Participation of Latin American Nuclear Medicine Centres in a strategy to support individual on-site monitoring of internal exposure to I-131

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1. Background and Goal of the present work

The Internal Dosimetry Group of REPROLAM (Latin American and Caribbean Network for the Optimization of Occupational Radiation Protection), framed in the RLA 9085 IAEA project for the 2020-2022 period, devised a strategy for the on-site control of internal exposure to I-131 in nuclear medicine Centres (NMCs) to be implemented by end users. The basis of that objective is the fact significant amounts of I-131 are handled in NMCs and its occupational intake is not properly monitored most of the times. This poster presents the perspectives and progress of the proposed strategy, applied within a regional scope.

Implementation of a surveillance program for internal exposure associated to NCMs workers who handle volatile solutions of I-131 on a routinely basis.

2. Challenges of monitoring the occupationally exposed workers in Nuclear Medicine

The general safety guide No. GSG-7 (occupational radiation protection) indicates that an assessment of the exposure of individual workers in normal and foreseeable abnormal conditions should be considered if, for any single component of the exposure (e.g. strongly penetrating photon irradiation, neutron irradiation or internal exposure), the corresponding annual effective dose is expected to exceed 1 mSv. Consideration should also be given to the likelihood and possible magnitude of potential exposures.

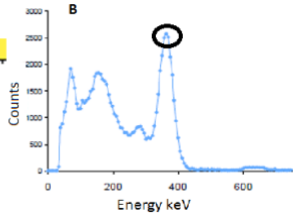
I-131 is the most radiotoxic of the radionuclides used in nuclear medicine. It has a radioactive decay half-life of about 8 days and decays. The following figure describes the beta and gamma emissions and the emission spectrum of I-131.

A

Main emissions (keV)

	Gamma or X		Beta (Emax)	
	E	%	E	%
E1	284	6	248	2
E2	365	82	334	7
E3	637	7	606	90
% omitted		11		1

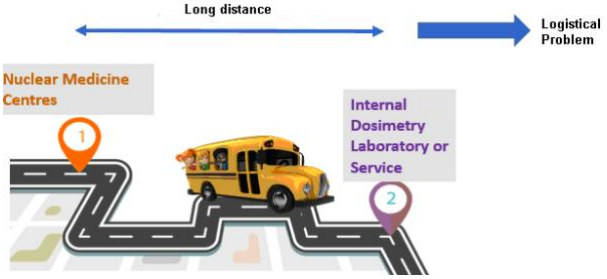
B



A) The beta emissions cannot leave the body and cause mutation and death in cells that it penetrates, and other cells up to several millimeters away. This is known as "therapeutic use". Gamma emissions can leave the body and can be detected and used to form images. The peak to be detected is 365 keV B) Emission spectrum of I-131

I-131 also has the property of being very volatile at room temperature. I-131 is supplied to patients in capsule or liquid form. Due to the volatility of I-131, workers at NMCs who handle I-131 in liquid form are more likely to incorporate I-131 than those who use capsules.

The routine control of the workers should be every 14 days at the most, which implies a logistical problem, since it is inconvenient when there is no internal dosimetry laboratory or service nearby from service. Even in many places in the Latin American and Caribbean region these internal dosimetry services do not exist.



ISO 16637 “Radiological protection -Monitoring and internal dosimetry for staff exposed to medical radionuclides as unsealed sources” describes a methodology to estimate the “decision factor”, d_j, corresponding to the order of magnitude of the annual dose likely to be received by a worker, defined for a specific radionuclide j. This methodology was used to get an idea of how much a single worker can handle in a year of I-131 without an exhaust hood, and without the need to control the dose by internal exposure, and the result was that the activity that can be handled is only of 540 mCi or 20 GBq, which is a very low activity.

ISO 16637 accepts that a NMC be monitored in situ with the available instruments, which is less precise than routine monitoring, but allows verification that a certain threshold is not exceeded.

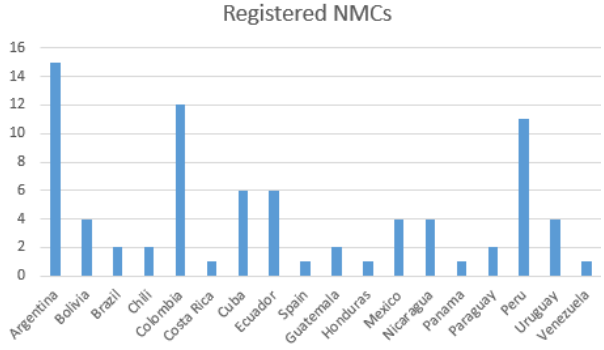
3. Work development

3.1. Strategy for the on-site control of internal exposure to I-131 in NMCs

A strategy was developed that included a virtual training and an interactive guide. Participants were provided with a set of instructions to allow the responsible physician, nuclear medicine technician, medical physicist or other suitable professional, to apply the available detection systems in their centre in order to investigate if the potential intake of I-131 will result in an effective committed dose ≥ 1 mSv / year for workers. This set of instructions was presented as a guidance. It was also proposed to the NMCs the possibility to participate in a pilot plan in order to apply the guidance and to know the magnitude order of the dose for internal exposure to I-131 of occupationally exposed workers. This support plan was developed by a committee of the Internal Dosimetry Group and it includes: advisory for the calibration of gamma cameras and I-131 detector probes, assistance for the implementation of the routine monitoring by the NMCs staff and a follow-up tool to assess the routine monitoring results.

3.2. Participation of Latin American NMCs in a strategy to support individual on-site monitoring of internal exposure to I-131

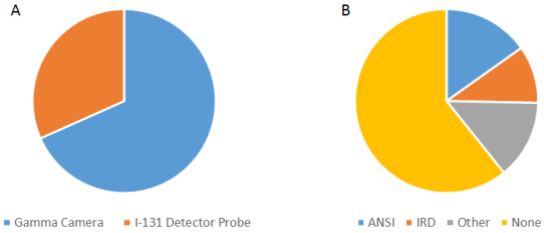
Great interest was proven from the NMCs to participate on this pilot plan, and there were around 80 NMCs enrolled from Argentina, Bolivia, Brazil, Chili, Colombia, Costa Rica, Cuba, Ecuador, Honduras, Mexico, Nicaragua, Paraguay, Peru, Uruguay, Venezuela and Spain. This participation is observed in the following bar chart.



Bar chart representing the countries interested in implementing the strategy for the on-site control of internal exposure to I-131

3.3. Instruments available in NMCs

All the NMCs that signed up to participate in the pilot plan responded to a survey detailing the available detection system they had for on-site monitoring of their workers. These detection systems are described in the following charts.



Representative graphs of the available detection systems in the centers. A) 68.35% of the NMCs have a gamma camera, while 31.65% have an I-131 detector probe. B) 60.8% of NMCs do not have a thyroid-neck phantom, 15.2% have the ANSI phantom, 10,1 % have the IRD phantom and 13.9 % have another type of phantom.

3.3. Preliminary results

At the moment, the measurements made by the participants have resulted in mostly undetectable activities, with the maximum activity detected being 224 Bq, which corresponds to an incorporated activity of 896 Bq and an effective committed dose of 0.015 mSv. Few measurements have been made so far, so it is necessary to continue implementing this routine monitoring to know if the potential intake of I-131 will result in an effective committed dose ≥ 1 mSv / year for the workers. These measurements should be made to the workers every 14 days for a period of approximately 6 months.

4. Conclusions

The reasons for the development of this strategy for the in situ control of internal exposure to I-131 in NMCs are presented. The working conditions of the participating NMCs and the preliminary results of the measurements of the internal exposure to I-131 are also presented. At the moment, more concrete conclusions cannot be made, because more measurements must still be made.