STEEP- A Model-Integrated Clinical Information System Application

Janos L. Mathe, Jason B. Martin, Peter Miller, Akos Ledeczi, Liza Weavind, Anne Miller, David J. Maron, Andras Nadas, Janos Sztipanovits
Institute for Software Integrated Systems, Vanderbilt HealthTech Laboratory, Vanderbilt University Medical Center, Vanderbilt University

Challenges

- Standardizing the care of patients in hospital settings
  - The use of evidence-based guidelines for managing complex clinical problems has become the standard of practice, but guidelines are protocols not patient care plans
  - To be effective, protocols must be deployed as a customized, individualized clinical care plan
- Knowledge transfer
  - Division of responsibilities among different individuals and teams in acute care settings (e.g.: ICUs)
  - Managing new findings and updates in best practice

Goals

- Support the overall clinical process management by generating individualized care plans from evidence-based clinical protocols
  - Provide health care professionals with a modeling environment for capturing best practice in a formal manner
  - Use customized and computerized protocol models to aid the clinical (treatment) process

Methodology

1) Development of abstractions in Domain-Specific Modeling Languages (DSMLs)
2) Construction of the models: capturing the key elements of operation
3) Translation (interpretation) of models
4) Execution and simulation of models

Results

These techniques are being applied to the management of sepsis in acute care settings at Vanderbilt Medical Center

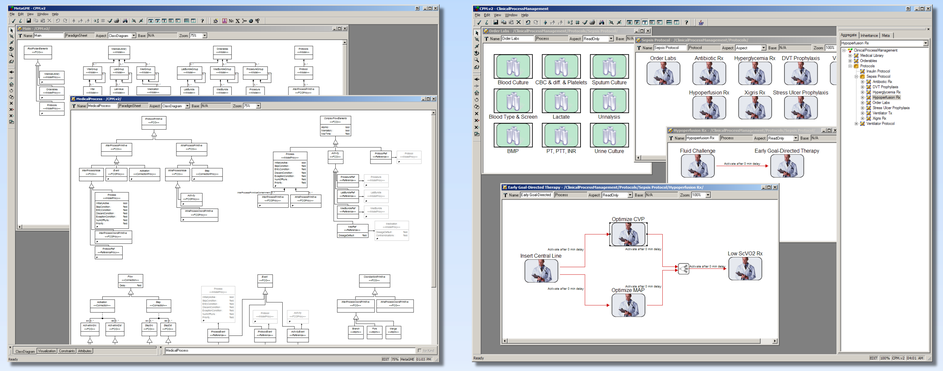
- Developed a modeling environment for formally representing clinical guidelines and treatment protocols
- Captured a treatment protocol for sepsis using the modeling environment working together with healthcare professionals
- Developed a execution and simulation environment for the validation of the protocol and for the testing of the effectiveness of the tool
- Created execution plan for clinical testing

Case Study: Sepsis

- 750 000 sepsis cases diagnosed each year in the US (≈ 1 person every 45 seconds)
- 10th leading killer worldwide
- 1400 people die each day worldwide (≈ 1 person every minute)
- Cost of sepsis care accounts for 40% of total ICU costs, roughly $16.7B
- Incidence rates in the US are expected to rise to 1 million cases a year by 2010 due to aging population

Implementation

- Use of model-based techniques for specifying and implementing guidelines as coordinated asynchronous processes
- Combined with visual dashboards, which show the status of the implemented guidelines



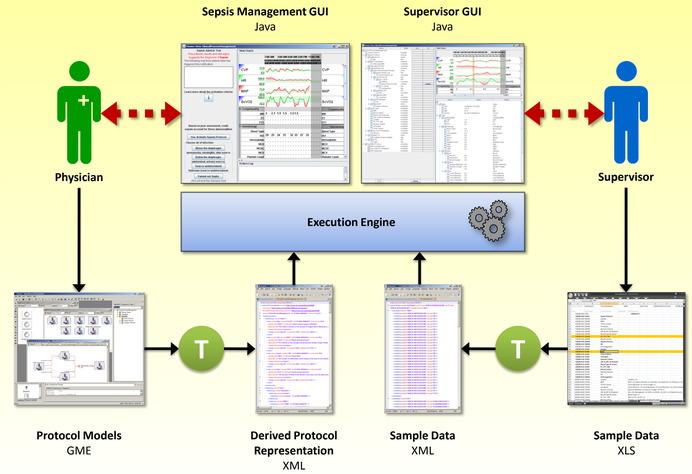
Integration Platform

- MICIS - Testbed for Health Information Systems
  - It includes a SOA-based execution environment, and is extended with policy evaluation and enforcement capabilities using an embedded PROLOG engine.
- Facilitating MICIS
  - MICIS allows for the integration of medical applications that use sensitive medical information
  - Applications communicate by using web services standards (OASIS, WC3)
  - Utilization of already available services is possible
  - Context dependent evaluation of privacy and security policies is available

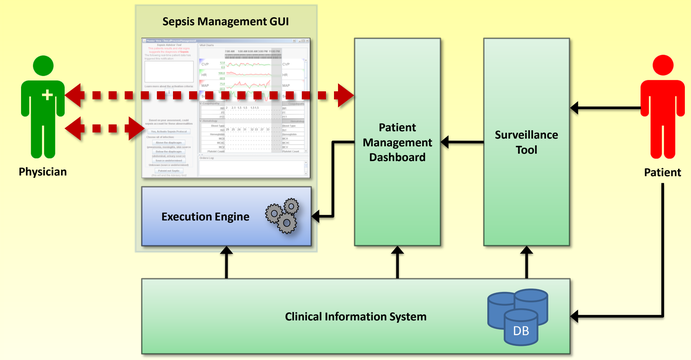
Future Work

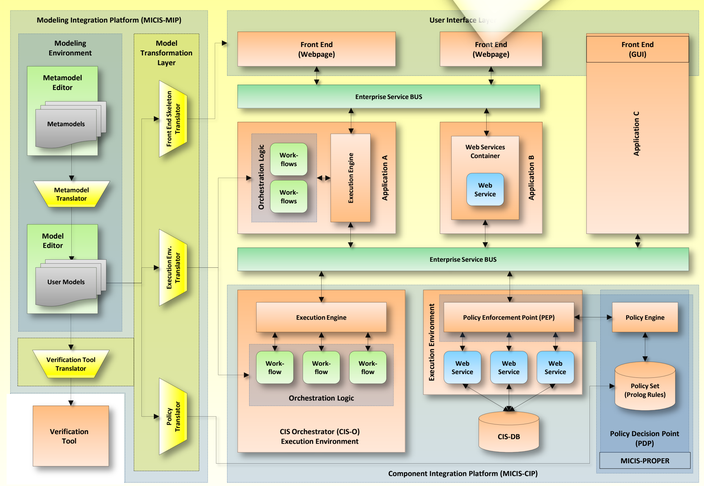
- Interface with existing clinical systems to be able to monitor of all relevant clinical conditions
- Verify continuity in existing implementation
- Run experiments to ensure the fitting with existing clinical workflows
- Evaluate the effectiveness of the tool using historical outcome metrics
- Target other acute and chronic diseases

Experimental Architecture



Operational Architecture





MICIS Architecture