United Nations Scientific Committee
on the Effects of Atomic Radiation

UNSCEAR

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UNSCEAR –
Data on medical exposures from a global point of view

Wolfgang Weiss, Chair of Sessions 58th and 59th

Malcolm Crick, Scientific Secretary

Ferid Shannoun, Scientific Officer

8-10 June 2011, European ALARA Network

UNEP

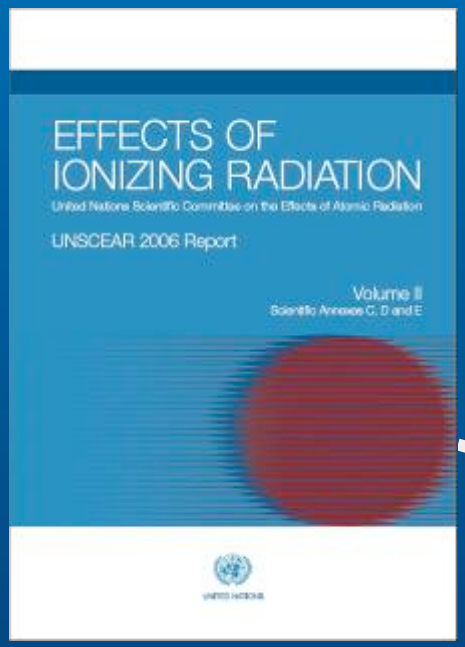
Content

- UNSCEAR's mandate and medical surveys
- UNSCEAR 2008 Report
  - Medical exposure categories
  - Population doses estimation
  - Summary of results
- UNSCEAR's strategy to improve data collection, analysis and dissemination
  - Summary of strategy

Mandate

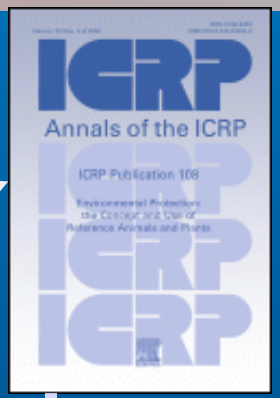
- Established by **General Assembly** resolution in 1955 (renewed annually)
- Assess **levels, effects & risks of ionizing radiation**
- Disseminate findings to General Assembly, scientific community & public
- Scientists from **21 UN Member States**
- Other States & organizations provide relevant data
- Holds **annual sessions** in Vienna
- **UNEP** arranges secretariat and provides support

International radiation safety regime



UNSCEAR
Scientific basis

issues
effects
risks



ICRP
Protection philosophy,
principles and units

recommendations

issues
levels
trends

ILO convention 115:
occupational
radiation protection

FAO/WHO
Codex Alimentarius Commission
(food contamination guides)

UN transport regulations for
radioactive material

IAEA, WHO, ILO, FAO etc.
-Safety standards
-Protection programmes

implemented by
Member States

UNSCEAR 2006/2008 reports

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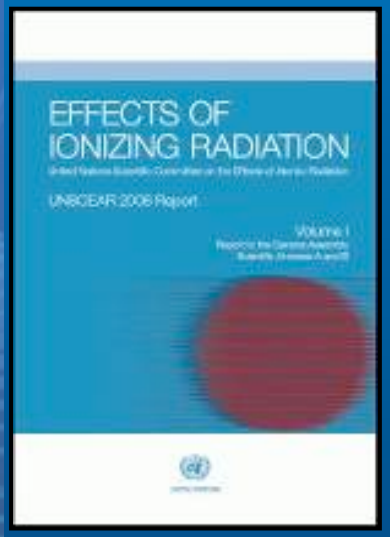
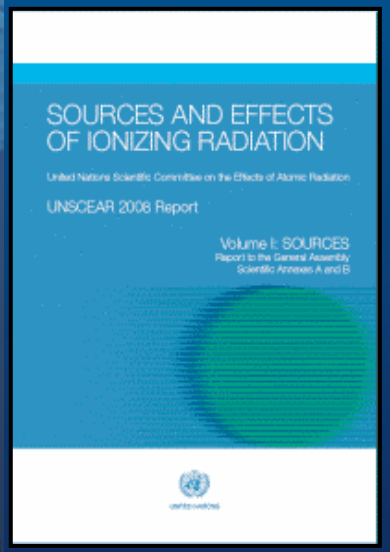


EFFECTS

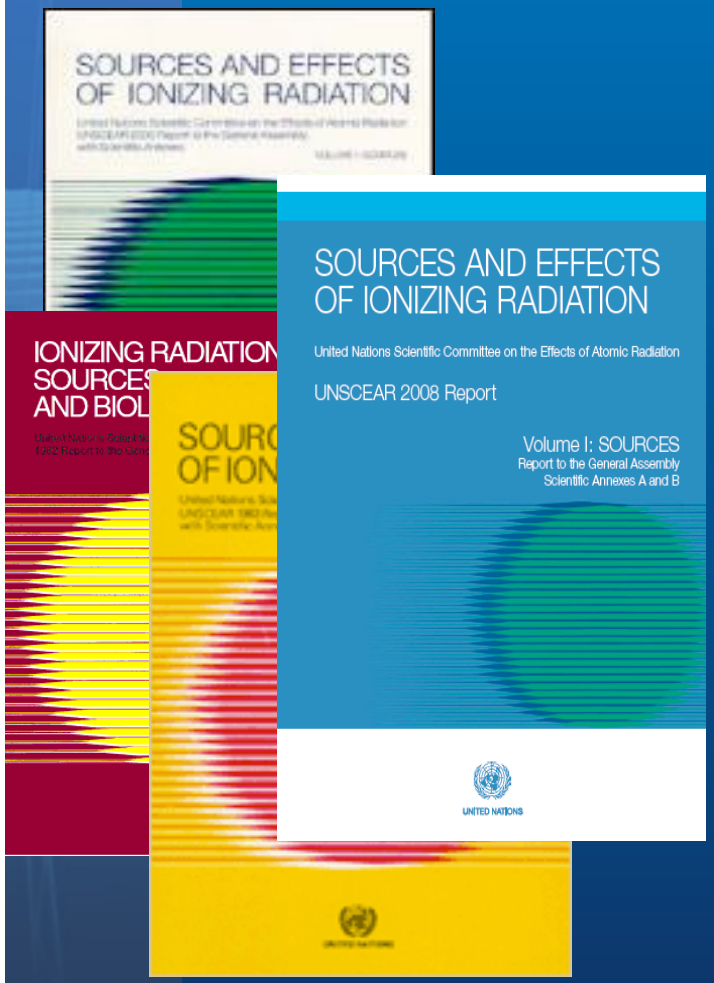
Annex A - Epidemiological studies of radiation and cancer
Annex B - Epidemiological evaluation of cardiovascular disease and other non-cancer diseases following radiation exposure
Annex C - Non-targeted and delayed effects of exposure to ionizing radiation
Annex D - Effects of ionizing radiation on the immune system
Annex E - Sources-to-effects assessment for radon in homes and workplaces



SOURCES

Annex A - **Medical radiation exposures**
Annex B - Exposures of the public and workers from various sources of radiation.
Annex C - Radiation exposures in accidents;
Annex D - Health effects due to radiation from the Chernobyl accident;
Annex E - Effects of ionizing radiation on non-human biota.

UNSCEAR's medical exposure survey



Objectives of UNSCEAR's survey to facilitate evaluation of:

- global estimates of frequency and levels of exposures, with break-downs by medical procedure, age, sex, health care level, and country;
- trends in practice (including those relatively fast-changing);

with supporting contextual evidence on equipment and staffing levels.

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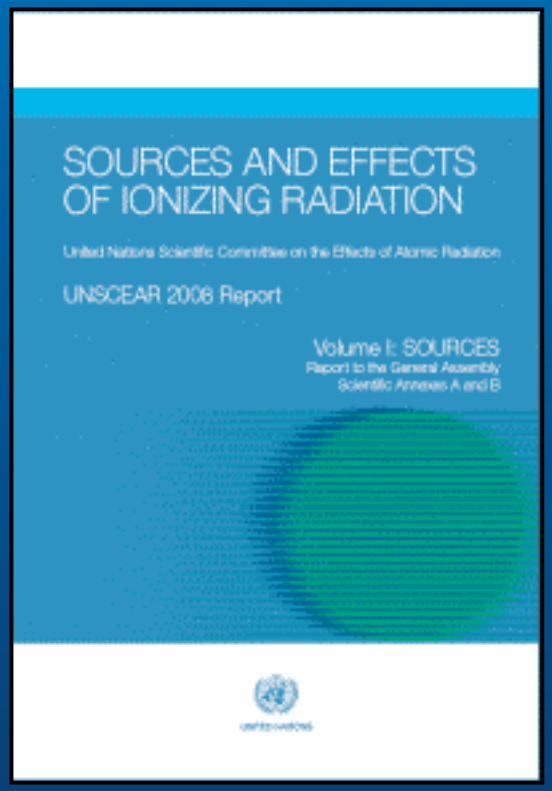

Volume I: Annex A
Medical Radiation Exposures

Assessment of the global population dose from medical exposures in the period 1997-2007

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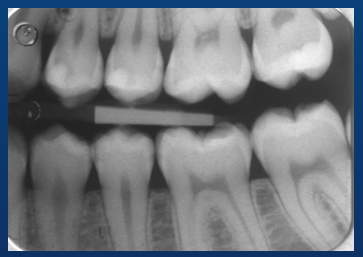
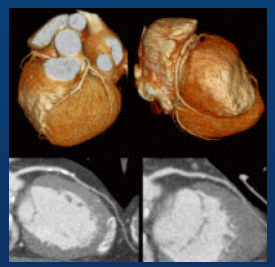
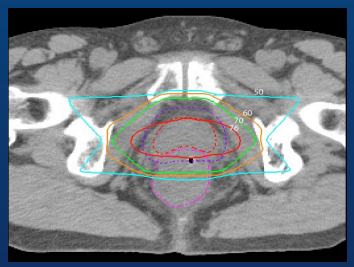
Medical exposures

- Exposure of patients as part of their medical diagnosis or treatment;
- Exposure of individuals as part of health screening programmes;
- Exposure of healthy individuals or patients voluntarily participating in medical, biomedical, diagnostic or therapeutic research programmes







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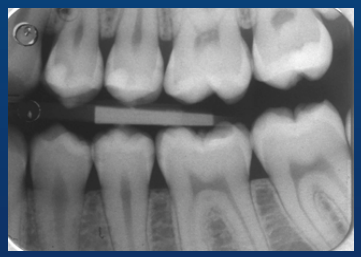
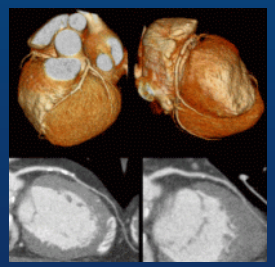
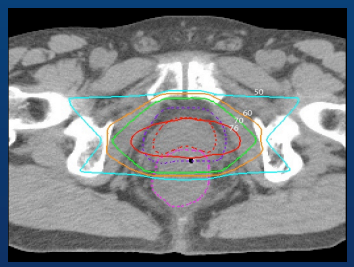
Medical exposures

- Approach of categorization:
  - Diagnostic radiology
    - Plain radiography, fluoroscopy, CT and DEXA
    - Image guided interventional procedures
  - Nuclear medicine
    - Gamma camera, PET/CT and NM treatments
  - Radiation therapy
    - External beam therapy and brachytherapy







Population dose estimation

- *H_T (Equivalent dose in tissue T)* is used for stochastic risk assessment
  - Given by: $H_T = \sum_R w_R D_{T,R}$

    where $D_{T,R}$ is average absorbed dose to tissue *T* from radiation *R*, and w_R is radiation weighting factor (w_R = 1 for X-rays and gamma rays).
- *E (Effective dose)* is used for expressing stochastic risk to radiation workers and to whole population
  - Given by: $E = \sum_T w_T H_T$

    where equivalent dose to tissue or organ, H_T, is weighted by dimensionless tissue weighting factor w_T.

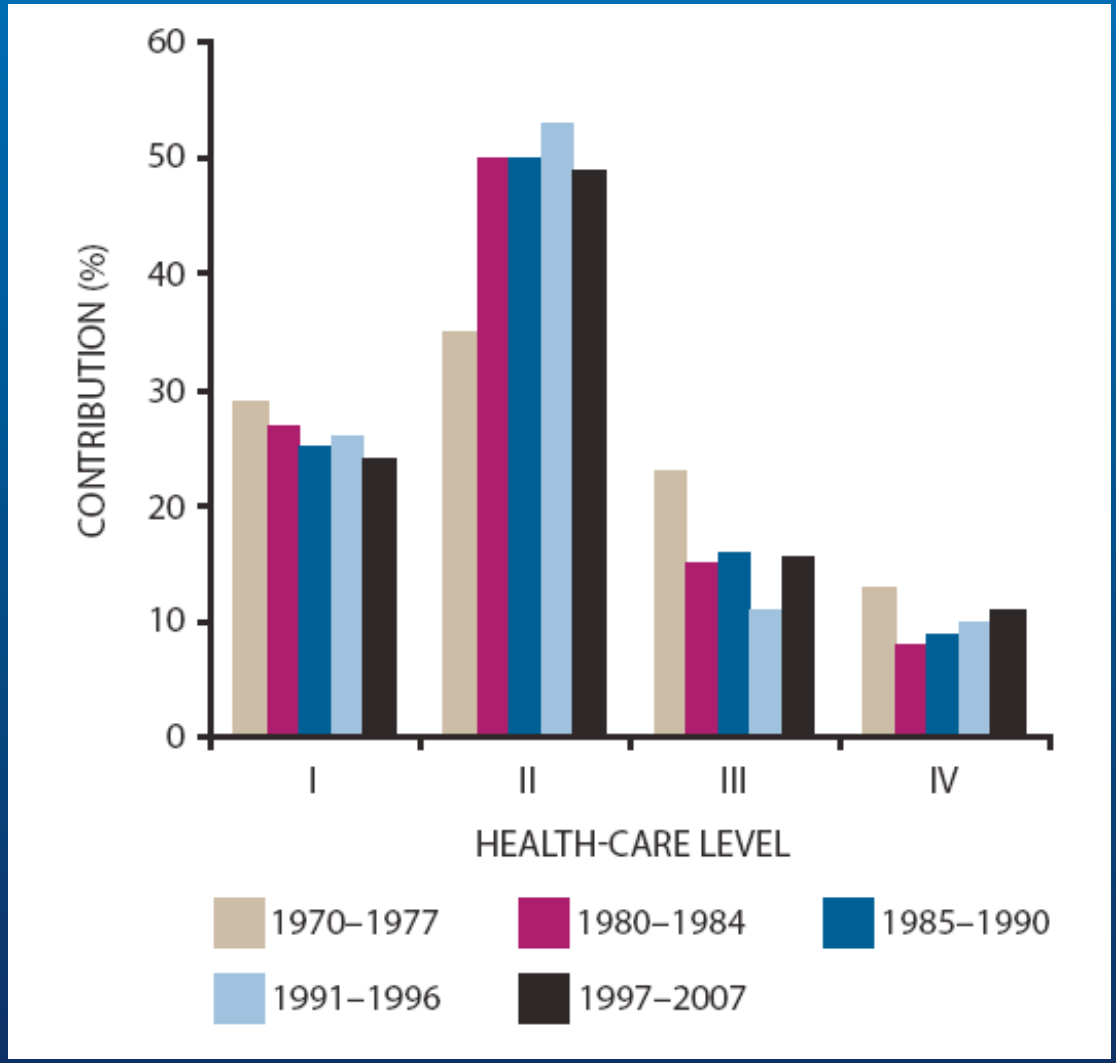
Population dose estimation

- *S (Collective effective dose)* is summation, over all types of examinations, of mean effective dose (E_e) for specific examination type multiplied by number of these examinations (n_e).
- *Effective dose per caput* is also used to quantify exposures which is *S* averaged over exposed and non-exposed individuals.
  - Number of examinations may be deduced from annual frequencies (expressed as number of examinations per 1,000 population)
  - Estimated population for country

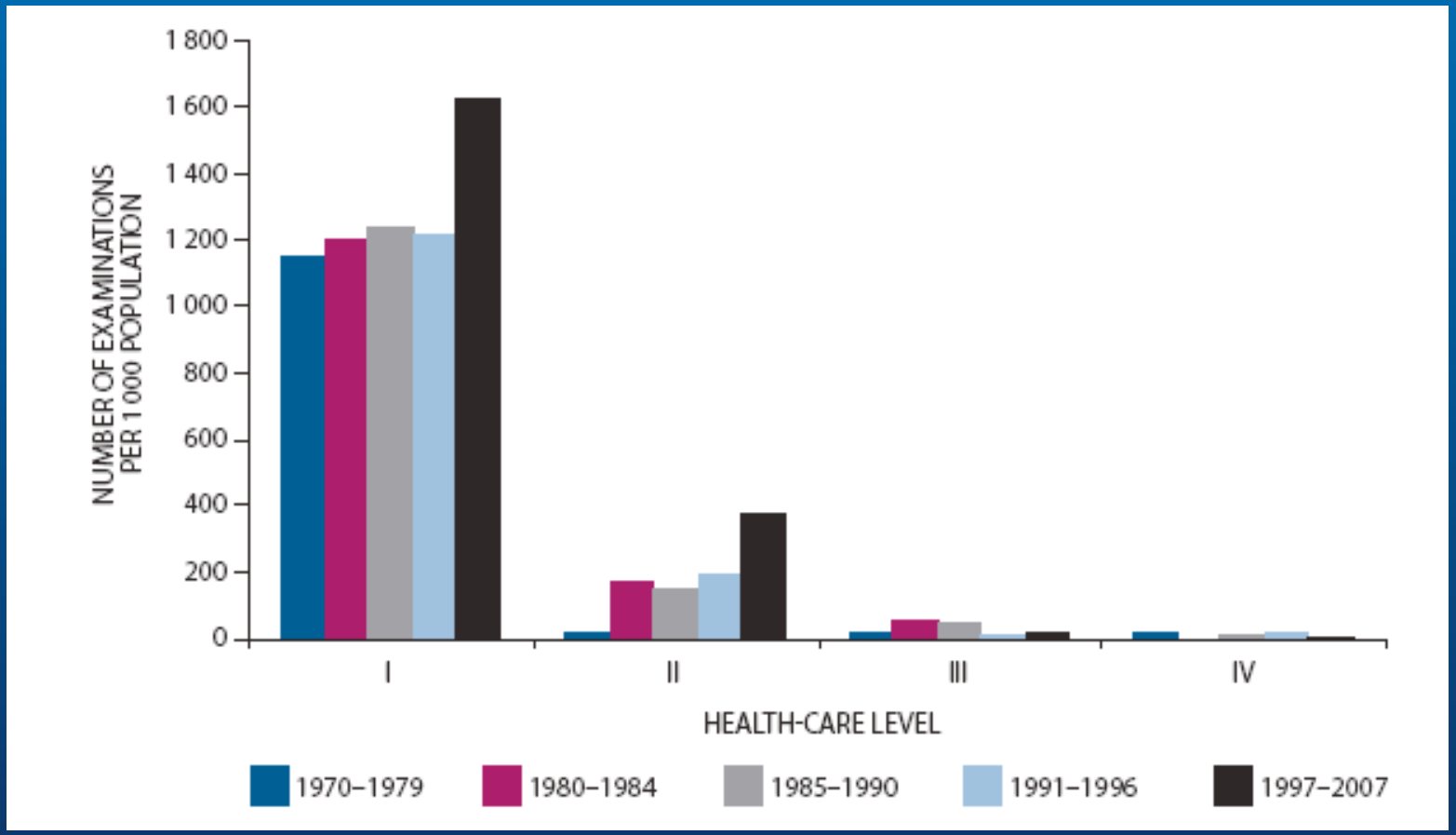
Population dose estimation

- Effective dose concept strictly applies only to lower dose levels, and therefore effective dose and collective effective dose are not appropriate to assess dose levels in radiation therapy.
- Consequently, contribution from radiation therapy are not included in UNSCEAR global estimate of population from medical exposures.

Global population distribution

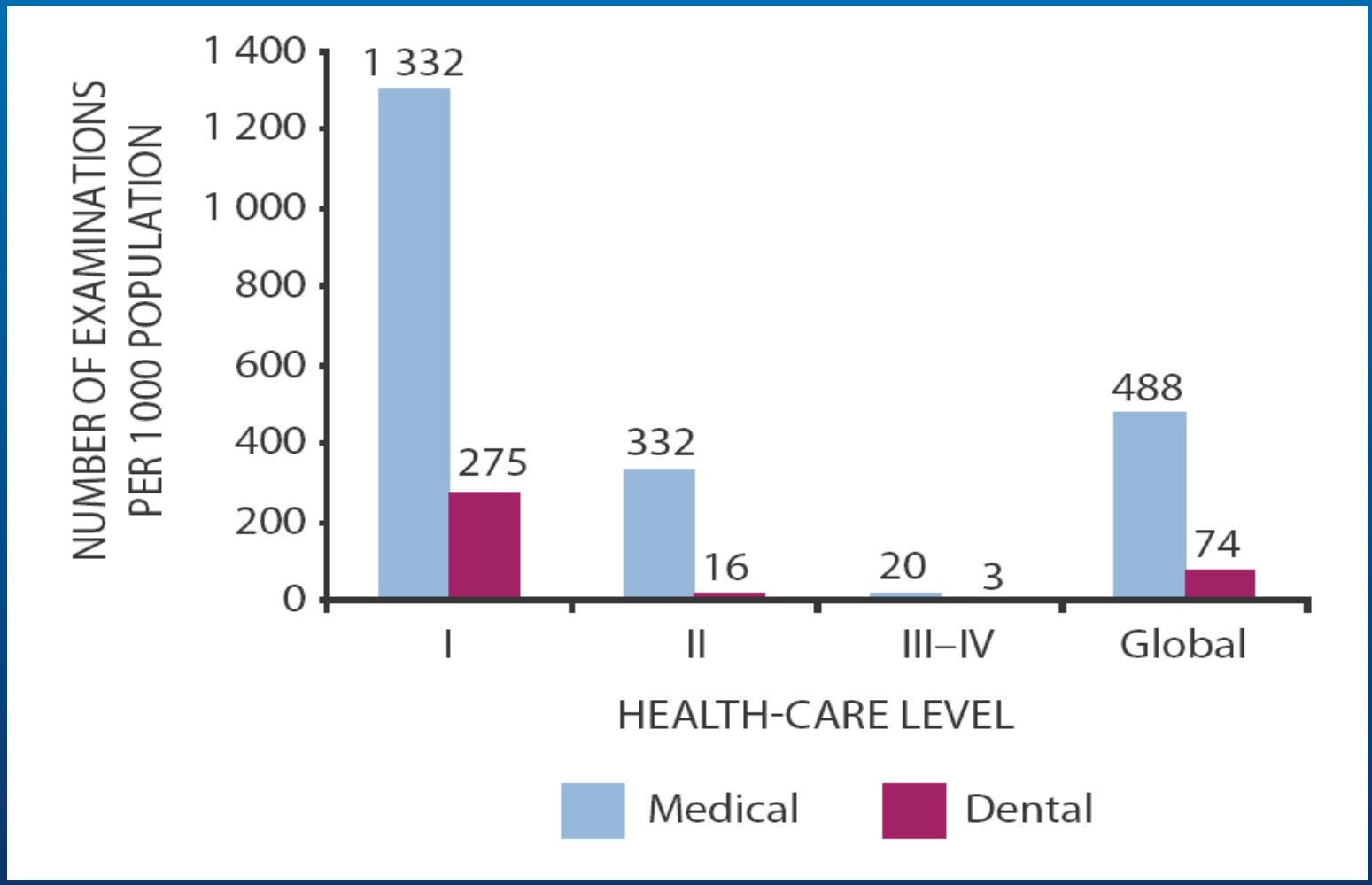


Diagnostic radiology: Trend in annual frequency



UNSCEAR 2008 Report (Evaluation period 1997-2007)

Diagnostic radiology: Annual frequency per health care level



UNSCEAR 2008 Report (Evaluation period 1997-2007)

Diagnostic radiology: Annual average per caput effective dose

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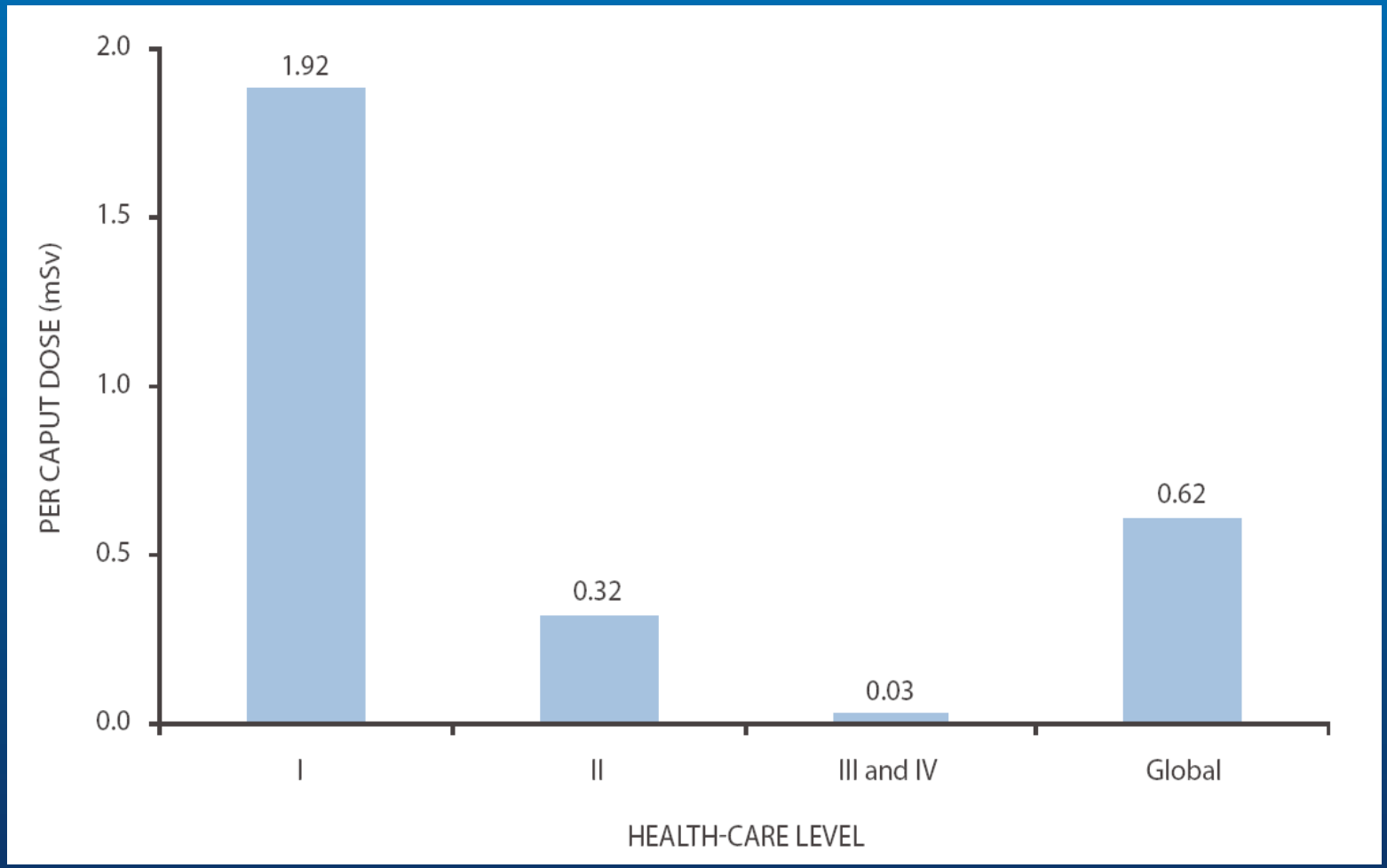
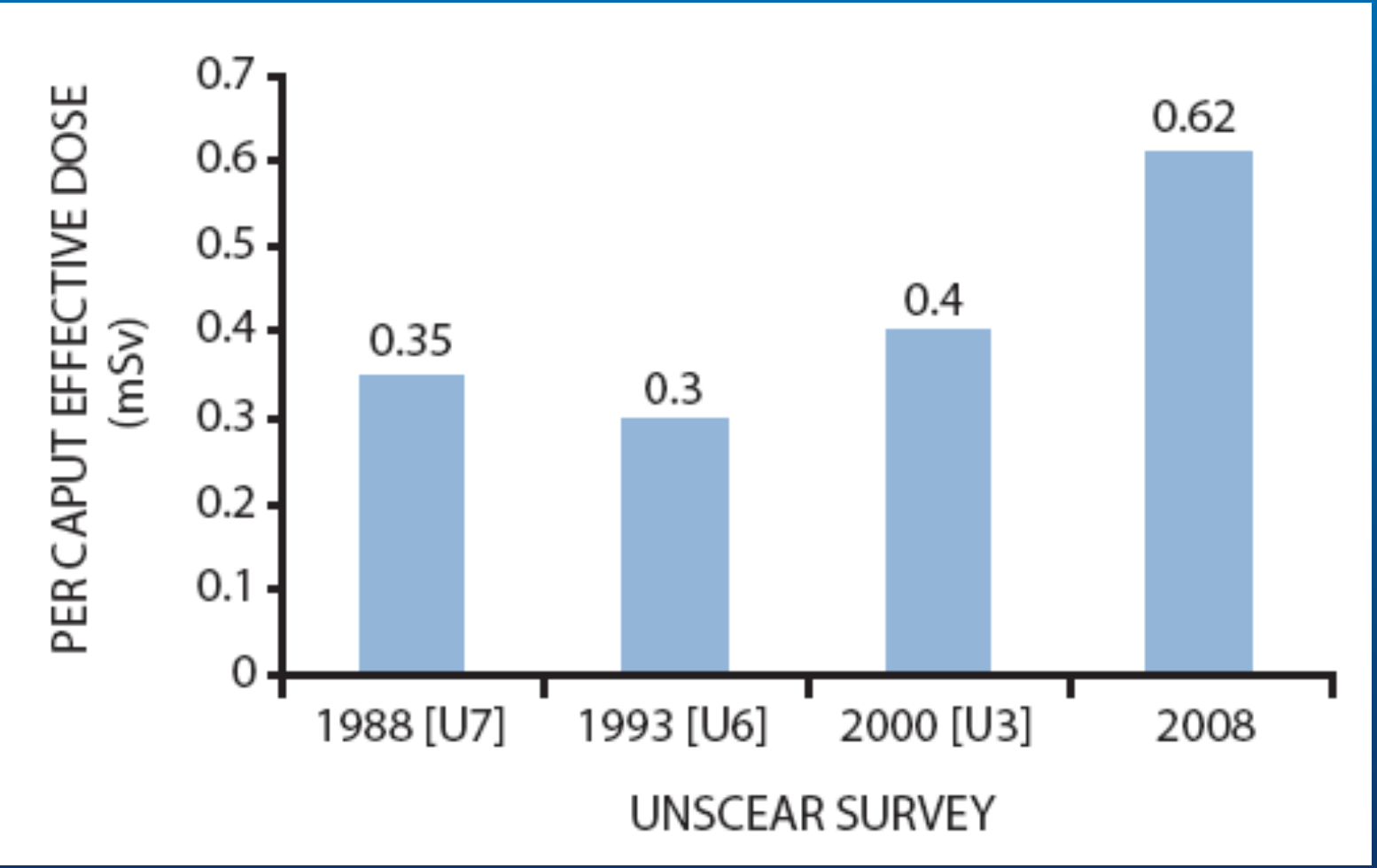
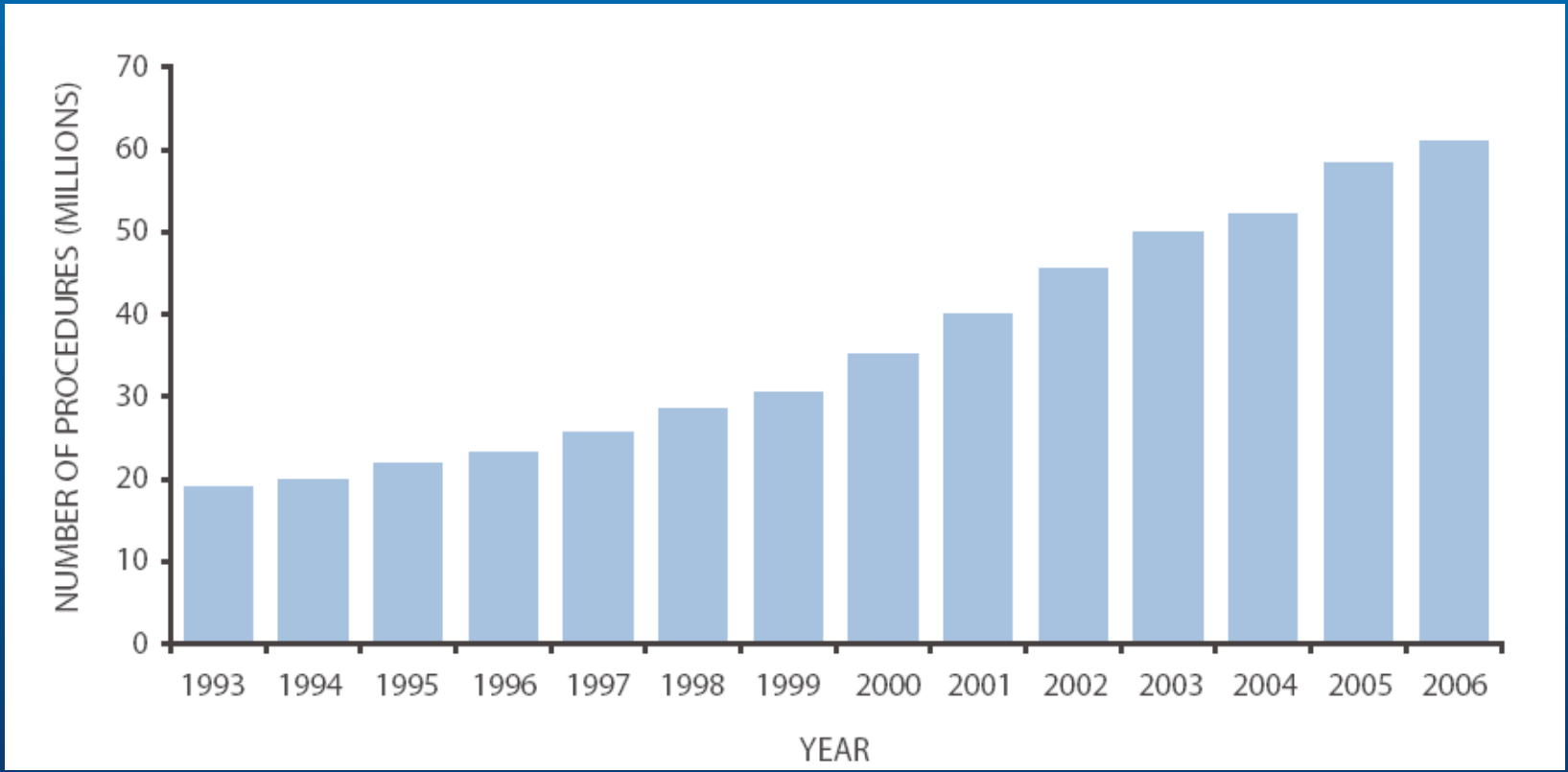


UNSCEAR 2008 Report (Evaluation period 1997-2007)

Diagnostic radiology: Trend in per caput effective dose

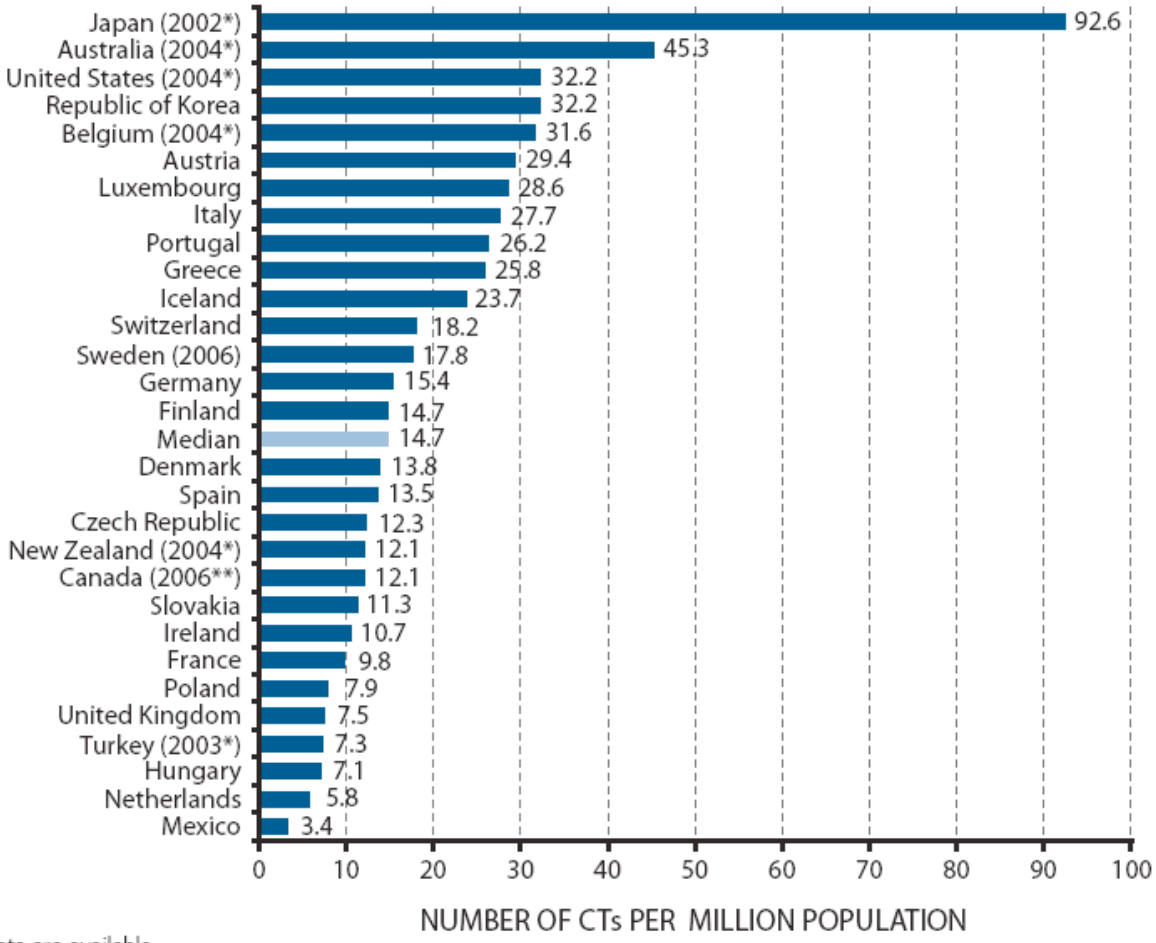


Computed tomography: Annual number of CT scans in USA



UNSCEAR 2008 Report (Mettler et. al)

Diagnostic radiology: CT scanners per million population



*Latest year for which data are available.
**As of January 1, 2006.

Sources: OECD Health Data 2007, OECD, for all countries except Sweden and Canada; Belgian Health Care Knowledge Centre, *HTA of Diagnostic Resonance Imaging*, KCE report vol. 37C, 2006, for Sweden; National Survey of Selected Medical Imaging Equipment, Canadian Institute for Health Information, for Canada. Reproduced with permission from the Canadian Institute for Health Information

Diagnostic radiology: Trend in annual frequency

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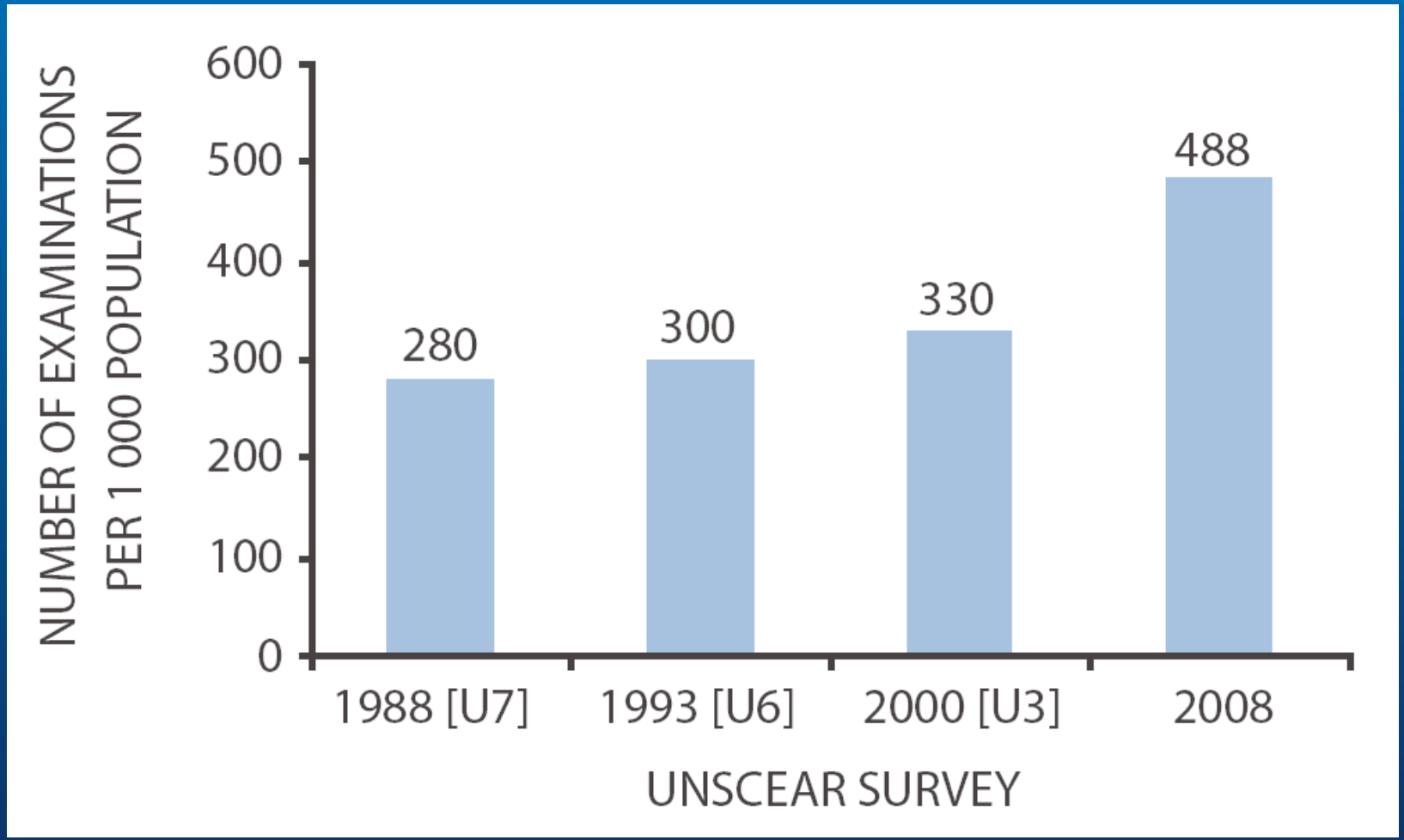

Nuclear medicine: Annual frequency per health care level

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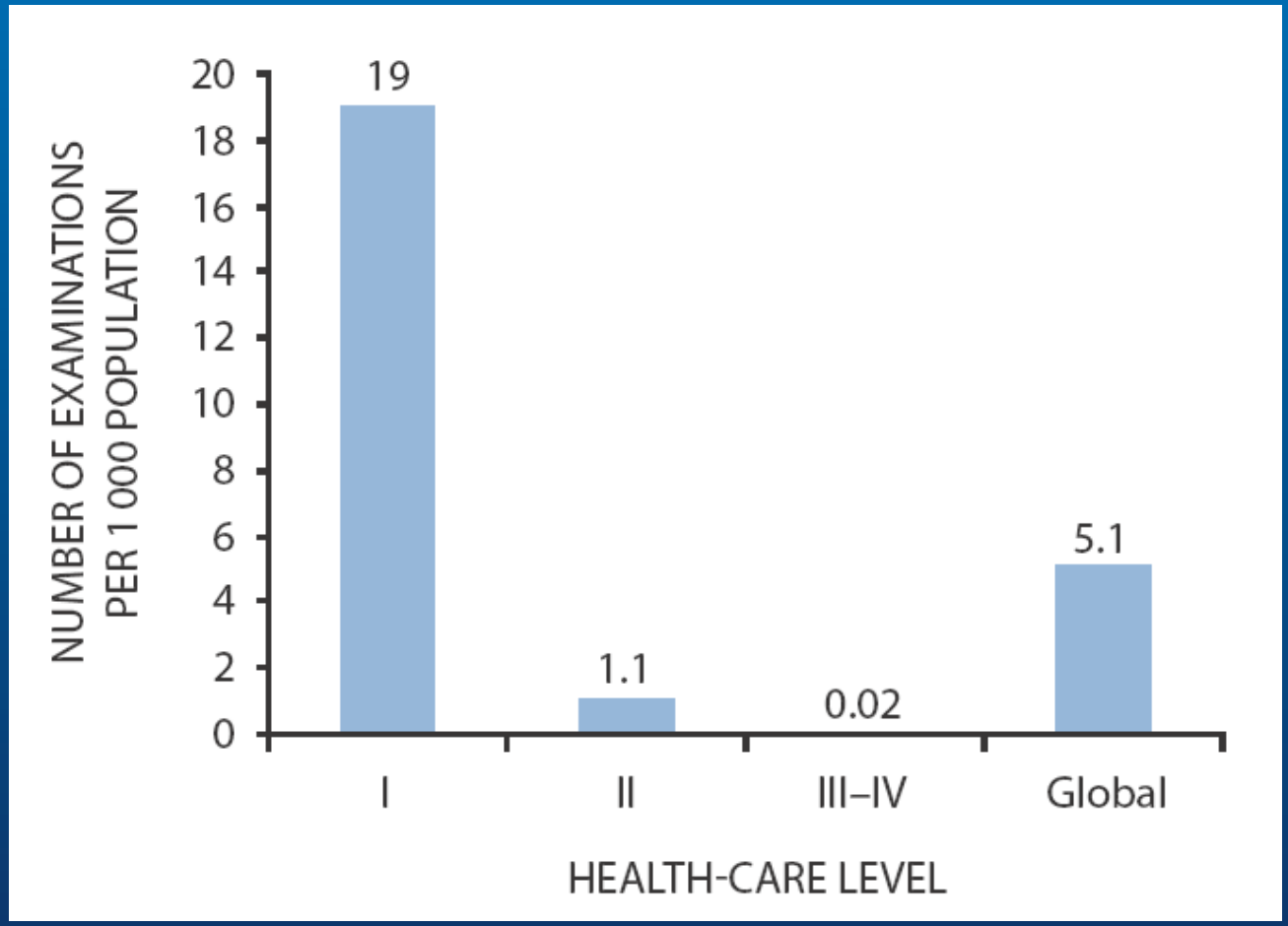

UNSCEAR 2008 Report (Evaluation period 1997-2007)

Nuclear medicine: Trend in annual frequency

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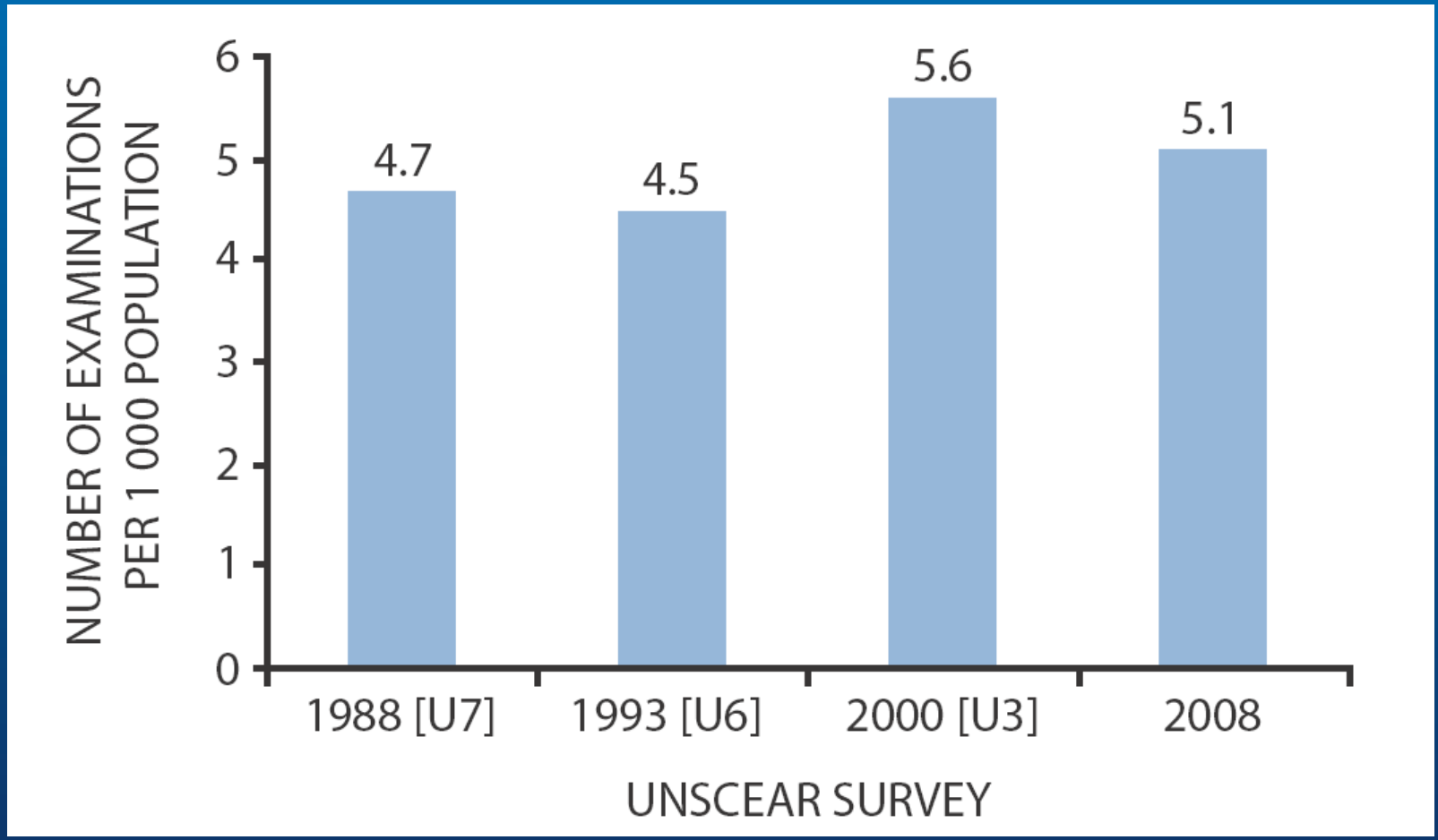
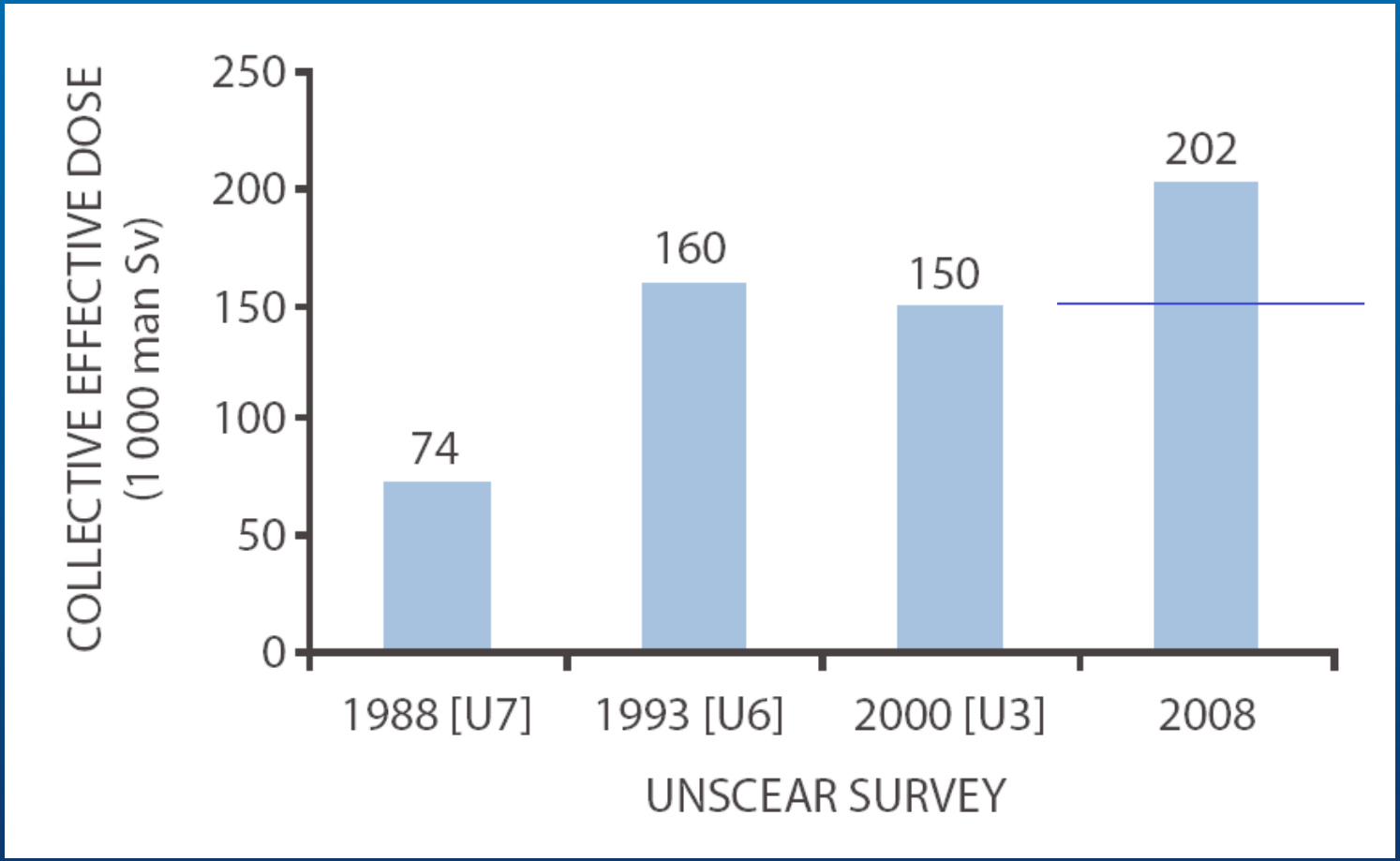
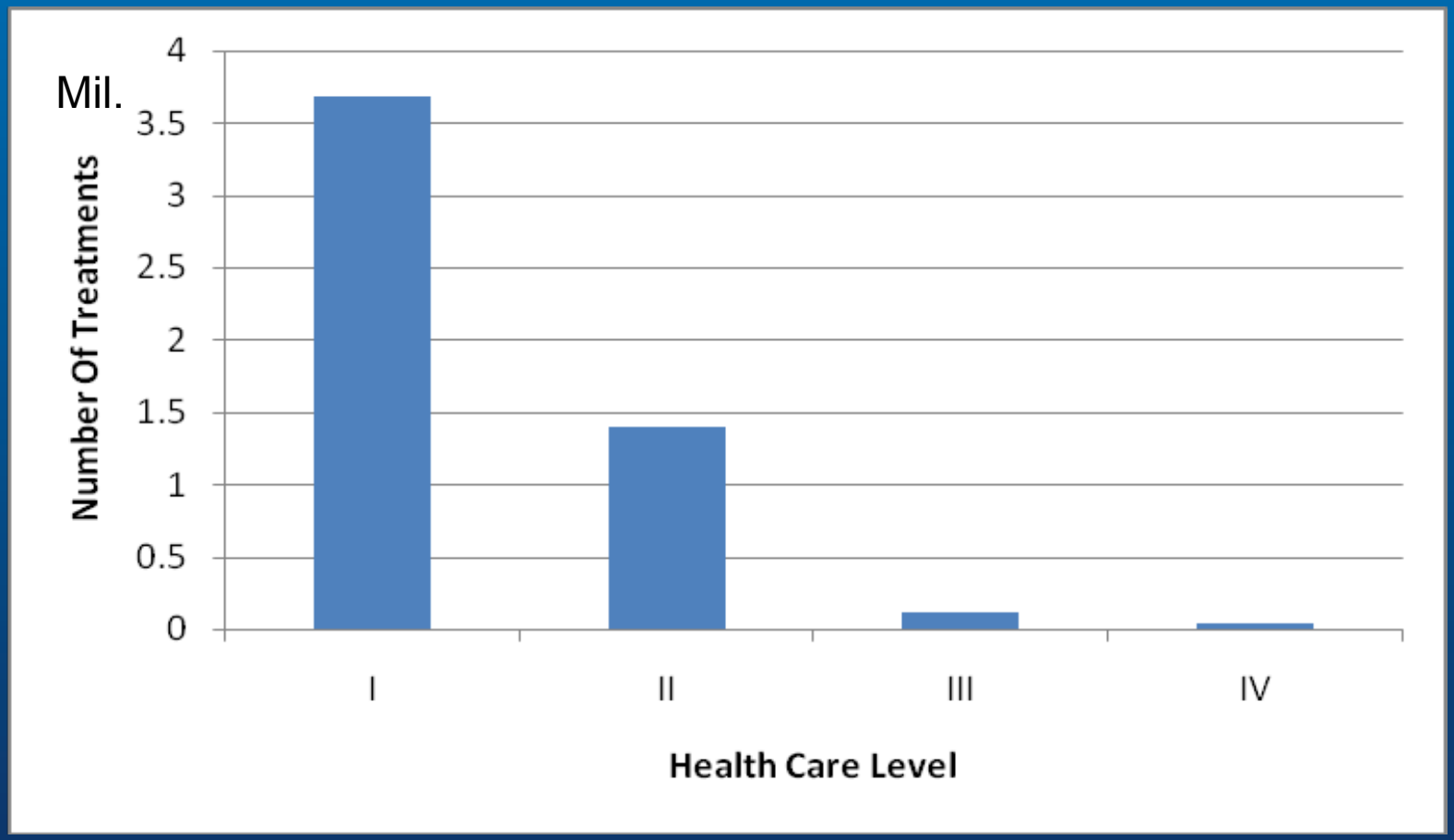


Nuclear medicine: Trend in annual collective dose



Radiotherapy: Annual number of treatments per HCL



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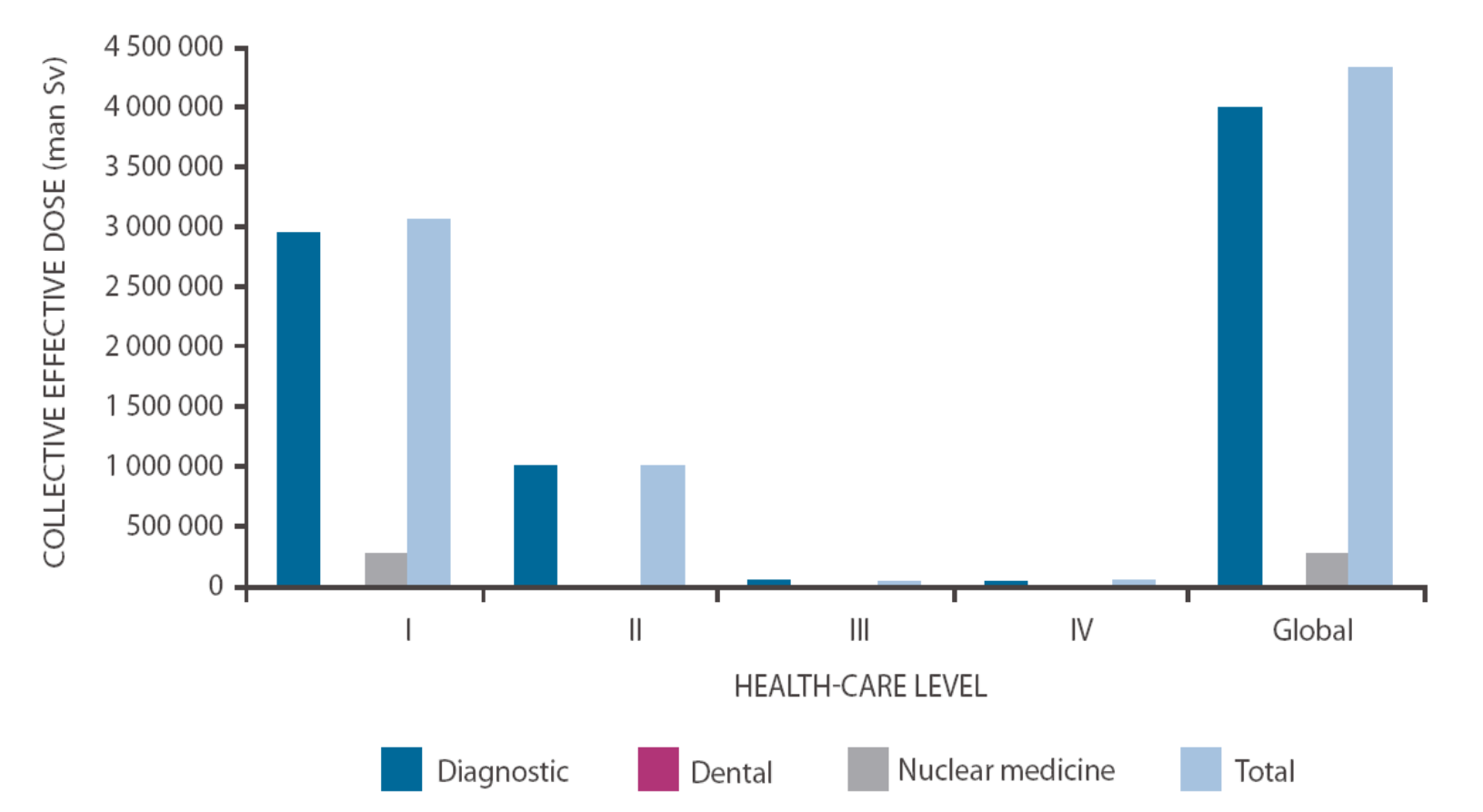
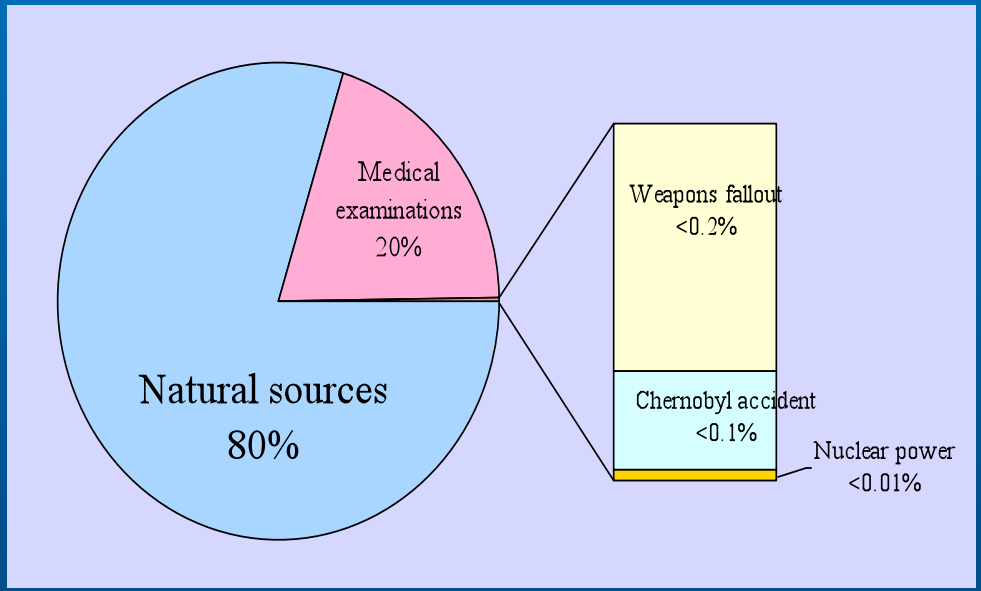
Annual collective effective dose per HCL



UNSCEAR 2008 Report (Evaluation period 1997-2007)

Main conclusions



- Medical exposure remains by far largest artificial source of exposure and continues to grow significantly.
- Medical exposure is second largest contributor to population exposure worldwide, representing approximately 20% of total.

Main conclusions

- For some countries, doses from diagnostic radiology exceed natural sources already.
- Overall greater use of CT scanning caused dramatic change in population dose.
- Even if annual frequency of diagnostic nuclear medicine procedures has remained fairly constant since 1988, its contribution to collective effective dose has tripled, due to introduction of high-dose **cardiac** studies as well as increase in 'hybrid' (PET/CT and SPECT/CT) imaging systems.

Main conclusions

- Distribution of medical exposures is uneven among countries and health care levels:

  24% of population living in health care level I countries
  - receive 71% of total radiation therapy treatments;
  - undergo over two-thirds of all diagnostic examinations;
  - occur 90% of nuclear medicine procedures.
- Use of medical radiological devices likely to increase world wide, especially in health care level II-IV countries including radiation therapy practice as cancer incidence will increase in populations with increasing lifespan.
- UNSCEAR needs to improve data collection and dissemination, especially for health care level II-IV countries.

Issues with UNSCEAR surveys

- Very **poor response** from countries of health care level II, III and IV.

- **Complexity** on patient **age** and **sex** distribution might have hindered submission of other important data and information.

- **Confusion** due to different interpretations of **dosimetric** approaches.

- Lack of clarity affects **quality** and consistency of data submitted.

- Health care levels classification don't allow **comparison** with WHO and World Bank data.

- **Language** difficulties to interpret requested information.

- Long **verification** and **publishing** process.

UNGA resolutions (65/96)

United Nations A/RES/65/96

General Assembly

Distr.: General
20 January 2011

Sixty-fifth session
Agenda item 49

9. *Also welcomes* the Scientific Committee's new strategy to improve data collection, encourages in this regard Member States, the organizations of the United Nations system and non-governmental organizations concerned to provide further relevant data about doses, effects and risks from various sources of radiation, which would greatly help in the preparation of future reports of the Scientific Committee to the General Assembly, and further encourages the International Atomic Energy Agency, the World Health Organization and other relevant organizations to establish and coordinate with the secretariat the arrangements for periodic collection and exchange of data on radiation exposures of workers, the general public, and, in particular, medical patients;

Strategy adopted by UNSCEAR's 57th session

Elements included:

(i) revise **design** and **content** of questionnaires based on feedback;

(ii) standardize **taxonomy** and **terminology**, improve **instructions** and provide **examples**;

(iii) **translate** into other official UN languages;

(iv)develop **electronic** versions of questionnaires;

(v) use **separate collection** approaches for frequency data and dosimetric data;

(vi) foster systematic data collection from **populous countries** (health care levels II, III and IV);

(vii) focus on most significant examinations and procedures in terms of their **contribution** to population dose;

Strategy adopted by UNSCEAR's 57th session

(viii) collect patients' age and sex distributions separately for selected countries;

(ix) use existing mechanisms to obtain data on frequency and doses in radiotherapy and nuclear medicine (IAEA), and health care indicators (WHO);

(x) introduce process for data sign-off by States' contact points to improve response rate and quality of data;

(xi) establish small standing expert group on patient exposures to conduct reality checks, assure quality and prepare evaluations;

(xii) review health care level methodology and consider adopting World Bank approach used by WHO to allow comparison with other public health issues;

(xiii) develop strategy for disseminating survey findings and making data available for countries and scientists.

Summary of improving strategy

- Simplify current questionnaire
- Target specific countries
- Create small expert group
- Establish national contact points
- Develop electronic solutions for data collection and dissemination
- Collaborate with other organizations (e.g. IAEA, WHO, OECD, EC)
- Collaborate with expert networks (e.g. ALARA, HERCA, DoseDataMed)

Acknowledgments

- Consultants
  - Dr Keith Faulkner (Diagnostic radiology)
  - Dr Mike Stabin (Nuclear medicine)
  - Dr Geoff Ibbott (Radiotherapy)

- All providers of data to UNSCEAR
  - National authorities
  - International organizations (e.g. IAEA, OECD)
  - Scientists published data

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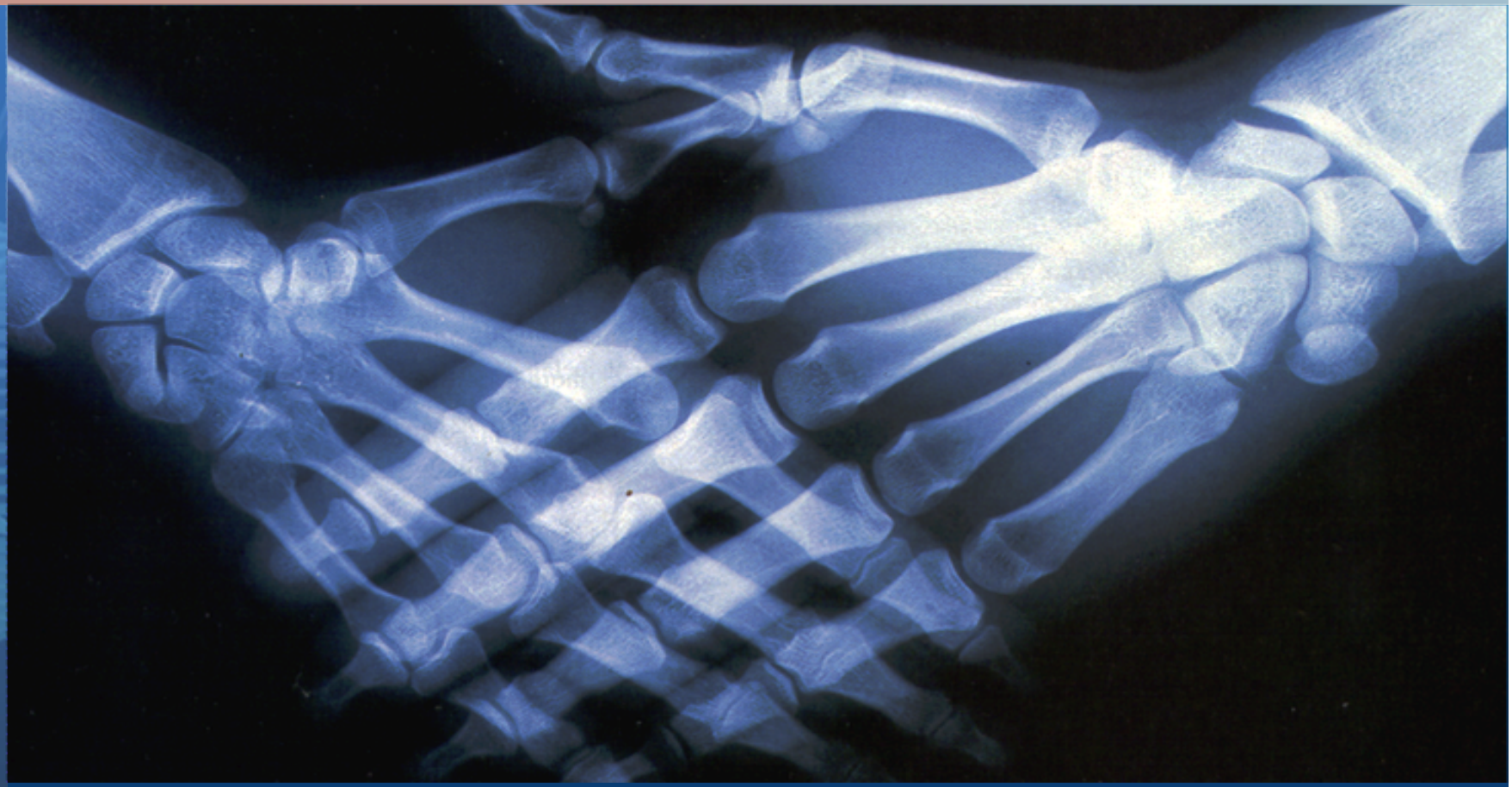
Thank you for your attention



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