AbstractID: 14062 Title: Multi-resolution Cumulative Summation (CUSUM) Images for Monitoring Gamma Camera Detector Uniformity

Purpose: Detect trends in gamma camera uniformity in order to predict service events. **Materials and Methods:** Cumulative summation statistical control (CUSUM) effectively detects subtle shifts in the expected mean of normally distributed data. This technique was applied to each pixel in a time series of gamma camera quality control floods to detect nonuniformities that might otherwise have gone undetected in any single flood image using NEMA uniformity calculations. One hundred statistically independent 10 M count uniformity floods were sequentially acquired in a 1024x1024 matrix. A progressively worsening nonuniformity was simulated beginning in the thirtieth flood image, where an attenuation disk 8 cm in diameter (~1% count loss) was positioned in the central field-of-view (FOV). Additional disks were added to the stack every ten subsequent acquisitions in order to mimic progressive count loss, up to the point that normal NEMA analysis was expected to yield differential uniformity values that exceeded our institution's action limit of 3%. Mean and error images were calculated with respect to time using the first thirty floods in the series, and the time series was normalized to these values. The CUSUM images were calculated by summing the deviations between a reference value of one-half of the standard deviation and each normalized pixel, adding to that the previous value of the CUSUM at each pixel location. Thus, the CUSUM images represent the accumulation of deviations between each normalized and expected pixel value. The process was repeated for larger pixel sizes and composite images were formed. **Results and Conclusion:** The results show a distinct signal at the location of the non-uniformity by time point 60, well in advance of reaching the level of degradation expected to cause a single flood to fail clinical criteria, given the rate of degradation. Thus, this technique sensitively detects non-uniformity trends.