Examining the Radiological Emergency Response Capabilities in the US: Lessons for the London Polonium Incident

Lisa C. McCormick, MPH
DrPH Candidate
School of Public Health
University of Alabama at Birmingham

Objectives

- Describe how the radiological dispersal event in London unfolded and issues with its detection.
- Describe the key areas of the public health response.
- Identify issues important to an effective response if an event of this nature were to occur in the US.
Alexander Litvinenko

Why Litvinenko?

- Former Russian internal security agent living in London
- Accused superiors in the FSB, which replaced the KGB, of staging the Moscow apartment bombings which were blamed on Chechen terrorists as a reason to go to war against them
- Was considered an “enemy of the state”
- Was investigating the shooting death of Anna Politkovskaya who had been critical of President Putin
November 1, 2006 Timeline

- Litvinenko fell ill the evening of the following meetings:
  - Mario Scaramella at the Itsu sushi bar – 3 pm
    - "Dignity & Honor"
    - Anna Politkovskaya – Killed October 7, 2006
  - Boris Berezovsky – 4:15 pm
  - Andrei Lugovoy, Dmitry Kovtun, and Vyacheslav Sokolenko at the Pine Bar at the Millennium Hotel – 5 pm
    - All seven bartenders on duty that day tested positive – at levels similar to those found in Litvinenko’s family
    - Polonium-210 found in both Lugovoy and Kovtun
    - Lugovoy was questioned at the British embassy in Moscow

Hospital and Identification of Poisoning

- Doctors’ initial concern was exposure to a biological agent
- Litvinenko did not respond to initial treatments
- Symptoms were similar to acute radiation sickness and doctors suspected Thallium 210 although NO gamma rays could be detected
- 22 days after falling ill Britain’s Atomic Weapons Establishment determined the poison to be Polonium 210 - the same day, Litvinenko suffered a heart attack and died
Polonium-210: a Radiological Poisoning and Dispersal Agent

- First element in the periodic table of which all of its isotopes are radioactive. (element 84)
- It is a very rare natural element – **100 ug per ton of uranium ores**
- Commercially produced in nuclear reactors for use as a static eliminator, primarily in Russia.
- Estimated < 1 ug is lethal if internalized (dot at the end of a sentence or one grain of salt enough to be lethal)

Special Phenomenon:
**Alpha Recoil Effect**
- Alpha particle released from atom with such momentum that it has a recoil effect, kicking out adjacent atoms.
- Therefore it can become *spontaneously airborne* and it can “creep” across materials when left out in the open.
Polonium-210” as a Radiological Dispersal Agent

HEALTH AFFECTS
- Does not represent a risk to human health outside of the body
- Ingested, Inhaled, Absorbed - Direct damage occurs from energy absorption into tissue from alpha particles
- Ingestion – Depending on solubility, 50-90% will be eliminated in feces and urine
- Damage dependent on amount of dose, its activity, and the in vivo properties of intake material
- “More nearly whole-body dose than almost all other alpha emitters” accumulating in the spleen, liver and kidneys– Argonne National Laboratories
- Biological half-life – 50 days – time for body to eliminate ½ of dose originally ingested

Public Health Response
- UK Health Protection Agency
  - Similar to US CDC
  - established in 2000
  - “organization covering radiological science, 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”
Public Health Response

HPA was the lead public health agency handling:

**Contamination Assessment**
1. Environmental Assessments /Monitoring (partly determined by results of human surveillance)
2. Human Surveillance
   and
3. Risk Communication

**Environmental Assessments / Monitoring**

- Police analytical teams did initial assessments of potential venues—focused on those known to be visited by key players on November 1
- 1 mSv – annual dose limit for controlled routine exposures of members of the public (ICRP Pub 60)
- 10 Bq/cm² – Reference Level – for measured levels of fixed surface contamination Environmental Monitoring
Environmental Assessments / Monitoring

- Step 1 - Quantify contamination (If > or = 10 Bq/cm², then)
- Step 2 – Assess the extent of spread
- Step 3 – Determine fixed fraction – Decontaminate - After mobile fraction removed; remonitor to determine fixed fraction (If > or = 10 Bq/cm², then)
- Step 4 - Remediate further by removing/coating items exceeding the reference value
- Advise Westminster City Council on restrictions of use. HPA is responsible for remonitoring in future to ensure further exposures eliminated.

Human Surveillance

Categories established for evaluation:

- **Category 1:**
  - Po-210 (5-15 mBq in urine test)
  - Unlikely to have been exposed

- **Category 2:**
  - Po-210 (>30mBq but <1mSv (0.1cSv) total exposure)
  - Exposed, but no health concerns

- **Category 3a:**
  - > 1mSv (0.1cSv) but < 6mSv (0.6cSv) exposure
  - Exposed, but no health concerns

- **Category 3b:**
  - > 6mSv (0.6cSv) exposure
  - Exposed, no illness in short term, slight risk in long term
Human Surveillance

As of March 27, 2007: Total of 738 people in Great Britain evaluated to date.

- Category 1: 601
- Category 2: 85
- Category 3a: 35
- Category 3b: 17

Risk Communication

- Setup hotline through the NHS:
  - Total =1,126 calls by 11/28/06
  - Total ~3,000 calls by 12/01/06
  - Total ~4,000 calls by 12/27/06
  This illustrates more concern initially with a drop off toward the end of the month of December

- Initial public information clearly and concisely identified Polonium 210 as an alpha emitter only dangerous if internalized
- Maintained website with timely summaries of scientific and technical information
- Released regular (almost daily) reports of monitoring procedures, methods, results, and actions being taken by HPA
Remediation

1) Covering or painting over source of activity to seal it in place.

2) Safely disposing of easily removable items.

3) Leaving low level contamination where it is found if it does not pose a risk.

4) Carrying out a thorough decontamination to reduce activity to a safe level.

CDC Response

- Notified by HPA on Nov 21 of potential radioactive poisoning of Litvinenko
- Served as a US public health point of contact for the HPA
- Nov 24 began responding to media inquires and provided Polonium 210 information to public
- Sent Health Alert Network notifications to state and local public health agencies
- Referred those US citizens identified by HPA as potentially contaminated for follow-up
General Challenges to Radiological Incidents

- Special public health/health physics challenges
- Environmental monitoring is difficult and time consuming and the tools are delicate and few
- Laboratories capable of testing urine samples for alpha radiation are rare
- Privacy rights and commercial laboratory testing - may delay effectiveness of public health response

Challenges to Radiological Incidents in USA

- No clear guidelines for how an incident like this would be handled in the US or who would take the lead (one agency or multiple agencies?)
- What time frame would be possible for establishing exposure categories? Would this be a lengthy bureaucratic process?
- Will risk communication be as forthcoming as the HPA’s?
- How would the many thousands or more public inquires be handled?
Methods

- Reviewed the manner in which radiation control is organized within federal and state agencies using state and federal agency websites.
- Reviewed the requirements for and differences between being a United States Nuclear Regulatory Commission agreement or non-agreement state

Agreement State Program

- Through the NRC's Agreement State Program, a state can assume portions of NRC's regulatory authority to license and regulate byproduct materials, source materials and certain quantities of special nuclear materials.
- This includes both inspection and enforcement responsibilities and gives them the authority to protect the public from the hazards associated with ionizing radiation.
- As of July 2008, thirty-five states are NRC agreement states, three other states have signed letters of intent to become NRC agreement states and the twelve remaining states and the District of Columbia are non-agreement.
- In NRC non-agreement states, and in the District of Columbia, NRC Regional Offices have regulatory authority for all source, byproduct, and special nuclear materials.
Subprograms of Radiation Control Programs

- In April of 1999, the Conference of Radiation Control Program Directors, Inc. (CRCPD) issued a publication, *Criteria for an Adequate Radiation Control Program*.
- This publication provided a means of standardization of RCPs and provided the managers of these programs a tool for evaluating program activities that represent the “hallmarks of an adequately functioning radiation control operation”.
CRCPD defines seven operational areas or subprograms of the RCP

1. Electronic product radiation – ionizing (x-ray),
2. Electronic product radiation – nonionizing,
3. Radioactive materials,
4. Radon,
5. Environmental radiation surveillance and monitoring,
6. Low-level radioactive waste, and

Conclusions

- In some states, the regulating authorities and responsibilities are split between two or more state agencies.
- The organization and functions of state level programs with the authority to regulate the use of radioactive materials and radiation varies from state to state.
- Radiation Control Programs (RCP) may be located in the environmental management agency in one state and in public health, emergency management, or as a standalone agency in another.
- At least one state, Wyoming, has no RCP that carries out the functions recommended by CRCPD.
- Looking across states it is obvious there are many differences in how RCPs are organized and the functions of these programs. We have identified six models of organization with 32% of states being in Model 1 (A radiation control program in an agreement state located within a division of environmental health in the state health department).
Conclusions

- The different organizational models of state radiation control agencies and the algorithmic protocols for emergency response responsibilities (as explained in the National Response Framework) indicate that the response to mass radiological events will be complicated.
- The response effort will not only vary from state to state but will vary according to the type, amount, and custody of (or authority over) radioactive material involved; the extent of the impact on the public and the environment; and the size of the affected area.¹
- With this in mind, it is vital that local responders, public health planners and emergency management agencies work together to develop plans for the types of potential radiological events that could take place in their area/region. In doing so, all response obligations can be worked out prior to the events and can be exercised accordingly.

Questions?

- Contact Information:
  Lisa McCormick, MPH
  lcraft@uab.edu
  (205)934-7148
References

10. Holmes, R. Radioactive teapot found at Russian spy hotel. This is Local London: 40 Local newspapers - one online voice, 2007, Jan 29. Available at: http://www.thisislondon.co.uk
References