Ask EuroSafe Imaging
Tips & Tricks

IR Working Group

Medical Simulators for Training in Dose Management and Radiation Protection

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Why Simulation?

- **Medical Simulation** is
  - a cross-disciplinary,
  - realistic,
  - and economical **training and feedback method**

Why Simulation?

- Trainees can repeatedly **practice & review** tasks and processes
- Using physical or virtual reality models (ranging from low to high fidelity), to **identify and understand factors which control the system** and/or predict its future behavior
- Simulation is used to **develop, maintain and improve skills** of Image Guided Interventionalists in a protected environment until proficiency is achieved
- **Without harming patients**

Endovascular Simulators

- Shorten the training course
- Provide a safe, virtual, but realistic atmosphere for procedure performance
  - No radiation exposure
- Provide a complete log of the procedure, also considering:
  - Fluoroscopy time
  - Patient exposure
  - Estimate of operator exposure

Any Feature of Cath. Lab Equipment Can Be Simulated

- State of the Art Angiography systems have:
  - Virtually unlimited Fluoroscopy time,
  - DSA,
  - Road Maps,
  - Cone-beam CT and many other options that are based on Ionizing Radiation

Virtual Reality Simulators

- Significant differences have been noted between pre- and post-training performance of procedures when using medical virtual reality simulators
  - with shortening of procedure and fluoroscopy time [1]

- Virtual reality simulation provides a
  - risk-free (including radiation-free) setting
  - in which technical skills can be obtained through repetition [2]

Procedure Planning

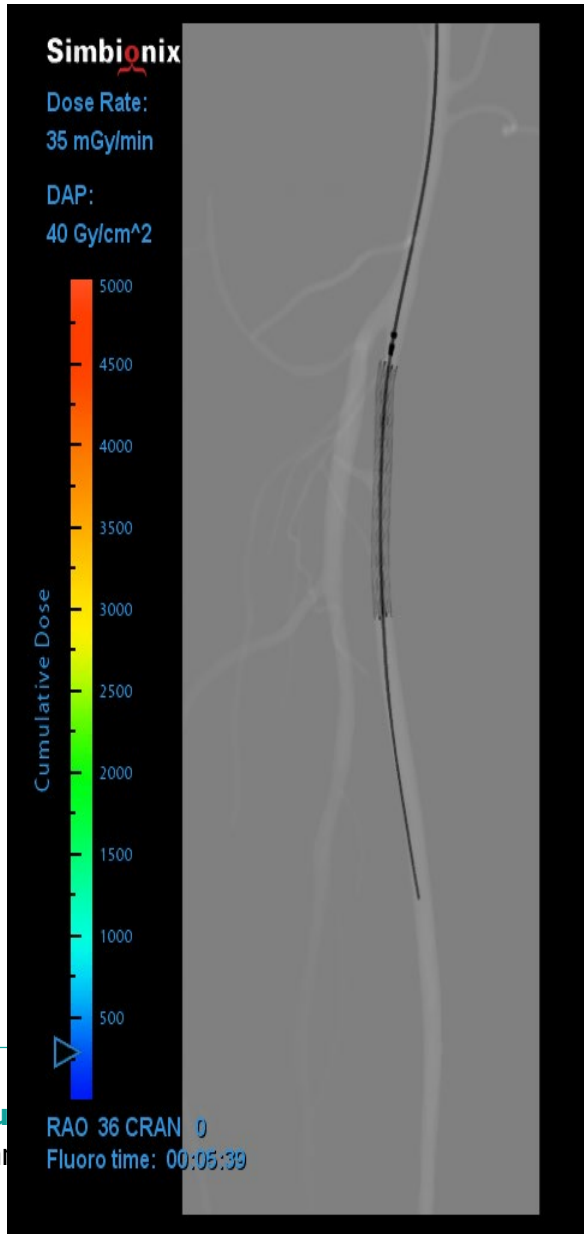
- Procedure planning should integrate dose management measures
- The goal is an efficient and optimal use of radiation
  - not an irrational fear or negligence
- Simulation is based on accurate procedure planning

Radiation Protection Simulation - Goals

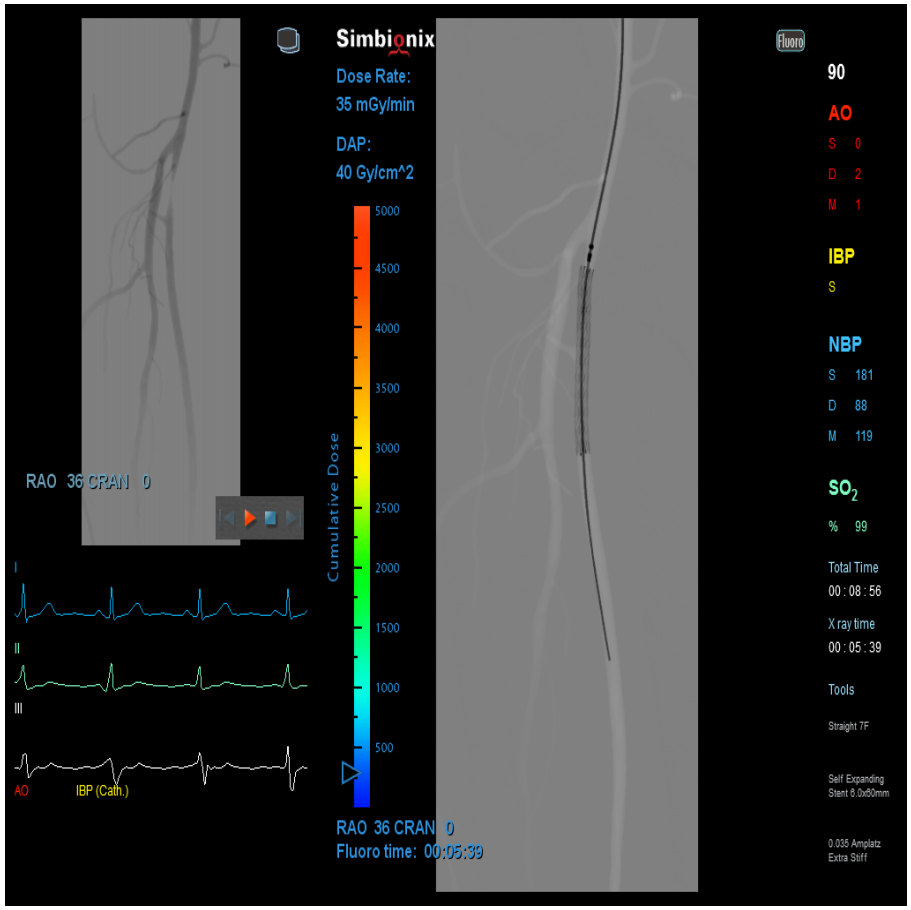
- Build up physician's awareness to dose levels during interventions
- To provide tools for dose reduction methods
- To practice dose management as an integral part of the hands-on simulation
  - shorten procedure and fluoroscopy time
- To provide scoring and subjective performance metrics
  - measure results
  - follow-up improvement

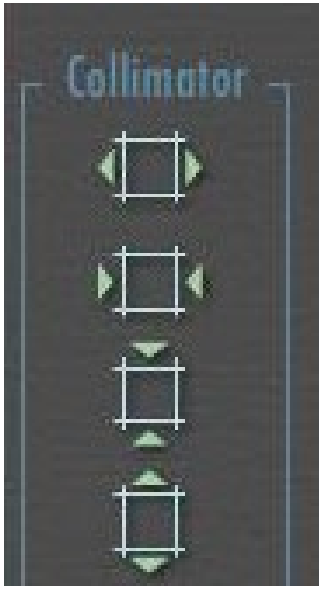
Real Time Dose Display

- Dose Rate/Cumulative Dose (mGy)
- Side Bar with Cumulative Dose/Dose Rate
- DAP mGycm^2



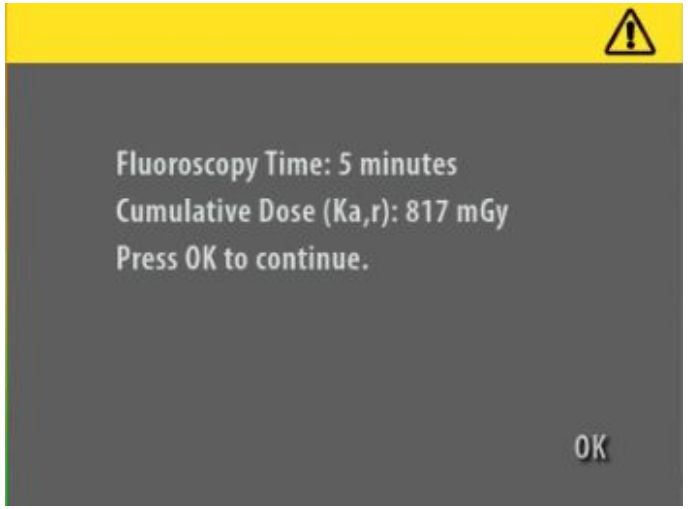
Off-Fluoro Collimation

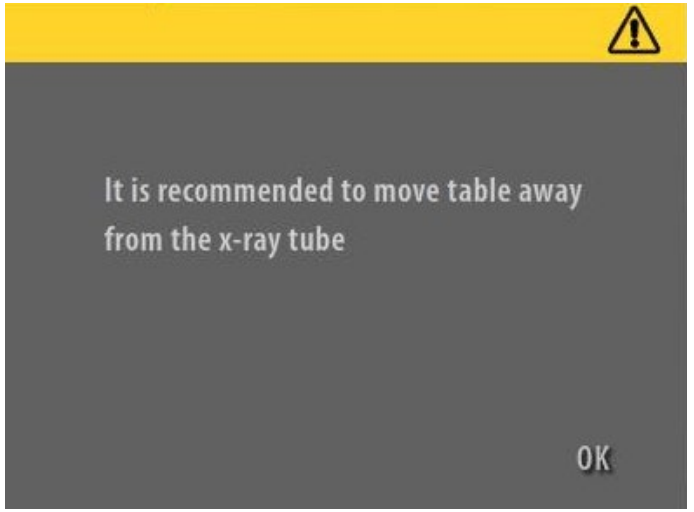




Messages and Alerts

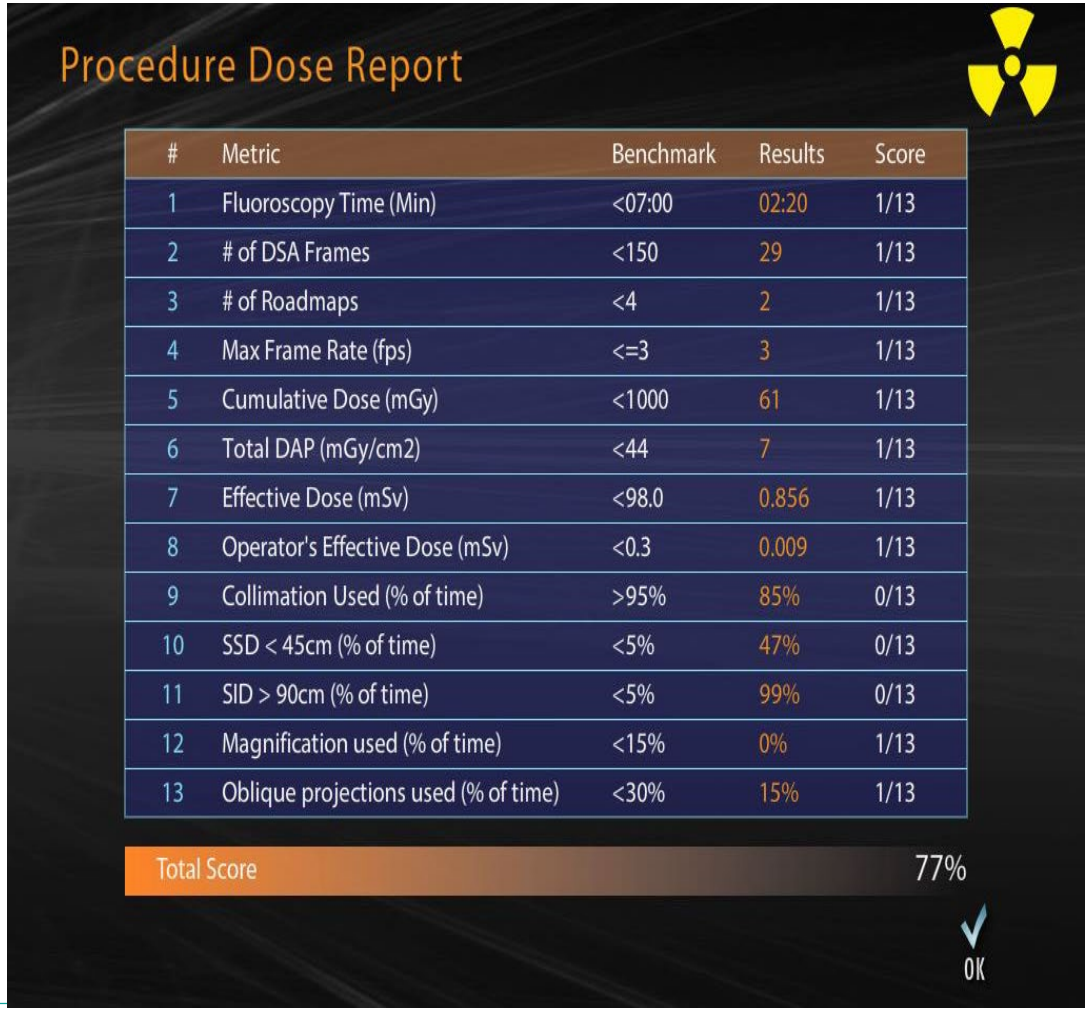
These alerts are displayed intermittently according with time of procedure



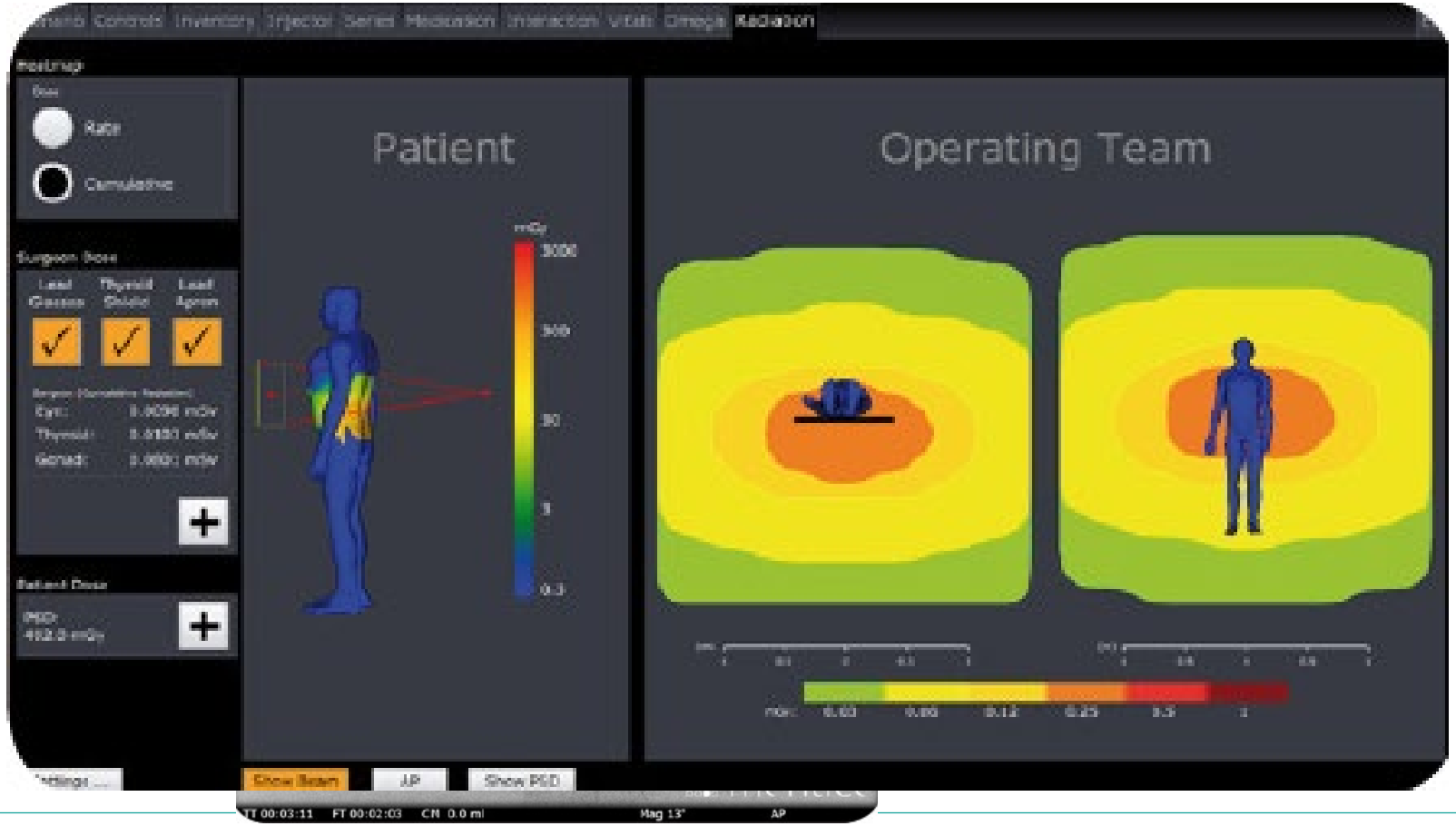


Performance and Dose Report

- Displayed at the end of each session
- Stored in the system in order to follow-up the progress of trainee



Radiation Safety Plug-in



Radiation Safety package

- Realistic and safe radiation safety training
- Hands-on training to newly-hired or current staff
- Hospital credentialing and privileging
- Skill center radiation training for nurses and techs
- Implementing an effective radiation safety program

Procedure Training Objectives

- Balancing between dose and image quality – ALARA
- Understanding deterministic and stochastic effects
- Understanding when and why high doses occur
- Adjusting table and detector height for optimal exposure
- Use of LIH, pulse rate and dose level to limit fluoroscopy dose
- Cine and DSA, frame rate and fluoro store
- Magnification, collimation, wedge filters, and virtual guidance

Procedure Training Objectives

- Reducing dose for steep angulation or large patients
- Varying beam angle and keeping extremities out of the beam
- Staff positions relative to direct beam and scatter
- Benefits of using protective wear and shielding
- Lowering dose throughout the case, not just after a notification

Summary

- Medical Simulation is an integral part of training personnel in the interventional suite
  - State of the art endovascular simulators allow training in complex interventions without staff radiation exposure
  - Effective and safe procedure performance saves exposure
- Virtual and augmented reality will become an indispensable tool in medical simulation and training [4]
- Simulation training is an ***effective tool for creating safe environment and prevention of unnecessary patient and staff exposure***

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1. Management of Patient and Staff Radiation Dose in Interventional Radiology: Current Concepts. Bartal G, Vano E, Paulo G, Miller D. Cardiovasc Intervent Radiol (2014) 37:289–298

2. Weisz G et al (2007) The use of interventional cardiovascular simulation to evaluate operator performance: the carotid assessment of operator performance by the Simbionix carotid Stenting Simulator Study (ASSESS). J Soc Simulation Healthcare 2(1)

3. Van Herzeele I, Aggarwal R, Neequaye S, Hamady M et al (2008) Experienced endovascular interventionalists objectively improve their skills by attending carotid artery stent training courses. Eur J Vasc Endovasc Surg 35(5):541–550

4. Is there a place for virtual reality simulators in assessment of competency in percutaneous renal access? Yasser A. Et al. World Journal of Urology volume 34, pages 733–739(2016)