Goiânia Radiological accident: Brazilian experience on risk communication

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Stakeholder Involvement and Communication in Remediation Projects

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Goiânia: the capital of Goiás State, Brazil
Population: ~1 million

The emergency happened in a poor section of the city, in an old abandoned radiotherapy facility
Late 1985, a private radiotherapy institute moves to a new facility. A Cs-137 teletherapy unit was left behind. The place was abandoned and partially demolished. Two people entered the old facility and remove the source assembly. September 13, 1987. No notification to regulatory authority.
Source assembly was removed from the site.

Source dismantled and capsule disrupted.

Fragments of source distributed to several families.

Rest of source assembly was sold for scrap.

September 18

Goiania Radiological Accident, Brazil
Abandoned Cesium-137 teletherapy unit

Activity (Sept. 87)
50.9 TBq (1375 Ci)

Form- CsCl powder
Mass - 93 g (CsCl);
19.3 g (Cs-137)

Cs-137-
half-life 31.6 years
Key facts affecting the course of the accident

Radioactive cesium chloride glow blue in the dark

- Thought to be valuable or even supernatural
- Friends and relatives were invited to see the phenomenon
- Distribution of pieces of the source as gift

High solubility of CsCl

- Extensive contamination of person, property and environment
Discovering the Emergency

• Within five days, people were showing gastrointestinal symptoms → ARS

• One of them realizes that it may be caused by the object found
  ▪ **Pieces were brought to the public health department in the city**

• Investigation leads to the discovery of the radioactive material

• CNEN is notified and responds
First Phase
Gaining control and containing the problem

- Terrestrial gamma survey (by car and on foot) and aerial gamma survey → 67 km²

- Hot Spots - 3 scrap metal yards and one house (about 1 km²)

- Interviews with the main subjects involved

- Evacuation of residences

- Identify persons who had received significant doses and were contaminated.
Second phase
Decontamination

5 mSv in the first year \(\rightarrow\) 1 mSv over 50 years

Decontamination of the city: 730 workers required

Number of houses affected: 98
  - 41 evacuated
  - 6 demolished
  - 53 repaired

Number of public places decontaminated: 58
  - pavements, squares, shops and bars

Number of vehicles decontaminated: 64
Contamination Check
Response Statistics

- Individuals surveyed = 112,800
- Persons contaminated = 271
  - Contamination on clothing and shoes = 120
  - Internal and external contamination = 151
- Local radiation injuries (burns) = 28
- Hospitalization required = 20
- Bone marrow failure = 14
- Acute radiation syndrome = 8
- Fatalities = 4
Other impacts

• Profound psychological effects such as fear and depression

• Discrimination against the victims and important products of local economy

• Need for the construction of a large deposit to store the radioactive waste
Large amount of waste generated

- Volume of waste stored: 3,500 m³
  - 4,500 metal drums (200L)
  - 1,400 metal boxes (5 tons)
  - 10 shipping containers (32m³)
  - 6 sets of concrete packaging

93 g (CsCl)
Waste Storage site:
Abadia de Goiás

- Less than 15,000 habitants - 20 km from Goiania and 2.5 Km from Abadia de Goiás

- Waste repository \(\rightarrow\) population protests

- Nowadays, population live harmonically with the repository
  - Educational programs,
  - Information Center
  - CNEN laboratory located in the area
  - Federal funds to the city
3.500 m³ waste repository

About 10 years later

Photo: P. Pavlicek - IAEA
Abadia - Information Center
Brazilian Nuclear Energy Commission was coordinating the emergency response

Lack of credibility

Brazilian Nuclear Energy Commission was accused of negligency in the fiscalization of the radiotherapy clinic
Raising credibility…

✓ Team workers explained to people “what and why”

✓ Accept offers of drinking water and food from people's houses

✓ Team workers made frequent appearances on television.

✓ Talks to journalists and different sections of the population

✓ Distribution of 250,000 pamphlets to the population: “What you should know about radioactivity and radiation”

✓ 24 hours telephone service → Answer inquiries or receive information about other possibly contaminated people or sites
Phases in the reaction of the communications media

First Phase
- Sensationalism, misinformation and criticism of the authorities.

Second Phase
- Responsible coverage of events
- Seek to describe the events and what actions were taken by CNEN and the Federal and State Governments
Termination of protective actions

Urgent need to go back to “normal life”

Fears of the long-term health effects
Government public health Service created to give medical and psychological assistance to the victims of the accident

Four groups for assistance were established defined mainly according to the radiation dose received

Medical assistance mostly to those individuals directly affected
Groups for medical assistance

Active medical follow-up

**Full assistance**

- **Group I**
  - Doses ≥ 20 cGy and internal dose ≥ 1.8 MBq μCi
  - skin lesions
  - 56 subjects

- **Group II**
  - Doses < 20 cGy and internal dose < 1.8 MBq
  - No skin lesions
  - 44 subjects

Limited medical assistance

- **Group III**
  - Relatives, neighbors, volunteers, health professionals
  - 499 subjects

- **Group IV**
  - Clean-up workers
  - (military, firefighters and others)
  - 541 subjects

**offspring**

Dynamic
Association of victims of the Goiania radiological accident

• Created in December 1987 by residents of the 57 street

• To fight for medical assistance, financial compensations, free medications to all members of groups III and IV....

• About 1,200 members (many even not included as eligible)
Claiming for compensations due to health detriment

Neighbourhood of focus contamination

Employee’s Sanitary Vigilance of Goiânia

employee’s transportation company from municipal district (CRISA)

Relatives of exposed $^{137}$Cs cohort

Nurses from Tropical disease hospital in Goiânia

Employee’s Sanitary Vigilance of Goiânia

Monthly allowance for lifetime

Special medical assistance and medicaments

Others...
Public risk perception...

Headline of local newspapers

It was already found 50 cases of cancer among neighbourhood of $^{137}$Cs...

More one neighbour of Cs-137 died ...

Cancer killed employee of the Public Health Department ...

CÉSIO 137
Câncer mata servidor da Vigilância Sanitária

Raimundo Correia, de 54 anos, lutava desde 2003 para ser reconhecido como vítima e ter direito à pensão, mas não conseguiu nem avaliação médica.
• More 616 victims from Cesium are considered eligible for monthly allowance ....

“People still ask if we shine in the dark”
13 de setembro de 2012
Goiania 25 years later....

- Increasing number of people asking for illness compensations (cancer and non-cancer)

- Strong believe that their diseases were radiation related
Different Groups...

Different motivations...

Different interests....

Different levels of knowledge about the subject...
Arguments

- Number of exposed or contaminated people is higher than the one officially recognized.
- Groups III and IV are also groups at risk. Doses are underestimated.
- All diseases in the affected population are radiation-related regardless of the disease and the dose received.
Beliefs

- Population who lives near the main focus of contamination presented a higher cancer incidence compared to other areas.

- People directly affected by the accident have not only higher cancer incidence but multiple cancers.

- Members of groups III and IV are also at higher risk.
Challenge explanations

- Life style and environment
  - Low radiation doses
  +

- Spontaneous cancer risk
  - Low cancer risks
  +

Irrelevant risk
Acceptable risk
Radiation dose-response

Cancer Risk

Dose (mSv)

Epidemiology challenge
Health risk studies conducted in Goiania

- Cohort study – cancer incidence and all causes mortality
- Spatial distribution of leukemia incidence in Goiânia
- Lifetime cancer risk projections
Goiania cohort study

Members of Groups I, II, III and IV

Objective

To evaluate if the cancer incidence in the directly affected population is different from what would be expected

Heavy internal contamination of Cs-137
Goiania cohort study

Groups I, II, III and IV (underway)

1987 2002 2012

Groups I and II (Koifman et al, 2005)

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<thead>
<tr>
<th></th>
<th>Obs/Exp</th>
<th>SIR (95% CI)</th>
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<tbody>
<tr>
<td>All cancers</td>
<td>2/4.3</td>
<td>0.47 (0.11-1.86)</td>
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<tr>
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<th>Obs/Exp</th>
<th>SMR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All causes of Death</td>
<td>6/3.4</td>
<td>1.73 (0.77-3.85)</td>
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Low statistical power due to the small size of the cohort
Spatial distribution of leukemia incidence in Goiânia

183 leukemia cases occurred at Goiânia, from 1997-2002 were georreferenced. Cluster analysis were done using the SaTScan software.

Objective ➔ To evaluate if there is any leukemia cluster that could be related to the contaminated areas.
Spatial distribution of leukemia incidence in Goiânia

Goiânia city and the 4 main focus of $^{137}$Cs contamination

- 57 street
- 6 street (JunkYard II)
- 26A street (JunkYard I)
- 16A street (Sanitary Vigilance building)
Kernel estimation of Leukemia incidence rate (per 100,000)

Spatial distribution of 183 leukemia cases at Goiânia, 1997-2002

No statistically significant leukemia cluster
Leukemia SIR (95% CI) for different periods as a function of distance from the main $^{137}$Cs focus of contamination
Huge challenge for a scientist…

How to “translate” these results to the public?

How to explain “excess risk but not statistically significant”?

How to explain some case exclusion criteria due to latency period?
Risk Projections

✓ Using NCI Risk Projection tool (adapted to the Brazilian population)”

✓ To estimate the lifetime risk of developing a radiogenic cancer for members of the Goiânia cohort

✓ To determine whether surveillance of the exposed population should be concentrated on certain cancer sites.  

Veiga et al, 2011
Estimated excess lifetime risk for radiation-induced cancer according to age at exposure

Median Effective dose (Sv)

- Group 1 – 0.36 (0.1-5.8)
- Group 2 – 0.14 (0-0.3)
- Group 3 – 0.0002 (0-0.3)
- Group 4 – 0.0002 (0-0.1)
Estimated excess lifetime risk for radiation-induced, site-specific cancer (per 10,000) for Groups 1 and 2 of Goiânia Cohort

![Graph showing ELCR per 10,000 for different sites (Stomach, Colon, Lung, Breast, Bladder, Thyroid, Leukemia) for Males and Females.]

- Males
- Females

ELCR per 10,000:
- Stomach
- Colon
- Lung
- Breast
- Bladder
- Thyroid
- Leukemia
Conclusions I

- There is no evidence of an increased cancer risk in Goiânia population due to the radiologic accident.

- Among the directly affected population, only members of groups I and II are under higher cancer risk.

- There is no program for risk communication.
Conclusions II

The Government is still struggling with hundreds of petition in court for financial compensations.

There is no framework to address this issue.

Radiation specialist have to evaluate if the reported disease is radiation-related (most cancers are radiation-induced!!)
Different Groups...

Different motivations...

Different interests....

Different levels of knowledge about the subject...
How to deal with...

Different interests....
Thanks!

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