Overview of ICRP Committee 2

Doses from Radiation Exposure

2 2nd October 2013 ï Abu Dhabi

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Committee 2 Remit

Committee 2 develops references models and data, including dose coefficients, for the assessment of exposures to radiation from both internal and external sources

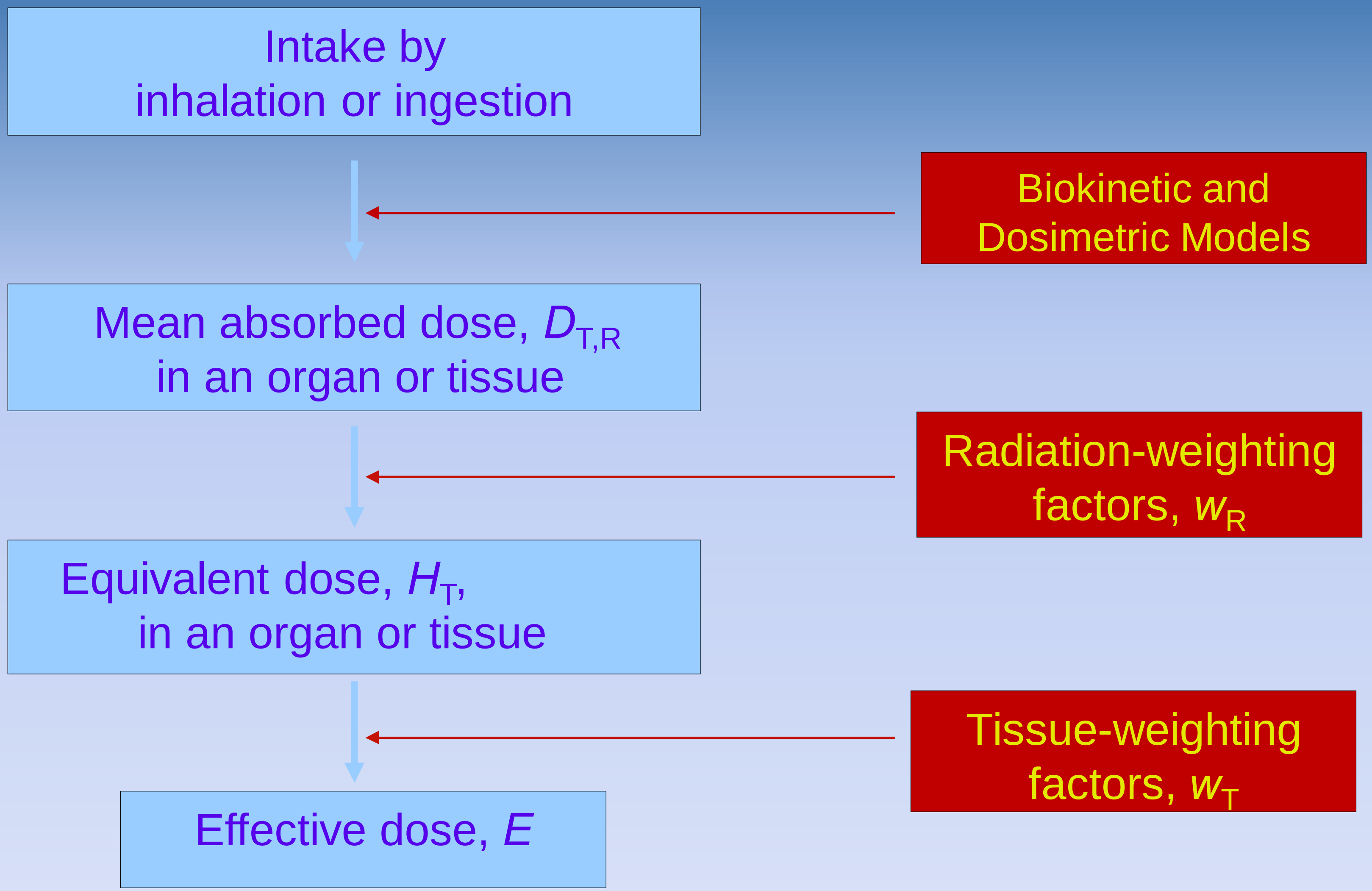
- Large programme of work to replace all published dose coefficients following :

Publication 103 The 2007 Recommendations of the International Commission on Radiological Protection. Ann ICRP 37 (2-4) 2007

Constraints, reference levels

BANDS OF PROJECTED DOSE	CHARACTERISTICS AND REQUIREMENTS
Greater than 20 - 100 mSv	Exceptional situations. Benefit on a case-by-case basis. Information, training and individual monitoring of workers, assessment of public doses.
Greater than 1 - 20 mSv	Individual direct or indirect benefit. Information, training and either individual monitoring or assessment.
1 mSv or less	Societal benefit (not individual). No information, training or individual monitoring. Assessment of doses for compliance.

Calculation of equivalent and effective dose



C2 Publications since 2007

Publication 107 Nuclear Decay Data for Dosimetric Calculations. Ann ICRP 38 (3) 2008

Publication 110 Adult Reference Computational Phantoms. Ann ICRP 39 (32) 2009

Publication 116 Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures. Ann ICRP 40 (2-5) 2010

Publication 119 Compendium of Dose Coefficients based on ICRP Publication 60. Ann ICRP 41 (Supp1) 2012

Publication 123 Assessment of Radiation Exposure of Astronauts in Space. Ann ICRP 42 (4) 2013

Planned publications

Phantoms and radiations transport calculations

ÅRadiation Transport for Adult Phantoms (Adult SAFs)

ÅPediatric Reference Computational Phantoms + SAFs

ÅPregnant Female and Fetus Reference Computational Phantoms + SAFs

Internal dose coefficients

ÅOccupational Intakes of Radionuclides, Parts 1 - 5

ÅInternal Dose Coefficients for Members of the Public, Pts 1 & 2

Å*In utero* Internal Dose Coefficients for Maternal Intakes

ÅBreast-feeding Infant Internal Dose Coefficients for Maternal Intakes

External dose conversion coefficients

ÅExternal Dose Coefficients for Members of the Public

Use of Effective Dose

Phantom development

Stylized Phantoms

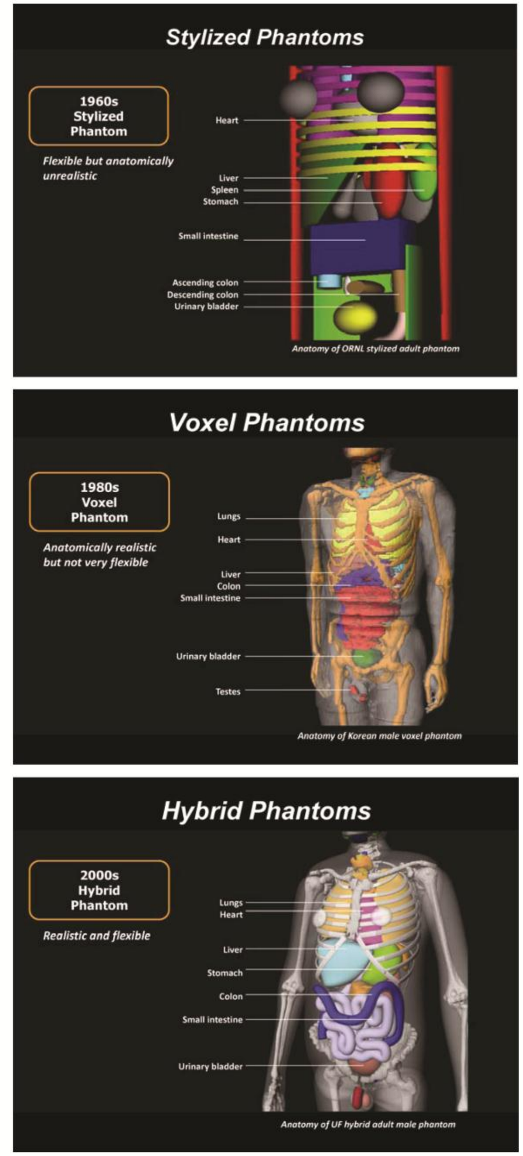
Organ / body contours defined by 3D mathematical surface equations

Voxel Phantoms

Organs and body tissues defined by groupings of 3D arrays of tagged image volume elements

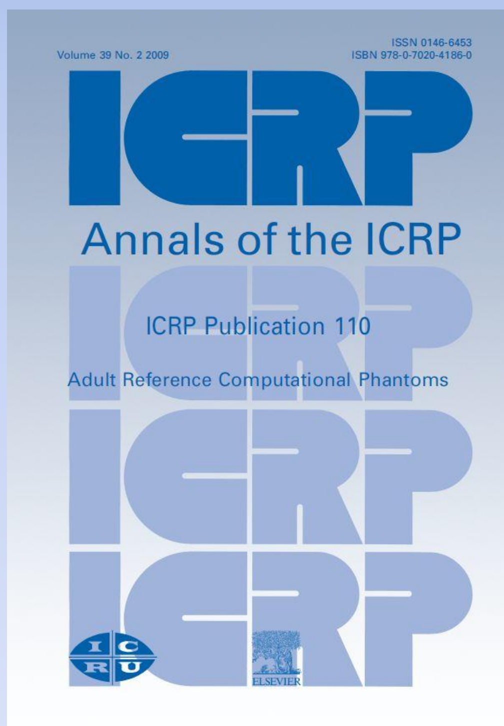
Hybrid Phantoms

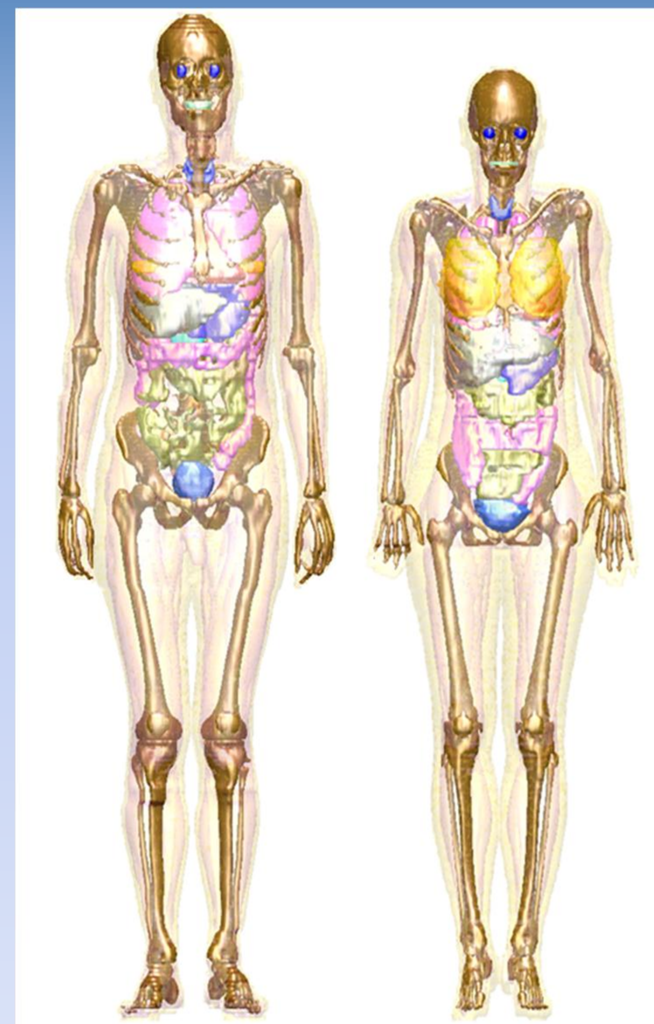
Organ / body contours defined by NURBS or polygon mesh surfaces



ICRP Adult Reference Computational Phantoms – Voxel Based

ICRP Publication 110
Ann ICRP 39 (2) 2009





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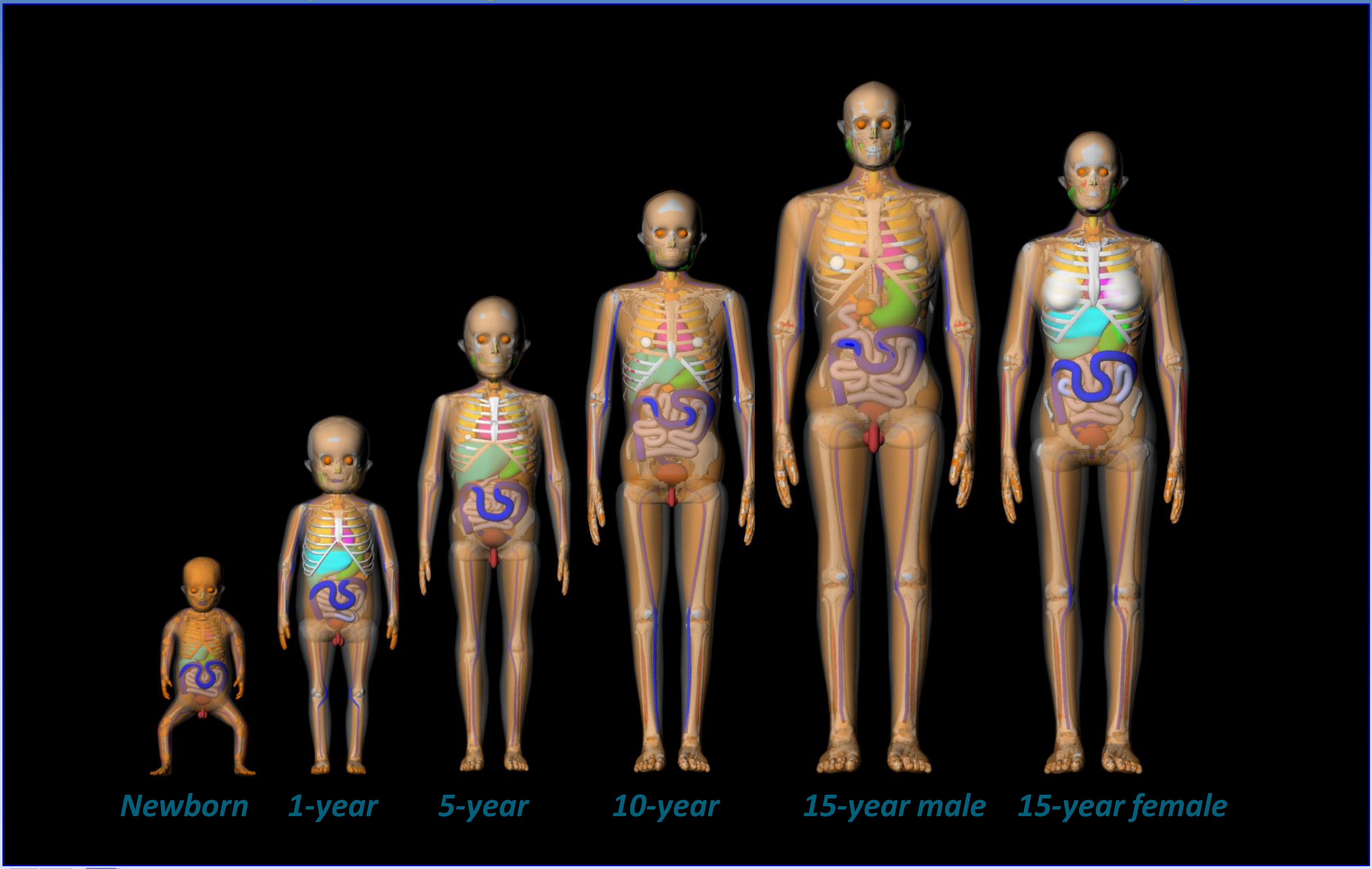
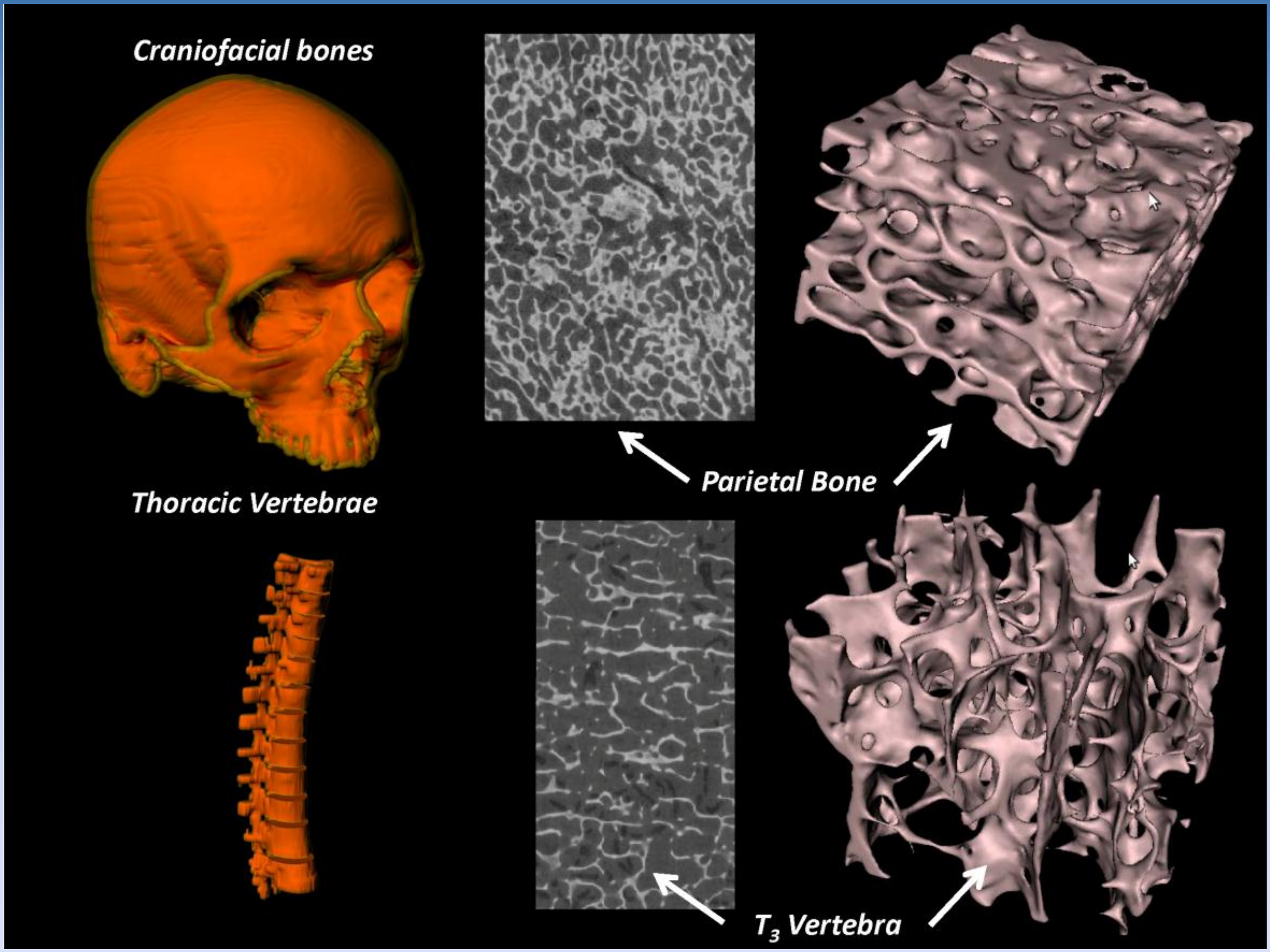
ICRP Computational Phantoms – Pediatric

Developed using NURBS and PM Surface Modeling



Skeletal Dosimetry Models



Occupational Intakes of Radionuclides

OIR Part 1
Introduction

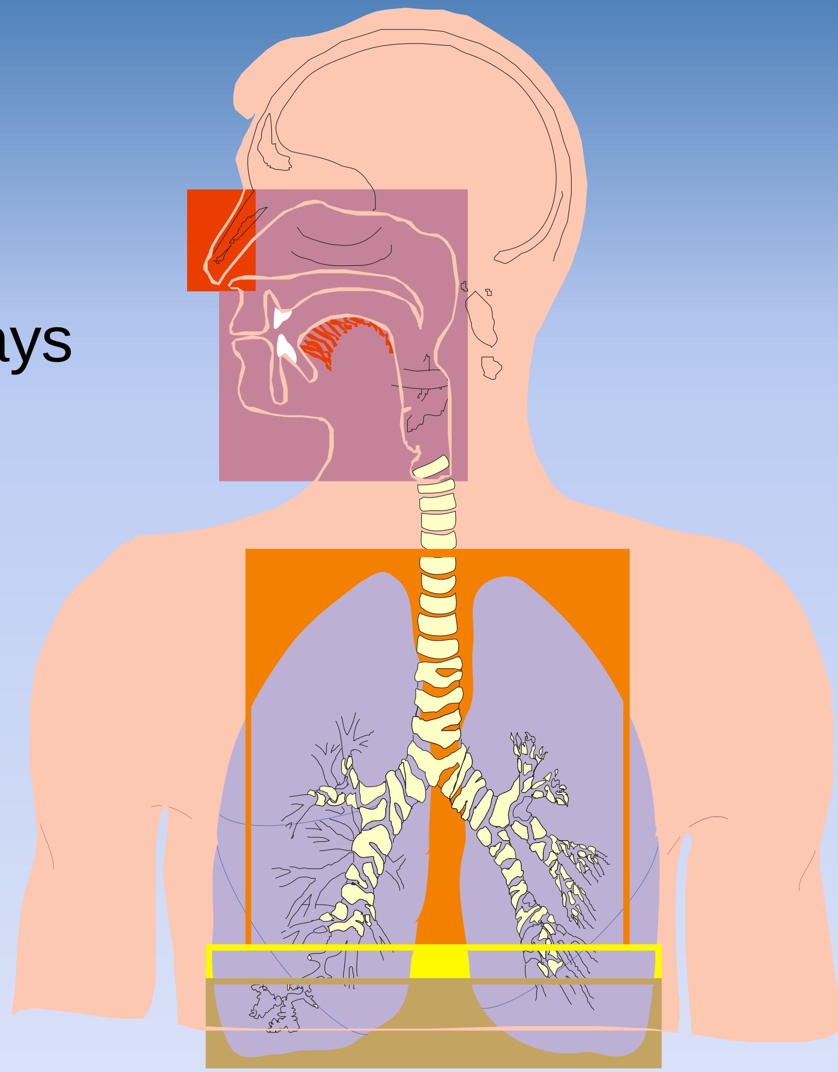
OIR Part 2
H, C, P, S, Ca, Fe, Co, Zn, Sr, Y, Zr, Nb, Mo, Tc

OIR Part 3
Ru, Sb, Te, I, Cs, Ba, Ir, Pb, Bi, Po, Rn, Ra, Th, U

OIR Part 4
Lanthanides and Actinides

OIR Part 5
F, Na, Mg, K, Mg, Ni, Se, Mo, Tc, Ag

Human Respiratory Tract Model, Pub 66 (1994)



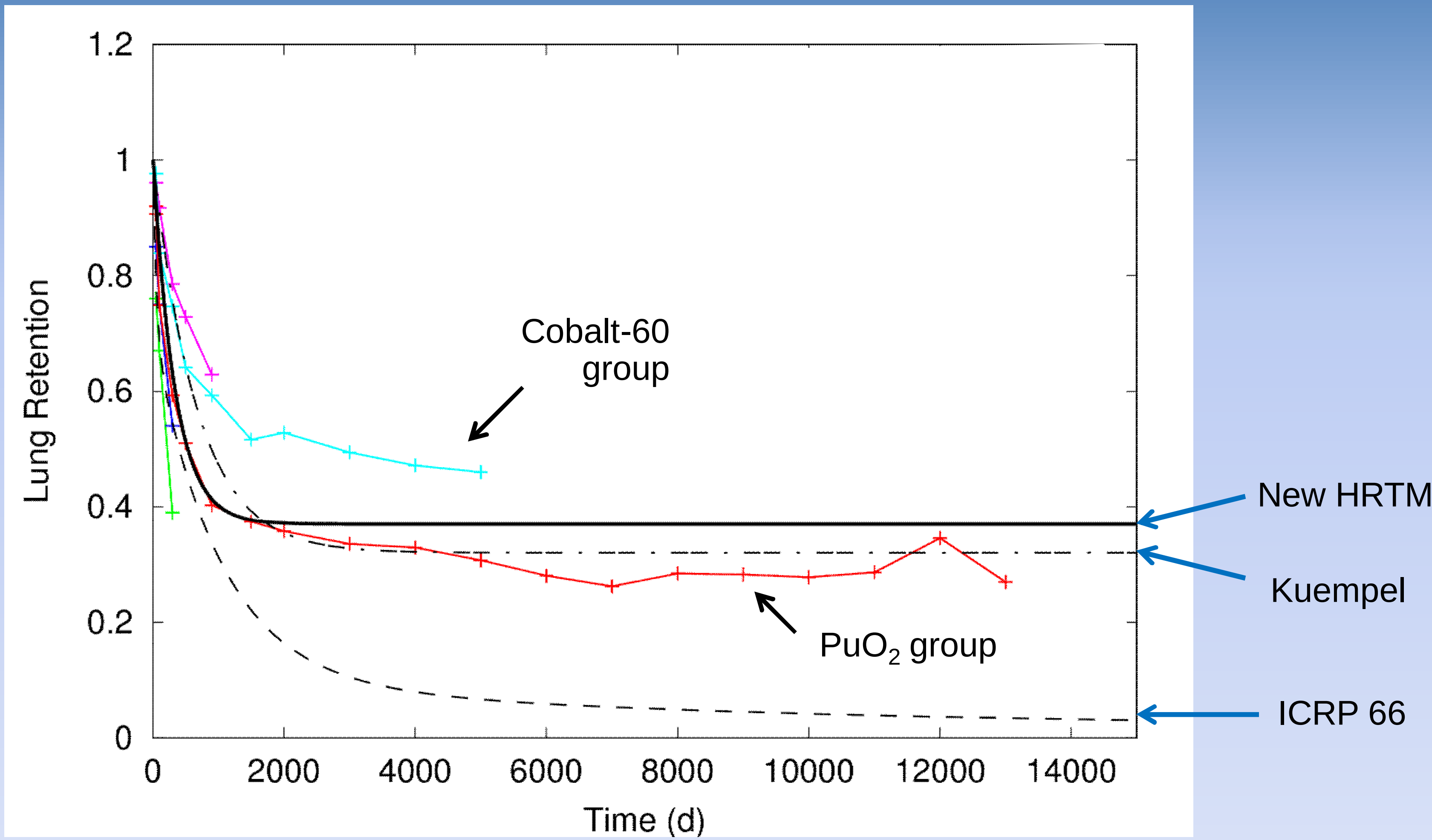
Extrathoracic airways — ET_1, ET_2

Bronchial — BB

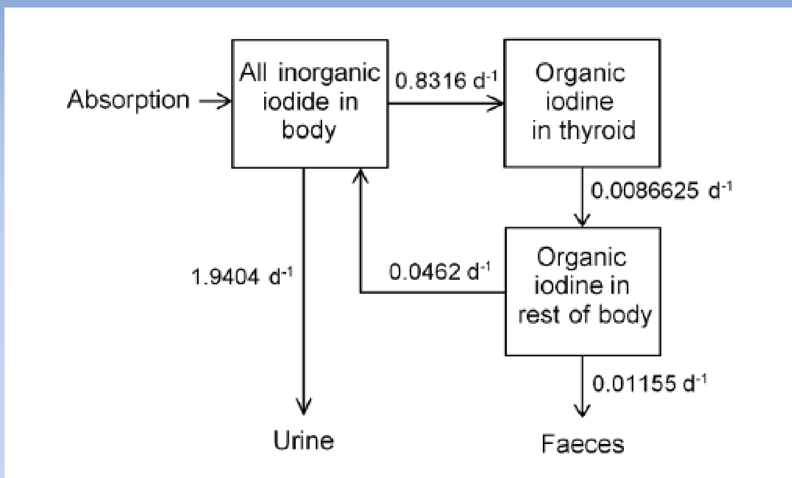
Bronchiolar — bb

Alveolar interstitial — AI

Al Retention: new data



Systemic model for Iodine



Former model (ICRP 1994)

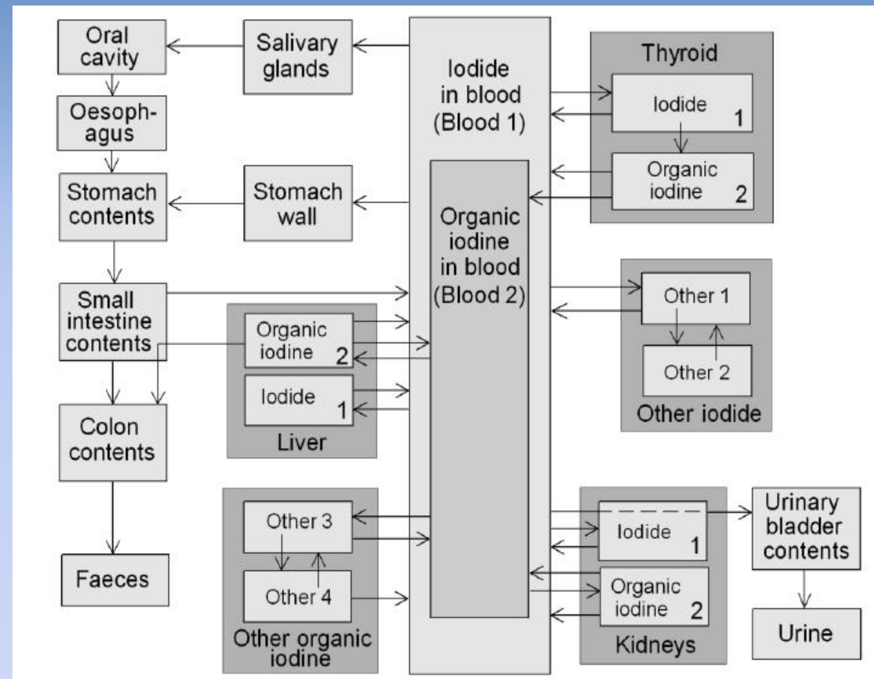


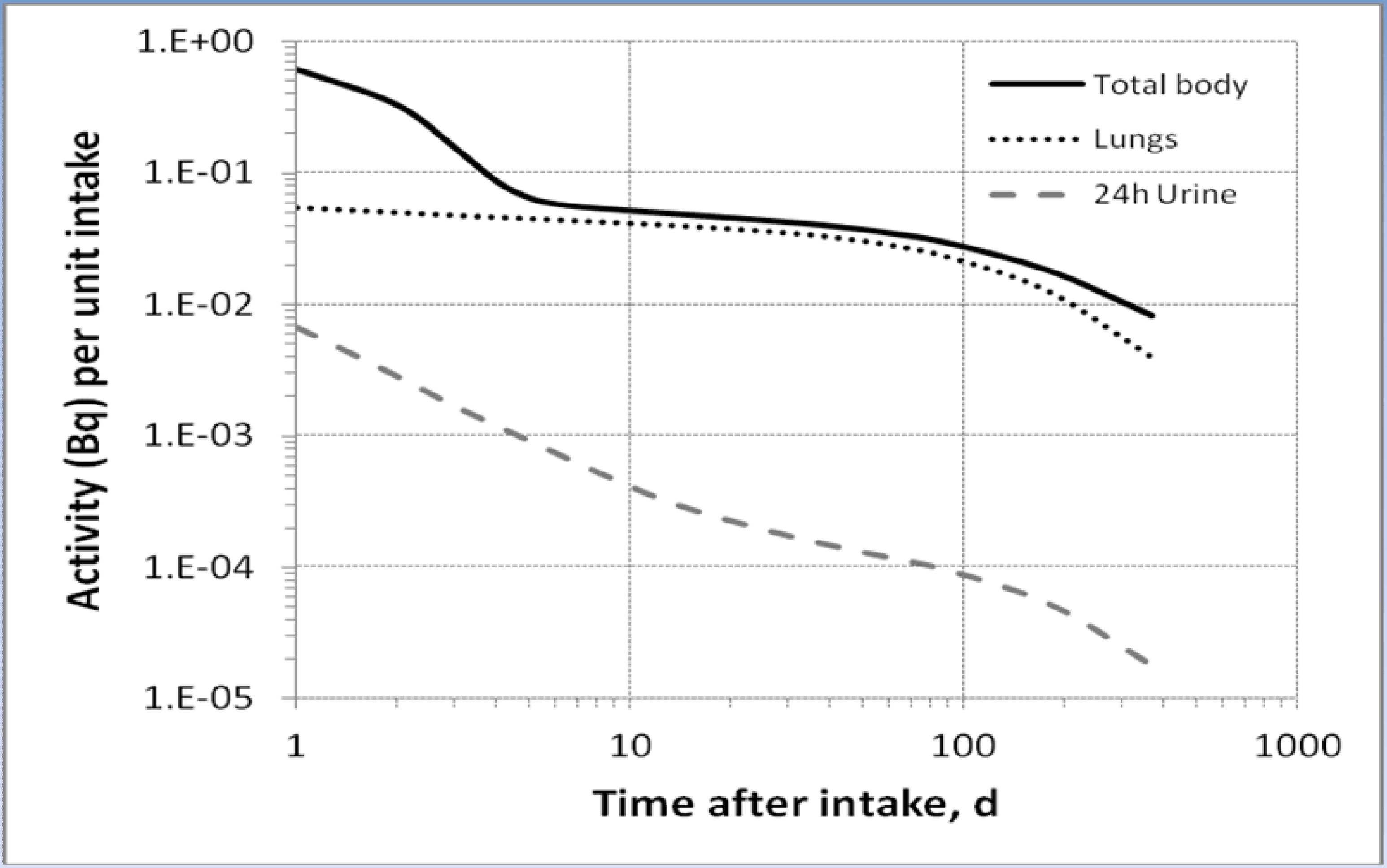
Figure 5-2. Structure of the biokinetic model for systemic iodine used in this report.

OIR model

OIR dose coefficients for cobalt

	Effective dose coefficients (Sv Bq^{-1})		
	^{57}Co	^{58}Co	^{60}Co
Inhaled particulate materials (5 µm AMAD aerosols)			
Type F, cobalt nitrate, chloride	3.3E-10	1.4E-09	1.1E-08
Type M, all unspecified forms	1.0E-09	4.3E-09	2.7E-08
Type S, cobalt oxide, FAP, PSL	2.4E-09	6.6E-09	1.7E-07
Ingested materials			
f_A = 0.1, all chemical forms	2.4E-10	1.2E-09	7.6E-09
f_A = 0.05, insoluble oxides	1.7E-10	9.8E-10	4.8E-09

Bioassay data for ^{60}Co : inhalation of 1 Bq Type M



Radon doses

Epidemiological approach

- Divide risk per WLM
  by risk per Sv
  = Sv per WLM

Dosimetric approach

- Calculate using models

Epidemiological approach

USING 5 x 10^{-4} per WLM lung cancer risk

Workers	4.2 x 10^{-2} Sv^{-1}	12 mSv WLM^{-1}
Public	5.7 x 10^{-2} Sv^{-1}	9 mSv WLM^{-1}

Publication 65 values

Workers	5 mSv WLM^{-1}
Public	4 mSv WLM^{-1}

Calculation for inhaled ^{222}Rn + progeny

Intake by inhalation

↓ ← Biokinetic and Dosimetric Models

Mean absorbed dose, $D_{T,R}$ to lung tissues, Gy

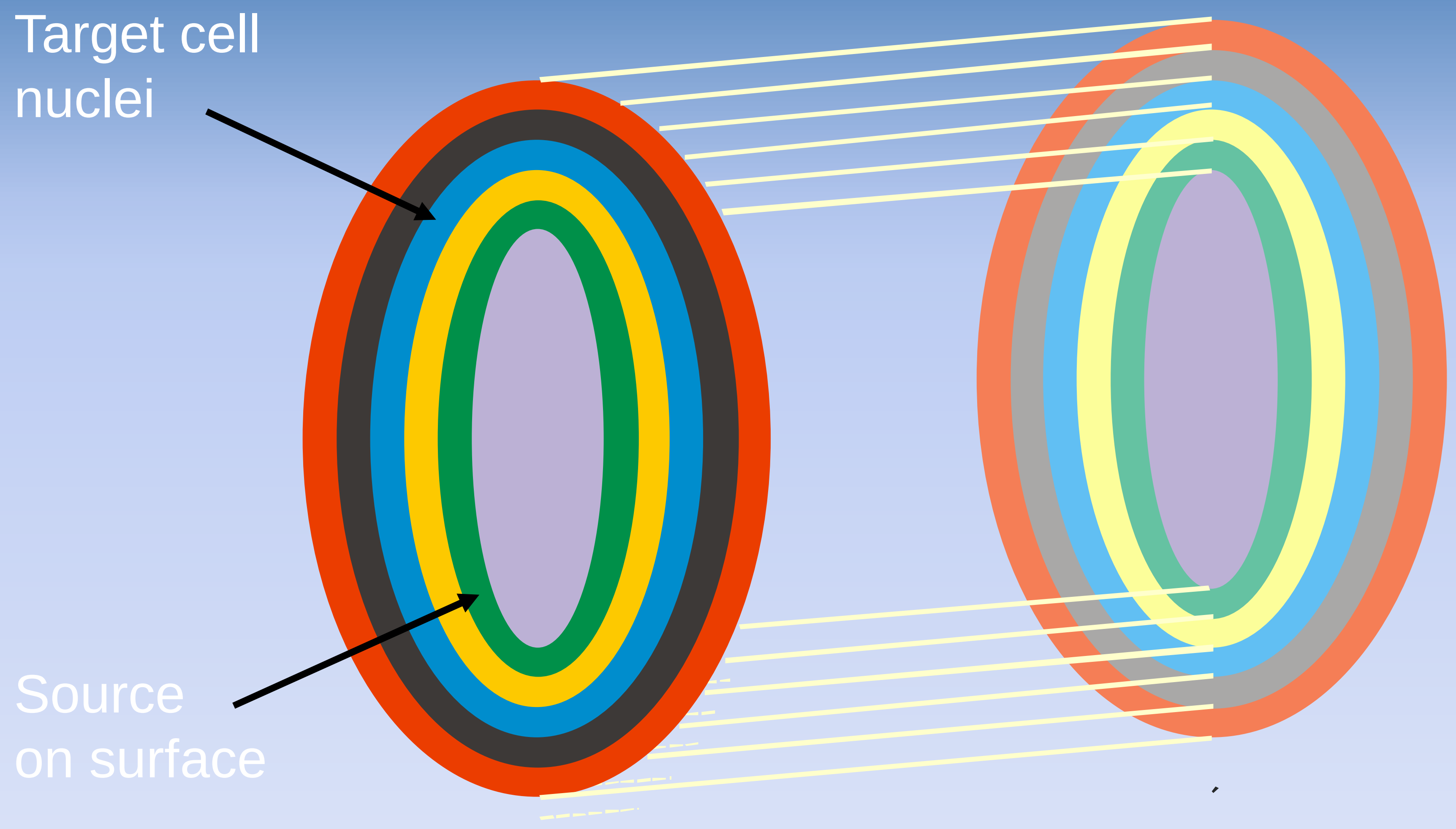
↓ ← Radiation-weighting factors, w_R = 20

Equivalent dose, H_T, to lungs, Sv

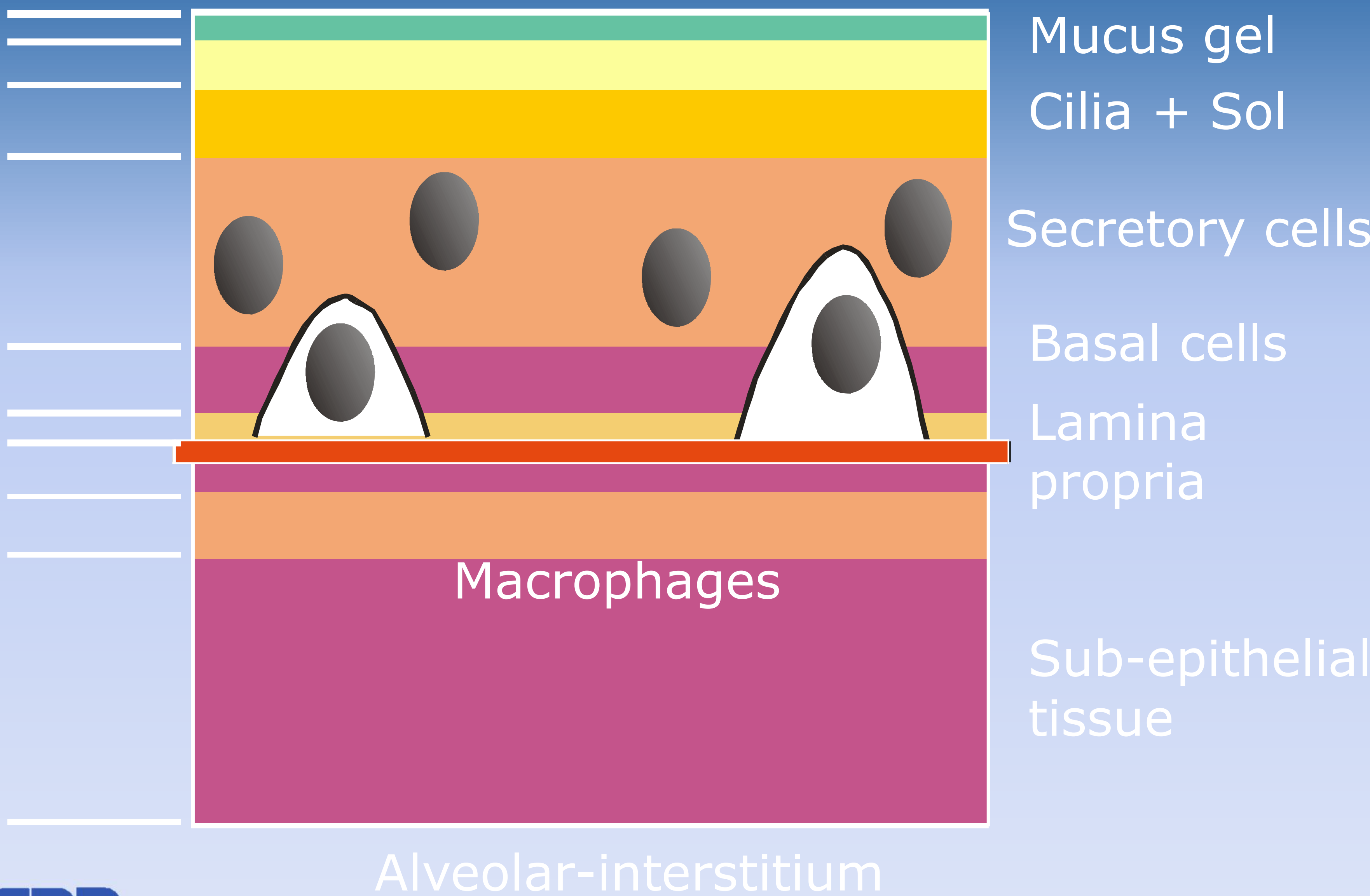
↓ ← Tissue-weighting factors, w_T = 0.12

Effective dose, E

Geometric Model of Airway for Dosimetry



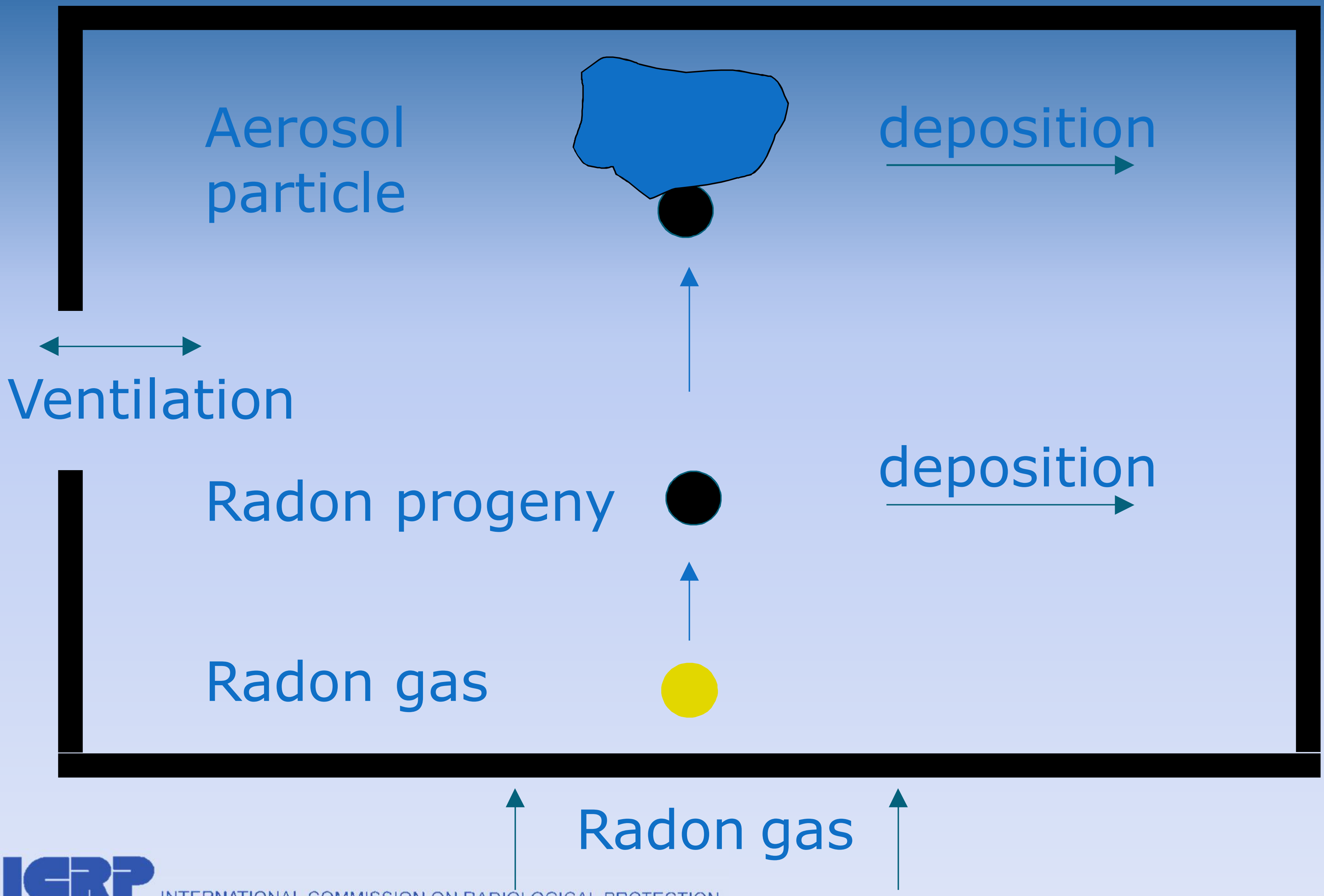
Bronchial (BB) Wall Dosimetry



Factors affecting dosimetric calculations

- Aerosol characteristics
  - Unattached fraction
  - Size distribution
- Equilibrium factor
- Breathing rate
- Absorption of progeny
- Systemic biokinetics

Formation of radon progeny aerosol



Equilibrium factor, F

F is a measure of the degree of dis-equilbrium between radon gas and its progeny

F=1		F=0.3	
Nuclide	Bq m^{-3}	Nuclide	Bq m^{-3}
^{222}Rn gas	1.0	^{222}Rn gas	1.0
^{218}Po	1.0	^{218}Po	0.6
^{214}Pb	1.0	^{214}Pb	0.3
^{214}Bi	1.0	^{214}Bi	0.2

The value of F depends on the ventilation rate :

Indoors :	$F \approx 0.4$	Natural ventilation
Mines :	$F \approx 0.2$	Forced ventilation

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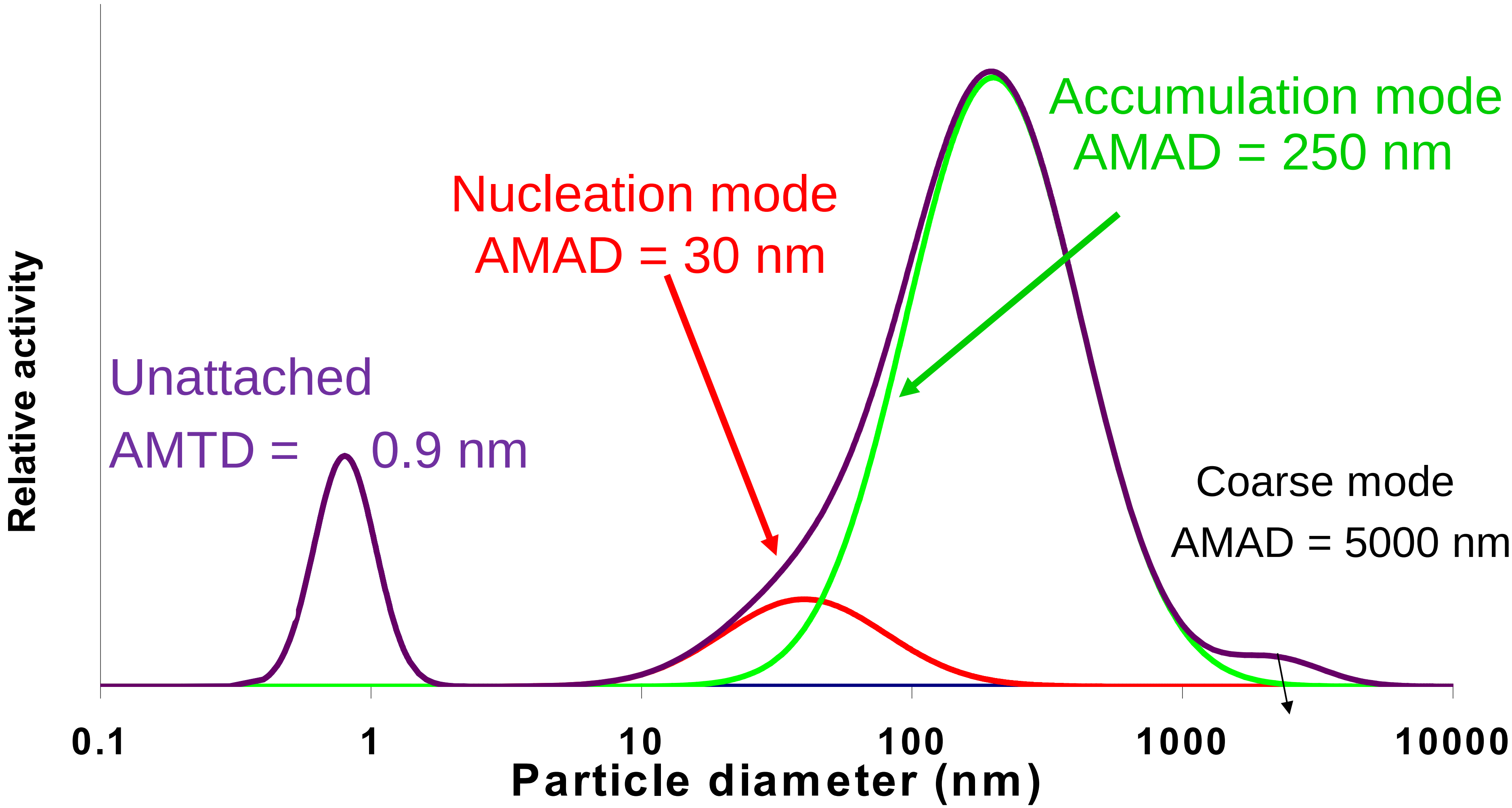
Activity size distribution for an indoor workplace



Porstendörfer 2001, Marsh *et al* 2002

Lung tissue weighting cf. relative detriment - Effect on Rn-222 progeny dose

Mine	*E* per WLM	= 12 mSv	
	Lung w_T	= 0.12	
Relative detriment for lung		= 0.286	all adults
E per WLM potentially		= 29 mSv	all adults

Lung dose apportionment
- Effect on Rn-222 progeny dose

Lung apportionment factors

	BB	bb	AI
AF	$^{1}/_{3}$	$^{1}/_{3}$	$^{1}/_{3}$
Mass (g)	1	2	1,100

Mine	*E* per WLM	= 12 mSv
Using average lung dose		= 0.6 mSv

Membership 2013 - 17

John Harrison (Chairman) UK
François Paquet (Vice-Chairman) France
Wesley Bolch (Secretary) USA

Mike Bailey UK
Vladimir Berkovski Ukraine
Luiz Bertelli USA
Doug Chambers Canada
Marina Degteva Russia
Akira Endo Japan

John Hunt Brazil
Chan Hyeong Kim (S Korea)
Rich Leggett USA
Jizeng Ma China
Dietmar Noßke Germany
Nina Petoussi-Henss Germany
Frank Wissmann Germany

Task Groups of Committee 2

- TG 04 - Dose Calculations (DOCAL)
  Wes Bolch
- TG 21 ï Internal Dosimetry (INDOS)
  François Paquet
- TG 79 ï Effective Dose
  John Harrison
- TG 90 ï Dose Coefficients for External Environmental Exposures
  Nina Petoussi-Henss

Summary

- *C2 has large programme of work to provide new dose coefficients*

- *Biokinetic and dosimetric modelling is world leading, with scientific as well as protection applications*

- *C2 leading in explaining use of Effective dose*

- *Strong interactions between committees, including C2 membership of Task Groups* www.icrp.org

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