Reducing X-ray use in the NICU

CS&E Course Cohort 22
Team #1
The Team

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Amy Quinn, MD, Neonatology
Faculty Support

Dr. Amy Quinn

Dr. Riley Scott
BACKGROUND
<table>
<thead>
<tr>
<th>X-ray examination</th>
<th>Infant ($\mu$Sv)</th>
<th>Adult ($\mu$Sv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babygram</td>
<td>23.8</td>
<td>No equivalent</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>14.4</td>
<td>100</td>
</tr>
<tr>
<td>Abdominal X-ray</td>
<td>17.8</td>
<td>700</td>
</tr>
</tbody>
</table>

Table 1. Equivalent dose due to ionizing radiation per X-ray type\(^7,17\)
Does medical radiation cause cancer?

We don’t know

We should act cautiously as if there is a potential risk
Choosing Wisely in Newborn Medicine: Five Opportunities to Increase Value

Timmy Ho, Dmitry Dukhovny, John A.F. Zupancic, Don A. Goldmann, Jeffrey D. Horbar, DeWayne M. Pursley

TABLE 2 Choosing Wisely Top Five List for Newborn Medicine

1. Avoid routine use of antireflux medications for treatment of symptomatic GERD or for treatment of apnea and desaturation in preterm infants.
2. Avoid routine continuation of antibiotic therapy beyond 48 hours for initially asymptomatic infants without evidence of bacterial infection.
3. Avoid routine use of pneumograms for predischARGE assessment of ongoing and/or prolonged apnea of prematurity.
4. Avoid routine daily chest radiographs without an indication for intubated infants.
5. Avoid routine screening term-equivalent or discharge brain MRIs in preterm infants.

GERD, gastroesophageal reflux disease.
Imaging: Number of Chest X-Rays per VLBW (<1500 g, Cohort 3) Singletons, CY 2010-14

<table>
<thead>
<tr>
<th>Region</th>
<th>Crude Rate</th>
<th>Adjusted Rate</th>
<th>Upper CI</th>
<th>Lower CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>15.1</td>
<td>15.1</td>
<td>15.1</td>
<td>15.1</td>
</tr>
<tr>
<td>Abilene</td>
<td>9.8</td>
<td>9.6</td>
<td>6.4</td>
<td>14.2</td>
</tr>
<tr>
<td>Amarillo</td>
<td>8.7</td>
<td>8.6</td>
<td>7.0</td>
<td>10.6</td>
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<td>Austin</td>
<td>15.9</td>
<td>15.5</td>
<td>13.8</td>
<td>17.3</td>
</tr>
<tr>
<td>Beaumont</td>
<td>9.3</td>
<td>9.4</td>
<td>7.5</td>
<td>12.0</td>
</tr>
<tr>
<td>Brownsville</td>
<td>14.3</td>
<td>11.4</td>
<td>9.7</td>
<td>13.5</td>
</tr>
<tr>
<td>College Station</td>
<td>13.0</td>
<td>11.7</td>
<td>8.4</td>
<td>16.2</td>
</tr>
<tr>
<td>Corpus Christi</td>
<td>16.0</td>
<td>13.5</td>
<td>11.4</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>Dallas</strong></td>
<td><strong>15.0</strong></td>
<td><strong>14.6</strong></td>
<td><strong>13.6</strong></td>
<td><strong>15.7</strong></td>
</tr>
<tr>
<td>Denton</td>
<td>9.3</td>
<td>7.3</td>
<td>5.7</td>
<td>9.5</td>
</tr>
<tr>
<td>El Paso</td>
<td>20.3</td>
<td>22.9</td>
<td>19.9</td>
<td>26.2</td>
</tr>
<tr>
<td>Fort Worth</td>
<td>10.6</td>
<td>9.2</td>
<td>8.5</td>
<td>10.1</td>
</tr>
<tr>
<td><strong>Houston</strong></td>
<td><strong>13.1</strong></td>
<td><strong>12.7</strong></td>
<td><strong>12.0</strong></td>
<td><strong>13.5</strong></td>
</tr>
<tr>
<td>Laredo</td>
<td>14.0</td>
<td>12.1</td>
<td>9.5</td>
<td>15.3</td>
</tr>
<tr>
<td>Longview</td>
<td>12.9</td>
<td>14.9</td>
<td>12.4</td>
<td>17.9</td>
</tr>
<tr>
<td>Lubbock</td>
<td>19.7</td>
<td>25.0</td>
<td>20.8</td>
<td>30.0</td>
</tr>
<tr>
<td>McAllen</td>
<td>20.7</td>
<td>18.8</td>
<td>16.5</td>
<td>21.3</td>
</tr>
<tr>
<td>Odessa</td>
<td>15.1</td>
<td>16.6</td>
<td>13.7</td>
<td>20.1</td>
</tr>
<tr>
<td><strong>San Antonio</strong></td>
<td><strong>23.3</strong></td>
<td><strong>25.2</strong></td>
<td><strong>23.1</strong></td>
<td><strong>27.5</strong></td>
</tr>
<tr>
<td>Temple</td>
<td>10.5</td>
<td>9.4</td>
<td>7.8</td>
<td>11.5</td>
</tr>
<tr>
<td>Tyler</td>
<td>13.5</td>
<td>12.8</td>
<td>9.6</td>
<td>17.1</td>
</tr>
<tr>
<td>Victoria</td>
<td>16.7</td>
<td>16.0</td>
<td>11.0</td>
<td>23.2</td>
</tr>
</tbody>
</table>
Average #X-rays per <1000g infant at UHS

- 2013: 45.8
- 2014: 57.7
- 2015: 56
- 2016: 62
- 2017: 46.2

San Antonio
Texas
Dallas
Average X-rays per Birth Weight Category

- <1000
- 1000-2000
- 2001-3000
- >3000

Data for years 2013 to 2017.
Total x-ray type per year

- BBG
- CXR
- KUB

Year:
- 2013
- 2014
- 2015
- 2016
- 2017
Aim Statement

To reduce the rate of total x-rays obtained per patient day in the UHS neonatal intensive care unit by 30% by August 2018

– Process measure: Decrease the percentage of babygram orders in relation to total radiograph orders by 10% by August 2018
Most frequent indications on x-ray orders (N=500 films)

- Routine: 47%
- Bowel Pattern/NEC: 70%
- Central Line: 80%
- Change in Status: 88%
- Procedure/Surgery: 87%
- Admission: 96%
- S/P intubation: 98%
- Evaluation/Other: 100%
- ETT Positioning: 100%
The image contains a table and text that outlines a project goal, primary drivers, and interventions. Here is the information presented in a clear and natural format in markdown:

### Driver Diagram

<table>
<thead>
<tr>
<th>Aim</th>
<th>Primary Drivers</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write your project goal here.</td>
<td>List the main drivers that you identified in your diagnostic journey that influenced your goal. Use a verb to describe the driver.</td>
<td>List the actions, processes, or interventions that when performed correctly will lead to a positive effect on a driver. Link these to the relevant driver.</td>
</tr>
<tr>
<td>To reduce the rate of total x-rays obtained per patient day in the UHS neonatal intensive care unit by 30% by August 2018</td>
<td>Unnecessary Routine X-rays</td>
<td>Protocol for stable intubated patients (RS3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provider education – thematic journal club (RS1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clarification of x-ray orders (RS2)</td>
</tr>
<tr>
<td></td>
<td>Repeat X-rays</td>
<td>Nursing staff education on infant positioning (RS1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RT at patient bedside at time of x-ray (RS3)</td>
</tr>
<tr>
<td></td>
<td>Excess Babygrams</td>
<td>NICU pre imaging checklist (RS3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Protocol for X-ray type (BBG, CXR, KUB) (RS3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collimation guideline development (RS3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EHR changes necessitating two indications for BBG (RS4)</td>
</tr>
</tbody>
</table>

**University Health System**
SPC u-Chart: X-rays per patient day for all UHS NICU Admissions Baseline (Nov2017-Jan2018)
Intervention: X-ray Ordering
Guideline for Intubated Patients

Acute Respiratory Failure

Unstable (blood gasses q 1-4 hrs)
Continue with daily or as needed x-rays until stable

Stable (blood gasses q >4-12 hrs)
X-rays twice weekly or as needed for change in status

Clinical judgement prevails

**Use for all intubated patients unless patient has umbilical lines.**
Visual Control

Viruses or Bacteria
What’s got you sick?

<table>
<thead>
<tr>
<th>Common Condition</th>
<th>What’s got you sick?</th>
<th>Common Cause</th>
<th>How long have you had it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sore throat</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Whipping cough</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Yes</td>
<td>Bacteria</td>
<td>No</td>
</tr>
<tr>
<td>Eye infection</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Middle ear infection</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Rash on body</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Rash on face</td>
<td>Yes</td>
<td>Bacteria</td>
<td>Yes</td>
</tr>
<tr>
<td>Common cold/tummy</td>
<td>Yes</td>
<td>Virus</td>
<td>No</td>
</tr>
<tr>
<td>Sore throat typical symptoms</td>
<td>Yes</td>
<td>Virus</td>
<td>No</td>
</tr>
</tbody>
</table>

To administer antibiotics always be sure.

Call our DAISY
1-866-358-8696.

*Clinical Judgment protocols*

X-ray Protocol for intubated patients:

1. X-ray protocol: PICC Line Insertion/Verification
2. X-ray protocol: Central line
3. X-ray protocol: Stable Blood pressure & stable oxygen saturation
4. X-ray protocol: Suctioning
5. X-ray protocol: Central line

5:37 PM
5:38 PM
Intervention: X-ray Ordering Guideline for PICC Line Insertion/Verification

Central Line

- Lower Extremity PICC
  - BBG adequate
- Upper Extremity PICC
  - CXR only
POST INTERVENTION DATA
Data Measurement

• Weekly reports of all NICU X-rays generated and analyzed by team

• Tracked total X-rays per patient day
  – Stratified data per BW category (i.e. <1000g, 1001-2000g, 2001-3000g, >3000g)
  – Collected data on X-rays per intubated patient day

• Balance Measure – tracked unplanned extubations
Unusual low patient census

Patient with Pneumothorax

CL 0.706 0.7331

UCL 0.954 0.9456

LCL 0.458 0.5205

X-rays per patient day

SPC u Chart: Total X-rays per patient day for all UHS NICU admissions (Nov2017 - May2018)
SPC u Chart: Total X-rays per patient day in <1000g infants (Nov2017 - May2018)
SPC u Chart: X-rays per intubated patient days in <1000g infants (Jan2018 - May2018)
Unstable Patient

CL 0.7290

UCL 1.0000

LCL 0.3847

0.210 0.310 0.410 0.510 0.610 0.710 0.810 0.910 1.010


# X-rays adherent to protocol/#applicable x-rays

spc P chart: X-ray Ordering Guideline Compliance

Week

University Health System

CR
SPC u Chart: Frequency of BBG to Total X-rays Ordered
X-ray Film Type Frequency (Jan2017 - May2018)
Balance Measure – Unplanned Extubations

![Extubations Rate Per 100 Vent Days](chart)

- **2015**: 1.02%
- **1st Quarter 2017**: 0.70%
- **2nd Quarter 2017**: 0.77%
- **3rd Quarter 2017**: 0.67%
- **4th Quarter 2017**: 1.31%
- **January 2018**: 1.39%
- **February 2018**: 0.62%
- **March 2018**: 0.00%
- **April 2018**: 0.76%
## Return on Investment

<table>
<thead>
<tr>
<th>Imaging</th>
<th>UHS Direct Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total direct cost for KUB, BBG, CXR over 3.5 years</td>
<td>$500,917.81</td>
</tr>
<tr>
<td>Yearly direct cost for KUB, BBG, CXR</td>
<td>$145,119.37</td>
</tr>
<tr>
<td>Potential Annual Savings (if 30% reduction met)</td>
<td>$43,535.81</td>
</tr>
</tbody>
</table>
• **Challenges:**
  – Culture change
  – Apply guideline to patients with umbilical lines
  – Time constraints to track compliance
  – Inability to track data by provider

• **Next Steps:**
  – Brainstorming ideas for sustainability
  – BBG order change on Sunrise requested
    • Will require providers to enter two indications
Acknowledgements

• Carma Bolton, UHS Senior Quality Data Analyst
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• Dr. Wayne Fischer
• Dr. Amy Quinn
• Dr. Riley Scott
• Sherry Martin, M. Ed
References


