Doses to sewage workers due to I-131 waste from therapeutic purposes

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All topics covered in GAEC's departments

- Licensing & Inspections Department
- Personal Dosimetry Department
- Environmental Radioactivity Control Department
- Ionizing Radiation Calibration Laboratory
- Division of Research, Development & Education

Materials & Methods

2 state hospitals in Athens

- Highest number of patients treated annually in Attica region
- System of delay tanks not installed

TLDs packed in plastic bags (groups of 3)

3 TLD plastic bags placed at each point (in man-holes)

3 TLD plastic bags kept for background monitoring

Materials & Methods

TLDs calibrated in terms of ambient dose equivalent H*

GAEC's ionizing radiation calibration laboratory

- N-200 (ISO Narrow series) X-ray beam quality (200 kV - 164 keV)
- Cs-137 beam (662 keV)

Calibration factor I-131 E:364 keV obtained by interpolation

All relevant correction factors (e.g. fading, etc) taken into consideration

Materials & Methods

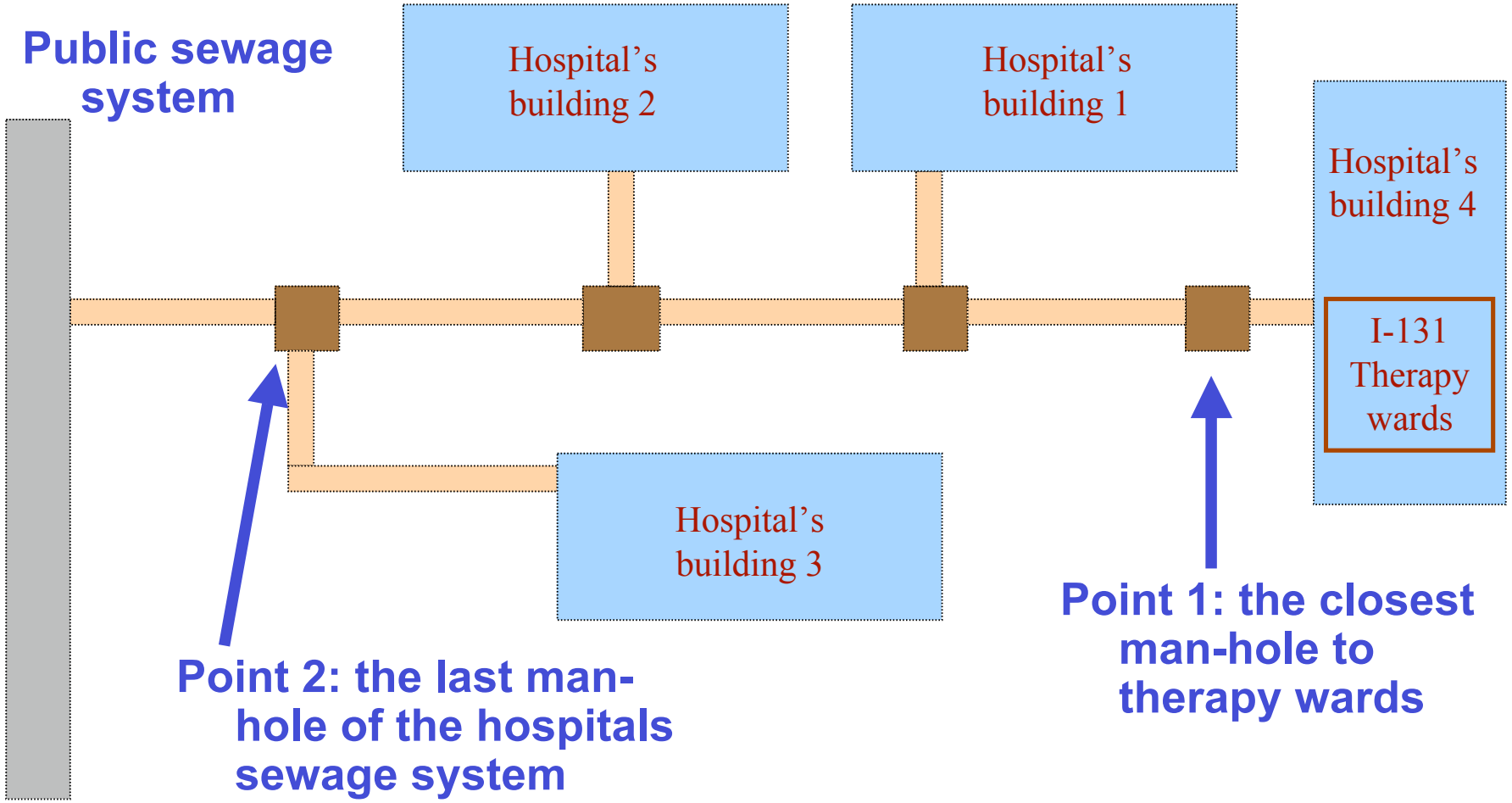
GAEC's records & databases

- number of patients treated annually in each hospital
- administered I-131 activity per patient
- I-131 activities annually delivered to hospitals

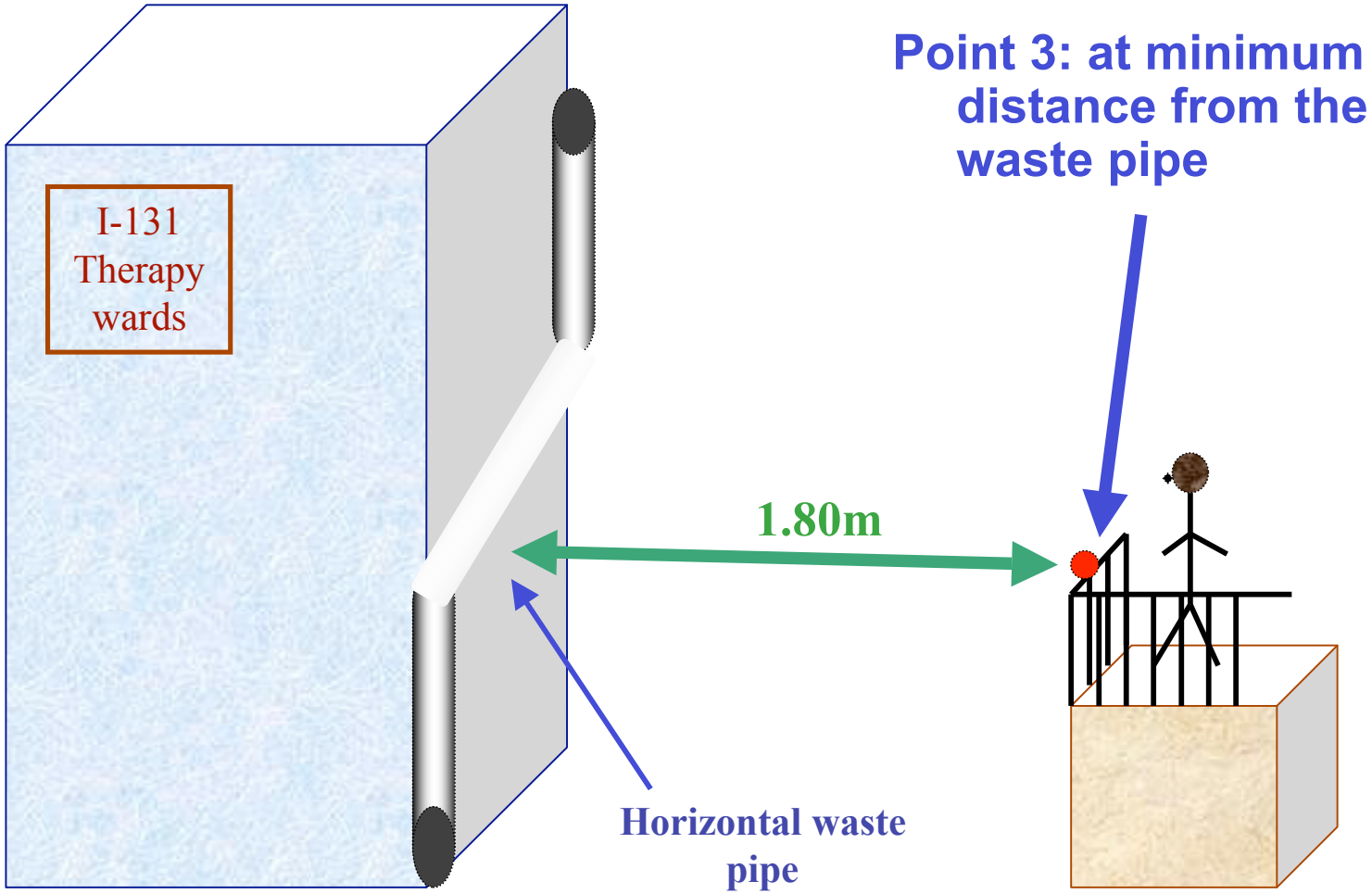
MCNP4C2 code

theoretical calculations simulating the real situation in both hospitals

Materials & Methods



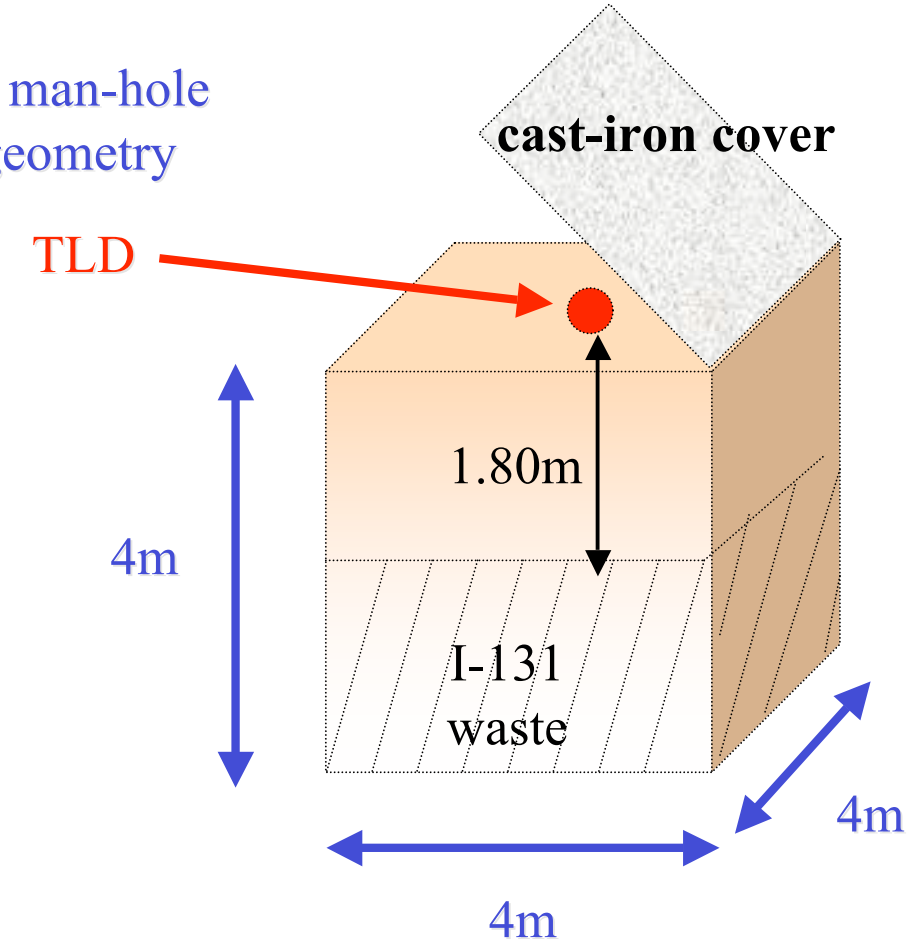
Materials & Methods



Materials & Methods

MCNP4C2 code

- 5cm thickness concrete walls
- 3cm thickness cast-iron cover
- I-131 average monthly concentration: 10MBq/m³

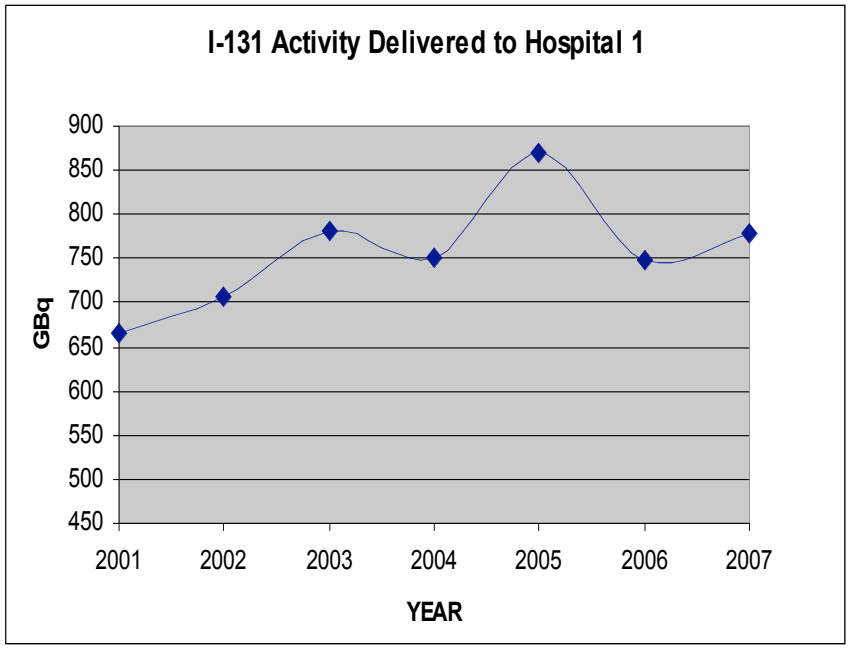


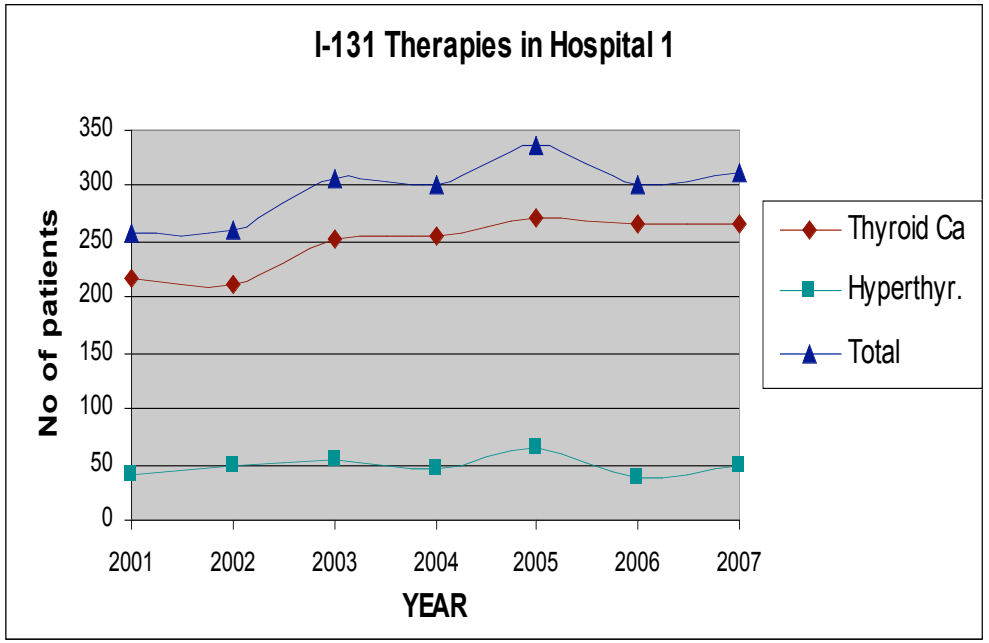
Sources of Errors

- TLD calibration procedure: 5% (95% confidence level)
- %SD of 3 TLDs: 3%
- Overall TLD response: 3.2%

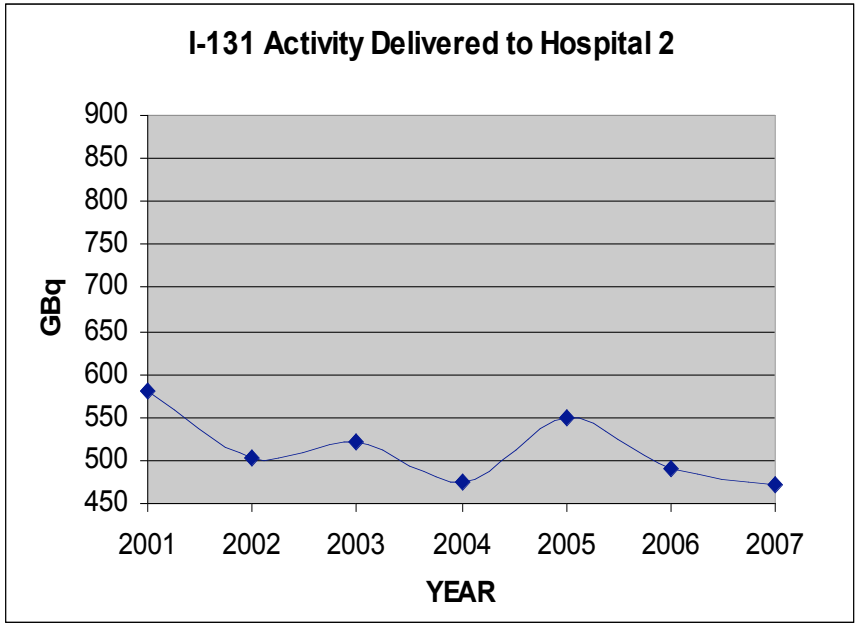
Overall uncertainty: 6.7% (95% confidence level)

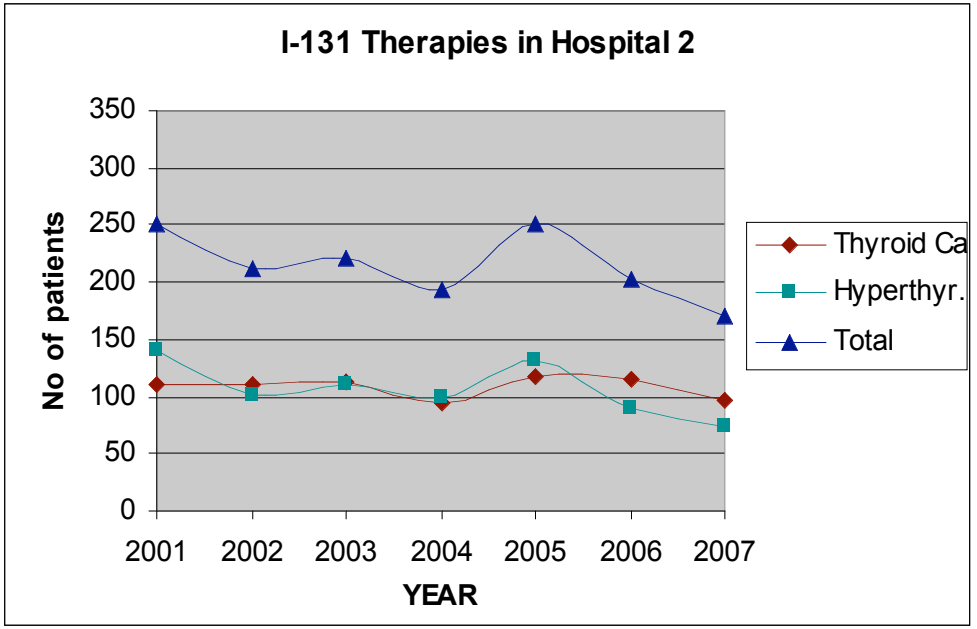
Results: Hospital 1



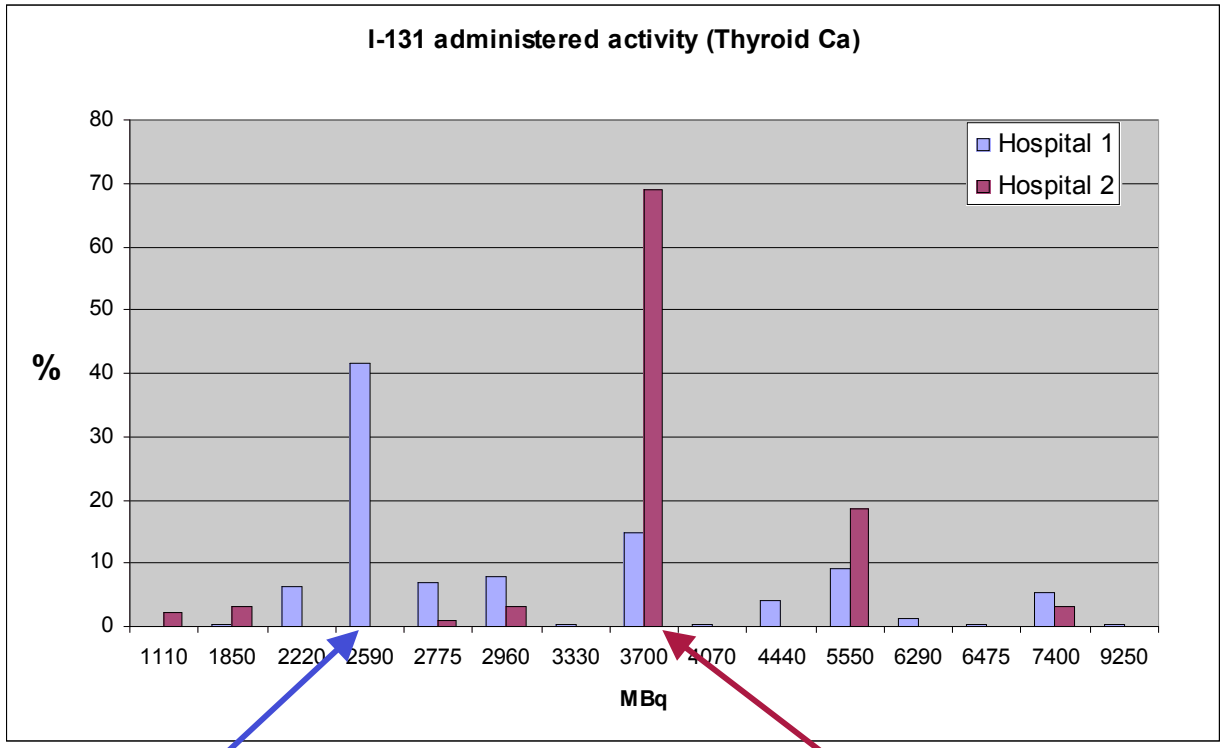


Results: Hospital 2





Results: most frequent I-131 administered activity



2590 MBq Hospital 1

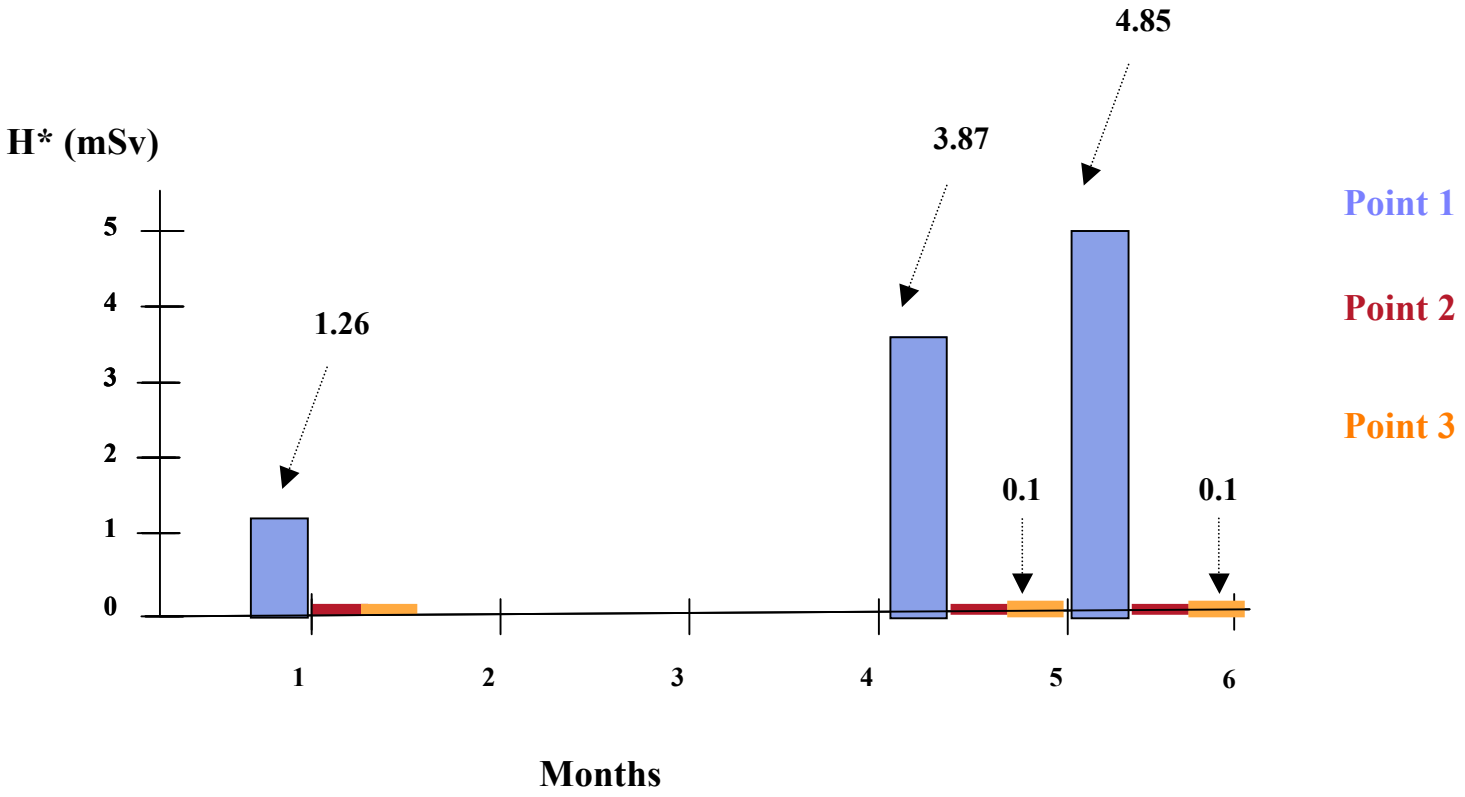
3700 MBq Hospital 2

Results: Hospital 1

Point 1: first man-hole

Point 2: last man-hole

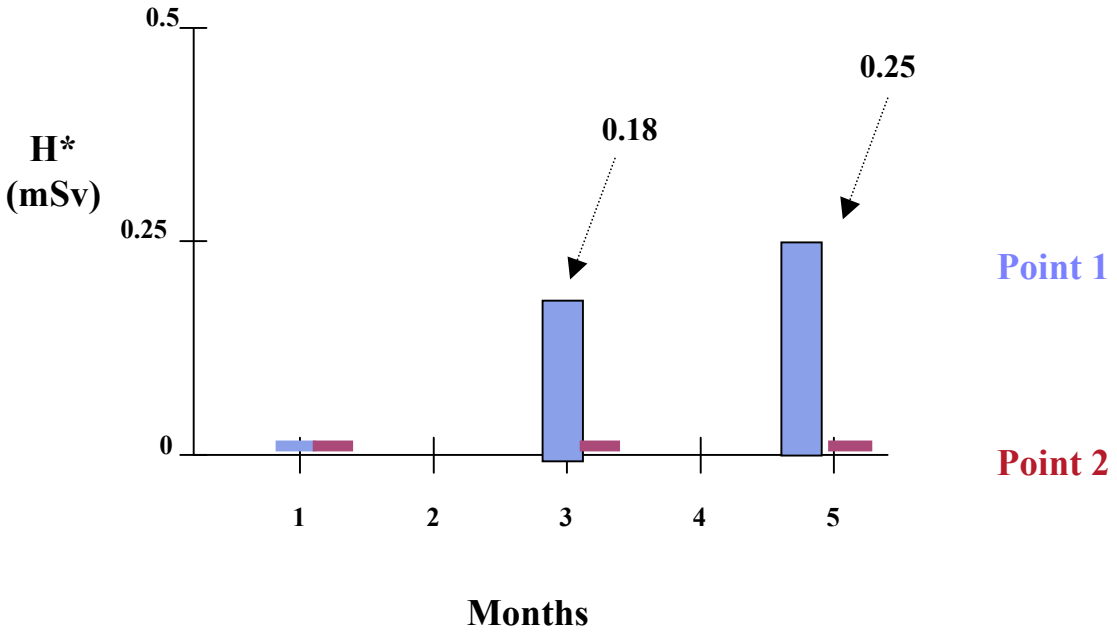
Point 3: minimum distance from waste pipe



Results: Hospital 2

Point 1: first man-hole

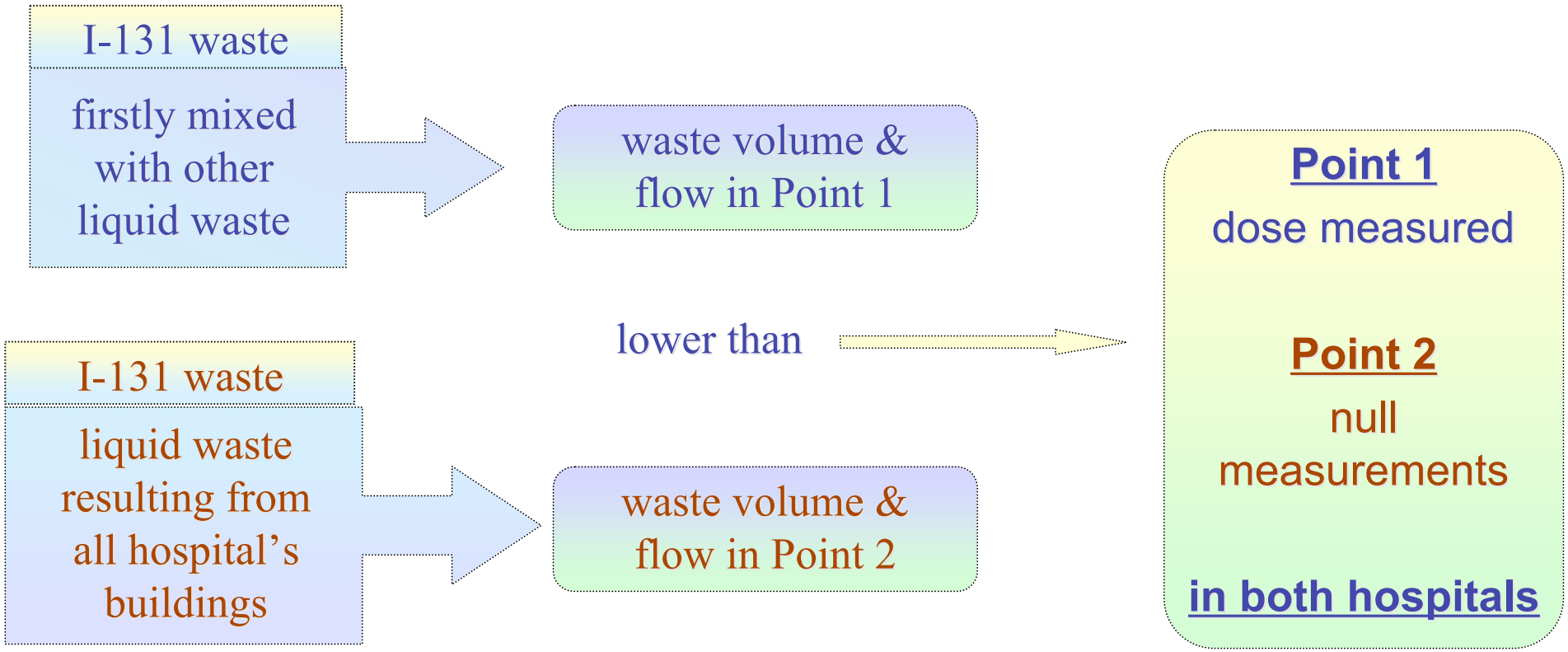
Point 2: last man-hole



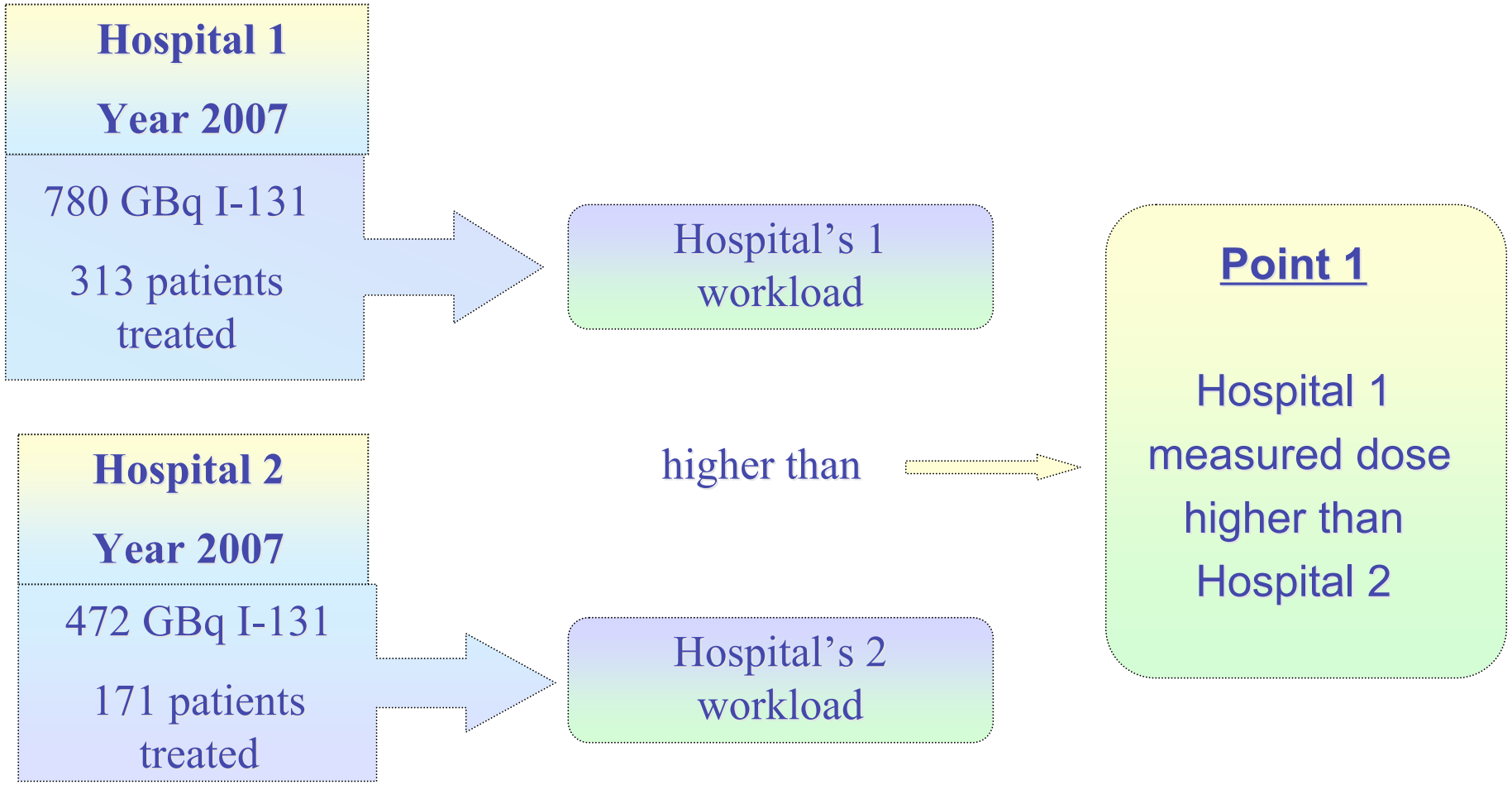
MCNP simulation results

	Point 1	
Days	Measured dose (mSv)	Simulated dose (mSv)
34	0.00	0.03
97	0.18	0.13
151	0.25	0.25

Discussion: differences between Points 1 & 2



Discussion: differences between Hospitals 1 & 2



Discussion

Experimental data:

Hospital 1: 28 - 37 μSv/day **Hospital 2: 0.0 - 1.9 μSv/day**

Calculated data (80% administered I-131 activity released first 48h):

Hospital 1: 2.2 – 2.5 GBq/day **Hospital 2: 0.6 – 0.8 GBq/day**

Hospital 1: 12.3 - 14.9 μSv/GBq **Hospital 2: 0.0 - 2.7 μSv/GBq**

Difference in derived μSv/GBq due to

hospitals sewage system geometry & water consumption.

Discussion

Two groups of interest:

- **hospital sewage system workers**
- **public sewage system workers**

Contamination risk should be considered when sewage system repair or maintenance is performed.

Discussion

Hospital sewage system workers

- procedures in place (e.g. scheduled maintenance, incident/repair - communication with radiation protection expert, dose measurements etc)
- time occupancy factor (working in man-holes)
- cast iron covers, ground, etc above the hospital's waste pipes
- waste pipes specially marked, route known, connected directly to 1st man-hole of the building

Discussion

Public sewage system workers

- **measured doses not exhibit risk for external irradiation**

- **applied Dose Constraints (100μSv/y) not expected to be exceeded**

I-131 concentration to public sewage system seems to be negligible.

Conclusions

Measured doses do not exhibit risk for external irradiation of sewage system workers

Contamination risk should be considered when sewage system repair or maintenance is performed.

I-131 concentration to public sewage system seems to be negligible.

Our warm thanks to hospitals staff for their collaboration and contribution to this study.

THANK YOU FOR YOUR ATTENTION

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