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Quality indicators in the intensity modulated/image-guided radiotherapy era

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ABSTRACT

Purpose: To propose new Quality Indicators (QIs) for the Intensity Modulated(IMRT)/Image-Guided(IGRT) Radiotherapy techniques.
Materials and methods: Two structure, 10 process and 2 outcome QIs were elaborated. A working group including Radiation Oncologist, Medical Physicist and Radiation Technologists was made up. A preliminary set of indicators was selected on the basis of evidenced critical issues; the criteria to identify more relevant and specific QIs for IMRT/IGRT were defined; structure, process and outcome QIs were defined. The elaborated indicators were tested in four Italian Radiotherapy Centers.
Results: Fourteen indicators were proposed. Seven indicators were completely new while a new standard is proposed for four indicators based on Validation Centers (VC) data. No change was reported for

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3 indicators. The indicators were applied in the four VC. The VC considered were able to respect all indicators except indicator 2 for one Center.
Discussion and conclusion: QIs may provide useful measures of workload and service performances.

1. Introduction

The Quality Indicator (QI) is an instrument that takes a "picture" of a hospital or a department, allowing the activity of different Centers to be compared. In particular, there is a widespread and increasing tendency to develop hospital performance indicators in the field of accreditation/certification systems and quality benchmarking. Indicators are designed not only to identify structures of excellence, but mainly to assess operative conditions and draw up plans of action to provide continuous quality improvement. A comprehensive indicator system should focus on 3 components: structure, process and outcomes, which produce useful information for decision making and become both a sign and a source of motivation for quality commitment (Albert and Das, 2012).

Thereby, the indicators will enable the health care team members to better assess their actions and enhance improvement by stimulating them with a new "forma mentis", leading to higher service quality. All indicators should guarantee quality achievement for technical (Albert and Das, 2012; Hermens et al., 2006) and clinical (Spencer et al., 2003; Bogdanich, 2010a; Danielson et al., 2011; Del Turco et al., 2010; Bujold et al., 2012) aspects of treatment and organizational (Albert and Das, 2012; Del Turco et al., 2010) training programs.

Quality Indicators (QIs) can be used to assess the quality of multiple components; for example, assessment may concentrate on a structure, process or outcome; alternatively, it may focus on a particular disease or a particular practice, or even evaluate the quality of a physician/personnel relationship, an institution or a health care system. Furthermore, some metrics may be developed to facilitate internal quality improvement efforts, while others may be designed for external reporting to local, national or international accreditation commissions.

Radiation oncology has a long history of leadership in quality of care assessment and it continues to work toward defining consensus about Quality Assurance and appropriate measurements derived from QIs (Albert and Das, 2012; Cionini, 2007; Stalfors et al., 2007; Rapporti ISTISAN, 2016; Gabriele et al., 2006). The introduction of new technologies of Radiotherapy (RT) requires the continuous introduction of complex quality and safety issue (Hayman, 2011; Hendee and Herman, 2011; Marks et al., 2011).

Nowadays, the 3-Dimensional Conformal Radiation Therapy (3DCRT) is still used for many tumor site/pathology but the use of Intensity Modulated Radiation Therapy (IMRT) is growing in more complicated tumor sites such as head and neck, prostate and lung where higher doses to tumor and lower doses to organs at risk are necessary. The technological advances in the delivery techniques such as IMRT have demanded equally accurate methods for identifying from day to day the position of the target and organs at risk. Moreover, the availability of daily imaging allows to indentify temporal changes in anatomy (e.g. tumor shrinkage, weight loss or internal motion) or changes in tumor biology/function (e.g. hypoxia) and therefore changing the radiation treatment plan delivered to a patient during a course of radiotherapy. The improvements in imaging have also introduced the possibility to incorporate higher level of complexity informations into treatment planning systems. The introduction of these techniques that, with respect to 3D-CRT, no longer rely on the number of fields per treatment, shaped fields or portal vision feasibility, require an update of old indicators. Moreover, the potentially devastating consequences of radiation therapy delivered appropriate safety and quality measures highlight the necessity of continuous QIs upgrade (Bogdanich, 2010a, 2010b).

The goal of this paper is to propose and to test the new indicators along with the classic indicators still applicable (Cionini, 2007; Gabriele et al., 2006) for Intensity Modulated (IMRT)/Image-Guided Radiotherapy (IGRT).

2. Material and methods

Quality indicators can be divided into three types: structure, process and outcome indicators. The meaning of structure, process and outcome was defined in a previous paper (Cionini, 2007); three structures, twelve processes and three outcome indicators were elaborated according to a previous template available in the cited literature.

A multidisciplinary team involving different professional profiles as Radiation Oncologist (RO), Medical Physicist (MP) and Radiation Technologists (RTT), was elaborated in order to take advantage from different points of view and to underline main critical issues in the use of IMRT/IGRT. Once the working group was built-up, the study was organized into the following steps: a preliminary set of indicators was selected on the basis of evidenced critical issues and starting from the data reported in literature. Then, the criteria to identify more relevant and specific indicators for IMRT/IGRT were defined by physicist and physicians during a dedicated regional Piedmont meeting among the preliminary set. Lastly, the final set of structure and outcome indicators was defined to comprehensively describe the IMRT/IGRT for all treatment steps. The QIs introduced during these discussions are the following: Structure indicators: 1. Adequacy of equipment for IMRT/IGRT, 2. Workload, Process indicators: 1. Multidisciplinary approach to patient care, 2. Adequacy of multi-parameter imaging, 3. Clinical record quality, 4. Waiting time, 5. Appropriateness of Quality Control programs (quality assurance QA) 6. Number of dosimetric controls on patients treated by IMRT/IGRT, 7. Number of Megavolt (MV) or Cone Beam Computed Tomography (CBCT) controls versus number of RT fractions, 8. Number of clinical controls of patient during treatment, 9. Number of Adaptive radiotherapy. 10. Treatment room occupation time. Outcome indicators: 1. Number of patients treated in clinical studies, 2. Machines uptime, The QIs are built following a grid model reported in ISSN 1123-3117 (Rosi and Viti, 2016). In this grid, among items, numerical values for the standards were selected from literature data or international guidelines on radiotherapy. The proposed indicators were administered in four Italian Centers. The total number of patients treated per year in these Centers are around 5000 using 7 Helical Tomotherapy and 6 Volumetric Modulated Arc Therapy machines. New standard will be proposed for some indicators starting from the data of these four Validation Centers (VC).

3. Results

This chapter explains the QIs and their application and validation in four Italian Centers, named Validation Centers.