A Radiologist’s Perspective: Communicating Benefit versus Risk

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No disclosures
Objectives

• Provide some perspective on the benefit-risk discussion through examples of other medical benefits and risks

• Outline a few helpful strategies when speaking with patients or their parents

• Present a few clinical scenarios involving pediatric patients and their families where radiation benefits and risks are discussed

• How do dosimetry tracking and quality assurance programs facilitate discussion and improve the quality of care to your patients?
Parenting Fears

**Imagined**

1. Kidnapping
2. School snipers
3. Terrorism
4. Stranger danger
5. Drugs
6. Vaccinations
7. Playing in the front yard or walking to school
8. Bullying
9. School buses
10. Natural disasters

**Reality**

1. Automobile accidents
2. Homicide (usually inner city males)
3. Abuse (usually a family member)
4. Suicide
5. Drowning
6. Fire
7. Suffocation
8. Bicycle accidents
9. Unintentional poisoning
10. Everything else

Medical Risks in the News

10th confirmed measles case in Puget Sound outbreak, exposure at Seattle Children’s

By Asia Fields
Seattle Times staff reporter

King County public health officials announced another confirmed case of measles on Friday and warned that anyone who visited Seattle Children’s emergency room or a Fred Meyer in Kent on certain days may have been exposed.

The child who was recently diagnosed is the eighth resident in King County to contract measles since the beginning of the year, according to Public Health – Seattle & King County. The case is the 10th in Western Washington since an outbreak was declared in May.

The child was at a Fred Meyer in Kent last week and at Seattle Children’s twice this week before being diagnosed, according to Public Health. Seattle Children’s says they are notifying visitors and patients who may have been exposed.

Officials say anyone who visited the following locations during the times listed could have been exposed to measles:

- Fred Meyer at 25150 Pacific Highway South in Kent on June 19 from 6:45 to 9:45 p.m.
- Seattle Children’s Emergency Department on June 23 from 12:45 to 2:45 a.m.
- Seattle Children’s Emergency Department on June 26 from 2:30 to 4:30 a.m.
- and 12:30 to 3:30 p.m.

Health officials are still working to determine the source of the child's measles and whether this case is connected to others in the area. Last month, an infant was diagnosed with measles after she was brought to Seattle Children’s emergency department.

Measles Cases and Outbreaks

Measles Cases in 2019

From January 1 to June 20, 2019, 1,077** individual cases of measles have been confirmed in 28 states. This is an increase of 33 cases from the previous week. This is the greatest number of cases reported in the U.S. since 1992 and since measles was declared eliminated in 2000.
U.S. Measles Burden: Before 1963 Vaccine Development*

Each year, measles caused an estimated 3 to 4 million cases

Close to 500,000 cases were reported annually to CDC, resulting in:

• 48,000 hospitalizations (~10%)

• 1,000 cases with encephalitis (~0.2%)

• 450 to 500 deaths (~0.1%)

*Source: www.cdc.gov/measles/about/history.html
Measles and Vaccinations

• Vaccine first introduced in 1963

• Measles was considered to be eradicated in US by 2000

• Within the first 20 years, the vaccine is estimated to have prevented;
  • 52 million cases of measles
  • 17,400 complications of CNS injury
  • 5,200 deaths
### U.S. Economic Burden of Measles*

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Number of Cases (outbreaks)</th>
<th>Estimated public health cost</th>
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<tbody>
<tr>
<td>2011</td>
<td>US</td>
<td>107 (16)</td>
<td>$2.7-5.3 million</td>
</tr>
<tr>
<td>2011</td>
<td>Utah</td>
<td>13 (2)</td>
<td>&gt; $330,000</td>
</tr>
<tr>
<td>2008</td>
<td>California</td>
<td>12 (1)</td>
<td>$125,000</td>
</tr>
<tr>
<td>2008</td>
<td>Arizona</td>
<td>14 (1)</td>
<td>$800,000 (limited to cost for 2 hospitals to respond to 7 cases in their facilities)</td>
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<tr>
<td>2005</td>
<td>Indiana</td>
<td>34 (1)</td>
<td>$168,000; 9% hospitalization rate</td>
</tr>
<tr>
<td>2004</td>
<td>Iowa</td>
<td>1</td>
<td>$142,000</td>
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</table>


^Public health and health care costs expended to control the spread of measles
Nature abhors a...
Fear, Hope, and Logic

Spock: Jim... the statistical likelihood that our plan will succeed is less than 4.3%.

Kirk: It'll work.

Spock: In the event that I do not return, please tell Lieutenant Uhura...

Kirk: Spock. It'll work.
Hope is Irrational
Long-term Differences in Language and Cognitive Function After Childhood Exposure to Anesthesia

Risk Assessment

FDA review results in new warnings about using general anesthetics and sedation drugs in young children and pregnant women

Safety Announcement

12-14-2016 The U.S. Food and Drug Administration (FDA) is warning that repeated or lengthy use of general anesthetics and sedation drugs during surgeries or procedures in children younger than 3 years or in pregnant women during their third trimester may affect the development of children’s brains.

Consistent with animal studies, recent human studies suggest that a single, relatively short exposure to general anesthetic and sedation drugs in infants or toddlers is unlikely to have negative effects on behavior or learning. However, further research is needed to fully characterize how early life anesthesia exposure affects children’s brain development.

To better inform the public about this potential risk, we are requiring warnings to be added to the labels of general anesthesia and sedation drugs (see List of General Anesthesia and Sedation Drugs Affected by this Label Change). We will continue to monitor the use of these drugs in children and pregnant women and will update the public if additional information becomes available.

Anesthetic and sedation drugs are necessary for infants, children, and pregnant women who require surgery or other painful or stressful procedures, especially when they face life-threatening conditions requiring surgery that should not be delayed. In addition, untreated pain can be harmful to children and their developing nervous systems.

Health care professionals should balance the benefits of appropriate anesthesia in young children and pregnant women against the potential risks, especially for procedures that may last longer than 3 hours or if multiple procedures are required in children under 3 years. Discuss with parents, caregivers, and pregnant women the benefits, risks, and appropriate timing of surgery or procedures requiring anesthesia and sedation drugs.

Parents and caregivers should discuss with their child’s health care professional the potential adverse effects of anesthesia on brain development, as well as the appropriate timing of procedures that can be delayed without jeopardizing their child’s health.

Pregnant women should have similar conversations with their health care professionals. Also talk with them about any questions or concerns.
In 2007, the Food and Drug Administration requested that manufacturers of all approved gadolinium-based contrast agents (GBCAs), drugs widely used in magnetic resonance imaging, use a new identifier text in their product labeling to describe the risk of nephrogenic systemic fibrosis (NSF). Accumulating information about NSF risk led to revision of the labeling text for all of these drugs in 2015. The present report summarizes the basis and purpose of this class labeling approach and describes some of the related challenges, gives the evolutionary nature of the NSF risk evidence. The class labeling approach for presentation of product risk is designed to decrease the occurrence of NSF and to enhance the safe use of GBCAs in radiologic practice.

1 GBCA, 2012

**2007**
- FDA required manufacturers of GBCA to describe the risk of NSF (Nephrogenic Systemic Sclerosis)

**2015**
- FDA issues a warning concerning tissue deposition of gadolinium with repeated use of GBCA
- Anaphylaxis?
Early death after discharge from emergency departments: Analysis of national US insurance claims data

Among discharged patients, 0.12% (12,375/10,093,678, in the 20% sample over 2007-12) died within seven days, or 10,093 per year nationally, despite no diagnosis of a life-threatening illness. Mean age at death was 69.


The mortality of patients in a pediatric emergency department at a tertiary medical center in China: An observational study.

Death rate was 0.5/1,000 visits. 89% were < 5 years, 69% 1 month-1 year in age. Respiratory disease accounted for 15%, neuromuscular disorders 14%, and cardiovascular disease 13%. 45% were DOA, with another 40% dead within 24 hours.

Pediatric Imaging

- CT accounts for ~50% of all medical radiation exposure
- Pediatric CT constitutes ~5-11% of all CT examinations (mainly head CT)
- 87% of emergency pediatric CT is performed outside of pediatric centers
- 40% of CT examinations performed at non-pediatric centers used an inappropriate number of phases when evaluating for appendicitis
- Resources and experience with alternative imaging techniques outside of pediatric facilities is limited

Explaining Radiation Risks

- Extrasensory
- Temporal delay in effects
- Stochastic versus deterministic
- Statistical probabilities versus certainties
- Background radiation and cancer mortality from all causes
The Benefit - Risk Balance

• Expected exposure within a 20 km area near Fukushima reactors = 16 mSv/year

• Number of prevented cancer deaths ~ 160

• Most residents would have received approximately 4 mSv/year

• ~1,600 individuals died from the stress of relocation

• No known radiation deaths

• “We’re bad at balancing risks, we humans, and we live in a world of continual uncertainty. Trying to avoid the horrors we imagine, we risk creating ones that are real.”
## Scenarios for Radiologists

**Preceding an examination**
- Just in Time
- Estimated data
- Risk in relationship to alternatives:
  - Conservative management
  - Imaging alternatives
  - Intervention

**Afterwards**
- Organized
- Tangible data
- Cumulative dose
- Relationship to other treatment risks:
  - Radiation therapy
  - Chemotherapy
  - Anesthesia, CP Bypass
  - Surgery

**Both**
- Preparation
- Comfort level
- Limited information
- Uncertainty
- Emotional content
Managing Negative Perceptions Through Patient Engagement

- Sense of autonomy and control
- Active dialogue concerning benefits, risks, and alternatives
- Shared decision making
- Cultural sensitivity - Physician as authority figure

Describing the Risks of Clinically Indicated Examinations in the Context of Clinical Benefits

- Individuals judge risks associated with an activity to be lower when they have a clear understanding of the benefits resulting from the activity.

- Small risks presented in isolation tend to be overestimated by both laypersons and scientists alike.

- The description of “clinically indicated” suggests that the immediate benefits of diagnosis outweigh the risk to long-term life expectancy from possible radiation-induced cancer.

- While ALARA is an integral concept to diagnostic imaging, the emphasis should remain on keeping “diagnostic” AHARA.

Maintaining an Effective Flow of Information Within the Institution

**Team approach:**

- Referring physicians
- Technologists, Nurses, and Child Life Specialists
- Radiologists
- Medical and Health Physicists
- Radiation Safety Officers
- Administrators
- Regulators and accrediting organizations
Clinical Appropriateness

• Clarify indications via direct discussion with ordering provider or patient and family

• Respect patient and family autonomy and participation in decision-making

• Evidence-based appropriateness guidelines or clinical care pathways

• Helpful in establishing trust and authority

• Minimizes concerns as to radiologist or facility financial interests

Achievements and Accomplishments

Illustrates;

- Risk awareness
- Dose Management
- Mitigation strategies to limit risk

- ACR CT Dose Index Registry
- ACR Accreditation
- Image Gently
- Protocol Reviews
- Appropriateness guidelines
- Clinical care pathways
- Scientific Publications

Technical Jargon

Radioactivity

• Becquerel (IU)
• Curie (US)

Exposure:

• Coulomb/kilogram (IU)
• Roentgen (US)

Absorbed dose:

• Gray (IU)
• Rad (US) = 0.01 Gy

Effective Dose:

• Sievert (IU)
• Rem (US) = 0.01 Sv

CTD Iv ol

• Measure of energy deposited per unit mass
• Proportional to absorbed dose (Gy)

DLP:

• $\text{CTD}_{\text{vol}} \times \text{scan length (mGy.cm)}$

$k$-factor

• Tissue weighting factor

Effective Dose for CT

$= \text{DLP} \times k$
Technical Jargon

• Clarification of various concepts and units can be quite helpful;
  • Engendering trust with the physician and team
  • Understanding of radiation and tissue interactions
• Effective dose estimates have limitations;
  • +/- 40% uncertainty (adults)
  • Judging the dose relative to background
  • Never intended as a risk measure for individuals
Describing Familiar Comparisons to Effectively Convey Risk

<table>
<thead>
<tr>
<th>Source</th>
<th>Biologic Dose (mSv)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level annual dose USA</td>
<td>3.1 2.28 inhaled radon, 0.33 cosmic radiation</td>
<td></td>
</tr>
<tr>
<td>Sea level annual dose Japan</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Smoking 1 ppd annual</td>
<td>0.36 Po-210 and Pb-210 in fertilizers</td>
<td></td>
</tr>
<tr>
<td>Airport X-Ray scan</td>
<td>0.0000148</td>
<td></td>
</tr>
<tr>
<td>1 flight NYC to LA</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Flight crew annual</td>
<td>2.0 - 5.0 Higher near poles</td>
<td></td>
</tr>
<tr>
<td>Recommended limit flight personnel</td>
<td>20 ICRP recommendation</td>
<td></td>
</tr>
<tr>
<td>Chest radiographs</td>
<td>0.1-0.2</td>
<td></td>
</tr>
<tr>
<td>Head CT</td>
<td>1 - 2.5</td>
<td></td>
</tr>
<tr>
<td>Abdomen/Pelvic CT</td>
<td>5-8</td>
<td></td>
</tr>
<tr>
<td>Cardiac catheterization</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>UGI with SBFT</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>ECG-gated cardiac CT</td>
<td>&lt;1.0 - 18.0 Range due to age and techniques</td>
<td></td>
</tr>
<tr>
<td>Cardiac catheterization</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>NM Biliary scan</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>NM ECG-gated cardiac perfusion</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Medical USA</td>
<td>3 primarily CT and NM</td>
<td></td>
</tr>
<tr>
<td>Average Fukushima dose</td>
<td>12 10 mSv during evacuation and 4 mSv year afterwards</td>
<td></td>
</tr>
<tr>
<td>Annual limit for radiation workers</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Pregnancy termination</td>
<td>100 ICRP recommendation</td>
<td></td>
</tr>
<tr>
<td>Typical ISS mission</td>
<td>100 Range 80-160; solar activity deflecting ionizing particles</td>
<td></td>
</tr>
<tr>
<td>Average A-bomb survivor dose</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>LD50/60</td>
<td>5,000</td>
<td></td>
</tr>
</tbody>
</table>

## Lifetime Risk of Death

<table>
<thead>
<tr>
<th>Source</th>
<th>Lifetime Risk (%)</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assault</td>
<td>0.47</td>
<td>1/214</td>
</tr>
<tr>
<td>Automobile passenger</td>
<td>0.33</td>
<td>1/304</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>0.15</td>
<td>1/652</td>
</tr>
<tr>
<td>Choking</td>
<td>0.11</td>
<td>1/894</td>
</tr>
<tr>
<td>Falling down stairs</td>
<td>0.05</td>
<td>1/2,024</td>
</tr>
<tr>
<td>Bicycling</td>
<td>0.02</td>
<td>1/4,734</td>
</tr>
<tr>
<td>Accidental firearms shooting</td>
<td>0.02</td>
<td>1/6,333</td>
</tr>
<tr>
<td>Airplane accident</td>
<td>0.01</td>
<td>1/7,058</td>
</tr>
<tr>
<td>Lightning strike</td>
<td>0.0012</td>
<td>1/84,388</td>
</tr>
</tbody>
</table>

Graphics and Visual Aids

• Diagrams illustrating a mortality risk of 1 in 4,000 (represented by the blue wedge) in a 10-year-old patient resulting from a 3-mGy radiation exposure, compared with the naturally occurring lifetime cancer mortality (22%).


• Demonstration of 1 in 2,500 risk in comparison to 550 in 2,500. For example of 10-‐y-‐old receiving 99mTc-‐MDP bone scan, excess attributable risk for cancer death is 1 in 2,500
Critical Communication

Patient and Parental Needs

**Cognitive**

- Understanding
- Questions answered and information provided

**Affective**

- To have concerns acknowledged and understood
- Empathy, compassion
- Respect, Concern
- Verbal - Reflecting upon feelings, silence
- Nonverbal - Eye contact, time for interaction and thought

Trust, Tone, and Perceptions

• People want to know you care, before they care what you know

• People under stress tend to recall the first and last thing heard

• Listen actively

• Speak deliberately

• Trust can be established (or destroyed) in as little as 30 seconds.

• Negative words (i.e. not, never, nothing, none, and however) receive greater attention and longer retention than positive or solution-oriented information

Physician Competencies for Health Care Communication

1. Develop a partnership with the patient
2. Establish or review the patient’s preferences for information
3. Establish or review the patient’s preference for his or her role in decision making
4. Ascertain and respond to the patient’s ideas, concerns, and expectations
5. Identify choices (including those suggested by the patient)
6. Present information and assist the patient to reflect on the impact of alternate decisions
7. Negotiate a decision with the patient
8. Agree upon an action plan and complete arrangements for follow up

Optimizing Communication with Patients and Families

- **Prepare** ahead with logical sequencing of information
- **Private** setting for discussion and decision-making
- **Personalize** the discussion by including the patient’s name
- Keep the **level of discussion** understandable
- Recognize and acknowledge emotional **distress**
- Discuss indications, risks, benefits, and alternatives
- **Visual aids**
- Encourage repeat-backs, questions, and clarifications
- **Avoid surprises** if possible

Issues specific to children and radiation

• Preverbal - More dependent on clinical signs and provider assessment
• Decisions are often made by surrogates/guardians
• Different clinical disorders in children
• Same disorder may be imaged differently
• Some imaging alternatives may not be available in specific settings
• Imaging use may be higher due to the unfamiliarity
• Techniques are often not appropriately adjusted for children

Issues specific to children and radiation

• Greater mitotic cellular activity and somatic growth

• Longer lifespan provides a larger window of opportunity for radiation damage to manifest

• For a similar radiation exposure, the smaller organs and tissues in children will receive a higher dose

<table>
<thead>
<tr>
<th>Parameter</th>
<th>&lt; 10 years</th>
<th>11-18 years</th>
<th>&gt; 18 years</th>
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</thead>
<tbody>
<tr>
<td>Section dose (mGy)</td>
<td>23.5</td>
<td>18.7</td>
<td>15.7</td>
</tr>
<tr>
<td>Energy imparted (mJ)</td>
<td>72.1</td>
<td>183.5</td>
<td>234.7</td>
</tr>
<tr>
<td>Effective dose (mrem)</td>
<td>610</td>
<td>440</td>
<td>390</td>
</tr>
</tbody>
</table>

Effects of diagnostic and therapeutic radiation in children

Greater radiosensitivity of tissues in childhood:

1. Thyroid (tinea capitis, hemangioma, tonsillar, thymic hypertrophy)
2. Breast (hemangioma, thymus, chest fluoroscopy, scoliosis)
3. Leukemia (tinea capitus, hemangioma)
4. Brain (tinea capitis)
5. Skin (hemangioma, tinea capitus)

Other factors may modify the risks:

Gender, $age_{exposure}$, $age_{attained}$, latency, underlying disease, and effects of other carcinogens

Who is your audience?

- Patient
- Families (parent or guardian)
- Referring provider
- Radiologists
- Administrators
- Regulators
For patients

• Toddlers and children - Will this hurt?
• Teens - Will this cause cancer?
• Everyone - How will this help me get better?
Awareness of Popular Media
13 year old female with autoimmune disease
Mother called our schedulers and requested a list of her daughter’s studies and associated radiation dose

<table>
<thead>
<tr>
<th>Date</th>
<th>Exam</th>
<th>DLP</th>
<th>Body Region</th>
<th>k-factor*</th>
<th>ED (mSv)</th>
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<tbody>
<tr>
<td>4/18/14</td>
<td>CT Thorax w/o Hi-res</td>
<td>128.02</td>
<td>chest</td>
<td>0.015</td>
<td>1.9</td>
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<td>9/2/15</td>
<td>CT Thorax w/o Contrast</td>
<td>109.45</td>
<td>chest</td>
<td>0.014</td>
<td>1.5</td>
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<td>6/26/15</td>
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<td>127.11</td>
<td>chest</td>
<td>0.014</td>
<td>1.8</td>
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<td>5/13/15</td>
<td>CT Thorax w/o Contrast</td>
<td>106.91</td>
<td>chest</td>
<td>0.014</td>
<td>1.8</td>
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<td>3/4/15</td>
<td>CT Thorax w/o Contrast</td>
<td>118.47</td>
<td>chest</td>
<td>0.014</td>
<td>1.7</td>
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<td>1/28/15</td>
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<td>130.13</td>
<td>chest</td>
<td>0.014</td>
<td>1.8</td>
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<tr>
<td>1/6/15</td>
<td>CT Thorax w/o Contrast</td>
<td>102.81</td>
<td>chest</td>
<td>0.014</td>
<td>1.4</td>
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<td>12/23/14</td>
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<td>127.93</td>
<td>chest</td>
<td>0.014</td>
<td>1.8</td>
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<td>10/14/14</td>
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<td>0.015</td>
<td>2.5</td>
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<td>chest</td>
<td>0.014</td>
<td>1.4</td>
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<td>CT Thorax w/ Contrast</td>
<td>301.13</td>
<td>chest</td>
<td>0.014</td>
<td>4.2</td>
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<td>11/11/14</td>
<td>CT Thorax w/ Contrast</td>
<td>110.29</td>
<td>chest</td>
<td>0.014</td>
<td>1.5</td>
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<td>10/29/14</td>
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<td>70.42</td>
<td>chest</td>
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<td>1.0</td>
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<tr>
<td>1/14/16</td>
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<td>chest</td>
<td>0.014</td>
<td>2.0</td>
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<td>3/31/15</td>
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<td>chest</td>
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<td>1.6</td>
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<tr>
<td>10/21/14</td>
<td>CT Sinus</td>
<td>45.71</td>
<td>head</td>
<td>0.0021</td>
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<tr>
<td>7/16/15</td>
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<td>head</td>
<td>0.0021</td>
<td>1.3</td>
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<tr>
<td>2/11/15</td>
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<td>head</td>
<td>0.0021</td>
<td>1.2</td>
</tr>
<tr>
<td>10/21/14</td>
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<td>331.89</td>
<td>CAP</td>
<td>0.015</td>
<td>5.0</td>
</tr>
</tbody>
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*k-factors from AAPM Report 96

Cumulative estimated effective dose ~40 mSv
Case Study - Provider Discussion

- 10 year old female with Takayasu arteritis
- MRI, CT, and PET-CT are all potential options for diagnosis and surveillance
- Biomarkers are different for each of these diagnostic modalities
- No comparative studies for sensitivity and specificity relating to diagnosis and disease activity
- As the disease process may involve head, neck, chest, abdominal, and pelvic arteries, MRI will often be an extended examination and may require sedation
- MRI schedule is heavily booked
- Surveillance may be required every 3-6 months
Case Study - Provider Discussion

• Exams (71 kg)
  • CT Chest with contrast
    • DLP ~500 mGy-cm.
    • Estimated effective dose ~ 15 mSv

• PET-CT
  • Weight-based dose 7.1 mCi
    • Calculated radioisotope effective dose = 9.1 mSv
    • Calculated AC CT effective dose estimated ~ 6 mSv
    • Total PET-CT effective dose ~ 15 mSv
  
• Thus, no real dose distinction between a CE Chest CT versus full body PET-CT
Radiation-sensitive genetically susceptible pediatric sub-populations

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Gene</th>
<th>Frequency</th>
<th>Primary Tumor</th>
<th>Subsequent Tumors</th>
<th>Gene-Radiation Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereditary retinoblastoma</td>
<td>RB1</td>
<td>1/20,000</td>
<td>Retinoblastoma</td>
<td>Osseous/Soft tissue sarcomas, melanoma, CNS</td>
<td>Definite for osseous and soft tissue sarcomas</td>
</tr>
<tr>
<td>Neurofibromatosis type I</td>
<td>NF1</td>
<td>1/3,500</td>
<td>Neurofibroma, optic pathway glioma</td>
<td>Glioma, MNPST, Soft tissue sarcoma, leukemia</td>
<td>Probable</td>
</tr>
<tr>
<td>Li-Fraumeni</td>
<td>P53</td>
<td>Rare</td>
<td>Breast cancer, soft tissue sarcoma</td>
<td>Brain, leukemia, adrenocortical</td>
<td>Possible</td>
</tr>
<tr>
<td>Nevoid basal cell carcinoma (Gorlin syndrome)</td>
<td>PTCH</td>
<td>Rare</td>
<td>Basal cell carcinoma</td>
<td>Medulloblastoma</td>
<td>Definite</td>
</tr>
</tbody>
</table>

Dosimetry Tracking

Undue Exposure to Radiation: Radiology Dosage Per Pediatric Head CT
2017 Distribution

Top Quartile: 498.9
Lower is Better

Definition: Total dose length product (DLP) for all head CTs divided by number of head CTs for pediatric patients.
Data Source: Washington State Hospital Association’s (WSHA) Quality Benchmarking System (QBS)
Dosimetry Tracking
Conclusions

• The risks of medical imaging continue to gather attention, often without regard to benefits.
• There are many risks associated with illness and medical imaging – unrelated to radiation!
• Active listening and thoughtful dialogue with parents or guardians can help establish effective and trusting communication.
• Quantify and relate radiation risks to other more commonly understood risks.
• Visual aids, handouts, and critically reviewed online resources.
• Remember that we are a team – understand everyone’s roles and utilize their strengths!