Hands-on fluoroscopy safety training with real-time patient and staff dosimetry

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Fluoroscopically guided interventions (FGI) are performed by many different hospital departments.

FGI staff often lack adequate training on safe & optimal use of their fluoroscopy systems:
- No training
- Minimal training

Fluoroscopy optimization can be rendered ineffective.
Inadequate Training

- Applications training
  - 1 time event, not all staff included
  - Not focused on safety or dose

- Fellowship and/or “on the job” training

- Annual safety lectures & online modules
  - Too general, not system specific
  - No direct, tangible feedback on efficacy of safety techniques
  - Tendency to not incorporate training content into clinical practice
Purpose

We developed and taught a hands-on fluoroscopy safety class incorporating real-time patient and staff dosimetry in order to promote safer and more optimal use of fluoroscopy during FGI.

Goals

- Include all FGI staff
- Hands-on, using their own fluoro system
- Direct, real-time feedback on efficacy of safety techniques
Investigate how **patient entrance dose**, **staff dose**, and **image quality** are affected by:

- System geometry
- Pulse rate
- Magnification
- Collimation
- Beam angulation
- Imaging mode
- Distance
- Shielding
Class Setup

- mobile C-arm
- phantom
- PowerPoint on fluoro safety
Phantom

CIRS test object plate

10” acrylic

Ion chamber
Class Setup

- real-time patient entrance dose display
- mobile C-arm
- phantom
- mobile leaded shield
- live fluoro display
- real-time staff dose display
- PowerPoint on fluoro safety
RaySafe i2 Dosimetry System™

Dosimeter Badge

Real-time dose display

Dose Rate Scale (mSv/h)

Instantaneous Dose Rate
Real-time Staff Dosimetry

Dosimeter at 0.2 m

Dosimeter at 3 m

Unshielded dosimeter at 1 m

Mobile leaded shield

Shielded dosimeter at 1 m

Real-time Dose Display

<table>
<thead>
<tr>
<th>Distance</th>
<th>mSv/h</th>
<th>0.2</th>
<th>2</th>
<th>20</th>
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<tbody>
<tr>
<td>Near</td>
<td></td>
<td></td>
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<tr>
<td>1 Step Away</td>
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<tr>
<td>Far</td>
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<tr>
<td>Shielded</td>
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Patient entrance dose vs. system geometry

Image Receptor

X-ray tube

Image Receptor

patient

49.40 mGy/min

Image Receptor

patient

38.55 mGy/min

75.41 mGy/min
Staff dose vs. system geometry

- X-ray tube
- Image receptor

<table>
<thead>
<tr>
<th>mSv/h</th>
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<th>2</th>
<th>20</th>
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<tbody>
<tr>
<td>Tube</td>
<td></td>
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<tr>
<td>Receptor</td>
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</tbody>
</table>
Dose and image quality vs. mag mode

Patient entrance dose

No Mag

$45.33 \text{ mGy/min}$

Mag

$56.13 \text{ mGy/min}$

Staff dose at 1 meter
Results

- Active + engaged staff operating/optimizing use of their own fluoroscopy system
  - Minimize patient and staff dose
  - Maintain sufficient image quality

- Real-time dose visualization provides direct, tangible feedback on technique efficacy

- Stimulates lots of questions and discussion

- Incorporation into clinical practice
Conclusion

**Hands-on** fluoroscopy safety training coupled with **real-time dose display** helps clinical staff visualize, internalize, and ultimately utilize the safety techniques learned during the training.

**Challenges**

- Access to clinical FGI suites
- Cost: Real-time dose display is expensive
- Time: teaching an entire health system of FGI staff