AN IN-HOUSE DEVELOPED DOSIMETRY SOFTWARE FOR LUTETIUM-177: MASTERDOSE

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Abstract:

Computer software for dosimetry has been used widely in nuclear medicine. Different software tools have been written to improve the dose assessment, especially in therapeutic nuclear medicine. Some software tools focus on computational phantom models from the international commission of radiation protection and units (ICRP) whilst others on Monte Carlo simulated models. While many studies have investigated therapeutic nuclear medicine dosimetry. The authors have noticed that very few have in-house developed software in the region of Africa. The aim of our study was therefore to develop an in-house dosimetry software tool called Masterdose.

Masterdose was written in Java (Sun Microsystems) programming language. The software was based on upgraded ImageJ software as a foundation, which was in the public domain. User interfaces (UIs) were developed using JavaFX, which is the latest version for desktop applications.

Masterdose runs on any *Windows*, *Linux* and *Macintosh* application. For the *Windows* and *Linux* platforms, a Java Runtime Environment is needed to run and download Masterdose. The *Macintosh* platform needs MacOS Runtime. Masterdose was designed to be a desktop application, which requires a license. Physics correction factors to convert counts to activity, attenuation, scatter and partial volume can be performed for dosimetry on the Masterdose software.

Introduction:

Several researchers have developed in-house computational software for radionuclide quantification in Nuclear Medicine. Example, in the study of Li et al. (2020) [1], they developed a comprehensive 3D dosimetric software, BIGDOSE, with new features of image registration and virtual computed tomography (CT) for patient-specific dosimetry. The software produced organ dose errors of -9.59%±9.06%, -8.36±5.82%, -23.41%±6.67% and -6.05%±2.06% for liver, spleen, kidneys and lungs, while OLINDA/EXM comparatively produced -25.72%±12.52%, -14.93%±10.91%, -28.63%±12.97% and -45.30%± 5.84% respectively. In recent studies, more research and commercial dosimetric software have been developed. These include HERMES® [2], RAYDOSE [3], PLANET® [4], OEDIPE [5], VoxelMed [6], JADA [7], STRATOS® [8], and VIDA [9]. Ramos et al. (2017) [10] have reviewed several of these software codes for internal dosimetry. This study aimed to develop an in-house dosimetry software for Lutetium-177. In order to achieve this aim, authors developed computer-based software Masterdose using Java language to quantify ^{177}Lu activity on neuroendocrine tumours and kidneys during therapy.

Software development:

Masterdose was written in Java (Sun Microsystems) programming language. The software was based on upgraded ImageJ software as a foundation, which was in the public domain. User interfaces (UIs) were developed using JavaFX, which is the latest version for desktop applications. The UIs theoretical framework design is demonstrated in Figure 1.
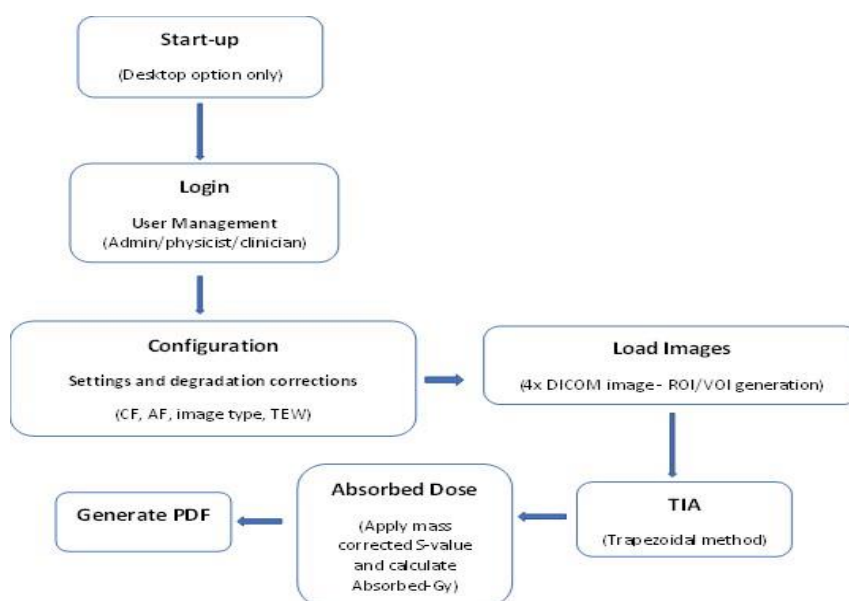

Figure 1: Theoretical framework design of Masterdose software

Results:

Masterdose runs on any *Windows*, *Linux* and *Macintosh* application, an example of the login on Masterdose is given in Figure 2. For the *Windows* and *Linux* platforms, a Java Runtime Environment is needed to run and download Masterdose. The *Macintosh* platform needs MacOS Runtime.

Figure 2: Masterdose login example

"User Management" tab allows different user rights on Masterdose as demonstrated in Figure 3, options available are "admin", "physicist", "consultant" and "registrar".
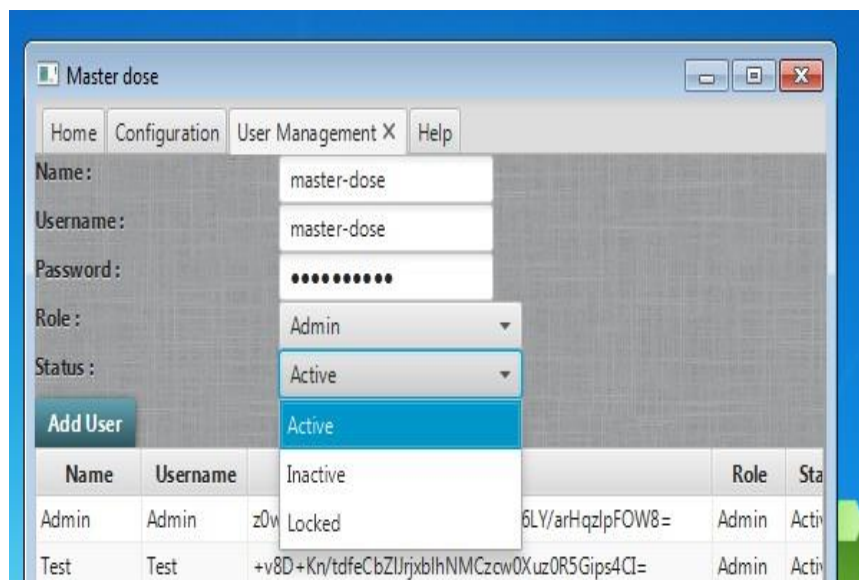

Figure 3: Masterdose user management example

The "Home" tab on Masterdose allows the user to load different time-point images, give patient demographics and generates the cumulated activity. An example of this tab is shown in Figure

4 (a) and (b), representing kidney and tumour cumulated activity receptively.
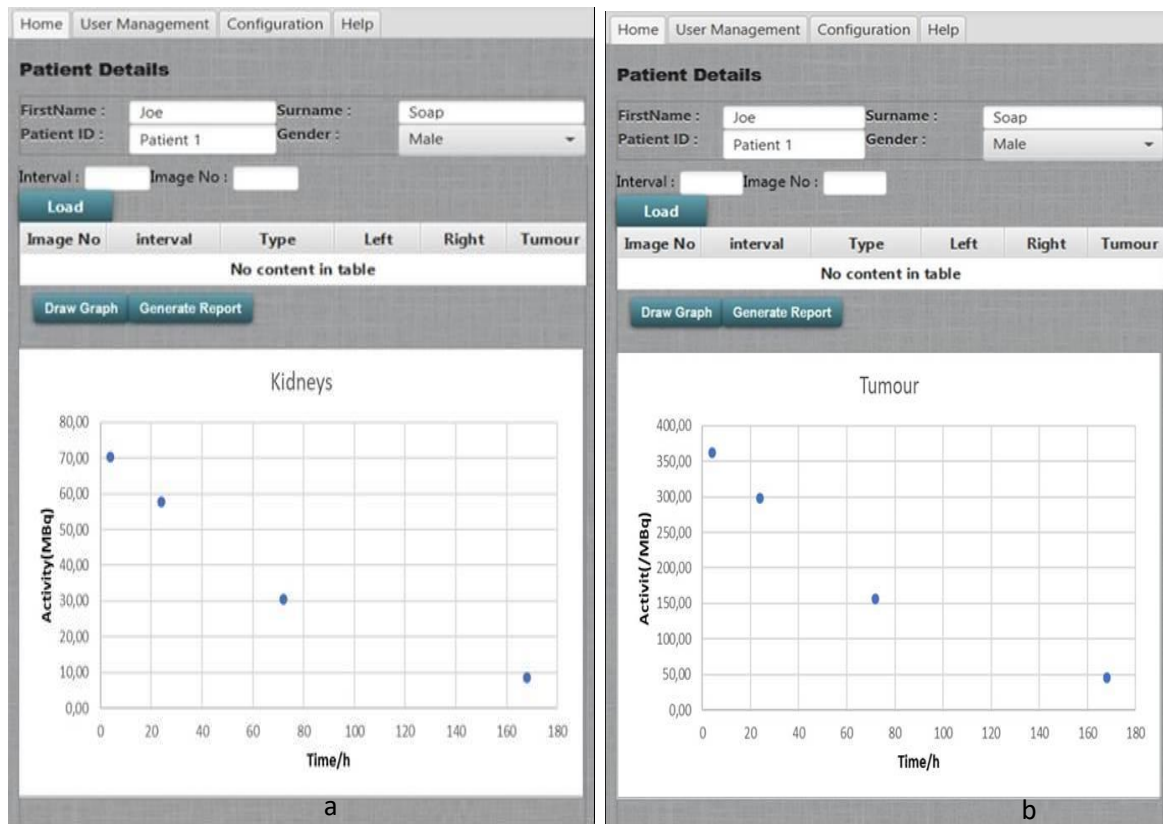

Figure 4: Masterdose software Home tab with (a) kidney and (b) tumour cumulated activity.

Masterdose was designed to generate a full report with all dosimetry parameters, aiding the clinician in deciding on follow-up therapeutic treatments. The report was generated in a PDF format using iText framework and is demonstrated in Figure 5.

Masterdose	
Dosimetric report	
Patient Name	Joe
Patient Surname	Soap
Date	07/06/2020
Study Name	Peptide Radiotherapy
Cycle number	1
Previous cycle (s) Absorbed Dose (s)	N/A
Radionuclide	^{177}Lu-DOTATATE
S-value Reference	OLINDA/EXM 1.0
Cumulated Activity Kidneys	Cumulated Activity Tumour
12301	63260
Absorbed Dose Kidney	Absorbed Dose Tumour
3.57 Gy	18.36 Gy

Figure 5: PDF dosimetry report example from Masterdose

Conclusion:

Funding to access some of the codes discussed in the introduction is often an obstacle for developing countries. The in-house designed Masterdose software addresses this need for dosimetry software. This software encompasses all the steps in a clinical dosimetry workflow and is accessible via a desktop installation.

The validation of the software using commercial software is not discussed in this poster but is available in various publications. The validation process will also be presented at the South African Society of Nuclear Medicine meeting in August of this year.

Selected References:

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