User Manual

Radiation Safety/ Dosimetry Instructions

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Portal Walkthrough

To access Virtual Medical Coaching's radiation safety training software, you should log in via the VMC WebPortal.

The opening page will be on "simulations" and any modules you have licenses for will be shown here.

Select radiation safety.

On the next page select whether you want your environment to load as Head (Cerebral angiography), Heart (Coronary angiography), or Liver (Hepatic angiography).


Choose whether you wish to access the simulation in Desktop mode or in Virtual Reality (VR).

These are labeled 2D and VR for convenience, although as you will see in the 2D app you can maneuver around in a 3D environment.

This will load the chosen simulation environment (Head, Heart, or Liver) onto either your Desktop screen or your VR headset.


First Time User? Head to the 'Downloads' section of the portal and install the simulation - your academic lecturer or IT person at your institution should be able to help you with this. Visit help.virtualmedicalcoaching.com for more information.

For VR equipment specs: https://help.virtualmedicalcoaching.com/what-vr-equipment-will-i-need
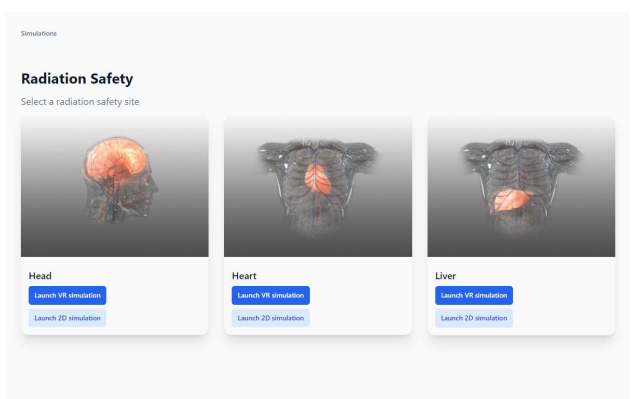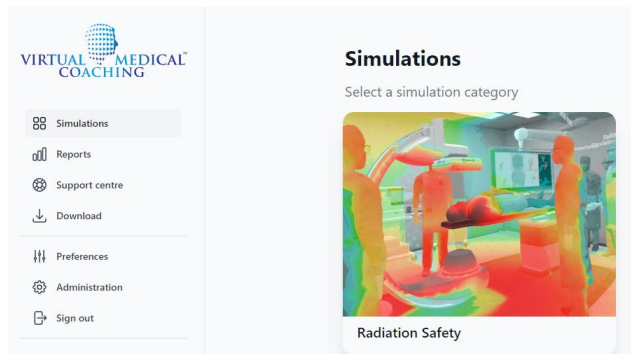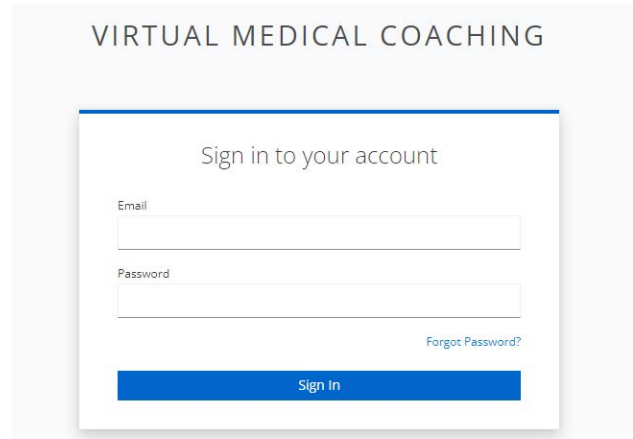
VR Controls

Depending on the VR head-mounted display (HMD) and hand controllers you are using, there will be different buttons to control the actions within the simulation. There is a reminder of what these buttons do for your specific VR HMD in the simulation. This is in the form of a poster on the wall with easy-to-understand graphics
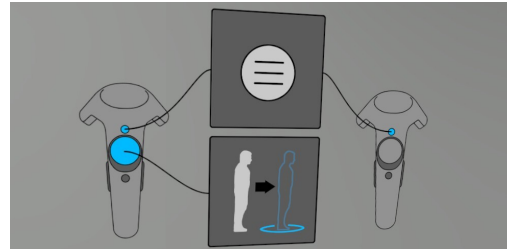

Teleport
The teleport function allows you to move around the virtual world without requiring physical movement. This function is especially useful for navigating in VR when physical space is limited.

To teleport, look at the area on the floor you'd like to teleport to and point your controller in the direction you want to go and press the teleport button. A green circle indicates that you are able to teleport to that spot. Release this button you will then be instantly transported to the location selected. If the circle is highlighted red, it means you are not able to teleport to this area (e.g. a wall), try to aim at the floor.
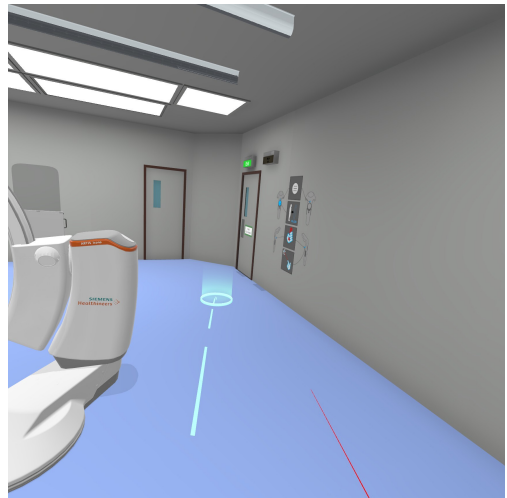
Grab/Move/Use
Reach out to the object you'd like to interact with, if it highlights in green, this means you are able to grab it. Pull a trigger to activate the grabbing function. Once you grab onto an object or person you can move them around. Where applicable, green area will indicate where your object/person will land once let go of.
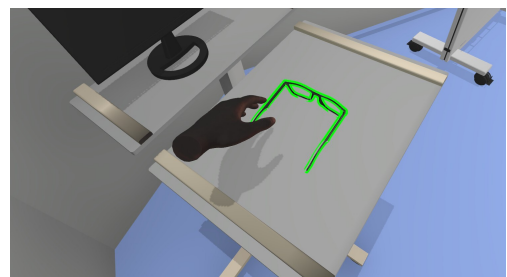
Point
Point is used for pressing a button or selecting a person. The left hand finger points at a short distance. The right hand does a laser point which works either short or long distance.

Practice Mode (VR)

In practice mode the simulation loads directly into the room.
Like all VR, you may start/phase into an unusual position. This will depend on your room setup. You might be very close to the operating table or even be partly/fully clipping a VR object. If this happens simply walk or teleport away to a location you'd like to start the scene in.

You might like to start by putting on your 0.75mm Pb lead equivalency protective glasses. These are designed to reduce more than 95% of scatter radiation reaching your eyes.

Once you are in your desired position, you can start to position your colleagues and objects in the room where you'd like them to be. For example, would you like one of the surgical trolleys next to the scrub nurse and the other next to the surgeon? Should those two colleagues be standing beside the patient's groin for femoral artery access? Where should the anesthetist and anesthetic machine be?

All of the staff are wearing lead aprons and thyroid shields. Some of these will be visible while some are under the staff member's sterile gown.

Once you have your VR room set up how you like it, you can open up the user interface to get access to the fluoroscopy machine controls and observe the way the scattered radiation's distribution changes with different positions of the tube(s) and personnel in the theater.

Once you turn the radiation on, the dose graphs will start to show three doses per person in the theater. These are measured at the eyes, chest, and pelvis. You also have a dosimeter on your right wrist.

Desktop Controls

User Interface in Desktop version of Radiation Safety
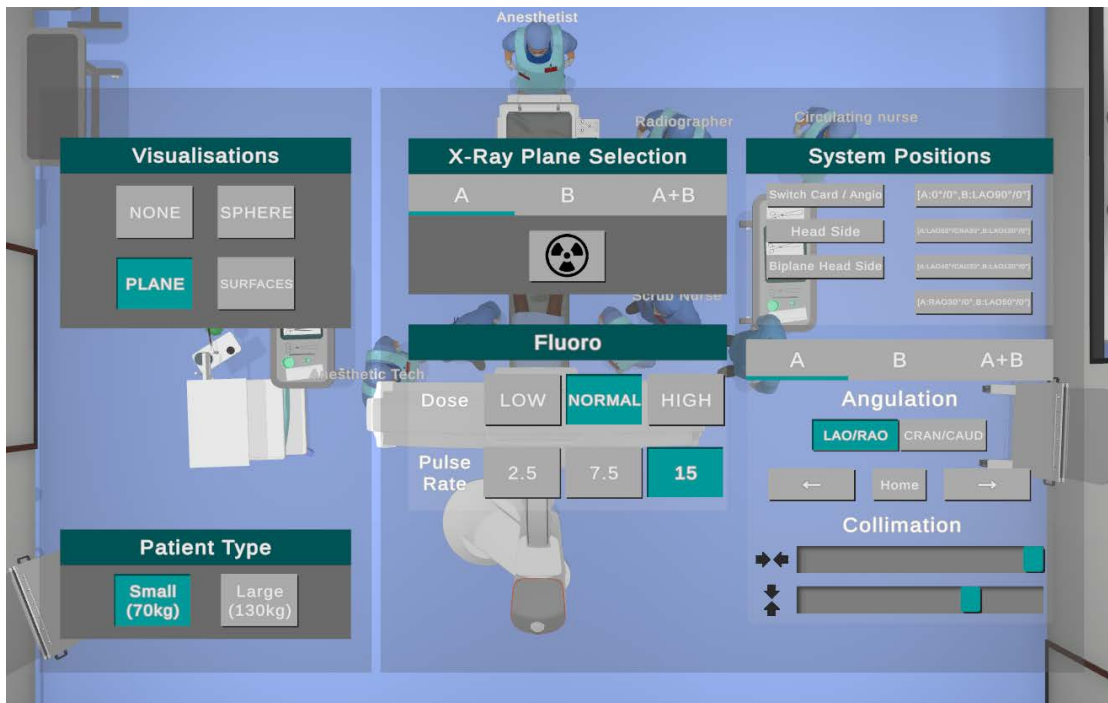
 The settings button opens up the user interface as shown above.

 Click on the camera button in order to walk around the room.

 Putting the glasses on and taking them off. A blue line on top of the button indicates it is active and means you have glasses on.

 This puts you in the first-person view.

 This puts you in a bird's-eye view.

The user can access the Machine Control Panel by pressing the Menu button on the VR hand controller

Through the Machine Control Panel, the user can activate the Fluoroscope, turn planes on and off, vary the exposure settings, choose from a selection of pre-set Fluoroscope setups, change the radiation visualization, and select other patient types.

Note: *The control panel attached to the surgical table does not function. Machine settings are only reached through the VR Controller buttons for improved user experience.*
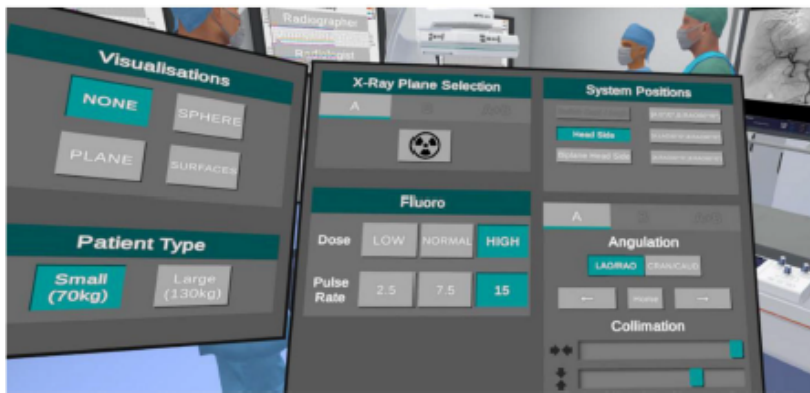

X-Ray Plane Selection
Here users can turn the radiation on and off using the 'radiation symbol' button.

Planes can be enabled individually using the 'A' and 'B' buttons or together using the 'A+B' button.


Fluoro (Fluoroscopy)
This section allows a Radiographer or Physician to access the technical aspects of the Fluoroscope, such as pulse rate and dose settings.

Dose modifiers for low normal and high are 0.55, 0.78 and 1 respectively. These are determined by predefined kVp and mAs in the Fluoroscopes operating settings.
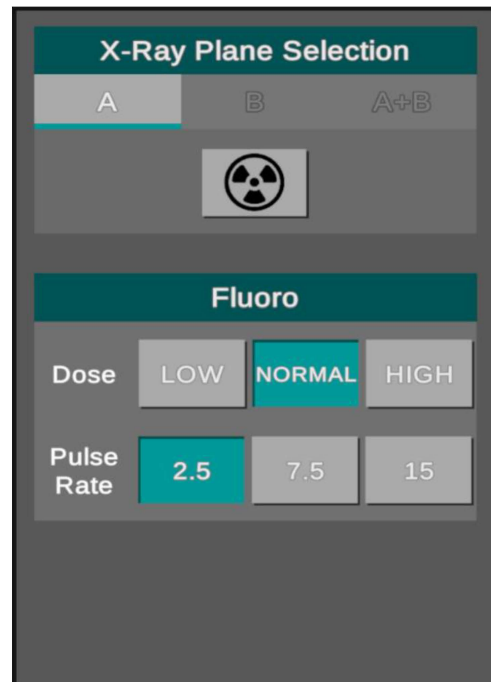
Visualizations

The visualizations are intended to let the user review the amount of radiation they will be exposed to throughout the room. There are 4 options:
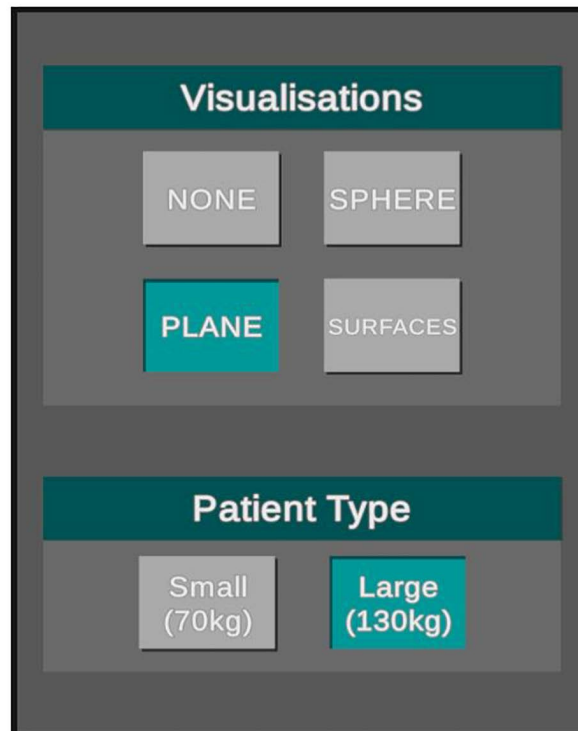
Surface - shows the radiation intensity on the surfaces of people and objects in the room

Plane - shows a moving sheet of radiation intensity coming from the ground up but from the direction of the source

Sphere - shows the radiation being emitted by the source and growing in a spherical shape

None - radiation is on but not visible this is useful for any assessments

The radiation can be on or off while any of these are selected. The controls for these only change the visualization.

In Surface mode, the rest of the world is rendered in gray scale to avoid any confusion as to what color is being applied to a surface.

Once you turn the radiation on, the dose graphs will start to show three doses per person in the theater. These are measured at the eyes, chest, and pelvis. You also have a dosimeter on your right wrist.

Tube Selection

With the User interface (UI) open, you will see that the middle panel offers you the choice of Tube A, Tube B, or both A+B.

Tube A is the floor-mounted C-arm

Tube B is the ceiling-suspended C-arm

To activate Tube B you may need to select "Biplane Head side" on the right side of the UI. This will depend on whether you are in Heart, Head, or Liver mode.

Once you have selected your tube(s) you can click on the radiation symbol to turn on the radiation. This will activate the visual radiation unless you have None selected and also activate the radiation warning lights in the room.

Below the C arm selection buttons are the Dose and Pulse rate options.

Dose rate may also be known to you as Detail mode and allows you to adjust the image quality or the number of x-rays used to create the image.

The pulse rate allows you to reduce the dose to the patient and staff by using short radiation pulses. Here you can select how many pulses per second you use.

System Positions
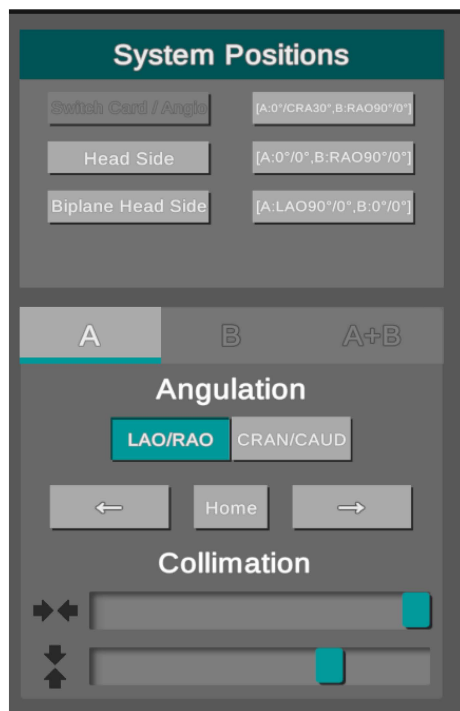
This is the area where you can rotate and angle your C arms.

You can choose from the presets or manually choose a position from the Angulation options below.

If you choose a manual position, you can select Tube A, Tube B, or Tubes A+B

C-Arm A can reach rotations in 30-degree steps around the longitudinal axis using the LAO/RAO control. Additionally, it can reach all of these at all three standard positions around the CRA/CA   D axis (-30, 0, and 30).
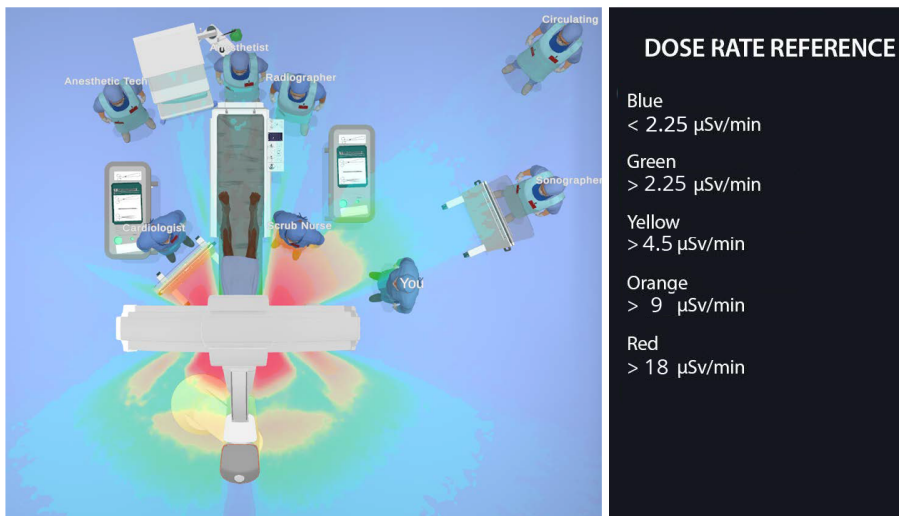
C-Arm B can reach the following rotations (note that the Switch Card/Angio function must be used to reach the second half of these rotations)

- All rotations in 30-degree steps around the longitudinal axis 0-360, when rotation around the CRA/CA   D axis is 0

- All rotations in 30-degree steps around the craniocaudal axis 0-360, when rotation around the CRA/CA   D axis is +/-30 except for

    o 0

    o 180

The C-Arm is mechanically constrained from reaching these four positions due to the design of its armature.

Pressing the Home button will return the arm(s) you are using to the starting position.

Patient Type & Dose Recordings

DOSE RATE REFERENCE

Blue
< 2.25 μSv/min

Green
> 2.25 μSv/min

Yellow
> 4.5 μSv/min

Orange
> 9 μSv/min

Red
> 18 μSv/min

The user can select different patient types varying in size and weight to observe how scattering patterns differ.
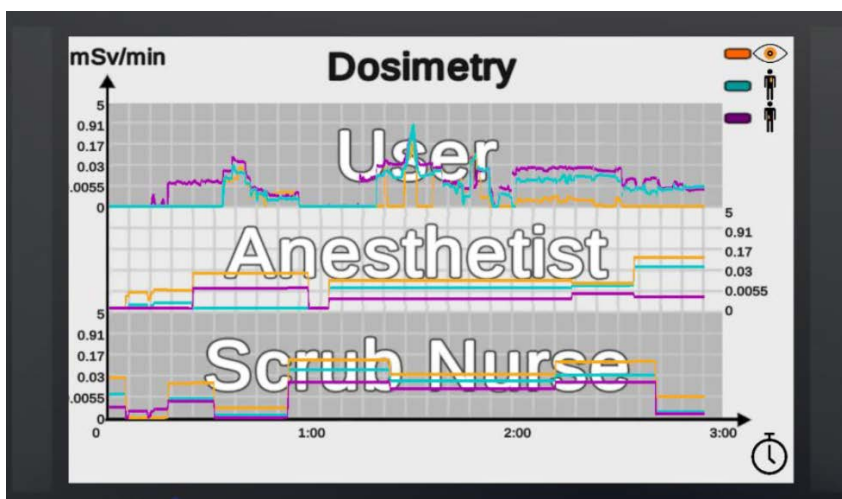
Radiation Dose Recording

Once the Fluoroscope has been turned on in the Machine Control Panel, dose readings for the theater personnel and user will be recorded and displayed on graphs attached to the wall of the OR.

There are three recording locations for each person: one at eye/lens height, one at chest height, and one at waist height.

Dose at these locations is measured and displayed on the graph in mSv/min.

There is also a dosimeter on the users' right wrist measuring the dose of that location in μSv/min.

This allows the data to be used for benchmarking and evidence that all the OR staff have been provided with adequate radiation safety training.

Common Misunderstandings

Even for more experienced Operating Theatre Staff, there are interactions which can be observed in the Radiation Safety simulation which are often misunderstood in conventional training.

Because of the inverse square relationship radiation dose has with distance, staff positioned closer to the source of radiation experience a larger decrease in absolute dose rate when moving away from the source than compared to the same movement applied further away from the source.

This is also reflected in the comparison of the waist, chest, and eye measurements. The closer measurements (typically the waist and chest) experience higher dose rates than the eyes.

Depending on the specific position of the X-ray tube and patient, deviation from this trend can be characterized by the specific scattering profile inherent to the location being imaged. This deviation is due to geometries, such as a patient's limbs or other personnel and shielding equipment leading to additional localized absorption and scattering.

It is because of these characteristics that the Radiation Safety Simulation Software provides unparalleled insight into the intricacies of Radiation Scatter which cannot be experienced by any other radiation safety training.

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COACHING

Prepare for risky events in a safe environment through immersive training.

Virtual Medical Coaching is committed to improve healthcare quality, reduce risk, and save lives. Our medical simulation software is used by hospitals and healthcare education providers around the world and have been demonstrated to positively impact students' clinical performance.

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