The ACR Fluoroscopy Dose Index Registry Pilot

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Disclosure

• A. Kyle Jones is President of FluoroSafety, a company that produces CME on quality and safety in medical imaging

• FluoroSafety will not be discussed in this talk
In the beginning

• On the way to Grouse Mountain in Vancouver during WAIS 2015

• Jeremy Durack asked a few basic questions about dose indices for the IR Registry

• One thing led to another...
The ACR NRDR

MIPS QCDR
Qualified Clinical Data Registry »

Lung Cancer Screening Registry »

Dose Index Registry »

Interventional Radiology Registry »

National Mammography Database »

General Radiology Improvement Database »

CT Colonography Registry »

CDS R-SCAN Registry »
Normative datasets

• Comparison of facility data to a normative dataset allows a practice to understand their performance relative to their peers

• The most well-known normative dataset is probably the ACR CT DIR
  • Currently more than 80M exams in the CT DIR
The need for a registry

• The RAD-IR study is the largest normative dataset for FGI

• Data for RAD-IR was collected in the mid- to late 1990s
  • 2,142 procedures
  • Single fluoroscope make and model (Siemens Multistar/Neurostar, pulsed/continuous fluoro, fixed 0.2 mm Cu filter for fluoro and small ACQ beam paths, XRII)
  • Herculean manual effort

• Substantial changes since the data collection period of RAD-IR
  • Scope and number of FGI
  • Mandatory reporting of $K_{a,r}$
  • RDSR
  • Technological advances, including variable added filtration, FPD, etc.
Radiation dose structured report (RDSR)

- Granular, detailed information
  - Every exposure event
  - Can soon contain calibration information for dose measuring device (NEMA XR-27)

- Often sent to Radiation Dose Index Monitoring (RDIM) system
  - PACS do not display in useful way

- Sites participating in DIR send RDSR to ACR via Triad
  - Only data format accepted
NEMA XR-27

• X-ray Equipment for Interventional Procedures User Quality Control Mode
  • Manual selection of X-ray parameters
  • Access to and export of FOR PROCESSING and FOR PRESENTATION images
  • **Single point calibration factor for dose indices**
    • Stored and transmitted in the RDSR, but not applied to machine-reported dose indices
  • Electronic documentation of system configuration
  • Access to RDSR in all scenarios

• Report of AAPM TG 190 provides the method for measuring the calibration factor

• Not universally available at the current time
Mechanics

• Participate in the ACR NRDR
  • Participation agreement and registry application signed
  • Triad server installed and configured

• Configure your IR fluoroscopes to send data to the Triad server
  • Directly or via RDIM
  • RDSR only

• Map your procedures to ACR Common™
<table>
<thead>
<tr>
<th>Record</th>
<th>StudyDescription</th>
<th>Requested Procedure Description</th>
<th>AcrCommand</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>6822</td>
<td>+++Native+++</td>
<td>IR GASTROSTOMY CATHETER EXCHANGE/RE-INSERTION</td>
<td>4011300 Inv-Fluoro, Gastrostomy Catheter Exchange, Abdomen, Stomach</td>
<td>Tagging Completed</td>
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<tr>
<td>58564</td>
<td>+++Native+++</td>
<td>IR PICC WITHOUT PORT/PUMP</td>
<td>4011653 Inv-Fluoro, Central Venous Catheter Placement, Peripherally Inserted, Unspecified</td>
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<tr>
<td>6849</td>
<td>+++Pelvis+++</td>
<td>IR EMBOLIZATION PELVIC</td>
<td>4011272 Inv-Fluoro, Pelvic Artery</td>
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<tr>
<td>58685</td>
<td>Abdomen</td>
<td>IR JEJUNOSTOMY PLACEMENT DE NOVO</td>
<td>4011326 Inv-Fluoro, Jejunostomy Tube Placement, Abdomen-Pelvis, Jejunum</td>
<td>Tagging Completed</td>
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<tr>
<td>58683</td>
<td>BILIARY</td>
<td>IR PLACEMENT BILIARY DRAINAGE CATHETER (INTERNAL-EXTERNAL)</td>
<td>4011338 Inv-Fluoro, Percutaneous Biliary Drainage Placement, Abdomen, Liver</td>
<td>Tagging Completed</td>
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<tr>
<td>58685</td>
<td>Biliary cath exchange 47536</td>
<td>Null</td>
<td>4011285 Inv-Fluoro, Biliary Catheter Exchange, Abdomen, Liver</td>
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<tr>
<td>58678</td>
<td>CENTRAL LINE PLACEMENT</td>
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<td>4011269 Inv-Fluoro, Central Venous Catheter Placement, Tunneled, Chest</td>
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<tr>
<td>58670</td>
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<td>58671</td>
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<tr>
<td>58672</td>
<td>CHOLANGIOGRAM</td>
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<td>4011342 Inv-Fluoro, Percutaneous Cholangiography, Abdomen, Liver</td>
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<tr>
<td>5873</td>
<td>CHOLE</td>
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<td>4011292 Inv-Fluoro, Percutaneous Choledochotomy Drain Placement, Abdomen, Gallbladder</td>
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</tr>
<tr>
<td>43107</td>
<td>CT ABD BX NEEDLE</td>
<td>IR SIR SPHERES-_DIAGNOSTIC WITHOUT EMBO</td>
<td>4011596 Inv-Fluoro, Radioembolization Cir-Spheres, Abdomen-Pelvis, Visceral Arteries</td>
<td>Tagging Completed</td>
</tr>
<tr>
<td>6909</td>
<td>CT ABD BX NEEDLE</td>
<td>IR RADIOEMBOLIZATION SIR SPHERES - TREATMENT</td>
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<td>IR RADIOEMBOLIZATION THERASPHERES - DIAGNOSTIC</td>
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<td>CT ABD BX NEEDLE</td>
<td>IR EMBOLIZATION RENAL ARTERY</td>
<td>4011275 Inv-Fluoro, Artery Embolization, Abdomen-Pelvis, Viscera</td>
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<tr>
<td>58689</td>
<td>CT ABD BX NEEDLE</td>
<td>IR EMBOLIZATION SPINE</td>
<td>4011543 Inv-Fluoro, Spinal Artery Embolization, Spine</td>
<td>Tagging Completed</td>
</tr>
<tr>
<td>6889</td>
<td>CT ABD BX NEEDLE</td>
<td>IR EMBOLIZATION HEPATIC ARTERY</td>
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<td>6982</td>
<td>CT ABD BX NEEDLE</td>
<td>IR EMBOLIZATION VISCERAL</td>
<td>4011275 Inv-Fluoro, Artery Embolization, Abdomen-Pelvis, Viscera</td>
<td>Tagging Completed</td>
</tr>
<tr>
<td>6891</td>
<td>CT ABD BX NEEDLE</td>
<td>IR EMBOLIZATION SPLENIC ARTERY</td>
<td>4011387 Inv-Fluoro, Artery Embolization, Abdomen, Spleen</td>
<td>Tagging Completed</td>
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<tr>
<td>6901</td>
<td>CT ABD BX NEEDLE</td>
<td>IR NEPHROSTOMY PLACEMENT</td>
<td>4011334 Inv-Fluoro, Nephrostomy Placement, Abdomen-Pelvis, Kidney</td>
<td>Tagging Completed</td>
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<tr>
<td>96239</td>
<td>CT GUIDE ABLAT</td>
<td>IR THERASPHERES-DIAGNOSTIC WITHOUT EMBO</td>
<td>4011493 Inv-Fluoro, Radioembolization Theraspheres, Abdomen-Pelvis, Visceral Arteries</td>
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<tr>
<td>6931</td>
<td>CT GUIDE ABLAT</td>
<td>IR EMBOLIZATION VISCERAL</td>
<td>4011275 Inv-Fluoro, Artery Embolization, Abdomen-Pelvis, Viscera</td>
<td>Tagging Completed</td>
</tr>
</tbody>
</table>
ACR Common

- Ontology for radiology procedures
  - Leverages existing ontologies and coding schemes
  - Organized around fundamental and derived axes such as scenario, procedure, and finding
  - Includes indications and more details about the procedure

- Updated based on experience during the pilot phase
  - Tried our best to maintain synchronization with the SIR IR Registry
<table>
<thead>
<tr>
<th>Site procedure</th>
<th>ACR Common name(s)</th>
<th>Requested change</th>
<th>Changes made to ACR Common name(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR ABDOMINAL AORTOGRAPHY</td>
<td>4011572 Inv-Fluoro, Angiography Aorta, Chest-Abdomen-PEHs, Aorta</td>
<td>Update code as described in Col C: Update code: 4011572 Inv-FLUOR, aortography, chest-abdomen-pehls, aorta</td>
<td>4011572 INV-FUOR, aortography, chest-abdomen-pehls, aorta</td>
</tr>
<tr>
<td>IR CHOLECYSTOSTOMY TUBE EXCHANGE</td>
<td>does not exist</td>
<td>Create new code: XXXXXXX Inv-Fluoro, Cholecystostomy Exchange, Abdomen, GallBladder</td>
<td>4012738 Inv-Fluoro, Cholecystostomy Exchange, Abdomen, Gallbladder</td>
</tr>
<tr>
<td>BRONCHIAL ARTERY EMBOLIZATION</td>
<td>does not exist</td>
<td>Create new code: XXXXXXX Inv-Fluoro, Bronchial artery embolization, Chest, Lungs</td>
<td>4012739 Inv-Fluoro, Bronchial artery embolization, Chest, Lungs Bronchial arteries</td>
</tr>
<tr>
<td>Renal artery embolization</td>
<td>4011275 Inv-Fluoro, Artery Embolization, Abdomen-PEHs, Viscera</td>
<td>Create new code: XXXXXXX Inv-Fluoro, Renal Artery Embolization, Abdomen-PEHs, Kidney</td>
<td>4012740 Inv-Fluoro, Renal Artery Embolization, Abdomen-PEHs, Kidney, Renal artery</td>
</tr>
<tr>
<td>IR INTRAPERITONEAL PLACEMENT (NON-TUNNELED) does not exist</td>
<td>Create new code: XXXXXXX Inv-Fluoro, Peritoneal Catheter Placement, Non-Tunneled, Abdomen, Peritoneum</td>
<td>4012741 Inv-Fluoro, Peritoneal Catheter Placement, Non-Tunneled, Abdomen, Peritoneum</td>
<td></td>
</tr>
<tr>
<td>Biliary Interventions</td>
<td>These seem to be duplicate codes: 4011286 Inv-Fluoro, Biliary Catheter Placement, Abdomen, Liver 4011338 Inv-Fluoro, Percutaneous Biliary Drainage Placement, Abdomen, Liver</td>
<td>Merge all procedures from 4011286 into 4011338 then Delete code:</td>
<td>4011286 Removed from ACR Common 4011338 Removed from ACR Common</td>
</tr>
<tr>
<td>Vena cava gram</td>
<td>These seem to be duplicate codes: 4011486 Inv-Fluoro, Venacavagram, Chest, Superior Vena Cava 4011903 Inv-Fluoro, Venagram, Chest, Superior Vena Cava</td>
<td>Merge all procedures from 4011486 into 4011601 then Delete code:</td>
<td>4011486 Removed from ACR Common 4011903 Removed from ACR Common</td>
</tr>
</tbody>
</table>
Challenges with procedure mapping

• Mapping is not 1:1 (in both directions)

• Combined procedures

• Study Description vs. Requested Procedure Description

• Change in procedure after case is started

• Varying granularity in facility clinical procedure names
The pilot phase

• The pilot of the ACR-SIR Fluoroscopy Dose Index Registry has 9 sites, including several sites performing substantial numbers of pediatric interventions

• Data collection period ran from March 1, 2018 through December 31, 2019

• RDSR collected for over 100,000 procedures
First results: technical data

• 28 single plane and 10 biplane angiographic fluoroscopes
  • 16 Siemens
  • 14 Philips
  • 6 GE
  • 2 Toshiba/Canon

• Average year of manufacture: 2012 (2002 – 2019)
First results: technical data

• Correction Factors (actual/machine-reported) were stable over an 18 month period
  • Measured using TG 190 methods

• Mean difference between CF for FLU and ACQ was 0.03

<table>
<thead>
<tr>
<th>Dose index (mode)</th>
<th>Mean (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$K_{a,r}$ (FLU)</td>
<td>0.94 (0.92 – 0.96)</td>
</tr>
<tr>
<td>$P_{KA}$ (FLU)</td>
<td>0.95 (0.93 – 0.96)</td>
</tr>
<tr>
<td>$K_{a,r}$ (ACQ)</td>
<td>0.96 (0.93 – 0.98)</td>
</tr>
<tr>
<td>$P_{KA}$ (ACQ)</td>
<td>0.98 (0.95 – 1.00)</td>
</tr>
</tbody>
</table>
Participation guide white paper

• Directions to key NRDR resources on the ACR website

• Guidance for assembling your DIR team

• Pitfalls and pearls from the pilot
The next piece of the puzzle

- We knew going in that collecting data as part of a registry was going to be challenging
  - Varying states of facility clinical procedure names
  - Procedure can evolve during the case
  - Likely unable to collect data on operator, a major variable that affects procedural dose indices

- However, there are some exciting developments coming with ACR Connect
Acknowledgments

• ACR Registries team, Department of Quality and Safety, IT
  • Chao Yen
  • Kay Zacharias-Andrews
  • Judy Burleson
  • Dustin Gress
  • Mike Simanowith
  • Tom Fruscello

• Kevin Wunderle

• Don Miller and Steve Balter

• Pilot sites
ACR-SIR Fluoroscopy Dose Index Registry Pilot Sites

- University of Texas MD Anderson Cancer Center (A. Kyle Jones)
- Cleveland Clinic (Kevin Wunderle)
- Memorial Sloan Kettering Cancer Center (Usman Mahmood)
- Montefiore Medical Center (Alan Schoenfeld)
- Boston Children’s Hospital (Don-Soo Kim)
- University of Washington (Jeff Moirano)
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