PhD Thesis title: 'Radiation Oncology Safety Information System (ROSIS): A Reporting and Learning System for Radiation Oncology'

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ABSTRACT:

Incident reporting is a recognized tool for learning from incidents. The Radiation Oncology Safety Information System (ROSIS) was established in 2001, to collate and share information on incidents and near-incidents in radiotherapy, and to learn from these incidents in the context of departmental infrastructure and procedures. This work describes the development of ROSIS, analyses the data collected in the first five years of the reporting system, defines a classification system for reporting and learning from incidents in radiation oncology, and designs department and incident report forms to incorporate this classification.

The data was collected from online Department Description and Incident Report Forms. 101 Departments and 1074 Incident reports were evaluated using simple descriptive statistics. Most incident data is reported directly, but the stage of incident occurrence, and the contribution of data transfer or record and verify systems were determined retrospectively. A hazard identification was prepared, and a frequency analysis conducted on 600 ROSIS incidents. A classification system was designed to organize reports and facilitate learning. A sub-class, the process classification, was tested for inter-rater reliability and a frequency analysis was undertaken on 500 ROSIS incident reports. Datasets were defined for the classification.

The ROSIS Departments represent about 150,000 patients, 343 megavoltage (MV) units, and 114 Brachytherapy units. On average, there are 437 Patients per MV unit, 281 per Radiation Oncologist, 387 per Physicist and 353 per Radiation Therapy Technologist (RT/RTT). Only 14 departments have a completely networked system of electronic data transfer, while ten

departments have no electronic data transfer. On average seven quality assurance (QA) or quality control (QC) methods are used at each department. A total of 1,074 ROSIS reports were analyzed; 97.7% relate to external beam radiation treatment and 50% resulted in incorrect irradiation. Many incidents arise pre-treatment, but are not detected until later in the treatment process. Where an incident is not detected prior to treatment, an average of 22% of prescribed treatment fractions were delivered incorrectly. The most commonly reported detection methods were "found at time of patient treatment" and during "chart-check".

From the hazard identification frequency analysis, the most common hazards were related to dose (32%), target volume (31%), and accessories (20%).

A classification system was developed with four main classes – Event/Occurrence, Outcome, Causes/Classification, and Detection. With the exception of the category "Treatment Preparation", the process classification showed good inter-rater reliability (Pearson Chi-Square 8.134, p=0.616). Most incidents originated in the pre-treatment stages of the RO process (359 of 500). The most commonly reported incorrect parameters were the position of the isocentre within the patient, and the field geometrical parameters.

Datasets were defined for the classification, and dynamic web-forms were developed encompassing these datasets to enable classification of information at source by the reporter. Recommendations for analyses are made based on the additional information and/or detail to be obtained from these forms.

The feasibility of the ROSIS system is demonstrated. While the majority of the incidents reported are of minor dosimetric consequence, they affect on average more than 20% of the patient's treatment fractions, despite defence-in-depth being apparent – indicating a need for further evaluation of the effectiveness of quality controls. This may be facilitated through the standardized collection of detailed information on the origin and detection of incidents, as proposed by the ROSIS classification. The incorporation of the classification into dynamic forms should facilitate the prospective collection of the classification dataset, but should be evaluated for validity and reliability. ROSIS can improve its analysis and feedback, ensuring lessons learned are disseminated to the RO Community.

References to author publications that relate specifically to the dissertation:

Cunningham J, Coffey M, Knöös T, Holmberg O: Radiation Oncology Safety Information System (ROSIS) – Profiles of participants and the first 1074 incident reports. *Radiotherapy and Oncology* 2010, 97(3):601-607.