# The Polonium-210 Poisoning in London



2007 J. Radiol. Prot. 27 1

(http://iopscience.iop.org/0952-4746/27/1/E02)

**INVITED EDITORIAL**

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The poisoning of Mr Alexander Litvinenko, in London, in November 2006 was followed by extensive investigations of a wide range of venues. These locations included hotels and offices, hospitals that had treated him, as well as planes, buses, cars and other vehicles. Some locations visited by persons involved in the incident in other countries were also investigated. All the circumstances of the poisoning incident are not yet clear. It soon became apparent, however, that a substantial amount of polonium-210 ($^{210}$Po) must have been used, causing the observed widespread contamination.

In the UK the police, supported by their own analytical teams, had the responsibility for investigating the crime scenes while the Health Protection Agency (HPA) was responsible for the associated issues of public health. The HPA was established by an Act of Parliament in 2004 as an organisation covering radiation sciences, chemical toxicology and infections as well as having expertise in dealing with emergencies, working with medical professionals, patients and the general public, and in communicating information. This structure, together with established working relationships with government departments, meant that the organisation had the necessary skills and capacity to effectively deal with this incident. HPA had the responsibility for monitoring the venues that showed some contamination and advising Westminster City Council, as the lead local authority, on whether there was any need to restrict their use by members of staff or the public. In the weeks following the incident it became important to assess intakes of $^{210}$Po that could have resulted in the death of Mr Litvinenko and also to monitor people who had potentially been contaminated at much lower levels and to assess their radiation doses.

The paper in this issue by John Harrison and colleagues addresses the subject of death by $^{210}$Po poisoning. It provides a comprehensive and authoritative analysis of published human and animal data and models that can be used to assess doses and risks from $^{210}$Po. The paper includes contributions from North American colleagues with particular expertise in radionuclide biokinetics and the acute effects of radiation. It reaches conclusions regarding amounts of $^{210}$Po that are likely to be required to cause death within a few weeks of an intake, using models developed by the International Commission on Radiological Protection (ICRP) and by the authors. This type of analysis demonstrates the considerable importance of being able to readily access data on radionuclide biokinetics and effects obtained in studies in many countries in recent decades and to bring together this 'jigsaw' of information to obtain a good understanding of the likely consequences to human beings of radionuclide exposures. There has been an increasing trend in recent years to reduce work on incorporated radionuclides in many countries, including Europe and North America. Yet this single incident forcefully demonstrates the importance of continuing work in this area and ensuring that the skills and experience that have been developed in radionuclide dosimetry and effects are maintained. It also demonstrates why it is essential to ensure that work that has been carried out world-wide at considerable expense is readily available to the scientific community. This applies to information on acute effects but also to effects at lower levels of exposure, which are usually the subject of interest. An extremely good example of this is the European Radiobiology Archive. This archive comprehensively covers studies carried out on experimental animals

and has been put together within the framework of the European Late Effects Project Group (EULEP) with support from the European Community (EC). This database (Gerber *et al* 2006) is being integrated into an international archive which includes data from both North America and Japan.

Some weeks elapsed between the poisoning incident and the realisation that radioactive materials were involved. Any hazard in contaminated areas was expected to arise predominantly from mobile $^{210}$Po on contaminated surfaces. This could be remediated by wiping and washing or by 'bagging' of contaminated objects and their removal to safe storage to await appropriate decontamination or disposal. To aid the work of the monitoring teams from HPA, and other collaborating organisations, a number of scenarios were considered involving people of different ages, engaged in a range of activities which could have resulted in inhalation of resuspended material, direct entry of contamination into wounds or ingestion of material. These scenarios were used to develop a reference level to inform the requirements for remediation.

On the basis of the level of surface contamination, together with further information about the locations, staff employed at the various venues involved were interviewed by HPA teams. If there was the potential for individuals to have been exposed to significant amounts of activity they were invited to give urine samples. These were then analysed for $^{210}$Po content to allow estimates of any doses. The results from these interviews and from monitoring of staff were also used to inform decisions about the need to monitor members of the public. The interpretation of the results of the analysis of urine samples was not straightforward, as no information was available on the physical and chemical form of the $^{210}$Po or of its route of entry into the body. In addition some $^{210}$Po is a natural component of the diet and is also taken into the body in cigarette smoke. Judgements therefore had to be made, based upon the experience of those involved, on how best to undertake the dose assessment. In particular, information from the interviews of the individuals monitored was used to assess the most likely route of intake whether by inhalation, ingestion or both.

In communicating the results to those people who had been monitored the aim was to develop a rational approach based upon the need to properly inform them of the results but not to cause unnecessary concern. By mid-January nearly 600 people had been monitored although less than 3% were shown to have levels of contamination that were considered to be of some concern. These cases are to be followed up with further monitoring. The majority of people monitored had received minimal contamination with doses not exceeding the annual dose from natural background in the course of a year. As $^{210}$Po has a biological half-life of 50 days and a physical half-life of 138 days, most of the committed dose would be received within a year of the intake.

The incident in London received substantial media coverage and as more venues continued to be identified through the end of 2006 and early 2007 there was the potential for considerable public concern. It was essential to provide accurate information on the monitoring programme at the earliest opportunity and this was largely done through the media and by publishing information on the HPA website (www.hpa.org.uk). In the last weeks of 2006 the HPA:

- provided almost daily press releases detailing the actions being taken;
- gave frequent media interviews;
- published on its website summaries of scientific and technical information on the monitoring procedures adopted, the methods used for analysis of urine samples, and the dose assessment procedure adopted; and
- assessed doses and communicated the results to those individuals that had submitted urine samples for analysis.

Handling the consequences of the London poisoning presented enormous challenges, not only in monitoring locations that had been contaminated, but in dealing with the many people who could have been exposed to $^{210}$Po as well as assessing any doses that they may have received as a result, and in communicating the overall results obtained to the media and general public. This process required enormous effort in a short space of time and would be the case for any similar incident occurring anywhere around the world. It will be essential that the challenges, experiences and lessons identified are well documented and made readily available for the international community.

## References

[1] Gerber G B, Wick R R, Kellerer A M, Hopewell J W, Di Majo V, Dudoignon N, Gössner W and Stather J W 2006 The European Radiobiology Archives (ERA)—Content, Structure and Use Illustrated by an Example *Radiat. Prot. Dosim.* **118** (1) 70–77

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