems because there is no independent measure of the total number of problems managed in Australian general practice. In contrast, the number of national encounters can be drawn from Medicare claims data.

When extrapolating from a single time period (e.g. Period 1, 2002–05):

- divide the 'rate per 100 encounters' of the selected event by 100, and then multiply by the average annual number of GP service items claimed through Medicare per year in Period 1, rounded to the nearest 100,000, see Table 2.1), to give the estimated average number of the selected event **per year** across Australia in Period 1 (2002–05).

When extrapolating measured change between Period 1 (2002–05) and Period 2 (2009–12) to the national estimated change, we:

- divide the 'rate per 100 encounters' of the selected event for Period 1 by 100, and then multiply by the average annual total GP service items claimed through Medicare, for Period 1 (rounded to the nearest 100,000, see Table 2.1), to give the estimated national annual number of events in **each year** from 2002–03 to 2004–05
- repeat the process using data for 2009–12.

The difference between the two estimates gives the estimated national change in the frequency of that event over the decade. Average annual estimates for the two data periods are rounded to the nearest 10,000.

Change is expressed as the estimated increase or decrease from Period 1 to Period 2, in the average annual number of general practice contacts for that event in the 3 years of Period 2, compared with the same annual average estimate for the 3 years in Period 1.

Table 2.1 provides the average (rounded) number of GP service items claimed from Medicare over the two data periods reported in this study: Period 1 (2002–05), and Period 2 (2009–12). It is clear from these figures that the national average number of visits per year increased. In fact, in the first year of the study period (2002–03) there were 96.9 million visits claimed through Medicare and in the last year (2011–12) there were 123.9 million.[4] This increase reflects more than one additional visit per head of population in 2011–12 than 10 years earlier.

Table 2.1: Rounded average annual number of GP service items claimed from Medicare Australia, in 2002–05 and 2009–12, and total sample size from BEACH for each period

	Period 1: 2002–05	Period 2: 2009–12
Annual average rounded number of MBS GP items of service claimed per year	97,100,000	119,900,000
Total sample of encounters	296,100	293,000

Source: Medicare statistics [4]

Note: MBS – Medicare Benefits Schedule.

Example of extrapolation and estimated national change:

This example estimates the extrapolation of the average change in the annual number of GP encounters at which imaging was ordered in the management of osteoarthritis between Period 1 and Period 2 (see Chapter 6).

How many times was osteoarthritis managed by GPs in Australia on average per year over Period 1?

Locate the number of times it was managed (raw figure), (in this case in Table 6.2 and in the parallel tables in each of chapters 5–8), and divide this figure by the total sample from BEACH for that period (from Table 2.1 above), then multiply by the average annual total claims from Medicare for GP service items (from Table 2.1 above).

Calculation A: (8,857/296,100) x 97,100,000 = 2,904,000

Alternatively you can use the management rate of osteoarthritis (3.0 per 100 encounters from Table 6.3) to calculate the same extrapolation, by dividing it by 100 and multiplying by the total average annual claims to gain the same answer.

Calculation B: (i.e. 3.0/100 x 97,100,000) = 2,913,000

Using this method also allows you to calculate the confidence interval around this estimate: (from Table 6.3 the lower 95% CI was 2.9 per 100 encounters and the upper confidence level was 3.1 per 100. To extrapolate these lower confidence level (LCL) and upper confidence levels (UCL):
LCL = (2.9/100)*97,100,000 = 2,815,900 and UCL = (3.1/100)*97,100,000 = 3,010,100 times

We can then say that the best estimate of the number of times osteoarthritis was managed by GPs on average **per year** in Period 1 was 2.91 million times, and that we are 95% confident that the true estimate lies between 2.82 million and 3.01 million.

However, the figures presented using the two extrapolation methods differ slightly. Calculation A is a more precise extrapolation, and has been used for all extrapolations presented in this report. Calculation B has been presented to allow readers to calculate their own extrapolations. As previously stated, readers should be aware that all extrapolations are estimates and are rounded to the nearest 100,000 or 10,000 (depending on the size of the figure). After rounding, both calculations equate to 2,900,000 occasions of osteoarthritis management in Period 1.

What was the average annual national number of imaging test orders made by GPs in management of osteoarthritis per year in Period 2?

We repeat this calculation for Period 2 (again using results from Table 6.3).

Our best estimate is that osteoarthritis was managed 3.36 million times per year in Period 2 but we are 95% confident that the true number lies between 3.24 million and 3.48 million. We can therefore state that in Period 2, osteoarthritis was managed by GPs in Australia 0.45 million more times per year on average than it was in Period 1, and we are 95% confident that the true increase was between 0.45 million and 0.47 million contacts with this problem per year on average.

How many imaging tests were ordered on average per annum in the two time periods?

We apply the imaging test order rate per 100 osteoarthritis problems managed (from Table 6.3) to estimate that:

In Period 1, there were 14.3 tests ordered per 100 osteoarthritis problems managed (95% CI: 13.4–15.2). We apply this result to the extrapolated estimate above ((14.3/100)*2.91 million) and we estimate that 0.42 million imaging tests were ordered per 100 osteoarthritis problems in Period 1.

The result for Period 2 was 0.62 million tests per annum on average, an increase of about 200,000 per annum between Period 1 and Period 2.

You can also continue, and apply this calculation to the 95% confidence interval.

Limitations of extrapolations

The extrapolations to the total events occurring nationally in any one year are only estimates. They may provide:

- an underestimate of the true 'GP workload' of a condition/treatment because the extrapolations are made to GP Medicare items claimed, not to the total number of GP encounters per year – an additional 5% or so of BEACH encounters annually include encounters paid by sources other than Medicare, such as Department of Veterans' Affairs (DVA), state governments, workers compensation insurance, and employers, or not charged to anyone.
- an underestimate of activities of relatively low frequency with a skewed distribution across individual GPs— a national random sample will provide an underestimate of activity because the sample reflects the population rather than the minority.

Further, the base numbers used in the extrapolations are rounded to the nearest 100,000, and extrapolation estimates are rounded to the nearest 10,000, so can only be regarded as approximations. However, the rounding has been applied to both study periods, so the effect on measures of change will be very small. Therefore, the extrapolation still provides an indication of the size of the effect nationally, of measured change.

Extrapolations are based on the unit of the encounter because the number of national encounters is quantifiable using Medicare claims data. However, the reader should be aware that where an event can occur more than once per encounter, the extrapolation represents the number of times that event occurs in general practice encounters across the country, rather than the number of encounters where that event occurs.

3 The BEACH database

Over the decade investigated in this study (2002–12), 9,802 GPs participated in BEACH, providing details of 980,200 GP–patient encounters. This chapter provides an overview of the whole BEACH database for the two time periods examined in detail (Period 1: April 2002–March 2005 and Period 2: April 2009–March 2012). Readers interested in an overview of the BEACH database for each individual year included in this report can refer to Appendix 4 or the published book *A decade of general practice activity 2002–03 to 2011–12*.[6]

3.1 GP characteristics

Table 3.1 outlines the characteristics of GPs who participated in BEACH during the two time periods. These data were drawn from the BEACH GP profile questionnaire, which participants return with their completed recording forms. Statistical comparisons were made between the two time periods, using both the chi-square statistic (χ^2) (significant at the 5% level) and 95% confidence intervals. As described in Chapter 2, comparisons using the 95% confidence intervals are a more conservative estimate of significance than the chi-square statistic, and are adjusted for the cluster sample study design in BEACH. Therefore all comparisons reported use 95% confidence intervals, although the chi-square statistic is also reported for interest.

Table 3.1 shows the following significant differences between BEACH participants in the two time periods.

- A significantly greater proportion of the GP sample was female in Period 2 (41.0% of participants) than in Period 1 (33.4%).
- A significantly greater proportion of the GP sample was aged 55 years and over in Period 2 (39.3%) than in Period 1 (32.4%), and a significantly smaller proportion aged 35–44 years (19.2% in Period 2, compared with 25.7% in Period 1).
- In Period 2, there were significantly fewer GPs working 45–54 hours (19.2% compared with 24.0% in Period 1) or 55 hours and over (9.7% compared with 15.1% in Period 1).
- There was a general move toward larger group practices, with the proportion of GPs working in practices of 10 or more GPs rising from 12.8% in Period 1 to 20.7% in Period 2, and the proportion in practices of 2–4 GPs decreasing (from 37.6% in Period 1 to 28.3% in Period 2) (Table 3.2).

These differences align with the general changes in characteristics of the total GP workforce over the study period,[6] and so reflect true changes rather than sampling error.

3.2 Characteristics of the patients

The characteristics of all patients sampled during BEACH over the two time periods are described in Table 3.2. Chi-square statistics and confidence intervals are also reported in Table 3.2, with differences assessed according to non-overlapping confidence intervals. In Period 2:

- there were significantly fewer patients in the 5–14, 15–24 and 25–44 year age groups, and more patients in the 65–74 and 75+ age groups than in Period 1

- a smaller proportion of the patients at encounters were new to the practice than in Period 1 (8.1% compared with 10.0%)
- a smaller proportion of patients had a health care card and/or Veterans' Affairs card (46.0% compared with 48.4% in Period 1) (Table 3.2).

These differences again reflect changes seen over the 16 years of the BEACH program, and thus represent true changes in the characteristics of patients seen at general practice encounters in Australia.

Table 3.1: Characteristics of participating GPs and their practices, 2002–05 and 2009–12

	2002–05 (Period 1)				2009–12 (Period 2)			
GP characteristic	Number[(a)]	Per cent of GPs[(a)] (*n* = 2,961)	95% LCL	95% UCL	Number[(a)]	Per cent of GPs[(a)] (*n* = 2,930)	95% LCL	95% UCL
Sex (missing *n*) (χ^2 = 36.33, *p* = <0.001)	(0)				(0)			
Male	1,973	66.6	64.9	68.3	1,730	59.0	57.3	60.8
Female	988	33.4	31.7	35.1	1,200	41.0	39.2	42.7
Age (missing *n*) (χ^2 = 48.02, *p* = <0.001)	(2)				(17)			
< 35 years	218	7.4	6.4	8.3	197	6.8	5.9	7.7
35–44 years	760	25.7	24.1	27.3	559	19.2	17.8	20.6
45–54 years	1,023	34.6	32.9	36.3	1,012	34.7	33.0	36.5
55+ years	958	32.4	30.7	34.1	1,145	39.3	37.5	41.1
Direct patient care hours worked (missing *n*) (χ^2 = 77.36, *p* = <0.001)	(69)				(44)			
<= 20 hours	299	10.3	9.2	11.4	321	11.1	10.0	12.3
21–34 hours	571	19.7	18.3	21.2	732	25.4	23.8	27.0
35–44 hours	891	30.8	29.1	32.5	999	34.6	32.9	36.4
45–54 hours	693	24.0	22.4	25.5	555	19.2	17.8	20.7
55+ hours	438	15.1	13.8	16.5	279	9.7	8.6	10.7
Size of practice – number of individual GPs (missing *n*) (χ^2 = 101.20, *p* = <0.01)	(24)				(39)			
Solo	358	12.2	11.0	13.4	296	10.2	9.1	11.3
2–4	1,103	37.6	35.8	39.3	819	28.3	26.7	30.0
5–9	1,101	37.5	35.7	39.2	1,178	40.7	39.0	42.5
10+	375	12.8	11.6	14.0	598	20.7	19.2	22.2
Practice location by ASGC (missing *n*) (χ^2 = 7.23, *p* = 0.027)	(4)				(5)			
Major cities	1,995	67.4	65.8	69.1	2,047	70.0	68.3	71.6
Inner regional	601	20.3	18.9	21.8	582	19.9	18.4	21.3
Outer regional/remote	361	12.2	11.0	13.4	296	10.1	9.0	11.2

(a) Missing data removed.

Note: LCL – lower confidence limit; UCL – upper confidence limit; ASGC – Australian Standard Geographical Classification.

Table 3.2: Characteristics of the patients at encounters, 2002–05 and 2009–12

	2002–05 (Period 1)				2009–12 (Period 2)			
Patient characteristic	**Number[(a)]**	**Per cent (*n* = 296,100)**	**95% LCL**	**95% UCL**	**Number[(a)]**	**Per cent (*n* = 293,000)**	**95% LCL**	**95% UCL**
Sex (missing *n*) (χ^2 = 17.09, *p* = <0.001)	(2,732)	—	—	—	(2,625)	—	—	—
Male	119,948	40.9	40.4	41.4	117,181	40.4	39.9	40.9
Female	173,420	59.1	58.6	59.6	173,194	59.6	59.1	60.1
Age (missing *n*) (χ^2 = 721.68, *p* = <0.001)	(2,792)	—	—	—	(2,244)	—	—	—
<1	5,619	1.9	1.8	2.0	5,906	2.0	1.9	2.1
1–4	13,176	4.5	4.3	4.6	13,384	4.6	4.5	4.8
5–14	16,933	5.8	5.6	5.9	15,525	5.3	5.2	5.5
15–24	27,965	9.5	9.3	9.8	24,921	8.6	8.4	8.8
25–44	72,507	24.7	24.3	25.1	66,933	23.0	22.6	23.4
45–64	79,816	27.2	26.9	27.5	80,516	27.7	27.4	28.0
65–74	35,432	12.1	11.8	12.3	37,459	12.9	12.6	13.1
75+	41,860	14.3	13.8	14.7	46,112	15.9	15.4	16.3
Status to the practice (missing *n*) (χ^2 = 642.02, *p* = <0.001)	(6,167)	—	—	—	(4,268)	—	—	—
New patient to practice	29,051	10.0	9.6	10.4	23,408	8.1	7.7	8.5
Health care/VA card status (missing *n*) (χ^2 = 318.64, *p* = <0.001)	(27,478)	—	—	—	(23,445)	—	—	—
Has a HCC/VA card	130,020	48.4	47.6	49.2	123,923	46.0	45.2	46.8
Language status (missing *n*) (χ^2 = 54.4, *p* = <0.001)	(31,834)	—	—	—	(28,730)	—	—	—
Non-English-speaking background	23,647	8.9	8.2	9.7	22,139	8.4	7.7	9.0
Indigenous status (missing *n*) (χ^2 = 58.5, *p* = <0.001)	(32,711)	—	—	—	(28,722)	—	—	—
Aboriginal and/or Torres Strait Islander	5,385	2.0	1.7	2.4	4,643	1.8	1.5	2.1

(a) Missing data removed.

Note: UCL—upper confidence limit; LCL—lower confidence limit; HCC – Health Care Card; VA – Veterans' Affairs.

3.3 Content of the encounters

Table 3.3 provides a summary of the content of GP–patient encounters in Period 1 and Period 2. This table is divided into two sections—one section showing encounter-based analysis and the other problem-based analysis. Significant differences between Period 1 and Period 2 are highlighted.

The number of reasons for encounter given by patients significantly increased from 151.1 per 100 encounters in Period 1, to 155.8 in Period 2. The number of problems managed per 100 encounters also significantly increased from 149.1 to 157.6 per 100 encounters. This suggests that any significant change from Period 1 to Period 2 in a management action (such as ordering imaging) per 100 encounters may simply reflect the overall increase in the number of problems managed per encounter.

We account for this by also reporting the rates per 100 problems managed, and these results are used as the basis for reporting all changes in management actions. However, we also report the rate of each management action per 100 encounters because this forms the basis of extrapolations of the national effect of change in GP behaviour.

There was a significant decrease in the rate of medications recorded per 100 problems managed between Period 1 and Period 2. This was reflected by a decrease in the rate of medications prescribed, from 55.9 per 100 problems to 52.5 per 100 problems. In contrast, the rate of medications supplied by the GP directly to the patient significantly increased from 6.2 per 100 problems to 7.7 per 100 (Table 3.4).

The rate of clinical treatments (including counselling, advice and education) decreased between Period 1 and Period 2, from 26.3 per 100 problems to 23.9 per 100 problems. However the rate of procedures increased from 10.4 per 100 problems to 11.3 per 100 over the two time periods.

Increases were shown in the overall rate of referrals per 100 problems managed, from 8.1 per 100 problems in Period 1 to 9.5 per 100 in Period 2, reflected in increases in referrals to both specialists and to allied health services. Orders for pathology tests also significantly increased from 25.4 per 100 problems in Period 1 to 31.8 per 100 problems managed in Period 2.

Orders for imaging tests increased from 5.9 per 100 problems managed in Period 1, to 6.5 per 100 in Period 2, an increase of 10.2%. However, the rate per 100 encounters increased by 17.2% (being influenced by the increasing number of problems managed at encounters).

Detailed analyses about imaging test ordering in the two time periods are described in Chapter 4.

Table 3.3: Summary of morbidity and management at GP–patient encounters, 2002–05 and 2009–12

	ENCOUNTERS				PROBLEMS	
	2002–05 (Period 1)		2009–12 (Period 2)		2002–05 (Period 1)	2009–12 (Period 2)
Variable	Number (*n* = 296,100)	Rate per 100 encounters (95% CI)	Number (*n* = 293,000)	Rate per 100 encounters (95% CI)	Rate per 100 problems (95% CI)	Rate per 100 problems (95% CI)
General practitioners	2,961	—	2,930	—	—	—
Encounters	296,100	—	293,000	—	—	—
Reasons for encounter	447,432	151.1 (150.2–152.0)	456,398	155.8 (154.8–156.7)	—	—
Problems managed	441,591	149.1 (148.1–150.2)	461,761	157.6 (156.4–158.8)	—	—
New problems	166,704	56.3 (55.6–57.0)	173,427	59.2 (58.5–59.9)	37.8 (37.3–38.2)	37.6 (37.1–38.0)
Chronic problems	153,593	51.9 (51.0–52.8)	160,933	54.9 (53.9–55.9)	34.8 (34.3–35.2)	34.9 (34.4–35.3)
Medications	302,735	102.2 (101.0–103.5)	307,136	104.8 (103.5–106.1)	68.6 (67.8–69.3)	66.5 (65.8–67.2)
Prescribed	246,691	83.3 (82.1–84.6)	242,515	82.8 (81.6–84.0)	55.9 (55.1–56.6)	52.5 (51.8–53.2)
GP-supplied	27,405	9.3 (8.7–9.8)	35,388	12.1 (11.5–12.6)	6.2 (5.8–6.6)	7.7 (7.3–8.0)
Advised OTC	28,639	9.7 (9.3–10.0)	29,233	10.0 (9.6–10.4)	6.5 (6.2–6.7)	6.3 (6.1–6.6)
Other treatments[(a)]	162,307	54.8 (53.6–56.1)	162,603	55.5 (54.2–56.8)	36.8 (36.0–37.5)	35.2 (34.5–36.0)
Clinical*	116,225	39.3 (38.2–40.3)	110,545	37.7 (36.6–38.9)	26.3 (25.6–27.0)	23.9 (23.3–24.6)
Procedural*	46,082	15.6 (15.1–16.0)	52,058	17.8 (17.3–18.2)	10.4 (10.1–10.7)	11.3 (11.0–11.5)

(continued)

Table 3.3 (continued): Summary of morbidity and management at GP–patient encounters, 2002–05 and 2009–12

	ENCOUNTERS				PROBLEMS	
	2002–05 (Period 1)		2009–12 (Period 2)		2002–05 (Period 1)	2009–12 (Period 2)
Variable	Number (*n* = 296,100)	Rate per 100 encounters (95% CI)	Number (*n* = 293,000)	Rate per 100 encounters (95% CI)	Rate per 100 problems (95% CI)	Rate per 100 problems (95% CI)
Referrals	35,877	12.1 (11.9–12.4)	43,994	15.0 (14.7–15.3)	8.1 (8.0–8.3)	9.5 (9.4–9.7)
Medical specialist*	24,002	8.1 (7.9–8.3)	26,799	9.1 (8.9–9.3)	5.4 (5.3–5.6)	5.8 (5.7–5.9)
Allied health services*	8,435	2.8 (2.7–3.0)	13,666	4.7 (4.5–4.8)	1.9 (1.8–2.0)	3.0 (2.9–3.0)
Hospital*	1,680	0.6 (0.5–0.6)	1,070	0.4 (0.3–0.4)	0.4 (0.3–0.4)	0.2 (0.2–0.3)
Emergency department*	485	0.2 (0.1–0.2)	857	0.3 (0.3–0.3)	0.1 (0.1–0.1)	0.2 (0.2–0.2)
Other referrals*	1,247	0.4 (0.4–0.5)	1,602	0.5 (0.5–0.6)	0.3 (0.3–0.3)	0.3 (0.3–0.4)
Pathology	112,072	37.8 (37.0–38.7)	146,730	50.1 (49–51.1)	25.4 (24.9–25.9)	31.8 (31.2–32.4)
Imaging	25,863	8.7 (8.5–9.0)	29,996	10.2 (10.0–10.5)	5.9 (5.7–6.0)	6.5 (6.4–6.6)
Other investigations[(b)]	3,208	1.1 (1.0–1.1)	2,602	0.9 (0.8–0.9)	0.7 (0.7–0.8)	0.6 (0.5–0.6)

(a) Other treatments include treatment given by practice nurses in the context of the GP–patient encounter and treatment given by GPs.

(b) Other investigations reported here include only those ordered by the GP.

* Includes multiple ICPC-2 or ICPC-2 PLUS codes (see Tables A4.4 to A4.7 available from Appendix 4 <http://hdl.handle.net/2123/9365>).

Note: CI – confidence interval; OTC – over-the-counter. Highlighting indicates significant change in the rate per 100 problems between Period 1 and Period 2.

4 Imaging test ordering by GPs

This chapter provides an overview of the imaging tests ordered by GPs, with comparisons between Period 1 (2002–05) and Period 2 (2009–12).

Table 4.1 shows that the vast majority of GPs recorded at least one imaging test over their 100 encounters, and that the proportion who ordered imaging at least once significantly increased between Period 1 and Period 2, from 97.7% in Period 1 to 98.9% in Period 2.

The number of imaging tests ordered per 100 encounters significantly increased from 8.7 (95% CI: 8.5–9.0) per 100 encounters in Period 1, to 10.2 (95% CI: 10.0–10.5) per 100 in Period 2. Extrapolating this result to the average number of GP–patient encounters claimed through Medicare per year in each of the time periods (see Chapter 2, Methods) suggests that in Period 1 there were about 8.45 million (95% CI: 8.25–8.74) imaging tests ordered by GPs per year, and in Period 2, 12.23 million (95% CI: 12.0–12.58) per year, an increase of 44.7%, or about 3.78 million test more orders per year on average over the 3 years of Period 2. The likelihood of an imaging order being placed at encounter increased by 15.8%, from 7.6% in Period 1 to 8.8% in Period 2. There was no change in the average number of imaging tests ordered per 100 tested problems, (111.0 in Period 1 and 112.1 in Period 2), which suggests that the growth in ordering was largely due to an increased likelihood of testing.

Table 4.1: Summary of imaging test order rates 2002–05 and 2009–12

BEACH data set	2002–05 (Period 1)	2009–12 (Period 2)
Number of participating GPs	2,960	2,930
Number of encounters	296,000	293,000
Number of problems managed	441,591	461,761
Number of GPs who ordered at least one imaging test in their 100 encounters	2,892	2,898
Per cent of all participating GPs ordering at least one imaging test (95% CI)	97.7 (97.1–98.2)	98.9 (98.5–99.3)
Total imaging test orders		
Number of imaging test orders	25,863	29,996
Imaging order rate per 100 encounters (95% CI)	8.7 (8.5–9.0)	10.2 (10.0–10.5)
Imaging order rate per 100 problems (95% CI)	5.9 (5.7–6.0)	6.5 (6.4–6.6)
At least one imaging order		
Number of encounters with at least one imaging order	22,445	25,697
Per cent of all encounters that involved at least one imaging order (95% CI)	7.6 (7.4–7.8)	8.8 (8.6–8.9)
Number of problems managed with at least one imaging order	23,291	26,755
Per cent of problems managed that involved at least one imaging order (95% CI)	5.3 (5.1–5.4)	5.8 (5.7–5.9)
Average number of imaging tests ordered per 100 tested problems	111.0	112.1

Note: GP – general practitioner; CI – confidence interval. Highlighting indicates a significant difference between data periods.

There was a 10% increase in the proportion of all problems managed that involved at least one imaging order, from 5.3% in Period 1 to 5.8% in Period 2 (Table 4.1). The order rate per 100 problems managed also increased between the two time periods, from 5.9 per 100 problems in Period 1 to 6.5 per 100 in Period 2.

This result is reflected in Figure 4.1, which shows the proportion of GPs who ordered imaging tests as a rate per 100 problems managed. It indicates an overall increase in imaging test ordering in the GP profession across the lower and middle range of the ordering spectrum, with order rates relatively steady for those GPs who ordered most frequently.

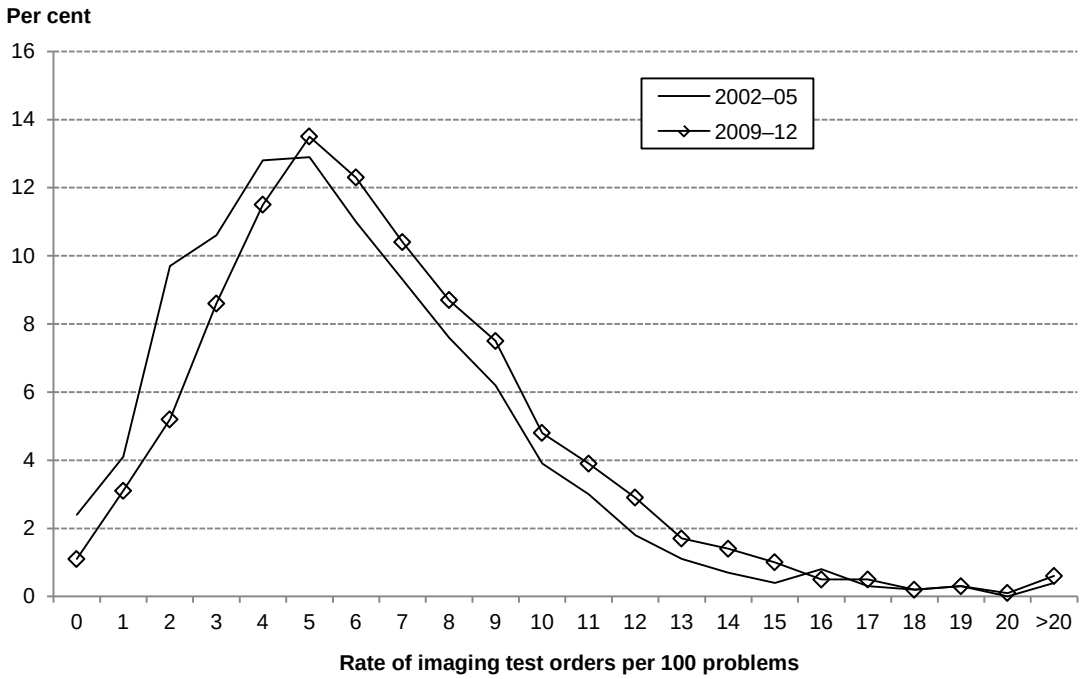

Figure 4.1: Distribution of GP imaging test order rates per 100 problems managed, 2002–05 and 2009–12

4.1 Imaging tests ordered by Medicare group

Table 4.2 shows the changes between Period 1 and Period 2 in imaging orders by Medicare imaging group as a rate per 1,000 problems managed. Analyses reported in Table 4.2 have been conducted per 1,000 problems rather than per 100 problems, as some of the rates presented in this table are relatively small.

The GP order rate for imaging tests increased significantly between the two time periods, from 58.6 to 65.0 per 1,000 problems. Diagnostic radiology was the imaging type recorded most often in both time periods, although there was a significant decrease in the diagnostic radiology order rate from Period 1 (32.7 per 1,000 problems) to Period 2 (29.8 per 1,000). This decrease was reflected in falls in order rates for x-rays of the chest, ankle, lumbosacral spine, cervical spine and marginal fall for finger/thumb. In contrast, the order rate for densitometry tests increased from 1.6 per 1,000 problems in Period 1 to 1.9 in Period 2.

Orders for ultrasound increased by 37.4% from Period 1 (17.1 per 1,000 problems) to Period 2 (23.5 per 1,000). Pelvic ultrasounds were the most often ordered, increasing from 3.7 per

1,000 problems in Period 1 to 4.5 per 1,000 in Period 2, an increase of 21.6%. The greatest increase was in orders for shoulder ultrasounds, which grew by 68.8% between the two time periods (from 1.6 to 2.7 per 1,000 problems). Ultrasounds of the renal tract decreased, from 0.7 per 1,000 problems in Period 1 to 0.4 per 1,000 in Period 2.

Computerised tomography (CT) scans grew by 25.4% between Period 1 and Period 2, from 5.9 per 1,000 problems to 7.4 per 1,000. This increase was reflected in orders for CT scans of the abdomen (0.7 per 1,000 in Period 1 and 1.0 per 1,000 in Period 2) and lumbar spine CT scans (0.6 per 1,000 and 0.8 per 1,000 problems managed).

Magnetic resonance imaging (MRI) increased from 0.3 per 1,000 problems in Period 1 to 1.0 per 1,000 in Period 2, representing growth of 333%. Reasons for this growth will be discussed in Section 13.4. An increase in other tests was reflected in the ordering rate for echocardiography, which rose by 57.1% (from 0.7 per 1,000 problems to 1.1 per 1,000).

Table 4.2: Imaging orders by Medicare imaging groups (rate per 1,000 problems), 2002–05 and 2009–12

Imaging type	Rate per 1,000 problems (95% CI)	
	2002–05 (Period 1) (*n* = 441,591)	2009–12 (Period 2) (*n* = 461,761)
Diagnostic radiology	**32.7 (31.7–33.7)**	**29.8 (29.0–30.6)**
X-ray; chest	7.3 (6.9–7.7)	6.5 (6.2–6.9)
X-ray; knee	2.9 (2.7–3.1)	3.0 (2.8–3.2)
Mammography; F	3.0 (2.6–3.4)	2.5 (2.3–2.7)
Densitometry	1.6 (1.4–1.7)	1.9 (1.8–2.1)
X-ray; foot/feet	1.5 (1.4–1.6)	1.6 (1.5–1.8)
X-ray; hip	1.5 (1.3–1.6)	1.6 (1.5–1.7)
X-ray; shoulder	1.4 (1.3–1.6)	1.6 (1.5–1.7)
X-ray; ankle	1.4 (1.3–1.5)	1.1 (1.0–1.2)
X-ray; spine; lumbosacral	1.2 (1.1–1.4)	0.7 (0.6–0.8)
X-ray; wrist	1.1 (1.0–1.2)	1.0 (0.9–1.1)
X-ray; hand	0.9 (0.8–1.0)	0.9 (0.8–1.0)
X-ray; spine; cervical	0.8 (0.8–0.9)	0.6 (0.5–0.6)
X-ray; finger/thumb(s)	0.7 (0.7–0.8)	0.6 (0.6–0.7)
X-ray; spine; lumbar	0.7 (0.6–0.8)	0.7 (0.6–0.8)
X-ray; abdomen	0.6 (0.5–0.7)	0.6 (0.5–0.7)

(continued)

Table 4.2 (continued): Imaging orders by Medicare imaging groups (rate per 1,000 problems), 2002–05 and 2009–12

Imaging type	Rate per 1,000 problems (95% CI)	
	2002–05 (Period 1) (*n* = 441,591)	2009–12 (Period 2) (*n* = 461,761)
Ultrasound	**17.1 (16.4–17.8)**	**23.5 (22.9–24.1)**
Ultrasound; pelvis	3.7 (3.4–4.0)	4.5 (4.2–4.8)
Ultrasound; breast; F	2.0 (1.6–2.4)	2.3 (2.1–2.4)
Ultrasound; abdomen	2.0 (1.8–2.1)	2.5 (2.4–2.7)
Ultrasound; shoulder	1.6 (1.4–1.7)	2.7 (2.5–2.9)
Ultrasound; obstetric	1.5 (1.4–1.7)	2.0 (1.8–2.2)
Ultrasound; renal tract	0.7 (0.6–0.8)	0.4 (0.3–0.5)
Ultrasound; NOS	0.7 (0.6–0.8)	0.3 (0.2–0.4)
Ultrasound; abdomen upper	0.7 (0.6–0.7)	0.6 (0.5–0.7)
Computerised tomography	**5.9 (5.6–6.2)**	**7.4 (7.1–7.8)**
CT scan; brain	1.1 (1.0–1.2)	1.1 (1.0–1.2)
CT scan; abdomen	0.7 (0.6–0.8)	1.0 (0.9–1.1)
CT scan; head	0.7 (0.6–0.8)	0.7 (0.6–0.7)
CT scan; spine; lumbar	0.6 (0.5–0.6)	0.8 (0.8–0.9)
CT scan; spine; lumbosacral	0.6 (0.5–0.6)	0.5 (0.4–0.5)
Magnetic resonance imaging	**0.3 (0.2–0.3)**	**1.0 (0.9–1.1)**
Nuclear medicine imaging	**0.8 (0.7–0.9)**	**0.7 (0.6–0.8)**
Scan; bone(s)	0.6 (0.5–0.7)	0.4 (0.3–0.5)
Other tests	**1.7 (1.6–1.9)**	**2.5 (2.3–2.6)**
Echocardiography	0.7 (0.6–0.8)	1.1 (1.0–1.2)
Test; Doppler	0.7 (0.6–0.8)	0.8 (0.7–0.9)
Total imaging tests	**58.6 (57.0–60.1)**	**65.0 (63.6–66.3)**

Note: CI – confidence interval; CT – computerised tomography; NOS – not otherwise specified. Highlighting indicates a significant difference between data periods.

4.2 Predictors of GP imaging test ordering at encounter

We estimated that nationally, the average annual number of GP imaging test orders increased from 8.45 million in Period 1 to 12.23 million in Period 2. Some of this growth would be due to the increasing visit rate of the population and the resulting increase in the total number of claims from Medicare for GP items of service. If there had been no change in the ordering behaviour of the GPs, using the order rate from Period 1 we can extrapolate the order rate for Period 1 to total claims in Period 2. We found that the increased population attendance rate alone would have resulted in 10.43 million tests on average per year in Period 2 with no change in GP ordering behaviour. Since the true extrapolated estimate was 12.23 million in Period 2, we can conclude that 1.8 million of the estimated average 3.8 million extra imaging tests ordered each year in Period 2 (compared with Period 1), were due to the increasing attendance rate of the population. The remaining 2 million per year extra test orders therefore must be due to changes in other factors including (but not limited to):

- the likelihood of testing a problem
- an increase in the number of tests ordered when the decision to test is made
- characteristics of GPs and their practices
- characteristics of patients seeing a GP (in terms of workload distribution)
- the content of the encounters, including number and types of problems managed.

We have earlier demonstrated in this chapter that there was a significant increase in the likelihood of GPs ordering at least one imaging test for a problem and we have also shown that once the decision to test was made there was no change between Period 1 and Period 2 in the number of tests ordered per 100 problems managed.

In Chapter 3 we demonstrated that compared with GPs in Period 1, those participating in Period 2 were older, more often female, and worked at practices that were on average larger. We also showed that patients at encounters in Period 2 were older, less likely to be new to the practice and less likely to hold a concession health card.

The content of the GP–patient encounters also changed from Period 1 to Period 2, the latter being more complex, involving more patient reasons for encounter, more problems managed (including more new problems and more chronic problems) (see Chapter 3).

In this section we seek to identify those factors which best predict GP imaging test ordering in Period 2, as this may help us to understand some of the reasons for the increase in imaging tests ordered, that are unrelated to the increased national visit rate. We used logistic regression at the univariate level, followed by multivariate analysis (see Chapter 2).

In this analysis, logistic regression was used with 'at least one imaging test ordered at the encounter' (No = 0, Yes = 1) as the outcome variable, with the following independent (explanatory) groups:

- GP/practice characteristics
- patient characteristics
- encounter characteristics.

Logistic regression

In logistic regression, results can be expressed as odds ratios where one group is used as the reference group. If the 95% confidence intervals around the odds ratio (OR) do not include

1.0, the difference between the group under investigation and the reference group is statistically significant. An odds ratio of 1.0 implies that the event is equally likely in both groups. For example, an odds ratio of 1.3 (OR=1.32, 95% CI: 1.26–1.38) is interpreted as: this event is 30% more likely at encounters with GPs/patients/encounters with this characteristic than at those without this characteristic.

Multivariate analysis

The multiple variables collected in BEACH necessitated adjustment for multiple potential confounding variables. This allows us to determine whether there were independent associations between GPs' imaging test ordering and specific characteristics of the GPs (e.g. their age and sex), their practices, and/or the types of patients and problems they manage.

To select the best regression model for each group of characteristics, the model was reduced using stepwise elimination: all predictor variables are fitted into the model, and the non-significant variables are eliminated in turn, (starting with the least significant variable) and the model refitted. The process stops when all the retained odds ratios are significant.

Descriptive univariate analyses were performed using SAS V9.3,[65] adjusting for the cluster design. Stata version 11[70] was used for univariate and multivariate logistic regression, also adjusting for the cluster design. Variables were significant at $p < 0.05$.

The variables included in the simple logistic regression within each group are listed in Box 1. Those marked with ✦ are those retained in the final model.

Box 1: Characteristics of GPs, patients and encounters used in multiple regression analyses

GP/practice characteristics
• GP sex✦ • GP age (<35 yrs; 35–44 yrs; 45–54 yrs; 55–64 yrs; 65+ yrs) ✦ • Fellowship of Royal Australian College of General Practitioners • Place of graduation for primary medical degree (Australia/overseas) • Co-located imaging service at practice✦ • Size of practice✦ • Location of practice
Patient characteristics
• Patient sex✦ • Patient age (<15 yrs; 15–24 yrs; 25–44 yrs; 45–64 yrs; 65–74 yrs; 75+ yrs) ✦ • Indigenous status • Concession card holder status (HCC and/or DVA) ✦ • Non-English-speaking background status • New patient to practice status✦
Encounter characteristics
• Number of problems managed✦ • Morbidity managed (presence/absence of 1+ problem managed in each ICPC-2 chapter ✦

✦ Denotes variables retained in the final multivariate regression model.

Note: HCC – Health Care Card; DVA – Department of Veterans' Affairs.

Results

The results of the univariate (unadjusted) and multivariate (adjusted) analyses are presented in Table 4.3. The positive predictive variables identified in the unadjusted analysis did not change after adjustment for all other confounding variables.

Only the adjusted results are summarised here.

Positive predictors of GP imaging ordering

GP and practice characteristics

- GP female – after adjustment, female GPs were 12% (OR: 1.12, 95% CI: 1.07–1.17) more likely to order at least one imaging test at encounters than male GPs (Ref: male GPs).
- GP aged 35–44 years (OR: 1.10, 95% CI: 1.01–1.19) (Ref: age <35 years).
- GP working in practice of 2–9 GPs (OR: 1.10, 95% CI: 1.01–1.19) (Ref: solo).
- GP working in practice with a co-located imaging service (i.e. imaging service is located in the practice premises or within 50 metres) (OR: 1.10, 95% CI: 1.03–1.08) (Ref: practice not co-located).

Patient characteristics

- Female (OR: 1.04, 95% CI: 1.00–1.07) (Ref: Male).
- Age group: the likelihood of ordering imaging was significantly higher at encounters with all age groups than at encounters with children aged less than 15 years. The patient age group with the strongest predictive value was 45–64 years (1.94, 95% CI: 1.81–2.07) followed by 65–74 years (OR: 1.89) and then 25–44 years (OR: 1.77).
- Patients who were new to the practice at the encounter (OR: 1.40, 95% CI: 1.30–1.51).

Encounter characteristics

- Number of problems managed
  For each additional problem managed the odds of an imaging order resulting from the encounter increased by 41% (OR: 1.41, 96% CI: 1.36–1.48).
- The types of problems managed at the encounter
  By far the strongest predictor of imaging test ordering at encounter was the management of one or more musculoskeletal problems—there was a 372% higher likelihood of an order for imaging (OR: 3.72, 95% CI: 3.52–3.93) than at encounters where no musculoskeletal problem was managed. Other positive predictors were management of:
  - pregnancy and family planning (OR: 1.60)
  - urinary problem(s) (OR: 1.32)
  - neurological problem(s) (OR: 1.33)
  - digestive problem(s) (OR: 1.18)
  - female genital problem(s) (OR: 1.97) and male genital problem(s) (OR: 1.36).

Negative predictors of GP imaging ordering

- Patient holds a health concession card (OR: 0.88)
- The encounter involved management of at least one:
  - psychological problem (OR: 0.41)
  - ear problem (OR: 0.42)
  - eye problem (OR: 0.42)

- skin problem (OR: 0.59)
- endocrine problem (OR: 0.64)
- respiratory problem (OR: 0.73).

Table 4.3: Univariate and multivariate analysis of likelihood of GP imaging ordering, 2009–12

	Odds ratio of imaging order at encounter against reference group						
	Univariate			Multivariate			Direction of odds ratio
Explanatory variable – characteristic	Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value	
GP/practice characteristics							
GP sex Ref = Male							
Female	1.25	1.20–1.31	<0.001	1.12	1.07–1.17	<0.001	↑
GP age Ref = <35 yrs							
35–44 yrs	1.11	1.02–1.21	0.018	1.10	1.01–1.19	0.038	↑
45–54 yrs	1.07	0.98–1.16	0.104	1.04	0.96–1.12	0.378	—
55–64 yrs	0.98	0.90–1.07	0.662	0.97	0.89–1.06	0.455	—
65+ yrs	0.95	0.86–1.05	0.334	0.99	0.89–1.10	0.879	—
Size of practice Ref = solo GP							
2–9 GPs	1.17	1.08–1.26	<0.001	1.10	1.01–1.19	0.024	↑
10+ GPs	1.19	1.09–1.29	<0.001	1.07	0.98–1.18	0.123	—
Co-located imaging Ref = No							
Yes	1.13	1.06–1.20	<0.001	1.10	1.03–1.18	0.003	↑
Patient characteristics							
Patient sex Ref = Male							
Female	0.51	0.36–0.72	<0.001	1.04	1.00–1.07	0.039	↑
Patient age Ref = 0–14 yrs							
15–24 yrs	2.14	1.99–2.30	<0.001	1.49	1.38–1.62	<0.001	↑
25–44 yrs	2.70	2.54–2.88	<0.001	1.77	1.65–1.89	<0.001	↑
45–64 yrs	2.97	2.80–3.16	<0.001	1.94	1.81–2.07	<0.001	↑
65–74 yrs	2.59	2.42–2.77	<0.001	1.89	1.75–2.04	<0.001	↑
75+ yrs	1.86	1.74–1.99	<0.001	1.46	1.34–1.59	<0.001	↑
Concession card holder Ref = non-card holder							
Concession. card holder	0.86	0.83–0.89	<0.001	0.88	0.84–0.91	<0.001	↓
Patient status to practice Ref = seen previously							
New patient	1.19	1.11–1.28	<0.001	1.40	1.30–1.51	<0.001	↑

(continued)

Table 4.3 (continued): Univariate and multivariate analysis of likelihood of GP imaging ordering, 2009–12

Explanatory variable – characteristic	Odds ratio of imaging order at encounter against reference group						Direction of odds ratio
	Univariate			Multivariate			
	Odds ratio	95% CI	*p* value	Odds ratio	95% CI	*p* value	
Encounter characteristics							
No. of problems managed at encounter Ref = 1,2,3,4							
Per additional problem	1.31	1.29–1.34	<0.001	1.41	1.36–1.48	<0.001	↑
At least one problem in following ICPC-2 Chapters Ref = No							
General/unspecified	0.72	0.69–0.75	<0.001	0.67	0.63–0.72	<0.001	↓
Digestive	1.34	1.28–1.39	<0.001	1.18	1.11–1.26	<0.001	↑
Eye	0.45	0.40–0.51	<0.001	0.42	0.36–0.48	<0.001	↓
Ear	0.38	0.35–0.42	<0.001	0.42	0.38–0.47	<0.001	↓
Circulatory	0.82	0.79–0.85	<0.001	0.64	0.60–0.69	<0.001	↓
Musculoskeletal	4.76	4.60–4.92	<0.001	3.72	3.52–3.93	<0.001	↑
Neurological	1.54	1.45–1.63	<0.001	1.33	1.23–1.44	<0.001	↑
Psychological	0.53	0.50–0.56	<0.001	0.41	0.38–0.44	<0.001	↓
Respiratory	0.67	0.64–0.70	<0.001	0.73	0.69–0.78	<0.001	↓
Skin	0.62	0.59–0.65	<0.001	0.59	0.55–0.62	<0.001	↓
Endocrine/metabolic	0.87	0.83–0.91	<0.001	0.64	0.60–0.68	<0.001	↓
Urinary	1.43	1.34–1.53	<0.001	1.32	1.21–1.43	<0.001	↑
Pregnancy, family planning	1.74	1.65–1.87	<0.001	1.60	1.47–1.74	<0.001	↑
Female genital	2.65	2.53–2.77	<0.001	1.97	1.85–2.11	<0.001	↑
Male genital	1.33	1.21–1.47	<0.001	1.36	1.22–1.53	<0.001	↑
Social	0.59	0.49–0.70	<0.001	0.44	0.37–0.53	<0.001	↓

Note: CI – confidence interval; Ref – reference category. Highlighting indicates a significant difference between data periods.

We can conclude from these results that the proportion of the increase in imaging test ordering not explained by the increased GP visit rate between Period 1 and Period 2 can be partially explained by the increases in variables that have higher predictive value of GP imaging ordering. Namely:

- the proportion of GPs that were female (see Chapter 3, Table 3.1)
- the proportion of patients encountered who were aged 25–44, 45–64, and 65–74 years (see Chapter 3, Table 3.2)
- the increasing numbers of problems managed at encounter (see Appendix 4, Table A4.1)
- increases between 2002–03 and 2011–12 in the management rate of musculoskeletal problems, digestive problems, and urological problems (see published results in *A decade of general practice activity 2002–03 to 2011–12*[6]).

This then combines with the overall significant increase in likelihood of testing the problem managed (reported earlier in this chapter), to result in increased numbers of imaging tests ordered across the country.

4.3 Problems for which imaging tests were ordered

Table 4.4 lists the problems for which imaging was frequently ordered, the proportion of each problem that resulted in an imaging test, and the imaging test order rate per 100 specified problems when at least one test was ordered.

Imaging orders for back problems accounted for 6.9% of all imaging orders in Period 1, falling to 5.9% in Period 2. However, there was no change in the proportion of back problems investigated using imaging between the two time periods.

The proportion of osteoarthritis problems for which imaging was ordered increased from Period 1 (12.4%) to Period 2 (16.0%), but this was not reflected in any change in the proportion of total imaging orders that was attributable to osteoarthritis (see Table 4.4).

There were increases in both the proportion of imaging orders attributed to a problem and in the proportion of problems for which imaging was ordered, for each of the following problems:

- pregnancy and related check-ups
- shoulder problems (excluding arthritis and osteoarthritis)
- bursitis/tendonitis/synovitis NOS
- menstrual problems.

Table 4.4: The problems for which an imaging test was most frequently ordered, 2002–05 and 2009–12

	Period 1 (2002–05)					Period 2 (2009–12)				
Problem managed	Number of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per 100 tested problems[c]	Number of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per 100 tested problems[c]
Back problems*	11,146	1,800	6.9 (6.5–7.3)	13.9 (13.1–14.6)	116.4	10,584	1,776	5.9 (5.5–6.2)	14.5 (13.7–15.2)	116.0
Osteoarthritis (excl back)*	8,857	1,264	4.8 (4.5–5.2)	12.4 (11.7–13.2)	115.0	8,329	1,537	5.1 (4.8–5.4)	16.0 (15.1–16.9)	115.3
Pregnancy & related check-ups*	4,887	754	2.9 (2.5–3.3)	15.4 (13.6–17.2)	100.3	5,027	1,199	4.0 (3.6–4.3)	23.3 (21.8–24.8)	102.4
Shoulder problems (excl arthritis/OA)*	2,161	703	2.7 (2.4–3.0)	24.2 (22.3–26.2)	134.2	2,637	1,173	3.9 (3.6–4.1)	33.2 (31.3–35.2)	133.9
Fracture (excl head/back)*	2,936	1,245	4.8 (4.4–5.1)	39.1 (37.1–41.1)	108.4	2,586	1,012	3.3 (3.1–3.6)	36.2 (34.2–38.2)	108.1
Sprain/Strain (excl back)*	3,249	696	3.1 (2.8–3.3)	21.4 (19.9–23.0)	115.5	2,861	940	3.1 (2.8–3.4)	26.7 (25.0–28.5)	122.9
Bursitis/tendonitis/ synovitis NOS	2,751	499	1.9 (1.7–2.1)	15.6 (14.2–17.0)	116.3	3,260	911	3.0 (2.8–3.2)	23.6 (22.1–25.2)	118.3
Abdominal pain*	2,053	729	2.8 (2.6–3.0)	31.4 (29.3–33.5)	113.0	2,182	905	3.0 (2.8–3.2)	36.1 (34.0–38.1)	115.0
Knee problems*	1,437	506	1.9 (1.7–2.1)	33.1 (30.6–35.6)	106.3	1,668	664	2.2 (2.0–2.4)	35.9 (33.5–38.3)	110.9
Injury musculoskeletal (excl shoulder/back/knee)*	1,527	538	2.1 (1.8–2.3)	31.8 (29.2–34.3)	110.9	1,514	651	2.1 (2.0–2.3)	38.3 (35.8–40.8)	112.2
Breast lump*	621	555	2.1 (1.8–2.4)	62.3 (57.8–66.8)	143.4	584	584	1.9 (1.7–2.1)	69.3 (65.4–73.3)	144.2
Menstrual problems*	2,265	359	1.4 (1.2–1.5)	15.6 (14.1–17.2)	101.4	2,238	488	1.6 (1.5–1.8)	21.8 (20.0–23.6)	100.0

(continued)

Table 4.4 (continued): The problems for which an imaging test was most frequently ordered, 2002–05 and 2009–12

	Period 1 (2002–05)					Period 2 (2009–12)				
	Number of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per 100 tested problems[c]	Number of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per 100 tested problems[c]
Female genital check-up/Pap smear*	6,524	635	2.4 (1.5–3.4)	8.0 (5.8–10.2)	121.4	6,832	471	1.6 (1.3–1.8)	5.5 (4.8–6.2)	124.3
Acute bronchitis/ bronchiolitis	7,017	398	1.5 (1.4–1.7)	5.6 (5.0–6.2)	101.0	6,879	447	1.5 (1.3–1.6)	6.5 (5.8–7.1)	100.9
Osteoporosis (excluding osteoporotic fracture)*	2,573	373	1.4 (1.2–1.6)	13.5 (12.0–15.0)	107.5	2,392	423	1.4 (1.2–1.5)	17.1 (15.4–18.7)	103.7
Injury skin, other	1,869	467	1.8 (1.6–2.0)	21.7 (19.5–23.9)	115.0	1,487	379	1.2 (1.1–1.4)	22.2 (19.9–24.5)	114.8
Pneumonia	947	282	1.1 (0.9–1.2)	29.4 (26.1–32.6)	101.4	1,028	341	1.1 (1.0–1.3)	32.1 (29.1–35.1)	103.3
Subtotal		*11,911*	*45.6*	—	—		*13,901*	*45.8*	—	—
Total	**441,591**	**26,121**	**100.0**	**8.0 (5.8–10.2)**	**121.4**	**461,761**	**30,350**	**100.0**	**5.5 (4.8–6.2)**	**124.3**

(a) A test was counted more than once if it was ordered for the management of more than one problem at an encounter. There were 25,863 imaging test orders and 26,121 problem–imaging links in Period 1, and 29,996 imaging test orders and 30,350 problem–imaging links in Period 2.

(b) The percentage of total contacts with the problem that generated at least one order for imaging.

(c) The rate of imaging orders placed per 100 tested problem contacts with at least one order for imaging.

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table 5.3).

Note: CI – confidence interval; excl – excluding; OA – osteoarthritis; NOS – not otherwise specified. Highlighting indicates a significant difference between data periods.

Section 2

Problem-based investigation

Introduction

In Chapter 4 we identified 17 problems that each accounted for >1% of problem–imaging test links. Since time and funds available for this project did not allow detailed investigation of 17 problem areas, the top 10 problems/indications, each generating >2% of problem–imaging links in Period 2 (2009–12) were identified as priority areas.

Each of these problem types was given further consideration. We considered the changes from Period 1 to Period 2 in the proportion of imaging orders accounted for by each problem, and GPs' imaging ordering in the management of these problems. Eight problems were selected for detailed investigation in this section. Box S2.1 summarises the reasons for our selection of the eight problems investigated:

- Back problems (Chapter 5)
- Osteoarthritis (excluding back) (Chapter 6)
- Shoulder problems (excluding arthritis/osteoarthritis) (Chapter 7)
- Sprain/Strain (excluding back) (Chapter 8)
- Bursitis/tendonitis/synovitis NOS (Chapter 9)
- Abdominal pain (Chapter 10)
- Knee problems (Chapter 11)
- Injury musculoskeletal (excluding shoulder/back/knee) (Chapter 12).

Box 2: Selection of indications for further investigation

Problem	Description of changes from 2002–05 to 2009–12 and comments regarding further investigation	Investigate further?
Back problems*	Back problems generate the majority of GPs' imaging ordering. The proportion of problem-imaging combinations generated by GPs' management of back problems has decreased over time, and there has been no change in the likelihood of GPs' ordering imaging over time. We chose to investigate the quality of GPs' imaging ordering for back problems due to the large volume of imaging orders generated in its management.	Yes
Osteoarthritis (excluding back)*	The proportion of problem-imaging combinations generated by GPs' management of osteoarthritis has not changed. However there has been a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication. We chose to investigate the quality of GPs' imaging ordering for osteoarthritis due to the increase in the likelihood of imaging being ordered. Arthritis is a national health priority area and the management of osteoarthritis problems generates the second highest amount of GPs' imaging orders. Further, it is likely that the prevalence of osteoarthritis will increase in the future due to the ageing population.	Yes
Pregnancy & related check-up*	The proportion of problem-imaging combinations and the likelihood of GPs' ordering imaging in the management of pregnancy increased significantly over time. BEACH does not collect information about the stage of pregnancy, which is essential data when determining the quality of GPs' imaging ordering for pregnancy. Therefore we decided not to further investigate imaging ordered for this problem.	No
Shoulder problems (excluding arthritis/ osteoarthritis)*	The proportion of problem-imaging combinations and the likelihood of GPs' ordering imaging in the management of shoulder problems increased significantly. These increases led us to further investigate GPs' imaging ordering in the management of shoulder problems.	Yes
Fracture (excluding head/back)*	The proportion of problem-imaging combinations generated by GPs' management of fractures has decreased over time, and there has been no change in the likelihood of GPs' ordering imaging in its management. Therefore this problem was excluded from those to be further investigated.	No
Sprain/Strain (excluding back)*	The proportion of problem-imaging combinations generated by GPs' management of sprain/strain did not change. However there was a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication. The latter result led us to include this indication for further investigation.	Yes
Bursitis/tendonitis/ synovitis NOS	The proportion of problem-imaging combinations accounted for by this problem, and the likelihood of GPs' ordering imaging in the management of bursitis/tendonitis/synovitis increased significantly. These increases led us to investigate this indication in more detail.	Yes
Abdominal pain*	The proportion of problem-imaging combinations generated by GPs' management of abdominal pain has not changed. However there has been a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication. The latter result led us to include this indication for further investigation.	Yes
Knee problems*	The proportion of problem-imaging combinations and the likelihood of GPs' ordering imaging in the management of knee problems did not change over time. This indication was identified as an area of poor quality of GPs' imaging ordering in the 2001 report and for this reason we decided to investigate further.	Yes
Injury musculoskeletal (excluding shoulder/back/ knee)*	The proportion of problem-imaging combinations generated by GPs' management of musculoskeletal injury has not changed. However there has been a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication. The latter result led us to include this indication for further investigation	Yes

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5).

Note: NOS – not otherwise specified.

5 Back problems

This chapter investigates imaging orders for back problems, recorded by GPs from April 2002–March 2005 (Period 1) to April 2009–March 2012 (Period 2). As reported at the beginning of Section 2, GP imaging orders for back problems were selected for investigation because:

- the management of back problems generates the majority of GPs' imaging orders, and
- a large volume of imaging orders was generated in the management of back problems.

Based on the rationale that guidelines recommend different management of back problems depending on their status as a symptom/complaint or as a defined condition (see Chapter 2), back problems were grouped and categorised as:

- 'back symptom/complaint (all)' and
- 'back syndrome (all)'.

The full list of ICPC-2 rubrics and ICPC-2 PLUS codes and terms included in each group are provided in Appendix 5, Table A5.1.

Imaging orders are investigated for:

- all back problems
- all back problems grouped as 'back syndrome'
- new problems grouped as 'back syndrome'
- all back problems grouped as 'back symptom/complaint'
- new problems grouped as 'back symptom/complaint'.

Changes in ordering over time between Period 1 and Period 2 are reported.

5.1 All back problems

Table 5.1 shows the total number of back problems managed, and the distribution of the back problems across back syndrome and back symptoms/complaints in Period 1 and Period 2.

There were no significant differences between the two data periods in the management rates reported for either of the back problem groups. Back symptoms/complaints and back syndromes each accounted for approximately 50% of all back problems in both data periods, and each were managed about twice in every 100 encounters.

However, while the management rate of total back problems per 100 encounters did not significantly change, there was a significant increase in the estimated annual encounters involving back problems nationally. These increased by 673,000, from 3.64 million encounters (95% CI: 3.52–3.77) in Period 1 to 4.32 million (95% CI: 4.19–4.44) in Period 2. This is due to the increased GP visit rate described in Chapter 2.

Table 5.1: Back problems managed by problem type, 2002–05 and 2009–12

Back problems[(a)]	2002–05 (Period 1)			2009–12 (Period 2)		
	Number of problems	Per cent of back problems	Per 100 encounters (95% CI)	Number of problems	Per cent of back problems	Per 100 encounters (95% CI)
Back syndrome	5,712	51.2	1.9 (1.9–2.0)	5,280	49.9	1.8 (1.7–1.9)
Back symptom/complaint	5,434	48.8	1.8 (1.7–1.9)	5,304	50.1	1.8 (1.7–1.9)
Total back problems	**11,146**	**100.0**	**3.8 (3.6–3.9)**	**10,584**	**100.0**	**3.6 (3.5–3.7)**

(a) For a list of inclusions refer to Appendix 5, Table A5.1.

Note: CI – confidence interval.

Table 5.2 shows that the rate at which imaging was ordered in the management of back problems did not change significantly over time.

In 2002–05, there were 11,146 back problems managed and at least one imaging test was ordered for 1,546 of these (13.9% likelihood). A total of 1,800 imaging test orders were placed, at a rate of 16.1 tests per 100 back problems managed.

In 2009–12, there were 10,584 back problems managed, and GPs ordered at least one imaging test for 1,531 of these (14.5% likelihood). In total, 1,776 imaging test orders were placed, at a rate of 16.8 imaging tests per 100 back problems managed. As discussed in Chapter 4, back problems contributed a smaller proportion of total imaging orders generated for all problems in Period 2 (5.9%) than in Period 1 (6.9%) (see Table 4.4).

When these results are considered with the increased GP visit rate (see Chapter 2) we calculate that in Period 1, 590,000 imaging orders were placed nationally by GPs for the management of back problems. In Period 2, there were 730,000 imaging orders placed, or about 140,000 more than in Period 1.

In summary, there were no changes in: the management rate of back problems (3.8 per 100 encounters in Period 1 and 3.6 in Period 2); the likelihood of ordering a test (13.9% in Period 1 and 14.5% in Period 2); or the rate at which imaging tests were ordered for back problems (16.1 per 100 problems in Period 1 and 16.8 in Period 2). There was also no change in the number of tests ordered per tested back problem (1.16 per tested problem in both periods) (results not tabled). Therefore we can conclude that the increase in the number of tests ordered nationally was entirely due to the increased GP visit rate.

Table 5.2: Back problem management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total back problems managed	11,146	10,584
Back problems for which at least one imaging test ordered (*n*)	1,546	1,531
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	13.9 (13.1–14.6)	14.5 (13.7–15.2)
Total imaging orders generated for back problems (*n*)	1,800	1,776
Imaging orders per 100 back problems (95% CI)	16.1 (15.2–17.1)	16.8 (15.8–17.7)

Note: CI – confidence interval.

Age-specific and sex-specific likelihood of management

In both data periods there was a significantly higher likelihood of management of back problems at encounters with males than females. There was a marginal decrease in the likelihood of management at encounters with males between Period 1 and Period 2.

Table 5.3 shows that the majority of patients for whom back problems were managed were aged between 45 and 64 years, in both data periods. The age-specific likelihood of management in the 25–44 year age group decreased significantly over time, from 4.5% of encounters with patients in this age group to 3.9%, but there was a marginal increase in the management among patients aged 75 years and over, from 3.3% to 3.7%.

There were no changes between Period 1 and Period 2 in either the age-specific or sex-specific imaging test order rates for back problems, although the order rate for females was marginally higher than for males in Period 1, and significantly higher in Period 2.

Table 5.3: Age-specific and sex-specific management of back problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	5,161	4.3 (4.1–4.5)	14.8 (13.7–16.0)	4,661	4.0 (3.8–4.1)	14.7 (13.5–15.9)
Females	5,842	3.4 (3.2–3.5)	17.2 (16.0–18.5)	5,801	3.3 (3.2–3.5)	18.5 (17.2–19.8)
Age						
<15 years	111	0.3 (0.3–0.4)	27.0 (17.6–36.4)	64	0.2 (0.1–0.2)	26.6 (15.3–37.8)
15–24 years	601	2.1 (1.9–2.4)	16.4 (13.1–19.7)	458	1.8 (1.7–2.0)	18.3 (14.5–22.2)
25–44 years	3,293	4.5 (4.3–4.8)	15.1 (13.6–16.5)	2,618	3.9 (3.7–4.1)	16.0 (14.3–17.6)
45–64 years	4,252	5.3 (5.1–5.6)	16.8 (15.3–18.2)	4,066	5.0 (4.9–5.2)	15.7 (14.3–17.0)
65–74 years	1,369	3.9 (3.6–4.1)	16.5 (14.1–18.9)	1,562	4.2 (3.9–4.4)	20.7 (18.2–23.1)
75+ years	1,378	3.3 (3.1–3.5)	15.5 (13.1–17.9)	1,702	3.7 (3.5–3.9)	16.4 (14.2–18.5)
Total	**11,109**	**3.8 (3.6–3.9)**	**16.1 (15.2–17.1)**	**10,584**	**3.6 (3.5–3.7)**	**16.8 (15.8–17.7)**

(a) Missing data removed: 2002–05 *n*=105 (age), *n*=106 (sex); 2009–12 *n*=78 (age), *n*=86 (sex).

(b) Number of encounters with at least one back problem managed at encounter. It is possible for more than one back problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 5.2).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

While the overall rate of imaging test orders per 100 back problems did not change over time (Table 5.3), there were considerable changes in the types of tests ordered across MBS groups.

There was a move away from diagnostic radiology (although this remained the predominant test group) toward CT and MRI orders. Table 5.4 shows there was:

- a marginal decrease in diagnostic radiology orders per 100 back problems managed, between Period 1 (10.5 per 100 back problems managed) and Period 2 (9.1 per 100). In particular, x-ray of the lumbosacral spine decreased from 3.5 to 2.3 tests per 100 back problems managed
- a significant increase in the rate of CT orders, from 4.7 to 6.1 per 100 back problems managed, and particularly CT of the lumbar spine. This increased by about 50% from 1.9 to 3.0 per 100 back problems managed
- a significant increase in the rate of MRI orders, from 0.2 per 100 back problems managed in Period 1 to 0.8 per 100 in Period 2.

Table 5.4: Imaging test orders by MBS test group and the most frequent individual tests ordered for back problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**1,170**	**65.0 (62.7–67.3)**	**10.5 (9.8–11.2)**	**963**	**54.2 (51.6–56.8)**	**9.1 (8.4–9.8)**
X-ray; spine; lumbosacral	387	21.5 (19.5–23.5)	3.5 (3.1–3.9)	246	13.9 (12.1–15.6)	2.3 (2.0–2.7)
X-ray; spine; lumbar	206	11.4 (9.9–13.0)	1.8 (1.6–2.1)	222	12.5 (10.9–14.1)	2.1 (1.8–2.4)
X-ray; spine; thoracic	107	5.9 (4.8–7.1)	1.0 (0.8–1.1)	83	4.7 (3.7–5.6)	0.8 (0.6–0.9)
X-ray; back	81	4.5 (3.5–5.5)	0.7 (0.6–0.9)	49	2.8 (1.9–3.6)	0.5 (0.3–0.6)
X-ray; spine	61	3.4 (2.5–4.3)	0.5 (0.4–0.7)	51	2.9 (2.1–3.6)	0.5 (0.4–0.6)
X-ray; hip	53	2.9 (2.2–3.7)	0.5 (0.3–0.6)	67	3.8 (2.9–4.6)	0.6 (0.5–0.8)
Test; densitometry	30	1.7 (1.1–2.3)	0.3 (0.2–0.4)	49	2.8 (2.0–3.5)	0.5 (0.3–0.6)
Computerised tomography	**526**	**29.2 (27.0–31.4)**	**4.7 (4.3–5.1)**	**643**	**36.2 (33.8–38.6)**	**6.1 (5.6–6.6)**
CT scan; spine; lumbar	209	11.6 (10.1–13.1)	1.9 (1.6–2.1)	315	17.7 (15.8–19.7)	3.0 (2.6–3.3)
CT scan; spine; lumbosacral	203	11.3 (9.7–12.9)	1.8 (1.5–2.1)	179	10.1 (8.5–11.7)	1.7 (1.4–2.0)
CT scan; spine	52	2.9 (2.1–3.7)	0.5 (0.3–0.6)	46	2.6 (1.8–3.4)	0.4 (0.3–0.6)
Ultrasound	**49**	**2.7 (1.9–3.5)**	**0.4 (0.3–0.6)**	**61**	**3.4 (2.5–4.4)**	**0.6 (0.4–0.7)**
Magnetic resonance imaging	**24**	**1.3 (0.8–1.9)**	**0.2 (0.1–0.3)**	**87**	**4.9 (3.8–6.0)**	**0.8 (0.6–1.0)**
Nuclear medicine	**31**	**1.7 (1.1–2.3)**	**0.3 (0.2–0.4)**	**22**	**1.2 (0.7–1.8)**	**0.2 (0.1–0.3)**
Total imaging tests	**1,800**	**100.0**	**16.1 (15.2–17.1)**	**1,776**	**100.0**	**16.8 (15.8–17.7)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

5.2 Back syndrome

Table 5.5 shows the rate at which imaging was ordered in the management of back syndrome over the two time periods.

In 2002–05, there were 5,712 back syndrome problems managed and GPs ordered at least one imaging test for 775 of these (13.6% likelihood). A total of 893 imaging test orders were placed, at a rate of 15.6 imaging tests per 100 back syndrome problems managed.

In 2009–12, there were 5,280 back syndrome problems managed, and for 770 of these, at least one imaging test order was made (14.6% likelihood). In total, 895 imaging test orders were placed at a rate of 17.0 imaging tests per 100 back syndrome problems managed.

This shows that there was no change in the GP imaging order rate for back syndrome problems between Period 1 and Period 2.

In Period 1, an estimated 290,000 imaging orders per annum were placed nationally by GPs for the management of back syndrome problems. In Period 2, there were about 360,000 per year on average, or about 80,000 more per year than in Period 1.

In summary, there were no changes in: the management rate of back syndrome problems (1.9 per 100 encounters in Period 1 and 1.8 in Period 2); the likelihood of ordering a test (13.6% in Period 1 and 14.6% in Period 2); or the rate at which imaging tests were ordered for back syndrome problems (15.6 per 100 problems in Period 1 and 17.0 in Period 2). There was also no change in the number of tests ordered per back syndrome problem (1.15 per tested problem in both periods) (results not tabled). Therefore, we can conclude that the increase in the number of tests ordered nationally was entirely due to the increased GP visit rate.

Table 5.5: Back syndrome management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total back syndrome problems managed	5,712	5,280
Back syndrome problems for which at least one imaging test ordered (*n*)	775	770
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	13.6 (12.6–14.6)	14.6 (13.5–15.6)
Total imaging orders generated for back syndrome problems (*n*)	893	895
Imaging orders per 100 back syndrome problems (95% CI)	15.6 (14.4–16.8)	17.0 (15.7–18.2)

Note: CI – confidence interval.

Age-specific and sex-specific management of back syndrome

In both data periods, the sex-specific likelihood of management of back syndrome was significantly higher at encounters with males than at those with females. Likelihood of management for males significantly decreased over the data period, but no change was noted for females (Table 5.6).

There were some significant changes in age-specific likelihood of management. There was a significant decrease for patients aged 25–44 years, and marginal decreases for patients in the 15–24 and 45–54 year age groups between Period 1 and Period 2.

However, there were no changes in the test ordering rates for back syndrome over the time period for any age or sex group.

Table 5.6: Age-specific and sex-specific management of back syndrome, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	2,721	2.3 (2.2–2.4)	15.2 (13.7–16.8)	2,337	2.0 (1.9–2.1)	15.1 (13.4–16.9)
Females	2,914	1.7 (1.6–1.8)	15.9 (14.2–17.5)	2,886	1.7 (1.6–1.8)	18.6 (16.8–20.3)
Age						
<15 years	40	0.1 (0.1–0.2)	27.5 (10.3–44.7)	17	0.1 (0.0–0.1)	23.5 (2.3–44.8)
15–24 years	276	1.0 (0.9–1.1)	13.4 (8.9–17.9)	185	0.7 (0.6–0.9)	14.6 (9.0–20.2)
25–44 years	1,451	2.0 (1.9–2.1)	15.5 (13.3–17.8)	1,107	1.7 (1.5–1.8)	15.5 (13.0–18.1)
45–64 years	2,133	2.7 (2.5–2.8)	17.0 (15.0–19.0)	1,931	2.4 (2.3–2.5)	17.3 (15.3–19.4)
65–74 years	828	2.3 (2.2–2.5)	16.0 (13.1–18.9)	911	2.4 (2.3–2.6)	20.9 (17.7–24.0)
75+ years	915	2.2 (2.0–2.4)	12.6 (10.0–15.2)	1,074	2.3 (2.2–2.5)	14.6 (12.2–17.1)
Total	**5,696**	**1.9 (1.8–2.0)**	**15.6 (14.4–16.8)**	**5,262**	**1.8 (1.7–1.9)**	**17.0 (15.7–18.2)**

(a) Missing data removed: 2002–05 *n*=53 (age), *n*=61 (sex); 2009–12 *n*=37 (age), *n*=39 (sex).

(b) Number of encounters with at least one back syndrome managed at encounter. It is possible for more than one back syndrome problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 5.5).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Table 5.7 shows there were considerable changes in the types of tests ordered across MBS groups. Between Period 1 and Period 2 the order rate for:

- x-ray of the lumbosacral spine significantly decreased from 3.2 to 2.1 per 100 back syndrome problems managed
- CT of the lumbar spine significantly increased, from 2.5 per 100 back syndrome problems managed, to 3.8 per 100
- MRI significantly increased from 0.2 to 0.9 per 100 back syndrome problems managed.

Table 5.7: Imaging test orders by MBS test group and the most frequent individual tests ordered for back syndrome, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**510**	**57.1 (53.7–60.5)**	**8.9 (8.0–9.8)**	**424**	**47.4 (43.7–51.1)**	**8.0 (7.1–9.0)**
X-ray; spine; lumbosacral	181	20.3 (17.5–23.1)	3.2 (2.7–3.7)	111	12.4 (10.1–14.7)	2.1 (1.7–2.5)
X-ray; spine; lumbar	103	11.5 (9.2–13.8)	1.8 (1.4–2.2)	89	9.9 (7.9–12.0	1.7 (1.3–2.1)
X-ray; spine; thoracic	32	3.6 (2.4–4.8)	0.6 (0.4–0.8)	28	3.1 (2.0–4.3)	0.5 (0.3–0.7)
X-ray; back	29	3.2 (2.0–4.5)	0.5 (0.3–0.7)	21	2.3 (1.2–3.5)	0.4 (0.2–0.6)
X-ray; spine	27	3.0 (1.9–4.1)	0.5 (0.3–0.6)	21	2.3 (1.4–3.3)	0.4 (0.2–0.6)
X-ray; hip	25	2.8 (1.8–3.8)	0.4 (0.3–0.6)	41	4.6 (3.3–5.9)	0.8 (0.5–1.0)
Test; densitometry	18	2.0 (1.1–2.9)	0.3 (0.2–0.5)	30	3.4 (2.2–4.5)	0.6 (0.4–0.8)
Computerised tomography	**349**	**39.1 (35.7–42.4)**	**6.1 (5.4–6.8)**	**386**	**43.1 (39.6–46.7)**	**7.3 (6.5–8.1)**
CT scan; spine; lumbar	142	15.9 (13.4–18.4)	2.5 (2.1–2.9)	199	22.2 (19.3–25.2)	3.8 (3.2–4.3)
CT scan; spine; lumbosacral	138	15.5 (12.9–18.0)	2.4 (2.0–2.8)	109	12.2 (9.8–14.5)	2.1 (1.6–2.5)
CT scan; spine	36	4.0 (2.8–5.3)	0.6 (0.4–0.8)	28	3.1 (2.0–4.3)	0.5 (0.3–0.7)
Ultrasound	**13**	**1.5 (0.7–2.2)**	**0.2 (0.1–0.4)**	**28**	**3.1 (1.8–4.4)**	**0.5 (0.3–0.8)**
Magnetic resonance imaging	**10**	**1.1 (0.4–1.8)**	**0.2 (0.1–0.3)**	**48**	**5.4 (3.8–6.9)**	**0.9 (0.6–1.2)**
Nuclear medicine	**11**	**1.2 (0.5–1.9)**	**0.2 (0.1–0.3)**	**9**	**1.0 (0.4–1.7)**	**0.2 (0.1–0.3)**
Total imaging tests	**893**	**100.0**	**15.6 (14.4–16.8)**	**895**	**100.0**	**17.0 (15.7–18.2)**

Note: CI – confidence interval; CT – computerised tomography; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of back syndrome problem

Table 5.8 shows the proportions of contacts generating an imaging order for new and old back syndrome problems in both data periods. About three-quarters of the GP contacts were for previously diagnosed back syndrome problems, in both 2002–05 and 2009–12. New cases of back syndrome problems were managed at a rate of 0.5 per 100 encounters in both periods (results not tabled).

In both data periods, the likelihood of ordering and the imaging order rate for back syndrome problems was about three times higher at initial presentations (30.3 orders per 100 back syndrome problems in Period 1 and 33.1 per 100 in Period 2) than at follow-up consultations (10.0 orders per 100 problems in Period 1 and 11.6 in Period 2). There were no significant changes in the imaging order rate per 100 new, or old, back syndrome problems, between the two data periods.

These results, combined with the increased GP visit rate, suggest that in Period 1, 155,000 imaging orders were placed nationally per year by GPs for management of new back syndrome problems. In Period 2, about 160,000 imaging tests were ordered, nationally per year, or about 5,000 more per annum than in Period 1.

In summary, there were no changes in: the management rate of new back syndrome problems (0.5 per 100 encounters in both periods); the likelihood of ordering a test (26.1% in Period 1 and 27.6% in Period 2); or the rate at which imaging tests were ordered (30.3 per 100 problems in Period 1 and 33.1 in Period 2). There was also no change in the number of tests ordered per new back syndrome problem (1.16 per tested problem in both periods) (results not tabled). Therefore, we can conclude that the increase in the number of tests ordered nationally is entirely due to the increased GP visit rate.

Table 5.8: Imaging ordering rates by status of back syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	1,550	4,162	**5,712**	1,317	3,963	**5,280**
Per cent of back syndrome problems	27.1	72.9	**100.0**	25.0	75.0	**100.0**
Total imaging orders generated for problems (*n*)	469	424	**893**	436	459	**895**
Imaging orders per 100 problems (95% CI)	30.3 (27.3–33.2)	10.0 (9.1–11.3)	**15.6 (14.4–16.8)**	33.1 (29.8–36.4)	11.6 (10.4–12.8)	**17.0 (15.7–18.2)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	26.1 (23.7–28.4)	8.9 (8.0–9.8)	**13.6 (12.6–14.6)**	27.6 (25.0–30.1)	10.3 (9.3–11.3)	**14.6 (13.5–15.6)**

Note: CI – confidence interval.

5.3 New back syndrome

Age-specific and sex-specific management of new back syndrome

In both data periods there was a higher likelihood of management of new back syndrome problems at encounters with males than females, but there were no changes in the sex-specific likelihood of management between Period 1 and Period 2 (Table 5.9).

The majority of patients for whom new back syndrome problems were managed were aged between 25 and 64 years, in both data periods. The age-specific likelihood of management decreased marginally in the 15–24, 25–44 and 45–64 year age groups.

There was no change in the overall imaging ordering rate for new back syndrome problems between Period 1 and Period 2.

Table 5.9: Age-specific and sex-specific likelihood of management and test order rate for new back syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**
Sex						
Males	716	0.6 (0.6–0.7)	31.4 (27.4–35.4)	590	0.5 (0.5–0.6)	32.1 (27.6–36.7)
Females	818	0.5 (0.4–0.5)	29.2 (25.2–33.1)	717	0.4 (0.4–0.5)	34.1 (29.6–38.7)
Age						
<15 years	24	0.1 (0.0–0.1)	33.3 (8.0–58.7)	10	0.0 (0.0–0.1)	20.0 (0.0–47.7)
15–24 years	138	0.5 (0.4–0.6)	17.4 (9.8–25.0)	77	0.3 (0.2–0.4)	19.5 (9.8–29.2)
25–44 years	418	0.6 (0.5–0.6)	28.9 (23.6–34.3)	324	0.5 (0.4–0.5)	28.1 (22.5–33.7)
45–64 years	555	0.7 (0.6–0.8)	36.1 (30.9–41.3)	463	0.6 (0.5–0.6)	34.7 (29.1–40.3)
65–74 years	216	0.6 (0.5–0.7)	27.3 (20.7–33.9)	233	0.6 (0.5–0.7)	40.2 (32.1–48.3)
75+ years	188	0.5 (0.4–0.5)	27.7 (19.5–35.9)	197	0.4 (0.4–0.5)	35.0 (26.8–43.2)
Total	**1,548**	**0.5 (0.5–0.6)**	**30.3 (27.3–33.2)**	**1,315**	**0.5 (0.4–0.5)**	**33.1 (29.8–36.4)**

(a) Missing data removed: 2002–05 *n*=9 (age), *n*=14 (sex); 2009–12 *n*=11 (age), *n*=8 (sex).

(b) Number of encounters with at least one new back syndrome problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 5.8).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Between Period 1 and Period 2, there were no changes in either the proportions of each MBS test group, or in their order rates. In both data periods diagnostic radiology was by far the predominant test group (Table 5.10). Orders for x-ray of the lumbosacral spine significantly decreased, from 7.2 to 4.6 per 100 new back syndrome problems managed.

Table 5.10: Imaging test orders by MBS test group and the most frequent individual tests ordered for new back syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**288**	**61.4 (56.8–66.0)**	**18.6 (16.2–21.0)**	**254**	**58.3 (53.1–63.4)**	**19.3 (16.5–22.0)**
X-ray; spine; lumbosacral	111	23.7 (19.6–27.8)	7.2 (5.7–8.6)	60	13.8 (10.4–17.2)	4.6 (3.3–5.8)
X-ray; spine; lumbar	51	10.9 (7.9–13.8)	3.3 (2.3–4.2)	61	14.0 (10.5–17.5)	4.6 (3.4–5.9)
X-ray; hip	17	3.6 (2.0–5.3)	1.1 (0.6–1.6)	26	6.0 (3.9–8.1)	2.0 (1.2–2.7)
X-ray; spine; thoracic	17	3.6 (1.8–5.4)	1.1 (0.5–1.6)	18	4.1 (2.3–6.0)	1.4 (0.7–2.0)
X-ray; back	17	3.6 (1.9–5.3)	1.1 (0.6–1.6)	11	2.5 (0.9–4.1)	0.8 (0.3–1.4)
X-ray; spine	14	3.0 (1.4–4.5)	0.9 (0.4–1.4)	12	2.8 (1.2–4.3)	0.9 (0.4–1.4)
X-ray; chest	11	2.3 (0.9–3.8)	0.7 (0.3–1.2)	11	2.5 (0.9–4.1)	0.8 (0.3–1.4)
Computerised tomography	**167**	**35.6 (31.1–40.1)**	**10.8 (9.2–12.4)**	**156**	**35.8 (30.8–40.7)**	**11.8 (10.0–13.7)**
CT scan; spine; lumbosacral	76	16.2 (12.7–19.7)	4.9 (3.8–6.0)	45	10.3 (7.3–13.3)	3.4 (2.4–4.4)
CT scan; spine; lumbar	59	12.6 (9.5–15.7	3.8 (2.8–4.8)	80	18.3 (14.5–22.2)	6.1 (4.7–7.4)
CT scan; spine	18	3.8 (2.1–5.6)	1.2 (0.6–1.7)	12	2.8 (1.2–4.3)	0.9 (0.4–1.4)
Ultrasound	**7**	**1.5 (0.4–2.6)**	**0.5 (0.1–0.8)**	**7**	**1.6 (0.4–2.8)**	**0.5 (0.1–0.9)**
Magnetic resonance imaging	**1**	**0.2 (—)**	**0.0 (—)**	**14**	**3.2 (1.5–4.9)**	**1.1 (0.5–1.6)**
Nuclear medicine	**6**	**1.3 (0.3–2.3)**	**0.4 (0.1–0.7)**	**5**	**1.1 (0.1–2.1)**	**0.4 (0.0–0.7)**
Total imaging tests	**469**	**100.0**	**30.3 (27.3–33.2)**	**436**	**100.0**	**33.1 (29.8–36.4)**

Note: CI – confidence interval; CT – computerised tomography; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

5.4 Back symptom/complaint

Table 5.11 shows the rate at which imaging was ordered in the management of back symptoms/complaints.

In 2002–05, there were 5,434 back symptoms/complaints managed and at least one imaging test order resulted from 14.2% of these. A total of 907 imaging test orders were placed, at a rate of 16.7 imaging tests per 100 back symptoms/complaints managed.

In 2009–12, there were 5,304 back symptoms/complaints managed, and for 14.3% of these, at least one imaging test order was made. In total, 881 imaging test orders were placed, with 16.6 imaging tests being ordered for every 100 back symptoms/complaints managed.

This shows that the rate of GP imaging ordering for back syndrome problems did not change between Period 1 and Period 2.

These results, combined with the increased GP visit rate, suggest that in Period 1, about 300,000 imaging orders were placed nationally by GPs per annum for the management of back symptom/complaint problems. In Period 2, we estimate that 360,000 imaging orders were placed on average per year, or about 60,000 per annum more than in Period 1.

In summary, there were no changes in: the management rate of back symptom/complaint problems (1.8 per 100 encounters in both periods); the likelihood of ordering a test (14.2% in Period 1 and 14.3% in Period 2); or the rate at which imaging tests were ordered (16.7 per 100 problems in Period 1 and 16.6 in Period 2). There was also no change in the number of tests ordered per back symptom/complaint problem (1.18 per tested problem in Period 1 and 1.16 in Period 2) (results not tabled). Therefore, we can conclude that the increase in the estimated number of tests ordered nationally was entirely due to the increased GP visit rate.

Table 5.11: Back symptom/complaint management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total back symptom/complaint problems managed	5,434	5,304
Back symptom/complaint problems for which at least one imaging test was ordered (*n*)	771	761
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	14.2 (13.1–15.2)	14.3 (13.3–15.4)
Total imaging orders generated for back symptom/complaint problems (*n*)	907	881
Imaging orders per 100 back symptom/complaint problems (95% CI)	16.7 (15.4–18.0)	16.6 (15.3–17.9)

Note: CI – confidence interval.

Age-specific and sex-specific management

In both data periods, the sex-specific likelihood of management of back symptoms/complaints was significantly higher at encounters with males than at those with females. There was no change in the management over time for either sex (Table 5.12).

The age-specific likelihood of management marginally decreased for patients aged 25–44 years, and marginally increased for patients aged 75 years or older.

There were no changes in the age-specific or sex-specific imaging ordering rates for back symptom/complaint over the time period.

Table 5.12: Age-specific and sex-specific likelihood of management and test order rate for back symptom/complaint problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	2,449	2.0 (1.9–2.2)	14.3 (12.7–16.0)	2,331	2.0 (1.9–2.1)	14.3 (12.6–16.0)
Females	2,934	1.7 (1.6–1.8)	18.6 (16.7–20.4)	2,923	1.7 (1.6–1.8)	18.4 (16.6–20.3)
Age						
<15 years	71	0.2 (0.2–0.3)	26.8 (15.4–38.1)	47	0.1 (0.1–0.2)	27.7 (13.4–41.9)
15–24 years	326	1.2 (1.0–1.4)	18.9 (14.3–23.5)	273	1.1 (1.0–1.2)	20.9 (15.6–26.1)
25–44 years	1,846	2.6 (2.4–2.7)	14.7 (12.8–16.6)	1,514	2.3 (2.1–2.4)	16.3 (14.1–18.5)
45–64 years	2,127	2.7 (2.5–2.8)	16.6 (14.5–18.6)	2,143	2.7 (2.5–2.8)	14.1 (12.4–15.9)
65–74 years	543	1.5 (1.4–1.7)	17.1 (13.1–21.1)	654	1.8 (1.6–1.9)	20.3 (16.5–24.1)
75+ years	463	1.1 (1.0–1.2)	21.2 (16.6–25.8)	629	1.4 (1.2–1.5)	19.4 (15.5–23.3)
Total	**5,428**	**1.8 (1.7–1.9)**	**16.7 (15.4–18.0)**	**5,301**	**1.8 (1.7–1.9)**	**16.6 (15.3–17.9)**

(a) Missing data removed: 2002–05 *n*=52 (age), *n*=45 (sex); 2009–12 *n*=41 (age), *n*=47 (sex).

(b) Number of encounters with at least one back symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 5.11).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Table 5.13 shows that there were considerable changes in the types of tests ordered across MBS groups. In both time periods, diagnostic radiology was the predominant test group; however, there was a general move away from these orders as a percentage of all imaging tests ordered, with a move toward CT and MRI. Between Period 1 and Period 2 the order rate for:

- x-ray of the lumbosacral spine decreased significantly from 3.8 to 2.5 tests per 100 back symptoms/complaints managed
- CT significantly increased, from 3.3 to 4.8 per 100 back symptoms/complaints managed, particularly CT of the lumbar spine. This increased by about 80% from 1.2 to 2.2 per 100 back symptoms/complaints managed
- MRI significantly increased from 0.3 to 0.7 per 100 back symptoms/complaints managed.

Table 5.13: Imaging test orders by MBS test group and the most frequent individual tests ordered for back symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**660**	**72.8 (69.7–75.8)**	**12.1 (11.0–13.3)**	**539**	**61.2 (57.8–64.6)**	**10.2 (9.2–11.2)**
X-ray; spine; lumbosacral	206	22.7 (20.0–25.5)	3.8 (3.2–4.3)	135	15.3 (12.8–17.8)	2.5 (2.1–3.0)
X-ray; spine; lumbar	103	11.4 (9.2–13.5)	1.9 (1.5–2.3)	133	15.1 (12.6–17.6)	2.5 (2.0–3.0)
X-ray; spine; thoracic	75	8.3 (6.5–10.1)	1.4 (1.1–1.7)	55	6.2 (4.7–7.8)	1.0 (0.8–1.3)
X-ray; back	52	5.7 (4.1–7.3)	1.0 (0.7–1.2)	28	3.2 (2.0–4.4)	0.5 (0.3–0.7)
X-ray; spine	34	3.7 (2.4–5.1)	0.6 (0.4–0.8)	30	3.4 (2.2–4.6)	0.6 (0.4–0.8)
X-ray; chest	31	3.4 (2.3–4.6)	0.6 (0.4–0.8)	24	2.7 (1.7–3.8)	0.5 (0.3–0.6)
X-ray; hip	28	3.1 (2.0–4.2)	0.5 (0.3–0.7)	26	3.0 (1.9–4.0)	0.5 (0.3–0.7)
X-ray; spine; thoracolumbar	23	2.5 (1.5–3.6)	0.4 (0.2–0.6)	17	1.9 (1.0–2.8)	0.3 (0.2–0.5)
Computerised tomography	**177**	**19.5 (16.9–22.1)**	**3.3 (2.8–3.3)**	**257**	**29.2 (26.0–32.3)**	**4.8 (4.2–5.5)**
CT scan; spine; lumbar	67	7.4 (5.6–9.1)	1.2 (0.9–1.5)	116	13.2 (10.8–15.5)	2.2 (1.8–2.6)
CT scan; spine; lumbosacral	65	7.2 (5.5–8.8)	1.2 (0.9–1.5)	70	7.9 (6.0–9.8)	1.3 (1.0–1.7)
CT scan; spine	16	1.8 (0.9–2.7)	0.3 (0.1–0.4)	18	2.0 (1.1–3.0)	0.3 (0.2–0.5)
Ultrasound	**36**	**4.0 (2.6–5.4)**	**0.7 (0.4–0.9)**	**33**	**3.7 (2.4–5.1)**	**0.6 (0.4–0.9)**
Ultrasound; pelvis	9	1.0 (0.3–1.6)	0.2 (0.1–0.3)	9	1.0 (0.4–1.7)	0.2 (0.1–0.3)
Magnetic resonance imaging	**14**	**1.5 (0.7–2.4)**	**0.3 (0.1–0.4)**	**39**	**4.4 (3.0–5.9)**	**0.7 (0.5–1.0)**
Nuclear medicine	**20**	**2.2 (1.2–3.2)**	**0.4 (0.2–0.5)**	**13**	**1.5 (0.7–2.3)**	**0.2 (0.1–0.4)**
Total imaging tests	**907**	**100.0**	**16.7 (15.4–18.0)**	**881**	**100.0**	**16.6 (15.3–17.9)**

Note: CI – confidence interval; CT – computerised tomography; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of back symptom/complaint

Table 5.14 shows the proportions of contacts generating an imaging order for new and old back symptom/complaint problems in both data periods. Three-quarters of the GP contacts were for follow-up of previously diagnosed back symptoms/complaints, in both 2002–05 and 2009–12. New cases of back symptom/complaint problems were managed at a rate of 0.5 per 100 encounters in both Period 1 and Period 2 (results not tabled).

In both data periods, the imaging order rate for back symptoms/complaints was much higher at initial presentations (31.6 per 100 back symptoms/complaints in Period 1 and 29.5 per 100 in Period 2) than at follow-up consultations (11.4 per 100 back symptoms/complaints in Period 1 and 12.3 per 100 in Period 2). There were no significant changes in the imaging order rate per 100 new, or old, back symptoms/complaints, between the two data periods.

These results, combined with the increased GP visit rate, suggest that in Period 1, about 150,000 imaging orders were placed nationally per year by GPs for the management of new back symptom/complaint problems. In Period 2, there were about 160,000 imaging orders placed per year, or about 10,000 more per annum than in Period 1.

In summary, there were no changes in: the management rate of new back symptom/complaint problems (0.5 per 100 encounters in both periods); the likelihood of ordering a test (26.4% in Period 1 and 25.4% in Period 2); or the rate at which imaging tests were ordered (31.6 per 100 problems in Period 1 and 29.5 in Period 2). There was also no change in the number of tests ordered per new back symptom/complaint problem (1.19 per tested problem in Period 1 and 1.16 in Period 2) (results not tabled). Therefore, the small increase in the number of tests ordered nationally was entirely due to the increased GP visit rate.

Table 5.14: Imaging ordering rates by status of back symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	1,419	4,015	**5,434**	1,321	3,983	**5,304**
Per cent of back symptom/complaint problems	26.1	73.9	**100.0**	24.9	75.1	**100.0**
Total imaging orders generated for problems (*n*)	448	459	**907**	390	491	**881**
Imaging orders per 100 problems (95% CI)	31.6 (28.3–34.9)	11.4 (10.2–12.6)	**16.7 (15.4–18.0)**	29.5 (26.2–32.8)	12.3 (11.1–13.6)	**16.6 (15.3–17.9)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	26.4 (23.8–28.9)	9.9 (8.9–10.9)	**14.2 (13.1–15.2)**	25.4 (22.8–28.1)	10.7 (9.6–11.7)	**14.3 (13.3–15.4)**

Note: CI – confidence interval.

5.5 New back symptom/complaint

Age-specific and sex-specific management

In both data periods, there was no difference in the likelihood of management of new back symptoms/complaints at encounters with males and females, and no changes between Period 1 and Period 2 for either sex.

The majority of patients for whom new back symptoms/complaints were managed were aged between 25 and 64 years, in both data periods.

There were no changes between Period 1 and Period 2 in either the age-specific or sex-specific imaging test order rates for new back symptoms/complaints (Table 5.15).

Table 5.15: Age-specific and sex-specific likelihood of management and test order rate for new back symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**
Sex						
Males	583	0.5 (0.4–0.5)	30.2 (25.5–34.9)	536	0.5 (0.4–0.5)	26.8 (22.4–31.3)
Females	824	0.5 (0.4–0.5)	32.4 (28.1–36.8)	772	0.5 (0.4–0.5)	31.3 (26.9–35.8)
Age						
<15 years	50	0.1 (0.1–0.2)	28.0 (13.8–42.2)	31	0.1 (0.1–0.1)	25.8 (6.9–44.7)
15–24 years	140	0.5 (0.4–0.6)	22.7 (15.2–30.2)	134	0.5 (0.4–0.6)	23.1 (14.7–31.5)
25–44 years	490	0.7 (0.6–0.8)	23.5 (18.8–28.1)	418	0.6 (0.6–0.7)	23.7 (18.7–28.7)
45–64 years	477	0.6 (0.5–0.7)	36.8 (31.0–42.6)	444	0.6 (0.5–0.6)	31.5 (26.3–36.6)
65–74 years	129	0.4 (0.3–0.4)	37.2 (25.9–48.6)	157	0.4 (0.4–0.5)	35.7 (26.0–45.3)
75+ years	119	0.3 (0.2–0.3)	48.7 (36.2–61.3)	130	0.3 (0.2–0.3)	42.3 (29.8–54.9)
Total	**1,417**	**0.5 (0.4–0.5)**	**31.6 (28.3–34.9)**	**1,320**	**0.5 (0.4–0.5)**	**29.5 (26.2–32.8)**

(a) Missing data removed: 2002–05 *n*=12 (age), *n*=10 (sex); 2009–12 *n*=6 (age), *n*=12 (sex).

(b) Number of encounters with at least one new back symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 5.14).

Note: CI – confidence interval.

Changes in imaging tests ordered for new back symptom/complaint problems, 2002–05 and 2009–12

Table 5.16 shows that there were considerable changes in the types of tests ordered across MBS groups. There was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered and a move toward CT and MRI orders.

Between Period 1 and Period 2 the order rate for:

- x-ray of the lumbosacral spine decreased significantly from 7.9 to 4.1 tests per 100 new back symptoms/complaints managed
- CT significantly increased, from 3.6 to 7.1 per 100 new back symptoms/complaints managed, particularly CT of the lumbar spine, which increased by about 145%, from 1.3 to 3.2 per 100 new back symptoms/complaints managed.

Table 5.16: Imaging test orders by MBS test group and the most frequent individual tests ordered for new back symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**373**	**83.3 (79.6–86.9)**	**26.3 (23.3–29.2)**	**276**	**70.8 (66.1–75.4)**	**20.9 (18.2–23.6)**
X-ray; spine; lumbosacral	112	25.0 (21.0–29.0)	7.9 (6.4–9.4)	112	25.0 (10.1–17.6)	4.1 (2.9–5.3)
X-ray; spine; lumbar	63	14.1 (10.8–17.4)	4.4 (3.3–5.6)	69	17.7 (13.8–21.5)	5.2 (4.0–6.5)
X-ray; spine; thoracic	47	10.5 (7.7–13.3)	3.3 (2.3–4.3)	34	8.7 (5.9–11.5)	2.6 (1.7–3.4)
X-ray; back	30	6.7 (4.3–9.1)	2.1 (1.3–2.9)	14	3.6 (1.8–5.4)	1.1 (0.5–2.9)
X-ray; chest	19	4.2 (2.4–6.1)	1.3 (0.7–1.9)	16	4.1 (2.2–6.1)	1.2 (0.6–1.6)
X-ray; hip	19	4.2 (2.4–6.0)	1.3 (0.7–1.9)	11	2.8 (1.2–4.4)	0.8 (0.3–1.3)
X-ray; spine	18	4.0 (2.0–6.0)	1.3 (0.6–1.9)	13	3.3 (1.6–5.1)	1.0 (0.5–1.5)
X-ray; spine; thoracolumbar	13	2.9 (1.3–4.5)	0.9 (0.4–1.4)	10	2.6 (1.0–4.1)	0.8 (0.3–1.2)
X-ray; pelvis	10	2.2 (0.9–3.6)	0.7 (0.3–1.1)	9	2.3 (0.8–3.8)	0.7 (0.2–1.1)
X-ray; spine; coccyx	8	1.8 (0.6–3.0)	0.6 (0.2–1.0)	13	3.3 (1.5–5.1)	1.0 (0.4–1.5)
X-ray; back lower	8	1.8 (0.6–3.0)	0.6 (0.2–1.0)	8	2.1 (0.6–3.5)	0.6 (0.2–1.0)
Computerised tomography	**51**	**11.4 (8.4–14.4)**	**3.6 (2.6–4.6)**	**94**	**24.1 (19.8–28.4)**	**7.1 (5.7–8.6)**
CT scan; spine; lumbosacral	24	5.4 (3.3–7.4)	1.7 (1.0–2.4)	27	6.9 (4.4–9.4)	2.0 (1.3–2.8)
CT scan; spine; lumbar	18	4.0 (2.2–5.8)	1.3 (0.7–1.9)	42	10.8 (7.5–14)	3.2 (2.2–4.2)
CT scan; spine; thoracic	4	0.9 (0.0–1.8)	0.3 (0.0–0.6)	6	1.5 (0.3–2.8)	0.5 (0.1–0.8)
CT scan; spine	3	0.7 (0.0–1.4)	0.2 (0.0–0.5)	9	2.3 (0.8–3.8)	0.7 (0.2–1.1)
Ultrasound	**14**	**3.1 (1.3–4.9)**	**1.0 (0.4–1.6)**	**12**	**3.1 (1.3–4.9)**	**0.9 (0.4–1.5)**
Magnetic resonance imaging	**1**	**0.2 (—)**	**0.1 (—)**	**5**	**1.3 (0.2–2.4)**	**0.4 (0.0–0.7)**
Nuclear medicine	**9**	**2.0 (0.7–3.3)**	**0.6 (0.2–1.0)**	**3**	**0.8 (0.0–1.6)**	**0.2 (0.0–0.5)**
Total imaging tests	**448**	**100.0**	**31.6 (28.3–34.9)**	**390**	**100.0**	**29.5 (26.2–32.8)**

Note: CI – confidence interval; CT – computerised tomography; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

5.6 Summary of findings

Changes over time

Overall, management rates of back problems in total, and of the two subgroups investigated individually, did not change between the two data periods. The imaging ordering rates did not change over time either (Table 5.17). However, there were changes in the types of tests: there was a marginal decrease in diagnostic radiology, and small but significant increases in CT scan and MRI imaging orders.

Table 5.17: Summary of changes over time for back problems

Back problems	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	No change (3.8, 3.6)	No change (13.9, 14.5)	No change (16.1, 16.8)	No change (1.16, 1.16)
Back syndrome	No change (1.9, 1.8)	No change (13.6, 14.6)	No change (15.6, 17.0)	No change (1.15, 1.15)
New	No change (0.5, 0.5)	No change (26.1, 25.4)	No change (30.3, 29.5)	No change (1.16, 1.16)
Back symptom/ complaint	No change (1.8, 1.8)	No change (14.2, 14.3)	No change (16.7, 16.6)	No change (1.18, 1.16)
New	No change (0.5, 0.5)	No change (26.4, 25.4)	No change (31.6, 29.5)	No change (1.19, 1.16)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

In recent practice, for both back syndrome and back symptom/complaint problems, new cases were managed less often than continuing cases, but were more than twice as likely to result in an imaging test than those cases previously managed.

When tests were ordered for back syndrome or for back symptom/complaint problems, they were most often diagnostic radiology tests or CT scans. On those occasions where ultrasound or MRI was ordered, there was no difference in the rate at which these tests were ordered for new problems or those previously managed (Table 5.18).

Table 5.18: Summary of GP imaging ordering for back problems, Period 2, 2009–12

Back problems	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	3.6 (3.5–3.7)	14.5 (13.7–15.2)	1.16	16.8 (15.8–17.7)	9.1 (8.4–9.8)	0.6 (0.4–0.7)	6.1 (5.6–6.6)	0.8 (0.6–1.0)
Back syndrome	1.8 (1.7–1.9)	14.6 (13.5–15.6)	1.15	17.0 (15.7–18.2)	8.0 (7.1–9.0)	0.5 (03–0.8)	7.3 (6.5–8.1)	0.9 (0.6–1.2)
New	0.5 (0.4–0.5)	25.4 (22.8–28.1)	1.16	33.1 (29.8–36.4)	19.3 (16.5–22.0)	0.5 (0.1–0.9)	11.8 (10.0–13.7)	1.1 (0.5–1.6)
Old	1.4 (1.3–1.4)	10.3 (9.3–11.3)	1.13	11.6 (10.4–12.8)	4.3 (3.5–5.0)	0.5 (0.3–0.8)	5.8 (5.0–6.6)	0.9 (0.6–1.1)

(continued)

Table 5.18 (continued): Summary of GP imaging ordering for back problems, Period 2, 2009–12

Back problems	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
Back symptom/ complaint	1.8 (1.7–1.9)	14.3 (13.3–15.4)	1.16	16.6 (15.3–17.9)	10.2 (9.2–11.2)	0.6 (0.4–0.9)	4.8 (4.2–5.5)	0.7 (0.5–1.0)
New	0.5 (0.4–0.5)	25.4 (22.8–28.1)	1.16	29.5 (26.2–32.8)	20.9 (18.2–23.6)	0.9 (0.4–1.5)	7.1 (5.7–8.6)	0.4 (0.0–0.7)
Old	1.4 (0.3–1.4)	10.7 (9.6–11.7)	1.15	12.3 (11.1–13.6)	6.6 (5.7–7.5)	0.5 (0.3–0.8)	4.1 (3.4–4.8)	0.9 (0.6–1.2)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging.

5.7 Summary of guidelines for imaging of back problems

An extensive review of guidelines for diagnostic imaging was undertaken using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

The final group of guidelines considered for this section of this report were: Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways[11] (these guidelines could be considered as the successor of the now obsolete Royal Australian and New Zealand College of Radiologists [RANZCR] Imaging Guidelines 2001,[19] and are endorsed by the RANZCR); the American College of Radiology Appropriateness Criteria (ACRAC);[71] the New Zealand Guidelines Group guidelines;[30] NHMRC guidelines;[72] and the NICE guidelines.[73]

The guidelines are generally developed by expert consensus (with little input from primary care physicians) with a variable research evidence base. As a result, there is significant variance between guidelines in the advice given regarding the appropriate imaging modalities to be used, however they suggest similar triggers for initiating investigation.

In regard to back problems, the guidelines generally separate back problems caused by significant trauma (e.g. motor vehicle accidents and significant height falls) from other causes of back problems. As the former are infrequently managed in general practice in Australia, these guidelines have largely been excluded from consideration in this report.

The NHMRC guidelines summarise well the overall approach of other guidelines for imaging of back problems: 'The Australian Guideline Evidence-Based Management of Acute Musculoskeletal Pain[74] recommends against routine use of plain x-rays or other imaging tests such as MRI or CT in the absence of 'red flags' in non-specific low back pain of less than 12 weeks duration. This guideline states that x-rays are unhelpful in identifying the cause of pain and do not contribute to greater improvement in a patient's physical function, pain or disability. Numerous other international clinical practice guidelines also recommend against imaging for acute non-specific low back pain'.[75-77]

Virtually all guidelines suggest that imaging is not indicated at initial assessment of back problems unless there are 'red flag' issues that prompt investigation. Suggested 'red flags'

include: significant trauma; unexplained weight loss; unexplained fever; history of malignancy; immune suppression; long term glucocorticoid use; intravenous drug use; suspicion of ankylosing spondylitis or other inflammatory conditions; neurological defects; or age >70 years. Patients with 'red flags' account for only a small proportion of those presenting with low back problems.

WADoH guidelines suggest that plain radiographs of the spine should be the initial investigation in patients with 'red flags' except for patients with neurological defects where MRI is advised as first investigation. The ACRAC and NICE guidelines suggest that MRI may be the appropriate initial investigation for patients with any 'red flags'. All guidelines suggest that CT may be indicated if MRI is unavailable or contraindicated.

5.8 Compliance with guidelines

In order to estimate general practitioner compliance with guidelines, in this study we separated back problems into 'back symptom/complaint' which are undifferentiated back problems without a specific diagnosis; and 'back syndrome' which groups patients with back problems where the GP has applied a specific diagnostic label. The two groups have been further separated into 'new' and 'old' problems to indicate whether this is the patient's initial attendance for the problem.

In the 10 years since the last BEACH report on imaging orders by general practitioners,[1] the overall imaging rate for back problems at encounters with GPs has remained constant at over 16 imaging orders per 100 back problems managed. However, the imaging rate for new presentations of back problems to GPs in both data periods was 30 per 100 problems managed, whereas the order rate in subsequent presentations was about 11 per 100 back problems managed. The rate of imaging referral was the same for new undifferentiated back problems (back symptom/complaint) and new differentiated back problems (back syndrome).

The high rate of imaging at initial encounter for back problems is inconsistent with all established guidelines for the management of back problems.

During the study period there was a marginal decrease in plain radiography of the spine and a small but significant increase in CT scan and MRI imaging orders. This change, although quantitatively small, is consistent with the change in the guidelines favouring the use of MRI investigation of complex back problems. The limited availability of MRI referrals to GPs probably explains the greater increase in orders for CT scans than in orders for MRIs.

The pattern of GP ordering for back problems remained relatively constant in the last decade and continues to be at odds with guidelines. As reported in a 2010 study using BEACH data,[78] a similar pattern of imaging orders by GPs occurs in the USA and Europe and seems resistant to alteration by passive distribution of imaging guidelines.

6 Osteoarthritis problems

This chapter investigates the imaging orders for osteoarthritis problems (excluding osteoarthritis of the back, as these are included in the investigation of back problems in Chapter 5). As reported at the beginning of Section 2, GP imaging orders for osteoarthritis problems were selected for investigation because:

- the management of osteoarthritis problems generates the second highest amount of GPs' imaging orders
- there was a statistically significant increase in the likelihood of GPs' ordering imaging in the management of osteoarthritis over time
- it is likely that the prevalence of osteoarthritis will increase in the future with Australia's ageing population.

Imaging orders are investigated for all osteoarthritis problems (excluding osteoarthritis of the back), and for new osteoarthritis problems (see Glossary). Changes in ordering over time between April 2002–March 2005 (Period 1) and April 2009–March 2012 (Period 2) are reported.

6.1 All osteoarthritis problems

Table 6.1 shows there was a marginal decrease in the management rate of osteoarthritis problems per 100 encounters between Period 1 and Period 2. However, when extrapolated, there was a significant increase in the estimated annual encounters involving osteoarthritis problems nationally, from 2.9 million encounters (95% CI: 2.8–3.0) in Period 1 to 3.4 million (95% CI: 3.3–3.5) in Period 2. This was due to the increased number of GP encounters claimed through Medicare nationally (as described in Chapter 2).

The rate at which imaging tests were ordered in the management of osteoarthritis problems increased significantly over time. In Period 1, there were 8,857 osteoarthritis problems managed, and at least one imaging test was ordered for 1,099 of these (12.4% likelihood). A total of 1,264 imaging tests were ordered at a rate of 14.3 imaging tests per 100 osteoarthritis problems managed.

In Period 2, there were 8,329 osteoarthritis problems managed, and GPs ordered at least one imaging test for 1,333 of these (16.0% likelihood). A total of 1,537 imaging tests were ordered at a rate of 18.5 tests per 100 osteoarthritis problems managed. Osteoarthritis problems contributed to 4.8% of total imaging orders generated for all problems in Period 1 and 5.1% in Period 2 (see Table 4.4).

These results, combined with the increased GP visit rate, suggest that in Period 1, an average 410,000 imaging tests were ordered by GPs nationally per year for osteoarthritis, and an average 630,000 per year in Period 2, about 220,000 more than in Period 1.

In summary, despite the small but significant decrease in the management rate of osteoarthritis problems (by 6.7%) the imaging order rate significantly increased (by 29.4%, from 14.3 to 18.5 per 100 osteoarthritis problems managed) over the time period. As there was no change in the number of tests ordered per problem when ordering occurred (1.15 tests per tested problem in both periods) this increase in the imaging order rate by GPs can be solely attributed to the increased likelihood (29.0%) of ordering at least one imaging test.

Table 6.1: Osteoarthritis problem management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total osteoarthritis problems managed	8,857	8,329
Management rate per 100 encounters (95% CI)	3.0 (2.9–3.1)	2.8 (2.8–2.9)
Osteoarthritis problems for which at least one imaging test ordered (*n*)	1,099	1,333
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	12.4 (11.7–13.2)	16.0 (15.1–16.9)
Total imaging orders generated for osteoarthritis problems (*n*)	1,264	1,537
Imaging orders per 100 osteoarthritis problems (95% CI)	14.3 (13.4–15.2)	18.5 (17.4–19.5)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods. For a list of inclusions refer to Appendix 5, Table A5.1.

Age-specific and sex-specific management

In both data periods the sex-specific likelihood of management of osteoarthritis problems was significantly higher at encounters with females than at those with males. Between Period 1 and Period 2, the likelihood of management marginally decreased for males and did not change for females. However, the sex-specific imaging ordering rates for both sexes increased significantly, with the trend for test order rates to be higher for males than females. On further investigation, this was not due to more tests being ordered per visit for males with osteoarthritis, but rather a greater likelihood of them having an imaging test ordered, perhaps because males visit the GP less often than females.

The majority of patients for whom osteoarthritis problems were managed were aged 65 years or older in both data periods. There was a marginal decrease in the age-specific likelihood of management among those aged 25–44 years, and significant decreases for those aged 46–64 years, and 65–74 years.

Despite a marginal decrease in the overall management of osteoarthritis problems, the imaging ordering rate increased significantly, from 14.3 per 100 encounters to 18.5 per 100. Significant increases were noted at encounters with patients aged 45–64 years, and 65–74 years (Table 6.2).

Table 6.2: Age-specific and sex-specific likelihood of management and test order rate for osteoarthritis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	3,208	2.7 (2.6–2.8)	15.7 (14.2–17.2)	2,936	2.5 (2.4–2.6)	20.1 (18.4–21.9)
Females	5,537	3.2 (3.1–3.3)	13.5 (12.4–14.6)	5,282	3.1 (2.9–3.2)	17.5 (16.3–18.7)
Age						
<15 years	21	0.1 (0.0–0.1)	33.3 (0.1–66.6)	8	0.0 (—)	12.5 (0.0–42.1)
15–24 years	38	0.1 (0.1–0.2)	15.8 (3.6–27.9)	24	0.1 (0.1–0.1)	20.8 (3.1–38.6)
25–44 years	496	0.7 (0.6–0.8)	23.0 (18.4–27.5)	377	0.6 (0.5–0.6)	27.3 (21.9–32.7)
45–64 years	3,104	3.9 (3.7–4.1)	16.9 (15.3–18.5)	2,817	3.5 (3.4–3.6)	23.3 (21.5–25.1)
65–74 years	2,361	6.7 (6.4–7.0)	14.4 (12.8–16.0)	2,182	5.8 (5.6–6.1)	19.2 (17.3–21.1)
75+ years	2,738	6.5 (6.3–6.8)	9.2 (7.9–10.5)	2,824	6.1 (5.9–6.4)	11.9 (10.4–13.3)
Total	**8,829**	**3.0 (2.9–3.1)**	**14.3 (13.4–15.2)**	**8,299**	**2.8 (2.7–2.9)**	**18.5 (17.4–19.5)**

(a) Missing data removed: 2002–05 *n*=71 (age), *n*=84 (sex); 2009–12 *n*=67 (age), *n*=81 (sex).

(b) Number of encounters with at least one osteoarthritis problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 6.1).

Note: CI – confidence interval. (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

In both Period 1 and Period 2, diagnostic radiology was by far the predominant test group (Table 6.3). Although diagnostic radiology orders accounted for significantly greater proportion of imaging tests ordered for osteoarthritis in Period 1 (92.6%) than in Period 2 (88.9%), the order rate of diagnostic radiology increased significantly over the time period, from 13.2 to 16.4 per 100 osteoarthritis problems. A significant increase was noted for x-ray of the knee, marginal increase for hand x-rays, and significant decrease for hip x-rays.

Ultrasound orders doubled from 0.6 per 100 osteoarthritis problems in Period 1 to 1.2 in Period 2. This was mostly related to a marginal increase in orders for ultrasound of the knee.

MRI orders significantly increased, both as a proportion of all imaging tests for osteoarthritis and in the rate per 100 osteoarthritis problems, however, the numbers of these tests were small and the results should be interpreted with caution.

Table 6.3: Imaging test orders by MBS test group and the most frequent individual tests ordered for osteoarthritis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**1,170**	**92.6 (91.1–94.1)**	**13.2 (12.4–14.1)**	**1,366**	**88.9 (87.2–90.5)**	**16.4 (15.4–17.4)**
X-ray; knee	471	37.3 (34.5–40)	5.3 (4.8–5.8)	581	37.8 (35.4–40.2)	7.0 (6.4–7.5)
X-ray; hip	247	19.5 (17.4–21.6)	2.8 (2.4–3.1)	265	17.2 (15.4–19.1)	1.0 (0.8–1.3)
X-ray; foot/feet	72	5.7 (4.4–7.0)	0.8 (0.6–1.0)	83	5.4 (4.3–6.5)	1.0 (0.8–1.2)
X-ray; hand	55	4.4 (3.2–5.5)	0.6 (0.5–0.8)	87	5.7 (4.5–6.9)	1.0 (0.8–1.3)
X-ray; shoulder	54	4.3 (3.2–5.4)	0.6 (0.4–0.8)	54	3.5 (2.6–4.4)	0.6 (0.5–0.8)
X-ray; ankle	48	3.8 (2.7–4.9)	0.5 (0.4–0.7)	52	3.4 (2.5–4.3)	0.6 (0.5–0.8)
Ultrasound	**52**	**4.1 (3.0–5.2)**	**0.6 (0.4–0.7)**	**98**	**6.4 (5.1–7.6)**	**1.2 (0.9–1.4)**
Ultrasound; shoulder	18	1.4 (0.8–2.1)	0.2 (0.1–0.3)	30	2.0 (1.3–2.6)	0.4 (0.2–0.5)
Ultrasound; knee	11	0.9 (0.4–1.4)	0.1 (0.1–0.2)	23	1.5 (0.9–2.1)	0.3 (0.2–0.4)
Ultrasound; hip	N/Av	—	—	16	1.0 (0.4–1.6)	0.2 (0.1–0.3)
Computerised tomography	**25**	**2.0 (1.2–2.8)**	**0.3 (0.2–0.4)**	**35**	**2.3 (1.5–3.0)**	**0.4 (0.3–0.6)**
Magnetic resonance imaging	**4**	**0.3 (0.0–0.7)**	**0.0 (0.0–0.1)**	**26**	**1.7 (1.0–2.4)**	**0.3 (0.2–0.4)**
Nuclear medicine imaging	**13**	**1.0 (0.5–1.6)**	**0.1 (0.1–0.2)**	**12**	**0.8 (0.3–1.3)**	**0.1 (0.1–0.2)**
Total imaging tests	**1,264**	**100.0**	**14.3 (13.4–15.2)**	**1,537**	**100.0**	**18.5 (17.4–19.5)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods.

Imaging test ordering rates by status of osteoarthritis problem

Table 6.4 shows the proportions of osteoarthritis problems managed that were new cases (i.e. first presentation to a medical practitioner), and those that were old (i.e. managed previously) in both data periods. More than 80% GP contacts were follow-up of previously diagnosed osteoarthritis problems, in both Period 1 and Period 2. The management rate of new osteoarthritis problems increased over time (17.1 per 100 osteoarthritis problems to 19.8 per 100), with a corresponding significant decrease in the management rate of old problems.

In both data periods, the imaging order rate was much higher at initial presentations (38.0 per 100 osteoarthritis problems in Period 1 and 44.0 per 100 in Period 2) than at follow-up consultations (9.4 per 100 in Period 1 and 12.1 per 100 in Period 2). Despite the decrease in management of old osteoarthritis problems, both the imaging ordering rate and the

likelihood of ordering imaging tests significantly increased between Period 1 and Period 2, for both new and old osteoarthritis problems.

These results, combined with the increased GP visit rate, suggest that in Period 1, an estimated average 190,000 imaging orders were placed nationally per year by GPs for new osteoarthritis problems. In Period 2, about 300,000 imaging tests per year were ordered, about 110,000 more per year than in Period 1.

Similarly, in Period 1, an estimated average 230,000 imaging orders were placed nationally by GPs per year for old osteoarthritis problems. In Period 2, about 330,000 imaging tests were ordered on average per year, or about 100,000 more per year than in Period 1.

In summary, as there was no change in the number of imaging tests ordered per tested new osteoarthritis problem (1.15 per tested problem in Period 1 and 1.14 in Period 2) the increased imaging order rate for new osteoarthritis appears to be a result of the 16% increase in the management rate of new problems and the increased likelihood (29%) of GPs ordering an imaging test when managing new osteoarthritis problems.

As the management rate of old osteoarthritis problems decreased and there was no change in the number of tests ordered per tested problem (1.16 in both periods), the increase in the imaging order rate per 100 problems managed was due to increased likelihood of ordering imaging tests for old osteoarthritis problems.

Table 6.4: Imaging ordering rates by status of osteoarthritis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	1,513	7,344	**8,857**	1,650	6,679	**8,329**
Per cent of osteoarthritis problems	17.1 (16.2–18.0)	82.9 (82.0–83.8)	**100.0**	19.8 (18.8–20.0)	80.2 (79.2–81.2)	**100.0**
Total imaging orders generated for problems (*n*)	575	689	**1,264**	726	811	**1,537**
Imaging orders per 100 problems (95% CI)	38.0 (35.0–41.0)	9.4 (8.6–10.2)	**14.3 (13.4–15.2)**	44.0 (41.0–47.0)	12.1 (11.2–13.1)	**18.5 (17.4–19.5)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	33.2 (30.8–35.7)	8.1 (7.5–8.8)	**12.4 (11.7–13.2)**	38.5 (36.0–41.0)	10.5 (9.7–11.2)	**16.0 (15.1–16.9)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

6.2 New osteoarthritis problems

Age-specific and sex-specific management

In both data periods, the sex-specific likelihood of management for new osteoarthritis was similar for males and females, and increased marginally for male patients over time. There were no significant differences in the sex-specific imaging test order rates for either male or female patients in either data period.

The age-specific rates show that the majority of patients for whom new osteoarthritis problems were managed were aged 45 years and over. There was a marginal increase in the likelihood of management for patients aged 65–74 years between Period 1 and Period 2. While there was a marginal increase in the overall imaging order rate, the age-specific order rate did not change for any individual age group (Table 6.5).

Table 6.5: Age-specific and sex-specific likelihood of management and test order rate for new osteoarthritis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	552	0.5 (0.4–0.5)	41.5 (36.5–46.5)	626	0.5 (0.5–0.6)	47.6 (42.7–52.5)
Females	945	0.5 (0.5–0.6)	36.0 (32.3–39.8)	1,010	0.6 (0.5–0.6)	41.8 (38.1–45.5)
Age						
<15 years	8	0.0 (—)	75.0 (0.0–161.5)	2	0.0 (—)	0.0 (—)
15–24 years	16	0.1 (0.0–0.1)	18.8 (0.0–40.2)	10	0.0 (0.0–0.1)	30.0 (0.0–64.6)
25–44 years	147	0.2 (0.2–0.2)	39.5 (30.1–48.8)	106	0.2 (0.1–0.2)	41.5 (31.2–51.8)
45–64 years	685	0.9 (0.8–1.0)	42.6 (38.0–47.1)	699	0.9 (0.8–1.0)	47.5 (43.1–51.9)
65–74 years	356	1.0 (0.9–1.1)	34.6 (28.8–40.3)	470	1.3 (1.1–1.4)	44.9 (39.2–50.6)
75+ years	289	0.7 (0.6–0.8)	30.1 (24.0–36.3)	349	0.8 (0.7–0.8)	37.5 (31.3–43.8)
Total	**1,512**	**0.5 (0.5–0.5)**	**38.0 (35.0–41.0)**	**726**	**0.6 (0.5–0.6)**	**44.0 (41.0–47.0)**

(a) Missing data removed: 2002–05 *n*=11 (age), *n*=15 (sex); 2009–12 *n*=10 (age), *n*=10 (sex).

(b) Number of encounters with at least one new osteoarthritis problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 6.4).

Note: CI – confidence interval; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging test types ordered

Between Period 1 and Period 2, there were very few changes in the distribution of test orders across MBS groups. Diagnostic radiology was the predominant test group in both data periods, accounting for similar proportions of all imaging tests and having similar imaging rates in both Period 1 and Period 2. There were no changes in either the proportions of other test types, or in their order rates (Table 6.6).

Table 6.6: Imaging test orders by MBS test group and the most frequent individual tests ordered for new osteoarthritis problem, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**541**	**94.1 (92.2–96.0)**	**35.8 (32.8–38.7)**	**677**	**93.3 (91.4–95.1)**	**41.0 (38.2–43.9)**
X-ray; knee	222	38.6 (34.5–42.7)	14.7 (12.8–16.5)	276	38.0 (34.5–41.5)	16.7 (14.9–18.5)
X-ray; hip	110	19.1 (16.0–22.3)	7.3 (5.9–8.6)	133	18.3 (15.6–21.1)	8.1 (6.7–9.4)
X-ray; foot/feet	49	8.5 (6.2–10.8)	3.2 (2.3–4.1)	45	6.2 (4.5–7.9)	2.7 (2.0–3.5)
Ultrasound	**24**	**4.2 (2.6–5.8)**	**1.6 (1.0–2.2)**	**31**	**4.3 (2.8–5.7)**	**1.9 (1.2–2.6)**
Computerised tomography	**5**	**0.9 (0.1–1.6)**	**0.3 (0.0–0.6)**	**8**	**1.1 (0.3–1.9)**	**0.2 (0.0–0.5)**
Magnetic resonance imaging	**1**	**0.2 (—)**	**0.1 (—)**	**6**	**0.8 (0.2–1.5)**	**0.4 (0.1–0.7)**
Nuclear medicine	**4**	**0.7 (0.0–1.4)**	**0.3 (0.0–0.5)**	**4**	**0.6 (0.0–1.1)**	**0.2 (0.0–0.5)**
Total imaging tests	**575**	**100.0**	**38.0 (35.0–41.0)**	**726**	**100.0**	**44.0 (41.0–47.0)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

6.3 Summary of findings

Changes over time

The overall management rate of osteoarthritis problems decreased over time. New cases accounted for a larger proportion of osteoarthritis problems in Period 2 than in Period 1. The imaging order rate increased over time in the management of all osteoarthritis problems, due solely to the increased likelihood that imaging was ordered (Table 6.7). Diagnostic radiology was the predominant test group in both data periods, and its ordering rate increased over time. Ordering rates of ultrasound and MRI also increased over time, but these test types were ordered in much smaller numbers.

Table 6.7: Summary of changes over time for osteoarthritis

Osteoarthritis	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	↓ 6.7% (3.0, 2.8)	↑ 29.0% (12.4, 16.0)	↑ 29.4% (14.3, 18.5)	No change (1.15, 1.15)
New	↑ 15.8% (0.5, 0.6)	↑ 16.0% (33.2, 38.5)	↑ 15.8% (38.0, 44.0)	No change (1.15, 1.14)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

In recent practice, new cases accounted for one-fifth of all contacts involving management of osteoarthritis, but they were four times more likely to result in an imaging order than previously diagnosed cases.

Diagnostic radiology tests were the most common tests ordered, accounting for almost 90% of imaging ordered. On those occasions where ultrasound, CT scan or MRI was ordered, there was no difference in the rate at which these tests were ordered for new problems or those previously managed (Table 6.8).

Table 6.8: Summary of GP imaging ordering for osteoarthritis, Period 2, 2009–12

OA	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	2.8 (2.8–2.9)	16.0 (15.1–16.9)	1.15	18.5 (17.4–19.5)	16.4 (15.4–17.4)	1.2 (0.9–1.4)	0.4 (0.3–0.6)	0.3 (0.2–0.4)
New	0.6 (0.5–0.6)	38.5 (36.0–41.0)	1.14	44.0 (41.0–47.0)	41.0 (38.2–43.9)	1.9 (1.2–2.6)	0.2 (0.0–0.5)	0.4 (0.1–0.7)
Old	2.3 (2.2–2.4)	10.5 (9.7–11.2)	1.16	12.1 (11.2–13.1)	10.3 (9.5–11.2)	1.0 (0.8–1.3)	0.4 (0.3–0.6)	0.3 (0.2–0.4)

Note: OA – osteoarthritis; CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging.

6.4 Summary of guidelines for imaging for osteoarthritis

An extensive review of guidelines for diagnostic imaging was undertaken using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

The final group of guidelines considered for this section of this report were: Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways[17] (these guidelines could be considered as the successor of the now obsolete Royal Australian and New Zealand College of Radiologists [RANZCR] Imaging Guidelines 2001,[19] and are endorsed by the RANZCR), the American College of Radiology Appropriateness Criteria (ACRAC),[24] and the NHMRC guidelines distributed by the Royal Australian College of General Practitioners.[33,34]

Osteoarthritis is a common disease in Australia and costs 1 to 2.5% of gross national product.[79] The frequency of ordering of imaging for osteoarthritis problems is relatively low at 18.5 per 100 problems. However due to the high prevalence and management frequency of osteoarthritis, it was second only to back problems in its contribution to the total number of imaging orders by GPs. 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 osteoarthritis.

All guidelines suggest that plain x-ray (preferably weight bearing) is the investigation of choice for assessment of non-traumatic joint pain where osteoarthritis is suspected. MRI may be indicated in a small number of situations, including assessment for surgery.

6.5 Compliance with guidelines

Compliance with current guidelines is reported only for the 2009–12 period as current guidelines are not applicable to the first study sample.

The majority of osteoarthritis problems seen in general practice are labelled at the level of 'Arthritis' or 'Osteoarthritis' rather than as arthritis of specific joints, as multiple joints are frequently involved. Therefore compliance with guidelines can only be assessed at the upper level of imaging modality.

The use of imaging other than diagnostic radiology is rare in the assessment of osteoarthritis problems. Ultrasound is used occasionally and MRI very rarely, possibly because the MBS rules limit GP ordering of MRI studies.

Diagnostic radiology was ordered at the rate of 16.4 per 100 contacts with all osteoarthritis problems and 41.0 per 100 new osteoarthritis problems. This rate of ordering is consistent with the use of radiology in initial diagnosis, and more limited use in assessing progress and outcomes. Ordering of imaging for osteoarthritis by general practitioners appears consistent with existing guidelines.

7 Shoulder problems

This chapter investigates imaging orders for shoulder problems, recorded by GPs from April 2002–March 2005 (Period 1) to April 2009–March 2012 (Period 2). Throughout the chapter, 'shoulder problems' include all problems of the shoulder excluding arthritis/osteoarthritis of the shoulder. As reported at the beginning of Section 2, GP imaging orders for shoulder problems were selected for investigation because there had been a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication.

Based on the rationale that guidelines recommend different management of shoulder problems depending on their status as a symptom/complaint or as a defined condition (see Chapter 2), shoulder problems were grouped and categorised as:

- 'shoulder symptom/complaint (all)'
- 'shoulder syndrome (all)'.

The full list of ICPC-2 rubrics and ICPC-2 PLUS codes and terms included in each group are provided in Appendix 5, Table A5.1.

Imaging orders are investigated for:

- all shoulder problems
- all shoulder problems grouped as 'shoulder syndrome'
- new problems grouped as 'shoulder syndrome'
- all shoulder problems grouped as 'shoulder symptom/complaint'
- new problems grouped as 'shoulder symptom/complaint'.

Changes in ordering over time between Period 1 and Period 2 are reported.

7.1 All shoulder problems

Table 7.1 shows the total number of shoulder problems managed, and the distribution of the shoulder problems across shoulder syndrome and shoulder symptoms/complaints in Period 1 and Period 2.

While the management rate for shoulder symptom/complaint did not change between the two data periods, the management rate for shoulder syndrome increased marginally, from 0.5 to 0.7 per 100 encounters. In both data periods, shoulder syndrome accounted for around three-quarters of all shoulder problems, and shoulder symptoms/complaints for the remaining quarter.

The management rate of total shoulder problems per 100 encounters significantly increased over the time period, resulting in a significant increase in the estimated annual encounters involving shoulder problems nationally. These increased by 368,000, from 0.71 million encounters (95% CI: 0.67–0.74) in Period 1 to 1.08 million (95% CI: 1.03–1.13) in Period 2. This is due to a combination of the increased management rate and increased GP visit rate.

Table 7.1: Shoulder problems managed by problem type, 2002–05 and 2009–12

Shoulder problems[(a)]	2002–05 (Period 1)			2009–12 (Period 2)		
	Number of problems	Per cent of shoulder problems	Per 100 encounters (95% CI)	Number of problems	Per cent of shoulder problems	Per 100 encounters (95% CI)
Shoulder syndrome	1,556	72.0	0.5 (0.5–0.6)	1,988	75.4	0.7 (0.6–0.7)
Shoulder symptom/complaint	605	28.0	0.2 (0.2–0.2)	649	24.6	0.2 (0.2–0.2)
Total shoulder problems	**2,161**	**100.0**	**0.7 (0.7–0.8)**	**2,637**	**100.0**	**0.9 (0.9–0.9)**

(a) For a list of inclusions refer to Appendix 5, Table A5.1.

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Table 7.2 shows that the rate at which imaging tests were ordered in the management of shoulder problems increased significantly over time. In 2002–05, there were 2,161 shoulder problems managed, and at least one imaging test was ordered for 524 of these (24.2% likelihood). A total of 703 imaging test orders were placed, at a rate of 32.5 tests per 100 shoulder problems managed.

In 2009–12, there were 2,637 shoulder problems managed, and GPs ordered at least one imaging test for 876 of these (33.2% likelihood). A total of 1,173 imaging test orders were placed at a rate of 44.5 imaging tests per 100 shoulder problems managed. Shoulder problems contributed a larger proportion of total imaging orders generated for all problems, increasing from 2.7% in Period 1 to 3.9% in Period 2 (see Table 4.4).

These results, combined with the increased GP visit rate, suggest that nationally in Period 1, about 230,000 imaging orders were placed per year by GPs in the management of shoulder problems. In Period 2, there were about 480,000 imaging orders placed per year, or 250,000 more per year than in Period 1.

In summary, there was a 37% increase in the imaging ordering rate for all shoulder problems between Period 1 and Period 2. As the average number of tests per tested shoulder problem did not change (1.3 tests per tested problem in both periods), the increase in ordering is a result of the increased management rate (by 23%), the increased likelihood (by 37%) of ordering an imaging test when shoulder problems were managed, and the increased visit rate to GPs.

Table 7.2: Shoulder problem management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total shoulder problems managed	2,161	2,637
Shoulder problems for which at least one imaging test ordered (*n*)	524	876
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	24.2 (22.3–26.2)	33.2 (31.3–35.2)
Total imaging orders generated for shoulder problems (*n*)	703	1,173
Imaging orders per 100 shoulder problems (95% CI)	32.5 (29.7–35.4)	44.5 (41.7–47.3)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Age-specific and sex-specific management of shoulder problems

The likelihood of management of shoulder problems increased significantly over time, from 0.7% to 0.9% of encounters. In both data periods, the likelihood of management was marginally higher at encounters with males than at those with females. Between Period 1 and Period 2, there was a marginal increase in likelihood of management at encounters with males, and a significant increase at encounters with females.

Patients aged between 45 and 64 years had the highest likelihood of management for shoulder problems in both data periods, and this increased significantly from 1.2% to 1.5%. There was also a marginal increase in management among patients aged 75 years and over, from 0.7% to 0.9%.

The imaging order rate for shoulder problems significantly increased between Period 1 and Period 2, from 32.5 to 44.5 tests per 100 shoulder problems. The sex-specific imaging test order rates for shoulder problems significantly increased for both males (33.4 to 44.4 per 100 shoulder problems) and females (32.0 to 44.4 per 100). The age-specific imaging ordering rates for shoulder problems significantly increased for the 45–64 and 65–74 year age groups, by 41% in the former and 56% in the latter.

Table 7.3: Age-specific and sex-specific management of shoulder problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	954	0.8 (0.7–0.9)	33.4 (29.5–37.3)	1,175	1.0 (0.9–1.1)	44.4 (40.2–48.5)
Females	1,183	0.7 (0.6–0.7)	32.0 (28.3–35.8)	1,430	0.8 (0.8–0.9)	44.4 (40.7–48.1)
Age						
<15 years	13	0.0 (0.0–0.1)	30.8 (1.7–59.8)	21	0.1 (0.0–0.1)	66.7 (33.4–99.9)
15–24 years	96	0.3 (0.3–0.4)	36.5 (23.7–49.2)	93	0.4 (0.3–0.5)	54.8 (40.2–69.5)
25–44 years	464	0.6 (0.6–0.7)	36.2 (30.1–42.3)	434	0.7 (0.6–0.7)	44.3 (37.7–50.8)
45–64 years	933	1.2 (1.1–1.3)	31.6 (27.6–35.5)	1,242	1.5 (1.5–1.6)	44.7 (40.8–48.6)
65–74 years	338	1.0 (0.9–1.1)	30.1 (23.5–36.7)	431	1.2 (1.0–1.3)	47.0 (40.1–53.9)
75+ years	297	0.7 (0.6–0.8)	32.0 (24.3–39.7)	391	0.9 (0.8–0.9)	38.9 (32.1–45.7)
Total	**2,159**	**0.7 (0.7–0.8)**	**32.5 (29.7–35.4)**	**2,629**	**0.9 (0.9–0.9)**	**44.5 (41.7–47.3)**

(a) Missing data removed: 2002–05 *n*=18 (age), *n*=22 (sex); 2009–12 *n*=17 (age), *n*=24 (sex).

(b) Number of encounters with at least one shoulder problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 7.2).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Between Period 1 and Period 2, there was a move away from diagnostic radiology toward ultrasound and CT. Table 7.4 shows:

- diagnostic radiology accounted for a significantly greater proportion of imaging tests ordered for shoulder problems in Period 1 (44.8%) than in Period 2 (32.1%)
- a marginal decrease in diagnostic radiology orders per 100 shoulder problems managed, from 17.6 to 14.3 per 100 shoulder problems managed
- ultrasound orders significantly increased from 17.6 to 28.9 per 100 shoulder problems, particularly ultrasound of the shoulder, which increased from 17.4 to 28.5 per 100 shoulder problems
- CT orders increased marginally from 0.2 to 0.8 per 100 shoulder problems managed
- the number of MRI orders increased over time. However, the numbers were small and the results should be interpreted with caution.

Table 7.4: Imaging tests ordered by MBS test group and the most frequent imaging tests ordered for shoulder problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**315**	**44.8 (41.7–47.9)**	**17.6 (15.8–19.3)**	**377**	**32.1 (30.0–34.3)**	**14.3 (12.8–15.8)**
X-ray; shoulder	281	40.0 (37.2–42.8)	13.0 (11.5–14.5)	341	29.1 (27.1–31.1)	12.9 (11.6–14.3)
X-ray; chest	10	1.4 (0.6–2.3)	0.5 (0.2–0.7)	8	0.7 (0.2–1.1)	0.3 (0.1–0.5)
Ultrasound	**380**	**54.1 (51.0–57.1)**	**17.6 (15.8–19.3)**	**762**	**65.0 (62.7–67.2)**	**28.9 (27.0–30.8)**
Ultrasound; shoulder	376	53.5 (50.4–56.5)	17.4 (15.7–19.1)	751	64.0 (61.8–66.3)	28.5 (26.6–30.3)
Computerised tomography	**4**	**0.6 (0.0–1.1)**	**0.2 (0.0–0.4)**	**21**	**1.8 (1.0–2.6)**	**0.8 (0.4–1.2)**
Magnetic resonance imaging	**2**	**0.3 (—)**	**0.1 (—)**	**13**	**1.1 (0.5–1.8)**	**0.5 (0.2–0.8)**
Nuclear medicine	**2**	**0.3 (—)**	**0.1 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**703**	**100.0**	**35.2 (29.7–35.4)**	**1,173**	**100.0**	**44.5 (41.7–47.3)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

7.2 Shoulder syndrome

Table 7.5 shows that the rate at which imaging tests were ordered in the management of shoulder syndrome increased significantly over time. In 2002–05, there were 1,566 shoulder syndrome problems managed, and at least one imaging test was ordered for 342 of these (22.0% likelihood). A total of 461 imaging test orders were placed, at a rate of 29.6 imaging tests per 100 shoulder syndrome problems managed.

In 2009–12, there were 1,988 shoulder syndrome problems managed, and at least one imaging test was ordered for 651 of these (32.7% likelihood). GPs placed a total of 860 imaging test orders, at a rate of 43.3 per 100 shoulder syndrome problems managed.

These results, combined with the increased GP visit rate, suggest that in Period 1, 150,000 imaging orders were placed per year nationally by GPs in management of shoulder syndromes. In Period 2, about 350,000 orders were placed per year, 200,000 more per year than in Period 1.

In summary, the likelihood of GPs ordering an imaging test when managing shoulder syndrome increased by almost 50% (from 22.0% of problems, to 32.7%). However, when they decided to order, the number of tests ordered per tested problem did not change (1.30 to 1.35 tests per tested shoulder syndrome) (results not tabled). The number of imaging tests ordered increased by 46% (from 29.6 to 43.3 per 100 shoulder syndrome problems managed), and this increase was totally due to an increased likelihood of ordering.

Table 7.5: Shoulder syndrome management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total shoulder syndrome problems managed	1,566	1,988
Shoulder syndrome problems for which at least one imaging test ordered (*n*)	342	651
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	22.0 (19.8–24.2)	32.7 (30.5–35.0)
Total imaging orders generated for shoulder syndrome problems (*n*)	461	860
Imaging orders per 100 shoulder syndrome problems (95% CI)	29.6 (26.4–32.8)	43.3 (40.1–46.4)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Age-specific and sex-specific management of shoulder syndrome

The likelihood of management of shoulder syndrome significantly increased over time, from 0.5% to 0.7% of encounters, and this was apparent at encounters with both males (0.6% to 0.7% of male encounters) and females (0.5% to 0.6% of female encounters).

The age-specific likelihood of management significantly increased for patients aged 45–64 years, from 0.9% to 1.2% of encounters with patients in this age group, with a marginal increase observed for patients aged 65–74 years (0.7% to 0.9%).

The increase in the overall rate at which imaging tests were ordered for shoulder syndrome (from 29.6 to 43.3 tests per 100 problems), was apparent for both males (30.9 to 43.2 per 100) and females (28.7 to 43.3 per 100). The age-specific imaging ordering rates significantly increased for patients aged 45–64 years (30.2 to 43.4 per 100 shoulder syndrome problems).

Table 7.6: Age-specific and sex-specific management of shoulder syndrome, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	689	0.6 (0.5–0.6)	30.9 (26.3–35.4)	861	0.7 (0.7–0.8)	43.2 (38.5–48.0)
Females	850	0.5 (0.5–0.5)	28.7 (24.5–32.9)	1,102	0.6 (0.6–0.7)	43.3 (39.1–47.4)
Age						
<15 years	7	0.0 (—)	42.9 (0.0–92.3)	10	0.0 (0.0–0.1)	120.0 (74.8–165.2)
15–24 years	56	0.2 (0.1–0.3)	32.1 (15.7–48.6)	57	0.2 (0.2–0.3)	63.2 (42.4–84.0)
25–44 years	298	0.4 (0.4–0.5)	31.2 (24.0–38.4)	310	0.5 (0.4–0.5)	44.2 (36.6–51.9)
45–64 years	701	0.9 (0.8–1.0)	30.2 (25.7–34.7)	977	1.2 (1.1–1.3)	43.4 (39.1–47.7)
65–74 years	261	0.7 (0.6–0.8)	29.1 (21.6–36.6)	340	0.9 (0.8–1.0)	42.5 (35.0–50.0)
75+ years	219	0.5 (0.4–0.6)	25.6 (17.2–34.0)	276	0.6 (0.5–0.7)	36.6 (28.8–44.4)
Total	**1,555**	**0.5 (0.5–0.6)**	**29.6 (26.4–32.8)**	**1,981**	**0.7 (0.6–0.7)**	**43.3 (40.1–46.4)**

(a) Missing data removed: 2002–05 *n*=13 (age), *n*=16 (sex); 2009–12 *n*=11 (age), *n*=18 (sex).

(b) Number of encounters with at least one shoulder syndrome problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 7.5).

Note: CI – confidence interval. (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Table 7.7 shows there were considerable changes in the distribution of test orders across MBS groups. Over the time period, there was a general move away from diagnostic radiology as a proportion of tests for shoulder syndrome, although the rate of ordering these tests per 100 shoulder syndrome problems did not change. Between Period 1 and Period 2 the order rate for ultrasound significantly increased from 17.4 to 30.1 per 100 shoulder syndrome problems managed, particularly ultrasound of the shoulder, which increased from 17.2 to 29.7 per 100 shoulder syndrome problems.

The number of orders for CT and MRI increased, however the numbers for both were very small and results should be interpreted with caution.

Table 7.7: Imaging test orders by MBS test group and the most frequent individual tests ordered for shoulder syndrome, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**187**	**40.6 (36.8–44.3)**	**12.0 (10.2–13.8)**	**244**	**28.4 (25.9–30.8)**	**12.3 (10.7–13.8)**
X-ray; shoulder	172	37.3 (33.9–40.7)	11.1 (9.4–12.7)	225	26.2 (23.9–28.5)	11.3 (9.9–12.8)
Ultrasound	**271**	**58.8 (55.1–62.5)**	**17.4 (15.4–19.4)**	**598**	**69.5 (67.1–72.0)**	**30.1 (27.9–32.2)**
Ultrasound; shoulder	268	58.1 (54.5–61.8)	17.2 (15.2–19.2)	590	68.6 (66.1–71.1)	29.7 (27.6–31.8)
Computerised tomography	**2**	**0.4 (—)**	**0.1 (—)**	**10**	**1.2 (0.4–1.9)**	**0.5 (0.2–0.8)**
Magnetic resonance imaging	**1**	**0.2 (—)**	**0.1 (—)**	**8**	**0.9 (0.3–1.6)**	**0.4 (0.1–0.7)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**461**	**100.0**	**29.6 (26.4–32.8)**	**860**	**100.0**	**43.3 (40.1–46.4)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of shoulder syndrome

Table 7.8 shows the proportions of contacts generating an imaging order for new and old shoulder syndrome problems in both data periods. Approximately 60% of GP contacts were for previously diagnosed shoulder syndrome problems, in both 2002–05 and 2009–12.

In both data periods, the likelihood of ordering and the imaging order rate for all shoulder syndrome problems were nearly three times higher at initial presentations (47.6 orders per 100 shoulder syndrome problems in Period 1 and 67.4 per 100 in Period 2) than at follow-up consultations (17.0 orders per 100 shoulder syndrome problems in Period 1 and 26.1 per 100 in Period 2). Both the imaging order rate and the likelihood of ordering at least one imaging test per 100 new and old shoulder syndrome problems, increased significantly over time.

These results, combined with the increased GP visit rate, suggest that nationally in Period 1, GPs ordered about 100,000 imaging orders per year in management of new shoulder syndrome problems. In Period 2, there were about 230,000 imaging orders placed per year, 130,000 test orders per year more than in Period 1. Similarly, in Period 1, on average each year about 50,000 imaging orders were placed nationally by GPs for the management of old shoulder syndrome problems. In Period 2, there were about 120,000 imaging orders placed per year, about 70,000 more per year than in Period 1.

In summary, as there was no change in the management rate between Period 1 and Period 2, and no change in the number of imaging tests ordered per problem, the increase in the test order rate for both new and old shoulder syndrome problems was due to the increased likelihood of ordering an imaging test when either new or old shoulder syndrome problems were managed.

Table 7.8: Imaging ordering rates by status of shoulder syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	643	913	**1,556**	827	1,161	**1,988**
Per cent of shoulder syndrome problems	41.3	58.7	**100.0**	41.6	58.4	**100.0**
Total imaging orders generated for problems (*n*)	306	155	**461**	557	303	**860**
Imaging orders per 100 problems (95% CI)	47.6 (41.7–53.4)	17.0 (13.8–20.1)	**29.6 (26.4–32.8)**	67.4 (61.8–72.9)	26.1 (22.9–29.3)	**43.3 (40.1–46.4)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	34.5 (30.7–38.4)	13.1 (10.8–15.5)	**22.0 (19.8–24.2)**	48.6 (45.0–52.3)	21.4 (18.9–24.0)	**32.7 (30.5–35.0)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

7.3 New shoulder syndrome

Age-specific and sex-specific management

The overall likelihood of management of new shoulder syndrome problems increased significantly between Period 1 and Period 2, from 0.2% to 0.3% of encounters. In Period 1, there was no difference in the sex-specific likelihood of management, but in Period 2 the likelihood of management was marginally higher at encounters with males (than with females). The sex-specific likelihood of management increased marginally for both sexes between Period 1 and Period 2 (Table 7.9). The age-specific likelihood of management for new shoulder syndrome problems increased significantly for patients in all age groups, except children aged <15 years.

There were several changes observed in the rate of imaging ordered for the management of new shoulder syndrome problems. The sex-specific rate of imaging ordering at encounters with female patients increased significantly, from 43.9 to 68.7 per 100 new shoulder syndrome problems managed, and age-specific rates increased significantly in the 45–64 year age group (50.7 to 69.2 per 100) between Period 1 and Period 2. In Period 1, there were 1.36 tests per tested problem, and in Period 2 there were 1.39 tests per tested problem.

Table 7.9: Age-specific and sex-specific likelihood of management and test order rate for new shoulder syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	280	0.2 (0.2–0.3)	53.0 (44.3–61.8	375	0.3 (0.3–0.4)	65.3 (57.1–73.6)
Females	358	0.2 (0.2–0.2)	43.9 (36.4–51.3)	442	0.3 (0.2–0.3)	68.7 (61.3–76.1)
Age						
<15 years	3	0.0 (—)	33.3 (0.0–176.8)	5	0.0 (—)	140.0 (72.0–208.0)
15–24 years	25	0.1 (0.1–0.1)	60.0 (31.3–88.7)	31	0.3 (0.2–0.4)	96.8 (66.1–127.4)
25–44 years	121	0.2 (0.1–0.2)	47.1 (34.1–60.1)	126	0.5 (0.4–0.5)	67.5 (54.1–80.8)
45–64 years	277	0.4 (0.3–0.4)	50.7 (42.0–59.5)	402	0.6 (0.5–0.6)	69.2 (61.6–76.9)
65–74 years	103	0.3 (0.2–0.4)	47.6 (32.4–62.8)	151	0.6 (0.5–0.7)	65.8 (52.5–79.4)
75+ years	107	0.3 (0.2–0.3)	37.4 (24.5–50.2)	107	0.4 (0.4–0.5)	51.4 (36.8–66.0)
Total	**642**	**0.2 (0.2–0.2)**	**47.6 (41.7–53.4)**	**825**	**0.3 (0.3–0.3)**	**67.4 (61.8–72.9)**

(a) Missing data removed: 2002–05 *n*=6 (age), *n*=4 (sex); 2009–12 *n*=3 (age), *n*=8 (sex).

(b) Number of encounters with at least one new shoulder syndrome problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 7.8).

Note: CI – confidence interval. (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging test types ordered

Table 7.10 shows there were considerable changes in the distribution of test ordering across MBS groups, and changes in ordering of specific tests between Period 1 and Period 2.

Ultrasound was the most commonly ordered group in both data periods, accounting for two-thirds of imaging orders for new shoulder syndrome problems in Period 2. The order rate for ultrasound also increased significantly, from 26.6 to 44.9 per 100 new shoulder syndrome problems managed.

There was a decrease in orders for diagnostic radiology as a proportion of imaging tests ordered for new shoulder syndrome management, but the imaging order rate did not change. CT and MRI technically increased, but the numbers are too small for reliability. Nuclear medicine was not employed in the management of new shoulder syndrome in either period.

Table 7.10: Imaging test orders by MBS test group and the most frequent individual tests ordered for new shoulder syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**134**	**43.8 (39.5–48.1)**	**20.8 (17.3–24.4)**	**178**	**32.0 (29.0–34.9)**	**21.5 (18.5–24.6)**
X-ray; shoulder	124	40.5 (36.5–44.5)	19.3 (16.0–22.5)	165	29.6 (26.9–32.4)	20.0 (17.1–22.8)
Ultrasound	**171**	**55.9 (51.6–60.1)**	**26.6 (23.1–30.1)**	**371**	**66.6 (63.6–69.6)**	**44.9 (41.3–48.5)**
Ultrasound; shoulder	170	55.6 (51.3–59.8)	26.4 (22.9–30.0)	370	66.4 (63.4–69.4)	44.7 (41.2–48.3)
Computerised tomography	**1**	**0.3 (—)**	**0.2 (—)**	**5**	**0.9 (0.1–1.7)**	**0.6 (0.1–1.1)**
Magnetic resonance imaging	**0**	**0.0 (—)**	**0.0 (—)**	**3**	**0.5 (0.0–0.1)**	**0.4 (0.0–0.8)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**306**	**100.0**	**47.6 (41.7–53.4)**	**557**	**100.0**	**67.4 (61.8–72.9)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only most frequent test descriptors are presented in each MBS group.

7.4 Shoulder symptom/complaint

Table 7.11 shows that the rate at which imaging was ordered in the management of shoulder symptom/complaint problems did not change significantly over time.

In 2002–05, there were 605 shoulder symptom/complaint problems managed and GPs ordered at least one imaging test for 182 or these (30.1% likelihood). A total of 242 imaging test orders were placed at a rate of 40.0 imaging tests per 100 shoulder symptom/complaint problems managed.

In 2009–12, there were 649 shoulder symptom/complaint problems managed, and GPs ordered at least one imaging test for 225 of these (34.7% likelihood). In total, 313 imaging test orders were placed at a rate of 48.2 per 100 shoulder symptom/complaint problems managed.

In Period 1, an estimated 80,000 imaging orders per year were placed nationally by GPs for the management of shoulder symptom/complaint problems. In Period 2, there were about 130,000 imaging orders placed per year, or about 50,000 more per year than in Period 1.

In summary, there were no significant changes in: the management rate of shoulder symptom/complaint problems (0.2 per 100 problems in both periods); or the likelihood of GPs ordering an imaging test when managing these problems (30.1% in Period 1 and 34.7% in Period 2). There was also no change in the number of imaging tests ordered per tested problem (1.33 in Period 1 and 1.40 in Period 2) (results not tabled). Therefore, the increase in the total estimated number of tests ordered nationally for this problem is due solely to the increased GP visit rate. GP behaviour did not change.

Table 7.11: Shoulder symptom/complaint contacts involving imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total shoulder symptom/complaint problems managed	605	649
Shoulder symptom/complaint problems for which at least one test ordered (*n*)	182	225
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	30.1 (26.2–34.0)	34.7 (30.8–38.5)
Total imaging orders generated for shoulder symptom/complaint problems (*n*)	242	313
Imaging orders per 100 shoulder symptom/complaint problems (95% CI)	40.0 (34.4–45.6)	48.2 (42.5–54.0)

Note: CI – confidence interval.

Age-specific and sex-specific management

The sex-specific likelihood of management of shoulder symptoms/complaints was similar at encounters with males and with females in both time periods. There was no change in the likelihood of management over time for either sex (Table 7.12).

The age-specific likelihood of management of shoulder symptoms/complaints was highest for patients aged 45–64 years in both data periods, and the rate marginally increased over time for patients aged 75 years or older. There were no changes in the age-specific or sex-specific imaging ordering rates for shoulder symptoms/complaints over the time period.

Table 7.12: Age-specific and sex-specific management of shoulder symptom/complaint, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	265	0.2 (0.2–0.3)	40.0 (32.2–47.8)	314	0.3 (0.2–0.3)	47.5 (39.0–55.9)
Females	334	0.2 (0.2–0.2)	40.4 (32.9–47.9)	329	0.2 (0.2–0.2)	48.3 (40.5–56.1)
Age						
<15 years	6	0.0 (—)	16.7 (0.0–59.5)	11	0.0 (0.0–0.1)	18.2 (0.0–45.4)
15–24 years	40	0.1 (0.1–0.2)	42.5 (21.6–63.4)	36	0.1 (0.1–0.2)	41.7 (22.9–60.4)
25–44 years	166	0.2 (0.2–0.3)	45.2 (34.2–56.2)	124	0.2 (0.2–0.2)	44.4 (31.2–57.5)
45–64 years	232	0.3 (0.3–0.3)	35.8 (27.7–43.8)	266	0.3 (0.3–0.4)	49.2 (40.2–58.3)
65–74 years	78	0.2 (0.2–0.3)	33.3 (19.3–47.4)	91	0.2 (0.2–0.3)	63.7 (46.9–80.6)
75+ years	78	0.2 (0.1–0.2)	50.0 (32.6–67.4	115	0.3 (0.2–0.3)	44.3 (31.5–57.2)
Total	**605**	**0.2 (0.2–0.2)**	**40.0 (34.4–45.6)**	**649**	**0.2 (0.2–0.2)**	**48.2 (42.5–54.0)**

(a) Missing data removed: 2002–05 *n*=5 (age), *n*=6 (sex); 2009–12 *n*=6 (age), *n*=6 (sex).

(b) Number of encounters with at least one shoulder symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 7.11).

Note: CI – confidence interval. (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Table 7.13 shows that there were some changes in the distribution of test orders across MBS groups. There was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered, with a move toward ultrasound orders.

Between Period 1 and Period 2 the order rate for ultrasound increased significantly, from 18.0 to 25.3 tests per 100 shoulder symptoms/complaints managed.

The number of orders for CT and MRI increased, however the numbers for both were very small and results should be interpreted with caution.

Table 7.13: Imaging test orders by MBS test group and most frequent individual tests ordered for shoulder symptom/complaint, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**128**	**52.9 (47.8–58.0)**	**21.2 (17.6–24.7)**	**133**	**42.5 (38.1–46.8)**	**20.5 (17.1–23.9)**
X-ray; shoulder	109	45.0 (40.4–49.7)	18.0 (14.9–21.1)	116	37.1 (33.2–40.9)	17.9 (14.9–20.8)
Ultrasound	**109**	**45.0 (40.0–50.1)**	**18.0 (14.8–21.3)**	**164**	**52.4 (48.0–56.8)**	**25.3 (21.8–28.8)**
Ultrasound; shoulder	108	44.6 (39.6–49.7)	17.9 (14.6–21.1)	161	51.4 (47.0–55.8)	24.8 (21.4–28.2)
Computerised tomography	**2**	**0.8 (—)**	**0.3 (—)**	**11**	**3.5 (1.3–5.7)**	**1.7 (0.6–2.8)**
Magnetic resonance imaging	**1**	**0.0 (—)**	**0.0 (—)**	**5**	**1.6 (0.0–3.3)**	**0.8 (0.0–1.6)**
Nuclear medicine	**2**	**0.8 (—)**	**0.3 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**242**	**100.0**	**40.0 (34.4–45.6)**	**313**	**100.0**	**48.2 (42.5–54.0)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of shoulder symptom/complaint

Table 7.14 shows the proportions of contacts generating an imaging order for new and old shoulder symptom/complaint problems in both data periods. Two-thirds of the GP contacts were for follow-up of previously diagnosed shoulder symptoms/complaints, in both Period 1 and Period 2.

In both data periods, the imaging order rate for shoulder symptoms/complaints was much higher at initial presentations (54.8 per 100 shoulder symptom/complaint problems in Period 1 and 68.4 per 100 in Period 2) than at follow-up consultations (30.9 per 100 problems in Period 1 and 35.6 per 100 in Period 2). There were no significant changes in the imaging order rate per 100 new, or old, shoulder symptom/complaint problems.

In Period 1, an estimated 40,000 imaging orders were placed per year, nationally, by GPs in management of new shoulder symptom/complaint problems. In Period 2, there were about 70,000 imaging orders placed per year—about 30,000 more per year than in Period 1.

Similarly, in Period 1, an estimated 40,000 imaging orders were placed nationally per year by GPs in management of old shoulder symptom/complaint problems. In Period 2, there were about 60,000 imaging orders placed per year—20,000 more per year than in Period 1.

In summary, there were no significant changes in: the management rate of shoulder symptom/complaint problems; the likelihood of GPs ordering an imaging test when managing new or old shoulder symptom/complaint problems; or the number of imaging tests ordered per problem. Therefore we can conclude that the increase in estimated total orders across the country was due solely to the increased GP visit rate.

Table 7.14: Imaging ordering rates by status of shoulder symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	230	375	**605**	250	399	**649**
Per cent of shoulder symptom/ complaint problems	38.0	62.0	**100.0**	38.5	61.5	**100.0**
Total imaging orders generated for problems (*n*)	126	116	**242**	171	142	**313**
Imaging orders per 100 problems (95% CI)	54.8 (45.1–64.4)	30.9 (24.7–37.1)	**40.0 (34.4–45.6)**	68.4 (58.1–78.7)	35.6 (29.1–42.1)	**48.2 (42.5–54.0)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	40.4 (33.9–47.0)	23.7 (19.3–28.2)	**30.1 (26.2–34.0)**	46.8 (40.5–53.1)	27.1 (22.5–31.6)	**34.7 (30.8–38.5)**

Note: CI – confidence interval.

7.5 New shoulder symptom/complaint

Age-specific and sex-specific management

There was no change in the likelihood of management of new shoulder symptoms/ complaints over time for either sex (Table 7.15). In both data periods, the likelihood of management for males and for females was the same (0.1% in both periods, for both sexes).

There were no changes between Period 1 and Period 2 in the age-specific or sex-specific imaging order rates for new cases of shoulder symptom/complaint. In Period 1 there were 1.35 tests per tested problem, and in Period 2 there were 1.46 tests per tested problem.

Table 7.15: Age-specific and sex-specific likelihood of management and test order rate for new shoulder symptom/complaint, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Tests per 100 new problems (95% CI)**	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Tests per 100 new problems (95% CI)**
Sex						
Males	100	0.1 (0.1–0.1)	49.0 (35.1–62.9)	116	0.1 (0.1–0.1)	66.4 (51.0–81.7)
Females	125	0.1 (0.1–0.1)	60.8 (47.0–74.6)	133	0.1 (0.1–0.1)	69.2 (55.3–83.0)
Age						
<15 years	3	0.0 (—)	33.3 (0.0–176.8)	7	0.0 (—)	14.3 (0.0–49.0)
15–24 years	23	0.1 (0.1–0.1)	47.8 (18.3–77.4)	17	0.1 (0.0–0.1)	41.2 (9.4–73.0)
25–44 years	67	0.1 (0.1–0.1)	55.2 (36.3–74.1)	50	0.1 (0.1–0.1)	58.0 (35.0–81.0)
45–64 years	75	0.1 (0.1–0.1)	48.0 (33.4–62.6)	97	0.1 (0.1–0.1)	77.3 (60.3–94.4)
65–74 years	27	0.1 (0.1–0.1)	55.6 (25.8–85.3)	34	0.1 (0.1–0.1)	85.3 (54.2–116.4)
75+ years	33	0.1 (0.1–0.1)	75.8 (45.0–106.5)	42	0.1 (0.1–0.1)	71.4 (45.8–97.0)
Total	**230**	**0.1 (0.1–0.1)**	**54.8 (45.1–64.4)**	**250**	**0.1 (0.1–0.1)**	**68.4 (58.1–78.7)**

(a) Missing data removed: 2002–05 *n*=2 (age), *n*=5 (sex); 2009–12 *n*=3 (age), *n*=1 (sex).

(b) Number of encounters with at least one new shoulder symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 7.14).

Note: CI – confidence interval; (—) – indicates the number of cases was too small to calculate a confidence interval.

Changes over time in imaging test types ordered

Table 7.16 shows that there were some changes in the types of tests ordered across MBS groups. There was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered and a move toward ultrasound orders. Between Period 1 and Period 2 the order rate for ultrasound of the shoulder increased significantly from 23.5 to 35.6 tests per 100 new shoulder symptoms/complaints managed.

The number of orders for CT increased, however the numbers were very small and this result should be interpreted with caution.

Table 7.16: Imaging test orders by MBS test group and the most frequent individual tests ordered for new shoulder symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**70**	**55.6 (48.8–62.3)**	**30.4 (23.9–37.0)**	**73**	**42.7 (37.0–48.4)**	**29.2 (22.9–35.5)**
X-ray; shoulder	60	47.6 (41.2–54.0)	26.1 (20.4–31.8)	63	36.8 (32.1–41.6)	25.2 (19.8–30.6)
X-ray; chest	4	3.2 (0.1–6.2)	1.7 (0.0–3.4)	3	1.8 (0.0–3.7)	1.2 (0.0–2.6)
Ultrasound	**54**	**42.9 (36.2–49.5)**	**23.5 (17.9–29.0)**	**91**	**53.2 (47.4–59.0)**	**36.4 (30.2–42.6)**
Ultrasound; shoulder	54	42.9 (36.2–49.5)	23.5 (17.9–29.0)	89	52.0 (46.3–57.8)	35.6 (29.6–41.6)
Computerised tomography	**0**	**0.0 (—)**	**0.0 (—)**	**6**	**3.5 (0.3–6.7)**	**2.4 (0.2–4.6)**
Magnetic resonance imaging	**0**	**0.0 (—)**	**0.0 (—)**	**1**	**0.6 (—)**	**0.4 (—)**
Nuclear medicine	**2**	**1.6 (—)**	**0.9 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**126**	**100.0**	**54.8 (45.1–64.4)**	**171**	**100.0**	**68.4 (58.1–78.7)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

7.6 Summary of findings

Changes over time

Management rates of total shoulder problems increased significantly between the two data periods. Of the two subgroups individually investigated, management of shoulder syndrome increased significantly but the rates for shoulder symptoms/complaints did not change. Both the likelihood of ordering imaging and the average number of tests ordered per 100 shoulder problems managed increased significantly over time. There was a general move away from diagnostic radiology toward ultrasound (Table 7.17).

Table 7.17: Summary of changes over time for shoulder problems

Shoulder problems	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	↑ 23.0% (0.7, 0.9)	↑ 37.0% (24.2, 33.2)	↑ 36.9% (32.5, 44.5)	No change (1.34, 1.34)
Shoulder syndrome	↑ 28.3% (0.5, 0.7)	↑ 48.6% (22.0, 32.7)	↑ 46% (29.6, 43.3)	No change (1.35, 1.32)
New	No change (0.2, 0.3)	↑ 40.9% (35.4, 48.6)	↑ 27.5% (47.6, 34.5)	No change (1.36, 1.38)
Shoulder symptom/ complaint	No change (0.2, 0.2)	No change (30.1, 34.7)	No change (40.0, 48.2)	No change (1.33, 1.40)
New	No change (0.1, 0.1)	No change (40.4, 46.8)	No change (54.8, 68.4)	No change (1.35, 1.46)

(a) Direction and proportion of change between 2002–05 and 2009–12 is shown. In parentheses the management rate for Period 1 and Period 2, used to calculate the proportion of change is shown.

Current imaging test order patterns

Shoulder syndrome problems were managed at a far higher rate than shoulder symptoms/complaints, and for both problem groups, follow-up consultations for previously managed cases were more common than management of initial presentations (Table 7.18).

Nearly half of new cases, and one-fifth of previously managed cases of shoulder syndrome, resulted in an order for ultrasound. For shoulder symptoms/complaints, an ultrasound was ordered for one-third of new problems, and one-fifth of previously managed problems.

For all shoulder problems, both problem subgroups, and for new and previously managed cases, ultrasounds were the most commonly ordered imaging test, followed by diagnostic radiology.

Table 7.18: Summary of GP imaging ordering for shoulder problems, Period 2, 2009–12

Shoulder problems	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	0.9 (0.9–0.9)	33.2 (31.3–35.2)	1.34	44.5 (41.7–47.3)	14.3 (12.8–15.8)	28.9 (27.0–30.8)	0.8 (0.4–1.2)	0.5 (0.2–0.8)
Shoulder syndrome	0.7 (0.6–0.7)	32.7 (30.5–35.0)	1.35	43.3 (40.1–46.4)	12.3 (10.7–13.8)	30.1 (27.9–32.2)	0.5 (0.2–0.8)	0.4 (0.1–0.7)
New	0.3 (0.3–0.3)	48.6 (45.0–52.3)	1.38	67.4 (61.8–72.9)	21.5 (18.5–24.6	44.9 (41.3–48.5)	0.6 (0.1–1.1)	0.4 (0.0–0.8)
Old	0.4 (0.4–0.4)	21.4 (18.9–24.0)	1.22	26.1 (22.9–29.3)	5.7 (4.3–7.0)	19.6 (17.2–22.0)	0.4 (0.1–0.8)	0.4 (0.1–0.8)
Shoulder symptom/ complaint	0.2 (0.2–0.2)	34.7 (30.8–38.5)	1.40	48.2 (42.5–54.0)	20.5 (17.1–23.9)	25.3 (21.8–28.8)	1.7 (0.6–2.8)	0.8 (0.0–1.6)
New	0.1 (0.1–0.1)	46.8 (40.5–53.1)	1.46	68.4 (58.1–78.7)	29.2 (22.9–35.5)	36.4 (30.2–42.6)	2.4 (0.2–4.6)	0.4 (—)
Old	0.1 (0.1–0.2)	27.1 (22.5–31.6)	1.31	35.6 (29.1–42.1)	15.0 (11.3–18.8)	18.3 (14.3–22.3)	1.3 (0.2–2.3)	1.0 (0.0–2.2)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging; (—) – indicates the number of cases was too small to calculate a confidence interval.

7.7 Summary of guidelines for imaging of shoulder problems

The Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways,[14] the American College of Radiology Appropriateness Criteria (ACRAC),[20] the New Zealand Accident Compensation Corporation guidelines,[32] and some of the literature, suggest that plain x-ray of the shoulder is the first investigation of choice in patients with shoulder pain.[80] Where there is a strong suspicion of rotator cuff or other soft tissue damage, then ultrasonography or magnetic resonance (MR) arthrography is the preferred second investigation. While plain x-ray accurately depicts bone damage following trauma, it does not provide accurate information regarding soft tissue injury.[81] Ultrasound has a high predictive value for full thickness rotator cuff tears, similar to that of MRI, when both are judged against the 'gold standard' of arthroscopy.[82-85] However, for partial thickness rotator cuff tears and other soft tissue injuries, MR arthrography is the preferred investigation when other imaging is negative.[86-88] CT arthrography may be indicated if MR arthrography is unavailable. Most of the papers on imaging for shoulder problems comment on the difficulties of establishing a clinical diagnosis without imaging studies.

7.8 Compliance with guidelines

Compliance with current guidelines is reported only for the 2009–12 period, as some changes in guidelines have occurred in the period between the two samples used in this study.

Shoulder problems managed by GPs were grouped almost equally between L08 Shoulder symptom/complaint (almost exclusively shoulder pain) and shoulder syndrome (ICPC code L92 Shoulder syndrome [including all soft tissue injuries/inflammation but excluding arthritis] and shoulder injury codes from L81 Injury musculoskeletal NOS). Osteoarthritis of the shoulder is included in Chapter 6 and sprain/strain of the shoulder is in Chapter 8.

The rate of ordering plain x-rays of the shoulder did not increase over the study period and varied from 11.3 per 100 problems for all shoulder syndrome problems, to 25.2 per 100 problems for new shoulder symptom/complaint problems in 2009–12. This use of plain x-ray is consistent with the recommendations for the use of plain x-ray as the initial test.

The use of ultrasound has increased substantially over the period of the study with a recent rate of 44.7 tests per 100 new shoulder syndromes presenting to GPs. Fewer ultrasounds were done for the other categories of shoulder problems. The use of MRI for shoulder problems was relatively rare and assessment of increasing use not therefore reliable. The low use of MRI may reflect the Medicare restrictions on GPs ordering MRI studies for patients with shoulder problems. The use of ultrasound is therefore consistent with guidelines, considering the unavailability of MRI.

GPs in this study used both x-ray and ultrasound in the imaging of shoulder syndrome. They tended to select ultrasound more frequently. This is consistent with WADoH Pathways but not with the ACRAC. The imaging test rate of 1.39 imaging orders per tested new shoulder syndrome problem, indicates that ultrasound and x-ray are frequently ordered together for this problem, which is consistent with the WA Pathways.

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

8 Sprains and strains

This chapter investigates the imaging orders for sprains and strains, recorded by GPs from April 2002–March 2005 (Period 1) to April 2009–March 2012 (Period 2). Throughout the chapter, 'sprains/strains' includes all sprains/strains, with the exception of those of the back. As reported at the beginning of Section 2, GP imaging orders for sprains/strains were selected for investigation because there had been a statistically significant increase over time in the likelihood of GPs' ordering imaging for this indication.

Imaging orders for sprains/strains are investigated for all and for new cases (see Glossary). Changes in ordering over time between Period 1 and Period 2 are reported.

8.1 All sprains and strains

Table 8.1 shows the total number of sprains/strains managed, and the distribution of the sprains/strains across ICPC-2 rubrics in Period 1 and Period 2.

There were no significant changes between the two data periods in the management rates reported in each of the rubric groups, with the exception of strains/sprains classified as muscle symptoms/complaints (i.e. predominately unspecified muscle strains) which was managed at a marginally lower rate in Period 2 (0.2 per 100 encounters) than in Period 1 (0.3 per 100). Sprains/strains of the joint (not otherwise specified) accounted for more than half of all sprains/strains managed in both data periods (0.6 per 100 encounters in both Period 1 and Period 2).

The management rate of sprains/strains per 100 encounters decreased marginally between Period 1 and Period 2, but there was a marginal increase in the estimated number of GP encounters involving sprains/strains nationally. These increased by 106,000, from 1.07 million encounters (95% CI: 1.02–1.12) in Period 1, to 1.17 million (95% CI: 1.12–1.23) in Period 2. This was purely due to the increased GP visit rate described in Chapter 2.

Table 8.1: Sprain/strain problems managed by ICPC-2 rubric, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Sprain/strain[(a)]	Number of problems	Per cent of sprains/ strains	Per 100 encounters (95% CI)	Number of problems	Per cent of sprains/ strains	Per 100 encounters (95% CI)
Sprain/strain of joint NOS	1,672	51.5	0.6 (0.5–0.6)	1,630	57.0	0.6 (0.5–0.6)
Muscle symptom/complaint NOS	781	24.0	0.3 (0.2–0.3)	535	18.7	0.2 (0.2–0.2)
Sprain/strain of ankle	637	19.6	0.2 (0.2–0.2)	562	19.6	0.2 (0.2–0.2)
Sprain/strain of knee	159	4.9	0.1 (0.0–0.1)	134	4.7	0.0 (0.0–0.1)
Total sprain/strain problems	**3,249**	**100.0**	**1.1 (1.0–1.1)**	**2,861**	**100.0**	**1.0 (0.9–1.0)**

(a) Excludes strain/sprain of the back. For a list of inclusions refer to Appendix 5, Table A5.1.

Note: CI – confidence interval; NOS – not otherwise specified. Highlighting indicates a significant difference between data periods.

Table 8.2 shows that both the likelihood of ordering imaging for sprains/strains, and the rate of imaging orders for sprains/strains increased significantly between the two time periods.

In 2002–05, there were 3,249 sprains/strain problems managed and GPs ordered at least one imaging test for 696 of these (21.4% likelihood). A total of 804 imaging tests were ordered, at a rate of 24.7 tests per 100 sprain/strain problems managed.

In 2009–12, there were 2,861 sprain/strain problems managed, and at least one imaging test was ordered for 765 of these (26.7% likelihood). In total, 940 imaging tests were ordered at a rate of 32.9 imaging tests per 100 sprains/strain problems managed.

These two results, combined with the increased GP visit rate, suggests that in Period 1, 260,000 imaging orders were placed on average per year nationally by GPs for the management of sprain/strain problems. In Period 2, there were 380,000 imaging orders placed per annum, or about 120,000 more per year than in Period 1.

In summary, despite the marginal decrease in the management rate of sprain/strain problems (by 9.1%) the imaging order rate significantly increased by 33.2%, (from 24.7 to 32.9 per 100 sprain/strain problems managed) over the time period. There was also little change in the number of tests ordered per tested problem (1.13 tests in Period 1 and 1.23 in Period 2). Therefore, the increase in imaging ordering was almost totally attributable to the increased likelihood (by 24.8%) of ordering at least one imaging test when managing sprains/strains.

Table 8.2: Sprain/strain problems generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total sprain/strain problems managed	3,249	2,861
Sprain/strain problems for which at least one imaging test ordered (*n*)	696	765
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	21.4 (19.9–23.0)	26.7 (25.0–28.5)
Total imaging orders generated for sprain/strain problems (*n*)	804	940
Imaging orders per 100 sprain/strain problems (95% CI)	24.7 (22.9–26.6)	32.9 (30.5–35.2)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Age-specific and sex-specific management

In both data periods, the sex-specific likelihood of management of sprain/strain problems was significantly higher at encounters with males than at those with females. However, there was no difference in the sex-specific order rate of imaging tests per 100 sprain/strain problems for males and females. While there was a marginal decrease in the likelihood of management at encounters with both sexes over time, the imaging order rate significantly increased, from 24.7 per 100 sprain/strain problems in Period 1, to 32.9 per 100 in Period 2 (Table 8.3), and this increase was apparent in both sexes.

For both time periods, the majority of patients for whom sprains/strains were managed were aged 25–44 years. The only change noted over time in the age-specific likelihood of management was a marginal decrease in the 25–44 year age group, from 1.5% to 1.3% of encounters in this age group.

Significant increases over time were also noted in the age-specific rates of imaging ordering for patients in the 25–44, 45–64 and 65–74 year age groups.

Table 8.3: Age-specific and sex-specific likelihood of management and test order rate for sprain/strain problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	1,577	1.3 (1.2–1.4)	24.4 (21.9–26.9)	1,357	1.2 (1.1–1.2)	34.9 (31.5–38.2)
Females	1,625	0.9 (0.9–1.0)	24.9 (22.4–27.4)	1,471	0.8 (0.8–0.9)	31.1 (28.0–34.2)
Age						
<15 years	290	0.8 (0.7–0.9)	36.2 (30.1–42.3)	245	0.7 (0.6–0.8)	32.9 (26.5–39.3)
15–24 years	493	1.8 (1.6–1.9)	24.7 (20.4–29.0)	412	1.7 (1.5–1.8)	32.5 (27.1–38.0)
25–44 years	1,102	1.5 (1.4–1.6)	22.1 (19.3–24.9)	844	1.3 (1.2–1.4)	28.8 (25.0–32.5)
45–64 years	891	1.1 (1.0–1.2)	23.3 (19.9–26.8)	873	1.1 (1.0–1.2)	35.2 (31.0–39.5)
65–74 years	246	0.7 (0.6–0.8)	23.6 (16.9–30.3)	239	0.6 (0.6–0.7)	42.3 (33.5–51.2)
75+ years	186	0.4 (0.4–0.5)	29.9 (21.2–38.7)	224	0.5 (0.4–0.6)	29.5 (20.7–38.3)
Total	**3,236**	**1.1 (1.0–1.1)**	**24.7 (22.9–26.6)**	**2,850**	**1.0 (0.9–1.0)**	**32.9 (30.5–35.2)**

(a) Missing data removed: 2002–05 *n*=28 (age), *n*=34 (sex); 2009–12 *n*=13 (age), *n*=22 (sex).

(b) Number of encounters with at least one sprain/strain problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 8.2).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

There was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered and a move toward ultrasound and MRI orders. The considerable changes in the types of tests ordered across MBS groups (Table 8.4) between Period 1 and Period 2 are described below.

- X-ray of the shoulder increased significantly, from 2.3 to 5.3 tests per 100 sprains/strains managed.
- Ultrasound significantly increased, from 6.2 per 100 sprain/strain problems managed, to 11.5 per 100, particularly ultrasound of the shoulder. This increased by almost 90% from 4.5 to 8.5 per 100 sprains/strains managed. Ultrasound of the ankle also more than trebled, from 0.2 to 0.7 per 100 sprains/strains managed between Period 1 and Period 2 (results not tabled).
- MRI significantly increased from 0.1 to 0.7 per 100 sprains/strains managed.

Table 8.4: Imaging test orders by MBS test group and the most frequent individual tests ordered for sprain/strain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**576**	**71.6 (68.5–74.8)**	**17.7 (16.3–19.2)**	**576**	**61.3 (58.5–64.0)**	**20.1 (18.4–21.8)**
X-ray; ankle	242	30.1 (26.6–33.6)	7.4 (6.5–8.4)	186	19.8 (16.9–22.7)	6.5 (5.5–7.5)
X-ray; shoulder	76	9.5 (7.5–11.4)	2.3 (1.8–2.9)	151	16.1 (13.9–18.2)	5.3 (4.4–6.1)
X-ray; wrist	50	6.2 (4.5–7.9)	1.5 (1.1–2.0)	56	6.0 (4.5–7.5)	2.0 (1.5–2.5)
X-ray; knee	43	5.3 (3.8–6.9)	1.3 (0.9–1.7)	37	3.9 (2.7–5.2)	1.3 (0.9–1.7)
X-ray; foot/feet	33	4.1 (2.8–5.5)	1.0 (0.7–4.1)	41	4.4 (3.0–5.7)	1.4 (1.0–1.9)
X-ray; finger(s)/thumb	20	2.5 (1.4–3.6)	0.6 (0.3–0.9)	21	2.2 (1.2–3.2)	0.7 (0.4–1.1)
X-ray; spine; cervical	15	1.9 (0.9–2.8)	0.5 (0.2–0.7)	6	0.6 (0.1–1.1)	0.2 (0.0–0.4)
Ultrasound	**203**	**25.2 (22.2–28.3)**	**6.2 (5.3–7.2)**	**329**	**35.0 (32.3–37.7)**	**11.5 (10.3–12.7)**
Ultrasound; shoulder	145	18.0 (15.4–20.7)	4.5 (3.7–5.2)	244	26.0 (23.3–28.6)	8.5 (7.5–9.6)
Computerised tomography	**16**	**2.0 (1.0–2.9)**	**0.5 (0.3–0.7)**	**13**	**1.4 (0.6–2.1)**	**0.5 (0.2–0.7)**
Magnetic resonance imaging	**4**	**0.5 (0.0–1.1)**	**0.1 (0.0–0.3)**	**19**	**2.0 (1.1–2.9)**	**0.7 (0.4–1.0)**
Nuclear medicine	**5**	**0.6 (0.0–1.3)**	**0.2 (0.0–0.3)**	**3**	**0.3 (0.0–0.7)**	**0.1 (0.0–0.2)**
Total imaging tests	**804**	**100.0**	**24.7 (22.9–26.6)**	**940**	**100.0**	**32.9 (30.5–35.2)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of sprain/strain problem

Table 8.5 shows the proportions of sprain/strain problems managed that were new cases (i.e. first presentation to a medical practitioner) and the proportion that were old (i.e. managed previously) in both data periods. Three-fifths of the GP contacts were for management of new sprains and strains in both Period 1 and Period 2.

In both data periods, the imaging order rate for sprains/strains was much higher at initial presentations (29.3 per 100 in Period 1 and 39.5 per 100 in Period 2) than at follow-up consultations (17.4 per 100 in Period 1 and 21.4 per 100 in Period 2). Both the imaging ordering rate and the likelihood of ordering imaging tests increased significantly between Period 1 and Period 2 for new problems, but there was no change in either of these measures for old sprain/strain problems over the time period.

These results, combined with the increased GP visit rate, suggest that in Period 1, an estimated 190,000 imaging orders were placed nationally by GPs per year for the management of new sprain/strain problems. In Period 2, about 290,000 imaging tests were ordered per annum, or about 100,000 more per year than in Period 1.

In summary, there was no change in the management rate of new sprain/strain problems (0.7 per 100 encounters in Period 1 and 0.6 per 100 in Period 2) or in the number of imaging tests ordered per new sprain/strain problem (1.17 per tested problem in Period 1 and 1.23 in Period 2). The increased imaging order rate for new sprain/strain problems (by 34.8%) appears to be a result of the increased likelihood of GPs ordering an imaging test when managing new sprain/strain problems (by 27.9%), and the increased GP visit rate.

Table 8.5: Imaging ordering rates by status of sprain/strain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	2,009	1,240	**3,249**	1,811	1,050	**2,861**
Per cent of sprain/strain problems	61.8	38.2	**100.0**	63.3	36.7	**100.0**
Total imaging orders generated for problems (*n*)	588	216	**804**	715	225	**940**
Imaging orders per 100 problems (95% CI)	29.3 (26.7–31.9)	17.4 (14.9–19.9)	**24.7 (22.9–29.6)**	39.5 (36.3–42.6)	21.4 (18.3–24.6)	**32.9 (30.5–35.2)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	25.1 (23.0–27.2)	15.4 (13.3–17.5)	**21.4 (19.9–23.0)**	32.1 (29.7–34.4)	17.5 (15.1–19.9)	**26.7 (25.0–28.5)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

8.2 New sprains and strains

Age-specific and sex-specific management

In both data periods the sex-specific likelihood of management of new sprain/strain problems was significantly higher at encounters with males than at those with females. There was no change in the sex-specific likelihood of management over time.

The sex-specific rates of imaging ordering increased significantly at encounters with males (28.5 to 40.9 per 100 new sprain/strain problems managed) and those with females (29.8 to 38.2 per 100), although there were no significant differences between the sexes in either data period.

There was no change in the age-specific likelihood of management between Period 1 and Period 2. However there was a significant increase in the imaging order rate for patients aged 45–64 (29.3 to 45.7 per 100 new sprain/strain problems) and 65–74 years (29.1 to 54.2 per 100) (Table 8.6).

Table 8.6: Age-specific and sex-specific likelihood of management and test order rate for new sprain/strain problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	968	0.8 (0.8–0.9)	28.5 (25.0–32.0)	896	0.8 (0.7–0.8)	40.9 (36.5–45.2)
Females	1,012	0.6 (0.5–0.6)	29.8 (26.3–33.2)	894	0.5 (0.5–0.6)	38.2 (34.0–42.5)
Age						
<15 years	200	0.6 (0.5–0.6)	39.5 (31.8–47.2)	184	0.5 (0.5–0.6)	35.3 (27.6–43.0)
15–24 years	337	1.2 (1.1–1.3)	27.6 (22.1–33.1)	285	1.1 (1.0–1.3)	36.8 (29.8–43.8)
25–44 years	650	0.9 (0.8–1.0)	25.8 (22.0–29.6)	547	0.8 (0.7–0.9)	33.1 (28.2–38.0)
45–64 years	534	0.7 (0.6–0.7)	29.3 (24.4–34.2)	504	0.6 (0.6–0.7)	45.7 (39.7–51.8)
65–74 years	151	0.4 (0.4–0.5)	29.1 (19.3–39.0)	143	0.4 (0.3–0.5)	54.2 (41.9–66.4)
75+ years	117	0.3 (0.2–0.3)	35.9 (23.6–48.2)	135	0.3 (0.2–0.4)	39.3 (26.4–52.1)
Total	**2,003**	**0.7 (0.6–0.7)**	**29.3 (26.7–31.9)**	**1,806**	**0.6 (0.6–0.7)**	**39.5 (36.3–42.6)**

(a) Missing data removed: 2002–05 *n*=14 (age), *n*=23 (sex); 2009–12 *n*=8 (age), *n*=15 (sex).

(b) Number of encounters with at least one new sprain/strain problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 8.5).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging tests ordered for new sprain/strain problems, 2002–05 and 2009–12

There was a general move away from diagnostic radiology orders and a move toward CT and MRI orders. Table 8.7 shows that there were considerable changes in the types of tests ordered across MBS groups.

Between Period 1 and Period 2, the order rate for x-ray of the shoulder significantly increased from 3.1 to 6.4 tests per 100 new sprain/strain problems managed.

The order rate of ultrasound increased significantly from 6.9 to 13.6 per 100 new sprain/strain problems managed. In particular, ultrasound of the shoulder doubled from 4.9 to 9.8 per 100 new sprain/strain problems managed. Ultrasound of the ankle also significantly increased from 0.2 to 7.8 per 100 new sprain/strain problems.

The number of orders for MRI increased, however numbers are small and results should be interpreted with caution.

Table 8.7: Imaging test orders by MBS test group and the most frequent individual tests ordered for new sprain/strain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**434**	**73.8 (70.4–77.3)**	**21.6 (19.6–23.6)**	**449**	**62.8 (59.7–65.9)**	**24.8 (22.5–27.1)**
X-ray; ankle	179	30.4 (26.2–34.6)	8.9 (7.6–10.3)	141	19.7 (16.5–22.9)	7.8 (6.4–9.1
X-ray; shoulder	63	10.7 (8.3–13.1)	3.1 (2.3–3.9)	116	16.2 (13.8–18.7)	6.4 (5.2–7.6)
X-ray; knee	36	6.1 (4.2–8.1)	1.8 (12.–2.4)	33	4.6 (3.0–6.2)	1.8 (1.2–2.5)
X-ray; wrist	31	5.3 (3.5–7.1)	1.5 (1.0–2.1)	44	6.2 (4.4–7.9)	2.4 (1.7–3.1)
X-ray; foot/feet	22	3.7 (2.2–5.3)	1.1 (0.6–1.5)	31	4.3 (2.8–5.9)	1.7 (1.1–2.3)
X-ray; finger(s)/thumb	17	2.9 (1.5–4.2)	0.8 (0.4–1.2)	15	2.1 (1.0–3.2)	0.8 (0.4–1.3)
X-ray; spine; cervical	12	2.0 (0.9–3.2)	0.6 (0.3–0.9)	3	0.4 (0.0–0.9)	0.2 (0.0–0.4)
X-ray; elbow	11	1.9 (0.8–3.0)	0.5 (0.2–0.9)	4	0.6 (0.0–1.1)	0.2 (0.0–0.4)
X-ray; chest	10	1.7 (0.7–2.7)	0.5 (0.2–0.8)	9	1.3 (0.4–2.1)	0.5 (0.2–0.8)
X-ray; hip	7	1.2 (0.3–2.1)	0.3 (0.1–0.6)	14	2.0 (1.0–3.0)	0.8 (0.4–1.2)
Ultrasound	**138**	**23.5 (20.1–26.8)**	**6.9 (5.7–8.1)**	**246**	**34.4 (31.4–37.4)**	**13.6 (11.9–15.2)**
Ultrasound; shoulder	99	16.8 (13.9–19.8)	4.9 (3.9–5.9)	178	24.9 (22.0–27.8)	9.8 (8.4–11.3)
Ultrasound; knee	6	1.0 (0.2–1.8)	0.3 (0.1–0.5)	13	1.8 (0.7–2.9)	0.7 (0.3–1.2)
Ultrasound; ankle	5	0.9 (0.1–1.6)	0.2 (0.0–0.5)	141	19.7 (16.5–22.9)	7.8 (6.4–9.1)
Computerised tomography	**12**	**2.0 (0.9–3.2)**	**0.6 (0.3–0.9)**	**6**	**0.8 (0.2–1.5)**	**0.3 (0.1–0.6)**
Magnetic resonance imaging	**2**	**0.3 (—)**	**0.1 (—)**	**12**	**1.7 (0.7–2.6)**	**0.7 (0.3–1.0)**
Nuclear medicine	**2**	**0.3 (—)**	**0.1 (—)**	**2**	**0.3 (—)**	**0.1 (—)**
Total imaging tests	**588**	**100.0**	**29.3 (26.7–31.9)**	**715**	**100.0**	**39.5 (36.3–42.6)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

8.3 Summary of findings

Changes over time

The management rate of sprain/strain problems decreased marginally over time, but the likelihood of imaging being ordered for this problem, and the imaging test order rate both significantly increased between Period 1 and Period 2 (Table 8.8).

Overall, there was a move away from diagnostic radiology as a proportion of all imaging tests ordered for sprain/strain problems, although there was a singular increase in x-rays of the sprain/strain of the shoulder. There was a general increase in ultrasounds and MRI orders, although each remained a small proportion of total imaging orders for this problem.

A similar pattern was observed for management of new sprain/strain problems. There was no change in the management rate over the study period, but both the likelihood of imaging being ordered, and the imaging order rate increased significantly.

There was again an overall move away from diagnostic radiology, with the exception of x-ray of the shoulder. Orders for ultrasound nearly doubled over time, and there was a significant increase in MRI test ordering.

Table 8.8: Summary of changes over time for sprains/strains

Sprains/strains	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	↓ 9.1% (Marginal) (3.0, 2.8)	↑ 24.8% (21.4, 26.7)	↑ 33.2% (24.7, 32.9)	No change (1.16, 1.23)
New	No change (0.7, 0.6)	↑ 27.9% (25.1, 32.1)	↑ 34.8% (29.3, 39.5)	No change (1.17, 1.23)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

New cases of sprains/strains were managed at a significantly higher rate and were significantly more likely to result in an order for imaging than previously managed cases. Diagnostic radiology was the most common imaging test ordered for any sprain/strain problem, followed by ultrasound. Order rates for CT and MRI were low and did not differ between new and previously managed cases (Table 8.9).

Table 8.9: Summary of GP imaging ordering for sprains/strains, Period 2, 2009–12

Sprains/ strains	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	1.0 (0.9–1.0)	26.7 (25.0–28.5)	1.23	32.9 (30.5–35.2)	20.1 (18.4–21.8)	11.5 (10.3–12.7)	0.5 (0.2–0.7)	0.7 (0.4–1.0)
New	0.6 (0.6–0.7)	32.1 (29.7–34.4)	1.23	39.5 (36.3–42.6)	24.8 (22.5–27.1)	13.6 (11.9–15.2)	0.3 (0.1–0.6)	0.7 (0.3–1.0)
Old	0.4 (0.3–0.4)	17.5 (15.1–19.9)	1.22	21.4 (18.3–24.6)	12.1 (9.9–14.2)	7.9 (6.2–9.6)	0.7 (0.2–1.2)	0.7 (0.2–1.2)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging.

8.4 Summary of guidelines for imaging of sprain/strain problems

An extensive review of guidelines for diagnostic imaging was undertaken using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

The final group of guidelines considered for this section of this report were: Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways[11] (these guidelines could be considered as the successor of the now obsolete Royal Australian and New Zealand College of Radiologists [RANZCR] Imaging Guidelines 2001,[19] and are endorsed by the RANZCR), the American College of Radiology Appropriateness Criteria (ACRAC),[71] and the New Zealand Guidelines Group (NZGG) guidelines.[30]

The guidelines are generally developed by expert consensus (with little input from primary care physicians) with a variable research evidence base. As a result there is significant variance between guidelines in the advice given regarding the appropriate imaging modalities to be used. However, they suggest similar triggers for initiating investigation.

Virtually all guidelines suggest that imaging is not indicated at initial assessment of sprains and strains unless there are 'red flag' issues suggesting fracture or other underlying pathology that prompt investigation.

Ankle sprain/strain

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.[89-98] The WADoH Imaging Pathways also suggest the use of the Ottawa ankle rules to determine indications for imaging studies in patients with acute ankle sprain.[13] The Ottawa rules have also been validated in the primary care setting in New Zealand by Wynn-Thomas et al.[99] Both the WADoH Imaging Pathways and the ACRAC suggest plain radiology for diagnosis of fracture.

Shoulder sprain/strain

The WADoH Imaging Pathways,[14] the ACRAC,[20] the New Zealand Accident Compensation Corporation guidelines[32] and some of the literature suggest that plain x-ray of the shoulder is the first investigation of choice in patients with shoulder pain.[80] Where there is a strong suspicion of rotator cuff or other soft tissue damage, then ultrasonography or MR arthrography are the preferred second investigation. While plain x-ray accurately depicts bone damage following trauma, it does not provide accurate information regarding soft tissue injury.[81] Ultrasound has a high predictive value for full thickness rotator cuff tears, similar to that of MRI, when both are judged against the 'gold standard' of arthroscopy.[82-85] However, for partial thickness rotator cuff tears and other soft tissue injuries, MR arthrography is the preferred investigation when other imaging is negative.[86-88] CT arthrography may be indicated if MR arthrography is unavailable. Most of the papers on imaging for shoulder problems comment on the difficulties of establishing a clinical diagnosis without imaging studies.

Knee sprain/strain

The WADoH Imaging Pathways for post traumatic knee pain suggest application of the Ottawa knee rules as part of clinical assessment and knee x-ray only if indicated by the Ottawa rules. The pathway suggested for Ottawa rule negative patients (and those where x-ray is negative) include ultrasound for assessment of superficial soft issues and MRI where there is a high suspicion of ligament or meniscus damage. Investigation of non-traumatic knee pain includes initial x-ray or ultrasound following clinical assessment, followed by MRI if initial imaging is non-diagnostic and underlying pathology is suspected.

The ACRAC for acute trauma to the knee also suggest x-ray only where signs similar to those in the Ottawa rules are present. If it is a twisting injury or fall with negative radiology and positive signs, then MRI is appropriate (or CT with contrast if a tibial plateau fracture is found on x-ray).

The NZGG guidelines suggest a similar pathway to the WADoH and ACRAC guidelines.

In a study of acute knee injuries managed in Emergency Departments in Canada, Stiell et al. found that 74.5% of patients had an x-ray and only 5.2% of these had fractures. Knee x-rays have the lowest yield for diagnosing clinical significant fractures.[100] The Ottawa knee rules for acute trauma to the knee synthesises the research of several developers of decision rules for knee imaging including Stiell.[101-103] The Ottawa knee rules have almost 100% sensitivity for knee fractures and about 50% specificity.[104]

Wrist sprain/strain

For wrist injuries, the ACRAC suggest plain x-ray if a fracture is suspected, followed by MRI if plain x-ray is negative and scaphoid fracture is suspected.[28] The WADoH Imaging Pathways suggest a similar approach, with CT suggested if MRI is unavailable for suspected scaphoid fracture.[10]

8.5 Compliance with guidelines

Compliance with current guidelines is reported only for the 2009–12 period as some changes in guidelines have occurred in the period between the two samples used in this study.

Sprains and strains reported in this chapter included problems classified in ICPC-2 rubrics: L79 Sprain/strain of joint NOS of which about 50% were shoulder problems and 10% wrist problems; L19 Muscle symptom/complaint NOS of which about 75% were labelled 'muscle strain'; L77 Sprain/strain of ankle; and L78 Sprain/strain of knee.

Ankle imaging

In this study, GPs ordered ankle x-ray at the rate of 6.5 per 100 contacts with all sprain/strain problems and 33.1 per 100 problems labelled as sprain/strain of ankle. For new problems labelled as sprain/strain, the order rate was 7.8 per 100 problem contacts and 38.6 per 100 new presentations of sprain/strain of ankle. Presumably these tests were ordered to exclude fracture and are therefore higher than would be expected if the Ottawa ankle rules were being used.

Ultrasound of the ankle was also ordered at the rate of 38.6 per 100 new sprain/strain of ankle. The test order rate of 1.23 per tested new sprain/strain of ankle suggests that x-ray and ultrasound are not infrequently ordered together. Neither the Australian nor ACRAC guidelines suggest the use of ultrasound in the investigation of ankle sprain/strain.

Shoulder imaging

About 50% of sprain/strain of joint NOS are sprain/strain of shoulder (results not tabled). GPs ordered shoulder x-ray at the rate of 5.3 per 100 contacts with all problems labelled sprain/strain and about 18.6 per 100 of all sprain/strain of shoulder. Ultrasound of the shoulder was ordered at the rate of 8.5 per 100 of all problems labelled sprain/strain and 29.8 per 100 contacts with all problems labelled sprain/strain of shoulder.

For new presentations of sprain/strain problems, GPs ordered shoulder x-rays at the rate of 6.4 per 100 contacts with new sprain/strain problems and 24.0 per 100 new sprain/strain of shoulder. Ultrasound of the shoulder was ordered at the rate of 9.8 per 100 new sprain/strain problems and 36.7 per 100 new sprain/strain shoulder problems.

These figures are almost identical to those seen in orders for shoulder syndrome (Chapter 7) and similar conclusions can be reached that these orders are consistent with published guidelines taking into consideration the unavailability of MRI.

Knee imaging

GPs ordered knee x-rays at the rate of 1.3 per 100 contacts with problems labelled sprain/strain and 17.6 per 100 contacts with problems labelled sprain/strain of knee. GPs ordered knee x-rays at the rate of 1.8 per 100 new sprain/strain problems and 24.3 per 100 new sprain/strain knee problems (results not tabled).

If the ACRAC were applied in the Australian context they have the potential to significantly reduce the need for diagnostic radiology of the knee without losing sensitivity of fracture detection. The current level of knee x-rays per 100 problem contacts for sprain/strain of knee, while well below North American Emergency Department levels quoted above, could probably be significantly reduced.

Data for ultrasound, CT and MRI of the knee are too small to be reliable. The lack of availability of MRI due to MBS restrictions in general practice at the time of this study probably contributed to the low level of use. With increased availability under the MBS, the use of MRI of the knee would be expected to rise in line with guidelines.

Wrist imaging

Wrist sprain/strain made up about 10% of problems labelled sprain/strain of joint NOS. GPs ordered x-ray of wrist at the rate of 2.0 per 100 contacts with all sprain/strain problems and about 35 per 100 wrist sprain/strain problems. For new presentations, GPs ordered wrist x-ray at the rate of 2.4 per 100 sprain/strain problems, or about 48 per 100 new wrist sprain/strain problems (results not tabled). Plain x-ray is the preferred initial investigation if fracture is suspected, with MRI used if scaphoid fracture is suspected and a plain x-ray is negative. Current ordering of wrist x-ray is consistent with published guidelines.

9 Bursitis/tendonitis/synovitis

This chapter investigates the imaging orders for bursitis/tendonitis/synovitis. In this analysis, bursitis/tendonitis/synovitis was defined as the ICPC-2 code L87 'Bursitis/ tendonitis/synovitis NOS'.

As reported at the beginning of Section 2, GP imaging orders for bursitis/tendonitis/ synovitis were selected for investigation because of the increasing use of imaging tests by GPs for this group of problems. Imaging orders are investigated for all and for new cases (see Glossary). Changes in ordering over time between April 2002–March 2005 (Period 1) and April 2009–March 2012 (Period 2) are also reported. In this chapter, bursitis/tendonitis/ synovitis will collectively be called 'bursitis' for ease of reading.

9.1 All bursitis/tendonitis/synovitis problems

Table 9.1 shows there was a significant increase in the management rate of bursitis between Period 1 and Period 2. There were also increases in the likelihood of ordering imaging tests and in the rate of imaging tests ordered for bursitis between the two time periods.

In Period 1, there were 2,751 bursitis problems managed, and at least one imaging test was ordered for 429 of these problems (15.6% likelihood). A total of 499 imaging tests were ordered, at a rate of 18.1 per 100 bursitis problems, and 1.16 tests per tested problems.

In Period 2, there were 3,260 bursitis problems managed, and at least one imaging test was ordered for 770 of these problems (23.6% likelihood). In total, 911 imaging tests were ordered, at a rate of 27.9 per 100 bursitis problems and 1.18 tests per tested problems.

We estimate that there were 41,000 more imaging tests ordered nationally for bursitis in Period 2 than in Period 1. Overall, there was a 54.1% increase in the tests ordered for bursitis per 100 problems between the two time periods. This increase was due to the combined effects of a significant increase (22.9%) in the management rate of these problems, a large (51.3%) increase in the likelihood of the GP ordering at least one imaging test for this problem, and the increased visit rate of the population to GPs.

Table 9.1: Bursitis/tendonitis/synovitis management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Number of bursitis/tendonitis/synovitis problems managed	2,751	3,260
Management rate per 100 encounters (95% CI)	0.9 (0.9–1.0)	1.1 (1.1–1.2)
Bursitis/tendonitis/synovitis problems for which at least one imaging test ordered (*n*)	429	770
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	15.6 (14.2–17.0)	23.6 (22.1–25.2)
Total imaging orders generated for bursitis/tendonitis/synovitis problems (*n*)	499	911
Imaging orders per 100 bursitis/tendonitis/synovitis problems (95% CI)	18.1 (16.4–19.9)	27.9 (26.0–29.9)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods. For a list of inclusions refer to Appendix 5, Table A5.1.

Age-specific and sex-specific management

Between the two time periods, the likelihood of management of bursitis significantly increased for females, and marginally for males. The imaging order rate increased for both males and females between Period 1 and Period 2 (Table 9.2). The growth was greater for females than males, so in Period 2 the imaging order rate for females became significantly higher than for males.

In both time periods, the majority of patients for whom bursitis was managed were in the 45–64 year age group. The likelihood of management increased significantly over time for patients aged 45–64 and 65–74 years, and increased marginally for patients aged 25–44 years.

In Period 1, the imaging ordering rate was significantly higher for patients aged less than 15 years compared with the 45–64 and 75+ year age groups. In Period 2, there were no differences in the imaging ordering rates between the age groups, however the age-specific imaging ordering rate significantly increased in the 45–64, 65–74 and 75+year age groups (Table 9.2).

Table 9.2: Age-specific and sex-specific likelihood of management and imaging order rates for bursitis/tendonitis/synovitis, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	1,102	0.9 (0.9–1.0)	17.8 (15.1–20.5)	1,212	1.0 (1.0–1.1)	24.5 (21.5–27.6)
Females	1,600	0.9 (0.9–1.0)	18.4 (16.1–20.6)	1,999	1.2 (1.1–1.2)	30.2 (27.7–32.8)
Age						
<15 years	88	0.3 (0.2–0.3)	30.7 (19.7–41.6)	73	0.2 (0.2–0.3)	28.4 (16.6–40.1)
15–24 years	176	0.6 (0.5–0.7)	18.2 (10.5–25.9)	142	0.6 (0.5–0.7)	31.7 (22.9–40.5)
25–44 years	673	0.9 (0.9–1.0)	20.4 (16.7–24.1)	747	1.1 (1.0–1.2)	25.2 (21.5–28.9)
45–64 years	1,122	1.4 (1.3–1.5)	16.3 (13.8–18.9)	1,407	1.8 (1.7–1.9)	28.6 (25.7–31.5)
65–74 years	355	1.0 (0.9–1.1)	18.8 (14.0–23.5)	505	1.4 (1.2–1.5)	30.5 (25.6–35.4)
75+ years	297	0.7 (0.6–0.8)	15.0 (10.4–19.6)	340	0.7 (0.7–0.8)	25.5 (19.9–31.1)
Total	**2,733**	**0.9 (0.9–1.0)**	**18.1 (16.4–19.9)**	**3,230**	**1.1 (1.1–1.2)**	**27.9 (26.0–29.9)**

(a) Missing data removed: 2002–05 *n*=22 (age), *n*=31 (sex); 2009–12 *n*=16 (age), *n*=19 (sex).

(b) Number of encounters with at least one bursitis/tendonitis/synovitis problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 9.1).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

In both time periods, the vast majority of imaging tests ordered for bursitis were diagnostic radiology tests or ultrasounds, together incorporating 97.8% of tests for this problem in Period 1 and 96.9% in Period 2 (Table 9.3).

In Period 1, diagnostic radiology was the imaging test ordered most frequently, accounting for 57.9% of all imaging tests ordered for bursitis, dropping in Period 2 to 33.7%. However, between the two time periods, there was no difference in the rate of diagnostic radiology ordered per 100 bursitis problems. There were fewer x-rays of the foot, heel, wrist and knee in Period 2 than in Period 1.

As a proportion of imaging tests ordered for the management of bursitis, ultrasounds increased significantly from 39.9% in Period 1 to 63.2% in Period 2. For every 100 bursitis problems managed, the rate of ultrasounds ordered more than doubled, from 7.2 per 100 in Period 1 to 17.7 per 100 in Period 2. This was reflected in increases in the ordering of wrist, foot/toe(s), shoulder and ankle ultrasounds.

Ultrasounds of the hip were the most frequent type of ultrasound recorded in Period 2. However, the ICPC-2 PLUS term for ultrasounds of the hip was not available in Period 1 and as such, a comparison between the two time periods is not possible. During Period 1, hip ultrasounds would have been captured using the term 'Ultrasound' which does not contain specificity about site. Given the relatively small number of general ultrasounds recorded in Period 1 (1.1 per 100 bursitis problems), compared with the high number of hip ultrasounds recorded in Period 2 (4.4 per 100 bursitis problems) it is reasonable to assume that the rate of hip ultrasounds has increased significantly between the two time periods.

Table 9.3: Imaging test orders by MBS test group and the most frequent individual tests ordered for bursitis/tendonitis/synovitis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**289**	**57.9 (53.7–62.1)**	**10.5 (9.3–11.7)**	**307**	**33.7 (30.7–36.7)**	**9.4 (8.3–10.5)**
X-ray; foot/feet	68	13.6 (10.5–16.8)	2.5 (1.9–3.1)	76	8.3 (6.5–10.2)	2.3 (1.8–2.9)
X-ray; heel	54	10.8 (8.0–13.6)	2.0 (1.4–2.5)	40	4.4 (3.1–5.7)	1.2 (0.9–1.6)
X-ray; wrist	38	7.6 (5.3–9.9)	1.4 (0.9–1.8)	32	3.5 (2.3–4.7)	1.0 (0.6–1.3)
X-ray; knee	34	6.8 (4.7–9.0)	1.2 (0.8–1.6)	27	3.0 (1.8–4.1)	0.8 (0.5–1.1)
X-ray; hip	26	5.2 (3.3–7.1)	0.9 (0.6–1.3)	53	5.8 (4.3–7.3)	1.6 (1.2–2.1)
X-ray; hand	16	3.2 (1.7–4.7)	0.6 (0.3–0.9)	10	1.1 (0.4–1.8)	0.3 (0.1–0.5)

(continued)

Table 9.3 (continued): Imaging test orders by MBS test group and the most frequent individual tests ordered for bursitis/tendonitis/synovitis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Ultrasound	**199**	**39.9 (35.7–44.1)**	**7.2 (6.1–8.3)**	**576**	**63.2 (60.2–66.3)**	**17.7 (16.2–19.1)**
Ultrasound; knee	42	8.4 (6.0–10.9)	1.5 (1.1–2.0)	50	5.5 (4.0–7.0)	1.5 (1.1–2.0)
Ultrasound; wrist	31	6.2 (4.1–8.3)	1.1 (0.7–1.5)	66	7.2 (5.5–9.0)	2.0 (1.5–2.5)
Ultrasound	30	6.0 (3.7–8.3)	1.1 (0.6–1.5)	11	1.2 (0.4–2.0)	0.3 (0.1–0.6)
Ultrasound; foot/toe(s)	21	4.2 (2.5–6.0)	0.8 (0.4–1.1)	99	10.9 (8.8–12.9)	3.0 (2.4–3.6)
Ultrasound; shoulder	15	3.0 (1.5–4.5)	0.5 (0.3–0.8)	44	4.8 (3.4–6.2)	1.3 (0.9–1.8)
Ultrasound; ankle	13	2.6 (1.2–4.0)	0.5 (0.2–0.7)	50	5.5 (4.0–7.0)	1.5 (1.1–2.0)
Ultrasound; hand/finger(s)	11	2.2 (0.9–3.5)	0.4 (0.2–0.6)	51	5.6 (4.0–7.2)	1.6 (1.1–2.0)
Ultrasound; elbow	5	1.0 (0.1–1.9)	0.2 (0.0–0.3)	18	2.0 (1.1–2.9)	0.6 (0.3–0.8)
Ultrasound; hip	N/Av	—	—	144	15.8 (13.3–18.3)	4.4 (3.7–5.2)
Computerised tomography	**5**	**1.0 (0.1–1.9)**	**0.2 (0.0–0.3)**	**12**	**1.3 (0.5–2.1)**	**0.4 (0.1–0.6)**
Magnetic resonance imaging	**1**	**0.2 (—)**	**0.0 (—)**	**8**	**0.9 (0.3–1.5)**	**0.2 (0.1–0.4)**
Nuclear medicine	**5**	**1.0 (0.1–0.9)**	**0.2 (0.2–0.3)**	**8**	**0.9 (0.2–1.5)**	**0.2 (0.1–0.4)**
Total imaging tests	**499**	**100.0**	**18.1 (16.4–19.9)**	**911**	**100.0**	**27.9 (26.0–29.9)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; N/Av – not available (the ICPC-2 PLUS code for ultrasounds of the hip was not available during Period 1); (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of bursitis/tendonitis/ synovitis

Table 9.4 shows the proportion of bursitis problems that were new cases (i.e. first presentation to a medical practitioner) and the proportion that were old problems (i.e. seen before by a medical practitioner) in both data periods. Over half the contacts were for the management of new presentations of bursitis in both time periods.

In Period 2, the imaging order rate for bursitis was higher at initial presentations (32.2 per 100 problems) than at follow-up consultations (22.1). A similar trend was apparent in Period 1, but the difference was not significant.

From Period 1 to Period 2, there were significant increases in the imaging order rates for both new and old bursitis, from 20.2 to 32.2 per 100 for new problems, and from 15.4 to 22.1 per

100 for old problems. The likelihood of ordering an imaging test for bursitis also increased for both new and old problems. For new problems, the likelihood of imaging being ordered increased from 17.0 to 27.1 per 100 problems, and for old problems the likelihood increased from 13.7 to 18.8 per 100 problems.

When extrapolated, these results, combined with the increased GP visit rate, suggest that in Period 1, nationally an estimated 100,000 imaging orders were placed per year by GPs for the management of new bursitis problems. In Period 2, about 250,000 imaging tests per year were ordered, or about 150,000 more per year than in Period 1.

Similarly, in Period 1, an average 60,000 imaging orders were placed nationally per year by GPs for the management of old bursitis problems. In Period 2, about 120,000 imaging tests were ordered per year, about 60,000 more than in Period 1.

In summary, as there was no change in the management rate or number of imaging tests ordered per new problem (1.12 per tested problem in Period 1 and 1.18 in Period 2), the increased imaging order rate (by 59.4%) appears to be a result of the increased likelihood (by 59.4%) of GPs ordering an imaging test when managing new bursitis problems.

Similarly, there was no change in the management rate or in the number of tests ordered for old problems (1.12 in Period 1 and 1.18 in Period 2). The increased imaging ordering rate (by 43.5%) seems due to the increased likelihood (by 37.2%) of GPs ordering imaging tests for these old problems.

Table 9.4: Imaging ordering rates by status of bursitis/tendonitis/synovitis, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	1,564	1,187	**2,751**	1,892	1,368	**3,260**
Per cent of bursitis/tendonitis/ synovitis problems	56.9	43.1	**100.0**	58.0	42.0	**100.0**
Total imaging orders generated for problems (*n*)	316	183	**499**	609	302	**911**
Imaging orders per 100 problems (95% CI)	20.2 (17.7–22.7)	15.4 (13.1–17.8)	**18.1 (16.4–19.9)**	32.2 (29.6–34.8)	22.1 (19.4–24.8)	**27.9 (26.0–29.9)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	17.0 (15.1–19.0)	13.7 (11.7–15.8)	**15.6 (14.2–17.0)**	27.1 (25.0–29.2)	18.8 (16.6–20.9)	**23.6 (22.1–25.2)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

9.2 New bursitis/tendonitis/synovitis

Age-specific and sex-specific management

The sex-specific likelihood of management of initial presentations of bursitis increased significantly among females (from 0.5% of female encounters in Period 1 to 0.7% in Period 2), but did not change for males. Similarly, in females the sex-specific rate of imaging orders for new bursitis increased from 20.0 tests per 100 new cases in Period 1, to 35.3 per 100 in Period 2, with no change observed for males (Table 9.5).

From Period 1 to Period 2, the age-specific likelihood of management of new cases increased among patients aged:

- 25–44 years (from 0.5% of encounters in this age group to 0.7%)
- 45–64 years (from 0.8% to 1.0%)

- 65–74 years (from 0.6% to 0.8%).

The imaging order rate for new bursitis increased significantly from Period 1 to Period 2 in the older age groups, as follows:

- 45–64 years (17.4 to 33.1 per 100 new cases)
- 65–74 years (22.8 to 37.3 per 100)
- 75+ years (14.0 to 28.4) (Table 9.5).

Table 9.5: Age-specific and sex-specific likelihood of management and test order rate for new bursitis/tendonitis/synovitis problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	636	0.5 (0.5–0.6)	20.3 (16.4–24.3)	716	0.6 (0.6–0.7)	27.7 (23.8–31.6)
Females	899	0.5 (0.5–0.6)	20.0 (16.9–23.4)	1,155	0.7 (0.6–0.7)	35.3 (31.8–38.7)
Age						
<15 years	61	0.2 (0.1–0.2)	36.1 (21.9–50.3)	56	0.2 (0.1–0.2)	25.0 (12.2–37.8)
15–24 years	102	0.4 (0.3–0.4)	21.6 (10.9–32.2)	75	0.3 (0.2–0.4)	29.3 (17.6–41.1)
25–44 years	387	0.5 (0.5–0.6)	22.9 (17.5–28.3)	448	0.7 (0.6–0.7)	29.8 (24.7–34.9)
45–64 years	620	0.8 (0.7–0.8)	17.4 (13.8–20.9)	790	1.0 (0.9–1.1)	33.1 (29.1–37.1)
65–74 years	202	0.6 (0.5–0.7)	22.8 (16.0–29.5)	311	0.8 (0.7–0.9)	37.3 (30.4–44.2)
75+ years	168	0.4 (0.3–0.5)	14.0 (7.6–20.5)	197	0.4 (0.4–0.5)	28.4 (21.1–35.8)
Total	**1,552**	**0.5 (0.5–0.6)**	**20.0 (17.7–22.7)**	**1,882**	**0.6 (0.6–0.7)**	**32.2 (29.6–34.8)**

(a) Missing data removed: 2002–05 *n*=12 (age), *n*=17 (sex); 2009–12 *n*=5 (age), *n*=11 (sex).

(b) Number of encounters with at least one new bursitis/tendonitis/synovitis problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 9.4).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging tests ordered for new bursitis/tendonitis/ synovitis problems, 2002–05 and 2009–12

As previously reported, the overall rate of imaging orders per 100 new bursitis problems increased significantly between Period 1 and Period 2. Table 9.6 shows the patterns of individual test types ordered for these problems in the two time periods.

Considered as a proportion of all imaging tests for new cases of bursitis, there was a definite shift away from diagnostic radiology to ultrasound. In Period 1, diagnostic radiology tests accounted for 58.5% of all tests ordered for initial presentations of bursitis, dropping to 37.4% in Period 2. In contrast, the ordering of ultrasounds as a proportion of all imaging tests increased from 39.9% to 60.6% between the time periods. The rate with which ultrasounds

were used for new presentations of bursitis more than doubled from 8.1 orders per 100 new cases in Period 1, to 19.5 per 100 in Period 2. There was no change in the use of diagnostic radiology as a rate per 100 new cases.

Within the diagnostic radiology group, x-rays of the heel and wrist decreased significantly as a proportion of imaging tests for new presentations of bursitis. Types of ultrasounds that increased significantly as a rate per 100 new cases of bursitis included:

- ultrasounds of the foot/toe (from 0.8 to 3.4 per 100 new cases)
- ultrasounds of the ankle (from 0.5 to 2.1 per 100)
- ultrasounds of the hand/finger (from 0.4 to 1.7 per 100).

Ultrasounds recorded without specifying the site decreased significantly, from 1.3 per 100 new cases in Period 1, to 0.3 per 100 in Period 2. As described in Section 9.1, the ICPC-2 PLUS term for ultrasounds of the hip was not available in Period 1 and as such, a comparison between the two time periods is not possible. Ultrasounds of the hip were the most frequent type of ultrasound recorded in Period 2 (4.7 per 100 new bursitis problems).

Table 9.6: Changes in imaging test orders and the most frequent imaging tests ordered for new bursitis/tendonitis/synovitis, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**185**	**58.5 (53.5–63.6)**	**11.8 (10.1–13.6)**	**228**	**37.4 (33.8–41.1)**	**12.1 (10.5–13.7)**
X-ray; heel	39	12.3 (8.6–16.1)	2.5 (1.7–3.3)	35	5.7 (3.9–7.6)	1.8 (1.2–2.5)
X-ray; foot/feet	36	11.4 (7.7–15.0)	2.3 (1.5–3.1)	61	10.0 (7.7–12.3)	3.2 (2.4–4.0)
X-ray; wrist	28	8.9 (5.7–12.0)	1.8 (1.1–2.5)	21	3.4 (2.0–4.9)	1.1 (0.6–1.6)
X-ray; knee	20	6.3 (3.7–9.0)	1.3 (0.7–1.8)	18	3.0 (1.6–4.3)	1.0 (0.5–1.4)
X-ray; hip	18	5.7 (3.2–8.2)	1.2 (0.6–1.7)	42	6.9 (4.9–8.8)	2.2 (1.6–2.9)
X-ray; elbow	9	2.8 (1.0–4.7)	0.6 (0.2–0.9)	8	1.3 (0.4–2.2)	0.4 (0.1–0.7)
X-ray; hand	8	2.5 (0.8–4.2)	0.5 (0.2–0.9)	8	1.3 (0.4–2.2)	0.4 (0.1–0.7)
Ultrasound	**126**	**39.9 (34.7–45.0)**	**8.1 (6.6–9.5)**	**369**	**60.6 (56.9–64.3)**	**19.5 (17.6–21.4)**
Ultrasound; knee	22	7.0 (4.2–9.8)	1.4 (0.8–2.0)	36	5.9 (4.0–7.9)	1.9 (1.3–2.5)
Ultrasound; wrist	21	6.6 (3.8–9.5)	1.3 (0.7–2.0)	38	6.2 (4.3–8.2)	2.0 (1.4–2.6)
Ultrasound	20	6.3 (3.6–9.1)	1.3 (0.7–1.9)	6	1.0 (0.2–1.8)	0.3 (0.1–0.6)
Ultrasound; leg	15	4.7 (2.2–7.3)	1.0 (0.4–1.5)	15	2.5 (1.2–3.7)	0.8 (0.4–1.2)

(continued)

Table 9.6 (continued): Changes in imaging test orders and the most frequent imaging tests ordered for new bursitis/tendonitis/synovitis, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Ultrasound; foot/toe(s)	13	4.1 (1.9–6.3)	0.8 (0.4–1.3)	64	10.5 (8.1–12.9)	3.4 (2.6–4.2)
Ultrasound; ankle	8	2.5 (0.8–4.3)	0.5 (0.2–0.9)	39	6.4 (4.5–8.4)	2.1 (1.4–2.7)
Ultrasound; shoulder	7	2.2 (0.6–3.8)	0.4 (0.1–0.8)	23	3.8 (2.2–5.3)	1.2 (0.7–1.7)
Ultrasound; hand/finger(s)	7	2.2 (0.6–3.8)	0.4 (0.1–0.8)	33	5.4 (3.6–7.2)	1.7 (1.2–2.3)
Ultrasound; hip	N/Av	—	—	89	14.6 (11.7–17.5)	4.7 (3.7–5.7)
Computerised tomography	**3**	**0.9 (0.0–2.0)**	**0.2 (0.0–0.4)**	**5**	**0.8 (0.1–1.5)**	**0.3 (0.0–0.5)**
Magnetic resonance imaging	**0**	**—**	**—**	**1**	**0.2 (—)**	**0.1 (—)**
Nuclear medicine imaging	**2**	**0.6 (—)**	**0.1 (—)**	**6**	**1.0 (0.1–1.9)**	**0.3 (0.0–0.6)**
Total imaging	**316**	**100.0**	**20.2 (17.7–22.7)**	**609**	**100.0**	**32.2 (29.6–34.8)**

Note: CI – confidence interval; N/Av – not available (the ICPC-2 PLUS code for ultrasounds of the hip was not available during Period 1).
(—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

9.3 Summary of findings

Changes over time

Imaging tests were more likely to be ordered for bursitis/tendonitis/synovitis in Period 2 than in Period 1. The imaging order rate increased between the two time periods for both new and all bursitis problems, although the increase was larger for new cases of bursitis (59.4%) than for all bursitis problems (54.1%). However, when GPs ordered imaging, on average they ordered the same number of tests (Table 9.7). With 41,000 more tests ordered in Period 2 than in Period 1, these findings indicate that the growth in GP ordering for bursitis is likely to be due to the aforementioned 54.1% increase in the management rate of bursitis, combined with GPs deciding to investigate bursitis using imaging more often, rather than ordering more imaging tests at encounters where they use imaging to investigate bursitis problems.

Among females, the increase in imaging tests ordered per 100 bursitis problems between the two time periods was striking, although greater for new bursitis (increased by 76.5%) than for all bursitis (64.1% increase). The rate with which GPs ordered imaging for new cases of bursitis in patients aged 75 years and over doubled between the two time periods.

Ordering of ultrasounds for bursitis more than doubled between the two time periods, but the ordering of diagnostic radiology did not change, suggesting that the growth in ordering for bursitis has been driven by the ordering of ultrasounds for this problem.

Table 9.7: Summary of changes over time for bursitis/tendonitis/synovitis

Bursitis/tendonitis/ synovitis	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered - per tested problem (% change, rate)[(a)]
All	↑ 22.2% (0.9, 1.1)	↑ 51.3% (15.6, 23.6)	↑ 54.1% (18.1, 27.9)	No change (1.16, 1.18)
New	No change (0.5, 0.7)	↑ 59.4% (17.0, 27.1)	↑ 59.4% (20.2, 32.2)	No change (1.19, 1.19)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

In recent years (2009–12), almost one-quarter of presentations of bursitis resulted in an imaging test order. Ultrasounds were ordered most frequently for bursitis, followed by diagnostic radiology (Table 9.8).

Table 9.8 also compares the status of the bursitis problem (new/old) with the imaging ordered. New cases of bursitis were managed more often than old cases, and were more likely to have imaging ordered, although there was no difference in the number of tests ordered per problem. Ultrasounds and diagnostic radiology were ordered most often for both new and old bursitis, although both were ordered more often for new cases.

Table 9.8 Summary of GP imaging ordering for bursitis/tendonitis/synovitis, Period 2, 2009–12

Bursitis/ tendonitis/ synovitis	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	1.1 (1.1–1.2)	23.6 (22.1–25.2)	1.18	27.9 (26.0–29.9)	9.4 (8.3–10.5)	17.7 (16.2–19.1)	0.4 (0.1–0.6)	0.2 (0.1–0.4)
New	0.7 (0.6–0.7)	27.1 (25.0–29.2)	1.18	32.2 (29.6–34.8)	12.1 (10.5–13.7)	19.5 (17.6–21.4)	0.3 (0.0–0.5)	0.1 (—)
Old	0.5 (0.4–0.5)	18.8 (16.6–20.9)	1.18	22.1 (19.4–24.8)	5.8 (4.4–7.1)	15.1 (13.1–17.2)	0.5 (0.1–0.9)	0.5 (0.1–0.9)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging; (—) – indicates the number of cases was too small to calculate a confidence interval.

9.4 Summary of guidelines for imaging of bursitis

An extensive review of guidelines for diagnostic imaging was undertaken using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

The only applicable guideline for the heterogeneous group of bursitis problems classified to ICPC-2 rubric L87 Bursitis/tendonitis/synovitis NOS was the Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways for soft tissue mass.[18] Bursitis occurring around specific joints such as shoulder or knee are discussed in the relevant chapters in this report where specific guidelines and compliance are examined.

9.5 Compliance with guidelines

Compliance with current guidelines is reported only for the 2009–12 period, as some changes in guidelines have occurred in the period between the two samples used in this study.

The WADoH Imaging Pathways for soft tissue mass suggests the use of ultrasound as the first investigation and this advice is consistent with the guidelines for the investigation of soft tissue problems around joints discussed in other chapters. Plain x-ray is suggested for peri-articular or suspected osseous masses, and MRI for situations of continuing clinical uncertainty.

GPs ordered ultrasound imaging at the rate of 17.7 per 100 of all bursitis problems and 19.5 per 100 new bursitis problems. Diagnostic radiology was ordered at the rate of 9.4 per 100 of all bursitis problems and 12.1 per 100 new bursitis problems. This range of investigation is consistent with the current guidelines. CT and MRI are infrequently ordered by GPs for these problems.

10 Abdominal pain problems

This chapter investigates the imaging orders for abdominal pain problems. As reported at the beginning of Section 2, GP imaging orders for abdominal pain were selected for investigation because:

- there was a significant increase in the rate at which imaging tests were ordered for the management of abdominal pain
- there was a statistically significant increase over time in the likelihood of GPs ordering imaging for the management of abdominal pain.

Imaging orders are reported for all and for new abdominal pain problems (see Glossary). Changes in ordering over time are investigated between April 2002–March 2005 (Period 1) and April 2009–March 2012 (Period 2).

10.1 All abdominal pain problems

Table 10.1 shows that while there was no significant change in the management rate of abdominal pain between Period 1 and Period 2, there was a significant increase in the imaging order rate between the two data periods.

The imaging order rate increased from 35.5 imaging tests ordered for every 100 abdominal pain problems managed in Period 1, to 41.5 per 100 in Period 2. The likelihood of an imaging test being ordered for the management of abdominal pain also significantly increased from 31.4% in Period 1, to 36.1% in Period 2.

The 16.9% increase in the imaging ordering rate was largely due to the increased likelihood of ordering (which increased by 15.0%), combined with the increased attendance rate, rather than an increase in the number of tests ordered after the decision to order was made.

When these results are extrapolated to encounters across Australia, we estimate that an average of 240,000 imaging tests were ordered per year in the management of abdominal pain in Period 1, and 370,000 imaging tests per year in Period 2. This is an estimated increase of 130,000 imaging tests per annum for abdominal pain between the two data periods.

Table 10.1: Abdominal pain problems management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Number of abdominal pain problems managed	2,053	2,182
Management rate per 100 encounters (95% CI)	0.7 (0.7–0.7)	0.7 (0.7–0.8)
Abdominal pain problems for which at least one imaging test ordered (*n*)	645	787
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	31.4 (29.3–33.5)	36.1 (34.0–38.1)
Total imaging orders for abdominal pain problems (*n*)	729	905
Imaging orders per 100 abdominal pain problems (95% CI)	35.5 (33.0–38.0)	41.5 (38.9–44.1)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods. For a list of inclusions refer to Appendix 5, Table A5.1.

Age-specific and sex-specific management of abdominal pain problems

There were no significant changes in the sex-specific or age-specific likelihood of management of abdominal pain between Period 1 and Period 2 (Table 10.2). In both data periods, there was a significantly higher likelihood of management of abdominal pain problems at encounters with females than at those with males.

Although there was no change in the management of abdominal pain problems across age groups, there were significant changes in the imaging order rate. The imaging order rate was significantly lower for patients aged less than 15 years in both data periods, when compared with other age groups. There was a 30% increase in tests ordered for those aged 45–64 years from 40.7 tests per 100 abdominal pain problems in Period 1, to 52.9 per 100 in Period 2. However the imaging order rate for all other age groups remained the same between the two data periods.

Table 10.2: Age-specific and sex-specific likelihood of management and test order rate for abdominal pain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	628	0.5 (0.5–0.6)	29.0 (24.8–33.2)	661	0.6 (0.5–0.6)	34.9 (30.7–39.2)
Females	1,406	0.8 (0.8–0.9)	38.5 (35.5–41.6)	1,497	0.9 (0.8–0.9)	44.2 (41.0–47.4)
Age						
<15 years	281	0.8 (0.7–0.9)	14.2 (9.6–18.9)	283	0.8 (0.7–0.9)	18.4 (12.9–23.8)
15–24 years	240	0.9 (0.7–1.0)	32.5 (25.3–39.7)	269	1.1 (0.9–1.2)	33.1 (26.7–39.5)
25–44 years	597	0.8 (0.8–0.9)	40.1 (35.3–44.9)	568	0.9 (0.8–0.9)	42.9 (38.1–47.6)
45–64 years	560	0.7 (0.6–0.8)	40.7 (35.8–45.7)	592	0.7 (0.7–0.8)	52.9 (47.7–58.0)
65–74 years	198	0.6 (0.5–0.6)	36.4 (28.3–44.4)	233	0.6 (0.5–0.7)	46.2 (38.0–54.3)
75+ years	154	0.4 (0.3–0.4)	40.3 (31.1–49.4)	219	0.5 (0.4–0.5)	41.6 (32.9–50.2)
Total	**2,050**	**0.7 (0.7–0.7)**	**35.5 (33.0–38.0)**	**2,180**	**0.7 (0.7–0.8)**	**41.5 (38.9–44.1)**

(a) Missing data removed: 2002–05 *n*=20 (age), *n*=16 (sex); 2009–12 *n*=16 (age), *n*=22 (sex).

(b) Number of encounters with at least one abdominal pain problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 10.1).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging tests ordered

The overall rate of imaging test orders per 100 abdominal pain problems significantly increased between Period 1 and Period 2 (from 35.5 to 41.5 per 100 abdominal pain problems managed) (Table 10.3).

Ultrasound was the most frequently ordered type of imaging test in both data periods. In Period 1, ultrasound was followed by orders for diagnostic radiology, which accounted for 16.9% of imaging tests for abdominal pain. However in Period 2, CT became the second most frequently ordered type of imaging test, accounting for 17.6% of imaging for abdominal pain.

The order rate for CT significantly increased, from 4.4 per 100 abdominal pain problems in Period 1, to 7.3 per 100 in Period 2. In particular, CT of the abdomen increased from 3.2 to 5.4 per 100 abdominal pain problems, and CT of the pelvis increased from 0.2 to 1.1 per 100 abdominal pain problems. However, the numbers were small and the results should be interpreted with caution

Table 10.3: Imaging test orders by MBS test group and the most frequent individual tests ordered for abdominal pain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**123**	**16.9 (14.1–19.7)**	**6.0 (4.9–7.1)**	**111**	**12.3 (10.0–14.5)**	**5.1 (4.1–6.1)**
X-ray; abdomen	71	9.7 (7.5–11.9)	3.5 (2.6–4.3)	76	8.4 (6.5–10.3)	3.5 (2.7–4.3)
X-ray; chest	15	2.1 (1.0–3.1)	0.7 (0.4–1.1)	17	1.9 (1.0–2.8)	0.8 (0.4–1.1)
Barium meal	4	0.5 (0.0–1.1)	0.2 (0.0–0.4)	3	0.3 (0.0–0.7)	0.1 (0.0–0.3)
Ultrasound	**513**	**70.4 (66.9–73.9)**	**25.0 (22.9–27.1)**	**632**	**69.8 (66.6–73.1)**	**29.0 (26.8–31.1)**
Ultrasound; abdomen	239	32.8 (29.3–36.3)	11.6 (10.2–13.1)	307	33.9 (30.7–37.2)	14.1 (12.5–15.6)
Ultrasound; pelvis	153	21.0 (17.9–24.0)	7.5 (6.3–8.6)	194	21.4 (18.7–24.1)	8.9 (7.6–10.1)
Ultrasound; abdomen upper	76	10.4 (8.2–12.7)	3.7 (2.9–4.5)	84	9.3 (7.3–11.3)	3.8 (3.0–4.7)
Ultrasound; abdomen lower	14	1.9 (0.9–2.9)	0.7 (0.3–1.0)	9	1.0 (0.3–1.7)	0.4 (0.1–0.7)
Computerised tomography	**90**	**12.3 (9.7–15.0)**	**4.4 (3.4–5.4)**	**159**	**17.6 (14.7–20.5)**	**7.3 (6.0–8.6)**
CT scan; abdomen	66	9.1 (7.0–11.2)	3.2 (2.4–4.0)	118	13.0 (10.8–15.3)	5.4 (4.4–6.4)
CT scan; pelvis	4	0.5 (0.0–1.1)	0.2 (0.0–0.4)	24	2.7 (1.6–3.7)	1.1 (0.6–1.6)
Magnetic resonance imaging	**1**	**0.1 (—)**	**0.0 (—)**	**1**	**0.1 (—)**	**0.0 (—)**
Nuclear medicine	**2**	**0.3 (—)**	**0.1 (—)**	**2**	**0.2 (—)**	**0.1 (—)**
Total imaging tests	**729**	**100.0**	**35.5 (33.0–38.0)**	**905**	**100.0**	**41.5 (38.9–44.1)**

Note: CI – confidence interval; (—) – indicates the number of cases was too small to calculate a confidence interval. Only the most frequently recorded imaging tests were included in this table. Highlighting indicates a significant difference between data periods.

Imaging test ordering rates by status of abdominal pain problem

Table 10.4 shows the proportion of abdominal pain problems managed that were new cases (i.e. first presentation to a medical practitioner) and the proportion that were old problems (i.e. seen before by a medical practitioner) in both data periods.

The imaging order rate and likelihood of ordering imaging was significantly higher at initial presentations of abdominal pain (new problems) than at follow-up in both periods.

The imaging order rate for new abdominal pain problems significantly increased from 40.6 per 100 new cases in Period 1 to 48.3 per 100 in Period 2. When we combined these results with the increased GP visit rate, we estimate that in Period 1, on average 140,000 imaging orders were placed per year nationally for GP management of new abdominal pain problems. In Period 2, about 220,000 imaging tests were ordered on average per year, or about 80,000 more per year than in Period 1. The increase can largely be explained by the significant increase (by 17.4%) in the likelihood of imaging being ordered for new abdominal pain problems, combined with the increased attendance rate.

There was no change in the imaging order rate or the likelihood of ordering imaging for old abdominal pain problems between the two data periods.

Table 10.4: Imaging ordering rates by status of abdominal pain problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	1,065	988	**2,053**	1,136	1,046	**2,182**
Per cent of abdominal pain problems	51.9	48.1	**100.0**	52.1	47.9	**100.0**
Total imaging orders generated for problems (*n*)	432	297	**729**	549	356	**905**
Imaging orders per 100 problems (95% CI)	40.6 (37.0–44.1)	30.1 (26.7–33.4)	**35.5 (33.0–38.0)**	48.3 (44.6–52.0)	34.0 (30.6–37.5)	**41.5 (38.9–44.1)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	35.6 (32.6–38.5)	26.9 (24.1–29.8)	**31.4 (29.3–33.5)**	41.8 (38.9–44.7)	29.8 (27.0–32.7)	**36.1 (34.0–38.1)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

10.2 New abdominal pain problems

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

There were no significant changes in the sex-specific or age-specific likelihood of management of new abdominal pain between Period 1 and Period 2 (Table 10.5). However there were significant changes in the imaging order rate. These results follow a very similar pattern to those for all abdominal pain problems shown in Table 10.2.

- The imaging order rate was significantly lower for patients aged less than 15 years in both data periods when compared with other age groups.
- There was a 30% increase in tests ordered for the 45–64 year age group, from 50.9 tests per 100 new abdominal pain problems in Period 1, to 66.9 per 100 in Period 2.
- The imaging order rate for all other age groups remained the same between the two data periods.

Table 10.5: Age-specific and sex-specific likelihood of management and test order rate for new abdominal pain problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	343	0.3 (0.3–0.3)	33.2 (27.3–39.2)	375	0.3 (0.3–0.4)	40.5 (34.9–46.2)
Females	712	0.4 (0.4–0.4)	44.0 (39.5–48.4)	746	0.4 (0.4–0.5)	51.9 (47.1–56.6)
Age						
<15 years	161	0.5 (0.4–0.5)	12.4 (6.8–18.1)	174	0.5 (0.4–0.6)	14.4 (9.0–20.0)
15–24 years	139	0.5 (0.4–0.6)	34.5 (25.0–44.1)	138	0.6 (0.5–0.7)	37.0 (27.5–46.4)
25–44 years	312	0.4 (0.4–0.5)	45.2 (38.3–52.1)	294	0.4 (0.4–0.5)	48.6 (42.0–55.3)
45–64 years	287	0.4 (0.3–0.4)	50.9 (43.5–58.2)	308	0.4 (0.3–0.4)	66.9 (59.3–74.5)
65–74 years	84	0.2 (0.2–0.3)	48.8 (36.1–61.5)	118	0.3 (0.3–0.4)	58.5 (46.5–70.5)
75+ years	69	0.2 (0.1–0.2)	43.5 (30.2–56.8)	101	0.2 (0.2–0.3)	54.5 (39.7–69.2)
Total	**1,065**	**0.4 (0.3–0.4)**	**40.6 (37.0–44.1)**	**1,136**	**0.4 (0.4–0.4)**	**48.3 (44.6–52.0)**

(a) Missing data removed: 2002–05 *n*=13 (age), *n*=8 (sex); 2009–12 *n*=3 (age), *n*=15 (sex).

(b) Number of encounters with at least one new abdominal pain problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 10.4).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging tests ordered for new abdominal pain problems

The overall rate of imaging test orders per 100 new abdominal pain problems significantly increased by 19%, from 40.6 per 100 new cases in Period 1, to 48.3 per 100 in Period 2.

Ultrasounds were the most frequently ordered type of imaging test in both data periods. In Period 1, these were followed by orders for diagnostic radiology, which accounted for 16.7% of imaging tests for new abdominal pain. However in Period 2, CT became the second most frequently ordered type of imaging test after increasing by 70%, accounting for 16.2% of imaging tests for new abdominal pain.

The order rate for CT scan doubled between the two data periods, from 3.8 per 100 new cases in Period 1, to 7.8 per 100 in Period 2. In particular, orders for CT of the abdomen doubled from 3.0 to 6.2 per 100 new cases (Table 10.6).

Table 10.6: Changes in imaging test orders and most frequent imaging tests ordered for new abdominal pain problem, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**72**	**16.7 (13.1–20.3)**	**6.8 (5.1–8.4)**	**69**	**12.6 (9.7–15.5)**	**6.1 (4.5–7.6)**
X-ray; abdomen	44	10.2 (7.3–13.1)	4.1 (2.9–5.4)	46	8.4 (6.1–10.7)	4.0 (2.9–5.2)
X-ray; chest	7	1.6 (0.4–2.8)	0.7 (0.2–1.1)	13	2.4 (1.1–3.6)	1.1 (0.5–1.8)
Ultrasound	**318**	**73.6 (69.2–78.0)**	**29.9 (26.9–32.8)**	**391**	**71.2 (67.0–75.4)**	**34.4 (31.3–37.5)**
Ultrasound; abdomen	152	35.2 (30.7–39.7)	14.3 (12.1–16.5)	178	32.4 (28.4–36.4)	15.7 (13.5–17.9)
Ultrasound; pelvis	97	22.5 (18.4–26.5)	9.1 (7.3–10.9)	120	21.9 (18.4–25.3)	10.6 (8.7–12.4)
Ultrasound; abdomen upper	46	10.6 (7.6–13.7)	4.3 (3.1–5.6)	59	10.7 (8.1–13.4)	5.2 (3.9–6.5)
Ultrasound; abdomen lower	7	1.6 (0.4–2.8)	0.7 (0.2–1.1)	5	0.9 (0.1–1.7)	0.4 (0.1–0.8)
Ultrasound; gallbladder	5	1.2 (0.1–2.2)	0.5 (0.1–0.9)	4	0.7 (0.0–1.6)	0.4 (0.0–0.8)
Ultrasound; kidney	2	0.5 (—)	0.2 (—)	6	1.1 (0.2–2.0)	0.5 (0.1–1.0)
Computerised tomography	**41**	**9.5 (6.5–12.5)**	**3.8 (2.6–5.1)**	**89**	**16.2 (12.6–19.8)**	**7.8 (6.0–9.7)**
CT scan; abdomen	32	7.4 (5.0–9.8)	3.0 (2.0–4.0)	70	12.8 (10.0–15.5)	6.2 (4.8–7.6)
CT scan; pelvis	1	0.2 (—)	0.1 (—)	12	2.2 (1.0–3.4)	1.1 (0.5–1.7)
Magnetic resonance imaging	**0**	**—**	**—**	**0**	**—**	**—**
Nuclear medicine	**1**	**0.2 (—)**	**0.1 (—)**	**0**	**—**	**—**
Total imaging tests	**432**	**100.0**	**40.6 (37.0–44.1)**	**549**	**100.0**	**48.3 (44.6–52.0)**

Note: Highlighting indicates a significant difference between data periods; CI – confidence interval; (—) – indicates the number of cases was too small to calculate a confidence interval.

10.3 Summary of findings

Changes over time

Table 10.7 summarises the changes to the imaging ordering behaviour of GPs over time. There was a significant increase in the likelihood of ordering imaging, and this resulted in an increased imaging order rate per 100 abdominal pain problems managed. These changes were mirrored for new cases of abdominal pain.

There was no change in the management rate of abdominal pain between the two data periods; however the management rate of abdominal pain and the imaging order rate were significantly higher at encounters with females than at those with males.

Ultrasound was the most frequently ordered type of imaging test for abdominal pain in both data periods. In Period 1, these were followed by orders for diagnostic radiology. In Period 2, there was a move away from diagnostic radiology toward CT, which was the second most frequently ordered type of imaging test.

For new cases of abdominal pain, ultrasound was also the most frequently ordered type of imaging test. In Period 1, these were followed by orders for diagnostic radiology. In Period 2, the rate at which CT was ordered per 100 new abdominal pain problems doubled, and became the second most frequently ordered imaging test.

Table 10.7: Summary of changes over time for abdominal pain

Abdominal pain	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	No change (0.7, 0.7)	↑ 15.0% (31.4, 36.1)	↑ 16.9% (35.5, 41.5)	No change (1.13, 1.15)
New	No change (0.4, 0.4)	↑ 17.4% (35.6, 41.8)	↑ 18.2% (40.6, 48.3)	No change (1.14, 1.16)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

Table 10.8 summarises the recent imaging ordering behaviour of GPs. GPs ordered imaging for about one-third of abdominal pain problems seen and usually ordered only one test. As a result, they ordered 41.5 tests on average for every 100 abdominal pain problems managed. Ultrasound was by far the most frequently ordered test, accounting for about 70% of all imaging tests ordered, followed by CT scans (17.6%) and diagnostic radiology (12.3%).

The imaging order rate and likelihood of ordering imaging was significantly higher for new presentations of abdominal pain than for old cases (Table 10.8). The average number of tests ordered per 100 problems was also higher for new abdominal pain. However, there was no change in the management rate of new and old cases of abdominal pain.

The rate at which ultrasound and CT was ordered was significantly higher for new abdominal pain than old cases. There was no difference in the rate at which diagnostic radiology was ordered for new and old cases of abdominal pain.

Table 10.8: Summary of GP imaging ordering for abdominal pain, Period 2, 2009–12

Abdominal pain	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	0.7 (0.7–0.8)	36.1 (34.0–38.1)	1.15	41.5 (38.9–44.1)	5.1 (4.1–6.1)	29.0 (26.8–31.1)	7.3 (6.0–8.6)	0.0 (—)
New	0.4 (0.4–0.4)	41.8 (38.9–44.7)	1.16	48.3 (44.6–52.0)	6.1 (4.5–7.6)	34.4 (31.3–37.5)	7.8 (6.0–9.7)	0.0 (—)
Old	0.4 (0.3–0.4)	29.8 (27.0–32.7)	1.14	34.0 (30.6–37.5)	4.0 (2.8–5.3)	23.0 (20.2–25.8)	6.7 (4.9–8.4)	0.0 (—)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging; (—) – indicates the number of cases was too small to calculate a confidence interval.

10.4 Summary of guidelines for imaging of abdominal pain problems

Both the Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways,[9] and the American College of Radiology Appropriateness Criteria (ACRAC) [21,23,26,27] divide the investigation of abdominal pain by location and/or presumptive diagnosis. WADoH Imaging Pathways generally advocate the use of ultrasound in elucidating the diagnosis in right upper and lower abdominal pain, particularly in women of child-bearing age and in children. Additional CT imaging is indicated when a negative examination is accompanied by high clinical suspicion. The common cause of 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. The ACRAC advocate CT as the investigation of choice for most abdominal pain sites except in women and children.

The limited literature on imaging orders for abdominal pain by GPs indicate both ultrasound and CT have reasonable sensitivity but both have low yield of diagnoses in the absence of 'red flag' indicators.[105-108]

The literature also indicates that GPs show similar discrimination to other medical specialists in requesting imaging orders for abdominal pain and demonstrate a high appreciation of the value of imaging in the management of this problem.[109]

10.5 Compliance with guidelines

The results of this study indicate that an appropriate range of modalities appear to be used by Australian GPs. The overall rate of imaging for abdominal pain problems increased significantly over the period of the study.

Ultrasound remains the modality of choice for general practitioners. There has been a shift away from plain x-ray imaging to CT scanning. Both of these findings are consistent with the guidelines for the investigation of abdominal pain. Due to the generally low yield of imaging investigations in this area, advice to GPs regarding the use of 'red flag' symptoms and signs to guide imaging ordering may decrease unnecessary imaging. Lameris found that "using ultrasonography first and CT only in those with negative or inconclusive ultrasonography results in the best sensitivity and lowers the exposure to radiation".[105] This sequential approach to imaging orders should be considered in reviews of guidelines.

11 Knee problems

This chapter investigates imaging orders for knee problems, recorded by GPs from April 2002–March 2005 (Period 1), to April 2009–March 2012 (Period 2). Throughout the chapter, 'knee problems' includes all problems of the knee excluding arthritis/osteoarthritis of the knee. As reported at the beginning of Section 2, GP imaging orders for knee problems were selected for investigation because, although the GPs' imaging ordering rates did not change over time, knee problems were identified as an area of poor quality of GP imaging ordering in 2001 and warranted further investigation.

Based on the rationale that guidelines recommend different management of knee problems depending on their status as a symptom/complaint or as a defined condition (see Chapter 2), knee problems were grouped and categorised as:

- 'knee symptom/complaint (all)' and
- 'knee syndrome (all)'.

The full list of ICPC-2 rubrics and ICPC-2 PLUS codes and terms included in each group are provided in Appendix 5, Table A5.1.

Imaging orders are investigated for:

- all knee problems
- all knee problems grouped as 'knee syndrome'
- new problems grouped as 'knee syndrome'
- all knee problems grouped as 'knee symptom/complaint'
- new problems grouped as 'knee symptom/complaint'

Changes in ordering over time between Period 1 and Period 2 are reported.

11.1 All knee problems

Table 11.1 shows the total number of knee problems managed, and the distribution of the knee problems across knee syndrome and knee symptoms/complaints in Period 1 and Period 2.

While the management rate for knee syndrome did not change between the two data periods, the management rate for knee symptom/complaint increased marginally, from 0.2 to 0.3 per 100 encounters. Knee syndrome and knee symptoms/complaints each accounted for around half of all knee problems in both data periods.

The management rate of total knee problems per 100 encounters significantly increased over the time period, resulting in a significant increase in the estimated annual encounters involving knee problems nationally. These increased from 0.5 million encounters (95% CI: 0.5–0.5) in Period 1 to 0.7 million (95% CI: 0.7–0.7) in Period 2. This is due to the increased GP visit rate described in Chapter 2.

Table 11.1: Knee problems managed by problem type, 2002–05 and 2009–12

Knee problems[(a)]	2002–05 (Period 1)			2009–12 (Period 2)		
	Number of problems	Per cent of knee problems	Per 100 encounters (95% CI)	Number of problems	Per cent of knee problems	Per 100 encounters (95% CI)
Knee syndrome	796	53.2	0.3 (0.2–0.3)	874	50.8	0.3 (0.3–0.3)
Knee symptom/complaint	699	46.8	0.2 (0.2–0.3)	845	49.2	0.3 (0.3–0.3)
Total knee problems	**1,495**	**100.0**	**0.5 (0.5–0.5)**	**1,719**	**100.0**	**0.6 (0.6–0.6)**

(a) For a list of inclusions refer to Appendix 5, Table A5.1.

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Table 11.2 shows that the rate at which imaging was ordered in the management of knee problems did not change between Period 1 and Period 2.

In 2002–05, there were 1,495 knee problems managed and at least one imaging test was ordered for 485 of these (32.4% likelihood). A total of 515 imaging test orders were placed, at a rate of 34.4 tests per 100 knee problems managed.

In 2009–12, there were 1,719 knee problems managed, and for 611 of these, at least one imaging test order was made (35.5% likelihood). In total, 676 imaging test orders were placed at a rate of 39.3 imaging tests per 100 knee problems managed. Knee problems contributed similar proportions of total imaging orders generated for all problems, in Period 1 (1.9%) and in Period 2 (2.2%) (see Table 4.4).

When these two results are considered with the increased GP visit rate, we calculate that in Period 1, 170,000 imaging orders were placed nationally by GPs for the management of knee problems. In Period 2, there were 280,000 imaging orders placed, or about 110,000 more than in Period 1.

In summary, there was a 14.2% increase in the imaging order rate for all knee problems between Period 1 and Period 2. As the rate of tests per tested problem did not change (average of 1.1 tests per problem in both periods), the increase in imaging orders for knee problems appears to be a result of the increased management rate (by 18.0%) and the increased likelihood (by 9.6%) of GPs ordering at least one imaging test when knee problems were managed.

Table 11.2: Knee problem management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total knee problems managed	1,495	1,719
Knee problems for which at least one imaging test ordered (*n*)	485	611
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	32.4 (30.0–34.9)	35.5 (33.2–37.9)
Total imaging orders generated for knee problems (*n*)	515	676
Imaging orders per 100 knee problems (95% CI)	34.4 (31.8–37.1)	39.3 (36.5–42.1)

Note: CI – confidence interval.

Age-specific and sex-specific management of knee problems

There was a significant increase over time in the management of knee problems, from 0.5% to 0.6% of encounters. In both data periods, the likelihood of management of knee problems was marginally higher at encounters with males than at those with females. There was a marginal increase in the management at encounters with males between Period 1 and Period 2, and a significant increase in the management at encounters with females.

The age-specific likelihood of management in the 45–64 year age group increased significantly, from 0.6% to 0.8% of encounters in this age group, with a marginal increase in the management among patients aged 75 years and over, from 0.2% to 0.3%.

However, there were no changes in the imaging order rate per 100 knee problems between Period 1 and Period 2, for either sex or any age group (Table 11.3).

Table 11.3: Age-specific and sex-specific likelihood of management and test order rate for knee problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	785	0.8 (0.7–0.9)	34.1 (30.5–37.8)	818	1.0 (0.9–1.1)	40.2 (36.1–44.3)
Females	694	0.7 (0.6–0.7)	34.6 (30.7–38.4)	885	0.8 (0.8–0.9)	38.8 (35.1–42.4)
Age						
<15 years	90	0.3 (0.2–0.3)	42.2 (30.4–54.1)	81	0.2 (0.2–0.3)	45.7 (32.0–59.4)
15–24 years	178	0.6 (0.5–0.7)	38.2 (30.1–46.3)	153	0.6 (0.5–0.7)	42.5 (32.9–52.1)
25–44 years	489	0.7 (0.6–0.7)	29.4 (24.9–35.0)	503	0.8 (0.7–0.8)	33.8 (29.3–38.3)
45–64 years	511	0.6 (0.6–0.7)	38.2 (33.6–42.8)	653	0.8 (0.8–0.9)	40.4 (36.0–44.7)
65–74 years	124	0.4 (0.3–0.4)	33.1 (24.8–41.3)	173	0.5 (0.4–0.5)	47.4 (37.7–57.1)
75+ years	91	0.2 (0.2–0.3)	27.5 (17.4–37.5)	143	0.3 (0.3–0.4)	38.5 (29.0–48.0)
Total	**1,495**	**0.5 (0.5–0.5)**	**34.4 (31.8–37.1)**	**1,716**	**0.6 (0.6–0.6)**	**39.3 (36.5–42.1)**

(a) Missing data removed: 2002–05 *n*=12 (age), *n*=16 (sex); 2009–12 *n*=10 (age), *n*=13 (sex).

(b) Number of encounters with at least one knee problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 11.2).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

There were some changes in the types of tests ordered across MBS groups. While there was a move away from diagnostic radiology, and toward MRI, the former remained the predominant test group. Table 11.4 shows that the ordering rate for MRI per 100 knee problems managed significantly increased between Period 1 (1.5 per 100 knee problems managed) and Period 2 (5.0 per 100). There was an apparent increase in nuclear medicine, however the numbers are very small and should be considered with caution.

Table 11.4: Imaging test orders by MBS test group and the most frequent individual tests ordered for knee problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**	**Number of tests**	**Per cent of tests for this problem (95% CI)**	**Test rate per 100 problems (95% CI)**
Diagnostic radiology	**436**	**84.7 (81.6–87.7)**	**29.2 (26.8–31.6)**	**493**	**72.9 (69.5–76.4)**	**28.7 (26.4–31.0)**
X-ray; knee	425	82.5 (79.3–85.7)	28.4 (26.1–30.8)	468	69.2 (65.7–72.7)	27.2 (25.0–29.4)
Ultrasound	**48**	**9.3 (6.8–11.8)**	**3.2 (2.3–4.1)**	**68**	**10.1 (7.8–12.3)**	**4.0 (3.0–4.9)**
Ultrasound; knee	45	8.7 (6.3–11.2)	3.0 (2.1–3.9)	62	9.2 (7.0–11.4)	3.6 (2.7–4.5)
Computerised tomography	**9**	**1.7 (0.5–3.0)**	**0.6 (0.2–1.0)**	**23**	**3.4 (2.0–4.8)**	**1.3 (0.8–1.9)**
Magnetic resonance imaging	**22**	**4.3 (2.5–6.1)**	**1.5 (0.8–2.1)**	**86**	**12.7 (9.8–15.6)**	**5.0 (3.8–6.2)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**6**	**0.9 (0.2–1.6)**	**0.6 (0.1–0.6)**
Total imaging tests	**515**	**100.0**	**34.4 (31.8–37.1)**	**676**	**100.0**	**39.3 (36.5–42.1)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

11.2 Knee syndrome

Table 11.5 shows the rate at which imaging was ordered in the management of knee syndrome over the two time periods, and that the imaging ordering rate for knee syndrome did not change.

In 2002–05, there were 796 knee syndrome problems managed and GPs ordered at least one imaging test for 248 of these (31.2% likelihood). A total of 266 imaging test orders were placed, at a rate of 33.4 imaging tests per 100 knee syndrome problems managed.

In 2009–12, there were 874 knee syndrome problems managed, and for 280 of these, GPs ordered at least one imaging test (32.0% likelihood). A total of 307 imaging test orders were placed, at a rate of 35.1 imaging tests per 100 knee syndrome problems managed.

In Period 1, an estimated 90,000 imaging orders per annum were placed nationally by GPs in the management of knee syndrome problems. In Period 2, there were about 130,000 imaging orders placed per year, or about 40,000 more per year than in Period 1.

In summary, there were no changes in: the management rate of knee syndrome problems (0.3 per 100 encounters in both periods); the likelihood of ordering a test (31.2% in Period 1, and 32.0% in Period 2); and the rate at which imaging tests were ordered for knee syndrome problems (33.4 per 100 problems in Period 1, and 35.1 per 100 in Period 2). There was also no change in the number of tests ordered per tested knee problem (1.1 per tested problem in both periods) (results not tabled). Therefore, the increase in the number of tests ordered nationally is entirely due to the increased GP visit rate.

Table 11.5: Knee syndrome management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total knee syndrome problems managed	796	874
Knee syndrome problems for which at least one imaging test ordered (*n*)	248	280
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	31.2 (27.7–34.6)	32.0 (28.8–35.3)
Total imaging orders generated for knee syndrome problems (*n*)	266	307
Imaging orders per 100 knee syndrome problems (95% CI)	33.4 (29.6–37.2)	35.1 (31.3–38.9)

Note: CI – confidence interval.

Age-specific and sex-specific management

In both data periods, the likelihood of management was significantly higher at encounters with males than at those with females. The sex-specific likelihood did not change over time at encounters with males, but marginally increased for females.

The age-specific likelihood of management was highest for patients in the age groups ranging from 15 to 64 years, but there were no changes for any age groups between the two time periods.

There were no changes in the overall rate at which imaging tests were ordered for knee syndrome problems, or for any age or sex (Table 11.6).

Table 11.6: Age-specific and sex-specific likelihood of management and test order rate for knee syndrome, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	471	0.4 (0.4–0.4)	34.8 (29.8–39.9)	463	0.4 (0.4–0.4)	36.4 (31.2–41.7)
Females	314	0.2 (0.2–0.2)	31.2 (25.9–36.6)	404	0.2 (0.2–0.3)	33.9 (28.6–39.2)
Age						
<15 years	38	0.1 (0.1–0.1)	36.8 (19.0–55.0)	25	0.1 (0.0–0.1)	41.3 (29.4–53.2)
15–24 years	110	0.4 (0.3–0.5)	35.5 (25.0–45.9)	92	0.4 (0.3–0.5)	41.3 (29.4–53.2)
25–44 years	305	0.4 (0.4–0.5)	31.1 (25.1–37.2)	303	0.5 (0.4–0.5)	29.0 (23.4–34.7)
45–64 years	271	0.3 (0.3–0.4)	35.1 (28.5–41.6)	337	0.4 (0.4–0.5)	33.7 (28.2–39.3)
65–74 years	42	0.1 (0.1–0.2)	33.3 (18.8–47.9)	71	0.2 (0.1–0.2)	52.1 (35.2–69.1)
75+ years	26	0.1 (0.0–0.1)	34.6 (13.1–56.1)	42	0.1 (0.1–0.1)	45.2 (25.8–64.7)
Total	**796**	**0.3 (0.2–0.3)**	**33.4 (29.6–37.2)**	**873**	**0.3 (0.3–0.3)**	**35.1 (31.3–38.9)**

(a) Missing data removed: 2002–05 *n*=4 (age), *n*=11 (sex); 2009–12 *n*=3 (age), *n*=6 (sex).

(b) Number of encounters with at least one knee syndrome problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 11.5).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging test types ordered

There were considerable changes in the types of tests ordered across MBS groups. Table 11.7 shows that, although the imaging ordering rate for diagnostic radiology did not change, there was a general move away from diagnostic radiology as a proportion of tests for knee syndrome toward MRI. Between Period 1 and Period 2, the order rate for MRI significantly increased from 2.0 to 7.0 per 100 knee syndrome problems managed.

Table 11.7: Imaging test orders by MBS and most frequent imaging tests ordered for knee syndrome, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**217**	**81.6 (76.9–86.2)**	**27.3 (24.0–30.5)**	**205**	**66.8 (61.3–72.3)**	**23.5 (20.4–26.5)**
X-ray; knee	212	79.7 (74.9–84.5)	26.6 (23.4–29.9)	195	63.5 (58.0–69.0)	22.3 (19.4–25.2)
Ultrasound	**26**	**9.8 (6.2–13.4)**	**3.3 (2.0–4.6)**	**28**	**9.1 (5.9–12.4)**	**3.2 (2.0–4.4)**
Ultrasound; knee	25	9.4 (5.8–13.0)	3.1 (1.9–4.4)	27	8.8 (5.6–12.0)	3.1 (1.9–4.3)
Computerised tomography	**7**	**2.6 (0.5–4.8)**	**0.9 (0.1–1.6)**	**12**	**3.9 (1.7–6.1)**	**1.4 (0.6–2.1)**
Magnetic resonance imaging	**16**	**6.0 (3.1–9.0)**	**2.0 (1.0–3.0)**	**61**	**19.9 (14.7–25.1)**	**7.0 (5.0–8.9)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**1**	**0.3 (—)**	**0.1 (—)**
Total imaging tests	**266**	**100.0**	**33.4 (29.6–37.2)**	**307**	**100.0**	**35.1 (31.3–38.9)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of knee syndrome problem

Table 11.8 shows the proportions of contacts generating an imaging order for new and old knee syndrome problems in both data periods. GP contacts were divided equally between new and previously diagnosed knee syndrome problems, in both 2002–05 and 2009–12.

In both data periods, the imaging order rate for knee syndrome problems was twice as high at initial presentations (45.7 orders per 100 knee syndrome problems in Period 1 and 48.5 per 100 in Period 2) than at follow-up consultations (21.5 orders per 100 knee syndrome problems in Period 1 and 21.7 per 100 in Period 2). Similarly, the likelihood of ordering was higher at initial presentations than follow-up consultations. Neither the imaging order rate nor the likelihood of ordering at least one imaging test per 100 new, or old, knee syndrome problems, changed between the two data periods.

These results, combined with the increased GP visit rate, suggest that in Period 1, about 60,000 imaging orders per year were placed nationally by GPs for the management of new knee syndrome problems. In Period 2, there were about 90,000 imaging tests ordered per year, or about 30,000 more per annum than in Period 1.

In summary, there were no changes in: the management rate of new knee syndrome problems (0.1 per 100 encounters in Period 1 and 0.2 in Period 2); the likelihood of ordering a test (42.1% in Period 1 and 43.7% in Period 2); the rate at which imaging tests were ordered (45.7 per 100 problems in Period 1 and 48.8 per 100 in Period 2); and no change in the number of tests ordered per new knee syndrome problem (1.08 per tested problem in Period 1 and 1.11 in Period 2). Therefore we can conclude that the increase in the number of tests ordered nationally was entirely due to the increased GP visit rate.

Table 11.8: Imaging ordering rates by status of knee syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	392	404	**796**	437	437	**874**
Per cent of knee syndrome problems	49.2	50.8	**100.0**	50.0	50.0	**100.0**
Total imaging orders generated for problems (*n*)	179	87	**266**	212	95	**307**
Imaging orders per 100 problems (95% CI)	45.7 (39.8–51.5)	21.5 (17.1–25.9)	**33.4 (29.6–37.2)**	48.5 (42.7–54.3)	21.7 (17.3–26.2)	**35.1 (31.3–38.9)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	42.1 (36.9–47.3)	20.5 (16.6–24.5)	**31.2 (27.7–34.6)**	43.7 (38.9–48.5)	20.4 (16.4–24.3)	**32.0 (28.8–35.3)**

Note: CI – confidence interval.

11.3 New knee syndrome

Age-specific and sex-specific management

The likelihood of management of new knee syndrome problems did not change between Period 1 and Period 2. In both data periods, the likelihood of management at encounters with males was significantly higher than at encounters with females. The sex-specific likelihood of management at encounters with females increased significantly between Period 1 and Period 2, but did not change for encounters with males (Table 11.9). The age-specific management likelihood increased significantly for patients aged 65–74 years.

There were no changes in the rate of imaging ordered for the management of new knee syndrome problems for either sex or any age group.

Table 11.9: Age-specific and sex-specific likelihood of management and test order rate for new knee syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	232	0.2 (0.2–0.2)	48.7 (40.9–56.5)	214	0.2 (0.2–0.2)	52.3 (43.9–60.8)
Females	157	0.1 (0.1–0.1)	40.8 (32.8–48.8)	220	0.1 (0.1–0.1)	45.5 (37.9–53.0)
Age						
<15 years	25	0.1 (0.0–0.1)	46.8 (31.6–61.9)	15	0.0 (0.0–0.1)	59.3 (42.1–76.4)
15–24 years	62	0.2 (0.2–0.3)	46.8 (31.6–61.9)	54	0.2 (0.2–0.2)	59.3 (42.1–76.4)
25–44 years	144	0.2 (0.2–0.2)	44.4 (34.2–54.7)	139	0.2 (0.1–0.2)	44.6 (34.7–54.5)
45–64 years	124	0.2 (0.1–0.2)	50.0 (40.0–60.0)	157	0.2 (0.2–0.2)	45.2 (36.3–54.2)
65–74 years	19	0.1 (0.0–0.1)	52.6 (27.9–77.4)	42	0.1 (0.1–0.2)	57.1 (37.4–76.9)
75+ years	18	0.0 (0.0–0.1)	33.3 (9.2–57.5)	28	0.1 (0.0–0.1)	53.6 (28.9–78.3)
Total	**392**	**0.1 (0.1–0.2)**	**45.7 (39.8–51.5)**	**437**	**0.2 (0.1–0.2)**	**48.5 (42.7–54.3)**

(a) Missing data removed: 2002–05 *n*=0 (age), *n*=3 (sex); 2009–12 *n*=2 (age), *n*=3 (sex).

(b) Number of encounters with at least one new knee syndrome problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 11.8).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging test types ordered

Table 11.10 shows there were very few changes in the types of tests ordered across MBS groups, or in the ordering rate of specific tests over the data period.

Between Period 1 and Period 2, orders for MRI increased significantly, both as a proportion of all imaging tests for new knee syndrome problems, and as a rate per 100 new knee syndrome problems managed. The latter had a more than threefold increase, from 2.8 to 8.9 per 100 new knee syndrome problems managed. There were no changes over the time period for diagnostic radiology, ultrasound or CT. Nuclear medicine was not employed in the management of new knee syndrome in either data period.

Table 11.10: Imaging test orders by MBS test group and the most frequent imaging tests ordered for new knee syndrome problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**142**	**79.3 (73.6–85.0)**	**36.2 (31.2–41.2)**	**148**	**69.8 (63.8–75.8)**	**33.9 (29.0–38.8)**
X-ray; knee	140	78.2 (72.4–84.0)	35.7 (30.7–40.7)	141	66.5 (60.4–72.6)	32.3 (27.7–36.9)
Ultrasound	**21**	**11.7 (7.2–16.3)**	**5.4 (3.1–7.6)**	**17**	**8.0 (4.3–11.7)**	**3.9 (2.0–5.8)**
Ultrasound; knee	20	11.2 (6.7–15.6)	5.1 (2.9–7.3)	17	8.0 (4.3–11.7)	3.9 (2.0–5.8)
Computerised tomography	**5**	**2.8 (0.3–5.2)**	**1.3 (0.2–2.4)**	**8**	**3.8 (1.2–6.4)**	**1.8 (0.6–3.1)**
Magnetic resonance imaging	**11**	**6.1 (2.4–9.9)**	**2.8 (1.1–4.6)**	**39**	**18.4 (12.8–24.0)**	**8.9 (6.1–11.7)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**0**	**0.0 (—)**	**0.0 (—)**
Total imaging tests	**179**	**100.0**	**45.7 (39.8–51.5)**	**212**	**100.0**	**48.5 (42.7–54.3)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only most frequent test descriptors are presented in each MBS group.

11.4 Knee symptoms/complaints

Table 11.11 shows that the rate at which imaging was ordered in the management of knee symptoms/complaints increased significantly over time.

In 2002–05, there were 699 knee symptoms/complaints managed and at least one imaging test was ordered for 237 of these (33.9% likelihood). A total of 249 imaging test orders were placed at a rate of 35.6 imaging tests per 100 knee symptoms/complaints managed.

In 2009–12, there were 845 knee symptoms/complaints managed, and GPs ordered at least one imaging order for 331 of these (39.2% likelihood). In total, 369 imaging test orders were placed at a rate of 43.7 imaging tests per 100 knee symptoms/complaints managed.

These results, combined with the increased GP visit rate, suggest that in Period 1, about 140,000 imaging orders were placed per annum nationally by GPs for the management of knee symptom/complaint problems. In Period 2, there were 150,000 orders placed per year, or about 10,000 more per annum than in Period 1.

In summary, there was a marginal increase in the management rate of knee symptom/complaint problems, from 0.2 to 0.3 per 100 encounters. However, there were no changes in: the likelihood of ordering a test (33.9% in Period 1 and 39.2% in Period 2); the rate at which imaging tests were ordered (35.6 per 100 problems in Period 1 and 43.7 in Period 2); and no change in the number of tests ordered per knee symptom/complaint problem (1.05 per tested problem in Period 1 and 1.11 in Period 2). Therefore, the increase in the number of tests ordered nationally was due to the increased management rate of knee symptom/complaint problems combined with the increased GP visit rate.

Table 11.11: Knee symptom/complaint management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Total knee symptom/complaint problems managed	699	845
Knee symptom/complaint problems for which at least one imaging test ordered (*n*)	237	331
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	33.9 (30.3–37.5)	39.2 (35.9–42.5)
Total imaging orders generated for knee symptom/complaint problems (*n*)	249	369
Imaging orders per 100 knee symptom/complaint problems (95% CI)	35.6 (31.8–39.4)	43.7 (39.6–47.7)

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Age-specific and sex-specific management

The likelihood of management of knee symptoms/complaints was similar at encounters with males and with females. Management at encounters with females increased significantly between Period 1 and Period 2 (Table 11.12).

The age-specific likelihood of management of knee symptoms/complaints increased over time for patients aged 45–64 years, and decreased for those aged 75 years or older. Imaging orders increased over time, for males, and for patients aged 25–44 years.

Table 11.12: Age-specific and sex-specific likelihood of management and test order rate for knee symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**	**At least one problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 problems (95% CI)**
Sex						
Males	314	0.3 (0.2–0.3)	33.1 (27.9–38.4)	357	0.3 (0.3–0.3)	45.1 (38.9–51.3)
Females	380	0.2 (0.2–0.2)	37.4 (32.0–42.8)	481	0.3 (0.3–0.3)	42.8 (37.7–47.9)
Age						
<15 years	52	0.2 (0.1–0.2)	46.2 (30.1–62.2)	56	0.2 (0.1–0.2)	48.2 (30.7–65.7)
15–24 years	68	0.2 (0.2–0.3)	42.6 (29.7–55.6)	61	0.2 (0.2–0.3)	44.3 (27.8–60.7)
25–44 years	184	0.3 (0.2–0.3)	26.6 (20.0–33.2)	200	0.3 (0.3–0.3)	41.0 (33.8–48.2)
45–64 years	240	0.3 (0.3–0.3)	41.7 (35.3–48.0)	318	0.4 (0.4–0.4)	47.5 (40.9–54.1)
65–74 years	82	0.2 (0.2–0.3)	32.9 (22.8–43.1)	102	0.3 (0.2–0.3)	44.1 (32.3–56.0)
75+ years	65	0.2 (0.1–0.2)	24.6 (13.7–35.5)	101	0.1 (0.0–0.1)	35.6 (25.4–45.9)
Total	**699**	**0.2 (0.2–0.3)**	**35.6 (31.8–39.4)**	**845**	**0.3 (0.3–0.3)**	**43.7 (39.6–47.7)**

(a) Missing data removed: 2002–05 n=8 (age), n=5 (sex); 2009–12 n=7 (age), n=7 (sex).

(b) Number of encounters with at least one knee symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 11.11).

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Table 11.13 shows that there were some changes in the types of tests ordered across MBS groups. While diagnostic radiology remained the predominant group in both data periods, there was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered, with a move toward CT and MRI orders. Between Period 1 and Period 2 the order rate for MRI increased significantly, from 0.9 to 3.0 tests per 100 knee symptoms/complaints managed.

The number of orders for CT and nuclear medicine increased, however numbers are small and results should be interpreted with caution.

Table 11.13: Imaging test orders by MBS test group and the most frequent individual tests ordered for knee symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**219**	**88.0 (83.9–92.0)**	**31.3 (27.8–34.9)**	**288**	**78.0 (74.0–82.1)**	**34.1 (30.7–37.5)**
X-ray; knee	213	85.5 (81.3–89.8)	30.5 (27.0–33.9)	273	74.0 (69.8–78.2)	32.3 (29.1–35.5)
Ultrasound	**22**	**8.8 (5.4–12.3)**	**3.1 (1.9–4.4)**	**40**	**10.8 (7.7–14.0)**	**4.7 (3.2–6.3)**
Ultrasound; knee	20	8.0 (4.7–11.3)	2.9 (1.6–4.1)	35	9.5 (6.5–12.4)	4.1 (2.7–5.5)
Computerised tomography	**2**	**0.8 (—)**	**0.3 (—)**	**11**	**3.0 (1.2–4.7)**	**1.3 (0.5–2.1)**
Magnetic resonance imaging	**6**	**2.4 (0.5–4.3)**	**0.9 (0.2–1.5)**	**25**	**6.8 (4.2–9.3)**	**3.0 (1.8–4.1)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**5**	**1.4 (0.2–2.5)**	**0.6 (0.1–1.1)**
Total imaging tests	**249**	**100.0**	**35.6 (31.8–39.4)**	**369**	**100.0**	**43.7 (39.6–47.7)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of knee symptom/complaint problem

Table 11.14 shows the proportion of contacts generating an imaging order for new and old knee symptom/complaint problems in both data periods. Just over half of the GP contacts were for follow-up of previously diagnosed knee symptoms/complaints, in both 2002–05 and 2009–12.

In both data periods, the imaging order rate for knee symptoms/complaints was much higher at initial presentations (52.6 per 100 knee symptoms/complaints in Period 1 and 58.3 per 100 in Period 2) than at follow-up consultations (22.1 per 100 knee symptoms/complaints in Period 1 and 32.4 per 100 in Period 2). There were no significant changes in the imaging order rate per 100 new knee symptom/complaint problems between the two data periods,

but the order rate for old problems increased significantly from 22.1 to 32.4 per 100 old knee symptom/complaint problems managed.

In Period 1, an estimated 55,000 imaging orders per year were placed nationally by GPs for the management of new knee symptom/complaint problems. In Period 2, there were about 90,000 imaging orders placed per year, or about 35,000 more per annum than in Period 1.

Similarly, in Period 1, an estimated 30,000 imaging orders per year were placed nationally by GPs for the management of old shoulder symptom/complaint problems. In Period 2, there were about 60,000 imaging orders placed per year, or about 30,000 more per annum than in Period 1 (double the number of tests).

In summary, there was no change in the management rate of new knee symptom/complaint problems (0.1 per 100 problems in both data periods), the likelihood of GPs ordering an imaging test when managing new knee symptom/complaint problems (49.7% and 50.9% respectively), or in the number of imaging tests ordered per tested problem (1.0 in Period 1 and 1.1 in Period 2) (results not tabled). Therefore we can conclude that the national increase in tests was due solely to the increased GP visit rate.

In contrast to new problems, the national increase in tests ordered for old knee symptom/complaint problems was due to multiple factors, including: a marginal increase in the management rate of these problems (increasing from 0.1 to 0.2 per 100 encounters over time) (results not tabled); a significant increase (by 40.8%) in the likelihood of GPs ordering imaging; and the increased GP visit rate. There was no change over time in the number of imaging tests ordered per tested old knee symptom/complaint problem (1.0 in Period 1 and 1.1 in Period 2) (results not tabled).

Table 11.14: Imaging ordering rates by status of knee symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	310	389	**699**	369	476	**845**
Per cent of knee symptom/complaint problems	44.3	55.7	**100.0**	43.7	56.3	**100.0**
Total imaging orders generated for problems (*n*)	163	86	**249**	215	154	**369**
Imaging orders per 100 problems (95% CI)	52.6 (46.5–58.7)	22.1 (17.7–26.5)	**35.6 (31.8–39.4)**	58.3 (51.7–64.9)	32.4 (27.8–36.9)	**43.7 (39.6–47.7)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	49.7 (44.0–55.3)	21.3 (17.2–25.5)	**33.9 (30.3–37.5)**	50.9 (45.8–56.1)	30.0 (25.9–34.2)	**39.2 (35.9–42.5)**

Note: CI – confidence interval. Highlighting indicates a significant difference between data periods.

11.5 New knee symptom/complaint

Age-specific and sex-specific management

In both data periods, there was no difference in the likelihood of management of new knee symptoms/complaints at encounters with males and females, and no changes between Period 1 and Period 2 for either sex.

There were no changes between Period 1 and Period 2 in either the age-specific or sex-specific imaging test order rates for new knee symptoms/complaints (Table 11.15).

Table 11.15: Age-specific and sex-specific likelihood of management and test order rate for new knee symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Patient characteristic[a]	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**	**At least one new problem managed[b]**	**Management likelihood (%) (95% CI)**	**Test order rate per 100 new problems (95% CI)**
Sex						
Males	130	0.1 (0.1–0.1)	50.8 (42.1–59.4)	147	0.1 (0.1–0.2)	61.2 (50.5–72.0)
Females	178	0.1 (0.1–0.1)	53.4 (44.9–61.9)	220	0.1 (0.1–0.1)	55.9 (47.5–64.3)
Age						
<15 years	31	0.1 (0.1–0.1)	51.6 (28.7–74.6)	26	0.1 (0.1–0.1)	53.8 (27.7–80.0)
15–24 years	28	0.1 (0.1–0.1)	53.6 (33.9–73.3)	32	0.1 (0.1–0.2)	56.3 (31.4–81.1)
25–44 years	75	0.1 (0.1–0.1)	45.3 (32.7–57.9)	83	0.1 (0.1–0.2)	51.8 (39.0–64.6)
45–64 years	125	0.2 (0.1–0.2)	55.2 (45.7–64.7)	144	0.2 (0.2–0.2)	63.2 (52.2–74.2)
65–74 years	29	0.1 (0.1–0.1)	55.2 (36.6–73.8)	39	0.1 (0.1–0.1)	66.7 (45.2–88.1)
75+ years	19	0.1 (0.0–0.1)	63.2 (39.3–87.0	44	0.1 (0.1–0.1)	52.3 (35.5–69.0)
Total	**310**	**0.1 (0.1–0.1)**	**52.6 (46.5–58.7)**	**369**	**0.1 (0.1–0.1)**	**58.3 (51.7–64.9)**

(a) Missing data removed: 2002–05 *n*=3 (age), *n*=2 (sex); 2009–12 *n*=1 (age), *n*=2 (sex).

(b) Number of encounters with at least one new knee symptom/complaint problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 11.14).

Note: CI – confidence interval.

Changes in imaging test types ordered

Table 11.16 shows that there were no changes between Period 1 and Period 2 in the types of tests ordered across MBS groups, apart from a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered.

Table 11.16: Imaging test orders by MBS group and the most frequent individual tests ordered for new knee symptoms/complaints, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**145**	**89.0 (84.2–93.7)**	**46.8 (41.0–52.6)**	**171**	**79.5 (74.6–84.5)**	**46.3 (40.9–51.8)**
X-ray; knee	141	86.5 (81.3–91.7)	45.5 (39.9–51.0)	163	75.8 (70.6–81.1)	44.2 (39.0–49.3)
Ultrasound	**14**	**8.6 (4.4–12.8)**	**4.5 (2.2–6.8)**	**27**	**12.6 (8.3–16.8)**	**7.3 (4.5–10.1)**
Ultrasound; knee	12	7.4 (3.4–11.3)	3.9 (1.7–6.0)	24	11.2 (7.2–15.1)	6.5 (4.0–9.0)
Computerised tomography	**1**	**0.6 (—)**	**0.3 (—)**	**6**	**2.8 (0.6–5.0)**	**1.6 (0.3–2.9)**
Magnetic resonance imaging	**3**	**1.8 (0.0–3.9)**	**1.0 (0.0–2.1)**	**8**	**3.7 (1.2–6.3**	**2.2 (0.7–3.7)**
Nuclear medicine	**0**	**0.0 (—)**	**0.0 (—)**	**3**	**1.4 (0.0–3.0)**	**0.8 (0.0–1.7)**
Total imaging tests	**163**	**100.0**	**52.6 (46.5–58.7)**	**215**	**100.0**	**58.3 (51.7–64.9)**

Note: CI – confidence interval; MBS – Medicare Benefits Schedule; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

11.6 Summary of findings

Changes over time

Overall, management rates of knee problems in total increased significantly between the two data periods. Management of knee symptoms/complaints also increased significantly, the change entirely due to the increase in management of old knee symptom/complaint problems, as there was no change in the management of new symptoms/complaints of the knee. All knee problems, and old knee symptoms/complaints, were the only areas in which significant increases were noted in the likelihood of testing and in the test-ordering rate per 100 problems. No other changes were observed. There was a general move away from diagnostic radiology toward ultrasound and MRI ordering (Table 11.17).

Table 11.17: Summary of changes over time for knee problems

Knee problems	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	↑ 18.0% (0.5, 0.6)	↑ 9.6% (32.4, 35.5)	↑ 14.2% (34.4, 39.3)	No change (1.06, 1.12)
Knee syndrome	No change (0.3, 0.3)	No change (31.2, 32.0)	No change (33.4, 35.1)	No change (1.07, 1.10)
New	No change (0.1, 0.2)	No change (42.1, 43.7)	No change (45.7, 48.8)	No change (1.08, 1.11)
Knee symptom/ complaint	↑ 20.8% (0.2, 0.3)	No change (33.9, 39.2)	No change (35.6, 43.7)	No change (1.05, 1.11)
New	No change (0.1, 0.1)	No change (49.7, 50.9)	No change (52.6, 58.3)	No change (1.06, 1.14)
Old	↑ 23.1% (Marginal) (0.1, 0.2)	↑ 40.8% (21.3, 30.0)	↑ 46.6% (22.1, 32.4)	No change (1.04, 1.08)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Current imaging test order patterns

The recent management rates of knee syndrome and knee symptom/complaint problems did not differ. For knee syndrome, the management rate of new and previously managed cases did not differ, but for knee symptoms/complaints, new cases were managed less often than previously managed cases.

The likelihood of ordering an imaging test for knee syndrome was significantly lower than that for knee symptom/complaint problems, and for both, GPs were far more likely to order imaging in the management of a new problem, than for a previously managed problem. The test ordering rate was significantly higher for knee symptom/complaint than knee syndrome, and in both, far higher for new cases than those previously managed.

The majority of tests for all knee problems were diagnostic radiology tests. MRIs ranked second in test choice to investigate knee syndrome problems (both new and old), but ultrasounds were the second choice when testing for new cases of knee symptom/complaint problems (Table 11.18).

Table 11.18: Summary of GP imaging ordering for knee problems, Period 2, 2009–12

Knee problems	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	0.6 (0.6–0.6)	35.5 (33.2–37.9)	1.12	39.3 (36.5–42.1)	28.7 (26.4–31.0)	4.0 (3.0–4.9)	1.3 (0.8–1.9)	5.0 (3.8–6.2)
Knee syndrome	0.3 (0.3–0.3)	32.0 (28.8–35.3)	1.10	35.1 (31.3–38.9)	23.5 (20.4–26.5)	3.2 (2.0–4.4)	1.4 (0.6–2.1)	7.0 (5.0–8.9)
New	0.2 (0.1–0.2)	43.7 (38.9–48.5)	1.11	48.8 (42.7–54.3)	33.9 (29.0–38.8)	3.9 (2.0–5.8)	1.8 (0.6–3.1)	8.9 (6.1–11.7)
Old	0.2 (0.1–0.2)	20.4 (16.4–24.3)	1.06	21.7 (17.3–26.2)	13.0 (9.8–16.3)	2.5 (0.9–4.1)	0.9 (0.0–1.8)	5.0 (2.9–7.2)

(continued)

Table 11.18 (continued): Summary of GP imaging ordering for knee problems, Period 2, 2009–12

Knee problems	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 selected problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
Knee symptom/ complaint	0.3 (0.3–0.3)	39.2 (35.9–42.5)	1.11	43.7 (39.6–47.7)	34.1 (30.7–37.5)	4.7 (3.2–6.3)	1.3 (0.5–2.1)	3.0 (1.8–4.1)
New	0.1 (0.1–0.1)	50.9 (45.8–56.1)	1.14	58.3 (51.7–64.9)	46.3 (40.9–51.8)	7.3 (4.5–10.1)	1.6 (0.3–2.9)	2.2 (0.7–3.7)
Old	0.2 (0.2–0.2)	30.0 (25.9–34.2)	1.08	32.4 (27.8–36.9)	24.6 (20.6–28.5)	2.7 (1.3–4.2)	1.1 (0.1–2.0)	3.6 (1.9–5.2)

Note: CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging.

11.7 Summary of guidelines for imaging of knee problems

The final group of guidelines considered for this section of this report were: Government of Western Australia Department of Health (WADoH) Diagnostic Imaging Pathways[15,16] (these guidelines could be considered as the successor of the now obsolete Royal Australian and New Zealand College of Radiologists [RANZCR] Imaging Guidelines 2001,[19] and are endorsed by the RANZCR), the American College of Radiology Appropriateness Criteria (ACRAC),[22] and the New Zealand Guidelines Group (NZGG) guidelines.[29,31]

The WADoH Imaging Pathways for post traumatic knee pain suggest application of the Ottawa knee rules as part of clinical assessment and knee x-ray only if indicated under the Ottawa rules. The pathway suggested for patients where the Ottawa rule does not suggest x-ray (and those where an indicated x-ray is negative) include ultrasound for assessment of superficial soft issues and MRI where there is a high suspicion of ligament or meniscus damage. Investigation of non-traumatic knee pain includes initial x-ray or ultrasound following clinical assessment followed by MRI if initial imaging is non-diagnostic and underlying pathology is suspected.

The ACRAC for acute trauma to the knee also suggest x-ray only where signs similar to those in the Ottawa rules are present. If it is a twisting injury or fall with negative radiology and positive signs, then MRI is appropriate (or CT with contrast if a tibial plateau fracture is found on x-ray).

The NZGG guidelines suggest a similar pathway to the WADoH and ACRAC guidelines.

In a study of acute knee injuries managed in Emergency Departments in Canada, Stiell et al. found that 74.5% of patients had an x-ray and only 5.2% had fractures. Knee x-rays have the lowest yield for diagnosing clinical significant fractures.[100] The Ottawa knee rules for acute trauma to the knee synthesise the research of several developers of decision rules for knee imaging including Stiell et al.[101-103] The Ottawa knee rules have almost 100% sensitivity and about 50% specificity for knee fractures.[104]

11.8 Compliance with guidelines

Compliance with current guidelines is reported only for the 2009–12 period as some changes in guidelines have occurred in the period between the two samples used in this study.

Knee problems managed by GPs were grouped almost equally between L15 Knee symptom/complaint (predominantly knee pain or swelling) and knee syndrome (almost exclusively L96 Acute internal damage knee). Osteoarthritis of the knee is included in Chapter 6 and sprains/strains of the knee are in Chapter 8.

Plain x-rays of the knee are primarily useful for the diagnosis of fracture in acute knee injuries. The yield of positive findings is very low in patients who do not have clinical findings consistent with the Ottawa knee rules. The reported levels of orders for knee x-rays in the management of knee problems in the current study (ranging from 27.2 per 100 contacts for all knee problems to 44.2 per 100 new knee symptoms/complaints) were well below the North American Emergency Department level reported above. However, they were still well above the rate required for the reported prevalence of knee fractures (5.2% of acute knee injuries[100]) and could probably be significantly reduced if the Ottawa rules were routinely implemented before deciding to order imaging studies.

Ultrasound and CT of the knee were ordered infrequently and this is consistent with current guidelines.

Ordering of MRI studies has increased significantly for new knee syndrome problems over the period of the study and are now ordered at the rate of 8.9 per 100 new knee syndrome problems. This is consistent with the guideline advice of the utility of MRI in defining internal knee damage. It could be expected that the order rate will increase in the future with increased access available under the MBS. The Direct Access to Magnetic Resonance Imaging: Assessment for Suspect Knees (DAMASK) trials in the United Kingdom have demonstrated some benefit from increased GP access to MRI for 'suspect knees' in that country.[110-112]

It is notable that in this study there has been no increase in MRI orders for patients presenting with new knee symptoms/complaints. This may change in the future with greater availability of MBS rebates for MRI ordered by GPs.

12 Other musculoskeletal injuries

This chapter investigates the imaging orders for other musculoskeletal injury (OMI) problems. Throughout this chapter, 'other musculoskeletal injury' includes all musculoskeletal injuries, with the exception of all sprains and strains, and all injuries of the shoulder, back and knee (see Appendix 5, Table A5.1).

As reported at the beginning of Section 2, GP imaging orders for OMI were selected for investigation because there was a statistically significant increase in the likelihood of GPs' ordering imaging for this indication.

Imaging orders are investigated for all and for new OMI problems (see Glossary). Changes in ordering over time between April 2002–March 2005 (Period 1) and April 2009–March 2012 (Period 2) are reported.

12.1 All other musculoskeletal injury problems

Table 12.1 shows there was no change between Period 1 and Period 2 in the management rate of OMI problems. There was a significant increase in the estimated annual encounters involving OMI problems nationally, from 500,000 (95% CI: 470,000–530,000) encounters in Period 1, to 620,000 (95% CI: 580,000–650,000) in Period 2, due to the increased number of GP encounters claimed through Medicare nationally (as described in Chapter 2).

Table 12.1 shows that the rate at which imaging tests were ordered in the management of osteoarthritis problems increased significantly over time. In Period 1, there were 1,527 OMI problems managed and at least one imaging test was ordered for 485 of these (31.8% likelihood). A total of 538 imaging test orders were placed, at a rate of 35.2 imaging tests per 100 OMI problems managed.

In Period 2, there were 1,514 OMI problems managed, and for 580 of these at least one imaging test was ordered (38.3% likelihood). In total, 651 imaging test orders were placed, at a rate of 43.0 tests per 100 OMI problems managed.

These results, combined with the increased GP visit rate, suggest that in Period 1, 180,000 imaging orders were placed nationally per year by GPs in the management of OMI problems. In Period 2, there were about 270,000 orders placed per year, or about 90,000 more per annum than Period 1.

In summary, while the management rate did not change, the imaging order rate significantly increased (by 22.4%) over the time period. As there was no change in the number of tests ordered per problem when ordering occurred (1.1 tests per tested problem in both periods) (results not tabled), the national increase was attributed to the increased likelihood (by 20.4%) of ordering imaging for OMI problems, plus the increased GP visit rate.

Table 12.1: Other musculoskeletal injury (OMI) management generating GP imaging orders, 2002–05 and 2009–12

	2002–05 (Period 1)	2009–12 (Period 2)
Number of OMI problems managed	1,527	1,514
Management rate per 100 encounters (95% CI)	0.5 (0.5–0.6)	0.5 (0.5–0.6)
OMI problems for which at least one imaging test ordered (*n*)	485	580
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	31.8 (29.2–34.3)	38.3 (35.8–40.8)
Total imaging orders generated for OMI problems (*n*)	538	651
Imaging orders per 100 OMI problems (95% CI)	35.2 (32.2–38.2)	43.0 (39.9–46.1)

Note: OMI – other musculoskeletal injury; CI – confidence interval. Highlighting indicates a significant difference between data periods. For a list of inclusions refer to Appendix 5, Table A5.1.

Age-specific and sex-specific management

There was no change in the management rate of OMI at encounters with either sex between Period 1 and Period 2. In both data periods the likelihood of management was significantly higher at encounters with males than at those with females. However there was no difference in the imaging order rate per 100 OMI problems between the sexes. The overall increase in the imaging order rate previously reported was not significant when stratified by sex.

Between Period 1 and Period 2, the age-specific imaging ordering rate increased in the 25–44 year age group, from 32.8 to 44.1 per 100 OMI problems, and in the 45–64 year age group from 27.4 to 37.8 per 100 OMI problems. There were no significant changes over time in imaging order rates in the other age groups (Table 12.2).

Table 12.2: Age-specific and sex-specific likelihood of management and test order rate for OMI problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)	At least one problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 problems (95% CI)
Sex						
Males	859	0.7 (0.7–0.8)	34.9 (30.9–38.9)	849	0.7 (0.7–0.8)	42.1 (38.0–46.2)
Females	648	0.4 (0.3–0.4)	35.9 (31.6–40.3)	649	0.4 (0.3–0.4)	44.5 (40.0–49.0)
Age						
<15 years	135	0.4 (0.3–0.5)	62.2 (53.2–71.2)	138	0.4 (0.3–0.5)	61.6 (52.5–70.6)
15–24 years	233	0.8 (0.7–1.0)	43.4 (36.1–50.7)	178	0.7 (0.6–0.8)	43.0 (34.7–51.3)
25–44 years	465	0.6 (0.6–0.7)	32.8 (27.4–38.1)	465	0.7 (0.6–0.8)	44.1 (38.8–49.4)
45–64 years	463	0.6 (0.5–0.6)	27.4 (22.7–32.2)	474	0.6 (0.5–0.6)	37.8 (32.3–43.2)
65–74 years	105	0.3 (0.2–0.4)	39.0 (28.0–50.1)	143	0.4 (0.3–0.5)	44.4 (34.1–54.8)
75+ years	110	0.3 (0.2–0.3)	27.3 (17.5–37.0)	107	0.2 (0.2–0.3)	35.5 (23.7–47.3)
Total	**1,523**	**0.5 (0.5–0.6)**	**35.2 (32.2–38.2)**	**1,512**	**0.5 (0.5–0.6)**	**43.0 (39.9–46.1)**

(a) Missing data removed: 2002–05 *n*=12 (age), *n*=16 (sex); 2009–12 *n*=7 (age), *n*=14 (sex).

(b) Number of encounters with at least one other musculoskeletal injury problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 12.1).

Note: OMI – other musculoskeletal injury; CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes over time in imaging test types ordered

Between Period 1 and Period 2, there was a general move away from ordering diagnostic radiology toward ultrasound and MRI, but diagnostic radiology remained predominant in Period 2, accounting for two-thirds of imaging tests ordered for OMI (Table 12.3).

There was no change in the order rate of diagnostic radiology over time, but it decreased significantly as a proportion of all imaging tests ordered for OMI.

Orders for ultrasound significantly increased both as a proportion of all imaging tests for OMI (from 17.7% in Period 1 to 26.0% in Period 2), and as a rate per 100 OMI problems managed (from 6.2 to 11.2 per 100 OMI problems managed). Orders for MRI also increased significantly, however the numbers were small and should be interpreted with caution.

Table 12.3: Imaging test orders by MBS test group and the most frequent individual tests ordered for OMI problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**430**	**79.9 (76.5–83.3)**	**28.2 (25.5–30.8)**	**441**	**67.7 (64.1–71.3)**	**29.1 (26.6–31.7)**
X-ray; ankle	79	14.7 (11.4–17.9)	5.2 (4.0–6.4)	59	9.1 (6.7–11.4)	3.9 (2.8–5.0)
X-ray; finger(s)/thumb	56	10.4 (7.7–13.1)	3.7 (2.7–4.6)	65	10.0 (7.6–12.4)	4.3 (3.2–5.3)
X-ray; hand	53	9.9 (7.3–12.4)	3.5 (2.6–4.4)	49	7.5 (5.4–9.6)	3.2 (2.3–4.2)
X-ray; foot/feet	48	8.9 (6.6–11.2)	3.1 (2.3–4.0)	58	8.9 (6.7–11.1)	3.8 (2.9–4.8)
X-ray; wrist	37	6.9 (4.7–9.0)	2.4 (1.6–3.2)	33	5.1 (3.3–6.8)	2.2 (1.4–2.9)
X-ray; knee	27	5.0 (2.8–7.2)	1.8 (1.0–2.6)	10	1.5 (0.6–2.5)	0.7 (0.3–1.1)
X-ray; elbow	19	3.5 (2.0–5.1)	1.2 (0.7–1.8)	18	2.8 (1.5–4.0)	1.2 (0.6–1.7)
X-ray; shoulder	19	3.5 (2.0–5.0)	1.2 (0.7–1.8)	16	2.5 (1.3–3.6)	1.1 (0.5–1.6)
X-ray; chest	18	3.3 (1.6–5.1)	1.2 (0.6–1.8)	22	3.4 (2.0–4.8)	1.5 (0.9–2.1)
Ultrasound	**95**	**17.7 (14.4–20.9)**	**6.2 (5.0–7.5)**	**169**	**26.0 (22.6–29.3)**	**11.2 (9.5–12.9)**
Computerised tomography	**3**	**0.6 (0.0–1.2)**	**0.2 (0.0–0.4)**	**12**	**1.8 (0.8–2.9)**	**0.8 (0.3–1.2)**
Magnetic resonance imaging	**4**	**0.7 (0.0–1.5)**	**0.3 (0.0–0.5)**	**25**	**3.8 (2.3–5.4)**	**1.7 (1.0–2.3)**
Nuclear medicine imaging	**6**	**1.1 (0.2–2.0)**	**0.4 (0.1–0.7)**	**4**	**0.6 (0.0–1.2)**	**0.3 (0.0–0.5)**
Total imaging tests	**538**	**100.0**	**35.2 (32.2–38.2)**	**651**	**100.0**	**43.0 (39.9–46.1)**

Note: OMI – other musculoskeletal injury; CI – confidence interval; MBS – Medicare Benefits Schedule. Highlighting indicates a significant difference between data periods. Only the most frequent test descriptors are presented in each MBS group.

Imaging test ordering rates by status of musculoskeletal injury problem

Table 12.4 shows the proportions of OMI problems managed that were new cases (i.e. first presentation to a medical practitioner) and those that were old (i.e. seen before by a medical practitioner) in both data periods. More than half of OMI contacts were for the management of new cases, in both Period 1 and Period 2.

In both data periods, the imaging order rate for OMI was much higher at initial presentations (44.1 per 100 new OMI problems in Period 1 and 55.4 per 100 in Period 2) than at follow-up (25.4 per 100 old OMI problems in Period 1 and 25.3 per 100 in Period 2).

There was a significant increase in the imaging order rate from 44.1 per 100 new OMI problems managed to 55.4 per 100, and a significant increase in the likelihood of at least one imaging order for new OMI problems managed (39.6% to 49.3%). However, for old OMI problems, neither the imaging order rate nor the likelihood of imaging being ordered changed over this study period.

Considering these results with the increased GP visit rate, we estimate that in Period 1, about 120,000 imaging orders were placed nationally per year by GPs in the management of OMI problems. In Period 2, about 200,000 imaging tests were ordered per year, or about 80,000 more than in Period 1.

While the management rate did not change, the imaging order rate significantly increased (by 25.6%) over the time period. As there was no difference in the number of tests ordered per problem when ordering occurred (1.1 tests per tested problem in both periods) (results not tabled), this increase was attributed to the increased likelihood (24.5%) of ordering at least one imaging test when OMI problems were managed, plus the increased GP visit rate.

Table 12.4: Imaging ordering rates by status of OMI problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
	New	Old	Total	New	Old	Total
Problem contacts (*n*)	803	724	**1,527**	890	624	**1,514**
Per cent of OMI problems	52.6	47.4	**100.0**	58.8	41.2	**100.0**
Total imaging orders generated for problems (*n*)	354	184	**538**	493	158	**651**
Imaging orders per 100 problems (95% CI)	44.1 (39.9–48.2)	25.4 (21.7–29.2)	**35.2 (32.2–38.2)**	55.4 (51.2–59.6)	25.3 (21.4–29.3)	**43.0 (39.9–46.1)**
Likelihood of ordering 1+ tests (per cent of problems) (95% CI)	39.6 (36.1–43.1)	23.1 (19.8–26.3)	**31.8 (29.2–34.3)**	49.3 (45.9–52.7)	22.6 (19.2–26.0)	**38.3 (35.8–40.8)**

Note: OMI – other musculoskeletal injury; CI – confidence interval; OMI – other musculoskeletal injury. Highlighting indicates a significant difference between data periods.

12.2 New other musculoskeletal injury problems

Age-specific and sex-specific management

In both data periods the likelihood of management of new OMI problems was significantly higher at encounters with males than at those with females. However there was no difference in the sex-specific imaging order rate. The test order rate increased significantly for male patients (from 43.2 per 100 new cases in Period 1 to 56.1 per 100 in Period 2) but did not change for female patients.

There was a significant increase in test ordering over time among patients aged 25–44 years (from 40.1 tests per 100 new OMI problems to 56.6 tests per 100) (Table 12.5).

Table 12.5: Age-specific and sex-specific likelihood of management and test order rate for new OMI problems, 2002–05 and 2009–12

Patient characteristic[a]	2002–05 (Period 1)			2009–12 (Period 2)		
	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)	At least one new problem managed[b]	Management likelihood (%) (95% CI)	Test order rate per 100 new problems (95% CI)
Sex						
Males	447	0.4 (0.3–0.4)	43.2 (37.8–48.5)	488	0.4 (0.4–0.5)	56.1 (50.4–61.9)
Females	346	0.2 (0.2–0.2)	45.8 (39.4–52.3)	396	0.2 (0.2–0.3)	54.8 (48.8–60.8)
Age						
<15 years	85	0.2 (0.2–0.3)	61.2 (49.6–72.8)	100	0.3 (0.2–0.3)	68.0 (57.5–78.5)
15–24 years	117	0.4 (0.3–0.5)	51.7 (41.2–62.2)	107	0.4 (0.4–0.5)	55.1 (43.9–66.4)
25–44 years	227	0.3 (0.3–0.4)	40.1 (32.3–47.8)	267	0.4 (0.4–0.5)	56.6 (49.4–63.7)
45–64 years	234	0.3 (0.3–0.3)	40.2 (33.1–47.3)	249	0.3 (0.3–0.4)	52.6 (44.3–60.9)
65–74 years	69	0.2 (0.2–0.2)	47.8 (33.0–62.6)	96	0.3 (0.2–0.3)	52.1 (39.8–64.4)
75+ years	63	0.2 (0.1–0.2)	34.9 (20.8–49.0)	68	0.2 (0.1–0.2)	47.1 (30.5–63.7)
Total	**802**	**0.3 (0.3–0.3)**	**44.1 (39.9–48.2)**	**890**	**0.3 (0.3–0.3)**	**55.4 (51.2–59.6)**

(a) Missing data removed: 2002–05 *n*=795 (age), *n*=793 (sex); 2009–12 *n*=887 (age), *n*=884 (sex).

(b) Number of encounters with at least one new other musculoskeletal injury problem managed at encounter. It is possible for more than one of the specified problem to be managed per encounter, therefore this total may differ from the total number of problems (reported in Table 12.4).

Note: OMI – other musculoskeletal injury; CI – confidence interval. Highlighting indicates a significant difference between data periods.

Changes in imaging tests ordered for new other musculoskeletal injury problems, 2002–05 and 2009–12

As previously reported, the overall rate of imaging test orders per 100 OMI problems increased significantly between Period 1 and Period 2. Table 12.6 shows that there were changes in the types of tests ordered across MBS groups. There was a general move away from diagnostic radiology orders as a percentage of all imaging tests ordered for new OMI problems and a move toward ultrasounds.

Between Period 1 and Period 2 orders for ultrasound significantly increased by about 80%, from 8.1 to 14.6 per 100 new OMI problems.

The number of orders for MRI increased, however numbers are small and results should be interpreted with caution.

Table 12.6: Changes in imaging test orders and the most frequent imaging tests ordered for new OMI problems, 2002–05 and 2009–12

	2002–05 (Period 1)			2009–12 (Period 2)		
Type of test ordered	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)	Number of tests	Per cent of tests for this problem (95% CI)	Test rate per 100 problems (95% CI)
Diagnostic radiology	**284**	**80.2 (76.2–84.3)**	**35.4 (31.6–39.1)**	**346**	**70.2 (66.2–74.2)**	**38.9 (35.3–42.5)**
X-ray; ankle	49	13.8 (9.9–17.8)	6.1 (4.3–7.9)	48	9.7 (7.0–12.5)	5.4 (3.8–7.0)
X-ray; finger(s)/thumb	38	10.7 (7.4–14.0)	4.7 (3.3–6.2)	49	9.9 (7.2–12.7)	5.5 (4.0–7.1)
X-ray; hand	36	10.2 (7.0–13.3)	4.5 (3.1–5.9)	42	8.5 (6.0–11.0)	4.7 (3.3–6.1)
X-ray; foot/feet	35	9.9 (6.9–12.9)	4.4 (3.0–5.7)	43	8.7 (6.2–11.3)	4.8 (3.4–6.3)
X-ray; wrist	27	7.6 (4.8–10.4)	3.4 (2.1–4.6)	22	4.5 (2.6–6.3)	2.5 (1.4–3.5)
X-ray; knee	16	4.5 (2.0–7.0)	2.0 (0.9–3.1)	8	1.6 (0.5–2.7)	0.9 (0.3–1.5)
Ultrasound	**65**	**18.4 (14.4–22.3)**	**8.1 (6.2–10.0)**	**130**	**26.4 (22.5–30.2)**	**14.6 (12.1–17.1)**
Ultrasound; shoulder	19	5.4 (2.9–7.8)	2.4 (1.3–3.5)	24	4.9 (3.0–6.7)	2.7 (1.6–3.8)
Ultrasound; leg	17	4.8 (2.6–7.0)	2.1 (1.1–3.1)	32	6.5 (4.3–8.7)	3.6 (2.4–4.8)
Computerised tomography	**3**	**0.8 (0.0–1.8)**	**0.4 (0.0–0.8)**	**3**	**0.6 (0.0–1.3)**	**0.3 (0.0–0.7)**
Magnetic resonance imaging	**1**	**0.3 (—)**	**0.1 (—)**	**12**	**2.4 (1.1–3.8)**	**1.3 (0.6–2.1)**
Nuclear medicine imaging	**1**	**0.3 (—)**	**0.1 (—)**	**2**	**0.4 (—)**	**0.2 (—)**
Total imaging tests	**354**	**100.0**	**44.1 (39.9–48.2)**	**493**	**100.0**	**55.4 (51.2–59.6)**

Note: OMI – other musculoskeletal injury; CI – confidence interval; (—) – indicates the number of cases was too small to calculate a confidence interval. Highlighting indicates a significant difference between data periods.

12.3 Summary of findings

Changes over time

The management rate of OMI problems did not change over time. However, between Period 1 and Period 2, the order rate of imaging tests in the management of OMI problems increased significantly, due to the increased likelihood that at least one imaging test was ordered (Table 12.7). Overall, there was a move away from diagnostic radiology as a proportion of all imaging tests ordered for all OMI problems, and proportionately more ultrasound and MRI orders. The order rate of ultrasound and MRI increased significantly over time.

A similar pattern was observed for management of new OMI problems. There was no change in the management rate between Period 1 and Period 2, but the imaging ordering rate increased significantly due to increased likelihood of ordering. Again, there was an overall move away from diagnostic radiology, and proportionately more ultrasounds.

Table 12.7: Summary of changes over time for OMI problems

OMI	Management rate (% change, rate)[(a)]	Likelihood of testing (% change, rate)[(a)]	Ordering rate per 100 problems (% change, rate)[(a)]	Number of tests ordered per tested problem (% change, rate)[(a)]
All	No change (0.5, 0.5)	↑ 20.4% (31.8, 38.3)	↑ 22.2% (35.2, 43.0)	No change (1.11,1.12)
New	No change (0.3, 0.3)	↑ 24.5% (39.6, 49.3)	↑ 25.6% (44.1, 55.4)	No change (1.11, 1.12)

(a) Direction and proportion of change between 2002–05 and 2009–12. The management rate for Period 1 and Period 2, used to calculate the proportion of change, is shown in parentheses.

Note: OMI – other musculoskeletal injury.

Current imaging test order patterns

In 2009–12, GPs managed OMI at approximately 620,000 encounters per annum, and about 60% of these contacts involved management of new cases of OMI problems. For all OMI problems, imaging was ordered at a rate of 43.0 tests per 100 OMI problems, with GPs ordering at least one test at 38.3% of OMI contacts. The likelihood of an imaging order resulting from the management of new cases of OMI (49.3%) was more than double that of the likelihood at follow-up consultations (22.6%). Diagnostic radiology accounted for two-thirds of all imaging ordered for OMI, and ultrasound accounted for one-quarter. These proportions were similar for new cases of OMI (Table 12.8).

Table 12.8: Summary of GP imaging ordering for OMI problems, Period 2, 2009–12

OMI	Rate/100 encounters (95% CI)	Likelihood test (%) (95% CI)	Tests/ tested problem	Tests/100 selected problem (95% CI)	Tests ordered per 100 problem contacts (95% CI)			
					Diagnostic radiology	US	CT scan	MRI
All	0.5 (0.5–0.6)	38.3 (35.8–40.8)	1.12	43.0 (39.9–46.1)	29.1 (26.6–31.7)	11.2 (9.5–12.9)	0.8 (0.3–1.2)	1.7 (1.0–2.3)
New	0.3 (0.3–0.3)	49.3 (45.9–52.7)	1.12	55.4 (51.2–59.6)	38.9 (35.3–42.5)	14.6 (12.1–17.1)	0.3 (0.0–0.7)	1.3 (0.6–2.1)
Old	0.2 (0.2–0.2)	22.6 (19.2–26.0)	1.12	25.3 (21.4–29.3)	15.2 (12.3–18.2)	6.3 (4.3–8.2)	1.4 (0.5–2.4)	2.1 (0.9–3.3)

Note: OMI – other musculoskeletal injury; CI – confidence interval; US – ultrasound; CT – computerised tomography; MRI – magnetic resonance imaging.

12.4 Summary of guidelines for imaging of other musculoskeletal injuries

An extensive review of guidelines for diagnostic imaging was undertaken using Medline, and national and international sources of guidelines such as the National Health and Medical Research Council (NHMRC), the United States Agency for Healthcare Research and Quality (AHRQ), the UK National Institute for Health and Care Excellence (NICE); and local and overseas colleges of radiology/radiologists.

Other musculoskeletal injuries are included in the ICPC rubric L81. This category contains a wide range of injuries, mainly soft tissue, and body locations. As the available guidelines are structured around type of injury and site, it is not possible to use the guidelines to measure GP compliance when ordering imaging for this category of patient problems. However, the rise in the use of ultrasound imaging from 8.1 per 100 new other musculoskeletal injury problems in 2002–05, to 14.6 per 100 in 2009–12, is consistent with the increasing use of ultrasound in soft tissue injuries as recommended in site-specific guidelines.

Section 3

Test-based investigation

Introduction

Section 3 investigates GP's use of each of the four types of tests: diagnostic radiology, ultrasound, CT, and MRI. Over time, there was a statistically significant decrease in the order rate of diagnostic radiology tests, and statistically significant increases in the order rates of ultrasound, CT scan and MRI tests. For each test group, we report the problems for which tests were most often ordered, and the extent to which management of each problem involves imaging from that test group, and the rate of test ordering for each specified problem.

13 Problems for which diagnostic radiology, ultrasound, CT scan and MRI were ordered

Table 13.1 summarises the overall ordering rates and the extrapolated estimated average number of tests ordered by GPs per year, for each of the imaging test types discussed in this chapter. The ordering rates are reported as both 'per 1,000 encounters', and 'per 1,000 problems'. When discussing change in GPs' ordering behaviour we focus on change measured as a rate per 1,000 problems (as discussed in Chapter 2). The rate per 1,000 encounters is shown, as this is used when calculating extrapolations (see Chapter 2).

As discussed in Chapter 4, the rate of imaging ordering increased from 58.6 per 1,000 problems in Period 1, to 65.0 per 1,000 in Period 2. This was reflected in statistically significant increases in the order rates (per 1,000 problems) of ultrasound, CT scan and MRI tests between Period 1 and Period 2. In contrast, the order rate of diagnostic radiology tests significantly decreased over time (Table 13.1).

Orders for ultrasound accounted for the greatest increase in volume of GP-ordered imaging tests over time. Between Period 1 and Period 2, GPs' order rate of ultrasound increased by 37%, generating an extra 6.4 orders per 1,000 problems managed in Period 2 compared with Period 1. The order rate of CT scan increased by 25%, generating an extra 1.5 CT scan orders per 1000 problems in Period 2 compared with Period 1, whereas the order rate for MRI increased by more than 200%, generating an extra 0.7 MRI orders per 1,000 problems managed over the period. The decrease in the rate of diagnostic radiology tests (–8.9% over time) meant that GPs ordered an average of 2.9 fewer diagnostic radiology tests per 1,000 problems managed in Period 2 compared with Period 1.

This chapter investigates the problems contributing to these changes for each imaging test type, and the extent to which there have been changes in GPs' imaging ordering in the management of the specified problems.

Table 13.1: Imaging orders by selected Medicare imaging groups, 2002–05 and 2009–12

	2002–05 (Period 1)					2009–12 (Period 2)				
Imaging type	**Number of tests**	**Per cent of all imaging**	**Per 1,000 encounters (95% CI)**	**Per 1,000 problems (95% CI)**	**Extrapolated number (millions) of tests ordered p.a. (95% CI)**	**Number of tests**	**Per cent of all imaging**	**Per 1,000 encounters (95% CI)**	**Per 1,000 problems (95% CI)**	**Extrapolated number (millions) of tests ordered p.a. (95% CI)**
Diagnostic radiology*	14,450	55.9	48.8 (47.3–50.3)	32.7 (31.7–33.7)	4.74 (4.59–4.88)	13,774	45.9	47.0 (45.7–48.3)	29.8 (29.0–30.6)	5.64 (5.48–5.79)
Ultrasound*	7,560	29.2	25.5 (24.5–26.6)	17.1 (16.4–17.8)	2.48 (2.38–2.58)	10,852	36.2	37.0 (36.0–38.1)	23.5 (22.9–24.1)	4.44 (4.32–4.57)
Computerised tomography*	2,617	10.1	8.8 (8.4–9.3)	5.9 (5.6–6.2)	0.86 (0.82–0.90)	3,440	11.5	11.7 (11.2–12.3)	7.4 (7.1–7.8)	1.41 (1.35–1.47)
Magnetic resonance imaging*	116	0.4	0.4 (0.3–0.5)	0.3 (0.2–0.3)	0.04 (0.03–0.05)	464	1.5	1.6 (1.4–1.8)	1.0 (0.9–1.1)	0.19 (0.17–0.21)
Total	**25,863**	**100.0**	**87.3 (85.0–89.7)**	**58.6 (57.0–60.1)**	**8.48 (8.26–8.71)**	**29,996**	**100.0**	**102.4 (100.2–104.5)**	**65.0 (63.6–66.3)**	**12.27 (12.00–12.54)**

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.3).

Note: CI – confidence interval; p.a. – per annum. Highlighting indicates a significant difference between data periods.

13.1 Diagnostic radiology

Diagnostic radiology was the imaging type most commonly ordered by GPs in Period 1 and Period 2. As discussed in Chapter 4, the order rate of diagnostic radiology per 1,000 problems decreased over time. In Period 1, diagnostic radiology accounted for 55.9% of all imaging tests and in Period 2 it accounted for 45.9%. However, due to the increased GP visit rate, the extrapolated number of diagnostic radiology tests ordered per annum increased significantly from 4.7 million (95% CI: 4.6–4.9) in Period 1, to 5.6 million (95% CI: 5.5–7.8) in Period 2 (Table 13.1).

Table 13.2 lists the problems for which diagnostic radiology was frequently ordered, the proportion of diagnostic radiology accounted for by each problem, the proportion of each problem that resulted in one or more diagnostic radiology test(s), and the number of diagnostic radiology tests ordered when at least one test was ordered.

The problems generating orders for diagnostic radiology were similar in Period 1 and Period 2. The most common were osteoarthritis, back problems, fracture and sprain/strain, which together accounted for 28% of all diagnostic radiology–problem links in each period (Table 13.2).

Individual problems contribute in different ways to the total volume of diagnostic radiology ordered in general practice. Three factors influence the total volume of test orders generated by a problem:

- how often a problem is managed in general practice
- the likelihood that diagnostic radiology will be ordered in the management of the specific problem
- the number of diagnostic radiology tests ordered once the decision to order has been made.

This is illustrated by looking at the more recent data (Period 2) in Table 13.2 for osteoarthritis and breast lump problems. Osteoarthritis management generated the highest proportion of diagnostic radiology orders (9.8%) in Period 2. It is a frequently managed problem in general practice,[113] and GPs ordered diagnostic radiology at 14.7% of contacts, at an average of 1.1 tests per order. In contrast, breast lump contributed to only 1.6% of diagnostic radiology orders. It was managed less often, but, when managed, 36.8% of contacts resulted in an order for diagnostic radiology and usually one test was ordered per occasion of testing (Table 13.2). This demonstrates that while orders for diagnostic radiology were more likely in the management of breast lump, osteoarthritis management generated a higher volume of orders because of its high management rate in general practice (despite a lower likelihood of testing).

In Table 13.2, significant changes over time in the proportion of tests accounted for by the problem, and/or the likelihood of ordering diagnostic radiology for the specific problem are highlighted. Between Period 1 and Period 2, there were significant changes in the likelihood that diagnostic radiology would be ordered in the management of the following problems.

- Osteoarthritis: GPs were significantly more likely to order diagnostic radiology in the management of osteoarthritis in Period 2 (14.7% of osteoarthritis problem contacts) than in Period 1 (11.8%). Correspondingly, the proportion of diagnostic radiology accounted for by osteoarthritis problems increased from 8.0% to 9.8%. GPs ordered 1.1 diagnostic radiology tests per tested osteoarthritis contact in Period 1 and this remained steady in Period 2 (1.1 tests per tested contact). GPs' imaging ordering behaviour in the management of osteoarthritis is investigated in more detail in Chapter 6.

- Back problems: GPs were significantly less likely to order diagnostic radiology in the management of back problems in Period 2 (7.8%) than in Period 1 (9.3%). Similarly the proportion of diagnostic radiology accounted for by back problems decreased from 8.0% to 6.9%. GPs ordered 1.1 diagnostic radiology tests per tested back problem contacts in Period 1 and 1.2 tests in Period 2. In this report, back problems are divided into two groups: back syndromes and back symptoms/complaints. The significant changes seen for testing of back problems as a whole were not reflected in these subgroups when investigated separately. GPs' imaging ordering behaviour in the management of back problems is investigated in more detail in Chapter 5.
- Osteoporosis: the proportion of contacts involving tests increased significantly from 12.9% of osteoporosis contacts in Period 1, to 16.7% in Period 2. GPs ordered 1.1 tests per tested osteoporosis contact in Period 1 and 1.0 in Period 2.

Table 13.2: Problems for which diagnostic radiology was ordered, 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Osteoarthritis (excl back)**	8,857	1,170	8.0 (7.5–8.6)	11.8 (11.1–12.5)	1.12	8,329	1,366	9.8 (9.2–10.4)	14.7 (13.9–15.6)	1.11
Back problems**	11,146	1,170	8.0 (7.5–8.6)	9.3 (8.7–10.0)	1.12	10,584	963	6.9 (6.4–7.4)	7.8 (7.3–8.4)	1.16
Back symptom/complaint**	5,434	660	4.5 (4.1–4.9)	10.7 (9.7–11.6)	1.14	5,304	539	3.9 (3.5–4.3)	8.9 (8.1–9.8)	1.14
Back syndrome**	5,712	510	3.5 (3.1–3.9)	8.1 (7.3–8.9)	1.11	5,280	424	3.0 (2.7–3.4)	6.7 (6.0–7.5)	1.19
Fracture (excl head/back)*	2,936	1,164	8.0 (7.4–8.5)	37.1 (35.2–39.0)	1.07	2,586	934	6.7 (6.2–7.2)	33.8 (31.8–35.8)	1.07
Sprain/Strain (excl back)**	3,249	576	4.0 (3.6–4.3)	17.0 (15.6–18.4)	1.04	2,861	576	4.1 (3.8–4.5)	19.4 (17.8–21.0)	1.04
Knee problems**	1,495	436	3.0 (2.7–3.3)	28.8 (26.5–31.2)	1.01	1,719	493	3.5 (3.2–3.9)	28.0 (25.8–30.2)	1.03
Knee symptom/complaint**	699	219	1.5 (1.3–1.7)	30.6 (27.2–34.0)	1.02	845	288	2.1 (1.8–2.3)	33.0 (29.8–36.2)	1.03
Knee syndrome**	796	217	1.5 (1.3–1.7)	27.3 (24.0–30.5)	1.00	874	205	1.5 (1.3–1.7)	23.1 (20.2–26.0)	1.02
Injury musculoskeletal (excl shoulder/back/knee)**	1,527	430	2.9 (2.6–3.3)	26.9 (24.4–29.3)	1.05	1,514	441	3.2 (2.8–3.5)	27.8 (25.5–30.2)	1.05
Female genital check-up/Pap smear*	6,524	427	2.9 (2.0–3.8)	6.5 (4.5–8.4)	1.01	6,832	308	2.2 (1.9–2.6)	4.4 (3.7–5.0)	1.03
Injury skin, other	1,869	412	2.8 (2.5–3.2)	20.2 (18.1–22.3)	1.09	1,487	313	2.2 (1.9–2.6)	19.4 (17.2–21.5)	1.09
Acute bronchitis/bronchiolitis	7,017	384	2.6 (2.3–2.9)	5.4 (4.9–6.0)	1.01	6,879	433	3.1 (2.8–3.4)	6.3 (5.7–6.9)	1.01

(continued)

Table 13.2 (continued): Problems for which diagnostic radiology was ordered 2002–05 and 2009–12

Problem	Period 1 (2002–05) No. of problems	No. of problem-test links[(a)]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[(b)]	Test order rate per tested problem[(c)]	Period 2 (2009–12) No. of problems	No. of problem-test links[(a)]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[(b)]	Test order rate per tested problem[(c)]
Osteoporosis (excl osteoporotic fracture)*	2,573	353	2.4 (2.1–2.7)	12.9 (11.4–14.4)	1.06	2,392	412	3.0 (2.6–3.3)	16.7 (15.1–18.4)	1.03
Shoulder problems (excl arthritis/OA)*	2,161	315	2.2 (1.9–2.4)	13.7 (12.1–15.3)	1.06	2,637	377	2.7 (2.4–3.0)	13.7 (12.3–15.1)	1.04
Shoulder syndrome (excl arthritis/OA)*	1,556	187	1.3 (1.1–1.5)	11.4 (9.7–13.1)	1.06	1,988	244	1.8 (1.5–2.0)	11.9 (10.4–13.4)	1.03
Shoulder symptom/complaint (excl arthritis/OA)*	605	128	0.9 (0.7–1.0)	19.7 (16.5–22.9)	1.08	649	133	1.0 (0.8–1.1)	19.3 (16.2–22.3)	1.06
Bursitis/tendonitis/synovitis NOS	2,751	289	2.0 (1.7–2.2)	10.1 (8.9–11.2)	1.04	3,260	307	2.2 (1.9–2.5)	9.0 (8.0–10.1)	1.04
Pneumonia	947	263	1.8 (1.6–2.0)	27.8 (24.6–30.9)	1.00	1,028	313	2.2 (2.0–2.5)	30.3 (27.3–33.2)	1.01
Breast lump*	621	248	1.7 (1.4–2.0)	39.5 (35.4–43.5)	1.01	584	216	1.6 (1.3–1.8)	36.8 (32.8–40.8)	1.01
Cough	1,472	235	1.6 (1.4–1.8)	15.3 (13.3–17.3)	1.04	1,907	278	2.0 (1.7–2.2)	14.5 (12.8–16.2)	1.01
Subtotal		*7,872*	*54.0*	—	—		*7,730*	*55.5*	—	—
Total	**441,591**	**14,579**	**100.0**	**—**	**—**	**461,761**	**13,926**	**100.0**	**—**	**—**

(a) A test was counted more than once if it was ordered for the management of more than one problem at an encounter. There were 14,450 diagnostic radiology test orders and 14,591 problem–imaging links in Period 1, and 13,774 diagnostic radiology test orders and 13,926 problem–imaging links in Period 2.

(b) The percentage of total contacts with the problem that generated at least one order for diagnostic radiology.

(c) The rate of diagnostic radiology orders placed per problem contact with at least one order for diagnostic radiology.

** Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.1).

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.2).

Note: No. – number; CI – confidence interval; excl – excluding; OA – osteoarthritis; NOS – not otherwise specified; UTI – urinary tract infection; Highlighting indicates a significant difference between data periods.

13.2 Ultrasound

The order rate of ultrasounds increased significantly over time. In Period 2, orders for ultrasound accounted for 36.2% of all imaging ordered, and approximately 4.4 million tests per year were ordered nationally by GPs. This is an increase from Period 1, in which it accounted for 29.2% of imaging tests, and GPs ordered an average of 2.5 million ultrasounds per year nationally (Table 13.1).

Table 13.3 lists the problems for which ultrasound was frequently ordered, the proportion of ultrasound accounted for by each problem, the proportion of each problem that resulted in at least one ultrasound test, and the number of ultrasound tests ordered when at least one test was ordered.

The problems generating orders for ultrasound were similar in Period 1 and Period 2. The most common were: pregnancy and pregnancy-related check-ups, abdominal pain, and shoulder problems. Together these accounted for 21% of ultrasound–problem links in Period 1 and 24% in Period 2.

Individual problems contribute in different ways to the total volume of ultrasound tests ordered in general practice. Three factors influence the total volume of test orders generated by a problem:

- how often a problem is managed in general practice
- the likelihood that ultrasound will be ordered in the management of the specific problem
- the number of ultrasound tests ordered once the decision to order has been made.

This is illustrated by looking at the more recent data (Period 2) in Table 13.3 for two problems: pregnancy and pregnancy-related check-ups, and female genital check-ups. Pregnancy and pregnancy-related check-ups generated the highest proportion of all ultrasound orders (10.8%) in Period 2. They are commonly managed in general practice, and GPs ordered ultrasound at 23.0% of pregnancy contacts, at an average of 1.0 test per order. In contrast, female genital check-ups only contributed to 1.5% of total ultrasound orders. It is also a commonly managed problem in general practice, but the likelihood of ordering ultrasound was far lower, only 2.3% of contacts resulting in an order for ultrasound, with an average of 1.0 test per order.

In Table 13.3, significant changes over time in the proportion of tests accounted for by the problem, and/or the likelihood that ultrasound was ordered in the management of the problem are highlighted. Between Period 1 and Period 2, there were significant increases in the likelihood that ultrasound would be ordered in the management of the following problems.

- Pregnancy and related check-ups: in Period 1, 15.1% of contacts involving management of these problems resulted in an order for ultrasound, and in almost all cases only one ultrasound was ordered (1.0 ultrasound tests per tested pregnancy problems). In Period 2, 23.0% of contacts involving these problems resulted in an order for ultrasound, and again only one ultrasound was ordered (1.0 per tested problem). The proportion of ultrasound tests accounted for by pregnancy and pregnancy-related check-ups did not change significantly over time (9.7% in Period 1 and 10.8% in Period 2).
- Shoulder problems: ultrasounds were ordered at 17.5% of shoulder problem contacts in Period 1, increasing to 28.6% in Period 2. This increase was reflected in both subgroups of shoulder problems when investigated separately (shoulder syndromes and shoulder symptoms/complaints). GPs' imaging ordering behaviour in the management of shoulder problems is investigated in more detail in Chapter 7.

- Menstrual problems: GPs were more likely to order ultrasound in Period 2 (21.4% of contacts with menstrual problems) than in Period 1 (15.4%).
- Breast lump: ultrasounds were ordered at 49.1% of contacts in Period 1, increasing to 62.7% in Period 2.
- Sprain/strain (excluding sprain/strain of the back): likelihood of ultrasound being ordered increased from 6.1% of contacts in Period 1 to 11.3% in Period 2. GPs' imaging ordering behaviour in the management of sprain/strain problems is investigated in more detail in Chapter 8.
- Bursitis/tendonitis/synovitis: likelihood of ultrasound being ordered increased from testing at 7.0% of contacts in Period 1 to 17.2% in Period 2. GPs' imaging ordering behaviour in the management of bursitis/tendonitis/synovitis problems is investigated in more detail in Chapter 9.
- Swelling: likelihood of ordering ultrasound increased from 21.4% of contacts in Period 1, to 31.8% in Period 2.
- 'Other' musculoskeletal injury (excluding shoulder, back and knee injuries): likelihood of ordering increased from 6.2% of contacts in Period 1 to 11.0% in Period 2. GPs' imaging ordering behaviour in the management of other musculoskeletal injury is investigated in more detail in Chapter 12.
- Abnormal test results: likelihood of ordering ultrasound increased from 3.7% of contacts in Period 1 to 5.4% in Period 2.
- Pain breast (female): ultrasound ordering likelihood increased from 24.3% of contacts in Period 1 to 39.5% in Period 2.

Table 13.3: Problems for which ultrasound was ordered, 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Pregnancy & related check-up*	4,887	739	9.7 (8.3–11.1)	15.1 (13.3–16.9)	1.00	5,027	1,181	10.8 (9.9–11.6)	23.0 (21.5–24.5)	1.02
Abdominal pain**	2,053	513	6.7 (6.1–7.4)	24.1 (22.1–26.0)	1.04	2,182	631	5.8 (5.3–6.3)	27.1 (25.2–29.0)	1.07
Shoulder problems (excl arthritis/OA)**	2,161	380	5.0 (4.4–5.5)	17.5 (15.8–19.3)	1.00	2,637	760	6.9 (6.4–7.5)	28.6 (26.8–30.5)	1.01
Shoulder syndrome (excl arthritis/OA)**	1,556	271	3.6 (3.1–4.0)	17.4 (15.3–19.4)	1.00	1,988	597	5.5 (5.0–5.9)	29.8 (27.7–32.0)	1.01
Shoulder symptom/complaint (excl arthritis/OA)**	605	109	1.4 (1.1–1.7)	18.0 (14.8–21.3)	1.00	649	163	1.5 (1.3–1.7)	25.0 (21.5–28.4)	1.01
Menstrual problems*	2,265	351	4.6 (4.1–5.1)	15.4 (13.8–16.9)	1.01	2,238	478	4.4 (4.0–4.8)	21.4 (19.5–23.2)	1.00
Breast lump*	621	306	4.0 (3.4–4.6)	49.1 (44.2–54.0)	1.00	584	367	3.4 (3.0–3.7)	62.7 (58.6–66.7)	1.00
Cholecystitis/cholelithiasis	544	215	2.8 (2.4–3.2)	39.3 (35.1–43.6)	1.01	526	213	1.9 (1.7–2.2)	40.1 (35.9–44.3)	1.01
Female genital check-up/Pap smear*	6,524	207	2.7 (1.1–4.3)	3.2 (1.3–5.0)	1.01	6,832	162	1.5 (1.2–1.7)	2.3 (1.9–2.7)	1.01
Genital disease, other (female)	665	202	2.6 (2.3–3.0)	30.1 (26.5–33.6)	1.01	656	188	1.7 (1.5–2.0)	28.2 (24.8–31.6)	1.02
Sprain/strain (excl back)**	3,249	200	2.6 (2.2–3.0)	6.1 (5.2–7.0)	1.01	2,861	326	3.0 (2.6–3.3)	11.3 (10.1–12.5)	1.01
Bursitis/tendonitis/synovitis NOS**	2,751	196	2.6 (2.2–3.0)	7.0 (5.9–8.0)	1.02	3,260	572	5.2 (4.8–5.7)	17.2 (15.8–18.6)	1.02
Urinary tract infection*	5,064	186	2.4 (2.1–2.8)	3.5 (3.0–4.1)	1.04	5,273	193	1.8 (1.5–2.0)	3.5 (3.0–4.1)	1.03

(continued)

Table 13.3 (continued): Problems for which ultrasound was ordered 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[(a)]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[(b)]	Test order rate per tested problem[(c)]	No. of problems	No. of problem-test links[(a)]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[(b)]	Test order rate per tested problem[(c)]
Goitre	327	113	1.5 (1.2–1.8)	34.6 (29.4–39.8)	1.00	413	163	1.5 (1.2–1.7)	39.2 (34.4–44.1)	1.01
Swelling*	487	106	1.4 (1.1–1.7)	21.4 (17.7–25.0)	1.02	594	194	1.8 (1.5–2.0)	31.8 (27.9–35.7)	1.03
Fibrocystic disease breast	299	104	1.4 (1.1–1.6)	34.8 (29.5–40.1)	1.00	233	92	0.8 (0.6–1.0)	39.5 (32.9–46.1)	1.00
Injury musculoskeletal (excl shoulder/back/knee)**	1,527	95	1.2 (1.0–1.5)	6.2 (4.9–7.4)	1.01	1,514	167	1.5 (1.3–1.8)	11.0 (9.4–12.7)	1.00
Abortion, spontaneous	260	95	1.2 (1.0–1.5)	36.2 (30.6–41.7)	1.01	271	91	0.8 (0.7–1.0)	33.6 (28.0–39.1)	1.00
Abnormal test results*	2,488	91	1.2 (0.9–1.4)	3.7 (2.9–4.4)	1.00	3,771	206	1.9 (1.6–2.1)	5.4 (4.6–6.1)	1.02
Pain, genital (female)	230	89	1.2 (0.9–1.4)	37.4 (31.2–43.6)	1.04	285	136	1.2 (1.0–1.5)	46.0 (40.1–51.8)	1.04
Pain, breast (female)	358	87	1.1 (0.9–1.4)	24.3 (19.7–28.9)	1.00	365	146	1.3 (1.1–1.6)	39.5 (34.5–44.4)	1.01
Endocrine/metabolic/nutritional disease, other	1,586	59	0.8 (0.6–1.0)	3.7 (2.7–4.6)	1.02	1,769	99	0.9 (0.7–1.1)	5.4 (4.4–6.5)	1.03
Subtotal		*4,334*	*56.8*	—	—		*6,331*	*57.9*	—	—
Total	**441,591**	**7,629**	**100.0**	**—**	**—**	**461,761**	**10,939**	**100.0**	**—**	**—**

(a) A test was counted more than once if it was ordered for the management of more than one problem at an encounter. There were 7,560 ultrasound test orders and 7,629 problem–imaging links in Period 1, and 10,852 ultrasound test orders and 10,939 problem–imaging links in Period 2.

(b) The percentage of total contacts with the problem that generated at least one order for ultrasound.

(c) The rate of ultrasound orders placed per problem contact with at least one order for ultrasound.

** Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.1).

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.2).

Note: No. – number; CI – confidence interval; excl – excluding; OA – osteoarthritis; NOS – not otherwise specified; Highlighting indicates a significant difference between data periods.

13.3 Computerised tomography scan

The order rate of computerised tomography (CT) scan increased significantly over time. In Period 2, orders for CT scan accounted for 11.5% of all imaging ordered, and approximately 1.4 million tests were ordered nationally by GPs per annum. In contrast, in Period 1 CT scans accounted for 10.1% of all imaging ordered, and approximately 860,000 tests were ordered nationally by GPs per annum (Table 13.1).

The problems generating orders for CT scans were similar in Period 1 and Period 2. The most common were: back problems, headache, sinusitis, abdominal pain, and neck syndrome. Together these accounted for 40% of CT scan–problem links in Period 1 and 37% in Period 2 (Table 13.4).

Individual problems contribute in different ways to the total volume of CT scan ordered in general practice. Three factors influence the total volume of test orders generated by a problem:

- how often a problem is managed in general practice
- the likelihood that CT scan will be ordered in the management of the specific problem
- the number of CT scan tests ordered once the decision to order has been made.

This is illustrated by looking at the more recent data (Period 2) in Table 13.4 for back problems and kidney symptoms/complaints. Back problems generated the highest proportion of all CT scan orders (18.3%) in Period 2, but likelihood of management involving CT scan was quite low, with GPs ordering CT scans at 5.9% of back problem contacts, at an average of 1.0 test per order. The main reason back problems accounts for a large volume of CT scan orders is because they are very commonly managed in general practice. In contrast, kidney symptoms/complaints contributed 1.0% of CT scan orders. It is managed less often, but, when managed, 22.2% of contacts resulted in an order for CT scan, with an average of 1.0 test per order (Table 13.4).

In Table 13.4, significant changes over time in the proportion of tests accounted for by the problem, and/or the likelihood that CT scan was ordered in the management of the problem are highlighted. Between Period 1 and Period 2, there were significant increases in the likelihood that CT scan would be ordered in the management of the following problems.

- Back problems: 4.7% of contacts for back problems resulted in an order for CT scan in Period 1, and only one CT scan was ordered (1.0 CT scan per tested back problem). In Period 2, 5.9% of back problem contacts resulted in an order for CT scan, and only one CT scan was ordered (1.0 CT scan per tested back problem). In this report, back problems are divided into two groups: back syndromes and back symptoms/complaints. The overall increase in back problems involving CT scans was only reflected in the subgroup of back symptoms/complaints. The likelihood that back symptoms/complaints involved CT scans increased from 3.2% of contacts in Period 1 to 4.7% in Period 2. GPs' imaging ordering behaviour in the management of back problems is investigated in more detail in Chapter 5.
- Abdominal pain: CT scans were ordered at 4.0% of contacts in Period 1, increasing to 6.2% in Period 2, an overall increase in likelihood of more than 50%. GPs' imaging ordering behaviour in the management of abdominal pain problems is investigated in more detail in Chapter 10.
- Neck symptom/complaint: the likelihood of GPs ordering CT scan in the management of neck symptom/complaint more than doubled, from 2.6% of contacts in Period 1 to 5.9% in Period 2.

- Kidney symptom/complaint: the likelihood that CT scan was ordered almost doubled between Period 1 (11.2% of contacts) and Period 2 (22.2%).
- Neurological disease: the likelihood that CT scan was ordered more than doubled over time, increasing from 3.2% of contacts in Period 1 to 7.8% in Period 2.
- Fracture (excluding fractures of the head/back): there was an almost threefold increase in the likelihood of ordering CT scan, from 0.5% of contacts in Period 1 to 1.4% in Period 2.

Table 13.4: Problems for which CT scan was ordered, 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Back problems**	11,146	526	19.7 (18.1–21.4)	4.7 (4.3–5.1)	1.01	10,584	643	18.3 (16.9–19.7)	5.9 (5.5–6.4)	1.02
Back syndrome**	5,712	349	13.1 (11.7–14.4)	6.1 (5.4–6.7)	1.01	5,280	386	11.0 (9.9–12.1)	7.2 (6.4–7.9)	1.02
Back symptom/complaint**	5,434	177	6.6 (5.6–7.6)	3.2 (2.8–3.7)	1.01	5,304	257	7.3 (6.4–8.3)	4.7 (4.1–5.3)	1.02
Headache*	3,943	273	10.2 (9.0–11.4)	6.7 (5.9–7.5)	1.04	3,236	245	7.0 (6.1–7.9)	7.2 (6.3–8.1)	1.06
Sinusitis acute/chronic	3,721	108	4.1 (3.3–4.8)	2.7 (2.2–3.3)	1.06	3,962	151	4.3 (3.6–5.0)	3.7 (3.1–4.3)	1.04
Abdominal pain**	2,053	90	3.4 (2.6–4.1)	4.0 (3.1–4.9)	1.10	2,182	159	4.5 (3.7–5.3)	6.2 (5.2–7.2)	1.18
Neck syndrome	1,468	69	2.6 (2.0–3.2)	4.6 (3.5–5.6)	1.03	1,270	83	2.4 (1.8–2.9)	6.3 (4.9–7.7)	1.04
Vertigo/dizziness	980	64	2.4 (1.8–3.0)	6.4 (4.9–7.9)	1.02	1,094	76	2.2 (1.7–2.7)	6.9 (5.3–8.4)	1.01
Transient cerebral ischaemia	452	44	1.7 (1.2–2.1)	9.7 (6.9–12.5)	1.00	388	44	1.3 (0.8–1.7)	10.8 (7.6–14.1)	1.05
Dementia (incl senile, Alzheimer's)	1,401	41	1.5 (1.0–2.0)	2.9 (1.9–3.8)	1.03	1,627	32	0.9 (0.6–1.3)	1.9 (1.2–2.6)	1.03
Stroke/cerebrovascular accident	640	30	1.1 (0.7–1.6)	4.7 (2.8–6.6)	1.00	511	22	0.6 (0.4–0.9)	4.3 (2.5–6.1)	1.00
Vertiginous syndrome	1,047	29	1.1 (0.7–1.5)	2.8 (1.7–3.8)	1.00	1,008	50	1.4 (1.0–1.8)	4.8 (3.4–6.1)	1.04
Abnormal test results*	2,488	27	1.0 (0.6–1.4)	1.0 (0.6–1.4)	1.04	3,771	38	1.1 (0.7–1.5)	0.9 (0.6–1.2)	1.12

(continued)

Table 13.4 (continued): Problems for which CT scan was ordered 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Injury head, other	276	27	1.0 (0.6–1.4)	9.8 (5.9–13.7)	1.00	302	32	0.9 (0.6–1.3)	10.3 (6.7–13.8)	1.03
Neck symptom/complaint	984	26	1.0 (0.6–1.4)	2.6 (1.6–3.7)	1.00	919	55	1.6 (1.1–2.0)	5.9 (4.3–7.5)	1.02
Kidney symptom/complaint	232	26	1.0 (0.6–1.4)	11.2 (6.8–15.6)	1.00	162	36	1.0 (0.7–1.4)	22.2 (15.9–28.5)	1.00
Diverticular disease	573	25	0.9 (0.5–1.3)	4.0 (2.4–5.6)	1.09	689	51	1.5 (1.0–1.9)	6.1 (4.3–7.9)	1.21
Osteoarthritis (excl back)**	8,857	25	0.9 (0.5–1.3)	0.3 (0.2–0.4)	1.00	8,329	35	1.0 (0.7–1.3)	0.4 (0.3–0.6)	1.00
Respiratory disease, other	555	23	0.9 (0.5–1.2)	4.1 (2.5–5.8)	1.00	631	34	1.0 (0.6–1.4)	5.4 (3.3–7.5)	1.00
Neurological disease, other	686	22	0.8 (0.5–1.2)	3.2 (1.9–4.5)	1.00	820	65	1.9 (1.4–2.3)	7.8 (5.9–9.7)	1.02
Fracture (excl head/back)*	2,936	17	0.6 (0.2–1.0)	0.5 (0.2–0.9)	1.06	2,586	37	1.1 (0.7–1.4)	1.4 (0.9–1.9)	1.03
Memory disturbance	190	15	0.6 (0.3–0.8)	7.9 (4.1–11.7)	1.00	252	37	1.1 (0.7–1.4)	14.7 (10.2–19.1)	1.00
Subtotal		*1,507*	*56.5*	—	—		*1,925*	*54.8*	—	—
Total	**441,591**	**2,666**	**100.0**	**—**	**—**	**461,761**	**3,510**	**100.0**	**—**	**—**

(a) A test was counted more than once if it was ordered for the management of more than one problem at an encounter. There were 2,617 CT scan orders and 2,666 problem–imaging links in Period 1, and 3,440 CT scan orders and 3,510 problem–imaging links in Period 2.

(b) The percentage of total contacts with the problem that generated at least one order for CT scan.

(c) The rate of CT scan orders placed per problem contact with at least one order for CT scan.

** Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.1).

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.2).

Note: No. – number; CI – confidence interval; incl – including; excl – excluding; Highlighting indicates a significant difference between data periods.

13.4 Magnetic resonance imaging

Over the period investigated in this study, magnetic resonance imaging (MRI) was one of the least frequently ordered imaging test types by GPs. This was probably due to the Medicare Benefit Schedule rules in place when the data for this study were collected, restricting funding of MRI services to those ordered by non-GP specialists. GPs could order MRIs that were funded privately, but were not able to access those funded through Medicare. These rules have since changed, and from November 2012, GPs could order Medicare-claimable MRI services for selected patients and indications.[114] Despite the Medicare reimbursement rules, the order rate of MRI tests did increase significantly over time. In Period 2, orders for MRI accounted for 1.5% of all imaging ordered, and we estimate about 200,000 tests were ordered nationally by GPs per annum (Table 13.1).

The most common problems generating orders for MRI tests were: back problems, knee problems, osteoarthritis, sprain/strains, and 'other' musculoskeletal injuries (excluding shoulder, back and knee injuries). Together these accounted for 50% of MRI–problem links in Period 1 and 52% in Period 2 (Table 13.5).

Individual problems contribute in different ways to the total volume of MRI tests ordered in general practice. Three factors influence the total volume of test orders generated by a problem:

- how often a problem is managed in general practice
- the likelihood that MRI will be ordered in the management of the specific problem
- the number of MRI tests ordered once the decision to order has been made.

This is illustrated by looking at the more recent data (Period 2) in Table 13.5 for back problems and knee syndrome problems. Back problems generated the highest volume of MRI orders (18.4%) in Period 2, but likelihood of management involving MRI was very low, with GPs ordering MRI at 0.8% of back problem contacts, at an average of 1.0 test per order. The main reason it accounts for a large volume of MRI orders is because the problem is very commonly managed in general practice. In contrast, knee syndrome contributed to 12.9% of MRI orders. These problems were managed less often, but when managed, 7.0% of contacts resulted in an order for MRI, with an average of 1.0 test per order (Table 13.5).

In Table 13.5, significant changes over time in the proportion of tests accounted for by the problem, and/or the likelihood that MRI was ordered in the management of the problem are highlighted. The overall number of MRI orders was small and these results should be interpreted with caution. Between Period 1 and Period 2, there were significant increases in the likelihood that MRI would be ordered in the management of the following problems.

- Back problems: GPs were significantly more likely to order MRI in Period 2 (0.8% of back problem contacts) than in Period 1 (0.2%). Only one MRI was ordered per tested contact in both periods.
  This increase was reflected in both subgroups of back problems when investigated separately (back syndromes and back symptoms/complaints). GPs' imaging ordering behaviour in the management of back problems is investigated in more detail in Chapter 5.
- Knee problems: GPs were more likely to order MRI in Period 2 (5.0% of knee problem contacts) than in Period 1 (1.5%). This increase was reflected in both subgroups of knee problems when investigated separately (knee syndromes and knee symptoms/complaints). GPs' imaging ordering behaviour in the management of knee problems is investigated in more detail in Chapter 11.

- Osteoarthritis: there was a more than threefold increase in the likelihood of MRI ordering in the management of this problem, from 0.0% of contacts in Period 1 to 0.3% in Period 2. GPs' imaging ordering behaviour in the management of osteoarthritis is investigated in more detail in Chapter 6.
- Sprain/strain: the likelihood of MRI ordering increased from 0.1% of contacts in Period 1 to 0.7% in Period 2. GPs' imaging ordering behaviour in the management of sprain/strain is investigated in more detail in Chapter 8.
- 'Other' musculoskeletal injuries: the likelihood of MRI ordering increased from 0.3% of contacts in Period 1 to 1.7% in Period 2. GPs' imaging ordering behaviour in the management of other musculoskeletal injury is investigated in more detail in Chapter 12.
- Headache: likelihood of MRI ordering increased from 0.1% of contacts in Period 1 to 0.6% in Period 2.

Table 13.5: Problems for which MRI was ordered, 2002–05 and 2009–12

Problem	Period 1 (2002–05) No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	Period 2 (2009–12) No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Back problems**	11,146	24	20.7 (13.2–28.2)	0.2 (0.1–0.3)	1.00	10,584	86	18.4 (14.6–22.1)	0.8 (0.6–1.0)	1.01
Back symptom/complaint**	5,434	14	12.1 (5.8–18.4)	0.3 (0.1–0.4)	1.00	5,280	48	10.1 (7.2–13.0)	0.9 (0.6–1.2)	1.00
Back syndrome**	5,712	10	8.6 (3.7–13.5)	0.2 (0.1–0.3)	1.00	5,304	38	8.2 (5.6–10.8)	0.7 (0.5–0.9)	1.03
Knee problems**	1,495	22	19.0 (11.8–26.1)	1.5 (0.8–2.1)	1.00	1,719	86	18.1 (14.4–21.9)	5.0 (3.8–6.2)	1.00
Knee syndrome**	796	16	13.8 (7.3–20.3)	2.0 (1.0–3.0)	1.00	874	61	12.9 (9.6–16.2)	7.0 (5.0–8.9)	1.00
Knee symptom/complaint**	699	6	5.2 (1.1–9.3)	0.9 (0.2–1.5)	1.00	845	25	5.3 (3.3–7.3)	3.0 (1.8–4.1)	1.00
Osteoarthritis (excl back)**	8,857	4	3.4 (0.0–7.6)	0.0 (0.0–0.1)	1.00	8,329	26	5.5 (3.4–7.6)	0.3 (0.2–0.4)	1.00
Sprain/Strain (excl back)**	3,249	4	3.4 (0.0–7.5)	0.1 (0.0–0.3)	1.00	2,861	19	4.0 (2.3–5.8)	0.7 (0.4–1.0)	1.00
Injury musculoskeletal (excl shoulder/back/knee)**	1,527	4	3.4 (0.0–6.9)	0.3 (0.0–0.5)	1.00	1,514	25	5.3 (3.2–7.4)	1.7 (1.0–2.3)	1.00
Malignancy NOS	235	3	2.6 (0.0–5.5)	1.3 (0.0–2.7)	1.00	286	0	0.0 (—)	0.0 (—)	—
Headache*	3,943	3	2.6 (0.0–5.4)	0.1 (0.0–0.2)	1.00	3,236	20	4.4 (2.4–6.4)	0.6 (0.3–0.9)	1.05
Fracture (excl head/back)*	2,936	3	2.6 (0.0–5.5)	0.1 (0.0–0.2)	1.00	2,586	3	0.6 (0.0–1.3)	0.1 (0.0–0.2)	1.00
Foot/toe symptom/complaint	484	3	2.6 (0.0–6.4)	0.6 (0.0–1.5)	1.00	552	1	0.4 (0.0–1.3)	0.2 (0.0–0.5)	2.00

(continued)

Table 13.5 (continued): Problems for which MRI was ordered 2002–05 and 2009–12

Problem	Period 1 (2002–05)					Period 2 (2009–12)				
	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]	No. of problems	No. of problem-test links[a]	Per cent of problem-test links (95% CI)	Per cent of problems with test (95% CI)[b]	Test order rate per tested problem[c]
Shoulder problems (excl arthritis/OA)*	2,161	2	1.7 (0.0–4.2)	0.1 (0.0–0.2)	1.00	2,637	13	2.7 (1.2–4.3)	0.5 (0.2–0.7)	1.08
Shoulder symptom/complaint (excl arthritis/OA)*	605	1	0.9 (0.0–2.6)	0.2 (0.0–0.5)	1.00	1,988	8	1.7 (0.5–2.8)	0.4 (0.1–0.7)	1.00
Shoulder syndrome (excl arthritis/OA)*	1,556	1	0.9 (0.0–2.6)	0.1 (0.0–0.2)	1.00	649	5	1.1 (0.0–2.1)	0.6 (0.0–1.2)	1.25
Joint symptom/complaint NOS	849	2	1.7 (0.0–4.0)	0.2 (0.0–0.6)	1.00	740	8	1.7 (0.5–2.8)	1.1 (0.3–1.8)	1.00
Neurological disease, other	686	2	1.7 (0.0–4.1)	0.3 (0.0–0.7)	1.00	820	9	1.9 (0.5–3.3)	1.0 (0.2–1.7)	1.13
Musculoskeletal disease, other	1,444	2	1.7 (0.0–4.2)	0.1 (0.0–0.3)	1.00	1,436	7	1.5 (0.3–2.7)	0.5 (0.1–0.9)	1.00
Neck syndrome	1,468	1	0.9 (0.0–2.6)	0.1 (0.0–0.2)	1.00	1,270	12	2.5 (1.1–3.9)	0.9 (0.4–1.5)	1.00
Peripheral neuritis/neuropathy	601	1	0.9 (0.0–2.5)	0.2 (0.0–0.5)	1.00	850	10	2.1 (0.8–3.4)	1.2 (0.5–1.9)	1.00
Bursitis/tendonitis/synovitis NOS**	2,751	1	0.9 (0.0–2.6)	0.0 (0.0–0.1)	1.00	3,260	8	1.7 (0.5–2.8)	0.2 (0.1–0.4)	1.00
Neurological symptom/complaint, other	301	1	0.9 (0.0–2.6)	0.3 (0.0–1.0)	1.00	368	8	1.7 (0.5–2.9)	2.2 (0.7–3.7)	1.00
Subtotal		*82*	*70.7*	—	—		*341*	*71.9*	—	—
Total	**441,591**	**116**	**100.0**	**—**	—	**461,761**	**474**	**100.0**	**—**	—

(a) A test was counted more than once if it was ordered for the management of more than one problem at an encounter. In Period 1, each MRI order was linked to only one problem, hence there were 116 MRI orders and 116 problem–imaging links. However, in Period 2 there were 464 MRI orders and 474 problem–imaging links.

(b) The percentage of total contacts with the problem that generated at least one order for MRI.

(c) The rate of MRI orders placed per problem contact with at least one order for MRI.

** Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.1).

* Includes multiple ICPC-2 and ICPC-2 PLUS codes (see Appendix 5, Table A5.2).

Note: No. – number; CI – confidence interval; excl – excluding; OA – osteoarthritis; NOS – not otherwise specified; Highlighting indicates a significant difference between data periods.

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Abbreviations

ACR	American College of Radiology
ACRAC	American College of Radiology Appropriateness Criteria
ACRRM	Australian College of Rural and Remote Medicine
AHRQ	Agency for Healthcare Research and Quality
AIHW	Australian Institute of Health and Welfare
ASGC	Australian Standard Geographical Classification
BEACH	Bettering the Evaluation and Care of Health
CI	confidence interval (in this report 95% CI is used)
CT	computerised tomography
DIP	diagnostic imaging pathways
DoH	Australian Government Department of Health
DVA	Australian Government Department of Veterans' Affairs
FMRC	Family Medicine Research Centre
GP	general practitioner
HCC	health care card
ICPC-2	International Classification of Primary Care – Version 2
ICPC-2 PLUS	a terminology classified according to ICPC-2
LCL	lower confidence limit
MBS	Medicare Benefits Schedule
MRI	magnetic resonance imaging
NHMRC	National Health and Medical Research Council
NICE	National Institute for Health and Care Excellence (United Kingdom)
NOS	not otherwise specified
NZGG	New Zealand Guidelines Group
OA	osteoarthritis
OMI	other musculoskeletal injury
OR	odds ratio
OTC	over-the-counter (medications advised for over-the-counter purchase)
QI&CPD	quality improvement and continuing professional development
RACGP	Royal Australian College of General Practitioners
RANZCR	Royal Australian and New Zealand College of Radiologists
RCR	Royal College of Radiologists
SAS	Statistical Analysis System

UCL	upper confidence limit
UK	United Kingdom
US	ultrasound
USA	United States of America
VA	Veterans' Affairs
WADoH	Government of Western Australia Department of Health
Wonca	World Organization of Family Doctors

Symbols

–	not applicable
<	less than
>	more than
n	number

Glossary

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 3 months by a participating GP.

Allied health services: Clinical and other specialised health services provided in the management of patients by allied and other health professionals including physiotherapists, occupational therapists, dietitians, dentists and pharmacists.

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

Chronic problem: see *Diagnosis/problem: Chronic problem*.

Complaint: A symptom or disorder expressed by the patient when seeking care.

Component (ICPC-2): In ICPC-2 there are seven components that act as a second axis across all chapters.

Consultation: See *Encounter*.

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

- *New problem:* The first presentation of a problem, including the first presentation of a recurrence of a previously resolved problem, but excluding the presentation of a problem first assessed by another provider.
- *Old problem:* A previously assessed problem that requires ongoing care, including follow-up for a problem or an initial presentation of a problem previously assessed by another provider.
- *Chronic problem:* A medical condition characterised by a combination of the following characteristics: duration that has lasted, or is expected to last, 6 months or more, a pattern of recurrence or deterioration, a poor prognosis, and consequences or sequelae that impact on an individual's quality of life. (*Source:* O'Halloran J, Miller GC, Britt H 2004. *Defining chronic conditions for primary care with ICPC-2*. Fam Pract 21(4):381–6).

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 (for example, prescription, referral).
- *Direct:* Encounter where there is a face-to-face meeting of the patient and the GP.

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).

GP consultation service items: Includes GP services provided under the MBS professional services category including MBS items classed as A1, A2, A5, A6, A7, A14, A17, A18, A19, A20, A22 and selected items provided by GPs classified in A11, A15 and A27.

MBS/DVA items: MBS item numbers recorded as claimable for activities undertaken by GPs and staff under the supervision of GPs. In BEACH an MBS item number may be funded by Medicare or by the Department of Veterans' Affairs (DVA).

Health care card: An entitlement card provided by the Australian Government, which entitles the holder to reduced-cost medicines under the Pharmaceutical Benefits Scheme and some other concessions from state and local government authorities.

Indigenous: The patient identifies himself or herself as an Aboriginal and/or Torres Strait Islander person.

Medication:

- *GP–supplied:* The medication is provided directly to the patient by the GP at the encounter.
- *Over-the-counter (OTC):* Medication that the GP advises the patient to purchase OTC (a prescription is not required for the patient to obtain an OTC medication).
- *Prescribed:* Medications that are prescribed by the GP (that is, does not include medications that were GP–supplied or advised for over-the-counter purchase).

Morbidity: Any departure, subjective or objective, from a state of physiological wellbeing. In this sense, sickness, illness and morbid conditions are synonymous.

Non-English-speaking background: The patient's primary language spoken at home is not English.

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

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

Problem managed: See *Diagnosis/problem*.

Provider: A person to whom a patient has access when contacting the healthcare 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. (*Source:* Commonwealth Department of Health and Aged Care 2001. *Medicare Benefits Schedule book*. Canberra: DHAC).

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 and allied health services, and for hospital and residential aged care facility 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.

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

Torres Strait Islander: The patient identifies himself or herself as a Torres Strait Islander person.

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

Work-related problem: See *Diagnosis/problem*.

Appendices

Appendix 1: Example of a 2011–12 recording form

BEACH (Bettering the Evaluation And Care of Health) - Morbidity and Treatment Survey - National DOC ID

Encounter Number

Date of encounter ___/___/___

Date of Birth ___/___/_ _ _ _

Sex M ☐ F ☐

Patient Postcode

	Yes	No
New Patient	☐	☐
Health Care/Benefits Card	☐	☐
Veterans Affairs Card	☐	☐
NESB	☐	☐
Aboriginal	☐	☐
Torres Strait Islander	☐	☐

PATIENT SEEN BY GP ☐

PATIENT NOT SEEN BY GP ☐

Medicare Item Nos: (if applicable)

1. ___
2. ___
3. ___

Workers comp paid ☐

State Govt/Other paid ☐

No charge ☐

START Time ___ : ___ AM / PM (please circle)

Patient Reasons for Encounter

1.
2.
3.

Diagnosis/ Problem ①: **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem

1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ②: **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem

1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ③: **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem

1. Prac Nurse? ☐ 2. Prac Nurse? ☐

Diagnosis/ Problem ④: **Problem Status** New ☐ Old ☐ Work related ☐

Drug Name AND Form for this problem	Strength of product	Dose	Frequency	No. of Rpts	OTC	GP Supply	Drug status New	Drug status Cont.
1.								
2.								
3.								
4.								

Procedures, other treatments, counselling this consult for this problem

1. Prac Nurse? ☐ 2. Prac Nurse? ☐

NEW REFERRALS, ADMISSIONS Problem(s)

1. ___ 1 2 3 4
2. ___ 1 2 3 4

IMAGING/Other tests Body site Problem(s)

1. ___ - ___ 1 2 3 4
2. ___ - ___ 1 2 3 4
3. ___ - ___ 1 2 3 4

PATHOLOGY Problem(s)

1. ___ 1 2 3 4
2. ___ 1 2 3 4
3. ___ 1 2 3 4

PATHOLOGY (cont) Problem(s)

4. ___ 1 2 3 4
5. ___ 1 2 3 4

Patient reported

Height: ___ cm

Weight: ___ kg

To the patient if 18+: Which best describes your smoking status?

- Smoke daily ☐
- Smoke occasionally ☐
- Previous smoker ☐
- Never smoked ☐

To the patient if 18+: How often do you have a drink containing alcohol?

- Never ☐
- Monthly or less ☐
- Once a week/fortnight ☐
- 2-3 times a week ☐
- 4+ times a week ☐

How many 'standard' drinks do you have on a typical day when you are drinking? ___

How often do you have 6 or more standard drinks on one occasion?

- Never ☐
- Less than monthly ☐
- Monthly ☐
- Weekly ☐
- Daily or almost daily ☐

FINISH Time ___ : ___ AM / PM (please circle)

BA14

Appendix 2: GP characteristics questionnaire, 2011–12

THE UNIVERSITY OF SYDNEY

GP profile

Family Medicine Research Centre

Doctor Identification Number | | | | | |

Please fill in boxes or circle answers

1. Sex ..... **Male / Female** *(Please circle)*

2. Age .....

3. How many years have you spent in general practice? .....

4. Country of graduation *(primary medical degree)*:

☐ Australia ☐ Other: (*specify*) _____

5. How many direct patient care hours do you work per week?

(Include hours of direct patient care, instructions, counselling etc and other services such as referrals, prescriptions, phone calls etc.) .....

6. Do you conduct any of your consultations in a language other than English?

☐ No ☐ Yes 25–50%

☐ Yes <25% ☐ Yes >50%

7. Are you a GP registrar (i.e. in training)?..... **Yes / No**

8. Do you hold FRACGP? ..... **Yes / No**

9. Do you hold FACRRM? ..... **Yes / No**

10. Do you bulk bill patients?..... **All / Some / None**

11. Is a computer available at your major practice? ..... **Yes / No**

If '**yes**', which clinical software is used? *(specify)* _____

12. Do **YOU** use the computer at your major practice? ..... **Yes / No**

*If '**yes**', please tick to indicate which functions of the computer/clinical software you use*

☐ Prescribing
☐ Internet
☐ Email

Active medical records:
☐ Completely paperless
☐ Combination of computer and paper
☐ Paper only

Pathology:
☐ Electronic ordering (online)
☐ Print/produce orders
☐ Receive results electronically

Imaging:
☐ Electronic ordering (online)
☐ Print/produce orders
☐ Receive results electronically

13. Did any of your BEACH consultations take place in an Aboriginal Community Controlled Health Service?

No.....1
Yes - all 2
Yes - some (which dates) _____3

14. Over the past four weeks have you provided any patient care...

(a) in a residential aged care facility? ..... **Yes / No**
(b) as a salaried/sessional hospital medical officer? ..... **Yes / No**

15. Postcode of major practice address.....

16. For your major practice, please specify the number of individuals (ie. headcount) and number of full time equivalents (FTE*) for each type of professional:

**Each FTE is defined as working 35-45 hours per week e.g. 2 GPs each working 20 hours/wk is recorded as 2 individual GPs and 1 FTE; 1 enrolled nurse working 20 hours/wk is recorded as 1 individual and 0.5 FTE.*

	No. individuals	No. FTEs
(a) GPs (including yourself)		
(b) Enrolled nurses		
(c) Registered nurses		
(d) Nurse practitioners		
(e) Midwives		
(f) Aboriginal health workers		

17. Is your major practice accredited?..... **Yes / No**

18. Are any of the following health services located or available at your major practice?

(includes services in the same building or within 50 metres, available on a daily or regular basis) *(Circle all that apply)*

Physiotherapist 1
Psychologist 2
Pathology lab/collection centre 3
Imaging 4
Specialist 5
Other (*specify*) _____ 6
None 7

19. What are the normal after-hours arrangements for your major practice? *(Circle all that apply)*:

Practice does its own 1
Co-operative with other practices 2
Deputising service 3
Other 4
None 5

20. Is your major practice a teaching practice? *(Circle all that apply)*:

For undergraduates 1
For junior doctors 2
For GP registrars 3
No 4

*Thank you for participating in the **BEACH PROGRAM.***
Please return this form with the completed BEACH pad.

FMRC, PO Box 533, Westmead Hospital, Wentworthville, 2145.
GP14 (V1) Ph: 02 9845 8151 fax: 02 9845 8155 email: jan.charles@sydney.edu.au Web: www.fmrc.org.au

Appendix 3: Patient information card, 2011–12

THE UNIVERSITY OF SYDNEY

Family Medicine Research Centre

INFORMATION FOR PATIENTS

The *BEACH* © Project

Today your doctor is taking part in a National Survey of general practice called *BEACH* © *(Bettering the Evaluation and Care of Health).* This study is being done by the Family Medicine Research Centre, University of Sydney.

Your Doctor will be recording information about each patient he/she sees (age, gender etc), the problems that you see the Doctor about and the treatments given to you. **There are no names on the forms so you cannot be identified.** The information about today's visit to the doctor will be one record in a set of 100,000 records collected in general practices across Australia over the year.

This information will be used by researchers to describe what happens in general practice and to look at different aspects of health care; by government departments to help them plan for our future health; and by pharmaceutical companies to gain a picture of the people who use their drugs and of the problems being treated with the drugs they produce.

Remember: your name will not be on the form and no information will ever be released which could possibly let anyone know who you are. However, if you do not wish your doctor to record any unidentified information about you or your visit **please tell your Doctor as soon as you go in**. Such a decision will not affect the care your doctor is providing in any way.

SEE OVER FOR PROJECT DETAILS

(page 1 / 2)

FMRC, Acacia House, Westmead Hospital, PO Box 533,WENTWORTHVILLE, 2145.
Ph: 02 9845 8151 fax: 02 9845 8155 email: jan.charles@sydney.edu.au Web: www.fmrc.org.au

BEACH © Program Details

This program has been approved by the Ethics Committee of the University of Sydney. The data are being collected in accordance with the Privacy Act 1988 as amended.

Organisations contributing financially to the conduct of this study in 2010–2011 are:

- ✦ The Australian Government Department of Health and Ageing
- ✦ AstraZeneca Pty Ltd (Australia)
- ✦ Pfizer Australia Pty Ltd
- ✦ Sanofi-Aventis Australia Pty Ltd
- ✦ CSL Biotherapies Pty Ltd
- ✦ GlaxoSmithKline Australia Pty Ltd
- ✦ Merck Sharp & Dohme (Australia) Pty Ltd
- ✦ Novartis Pharmaceuticals Australia Pty Ltd

BEACH is endorsed by the Royal Australian College of General Practitioners

BEACH is endorsed by the Australian Medical Association

FURTHER INFORMATION:

Family Medicine Research Centre
The University of Sydney
Acacia House, Westmead Hospital
Westmead 2145

Phone: (02) 9845 8151
Fax: (02) 9845 8155
Email: jan.charles@sydney.edu.au
Web: www.fmrc.org.au

Any person with concerns or complaints about the conduct of this research study can contact The Manager, Human Ethics Administration, University of Sydney on +61 2 8627 8176 (Telephone); +61 2 8627 8177 (Facsimile); ro.humanethics@sydney.edu.au (Email).

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Appendix 4: Initial results of analyses of the BEACH data by year, from 2002–03 to 2011–12 inclusive

Available at <hdl.handle.net/2123/10610>, see 'Electronic editions and downloads'.

Appendix 5: Code groups from ICPC-2 and ICPC-2 PLUS

Available at <hdl.handle.net/2123/10610>, see 'Electronic editions and downloads'.

Eight problems selected for investigation

Table A5.1: Code groups from ICPC-2 and ICPC-2 PLUS – eight problems selected for investigation

Other problems managed

Table A5.2: Code groups from ICPC-2 and ICPC-2 PLUS – other problems managed

Imaging test orders

Table A5.3: Code groups from ICPC-2 and ICPC-2 PLUS – imaging test orders (MBS groups)

This book reports changes in GP ordering of imaging tests in Australia from 2002–03 to 2011–12, and evaluates alignment between guidelines and recent GP test ordering for selected problems.

Over the decade, 9,802 GPs participated in BEACH, providing details of 980,200 GP–patient encounters. The likelihood of GPs ordering imaging in the management of a problem increased over time. In recent practice, at least one imaging test was ordered at 9% of encounters, at a rate of 10 imaging tests per 100 encounters.

Diagnostic radiology was the most commonly ordered type of imaging test, but the order rate decreased over time, with a shift toward orders for ultrasound, CT and MRI, which all significantly increased.

Eight selected problems accounted for one-third of all imaging orders. Imaging ordering behaviour suggests broad compliance with published guidelines in the management of osteoarthritis, shoulder problems, bursitis/tendonitis/synovitis, abdominal pain and other musculoskeletal injuries. Current ordering patterns for knee problems and some sprains/strains have potential for improvement. The ordering pattern for new presentations of back problems was inconsistent with all established guidelines for management of back problems.

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