

Case study 3b: NCI's cohort study

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NCI Chernobyl thyroid study

- Cohort study of about 13,000 Ukrainian individuals exposed as children.
- Lived in contaminated areas of the country.

THYROID DOSE FROM ^{131}I

- Mainly due to the consumption of fresh cow's milk.
- Because ^{131}I has a half-life of 8 days, the thyroid dose was essentially delivered within two months after the accident.

Other pathways of thyroid exposure

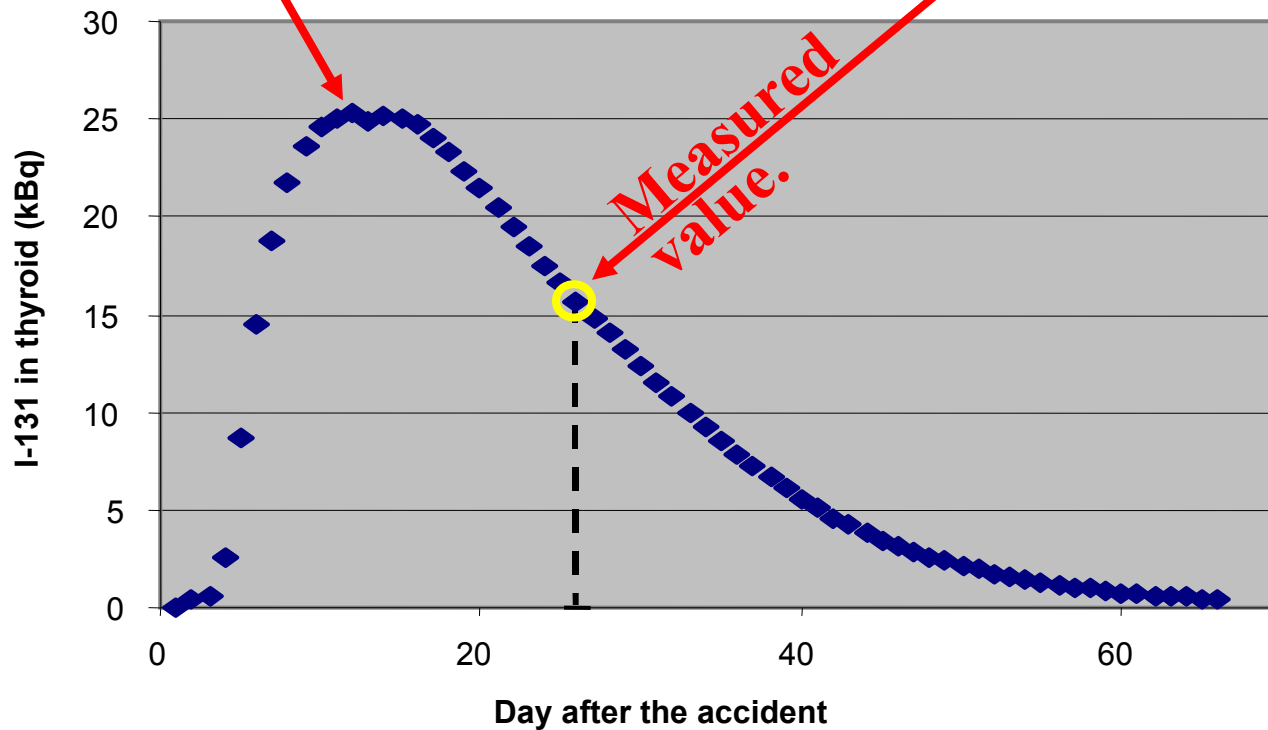
^{131}I (milk consumption): 96%

- ^{133}I (inhalation and ingestion): 2%
- ^{134}Cs and ^{137}Cs :
 - milk consumption: 1%
 - external irradiation: 1%

Data needed to estimate individual thyroid doses from ^{131}I

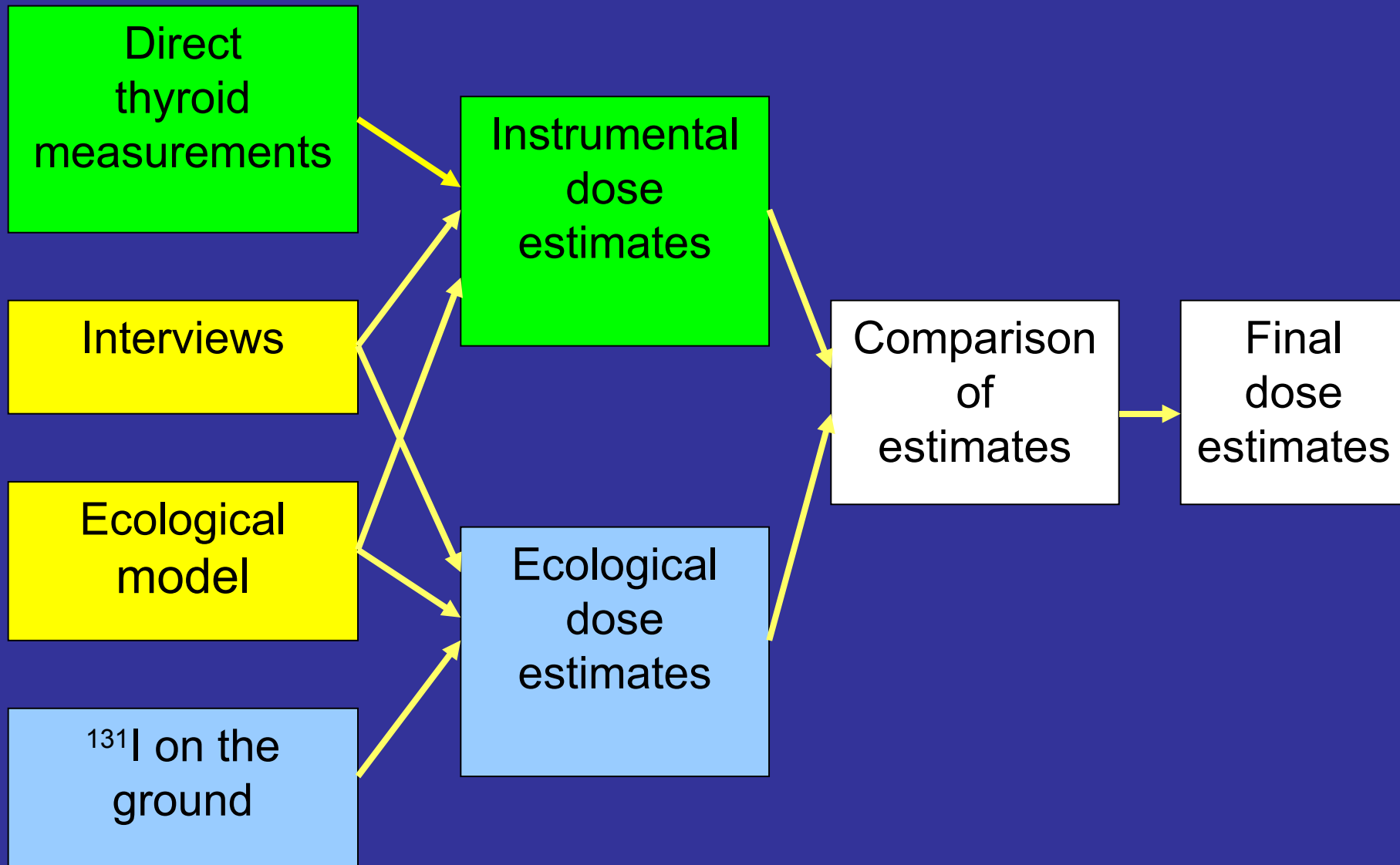
- **Radiation measurements:** human or environmental.
- **Personal interviews:**
 - Residential history
 - Milk type and consumption
 - Thyroid blockade (?)
- **Models** of environmental transfer and biokinetics of ^{131}I .

Curve derived from ^{131}I models plus data from interview.



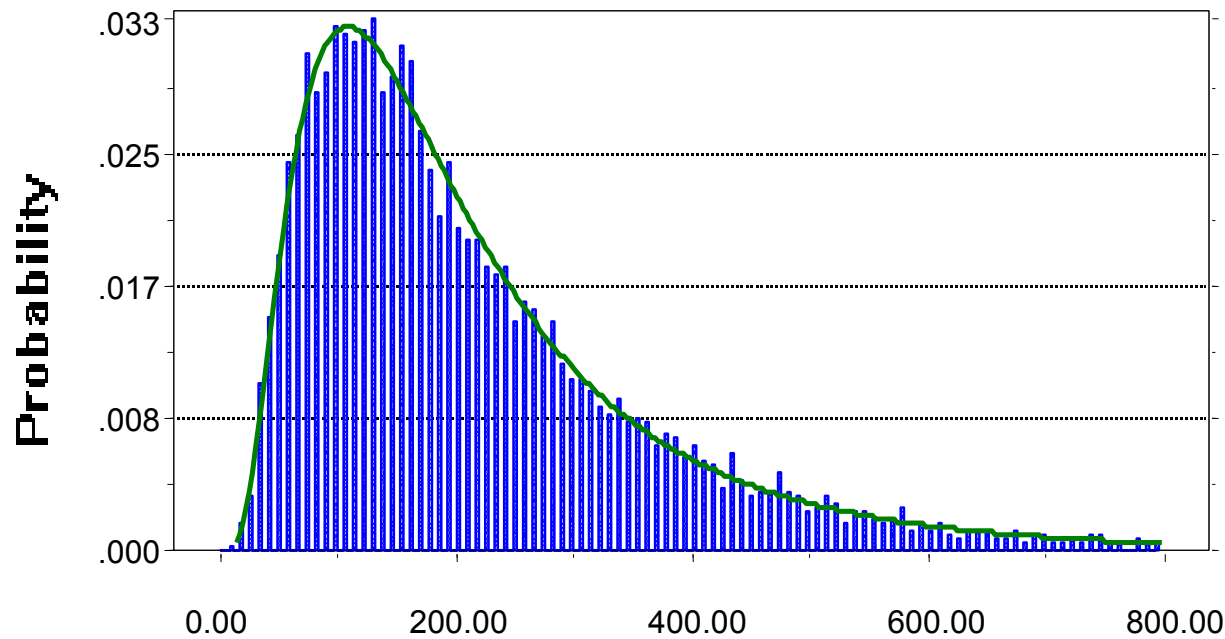
Thyroid dose is proportional to area beneath curve.

Scheme of dose estimation



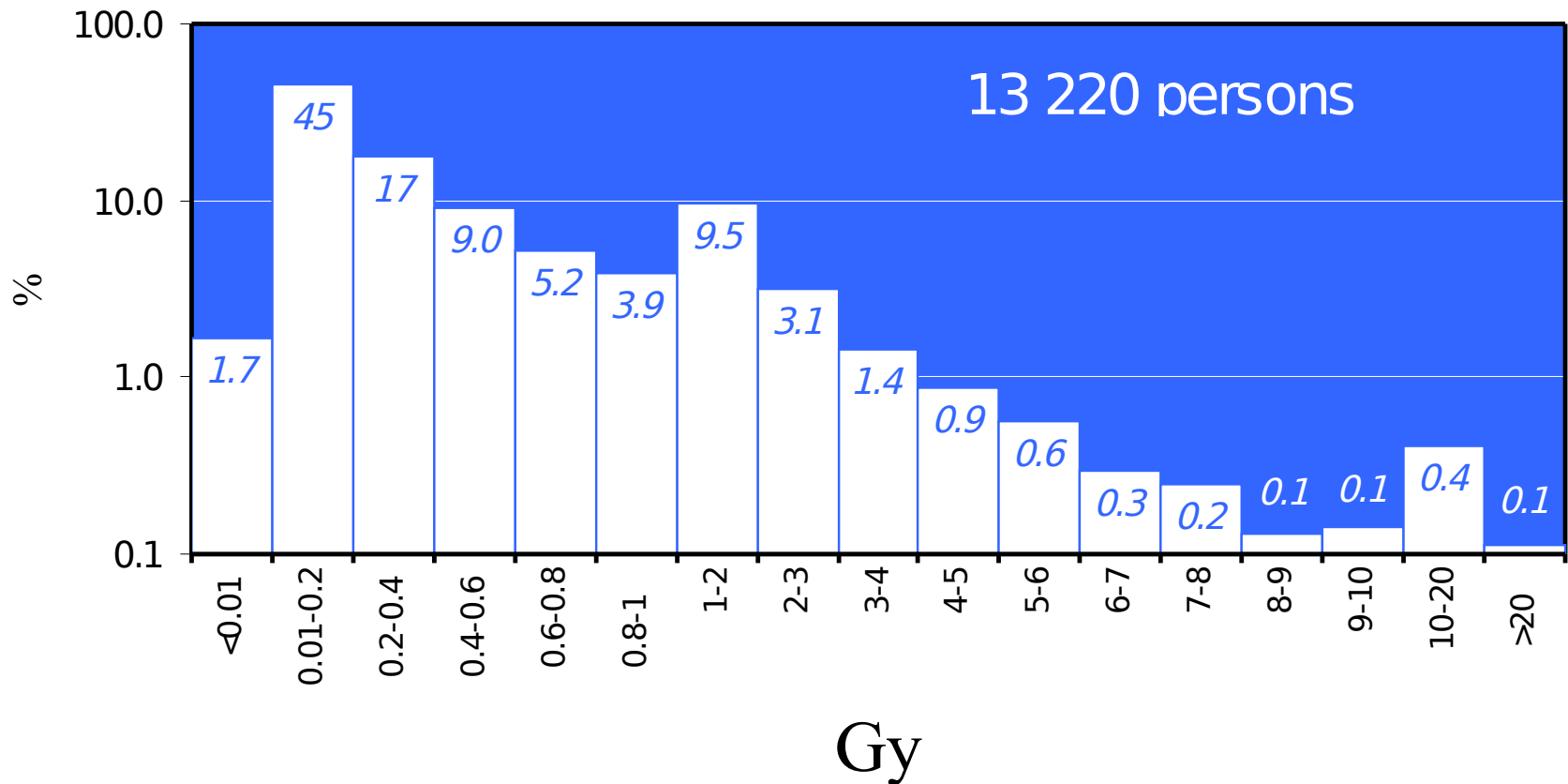
2002 thyroid dose estimation with a simple Monte-Carlo procedure: probability distribution of the thyroid dose (mGy) for a specific individual

Lognormal distribution ; GM = 180 mGy; GSD = 2.0



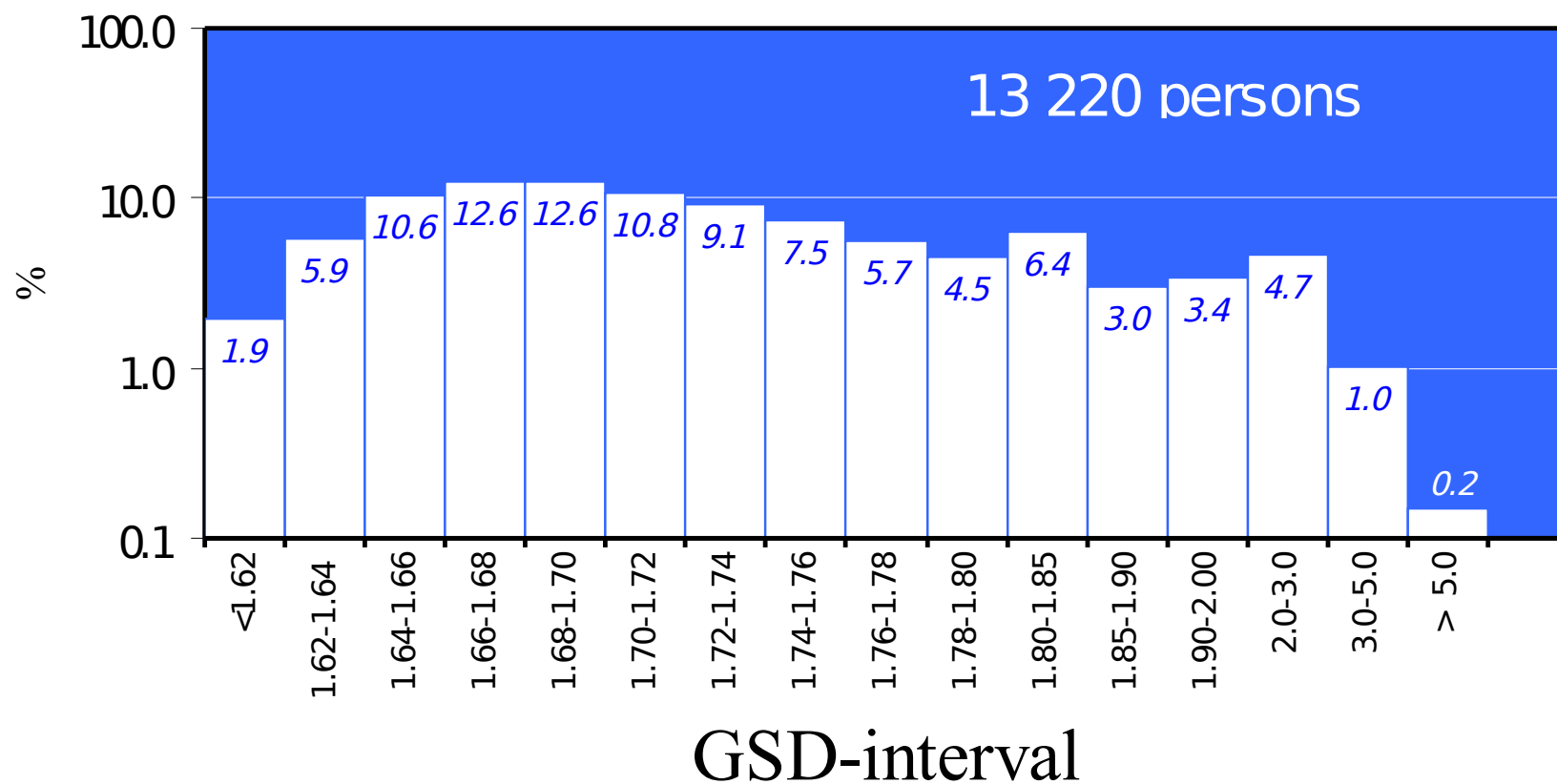
2002 thyroid dose estimates

Distribution of cohort subjects in Ukraine according to individual thyroid dose



2002 thyroid dose uncertainties

Distribution of Ukrainian cohort subjects
according to GSD



2002 sensitivity analysis

- Two important parameters:
 - Direct thyroid measurement
 - Thyroid mass

2009 thyroid dose estimation

- Classification of parameters:
 - Constants
 - 24 independent of the study (half-life of I-131, etc)
 - Thyroid uptake in case of iodine prophylaxis
 - Shared
 - I-131 deposition densities in 12,800 settlements
 - Other ecological parameters
 - Unshared
 - Dependent on the cohort member being considered

Principle of the 2009 thyroid dose estimation

- Preparation of 1,000 environmental scenarios (shared parameters)
- Insertion of the individual cohort members into the environmental scenarios (unshared parameters)
- Calculation of 1,000 sets of dose estimates.

2009 scheme of thyroid dose estimation

Universal scenario i ($i=1$ to 1001)

Matrix of shared ecological parameters

Scenario i	Parameters of ecological scenario		
	TF	M ^{biot}	...
1	[1x29]		
...	[1x29]		
1000	[1x29]		
1001_AM	[1x29]		

Tables of constants

#	λ	E	...
1	[1x24]		

k	Age	Sex	iod	UC...
	1 ... 36	1 ... 66	1 ... 66	
1				
2	[13234x(66+36)]			
...				
13234				

Matrices of unshared individual parameters for all cohort members

k	Parameters			milk/day			...
	M	Act	...	1 ... 66	1 ... 66	1 ... 66	...
1							
2	[13234x(16+6x66)]						
...							
13234							

k	Parameters			milk/day			...
	M	Act	...	1 ... 66	1 ... 66	1 ... 66	...
1							
2	[13234x(16+6x66)]						
...							
13234							

k	Parameters			milk/day			...
	M	Act	...	1 ... 66	1 ... 66	1 ... 66	...
1							
2	[13234x(16+6x66)]						
...							
13234							

k	Parameters			milk/day			...
	M	Act	...	1 ... 66	1 ... 66	1 ... 66	...
1							
2	[13234x(16+6x66)]						
...							
13234							

Output of individual dose matrices

Dose matrices of universal scenarios

k	D^1_k
1	D^1_1
2	D^1_2
...	...
13234	D^1_{13234}

[13234x1]

k	D^i_k
1	D^i_1
2	D^i_2
...	...
13234	D^i_{13234}

[13234x1]

k	D^{1000}_k
1	D^{1000}_1
2	D^{1000}_2
...	...
13234	D^{1000}_{13234}

[13234x1]

k	D^{1001}_k
1	D^{1001}_1
2	D^{1001}_2
...	...
13234	D^{1001}_{13234}

[13234x1]

Matrix of dose estimates

k	Parameters		
	D^1	D^i	D^{1000}
1			
...			
13234			

[13234x1000]

Calculation of the thyroid doses

Calculations? In progress

Thank you for your
attention

2009 thyroid dose estimation

- Two important parameters:
 - Direct thyroid measurement
 - Thyroid mass