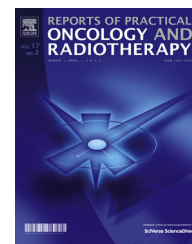




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Original research article

Assessment of performance indicators of a radiotherapy department using an electronic medical record system



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ABSTRACT

Aim: To retrospectively assess the performance indicators of our radiotherapy department and their temporal trends, using a commercially available electronic-medical-record (EMR) system.

Background: A recent trend in healthcare quality is to define and evaluate performance indicators of the service provided.

Materials and methods: Patient and external-beam-radiotherapy-treatments data were retrieved using the Mosaik EMR system from 1-January-2012 till 31-December-2015.

Annual performance indicators were evaluated as: productivity (number of new cases/year and diagnosis distribution); complexity (ratio of Volumetric-Modulated-Arc-Therapy (VMAT) courses, average number of imaging procedures/patient); and quality (average, median and 90th percentile waiting times from admission to first treatment).

The temporal trends of all performance indicators were assessed by linear regression.

Results: Productivity: the number of new cases/year increased with an average rate of 4%. Diagnosis distribution showed that breast is the main pathology treated, followed by gastrointestinal and head-and-neck.

Complexity: the ratio of VMAT courses increased from 13% to 35%, with an average rate of 7% per year. The average number of imaging procedures/patient increased from 8 to 11.

Quality: the waiting times from admission to treatment remained stable over time ($R^2 \leq 0.1$), with average, median and 90th percentile values around 20, 15, and 31 days, respectively.

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Conclusions: An EMR system can be used to: monitor the performance indicators of a radiotherapy department, identify workflow processes needing attention and improvement, estimate future demands of resources.

Temporal analysis of our data showed an increasing trend in productivity and complexity paired with constant waiting times.

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1. Background

As an attempt to improve the healthcare quality, a recent and increasing trend is to define and evaluate performance indicators of the service provided. Performance indicators are specific to each medical specialty and designed to assess operational conditions and trends of practice over time, as well as plans of action for a continuous quality improvement.^{1–4}

Practical tools to generate data for performance assessment are the electronic medical record (EMR) systems which allow departments not only to collect and access comprehensive patient information, but furthermore to report and monitor data on their performance.^{5,6}

The performance evaluation by indicators is still not largely used in radiotherapy and only a few experiences have as yet been reported.^{7–9} Due to the increase in cancer incidence and developments in technology and knowledge, the radiotherapy practice is constantly evolving, therefore measuring and responding to temporal changes is useful in ensuring that a department runs efficiently.

The purpose of the current study is to retrospectively assess the performance indicators of our radiotherapy department and their trends during the last 4 years, using a commercially available EMR system.

2. Materials and methods

Patient and treatment data were retrieved using reports generated by the Mosaic EMR system (Elekta AB, Stockholm, Sweden) version 2.6, from 1 January 2012 till 31 December 2015. Retrospective data analysis included external beam radiotherapy treatments (EBRT) delivered on 3 linear accelerators (linacs), all equipped with on-board imaging systems and used in clinical routine since June 2007, June 2010 and February 2012, respectively. One of the linacs was decommissioned from clinical use in February 2013.

Mosaic EMR system is specifically designed for oncology departments, offering tools of recording patient information such as: clinical assessment, prescribed medication, diagnostic images, laboratory results, and external documentation. In addition to the management of a clinical cancer database, it provides the function of a record-and-verify system for radiotherapy through the ability to distribute and access radiotherapy planning, treatment, and patient management information. The system stores all radiotherapy-related information (e.g. beam data, patient's reference images and associated structures, treatment set-up

data) and transfers them to the treatment units. Treatment is allowed only after verification and appropriate approvals, and once delivered the system records the delivery parameters.

All patients receiving EBRT were registered in the EMR system at the time of admission. Data were exported to an Excel worksheet version 2010 (Microsoft Corporation, Washington, USA). All radiotherapy courses were image-guided.

A multi-disciplinary team including all radiotherapy department stakeholders (radiation oncologists, physicists, radiation therapists, nurses, administrative assistants) defined and evaluated the performance indicators on annual basis, as follows:

1. Productivity, measured by the number of new cases per year, and diagnosis distribution.
2. Complexity, measured by the ratio of Intensity-Modulated-Radiation-Therapy (IMRT) and Volumetric-Modulated-Arc-Therapy (VMAT) courses, average number of fractions per patient, and average number of images per patient.
3. Quality, measured by the average, median and 90th percentile waiting times from admission to first treatment session, and number of patients exceeding 31 days waiting time.

The trends of all performance indicators during the analyzed time interval were assessed by linear regression, using IBM SPSS Statistics software version 20 (IBM Corporation, NY, USA).

3. Results

3.1. Productivity

The number of new cases per year increased from 696 to 833, with an average rate of 4% per year; consequently, the number of radiotherapy fractions rose over time from about 12400 to 14750. The trend lines in Fig. 1a and b show a continuous shift from three-Dimensional-Conformal-Radiation-Therapy (3D-CRT) toward VMAT treatments.

Diagnosis distribution showed that breast is the main pathology treated in our department, followed by gastrointestinal (GI) and head-and-neck (H&N). Breast cases ratio constantly increased, from 38% to 46%, with an annual average rate of 6%. GI and head-and-neck cases ratio slightly fluctuated over time around the average value of 12% each.

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