A database-driven verification system for CT-simulation, contouring and planning

M. AYLES[1], D. MARTIN[1], L. ARCHAMBAULT [1], P. MUNGER [1], M. BRUNET-BENKHOUCHA [1] and G. JARRY[1]
1CIUSSS de l'Est-de-l'Ile-de-Montréal, Montreal, Canada

JULY 12–16 2020 VIRTUAL
JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

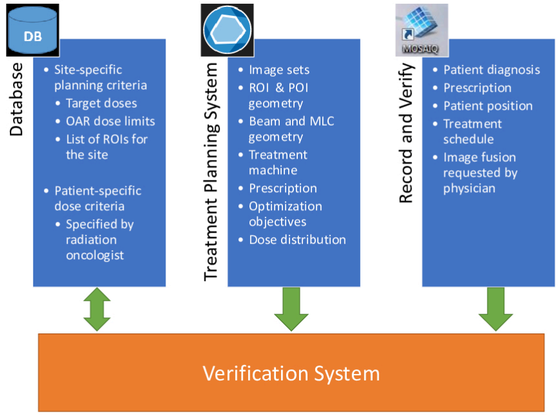
INTRODUCTION

From CT-simulation to contouring to planning and chart checks, the patient chart passes through many hands before treatments begin. This goal of this work was to **create and implement a verification system** to improve the quality and safety of our treatments in three key ways:

- Reducing the time required for verifications
- Automating verifications to reduce errors
- Improving communication between sectors

CONNECTED SYSTEMS

The verification system was written in Python using the wxPython library. It integrates information from three sources: the **treatment planning system** (RayStation), the **record-and-verify system** (Mosaiq) and an **in-house database** used to store dosimetric criteria.



The verification system uses the information from each source to perform **automated checks**, *eg* comparing OAR doses in the TPS to the values specified by the radiation oncologist in the database.

The **results of the verifications are written to the database** for later consultation. Comments and messages can be left for the next user to **improve communication** as the chart moves from simulation to contouring to planning.

WORKFLOW

VERIFICATION PHASES

A typical IMRT/VMAT plan is verified at five different moments in our workflow:

- **Scan** • CT Simulation (technologist)
- **MD** • Contouring (radiation oncologist)
- **Plan** • Start of planning (planner)
- **V1** • During planning (second planner)
- **V2** • After transfer to R&V (dosimetrist)

Simpler plans (3D-CRT, electrons, virtual simulation) have a reduced number of steps. For each step, a checklist is generated for the user to follow during verification. Checklist templates are stored in the database and can be quickly and easily modified whenever clinical needs change.

SUMMARY VIEW

Upon launching the system, a summary view opens displaying the different verification steps in order. The summary view allows the user to quickly see:

- The **status** of each step
- **When** it was modified
- By **whom**
- Any **comments** left by the person who verified each step

Verifications can be initiated, modified or consulted using the button associated with each panel. A completed verification can be re-initialized if necessary; all results are kept in the database even if they are not displayed. The bottom button switches over to a comment summary view, allowing users to quickly peruse the case history.

Figure 1: The verification summary window, showing the status of each verification.

PERFORMING A VERIFICATION

The verification window displays a **checklist** specific to the selected verification step. Each item may have an associated function if desired.

- Items that are common to the case are verified **once**
- Items that must be verified for each beamset (for sequential plans) are verified **once per beamset**
- Checklists may be split into multiple pages
- Partially completed lists may be **saved** and **resumed** later
- The user may leave **comments** for each item on the checklist. These can be identified as optional (suggestions) or mandatory, depending on the nature of the issue identified.
- There are special fields for the planner to leave **general comments** for the person verifying the plan, in case any specific information needs to be shared

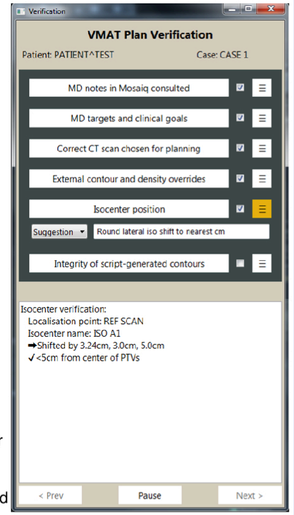


Figure 2: A sample verification checklist, including buttons to launch scripts and comment boxes

VERIFICATION FUNCTIONS

Each item in a verification checklist can have a **function** associated with it. These functions, scripted in Python, can **combine information from the TPS, the R&V and the in-house database** to quickly and securely compare data between the different systems. Examples of these functions include:

- Comparing the **prescription** in RayStation to the one in Mosaiq
- Verifying that the **treatment machine** used to create the plan in the TPS matches the room where the patient is scheduled to be treated in the R&V
- Checking whether specific **OAR criteria** requested by the radiation oncologist are present in the Clinical Goals panel in RayStation
- Verifying whether standard **OARs** for a given treatment type are present and whether the physician interpolated their contours
- Validating the position of the **isocenter**
- Checking that **MLC constraints** such as leaf gap and minimum field size are respected in the optimized plan

CONCLUSIONS

The verification system has been **implemented clinically across all phases** of treatment planning. It has helped to **standardize verifications and improve communication** between the different sectors of the department.

Integrating plan verifications directly with the TPS and R&V allows for **fast, automated verifications**. Manual data-entry is limited, reducing the risk of transcription errors. Use of the database allows us to **link the verification steps together**, preserving information from one verification to the next. **Retrospective studies** can be performed using the verification results stored in the database, allowing us to identify trouble spots in our planning process.

One of the greatest challenges in implementing this type of system is **convincing people to use it**. In designing the verification system, we consulted extensively with **technologists, dosimetrists and physicians** to ensure that the tools we were building would be of use to them. Regular feedback will be collected to ensure that the tools remain current and useful and that further improvements are made as trouble spots are identified.

WHAT'S NEXT?

The verification system has been in clinical use for about one month. The next step is **to collect user feedback** to improve the functionality and efficiency of the system by removing minor usability roadblocks and improving the various verification functions in the checklists.

As we continue using the system, we will start to amass data that can be used for **retrospective studies**. Querying the database will allow us to determine which individual items are flagged most frequently, which will indicate places in our planning procedure that need improvement.

WANT TO KNOW MORE?

Visit our other poster:

Improving Plan Quality Through Automation of Treatment Planning Processes Using Scripting in RayStation

CONTACT INFORMATION

mayles.hmr@ssss.gouv.qc.ca