

8 Analysis of selected test types

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

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

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

Where appropriate, further analysis is presented regarding:

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

8.1 Chest x-ray

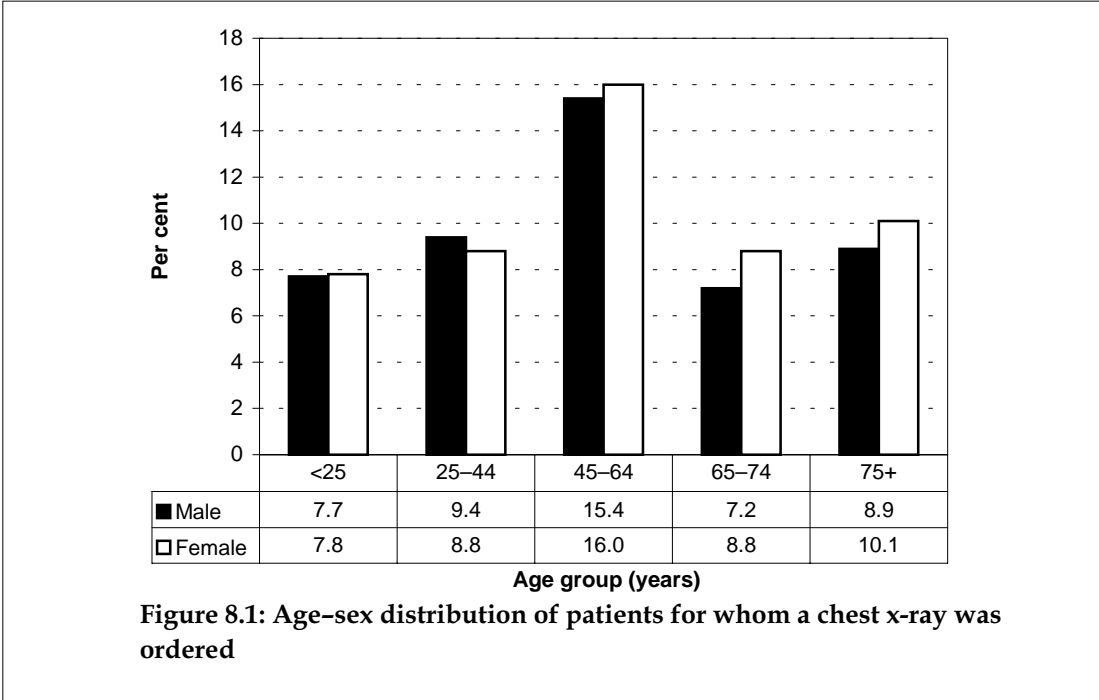
Chest x-ray includes ICPC-2 PLUS code A41002 – Chest x-ray.

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

Age–sex distribution of patients

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

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



Care process

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

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

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

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

Problems for which chest x-rays ordered

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

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

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

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

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

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

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

Discussion

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

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

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

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

8.2 Mammography and breast ultrasound

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

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

Age–sex distribution of patients

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

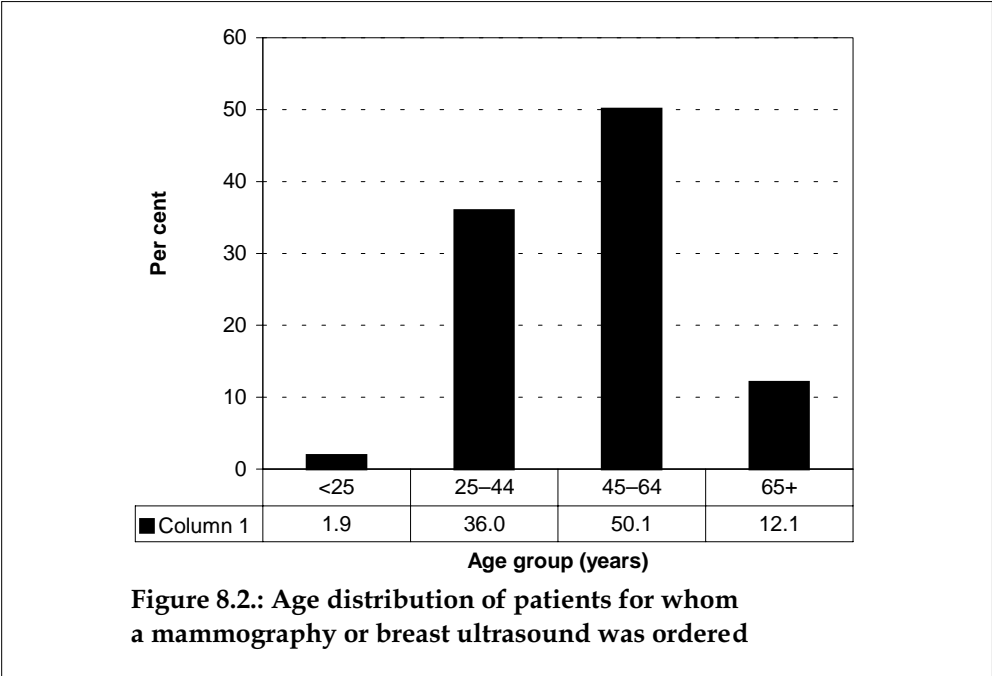
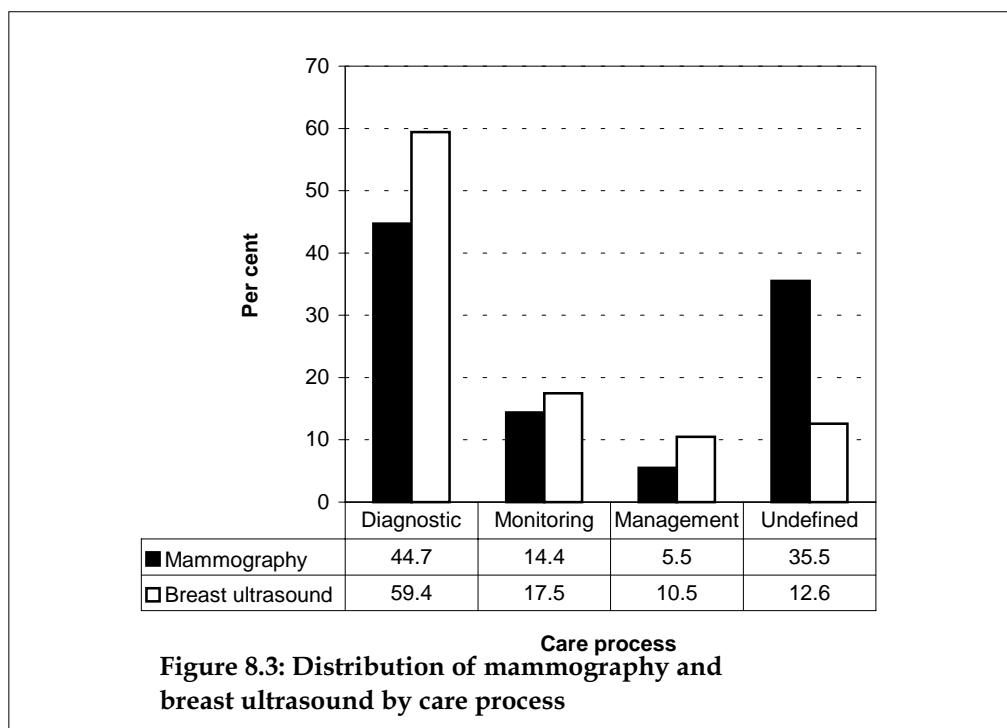


Figure 8.2.: Age distribution of patients for whom a mammography or breast ultrasound was ordered

Care process

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



Problems for which mammography or breast ultrasound ordered

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

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

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

Table 8.3: Most common problems associated with orders for mammography

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

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

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

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

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

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

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

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

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

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

Test choice and problem status

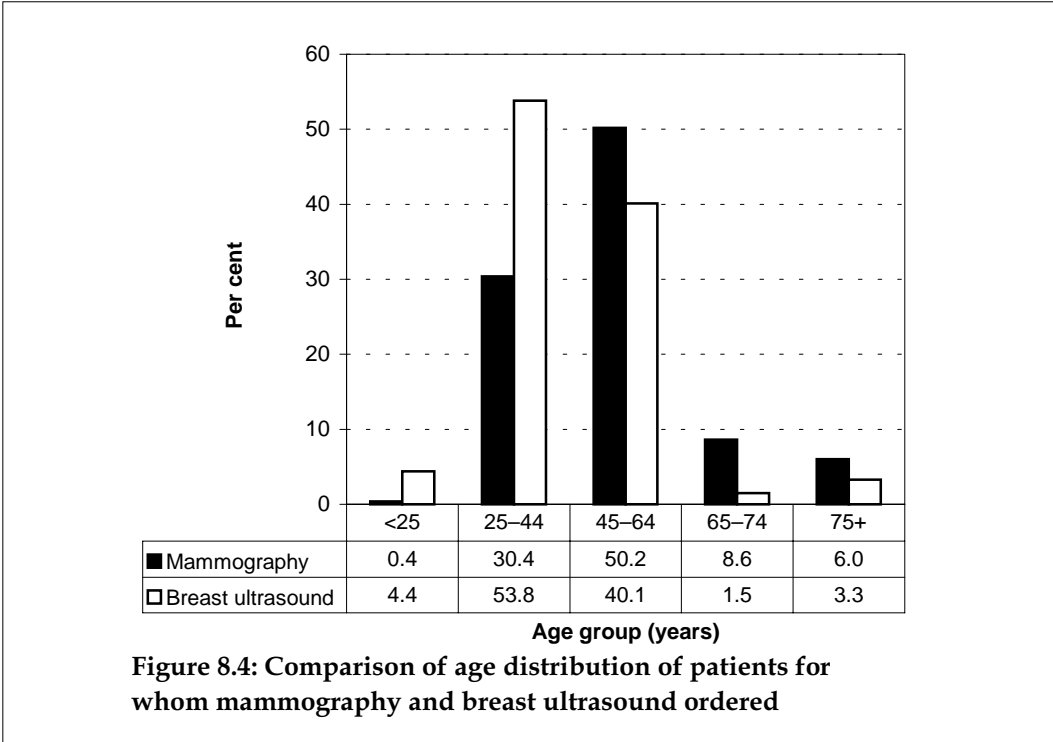
Whether the problem was new to the patient or the subject of a follow-up consultation had little influence on the imaging test selected by the GP. Table 8.5 shows that where mammography and/or breast ultrasound were ordered for a new problem, breast ultrasound accounted for more than two-thirds of the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

Table 8.5: Imaging order type by problem status

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

Test choice and patient age

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



Discussion

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

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

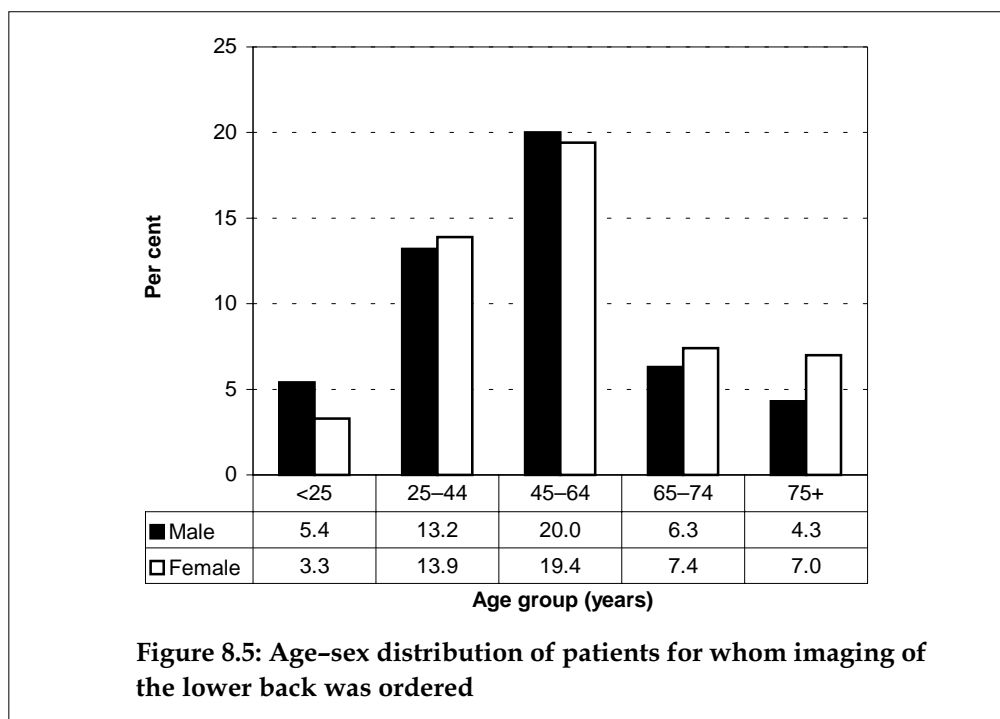
The results of this analysis suggest that GPs use both mammography and ultrasound in the diagnostic mode, in line with the recommendations, and that they use ultrasound almost exclusively in the under 25 years age group.

8.3 Imaging of the lower back

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

Age–sex distribution of patients

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



Plain x-rays of the lower back

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

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

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

Care process

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

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

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

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

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

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

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

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

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

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

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

Low back CT scans

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

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

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

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

Care process

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

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

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

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

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

Problems associated with orders for a low back CT scan

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

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

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

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

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

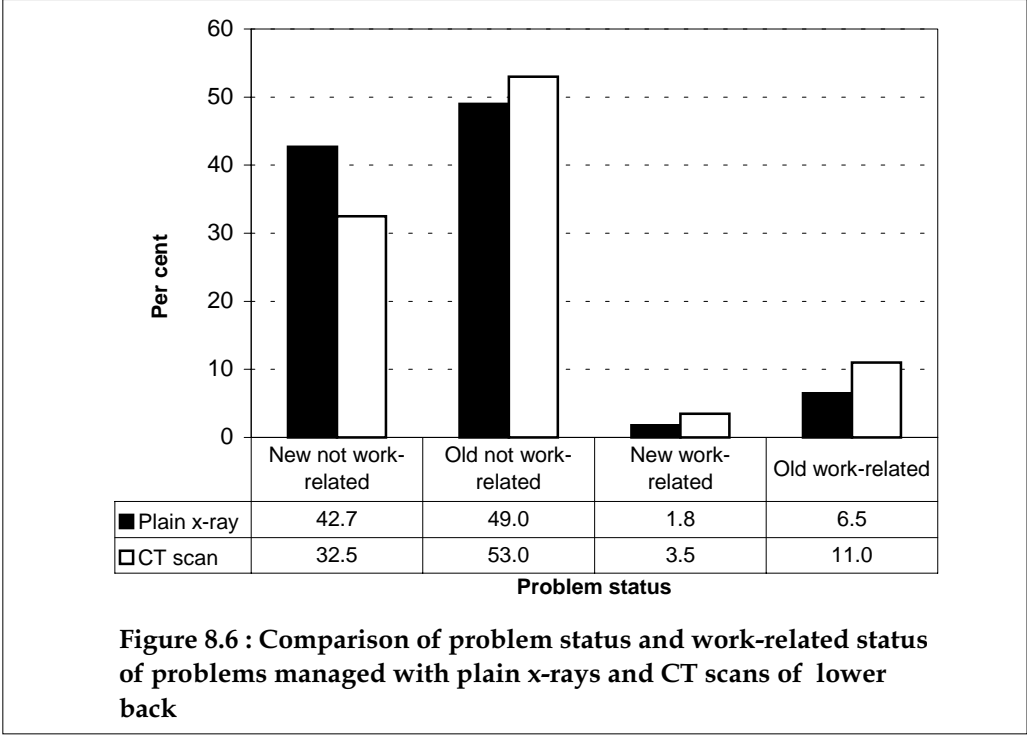
Note: Columns may not add to column total due to rounding.

Test choice and problem status

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

Whereas problems thought by the GP to be work-related made up only 2.2% of all problems in the total dataset (Britt et al. 2000), 8.3% of problems associated with orders for plain

x-rays of the lower back and 14.5% of those associated with low back CT scans were thought to be work-related. Figure 8.6 demonstrates a slight trend for GPs to choose a CT scan rather than a plain x-ray when the problem was thought to be work-related. However, again the small sample sizes involved must be kept in mind.



Discussion

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

8.4 Imaging of the shoulder

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

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

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

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

Age–sex distribution of patients

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

Care process

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

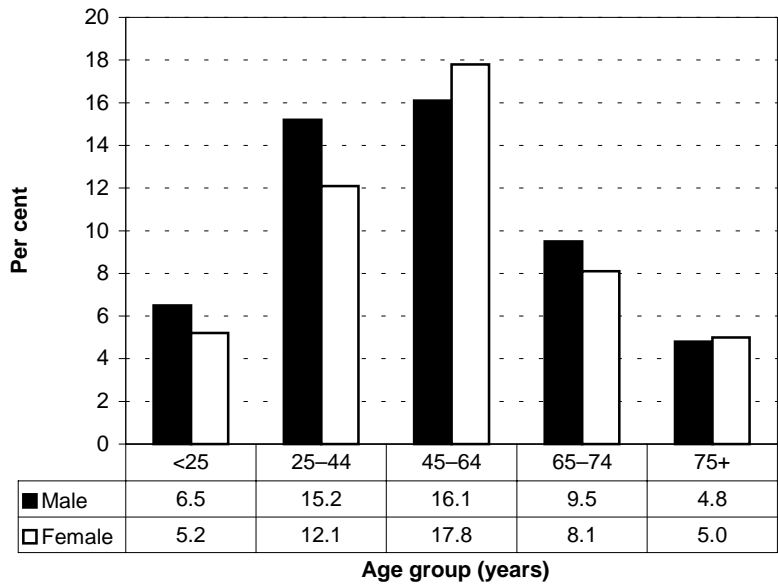


Figure 8.7: Age-sex distribution of patients for whom imaging of the shoulder was ordered

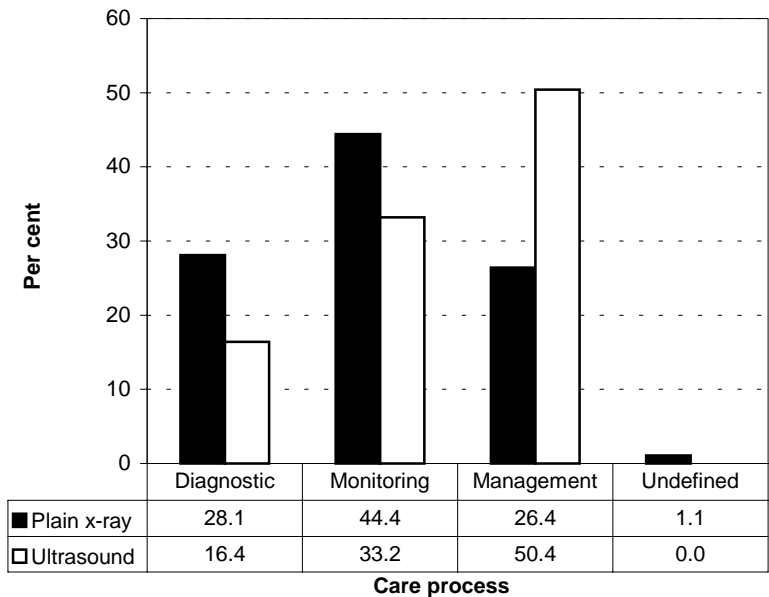


Figure 8.8: Distribution of plain x-ray of shoulder and ultrasound of shoulder by care process

Problems associated with imaging of the shoulder

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

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

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

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

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

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

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

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

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

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

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

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

Discussion

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

8.5 Imaging of the pelvis

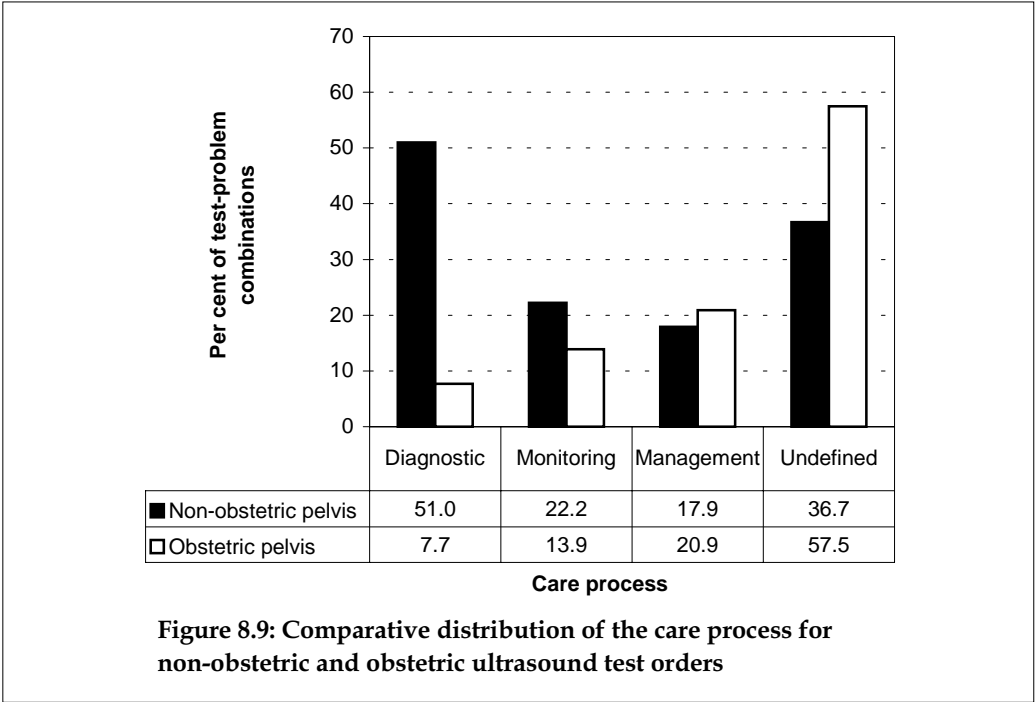
Pelvic imaging tests investigated in this section include the following ICPC-2 PLUS codes and rubrics:

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

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

Care process

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



Imaging of the pelvis—non-obstetric

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

Problems associated with orders for non-obstetric pelvic imaging

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

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

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

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

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

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

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

Imaging of the pelvis — obstetric

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

Problems associated with orders for obstetric pelvic imaging

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

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

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

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

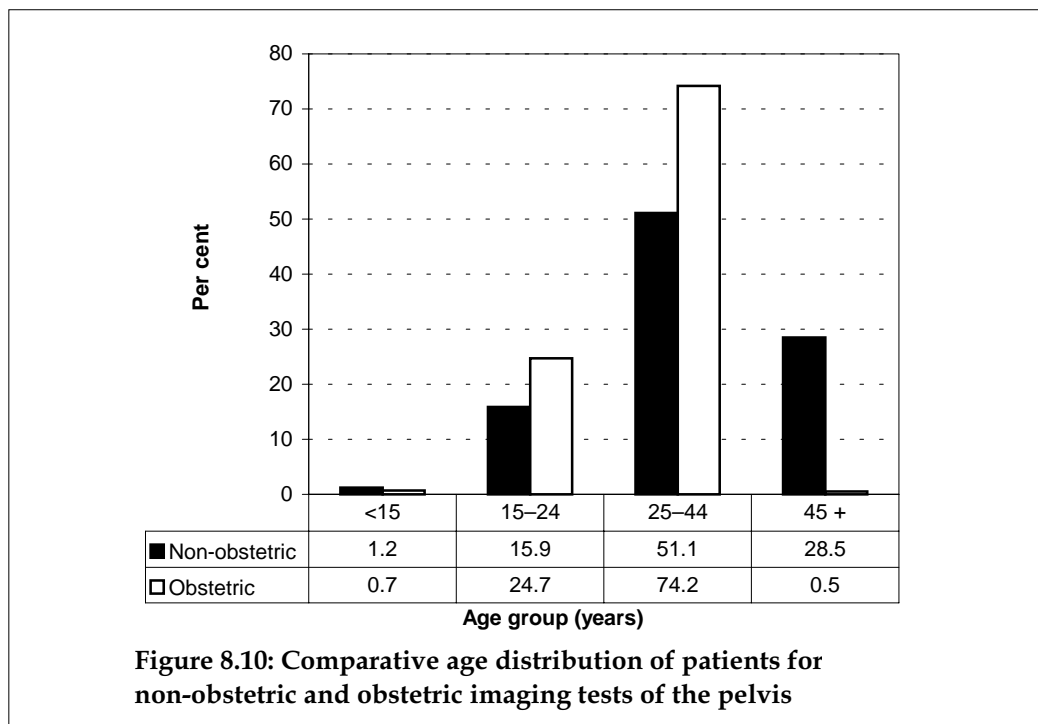
* Includes multiple ICPC-2 and/or ICPC-2 PLUS codes (see Appendix 4).

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

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

Comparative age distribution of patients

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



Discussion

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

8.6 CT scans of the brain/head

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

- N41006 – CT scan brain ($n=130$)
- N41008 – CT scan head ($n=107$).

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

Age–sex distribution of patients

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

Care process

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

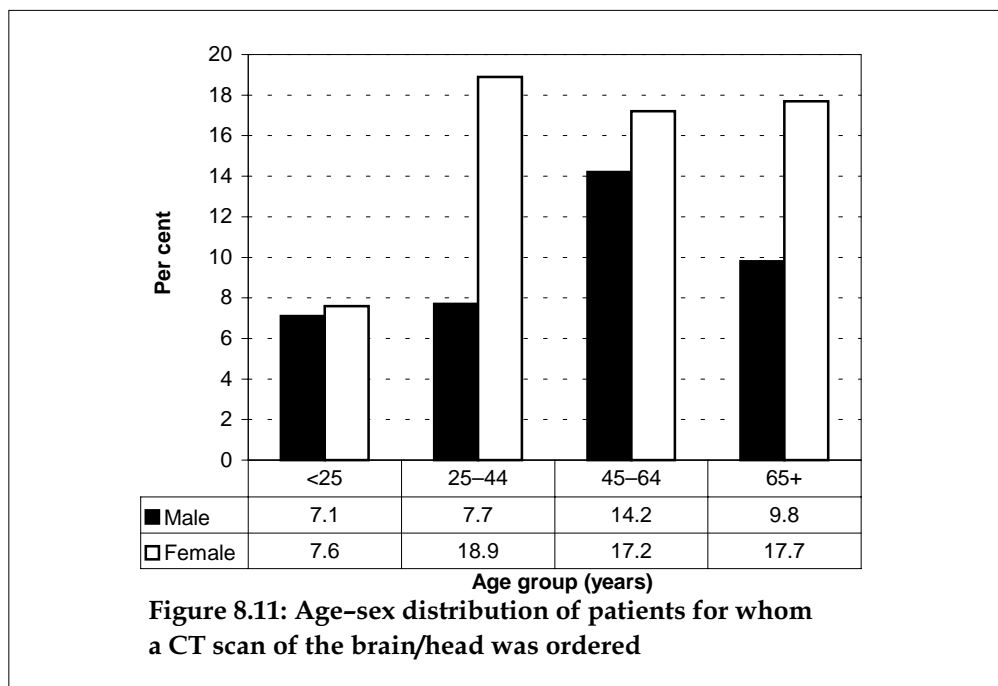


Table 8.14: Care process involved in orders for CT scan of the brain/head

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

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

Problems associated with CT scan of the brain/head

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

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

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

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

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

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

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

Problem status

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

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

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

Discussion

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

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

8.7 Doppler tests

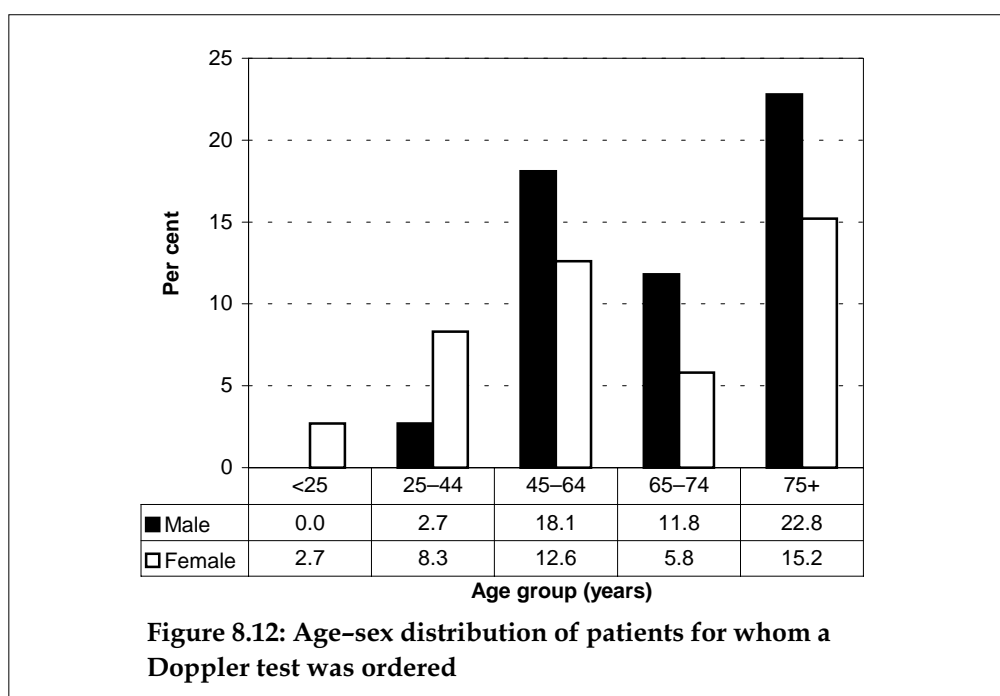
This group includes the following ICPC-2 PLUS codes and rubrics:

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

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

Age and sex distribution of patients

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



Care process

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

Table 8.17: Care process involved in orders for Doppler tests

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

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

Problems associated with orders for a Doppler test

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

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

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

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

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

Patient reasons for encounter at Doppler encounters

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

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

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

Discussion

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

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

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

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

8.8 Imaging of the kidney

Included in this group were intravenous pyelograms (IVPs) and ultrasounds of the kidney. IVPs include only one ICPC-2 PLUS code: U41001 ($n=70$).

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

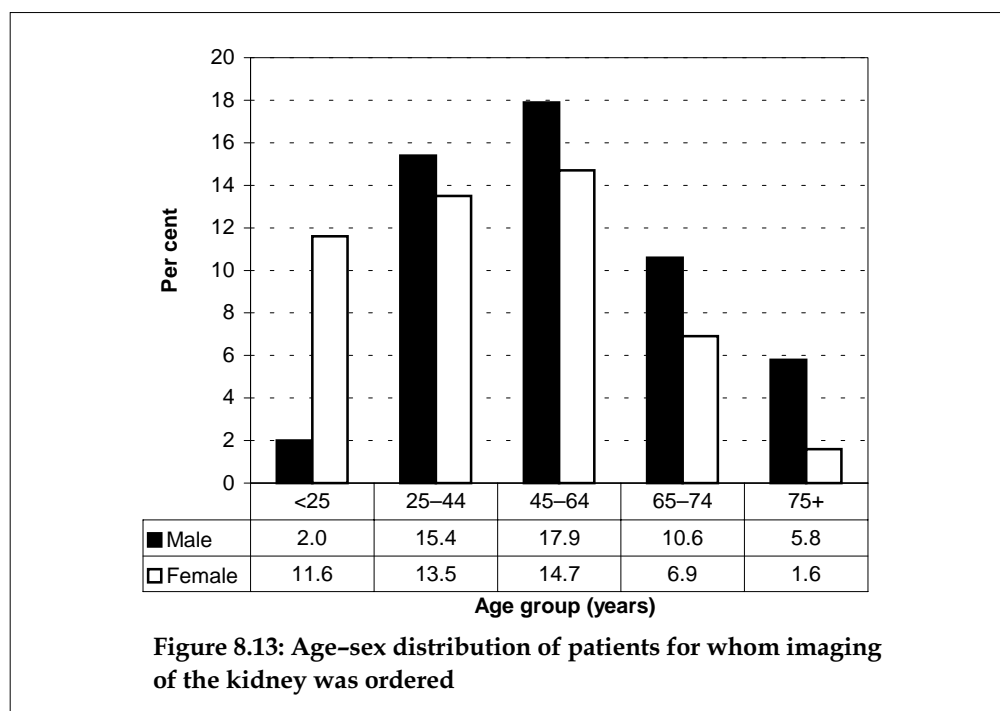
- U41009—Ultrasound; renal tract ($n=44$)
- U41010—Ultrasound; kidney ($n=98$).

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

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

Age–sex distribution

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



Care process

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

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

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

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

Most common problems managed with imaging of the kidney

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Discussion

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

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

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