



# Fluoroscopy Dose Management

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July 31, 2018 | JB95963US

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Various organizations have announced changes intended to encourage providers to better manage patient fluoroscopy dose

**TX** Establish and implement FGI procedure protocols, recommended reference level for FGI procedures, make and maintain a record of radiation output information so the radiation dose to the skin may be estimated.  
(25 Texas Administrative Code, §289.227, 2018)

**AAPM**  $K_a$  and  $P_{sk}$  must be recorded, and when possible detailed information for each irradiation event of a procedure – so a more thorough assessment of peak skin dose (PSD) can be performed.  
(AAPM Medical Physics Practice Guideline G.2.027)

**TJC** Education, tracking, monitoring, review of fluoroscopy dose effective Jan 2019.  
Released June 25, 2018  
https://www.aacr.org/standards/information/registration\_identification



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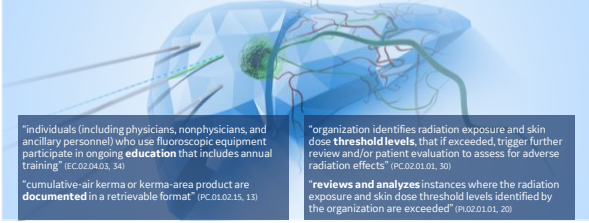
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### Joint Commission Fluoroscopy Pre-publication Requirements Effective Jan 1, 2019: Hospital, Critical Access Hospital, Ambulatory Health Care, Office-based Surgery



"individuals (including physicians, nonphysicians, and ancillary personnel) who use fluoroscopic equipment participate in ongoing **education** that includes annual training" (EC.02.04.03, 34)

"cumulative-air kerma or kerma-area product are **documented** in a retrievable format" (PC.01.02.15, 15)

"organization identifies radiation exposure and skin dose **threshold levels**, that if exceeded, trigger further review and/or patient evaluation to assess for adverse radiation effects" (PC.02.01.01, 30)

"**reviews and analyzes** instances where the radiation exposure and skin dose threshold levels identified by the organization are exceeded" (PC.02.01.01, 20)

https://www.jointcommission.org/standards/information.aspx?id=13836

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### Key components for success



Project and Change Management



Right Technology

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# What is your vision?

Vision and strategy are important, but vision comes first



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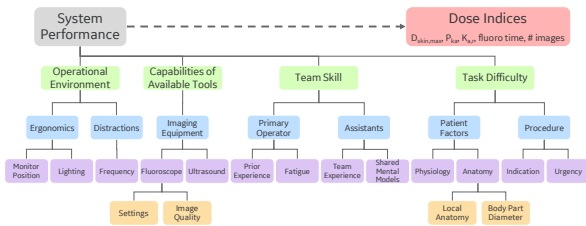
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## Where to Start?

Sources of Variability, Fluoroscopically Guided Interventional Procedures<sup>1</sup>



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<sup>1</sup>National Council on Radiation Protection & Measurements, Report 170: Reference Levels and Achievable Doses in Medical and Dental Imaging. Recommendations for the United States, 2012

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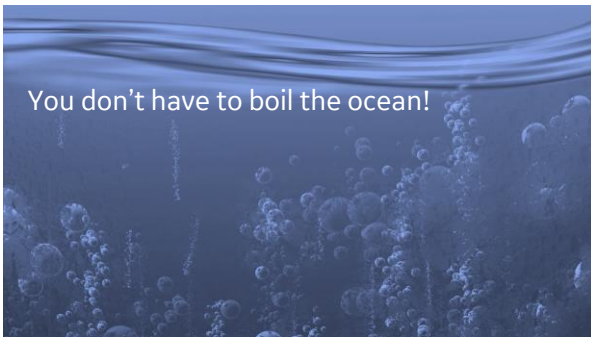
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You don't have to boil the ocean!

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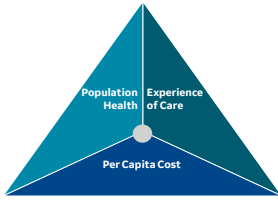
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Consider framing your goals in terms of health outcomes



A common framework for health outcomes is "The Triple Aim"<sup>1</sup>

Outcomes

- Better care for individuals
- Better health for populations
- Lower per capita cost

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<sup>1</sup>Institute for Healthcare Improvement

Example outcomes associated with "Experience of Care"

|                 | General Aim or Desired Outcome <sup>1,2</sup>                      | Potential Dose Management Impact   |
|-----------------|--|--|
| Effective       | Care is appropriate and scientific                                 | Identify high risk patients more accurately & earlier; location of skin damage                     |
| Efficient       | Care is provided efficiently                                       | Decreased effort to manage patient dose  |
| Timely          | Care is available as needed  | Faster identification of high risk patients and estimation of peak skin dose                       |
| Safe            | Minimized risk, reduced mistakes                                   | Drive dose optimization and safe practices   |
| Equitable       | Care is equitable across race, gender, income, age, location       | Access to medical physics expertise regardless of facility size or location                        |
| Patient Centric | Patient culture, preferences, values, specific needs are respected | Tracking of radiosensitive patients, cumulative dose history to identify potential FGI dose issues |

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<sup>1</sup>Centers for Medicare and Medicaid Services, Quality Improvement Roadmap  
<sup>2</sup>Agency for Healthcare Research & Quality, US Dept of Health & Human Services

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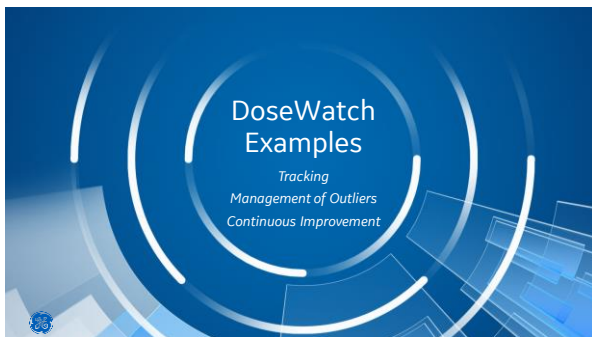
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### Tracking

Collection of dose indices in a retrievable format

| Image and Fluoroscopy DAP (mRy/cm²) | Ref. Point Entrance Dose (Kerma <sub>air</sub> ) (mRy) | Total Time of Fluoroscopy (s) |
|-------------------------------------|--|-------------------------------|
| 2902.40.00                          | 2902.80  | 699                           |
| 295140.00                           | 2973.30  | 2062                          |
| 357360.00                           | 3654.59  | 1132                          |
| 321030.00                           | 3403.74  | 676                           |



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### Tracking

Collection of detailed information for further investigation

Run specific data: frame rate, mode, angulation, table position, etc.

| Tube Voltage (kV) | Tube Current (mA) | Exposure (mAs) | Distance Source to Patient (cm) | Distance Source to Detector (cm) | Table Vertical Position (cm) |
|-------------------|-------------------|----------------|---------------------------------|----------------------------------|------------------------------|
| 77.00             | 221.30            | 184.121        | 75.00                           | 108.60                           | 24.37                        |
| 77.00             | 187.70            | 42.758         | 75.00                           | 104.40                           | 24.37                        |
| 77.00             | 241.70            | 48.406         | 75.00                           | 104.40                           | 24.37                        |
| 78.00             | 242.40            | 77.568         | 75.00                           | 104.40                           | 24.37                        |



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### Data collection considerations



#### Equipment Age and Licensing

- Can my imaging system send dose information? Is there a fee?
- Can it only send to one location?

#### Data Type

- How complete is it?  
MPPS < Proprietary ≤ RDSR

#### Does it need to go anywhere else?

- Registry: Do I need to map study description?
- RIS / EMR



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### Management of Outliers Setting of Thresholds

#### Study Dose

Add on alert

Study Description: *Fluorosc*

|                               | Level 1 | Level 2 |
|-------------------------------|---------|---------|
| DAF (mGy/cm²)                 | 30000   | 50000   |
| Total time of fluoroscopy (s) | 1800    | 3600    |
| K <sub>AP</sub> (mGy)         | 3000    | 5000    |

Save

#### DRLs and Additional Granularity

- Create / Import / Export DRLs
- Site - Specific Thresholds
- Device
- Patient Age
- Patient Weight

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### Management of Outliers Setting of Thresholds - Cumulative Dose

Activate cumulative dose alerts

K<sub>AP</sub> (mGy): 9000.0

Period (days): 180

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### Management of Outliers Notifications

#### E-mail

- Customizable distribution list
- Site specific
- Customizable Content
  - Metric
  - Thresholds
  - Performing Physician

#### User Interface

Listing of exams and alert status

| Study                  | Device | Device | Alert |
|------------------------|--------|--------|-------|
| Study 1 Series 1 DRL 0 | DRX    | DRX    | Alert |
| Study 2 Series 1 DRL 0 | DRX    | DRX    | Alert |
| Study 3 Series 1 DRL 0 | DRX    | DRX    | Alert |

#### Reporting

Listing of reviewed and unreviewed alerts

Patient Watchlist (based on cumulative air kerma)

| Patient ID | Alert Period | Alert Status | Alert Date |
|------------|--------------|--------------|------------|
| P001       | 2018-07-01   | Alert        | 2018-07-01 |
| P002       | 2018-07-01   | Alert        | 2018-07-01 |
| P003       | 2018-07-01   | Alert        | 2018-07-01 |

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Management of Outliers  
Review and Documentation

Codes and Comments  
Audit Trail



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Management of Outliers  
Detailed Assessment - Incidence Map (Angulation)



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Management of Outliers  
Detailed Assessment - 4D Skin Dose Map



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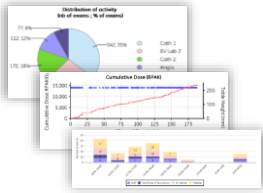
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### Continuous Improvement

#### Analytics & Reporting



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#### Purpose

#### Operational Visibility

- Devices
- Personnel
- Technique
- Review of Outliers

#### Visibility to high risk cases

#### Benchmarking

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### Practical Case

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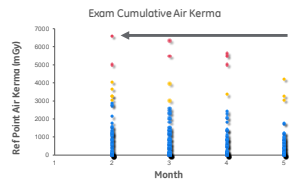
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### Event Information

Identify Significant Radiation Dose Level Incidents



| Mode   | AK mGy | # Events |
|--------|--------|----------|
| Fluoro | 2357   | 128      |
| Record | 4232   | 36       |
| Total  | 6589   | 164      |

164 Exposure Events  
31167 frames @ 30 fps

Other Available Data

DAP, FT, Table Height, Table lateral position, SID, kV, mA, patient weight, etc.

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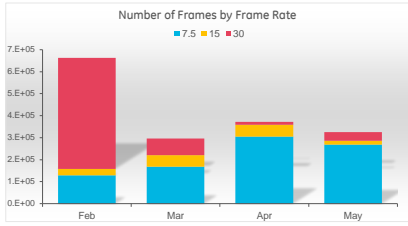
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### Evolution of Imaging Technique Frame Rate



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### Physician Performance (\*Real names removed)

| Performing Physician* | Exams | 3-5 Gy | >5 Gy | % 3-5 Gy | % > 5 Gy |
|-----------------------|-------|--------|-------|----------|----------|
| Laudie Lindley        | 1     | 0      | 1     | 0.0%     | 100.0%   |
| Carl Tower            | 14    | 1      | 2     | 7.1%     | 14.3%    |
| Corrin Gayer          | 11    | 1      | 1     | 9.1%     | 9.1%     |
| Jeremy Kell           | 12    | 1      | 1     | 8.3%     | 8.3%     |
| Ladonna Douse         | 46    | 3      | 2     | 6.5%     | 4.4%     |
| Freeman Liverman      | 4     | 1      | 0     | 25.0%    | 0.0%     |
| Hue Carbonaro         | 17    | 2      | 0     | 11.8%    | 0.0%     |
| Brigette Orloff       | 7     | 2      | 0     | 28.6%    | 0.0%     |
| See Wilkins           | 8     |        |       |          |          |
|                       |       |        |       |          |          |
|                       |       |        |       |          |          |
|                       |       |        |       |          |          |
| Paris Euell           | 2     |        |       |          |          |
| Michaele Ballargeon   | 6     |        |       |          |          |
| Deangelo Purves       | 27    |        |       |          |          |
| Sparkle Lenhardt      | 35    |        |       |          |          |
| Grand total           | 293   | 11     | 7     | 3.75%    | 2.39%    |

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### Key Learnings

Many sites have challenges creating change in the organization: politics, goals, motivation, education, communication challenges.

Technology can enable and provide insights, but it doesn't make the change.

Set the vision, realistic goals, and ownership.

Medical physicist insight is critical to success.

It takes a team – physicist, technologist, physician, and hospital leadership.

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