UC research provides prescription for healthier hospital supply chains

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These are hospital supply bins. Credit: Michael Magazine, UC

University of Cincinnati analysis of hospital supply chains – how hospitals stock nursing stations with the hundreds of medicines, materials and even office supplies needed – holds promise in helping to make supply and re-supply efforts leaner and more cost effective.

The research, to be presented June 22 at the Institute for Operations Research and Management Science Healthcare Conference in Montreal, has implications for affecting the significant costs associated with hospital supplies. On average, supplies and inventory account for 30 to

40 percent of an average hospital's budget.

The UC cost-improvement research, "Storing and Dispensing Hospital Supplies to Nursing Wards – The RFID-Enabled, Two-Bin System," will be presented by Claudia Rosales, a just-graduated doctoral student in quantitative analysis now at Michigan State University; Michael Magazine, UC professor of operations and business analytics; and Uday Rao, UC associate professor of operations and business analytics.

The presentation is part of a long-term research project involving analysis of supply chains at Cincinnati Children's Hospital and Medical Center, Sacre-Coeur Hospital in Montreal and the Hospital for Sick Children (SickKids) in Toronto.

SUGGESTING A HYBRID MODEL FOR HOSPITAL SUPPLY CHAINS

Traditionally, hospitals have opted to resupply nursing stations at set periodic times (perhaps once a day) or to resupply a particular item when that item runs low. Each policy has fixed costs associated with it.

With periodic resupply, if a critical need for an item is experienced due to unexpected demand, caregivers have to scramble, e.g. "steal" from other stations to meet needs. In other words, demand has spiked, and a needed item isn't there because it isn't due to be replenished till a set time.

New RFID technology (radio-frequency identification) makes continuous replenishment (when an item runs low) easier. Basically, when an item runs low, a signal is sent to the storeroom indicating that replenishment should be considered for that item. Said UC's Magazine, "In a lot of ways, continuous replenishment is best, to only resupply as

needed. The problem is we have hundreds of product items needed in lots of locations with very few people to deliver them."

In earlier stages of research, the UC team determined that given the availability of this technology, a "hybrid model" that combines features of periodic and continuous resupply could potentially save hospitals 18 percent in labor costs associated with resupply, while also making sure supplies are available to care givers and patients.

Next, the UC team examined the "joint replenishment model." According to Rosales, this "joint model" asks a basic question when the system triggers a resupply of a needed item. That question: In terms of periodic resupply, what else is likely to be needed soon? So, when the supply personnel go to deliver the item requested due to the signal transmitted to the store room , they also "bring up" other items likely to be needed soon in terms of periodic resupply. This "what else will be needed soon" question can be asked either by supply personnel or by means of software.

According to UC quantitative analysis and follow-up simulations, this approach would result in an average 38 percent reduction in the need for out-of-cycle replenishment. (Out-of-cycle is defined as supplies being replenished before the periodic set point for replenishment. In other words, a "we need it now" emergency, which is costly in terms of labor and time usage by employees, not to mention a potential risk for patients.)

This is an interior view of a hospital supply bin. Credit: Michael Magazine

Said Rosales, "Hospitals want to hit the right balance of sufficient but not-too-many supplies. Keeping unnecessary levels of inventory can increase costs significantly. But lack of sufficient inventory may hinder patient care and disrupt nursing activities. So, there's a cost associated with that too."

She added, "The joint resupply model tends to even out demand uncertainty, which is where there is a burst of demand for an item. If we can even out such emergency demand spikes via the joint model, that's a significant cost savings for the hospital."

LATEST RESEARCH: TRACKING BINS INSTEAD OF ITEMS

In its latest research, the UC team is seeking to estimate any cost savings that might be available by foregoing the tracking and ordering of individual items, but instead, tracking entire bins of items. This is similar

to a Kanban approach where each item is stored in 2-bins, tracking only how many bins have been depleted rather than how many items are still in inventory.

Stated Magazine, "In other words, if you're only tracking whether a bin is empty or not, that's a lot less information to process and track than the specific number of individual items, especially when the number of items are in the hundreds. You'd know from the RFID technology if you were using the second (back-up) bin because the tag on the second bin would be different from the color of the tag on the first. And when a certain number of first bins (of different items) become empty, that's when you resupply."

METHODOLOGY

The analysis of the practice of tracking bins was conducted using a semi-Markov decision model. The quantity and time at which hospital supplies are demanded cannot be perfectly predicted, and is therefore considered stochastic in nature. The Markov assumption states that it is only necessary to consider the current state of the system and past history is not needed to be tracked. Since the time between events is assumed random decisions (replenish or not) are made in random intervals leading to a semi-Markov model.

Provided by University of Cincinnati