Speakers

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Washington State Hospital Association

Undue Exposure to Radiation: Child Head CT Dosage

**Definition**

**Numerator:** Total dose length product (DLP) for all head CTs (child)

**Denominator:** Total number of CTs with recorded DLP (child)

**Data Source:** Facility direct report to WSHA.
Washington reduced the radiation dose in 2840 children – this translates into 6 elementary schools full of children.
Strategy Implementation

• Reduce inappropriate studies
• Reduce inappropriate orders
• Reduce inappropriate techniques
• Build a framework for ongoing work
Keys to Success

- **Right Study**
  - Percent of pediatric patients receiving observation for minor head trauma
  - Percent of pediatric patients receiving ultrasound for suspected appendicitis

- **Right Order**
  - Percent pediatric single phase head computed tomography (CT)
  - Percent of single phase chest computed tomography (CT)

- **Right Way**
  - Pediatric CT protocols developed, labeled and consistently used

- **Right Report**
  - Optimize radiation dose for pediatric head computed tomography (CT)

- **Right Action**
  - Quality data and performance improvement reported to organizations’ Quality Committee and shared with Emergency Department leadership

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Next Steps

• Define a champion and main contact from your organization

• Join us for bi-monthly calls on best practice and review of statewide data

• Access measure definitions at http://www.wsha.org/0694.cfm and submit data to QBS at http://www.wsha.org/0202.cfm

• For more information and to get started submitting data, contact Karen Lautermilch: karenl@wsha.org 206.216.2509

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The Spring 2014 issue of PHC Pulse has arrived.

Inside, you’ll find:

The groundbreaking work of radiologists like Gordon Teel, MD, and Robin Hines, MD, who are spearheading efforts to reduce radiation dose to patients undergoing CT exams.

PR work in support of physician education. Similar article published in Heart Beat, our consumer focused community news magazine.
Understanding Medical Radiation Exposure: What We Know and What We Don’t

Robin Hines, MD
Medical Director for Radiology, Providence Health Care
Emergency Radiology Section Chief, Inland Imaging
Overview

Appropriate use of Radiology Resources:
- in the Emergency Department
- CT in the Emergency Department
- CT in children in the Emergency Department
- CT of the head & neck in children in the ED

Background in:
- Radiation Exposure
- Radiation in Medical Imaging
- Radiation Dose
- Radiation in Children
What are some Key Questions to Answer?

- Why worry about radiation exposure?
- What is the scope of the problem?
- What is concerning about imaging with ionizing radiation in children?
- What are the risks? Who are we worried about and why?
- What can be done to minimize risk? Whose role is it?
- When should we scan kids in the ED?
- What do we tell patients and families?
- Where do we get additional/updated information?
Radiation Exposure

- **Background radiation** - from naturally occurring sources in the environment (radon, terrestrial rock, natural radionuclides) and cosmic rays from outer space

- **Medical radiation** – has increased 6-fold over the past 25 years - most significant source in this category is CT

- **Nuclear Explosion** - Atom Bomb Detonation at Hiroshima and Nagasaki

- **Nuclear Accidents** - Chernobyl, Ukraine and Fukushima, Japan
Ionizing radiation – high energy radiation capable of ionizing the tissues through which it passes.
High-level: radiation sickness/poisoning
Low-level: increased risk of cancer

Ionizing radiation classified as a carcinogen by:

- WHO International Agency for Research on Cancer
- Agency for Toxic Substances and Disease Registry of the Centers for Disease Control
- National Institute of Environmental Health Sciences
Low-Level Radiation Exposure

- Background radiation in U.S. estimated to be an average of 3 mSv/year
- High altitude residents (Denver, CO) are exposed to higher level of cosmic radiation – an additional 1.5 mSv/year average background radiation compared to residents at sea level
- High radon levels increases radiation exposure
- In 1987, it was estimated that medical imaging contributed less than 15% of the total radiation exposure to the U.S. population/year. 25 years later exposure from medical imaging increased six-fold from an average of 0.5 mSv to 3 mSv/year
Radiation Exposure and Cancer Risk

- Background rate of cancer is high – 4 of out 10 will be diagnosed with cancer in their lifetime
- Low-level radiation is “weakly carcinogenic” – how do we measure the impact on cancer rates when the background rate is so high?
- How do we estimate impact when cancer presentation can be delayed 1-2 decades or more?
- Survivors of Chernobyl have shown a significantly increased incidence of thyroid cancers only in the 25 years since the accident
Radiation Exposure and Cancer Risk

- Background radiation – 3 mSv
- Low level radiation – 100-150 mSv
- Based on data from atomic bomb survivors in Japan, there is a statistically significant increased chance of cancer at doses in excess of 50 mSv
- There is no specific data linking medical imaging with cancer – no study of radiation-induced cancers from CT or other imaging modalities – but it follows that as we add to the population’s radiation exposure, the risk of imaging-induced cancers will increase
The Benefits of CT

- Extraordinary detail yields high sensitivity and specificity
- Early, definitive, accurate diagnosis
- Quick and generally painless
- Decreased need for hospitalization for observation – reduces expense
- Decreased need for exploratory surgery/unnecessary treatments – reduces potential risk
- All these benefits make CT almost IRRESISTIBLE in the emergency setting

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Common and Appropriate Indications for CT

- **Major trauma** – evaluation head, spine, chest and abdominal/pelvic injuries
- **Inflammatory conditions** – appendicitis, abscess (paratonsillar, lung, perinephric)
- **Cancer evaluation** – primary tumor and metastatic disease, detection and surveillance

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Effective Dose in mSv

- Synthesis or summary of data which expresses a complex dose pattern, a quantity roughly proportional to the risk of harmful radiation effects

- Absorbed radiation is tissue-specific, influenced by age, size, gender, and is not easily measured

- Radiation dose is a complex business!

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Typical Radiation Doses from Medical Imaging of Children

<table>
<thead>
<tr>
<th>Exam</th>
<th>Dose (mSv)</th>
<th>CXR Equivalents</th>
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</thead>
<tbody>
<tr>
<td>Ankle X-ray (3V)</td>
<td>.0015</td>
<td>1/14th</td>
</tr>
<tr>
<td>CXR (2V)</td>
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<td>1</td>
</tr>
<tr>
<td>Nuclear Cystogram</td>
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<td>9</td>
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<tr>
<td>Fluoro Cystogram</td>
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<td>16</td>
</tr>
<tr>
<td>Brain CT</td>
<td>.33</td>
<td>100</td>
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<tr>
<td>Chest CT</td>
<td>3</td>
<td>150</td>
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<tr>
<td>Abdomen CT</td>
<td>5</td>
<td>250</td>
</tr>
<tr>
<td>Bone Scan</td>
<td>4-6</td>
<td>Up to 310</td>
</tr>
<tr>
<td>PET Scan</td>
<td>15</td>
<td>765</td>
</tr>
</tbody>
</table>

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ALARA PRINCIPLE

Radiation dose should be

As Low As Reasonably Achievable
ALARA

- Evaluate Benefit: Risk ratio of medical imaging
- Know that for most patients, the benefit of imaging in the appropriate setting will far outweigh the risk
- Be cognizant of issues of radiation exposure
- Know your patient’s imaging history
- Consider alternative imaging (ultrasound, MRI) that don’t use ionizing radiation
- Limit region being examined
- Consult with the radiologist – yes, you can!
ALARA

- For individual patients, generally, the benefits of medical imaging substantially outweigh the risks.
- For a population, the increasing use of medical imaging which employs ionizing radiation presents a public health risk.
- Estimated increased cancer risk is: 1 fatal cancer/1000 patients imaged/lifetime.
- We have no data which includes cancer incidence (fatal and nonfatal cancers and its associated morbidity/expense) vs. cancer mortality.

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Modifying Radiation Exposure

- Generally, more radiation yields better quality diagnostic images
- Since 2001, concern for radiation exposure, especially in young patients, has driven changes in scanner design/flexibility
- New scanners are equipped with Automatic Exposure Control or Tube Current Modulation
- Allows technologist to more easily reduce total radiation exposure – the scanner automatically decrease radiation to thinner, less dense body parts

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Regulation of CT – or Not

- No CT usage regulation by the FDA today, FDA only regulates equipment. Expect regulations by 2016.
- No standard dose requirements
- No requirements to display or record dose
- No mandate for ACR CT accreditation
- No warning for excessively high dose
- No warning for high cumulative dose from prior studies

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Limiting Radiation Exposure

- Increase awareness of the entire health care team for the need to reduce radiation exposure in children whenever possible, follow the ALARA Principle – includes physicians, PA’s, nurses, physicists, and technologists

- Use single phase imaging whenever possible

- Limit anatomic coverage whenever possible

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Why worry about radiation exposure more in children?

- Risk from radiation exposure - increased risk of developing cancer from being exposed to radiation - is cumulative over a lifetime.
- If you have your whole life ahead of you, you have more time to express that risk – to develop cancer.
- Radiation is more damaging to actively dividing cells and kids have more dividing cells than mature adults.
- “Non-essential” tissue (fat, muscle) attenuates ionizing radiation.
- Little people have less “non-essential” tissue so “essential” tissue (glandular) absorbs more radiation.
Radiation-Sensitive Tissues

- Fetus *
- Eyes
- Thyroid *
- Breasts *
- Bone Marrow
- GI tract
- Gonads *

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TALKING POINTS

- There is always some radiation exposure associated with CT scanning.
- Exposure from CT scans is generally considered low-level radiation.
- There is some small risk of developing cancer from exposure to low-level radiation and this increases with dose.
- There is no specific or well-defined measurable risk – risks from CT scans is estimated.
- The amount of radiation from CT is variable and depends largely on equipment and protocols used.

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TALKING POINTS

- Properly performed CT scans on newer equipment exposes children to much lower radiation dose than adults.

- The potential benefit from an indicated CT scan generally far out-weighs the risks of subsequent cancer.

- We use the ALARA principle!
Where to get additional/updated information

- The Alliance for Radiation Safety in Pediatric Imaging: www.imagegently.org
- American Academy of Pediatrics: www.aap.org

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Washington State Hospital Association
In Person Safe Table

Date: Wednesday February 25, 2015

Time: 9:00 a.m. – 2:30 p.m.

Location: DoubleTree Hotel, 18740 International Blvd, SeaTac, WA

Topic: 100K Children Campaign – Safe Imaging

To register for this event: Michelle Graham michelleg@wsha.org
206.216.2557