

# Making a *Hybrid Room* Functional Elements of a *Good One*

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## Conflicts of interest

- I have no conflict of interest, related to this topic
- Financial support provided by
  - Research grant, Senior Clinical Fellowship, Fellowship Fundamental Research
  - Innovation Fund, Ghent University Hospital
- Member of Surgical Safety Network



Officiële opening hybride ... meer weergeven



Spaarne Gasthuis

*Hertault A et al.* EJVES 2020; 60:374-85

## Definition Hybrid Room

= High performance imaging system with the latest image processing software combining the capabilities of a standard operating room environment

### “Good one”

- Efficient work environment
- Easy to use
- Flexible use
- **Safe** for patient and team
- Affordable

## 1. Space requirement

- Location
- Size
- Asepsis- restricted environment

## 2. Surgical Equipment

## 3. Imaging Equipment

- Imaging system
- Control Room
- System component room

## 4. Radiation protection

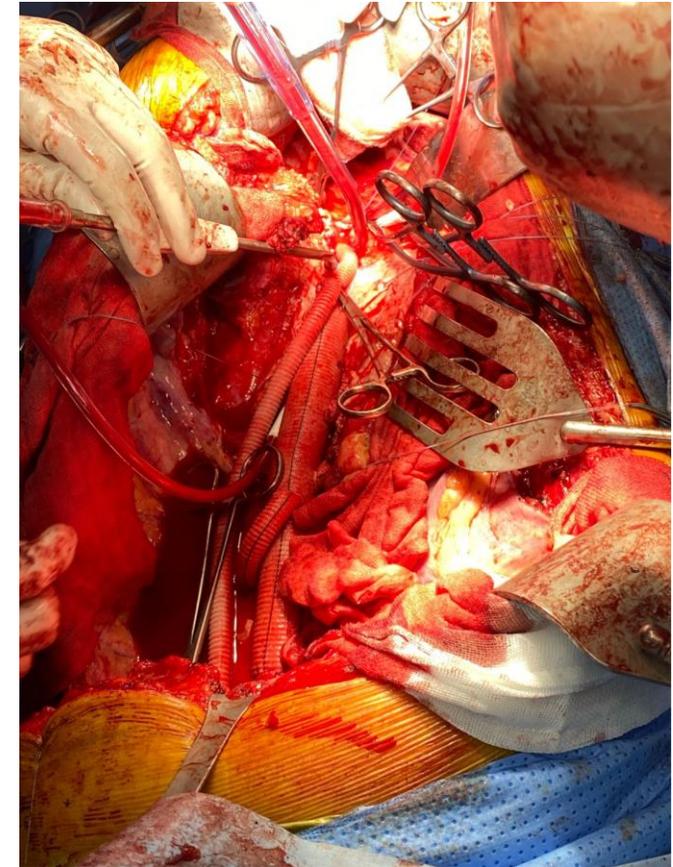
## 5. Storage room

## 6. TEAM & workflow

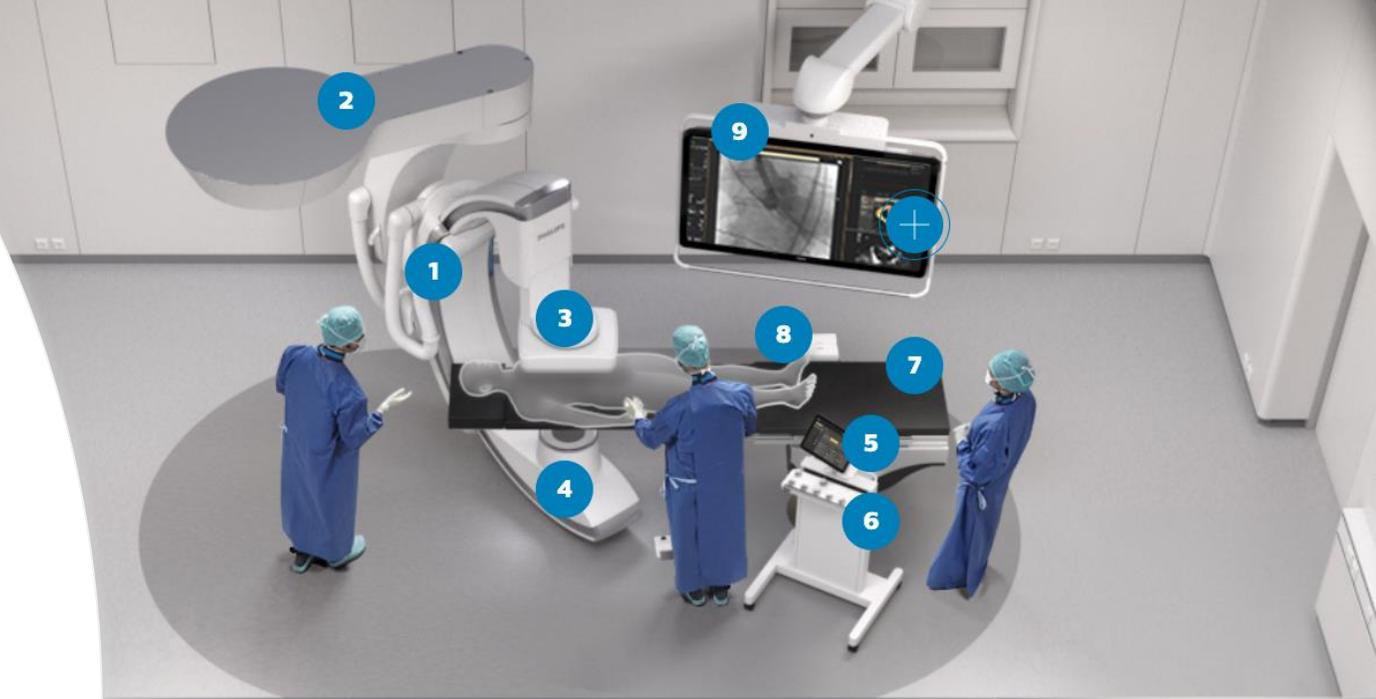


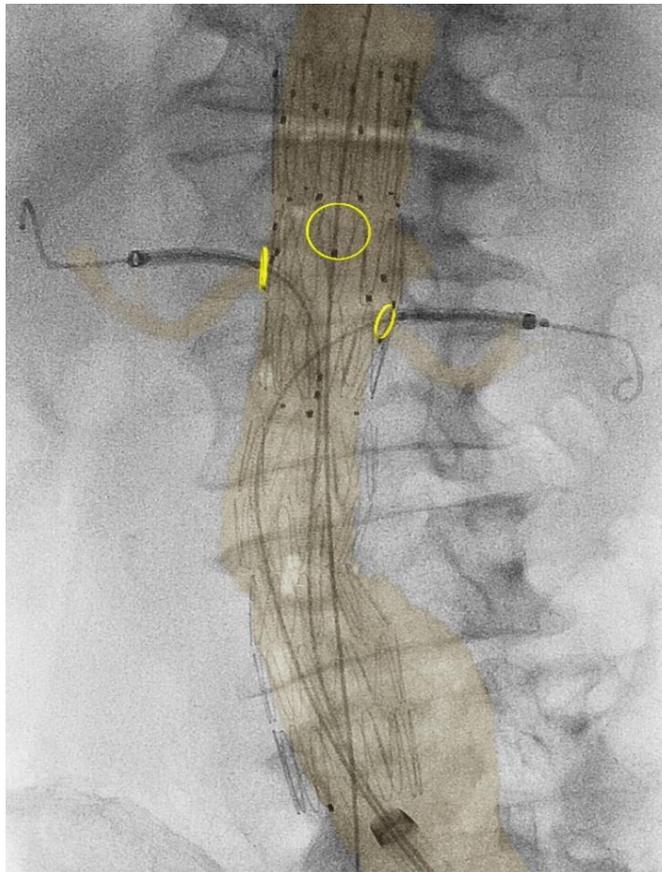
## 2. Surgical equipment

- Compatible OR table integrated with imaging system
- Surgical lights – variable
- Monitors
- Equipment booms
  - Aspiration
  - Cell saver
  - Belmont
  - ECC
  - Elektrosurgery
- Gas, water and power lines
- ...

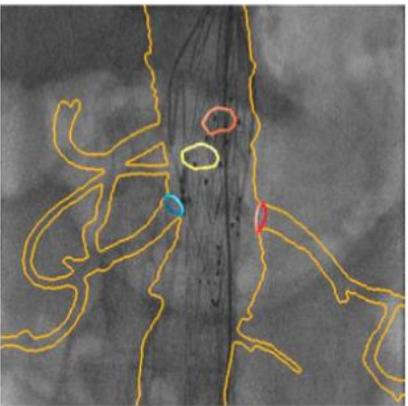


# 3. Imaging Equipment & Control Area

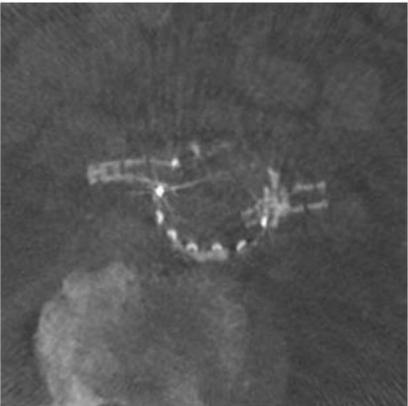




Plan



Guide



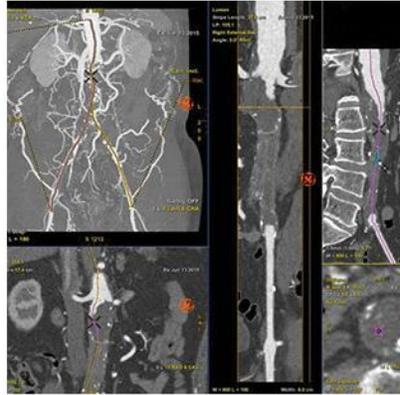
Assess

3D cone beam CT

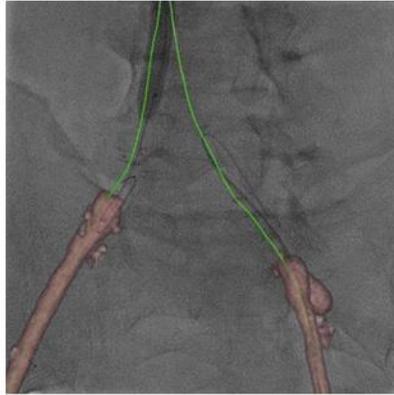
# Advanced Imaging Tools



### Aorto-iliac Chronic Total Occlusion



Plan



Guide

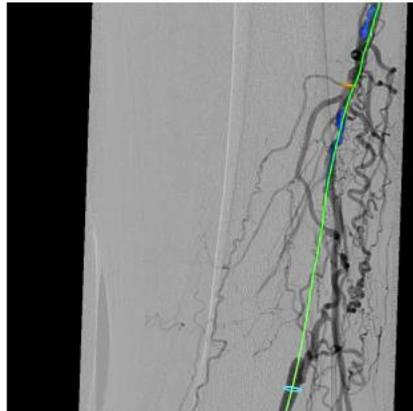


Assess

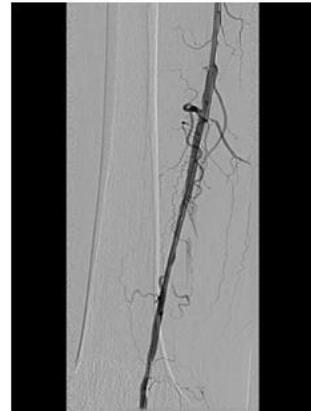
### SFA Chronic Total Occlusion



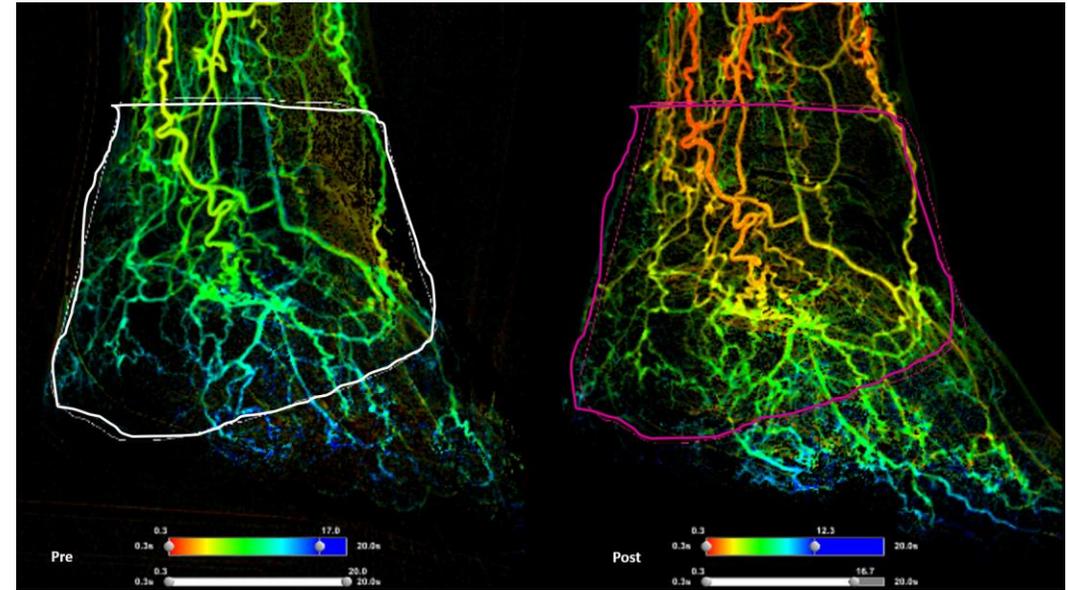
Plan



Guide



Assess



Pre

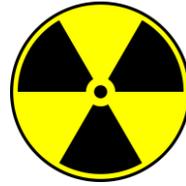
Post

# 4. Radiation Protection

## X-rays



**BUT**



Are **everywhere**

AFFECT PATIENTS AND TEAM  
MEMBERS



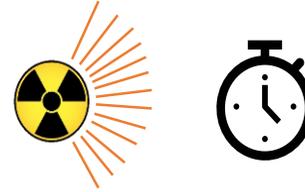
They **MAY** cause **damage**

SHORT TERM & LONG TERM EFFECTS

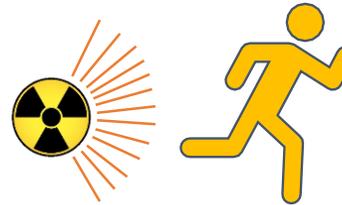


## ALARA: 3 pillars *As Low As Reasonably Achievable*

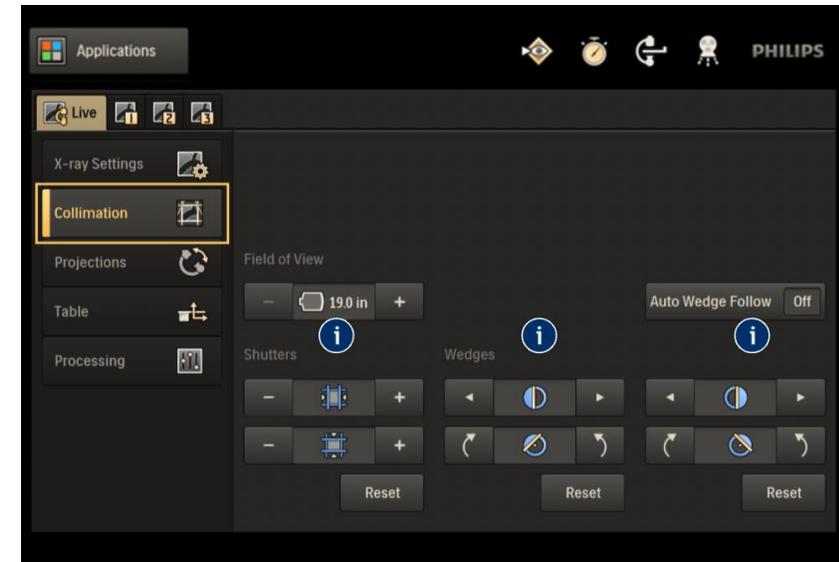
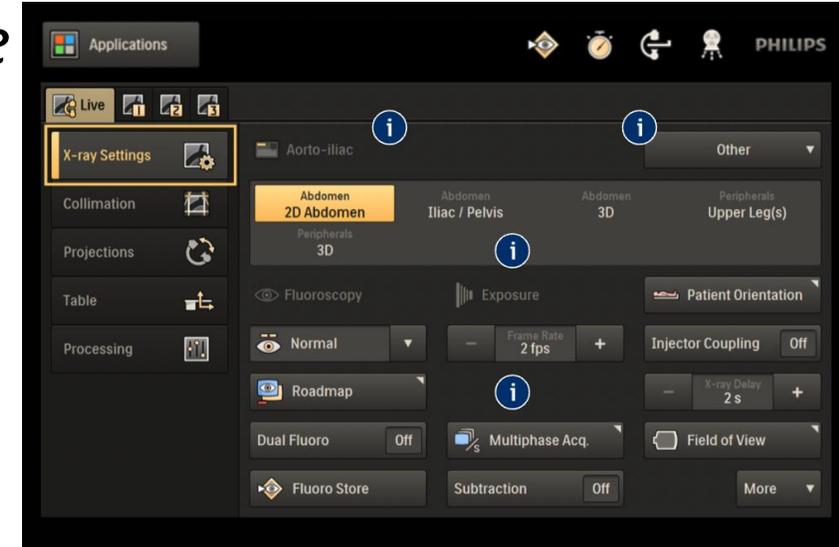
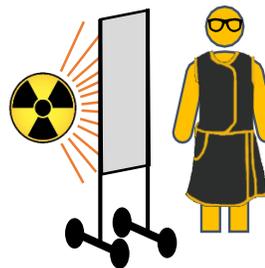
1 Reduce exposure **time** as much as possible



2 Maximize the **distance** from the radiation source

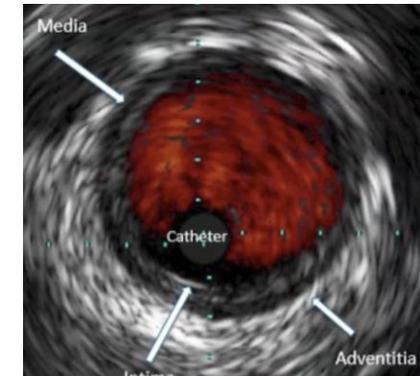
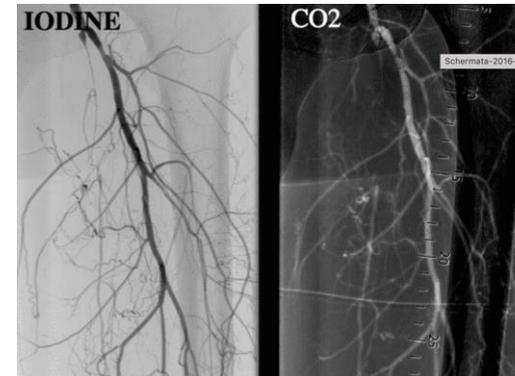
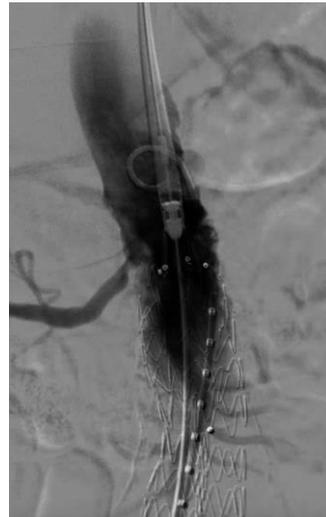


3 Use protective **shielding** equipment

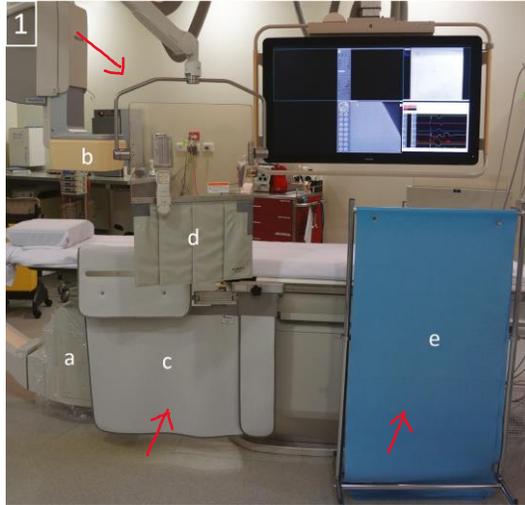


THE 24<sup>TH</sup> INTERNATIONAL EXPERTS SYMPOSIUM  
**CRITICAL ISSUES**  
IN AORTIC ENDOGRAFTING

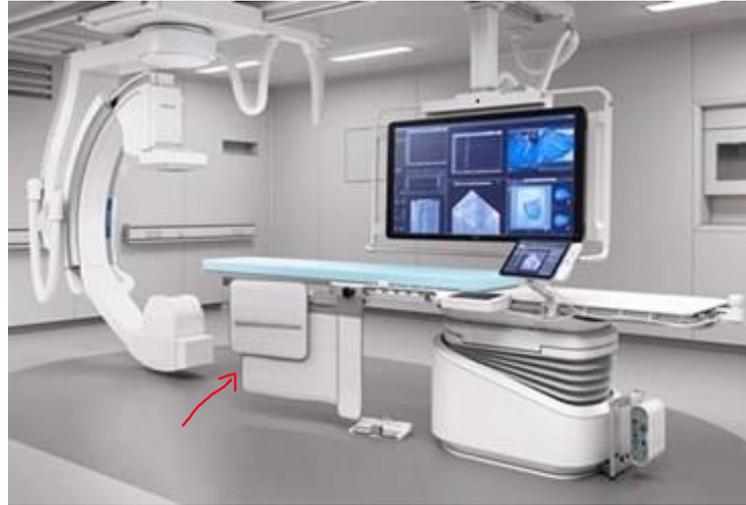
**DECEMBER 17 & 18 2021**  
PULLMAN PARIS BERCY PARIS - FRANCE



# Protect Healthcare Workers, Patients and Yourself



Shielding



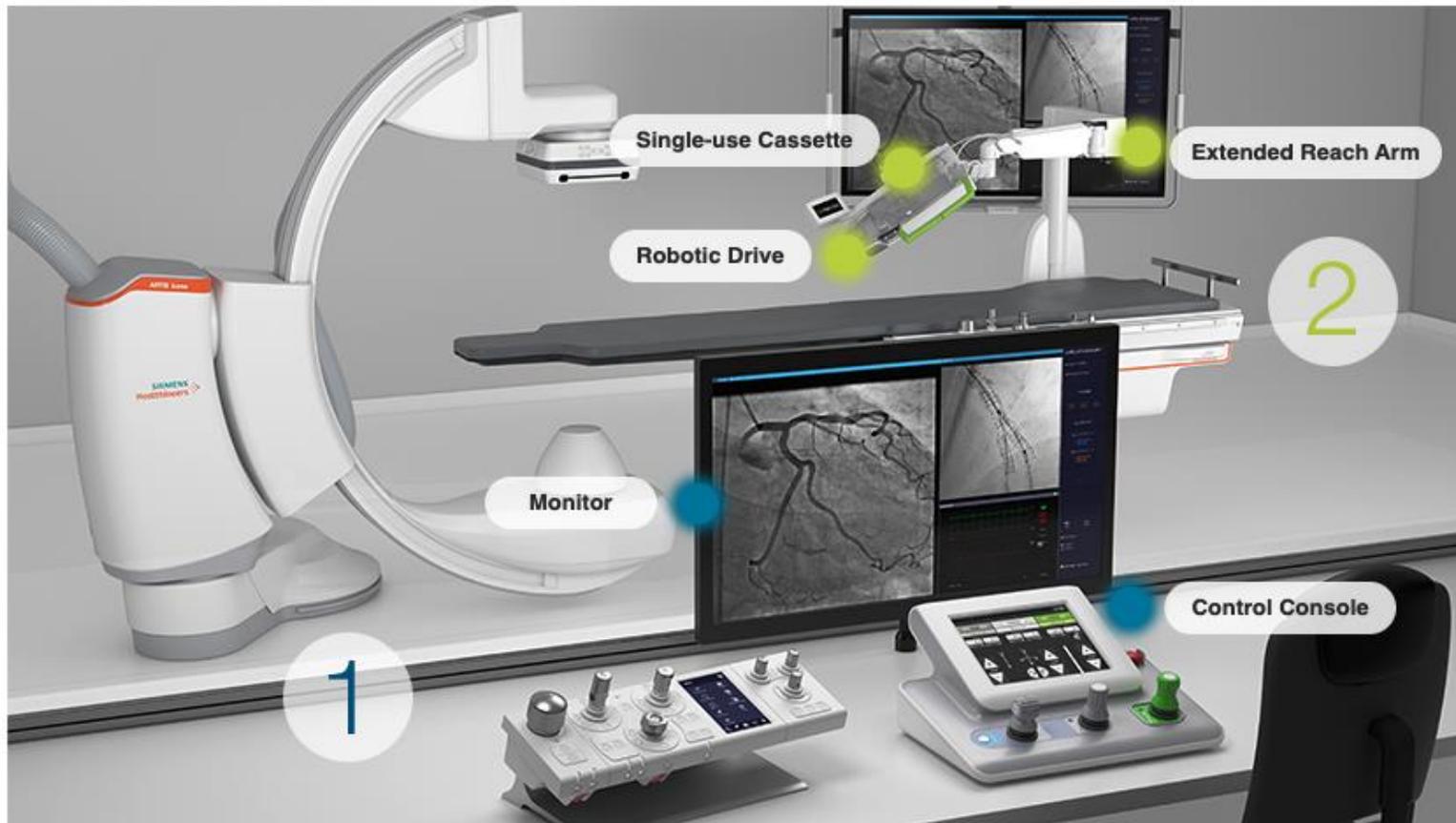
Personal protection



### Safety and Feasibility of Robotic Percutaneous Coronary Intervention

PRECISE (Percutaneous Robotically-Enhanced Coronary Intervention) Study

Giora Weisz, MD,\* D. Christopher Metzger, MD,† Ronald P. Caputo, MD,‡ Juan A. Delgado, MD,§  
J. Jeffrey Marshall, MD,|| George W. Vetrovec, MD,¶ Mark Reisman, MD,# Ron Waksman, MD,\*\*  
Juan F. Granada, MD,§ Victor Novack, MD, PhD,†† Jeffrey W. Moses, MD,\* Joseph P. Carrozza, MD‡‡  
*New York and Syracuse, New York; Kingston, Tennessee; Medellin, Colombia; Gainesville, Georgia;  
Richmond, Virginia; Seattle, Washington; Washington, DC; Beersheba, Israel; and Boston, Massachusetts*



Miscellaneous

Eur J Vasc Endovasc Surg (2021) 61, 317–325

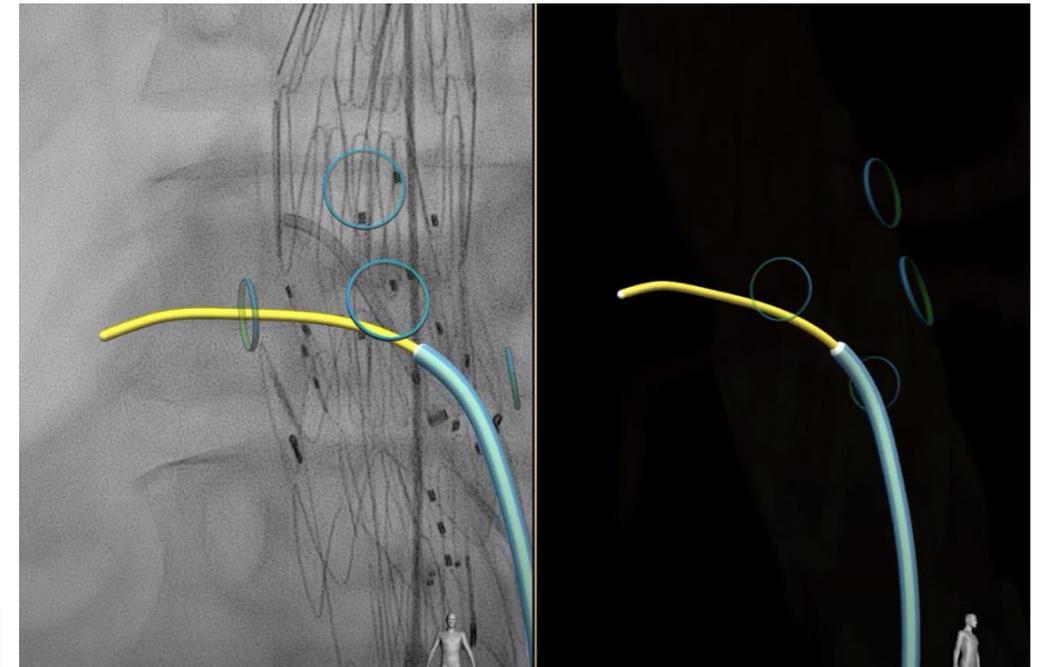
### First in Human Clinical Feasibility Study of Endovascular Navigation with Fiber Optic RealShape (FORS) Technology

Joost A. van Herwaarden <sup>a,\*</sup>, Marloes M. Jansen <sup>b</sup>, Evert-Jan P.A. Vonken <sup>b</sup>, Trijntje Bloemert-Tuin <sup>a</sup>, Roland W.M. Bullens <sup>c</sup>, Gert J. de Borst <sup>a</sup>, Constantijn E.V.B. Hazenberg <sup>a</sup>

<sup>a</sup> Department of Vascular Surgery, University Medical Center Utrecht, Utrecht, the Netherlands

<sup>b</sup> Department of Radiology, University Medical Center Utrecht, Utrecht, the Netherlands

<sup>c</sup> Philips Medical Systems Nederland, Best, the Netherlands



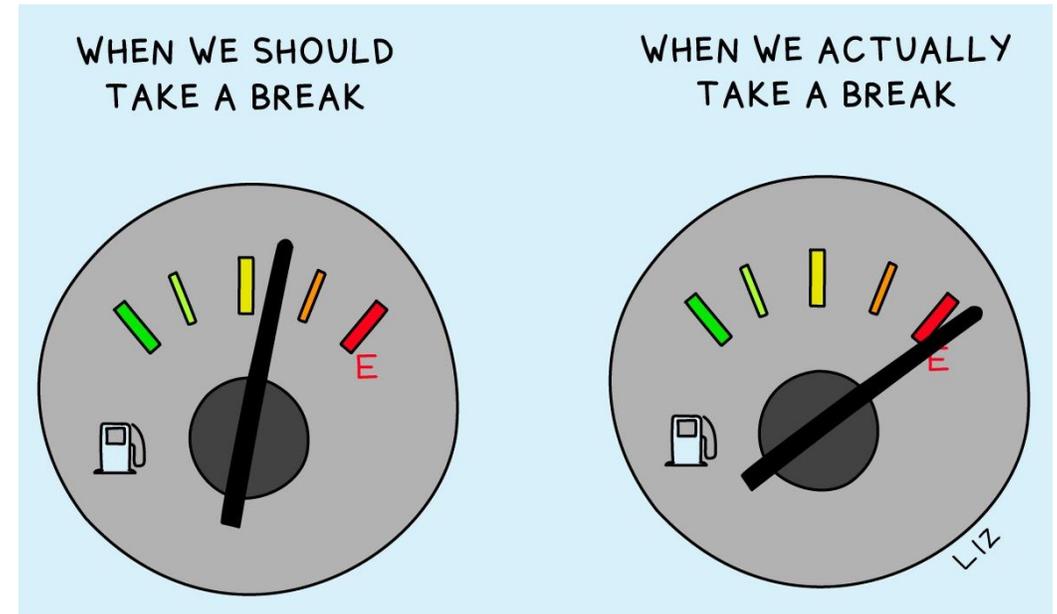
**Figure 1.** The Fiber Optic RealShape (FORS) system with workstation (1), trolley (2), docking base (3), docking top that connects to the FORS enabled devices (4). The FORS enhanced devices are visualised in context of an anatomical roadmap on the screen (5). Copyright © (2020) Koninklijke Philips N.V. All rights reserved.

## 5. Storage Room



## 6. TEAM & Workflow

- Anaesthesiology
- Nurses
- Vascular Surgeon
- Interventional Radiologist
- Radiology technicians
- Perfusion technicians
- Cardiac surgeons
- ...



We cannot change the human condition, but  
We can change the conditions under which humans work

*James Reason*

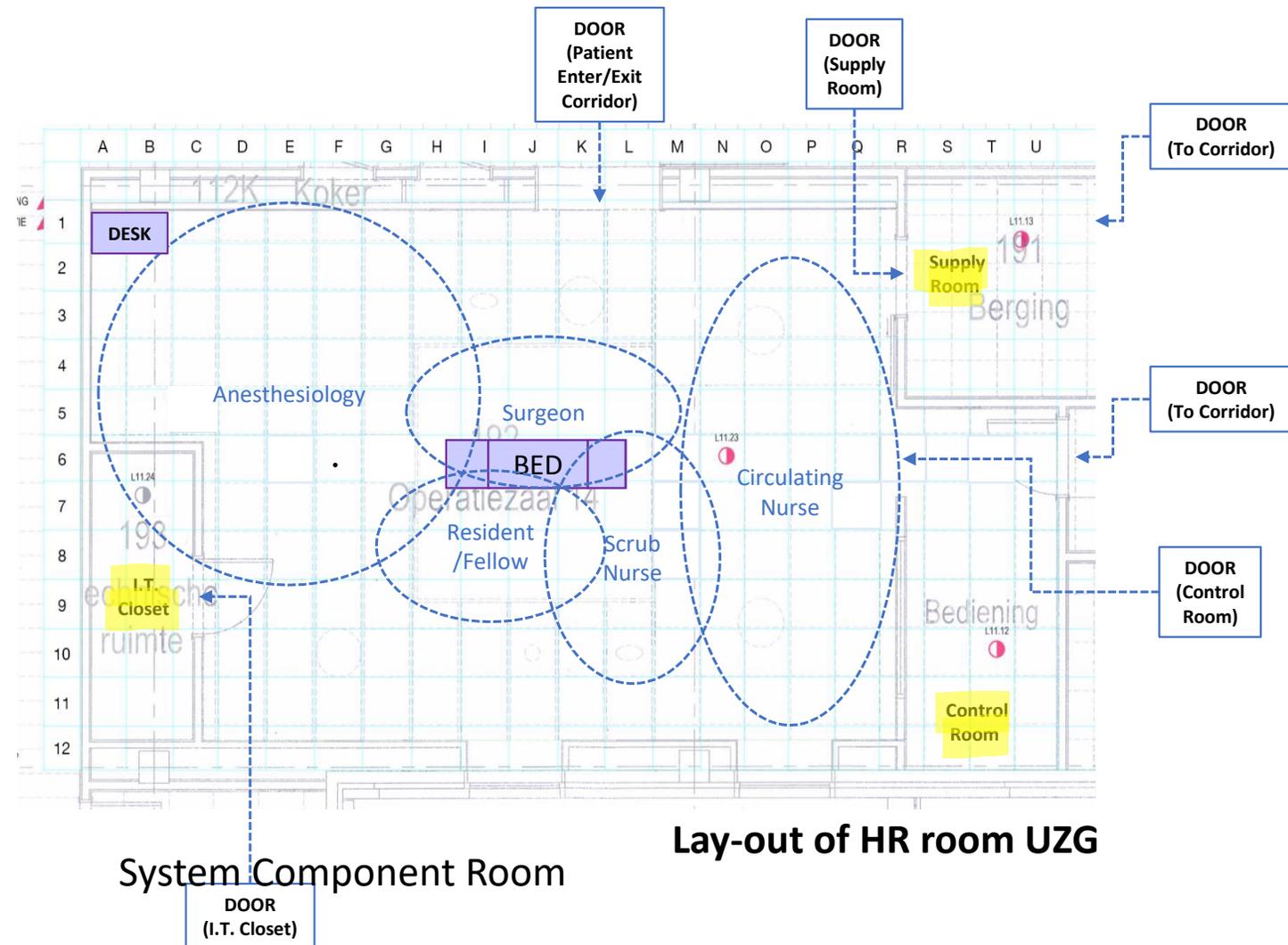


## Observed Operating Room Traffic Flow Patterns 10 cardiothoracic procedures

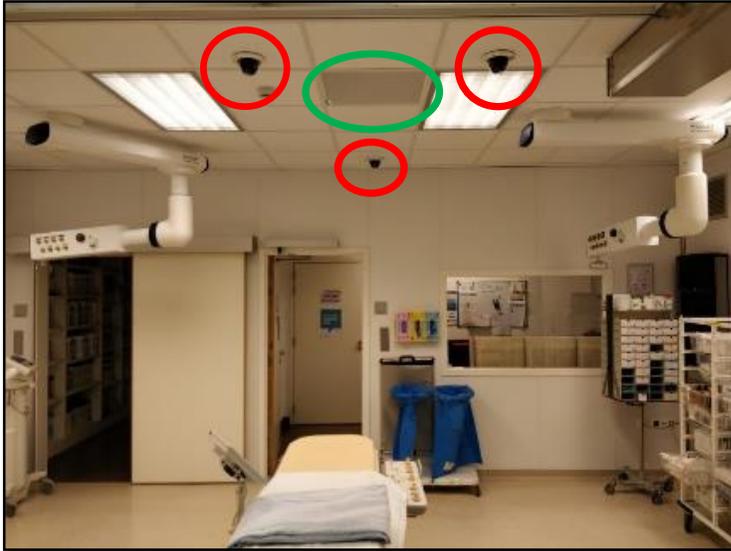
-  Anesthesiologists
-  Nurses
-  Perfusionists
-  Cardiothoracic surgeons
-  Areas of concern

## SAFE environment?

- Flow of patients
- Flow of team members
- Supplies to perform procedures
- Define collision-free zones



# 7. Medical Data Recorder in a 'good' hybrid room



## OR Black Box

4 HD Cameras

3 Microphones

1 Touchscreen PC

## 1 Capture server

- Audio-visual data
- Fluoroscopy screen
- Anaesthesia monitor

## 1 Storage server

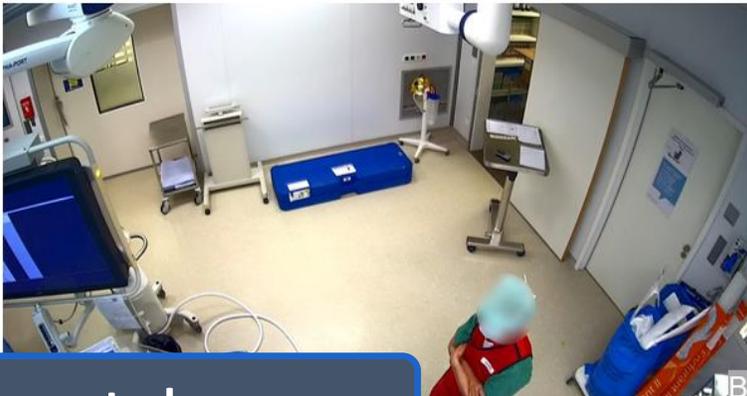
# Captured by OR Black box system in the hybrid room

Surgical/Nursing team



Circulating nurse

Doors to storage and control room



Anaesthesiology Monitor



Four ceiling-mounted cameras



Overview Hybrid Room

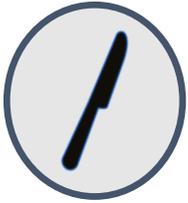


Anaesthesiology team



Fluoroscopy screen

# OR Black box evaluation



## Technical

- Global rating scale (GRS)
- Procedure specific rating scale (PRS)



## Non-Technical

- Surgeons: Non-technical skills for Surgeons (NOTSS)
- Nurses: Scrub Practitioners' List of Intraoperative Nontechnical skills (SPLINTS)



## Distractions

- Disruptions in Surgery Index (DiSI)



## Radiation safety

- Objective measures: Radiation doses
- Behavioral measures: Team positions; Radiation safety behavior rating scale

### NOTSS

Score (/4)

- Situational awareness
- Decision making
- Communication
- Leadership

### SPLINTS

Score (/4)

- Situational awareness
- Communication-teamwork
- Task management

# DiSI

Median auditory distractions 12 (6-23)  
 Doors opening 43 (34-53) times per hour

## Radiation safety dose

Within safe ranges,  
 but in three EVAR - DAP > 500 Gy.cm<sup>2</sup>

## Behavioural measures

	Radiation safety scale	11 - 55
Procedure type	EVAR +-IBD N = 6	PVI N= 16
Median IQR	31 27.1 – 35.1	32 30.1 – 33.5

→ Below 'acceptable' score of 33

## Radiation Safety Performance is More than Simply Measuring Doses! Development of a Radiation Safety Rating Scale

Bart Doyen<sup>1</sup> · Blandine Maurel<sup>2</sup> · Adrien Hertault<sup>3</sup> · Peter Vlerick<sup>4</sup> · Tara Mastracci<sup>5</sup> · Isabelle Van Herzelele<sup>4</sup> · On behalf of: PRET (Principles of Radiation protection within Endovascular Team) group

CVIR 2020; 43(9): 1331-41

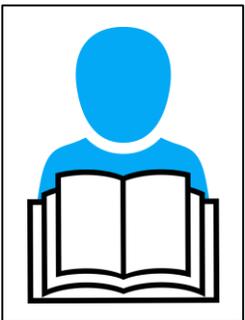
Please circle the number corresponding to the team's performance in each category, irrespective of training level.						
1. Pre-procedural planning	1 Significant fluoroscopy issues / delay due to poor planning or team unawareness.	2	3 Limited fluoroscopy issues / delay due to poor planning or team unawareness.	4	5 Superior planning, without fluoroscopy issues / or delay.	
2. Setup of angiography suite/ operating room	1 Clear lack of preparation of equipment and environment.	2	3 Suboptimal preparation of equipment and environment, but easily correctable (e.g. display monitor placed too far).	4	5 Optimal preparation of equipment and environment.	
3. Additional shielding equipment	1 Additional shielding equipment not used or used incorrectly.	2	3 Additional shielding equipment occasionally used inefficiently.	4	5 Additional shielding equipment used most efficiently, given room setup.	
4. Personal protective equipment	1 Personal protective equipment not worn or dosimeters in wrong position.	2	3 Protective equipment worn, but suboptimal (e.g. wrong size).	4	5 Personal protective equipment and dosimeters worn correctly.	
5. Position of operator/team relative to radiation source	1 Continuously stands too close to radiation source and remains in the same spot.	2	3 Tries to keep distance from radiation source. Occasionally steps away from radiation source.	4	5 Maximal distance from radiation source, adapts position according to situation.	
6. Awareness of radiation usage	1 Excessive radiation usage.	2	3 Some unnecessary radiation usage. Room for improvement.	4	5 Maximum efficiency. Clear economy of radiation usage.	
7. Handling of the C-arm system	1 Excessive use of steep angulations / incorrect table and detector positions.	2	3 Some unnecessary use of steep angulations or suboptimal table and detector positions.	4	5 Steep angulations used sparingly. Optimal table and detector positions.	
8. Image quality versus radiation dose	1 Settings not well-adjusted; Frequent overuse of (unnecessary) high-quality imaging or lack of image quality.	2	3 Settings mostly well-adjusted; Occasional overuse of (unnecessary) high-quality imaging or lack of image quality.	4	5 Image quality settings well-adjusted. Image quality as low as reasonably achievable.	
9. Use of additional dose reducing functions.	1 Incorrect use of dose reducing functions.	2	3 Adequate use of dose reducing functions most of the time.	4	5 Optimal use of dose reducing functions.	
10. Communication and leadership	1 No or ineffective communication about radiation safety. Leadership clearly missing.	2	3 Communication about radiation safety is mostly effective. Leadership present but lacking at times.	4	5 Communication about radiation safety is clear and effective. Effective leadership during the procedure.	
11. Overall radiation performance including the ALARA principles	1 Poor performance. Deficient knowledge or excessive radiation dose.	2	3 Acceptable performance. Most ALARA principles are known and used. Room for improvement.	4	5 Excellent performance. The ALARA principles are known and used correctly.	
Procedure type:	Difficulty (1-5):	Patient BMI	Procedure time: (mm:ss)	Fluoroscopy time (mm:ss)	DAP Gy.cm <sup>2</sup>	Kerma Gy

# A 'GOOD' Hybrid Room - TEAM approach

## Radiation safety culture

Improving radiation safety knowledge?

Education



Workplace-based dissemination

- Communication
- Leadership
- Risk-awareness



Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: [www.elsevier.com/locate/ijssu](http://www.elsevier.com/locate/ijssu)



Original Research

Team perception of the radiation safety climate in the hybrid angiography suite: A cross-sectional study

Bart Doyen<sup>a,\*,\*</sup>, Peter Vlerick<sup>b</sup>, Gilles Soenens<sup>a</sup>, Frank Vermassen<sup>a</sup>, Isabelle Van Herzeele<sup>a</sup>

<sup>a</sup>Department of Thoracic and Vascular Surgery, Ghent University Hospital, Ghent, Belgium

<sup>b</sup>Department of Work, Organisation and Society, Ghent University, Ghent, Belgium



# Quality initiative - MOOC Radiation Safety in the Hybrid Room: "Do's and Don'ts"

**Radiation Safety in the hybrid angiography suite**  
"Do's and don'ts"

**COURSE INFORMATION**

- How to navigate the course
- Replay course introduction
- Review course objectives



**COURSE CONTENT**

- E-learning
- Video cases
- Serious game

**CHAPTER 2: HOW TO REDUCE RADIATION DOSES (1/2)**

- Use appropriate personal protective equipment
- Use additional shielding equipment
- Patient and image detector positions
- Adjust image settings and use low-dose mode
- Maximize the distance from the radiation source
- Reduce the radiation exposure time

Next page



**Which of the following statements is correct?**

Harmful effects of radiation exposure...

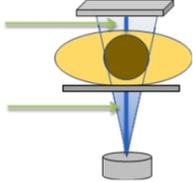
- Affects all team members who are present in the room.
- Only affects team members who are scrubbed in.
- Affect patients more often than team members.
- Only affect team members who are directly exposed to the primary X-ray beam.

**PATIENT AND IMAGE DETECTOR POSITIONS**

Because of the **inverse square law**, the intensity of an X-ray beam will decrease when it travels further from the radiation source.

This physical phenomena has two important consequences when it comes to radiation safety.

- 01 Place the image detector as close to the patient as practically possible.**  
This ensures that as much signal as possible reaches the detector, which minimizes the chances of under-exposing the detector.
- 02 Place the operating table as high as practically possible.**  
This increases the distance between the X-ray source and the patient, which reduces the radiation dose to the patient's skin and scatter doses.



**Remember: Patient High – Detector low!**

**Phase 1: C-arm Positioning and Fluoroscopy Control**

- LAO: 0 30
- RAO: 0 30
- CRAN: 0 15
- CAUD: 0 15
- SID: HIGH LOW
- Bed: DOWN UP
- Zoom: 0%
- Collimation: 0%
- Quality: HIGH LOW

Reset All Road Map



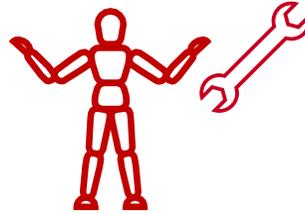
# Do not *only* invest in a 'good' Hybrid Room but **ALSO** in the Endovascular Team

## Barriers

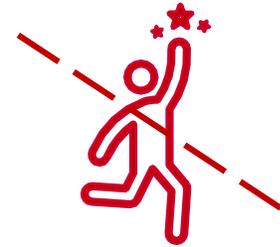
Lack of time



Lack of technical /  
logistical support



Lack of motivation



## Facilitators

Dedicated  
training time



Transformational leader+  
Simulation- based training



Mandatory training  
Repeated

