Multidimensional Theatre Imaging in the National Trauma Centre

RP Study Day 2026

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THE MATER HOSPITAL

Overview

- Role of C-Arms in the hospital
- C-Arms in MMUH
- MMUH as the National Trauma Centre
- 3D C-arms: *Overview & Preferences*
- Staff Training
- Dose Management System: *Teamplay*
- Diagnostic Reference levels (DRLs)
- Radiation Protection Tools
- Service Evaluation of 2D Pelvis Screening with the Siemens CIOS Spin

Role of C-Arms in the Hospital

Intraoperative Imaging

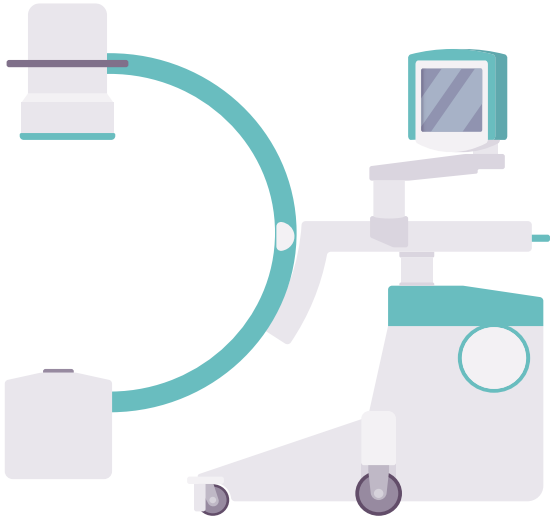
- Provides “live” imaging of the patients internal anatomy during surgical procedures.
- Allows surgeons to guide and carry out minimally invasive surgical and radiological procedures.

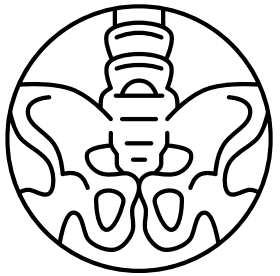
Main areas of use in the hospital

- Cardiology
- Orthopaedics
- Interventional Radiology
- Gastrointestinal Studies

Benefits

- Real-time feedback for surgeons.
- Efficient workflows (Conebeam CT, Digital Subtraction Angiography)





C-Arms in MMUH

Medtronic O-Arm x 1

GE OEC One CFD x 2

Philips BV Endura x 1

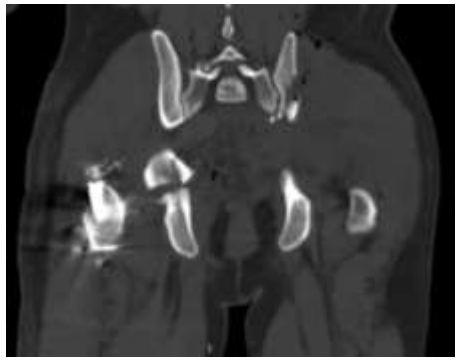
Siemens CIOS Spin x 1

Xograph Ziehm RFD x 2

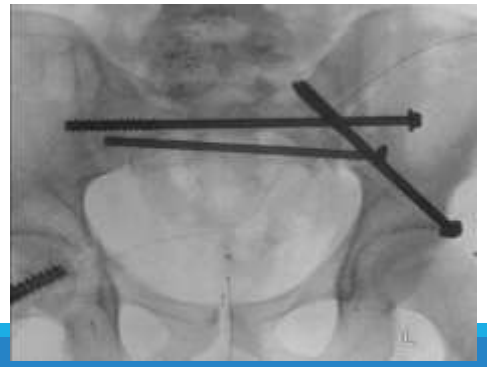
Xograph Ziehm RFD Hybrid x 1

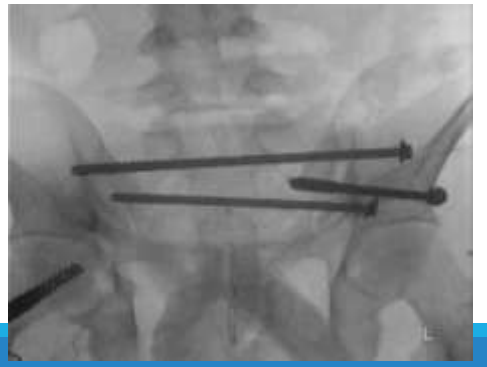
MMUH as the National Trauma Centre

- In 2021 the Mater Hospital was designated as the Major Trauma Centre (MTC) for the Central Trauma Network. It is also the National Spinal Injuries Centre.
- On average, around 1,600 patients in Ireland suffer major trauma injuries each year.
- MMUH receives emergency referrals from across the country including severe spinal cord injuries and complex polytrauma cases that require immediate specialist intervention.



Male 22yrs – transfer from regional hospital. Fall from height with pelvic instability





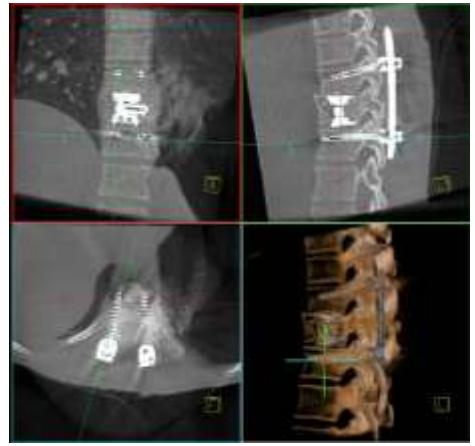
Medtronic O-Arm

- **Imaging Modalities:** Hybrid 2D fluoroscopy and 3D platform (not used for level checks).
- **Surgical Navigation:** Seamless integration with Medtronic StealthStation™ for real-time optical navigation.
- **Gantry Design:** O-shaped gantry allows for 360° imaging without repositioning the system.
- **Field of View (FOV):**
  - ➢Integrated FOV preview to minimize "cut-off" and repeat scans.
  - ➢Selectable 3D volumes: 20 cm and 40 cm longitudinal coverage.
- **Long-Film Capability:** Automated stitching mode for 2D scoliosis imaging.
- **Operator Interface:** Dual-control options via hand switch or wired foot pedal.

Siemens CIOS Spin

- **Disclaimer:** We are '*super-users*' of this system in MMUH.

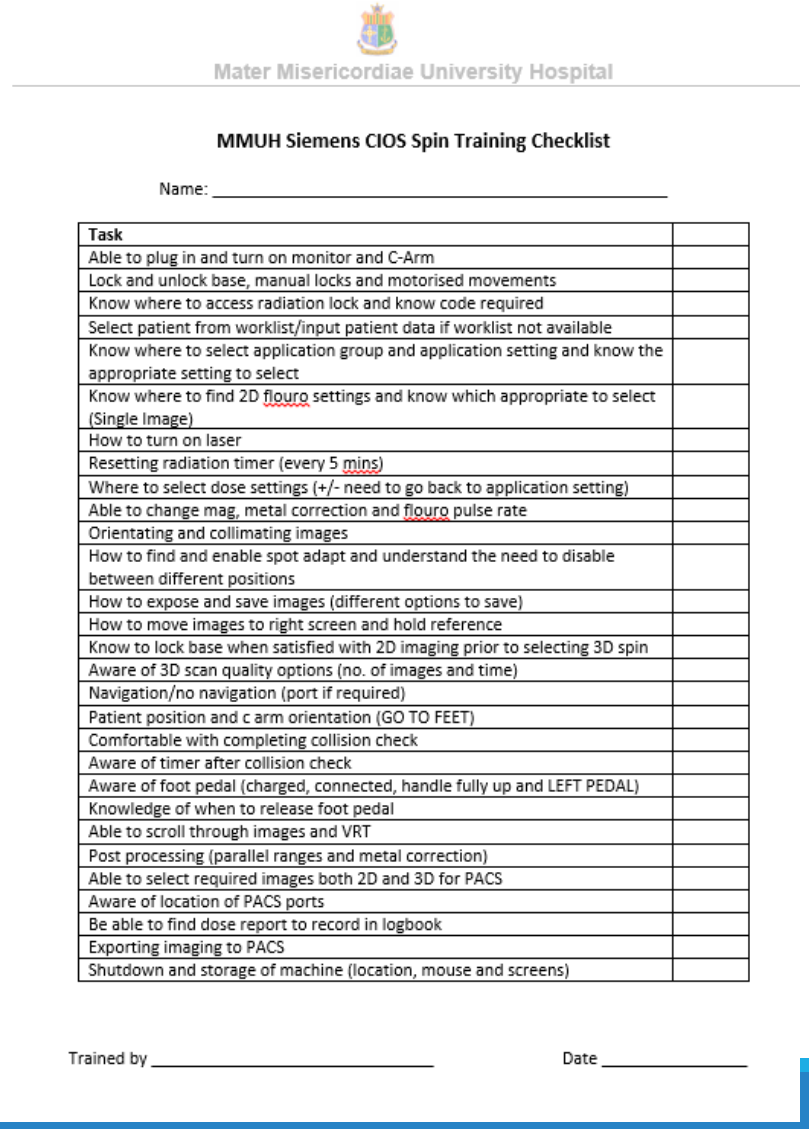
- **High-end 2D fluoroscopy and 3D volumetric acquisition.**
- **Motorised Handling:** Motorised – assisted positioning reduces physical strain.
- **Smart Storage:** One-touch recall of saved c-arm positions for faster surgical transitions.
- **MAR for 3D:** Enhances clarity around metallic implants & reduces streak artefact.
- **Spot Adapt:** Automatically windows for localized 2D viewing, potentially reducing need for increased or repeat exposure.
- **Advanced 3D Volume Rendering**
- **Dual Control:** Both hand switch and wireless foot pedal.



Staff Training for the Siemens CIOS

- There are **77 radiographers** rotated through theatre in MMUH

- Approx. **40 radiographers** are on the theatre call rota
  - ➢ i.e., may have to screen during night and/or weekends.
- We developed a protocol for staff training in a less pressurised environment.
- A spine phantom was set up in the Physics Lab to demonstrate use of the CIOS Spin system.
- Ensured staff were comfortable and competent with machine before going to theatre.
- Created a step by step user-friendly manual.



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MMUH Siemens CIOS Spin Training Checklist

Name: _____

Task	
Able to plug in and turn on monitor and C-Arm	
Lock and unlock base, manual locks and motorised movements	
Know where to access radiation lock and know code required	
Select patient from worklist/input patient data if worklist not available	
Know where to select application group and application setting and know the appropriate setting to select	
Know where to find 2D flouro settings and know which appropriate to select (Single Image)	
How to turn on laser	
Resetting radiation timer (every 5 mins)	
Where to select dose settings (+/- need to go back to application setting)	
Able to change mag, metal correction and flouro pulse rate	
Orientating and collimating images	
How to find and enable spot adapt and understand the need to disable between different positions	
How to expose and save images (different options to save)	
How to move images to right screen and hold reference	
Know to lock base when satisfied with 2D imaging prior to selecting 3D spin	
Aware of 3D scan quality options (no. of images and time)	
Navigation/no navigation (port if required)	
Patient position and c arm orientation (GO TO FEET)	
Comfortable with completing collision check	
Aware of timer after collision check	
Aware of foot pedal (charged, connected, handle fully up and LEFT PEDAL)	
Knowledge of when to release foot pedal	
Able to scroll through images and VRT	
Post processing (parallel ranges and metal correction)	
Able to select required images both 2D and 3D for PACS	
Aware of location of PACS ports	
Be able to find dose report to record in logbook	
Exporting imaging to PACS	
Shutdown and storage of machine (location, mouse and screens)	

Trained by _____ Date _____

User Preference: Surgeons & Radiographers

O-arm

- Medtronic navigation
- Larger FOV for 3D spins – 40cm capability
- One spinal surgeon commented '3D spin image quality superior on O-Arm'

Cios Spin

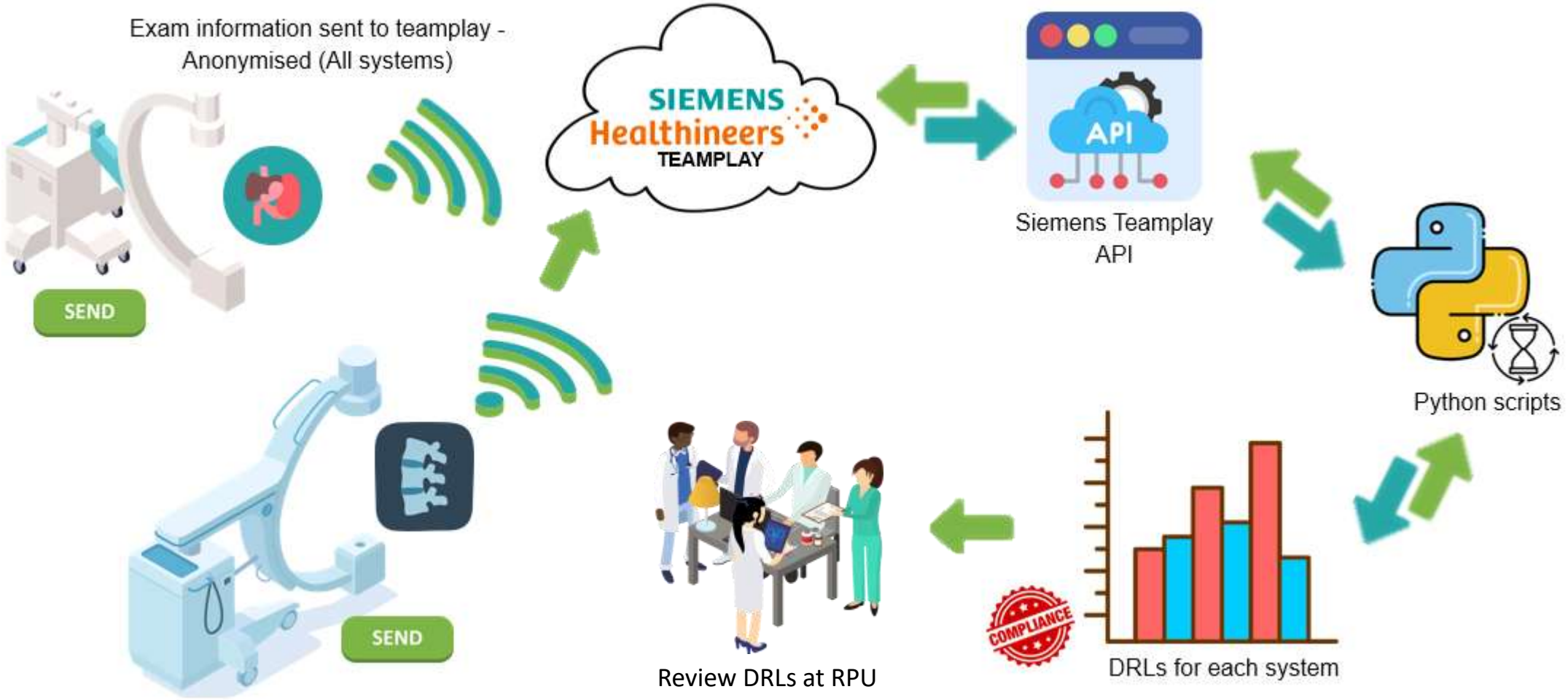
- Johnson & Johnson navigation
- 2D & 3D Capabilities (workflow & manual handling)
- Larger FOV for 2D imaging (30cm)
- Metal suppression

Radiographers: Overall preference for CIOS system – reduced manual handling and easier to navigate in and out of theatres

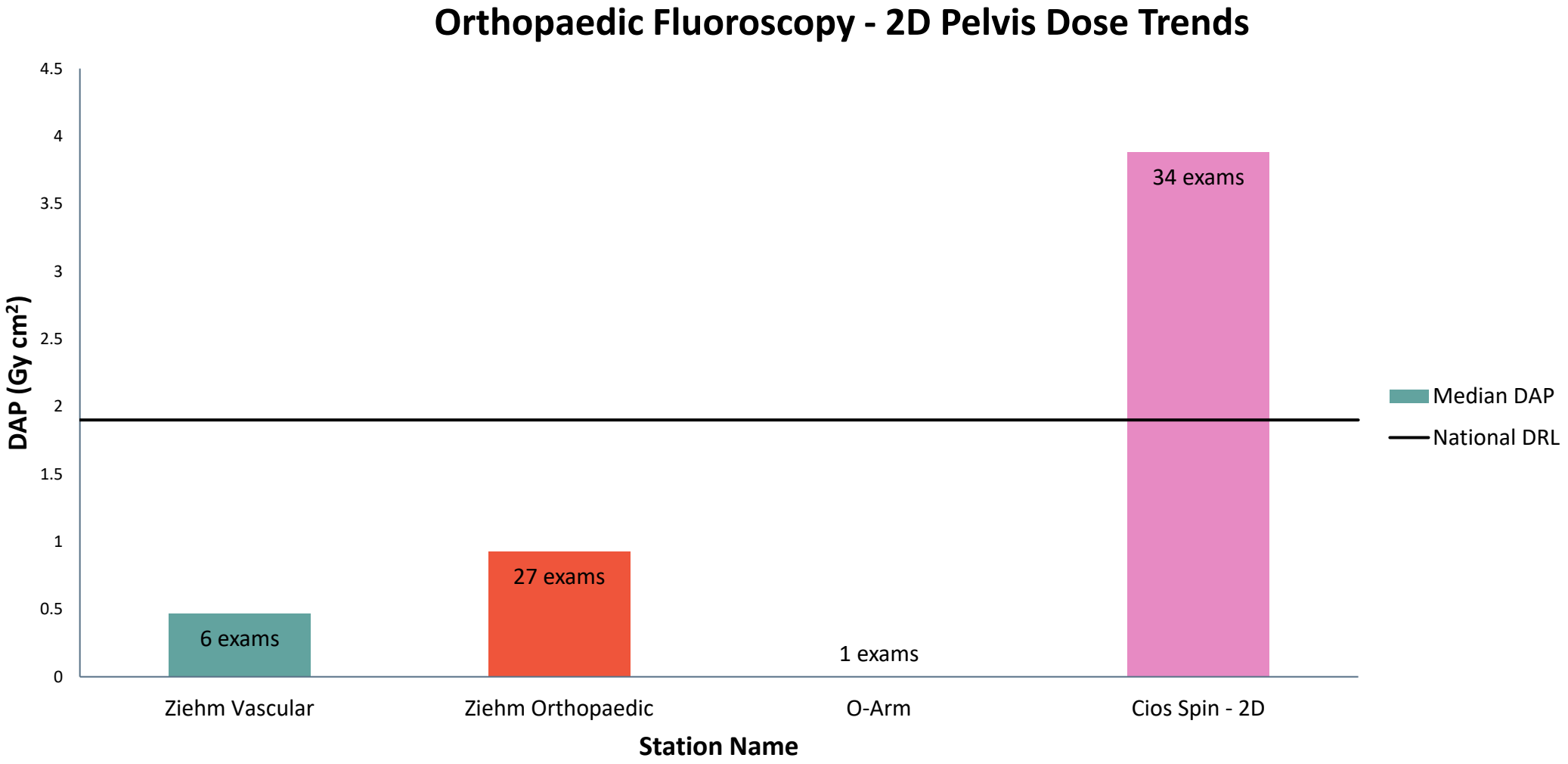
Monitoring Patient Exposure in MMUH

- The Radiation Protection Unit (RPU) is a multidisciplinary team comprising of radiographers and physicists including the RPO, CSRs, MPEs and RPA.
- The RPU meets once per month.
- Each meeting, a modality/area is subject to review of local diagnostic reference levels.
- Any local DRL above the national DRL is subject to further investigation.
- Local DRLs are generated by the physicists using data from our Dose Management System (Siemens Teamplay).

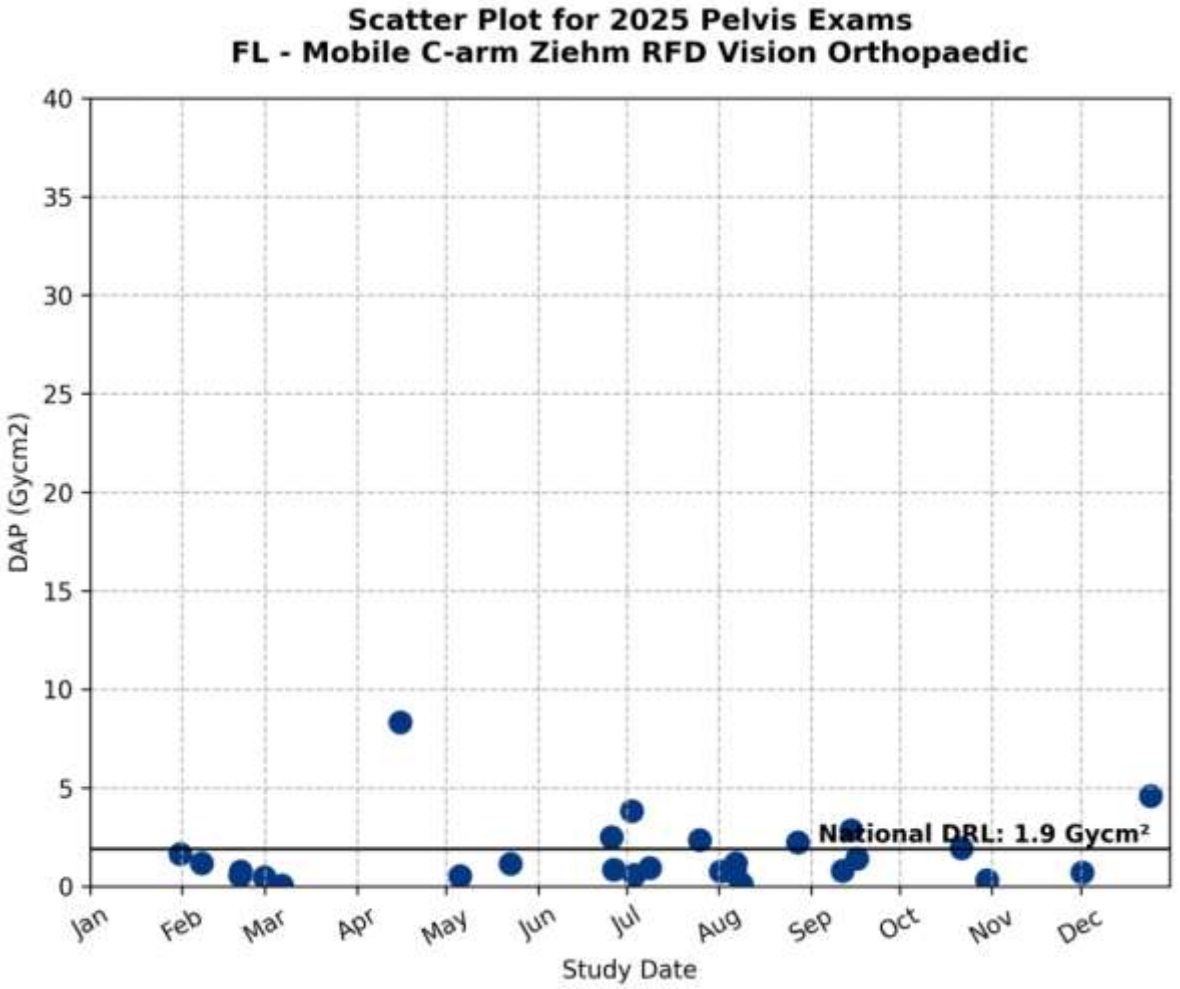
Generating Local DRLs in MMUH

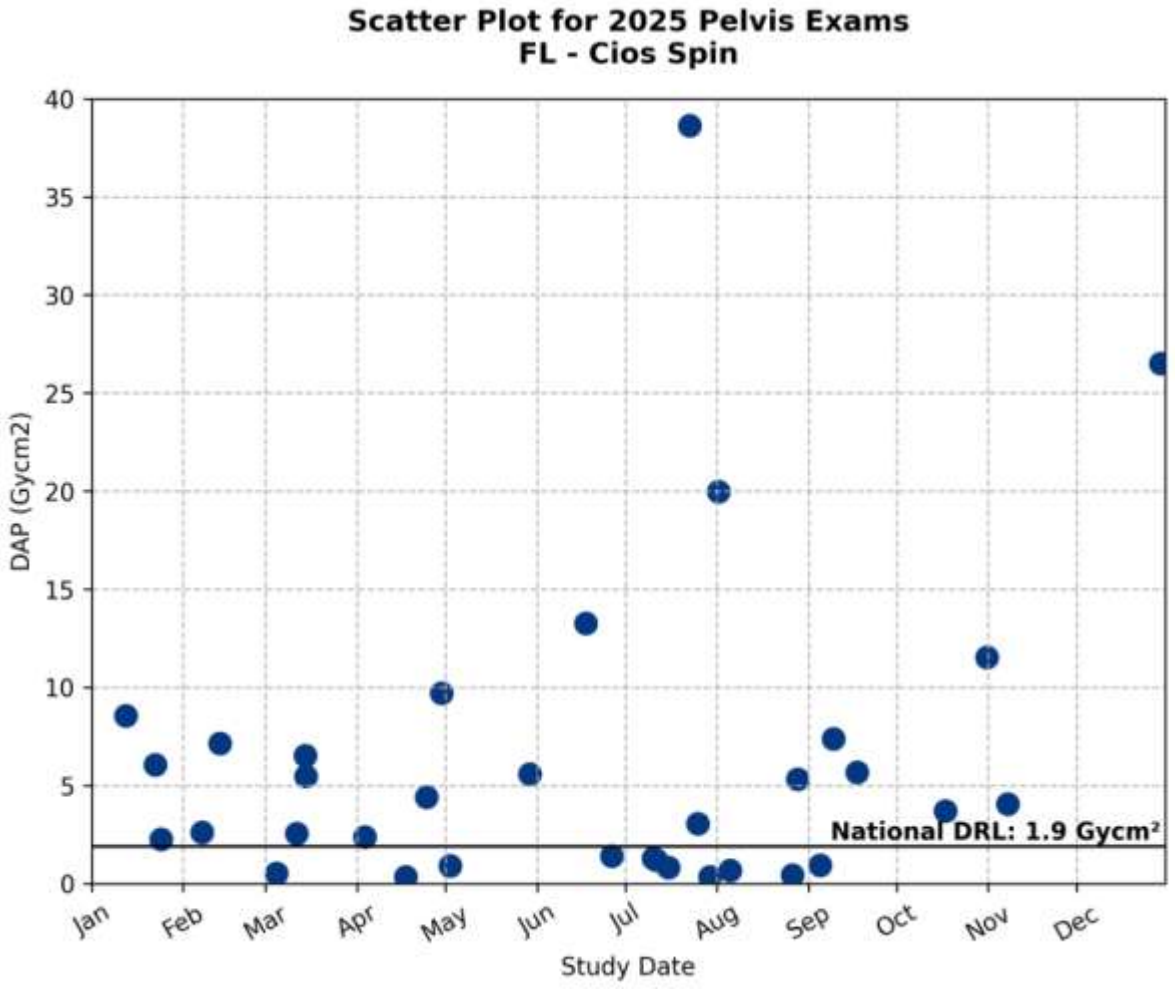


Review of 2D Pelvis Doses (Medians)



Review of 2D Pelvis Doses (Case-by-Case)

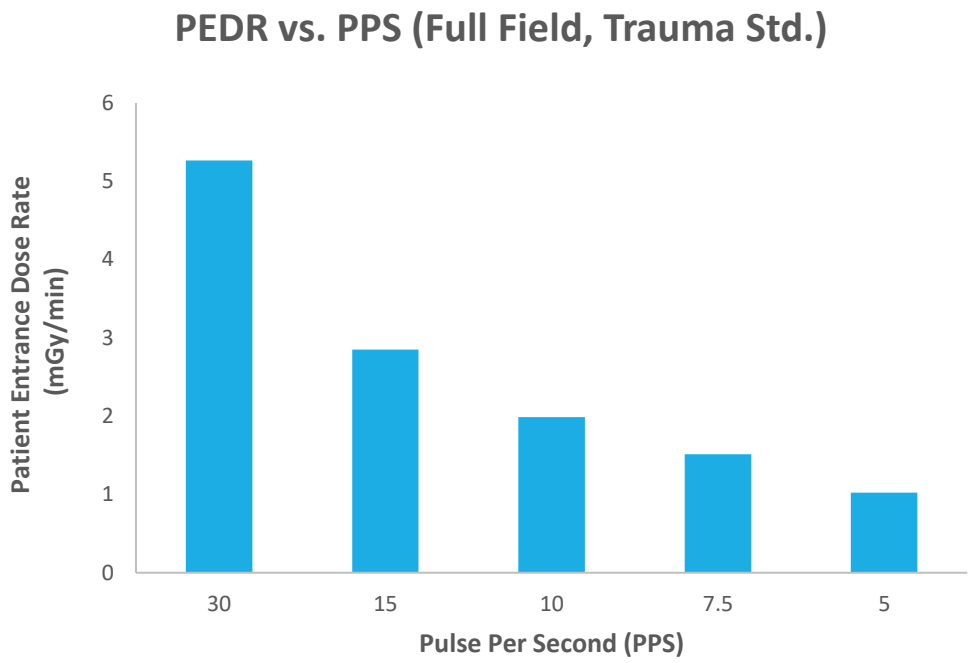




Simple Optimisation Tools (PPS)

System pulse rates

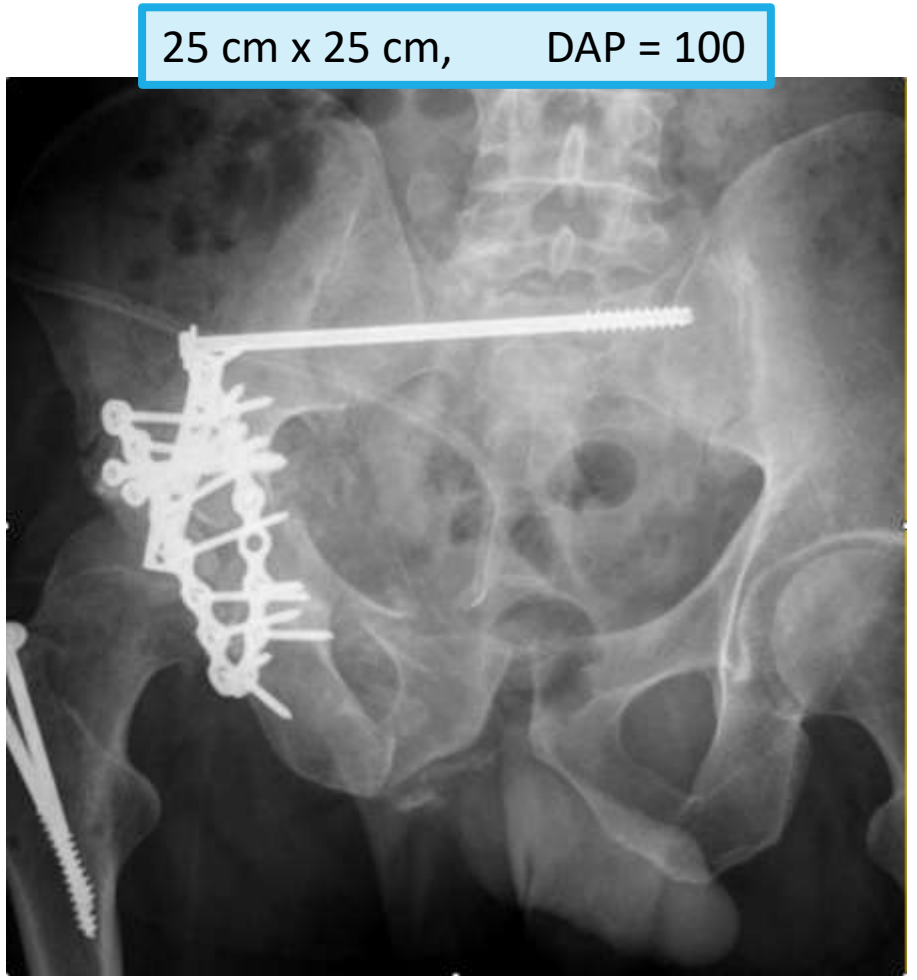
- Lowering pulse rates for certain parts of exams can be a good way to reduce patient and staff exposure.
- Especially useful if anatomy is static or slow moving.
- Start with lower pulse rates and work up if required.
- Must ensure no compromise on diagnostic quality.



Simple Optimisation Tools (Collimation)

Collimation

- Limit field size to area of interest only.
- Decreases DAP but also scattered radiation (lower staff doses).
- Even a small reduction in field of view can have a large impact on DAP.



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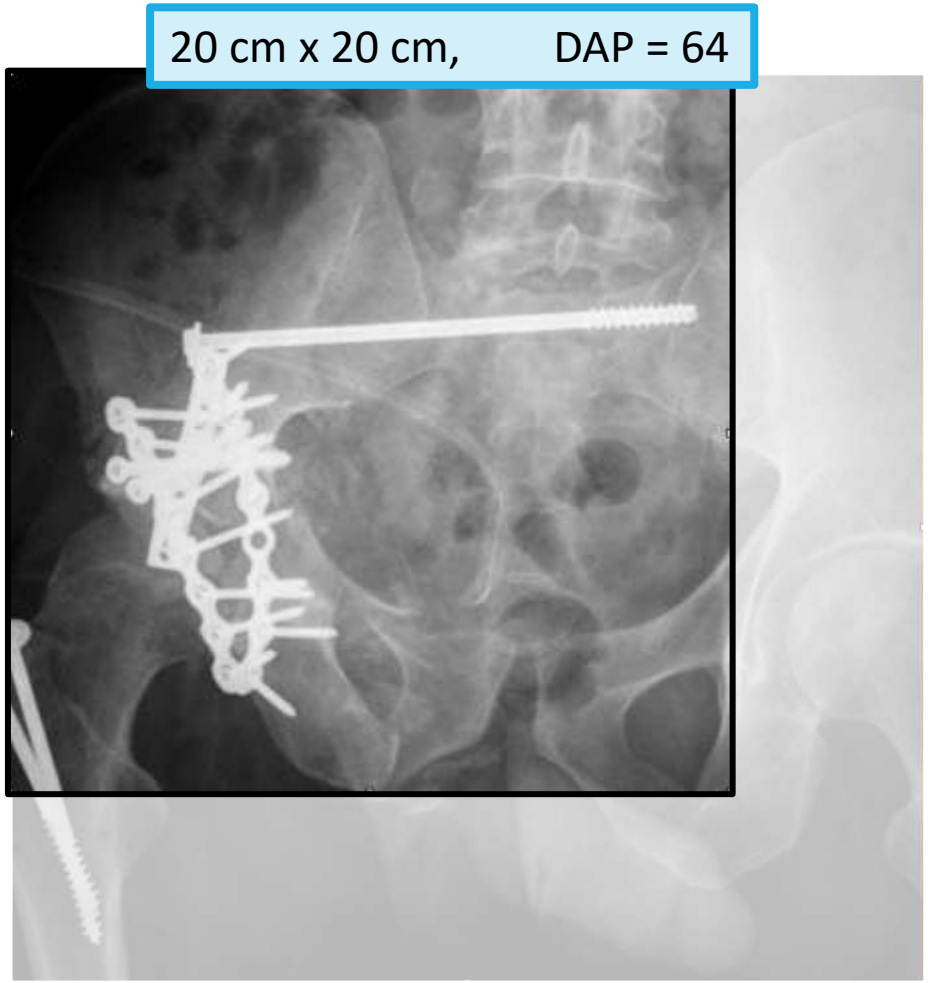
For example:

- Moving from a 25 cm x 25 cm FOV to a 20 cm x 20 cm FOV for the same dose rate will reduce the DAP by **36%**



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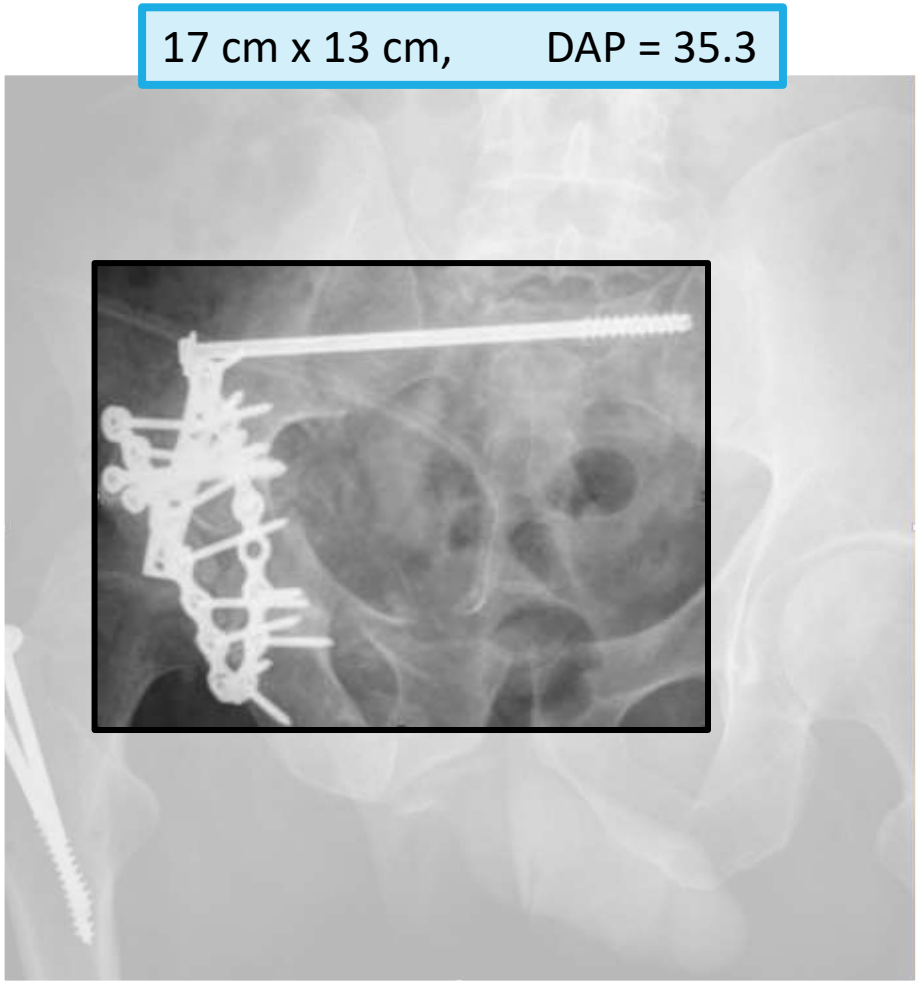
For example:

- Moving from a 25 cm x 25 cm FOV to a 17 cm x 13 cm FOV for the same dose rate will reduce the DAP by **65%**



Service Evaluation: Pelvic Screening

- Local DRLs calculated for a RPU meeting flagged that the 2D screening for the Siemens CIOS Spin were consistently higher than the national DRL.
- The median DAP for 2D Pelvic Screening on the CIOS Spin was found to be **3.77 Gy cm²**.
- This is much higher than the national DRL for Orthopaedic Pelvis Screening (**1.9 Gy cm²**).

Diagnostic Reference Levels
Health Information and Quality Authority

Table 7. National adult fluoroscopy DRLs [22]

Procedure/Clinical task	DRL Quantity	DRL
Intramedullary (IM) nail - femur	PKA	1.9 Gy.cm²
Orthopaedic – extremity excluding Intramedullary (IM) nail	PKA	0.1 Gy.cm²
Orthopaedic - pelvis	PKA	1.9 Gy.cm²
Orthopaedic - spinal	PKA	1.2 Gy.cm²

Is this due to the complex nature of cases in MMUH as we are the National Trauma Centre?

- Many of our pelvic cases involve screening over the iliac crests and pubic rami – increased dose due to soft tissue overlying structures

Is this due to different aspects of machine (larger FOV on CIOS)?

Service Evaluation: Pelvic Screening

Is it due to factors that radiographers can control?

- **Pulse Rate**
- **Collimation**

- We have decided to perform a service evaluation seeking to create a local DRL for 2D spinal and pelvic trauma cases using the CIOS system.
- We also want to see what the impact of reducing pulse rate and increasing collimation habits will have on the dose.

AUDIT TOOL

	Audit Number	Spine or Pelvis	DAP (mGy.cm2)	Instrument to skin time	Screening time	Pulse rate used	Dose Setting	Collimation used	Single image setting used	Mode used (ortho trauma or other)	Patient weight	Consultant name	Comment
2	1												
3	2												
4	3												
5	4												
6	5												
7	6												
8	7												
9	8												
10	9												

Thank you for your attention.

Any questions?

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