Optimizing FDG dispensing: an environmental and workers evaluation

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Introduction

The Uruguayan Centre of Molecular Imaging (CUDIM) is dedicated to develop research, training and applications in health sciences, where diagnosis and biomedical research activities are promoted. Clinical examinations for patients primarily in the fields of oncology and neurology are performed.

In this frame the aim of this work was to optimise the exposition of workers to radiation during FDG dispensing in the Radiopharmacy Production area.

The original laboratory layout resulted in an unnecessary exposure of the staff during FDG production. The situation was analysed and a new layout of the laminar flow was proposed. The influence of this modification in the total dose of the laboratory environment is presented in this paper.

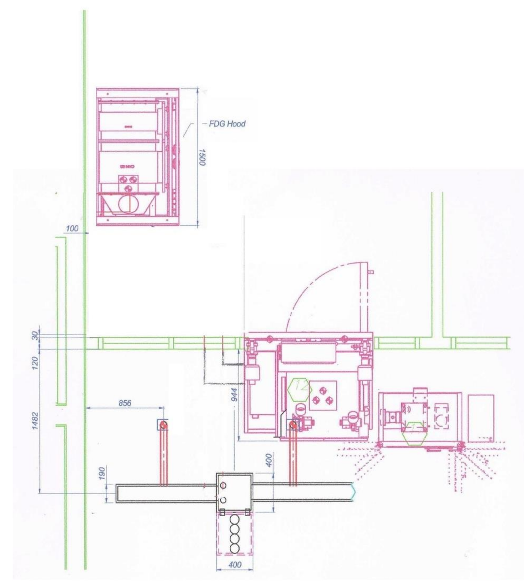
Methods

The centre operates with a MediSmart centralised system, particularly the FDG laboratory has a GM detector, that records the Dose and Dose Rate every second in a 24/7 regime. Supported by these data and TLD dosimetries of staff members dedicated to production, three situations were analised.

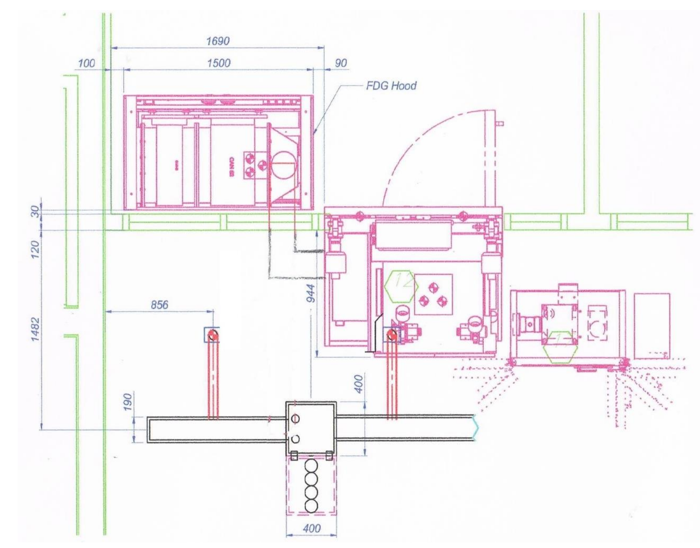
The first one was associated to an important increase in dose rate that was detected during FDG manual transport in a lead shield from the hot cell to the laminar flow. The need of change in the laboratory layout was observed and suggested by workers involved in the FDG production. As a result, there was a modification in the laboratory arrangement and the laminar flow was switched to a nearer position to the hot cell and a shielded tubing was installed to transport the FDG solution to the shielded laminar flow.

The second situation was related to the increase of FDG production in the centre, an increment higher than 240% has occurred since the second semester of 2013 till date. Thus, an evaluation of the environmental dose was compared with the previous layout of the laboratory.

In third place, hand doses of 3 workers involved in this task were analysed in order to relate them to the increase of produced activity.



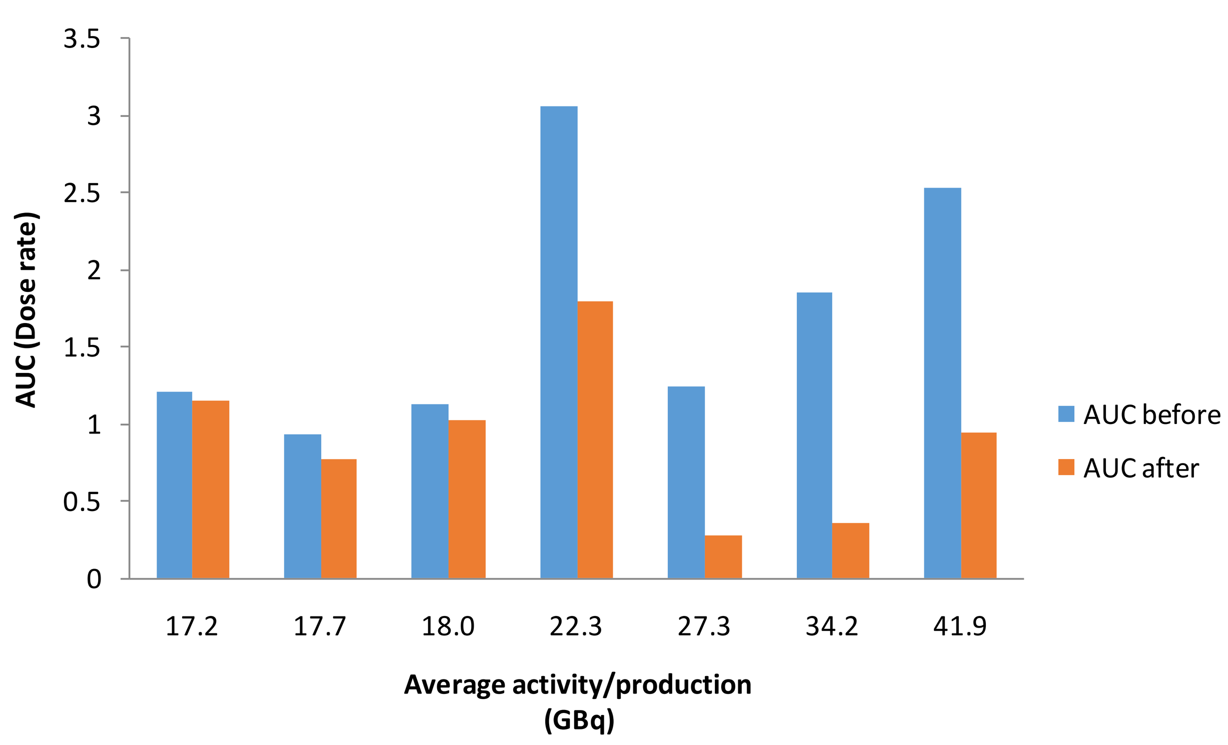
Laboratory layout before change



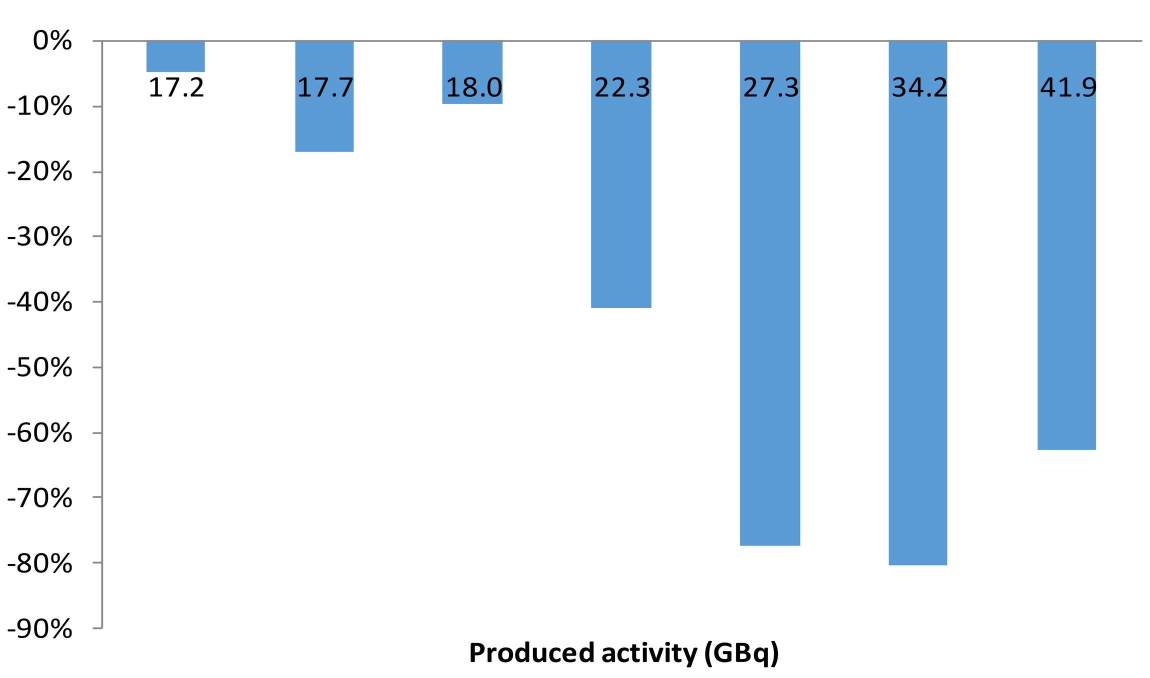
Laboratory layout after change

Results and discussion

Values of dose rate during FDG preparation vs. time were plotted for productions before and after layout modification. Special attention was paid to compare productions of the same magnitude. Areas under the curve (AUC) profiles were calculated and total dose was determined for each production



AUC behaviour before and after hot cell layout modification



Decrement profile in dose rate percentage

The displacement of the laminar flow to a new position lead to a drastic decrease in dose rate during FDG production as can be seen in Figure 1 where AUC vs activity production were plotted; each series corresponds to similar amounts of total activity.

Situation	Dose rate (µSv/h)	µSv/MBq	Decrement in Dose/GBq	Increment in Dose /GBq after 243.5% if FDG activity
Before layout change	2.72	66		--------
After layout change	1.01	20	71.2%	--------
After production increase	**10**	**80**	**-----**	**20.3 %**

Dose rate/GBq ratios and their modification with activity production

Period of analysis	Average hand doses (mSv)	% increment in hand doses	Average activity of FDG (GBq)	% increment in activity of FDG
01-2013 to 05-2013	9 ± 3		30.2	
06-2013 to 09-2013	11 ± 1	14	62.4	207
10-2013 to 12-2013	14 ± 3	48	74.4	245

Hand's doses profile compared with total FDG activity

Conclusions

The change in layout lead to a decrease in environmental dose. Moreover, with the important augment in FDG demand 2,4 times higher, the total dose rate was of the same order of magnitude after the modifications. This is a clear example of continuous improvement in radiation protection optimisation. Despite hand doses are far below the allowed limits, it is obvious that if the centre continues increasing FDG production, it will be necessary to pay attention to dispensing process in order to keep under control these values.

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