Clinical Oncology xxx (2014) 1–7

Contents lists available at ScienceDirect

Clinical Oncology

journal homepage: www.clinicaloncologyonline.net

Overview

Evidence-based Estimates of the Demand for Radiotherapy

G.P. Delaney, M.B. Barton

Ingham Institute for Applied Medical Research, UNSW Australia, Liverpool Hospital, Liverpool, Australia

Received 15 August 2014; accepted 15 October 2014

Abstract

There are different methods that may be used to estimate the future demand for radiotherapy services in a population ranging from expert opinion through to complex modelling techniques. This manuscript describes the use of evidence-based treatment guidelines to determine indications for radiotherapy. It also uses epidemiological data to estimate the proportion of the population who have attributes that suggest a benefit from radiotherapy in order to calculate the overall proportion of a population of new cases of cancer who appropriately could be recommended to undergo radiotherapy. Evidence-based methods are transparent and adaptable to different populations but require extensive information about the indications for radiotherapy and the proportion of cancer cases with those indications in the population.

In 2003 this method produced an estimate that 52.4% of patients with a registered cancer-type had an indication for radiotherapy. The model was updated in 2012 because of changes in cancer incidence, stage distributions and indications for radiotherapy. The new estimate of the optimal radiotherapy utilisation rate was 48.3%. The decrease was due to changes in the relative frequency of cancer types and some changes in indications for radiotherapy. Actual rates of radiotherapy utilisation in most populations still fall well below this benchmark.

Key words: Demand planning; radiotherapy; utilisation

Statement of Search Strategies Used and Sources of Information

This paper reflects expert opinion and current literature accessed by the authors; no formal search strategy has been defined.

Introduction

Estimating demand for a medical service involves calculating the number of patients or proportion of a population expected to require that service during any period of time. There are several approaches to estimating current and future demand for health services; expert opinion, extrapolation from historical levels of activity, use of historical activity data from a 'model' area or evidence-based estimates. A comparison of some of the benefits and shortfalls of each of these methods is given in Table 1.

Evidence-based models predict the proportion of patients for whom radiotherapy would be the treatment of choice based on published evidence rather than extrapolating from historical demand, which is prone to a number of limitations. An accurate estimate relies on knowledge of the indications for that service and an understanding of the underlying general population and the proportion of a particular population that have attributes that have indications for treatment.

Benchmarks can be created to estimate the demand for radiotherapy from data produced by central cancer registries that record all new cases of cancer in a population. Registries do not routinely collect data on recurrence or metastases. Estimates of demand are therefore confined to the proportion of cancer cases that have an indication for radiotherapy at least once in the course of their illness. Retreatment has not been considered because of the lack of longitudinal data.

Our approach has been to use the published evidence-based cancer treatment guidelines to identify indications

Author for correspondence: M.B. Barton, Ingham Institute for Applied Medical Research, UNSW Australia, PO Box 3151 Westfields Liverpool, Liverpool, NSW 2170, Australia.

E-mail address: Michael.Barton@unsw.edu.au (M.B. Barton).

http://dx.doi.org/10.1016/j.clon.2014.10.005

Please cite this article in press as: Delaney GP, Barton MB, Evidence-based Estimates of the Demand for Radiotherapy, Clinical Oncology (2014), http://dx.doi.org/10.1016/j.clon.2014.10.005

Table 1
The advantages and disadvantages of each method of estimation

Method of estimation of Radiotherapy utilisation rate (RTU)	Description	Advantages	Disadvantages
Expert opinion	Experienced clinicians' opinions.	Simple	High potential for bias. Not validated. Assumptions are not explicit.
Historical activity data	Activity of a particular region or service.	Usually relatively simple to collect.	Assumes that use of radiotherapy is appropriate and that under- or over-referral does not occur. Historical values vary significantly.
Evidence-based guideline modelling	Using evidence-based guidelines and epidemiological data to calculate an ideal rate.	Able to be modified for different regions. Relatively simple to adapt. Does not require activity data.	Requires good-quality generalisable evidence of treatment efficacy. Requires data on proportions of population with indication to be known in fine detail. Some epidemiological data for rare indications may be of poor quality.
Malthus model [20]	Developed on a virtual population of cancer patients, which accounts for local variations in cancer incidence and stage distributions and other patient factors. Incorporates demand and type of surgery being used.	Able to be modified for different regions. Patient choice included.	Need high-quality activity and cancer data. Incorporates actual rates of surgery, which may not reflect the evidence base and therefore can be influenced by non-evidence-based practices.
Criterion-based benchmarking [40]	Actual utilisation of radiotherapy is assessed in regions that meet a number of criteria that suggest that there is no barrier to optimal service deliver or access.	Includes expert decision making in the real world. Generalisability of clinical trials is not an issue.	Relies on there being a region that meets the criteria. Rates not representative for regions with different incidences. Requires moderate to high quality of data collection.

for radiotherapy when radiotherapy is the treatment of choice and to integrate them with population-based data on the proportion of cancer patients with each treatment indication to develop a model of radiotherapy utilisation. This approach was first described by Tyldesley and others from Kingston Regional Cancer Clinic, Kingston, Ontario, Canada, for lung cancer [1] and then applied to prostate and breast cancer [2,3]. In 2003 this method was modified and applied to estimate the evidence-based demand for radiotherapy for all notifiable cancer types with an incidence of 1% or greater of all cancer cases, using Australasian data wherever possible [4].

Indications for Treatment

In the evidence-based utilisation model, radiotherapy was considered indicated if it was identified in treatment guidelines as the treatment of choice for a condition because it offered superior outcomes in survival, local tumour control, quality of symptom relief or side-effect profile when compared with alternative treatments. For the purposes of calculating the total proportion of patients who should receive a treatment at least once, the treatment could be used alone or in combination with other anticancer treatments. Retreatment was not considered. Treatment intent may be palliative, adjuvant or curative. In order for a treatment to be indicated, the patient must be suitable for treatment. They should be fit enough to undertake treatment. The scope for this study was limited to indications for the use of external beam radiotherapy for all cancers notified to a central cancer registry, thus excluding non-melanomatous skin cancers and benign disease for which there are no incidence data. Evidence for indications for treatment was obtained from national and international evidence-based treatment guidelines. If these were not available, randomised and non-randomised studies were examined. The quality of the evidence was ranked using the National Health and Medical Research Council evidence quality rating scale [5].

Epidemiology

The proportion of cancer cases with attributes for each treatment decision is best determined from population-based studies because they are the most representative of the general population. National cancer incidence figures should be used to determine the relative proportions of cancer types and tumour sites. Australian data were given precedence in our model as it was designed initially for application locally. Data from other jurisdictions can easily be substituted to modify the estimates for other populations. Major attributes that describe large proportions of the population, such as cancer incidence and stage proportions, are usually able to be found from high-

Please cite this article in press as: Delaney GP, Barton MB, Evidence-based Estimates of the Demand for Radiotherapy, Clinical Oncology (2014), http://dx.doi.org/10.1016/j.clon.2014.10.005