

1 Background

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

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

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

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

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

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

1.1 Literature review

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.2 Aims

This report aims to:

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