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Original article

Testing criterion-based benchmarking for the appropriate use of radiotherapy

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ABSTRACT

Introduction: Planning for radiotherapy (RT) services requires information on the proportion of patients who should be given radiotherapy. Criterion-Based Benchmark (CBB) has been proposed in Canada to estimate the proportion of cancer patients who should be treated with radiotherapy.

The aim of this study was to assess CBB in a health system outside of Canada.

Methods: Radiotherapy data for all new cases of cancer in New South Wales (NSW), and the Australian Capital Territory (ACT) Australia in 2004–06 and were linked to Central Cancer Registry records. Road distances between patient residence and the nearest RT centre were calculated.

Local Government Areas (LGAs) with public radiotherapy departments were selected as CBB LGAs if they met the following criteria:

1. Patients make no direct payment for radiotherapy.
2. All RT is provided by site-specialised radiation oncologists in multi-disciplinary centres.
3. Radiation oncologists receive salary for their service.
4. More than 75% of patients live within 30 km from the nearest RT, and
5. Patients' waiting times were <4 weeks.

Results: 25,383 (26%) out of 98,000 eligible patients in NSW and ACT received radiotherapy in the study period as part of their initial treatment. An average of 31% of patients in the CBB LGAs received radiotherapy compared to an average of 26% in all LGAs during the study period.

Discussion: NSW-ACT RT utilisation for selected tumour sites was 7–16% higher in the CBB LGAs than in all LGAs, but was still 30–65% below the estimated optimal radiotherapy utilisation rates and differed significantly from Canadian CBBs. CBB is based on the assumption that there is perfect service delivery in some parts of the health service that can be used to benchmark the whole service. It may be applicable in well-resourced publicly-funded services in Canada, but the CBB approach may not be reproducible in other jurisdictions.

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Planning for radiotherapy (RT) services requires information on the proportion of cancer patients who should be given radiotherapy. There are several approaches; expert opinion, a synthesis of the best evidence and a criterion-based approach.

Due to the obvious inadequacies of expert opinion, we developed an evidence-based approach that identified the indications for radiotherapy and the proportion of cancer patients with each indication to estimate the proportion of cancer patients that would need radiotherapy at least once in their illness [1,2] based on the approach of Tyldesley [3]. The advantage of this approach is that it is transparent, its assumptions can be tested, it can be updated

when new evidence is available, it does not rely on current referral and treatment practices, and it can be applied to different jurisdictions where the distribution of cancer types is known. Our initial study estimated that 52% of Australian cancer patients had an indication for radiotherapy at least once in their illness. A review after 10 years revised that estimate to 48% because of changes in RT indications and changes in epidemiology. The evidence-based method has been used to estimate the demand for and benefits from radiotherapy globally [4]. The disadvantage of the evidence-based approach is that it is only as good as the available data and it is time-consuming to accumulate the evidence. Population-based data on some patient characteristics such as performance status can be hard to find.

Mackillop and colleagues in Ontario, Canada established a Criterion-Based Benchmarking (CBB) approach to estimate the

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proportion of cancer patients who should be treated with RT [5–9]. The approach identifies criteria that the authors felt should be consistent with optimal access and delivery of radiotherapy. The CBB approach [5] identified geographic areas that satisfied the following radiotherapy benchmark criteria:

1. Patients make no direct payment for radiotherapy.
2. All RT is provided by site-specialised radiation oncologists in multi-disciplinary centres.
3. Radiation oncologist receive a salary for their service, and
4. Selected counties are located close to cancer centres and without long waiting lists for RT.

The Radiotherapy Utilisation (RTU) rates in these geographic areas that met the criteria were used to set the benchmark for the surrounding regions. The approach makes the assumption that treatment decisions in CBB regions align with best practice but has the advantage of incorporating more factors than are able to be included in an evidence-based model. CBB is not able to assess the potential impact of changes in practice due to changes in characteristics of the cancer population such as may occur with the introduction of screening. CBB relies on extensive local data at a population level and cannot be used to estimate radiotherapy demand where this is not available.

CBB has only been estimated in Canada which has a single national health system administered by a number of provinces. The aim of this study was to calculate CBB in another country with different health financing and organisation and compare the results with the evidence-based model.

Methods

We calculated actual radiotherapy utilisation (RTU) rates for the New South Wales (NSW) and Australian Capital Territory (ACT) populations, CBB RTU rates for the benchmark communities and compared actual and CBB RTU with the evidence-based optimal RTU rates.

New South Wales (NSW) is the most-populous state of Australia and is situated in the South-Eastern region of Australia. It has a population of 7.4 million and during the study period, approximately 36,000 cancers were notified to the Central Cancer Registry (CCR) every year. The study cohort consisted of all patients diagnosed with cancer and notified to the CCR in NSW and ACT during the study period 2004–2006. This period was chosen because it was the only available dataset for the whole of NSW–ACT. This formed the denominator for the calculation of actual RTU. The numerator consisted of all patients diagnosed with notifiable cancers who received radiotherapy during the same period. During the study period, there were 11 public and 5 private RT centres in NSW. We excluded public facilities that shared catchments with private RT facilities. The ACT is entirely contained within NSW. It has one public radiotherapy centre that treats a number of NSW residents in addition to ACT residents.

The radiotherapy data collection period was extended to 30 June 2007 to capture patients diagnosed during the study period who received radiotherapy during the first 6 months after the diagnosis in the last year of study accrual. Data on individual patient waiting time were collected from all radiotherapy centres. Waiting time was measured from Ready for Care date [10] to the first day of radiotherapy.

Patient residential addresses and RT centre street addresses were geocoded into longitude and latitude. ArcGIS [ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute] was used to calculate actual road distance between patient residential address and the closest RT centre.

For patients living in locations where a lack of road nodes connecting their residence coordinates precluded calculation of a road distance, the Euclidean distance from each patient residential address was computed to the closest RT centre.

Patients were excluded from the study if they were overseas residents, diagnosed with non-notifiable cancers or diagnosed outside study period. Patients with breast ductal carcinoma in situ (DCIS) were included in the study because they are routinely treated in RT centres. This study was limited to NSW and ACT residents and RT centres only. However, patients who lived near one of the State borders may have been referred across the State border to a closer RT treatment facility outside NSW. Cancer patients located near the State border where their closest RT centre was identified to be interstate were excluded from the analysis otherwise their inclusion may artificially lower RTU.

The basic geographic unit used in the study was the Local Government Area (LGA). There are 153 LGAs in NSW. Local Government Areas (LGAs) were selected with average population of 45,000 in each LGA. The following were the criteria for selecting benchmark LGAs for the study:

- Only LGAs where public RT centres were located.
- Public RT centres that were located adjacent to private RT centres were excluded.
- More than 75% of patients lived within 30 km of the nearest public radiotherapy centre.
- Public RT centres had relatively short RT waiting lists (waiting time ≤ 4 weeks).

Benchmark LGAs were compared to LGAs that did not meet the criteria in order to assess any shortfall in RTU. Adjacent LGAs with fewer than 500 patients in each LGA were merged to form larger geographical areas with a number of patients equivalent to the average number of patients in other LGAs.

Actual RTU in LGAs was compared with evidence-based benchmark estimates of the proportion of cancer cases with an indication for radiotherapy within one year of diagnosis [11] because of the short period of observation for the estimates of actual utilisation. The previously published evidence-based estimates of optimal radiotherapy utilisation at any stage in the course of a patient's illness [2] were modified to remove all indications for treatment of recurrence or metastasis that were likely to occur more than one year after diagnosis [12].

Ethical approvals were obtained from all institutional and registry Human Research Ethics Committees.

Results

108,064 new cases of cancer were notified to the NSW and ACT Central Cancer Registries between 2004 and 2006. 10,008 cases (9%) were excluded because they lived closer to an interstate radiotherapy facility and 56 were unable to be geocoded, leaving 98,000 analysable cases. Of these cases 25,383 (26%) received radiotherapy in NSW or ACT during the study period.

Fig. 1 shows the distribution of radiotherapy departments and LGAs. The distribution of actual RTUs by LGA is shown in Fig. 2. The average RTU was 26% (range 10% to 34%). Eight LGAs met the CBB criteria with an average value of 31% (range 27% to 33%).

Fig. 2 shows RTU rates for all LGAs in NSW–ACT sorted in ascending order with vertical bars representing 95% confidence intervals. CBB LGAs are marked in blue. Fig. 2 shows that most of the LGAs that contained a CBB facility had RTU rates above the average actual RTU for NSW and ACT.

Overall, an average of 26% of cancer patients received radiotherapy as part of their initial treatment (within 1-year of diagnosis) in

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