Integrating Data, Models, and Reasoning in Critical Care

Funding: NIBIB R01 EB001659

MIMIC II

- Explosion of information in the ICU: “data overload”, complicated by:
  - Scattered sources (paper, computers, images...)
  - False alarms, artifacts
  - Lack of logical organization

- The complex, multiparameter, dynamic data streams may well reflect underlying physiologic changes, BUT patterns are difficult or impossible to recognize:
  - Early warning signs of impending physiologic change may be missed or unrecognizable

- Engineering Opportunity:
  - Utilize the rich and detailed streams of multi-parameter data to:
    - Interpret pathophysiologic scales
    - Track patient state over time
    - Predict impending clinical changes

MIMIC II ICU Database

- Waveforms, numeric trends, alarms from bedside monitor network
- Clinical data from bedside workstation network
- Hospital archives
- Additional clinical data, discharge summaries, ICD-9 codes, POE, etc.

MIMIC II Contents (1)

- Clinical Data for entire ICU stay
  - Hourly physiologic measures
  - Laboratory results
  - Fluid balance
  - IV medications
  - Ventilator settings
  - Demographics
  - ICD-9 codes
  - Physician orders
  - Reports: radiology, echo, ECG
  - Nurse progress notes
  - Discharge summaries
  - etc.

MIMIC II Contents (2)

- Continuous Physiologic Data
  - Waveforms (sampled @ 125 Hz)
  - Waveforms with IV Medication Record
  - Minute-by-minute time series of physiological measurements (trends)

Status – April 2009
(At initial public release)

- ICU admission records - 33,286 (2001 – 2007)
  - 25,779 adults
  - 7,507 neonates
- Distribution (adults)
  - MICU - 38%
  - SICU – 26%
  - CSRU – 20%
  - CCU – 16%
- Records with waveforms / trends – 2,430
- Database size ~ 11B
“Open” MIMIC II

- Over 5,000 waveform records have been placed on PhysioNet - durations from days to several weeks. Free access to all.
- Full MIMIC II database now freely available subject only to a Data Use Agreement.

Some projects so far

- Mortality prediction
- Sepsis prediction
- Hemodynamic instability
- Hypoglycemia prediction
- False alarm reduction
- Deidentification
- Prediction of fluid requirement ...

Bayesian network model predicting maintenance fluid requirement on day two in the ICU.

Prediction of fluid requirement

- Selected patients similar to age, sex, severity, ... security, score and co-occurrence.
- Patients and clinical scenarios, specific model.
- ICU stunning.
- Predicted range of fluid requirement, e.g. 2,272-3,661 mL.

How do I get in?

- Contact us: maurov@mit.edu
decot@mit.edu
- Do COUHES
- Sign up: www.physionet.org/cgi-bin/request
http://www.physionet.org/physobank/database/mimicdb
- Use web portal, or come to our lab (E25-505)
Patient variables evaluated as possible predictors of maintenance fluid requirement.

<table>
<thead>
<tr>
<th>Agent characteristics</th>
<th>Value</th>
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<tbody>
<tr>
<td>Age</td>
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<td>Weight</td>
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<table>
<thead>
<tr>
<th>Maintenance variables</th>
<th>Value</th>
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<tbody>
<tr>
<td>Fluid requirement</td>
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<tr>
<td>Metabolic rate</td>
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<td>Cardiac output</td>
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*Note: *Variables that alter when expressed with fluid rate

- Vasoconstriction
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*Note: *Variables that affect severity of disease

- Cardiac output
- Metabolic rate
- Renal function
- Cardiac output
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- Renal function
- Cardiac output
- Metabolic rate