

Patient and Staff Dose Management using Medical Simulators in Complex Endovascular Procedures

Gabriel Bartal MD, FCIRSE, FSIR

CIRSE'15 Radiation Protection Pavilion
Industry presentation– SIMBIONIX

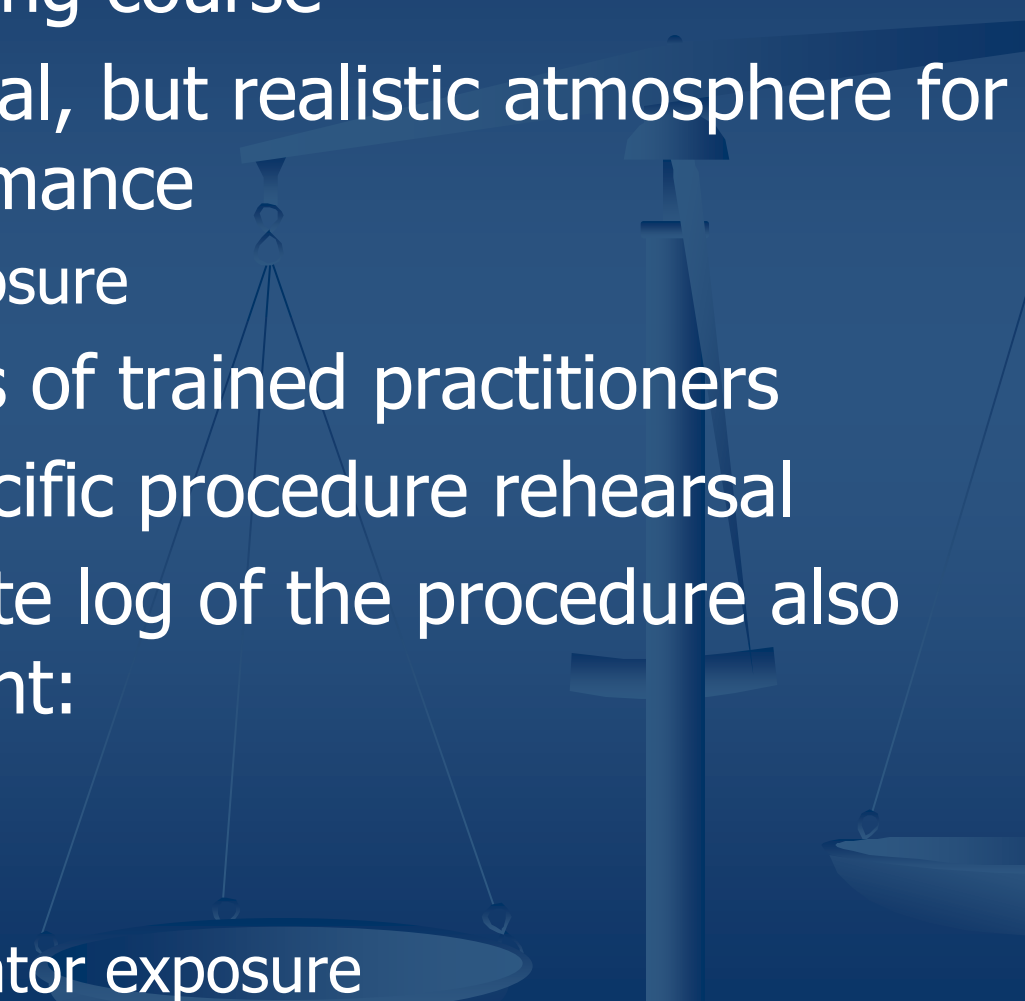
INNOVATION | EDUCATION | INTERVENTION



CIRSE 2015

September 26-30 | Lisbon, Portugal

Endovascular Simulators

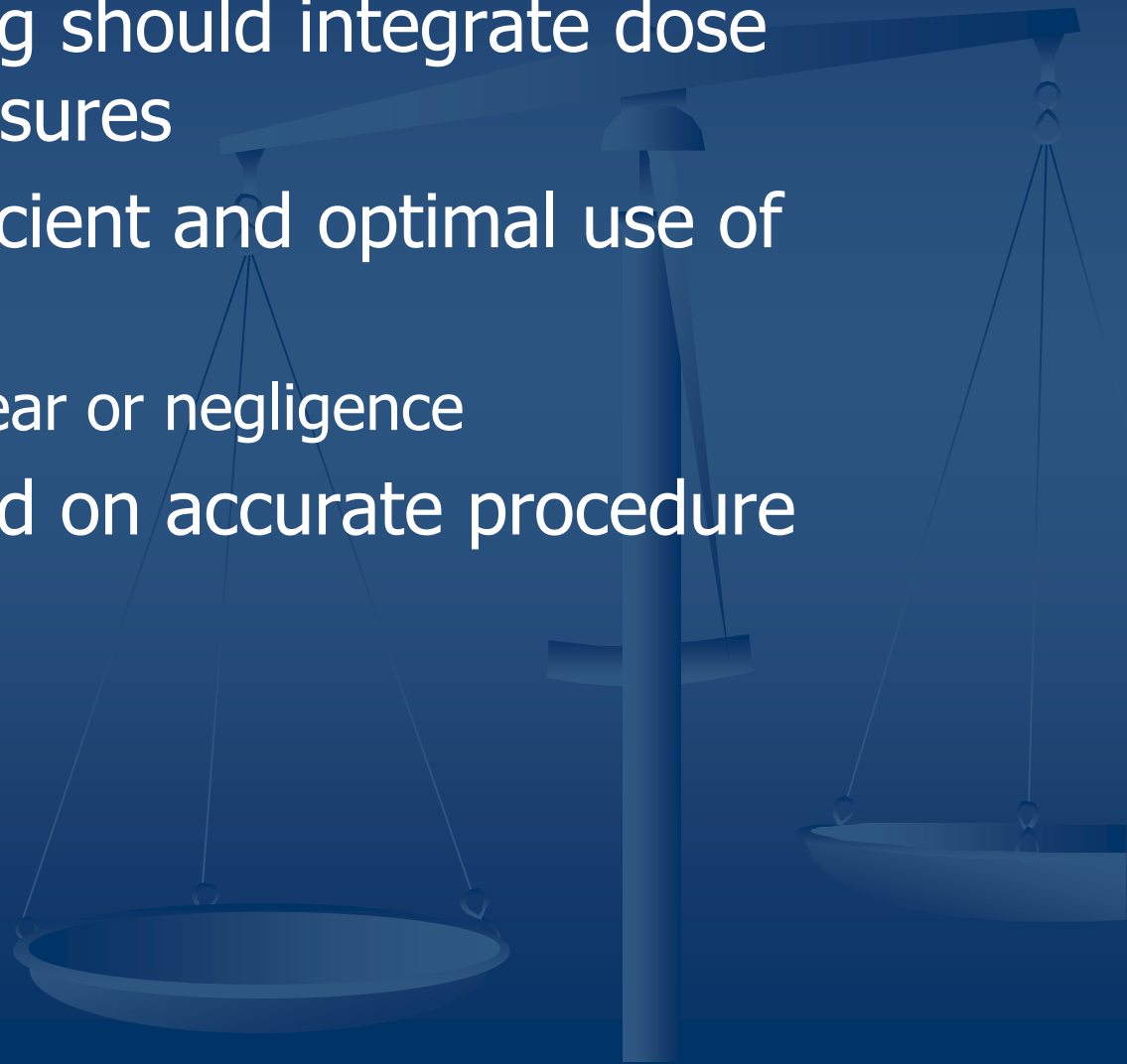
- Shorten the training course
 - Provide safe virtual, but realistic atmosphere for procedure performance
 - No radiation exposure
 - Improve the skills of trained practitioners
 - Allow patient specific procedure rehearsal
 - Provide a complete log of the procedure also taking into account:
 - Fluoroscopy 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
 - Work in progress

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

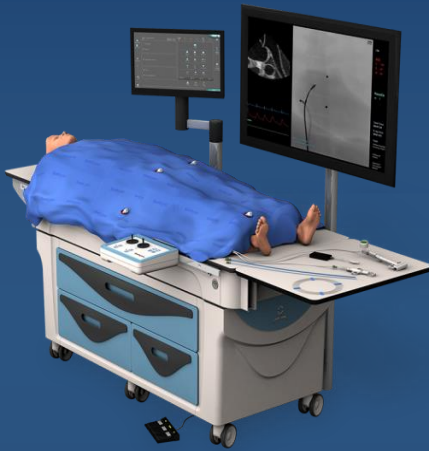


3DS Simbionix ANGIO Mentor

- Multi-disciplinary endovascular training system
- Team training and portable platforms available
- Realistic Cath. Lab environment
- Simulated C-arm and patient table with angiographic imaging
- Wide variety of interventional devices



ANGIO Mentor Family of Products



ANGIO Mentor Suite

A life size mannequin and a true-to-life clinical environment. Ideal for MDT training



ANGIO Mentor Flex

An easy to setup, ultra-portable training solution, ideal for remote meetings and courses



ANGIO Mentor TAB

A light weight solution. Operates original deployment handle

3DS Simbionix ANGIO Mentor

- Over 20 various endovascular procedures across medical specialties
- Designed to enhance skills
- PROcedure Rehearsal Studio software allows to build an unlimited number/variety of virtual patient cases for the ANGIO Mentor



Realistic Simulation

- Realistic physical simulation and tactile sensations of interventional devices
- Realistic clinical environment, using real industry devices and tools



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

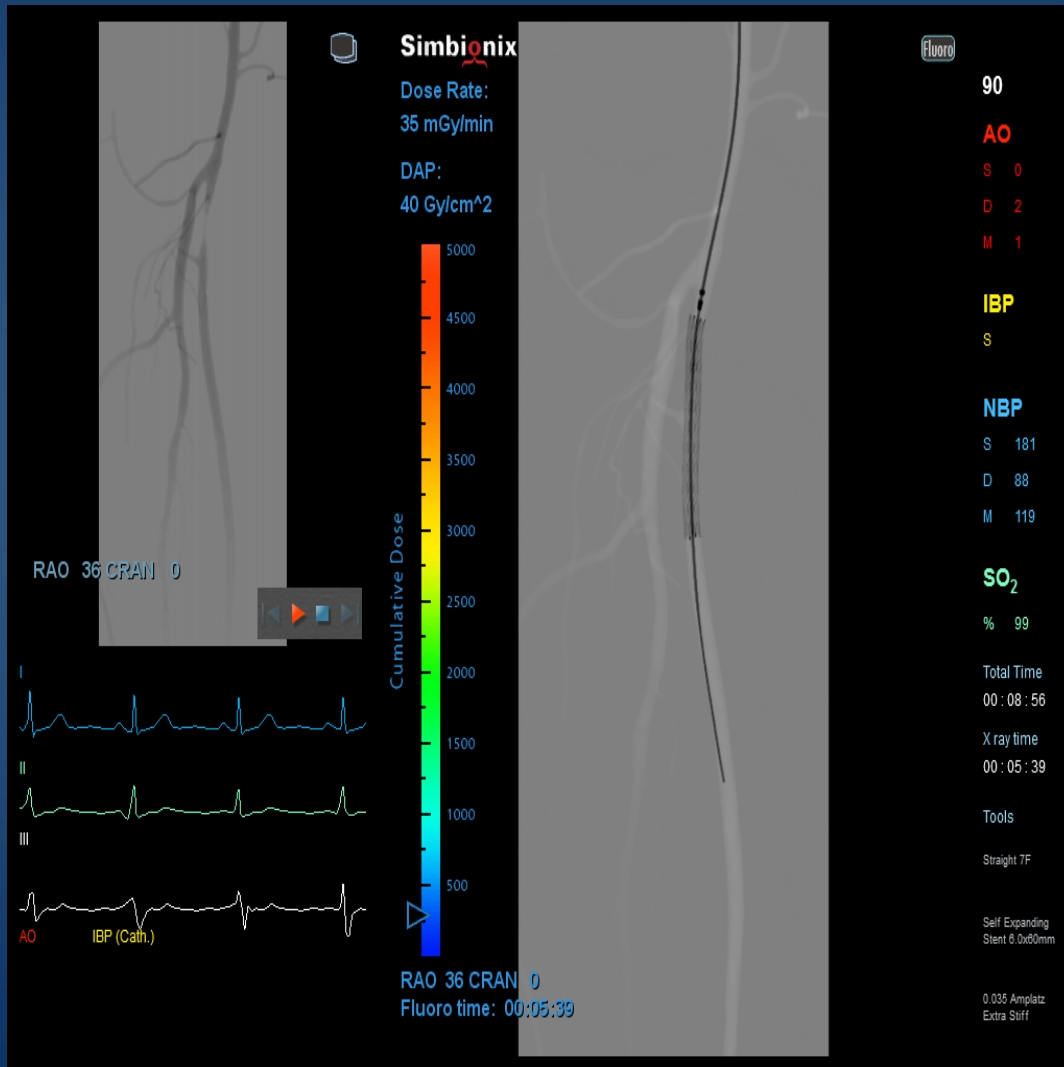


Real Time Dose Display

- Dose Rate/Cumulative Dose (mGy)
- Side Bar with Cumulative Dose/Dose Rate
- DAP mGycm²



Off-Fluoro Collimation



Messages and Alerts

Please remember to put on your protective wear:



Lead Apron



Thyroid Shield



Protective Gloves



Protective Eyewear



Dosimeters



OK



Fluoroscopy Time: 5 minutes
Cumulative Dose (Ka,r): 817 mGy
Press OK to continue.

OK



It is recommended to move table away
from the x-ray tube

OK

Performance and Dose Report

Procedure Dose Report



#	Metric	Benchmark	Results	Score
1	Fluoroscopy Time (Min)	<07:00	02:20	1/13
2	# of DSA Frames	<150	29	1/13
3	# of Roadmaps	<4	2	1/13
4	Max Frame Rate (fps)	<=3	3	1/13
5	Cumulative Dose (mGy)	<1000	61	1/13
6	Total DAP (mGy/cm2)	<44	7	1/13
7	Effective Dose (mSv)	<98.0	0.856	1/13
8	Operator's Effective Dose (mSv)	<0.3	0.009	1/13
9	Collimation Used (% of time)	>95%	85%	0/13
10	SSD < 45cm (% of time)	<5%	47%	0/13
11	SID > 90cm (% of time)	<5%	99%	0/13
12	Magnification used (% of time)	<15%	0%	1/13
13	Oblique projections used (% of time)	<30%	15%	1/13

Total Score

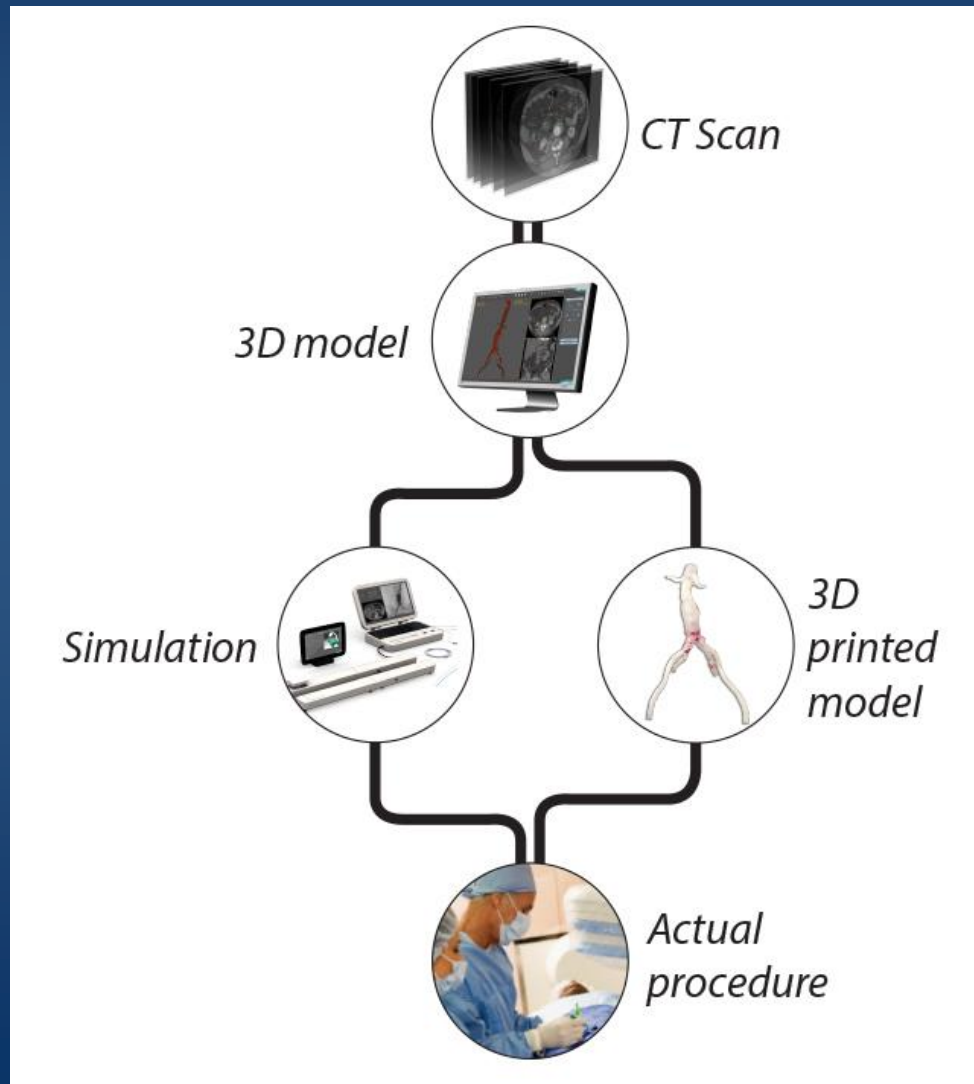
77%



OK

Procedure Rehearsal Studio

Patient Specific Simulation



3DS Simbionix

Patient Specific Simulation

- Allows procedure clinical rehearsal (510K clearance)
- Upload patient CTA scans to create 3D models or import 3rd party model to simulate, analyze and evaluate preprocedural options
- Is aimed to reduce user errors and improve outcomes
- Creates an unlimited growing library of patient specific cases
 - allows sharing cases among users
- Patient specific dose simulation (work in progress)

Procedure Rehearsal Studio - Studies

Patient Specific Simulation Enabling Hands-On
Rehearsal of Carotid Stenting

G. Weisz, Columbia University MC, NY, USA

- “Rehearsal Studio™ helps with planning of procedure and device selection, leading to use of less contrast and radiation, and shorter procedure duration.”

Procedure Rehearsal Studio - Studies



European Journal of
Vascular & Endovascular Surgery

esvs
Journal

Patient-specific Rehearsal Prior to EVAR: A Pilot Study

Desender L, et al. EVEREST (European Virtual Reality Endovascular RESearch Team).

- "Subjective evaluation indicates that it may influence optimal C-arm angles and be valuable to prepare the entire team"

Procedure Rehearsal Studio - Studies

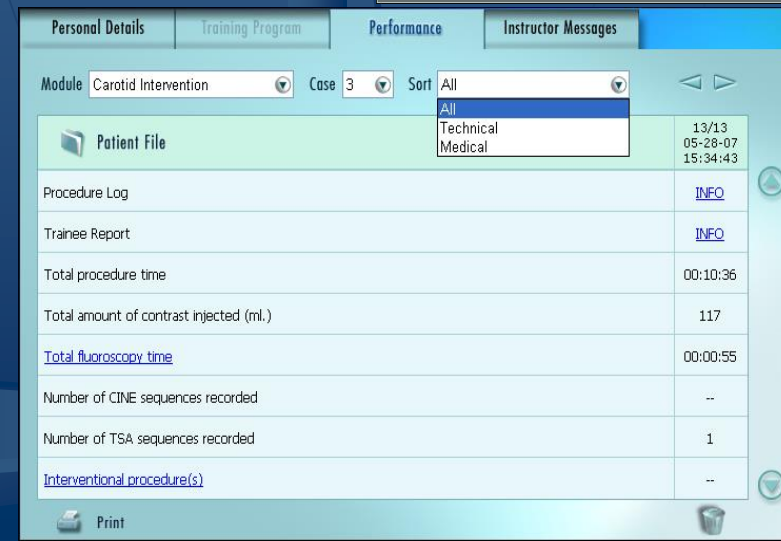
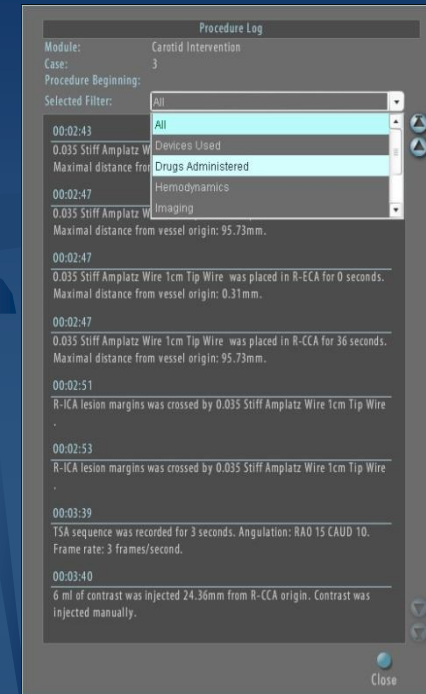
Patient Specific Endovascular Simulation Influences the Material Selection of All Interventionalists Performing a **Carotid Artery Stent (CAS) Procedure**

W. Willaert, R. Aggarwal, I. Van Herzeele, et al

- "Conclusions: Patient specific simulation remarkably influences the endovascular tool selection and C-arm positions in CAS procedures, irrespective of the level of endovascular CAS experience"

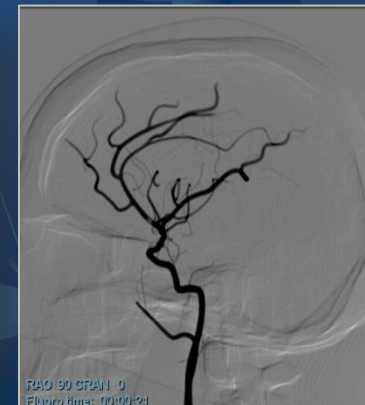
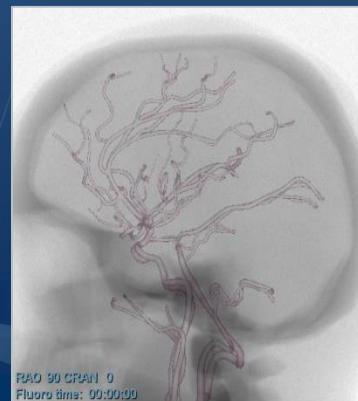
Performance Metrics and Procedure Log

- Assessment of trainee performance and improvement over time
- Scoring for basic skills
- Storing performance info
 - snapshots and video
- Each action is registered in the procedure log:
 - usage of devices
 - imaging
 - contrast and drug injection
- Procedure log allows tracking trainee actions



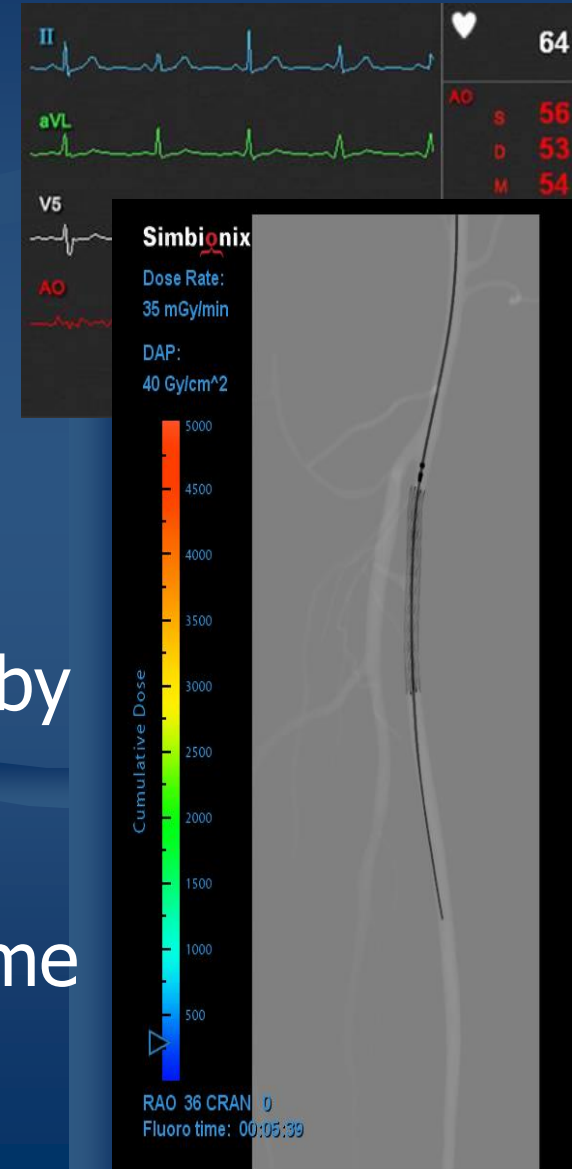
IR Suite Simulation

- Simulation and display of real time fluoroscopic images and C-arm operation
- Allows acquiring roadmap, DSA and cine-angiographic images
- 3D/3D overlay views for better orientation and understanding of the vascular system



Patient Monitoring

- Simulation of clinical routines:
 - virtual patient vital signs monitoring
- Vital signs simulation reflects:
 - Procedure outcome,
 - Proper choice of administered drugs,
 - intra-procedural complications
- ACT level is monitored and affected by Heparin administration
- Radiation Dose monitoring as an integral part of the procedure outcome

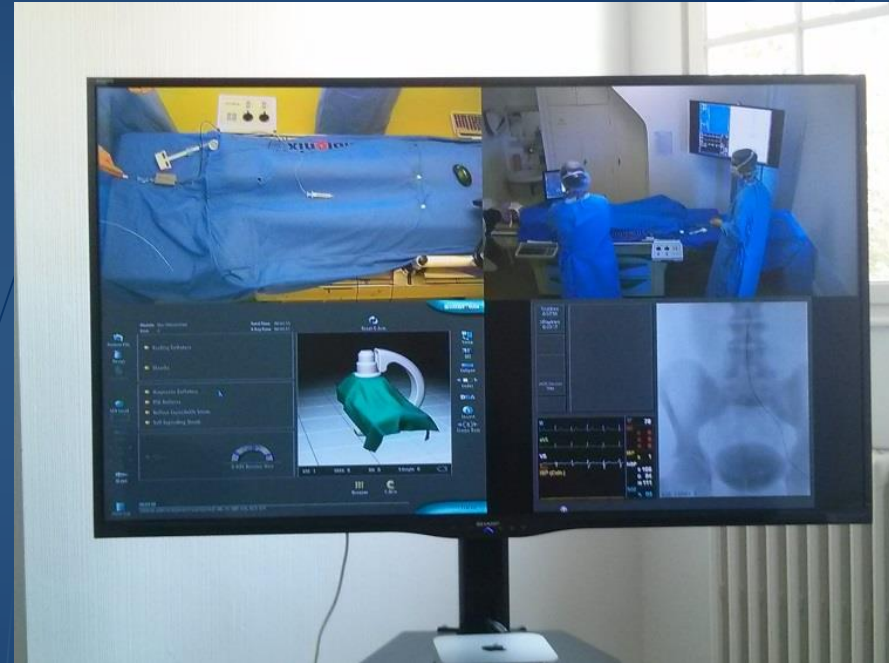


Management of Complications

- Expose the trainee to the real life complications
- Simulation of extreme situations will deliver tools and confidence in handling live case
- 3 types of simulated complications:
 1. Pre-programmed
 2. 'On the fly' – 'Sandboxing'
 3. "Out of the blue", as initiated by the proctor (keyboard shortcut)



Variety of Settings



Geprovas Simulation center, Nouvel Hospital Civil, Strasbourg, France

Variety of Settings



Anglia Ruskin University, UK

Variety of Settings



Integrated C-arm, AIM/VEITH meeting 2014

Thank You

