Canadian Partnership for Quality Radiotherapy

Guidance on the Use of Common Nomenclature in Canadian Radiation Treatment Programs

A guidance document on behalf of:

Canadian Association of Radiation Oncology

Canadian Organization of Medical Physicists

Canadian Association of Medical Radiation Technologists

Canadian Partnership Against Cancer

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Preface

Approximately 50% of all incident cases of cancer require radiation treatment at some point during the management of the disease [4]. In Canada, it is estimated there will be approximately 225, 800 new cases of cancer in 2020 [16] and around 103, 551 courses of radiation treatment were administered in 2017 (data from the Canadian Association of Radiation Oncology (CARO) biannual human resource survey of Canadian radiation oncology programs). There are currently 48 radiation treatment facilities in Canada.

The Canadian Partnership for Quality Radiotherapy (CPQR) is an alliance amongst the three key national professional organizations involved in the delivery of radiation treatment in Canada: CARO, the Canadian Organization of Medical Physicists (COMP), and the Canadian Association of Medical Radiation Technologists (CAMRT), together with financial and strategic backing from the Canadian Partnership Against Cancer (CPAC), which works with Canada's cancer community to reduce the burden of cancer on Canadians. The vision and mandate of the CPQR is to support the universal availability of high quality and safe radiotherapy for all Canadians through system performance improvement and the development of consensus-based guidelines and indicators to aid in radiation treatment program development and evaluation.

This document provides guidance for radiation treatment programs on how to implement and use common nomenclature related to clinical, dosimetric, and treatment data. Elements included in the document complement key quality indicators contained within the CPQR *Quality Assurance Guidelines for Canadian Radiation Treatment Programs* and are designed to benefit the care of individual patients and improve quality and system performance through harmonized care and improvements to the care process. This document is one in a suite of guideline documents created by the CPQR that include:

- *Quality Assurance Guidelines for Canadian Radiation Treatment Programs* outlines the overarching elements of quality that are important in all radiation treatment programs, together with key quality indicators (KQI)s for periodic programmatic self-assessment and quality improvement;
- The suite of *Technical Quality Control Guidelines for Canadian Radiation Treatment Programs* outlines key elements of radiation treatment technology quality control;
- *National System for Incident Reporting – Radiation Treatment Minimum Data Set*, which provides guidance for reporting radiation treatment incidents nationally and helps users navigate the National System for Incident Reporting – Radiation Treatment (NSIR-RT) database managed by the Canadian Institute of Health Information (CIHI);
- *Patient Engagement Guidance for Canadian Radiation Treatment Programs*, which outlines overarching elements of quality that are important to ensure that patients and family members are engaged in the care process and satisfied with both the process and outcomes of care;
- *Patient Education Guidance for Canadian Radiation Treatment Programs*, which provides guidance on activities radiation treatment programs can incorporate to ensure that patients and family members are adequately and appropriately educated in their care; and

- *Guidance on the use of Patient Reported Outcomes in Canadian Radiation Treatment Programs*, which provides guidance for radiation treatment programs on how they can enhance and optimize the collection and use of patient reported outcomes (PROs) in routine clinical practice.

When considered together, these documents address all aspects of quality and safety related to radiation treatment delivery. All CPQR documents are considered living documents and are reviewed and revised at regular intervals by the CPQR to maintain relevance in the Canadian radiation treatment environment.

Ownership of CPQR documents resides jointly with the national professional organizations involved in the delivery of radiation treatment in Canada – CARO, COMP, CAMRT and CPAC. All documents can be accessed online at www.cpqr.ca.

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Abbreviations and Definitions

Abbreviations	
AAPM	American Association of Physicists in Medicine
ASTRO	American Society of Radiation Oncology
CAMRT	Canadian Association of Medical Radiation Technologists
CARO	Canadian Association of Radiation Oncology
CBRTDI	Canadian Big Radiotherapy Data Initiative
COMP	Canadian Organization of Medical Physicists
CPAC	Canadian Partnership Against Cancer
CPQR	Canadian Partnership for Quality Radiotherapy
DICOM	Digital Imaging and Communication in Medicine
DVH	Dose Volume Histogram
ESTRO	European Society for Radiotherapy and Oncology
ICR	Implementing Common Nomenclature
IGRT	Image Guided Radiotherapy
OAR	Organs at Risk
PTV	Planning Target Volume
RTOG	Radiation Therapy Oncology Group
SBRT	Stereotactic Body Radiotherapy
SRS	Stereotactic Radiosurgery
TPS	Treatment Planning Systems
Definitions	
Big Data	A process that systematically extracts information from, analyses or deals with data sets that are too large or complex to be dealt with by traditional
Cancer Program	The multidisciplinary cancer program that encompasses the radiation treatment program
Organization	The hospital, cancer centre, or institution in which the radiation treatment
Radiation Treatment Program	The personnel, equipment, information systems, policies and procedures, and activities required for the safe delivery of radiation treatment according to evidence-based and/or best practice guidelines
Resources	Educational resources such as written materials, online materials or educational classes
Standardization	The process of making things of the same type have the same basic features.
TG-263	American Association of Physicists in Medicine (AAPM)'s Task Group (TG)-263 guideline for Standardizing Nomenclatures in Radiation Oncology

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1. Introduction

The assessment of radiation treatment plan variability through the collection and analysis of data can help identify appropriate opportunities to reduce unnecessary clinical variation, while respecting the balance between process standardization and individualized care [14]. Moreover, given recognition that variability in radiation treatment plan quality can affect patient outcomes [15], efforts are currently underway in Canada and around the world to promote standardization of radiation treatment nomenclature, data sets and procedures. Supporting the harmonization of radiation treatment practice in Canada, the CPQR established the Canadian Big Radiotherapy Data Initiative (CBRTDI). The CBRTDI aims to encourage uptake of standardized nomenclature in Canadian radiation treatment programs to improve consistency in treatment planning and local quality assurance, and as an incremental step towards future pan-Canadian data sharing and data analysis efforts. Through the introduction of standardized nomenclature, automated approaches for extracting data from electronic records become possible for quality improvement and research initiatives, while also introducing efficiencies that improve the local clinical experience and facilitate shared learning. Guidance provided by the CBRTDI takes considers international efforts such as:

- The American Association of Physicists in Medicine (AAPM)'s Task Group (TG)-263 guideline *Standardizing Nomenclatures in Radiation Oncology* [10];
- Consensus papers from the American Society of Radiation Oncology (ASTRO) recommending standardized normal tissue contouring [6] and a standardized minimum data set (MDS) for radiation treatment plans [7];
- The Commission on Cancer Workgroup's multidisciplinary consensus recommendation for synoptic radiation treatment summaries [2]; and
- Ongoing work being undertaken by the AAPM Subcommittee 263 (SC-263) which oversees the extension of TG-263 nomenclatures and the addition of non-English versions.

In addition to providing guidance on standardizing nomenclature of structures, as per the American Association of Physicists in Medicine (AAPM) Task Group 263 (TG-263), this guidance document describes approaches for overall management of the nomenclature standardization process, including information on how radiation treatment programs can incorporate appropriate evaluation and benchmarking protocols. Standardization of nomenclature for radiation treatment plan and course names, structure sets and reference points are considered beyond the direct scope of this document; however, Appendix A outlines possible approaches to introducing naming standardization within radiation treatment programs, as well as additional project management resources for departmental implementation, components also beyond the current scope of TG-263.

2. Benefits of Nomenclature Standardization

Although the long-term motivation for the CBRTDI's guidance is preparing for future pan-Canadian data sharing, nomenclature standardization has immediate tangible benefits for individual Canadian cancer

centre workflows. Facilitating clear case-based communication is particularly beneficial within Canada, where public healthcare funding and provincial-level administration of cancer care services may lower some barriers to a patient being treated with radiation therapy at multiple centres. Understanding all the benefits (Table 1) can help promote transitioning to nomenclature standardization.

Table 1. The major benefits of nomenclature standardization.

Individual centre workflows	Case-based clinical data sharing between centres	Big Data initiatives
Increased consistency, improved communication, and reduced likelihood of adverse incidents in treatment planning. Facilitation of automation for treatment planning and plan Quality Assurance (clinical templates/protocols, treatment planning system scripting). Improved quality of broad treatment plan analytics and departmental reporting.	Coherent sharing of treatment plan data in instances of inter-centre patient retreatment. Improved communication for inter-centre case-based peer reviews and process audits.	Facilitation of inter-centre data aggregation, allowing for comparison of clinical approaches across Canada and identification of treatment plan predictors of outcomes at larger scales.

2.1 Treatment Plan Consistency and Quality Assurance

The planning and delivery of safe and effective radiation treatment is a complex process requiring clear communication between multidisciplinary teams. By reducing the potential for ambiguities and subsequent miscommunication, which are major sources of adverse events in multidisciplinary clinical workflows [3,6], improvements in treatment plan quality and patient safety are likely to be realized. Such standardization also facilitates improved plan quality assessment, as deviations from established conventions become easier to detect during the plan review process. The communication-related benefits of standardized nomenclature also extend to treatment delivery, where consistency promotes clarity and efficiency for the front-line therapy team (e.g. clear communication of structures to use as image-guided radiotherapy (IGRT) references) [6].

2.2 Treatment Planning Automation

Standardized naming of treatment plan objects (e.g. structures) is required to maximize the utility of several types of treatment planning automation tools as described below. For radiation treatment

programs, these automation tools offer potential gains in planning efficiency and consistency compared to manual preparation.

First, most treatment planning systems (TPS) allow the use of customizable clinical templates and protocols that can be developed and employed without the need for specialized software expertise. Structure set templates can be used to immediately produce structures with standardized names, removing the onus on the planner to manually create them according to departmental naming guidelines. TPS templates and protocols for treatment planning may also include the automated generation of optimization goals for inverse planning and dose volume histogram (DVH) metrics for plan reporting. However, the effectiveness of these tools is dependent on the existence and application of a consistent structure naming convention.

Second, the ability to use scripting to modify elements of treatment plans is supported in the current generation of TPSs from all major vendors. Such TPS scripting, while requiring specialized software skills supplementary to typical front-end TPS use, allows for greater flexibility than that offered by clinical templates in developing tools for the automation of treatment planning and plan quality assurance (QA). The development and application of clinical scripting tools requires consistent nomenclature of treatment planning objects.

Third, to accelerate the planning process, there are now commercially available tools such as automated segmentation based on structure atlases and knowledge-based inverse optimization, which uses libraries of prior treatment plans. However, to build the prior knowledge libraries that are required by these tools, consistency in the input data, including standardized nomenclature, is a prerequisite. Moreover, the standard labelling of input data is a requirement when training machine learning models, which are growing in importance in radiation oncology with the advent of novel artificial intelligence approaches to treatment planning automation.

2.3 Big Data Sharing

Non-standardized radiation treatment data poses significant challenges not only to radiation treatment quality and efficiency within a single centre, but also for large-scale efforts aiming to assess RT clinical practice patterns and variability across centres. While respecting the balance between process standardization and individualized care, the assessment of radiation treatment plan variability through the collection and analysis of aggregate multi-centre data can help to identify appropriate opportunities to reduce unnecessary clinical variation [18], which may exist for a variety of reasons (e.g. historical precedent, practitioner preference, differential integration of new clinical evidence). Moreover, analyses of large pools of shared data between centres have been shown to be effective in explaining new clinical evidence, as has been routinely demonstrated by multi-centre clinical trials. Big Data approaches for inter-centre data sharing are of growing interest in the field of radiation oncology [1,12], probing not only conventional radiation therapy data, but also emerging sources of data such as radiomics, biomarkers, patient-reported outcomes, etc. However, the promise of such Big Data initiatives hinges on the ability to effectively pool and share large amounts of clinical radiation therapy data between institutions.

Standardized nomenclature can help facilitate such large-scale data sharing and may allow these initiatives to aggregate larger patient data sets in shorter data collection periods than traditional clinical trials.

3. Radiation Treatment Planning Nomenclature Standardization

Most of the clinically-relevant information about the treatment planning objects (e.g. plans, structures, beams, etc.) can be accessed directly from the TPS front-end, queried from the TPS database, or parsed from the relevant exported *Digital Imaging and Communication in Medicine* (DICOM) RT objects. However, the geometric and anatomical information associated with contoured structures cannot be easily distilled into simple object parameters within the TPS. For these objects, a standardized nomenclature such as that developed in the TG-263 report is necessary to relate numerical polyline structure data to the underlying represented anatomy.

3.1 Nomenclature Recommendations

3.1.1 Structures

While a comprehensive review of TG-263 is beyond the scope of this document, the CBRTDI has chosen to provide discussion on several important TG-263 structure naming recommendations to facilitate their integration into Canadian radiation therapy planning practice.

1. Organs at risk (OARs): Centres should endeavour to follow the recommended TG-263 nomenclature for OARs (TG-263, Section 7.2). TG-263 recommends using a 'Primary Name' format whereby the structure categorization proceeds from general to specific with laterality on the end, reading left to right. Certain radiation treatment programs may prefer the 'Reverse Order Name' format with laterality characters preceding organ name (e.g. R_Hilum_Kidney versus Kidney Hilum_R) to ensure that sufficient information can be displayed to safely identify the correct structure if the vendor system limits the number of characters displayed (e.g. R_Hilum_Ki). The TG-263 recommendation that partially contoured OAR structures (e.g. serial OAR only contoured in region proximal to the target volumes) be identified using the '~' prefix is endorsed by the current working group.

2. Target volumes: Target volumes should follow a logical and self-consistent naming schema that is standardly applied among all physicians within a practice. We recommend adoption of TG-263's *guiding principles* (TG-263, Section 8.2) for target naming.
    a. Segmented and non-segmented target structures: In treatment plans involving multiple dose levels, it is critical to define whether the lower dose planning target volume (PTV) excludes (segmented) or includes (non-segmented) the higher dose PTV volume so that DVH metrics may be compared accurately when pooling multi-centre data. TG-263 recommends the use of non-segmented target structures as default for reporting but recommends a '!' character suffix to define segmented volumes when they are used (e.g. PTV_5000!).

b. Multi-dose targets**:** In treatment plans involving multiple dose levels, TG-263 suggests using relative dose descriptions for targets (e.g. PTV_High, PTV_Mid, PTV_Low). Use of relative dose levels over numerical dose levels is preferred by TG-263 as it allows greater flexibility when employing plan standardization tools in scenarios where the dose to be delivered is altered from the original prescription. It also simplifies searching databases to correctly identify the target. If centres choose to follow this approach, it is recommended that multi-level dose prescriptions are entered in the TPS where available. If radiation treatment programs opt to use numerical values for the physical dose instead, units of cGy are recommended by TG-263 (e.g. PTV_5000).

3. Non-dose evaluation structures: The names of structures that are not used for dose evaluation (e.g. optimization structures) are left to the planner's discretion. However, recognizing that these structures can pose a safety risk if they are confused with the structures used for dose evaluation (e.g., PTV, versus PTVHot or PTVCold), a single character prefix may be applied to these structures in order to ensure that they appear at the end or beginning of an alphabetically-sorted list. TG-263 suggests 'z' as a prefix (e.g. zPTVHot, zPTVCold).

4. Geometric information: Geometric parameters providing information about a structure that may otherwise be difficult to retrospectively retrieve from the TPS should be explicitly included in the structure's name where possible without causing undue confusion. A primary example is the expansion margins used in the creation of PRV and PTV volumes. For PRVs, uniform expansion margins should be expressed in millimetres with 2 digits (e.g. Brainstem with 5 mm PRV margin, versus Brainstem_PRV*05*). If such information is excluded from the structure name to facilitate planning automation with fixed clinical templates or protocols, or if non-uniform margins are used, efforts should be made to communicate this information by including the full TG-263 name or margin description in another one of the structure's property fields (e.g. secondary identifier, comments, etc). Due to the potential complexity of PTV suffixes (e.g. multi-dose levels, spatially distinct targets in the same plan), it is recommended that the expansion margin information be communicated using an alternate property field.

5. Consistency across disease sites: A structure's name should be consistent regardless of the plan's treatment site (e.g. "Femur_Head_L" would be the correct label in both prostate and bladder plans). For treatment plans that are part of a clinical trial that employs a non-TG-263 naming scheme, centres may consider using their standard TG-263 nomenclature during the planning process, and apply structure name translation to any exported data (e.g. modification of structure names within an exported structure set DICOM) prior to trial submission, where possible.

3.2 Contour Standardization

It is important to note that the benefits of standardized structure nomenclature are dependent on having standardized methods for defining/delineating the structures themselves. Development of such structure delineation standards is more straightforward for OARs than for target volumes due to less observer and patient-specific variability of visible anatomical boundaries. Detailed structure delineation standards are often included in clinical trial protocols, and published atlases from groups such as ASTRO, the Radiation

Therapy Oncology Group and the European Society for Radiotherapy and Oncology provide contouring guidance for some treatment sites. In Canada, some structure delineation standards exist at the local, regional, and provincial levels, and initiatives such as the Anatomy and Radiology (ARC) Bootcamp [8] aim to help standardize structure contouring nationally. While the development of these resources underscores the importance of standardized structure delineation, the current slate of resources does not offer a coherent and comprehensive reference. Developing such a definitive structure reference represents an admirable challenge that is beyond the scope of this guidance document, but it is ultimately necessary to ensure both the consistency of individual clinic treatment plans and the effectiveness of national data-sharing efforts.

3.3 Tumour Diagnosis, Stage, And Laterality

Diagnosis, staging and laterality are key categorization factors for almost every application of clinical data. It is critical that standardized diagnosis codes (e.g. ICD-10) and tumour stage from up-to-date coding systems (e.g. the American Joint Committee on Cancer-AJCC) be systematically included into the oncology information system, or TPS directly, and used clinically along with patient-specific laterality information.

While use of diagnosis codes may be straightforward for most disease sites, there is risk of confusion and therefore unnecessary data variability in certain clinical contexts. For example, the correct code for the diagnosis of a metastasis is the metastatic site (e.g. secondary malignant neoplasm of bone C79.5) and not the primary site (e.g. malignant neoplasm of prostate C61). Treatment site information that can be included within course names, as outlined in the Appendix, is likely to be insufficient for proper disease categorization.

It should be noted that inclusion of these diagnosis codes, when coupled with treatment site information in the course name and treatment plan information contained within the TPS (e.g. dose, fractionation, radiation modality, treatment technique, start and end dates of treatment course), would satisfy ASTRO's recent recommendations for the minimum data elements in radiation oncology [7].

3.4 Considerations for Encoding Information for Big Data Sharing

The potential power of Big Data analytics in radiation treatment will ultimately be realized with the ability to recognize patterns based on the integration of data from precise disease categorization (diagnosis and stage), patient outcomes (local control, survival, clinician and patient-reported outcomes) and treatment planning/delivery metrics.

For Big Data endeavours specifically, the mechanics of sharing treatment planning information may involve the sharing of DICOM-RT objects (e.g. plans, images, structure sets, dose volumes, etc.). Although most modern TPSs are DICOM-RT conformant, the treatment planning information contained within exported DICOM-RT objects is not a complete representation of the information contained within the TPS

itself. Efforts to use naming schemes to encode information that might otherwise be missing from the DICOM data (e.g. the margin size used to create a planning organ at risk volume, PRV) must be balanced against the need to maintain flexibility for automated plan analyses (e.g. evaluating a "PRV" structure against a basic template of structure-defined DVH goals). This balance is particularly important when considering the incorporation of parameters that may have some case-to-case variability into object names. Consequently, continued improvements to TPS vendor support of DICOM-RT support are likely to aid in ensuring the inclusion of all pertinent information in exported DICOM-RT objects in a manner that better facilitates automation.

4. Management of The Nomenclature Standardization Process

The successful clinical implementation of standardized nomenclature involves a coordinated effort by all personnel that interact with the treatment records of radiation therapy patients. Initiation of the implementation effort should involve local leaders communicating the rationale and benefits of common nomenclature to all stakeholders in order to build buy-in for the change. This can be accomplished through the distribution of reference materials, such as the present document, and the use of face-to-face information sessions.

4.1 Establishing a Multidisciplinary Implementation Team

A multidisciplinary implementation team is best placed to facilitate a safe and timely adoption process for standardized nomenclature [10]. The most important task for the administration is to prioritize and decide how the limited resources of the radiation treatment program can be best allocated to facilitate the process. Managers are in the best position to provide support where needed and to promote compliance. Recruitment of a local project manager and staff champions (medical physicists, radiation oncologists, radiation therapists) to provide training and guidance to the team would ensure that the project is well structured and bound for success [5]. The team's mandate should be clearly defined, and staff champions can help ensure that change is fully carried through. As deliberations become more clearly defined, particular topics may be best discussed by focus groups with in-depth knowledge of specific implications (e.g. the impact of nomenclature standardization on operations involving auxiliary treatment planning systems such as brachytherapy/SRS, the potential effect on provincial data reporting, and on adaptive planning/retreatment scenarios). Appendix B identifies the key stakeholders who should be included in the multidisciplinary implementation team.

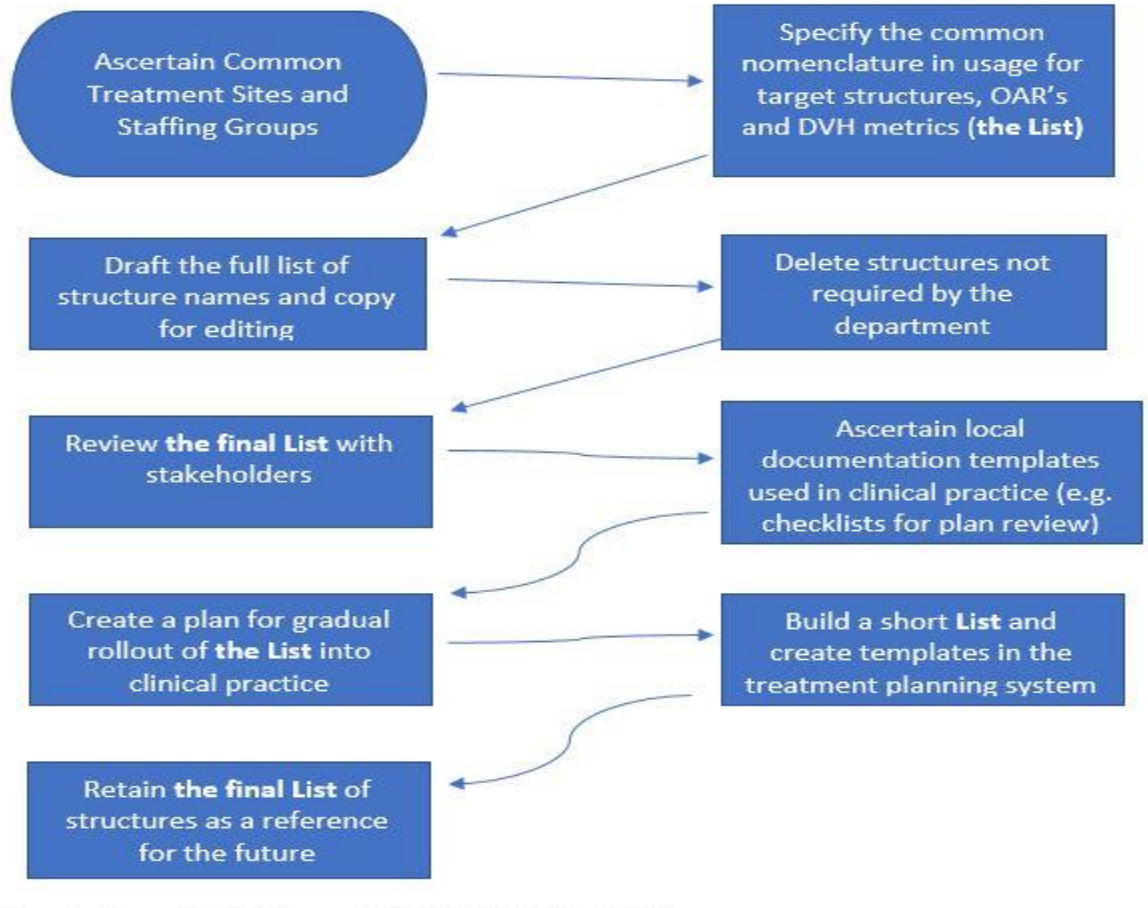
4.2 Implementation of a Standardized Nomenclature Project

The CBRTDI working group considers the following to be key elements for successful implementation of standardized of nomenclature in Canadian radiation treatment programs:

- Review of current nomenclature and associated processes/procedures of the local radiation treatment program;
- Review of the CPQR, TG-263 and ASTRO recommendations (e.g. structure nomenclature);

- Creation of an implementation plan (See Figure 4.1), setting realistic and achievable goals and timelines [10];
- Identification of what is needed in terms of standardization tools (e.g. associated templates, procedures, checklists to be created or modified);
- Assignment of tasks to working groups or site groups, with appropriate overlap to ensure harmonization of nomenclature that is common across site groups, and appropriate follow-through;
- Provide adequate training and continuing support to all staff;
- Measure and assess compliance, perceived barriers and facilitators; and
- Refinement of the project/process based on feedback.

Figure 4.1 – Overview of a plan for implementation of standardized nomenclature in a radiation treatment program [10].



4.3 Project Management During Implementation

Project management can be organized into five process clusters: initiating, planning, executing, monitoring and controlling, and closing [9]. There exist several models for improvement that have been tested in the healthcare setting. These methods can serve as valuable tools when initiating a nomenclature standardization project and to track progress methodically throughout. While the models for improvement differ in emphasis and subparts, all have the following elements in common: aims, measures, ideas for change, and cumulative testing. The choice of method depends on the local expertise, the scope of the project and team dynamics. While any model can be chosen to implement the change, it is helpful to stick to a single model in order to follow a logical sequence of steps and help team members work collaboratively towards their goals [9].

A key tool for programs to consider for use in their nomenclature standardization project implementation is a project charter. A project charter is an underpinning record that properly recognizes the presence of a project and increases the project's likelihood of success [17]. A project charter is a helpful tool in clarifying the purpose, scope, measures and targets of the project at the outset [9]. In addition, it identifies key members of the team and can be used to plan the project, communicate with leadership, and keep track of the changes being made. See Appendix C for an example of a project charter that may be used to implement a nomenclature standardization project.

5. Evaluation and Benchmarking

An important part of any quality improvement project in a busy clinic is measuring and auditing the compliance of the project's new operating procedures [13]. This is essential for a project with a large impact such as nomenclature standardization.

In the initial stage, it is critical to have an implementation plan that includes objectives used to define the scope of the project [17]. It is important to define key indicators that are measurable from these objectives and define success. Balancing factors must be considered to ensure other areas of the clinical operation are not affected negatively with the nomenclature standardization implementation.

5.1 Auditing Compliance of the Project

Project success relies on auditing of compliance and refinement of processes based on results and team member feedback. The use of chart rounds is one example of a forum available to discuss the success or challenges of the new nomenclature/data set standardization initiative [20,11][11]. Having a score of compliance for randomly selected plans and then sharing this information with the project team can show the compliance rate.

Robust metrics for all types of planning are advantageous for data analysis. Such metrics can include staff satisfaction surveys and online staff feedback forms to measure compliance, uptake, workload measurement activities, and training challenges. These actions would give concrete indicators and the impact of a standardized nomenclature project [11].

Conclusion

The CBRTDI was formed by the CPQR with a long-term goal of facilitating efforts towards pan-Canadian sharing of radiation treatment data. This document is the CBRTDI's first step in that process, providing guidance on nomenclature standardization through the endorsement of international efforts (AAPM, ASTRO) and practical recommendations

Appendix A - Secondary Suggestions for Treatment Plan Object Naming

It is acknowledged that suggestions provided below may be subject to change in order to coalesce with forthcoming recommendations from the multinational SC-263 committee. The CBRTDI did, however, consider it critical to discuss how radiation treatment programs may approach standardization of radiation treatment plan components beyond the current scope of TG-263, recognizing an information gap awaiting SC-263's follow-up report to TG-263.

A.1 Plan Names

Since the vast majority of treatment plan information is explicitly contained within the TPS as discrete parameters, sensible treatment plan names can largely be left at the planner's discretion, often using elements of the treatment site or beam arrangement such as, "Prostate", "LUNG_L", "APPA", "VMAT. Naming suggestions are provided for a few scenarios below, but centres are encouraged to continue following any established local plan naming schemes that promote clarity and are employed consistently as follows:

1. When a treatment course has plans for multiple sites to be delivered concurrently (particularly in the absence of individually-associated TPS prescriptions), the plan names may benefit from consistent inclusion of their respective treatment site description (e.g. "Breast_L", "Sclav_L").
2. When a treatment course has plans to be delivered in multiple sequential phases, a 'PH#' prefix may be used to distinguish between phases (e.g. PH1_Breast_L, PH1_Sclav_L, PH2_Boost) unless otherwise differentiated in the TPS (e.g. under individual prescriptions).
3. When a minor plan revision considering *unchanged* patient anatomy/geometry (e.g. same reference image volume) is required after the start of the course delivery and the new plan is not named automatically according to a TPS revision scheme, an ':R#' or ':RV#' suffix may be considered.
4. When a significant replan considering *modified* patient anatomy/geometry (e.g. replan associated with a new and unique reference image) is required after the start of the course delivery, including adaptive planning scenarios, the new plan name should follow the standard

suggestions above, and the inclusion of a prefix/suffix to identify the replan (e.g. 'rp') may be considered.

A.2 Reference Points

To avoid TPS warnings and errors that may occur due to identically-named reference points existing in multiple courses and plans for the same patient, the use of the course number and phase number, where applicable, prefixes are suggested (e.g. 'C1_iso', 'C2_PH1_norm'). While the aim of standardized nomenclature for the following treatment planning objects is to provide clarity and consistency, unequivocal verification of important clinical information should involve direct examination of any associated planning parameters within the TPS, should they exist. For example, the location of a reference point 'iso' should not be assumed to match the location of a treatment beam isocenter when the coordinates of the respective locations can be explicitly verified.

A.3 TPS-Generated Image Volume Names

Using a consistent naming scheme may help to avoid confusion when dealing with multiple image volume objects created within a TPS for a single patient. Therefore, the following suggestions are offered:

1. Image volume names should include the standard 2-character DICOM modality identifier (e.g. 'CT' for computed tomography, 'MR' for magnetic resonance imaging, 'PT' for positron emission tomography).
2. The image series acquisition date ('YYYYMMDD') is encouraged as confusion can arise in some TPSs due to multiple timestamps (acquired, created, entered, modified) associated with image volumes (e.g. 'CT_20190101').
3. If more than one non-MRI volume with the same modality type from the same date needs to be imported into the TPS, a letter suffix can be used for unique identification (e.g. 'CT_20190101a', 'CT_20190101b').
4. A short MRI sequence description may be useful when importing multiple MRI image series from the same study or date (e.g. 'MR_T1C+_20190101', 'MR_DWI_20190101'). If more than four characters are needed for the sequence description, it may be possible to include the sequence details within a secondary field (e.g. comments field) within the TPS.

A.4 Structure Set Names

Structure sets are inherently associated with a primary image series (often a 3D image volume object within the TPS) via a shared frame of reference unique identifier (UID). However, centres may consider matching the structure set name to that of its associated primary image volume for consistency, following the same suggestions in A.3. This approach may help to avoid confusion in cases where structure sets may be imported or exported from TPSs in the absence of their associated image series data. For example, an exported structure set DICOM with the identifier 'MR_T2_20190314' would convey that the structures were delineated based on a T2-weighted MRI volume should the associated

MRI DICOM image series not be exported as well. Approaches and limitations noted above for image sets are similar for structure sets.

A.5 Course Names

A second piece of treatment planning information that may be absent or incomplete within the TPS is a full accounting of a patient's previously received radiation. In cases of patient retreatment, in which the TPS does not contain the patient's complete radiation history, standardization of course names can help to prevent information loss or confusion.

A standardized course naming scheme using a prefix to indicate the patient's lifetime course number (e.g. 'C2') is a simple way to avoid confusion when patients are retreated. In cases of retreatment, it is often imperative to know all previous radiation received and the complete treatment history may not be available in the current TPS (e.g. previous radiation was delivered at another centre or was delivered locally prior to inclusion in the current TPS database). It is suggested that the lifetime treatment course prefix be combined with a brief treatment-site description (e.g. 'C1_Breast_L') that will adhere to any character limit placed on the course name by the TPS.

For clarity, QA verification plans and supplementary investigative plans by medical physics personnel may be assigned to separate courses from the clinical patient plan and centres may wish to include the associated course number into the names of these QA and physics courses (e.g. 'QA_C1' rather than simply 'QA').

A.6 Replans

For replans, including adaptive planning, structures may be named according to the rules above without modification when using TPSs in which versions of the structures are differentiated at the structure set level. For example, if the structure 'Rectum' exists in the original planning structure set, the replan structure set should also have the 'Rectum' structure as opposed to a modified name such as 'Rectum2' or 'Rectum_replan'. For TPSs that do not allow for different geometries for a given structure name (between different structure sets), a consistent naming approach for replanned structures is encouraged.

Appendix B - Key Stakeholders for A Nomenclature Standardization Implementation Project

Title	Role	Tasks
Medical physicists (MP)	Create and implement nomenclature standards in the department	Interpret AAPM Report TG-263 and other related documents as preparation for the project. This role is critical for data integration, data collection, developing scripts, and clinical protocol templates to allow for trouble-free data sharing between cancer centres and for quality and safety of patients being treated with radiation therapy. To ensure compliance with clinical trial protocols, data sharing with other cancer agencies, and contributing to radiation therapy patient quality and safety databases.
Radiation oncologists (RO)	Provide input and build awareness to keep nomenclature standard in treatment planning templates	Provide input for the naming of target volumes and OAR based upon specified tumour groups. Relate this information to their peers and how this would impact patient workflows based upon palliative/curative intent, clinical trials, and treatment technique. Be informed of the risks to patient safety and data quality if they deviate from the established standards (e.g. not changing structure or target names when contouring).
Dosimetrists /radiation therapists	Give input and communicate downstream the changes for nomenclature in treatment planning data parameters.	Provide input on the workflow and training required for the simulation, treatment planning and treatment delivery components for the project. Workflow and training protocols would need to be developed to ensure that patient quality and safety is maintained. These changes are then communicated and documented so all the clinical radiation therapy staff are aware.
Data/IT analysts	For data support and integrity	Acts as a specific and tangible resource to fix any technical data elements related to the project.
Department manager	Sponsor for project charter, coordinate administrative support for meetings, communication plan, training for staff	Advocate for the proper fiscal, human, and capital resources required from the project sponsor to ensure that the staff are fully onboard with the anticipated changes. Will plan, lead, organize, control these resources required for the project, and help coordinate

		the governance and administration of the project through a matrix reporting system.
Project manager	Local lead to coordinate project plan through milestones and deliverables	An internally trained employee who has taken courses in project management or hired as an external consultant. To implement the parameters addressed in the project charter with as little changes and conflicts as possible. Communicate the vision, values, and stated benefits developed by the core committee. Identify the early adopters and build the momentum for the project.
Admin staff	For updating patient booking protocols in the R&V system & ICD-10 coding	Acts as a specific and tangible resource to carry out the required administrative tasks of the project.
Industry vendor support	Help desk support for software and DICOM import/export issues	Acts as a specific and tangible resource to consult on any software related tasks of the project.

Appendix C - A Sample Nomenclature Standardization Project Charter

<table>
<tr><th colspan="2">Project Identification</th></tr>
<tr><td colspan="2">Project Name:
Full project name and, if applicable, shortened version of the name that will be used in documents
Example: Implementation of standardized nomenclature for collecting radiation therapy Big Data</td></tr>
<tr><td>Department:
Indicate clinical department, business unit or division affected by the project
Example: Radiation oncology</td><td>Site:
Indicate the site(s) where the project takes place
Example: Main cancer centre campus</td></tr>
<tr><td>Project Start:
YYYY-MM
Example: 2019-11</td><td>Project Completion (expected):
YYYY-MM
Example: 2020-02</td></tr>
<tr><th colspan="2">Project Governance</th></tr>
<tr><td>Requester:
Name of the person that signed the project proposal or that requested help for the project
Example: Head of medical physics</td><td>Sponsor(s):
Name of the person that has been designated as responsible for the project within the organization (can be the same person as the requester)
Example: Head of medical physics</td></tr>
<tr><td>Clinical or Other Leader(s):
Name of the person that have a lead role other than sponsor and specify that role for each person
Example: Director of radiation oncology, RT manager, clinical medical physicist, dosimetrist, treatment delivery radiation therapist, data Analyst</td><td>Project Manager(s):
Name of the person mandated to manage the project (including planning and coordinating project activities)
Example: Project manager consultant</td></tr>
<tr><th colspan="2">Project Environment</th></tr>
<tr><td colspan="2">Strategic Justification:
Indicate which organisational, hospital or departmental strategy or mission this project will help to attain.
Example: This project will determine, design, implement, and measure standardized nomenclature for Big Data radiation therapy parameters including diagnosis, course name, plan name, structure name, scan name, reference point name, field name, DRR name, and DVH endpoints.</td></tr>
</table>

Project Context:

Describe the current environment within the department, the origin of the project request, etc.

Example: Currently, in the department, there is a lack of consensus about how to name radiation therapy parameters. Each dosimetrist, physicist, and oncologist may have their own set of preferred naming conventions in the treatment planning system including target and OAR naming, plan and field naming, and course naming. This situation leads to unclear clinical and user guidelines, confusing dose limits to OAR's and dose prescription levels for target volumes, safety issues for retreatment or multiple site treatment, and the inability to track treatment technique utilization rates based on tumour group and site.

Problem/Opportunity Statement:

Briefly describe the problem or opportunity the project is responding to

Example: The inability to collect standardized Big Data radiation therapy metrics is hindering the ability to forecast future utilization rates, change of practice patterns, retreatment rates, clinical protocol compliance, mitigating/reporting of radiation therapy planning/treatment errors, and measuring complexity changes (e.g. 3D conformal vs. IMRT/VMAT).

Key Stakeholders:

Identify key people or organizations impacted, involved, influential or participating in the project. Avoid using person's names.

Example:

- Medical physicist (create and implement Big Data nomenclature standards in the department)
- Radiation oncologist (give input and awareness to keep nomenclature standard in treatment planning templates)
- Dosimetrist (give input and QA usage of nomenclature in treatment planning templates)
- Radiation therapist (communicate nomenclature changes downstream to treatment units)
- Oncology nurse (for proper staging & diagnosis, retreatment interventions)
- Data analyst (for data support and integrity)
- Manager/Director (sponsor for project charter, coordinate administrative support for meetings, communication plan, training for staff)
- Project manager (local lead to coordinate project plan through milestones and deliverables)
- Clinical trials coordinator (for seamless transition of treatment plans for patients on clinical trials to QA centres)

Project Definition
Aim: **Describe what the project is targeting, what is the desired end result. The aim should be sustainable, even once the project is completed.** Example: The aim of this project is to standardize nomenclature for Big Data radiation therapy data elements, which has an impact on fiscal budgets, staffing levels, wait times (ready to treat to first treatment), quality & safety reporting, patient acute/chronic toxicity reporting, cancer registry statistics, and multi-centre collaborative research.
Project Description: **Overall description of the goal and project purpose, as well as the actions to be taken in order to attain the desired end result (short paragraph)** Example: To implement and sustain a system where Big Data in radiation therapy can be clear, concise, concrete, and communicated to staff, patients, researchers, and administrators. This will allow a streamlined approach to capture vital cancer data metrics related to patient toxicity and survival outcomes; to reduce radiation treatment errors; to prove the efficacy of new techniques by technique and dose; to reallocate human and fiscal resources based upon evidenced-informed practice.
Expected Benefits: **List efficiency and/or quality gains that the completion of the project should help the department/service/mission obtain** Example: There will be a positive impact in the following areas: ● Fiscal budgets - reduction of administrative work and introduction of an activity-based funding model. ● Staffing levels - reallocation of dosimetry resources to treatment delivery through increased utilization of adaptive planning and AI algorithms to decrease planning times. ● Wait times (ready to treat to first treatment) - more concise and accurate reporting to cancer authority/ministry of health. ● Quality & safety reporting - sustainable and robust reporting data metrics at the local and national levels. ● Patient acute/chronic toxicity reporting - more information to oncologists and nurses for tracking grading toxicity based on plan type and technique. ● Cancer registry statistics - increased diagnosis to concisely measure tumour group frequency by technique and dose. ● Multi-centre collaborative research - more accurate survival rates and grading toxicity by capturing DVH endpoints at multiple cancer centres.

Objectives: **Describe desired outcomes of the project. Each objective should be SMART (specific, measurable, attainable, realistic and time-oriented)** Example: 1. Implement new OAR nomenclature 2. Create proposal for new PTV nomenclature 3. Write procedures on new convention for OAR and PTV naming	Evaluation Indicators: **Each metric is linked to an objective (to be developed with the person in charge of project evaluation)** Example: -compliance for OARs -compliance for targets -# of reportable events
4. Write procedures and provide training for event reporting 5. Implement new PTV nomenclature 6. Implement event reporting 7. Review reported events and resolve any areas of vagueness	
Scope (Inclusions): **List what is included in the project** Example: All curative and palliative cases that involve CT simulation, modified and multiple plans	Scope (Exclusions): **List what is excluded from the project** Example: This must be decided upon by the steering committee who oversees the project to implement a standardized Big Data RT nomenclature system.
Constraints: **List specific factors that limit or place conditions on the project. Factors can be social, environmental, political, economic, technological or linked to time, resources, expertise, legal requirements, facilities, etc.** Example: Identifying the constraints are critical to the success of the project. Have each member of the steering committee and working groups identify the potential constraints based upon their area of expertise. The project manager would gather, itemize and prioritize these constraints by risk, frequency, and severity.	

<table>
<tr><th colspan="2">Preliminary Project Planning</th></tr>
<tr><td colspan="2">Working Hypotheses:
List assumptions under which the project team will be working, and main dependencies linked to those assumptions
Example: The steering committee has the support of the project sponsor to carry out the terms of the project charter. Support in terms of allowing time for staff to attend meetings, purchase or upgrade required software/hardware, administrative support, and develop the necessary policies and procedures to implement and maintain the standard nomenclature system.</td></tr>
<tr><td colspan="2">Risks:
Identify uncertain events or conditions that, if it occurs, influence at least one of the project objectives. Requirements, constraints and assumptions help identify risks since they are common causes.
Example: Getting buy in from the various stakeholders is vital. If the staff are not onboard with the proposed changes, then training, compliance, and patient safety are at risk for potential issues surrounding the standardized nomenclature system.</td></tr>
<tr><td>Key Milestones:
List key dates, phases, decision gates or important steps relevant to the project team
Example:
1. OAR nomenclature implemented
2. PTV nomenclature implemented
3. Event reporting implemented</td><td rowspan="2">Expected Completion:
Indicate preliminary dates for completion of main project milestones and deliverables identified
Example:
Phase 1: 2020-11
Phase 2: 2020-12
Phase 3: 2021-01
Phase 4: 2021-02</td></tr>
<tr><td>Key Deliverables:
List key deliverables that are required to produce in order to achieve stated objectives (e.g. process review, implementation of a change, etc.)
Example:
1. Draft of the PTV & OAR guide written
2. Draft for PTV & OAR reviewed by MDs and feedback provided
3. PTV and OAR naming finalized
4. PTV and OAR naming procedures written, and templates modified
5. Script for verifying names
6. Event reporting procedures written</td></tr>
</table>

Resources Needed:

Roughly describe human, material or financial resources necessary to complete the project, including which experts will be needed to support the project

Example: The resources required for this project include the following:

1. Administrative support for meetings
2. Data/IT analytics support
3. Project management support
4. Clinical personnel training
5. Medical physicist support
6. Radiation oncologist support
7. Compliance auditing

Steering Committee:

List all members, their position and their role within the committee (e.g. chair)

Example:

- Medical physicist (create and implement Big Data nomenclature standards in the department)
- Radiation oncologist (give input and awareness to keep nomenclature standard in tx planning templates)

- Dosimetrist (give input and QA usage of nomenclature in tx planning templates)
- Radiation therapist (communication nomenclature changes downstream to tx units)
- Data analyst (for data support and integrity)
- Manager/Director (sponsor for project charter, coordinate administrative support for meetings, communication plan, training for staff)
- Project manager (local lead to coordinate project plan through milestones and deliverables)

Project Authorization

Sponsor's Signature: Date: _____

_____

Date: _____

Clinical Leader's Signature:

_____

Date: _____

Project Manager's Signature:

_____

**In the absence of signatures, electronic approval is required*

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