Experience of pediatric CT practice in over 40 countries

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Section Head, Radiation Protection
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President of Bulgarian Society of Biomedical Physics and Engineering

Sofia, Bulgaria
Bulgaria

- Population: 7,5 million
- Member of UN since 1955
- Member of IAEA since 1957
- Member of EU since 2007
- About 70 clinical medical physicists
International cooperation

 mappedBy

 IAЕA

 • training courses
   - regional
   - national (lecturers)
 • regional projects
 • individual fellowships

 European Union

 • twining projects
 • research projects
 • other projects

 Other

 • conferences
 • meetings
International Conference on Radiation Protection in Medicine
Where we are and where we are going?
1-3 September 2010
Varna, Bulgaria

http://rpm2010.roentgen-bg.org/

280 participants
55 countries
RPM 2014
INTERNATIONAL CONFERENCE ON RADIATION PROTECTION IN MEDICINE

Facing increasing challenges

30 May - 2 June 2014
Riviera Holiday Club
Varna, Bulgaria

www.rpm2014.org
IAEA project on pediatric CT

- Introduced in January 2010
- Three phases

**Phase A. Overview of the practice in pediatric CT**
- Form A1. Data for CT scanner, number of CT examinations in 2007 and 2009 and typical exposure parameters for CT examinations of adults and children
- Form A2. Questionnaire for pediatric radiologist (appropriateness)
- Form A3. Questionnaire for radiographer (practice)

**Phase B. Retrospective study of patient doses for pediatric CT examinations in 2007**

**Phase C. Prospective study of patient doses for pediatric CT examinations in 2010**

- Data collection forms in Excel (separate for each facility/phase)
- Continuous feedback from IAEA
### 40 countries, 126 hospitals, 146 CT facilities

#### 73 (50%) in Asia
- China (3)
- Indonesia (1)
- Iran (10)
- Israel (7)
- Kuwait (5)
- Lebanon (6)
- Malaysia (1)
- Myanmar (1)
- Oman (1)
- Pakistan (5)
- Qatar (1)
- Singapore (1)
- Sri Lanka (2)
- Syria (8)
- Thailand (1)
- UAE (15)

#### 51 (35%) in Europe
- Armenia (1)
- Belarus (1)
- Bosnia and Herzegovina (3)
- Bulgaria (12)
- Croatia (3)
- Czech Republic (6)
- Estonia (2)
- Lithuania (3)
- FYR Macedonia (5)
- Malta (1)
- Moldova (5)
- Montenegro (1)
- Poland (1)
- Serbia (3)
- Slovakia (4)
- Slovenia (1)

#### 10 (7%) in Africa
- Algeria (4)
- Sudan (3)
- Tanzania (3)

#### 12 (8%) in Latin America
- Brazil (5)
- Costa Rica (1)
- Mexico (1)
- Paraguay (3)
IAEA Survey of Pediatric CT Practice in 40 Countries in Asia, Europe, Latin America, and Africa: Part I, Frequency and Appropriateness

<table>
<thead>
<tr>
<th>Name</th>
<th>Country/Institution</th>
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<td>Jenia Vassileva</td>
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<td>Madan M. Rehani</td>
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<td>Dejan Zontar</td>
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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-Dhuhlil · Huda M. Al-Naemi

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CT technology

40 countries, 126 countries, 146 CT facilities
Siemens (33%), GE (28%), Philips (16%), Toshiba (15%), others (8%)

Year of installation
- after 2005: 65%
- 1997 - 2004: 27%
- before 1996: 5%
- unknown: 3%

Number of detector rows
- SDCT: 23%
- MDCT with >=64 detectors: 31%
- MDCT with 2-40 detectors: 46%
Frequency of pediatric CT exams

95 CT facilities in 28 countries

• Overall increase of 6.8% in the number of pediatric examinations in 2 years (2007 – 2009)
• The frequency of pediatric CT examinations ranged from less than 1% to 49.4%.
• Head was the most frequently scanned body part (69%)
• No significant difference between regions
Availability of referral guidelines

Are written referral guidelines for imaging available in your hospital? (answered by 132 radiologists)

- Europe (52 answers)
- Asia (62 answers)
- Latin America (8 answers)
- Africa (7 answers)

![Bar chart showing the availability of referral guidelines in different regions.](chart.png)
Lack of availability of previous images

Are previous images and/or patient dose records required when refereeing to CT? (129 radiologists answered)

- Europe (52 answers)
- Asia (62 answers)
- Latin America (8 answers)
- Africa (7 answers)

Graph showing the percentage of YES and NO responses for each region.
Is head CT mandatory for a pediatric patient with an accidental head trauma? (127 radiologists answered)

- Europe (52 answers)
- Asia (62 answers)
- Latin America (8 answers)
- Africa (7 answers)
Appropriateness Issues

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

- Infant with hydrocephalus
- Infant with congenital torticollis
- Child with acute abdominal pain
- Child with pleural effusion
- Child with persistent headache
- Child with possible ventriculo... 
- Small child (<5 years old) with...

Diagram showing the percentage of each examination (MRI, US, X-ray, CT) in different scenarios.
CT practice
Responses from 141 CT operators from 40 countries

*Dedicated scanning protocols for pediatric exams available?*

- **Africa (7 answers)**
  - Yes: 94%
  - No: 6%
  - Don't know: 0%

- **Latin America (63 answers)**
  - Yes: 100%
  - No: 0%
  - Don't know: 0%

- **Total (141 answers)**
  - Yes: 94%
  - No: 6%
  - Don't know: 0%

Protocols for some age groups were unavailable in around 50% of the facilities surveyed.
CT practice
Responses from 141 CT operators from 40 countries

*Indication based protocols for pediatric exams available?*

Often protocols were not used for patient examinations

- **Africa (7 answers)**
  - Yes: 42.86%
  - No: 57.14%
  - Don't know: 0%

- **Latin America (63 answers)**
  - Yes: 73.79%
  - No: 15.87%
  - Don't know: 0.79%

- **Total (141 answers)**
  - Yes: 58%
  - No: 40%
  - Don't know: 2%
Results: Patient doses and protocols

- 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 facilities the same protocol was used for all age groups.
- In > 50% of facilities, manufacturers’ pre-programmed protocols were used without any change, or, were modified mostly by the manufacturer’s representative.
- In < 20% validation of displayed CTDI data by measurements was carried out.
### Results: CTDI\textsubscript{vol} (83 CT facilities)

**CTDI\textsubscript{vol} – Chest examination**

<table>
<thead>
<tr>
<th>CTDI\textsubscript{vol} (mGy)</th>
<th>&lt; 1y</th>
<th>1-5y</th>
<th>5-10y</th>
<th>10-15y</th>
<th>Adult</th>
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<tbody>
<tr>
<td>min</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>4.7</td>
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<tr>
<td>max</td>
<td>40.1</td>
<td>40.1</td>
<td>27.4</td>
<td>42.0</td>
<td>99.0</td>
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<tr>
<td>average</td>
<td>6.3</td>
<td>6.7</td>
<td>7.6</td>
<td>10.3</td>
<td>13.7</td>
</tr>
<tr>
<td>median</td>
<td>3.4</td>
<td>4.9</td>
<td>5.5</td>
<td>7.5</td>
<td>10.9</td>
</tr>
<tr>
<td>3d quarter</td>
<td>7.0</td>
<td>8.2</td>
<td>10.0</td>
<td>13.2</td>
<td>15.5</td>
</tr>
</tbody>
</table>

- Mean and median CTDI\textsubscript{vol} values increase with age.
- The ratio of max/min CTDI\textsubscript{vol} values varied between different examinations and age groups – from 15 for abdomen CT in the 5–10-year age group up to 100 for chest CT in the <1-year age group.
### 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)

<table>
<thead>
<tr>
<th>Scanner number</th>
<th>mode</th>
<th>Tube voltage, kV</th>
<th>Tube current, mA</th>
<th>t rot, s</th>
<th>Pitch value</th>
<th>CTDI$_{vol}$, mGy</th>
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</thead>
<tbody>
<tr>
<td>39</td>
<td>helical</td>
<td>80</td>
<td>129</td>
<td>0.5</td>
<td>1.3</td>
<td>1.89</td>
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<tr>
<td>40</td>
<td>helical</td>
<td>120</td>
<td>120</td>
<td>0.5</td>
<td>0.984</td>
<td>10.21</td>
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<tr>
<td>102</td>
<td>helical</td>
<td>80</td>
<td>240</td>
<td>0.5</td>
<td>0.984</td>
<td>2.64</td>
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<tr>
<td>26</td>
<td>helical</td>
<td>80</td>
<td>100-250</td>
<td>0.5</td>
<td>0.9</td>
<td>4.26</td>
</tr>
</tbody>
</table>

**Variation in CTDI dose values:**

- 14-fold for chest
- 6-fold for abdomen examination
- 4-fold for head examination
Results: Typical exposure parameters

✧ Most commonly used is 120 kVp
✧ Use of <120 kV: in only 30% for newborn and 12% for 1-15y
Results: Typical exposure parameters

Tube current - largely adapted to body size, but high individual variations within the same age group
CT practice

Responses from 141 CT operators from 40 countries

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

- Yes
- No
- Don't know

Africa (7 answers)

Latin America (63 answers)

Asia (63 answers)

Europe (60 answers)

Total (141 answers)

75%

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

CT practice

Responses from 141 CT operators from 40 countries

How often is sedation used for small children (< 5 y old)?
How often does CT examination of pediatric patient need supporter in the room?

- Hardly ever
- in <50%
- in >50%
- always

**Total (141 answers)**
- 18% Hardly ever
- 34% in <50%
- 31% in >50%
- 17% always

**Europe (60 answers)**
- 31% Hardly ever
- 17% in <50%
- 34% in >50%
- 18% always

**Latin America (63 answers)**
- 40% Hardly ever
- 28% in <50%
- 20% in >50%
- 12% always

**Asia (63 answers)**
- 40% Hardly ever
- 30% in <50%
- 20% in >50%
- 10% always

**Africa (7 answers)**
- 71% Hardly ever
- 29% in <50%
- 0% in >50%
- 0% always
CT practice
Responses from 141 CT operators from 40 countries

Bismuth shields available?

- Yes
- No
- Don't know

<table>
<thead>
<tr>
<th>Region</th>
<th>Answers</th>
<th>Yes</th>
<th>No</th>
<th>Don't know</th>
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<tr>
<td>Africa</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Latin America</td>
<td>63</td>
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<td>Asia</td>
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<tr>
<td>Europe</td>
<td>60</td>
<td></td>
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<tr>
<td>Total</td>
<td>141</td>
<td>13</td>
<td>74</td>
<td>14</td>
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Total (141 answers) 84%
CT practice
Responses from 141 CT operators from 40 countries

Do you keep records of patient doses?

-Yes
-No
-Don't know

Africa (7 answers)
-Yes: 0%
-No: 100%
-Don't know: 0%

Latin America (63 answers)
-Yes: 46%
-No: 54%
-Don't know: 0%

Asia (63 answers)
-Yes: 46%
-No: 54%
-Don't know: 0%

Europe (60 answers)
-Yes: 83%
-No: 17%
-Don't know: 0%

Total (141 answers)
-Yes: 46%
-No: 54%
-Don't know: 0%
CT practice

Responses from 141 CT operators from 40 countries

Is a medical physicist available?

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<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Don't know</th>
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<td>Africa (7 answers)</td>
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<tr>
<td>Total (141 answers)</td>
<td>50%</td>
<td>50%</td>
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CT practice
Responses from 141 CT operators from 40 countries

Is a medical physicist available?

In only 28% of facilities medical physicists is involved in optimisation
Making a difference

✧ This survey provides critical baseline data for ongoing quality improvement efforts
✧ Important findings that necessitated feedback and correction
✧ Every participant was provided with detailed comments, suggestions, and recommendations for corrective actions
✧ For many countries – the only source of information and expert advise
✧ Documented improvement in optimisation
✧ Creation of multinational networks is very effective mechanism
### Conference Topics
- Appropriateness and decision support
- Optimization
- Protecting children
- Preventing accidental exposures
- Exposure & dose tracking
- Dose surveys and DRL
- Radiation effects
- Pregnancy and radiation
- Regulations, standards & implementation
- Quality assurance and clinical audit
- Education and training
- Risk communication

### Important Dates
- Abstract submission opening
  - 1st September 2013
- Abstract submission deadline
  - 20th January 2014
- Notification of acceptance of abstracts
  - 1st March 2014
- Registration opening
  - 1st October 2013
- End of early registration
  - 31st March 2014
- End of online registration
  - 20th May 2014

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