Health Policy 121 (2017) 823–829

Contents lists available at ScienceDirect

Health Policy

journal homepage: www.elsevier.com/locate/healthpol

Increase in computed tomography in Australia driven mainly by practice change: A decomposition analysis

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ARTICLE INFO

Article history:
Received 24 June 2016
Received in revised form 12 April 2017
Accepted 21 April 2017

Keywords:
Computed tomography
Computed axial tomography
CT scan
Health service utilisation

ABSTRACT

Background: Publicly funded computed tomography (CT) procedure descriptions in Australia often specify the body site, rather than indication for use. This study aimed to evaluate the relative contribution of demographic versus non-demographic factors in driving the increase in CT services in Australia.
Methods: A decomposition analysis was conducted to assess the proportion of additional CT attributable to changing population structure, CT use on a per capita basis (CPC, a proxy for change in practice) and/or cost of CT. Aggregated Medicare usage and billing data were obtained for selected years between 1993/4 and 2012/3.
Results: The number of billed CT scans rose from 33 per annum per 1000 of population in 1993/94 (total 572,925) to 112 per 1000 by 2012/13 (total 2,540,546). The respective cost to Medicare rose from $145.7 million to $790.7 million. Change in CPC was the most important factor accounting for changes in CT services (88%) and cost (65%) over the study period.
Conclusions: While this study cannot conclude if the increase is appropriate, it does represent a shift in how CT is used, relative to when many CT services were listed for public funding. This ‘scope shift’ poses questions as to need for and frequency of retrospective/ongoing review of publicly funded services, as medical advances and other demand- or supply-side factors change the way health services are used.

1. Background

Computed tomography (CT) scanning is a commonly used medical imaging technique which takes multiple X-ray images, and assembles them to provide a 3-dimensional image [1]. Since its introduction in the 1970s, CT technology has advanced substantially and its added clinical utility has led to increased use in Australia. Organisation for Economic Cooperation and Development (OECD)-collated data for Australia estimated that CT non-public hospital examinations (approximately 75% of the total [2]) increased 32% between 2007 and 2013, from 83.2 to 109.8 CT examinations per 1000 of population [3]. If the increase were due to population increases or change in distribution (i.e. reflective of an ageing population) then increasing counts of CT and associated costs should be proportionate to these changes. Indeed, population ageing is often cited as a major driver of increasing health resource utilisation and costs [4]. Changes outside of that expected due to demographic changes would therefore reflect a change in the way that CT is being used. Whilst examining these proportionate changes cannot alone aid judgment in whether any ‘change in practice’ is appropriate, it would serve to demonstrate changes in the way that CT is being used from the original intention when descriptive service parameters were developed and evaluated, and decisions to provide public funding made. Whilst the potential for ‘scope shift’ is not unique to CT, it is worth examining CT in particular as, because of the radiation dose delivered in addition to the cost of the procedure, use of CT outside of settings found to be clinical and economically effective has the potential to cause harm, in addition to burden on publicly funded health systems. The absolute risk associated with CT radiation at a population-level is currently not well characterised. Epidemiological studies published to date [5–7] likely over-estimate the

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http://dx.doi.org/10.1016/j.healthpol.2017.04.010
0168-8510/

risk from CT exposure for adults [8]. However, existing indirect evidence (e.g. [9]) suggests the risk is non-negligible and offers support to the presiding 'as low as reasonably achievable' (ALARA) principle with respect to ionising radiation in medical imaging [10].

1.1. Public funding arrangements for CT in Australia

Australia has a fee-for-service model for CT scanning outside of public hospitals, where the Federal Government reimburses private radiology providers for individual services through Medicare. Medicare also funds general practitioner (GP), pathology, other diagnostic, medical specialist and allied health services, with specific item descriptors and the service fee described in the Medicare Benefits Schedule (MBS). The 'benefit' publicly reimbursed to the provider is usually 85% of the listed schedule fee, which the provider can either accept as the total payment, or also charge a co-payment to the patient. CTs are performed at the request of a medical practitioner, often a GP in an out of hospital setting. Services through public hospitals are funded through a combination of state and national funding and are typically not reported by Medicare. Since 1998, recommendations for item listing are made by the Medicare Services Advisory Committee to the Minister for Health, following extensive health technology assessment [11]. Prior to this period services were funded without assessment and the legacy of this is that many services have extremely non-specific (if any) descriptors for their intended use. Examples of this include many CT examinations in which the item descriptor merely states the area of the body without any identification of the clinical setting under which the examination has been listed for funding. In contrast descriptors for more recently funded diagnostic technologies, such as magnetic resonance imaging and positron emission tomography, tend to be very specific about the circumstances of their use under public funding, reflective of advances in health technology assessment and concerns about the impact of technological advancement on health budgets over time [12]. On 22 April 2015, the Minister for Health announced the formation of a taskforce to review whether more than 5700 MBS items could be better aligned with contemporary clinical practice and evidence [13]. Diagnostic imaging is one of the larger areas for review, due to the number of items and since many descriptors have not been re-evaluated since they were first included on the MBS.

1.2. The present study and implications for health policy

Previous descriptive studies have quantified the increase in CT use [14–20], including in Australia [21,22]. However, to our knowledge, no study has analysed the proportion of change due to demographic versus non-demographic factors, to infer then change in use potentially outside of that intended when the decision to publicly fund a service was made. Thus in this study, we aimed to find whether the major proportion of change in CT scans and associated costs billed to Medicare was due to population size and structure changes, or else the complement of this (i.e. that explained by 'change in practice')?

2. Methods

2.1. Data sources

Population data estimates disaggregated by age, sex and state/territory were sourced from the Australian Bureau of Statistics [23]. The estimated population was as at June of the earlier calendar year (e.g. June 2012 for the 2012/13 fiscal year).

CT scan utilisation data were sourced from publicly available Medicare Benefits Schedule (MBS) records, extracting 'Item I2: Computed Tomography' [24]. The MBS lists all services eligible for reimbursement through Australia's Medicare programme. Almost all (~99% [2]) of the CT services provided in public hospitals are excluded from these data. These records were categorised by sex, age group and state/territory of service. The quarter and year recorded for a service reflected the time period that the claim was processed by Medicare. Costs are in Australian dollars as at the time of processing.

2.2. Decomposition analysis

We analysed six separate fiscal years (covering the period 1 July–30 June): 1993/4, 1996/7, 2000/1, 2004/5, 2008/9, and 2012/13. The population (P); number of CT scans (E); and Medicare benefit paid (T) were extracted for each time period, excluding two records for which the age group was not known. From the extracted data, the mean number of CT scans per capita (CPC) in each age-specific group, j was calculated as: $CPC_j = E_j/P_j$. Similarly, the mean cost per episode (CPE) was be calculated as: $CPE_j = T_j/E_j$, where T_j is the cost of benefit paid for that time period by age-specific group, j. The CPC and CPE were also calculated for the study population overall (i.e. aggregating over all j groups). Sub-analyses were conducted for each sex (comparing each of the years in the original analysis), and for individual state/territories, comparing 1993/4 to 2012/13 only.

The decomposition analysis was based on methods used by Ha and colleagues [25]; the methods are briefly summarised below and described in detail in Appendix A in Supplementary material. Firstly, we investigated the proportion of the change in the number of CTs that was accounted for by: (i) change in population size; (ii) change in population distribution and (iii) change in CPC. The change in CPC metric acted as an indirect measure of change in practice (i.e. changes in the clinical indications for CT facilitated by technological advancement). One time period was compared to the next successive time period. In addition, 2012/13 was compared to 1993/4, which compares across the entire duration of our data collection.

The proportionate change in CT count was decomposed into three explanations, namely: population growth, age distribution and the CPC metric. To estimate the proportion of change due to population growth, we assumed that both the population age distribution and number of CTs performed per capita for the latter time period did not change from the earlier comparator year. The difference between time periods predicted by holding these factors constant, as a proportion of the actual change in CT count observed, was attributed to population growth. Relaxing the assumption of the age distribution remaining identical between time periods allowed the proportion of change attributable to shifting population distribution to be calculated next. Finally, the proportion attributable to CPC – a proxy for change in practice – was simply the remaining CT growth unexplained by population growth or distribution change.

For the second part of the decomposition analysis, we repeated the approach from part one, but with five explanations for the change in cost, these being: (i) change in population size; (ii) change in population distribution; (iii) change in CPC; (iv) change in CT distribution by age group and (v) change in CPE. As in the count decomposition, each factor was isolated in-turn to account for the change between compared time periods (see Appendix A in Supplementary material for further details). The analyses were conducted using Microsoft Excel Version 14.5.5 (Redmond, Washington, United States).