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Measuring the Accuracy of Predictions from Patient-Specific Models of Intracranial Pressure Dynamics

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Objective

Determine the prediction capability of a computer model of ICP dynamics

Background

• Outcomes for elevated ICP following traumatic brain injury (TBI) remain mixed

• TBI remains leading cause of death and disability in children

• Sophisticated computer models calibrated to fit patient-specific clinical data

• No studies have reported the prediction capability of these models

Discussion/Conclusion

• Despite small error in model fit to data, model prediction error is too large to be clinically useful
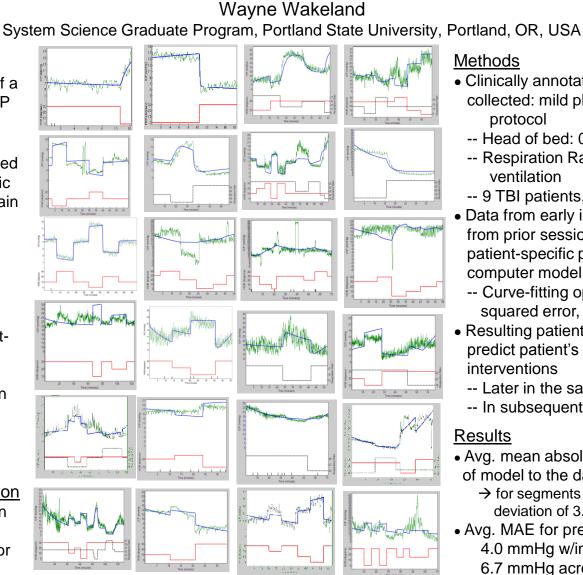
• Caution warranted: prediction is hard!!

→A good fit between model and historical data may not yield good predictions!

Figure 1: Model ICP (blue) vs. Actual ICP (green), w/HOB (red) and Respiration Rate (dotted black)

Methods

• Clinically annotated prospective data collected: mild physiologic challenge protocol

-- Head of bed: 0 to 30 degrees

-- Respiration Rate: mild hyper- to hypo-ventilation

-- 9 TBI patients, 24 sessions

• Data from early in single long session or from prior sessions used to estimate patient-specific parameter values for computer model of ICP dynamics

-- Curve-fitting optimization minimized squared error, modeled ICP vs. data

• Resulting patient-specific models used to predict patient's ICP response to interventions

-- Later in the same session

-- In subsequent sessions

Results

• Avg. mean absolute error (MAE) for fitness of model to the data: 1.9 mmHg

→ for segments with avg. mean absolute deviation of 3.1 mmHg

• Avg. MAE for predictions:

4.0 mmHg w/in same session;

6.7 mmHg across sessions