IHI Expedition
Eliminating Overuse in Medical Imaging

Wednesday, February 5, 2014
These presenters have nothing to disclose

Jimi Duncan, MD, PhD
Kelly McCutcheon Adams, LICSW

Expedition Coordinator

Kayla DeVincentis, CHES, Project Coordinator, Institute for Healthcare Improvement, currently manages web-based Expeditions and the Executive Quality Leaders Network. She began her career at IHI in the event planning department and has since contributed to the State Action on Avoidable Rehospitalizations (STAAR) Initiative, the Summer Immersion Program, and IHI’s efforts for Medicare-Medicaid enrollees. Kayla leads IHI’s Wellness Initiative and has designed numerous activities, challenges, and educational opportunities to improve the health of her fellow staff members. In addition to implementing the organization’s first employee health risk assessment. Kayla is certified in health education and program planning. Kayla is a graduate of Northeastern University in Boston, MA, where she obtained her Bachelors of Science in Health Science with a concentration in Business Administration.
WebEx Quick Reference

- Welcome to today’s session!
- Please use chat to “All Participants” for questions
- For technology issues only, please chat to “Host”
- WebEx Technical Support: 866-569-3239
- Dial-in Info: Communicate / Join Teleconference (in menu)

When Chatting…

Please send your message to All Participants
Chat Time!

What is your goal for participating in this Expedition?

Join Passport to:

- Get unlimited access to Expeditions, two- to four-month, interactive, web-based programs designed to help front-line teams make rapid improvements.
- Train your middle managers to effectively lead quality improvement initiatives.

. . . and much, much more for $5,000 per year!

Visit www.IHI.org/passport for details.
To enroll, call 617-301-4800 or email improvementmap@ihi.org.
What is an Expedition?

**ex•pe•di•tion (noun)**
1. an excursion, journey, or voyage made for some specific purpose
2. the group of persons engaged in such an activity
3. promptness or speed in accomplishing something

Expedition Support

- All sessions are recorded
- Materials are sent one day in advance
- Listserv address: medicalimaging@ls.ihi.org
  - Sends an email to all participants and faculty
  - Use only for questions relevant to all participants
  - To add yourself or colleagues, email us at info@ihi.org
Expedition Director

Kelly McCutcheon Adams, LICSW has been a Director at the Institute for Healthcare Improvement since 2004. Her primary areas of work with IHI have been in Critical Care and End of Life Care. She is an experienced medical social worker with experience in emergency department, ICU, nursing home, sub-acute rehabilitation, and hospice settings. Ms. McCutcheon Adams served on the faculty of the U.S. Department of Health and Human Services Organ Donation and Transplantation Collaboratives and serves on the faculty of the Gift of Life Institute in Philadelphia. She has a B.A. in Political Science from Wellesley College and an MSW from Boston College.
Today’s Agenda

- Ground Rules & Introductions
- The Harm Caused by Overuse in Medical Imaging
- IHI’s Model for Improvement
- Homework for next session

Ground Rules

- We learn from one another – “All teach, all learn”
- Why reinvent the wheel? – Steal shamelessly
- This is a transparent learning environment
- All ideas/feedback are welcome and encouraged!
Overall Program Aim

The goal of this Expedition is to help teams to build systems that preserve the benefits of imaging while reducing the risks.

Expedition Objectives

At the end of this Expedition, participants will be able to:

- List common examples of medical imaging overuse
- Explain strategies for reducing overuse in medical imaging
- Plan tests to make changes in own environment
- Utilize tools to assess what changes generate improvement
Schedule of Calls

Session 1 – The Harm Caused by Overuse in Medical Imaging  
Date: Wednesday, February 5, 1:00 PM – 2:30 PM ET

Session 2 – Measuring Overuse  
Date: Wednesday, February 19, 1:00 PM – 2:00 PM ET

Session 3 – Strategies for Eliminating Overuse  
Date: Wednesday, March 5, 1:00 PM – 2:00 PM ET

Session 4 – Measuring What Changes Lead to Improvement  
Date: Wednesday, March 19, 1:00 PM – 2:00 PM ET

Session 5 – Sustaining the Gains  
Date: Wednesday, April 2, 1:00 PM – 2:00 PM ET

Faculty

Jim Duncan, MD, PhD, is a Professor of Radiology and the Chief Quality and Safety Officer for the Mallinckrodt Institute of Radiology at Washington University School of Medicine. He maintains a clinical practice in interventional radiology and divides his time between St. Louis Children’s Hospital and Barnes-Jewish Hospital in St. Louis. Dr. Duncan works on multiple quality and safety improvement initiatives for both local and national organizations. He has a BS from the University of Michigan as well as an MD and PhD in Cellular and Molecular Biology from Washington University. He completed the IHI Improvement Advisor Professional Development Program in 2012.
Medical Imaging Experience

- Raise your hand if:
  - You have had a CT scan in the last 5 years
  - A family member has had a CT scan in the last 5 years
- Estimated 80 million CTs in US during 2013
  - With a population of 320 million, suggests that on average 1 out of every 4 in the US had a CT in 2013.
- CT and other imaging studies save lives
  - Still, too much of a good thing …
  - Aim: Preserve the benefit, reduce the risk

Common Scenario

- Your child
  - Fell at playground
  - Huge visible contusion
  - Screaming uncontrollably
- What do you do?
  - As his father who happens to be a radiologist, I drove frantically to the ER because my mental model is: “He needs an urgent head CT”
- St Louis Children’s Hospital ER
  - Recommended watch and wait
Meet Jonathan Duncan

Session 1 Outline

- Review results from the survey
- Definition of overuse
- Dangers of overuse
- Examples
- Strategies for improvement
- Measuring overuse
Pre-Survey Excerpts

What do you believe are the top three reasons for overuse of medical imaging in your organization?

- Lack of awareness
- Belief that more is always better
- It saves time/multiple tests are ordered at one time before seeing results of first test
- Medical oncology lack of knowledge regarding evidence-based practice and regulatory standards
- Patient demand/expectations
- Referring physician expectations
- Maintenance of revenue stream
- Concerns about missing something: risk/liability/"CYA"
- Clinical practice – some doctors order more than others
- Increased reliance on diagnostic tools vs. clinical exam

Pre-Survey Excerpts

What do you believe are the top three barriers to eliminating overuse of medical imaging at your organization?

- Lack of awareness
- Lack of decision support that convinces “less is more”
- Lack of appropriate financial incentives
- Changing behaviors of affiliated physicians (but not hospital-employed physicians)
- Potential for decrease in revenue
- Patient demand/expectations
- Risk concerns/fear of lawsuits
- Accountability of those ordering the tests
- Education
- Physician consensus
- Changing culture
Pre-Survey Excerpts

What are you most proud of that your organization has done to impact overuse in medical imaging?
- Cut our dose/procedure in half for Interventional Radiology
- Having an online system
- Completing evaluation of use and individual providers notified of their performance
- Fluoroscopy and ultrasound guided medical procedures; diagnostic and therapeutic treatment for medical diseases rather than going blind
- Recognition of problem and working on programs to guide appropriate imaging
- Triaging requests to reduce wait time for breast ultrasound and reduce ultrasounds not required
- Triaging CT and MR requisitions based on clinical indications

Fellow Travelers for this Expedition

During this Expedition, What Roles Will Be Represented on Your Team?

- MOs (Imagers)
- MDs (Referring)
- Imaging Manager
- Technologist
- Nurse
- Quality/Safety Manager
- Hospital Administrator
- Equipment Manufacturer

0%  20%  40%  60%
Overuse in Imaging

- Definition
  - “Imaging that is provided under circumstances in which its potential for harm exceeds the possible benefit.” (Institute of Medicine 2002)

- Opportunities to improve imaging
  - Imaging provides tremendous benefit
    - Clear utility, life-saving technology
  - Improvement starts with recognition
    - Preserve and increase the benefit; reduce the risk

Overuse, Underuse, Misuse

- Imaging provides straightforward examples
  - Overuse
    - Risk of test or treatment exceeds the benefit
      - Head CT for minor head trauma
  - Underuse
    - Risks of not imaging
      - Mammography, imaging guidance for central venous catheters
  - Misuse
    - Choosing the wrong imaging exam
      - Child with abdominal pain: CT rather than ultrasound
Dangers of Overuse

- Radiation
- Overdiagnosis
- Financial

Overuse of Ionizing Radiation

- High energy particles
  - photons (x-rays and gamma rays)
  - electrons (beta) and nuclei (alpha)
- Result in damage to DNA
  - Double strand breaks (DSBs) in DNA
    - Multiple DSBs often lead to cell death via apoptosis
    - Single DSBs are difficult to repair
    - Blunt ended DSBs usually result in small deletions
    - Errors in repair implicated in lymphoid cancers such as Burkitt’s lymphoma

Carcinogenesis 23:687
Exposed Everyday

- Natural sources
  - Radon, other natural isotopes, cosmic radiation

Modeling Cancer Risk

Future Cancer Risk in 100,000 People With Increasing Radiation Doses

Adapted from Mettler et al 2009
Risks of Radiation

- Stochastic: risk of cancer causing mutation
  - Based on probability of rare events
  - No threshold, each exposure is independent event
    - E.g. chance of rolling all 1’s with 10 dice

- Deterministic: risk of cell death
  - Based on probability of inducing apoptosis
    - Threshold and timeframes are important
    - Cell death exceeds regenerative capacity

Results of DNA Damage

- Organ injury
  - Examples:
    - Skin burns (months later)
    - Cardiac (10+ years later)
    - Especially radiotherapy & high dose fluoro procedures

- Point mutations in germline cells (ovaries/ testes) that are passed to future generations
Role of the Imaging History

- Tracking cumulative dose is controversial
  - Arguments against tracking
    - Risk/benefit of $N$th scan = Risk/benefit of 1st scan
    - If the 21st Chest CT for possible pulmonary embolism is indicated, the imaging history doesn’t matter
    - Patients will be so scared that they will refuse medically necessary studies

Breaking down risks and benefits

- Multiple studies
  - Risk of $N$th scan is independent of prior scans
    - Agree (cancer risk), Disagree (organ damage)
  - Benefit of $N$th scan is independent of prior scans
    - Disagree
      - First scan typically provides the most benefit
      - Follow-up scans usually provide less benefit
        - Almost invariably contain fewer new findings
        - Retrieval and review of prior scans is crucial
        - Rationale behind reducing dose for follow-up studies
Counterpoint Example

When evaluating a patient with chest pain:
- A string of 20 prior negative CTs
  - Proves that CT is not an effective means of treating this patient’s chest pain
- Bayesian approach
  - Pretest probability depends on results of the prior imaging studies
  - 5 min after negative CT, patient still has chest pain
  - Does not make sense to repeat the CT

Children = High Risk Population

Risk of future cancer after exposing 100,000 women to a single dose of 100 mGy

- Up to 100x greater risk for newborns vs grandparents
- Risk of “rolling snake eyes” accumulates
Meet Morgan

- 11yr old girl with RLQ pain, R/O appy
  - CT abdomen and pelvis (instead of US)
    - 3.7mm noncalcified nodule
      - “unknown malignant potential … recommend follow-up CT without & with contrast”
    - Follow-up Chest CT
      - 3.7mm noncalcified nodule, recommend further follow-up
      - Referred to Interv Radiology for possible needle biopsy

Harm of Incidental Findings

- Additional procedures
  - More imaging
  - Biopsies and other invasive procedures
- Anxiety
  - Does not cease with a benign diagnosis
- Costs
  - Additional tests and procedures
  - Missed work

Timeline for Morgan and her parents

J Pt Safety 2013
## Financial Burden of Healthcare

- Escalating costs
- Costs might be justified if they led to improved health, but ...

### U.S. Healthcare Costs as a Percentage of GDP

<table>
<thead>
<tr>
<th>Year</th>
<th>% of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>13.8</td>
</tr>
<tr>
<td>2001</td>
<td>14.3</td>
</tr>
<tr>
<td>2002</td>
<td>15.1</td>
</tr>
<tr>
<td>2003</td>
<td>15.8</td>
</tr>
<tr>
<td>2004</td>
<td>16.1</td>
</tr>
<tr>
<td>2005</td>
<td>16.4</td>
</tr>
<tr>
<td>2006</td>
<td>16.4</td>
</tr>
<tr>
<td>2007</td>
<td>16.4</td>
</tr>
<tr>
<td>2008</td>
<td>16.4</td>
</tr>
<tr>
<td>2009</td>
<td>16.8</td>
</tr>
<tr>
<td>2010</td>
<td>17.3</td>
</tr>
<tr>
<td>2011</td>
<td>17.9</td>
</tr>
</tbody>
</table>

## Financial Harm of Overuse

- 30% of $2.5T = $750 Billion/year
  - Entire Department of Defense is only $650 B/year
  - Annual infrastructure investment is $500 B/year
- $750 Billion/year could be put to better use
  - Buying groceries for every household in the US
  - Paying college tuition for every 18-24yr old
  - Paying the salaries of all first responders
    - Firefighters, police officers, EMTs (for 12 years)

Institute of Medicine 2013
Eliminating Overuse in Imaging

- Part of the IHI Triple Aim
  - Better care
    - The best care avoids overuse of diagnostic tests
    - Same outcome with less waiting for tests and their results
  - Better health
    - Reduction of radiation, incidental findings
    - Benefits that accrue over time
  - Lower cost
    - Overuse adds costs
      - Cost of the exam (variable cost)
      - Cost of facilities needed to handle overuse (fixed cost)

Opportunities for Improvement

- Systematic approach to imaging
- Imaging as a means to an end
- Five basic steps
  - Failure at any step leads to waste
  - Failure is common

The 5 Rights of Imaging

J Patient Safety (in press)
Exercise: Causes of Overuse

- Identify failure modes for each step
  - Right study
  - Right order
  - Right way
  - Right report
  - Right action
- Type your ideas into
  the chat box
  - Will post a table of examples

Examples of Overuse in Imaging

- Overuse comes in many different flavors
  - Extra studies/illness
    - Prescribing antibiotics for a viral infection
    - CT instead of observation for minor head trauma
  - Extra images/study
    - Multiple antibiotics when a single agent is sufficient
    - CT scans done without and with IV contrast
  - Extra dose/image
    - Children receiving adult doses
Imaging Budget

- Studies per illness
  - Overuse of CT during initial diagnosis
    - Head CTs for minor head trauma
      - Alternative is observation
    - Abdominal CTs for possible appendicitis
      - Alternative is ultrasound
  - Overuse of CT during follow-up
    - Kidney stones, inflammatory bowel disease, and other benign conditions

Images per Study

- No free lunch, there is a cost to collecting data
  - More pixels → more dose
  - More images → more dose
- Multiple scans through the same body part
  - Dual or combination CT scans
    - Without then with IV contrast
      - Double the radiation dose and increased reimbursement
    - Without, with and delayed scans
      - Triple the radiation dose
Chest CT +/- Metric (Adults)

2010 Hospital Compare Data

ACR Data: Similar Results
Dose/Image: Pediatric CT Settings

7 yr old Male

Community Hospital
DLP = 1165
6.6 mSv

SLCH
DLP = 251
1.4 mSv

The Mona Lisa 1504

6x9 pixels .05K

12x19 pixels 0.2K

24x37 pixels 0.9K

48x75 pixels 3.6K

95x150 14K

187x300 57K

375x600 230K

750x1200 900K
The Beatles 1967

8x6 pixels  .04K   16x12 pixels  .18K   31x24 pixels  .75K   62x47 pixels 3.0K

125x94  12K   250x188  48K   500x375  192K   1000x750  768K

Duncan and Evens, JAMA 2009;301:2383
Overuse Adds Up

- Rule out appendicitis example
  - Studies per illness that use Xray
    - 1 US vs 3 CT scans (1 abd/pelvis CT, 2 chest CTs)
  - Images per study
    - Single phase Chest CT vs without and with
  - Dose per study
    - Pediatric vs adult CT settings
- Same outcome: 0 vs 25 mSv
  - Annual limit for nuclear plant workers (50 mSv)
  - 25 mSv has an estimated future cancer risk of 1 in 400

Combating Overuse

- Requires a systematic approach and long term perspective
  - Some aspects lie outside our direct control
    - Ex: Head CTs in ER
    - Team includes ER physicians
  - Room for improvement in the aspects that we do control
    - Ex: Dual CTs
    - Team includes ordering MDs and CT techs
- Healthcare is a team sport
### Ongoing Initiative

- **100K Children** ([www.100KChildren.org](http://www.100KChildren.org))
  - Structured as a campaign
  - 100K good decisions for imaging children by 7/1/15
  - SLCH has pledged 10K and is ahead of that pace

Follow us on Twitter - @100KChildren

![Progress at St Louis Children's Hospital](chart.png)

---

### Why Measure?

- You cannot improve things that you cannot measure
  - Lord Kelvin, circa 1890
- You cannot measure anything with absolute accuracy
  - Fisher and Heisenberg, circa 1920
- Although measurements are flawed, they are far superior to using emotion to make decisions
  - W. Edwards Deming, circa 1960
- In God we trust. All others must bring data.
  - W. Edwards Deming, circa 1960
- If we have data, let’s look at data. If all we have are opinions, let’s go with mine.
  - Jim Barksdale, former Netscape CEO, circa 2000
Imaging Measures

- Hospital Compare
  - Outpatient imaging measures for Medicare
- New Joint Commission requirement
  - Recording CT dose metrics
    - CTDivol or DLP
  - Similar to California State Bill 1237

---

Homework and Next Sessions

- Homework: Prepare to improve imaging at your site
  - Find local examples of overuse in imaging
  - Review compliance with measuring radiation exposure in CT
- Session 2
  - Discuss examples of overuse, problems with CT measurement
  - Build driver diagrams, identify improvement opportunities
  - Measurement strategies
- Session 3
  - Testing strategies for improvement (PDSAs)
- Session 4
  - Determining what changes led to improvement
- Session 5
  - Sustaining the gains, expanding to all aspects of imaging
What We Need From You

- Examples of overuse
  - Expect problems with each step
    - Right study, Right Order, Right Way
    - Right report, Right action
  - Compliance with measuring CT dose

Summary

- Healthcare is changing
  - Imaging must change
    - Past: paid for volume
    - Future: paid for value added
- Preserve the benefit, eliminate the waste
  - Overuse = waste
- Will not be easy
  - “We choose to do this, not because it is easy, but because it is hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone.” (JFK)
Questions?

Raise your hand

Use the Chat

---

Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

What change can we make that will result in improvement?

Aim of Improvement

Measurement of Improvement

Developing a Change

Testing a Change

Act

Plan

Study

Do

Create action plan to carry
• Make changes
• Arrange next cycle

Compose aim
• Pose questions/predictions
• Create action plan to carry out cycle (who, what, when, where)
• Plan for data collection

Complete data analysis
• Compare to predictions
• Summarize learning

Carry out the test and collect data
• Document what occurred
• Begin analysis of data

Principles & Guidelines for Testing

A test of change should answer a specific question
A test of change requires a theory and prediction
Test on a small scale
Collect data over time
Build knowledge sequentially with multiple PDSA cycles for each change idea
Include a wide range of conditions in the sequence of tests
Repeated Use of the PDSA Cycle

Sequential building of knowledge under a wide range of conditions

Aim: Implement Rapid Response Team on non-ICU unit

Cycle 1: ICU nurse responds to rapid response team calls on one unit, one shift for one day

Cycle 2: Repeat cycle 1 for three days

Cycle 3: Have Respiratory Therapist attend rapid response calls with ICU Nurse

Cycle 4: Expand coverage of RRT on unit to one unit for one shift for five days

Cycle 5: Have Nurse Practitioner respond to calls in addition to RT and RN

Cycle 6: Expand rounds to one unit for one shift seven days a week
Questions?

Raise your hand

Use the Chat

Action Period Assignment

- Prepare to improve imaging at your site
  - Find local examples of overuse in imaging
    - Expect every site has stories that match Jonathan’s and Morgan’s
      - Hopefully more Jonathans than Morgans
      - Tell us your versions of these stories
  - Review compliance with measuring radiation exposure in CT
  - Expect sites in CA and TX have already invested in improvement
    - What about other sites?
    - What worked in CA and TX?
Expedition Communications

- Listserv for session communications: medicalimaging@ls.ihi.org
- To add colleagues, email us at info@ihi.org
- Pose questions, share resources, discuss barriers or successes

Next Session

Wednesday, February 19, 1:00 PM – 2:00 PM ET
Session 2 – Measuring Overuse