Cyber-Physical Systems for the Hospital Operating Room (CyBHOR)

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Coordinated Operating Room Network: A Path Toward an Artificial Intelligence System

Time in the operating room (OR) is one of the most significant budget items in modern hospitals. Importantly, it been shown that delays in operating room (OR) procedures due to mix-ups and lapses in scheduling and/or resource availability account for countless surgical delays and a significant number of post-surgical complications.

Optimizing management of multiple hospital operating rooms (ORs) is an extremely complex proposition. In every hospital, but especially in a large hospital like Houston Methodist that has more than 70 active ORs, staff must schedule and coordinate an enormous number of different procedures per day in each OR. Complicating the situation is the fact that because patients can differ so much, even common procedures can require significant variations in amounts of time required for the procedure.

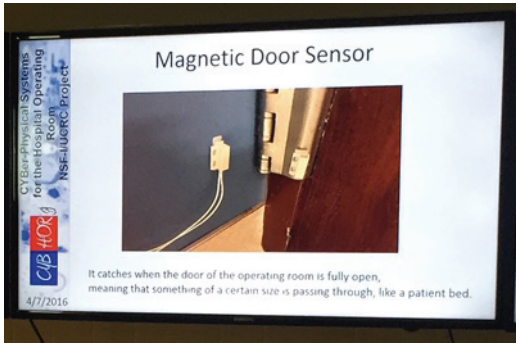
An example of the CORNET artificial intelligent (AI) system collecting data from operating rooms.

This breakthrough known as the CORNET artificial intelligent (AI) system, offers an innovative, cost-effective hardware/software OR awareness solution that: 1) detects what step of a given procedure the OR staff is at; 2) determines if steps are out of order; 3) identifies procedural delays, irregularities and unused OR time; 4) recognizes missed steps, and; 5) assists in root cause identification, analyses and assessment.

Optimal OR scheduling methods assume specific lengths of surgeries based on the procedure being performed and do not take into account differentiations in medical teams' performance. The reality is that each specific OR procedure requires gathering a complex and multi-skilled team led by a surgeon for a specific block of time; often for differing amounts of time for the same procedure.

The other unfortunate reality is that too often surgical procedures need to be either delayed or canceled because previous procedures have taken more time than expected and/or they did not start on time in the first place. Consequently, surgical teams can cause conflicts of space and time that had been reserved for other scheduled procedures.

This centers' team of researchers has developed an agent-base mathematical solution that reintroduces the human factor into the equation. The OR/AI system takes into account multiple factors from several levels of the hospital organization. It automatically informs what become, in essence, smarter OR units. It does so unobtrusively, without getting in the way of the functioning of surgical teams. The model is capable of providing better informed recommendations for improving OR management in real time, and timely early alerts when decisions to adjust and adapt are needed in order to improve scheduling and/or minimize delays.



The model OR/AI system was designed by an inter-disciplinary team of applied mathematicians, computer scientists, electrical engineers, physicians and nurses. Because it improves the processes of OR management, both patients and staff should benefit from a more efficiently run, more user-friendly OR systems that provide fairer and less biased assessments of situations as they develop and subsequent needed actions.

Economic impact: It is generally accepted that one minute in the OR costs about $100. In 2014, the OR management product market was estimated to be about 2.7 billion. It has been projected to expand to 4.5 billion by 2019. Our CORNET artificial intelligent system could be compared to an air traffic control system, managing multiple ORs, surgical teams, increasing efficiencies, improving patient outcomes and stakeholder satisfaction in real time.

CORNET artificial intelligent (AI) system is centered on patient and stakeholder satisfaction, health sustainability, and safety. The cost of deploying this system is predicted to be about $10,000 per OR per year. Our conservative estimate is a 10% increase in OR efficiency, which for a block of 20 ORs would result in an additional 800 surgeries per year. As a result, this advance has the potential to make possible substantial enhancements to patient care and increases in revenues for the hospital. Furthermore, increased efficiency

and more dependable OR schedules would result in decreases in staff overtime, leading to additional cost savings for the organization. Though almost impossible to estimate, the saving that could accrue from reducing post-op complications would be one of the most important aspects of this innovative work. The estimated ROI could easily be in the range of 1:50.

ORintel (LLC), a CyBHOR spinoff, is taking on the challenge of bringing this cost-effective solution to market.

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