Multivariate Conditional Anomaly Detection and Its Clinical Application

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Motivation

- Reports from medical/clinical surveys
- The occurrence of medical errors remains a persistent and critical problem
- Medical errors that correspond to preventable adverse events are estimated to be up to 440k patients each year [James 2013]
- This is the third leading cause of death in America

Motivation

- We aim at developing a clinical decision support system that can **automatically detect erroneous clinical decisions**

- A data-driven approach to support clinical decisions

- We want to identify clinical decisions that do not conform with past records (*anomalies*)

- Cases requiring clinical attention for reconsideration could be identified by detecting statistical anomalies in patient care patterns [Hauskrecht et al. 2007, 2013]
Our Approach

• Model-based Anomaly Detection
Our Approach: What It Does [Hong, Batal, Hauskrecht 2015]

• Modeling *multivariate* relations among clinical decisions

Medications usually given together

Alternative medications among which only one is given

Adverse medications should not be given together
Our Approach: What It Does [Hong, Batal, Hauskrecht 2015]

- Modeling *multivariate* relations among clinical decisions
- We present efficient ways to learn clinical decision models
Our Approach: What It Does

- Anomaly detection with *multivariate* data models
  - Can improve the quality of anomaly detection by considering the interactions between medications

![Diagram showing adverse medications and alternative medications with possible orders](image)

An order with adverse meds: Valid?

Possible meds order 1:  
Possible meds order 2:
Summary

• We develop **clinical decision support systems** by detecting clinical anomalies
  • We first model the past clinical data stored in a medical database
  • We then use the model to identify anomalies that contains the clinical decisions that do not conform with past records
• Virtually every hospital runs its own **electronic medical record (EMR)** system, to which our system can be applied
  • Our solution will have a huge impact on the utilization of EMRs
Thank you!

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References


