# Dose Reduction in Paediatric Head CT Examinations

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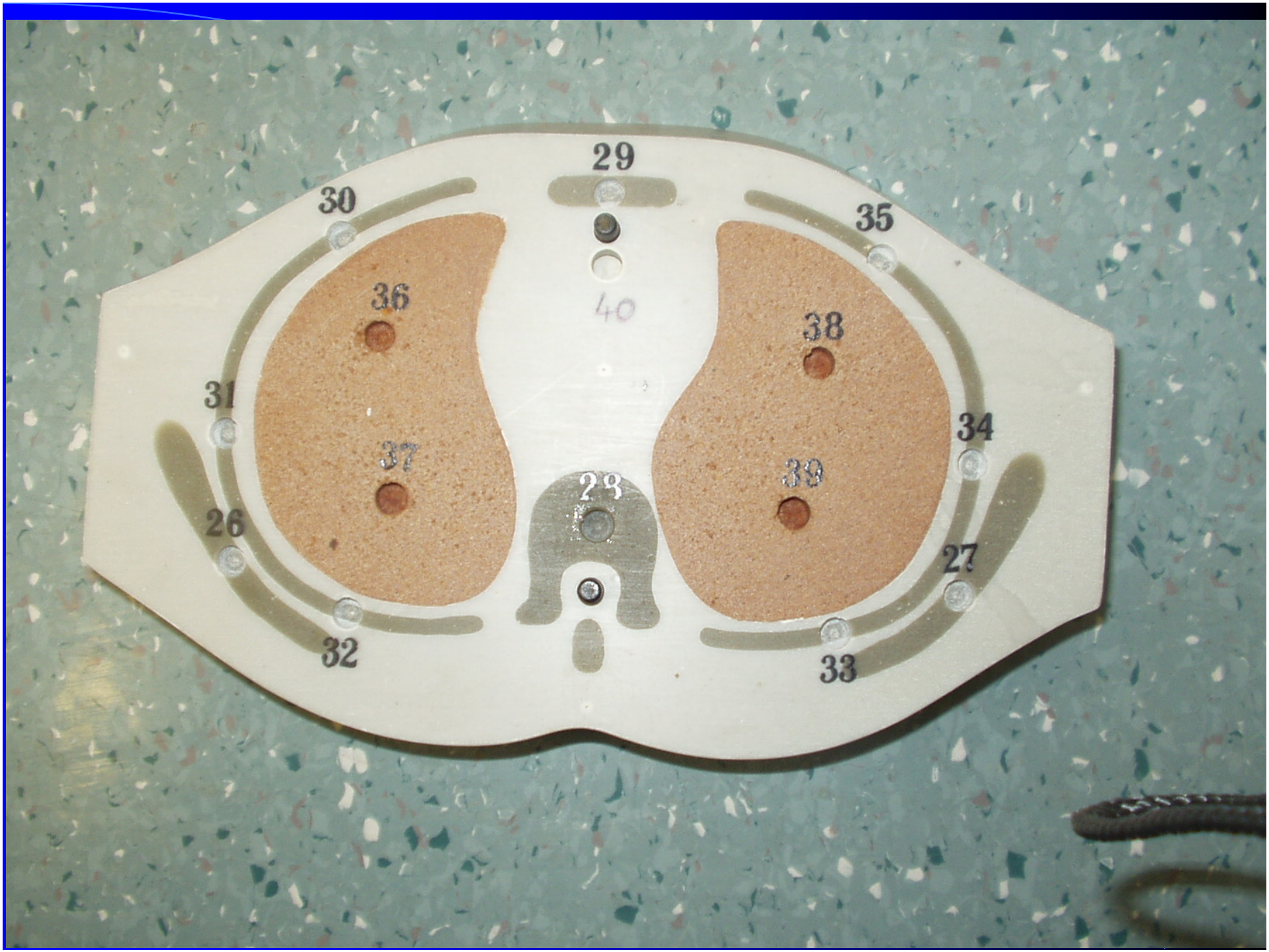
# Background

- Paediatric CT doses shown to be high
- NICE guidelines likely to increase numbers of CT head scans
- Shielding always recommended during ‘normal’ paediatric X-ray exams
- Would lead shielding of the trunk reduce dose during head CT?

# Experimental Technique

- Anthropomorphic phantoms loaded with TLD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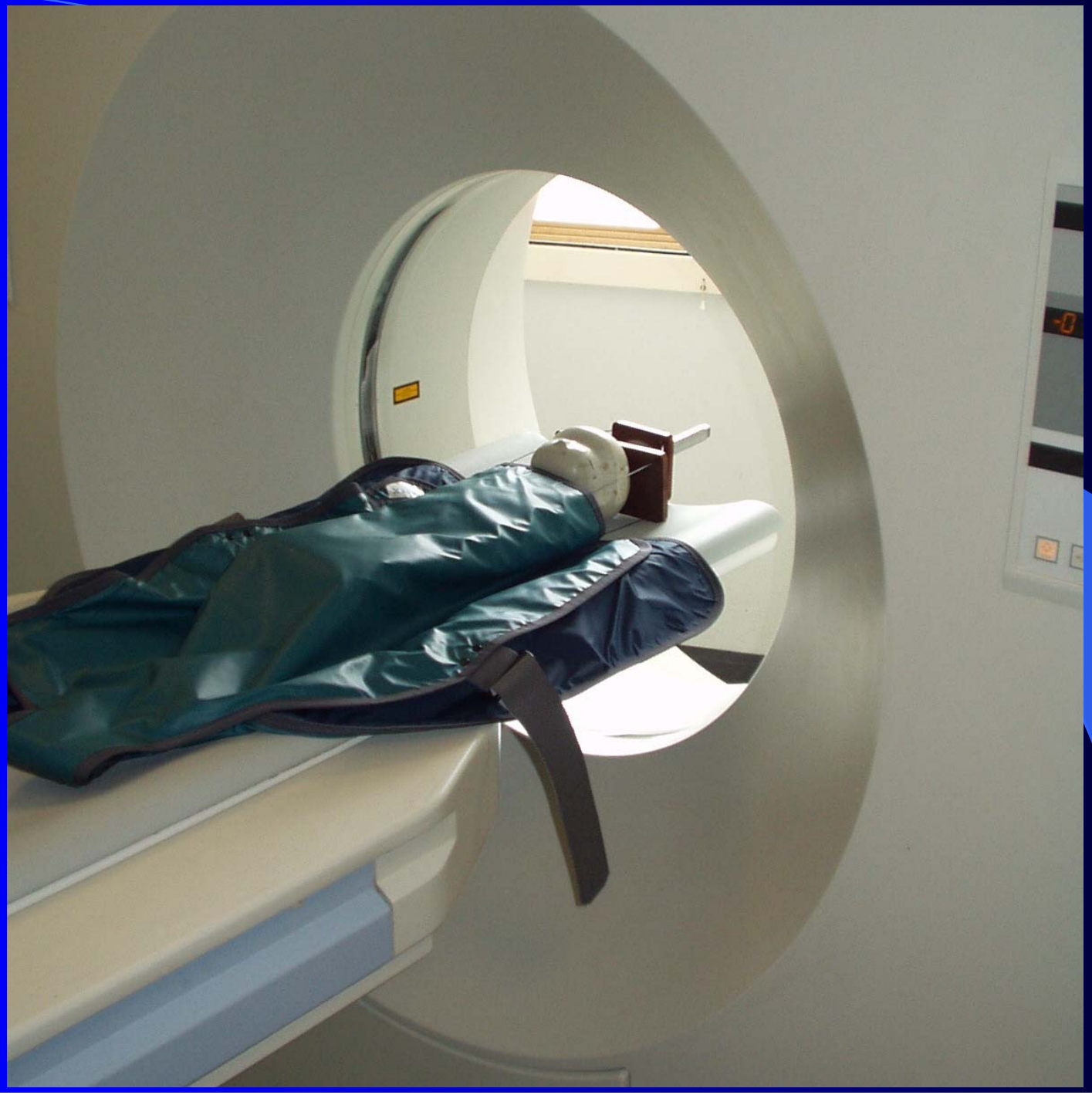
# Experimental Technique

- Anthropomorphic phantoms loaded with TLD
- Phantoms scanned using typical head scan parameters
- Experiment repeated with lead shielding of torso
- Experiment repeated for varying slice widths

# Scan Protocols

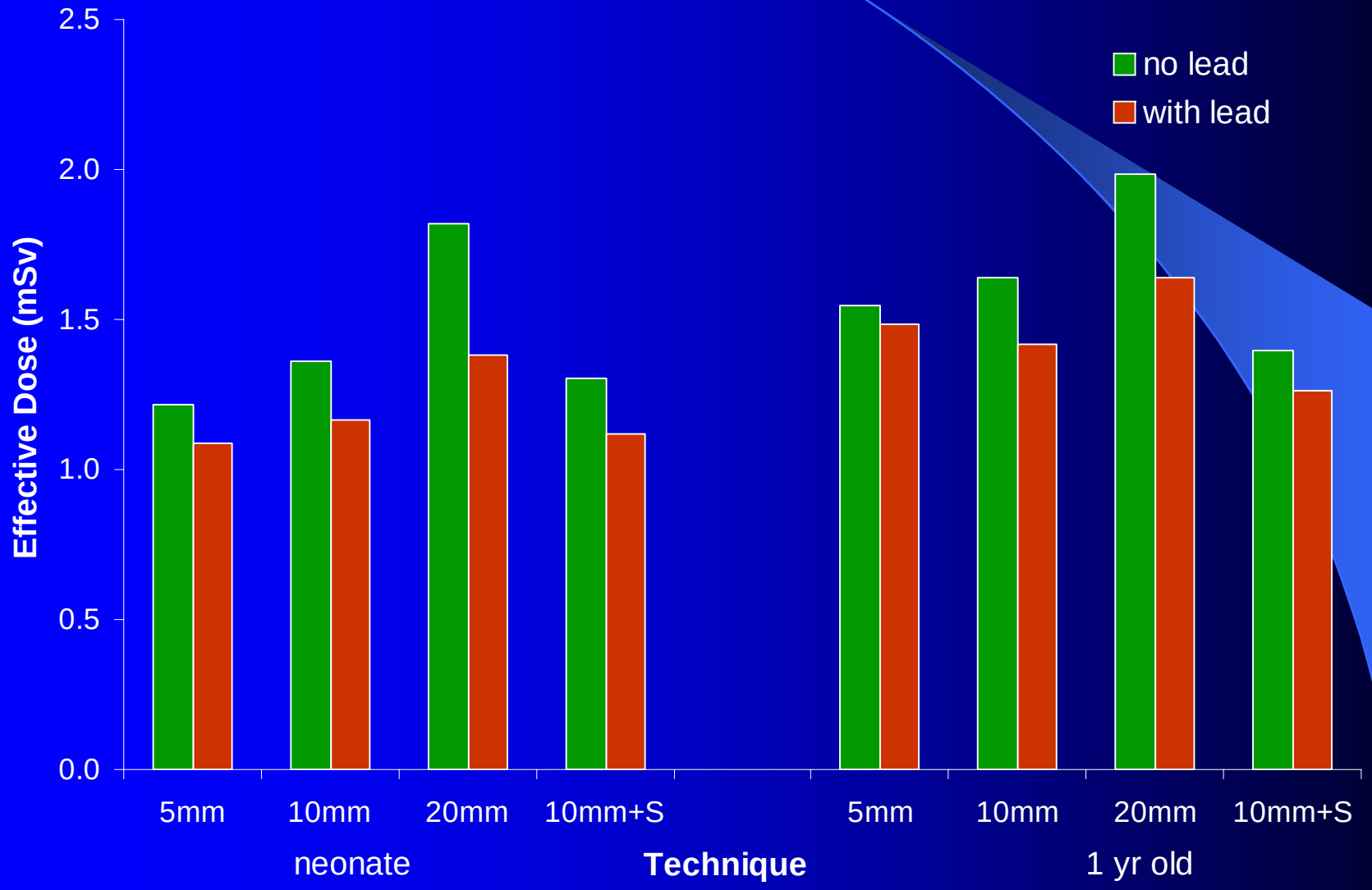
| | Scanner | Slice width | Protection used |
|---|---|---|---|
| 1 | Scanner A | 5mm | Lead apron |
| 2 | Scanner A | 10mm | Lead apron + collar |
| 3 | Scanner A | 10mm + scout | Lead apron + collar |
| 4 | Scanner B | 20mm | Lead apron + collar |



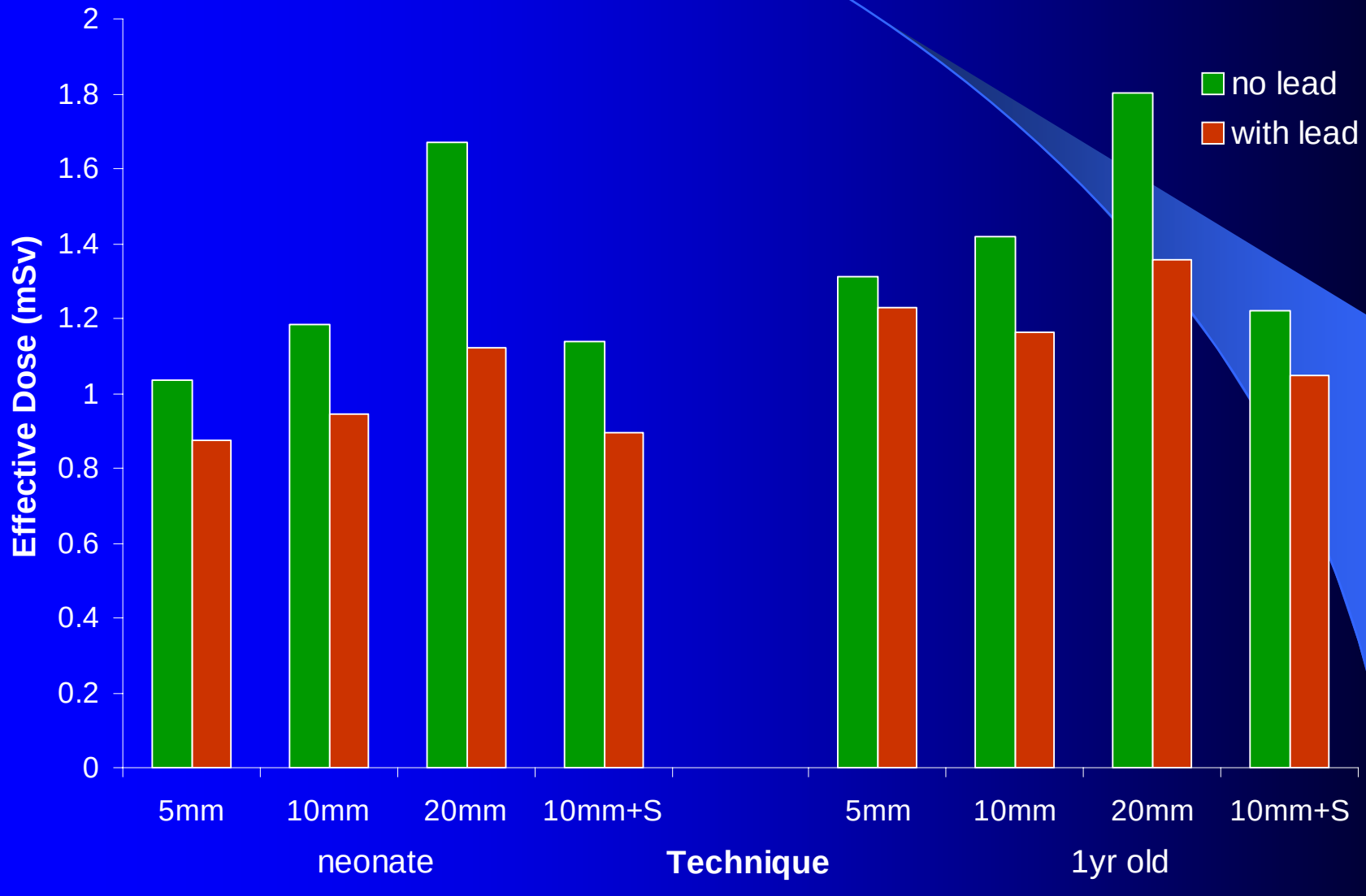
# Determination of Organ Doses

- TLD Loading schemes supplied with phantoms
- Skin dose from surface TLD measurements
- Muscle dose approximated as that to trunk
- RBM dose calculated using active bone marrow fractions
- Absorption factor included for bone surface

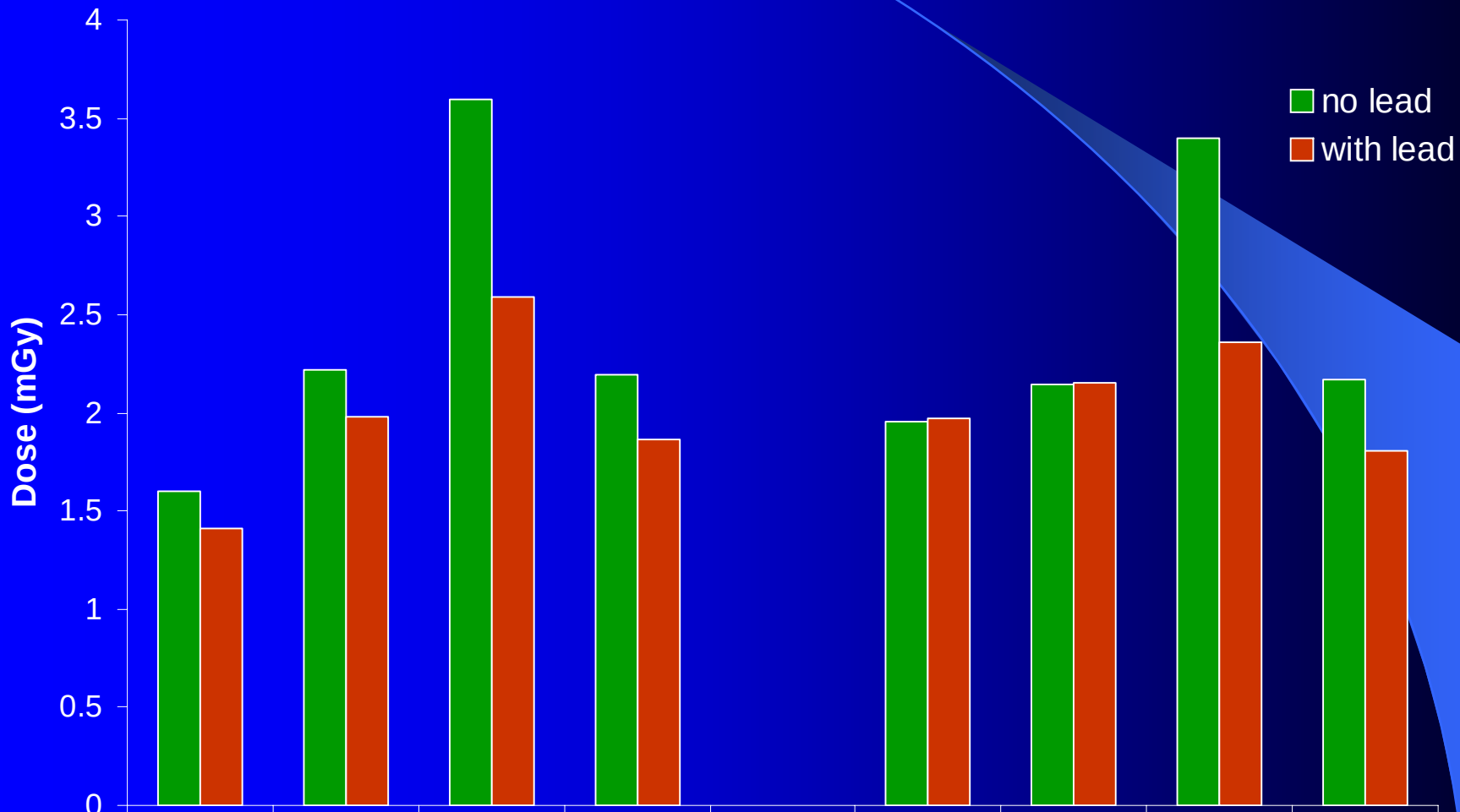
# Effect of lead protection on effective dose, calculated with current weighting factors



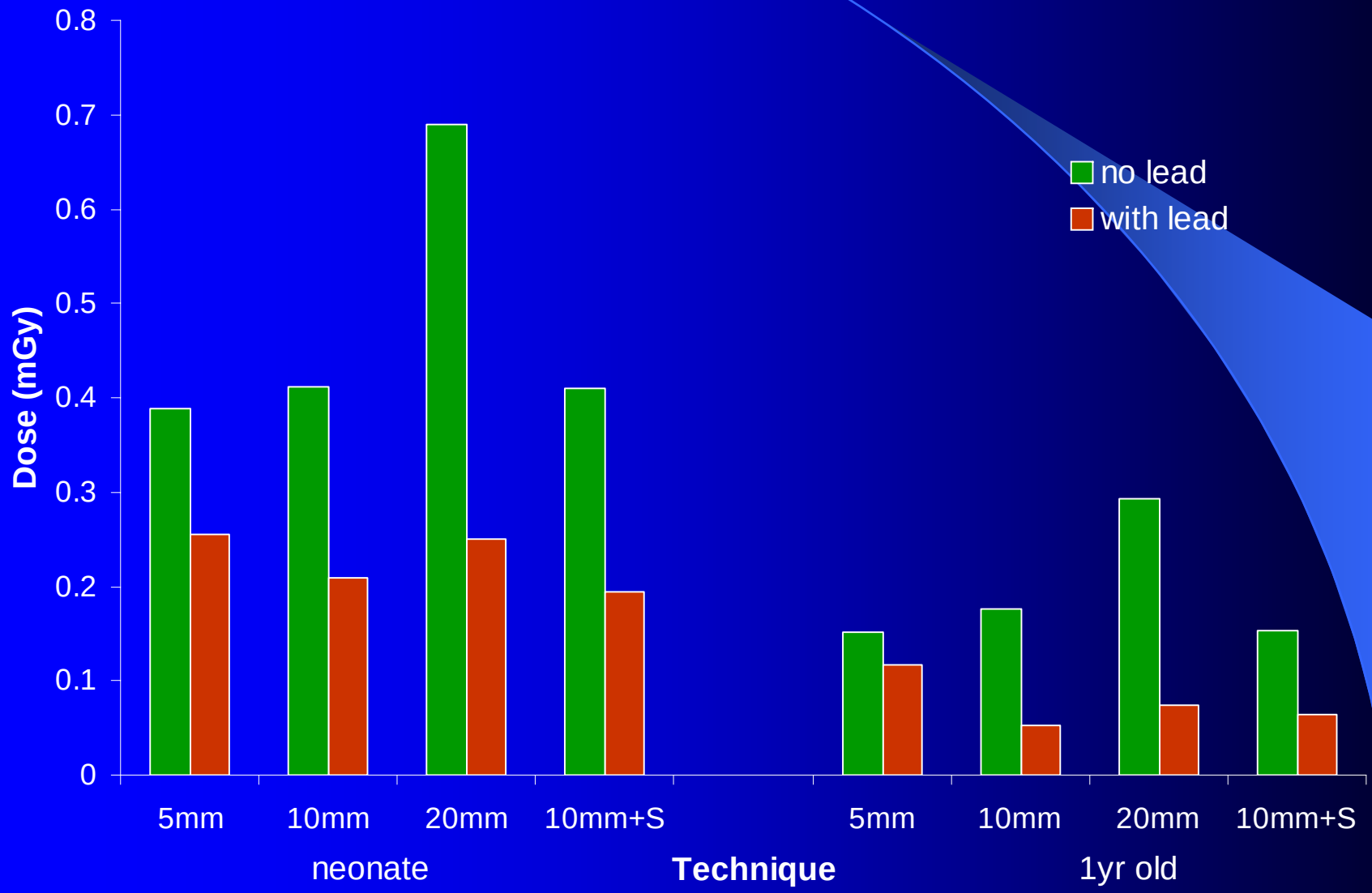
# Effect of lead protection on effective dose, calculated with new weighting factors



# Effect of lead protection on thyroid dose



# Effect of lead protection on breast dose



# Discussion (1)

- Significant proportion of scattered dose comes from outside the body
- Scattered dose increases with slice width
- Reduction in effective dose greater for neonate
- Reduction in effective dose more marked with proposed new weighting factors

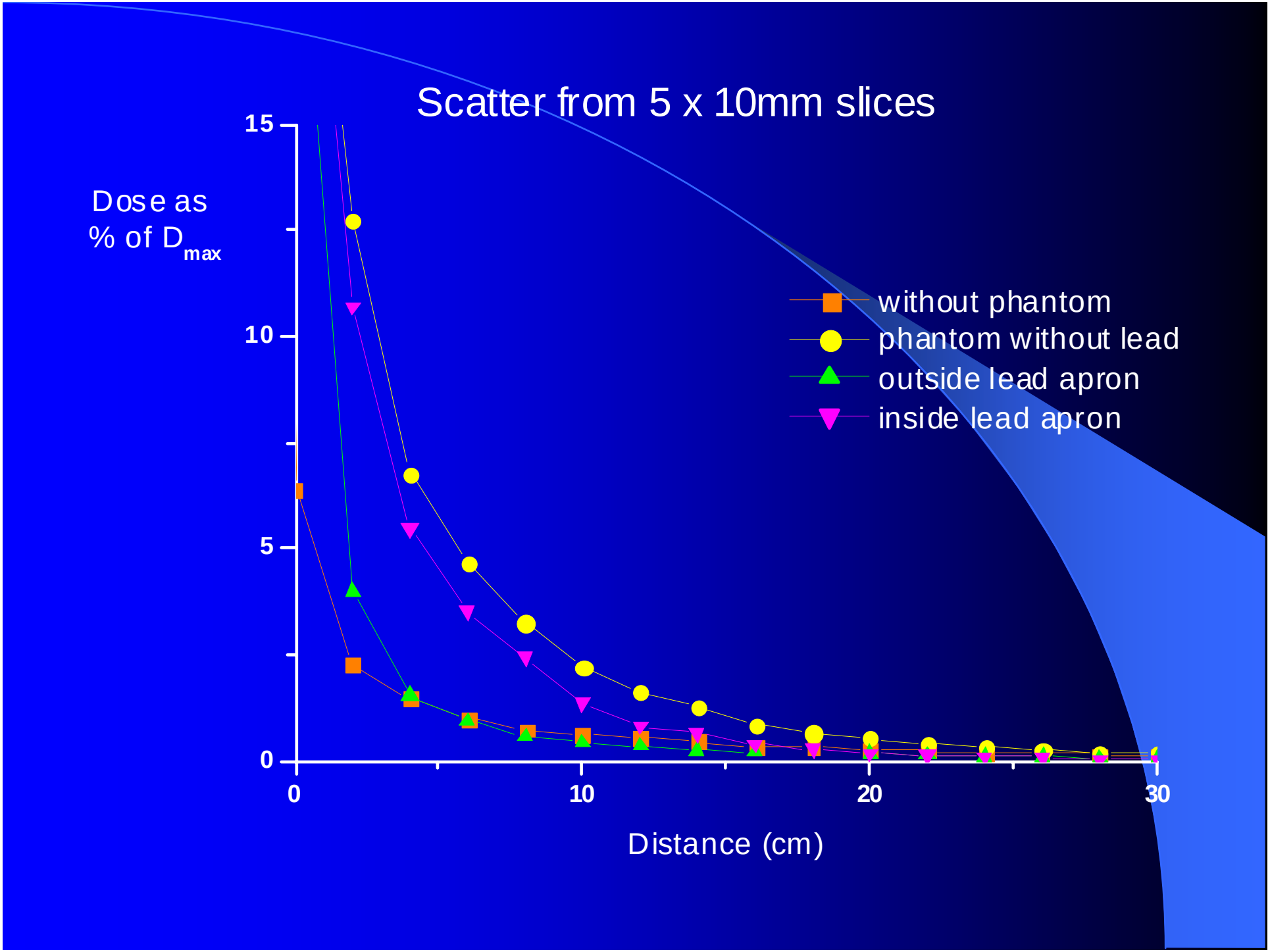
# Discussion (2)

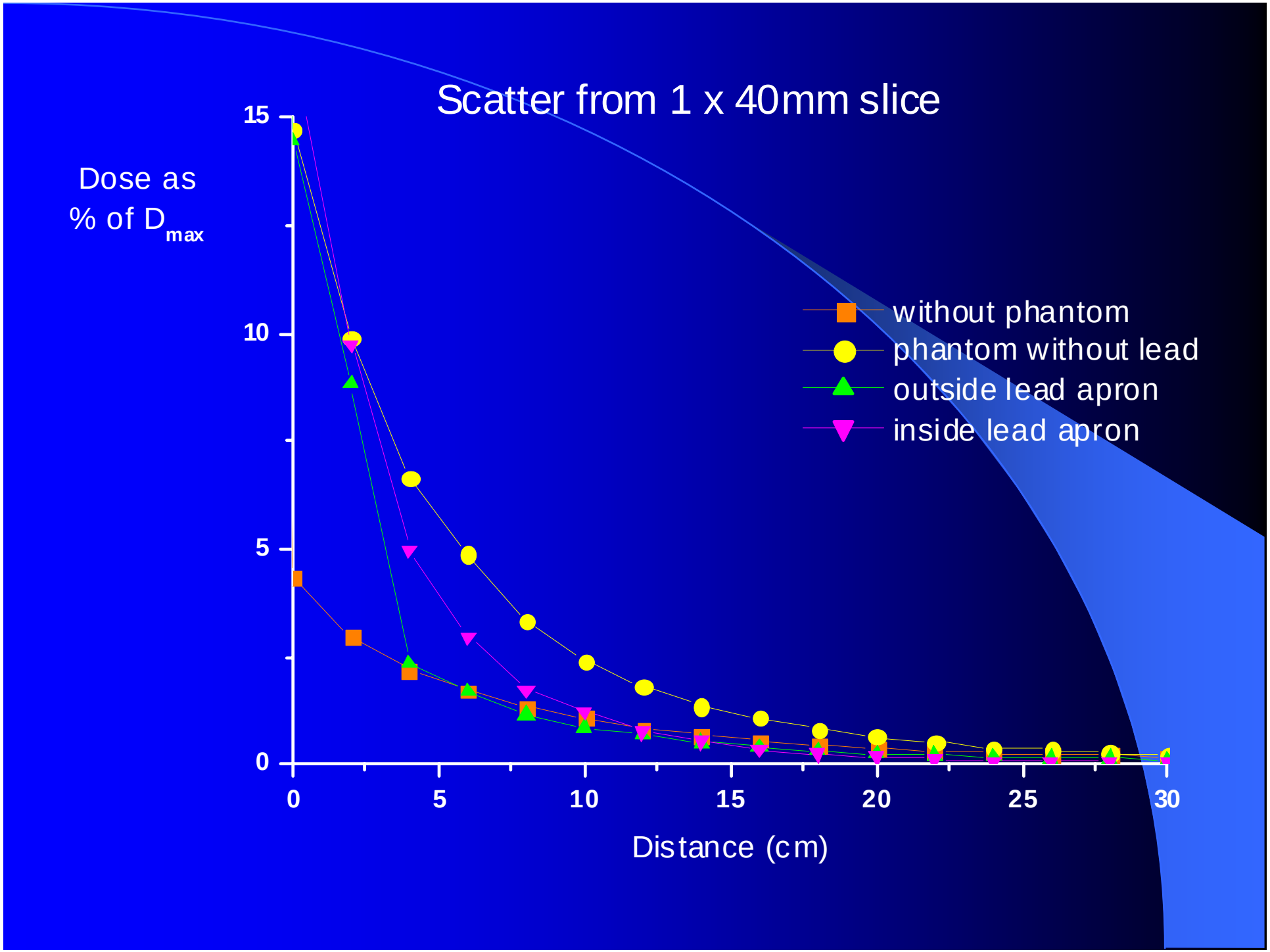
- Weighting factors not necessarily appropriate for infants
- Individual organ doses may be of more interest
- Thyroid results influenced by difficulties in positioning lead
- In practice, a sleeping or sedated baby would be easy to wrap up

# Further Work

- Measurements in New York show broadly similar results (chest scan, 3 phantoms)[1]
  - 40% reduction in dose to head
  - 25% reduction to dose to abdomen
- Dose profile measurements carried out for 2 slice widths –with & without phantom & lead

[1] Walter Huda, personal communication


Scatter from 5 x 10mm slices
Dose as
% of D max
15
10
5
0
0
10
20
30
Distance (cm)
without phantom
phantom without lead
outside lead apron
inside lead apron


Scatter from 1 x 40mm slice
Dose as
% of D max
15
10
5
0
0
5
10
15
20
25
30
Distance (cm)
without phantom
phantom without lead
outside lead apron
inside lead apron

# Conclusion

- Routine use of lead shielding could significantly reduce radiation dose to neonates & infants from head CT
- Measurements show reductions of
  - 30% in effective dose
  - 30% in thyroid dose
  - 70% in breast dose