## The Generalization of a Photon Pencil Beam Algorithm for Electron Beam Dose Calculations.

The semi-empirical pencil beam dose calculation algorithm for photon beams based on Scatter-Air-Ratios (SAR) has become the conceptual basis for dose computation in some modern treatment planning systems. For electron beams, the adoption of the SAR algorithm was first proposed by Dutreix et al. and more recently by re-introduced by Cunningham. This provides the possibility of using the same photon beam codes for electron dose calculations. Perhaps, the most deterring factor in such application is the ambiguity of Peak-Scatter-Factor or zero area Tissue-Air-Ratio concepts for electron beams. In contrast, the most widely used algorithm for electron beams in treatment planning was devised by Hogstrom. It is the solution to a superposition integral in which the kernel describes the spatial spread of dose from a pencil beam incident on the surface of a phantom. Hogstrom's formulation is based on Eyges whose analytical solution had a number of simplifying assumptions. The SAR algorithm on the other hand does not contain such assumptions. In this work, we expressed the SAR algorithm in the nomenclature of Hogstrom's analytical solution and defined the Peak Scatter Factor and zero area Tissue-Air-Ratio. We compared the kernels used in the two formalisms and their dose predictions against measurements made in water and inhomogeneous phantoms at different energies. We conclude that SAR and the Hogstrom formalism are similar in concept and performance, their difference lies in how the kernels are obtained.