

AbstractID: 2867 Title: Development of a Customizable Neural Network Brachytherapy Nomogram Equivalent

Purpose: The objective is to develop a software brachytherapy nomogram equivalent. Although modern techniques obviated much nomogram usage, situations arise where nomograms prove useful. If site dimensions are unknown, they can be measured followed by nomogram treatment planning. Regulatory agencies mandate independent checks. Deploying this software could easily meet this requirement. A graphical nomogram is fixed and cannot be modified. In contrast, the nomogram equivalent is configurable. This field-customizable tool should further empower clinicians.

Methods and Materials: The nomogram equivalent is a three-layer feed-forward neural network (NN). The inputs consist of three site dimensions and volumes. The hidden layer has ten processing elements (PE's). The output layer is a single PE representing air kerma strength. The PE inputs are weighted, summed and applied to the sigmoid function, defining the PE output. A training algorithm based on differential evolution was developed. A group of fifty competing NN's are continuously evolved by simulating biological evolutionary processes. The weights are initially assigned random values. During training they are evolved to decrease the error between the NN output and desired value. Training data consist of three dimensions, volumes and air kerma strengths from past implants. The software cycles through the training data, altering the weights. The sum-of-squares difference between the outputs and air kerma strengths drives the training process. Once trained the NN can predict air kerma strengths for new implants.

Results: The differential evolution training algorithm successfully determined NN weights for predicting required air kerma strengths. In most cases the network predicted air kerma strength within 11 percent. Consistent training data representing the full range of possible implant site dimensions and volumes are important for obtaining accurate predictions.

Conclusion: The software is ready for clinical use. The authors believe that the NN paradigm is a sound method for implementing a field-customizable nomogram equivalent.