Radiation Protection of Children

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IAEA

Atoms for Peace: The First Half Century
1957–2007

How radiation sensitive are children?

Statement that children are in general 3-10 times more sensitive to radiation is not correct

Radio-sensitivity of children (UNSCEAR)

- Children are clearly more radiosensitive for about 30 per cent of tumour types when compared with adults.
- These types include
  - Leukaemia
  - Thyroid
  - Skin and
  - Brain cancer.

Radio-sensitivity of children (UNSCEAR)

- They have the same sensitivity as adults when it comes to 25 per cent of tumour types such as
  - Kidney and bladder,
- They less sensitive than adults when it comes to 10 per cent of tumour types including lung cancer.

Radio-sensitivity of children (UNSCEAR)

- For about 15% of tumour types (including oesophagus cancer), the data are too weak to draw a conclusion regarding differences in risk with age at exposure. Finally, for about 20% of tumour types (including myeloma, Hodgkin's disease, kidney, prostate, rectum and uterus cancer), there is only a poor or no relation between radiation exposure and risk.

Radio-sensitivity of children: High doses

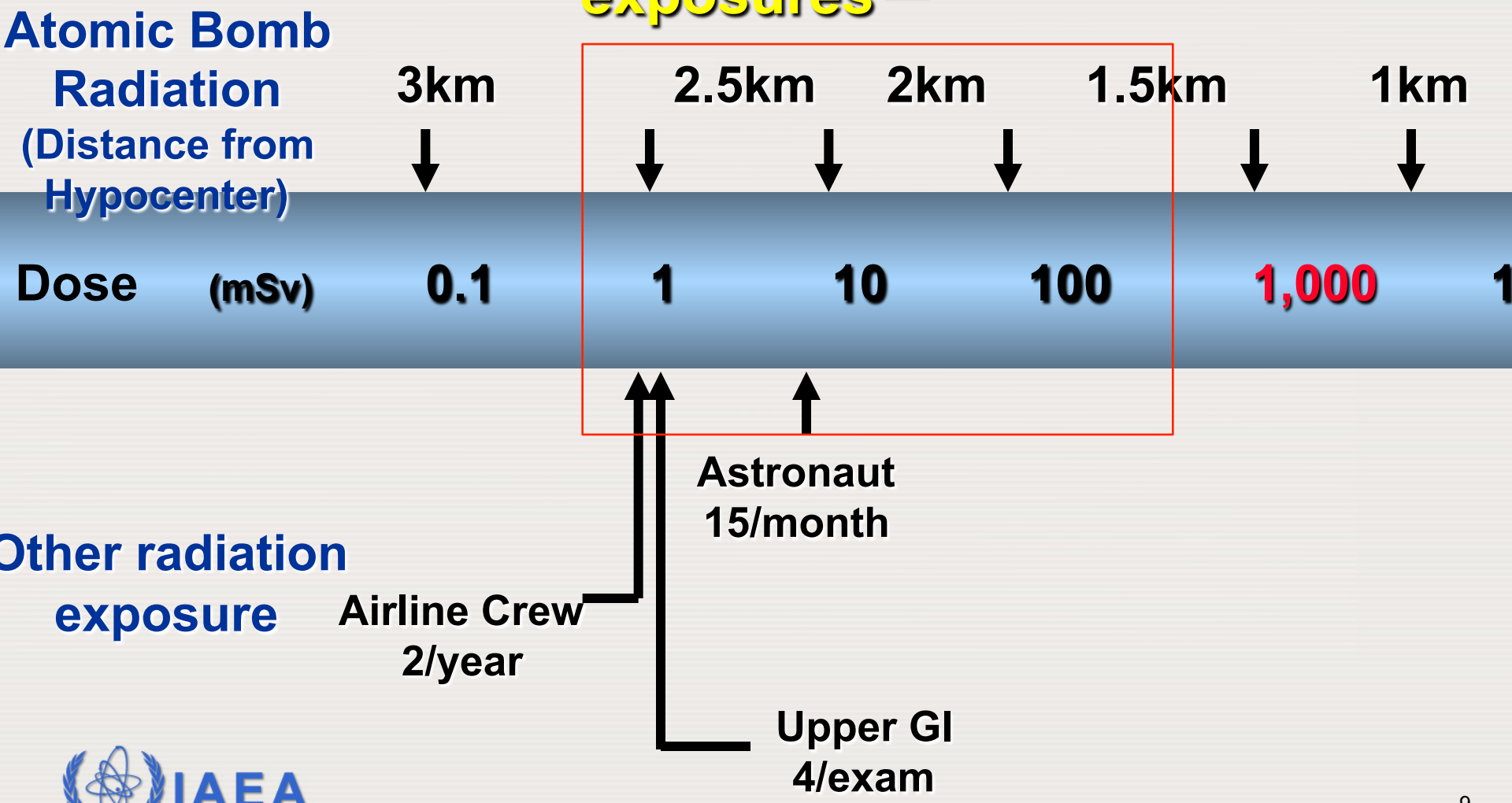
- Instances in which childhood exposure poses more risk than adult exposure (e.g. for effects in the brain, cataracts, and thyroid nodules).
- Risk appears to be about the same (e.g. neuroendocrine system and effects in the kidneys) and
- Instances where children's tissues are more resistant (lung, immune system, marrow and ovaries).

Global scenario

- ≈180 million examinations on children
- Typically ≈10% examinations are CT
  - ≈ 18 million CT examinations on children
- A single CT ≥ 5 mSv

Levels of Radiation Exposure

—Comparison between A-bomb and other exposures—



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Frequency of pediatric CT exams

95 CT facilities in 28 countries

Region	Number of CT facilities	Frequency of pediatric examinations in 2007 (%)		Frequency of pediatric examinations in 2009 (%)	
		mean	range	mean	range
Europe	30	4.6	0.1 – 18.2	4.3	0.2 – 26.8
Asia	57	9.4	0.1 – 29.0	12.2	0.1 – 49.4
Latin America	1	-	-	-	-
Africa	7	9.6	4.2 – 19.7	7.8	2.2 – 18.2
All countries	95	7.5	0.1 – 29.0	9.0	0.1 – 49.4

Children- Interventional procedure

TABLE 8: Annual Number of Diagnostic, Therapeutic, and Diagnostic and Therapeutic Procedures in Participating Hospitals That Treated Both Adult and Pediatric Patients 2006

Country	Adults	Children	Total Annual Workload	Percentage of Children in Annual Workload	Percentage of Children Compared With Adult Workload
Algeria	3,684	0	3,684	0	0
Kenya	339	138	477	28.9	40.7
Morocco	4,841	210	5,051	4.2	4.3
Sudan	3,570	189	3,759	5.0	5.3
Tunisia	4,619	252	4,871	5.2	5.5
Kuwait	5,664	288	5,952	4.8	5.1
Lebanon	3,890	18	3,908	0.5	0.5
Syria	3,941	50	3,991	1.3	1.3
Thailand	6,977	16	6,993	0.2	0.2
United Arab Emirates	527	0	527	0	0
Pakistan	12,338	989	13,327	7.4	8.0
Armenia	1,919	178	2,097	8.5	9.3
Bosnia and Herzegovina	1,106	20	1,126	1.8	1.8
Bulgaria	2,110	160	2,270	7.0	7.6
Croatia	460	0	460	0	0
Greece	5,775	966	6,741	14.3	16.7
Lithuania	8,660	30	8,690	0.3	0.3
Moldova	7,136	65	7,201	0.9	0.9
Slovenia	8,225	194	8,419	2.3	2.4
Taiikistan	310	170	480	35.4	54.8

Br J Radiol. 2012 Jan;85(1009):53-60.

Radiation exposure from CT in early childhood: a French large-scale multicentre study.

Bernier MO, Rehel JL, Brisse HJ, Wu-Zhou X, Caer-Lorho S, Jacob S, Chateil JF, Aubert B, Laurier D.

Epidemiology Department.

- **Message: Millions of Children undergoing relatively higher dose (≥5 mSv) procedures**
- **Repeat examinations, not uncommon**

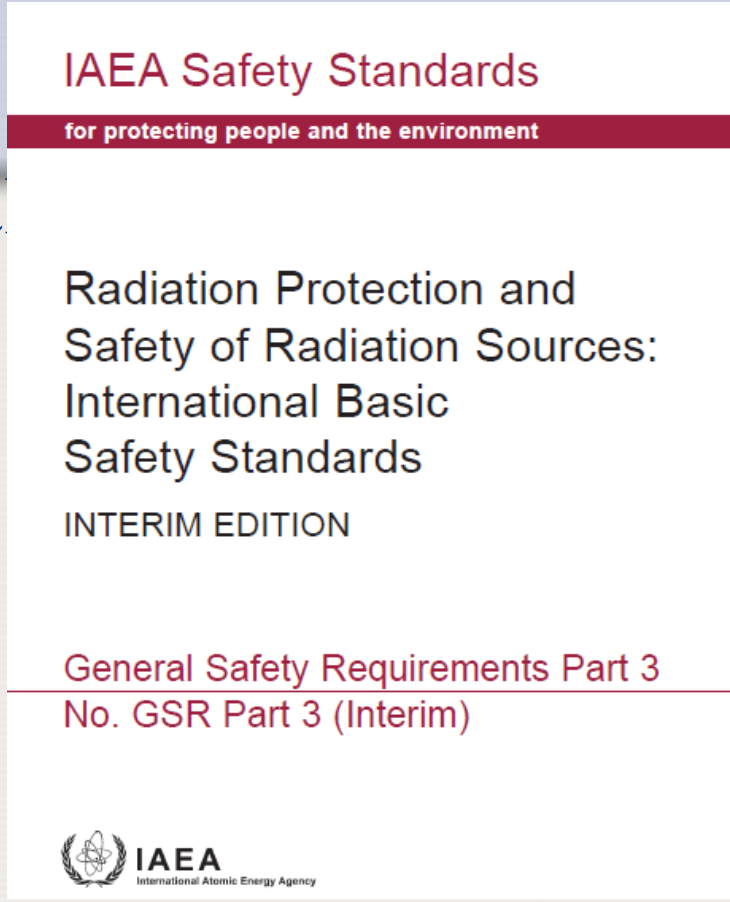
What are we doing?

Actions Taken

1. Requirements
2. Projects in countries
3. Website- specific information
4. Training material- pediatric
5. IAEA Publication
6. Networks
7. Posters

New BSS

3.156. The justification of medical exposure for an individual patient shall be carried out through consultation between the radiological medical practitioner and the referring medical practitioner, as appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or paediatric,



New BSS

3.165. Registrants and licensees shall ensure that the particular aspects of medical exposures are considered in the optimization process for:

- Paediatric patients subject to medical exposure;

Actions Taken

1. Requirements
2. Projects in countries
3. Website- specific information
4. Training material- pediatric
5. IAEA Publication
6. Networks
7. Posters

IAEA survey of practice in pediatric CT in 40 countries in Asia, Europe, Latin America, and Africa

First ever study of this kind

40 countries that are participating

Armenia,
Belarus,
Bosnia & Herz.
Brazil,
Bulgaria,
China,
Costa Rica,
Croatia,
Czech Republic,
Estonia,
Indonesia,
Iran,
Israel,
Kuwait,
Lebanon,
Lithuania,
Malaysia,
Malta,
Mexico,
Montenegro,
Moldova,
Myanmar,
Oman,
Pakistan,
Paraguay,
Peru,
Poland,
Qatar,
Serbia,
Singapore,
Slovakia,
Slovenia,
Sri Lanka
Sudan,
Syria,
Tanzania,
Thailand,
The Former Yugoslavia Republic (FYR) of Macedonia,
United Arab Emirates UAE .

Less resourced countries

IAEA Survey of Pediatric CT Practice in 40 Countries in Asia, Europe, Latin America, and Africa: Part I, Frequency and Appropriateness

AJR FOCUS ON:

Jenia Vassileva[1]
Madan M. Rehani[2]
See end of article for complete author list

OBJECTIVE. The purpose of this study was to assess the frequency of pediatric CT in 40 less-resourced countries and to determine the level of appropriateness in CT use.

MATERIALS AND METHODS. Data on the increase in the number of CT examinations during 2007 and 2009 and appropriate use of CT examinations were collected, using standard forms, from 146 CT facilities at 126 hospitals.

Eur Radiol
DOI 10.1007/s00330-012-2639-3

COMPUTED TOMOGRAPHY

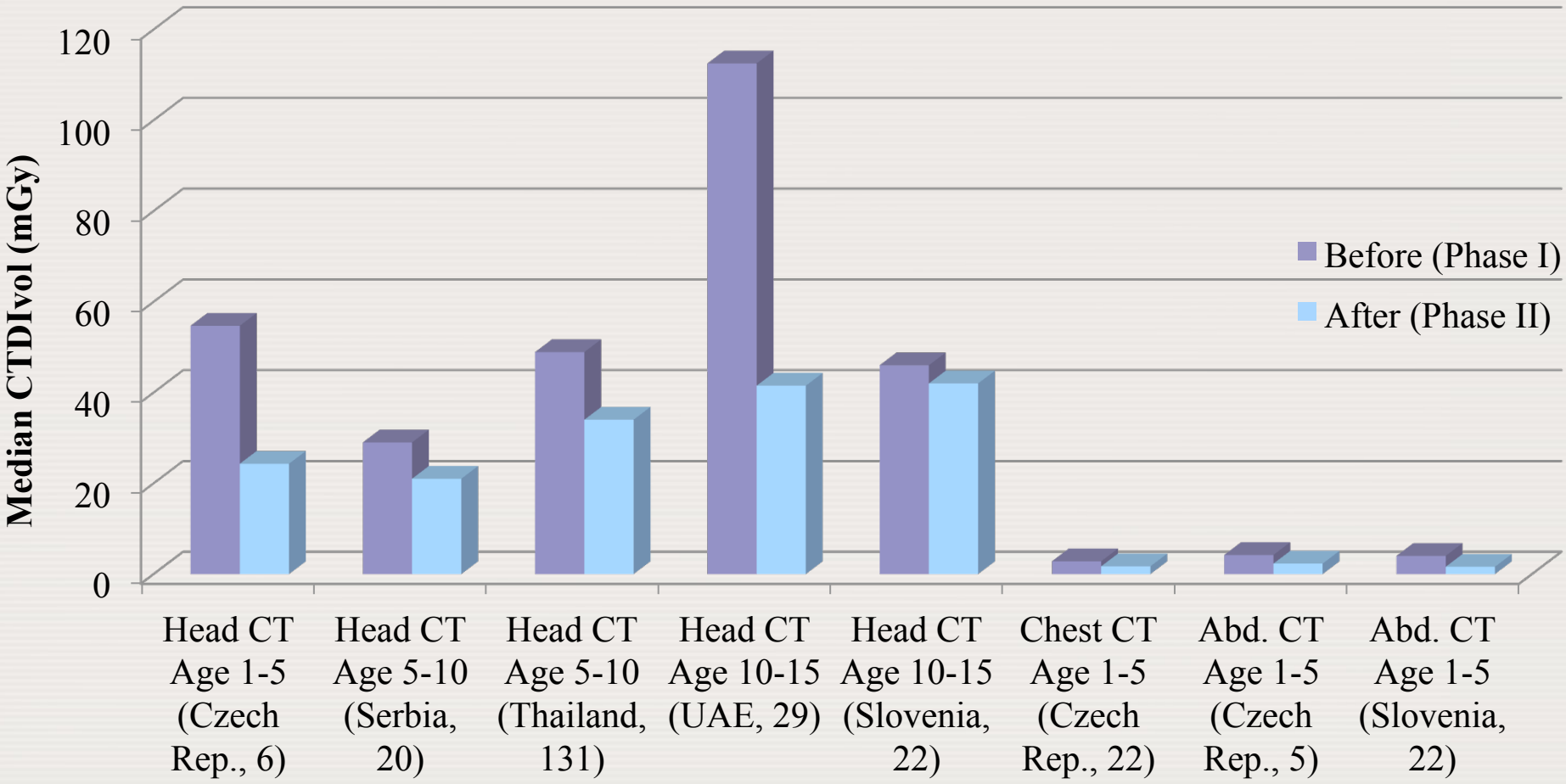
IAEA survey of paediatric computed tomography practice in 40 countries in Asia, Europe, Latin America and Africa: procedures and protocols

Jenia Vassileva · Madan M. Rehani · Kimberly Applegate · Nada A. Ahmed · Humoud Al-Dhuhli · Huda M. Al-Naemi

Findings from these papers

- Modern MDCT available in 77%
- Dedicated CT protocols in 94%
- Protocols for some age groups not available 50%
- Indication based protocols used in 57%
- $CTDI_{vol}$ for head, chest in some facilities 2-5 times adults
- Up to 100 times variation in radiation dose

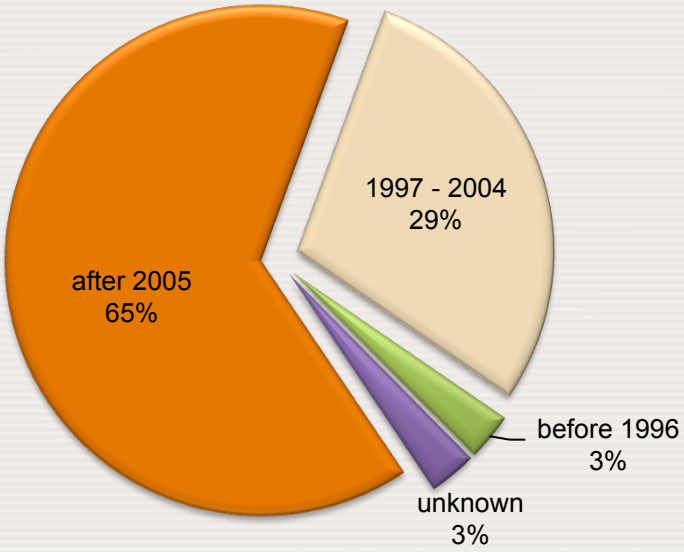
Impact of optimization



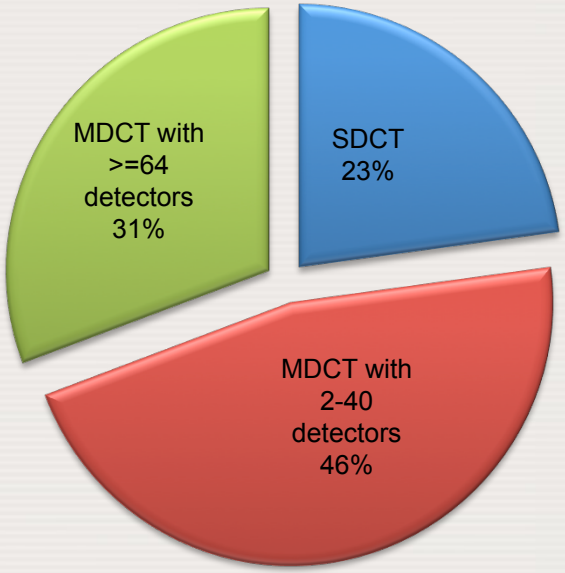
IAEA Survey in 40 countries

CT equipment

Year of installation



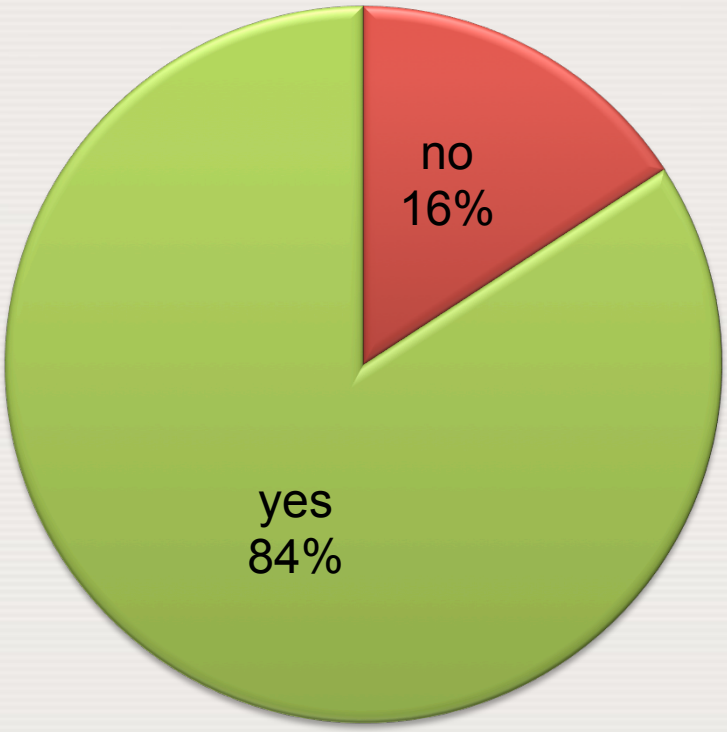
Number of detector rows



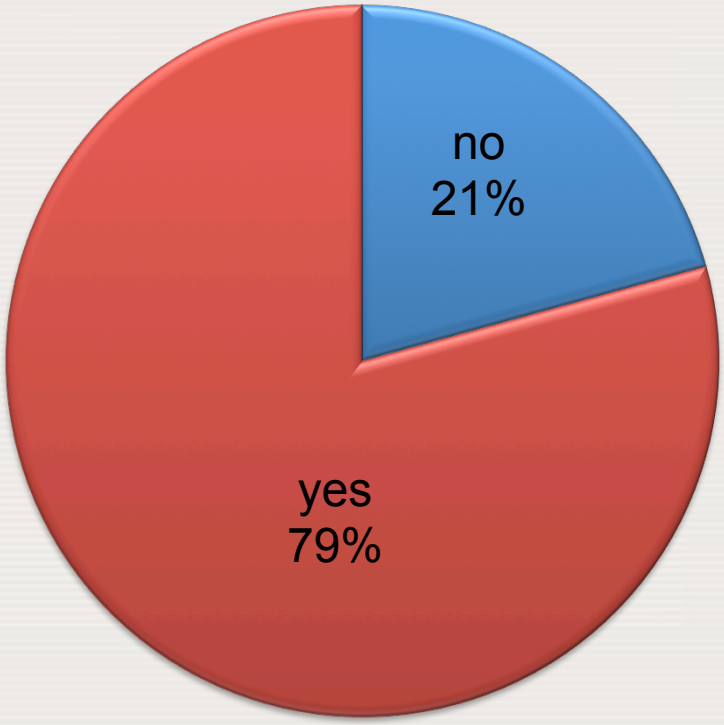
IAEA Survey in 40 countries

- CT equipment

AEC available?



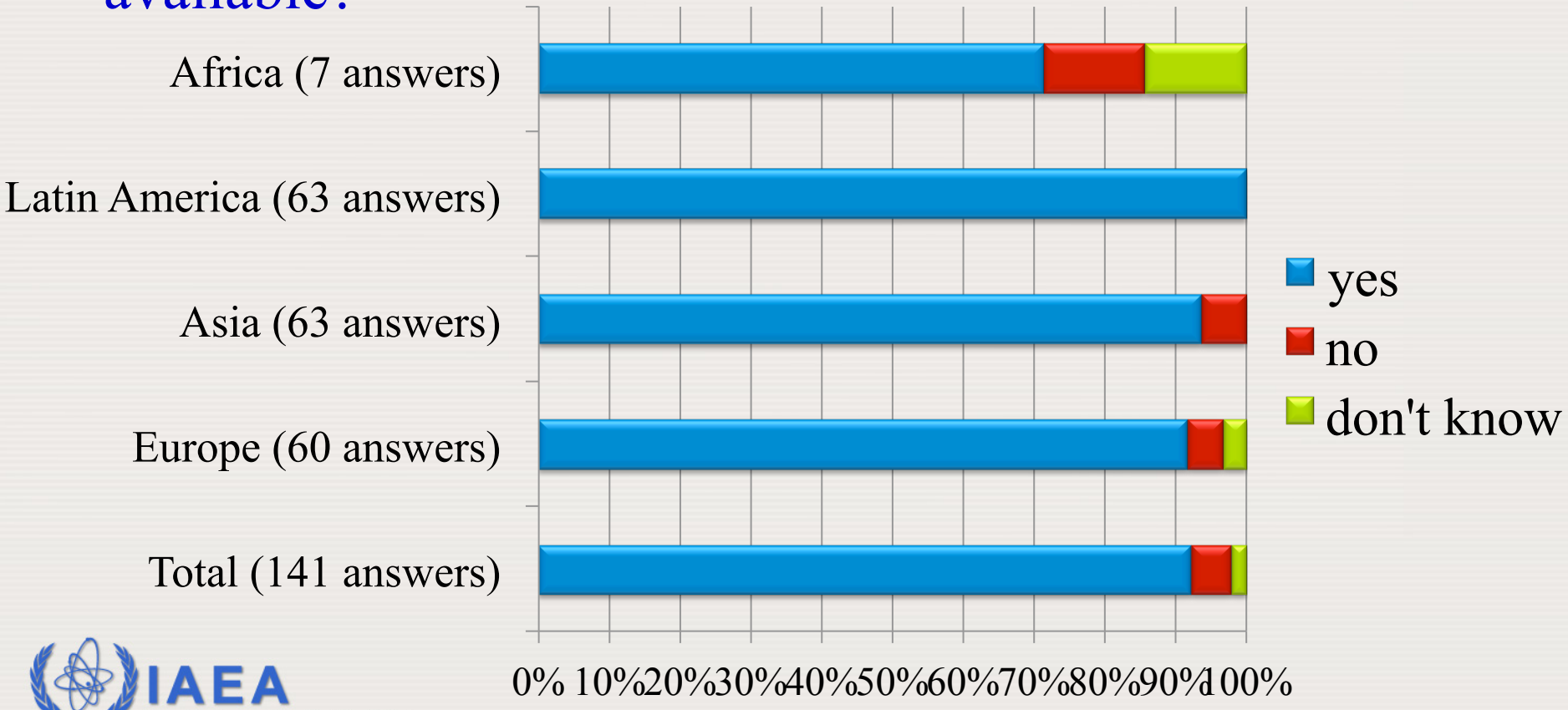
Dose display available?



IAEA Survey in 40 countries

- **141 radiologographers/ technologists answered**

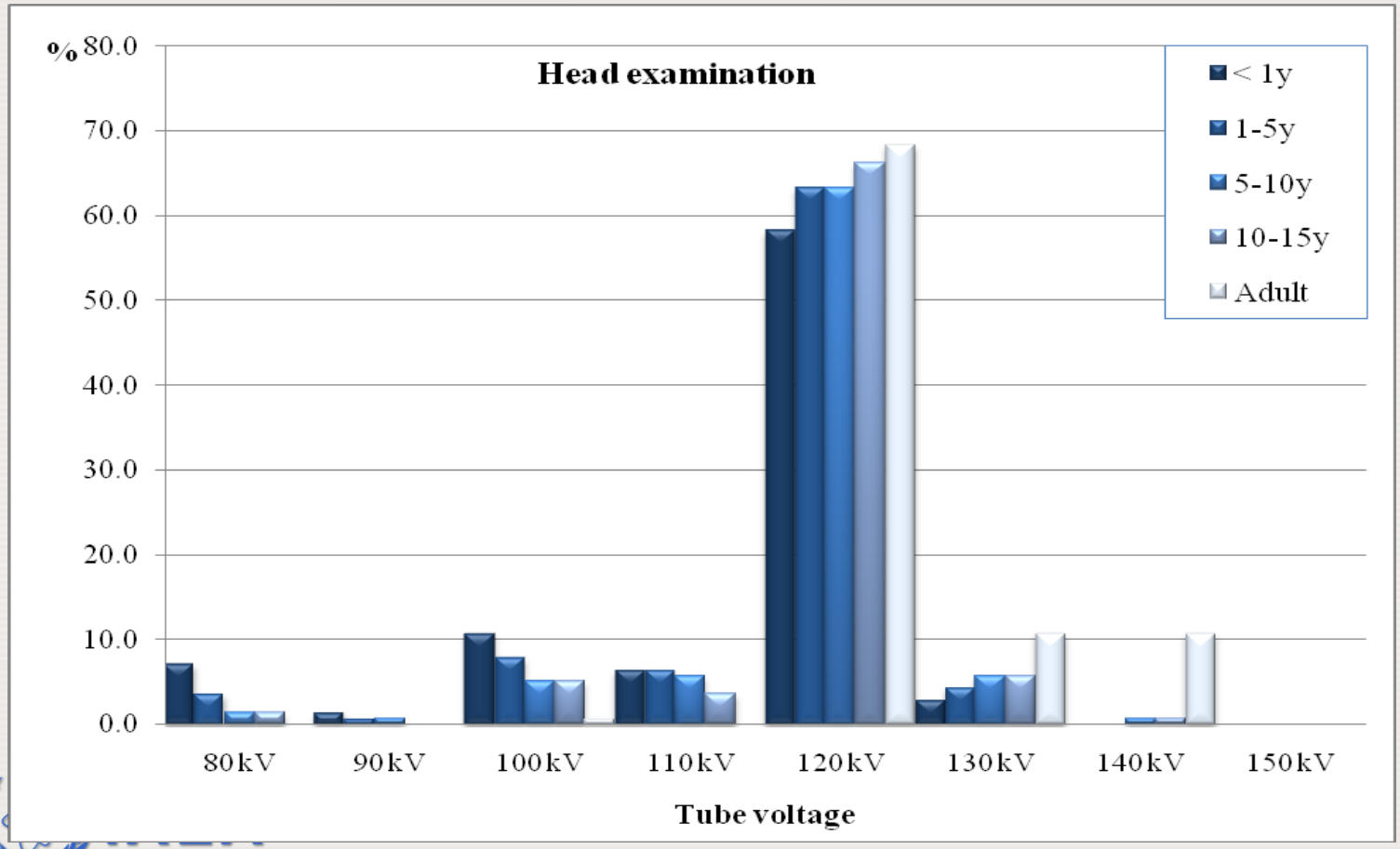
  Dedicated scanning protocols for pediatric examinations available?



IAEA Survey in 40 countries

Most commonly used kVp=**120**

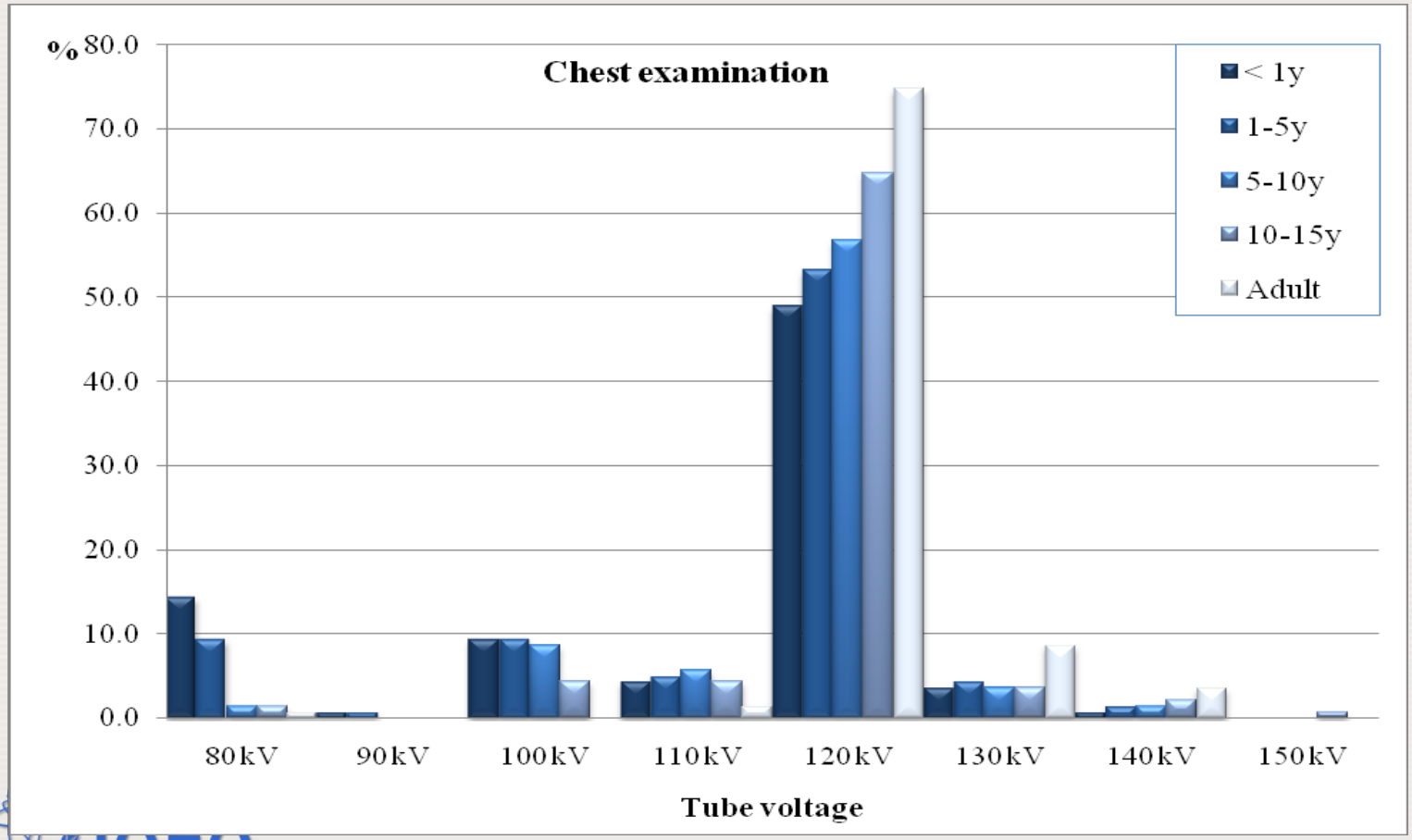
- Head CT



IAEA Survey in 40 countries

Most commonly used kVp=120

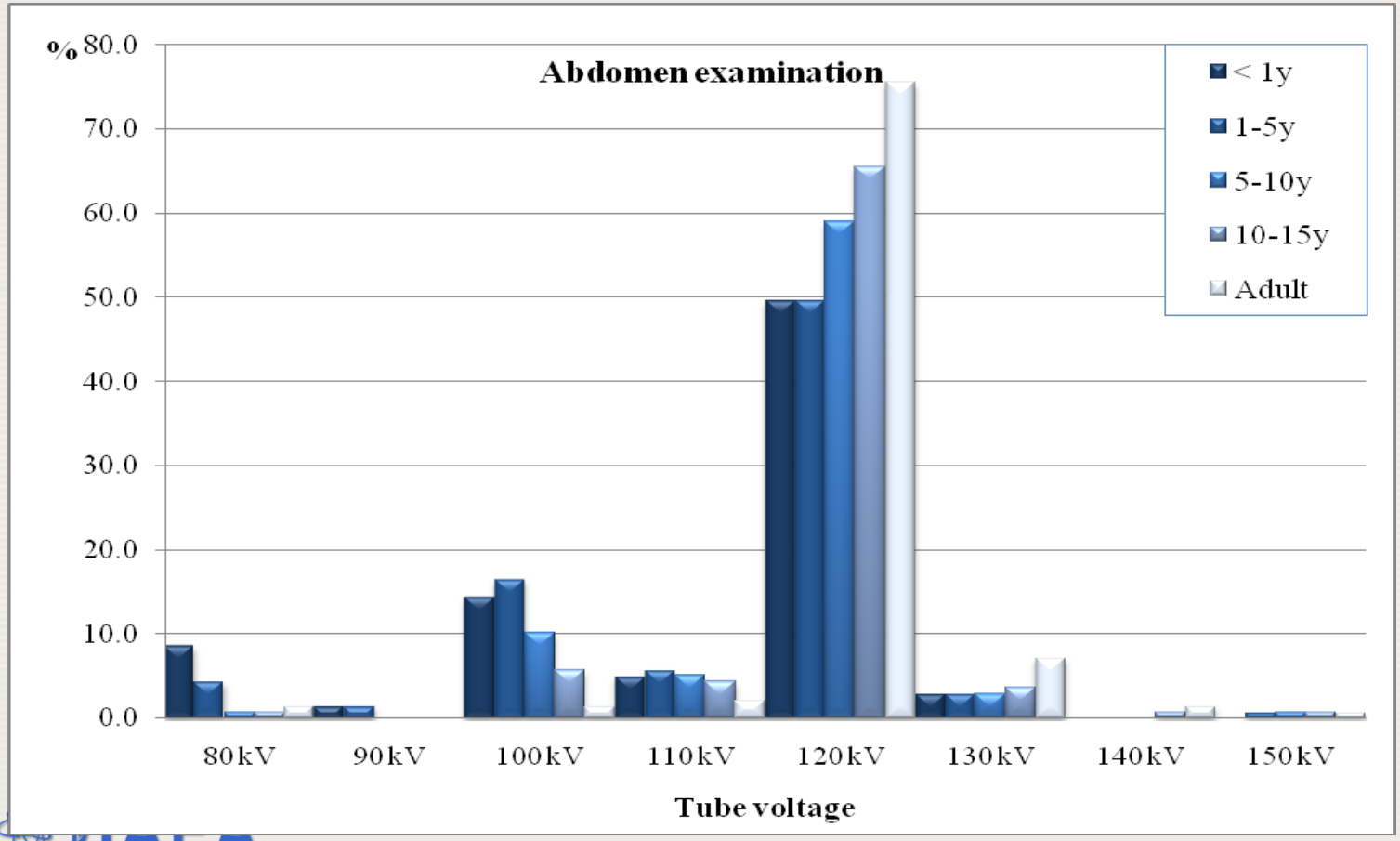
Chest CT



IAEA Survey in 40 countries

Most commonly used kVp=120

Abdomen CT



RESULTS: Typical exposure parameters

$CTDI_{vol}$ – Head examination

		< 1y	1-5y	5-10y	10-15y	Adult
CTDIvol (mGy)	min	2.3	2.7	5.0	14.5	4.5
	max	97	115	159	250	280
	average	25	33	41	52	67
	median	23	30	36	42	59
	3d quarter	29	38	48	59	75
DRL in $CTDI_{vol}$ (mGy)	UK, 2005	30	45	50	-	65
	Switzerland, 2008	20	30	40	60	
	Germany, 2007	33	40	50	60	
	France, 2009	30	40	50	-	

RESULTS: Typical exposure parameters

$CTDI_{vol}$ – Chest examination

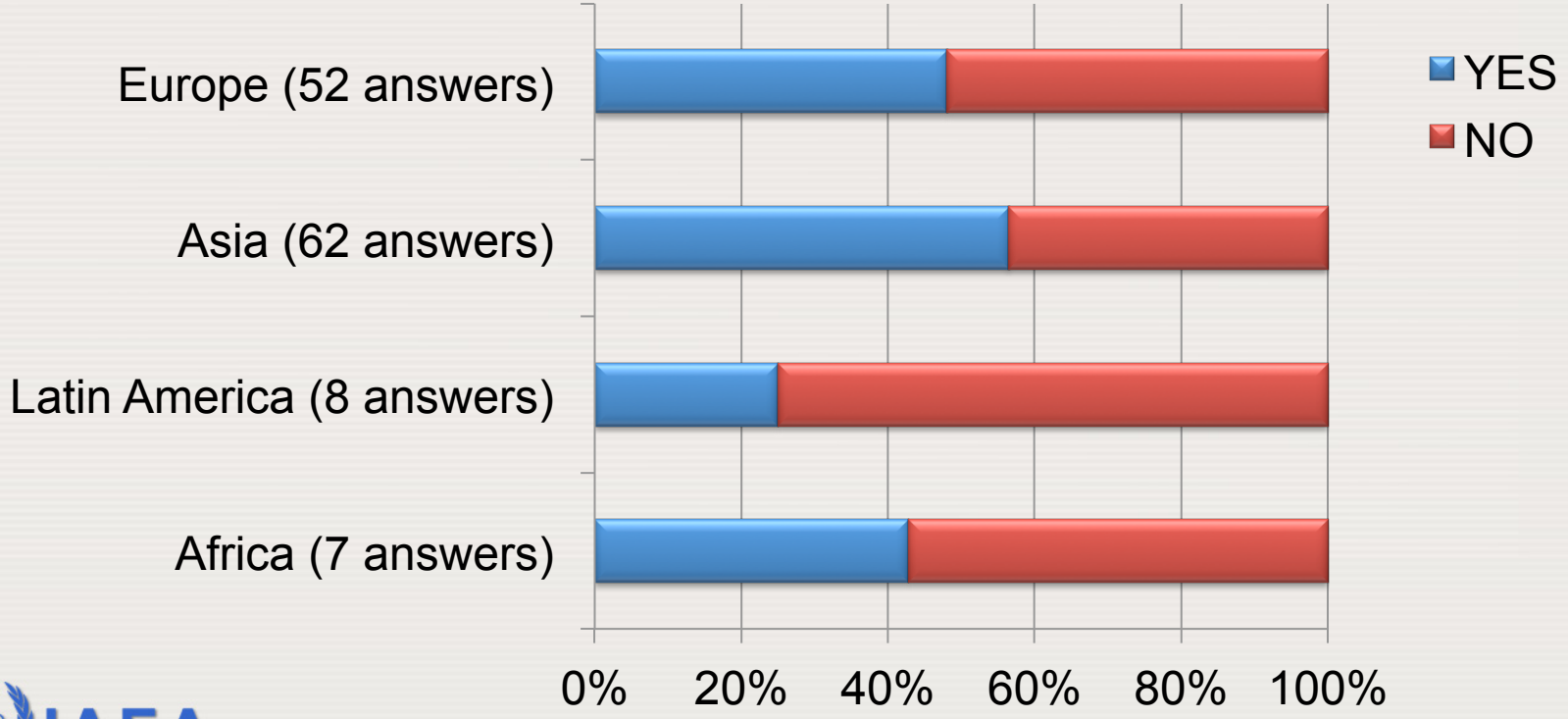
		< 1y	1-5y	5-10y	10-15y	Adult
CTDIvol (mGy)	min	0.4	0.5	0.5	0.5	4.7
	max	28.4	21.3	27.4	39.9	39.9
	average	5.2	6.0	7.3	9.9	12.3
	median	3.2	4.3	5.4	7.3	10.5
	3d quarter	6.8	7.3	9.3	13.0	15.5
DRL in $CTDI_{vol}$ (mGy)	UK, 2005	12*	13*	20*	-	-
	Switzerland, 2008	5	8	10	12	-
	Germany, 2007	1.7	2.7	4.3	6.8	-
	France, 2009	3	3.5	5.5	-	-

*DRLs in $CTDI_{vol,16}$

QUESTIONNAIRE - RADIOLOGIST

- **129 radiologists answered**

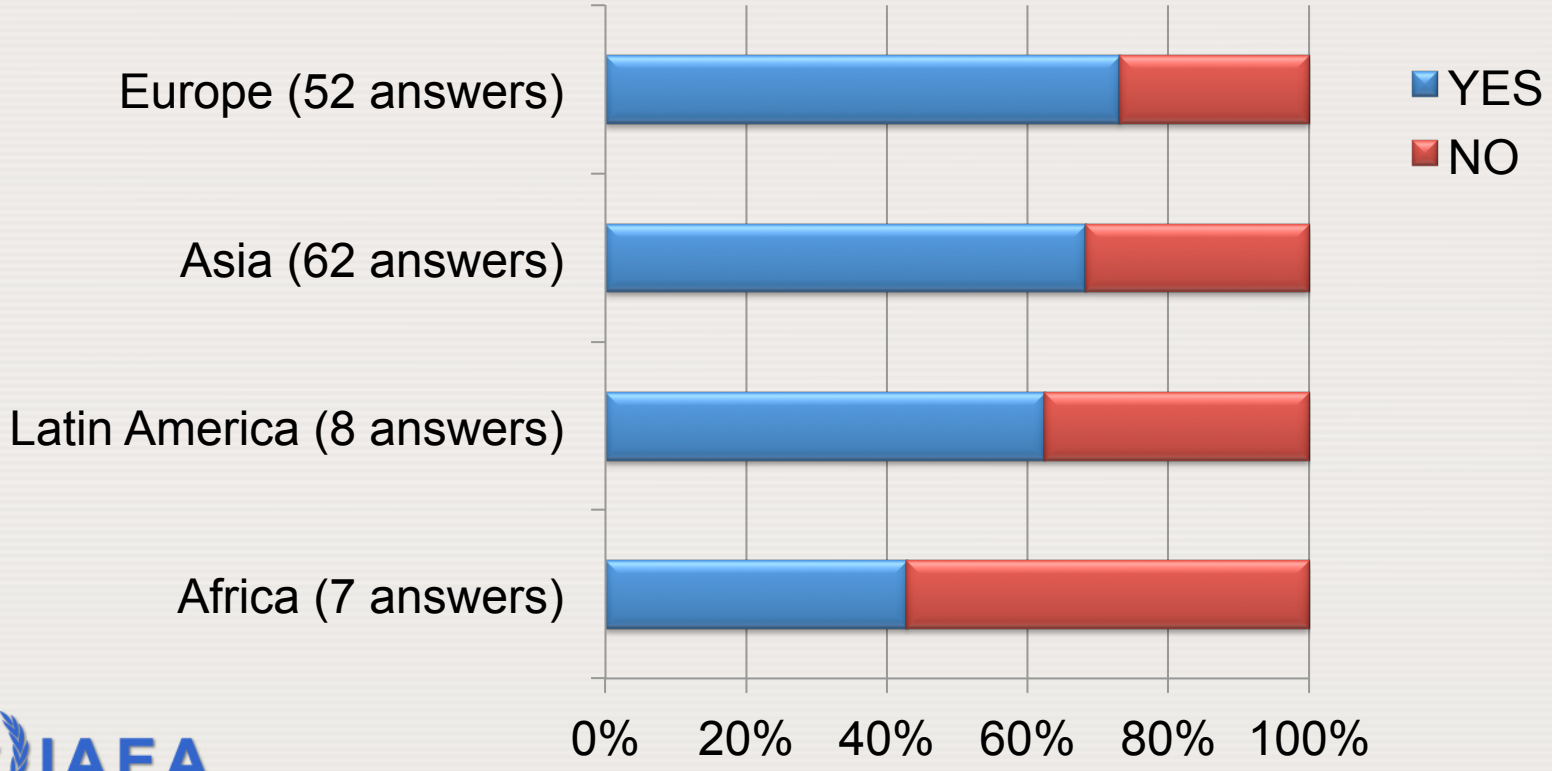
Are written referral guidelines for imaging available in your hospital?



Lack of availability of previous images

- **127 radiologists answered**

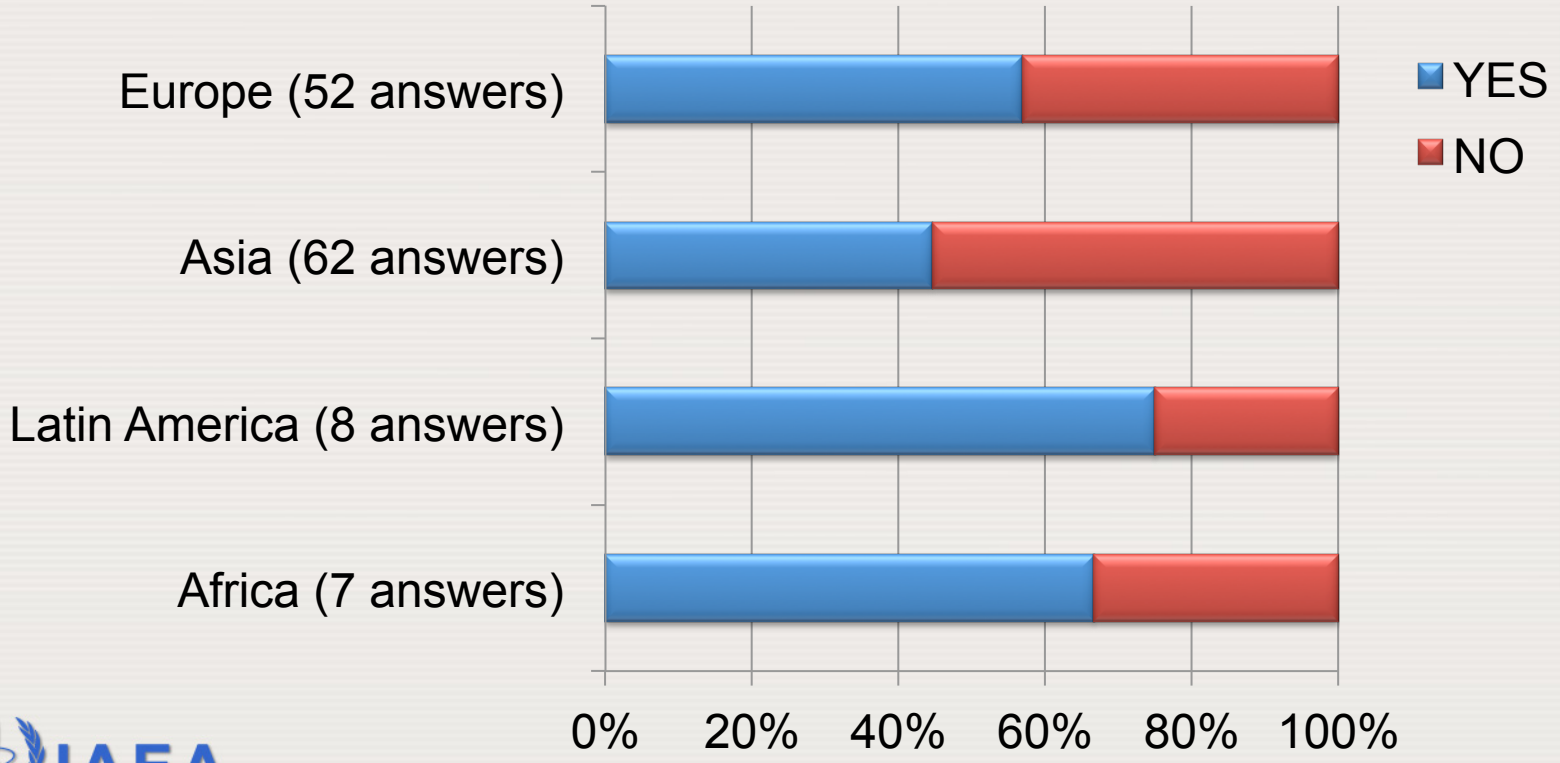
3. Are previous images and/or patient dose records required when refereeing to CT?



QUESTIONNAIRE - RADIOLOGIST

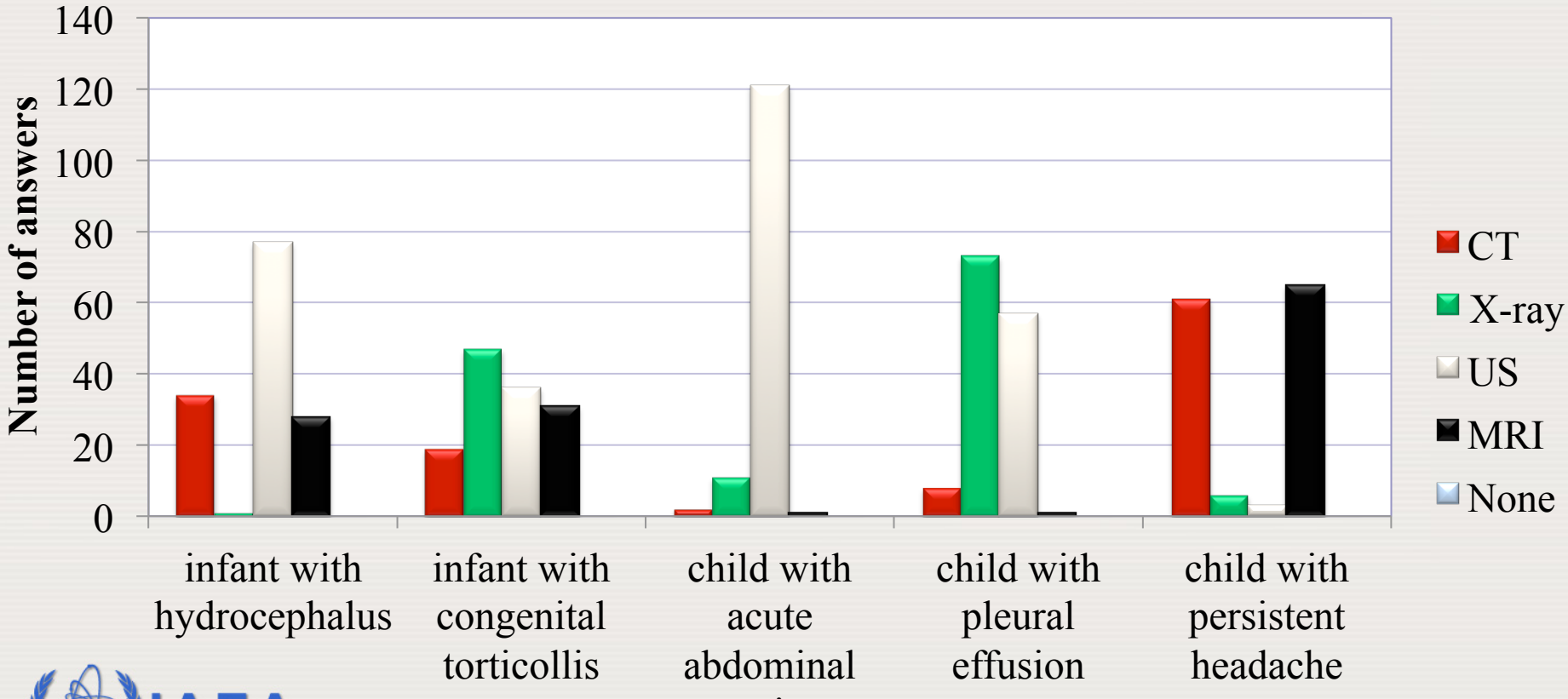
- **129 radiologists answered**

4. Is head CT mandatory for a pediatric patient with an accidental head trauma?



Appropriateness Issues

Which examination is " the first choice examination" in case of:



Appropriateness Issues

Not according to available guidelines in

- Accidental head trauma, (not in about 50%. Minor trauma and suspected abuse)
- Infants with congenital torticollis;
- Children with possible ventriculo-peritoneal shunt malfunction and
- Young children (<5 years old) with acute sinusitis.
- _____

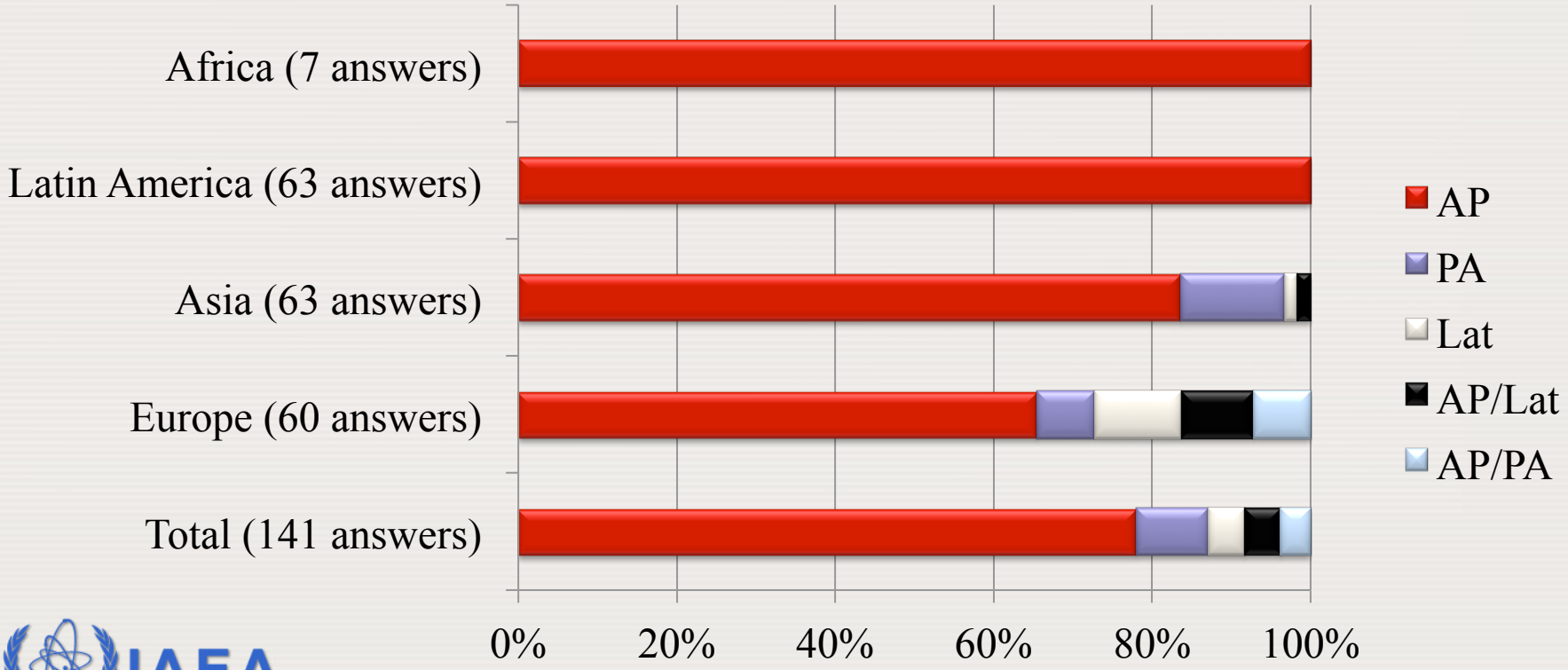
Mostly according to guidelines

- Infant with hydrocephalus (76% use other than CT)
- Child with indication for appendicitis (acute abdominal pain)
- Child with persistent headache

IAEA Survey in 40 countries

- **141 radiologographers/ technologists answered**

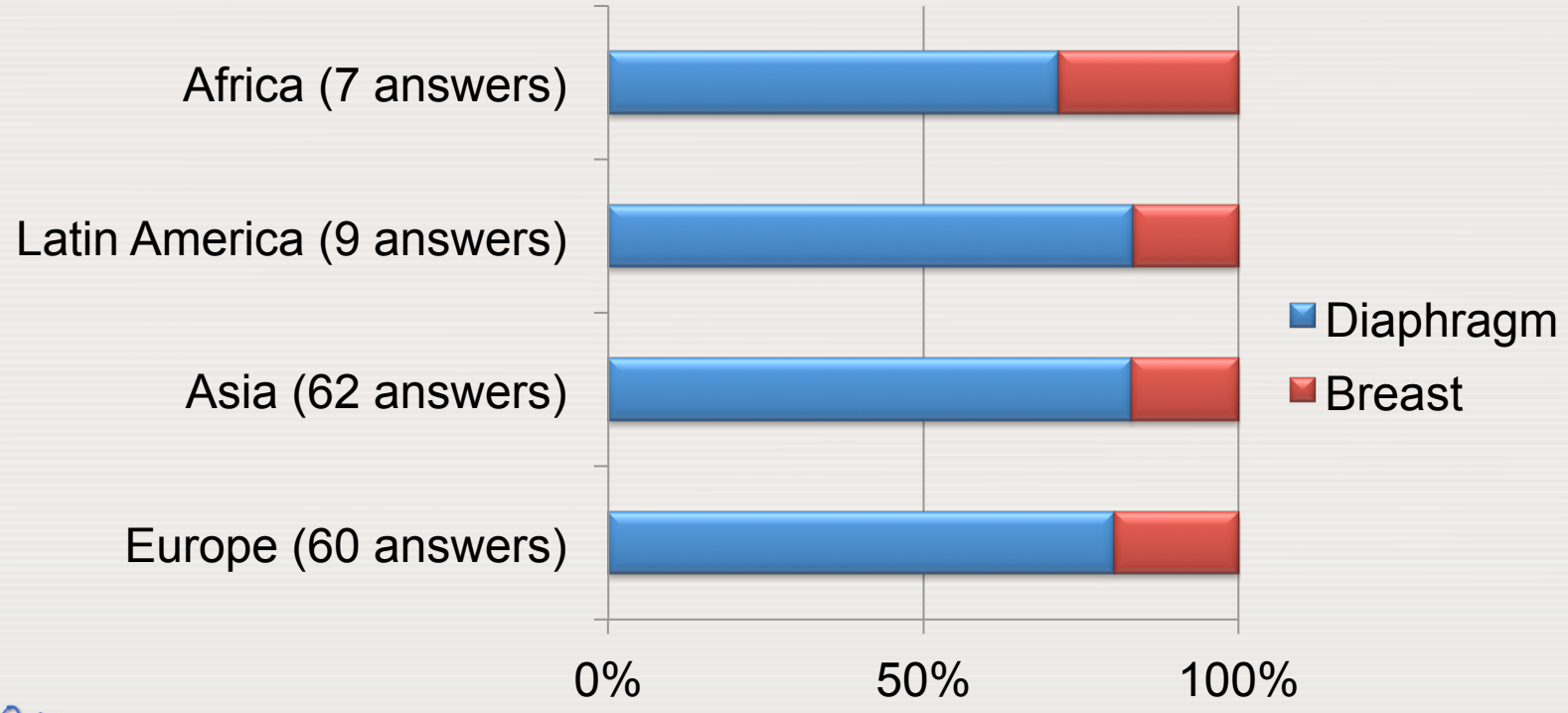
  Scout image for pediatric patient is performed usually in PA or AP projection?



QUESTIONNAIRE - RADIOGRAPHER

- **138 radiolographers/ technologists answered**

  Is typical scout image and CT scan of the pediatric abdomen extend to the breast (B) or to diaphragm (D)?



Frequency of pediatric CT exams

95 CT facilities in 28 countries

Region	Number of CT facilities	Frequency of pediatric examinations in 2007 (%)		Frequency of pediatric examinations in 2009 (%)	
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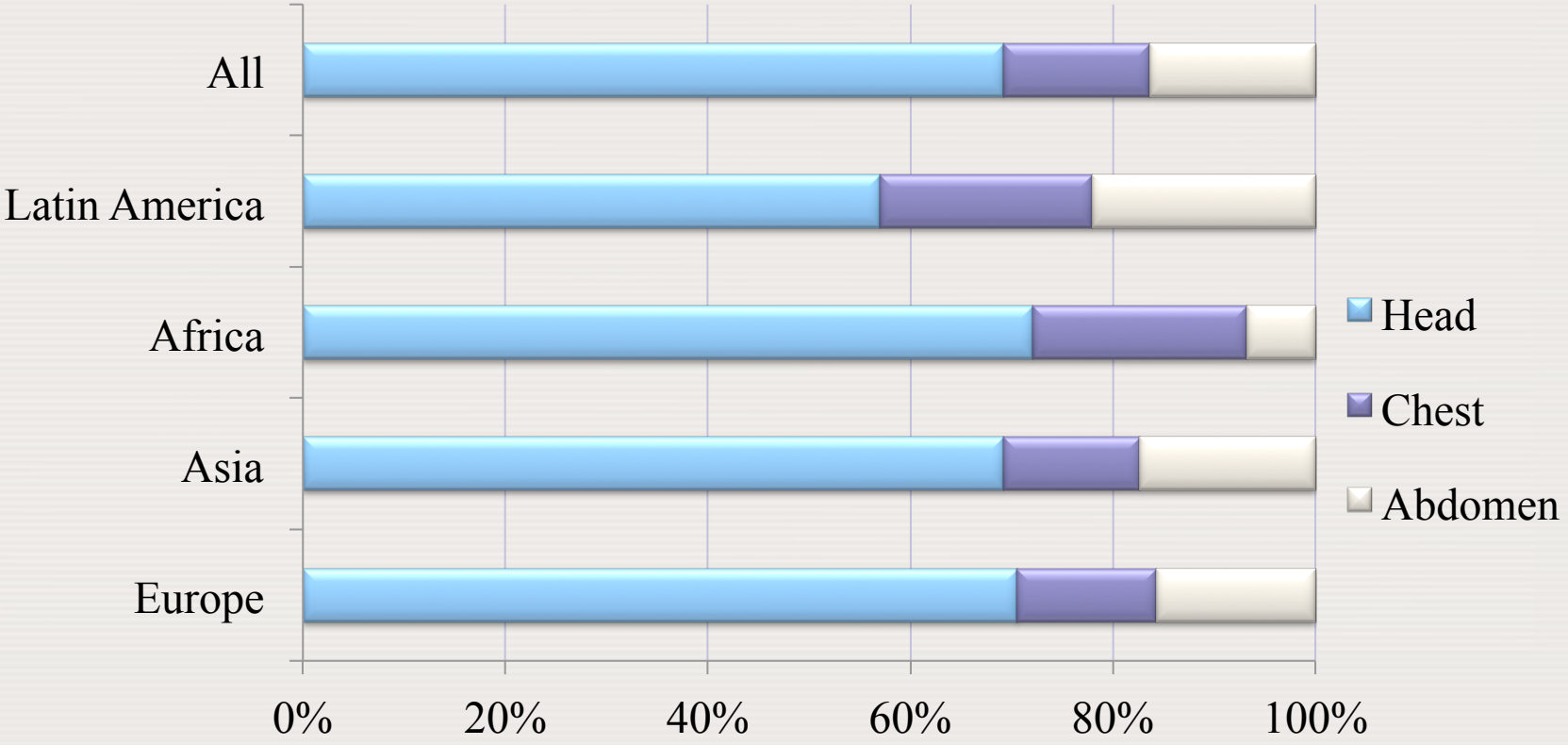
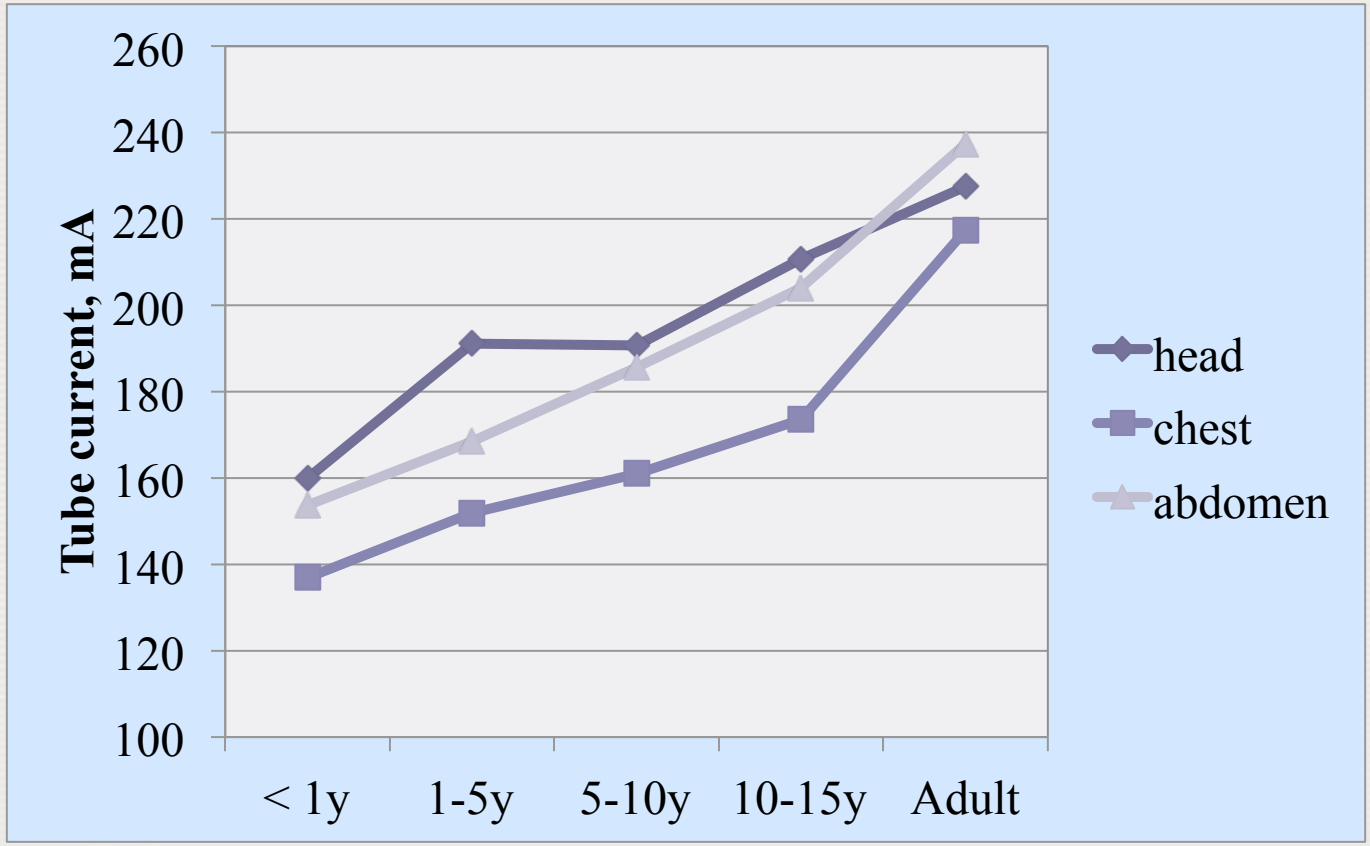
Frequency of pediatric CT exams

Frequency distribution of pediatric CT exams of head, chest and abdomen in 98 facilities in 30 countries in 2009



RESULTS: Typical exposure parameters

Mean values of tube current utilized for head, chest and abdomen exams in function of patient age



Results: Typical exposure parameters

Protocols for **head examination** of infant (<1 y) in 8 CT facilities with the same 64-detector scanner model (Light Speed VCT, GE)

Scanner number	mode	Tube voltage, kV	Tube current, mA	t rot, s	Pitch value	$CTDI_{vol}$, mGy
39	helical	100	100	0.5	0.531	10.36
40	axial	120	125	1	NA	22.19
102	axial	120	240	0.5	NA	21.31
26	helical	100	50-250	0.8	0.531	29.16
29	axial	120/100	200/130	1	NA	24/16
8	axial	80	200	0.8	NA	6
124	axial	120	240	0.5	0.5	21.31
119	helical	120	80	0.6	0.9	10

5-fold variation

Results: Typical exposure parameters

Protocols for **chest examination** of infant (<1 y) in 8 CT facilities with the same 64-detector scanner model (Light Speed VCT, GE)

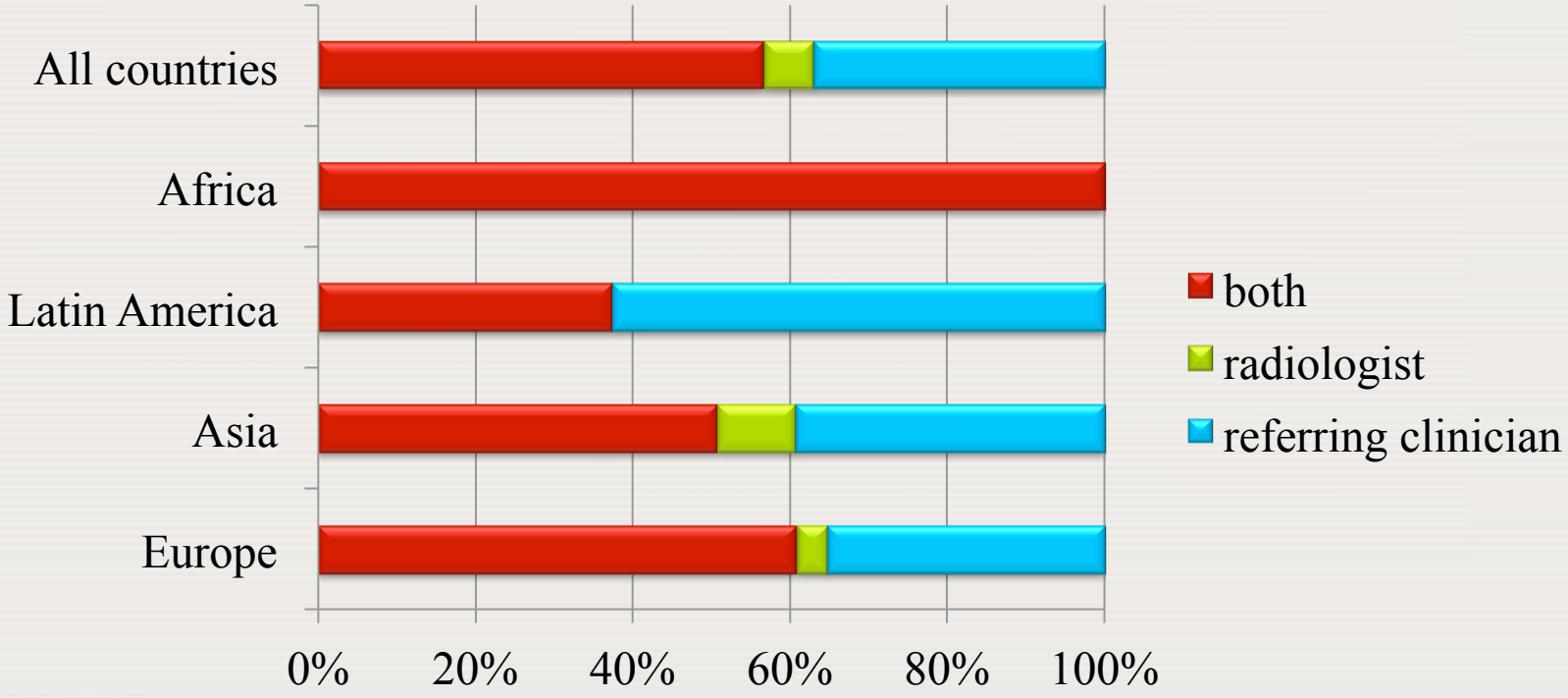
Scanner number	mode	Tube voltage, kV	Tube current, mA	t rot, s	Pitch value	$CTDI_{vol}$, mGy
39	helical	80	129	0.5	1.3	1.89
40	helical	120	120	0.5	0.984	10.21
102	helical	80	240	0.5	0.984	2.64
26	helical	80	100-250	0.5	0.96	4.26
29	helical	100	180	0.4	0.98	3.2
8	helical	120	80	0.4	1.375	4.5
124	helical	80	25	0.5	0.9	0.71
119	helical	120	80	0.6	0.9	10

14.5-fold variation

QUESTIONNAIRE - RADIOLOGIST

- **129 radiologists answered**

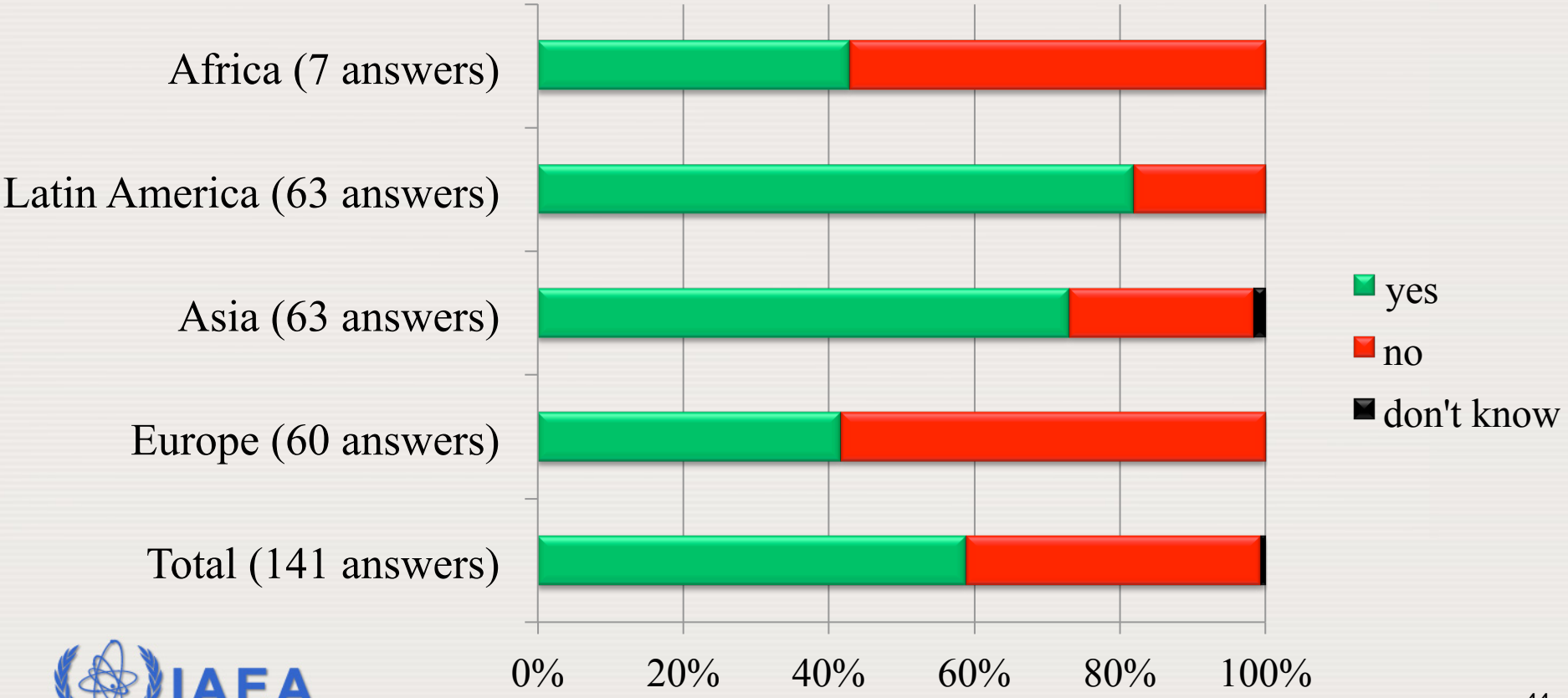
Who decides whether a CT examination of pediatric patient is to be performed?



IAEA Survey in 40 countries

- **141 radiologographers/ technologists answered**

  Indication based protocols available?



IAEA Survey in 40 countries

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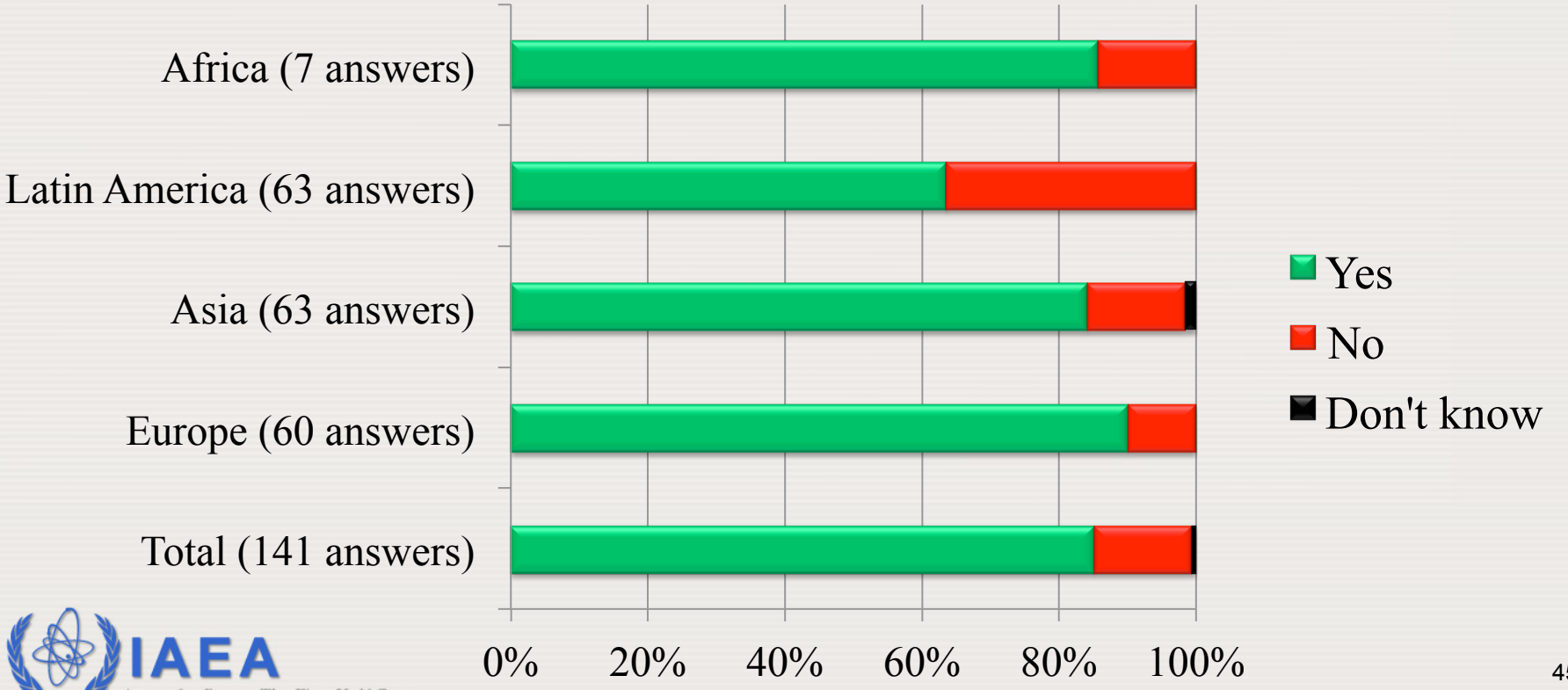
  Are any immobilization means available, e.g. swaddling clothes, straps, etc.?



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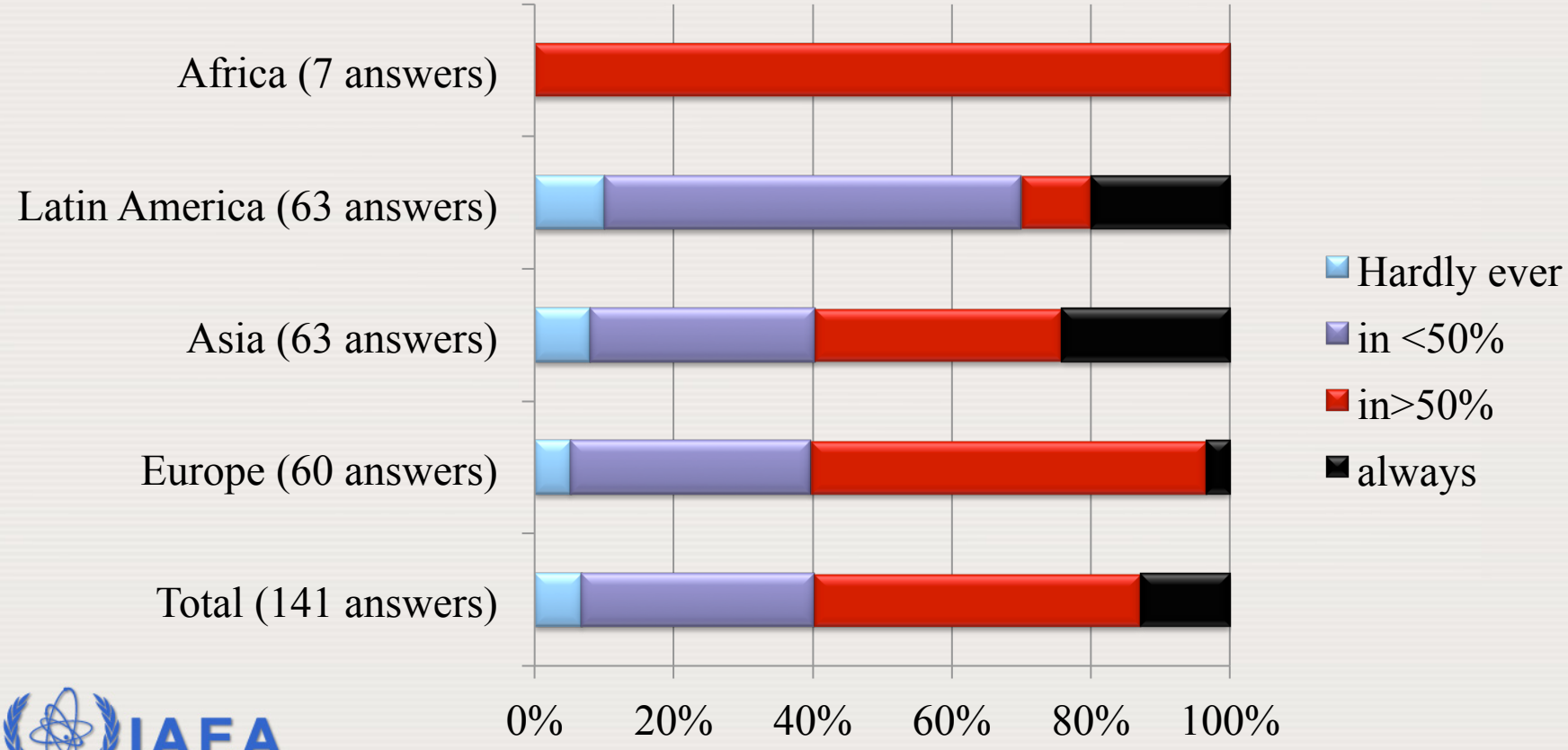
1957–2007

IAEA Survey in 40 countries

- **141 radiologographers/ technologists answered**

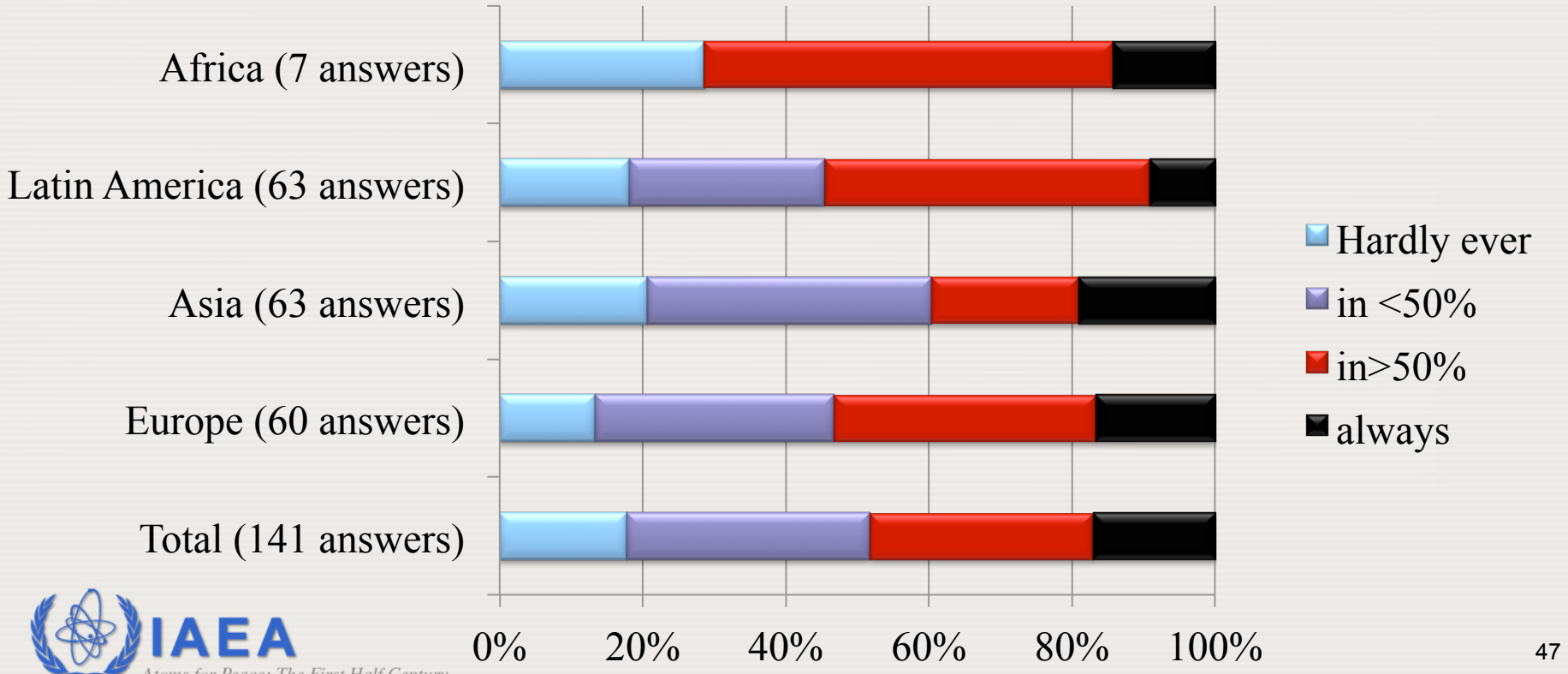
  How often is sedation used for small children (< 5 y old)?



IAEA Survey in 40 countries

- **141 radiolographers/ technologists answered**

  How often does CT examination of pediatric patient need supporter in the room?



IAEA Survey in 40 countries

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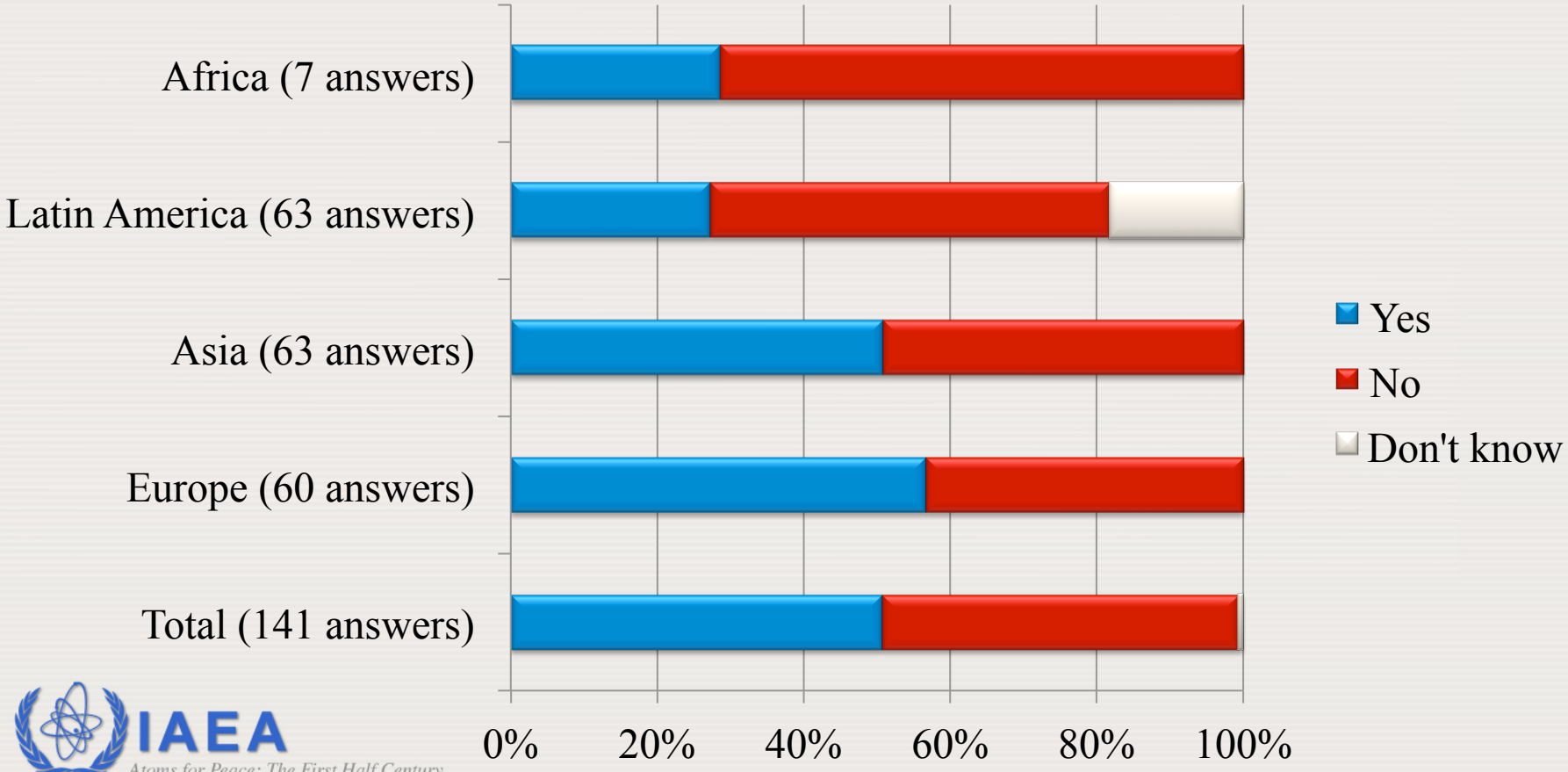
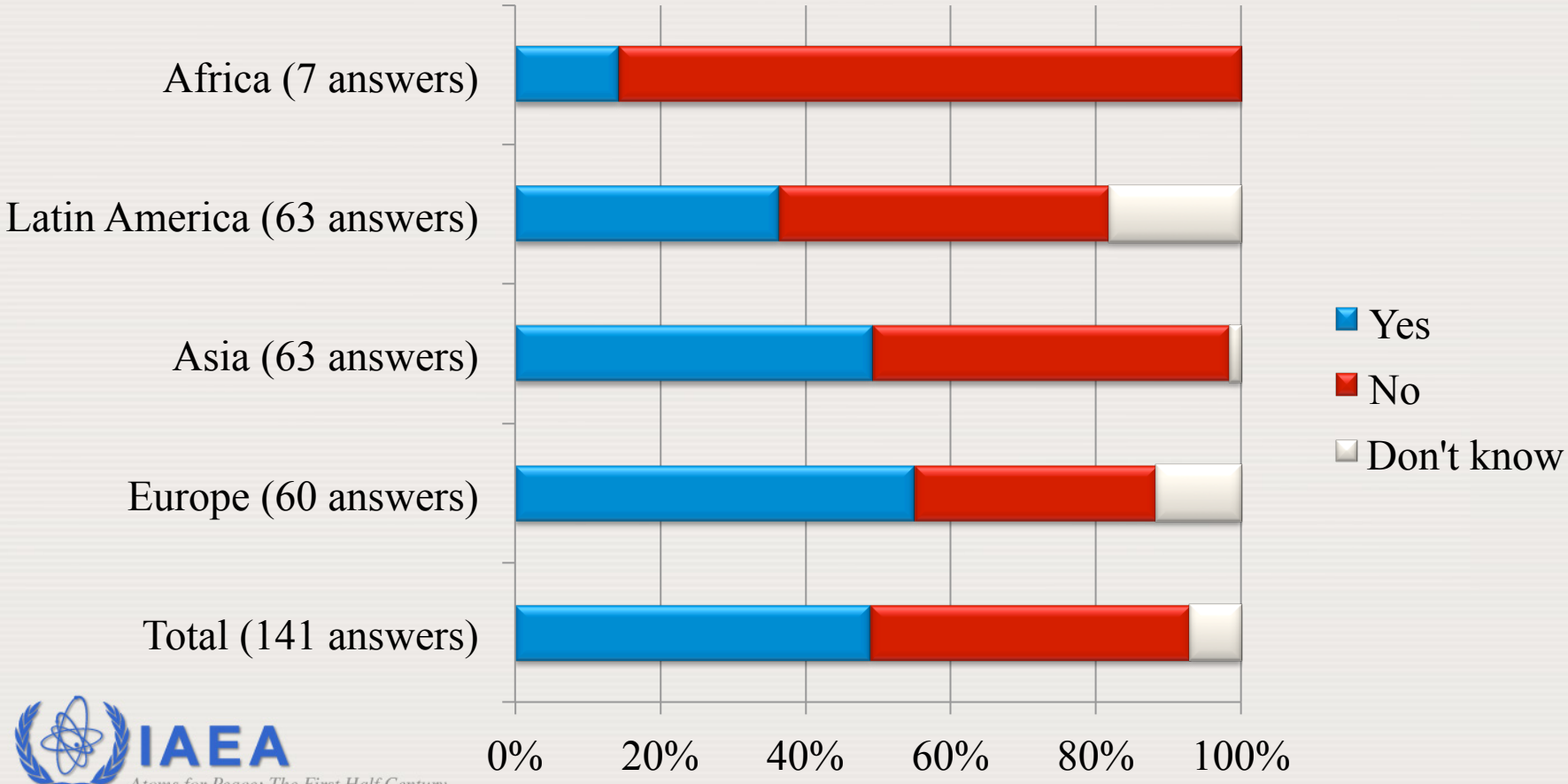
  Is a medical physicist available?



IAEA Survey in 40 countries

- **141 radiologographers/ technologists answered**

  Do you keep records of patient doses?



Results: Typical exposure parameters

- In 8.2% of the scanners CTDI values for pediatric patients were higher than for adults in at least one age group and one examination.
- In 40% facilities the scanning protocols were not adapted to the body size.
- In 13% of them the same protocol was used for all age groups.

Radiation Protection Dosimetry Advance Access published August 17, 2009

Radiation Protection Dosimetry (2009), pp. 1–9 doi:10.1093/rpd/ncp144

PATIENT DOSES IN CT EXAMINATIONS IN 18 COUNTRIES: INITIAL RESULTS FROM INTERNATIONAL ATOMIC ENERGY AGENCY PROJECTS

W. E. Muhogora[1], N. A. Ahmed[2], A. Beganovic[3], A. Benider[4], O. Ciraj-Bjelac[5], V. Gershan[6], E. Gershkevitsh[7], E. Grupetta[8], M. H. Kharita[9], N. Manatrakul[10], M. Milakovic[11], K. Ohno[12], L. Ben Omrane[13], J. Ptacek[14], C. Schandorf[15], M. S. Shabaan[16], D. Stoyanov[17], N. Toutaoui[18], J. S. Wambani[19] and M. M. Rehani[20,*]

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[13]Center National de Radioprotection, Hospital d'Enfants, Place Bab, Saadoun, 1006 Tunis, Tunisia
[14]Department of Medical Physics and Radiation Protection, University Hospital Olomouc, I.P. Pavlova 6,

PAEDIATRIC CT EXAMINATIONS IN NINETEEN DEVELOPING COUNTRIES: FREQUENCY AND RADIATION DOSE

PAEDIATRIC CT EXAMINATIONS IN DEVELOPING COUNTRIES

W.E.Muhogora[1], N. A. Ahmed[2], J.S. AlSuwaidi[3], A. Beganovic[4], O Ciraj-Bjelac[5], V. Gershan[6], E. Gershkevitsh[7], E. Grupetta[8], M. H Kharita[9], N. Manatrakul[10], B. Maroufi[11], M. Milakovic[12], K. Ohno[13], L. Ben Omrane[14], J. Ptacek[15], C.Schandorf[16], M. S. Shaaban[17], N. Toutaoui[18], D.Sakkas[19], J. S. Wambani[20] and M. M. Rehani[21]*

- **28 countries, but dose information from 19 countries of Africa, Asia and Eastern Europe**
- **The frequency of paediatric CT examinations was 20% (Africa), 16% (Asia) and 5% (E. Europe) of all CT examinations in participating centres**
- **Eleven CT facilities in six countries were found to use adult CT exposure parameters for paediatric patients**
- **The CTDIw variations ranged up to a factor of 55 (Africa), 16.3 (Asia) and 6.6 (Eastern Europe).**
- **The corresponding DLP variations ranged by a factor of 10, 20 and 8 respectively.**
- **Generally, the CTDIw and DLP values in Japan are lower than corresponding values in three regions in this study.**

Actions Taken

1. Requirements
2. Projects in countries
3. Website- specific information
4. Training material- pediatric
5. IAEA Publication
6. Networks
7. Posters

Website http://rpop.iaea.org

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Be Informed About the *Safe Use* of Ionizing Radiation in Medicine

Information to help health professionals achieve safer use of radiation in medicine for the benefit of patients

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Training

Special Groups
Pregnant Women
Children

Member Area
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Actions to Protect Patients In:
- Radiology →
- Radiotherapy →
- Nuclear Medicine →
- Interventional Radiology →
- Interventional Cardiology →
- Other Specialities & Imaging Modalities →

Latest Literature

Ferrandino, M.N., Bagrodia, A., Pierre, S.A., Scales, C.D. Jr., Rampersaud, E., Pearle, M.S., Preminger, G.M.,
Radiation exposure in the acute and short-term management of urolithiasis at 2 academic centers, J. Urol. **181** 2 (Feb. 2009) 668-672.

Keeley, F.X., Jr, Thornton, M.,
Radiation safety: Implications for urologists and patients, J. Urol. **181** 2 (Feb. 2009) 443-444.

Vano, E., Ubeda, C., Leyton, F., Miranda, P., Gonzalez, L.,
Staff Radiation Doses in Interventional Cardiology: Correlation With Patient Exposure, Pediatr. Cardiol. (Jan. 2009)

Did You Know That...

3. It is safe to have an X ray examination of the extremities (feet, legs, hands, arms) in pregnancy, provided the examination is clinically justified and radiation protection principles are observed

« Prev Next »

Latest News

New Publications on Newer Imaging Techniques released
Download FREE three new publications on radiation protection in newer imaging techniques (PET/CT, Cardiac CT and CT colonography)

Cardiologists' Newsletter
Next issue of the Newsletter of the Asian Network of Cardiologists in Radiation Protection is now available

All News

Upcoming Events

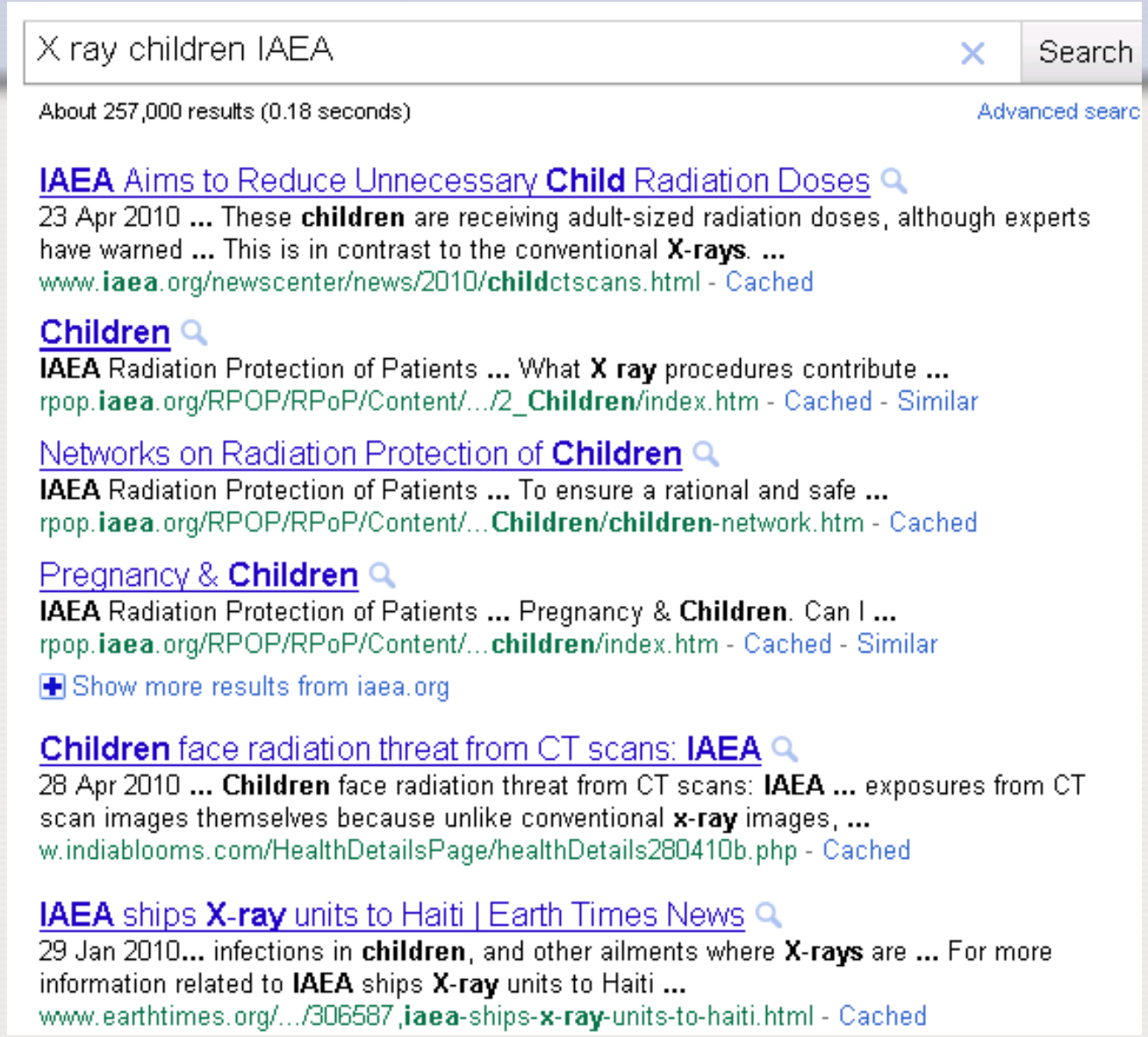
Meeting planned to prepare contents for patient information part of this website, Vienna, 4-8 May 2009
Meeting to discuss framework for patient information, draw guidelines and prepare contents

Meeting for Smart Card for long term record of patient doses, Vienna, 27-29 April 2009
The first meeting on this project will be held in IAEA Vienna

All Events

15 million hits/y

≈0.23 million visits/y, 190 countries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23 Apr 2010 ... These children are receiving adult-sized radiation doses, although experts have warned ... This is in contrast to the conventional X-rays. ...
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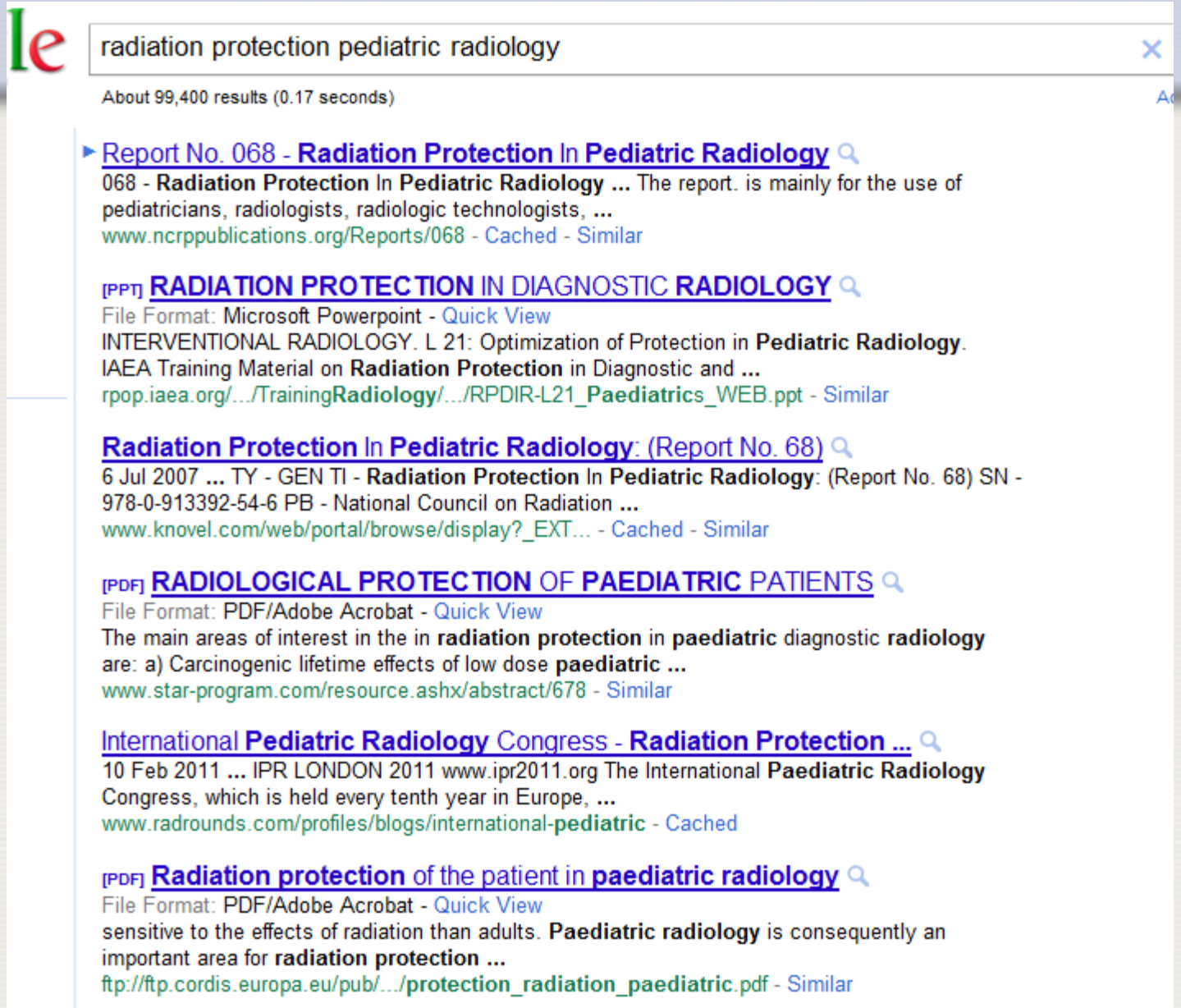
IAEA ships X-ray units to Haiti | Earth Times News
29 Jan 2010... infections in children, and other ailments where X-rays are ... For more information related to IAEA ships X-ray units to Haiti ...
www.earthtimes.org/.../306587,iaea-ships-x-ray-units-to-haiti.html - Cached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rpop.iaea.org/.../TrainingRadiology/.../RPDIR-L21_Paediatrics_WEB.ppt - Similar
Radiation Protection In Pediatric Radiology: (Report No. 68)
6 Jul 2007 ... TY - GEN TI - Radiation Protection In Pediatric Radiology: (Report No. 68) SN - 978-0-913392-54-6 PB - National Council on Radiation ...
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International Pediatric Radiology Congress - Radiation Protection ...
10 Feb 2011 ... IPR LONDON 2011 www.ipr2011.org The International Paediatric Radiology Congress, which is held every tenth year in Europe, ...
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sensitive to the effects of radiation than adults. Paediatric radiology is consequently an important area for radiation protection ...
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radiation children IAEA

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... disaster: implications for the study of **radiation** ... - Nikiforov - Cited by 86
... from **children** exposed to ionizing **radiation** after the ... - Padovani - Cited by 26
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IAEA Aims to Reduce Unnecessary **Child Radiation** Doses

23 Apr 2010 **...** An international study, conducted by the **IAEA**, has shown that some countries are over-exposing **children** to **radiation** when performing **...**
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To ensure a rational and safe practice of **radiation** exposure in **children** of **...**
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IAEA to establish a network of medical professionals on "**radiation ...**

Continuing with emphasis to **radiation** protection of **children**.
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/images/isrrt/RPD **Children**.pdf. **Radiation** protection website **IAEA**. Latest additions 11th January 2011. While leaving behind 2010, I wish to give you a brief **...**
www.isrrt.org/.../**Radiation**_protection_website_**IAEA**1_EN.asp?... - Cached - Similar

Home

Children

Children have higher radiation sensitivity than adults and have a longer life expectancy. Therefore, imaging techniques that do not use ionizing radiation should always be considered as an alternative. Increasing numbers of radiological examinations are being performed in infants and children. Millions of children undergo high dose procedures such as computed tomography and interventional procedures. A paediatric radiological procedure should be individually planned and projections should be limited to what is absolutely necessary for a diagnosis.

Radiography and fluoroscopy

1. What X ray procedures contribute most to individual patient dose and collective population dose?
2. Are there special technical considerations required to reduce patient exposure and maintain good image quality in paediatric radiography?
3. How does the radiation dose in screen-film combination imaging compare to digital imaging in paediatric radiography?
4. Can low dose fluoroscopic image replace conventional radiographic examinations?
5. What are the typical dose levels in paediatric radiology?
6. What are the most significant things I can do to reduce patient dose during fluoroscopic examinations?
7. Are there situations in which I should consider reducing the number of radiographic projections?
8. How should one deal with possible pregnancy in adolescent patients?

Computed tomography

9. How do I reduce the dose in paediatric chest CT?

Networks on Radiation Protection of Children

Training material paediatric radiology

Publications

Children Posters

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Communication of Radiation **Benefits** and **Risks** in Decision ...
... **Benefit** and **risk** of medical radiological ... Unlike poles of a simple bar magnet, **benefits** of a procedure are often disproportionate to the **risks**. ...
http://rpop.iaea.org/RPOP/RPoP/Content/Documents/Whitepapers/NCRP-2010-annual-meeting-program.pdf -

Momentum catching with radiation protection in cardiology
... with the core issue of **risk-benefit** evaluation of ... one is dealing with high **risk** of death or ... can indisputably overweigh minor radiation **risks**; they are ...
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Information for Public
... be taken into account, including the **benefit** the patient ... a quantity that adds up the **risks** to different ... Nominal **risk** coefficients for cancer and heritable ...
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Home

Use of social media to achieve interaction with the public on medical radiation protection

The IAEA's Division of Public Information organized an interactive session with the public through social media to encourage people to address their medical radiation protection questions to experts. Questions received over a stipulated period of about a week were pooled. Two experts answered selected questions that pertained to medical radiation protection.

According to the IAEA's Division of Public Information, the event "Ask an Expert in Radiation Protection" had unprecedented popularity. 140 people connected to and tweeted this event, commenting or asking questions. The overall discussion was very scientific. The information on radiation protection of patients posted during the event week received an average of 35,000 impressions per post and over 50 likes.

More than 15,000 impressions (number of people who saw these posts) for each video have been observed during the three weeks following the posting of the videos.

The feedback on the videos and the important scientific information contained therein was very positive, congratulatory and appreciative.

Please see links below for answers to questions:

Professor Marilyn Goske, Cincinnati Children Hospital, Cincinnati, USA

Dr Madan M Rehani, Radiation Safety Specialist, International Atomic Energy Agency

Information for
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→ Information for Patients
→ Information for Public

Member Area
• Member States Area
• Drafts Management Area

Social Media

Information for Public

Radiation is an essential part of our life

Radiation is an essential part of daily life. From birth, we are exposed to radiation from cosmic rays in our surroundings and from food and drink that may contain traces of radioactivity. In fact, even the human body contains small amounts of radioactivity (in the form of radioisotopes of potassium, caesium and radium). The typical adult body emits about 24,000 gamma rays per minute, a very tiny amount of radiation. There are many different types of radiation that can act as a source of exposure for patients. We will focus on one type, ionizing radiation, throughout most of this discussion. Radiation is called 'ionizing radiation' when it is powerful enough to break molecular bonds. These bonds can be broken in materials such as water or even DNA, the building blocks of human life (see question 3). Because there is evidence that ionizing radiation can cause these changes in the human body, it is important that the various sources of radiation be understood. Non-ionizing radiation used in cell phones and microwave ovens, ultra-violet radiation, infrared radiation and radiofrequency waves used in TV and radio will not be discussed here.

Not only is radiation an essential part of human life, it can also be used to improve human life. It is the role of health care providers to use ionizing radiation in medicine efficiently so as to maximize benefit and minimize risk. The International Atomic Energy Agency (IAEA) continuously works towards making radiation use safer. More information about the uses of radiation and the IAEA's work in improving radiation protection may be found on the IAEA website (www.iaea.org). However, potential benefits from radiation use come with a risk as

7. How is the risk of cancer connected with dose?

Studies on large numbers of humans or populations that have been exposed to relatively high radiation doses have been and continue to be conducted throughout the world. Such populations include the survivors of the atomic bombings in Japan during World War II, survivors of major radiological accidents, as well as patients who have undergone clinical procedures utilizing high radiation doses, such as radiotherapy. Life-long follow-up studies of these populations that have received high levels of known whole body doses or specific organ doses have revealed the correlation between radiation dose and cancer. International organizations have collected and continue to collect epidemiological data, from which radiation related cancer incidence coefficients are calculated. These coefficients refer to the risk for radiation-induced cancer to specific organs or in general for cancer occurrence anywhere in the human body. Effective dose relates to the assessment of the possibility of radiation-induced cancer anywhere in the body. UNSCEAR and ICRP are examples of international organizations that collect data on radiation risk for cancer.

It is important to note that cancer is a relatively common worldwide disease. Radiation may cause an increase in the number of cancers or 'excess cancers' above this baseline risk. When an estimate of cancer risk is given for a population, it means that there is a potential and in quantitative terms a probability (chance) that cancer will occur. One has to see this in the light of the quite high background rate of cancer, which ranges between 14% an 30.1% depending upon sex, the country and region [Global Cancer Statistics, 2011]. For example if one says that the probability of cancer from radiation exposure is 1 in 2000 at radiation dose of 10 mSv, that implies that if 2000 persons all receive a radiological examination that imparts 10 mSv to each person, there is probability that 1 amongst them may have cancer over and above the background cancer rate, which is about 280 to 602 out of the 2000 persons

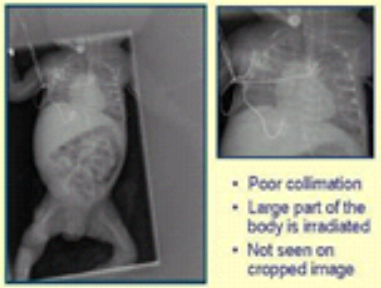
8. How much is the risk for cancer as a result of radiation exposure?

The risk of occurrence of radiation-induced cancer depends on the total dose that was received by the person radiated. The ICRP has published [ICRP, 1991] radiation-induced cancer estimates. The following table summarizes the risk coefficients for different population groups. It should be pointed out that these estimates relate to the risk of cancer induction in any part of the human body. In addition as noted above, they refer to a population and *should not be applied to individuals*. Radiosensitivity is not the same for all humans; rather it is different depending on age and gender. These estimates or coefficients should only be used for the comparison of the risk arising from different practices. In the light of new epidemiological data, cancer risk factors (called tissue weighting factors) were revised in 2007 [ICRP, 2007]. Some factors were decreased (for example, for the gonads, from 0.20 to 0.08), whereas the factor for the breast was increased from 0.05 to 0.12 on the basis of new data that became available in preceding decade. The table below shows the nominal risk coefficients for cancer and heritable effects in % per Sv.

Actions Taken

1. Requirements
2. Projects in countries
3. Website
4. **Training material**
5. IAEA Publication
6. Networks
7. Posters

IAEA Training Material on Radiation Protection of Children



- Poor collimation
- Large part of the body is irradiated
- Not seen on cropped image

Possible radiation effects

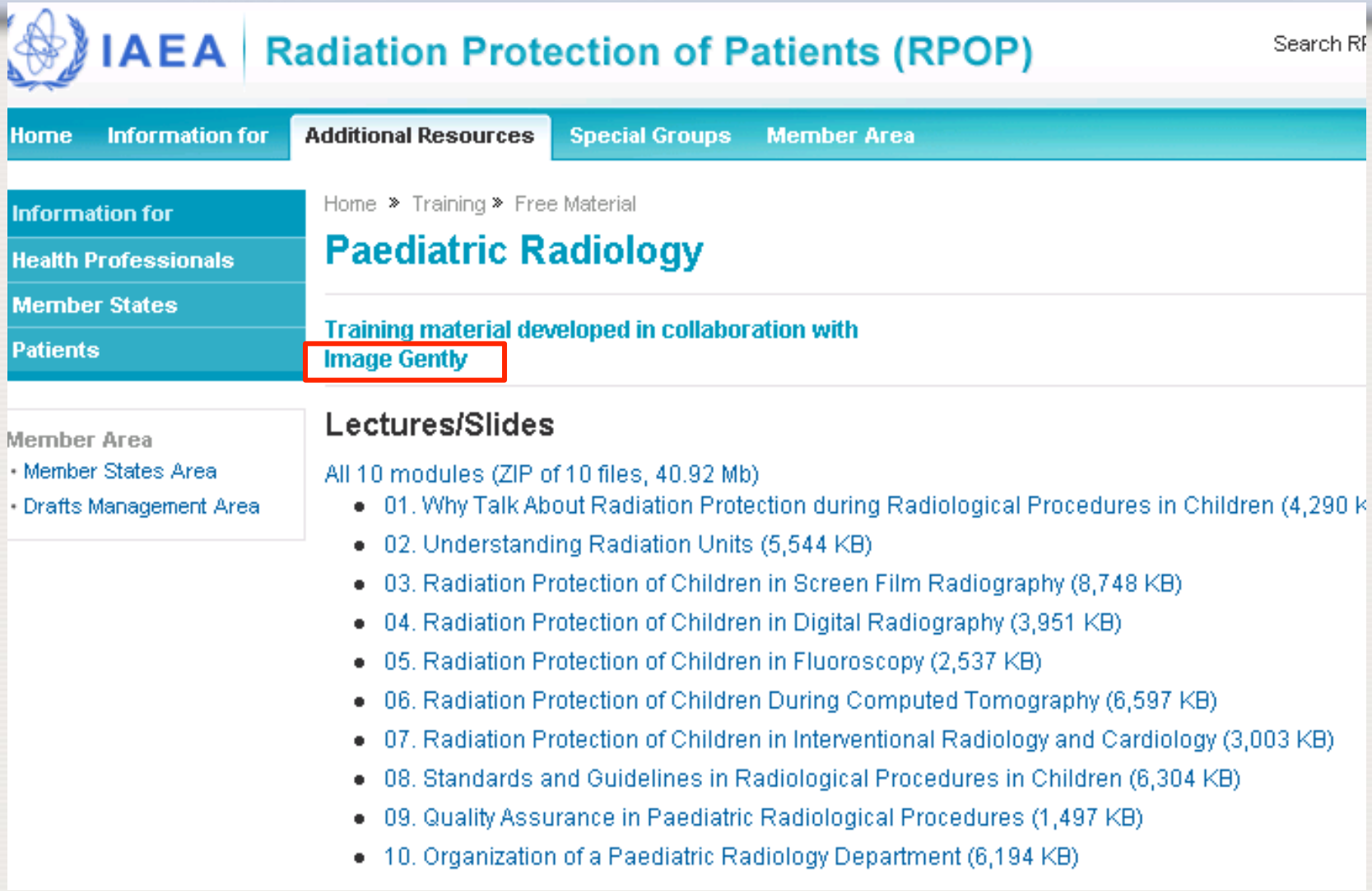
Radiation risk in paediatric radiology

in collaboration with image gently

Version: November 2010

IAEA
Atoms for Peace: The First Half Century
1957–2007

Power Point Slides (not pdf)



Actions Taken

1. Requirements
2. Projects in countries
3. Website
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5. **IAEA Publication**
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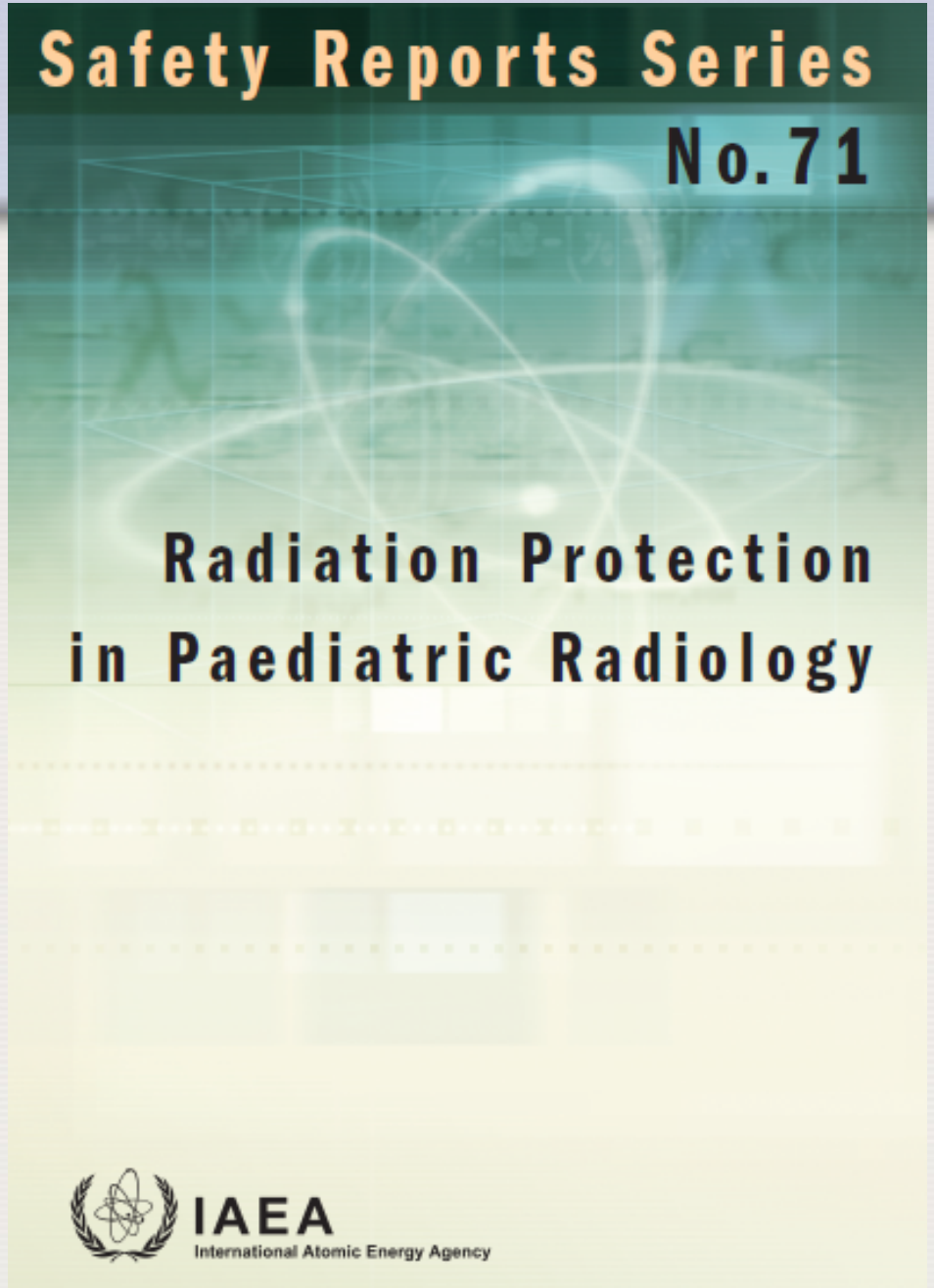

- Release Dec. 2012
- Image Gently involved in reviewing

- Will be available for free download from RPOP website http://rpop.iaea.org

The Alliance for Radiation Safety in Pediatric Imaging

Test Procedures | In The News | Parent | Radiologic Technologist | Medical Physicist | Radiologist | Referring Physician | Partners in Industry | Global Resources | FAQs

image gently when we care for kids! The ***image gently*** Campaign is an initiative of the Alliance for Radiation Safety in Pediatric Imaging. The campaign goal is to change practice by increasing awareness of the opportunities to promote radiation protection in the imaging of children.

Image Gently Impact

The image gently campaign launched 1/22/08. This is a snapshot of what has happened since:

- 20,831 medical professionals have taken the pledge
- This website has been visited 402,563 times
- The CT protocol has been downloaded over 32,430 times

IAEA: Radiation Protection in Paediatric Radiology The International Atomic Energy Agency (IAEA) has released a new document on pediatric radiation protection. .
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Actions Taken

1. Projects in countries
2. Website
3. Training material
4. IAEA Publication
5. Networks
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Network of Health Professionals on Radiation Protection of Children 2010

- Armenia, Bulgaria, Belarus, Croatia, Czech Republic, Greece, Lithuania, The Frmr.Yug.Rep. of Macedonia, Malta, Montenegro, Republic of Moldova, Poland, Portugal, Slovenia, Slovenia, Slovakia, Serbia, Serbia, Tajikistan
- Bangladesh, China, Indonesia, Iran, Israel, Lebanon, Malaysia, Myanmar, Oman, Pakistan, Philippines, Qatar, Singapore, Sri Lanka, Thailand, UAE
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Networks on Radiation Protection of Children

Introduction

Children have higher radiation sensitivity than adults and have a longer life expectancy. Recently raised concerns about repeated and unnecessary use of relatively high dose examinations, such as CT in children, require specific focus. A number of studies have demonstrated that there is scope for strengthening justification and optimization of these procedures.

Based upon experience gained through the Asian Network of Cardiologists in Radiation Protection and Network of Gastroenterologists in Radiation Protection the IAEA has now established networks for Radiation Protection of Children in different regions. The Asian Network on Radiation Protection of Children was established in a meeting held in Bangkok from 15 to 17 December 2010, while a European network was initiated in Varna, Bulgaria, during a meeting held from 30 August to 1 September 2010.

The Alliance for Radiation Safety in Paediatric Imaging, Image Gently, is cooperating with the IAEA in this activity. The two organizations support each other's efforts to enhance radiation safety of children.

Radiation Protection of Children
(Asian Network under IAEA project RAS9055)

Newsletter
Issue No. 1
February 2011

Mission: To promote a rational and safe practice of medical radiation exposure in children

IAEA
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10 Pearls: Radiation protection for children in interventional procedures

1. Remember: Some tissues of a growing child are more sensitive to radiation than adult

Children have longer life span to manifest radiation effects

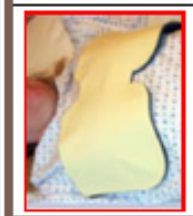
2. Discuss with parents before the procedure

- Ask about previous exposures
- Answer their concerns about radiation safety

3. Increase awareness among your team members through the use of a pre-procedure safety checklist

http://www.pedrad.org/associations/5364/files/ImiGen_StpLight_Chcklst.pdf

4. Plan the procedures in detail and in advance to avoid improper or aborted runs or other repeated exposures



5. Protect the patient's thyroid, breast, eyes and gonads where possible

RPOP Radiation Protection of Patients

image gently®

RPOP Posters webpage!

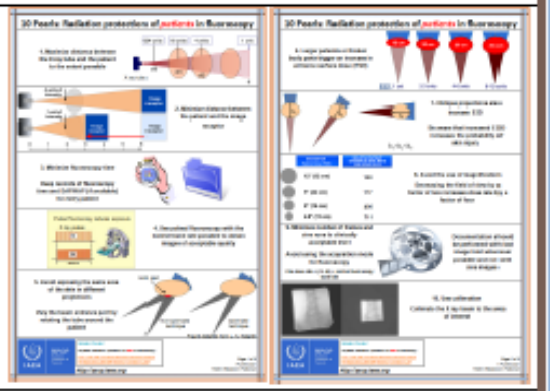
Page 1 of 2
Interventional Radiology
Children Radiation Protection

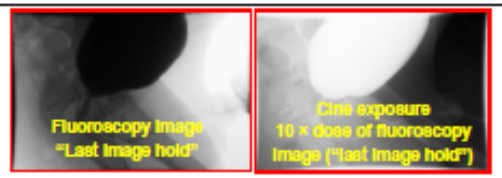
http://rpop.iaea.org http://www.pedrad.org/associations/5364/ig/

10 Pearls: Radiation protection for children in interventional procedures

6. Use optimal technique:

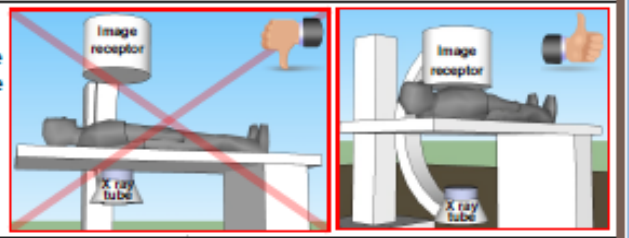
- Lower frame rates. Decrease from 7.5 to 3 pulses per second when possible
- Remove grids from machine if possible for infants under 20 kg Use air-gap technique instead
- Minimize imaging time
- Minimize field overlap in repeated acquisitions
- Use tighter collimation
- Minimize magnification usage





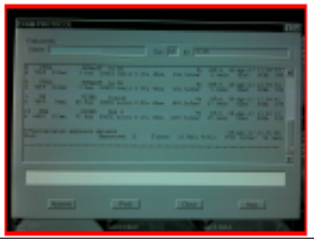
7. Use "last image hold" rather than additional exposures, where appropriate

8. Increase distance between patient and the X ray tube and decrease distance between patient and image receptor



9. Use dose recording and dose reduction technologies in equipment

10. Review and record radiation dose after the procedure



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10 Pearls: Appropriate referral for CT examinations

1. Avoid inappropriate examinations by asking yourself:
   - A. Has it been done already?
   - B. Do I need it?
   - C. Do I need it now?
   - D. Is this the best examination?
   - E. Have I explained the clinical problem?

Adapted from: iRefer: Making the best use of clinical radiology. Royal College of Radiologists
http://www.rcr.ac.uk/content.aspx?PageID=995

More information at:
https://rpop.iaea.org/RPOP/RPoP/Content/InformationForHealthProfessionals/6_OtherClinicalSpecialities/referring-medical-practitioners/index.htm

2. Discussion with the radiologist may help strengthen the justification process and reduce unhelpful imaging

3. Inform and discuss with the patient the benefits and risks of the examination

4. Keep informed about the appropriateness criteria and referral guidelines and use them in daily practice

Diagnostic Imaging Pathways
http://www.imagingpathways.health.wa.gov.au/includes/index.html

http://www.rcr.ac.uk/content.aspx?PageID=995

IAEA RPOP Radiation Protection of Patients

Related Poster!
10 Pearls: Radiation protection of patients in CT
https://rpop.iaea.org/RPOP/RPoP/Content/Documents/Whitepaper/poster-of-radiation-protection.pdf

http://rpop.iaea.org

10 Pearls: Appropriate referral for CT examinations

5. Consult the radiologist/medical physicist and seek information at:

- https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/6_OtherClinicalSpecialities/referring-medical-practitioners/index.htm
- https://rpop.iaea.org

CT scans are among the most common radiation dose burdening examinations for patients

The effective dose from one chest CT scan may be equal to the corresponding dose of about 500 PA chest X rays

6. Be particularly careful to avoid inappropriate paediatric examinations. Some tissues in children are more sensitive to radiation and they have a longer lifespan over which cancer effects may be expressed

7. While the risk of cancer due to the x-rays from CT scans is very low, there is evidence that multiple CT scans can slightly increase the risk in children

Minimize the number of CT scans, especially in children

8. Always ask if the woman of reproductive age could be pregnant

9. Resist patient wishes to be examined when you feel it is not necessary

10. Repeat scanning of the patient to save time because previous records are not readily available is not part of a good practice

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Computed Tomography
Ensuring appropriate referrals

- **When to say that it is**
  - **safe**
  - **on border line**
  - **Unsafe**
- **How to say?**

8. Should I be concerned about radiation if my child has been prescribed a CT?

Not really if the examination has been fully justified based on risk and benefit considerations. But it is necessary to establish this by discussion with the doctor why your child needs the CT scan and why it cannot be replaced by another examination like ultrasound or MRI. You might also bring a card for the doctor to write how much dose was given in the CT examination, such as the one that can be downloaded from image gently website. It is important that children get as little radiation exposure as possible because they are more sensitive to radiation than adults and they have a longer life expectancy.

For more information as to what parents should know about CT scans for children »

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9. Should I be concerned about radiation if my child has been prescribed an interventional procedure?

Not really based on radiation risk alone as the benefit of the procedure may overweigh the risks. Thus the issue is how much benefit is expected and to rule out if another procedure that does not involve ionizing radiation can serve the purpose.You might also bring a card for the doctor to write how much dose was given in the interventional procedure.

For more information as to what parents should know about medical radiation safety in paediatric interventional radiology »

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Recap

1. Radiation sensitivity of children
2. What are issues?
3. What are we doing?
   a. Projects in countries
   b. Website
   c. Training material
   d. IAEA Publication
   e. Networks
   f. Posters

Thank You

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IAEA
Atoms for Peace: The First Half Century
1957–2007