Advanced Temporal Data Abstraction for Guideline Execution

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Overview

• Motivation
  – Why Guideline Execution
  – Why Temporal Data Abstraction

• Definitions

• Abstractions with example

• Strength & limitations
Why Guideline Execution?

- Deliver the right recommendation at the right time
  - Reduce information overload
  - Improve quality of health care
- Prerequisites
  - Information about patient state
  - Formal representation of guideline
Why Data Abstraction?

• Integration into clinical data flow necessary
  
    Additional data entry
    = additional work
    = barrier to usage of
      guideline execution system
Why Data Abstraction?

• Integration into clinical data flow necessary

• Gap between raw data and medical concepts
  – Quantitative raw data:
    11:23:05 SpO2=96%
    11:23:06 SpO2=95%
    11:23:07 SpO2=96%
  
  – Qualitative medical concept:
    sufficient oxygen supply in artificial ventilation
Why *Temporal* Data Abstraction?

• Temporal dimension crucial part of medical concepts (often implicit)
  – *Recent* readings of SpO2

• Combinations of different time windows necessary
  – Short term trend can invalidate long term observation
The Big Picture

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Plan Library

INSTANTIATED PLANS

Temporal Data Abstraction

Guideline Execution

INPUT

Time-Oriented

Patient Data

Raw Data

Qualitative High-level Information

Context
Definitions

• Parameter = Variable plus history of measurements
• Episode = period of time during which a parameter has a certain value
• Parameter proposition
  = parameter
  + value constraint
  + context
  + temporal constraints
In artificial ventilation, hypoxic episode is a period of time lasting longer than 4 seconds during which the SpO2 reading is below 80.

• Solution
  – Parameter proposition
  – Parameter name: SpO2
  – Value constraint: less than 80
  – Context: artificial ventilation
  – Minimum duration: 4 seconds
Abstractions

• Qualitative values
• Sliding time windows
• Statistical measures
• Time/date oriented abstraction
• Repetitions
Combinations/Temporal Patterns

- Logical
  - and, or
- Arithmetic
  - sum, difference

- Different parameter propositions
- Aggregates of different time ranges
Complex Example

Overshooting hyperoxy is an episode of dangerously increased SpO2 which starts at less than 20 seconds after a hypoxic episode. SpO2 > 96 considered dangerous.

• Solution
  – Hypoxy as before
  – Hyperoxy similar but time constraint: Latest start 20 seconds after end of hypoxy
Interactive Configuration

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Strengths

• Detection of episodes
• Aggregates for sliding time windows
• Monitoring of repetitions
• Free combination of abstractions
Limitations

- Knowledge acquisition
- Access to all required inputs
- Integration with precise formalized guideline
- Some abstractions not implemented
Conclusion

• Guideline execution needs temporal data abstraction

• Temporal data abstraction needs guideline execution