Improving Patient Safety and Hospital Performance Using Simulation Models and Real-time Data Capture Systems: Results from Japanese Hospitals

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Michael Siegel
Principal Research Scientist
Sloan School of Management
617-253-2937
msiegel@mit.edu

Dr. Masanori Akiyama
poas@mit.edu

Atsushi Koshio
koshio@mit.edu

Daniel Goldsmith
goldsmith@mit.edu
New Opportunities in Data-Driven Simulation Modeling

Powerful new opportunity with operations data and simulation models:

- Real-time data capture (bar-code, RFID, EHR, test data)
- Data mining techniques
- System Dynamics Modeling

To increase the efficiency in operations, improve management systems, and reduce risk
Example Data Capture: From Delivery to Injection

<table>
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<tr>
<th>Order ID</th>
<th>Patient Code</th>
<th>Medical Dept Code</th>
<th>Hospital Ward Code</th>
<th>Scheduled Inject Date</th>
<th>Delivery of Goods Date</th>
<th>Injection Execution Date</th>
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Injection Process Flow and POAS Improvements

1. Physician
   - Enter prescription
   - Change or Cancellation

2. Pharmacy
   - Fill prescription

3. Nurse Station
   - Mix Injection

4. Bedside
   - Administer Injection
Changes in POAS Performance: Patient Risk and Hospital Operations

% Errors

POAS Savings

Unexpected Reduction In Savings
SD Modeling Used to Investigate Changes in Performance

One example: Our modeling of the POAS system uncovered a process – *batch mixing* – that nurses had recently adopted.

- Nurses thought batching (mixing drugs in groups) saved time.
- Our model explored this process and uncovered its direct and indirect effects.
- POAS data was used to recommend improvement, calibrate and validate our findings.
Using IT Data with Simulation Models to Formulate Improvements

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Novact-M
Funguard
Kenketsu Venoglobulin-IH
Rituximab
Gran Injection

24.8% of Waste
System Dynamics Model: Drug Order and Injection

1. Causal Diagram

2. Simulation Model
Simulation Results: Exempting Five Drugs From Batching

Total Cost (in millions of yen)

- **Base Run (Blue)**
- **Improvement (Red)**

- **MATERIALS SAVINGS**
  - 70 million yen
  - 600 thousand USD Per Year
  - (Evidence for Managers)

- **STAFF SAVINGS**
  - 4,000 Hours Of Nurse Time Per Year
  - (Evidence for Nurses)
POAS DATA: Relationship between wasted rate and mixing time

Decreasing time between mixing and injection leads to decrease of wasted drugs

Suggested Intervention

Present Results

Time between mixing and injection (Left Axis)  Wasted Rate (Right Axis)
Interviews with Nurses in IMCJ

Summary of Interviews

Nurses have been using PDA for every medication from the introduction. They sometimes had meetings to ensure right usage of PDA to prevent medication error.

They tried to reduce time between mixing and injection as a result of our first interview. But it was difficult because the scheduled orders were clustered at certain period of time. Need to change behaviors of physicians and pharmacists to reduce more.

These data sets are extremely worthwhile. We look forward to use this data to improve operations.