Reducing unnecessary radiation exposure to patients is an ethical obligation outlined in the profession's Code of Ethics. Having a good working knowledge of exposure indicators provides technologists the ability to adjust technical factors in a way that will reduce patient exposure while maintaining high image quality.

Image receptor (IR) exposure levels affect image quality. IR exposures that are too low, for example, produce images of limited diagnostic value because noise in the form of quantum mottle obscures image resolution. IR exposures that are too high increase patient dose unnecessarily and can sometimes render digital imaging systems unable to erase images completely, resulting in a ghosting artifact on subsequent exposures (see Figure).

Digital imaging systems can, within certain limits, compensate for errors in IR exposure resulting from incorrect technique selection. This ability allows for a wider exposure latitude than that offered by analog imaging systems, where errors in technique were seen as increased radiographic density with overexposure, or decreased radiographic density with underexposure; both necessitate repeat exposures. Digital images lack these visual cues, which presents a challenge for the technologist to recognize IR exposure errors. Fortunately, exposure indicators serve as a numerical measure corresponding to a certain level of IR exposure technologists can use to gauge the appropriateness of a

Figure. An example of a ghosting artifact. Image receptor saturation results in a residual image that then appears on subsequent images. Notice the patient's initial lateral image (arrows) appearing on the second. Images courtesy of the author.
Table

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<td>300</td>
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<td>Agfa</td>
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Abbreviations: EI, exposure index; IR, image receptor; LgM, log mean; S, sensitivity

Exposure indicators are logarithms calculated once the image histogram is generated. Based on the histogram data, a numerical value is tabulated corresponding to the level of IR exposure. The 3 most common exposure indicator systems are the exposure index (EI; Carestream systems), log mean number (LgM; Agfa systems), and sensitivity number (S; Fuji systems).

The first 2 systems, EI and LgM, are related but not proportional to IR exposure. As exposure to the IR increases, so too does the EI or LgM number. When the IR exposure doubles, the EI number increases by 300, whereas the LgM number increases by 0.3. Conversely, halving IR exposure reduces the EI number by 300 and decreases the LgM number by 0.3.  For example, if the target EI number for a facility is 1800, and the EI number following exposure is 1500, doubling the IR exposure increases the EI by 300 to 1800. LgM numbers are similar to EI numbers in that increased exposure to the IR increases the LgM. S numbers inversely are related to IR exposure. As IR exposure increases, the S number decreases. Doubling the IR exposure reduces the S number by 100, whereas halving the exposure increases the S number by 100 (see Table).

IR exposure can be increased or decreased by adjusting technical factors. To double the IR exposure, the technologist doubles the milliampere seconds (mAs) or increases the kilovoltage peak (kVp) by 15%. To reduce the IR exposure by half, reducing the mAs is the most appropriate adjustment because decreasing the kVp by 15% might underpenetrate the anatomy of interest and increases the amount of beam absorption, thus increasing the resulting dose to the patient.

Overall, knowledge of technical factors and exposure indicators will afford technologists the ability to adjust exposures in a way that will ensure an appropriate IR exposure and reduce patient exposures from excessive or insufficient exposures.

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References