

CPS: TTP Option: Synergy: Collaborative Research: An Executable Distributed Medical Best Practice Guidance (EMBG) System for End-to-End Emergency Care from Rural to Regional Center Hospitals

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UIUC: <https://publish.illinois.edu/mdpnp-architecture>

SDSU: <https://ictp.sdsu.edu>

Challenges:

- EMBG System:
 - How to make medical knowledge executable in the form of a guidance system validated by medical doctors, and verifiable safe through formal methods?
- TTP
 - How to ensure that the EMBG system does not introduce software related errors that may cause patient danger?
 - How to adaptively deploy the EMBG system at different medical facilities?
 - How to accurately quantify the medical best practice adherence improvement with EMBG system ?

Solutions:

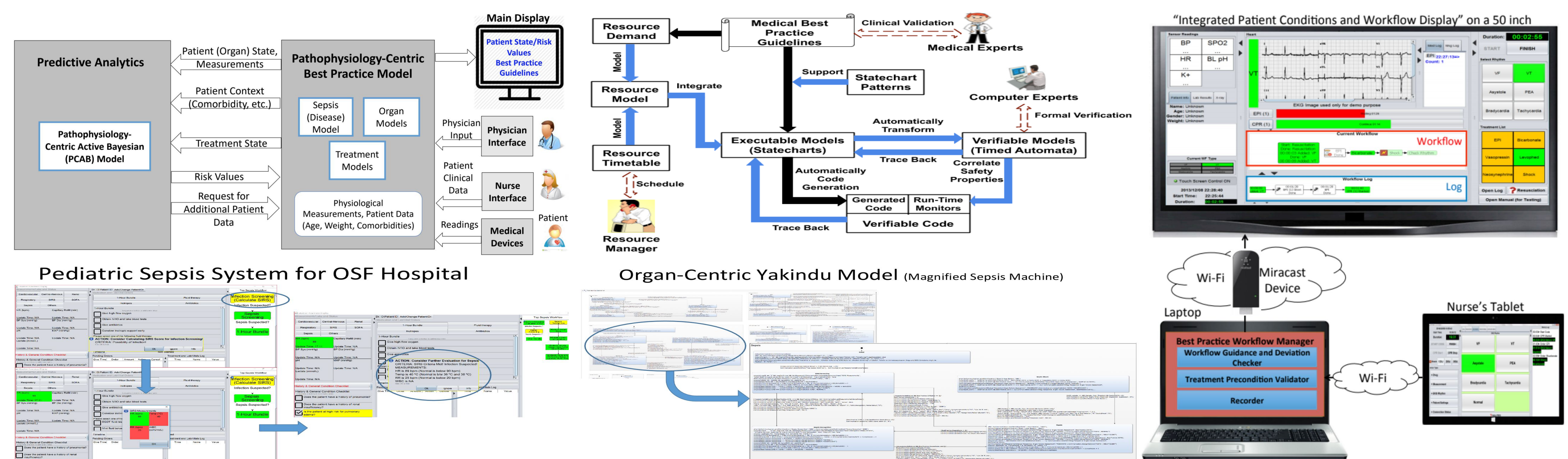
- EMBG System:
 - Computational pathophysiology models
 - Integrated model verification and clinical validation
- TTP
 - Extensive testing the EMBG system with focus on functional testing, conformance testing, destructive testing, and usability testing.
 - Quantitative measurements for adherence to standardized medical treatment guidelines: number and types of medical errors
 - Agile Adaption to Different Healthcare Facilities

Broader Impact:

- Cardiac Arrest Resuscitation Guidance System: the system has been **approved by IRB for Phase II clinical evaluation at Carle Foundation Hospital**.
 - More rapid and accurate identification of critical changes of patient conditions
 - Stricter adherence to up-to-date standardized medical treatment guidelines and protocols
 - Reduced medical errors from an altered sense of time and memory lapses (due to high stress)

Scientific Impact:

- Computational pathophysiology model:
 - Executable model of medical knowledge in the form of networked organ disease statechart and best practice statechart
- Integration of clinical validation and formal verification
 - The statechart's stimulation capability allows close interaction with physicians to check the validity of the model.
 - **Activity models discovered from medical logs can assist doctors to better confirm medical guidelines.**
 - The clinical assumption management system prevents invalid assumptions.



Broader Impact:

- Pediatric Sepsis Guidance System: the system is in the progress of **preparing for Phase I clinical evaluation at JUMP**.
- Extend cardiac arrest resuscitation **for COVID 19 pediatric patients with U of Chicago Med School**
- Provide real-time assistance with clinical management of pediatric sepsis
- Improve adherence to accepted practice standards for management of pediatric sepsis

Broader Impact:

- Education:
 - Assist hospitals and medical schools to train less experienced clinicians and clinicians-in-training important tenants of cardiac arrest and pediatric sepsis management
 - Involve computer science undergraduate and graduate students in medical cyber-physical systems and software engineering research