POSITION STATEMENT

DOCUMENTING IONIZING RADIATION EXPOSURE IN THE ELECTRONIC HEALTH RECORD

Adopted by the IEEE-USA
Board of Directors, 11 Nov. 2011

IEEE-USA believes that maintaining an accurate record of a patient's cumulative exposure to ionizing radiation can be of substantial value for clinical, health services management and research purposes.

Excessive radiation can cause cancer, skin and bone marrow disease and a variety of other diseases. Radiation exposure can come from a number of sources, both natural and manmade. Over the lifetime of the individual, medical procedures, such as X-rays, Computed Tomography (CT) scans, and isotope radiation therapy, contribute significant radiation dosages. Monitoring the use of radiological procedures, measuring the radiation dose directly, and recording the dose in the Electronic Health Record (EHR) can help assess and reduce the risk posed by excessive radiation while optimizing the diagnostic value of these procedures.

With these risks and benefits in mind, IEEE-USA recommends the following:

1. Health Level Seven International (HL7), the global authority responsible for standards for interoperability of health information technology, should add the appropriate "dose object" radiation parameters, as defined in the IHE *Radiology Technical Framework Supplement, Radiation Exposure Monitoring (REM),* to HL7/CDA format longitudinal electronic health records (EHRs), to create a longitudinal record of a patient's exposure to radiation resulting from medical procedures. These records should note both the procedure and estimated radiation dose from each procedure.

2. The Office of the National Coordinator for Health Information Technology (ONCHIT) should make radiation dose monitoring a part of meaningful use criteria for EHRs.

3. Healthcare accreditation organizations (JCAHO, NCQA and URAC), in collaboration with the American College of Radiologists (ACR), should continue their efforts to establish utilization review guidelines for radiological procedures;

develop guidelines relative to acceptable exposures per procedure; and provide guidelines to assist clinicians in selection of optimal radiological procedures, for both diagnostic and therapeutic purposes; with due recognition of the health hazards posed by excessive radiation. Making these guidelines part of the accreditation process would contribute significantly to the establishment of uniform national standards. These guidelines would be particularly important to state legislatures as they consider legislation.

4. While it is useful to include estimated radiation dose information in the longitudinal EHR, the ACR should continue its efforts to define actual skin dose, body dose and organ dose for radiological procedures and their effects on patient health.

5. The ACR should also continue its efforts to establish a "dose registry" of anonymized patient radiation dose monitoring information, to enable further research on the impact of various levels of radiation on patient health.

6. Integrating the Healthcare Enterprise (IHE) should continue working to include nuclear medicine (Single Photon Emission Tomography, or SPECT scans; Positron Emission Tomography, or PET scans; and radioisotope therapy) in the *Radiation Exposure Monitoring (REM)* Profile.

This statement was developed by the IEEE-USA Medical Technology Policy Committee, and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public-policy interests of the more than 210,000 engineers, scientists and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of the IEEE or its other organizational units.

BACKGROUND:

“Ionizing radiation” is defined as radiation that is energetic enough to detach electrons from atoms or molecules. Examples include x-rays, gamma rays, and alpha and beta particles emitted by radioactive substances. There are multiple units of measure for different types of radiation, and the measures commonly used in the United States differ from the international units of measure. For radiated energy like x-rays or gamma rays, the radiation absorbed dose (rad) measures the amount of energy absorbed per unit mass by a material like human tissue. The equivalent international unit to the rad is the Gray (Gy). One Gray = 100 rad. The Roentgen is a traditional measure of the amount of radiation energy in the air, and a Roentgen equivalent man (rem) measures the biological effect of radiation. The Sievert is the international unit equivalent to the rem. One Sievert(Sv) = 100 rem, and one milliSievert (mSv) = 100 millirem(mrem).

For radioactive substances, the curie is the measure of radioactivity. One curie is the amount of radioactive substance (radionuclide) that undergoes 37 billion nuclear decays per second. The equivalent international unit is the becquerel. One nanocurie = 37 becquerels.

People are exposed to low-dose radiation from a variety of natural sources, including radioactive minerals, radon gas, and cosmic rays from non-terrestrial sources. Factors that may influence an individual's cumulative radiation dose from naturally occurring sources include his/her geographical location and frequency of air travel, which determines exposure to both a) higher background radiation at high altitudes and b) additional radiation from security scanners at airports. (The Transportation Security Administration (TSA) has required that the backscatter x-ray systems approved for deployment conform to the ANSI/HPS standard, ANSI/HPS N43.17-2009, which recommends a dose per screening of less than 0.25 microSievert (μSv)/25 μrem.)

The average resident of an industrialized country probably receives a dose of about 3 mSv/300 mrem per year. More study is needed to estimate the health risk posed by average levels of low-dose radiation. It is also unclear if there is a difference in risk between long-term, steady-state exposure, and higher-level, short-term "bursts" of exposure. Research should be done to develop practical algorithms for estimating exposure to non-medical radiation, and for inclusion of such data in Electronic Health Records or registries, as appropriate.

Short-term bursts of high-level exposure can occur in nuclear accidents, occupational exposure in mines and nuclear plants, and high-dose exposures related to radiation therapy for cancer, and other disorders. The U.S. Environmental Protection Agency recommends an evacuation after an incident releases 10 mSv/1000 mrem of radiation, and workers in the U.S. nuclear industry are allowed an upper limit of 50 mSv/5000mrem per year. Doses above 100 mSv/10 rem can increase the long-term risk of cancer, while 1 Sv/100 rem can produce radiation sickness.

ALARA is the acronym for "**A**s **L**ow **A**s **R**easonably **A**chievable." The Nuclear Regulatory Commission (NRC) regulations (10 CFR 20.1101) require every licensee to "develop, document and implement a radiation protection program commensurate with the scope and extent of licensed activities …" and to "use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are . . . ALARA."

A chest X-ray delivers a one-time dose of about .1 mSv/10 mrem, a mammogram around .3 mSv/30 mrem, and a CT scan dose of approximately 7 mSv/700 mrem. A common PET scan dose is approximately 1.1 rem from the radionuclides used; the accompanying CT scan typically adds 700-1300 mrem, depending on required resolution.

Proper calibration of radiation-emitting medical equipment plays an important role in ensuring patient safety. *NIST Handbook 150-2D, National Voluntary Laboratory Accreditation Program, Technical Guide for Ionizing Radiation Measurements* (available online at http://www.nist.gov/manuscript-publication-search.cfm?pub_id=905612), provides guidelines for assessing the conformance and competence of calibration laboratories in measuring emission of various types of ionizing radiation.

Initially, simply keeping track of the number and type of medical procedures involving radiation, assuming some "standard" levels of equivalent dose for each procedure, would be helpful. As the use of longitudinal EHRs evolves, more comprehensive tracking procedures should be developed.

NIH started to ask for radiation dose tracking at the beginning of 2010
See: http://www.rsna.org/Publications/rsnanews/May-2010/NIH_feature.cfm

In May 2010, California proposed and adopted a law requiring radiation dose tracking for CT scans. See: http://www.cmio.net/index.php?option=com_articles&article=23876&publication=68&view=portals

Because of EU concerns, in 2008 IHE International (www.IHE.net) began a Radiation Exposure Monitoring (REM) project to automatically capture and add radiation dose data to the DICOM image produced by most radiological imaging devices. The REM data are designed for the device to provide them automatically, and the EMR/EHR software can read and store those data in each patient's lifelong health record. Links to the IHE-REM profile are provided below. The IHE REM project was demonstrated in November 2011. It included a link to the American College of Radiology, so that each dose record can be saved in an anonymized national quality assurance repository. Using this approach, radiology departments can periodically compare their radiation exposure profiles to peers, to allow them to improve their practices. See: http://www.cmio.net/index.php?option=com_articles&article=25334

See: IHE Radiology Technical Framework Supplement, Radiation Exposure Monitoring (REM), http://www.ihe.net/Technical_Framework/upload/ IHE_RAD_Suppl_REM_Rev2-1_TI_2010-11-16.pdf

ADDITIONAL REFERENCES:

"Health Effects," Radiation Protection, U.S. Environmental Protection Agency, http://www.epa.gov/radiation/understand/health_effects.html

Ionizing Radiation Division, National Institute of Standards and Technology (NIST), http://www.nist.gov/pml/div682/index.cfm

"Radfacts (A Quick Reference Guide to Radiation Terms and Concepts)," Radiation Protection, http://www.epa.gov/radiation/rert/radfacts.html