Radiation Benefit - Risk Dialogue in Healthcare

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A balanced approach is required to recognize the multiple benefits and to ensure that risks will be minimized without reducing the efficacy of the procedures.

A communication strategy to raise awareness about benefits and risks, and to avoid causing alarm, often fueled by the media.
Let’s remember what HEALTH means

“Health is a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity“

WHO's Constitution (1948)
Talking about health care

- Efforts made to improve, maintain or restore physical, mental, or emotional well-being, especially by trained and licensed professionals.

- The healthcare pathway includes health promotion, prevention, diagnosis, treatment, rehabilitation, palliative care…

The **benefit-risk dialogue** about health-care interventions is an ethical duty for care providers
Citizens are more engaged and have increasing expectations and demands (e.g. quality of services, healthy cities, food safety, water quality, etc). This includes **HEALTH CARE SERVICES**.

This **challenge** is at the same time an **opportunity** for engaging consumers and building partnerships with competent authorities, professional societies, patients, families, community, and other stakeholders.
Integrated people-centred health services

- **A fundamental change** in the way health services are funded, managed and delivered, shifting away from health systems designed around diseases/institutions towards health systems designed **for people**.
  - Patients, families and communities are participants in, and beneficiaries of, health systems organized around **people needs**.
  - Care is delivered in an **equal and reciprocal long-term relationship** between professionals, people using care services, their families and the communities to which they belong.
  - Health systems where **information, decision-making** and **service delivery** are shared (i.e. **communication** as a priority).
The 5 strategies of the WHO framework on integrated people-centred health services

- Engaging and empowering people and communities
- Coordinating services within and across sectors
- Creating an enabling environment
- Strengthening governance and accountability
- Reorienting the model of care
Patient And Family Engagement: A Framework For Understanding The Elements And Developing Interventions And Policies

Levels of engagement

- Direct care
- Consultation
  - Patients receive information about a diagnosis
- Involvement
  - Patients are asked about their preferences in treatment plan
- Partnership and shared leadership
  - Treatment decisions are made based on patients' preferences, medical evidence, and clinical judgment

Organizational design and governance

- Organization surveys patients about their care experiences
- Hospital involves patients as advisers or advisory council members
- Patients co-lead hospital safety and quality improvement committees

Policy making

- Public agency conducts focus groups with patients to ask opinions about a health care issue
- Patients' recommendations about research priorities are used by public agency to make funding decisions
- Patients have equal representation on agency committee that makes decisions about how to allocate resources to health programs

Factors influencing engagement:
- Patient (beliefs about patient role, health literacy, education)
- Organization (policies and practices, culture)
- Society (social norms, regulations, policy)
The old paternalist paradigm

- Doctors were trusted, respected and the source of all medical advice...
- Patients and families took followed our advice, they did not expect information.
- No one complained about lack of communication or dialogue.
Have we actually shifted from old paradigms?

- Although a transformation of patients’ roles has taken place, many patients and care providers still operate under the old paternalist paradigm.

- This conspires against an effective communication, including radiation benefit-risk dialogue.
Today patients and families look for other sources of information

- More people go on-line for health information and get health advice on electronic devices.

- While social media cannot replace the personalized benefit-risk dialogue, we can use those resources as supporting tools for our communication with patients, families and communities.
Can artificial intelligence (AI) help improve communication with patients?

What can AI do?
- Analysis of words and phrases.
- Analysis of turn-taking.
- Tone and style in interactions.
- ... Other/s?
- But still not a magic solution...

Can Artificial Intelligence Help Doctors and Patients Have Better Conversations?

**NEWS**
Original Press Release from The Dartmouth Institute for Health Policy and Clinical Practice


Using artificial intelligence to assess clinicians' communication skills.
Ryan P1, Luz S2, Albert P3, Vogel C3, Normand C1, Elwyn G4.
Factors influencing effectiveness of benefit-risk dialogue

- Individual factors that can affect patients’ and families’ ability to engage with care providers:
  - knowledge, attitudes, and beliefs;
  - functional capacity (e.g. health literacy, health status, language proficiency, age, cognitive and emotional status);
  - previous experiences (with radiation, with the health care system);
  - self-efficacy (e.g. motivational and affective processes);
  - vulnerability (e.g. anxiety, marginality, stigmatization, discrimination).
Importance of an effective radiation benefit-risk dialogue

- Communication about health interventions is an **ethical duty**.
- The provision of information to the patients is a requirement explicitly mentioned in the **international BSS** and the **Euratom BSS**.
- A **patient-centred communication**
  - Yields diagnostic information,
  - Gives patients and families a sense that they are being listened and that what they have to say matters, and
  - Builds rapport between the patient and the care provider.
Improve benefit/risk dialogue

- Patients and families should be part of benefit-risk discussions so they can understand the information and use it for making informed decisions.

- If they are not properly informed, they may make choices that are not beneficial and may be even harmful:
  - They might refuse a procedure that is needed, or
  - They might demand a procedure which is not justified.
Benefit-risk dialogue: empowering patients and families with information

- Do parents request unnecessary scans for their children?
  ✓ “Parents may overestimate the benefits and underestimate the risks of radiation”

- Do parents hesitate to authorize needed imaging?
  ✓ “Parents may be more concerned about radiation exposure than about their child’s medical condition”

Adapted from H. Haskell, WHO Patients for Patient Safety (PFPS)
Health-care providers requesting or performing radiological medical procedures share the responsibility to **communicate radiation risks** accurately and effectively to patients and families.

They need information and tools to ensure a **balanced benefit-risk dialogue** to support informed decision making.
Inter-professional dialogue

- Radiological medical practitioners, radiographers, technologists, medical physicists and other team members performing radiological procedures need to communicate about **radiation benefits and risks** with other care providers.

- Need **to tailor the messages to the target audiences** (e.g. GPs, family doctors, paediatricians, emergency department physicians, hospital managers, other/s)
Which is your SOCO?

- Single overriding communication objective (SOCO): main message by which we would like to achieve our communication aim.
- This message has to be tailored to the specific clinical scenario where the radiation benefit-risk conversation takes place.
- We expect that:
  - Patients and families trust us;
  - They are reassured and do not worry unnecessarily;
  - They take our advice when making decisions to protect their health;
  - They become informed advocates.
Conversations in clinical practice

- Are they meetings with a pre-determined shape, having the doctor as the “driver”? Is the patient there just to report symptoms and listen to what the doctor advises?

- Or…we accept that each conversation is unique and both parties play an equal part in determining its direction?
Moving from monologue to dialogue

• A prolonged discourse by a single speaker?

• Or a conversation between two or more people?

A conversation between two parties who are not really understanding each other would be just two monologues rather than a dialogue !!!!!!
From informed consent to informed decision-making process

- Benefit risk dialogue and consent
  - Without undue influence or coercion
  - Opportunity to refuse or withdraw consent
  - Explicit vs. implicit consent
  - Consent and assent

- To provide the necessary information
  - Understandable and tailored to the individual and scenario
  - Including what is proposed, how it will be done, associated risks, consequences of consent, consequences of refusal to consent
Bonn Call for Action: 10 actions to improve radiation protection in medicine between 2012-2022

1. Enhancing implementation of justification of procedures
2. Enhancing implementation of optimization of protection and safety
3. Strengthening manufacturers’ contribution to radiation safety
4. Strengthening RP education and training of health professionals
5. Shaping & promoting a strategic research agenda for RP in medicine
6. Improving data collection on radiation exposures of patients and workers
7. Improving primary prevention of incidents and adverse events
8. Strengthening radiation safety culture in healthcare
9. Fostering an improved radiation benefit-risk-dialogue
10. Strengthening the implementation of safety requirements (BSS) globally

http://www.who.int/ionizing_radiation/about/med_exposure/en
https://rpop.iaea.org/RPOP/RPoP/Content/News/bonn-call-for-action joint-position-statement.htm
Foster an improved radiation benefit-risk-dialogue

- Increase awareness about radiation benefits and risks among health professionals, patients and the public;
- Support improvement of risk communication skills of health care providers and radiation protection professionals – involve both technical and communication experts, in collaboration with patient associations, in a concerted action to develop clear messages tailored to specific target groups;
- Work towards an active informed decision making process for patients.
Tools to support the benefit-risk dialogue in medical settings

For health care providers: contents & structure

Chapter 1: Scientific background

Chapter 2: Radiation protection concepts and principles

Chapter 3: Risk-benefit dialogue
Section 1.1

Types of radiation, quantities & units, sources of exposure, current trends in the utilization of ionizing radiation in medical imaging (in general and in paediatric imaging).

Box 1.1 Quantities and units

The *absorbed dose* is the amount of energy deposited in tissues/ organs per unit of mass and its unit is the gray (Gy). One gray is a very large unit for diagnostic imaging and it is often more practical to talk in terms of milligrays (mGy). One gray is equal to one thousand milligrays.

Box 1.2 How to express an amount of radioactive material

The becquerel (Bq) is the unit of radioactivity used in the International System of Units. In nuclear medicine it is used to express the amount of radioactivity administered to a patient. It is a quite large amount of radioactive material: it corresponds to $3.7 \times 10^{10}$ (37 billion) radioactive disintegrations per second. Today, the unit Ci is hardly ever used worldwide but it is still used primarily in the United States.

Figure 1: Distribution of average annual radiation exposure for the world population

Worldwide average radiation exposure (mSv)

- Artificial sources other than medicine (57%)
- Medical exposure (14%)
- Natural sources other than cosmic (15%)
- Natural sources due to cosmic (8%)

Total: 3 mSv

Figure 4: Variation in the contribution of medical exposure to the annual average radiation dose per person in countries with similar healthcare level

- United States (2006)
- Germany (2005)

Natural Radioactivity in Food

<table>
<thead>
<tr>
<th>Food</th>
<th>$^{40}$K (Potassium)</th>
<th>$^{226}$Ra (Radium)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>130 Bq/kg</td>
<td>0.037 Bq/kg</td>
</tr>
<tr>
<td>Brazil Nuts</td>
<td>207 Bq/kg</td>
<td>37–260 Bq/kg</td>
</tr>
<tr>
<td>Carrot</td>
<td>130 Bq/kg</td>
<td>0.02–0.1 Bq/kg</td>
</tr>
<tr>
<td>White Potato</td>
<td>130 Bq/kg</td>
<td>0.037–0.09 Bq/kg</td>
</tr>
<tr>
<td>Beer</td>
<td>15 Bq/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Red Meat</td>
<td>110 Bq/kg</td>
<td>0.02 Bq/kg</td>
</tr>
</tbody>
</table>
Chapter 1: Scientific background

Figure 3: Annual average radiation dose per person (mSv) in the USA population: note the rise in medical imaging over the years.

Figure 5: Percentage of the total CT scans which are performed in children in different regions of the world.

Table 2. Global average relative frequency and collective dose of various types of diagnostic X-ray procedures (all ages, both sexes)^

<table>
<thead>
<tr>
<th>X-ray examination</th>
<th>Relative frequency (%)</th>
<th>Collective dose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest examinations (PA, lateral, others)</td>
<td>40</td>
<td>13.3</td>
</tr>
<tr>
<td>Limb and joint</td>
<td>8.4</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Skull</td>
<td>3.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Abdomen, pelvis, hip</td>
<td>5.2</td>
<td>4.5</td>
</tr>
<tr>
<td>Spine</td>
<td>7.4</td>
<td>4.2</td>
</tr>
<tr>
<td>Fluoroscopic studies of the gastrointestinal tract</td>
<td>4.8</td>
<td>14.5</td>
</tr>
<tr>
<td>Mammography</td>
<td>3.6</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Computed tomography</td>
<td>6.3*</td>
<td>43.2*</td>
</tr>
<tr>
<td>Angiography and fluoroscopy-guided interventional procedures</td>
<td>&lt; 1</td>
<td>6.1</td>
</tr>
<tr>
<td>Other X-ray medical imaging procedures</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Dental procedures</td>
<td>13</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>
Section 1.2

Radiation doses in paediatric procedures, known and potential risks associated with radiation exposure during childhood.

Table 4. Typical effective doses for diagnostic imaging examinations and their equivalence in terms of number of chest X-rays and duration of exposure to natural background radiation.

<table>
<thead>
<tr>
<th>Diagnostic procedure</th>
<th>Equivalent number of chest X-rays</th>
<th>Equivalent period of exposure to natural radiation</th>
<th>Typical effective dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest X-ray (single PA film)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>350</td>
<td>3 years</td>
<td>5.3</td>
</tr>
<tr>
<td>5-year-old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>265</td>
<td>2.2 years</td>
<td>4.2</td>
</tr>
<tr>
<td>Newborn</td>
<td>210</td>
<td>1.8 years</td>
<td>3.7</td>
</tr>
<tr>
<td>1-year-old</td>
<td>185</td>
<td>1.5 years</td>
<td>3.7</td>
</tr>
<tr>
<td>5-year-old</td>
<td>185</td>
<td>1.5 years</td>
<td>3.7</td>
</tr>
<tr>
<td>10-year-old</td>
<td>110</td>
<td>1.5 years</td>
<td>3.7</td>
</tr>
<tr>
<td>Paediatric head CT angiography†</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT chest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>765</td>
<td>6.4 years</td>
<td>16.3</td>
</tr>
<tr>
<td>Newborn</td>
<td>9</td>
<td>1 month</td>
<td>0.18</td>
</tr>
<tr>
<td>1-year-old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-year-old</td>
<td>300</td>
<td>2.5 years</td>
<td>6</td>
</tr>
<tr>
<td>10-year-old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear medicine examinations (5-year-old)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tc-99m cystogram</td>
<td>0.25</td>
<td>&lt; 1 day</td>
<td>0.005c</td>
</tr>
<tr>
<td>Tc-99m bone scan</td>
<td>0.5</td>
<td>1.5 days</td>
<td>0.01c</td>
</tr>
<tr>
<td>Dental examinations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intra-oral radiography</td>
<td>&lt; 50</td>
<td>&lt; 5 months</td>
<td>&lt; 1h</td>
</tr>
<tr>
<td>Panoramic (dental)</td>
<td>300</td>
<td></td>
<td>Median 6 (range 1–37)</td>
</tr>
<tr>
<td>Craniofacial cone-beam CT</td>
<td>(range from 50 to 1850)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoroscopy-guided paediatric interventional cardiology</td>
<td>16</td>
<td>1.7 months (range from 5 months to 15 years)</td>
<td>0.33</td>
</tr>
<tr>
<td>Fluoroscopic cystogram (5-year-old)</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 9: Sex-averaged lifetime attributable risk of cancer incidence associated with low-and abdominal CT, as a function of the age at exposure.

Assuming the LNT model described above, and keeping in mind the uncertainty on lifetime risk presented in Fig. 9 should be compared with the high LBR for cancer incidence (i.e. more than 1 in 3), and the substantial benefits provided by a medically necessary CT scan. Nevertheless, the public health issue at hand concerns the increasingly large paediatric population being exposed to these small risks (Brody et al., 2007; UNSCEAR, 2013).
Section 1.2

Examples of qualitative approaches to communicate radiation risks

Table 6. Examples of a qualitative approach to communicate different levels of risk of cancer incidence compared with the lifetime baseline risk of cancer incidence

<table>
<thead>
<tr>
<th>Risk qualification</th>
<th>Approximate level of additional risk of cancer incidence</th>
<th>Probability of developing cancer in the general population (% LBR)²</th>
<th>Probability of developing cancer in the general population if adding this extra level of risk (% LBR + % LAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>&lt; 1 in 500 000</td>
<td>42</td>
<td>42.00</td>
</tr>
<tr>
<td>Minimal</td>
<td>Between 1 in 500 000 and 1 in 50 000</td>
<td>42</td>
<td>42.00</td>
</tr>
<tr>
<td>Very low</td>
<td>Between 1 in 50 000 and 1 in 5 000</td>
<td>42</td>
<td>42.02</td>
</tr>
<tr>
<td>Low</td>
<td>Between 1 in 5 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Proposed qualitative presentation of risk at three different ages for some common paediatric examinations based on data presented in this section

<table>
<thead>
<tr>
<th>Examination</th>
<th>Age 1 year</th>
<th>Age 5 years</th>
<th>Age 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental intra-oral</td>
<td>NA</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Head CT</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Chest CT</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Abdominal CT</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>FDG PET CT</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Section 2.1

Basic concepts & principles of radiation protection and how they are applied to paediatric imaging.

Table 9. Socratic questions for referring clinicians when considering imaging procedure.

<table>
<thead>
<tr>
<th>What the referer should answer</th>
<th>Preventable, wasteful exposures to radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has it been done already?</td>
<td>Unnecessarily repeating an already done procedure</td>
</tr>
<tr>
<td>Do I need it?</td>
<td>Undertaking investigations that affect patient management</td>
</tr>
<tr>
<td>Do I need it now?</td>
<td>Investigating too early, before the patient is ready</td>
</tr>
<tr>
<td>Is this the best investigation?</td>
<td>Designing the investigation with due consideration to the patient's safety</td>
</tr>
</tbody>
</table>

Table 10. Examples of the influence of some common adjustable CT techniques on radiation dose.

<table>
<thead>
<tr>
<th>CT Technique</th>
<th>Influence on Radiation Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray energy (kilovoltage peak - kVp)</td>
<td>Decreased kVp → decreased dose</td>
</tr>
<tr>
<td>Tube current (milliamperes-mA)</td>
<td>Decreased mA → decreased dose</td>
</tr>
<tr>
<td>X-ray tube rotation speed (seconds)</td>
<td>Faster tube (gantry) spinning → increased dose</td>
</tr>
<tr>
<td>Scanning range/distance (in cm)</td>
<td>Shorter scanning distance → decreased dose</td>
</tr>
<tr>
<td>Patient position in scanner</td>
<td>Improper positioning in gantry → increased dose</td>
</tr>
<tr>
<td>Number of scan sequences (phases)</td>
<td>Increasing phases (e.g. pre and post contrast) → increased dose</td>
</tr>
<tr>
<td>Scanning multiple body regions</td>
<td>Minimizing scan overlap decreases dose</td>
</tr>
<tr>
<td>Optimal use of intravenous contrast (dye)</td>
<td>Improved structure visibility → decreased dose</td>
</tr>
<tr>
<td>Special technologies</td>
<td>Scanner dependent; additional techniques → increased dose</td>
</tr>
</tbody>
</table>
Section 2.2

Key elements to establish and maintain a radiation safety culture in health care to improve practice.

Box 2.4 Steps to establish and maintain radiation safety culture

(a) Promote individual and collective commitment to protection and safety at all levels of the organization
(b) Ensure a common understanding of the key aspects of safety culture within the organization
(c) Provide the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, with account taken of the interactions between individuals, technology and the organization
(d) Encourage the participation of workers and their representatives and other relevant persons in the development and implementation of policies, rules, procedures dealing with protection and safety
(e) Ensure accountability of the organization and of individuals at all levels for protection and safety
(f) Encourage open communication with regard to protection and safety within the organization and as appropriate
(g) Encourage a questioning attitude, discourage censorship
(h) Promote culture of continuous improvement

Table 11: Strategies to improve radiation safety culture

<table>
<thead>
<tr>
<th>Elements affecting the culture</th>
<th>Strategies to improve radiation safety culture</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic underlying assumptions</td>
<td>Education, advocacy (i.e., raising awareness)</td>
<td>Radiation protection education in medical and dental schools, campaigns</td>
</tr>
<tr>
<td>Adopted shared values</td>
<td>Standards, norms, guidelines</td>
<td>Radiation basic safety standards, referral guidelines for medical imaging</td>
</tr>
<tr>
<td>Artefacts/visible products</td>
<td>Training, audit, feedback and quality</td>
<td>On-the-job training, operational rounds, behavioural change through targeted messages</td>
</tr>
</tbody>
</table>
Chapter 3: Risk-benefit dialogue

Section 3.1

Practical tips to support the risk-benefit dialogue

Table 12. Clinical questions about risks of a radiological examination and possible answers

<table>
<thead>
<tr>
<th>Question</th>
<th>Possible responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Why are you recommending this radiological examination?”</td>
<td>“We need more information to clarify your child’s diagnosis, and to direct our treatment. This radiological examination can rapidly and accurately provide that information.”</td>
</tr>
<tr>
<td>“Are there any risks of this radiological examination?”</td>
<td>“One concern is the possibility of cancer resulting from the radiation from this examination.”</td>
</tr>
<tr>
<td>“How great is this risk?”</td>
<td>“The risk from this radiological examination is very small, if a risk at all. We are not certain that there is a risk at very low doses, like those doses in the vast majority of X-ray procedures or CT.”</td>
</tr>
</tbody>
</table>
| “How does the risk from this radiological examination compare to the risk of my child’s presenting condition?” | “I have considered your current situation carefully, taking into account many factors.” Depending on the circumstances, 
- “I have significant concern that your child has an injury or serious medical condition.” |

Box 3.2 Messaging: An example of two ways to present the facts related to radiation exposure risk

A. After a pelvic CT scan of a pregnant patient in the emergency department to evaluate trauma following a motor vehicle accident, she was seen by her primary physician. “The CT was an important exam that allowed the physicians to rapidly evaluate and treat your injuries which otherwise could have placed your health and that of your child at risk.”

B. “The CT was an important exam that allowed the physicians to rapidly evaluate and treat your injuries which otherwise could have placed your health and that of your child at risk.”
Section 3.1

Message mapping and examples of Q&As

<table>
<thead>
<tr>
<th>Stakeholder: parents</th>
<th>Message 1</th>
<th>Message 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anticipated question:</strong> How much radiation will my child receive from this head CT?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This CT is recommended now to aid in diagnosis and guide the treatment of your child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your child will receive the lowest possible dose without decreasing the diagnostic quality of the image.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supporting information 1-1</th>
<th>Supporting information 2-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have evaluated the clinical condition of your child and agreed that we need to confirm the diagnosis to make a decision about the treatment (examples/stories).</td>
<td></td>
</tr>
<tr>
<td>There are many techniques to lower the dose without compromising the diagnosis (examples, visual communication).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supporting information 1-2</th>
<th>Supporting information 2-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have considered alternative tests and agreed that this is the examination indicated for your child (referral guidelines).</td>
<td></td>
</tr>
<tr>
<td>This imaging facility uses equipment, protocols and techniques suitable for children (accreditation, audits).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supporting information 1-3</th>
<th>Supporting information 2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>This examination has to be done now to avoid any delay in the treatment, in case the diagnosis is confirmed (examples, scientific data).</td>
<td></td>
</tr>
<tr>
<td>This facility periodically compares its doses with national and international reference values and stays within those ranges (pediatric DRLs).</td>
<td></td>
</tr>
</tbody>
</table>

**Table 13. Example of message mapping in paediatric imaging**

**c) What medical imaging procedures use ionizing radiation?**
- The most common radiological imaging procedures utilizing ionizing radiation are:
  - conventional radiography, computed tomography (CT), fluoroscopy, and nuclear medicine examinations, including positron emission tomography (PET) and single-photon emission computed tomography (SPECT), as well as hybrid techniques combining these modalities (e.g. PET-CT).

**d) What medical imaging procedures do not use ionizing radiation?**
- Two common imaging techniques that do not utilize ionizing radiation are ultrasound and magnetic resonance imaging (MRI).

**e) Why can’t we do a procedure that does not use radiation instead?**
- Your child’s physician (e.g., paediatrician, family physician) can talk with the imaging specialist to get help in determining which type of test might be best.
- We have considered using examinations that do not require radiation, but we have determined that they will not give us the necessary information.
- Following careful consideration of your child’s unique medical needs, this is the best procedure to answer the clinical question.
- While there are other procedures that do not use radiation, this procedure will best provide us with the information needed to inform our treatment plan.

**f) Does my child need it? Does she/he need it now?**
- The referring medical practitioner and radiologist have done a risk–benefit analysis for the recommended imaging procedure. They have considered alternative tests, and this specific procedure is recommended to aid in diagnosis and/or treatment of your child.
- The referring practitioner and radiologist have done a risk–benefit analysis for the recommended imaging procedure. They have considered alternative tests, and this specific procedure is recommended to aid in diagnosis and/or treatment of your child.
- Although some conditions may be self-limiting and tests for such conditions may be postponed, other conditions will need investigation sooner to help with the care of your child.
Section 3.2

Ethical issues related to communication of radiation risks

3.2 Ethical considerations

This section emphasizes the importance of an effective radiation risk communication process. In the context of ethics and health, the respect for the dignity of persons includes the right to make autonomous, informed, and free choices. An informed decision-making process is valid only if the final decision is free of coercion and based on understandable and transparent information provided to the patient. There are different ways in which consent is given. In paediatric imaging, the informed decision-making process usually consists of a verbal exchange between the health-care professionals and the patient and caregiver. It is important to note that a written consent form merely documents the discussion but the act of signing a consent form is not a substitute for an informed discussion. Most often written consent is not necessary in diagnostic imaging procedures. The consent does not necessarily need to be explicitly expressed (i.e., it can be "implied consent").
Creating a dialogue in the medical community: scenarios and key players
Example of information tools for patients and families

The radiation dose can be adjusted based on the type of exam and the detail of the images needed. The exposure settings can be adapted for children (“child-sized”) to deliver the least amount of radiation for producing an image that shows the information the doctors need.

A CT scan gives a small amount of radiation to the patient, and conventional radiography can give a hundred times less. Chest X rays, for example, give about the same amount of radiation as we are exposed to just from several days’ worth of naturally occurring radiation in our everyday environment.

<table>
<thead>
<tr>
<th>Paediatric exam</th>
<th>Equivalent period of exposure to natural radiation</th>
<th>Increase in the risk of cancer in the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental intraoral exam</td>
<td>&lt; 1 day</td>
<td>Extremely small</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>3 days</td>
<td>Extremely small</td>
</tr>
<tr>
<td>Head CT scan</td>
<td>≈1 year</td>
<td>Minimal (very much less than 1%)</td>
</tr>
<tr>
<td>Abdominal CT scan</td>
<td>≈1.5 year</td>
<td>Very low (much less than 1%)</td>
</tr>
<tr>
<td>PET CT*</td>
<td>≈6 years</td>
<td>Low (less than 1%)</td>
</tr>
</tbody>
</table>

When these exams are needed, their benefit is very high, and much greater than the risks.

What questions might we ask?

You should feel confident that your referring physician or the imaging facility staff can provide information about your child’s X-ray exams. Here are some examples of questions you may ask:

- IS THE EXAM NEEDED?
- IS THE EXAM NEEDED NOW?
- DO YOU KNOW IF THIS EXAM HAS BEEN DONE RECENTLY?
- CAN ANOTHER EXAM BE DONE WHICH DOES NOT USE IONIZING RADIATION?
- CAN AN EXAM THAT HAS BEEN ALREADY DONE GIVE THE INFORMATION NEEDED?
- HOW WILL THE EXAM HELP WITH MY CHILD’S CARE?
- WHAT ARE THE RISKS OF THIS EXAM?
- WHAT ARE THE RISKS OF NOT HAVING THIS EXAM?
- HOW DOES THE IMAGING FACILITY ASSURE THAT THE RIGHT RADIATION DOSE IS USED ACCORDING TO MY CHILD’S SIZE?

Additional Resources

This leaflet, as well as other more specific leaflets on different types of X-ray imaging exams, have been developed as a complementary tool to the WHO report Communicating Radiation Risks in Paediatric Imaging, where you can find more detailed information.

Further useful information is available at Image Gently http://www.imagelientlyparents.org

Do you need further information?

More specific leaflets on different types of imaging exams that use ionizing radiation are available.
X-rays for children: benefits and risks

On average, 1 in 3 people will develop cancer during their lifetime. X-ray exams may slightly increase this normal chance of developing cancer later in life. Children are especially vulnerable to the effects of radiation due to their growing tissues and their longer lifespan. When X-ray exams are needed for diagnosing an illness or injury in a child and they are performed with the proper technique, the benefits far outweigh the radiation risks.

How much do you know about radiation?

Radiation is energy that travels in the form of waves or particles. Radiation is part of our everyday environment. People are exposed to cosmic radiation from outer space, as well as to natural radioactive materials found in the soil, water, food, air and also in the body. The use of radiation in medicine is the largest artificial source of radiation exposure.

An important fact about radiation

There are two types of radiation: ionizing and non-ionizing radiation.

Ionizing radiation can remove electrons from atoms (ionize). Medical and dental conventional radiography, computed tomography (CT), nuclear medicine and fluoroscopy are examples of exams that use ionizing radiation.

In contrast, non-ionizing radiation can make atoms vibrate, but does not have enough energy to remove electrons. Ultrasound and magnetic resonance imaging (MRI) are examples of exams that use non-ionizing radiation.

What exams use X-rays?

Medical and dental conventional radiography

Radiography is the use of X-rays to visualize the internal organs and structures of the body including film-based techniques as well as digital technologies.

Computed Tomography

A computed tomography or CT scan is an exam that uses X-rays to get images of the body, showing detail of organs which is not available on conventional radiographs.

Fluoroscopy and fluoroscopy-guided exams

Fluoroscopy is like a video which uses x-ray pulses to show organ motion within the body in real-time, and allows performing procedures involving small devices (e.g. catheters, needles, balloons).

Imaging exams that do not use X-rays

Ultrasound

Magnetic Resonance Imaging (MRI)

What is the value of medical imaging in children?

Radiology is an essential part of pediatric health care. X-ray imaging exams can save lives and X-ray guided interventions may replace more invasive surgery.

The benefit of an X-ray exam should always outweigh the radiation risks. It is not certain that there is any risk at very low doses, and if there is, it is very small. Even so, your radiology team takes radiation protection in pediatric imaging seriously and uses the smallest amount of radiation necessary.

We should be sure that an imaging exam will do more good than harm (doctors call this “justification”). It is important to deliver the smallest amount of radiation needed to obtain images for the desired purpose (doctors call this “optimization”). Both are part of responsible and ethical medical practice.

Tell your doctor if your child has had imaging exams before
Posters and leaflets for patients and families

Toolkit to be populated with other information materials and e-learning tools for health care providers and medical students
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- Angela Shogren, USEPA, USA
Every good conversation starts with good listening.

“The doctor will see you now—I can’t promise that he’ll talk to you, but he’ll see you.”

Thank you for your attention.

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World Health Organization