AbstractID: 7746 Title: Experimental evaluation of effective detective quantum efficiency for digital radiographic imaging systems

ABSTRACT:

Purpose:

To develop and evaluate an experimental methodology for measuring the effective detective quantum efficiency (eDQE) of digital radiographic systems which reflects the actual signal-to-noise performance of the system per unit exposure.

Method and Materials:

A NEXT phantom, simulating the scatter and attenuation properties of an adult human thorax was used to measure the resolution, noise, and scatter performance of a digital radiographic system (GE xQi) under conditions approximating those seen in clinical chest radiography. The resolution was measured in terms of the modulation transfer function (MTF) using an edge device placed at the phantom surface closest to the x-ray tube. The noise was measured in terms of the noise power spectrum (NPS) of the region corresponding to the phantom center, acquired at three exposure levels. The scatter fraction (SF) was evaluated using a beam-stop technique. These measurements along with measures of phantom attenuation and estimates of x-ray flux and exposure were incorporated in the computation of the effective Detective Quantum Efficiency (eDQE).

Results:

The phantom exhibited a broad-beam transmission fraction of 18.65%. The measured scatter fraction in the presence of grid and phantom was 33%. The MTF of the system dropped by 25% at 1.0 cycles/mm when the edge was placed at the phantom surface due to scatter and focal spot blurring. The computed eDQE was assessed to be 0.038 and 0.028 at 0.5 and 1.0 cycles/mm, respectively (for E= 5.6 mR).

Conclusion:

Conventional DQE measurements performed under relatively idealized conditions do not accurately represent the relative performance of digital radiographic imaging systems in routine clinical use. A more appropriate metric, the eDQE, measured under conditions that reasonably approximate those encountered clinically reflects the additional contributions from scatter, grid, and focal spot blurring, and provides a better estimate of the relative clinical performance of digital radiographic imaging systems.