AbstractID: 4954 Title: A Critical Look at the Numerical Coefficients in CTDI_{VOL}

Purpose:
To critically examine the assumptions leading to the formula for $CTDI_{VOL}$, which uses measured CTDI values at the center and periphery to estimate the overall average dose to a homogeneous cylindrical phantom.
Method and Materials:
$CTDI_{VOL}$ is a widely used figure of merit that estimates the average dose delivered by a CT scan to standard homogeneous cylindrical cylinders and offers a means of comparing doses delivered by different machines, or by the same machine using different scanning parameters. The calculation of $CTDI_{VOL}$ requires the measurement of two CTDI values: $CTDI_E$ measured at the edge of the cylinder and $CTDI_C$ measured at the center. $CTDI_{VOL} = (a \bullet CTDI_E + b \bullet CTDI_C)/Pitch$. The following three assumptions are made in order to determine *a* and *b*: 1): The phantom is a homogeneous cylinder positioned coaxially with the gantry. 2) The cylinder is exposed to a constant beam of radiation during the rotation of the gantry. 3) At any one instant during the scanner's rotation, the radiation density within the cylinder varies smoothly with position. Following a 360^o rotation, assumptions 1 - 3 imply that the dose distribution is also cylindrically symmetric, smoothly varying, and at an extremum at the center.
Results:
The simplest result following from assumptions 1 - 3 is that $a = b = 1/2$. These do *not* agree with the values of *a* and *b* (2/3 and 1/3, respectively) that are used conventionally; these conventional values have the unphysical implication that the dose gradient at the center is discontinuous.
Conclusion:
$CTDI_{VOL}$, as it is currently calculated, underestimates the relative contribution made by the central CTDI value to the average dose, leading to a significant systematic error in a number used by regulatory and accreditation agencies. Equal weighting provides a more accurate value and should be employed.