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## Case Article

# A Prescription for Budget Woes at Gracious University Hospital

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**Abstract.** This case study focuses on pharmacy operations from the standpoint of the chief financial officer for Gracious University Hospital. Her charge was to reduce operational expenses on top of pre-established budget cuts. Her first order of business was to handle inventory of the automated dispensing cabinets (ADCs) located on each floor of the hospital which contains a limited supply of medication supplied by the central pharmacy. In order to develop an effective inventory plan, a tiger team was developed consisting of physicians, patients, nurses, and pharmacists who developed a physical simulation competition between hospital unit floors which focused on the medication delivery process from prescription entry to medication administration. While observing the process, data would be captured and teams would attempt to derive better inventory policies for the medications kept in the ADCs. This case introduces students to healthcare operations by providing background on pharmacy medication delivery systems. The learning objectives of the case and accompanying simulation activity are to (1) explore the challenges of inventory management in healthcare (2) develop and analyze inventory policies based on data collection and observation (3) understand the impact of variability and perishability on inventory management.

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**Supplemental Material:** An electronic companion is available at <https://doi.org/10.1287/ited.2016.0159ca>.

**Keywords:** cases • classroom games • active learning • teaching decision analysis • teaching supply chain management • physical simulation • hospital operations • inventory management

## Motivation

In an era in which healthcare spending is scrutinized and hospitals are seeking ways to reduce costs, the need to improve medication inventory management is critical. Americans spent more than \$260 billion on medication in 2012 (Langreth 2014). According to Swendrzynski (2008, p. 412) “the rate of drug-expenditure growth has frequently been higher than inflation, increases in wages, and other health care spending.” The pharmacy budget, which is second to labor as the highest cost center in the average hospital, can account for nearly 10 percent of the overall budget and drug costs contribute approximately two-thirds of the total pharmacy budget (McEwen 2015). For example, at Intermountain Healthcare 60–70 percent of the pharmacy budget come from medication inventory costs (Moore 2014). Due to the effect medication costs have on pharmacy budgets, drug costs continue to be a “target for cost containment initiatives” (Swendrzynski 2008, p. 412). Resource allocation to improve medication distribution and lower

costs is a continuing initiative of pharmacy directors (Moore 2014).

This case was motivated by authors’ experience with hospital pharmacies and the companies that provide inventory storage equipment. Medication inventory is frequently stored in the hospital’s automated dispensing cabinets (ADCs) which are computerized decentralized medication storage units. The use of ADCs has been shown to increase patient safety and the change in pharmacy distribution has significant impact for pharmacist, pharmacy technician, and nurse workflow (Fung et al. 2009). ADCs improve pharmacy and patient care in many ways, including providing nurses with easier access to medication which decreases the turnaround time from the central pharmacy to the patient (Institute for Safe Medication Practices 2008).

Healthcare companies who develop these technologies and the pharmacists are both interested in developing a better understanding of their demand and resulting inventory strategies. The issues faced by the hospital pharmacists include determining appropriate inventory levels while reducing cost and avoiding

waste. While it is important to be able to administer medication in a timely manner, storing an abundance of medication is costly. The healthcare companies who develop the ADCs are concerned with producing technologies that enable the hospital to meet these goals. In this case study, we introduce ways to model a real-life problem of medication inventory through a physical simulation. Participants in the case study are challenged to determine optimal policies given a particular demand for each drug from the perspective of multiple stakeholders. They are also able to see the impact of wastefulness to a hospital as well as resource utility (i.e., the utility of the nurse and pharmacy technician) therefore creating a connection between a policy and its impact on the individuals. This case can be used in undergraduate operations management courses, industrial engineering courses that focus on process analysis, pharmacy school courses that cover inventory management, and introduction to operations management courses in the MBA curriculum. The case study focuses on topics related to inventory policy evaluation and development, process analysis, and exploration of the impacts of variability on operations.

### Learning Objectives

The learning objectives of the case and accompanying simulation activity are to:

- explore the challenges of inventory management in healthcare;
- develop and analyze inventory policies based on data collection and observation;
- understand the impact of variability and perishability on inventory management.

Use of the case can help achieve these objectives in several ways. First, the case itself is based on real-world challenges faced by hospitals and clinicians today. The intricacies of the healthcare delivery system are described in the context of pharmacy operations. Second, the students take part in a physical simulation that is intended to mimic the simulation developed in the case by the clinical staff. Through this simulation the students will experience the challenges faced by the clinical staff first hand. The students will collect and analyze data related to various performance measures defined by the case and instructor. Finally, the students have the opportunity to develop their own inventory policies in order to improve the current inventory strategy.

### Case Description

In the case study the chief financial officer of the fictitious Gracious University Hospital, Sandra Jones, is faced with many issues including establishing policies for pharmacy operations. Although it was decided that ADCs will best serve the hospitals' needs, the hospital

is faced with the issue of understanding the amount of inventory that should be stored in the cabinet at all times that best serves patient needs and eliminates waste. The case study is unique in that it outlines ways for students to participate in a physical simulation and offer improvements in inventory and pharmacy operations as they take on roles of hospital personnel. This fact will allow students to move beyond optimization equations to create connections between inventory policies and the process stakeholders. We hope that the physical simulation help students recognize the need to consider the consequences of policies on those that carry out the work.

### Experience in Teaching the Case

This case has been used in a multitude of settings including an industrial engineering summer camp (high school), a stochastic processes course (undergraduate), a quality engineering course (undergraduate), project management for engineers (graduate) and with a healthcare company. The strength of this case is its diverse course applications. In the stochastic processes course, the case focused on understanding variability and uncertainty while in the summer camp and quality engineering and project management courses, the focus is on data collection, analysis, waste and process mapping.

#### Summer Camp

In the engineering summer camp a group of approximately 80 students were divided into four teams of 20. Each team competed against one other team. The major focus of the summer camp was to expose students to common terminology, methods, and principles used in industrial engineering. In the summer camp, the high school students were introduced to inventory management concepts and were able to translate the information gathered through the simulation to create a computer simulation. Using the computer simulation, the students were able to use the data they collected and test out various policies with the goal of finding policies that optimize the system.

#### Quality Engineering and Project Management for Engineers

For the undergraduate and graduate courses, students have more experience than students participating in the summer camp with industrial engineering principles and are able to consider more aspects of the problem at hand. Determining the best inventory policy is one of the major outcomes of the physical simulation, however in the quality engineering and project management for engineers courses an integral component of the exercise is understanding the process, determining the information or metrics needed

for analysis and looking for opportunities to minimize wasteful activities. In the quality engineering course, students were able to identify the various issues faced by the hospital and its pharmacy operation from the multiple stakeholders' perspectives in addition to laying out the process while identifying pertinent performance metrics. Outcomes of the exercise included an explanation of the main problem faced by the hospital and potential causes, identification of quality from multiple perspectives (i.e., a patient's perspective versus a nurse's perspective), lay-out of process using different methods (e.g., SIPOC—Suppliers, Inputs, Process, Outputs, Customers), and the identification of graphic tools that could be used to monitor measurements.

The students have enjoyed the case in all of the settings described above. The environment is typically one of controlled chaos as the student teams rush around the room fulfilling patient orders. The competition between teams keeps students motivated throughout the simulation rounds.

Further suggestions for implementing the case are provided in the teaching note ([https://www.informs](https://www.informs.org/Publications/Subscribe/Access-Restricted-Materials)

[.org/Publications/Subscribe/Access-Restricted-Materials](https://www.informs.org/Publications/Subscribe/Access-Restricted-Materials)) which contains suggested questions, analysis, recommended plan, and summary of examples of student responses.

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