

## MANAGEMENT OF RADIOACTIVE WASTES DERIVED FROM MEDICAL USE: FOUR YEARS EXPERIENCE IN A MULTIHOSPITAL DEPOSIT

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### ABSTRACT

The Authors describe the procedure followed in Bologna (Italy) to manage the radioactive wastes deriving from medical use of radioisotopes. Five hospitals send their wastes to a deposit which has been built to store the contaminated materials until their radioactivity reach the levels below which the disposal is permitted by means of conventional ways.

After four years experience it is possible to affirm that this solution not only reduces the risk of environment pollution but also represents an inexpensive and safe way to manage those low level radioactive waste.

### INTRODUCTION

The increasing use of unsealed radionuclides in medicine for *in vivo* and *in vitro* diagnostics and for therapy, presents the problem of safe management of radioactive wastes in order not to pollute the environment (1,2).

In Figs. 1 & 2 are shown the amount of radionuclides used for diagnostics during the last 17 years in Bologna, Italy (population 500,000; 5 hospitals; 4700 beds, 2 Nuclear Medicine Depts; 5 Radioimmunoassay Labs; 2,400,000 determinations per year; 10,000,000 US\$/year spent for radionuclides).

In 1990 more than 6 GBq of  $^{125}\text{I}$  and more than 5 TBq of  $^{99}\text{Mo}$  were utilized, while the use of longer lived radioisotopes ( $T_{1/2} > 9 \text{ d}$ ) is presently decreasing.

The Italian laws allow the disposal of radioactive wastes into the environment without particular authorization, if the amount of radioactivity is below fixed limits (some of these are listed in Table I) which refer to the maximum radioactivity per year as well as the maximum concentration for the nuclides mostly used in hospital.

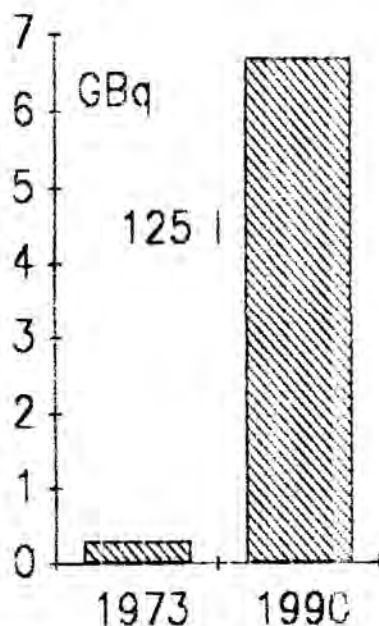


Fig. 1. Purchased radioisotopes for in vitro diagnostics during the last 17 years.

Since it is very difficult to obtain the necessary authorization to exceed these limits and to prevent polluting the environment as much as possible, Bologna has adopted the following procedure to manage the radioactive wastes coming from its hospitals.

- collection of the wastes from all the city users;
- storage in only one deposit for an appropriate number of half lives;



Fig. 2. Purchased radioisotopes for in vivo diagnostics during the last 17 years.

TABLE I

Disposal Limits For Radioactive Wastes According To Italian Laws

Nuclide	Max Activity Per Year (MBq)	Max Concentration Liquid Wastes (Bq/cm <sup>3</sup> )	Max Concentration Solid Wastes (Bq/g)
$^{125}\text{I}$	3.7	0.037	3.7
$^{131}\text{I}$	37.0	3.7	3.7
$^{57}\text{Co}$	37.0	1850.0	37.0
$^{201}\text{Tl}$	370.0	1110.0	37.0
$^{67}\text{Ga}$	3.7	0.037	0.37
$^{99}\text{Mo}$	370.0	0.74	37.0

- disposal, by means of conventional system for waste treatment, when the amount of radioactivity is below the limits which are defined by national laws.

### OPERATION

The user must dispose the radioactive solid waste into 25 l drums provided with a safety lock. At the moment of locking, some data must be written on the cover such as isotope, activity, weight and date.

Periodically an authorized vehicle collects from the users the drums and brings them to the deposit - a building which lies 30 km from the city in a poorly inhabited area.

The plan of the building is shown in Fig. 3 where it is possible to distinguish three main zones.

- This is an area with an office (A1), a radiometry laboratory (A2) Fig. 4 and personal decontamination facilities (A3).
- In this area the wastes are received, catalogued and put into 100 l oil drums Fig. 5. They are also identified with a label on which are indicated the radioisotope, the radioactivity and the reference date.
- In this area all the drums are stored for an appropriate number of half lives Fig. 6. A part of the area (C1) is dedicated to the wastes containing scintillation liquid for beta counting.

All the identification data are recorded in a data base operating on a personal computer. Moreover, a computer program calculates the radioactivity inside each drum at a certain date when it is necessary to perform a disposal. The program gives the list of the drums whose radioactive content and active concentration is below a predetermined value in order to prepare a disposal plan. After the disposal the records are marked and the disposed activity is updated to prevent the exceeding the annual limit.

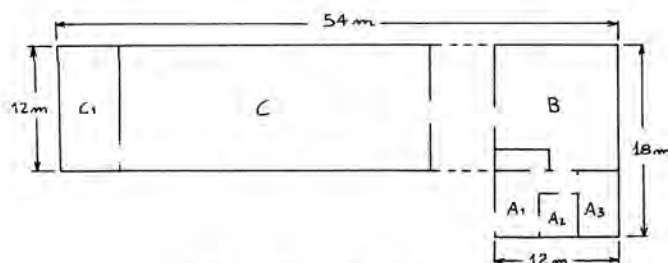


Fig. 3. Plan of the deposit.



Fig. 4. Available instrumentation for gamma spectrometry.



Fig. 5. Waste reception.



Fig. 6. Storage zone.

The program is also used to produce all the documentation which must be forwarded to the local authority.

The main features of the building are:

- Total surface : 650 m<sup>2</sup>
- Capacity : 1760 100l drums (sufficient to store the wastes deriving from the city hospitals for about 5 years without turnover).

Safety precautions :

- Everything inside the deposit is fire-proof. In addition, a fire detection system is permanently connected to the fire brigade station.
- The deposit has been built using criteria against the risk of inundation.
- All the liquids used for washing the deposit are collected into two containers in order to prevent pollution in the case of accidental contamination.
- Some instrumentation for the detection of radioactive contamination is available as well as a multi-channel analyzer connected to a well-type NaI detector for gamma spectrometry.

### CONCLUSIONS

After 4 years experience in the management of the deposit it is possible to outline the following:

1. All city users are not burdened with the problem of radioactive wastes.
2. Unauthorized disposals are avoided and all radioactive wastes are under control.
3. No accident happened.

4. The cost of the structure has been paid off after only one year of operation.

**REFERENCES**

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