Effective dose (E) has been developed by the International Commission on Radiological Protection (ICRP) as a dose quantity with a link to risks of health detriment, mainly cancer. It is based on reference phantoms representing average individuals. In practice there have been either situations of overuse of E or unnecessary cautions have been propagated that lead to fear in rightful use. It is true that E is dose to a phantom, but it is forgotten that one always talks about dose to the phantom when one has to deal with absorbed dose or further dose quantities that depend upon absorbed dose. Further, it is true with almost all situations where one transitions from dose outside the body to dose within the body including doses in radiotherapy. Thus, using E as a dose to an individual patient with proper understanding that it is dose to a phantom, is appropriate. The overuse situations include its use when extremities only are involved or exposure to a single organ like breast is involved. Overcautious situations involve not using E for cumulative dose assessment where in fact E is the only way to talk about total dose from a series of imaging exams. Organ doses are theoretically the best but have very limited place in clinical practice. A paper published recently (Phys Med. 2020 Nov;79:87-92) is aimed at creating clarity in use of E so that its potentials are utilized, while limitations are recognized, and misuse avoided.

Correct answer b) Refer to FAQs in this paper

2. Cumulative effective dose
   a. is the only quantity which can reasonably and practically be used to sum doses from different types of exposures
   b. Should not be estimated as it is dose to a phantom not to the patient
   c. Is only to be used for risk estimation rather than as a dose quantity
   d. Is not applicable in combining dose from X-ray and nuclear medical exposures

Correct answer a) Refer to FAQs in this paper
**Speaker 2:** Colin J Martin PhD  
**Presentation title:** Latest from ICRP on effective dose  

**Outline**  

ICRP introduced the concept of effective dose \( (E) \) in their 1990 recommendations. \( E \) is a radiation protection dose quantity that incorporates adjustments taking account of differences in the biological effectiveness of different radiations in damaging tissues and variations in tissue radiosensitivity. The link with health detriment means that \( E \) is a dose quantity that provides a measure of radiation risk and it has proved valuable in making comparisons between doses from different sources. \( E \) has been highly successful because of its simplicity in embodying radiation risk in a single quantity. In occupational and public exposures \( E \) is used for planning and personal dosimetry. \( E \) is well suited to comparisons of risk for medical procedures in which different parts of the body are exposed, but the fact that \( E \) applies to a reference person averaged between the sexes and not an individual is often forgotten, and the way in which \( E \) is used in medicine varies across the globe. In order to clarify their position on \( E \), ICRP this year published Report 147 about dose quantities used in radiation protection that sets out recommendations on the derivation and use of \( E \). Since \( E \) is not measured directly and calculation involves approximations, measurable dose quantities are better for many practical situations such as assessing patient doses in surveys, setting diagnostic reference levels, and optimising procedures. But measurable quantities take no account of the risk from radiation exposure. In medicine ICRP recommend that \( E \) be used for every day application where differences in risk are concerned, such as in referral guidelines, justification of medical procedures, and guidance in choice of imaging technique. It can also be used for evaluating doses from research studies and unintended imaging exposures. Members of ICRP are aware that use of a reference phantom precludes accurate organ dose evaluation for individuals and that a single quantity can never take account of the significant differences in health risk with age and sex. An ICRP Working Party is being established to look at how the radiological protection dose system might be taken forward.

**Question set 2:**

1. ICRP have developed effective dose as a dose quantity:  
   a. that provides an accurate measure of risk  
   b. in which estimated doses to organs of an individual are weighted according to the risk of inducing cancer  
   c. equal to the sum of equivalent doses in organs and tissues within a reference phantom weighted according to the risk of stochastic effects  
   d. related to risk that can be used for comparing doses to individual patients

   Answer C.  
   - ICRP 2021 The Use of Dose Quantities in Radiological Protection. Publication 147, Ann ICRP 50(1)

2. ICRP recommend that effective dose can be used:  
   a. When considering risks in the justification of medical imaging procedures
b. For setting diagnostic reference levels for different examinations
c. For comparing doses for examinations in different hospitals
d. For collection of data for patient dose surveys
e. For calculating the risk of dying of cancer

Answer a.
• ICRP 2021 The Use of Dose Quantities in Radiological Protection. Publication 147, Ann ICRP 50(1)
**Speaker 3:** Ehsan Samei, PhD  
**Presentation Title:** What is the best metric to assess patient exposure  

**Synopsis:**  
Patient exposure, its assessment, minimization, and optimization, is founded on the assumption that radiation exposure imparts a non-negligible level of harm to the patient. While the magnitude of this harm has been questioned and debated, without a presumption of harm, patient exposure would be of no relevance. It follows then that patient exposure should best be characterized in terms of the likelihood of harm that it might impart. In the development of medical radiation devices and radiation protection measures, many metrics have been deployed to characterize patient exposure. Most such metrics are based on the specific technologies deployed. For example in fluoroscopy, patient radiation exposure is characterized in terms of entrance exposure or dose area product. Likewise in CT imaging, radiation exposure is measured in terms of CT dose index and dose length product. While practical, these metrics are more reflective of the technology than the patient harm. They cannot be assumed equivalent to patient harm or compared across medical procedures. To relate patient exposure metric to likelihood of harm, the metric should capture the magnitude of radiation in combination with varying sensitivities of body tissues and patient attributes. This is only possible at the level of organs. This creates three challenges: First, we need to know both the patient internal structure as well as the details of the exposure condition associated with the procedure. Second, an algorithm should use such data to assess doses at the level of organs. And finally, the multiplicity of organ doses needs to combined into a likelihood of harm at the level of the whole of the patient. In this presentation we describe how these challenges can be tackled, providing means to precisely estimate effective dose at the level of patient, as recently advocated by ICRP, as well as more comprehensive metrics of patient risk towards optimizing imaging practice.

**Question set 3:**

1. In CT, the estimation of effective dose from CT dose index is prone to errors for all these reasons except which one?  
   a. Because that process does not account for patient size  
   b. Because that process does not account for tube current modulation  
   c. Because that process does not account for patient age  
   d. Because that process does not account for the kV setting of the exam  
   
   Answer: (c)  

2. Radiation Risk Index is a more comprehensive reflection of patient risk because  
   a. It accounts for patients fear of radiation  
   b. It accounts for patient age and gender  
   c. It accounts for the prior radiation exposure of the patient  
   d. It accounts for the safety of the exam for the operator
Answer: (b)