

#### 4. Modern linear accelerators employ a record and verify (R&V) system.

- a. Briefly give the justification for a R&V system.
- b. Describe the essential and optional features of a R&V system.
- c. Discuss the ways that a modern R&V system can improve efficiency and safety in patient treatment.
- d. Discuss the new errors introduced, and errors not diminished by a modern R&V system.

##### Part A

- Manual systems for setting up patients in treatment positions requires the radiation therapist to:
- Position the patient correctly on the treatment bed
- Set up the treatment parameters on the machine including bed, collimator and gantry positions
- With modern treatment techniques where multiple beam arrangements and angles are used, this can become very time consuming.
- An R&V system automates some of these processes, saving time and the potential for human error.

this is all correct .... BUT ... you are trying to answer a question and the Q is not being answered directly. The JUSTIFICATION for a R&V system is the reduction in the potential for human error. So you have the emphasis wrong, reverse the order so that you explain the justification (not the other way around).

##### Part B

Essential:

- Tolerances allowable for various treatment parameters (e.g. gantry angle) should be set and programmed into the treatment machine (this statement is a 'shot in the foot!' the settings and tolerances are set in the R&V)
- An override feature that allows the therapist to institute treatment despite the tolerance readings. I am not sure that this is 'essential'
- A recording system of the actual machine settings used.

Optional:

- Automated computers set up which allows the treatment machine to position the bed, gantry and collimator once the patient is correctly positioned on the bed. Correct

The answer does not demonstrate a clear understanding of what is going on. The answer to this Q is in the name! RECORD and VERIFY! Actually it is the reverse, operationally its V&R, so the essential features are:

1. VERIFICATION, using 3 components
  1. the intended settings with tolerances entered in Planning and derived from the accepted plan entered into a database
  2. the actual settings derived from hardware intercepts on the linac
  3. a software comparison mechanism for the two sets of readings to VERIFY that they are identical
2. RECORDING which occurs after the delivery has been triggered and should include all of the settings and all of the individuals responsible for the recordings or delivery.

As the technology becomes more and more complex, the fundamentals of what is happening get more and more lost in the details of the technology.

##### Part C

- As some of the set up processes may be automated, time is saved from having to set up each treatment parameter. This is especially useful where multiple fields are used in one treatment. An R&V system with automated features means that the therapist does not have to enter the room each time to set up new treatment positions.
- Because pre-programmed tolerances are set, human error is reduced. Manual system errors could occur with a number of steps including:
  - Using the set up intended for another patient
  - Incorrectly reading the tolerance numbers for the set up position

As a structural issue, the Q asks for IMPROVED EFFICIENCY and IMPROVED SAFETY, so why don't you use those categories to focus your writing?

- IMPROVED EFFICIENCY

- automation reduces time from isocentre set up to beam on and later gantry movements and field setting since room entry is not required
- feedback loops on automated setting means that measurements can be set with smaller tolerances more quickly
- better use of technological abilities of linacs – e.g. RapidArc type movements
- IMPROVED SAFETY
  - automation means more can be checked and verified

#### Part D

##### New errors:

- Incorrect data transfer from the treatment planning system into the treatment computer may lead to systematic error in treatment of the patient that may not be detected.
- Greater potential for collisions as the set up is done by a computer
- Programmed errors where the computer system reads the wrong machine set up positions.

##### Errors not prevented:

- Correct positioning of the patient on the treatment couch. RV systems only position the patient correctly once they are in the right position relative to the couch. Therefore, isocentric errors may still occur if the patient is not in the right treatment position relative to the couch.
- Errors in the mechanical isocenter
- Incorrect measurement devices and readouts
  - Errors in the use of external devices such as physical blocking trays, bolus

The difficulty with all automated systems is .... the INTERFACE with HUMANS and to a lesser extent between computing systems! The more integrated the system, the fewer the internal errors, but at the interfaces there is more danger. The errors here become less frequent but much larger. Think about things you described, like TPS > R&V interface plays up, database is corrupted. But think about CALLING THE WRONG PATIENT INTO THE ROOM! you could do marvelous prostate IMRT on a cervix cancer patient! The identification of patients in electronic systems is a major major problem.