

# Best-Practice Guidelines for Radiation Treatment Plan Physics

## Review: Report of the Ontario Provincial Working Group

A. RINK<sup>1</sup>, G. SALOMONS<sup>2</sup>, A. VANDERMEER<sup>3</sup>, L. CONROY<sup>1</sup>, D. GRANVILLE<sup>4</sup>, J. GAUL<sup>5</sup>, T. MUTANGA<sup>6</sup>, M. PAUDEL<sup>7</sup>, R. JIANG<sup>8</sup>, J-P. BISSONNETTE<sup>1</sup>, J. KRAUS<sup>9</sup>, H. KELLER<sup>1</sup>

<sup>1</sup> The Princess Margaret Cancer Centre, Toronto, Canada, <sup>2</sup> Cancer Centre of Southeastern Ontario, Kingston, Canada, <sup>3</sup> R.S. McLaughlin Durham Regional Cancer Centre, Oshawa, Canada, <sup>4</sup> The Ottawa Hospital, Ottawa, Canada, <sup>5</sup> Windsor Regional Hospital, Windsor, Canada, <sup>6</sup> Credit Valley Hospital and Trillium Health Centre, Mississauga, Canada, <sup>7</sup> Sunnybrook Odette Cancer Centre, Toronto, Canada, <sup>8</sup> Grand River Hospital, Kitchener, Canada, <sup>9</sup> Ontario Health, Toronto, Canada

## INTRODUCTION

- Ontario Health (Cancer Care Ontario) Physics Community of Practice (CoP) tasked with defining Quality-based procedures (QBP) for radiation treatment plan review
- radiation treatment is a complex process involving many medical personnel, equipment, software, data and information transfer between staff and systems
- many instances where errors can be made, with potential to propagate to patient treatment
- high potential severity incidents were analysed to determine which quality control measured could detect the associated errors<sup>1</sup>
- the most sensitive measure was the pre-treatment physics plan review, aka *plan checking* or *chart checking*, with a detection of >60%
- medical physicists are uniquely positioned to understand the potential errors in the entire process of treatment planning, from imaging to execution, and be able to detect them through plan review
- treatment plan review by a qualified medical physicist is an integral part of the treatment planning process, and *must be completed prior to the start of treatment*
- the scope of this plan review does not include weekly or monthly chart checks while patient is on treatment

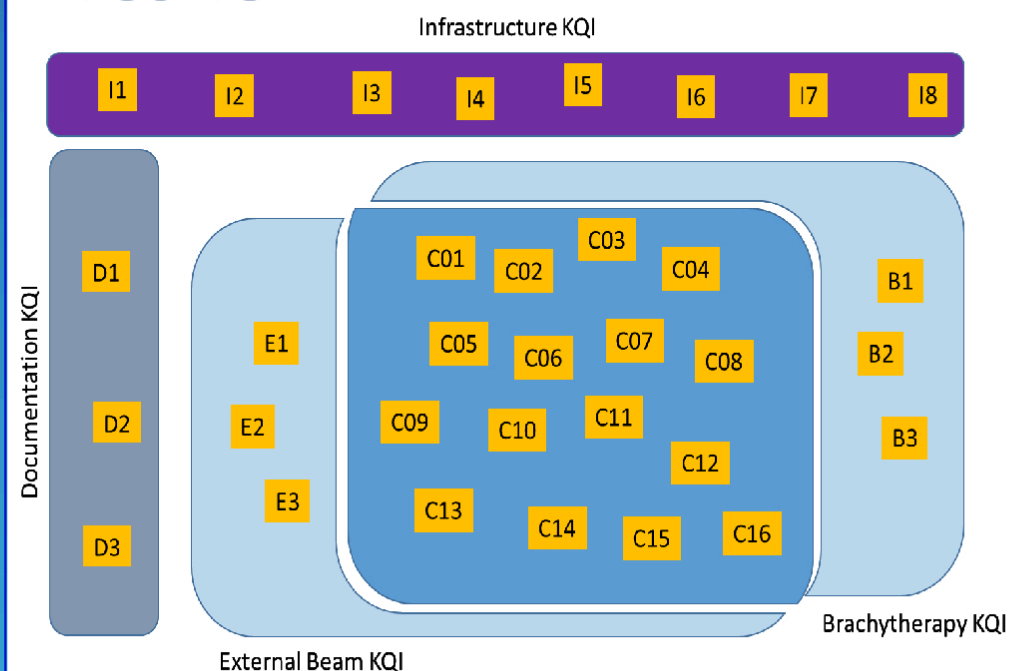
## AIM

- primarily, to generate best practice guidelines to facilitate standardization of physics plan review in preparation for the introduction of a provincial QBP funding model
- secondly, to provide Medical Physics training and education to achieve primary objective

## METHOD

- working group of eleven medical physicists
- external beam (EBRT) and brachytherapy (BT) background
- representation from eight different institutions (academic and community centers)
- reviewed literature on existing guidelines and peer reviewed publications to create a list of best practice recommendations in the form of Key Quality Indicators (KQIs)
- clinical experience and expertise of the group members used in absence of published recommendations
- lists of failure modes for photon/electron EBRT and gynecological high dose-rate BT described in AAPM Task Group 275 (TG 275, tables S1.A.i and S3.A.i, respectively)<sup>2</sup> were used to check whether resulting recommended chart review can catch these errors
- Identified failure modes not detectable during physics review or those to be checked after start of treatment include, but are not limited to “incorrect or missing pathology”, “treatment not recorded in record and verify or paper chart”, “infection”, “proper signatures not obtained”, etc.

## RESULTS



KQI	Table 1: Infrastructure
I1	A) Percentage of chart checking physicists that are Qualified Medical Physicists (QMP) or B) percentage of charts that are checked by QMPs.
I2	Chart checking follows a well-defined procedure that is outlined in institutional policies.
I3	A Health Canada Approved Treatment Planning System is used to generate the plan.
I4	The treatment planning system is commissioned following accepted guidelines.
I5	A secondary dose or monitor unit calculation is performed using a software that is commissioned according to accepted guidelines.
I6	Standardized nomenclature is established and consistent across EBRT and Brachytherapy
I7	Radiation treatment centres follow well-defined procedures to ensure correct data transfer between treatment planning, record & verify, treatment delivery, and secondary dose verification systems.
I8	A feedback learning system for chart checking is in place.

KQI	Table 2: Combined EBRT and BT
Patient Assessment and Treatment Prescription	
C01	The patient identifiers in the treatment plan are verified against the patient identifiers in the institution's Electronic Medical Record (EMR).
C02	Previous irradiation, pacemaker, and pregnancy status (if applicable) are identified.
C03	Treatment intent is documented and meets institutional policies.
C04	The prescription is assessed against accepted guidelines and/or institutional policies or follows the study protocol.
Simulation	
C05	The primary dataset is reviewed and assessed for image quality.
C06	Documentation on patient setup instructions and supporting devices is assessed.
Treatment Planning	
C07	Selection and registration of all planning image datasets are reviewed.
C08	The prescription in the plan is assessed against the prescription approved by the oncologist and laterality for paired sites is documented.
C09	Any ROI structure that is used in the planning process is checked for nomenclature, integrity, and appropriateness according to institutional planning protocols.
C10	Prior radiation and its dose distribution (if applicable) are accounted for.
C11	Plan parameters are assessed and are appropriate.
C12	Spatial dose distribution and dosimetric parameters to targets and OARs are assessed and meet institutional plan quality goals as well as quality expected for the individual patient.
Dose Verification	
C13	Independent dose calculation is performed.
C14	Patient specific QC is performed according to institutional policies.
Data Transfer between systems	
C15	Plan and all parameters transferred to the RT-EMR or delivery unit are checked for accuracy.
C16	All plans are reviewed and approved as per institutional policy prior to the start of radiation delivery.

KQI	Table 3: EBRT
Image Guidance	
E1	Motion management instructions and parameters (gating, breath hold) are assessed for completeness and appropriateness for the planning and treatment technique.
E2	Image guidance instructions are assessed for completeness. Reference image transfer and/or transfer of DRRs is verified, if applicable.
Safety	
E3	Potential for treatment machine collision with the patient is assessed prior to treatment.

KQI	Table 4: BT
B1	Review of verification images for applicator placement is performed, if applicable.
B2	Review of applicator/needle reconstruction is performed.
B3	Pre-treatment QA for HDR/LDR is performed.

KQI	Table 5: Documentation
D1	Record of treatment details in patient chart is assessed for completeness as per institutional policies.
D2	Record of patient-specific QA (PSQA) is assessed for completeness as per institutional policies.
D3	Record of deviations from institutional policies is assessed for completeness and signed off by a physician.

- list of 33 KQIs was generated
- five main categories of Infrastructure, Combined EBRT and BT, EBRT, BT, and Documentation (Tables 1 - 5).
- binary outcome of 0 or 1 (except I1, which has 0-100%), allowing for an easy assessment of institutional plan review procedures
- significant overlap in KQIs between EBRT and BT, underscoring similarity between two practices
- 5/46 and 13/53 failure modes in TG 275 S1.A.i and S3.A.i tables were not detectable by pre-treatment physics chart check
- the remaining 41/46 (89%) and 40/53 (75%) of failure modes would be detected by the plan review according to the new provincial guidelines

## CONCLUSIONS

- Physics CoP created a tool for assessing and improving quality and education of radiation treatment plan physics review and for standardization across different institutions
- TG 275 high failure modes were used to validate the provincial guidelines
- All detectable failure modes identified by TG 275 would be detected using physics pre-treatment chart review

## REFERENCES

- 1 **Ford et al.** Quality control quantification (QCQ): A tool to measure the value of quality control checks in radiation oncology. *Int J Radiat Oncol Biol Phys* 2012; 84(3): e263-e269
- 2 **Ford et al:** Strategies for effective physics plan and chart review in radiation therapy: Report of AAPM Task Group 275. *Med Phys*, accepted 8 January 2020

## CONTACT INFORMATION

Harald.Keller@rmp.uhn.ca