Artificial Neural Networks in Stroke Surveillance
The Brain Attack Surveillance In Corpus Christi (BASIC) Study

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Introduction
This work illustrates the potential utility of an Artificial Neural Network (ANN) as a screening tool for stroke surveillance studies. Neural networks’ greater predictive power have been successfully used in medical diagnostic decision support systems (MDSS). Screening is a key step for case ascertainment in population-based studies. This step requires a great deal of time, effort, and expense to ensure accurate and complete case capture. We studied whether an ANN could diagnose stroke as well as a fellowship trained stroke neurologist armed with the same clinical data.

Methods
A Multi-Layer Perceptron (MLP) back propagation network was developed using Neurosolutions version 4.13. Data from an ongoing prospective, community-based stroke surveillance project was used to train and test the network. This technique involved partitioning data collected in the first year of the study into two portions, a training set and a testing set. The model was designed with 15 nodes in the input layer representing neurological focal signs and symptoms, 10 nodes in a non-linear hidden layer, and one binary node in the output layer to determine if a case was a potential stroke. The network architecture is presented in Figure 1.

Figure 1: Neural Network

The neural network was trained with data for admissions between 1/1/00 and 7/31/00 (3,482 screenings). The network was tested using an internal and an external data set. A random sample consisting of 20% of the training data (697 cases) was used for the internal data set. Admissions between 8/1/00 and 12/31/00 (2,756 cases) were used for the external data set. The network performance was compared to the verification recorded by trained chart abstractors.

Results
Testing the network on the random sample of the training data yielded sensitivity = 79%, specificity = 96%, positive predictive value (PPV) = 75%, and negative predictive value (NPV)=96%. Testing the ANN on the external data set yielded sensitivity = 86.6%, specificity = 97.4%, PPV = 85.1%, NPV = 97.6%. Using the neurologist verification as the gold standard, we also compared the verification recorded by trained data abstractors for admissions between 1/1/00 and 7/31/00 and the results of testing the model using data for the same period. The network yielded sensitivity = 80.3%, specificity = 97.8%, PPV = 85.9%, and NPV = 96.8% while the trained abstractors yielded sensitivity = 91.9%, specificity = 97.6%, PPV = 86.1%, and NPV = 98.6%.

Conclusions
The ANN had high sensitivity and specificity to verify strokes and can be used as a screening tool in surveillance studies. This network model may obviate the need for physician stroke verification in the screening process and greatly improve surveillance efficiency.

References