



# Very low occupational exposure in the medical field

P. Covens  
VUB

# Occupational exposures in hospitals

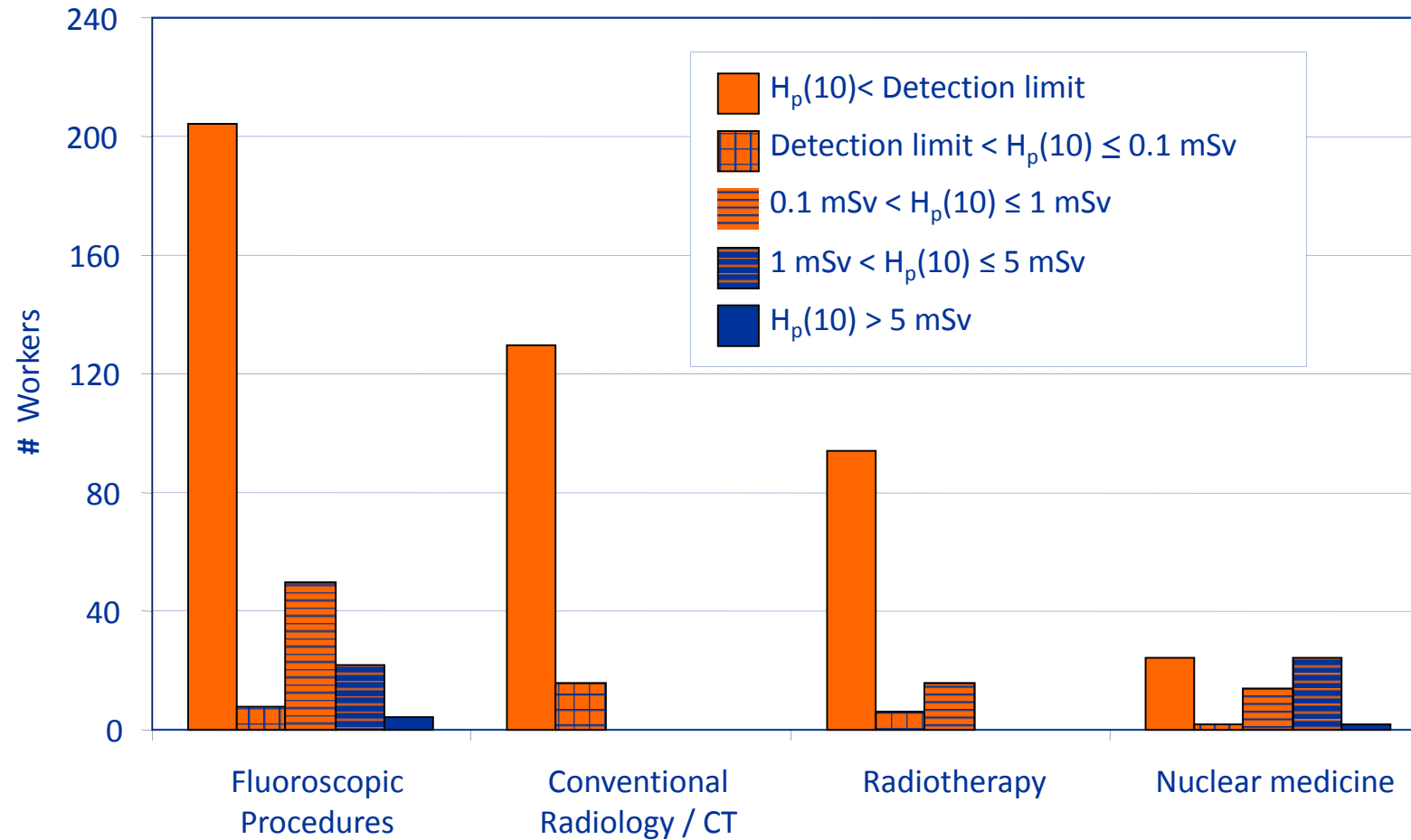


- Diversity of procedures
  - Radiology (diagnostic, interventional)
  - Nuclear medicine (diagnostic, therapeutic)
  - Radiotherapy
- Optimisation
  - Collective and individual protection measures
  - Workers training/education
  - Working procedures
- Dose limitation tools
  - Regulatory dose limits
  - Dose constraints (regulatory, local)

# Individual monitoring in hospitals

- Mandatory for many workers
  - Routine exposure
  - Potential risk of exposure
- Typical measurable routine exposures
  - Nuclear medicine
  - Interventional radiology/cardiology
- Potential risk of accidental exposures
  - External beam therapy / brachytherapy
  - Routine cyclotron operations

# Typical distribution of occupational exposures

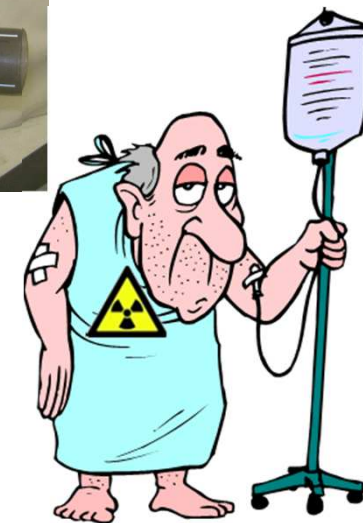


# “Grey zones” inside hospitals

- Questionable zones: significant exposure present or not?
- Measurable radiation exposure present!
- But...
  - Limited frequency of exposures
  - Limited duration of exposures rates
  - Limited order of magnitude of exposure rates
- Nevertheless
  - Often subject for discussions
  - Sometimes invokes radiophobia

# Measurable dose rates in "grey zones"

- CT:  
1-30 $\mu$ Sv/h at operator console
- Dental radiology:  
1-5  $\mu$ Sv/h at 1m of X-ray tube
- Ambulant nuclear medicine patients  
inside the hospital:  
5-20 $\mu$ Sv/h at 1m, 1h post injection



# Elements associated with “grey zones”

## RPE view

- Optimised shielding design CT?
  - Contribution to the dose of measurably exposed workers due to present room design?
  - Subject of improvements (ALARA)?
- Dental radiology: foresee personal dosimetry?
- Risk assessment of the nuclear medicine patient
  - Do NM patients cause a radiation protection problem outside the NM department?
  - Do we need restrictions in the behaviour?

# Elements associated with “grey zones”

## Worker view

- What about measurable dose rates through shielding?
  - Is there radiation coming through the lead glass!?
  - How much dose do I receive due to this transmission?
  - Does my dosimeter really work?
- What is the minimum safe distance from my dental X-ray apparatus?
- NM patients during complementary examinations
  - Is this legal?
  - What if I am pregnant?
  - Does this affect my fertility?



# Tools to answer questions in “grey zones”



- Personal routine dosimetry
  - 80% of “occupationally exposed workers” not measurably (< reporting levels) exposed
  - Workers are often part of clusters and do not work solely in “grey zones”
- Real-time dosimetry using Active Personal Dosemeter (APD’s)
  - Low detection limit
  - Difficult for reliable long-term data
- Long-term monitoring using passive dosimeters specifically in these grey zones

## Method using TLDs

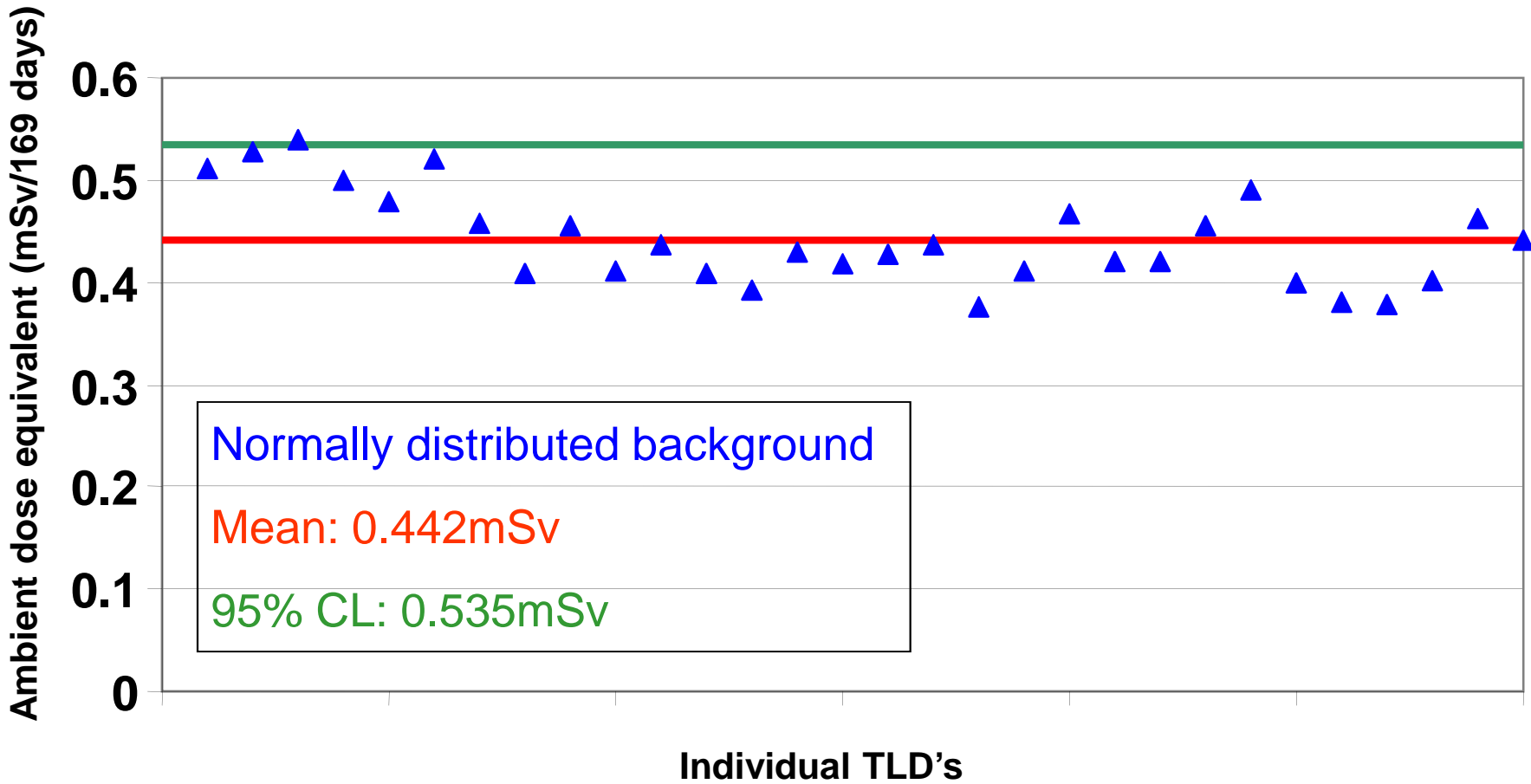
- 6 months (169 days) monitoring using 44 sets of 3 individual calibrated TLDs (TLD100H)

# Sets	Location	Specific
10	Background locations	Offices, meeting rooms
9	3 different CT-units	Inside imaging rooms, operator consoles
13	Dental radiology	Control switches equipment
5	Ultrasonography	Equipment, wall or room

# Searching for answers

- CT-units: what is the order of magnitude of cumulated radiation exposure at consoles?
- Is staff radiation exposure in dental radiology measurable in routine conditions?
- What is the order of magnitude of cumulated radiation exposure of ultrasonographers attributable to nuclear medicine patients?

# Results Background monitoring



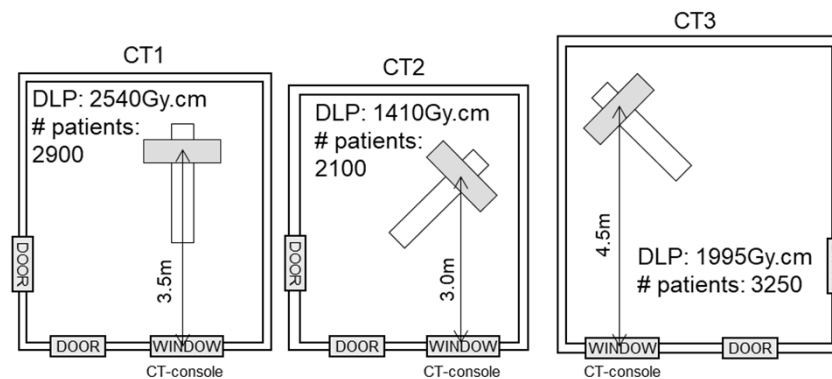
# Results at CT-consoles (1)

## ➤ Workload of CT-scanners

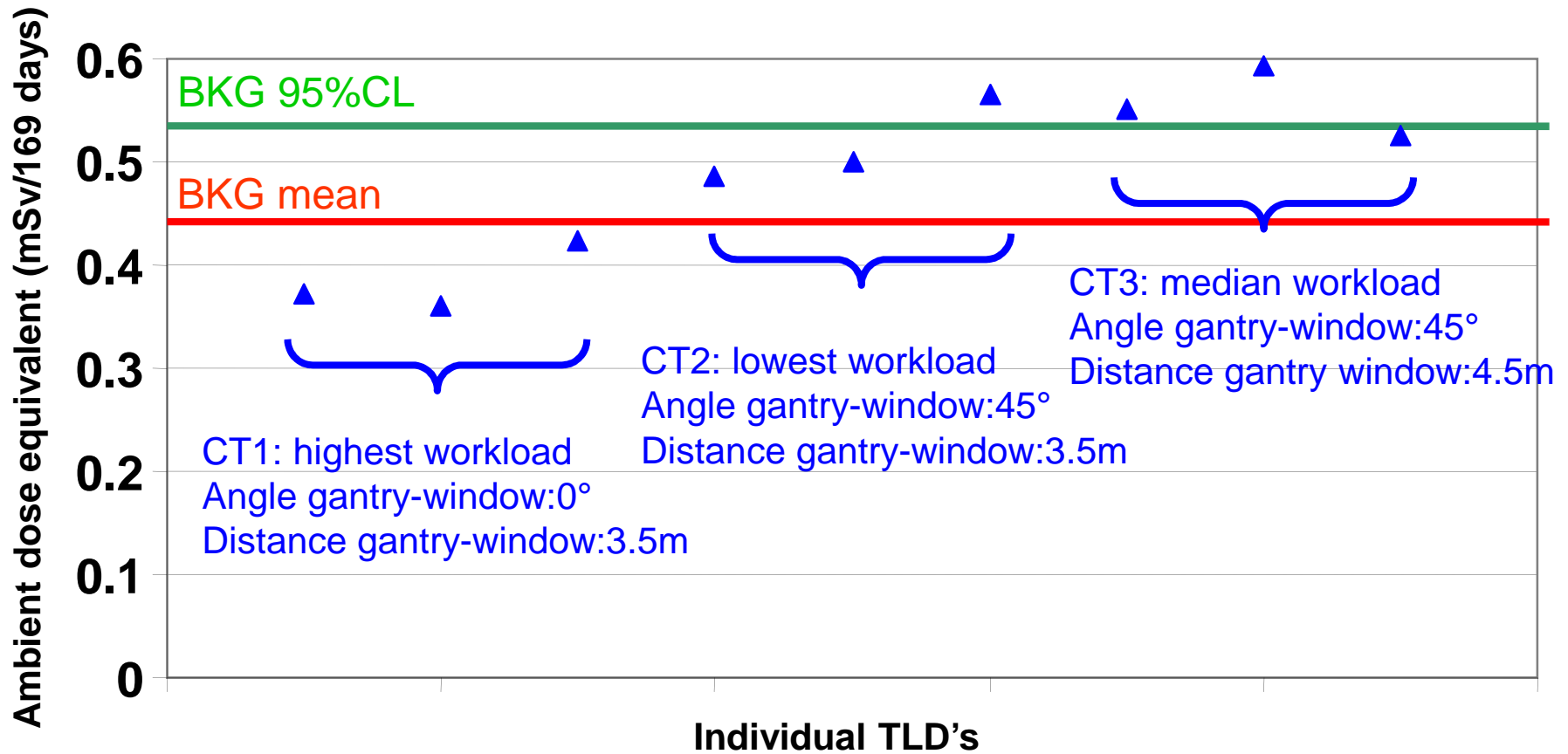
- Variable # procedures: 1000-2500/CT-scanner
- Variable DLP (1000-3000Gy.cm)/CT-scanner

## ➤ CT-room design

- 2mm lead equivalent walls, doors, window
- Variable distance/angle consoles-gantry



# Results at CT-consoles (2)

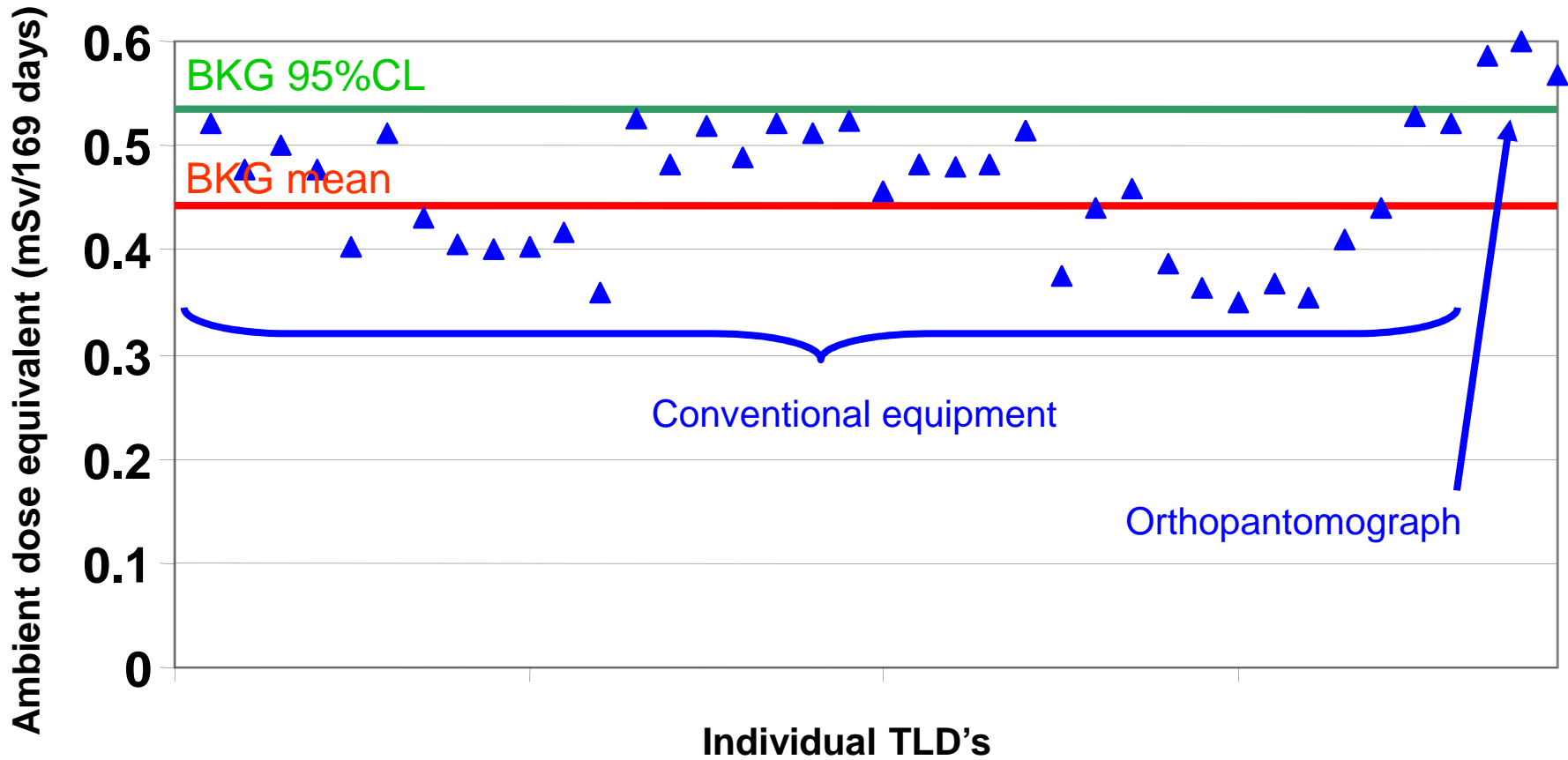


# Results Dental radiology equipment (1)



- Workload of equipment
  - 1 Orthopantomograph: 400 patients (20000 mAs)
  - 12 Conventional: 2200 patients (6000 mAs)
- No shielding devices present
- Maximum distance switches – tube: 1.5m

# Results Dental radiology equipment (2)



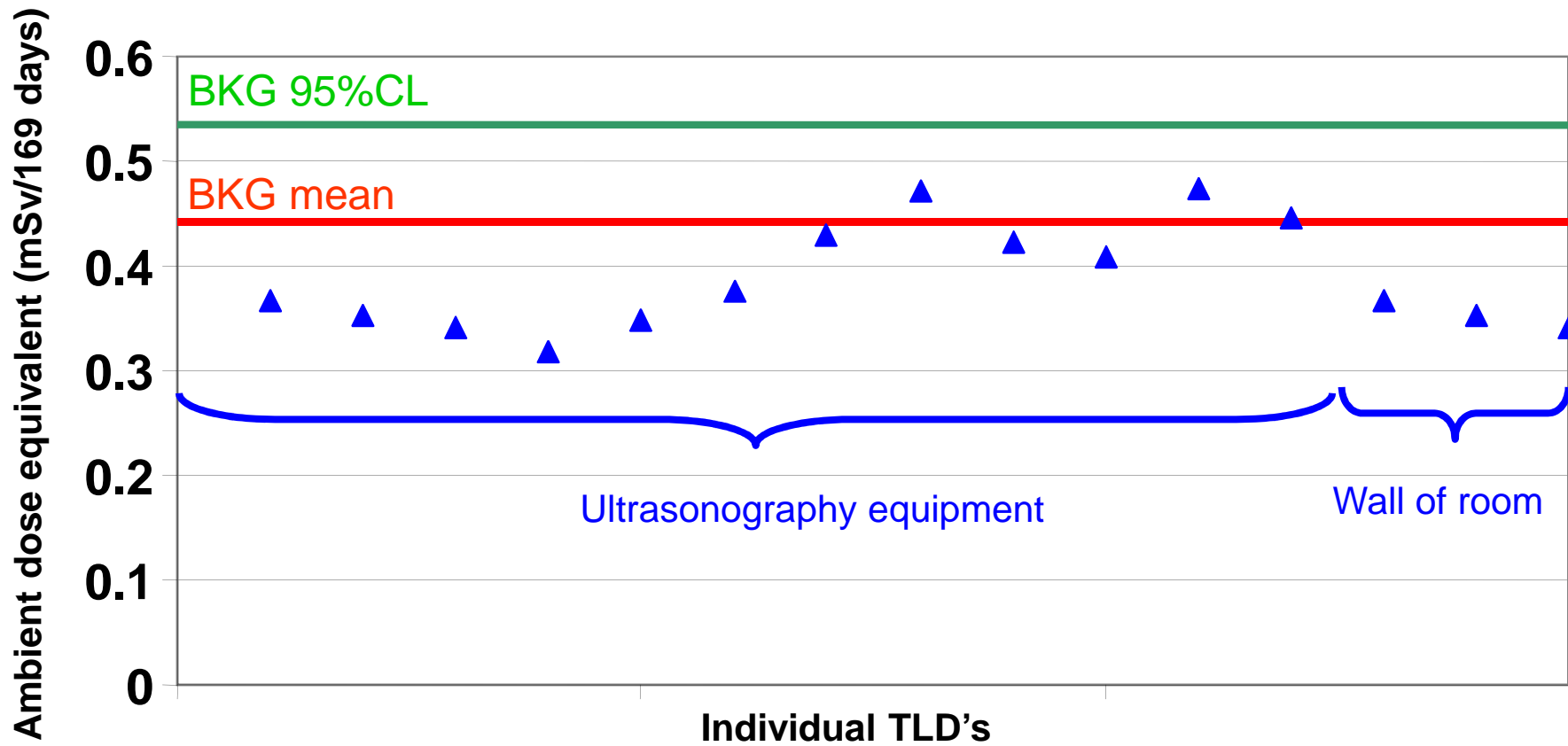


# Results ultrasonography (1)

- Number of nuclear medicine patients during measuring period
  - 5500 procedures in nuclear medicine department
  - 450 (8%) patients: ultrasonography same day (spread over 4 apparatus)
- Total injected Activity of patients for ultrasonography: 350 GBq (99%  $^{99m}\text{Tc}$ )
- Distance patients-TLD's: <0.5m



# Results ultrasonography (2)



 **NM-Patients are not observable based on this long-term area monitoring**

# Questions

- Are our dosimeters representative for whole body radiation doses of comforters/carers?
- Have we covered all possible scenarios?
- Do we need apply restrictions after diagnostic procedures?

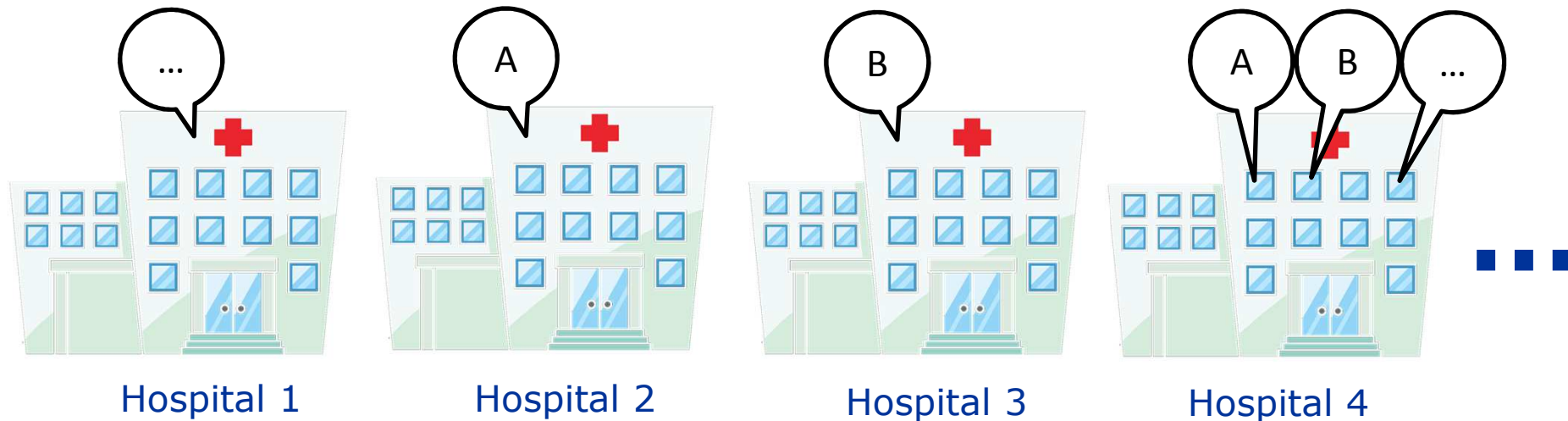
# Ambulant NM-patients: current situation

## ➤ Regulations

- RD 20/07/2001, Art 52.2.4 c): written instructions after treatment and diagnosis
- EURATOM BSS, Art 56.6: in the case of a patient undergoing treatment or diagnosis with radionuclides, the practitioner ... provides the patient or their representative with... appropriate instructions with a view to restricting doses to persons in contact with the patient...  
Instructions should be written in case of therapy
- Draft new RD, Art 24 §1: written instructions after treatment and diagnosis

# Ambulant NM-patients: current situation

- In the field...which instructions are used?



A mix of “no”, “sometimes”, “soft”, “very strict”!

Need for consensus!

# Conclusions

- Radiation exposure in “grey zones”
  - Hardly observed due to background fluctuations
  - Area monitoring is overestimation (high workload)
  - Validation using APD in real-time should be considered
- Effectiveness room design
- Exposure of ambulant NM patient
  - Better insight
  - More scientific data could help
- Using these results as the sole tool in risk communication is utopian!



# Thanks for the attention!