MEDICAL RADIATION AND RESEARCH

Decision making – science, values, expectations

UMEÅ UNIVERSITET

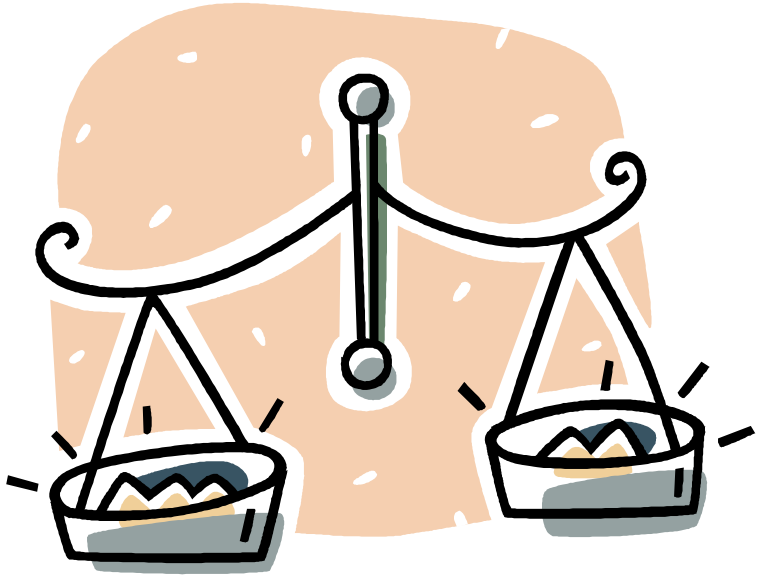
INTENTIONAL EXPOSURES

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

Actors

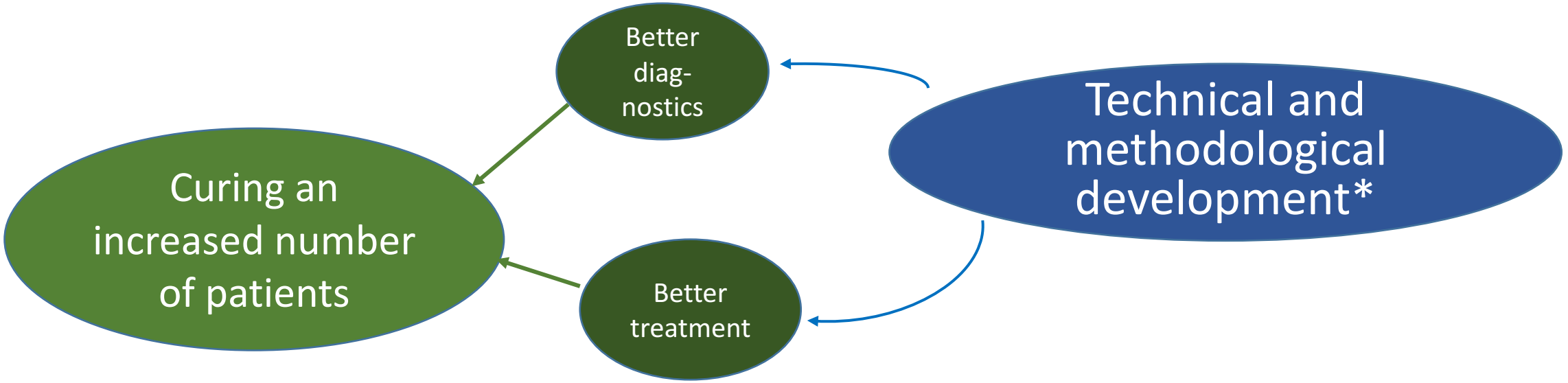
- Hospitals – health care
- Universities - research
- Industry - products
- Authorities - regulations

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

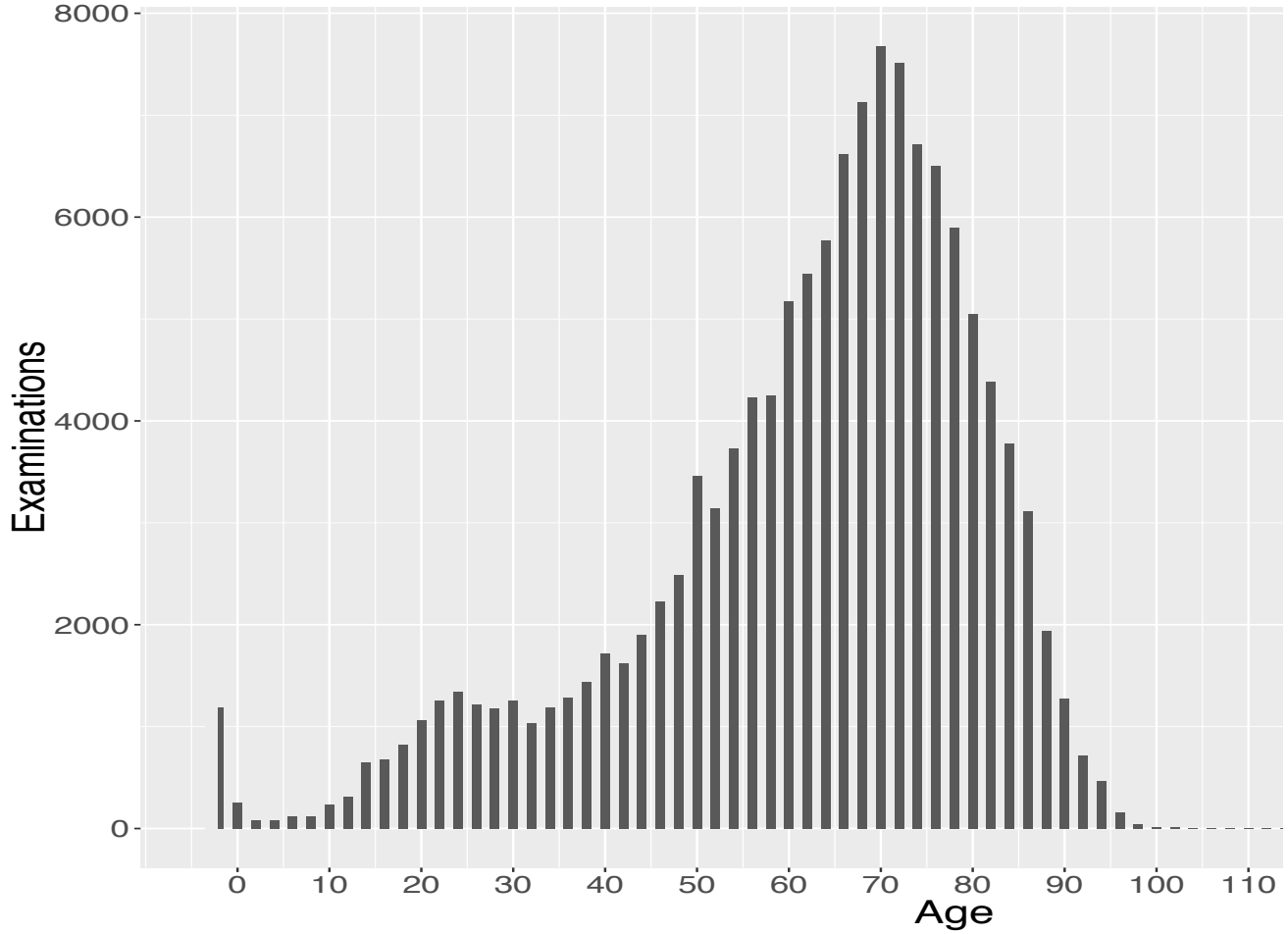
THE PATIENT

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

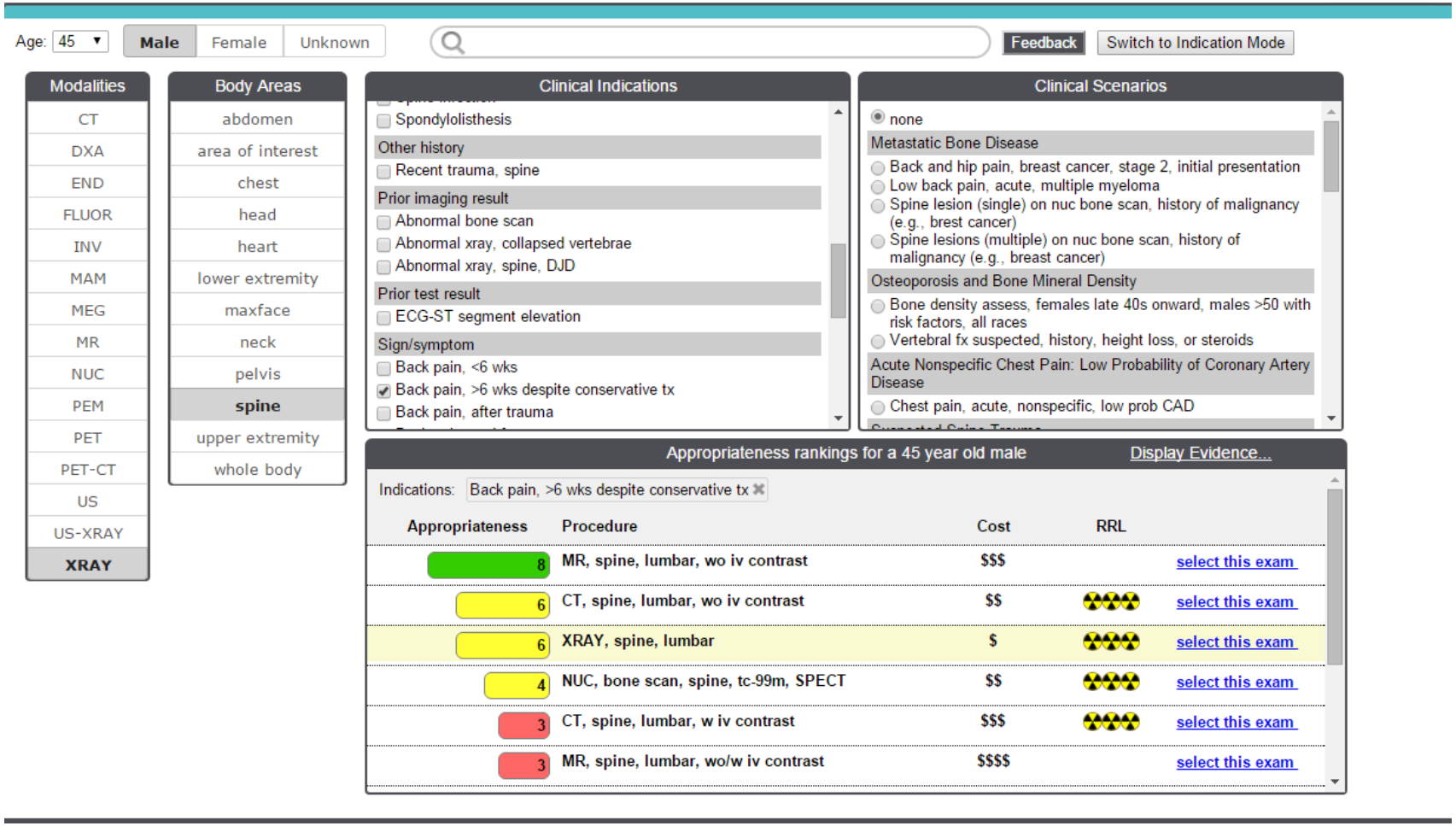
Referral criteria

Follow up
Feedback
Trend analysis

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

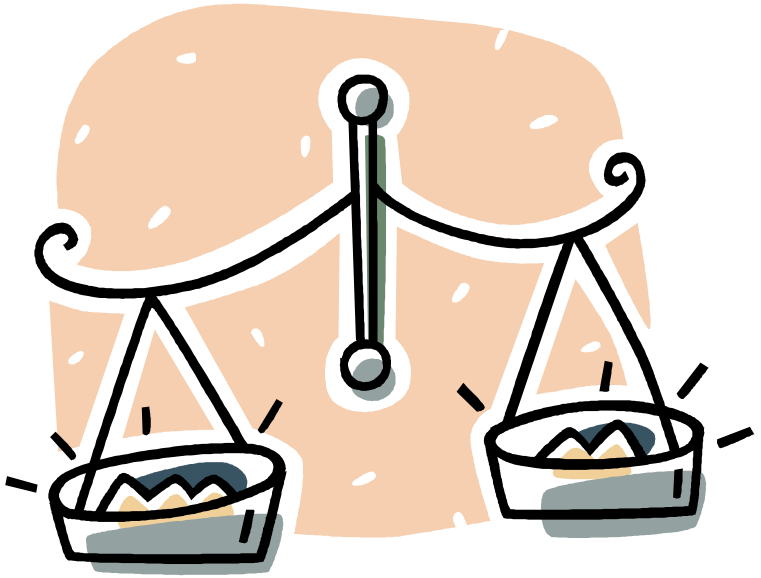
UMEÅ UNIVERSITET

I-GUIDE – COMPUTER SUPPORT FOR REMITTENTS



Program is tested in Jönköping

OPTIMISATION



Absorbed dose

risk

Image quality

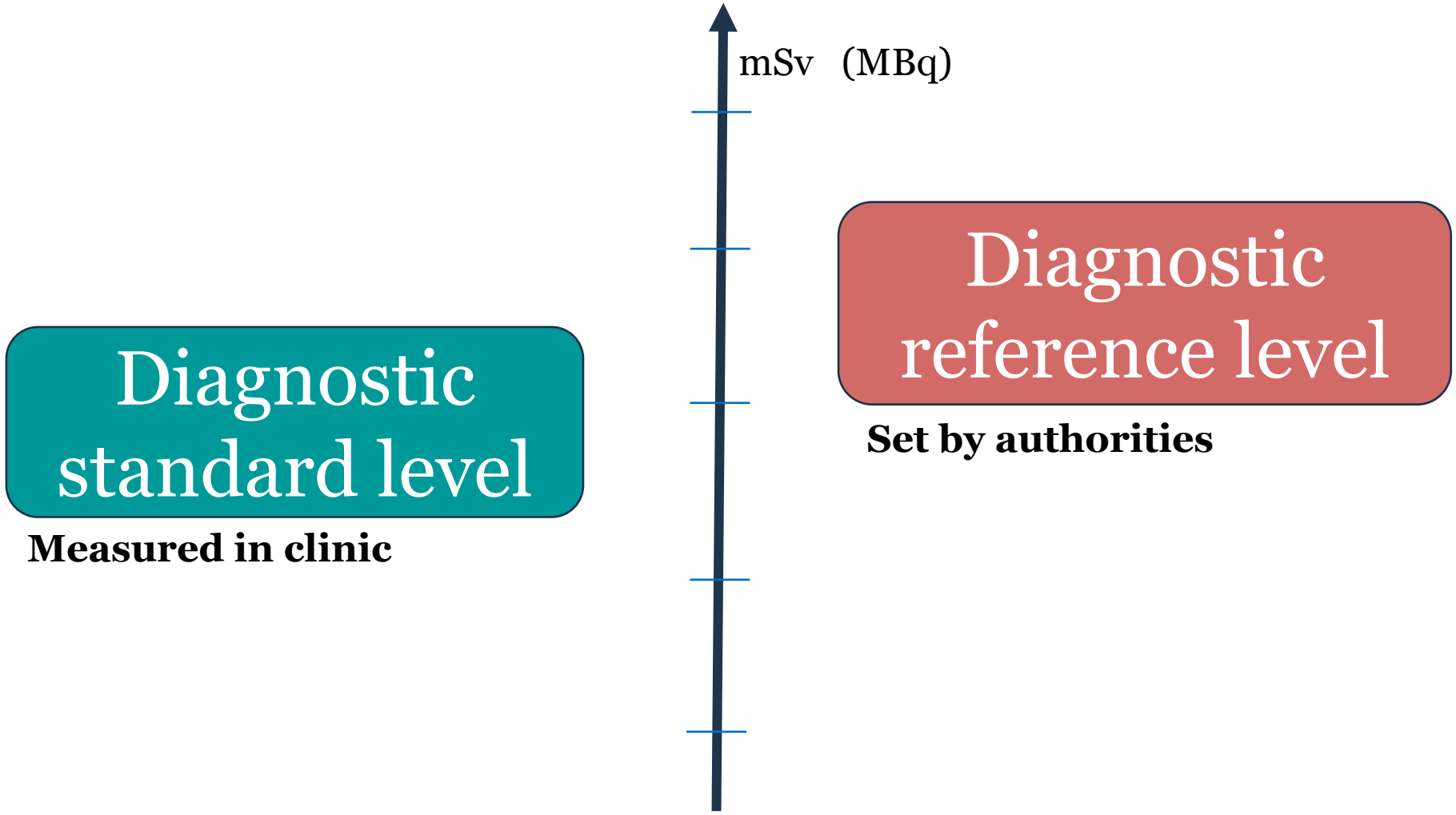
diagnostic safety

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

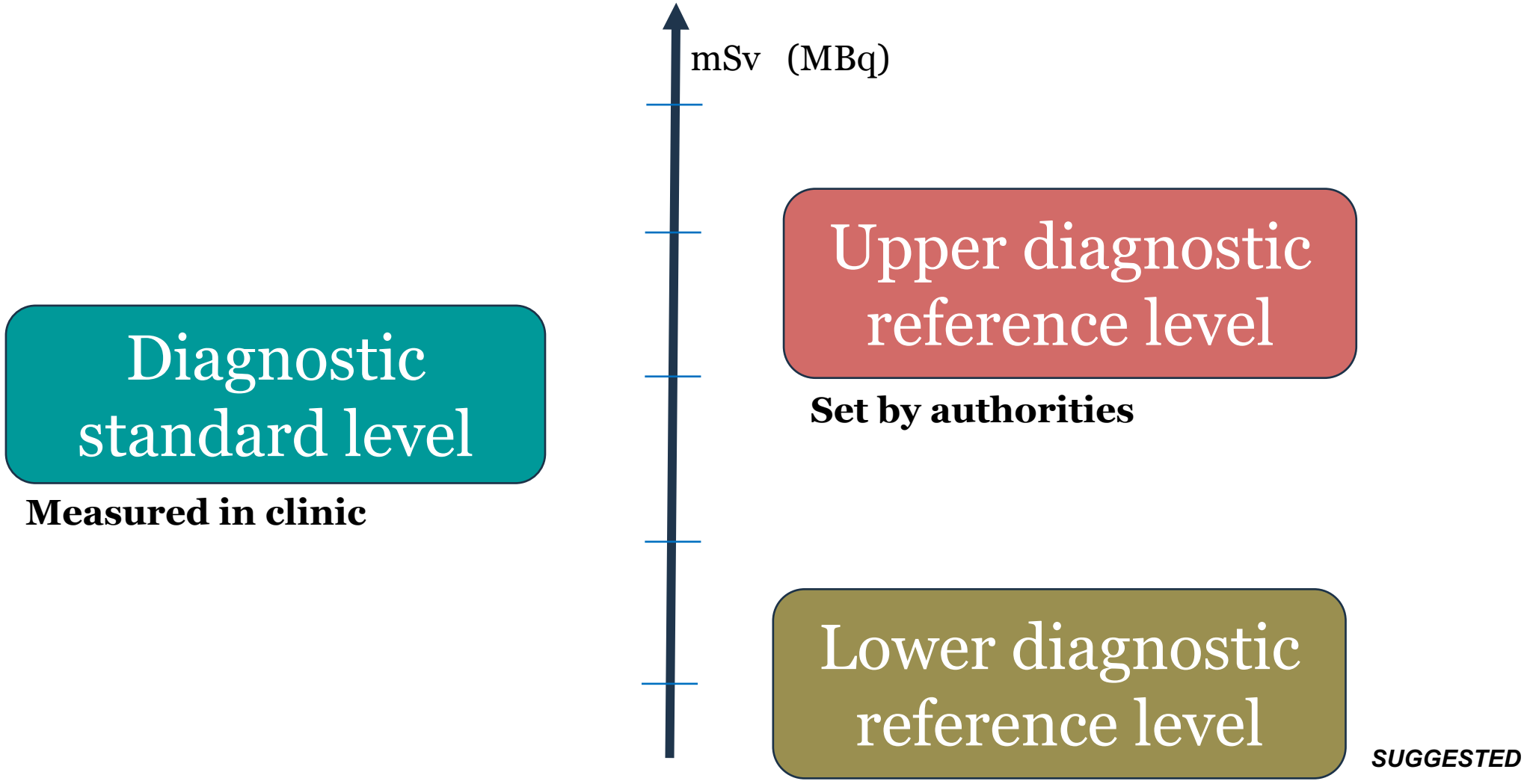
Optimisation

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

TOOL TO ENSURE OPTIMISATION



TOOL TO ENSURE OPTIMIZATION - NEW



FACTORS FOR CONSIDERATION – INCLUDED IN SSM-REGULATIONS

to be

new

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

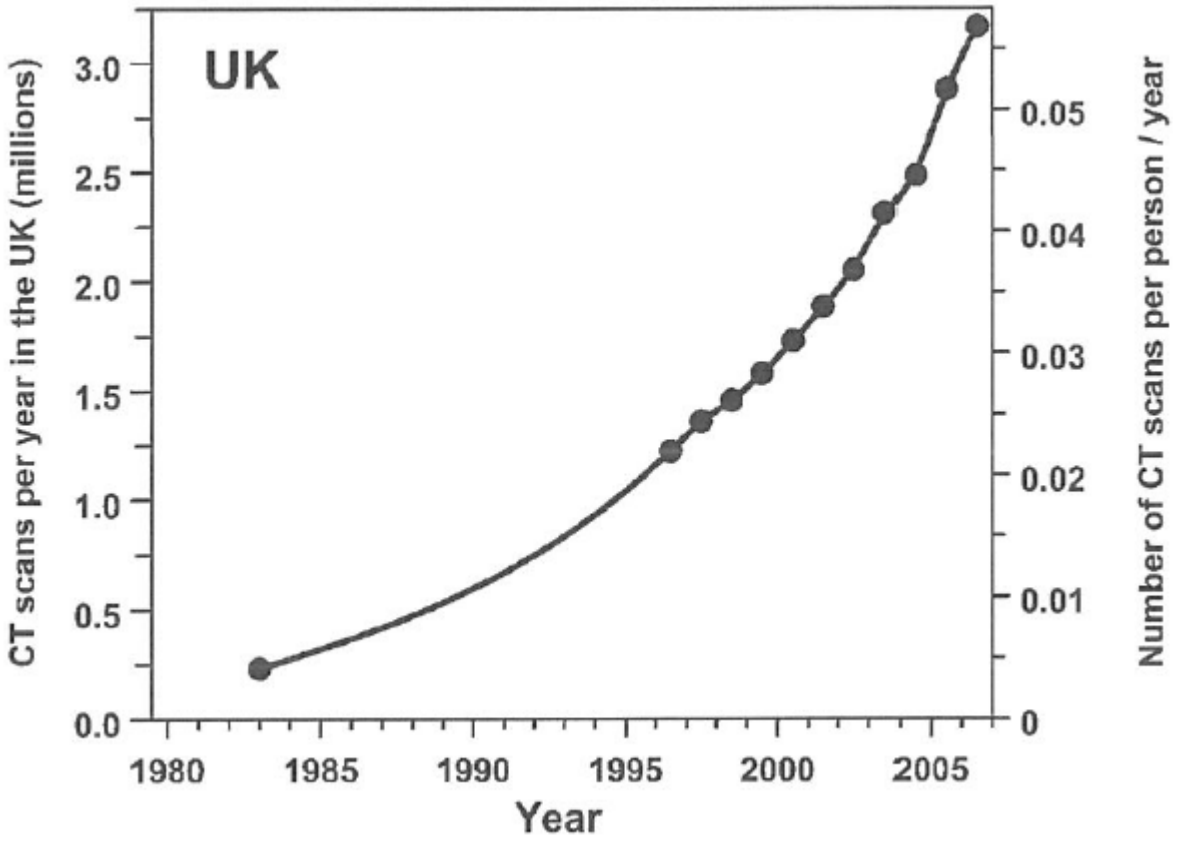
No maximum allowed dose for patients but:

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.*

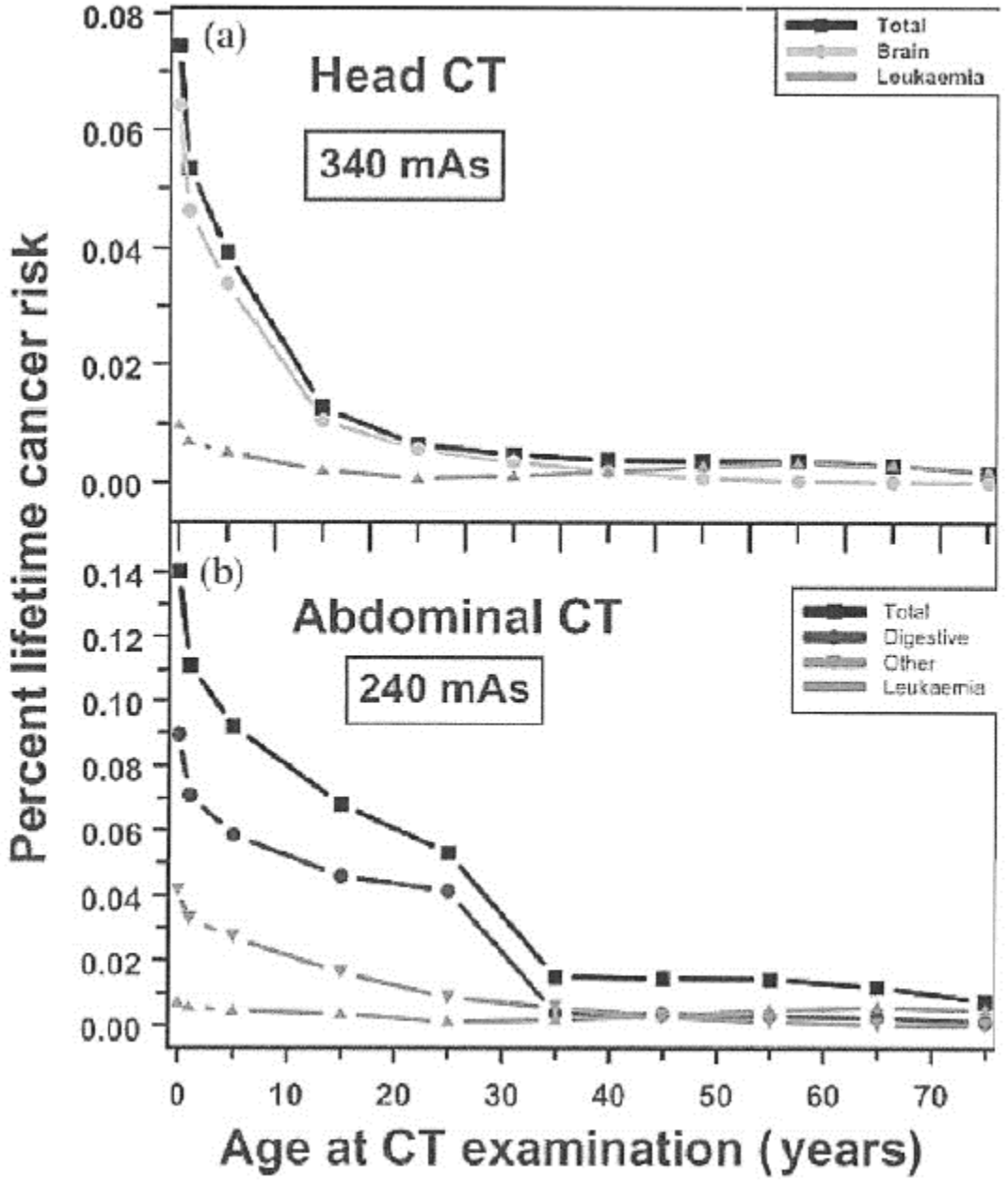


Hall & Brenner, Brit.J. Radiol. 2008

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

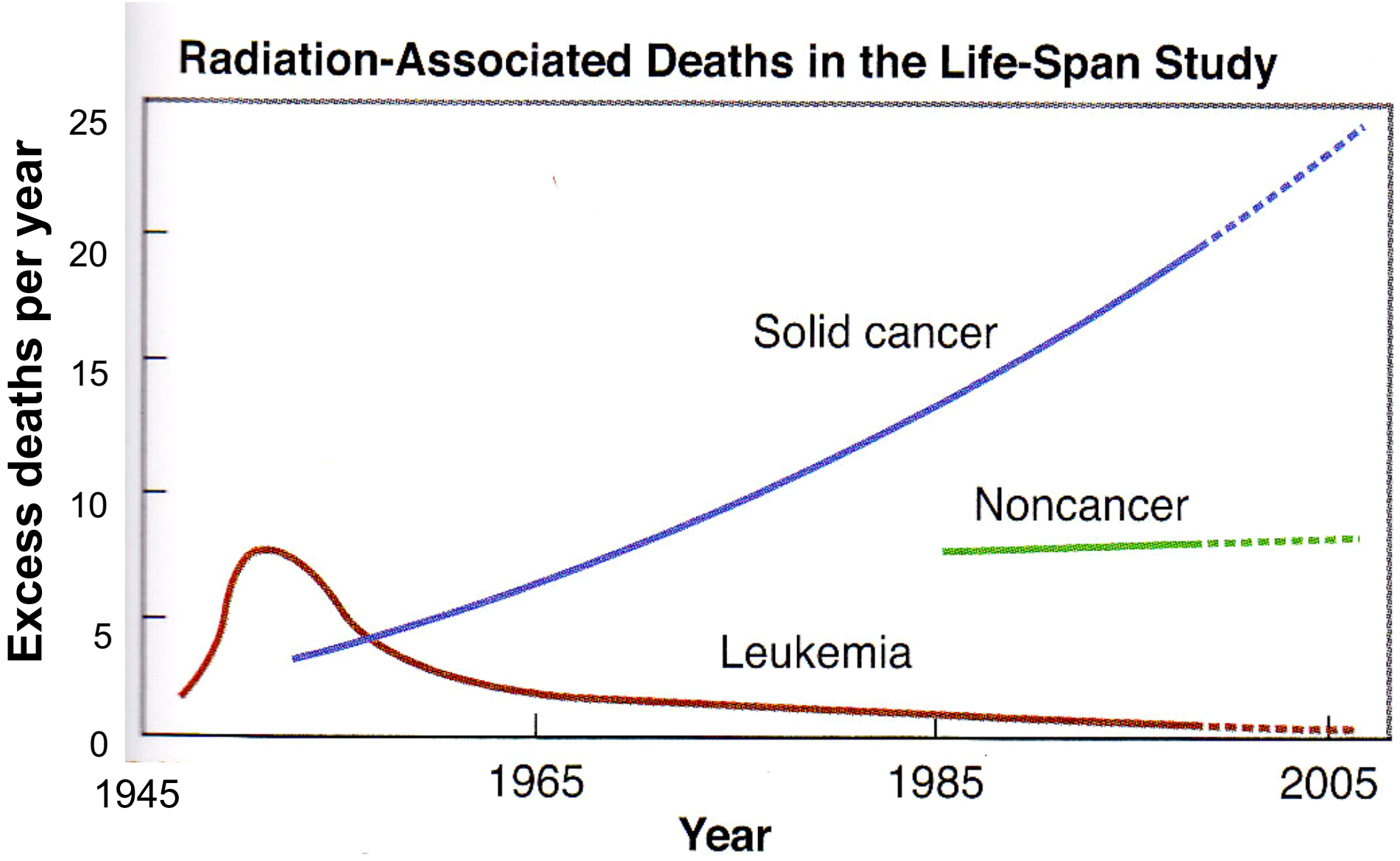
RISKS
PATIENTS

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



UMEÅ UNIVER

Hall and Brenner, Brit. J. Radiol. 2008



Hall 7:th ed. sid 145

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 specificty
  - 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 societal benefit
Trivial	Category I ($\sim 10^{-6}$ or less)	<0.1	Minor
Minor to intermediate	Category II		Intermediate to moderate
	IIa ($\sim 10^{-5}$)	0.1–1	
	IIb ($\sim 10^{-4}$)	1–10	
Moderate	Category III ($\sim 10^{-3}$ or more)	>10[a]	Substantial

[a]To 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
-