

MEDICAL RADIATION AND RESEARCH

**Decision making – science, values,
expectations**



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INTENTIONAL EXPOSURES

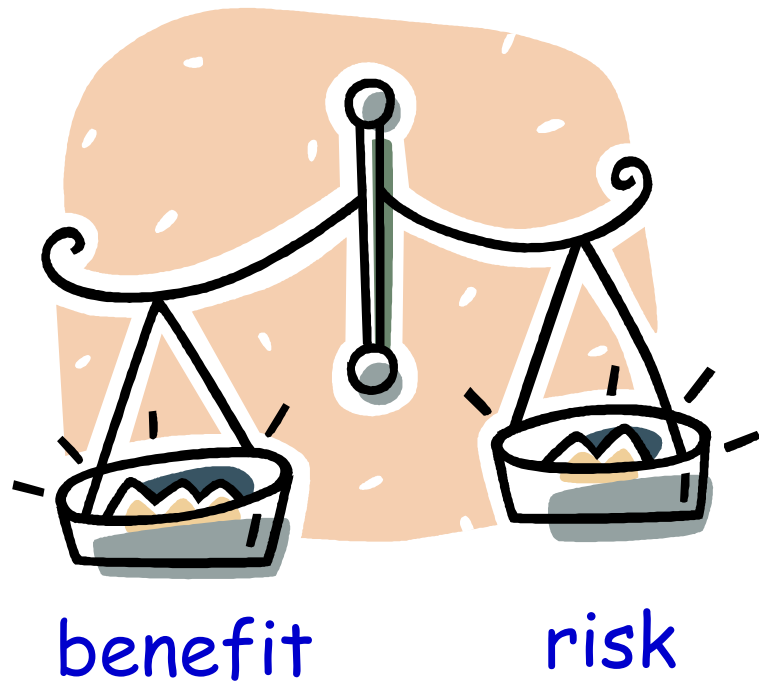
- **Patients for diagnostics**
 - X-rays (incl. CT)
 - Nuclear medicine (& PET)
- **Patients for therapy**
 - External therapy
 - Brachytherapy
 - Systemic radionuclide therapy
- **Volunteers for research**

Actors

- Hospitals – health care
- Universities - research
- Industry - products
- Authorities - regulations



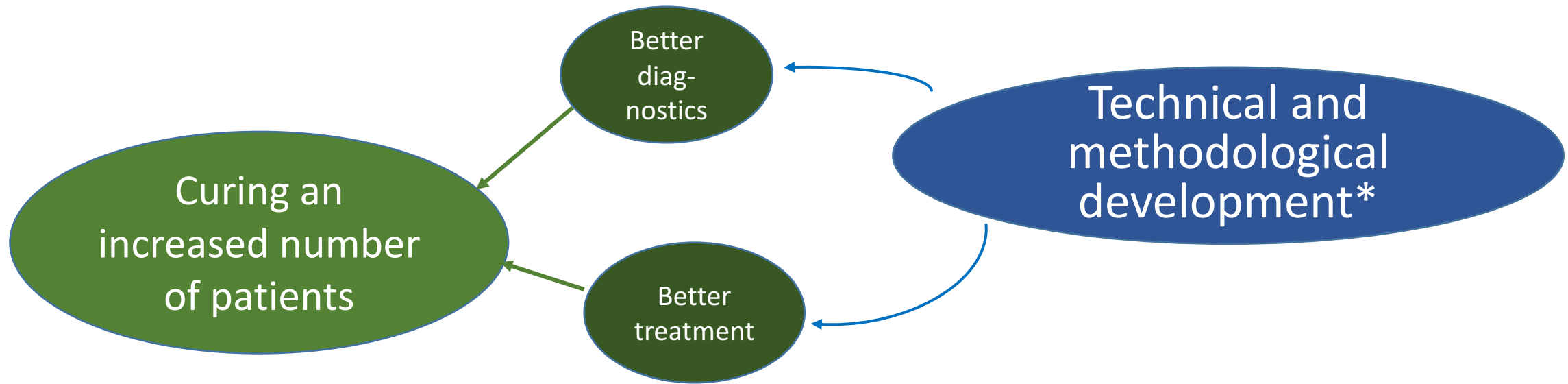
JUSTIFICATION – A MAIN PRINCIPLE



“Does the shoe fit?”



Example of not justified use of radiation.



Annual average dose in Sweden

Diagnostics: 0,7 mSv

Therapy: 0,7 mSv

Only about 80% of
CT- investigations are
justified

SSM Rapport 2009:03

THE PATIENT

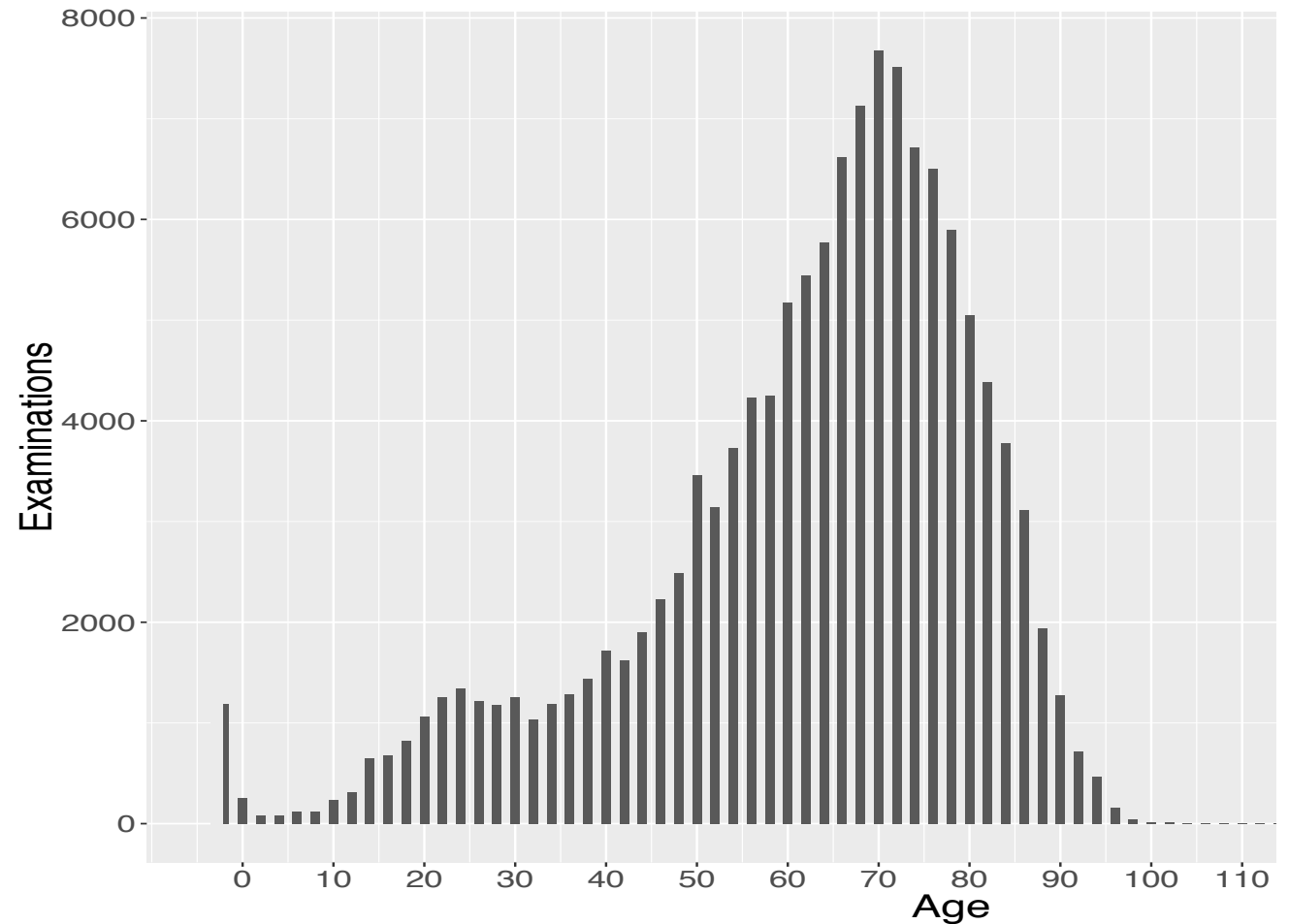
FACTORS INFLUENCING RISK

- Age distribution deviates from that of the general and working population
- Dose rate – in X-ray diagnosis, the total dose may be obtained in fractions of a second
- Therapy – repeated exposure, risk of secondary cancers

Note!

*Risk for **deterministic** effects should also be considered and avoided.*

CT – patients in Västerbotten, 2015- 2016



HOW TO ENSURE JUSTIFICATION?

*NEW RADIATION PROTECTION LAW AND
REGULATIONS, FEBRUARY 2018*

Referral criteria

*Inform the patient
about the risk
e.g. comparison with natural
background*

Follow up
Feedback
Trend analysis



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I-GUIDE – COMPUTER SUPPORT FOR REMITTENTS

Age: 45 ▾ **Male** Female Unknown

Modalities

- CT
- DXA
- END
- FLUOR
- INV
- MAM
- MEG
- MR
- NUC
- PEM
- PET
- PET-CT
- US
- US-XRAY
- XRAY**

Body Areas

- abdomen
- area of interest
- chest
- head
- heart
- lower extremity
- maxface
- neck
- pelvis
- spine**
- upper extremity
- whole body

Clinical Indications

- ☐ Spondylolisthesis
- Other history**
- ☐ Recent trauma, spine
- Prior imaging result**
- ☐ Abnormal bone scan
- ☐ Abnormal xray, collapsed vertebrae
- ☐ Abnormal xray, spine, DJD
- Prior test result**
- ☐ ECG-ST segment elevation
- Sign/symptom**
- ☐ Back pain, <6 wks
- ☒ Back pain, >6 wks despite conservative tx
- ☐ Back pain, after trauma

Clinical Scenarios

- ☒ none
- Metastatic Bone Disease**
- ☐ Back and hip pain, breast cancer, stage 2, initial presentation
- ☐ Low back pain, acute, multiple myeloma
- ☐ Spine lesion (single) on nuc bone scan, history of malignancy (e.g., breast cancer)
- ☐ Spine lesions (multiple) on nuc bone scan, history of malignancy (e.g., breast cancer)
- Osteoporosis and Bone Mineral Density**
- ☐ Bone density assess, females late 40s onward, males >50 with risk factors, all races
- ☐ Vertebral fx suspected, history, height loss, or steroids
- Acute Nonspecific Chest Pain: Low Probability of Coronary Artery Disease**
- ☐ Chest pain, acute, nonspecific, low prob CAD

Appropriateness rankings for a 45 year old male [Display Evidence...](#)

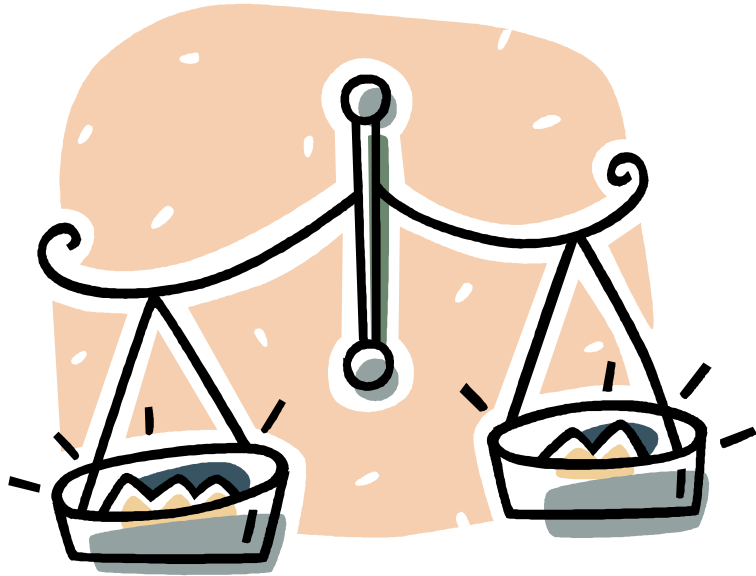
Indications:

Appropriateness	Procedure	Cost	RRL
8	MR, spine, lumbar, wo iv contrast	\$\$\$	select this exam
6	CT, spine, lumbar, wo iv contrast	\$\$	☢☢☢ select this exam
6	XRAY, spine, lumbar	\$	☢☢☢ select this exam
4	NUC, bone scan, spine, tc-99m, SPECT	\$\$	☢☢☢ select this exam
3	CT, spine, lumbar, w iv contrast	\$\$\$	☢☢☢ select this exam
3	MR, spine, lumbar, wo/w iv contrast	\$\$\$\$	select this exam

Program is tested in Jönköping

OPTIMISATION

Limited resources → BAT (best available technique) is not a reasonable principle in Health care.



Absorbed
dose

↙
risk

Image
quality

↘
*diagnostic
safety*

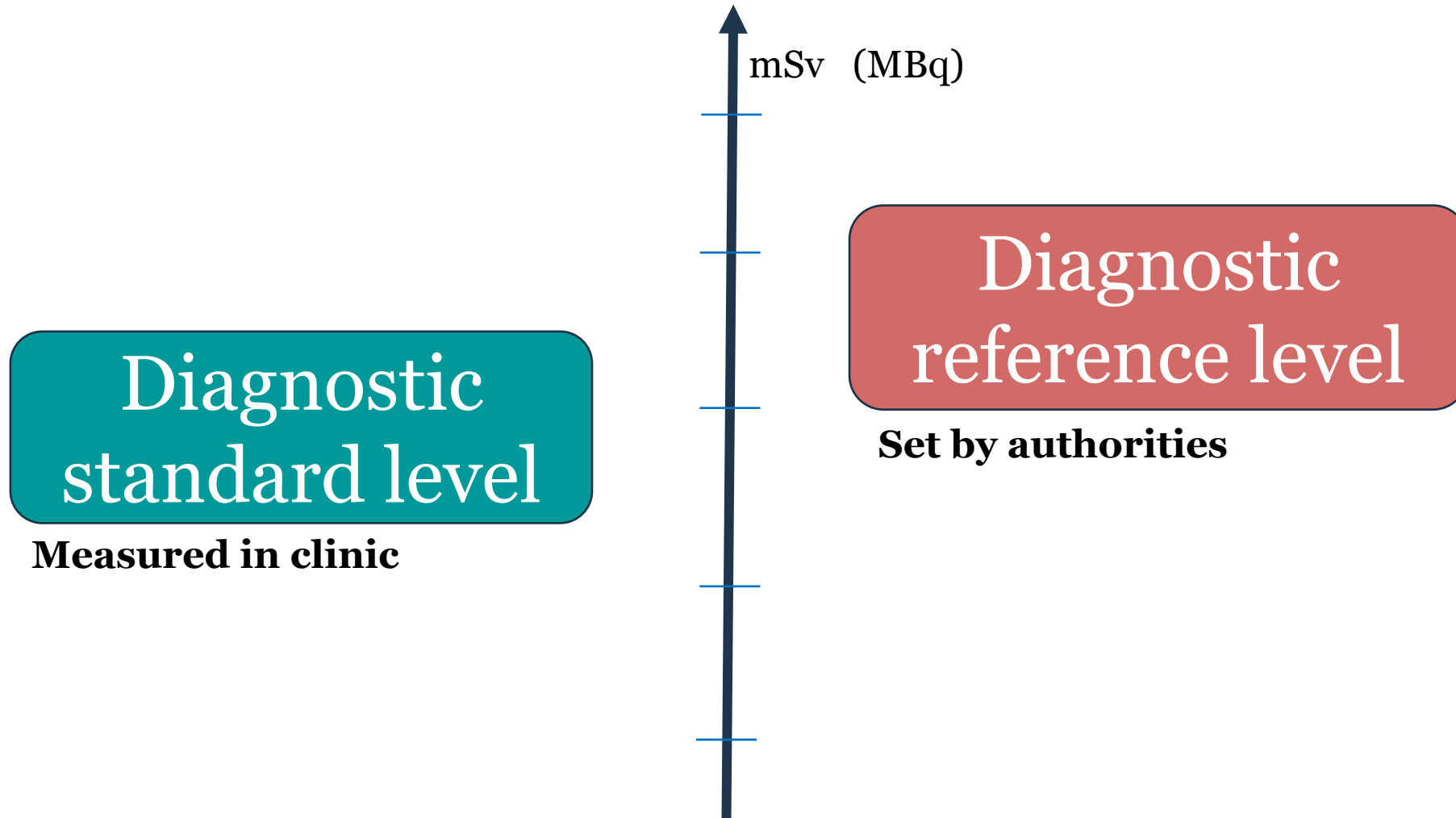
Optimisation

- Technical devices, e.g. X-ray equipment
- Methods
- Personnel – competence and awareness

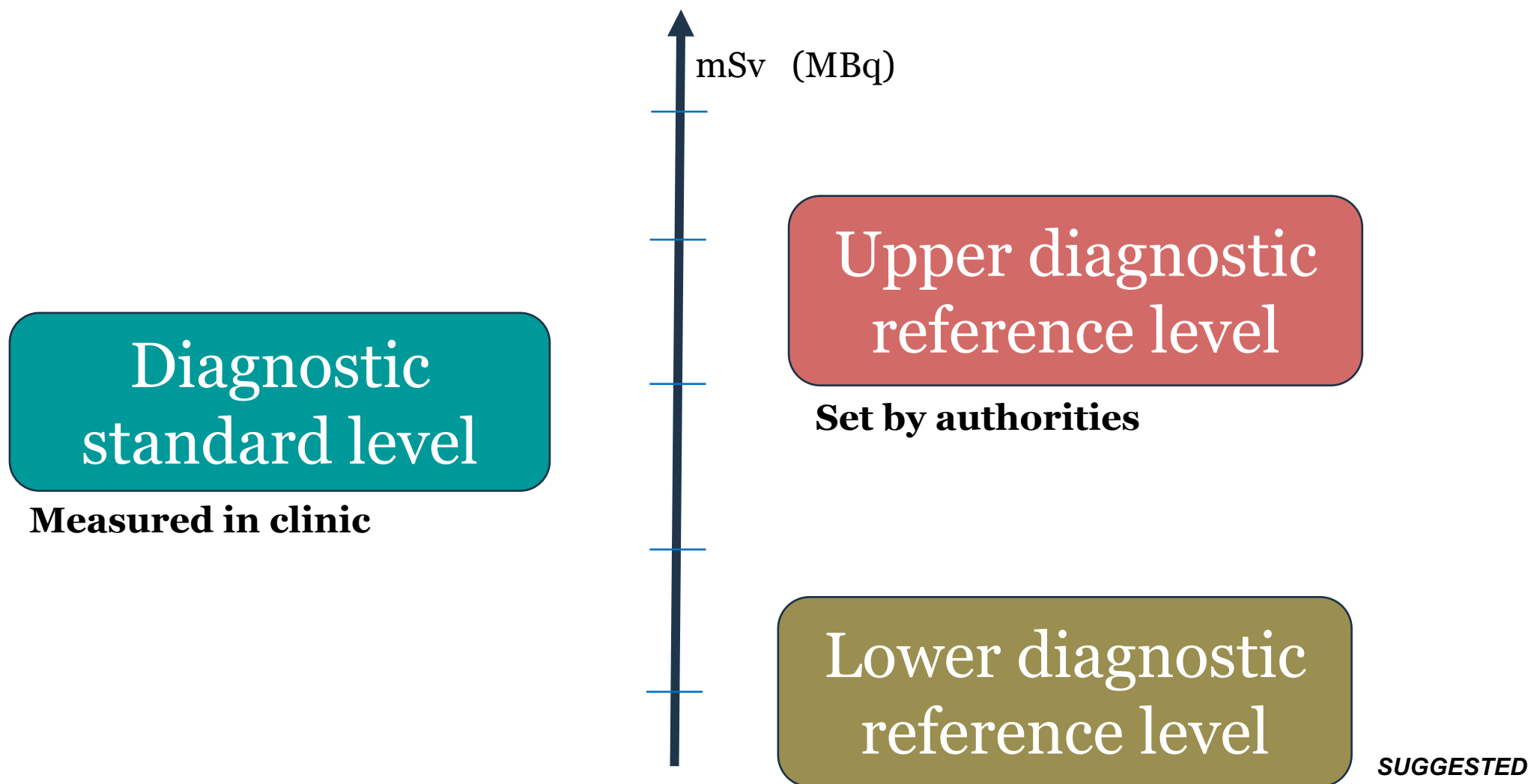


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TOOL TO ENSURE OPTIMISATION



TOOL TO ENSURE OPTIMIZATION - NEW



FACTORS FOR CONSIDERATION – INCLUDED IN SSM- REGULATIONS

- Justification
 - Referral criteria
- Optimisation
- Education and competence
- Equipment and facilities
- Methods
- Information
- Feed back of experiences
- **Management system**

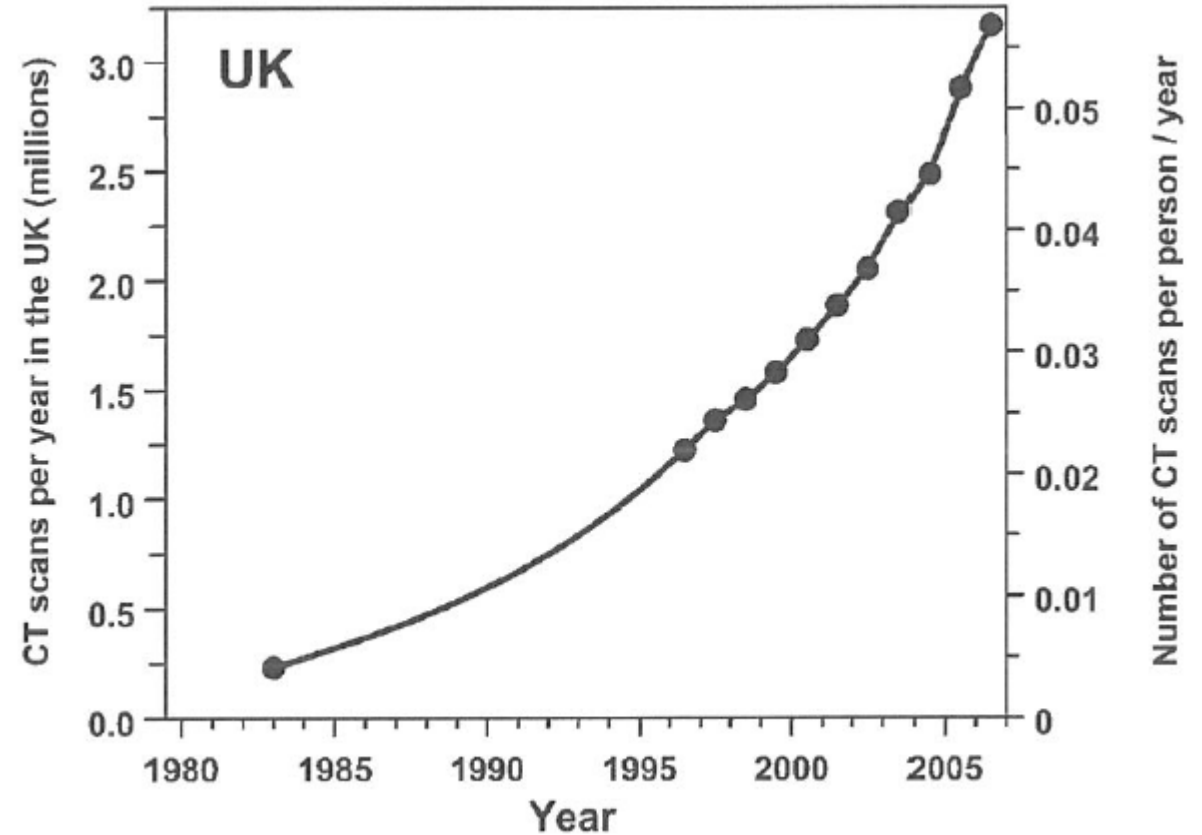
No maximum allowed
dose for patients
but:

Diagnostic
reference levels



Computed tomography – a challenge for radiation protection

- CT will continue to increase
- CT also at smaller hospitals and health centers
- MR will partly replace
- Excess incidence of leukaemia and brain cancer in children who have underwent a CT-scan are indicated.*

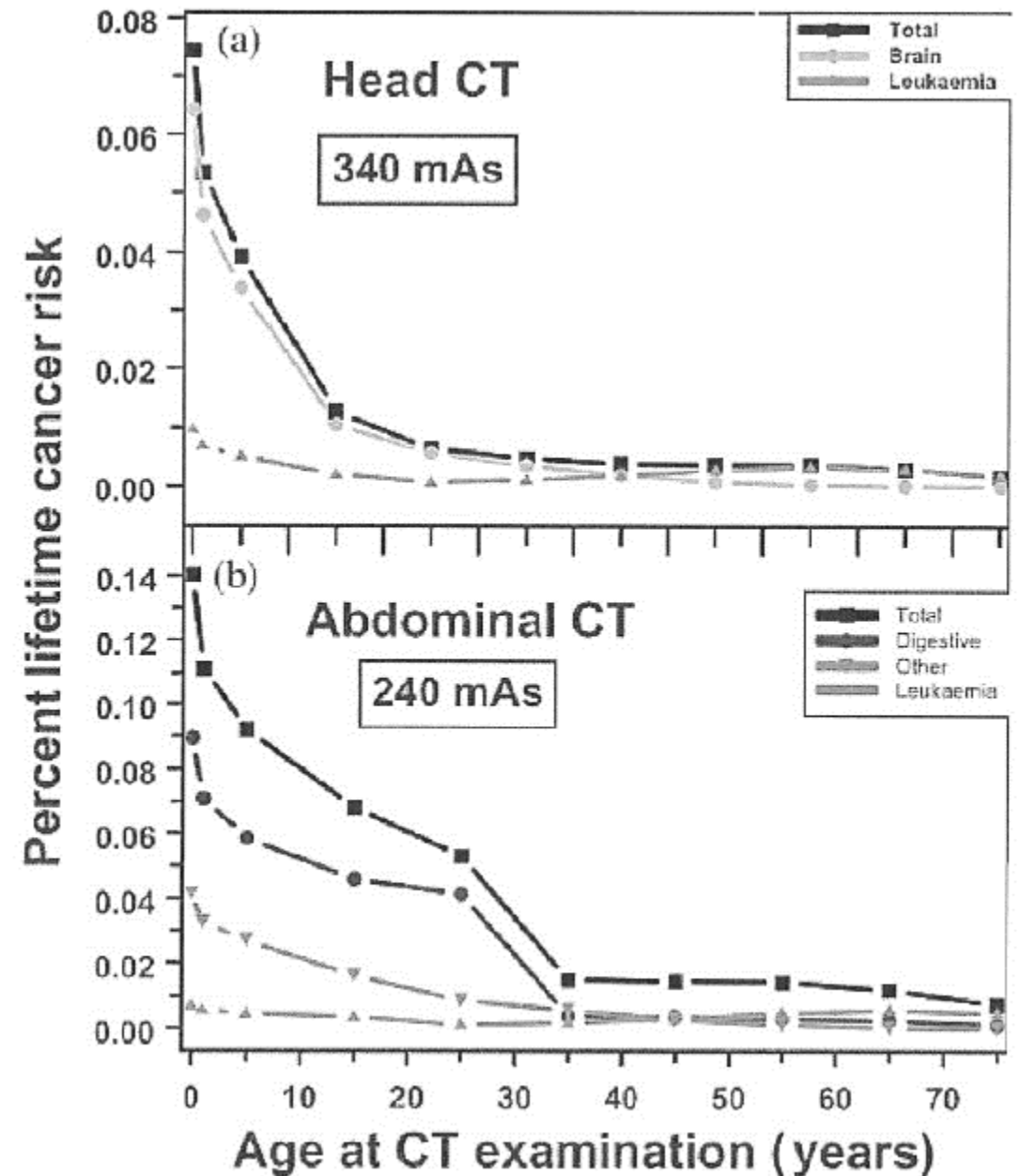


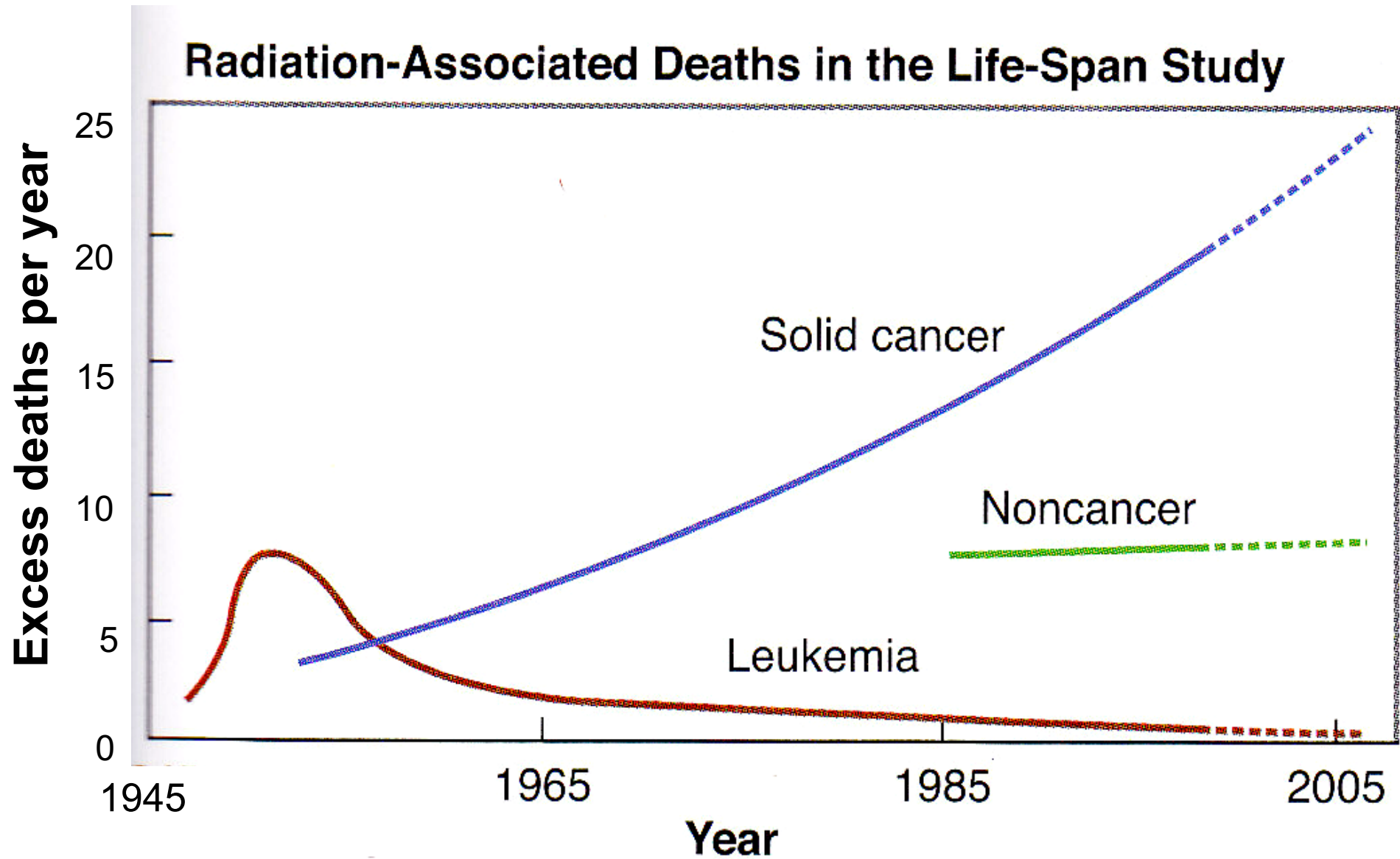
Hall & Brenner, *Brit.J. Radiol.* 2008

*UK data 178 600 patients exposed 1985-2002 (*Pearce et al. Lancet* 2012)

RISKS PATIENTS

- The effective dose concept is often used, even if its applicability may be questioned
- DDREF?
- Adjustment for age distribution
- Risk for deterministic effects > 0





OPEN SOURCES – REGULATIONS IN NUCLEAR MEDICINE

- Equivalent regulations for open sources in Health care and Industry;
 - Half-life and activity
 - Control of contamination
 - Patient as a radiation source
 - Waste handling
 - "Release" of activity from patients?



RESEARCH

EXPOSING PATIENTS OR NORMAL VOLUNTEERS TO RADIATION

Purpose

- Evaluating new diagnostic or therapeutic methods
 - Safety and specificity
 - Biokinetic studies
 - Assessment of absorbed dose
- Radiation biology



ICRP 62 (1991) – *DECISION MAKING IN BIOMEDICAL RESEARCH*

Table 2. Categories of risk and corresponding levels of benefit

Level of risk	Risk category (total risk—see text)	Corresponding effective dose range (adults) (mSv)	Level of <u>societal</u> benefit
Trivial	Category I ($\sim 10^{-6}$ or less)	<0.1	Minor
Minor to intermediate	Category II IIa ($\sim 10^{-5}$) IIb ($\sim 10^{-4}$)	0.1–1 1–10	Intermediate to moderate
Moderate	Category III ($\sim 10^{-3}$ or more)	$>10^a$	Substantial

^aTo be kept below deterministic thresholds except for therapeutic experiments.

NEED FOR RADIATION PROTECTION RESEARCH

RELATED TO MEDICAL EXPOSURES

- Patient data for epidemiological studies
- Risk assessment at high dose rates (e.g. X-rays)
- Data for children – dose and risks
- DNA-analysis for test of individual radiation sensitivity
- Better risk assessments for subgroups of the population
- Risks with radiation treatment
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