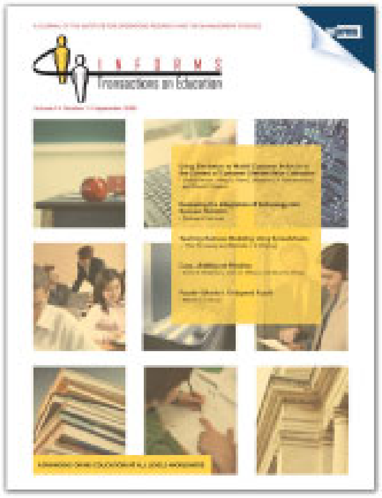

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Case Article

Medication Waste Reduction in an In-Hospital Pharmacy: A Case That Bridges Problem Solving Between a Traditional Case and an Industry Project

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This operations management case describes a waste-reduction project in a compounding pharmacy in a hospital. Every day, pharmacy technicians prepare a large number of patient-specific medication doses and then deliver these doses to various hospital units. With the rising cost of medications, pharmacy managers become concerned that a significant number of compounded medication doses are not administered to patients and are subsequently wasted. The students are asked to quantitatively evaluate proposed changes to the compounding and delivery process and to estimate savings from process reconfiguration. Two large data sets are provided with the case to facilitate hypothesis generation regarding probable causes of waste and to analyze proposed changes. The analysis will deepen students' spreadsheet skills as well as mathematical modeling of inventory problems. The case is presented in parts, and it is discussed over one-and-a half class meetings—simulating the steps of a field project: interviewing a client, framing the client's problem, formulating a data request, and then analyzing the data and delivering a recommendation. This case has been used in a core MBA operations management class; it could also be used in a health-care operations or in a business modeling course.

Keywords: developing analytical skills; spreadsheet modeling; teaching with projects; teaching inventory management; teaching healthcare operations
History: Received: August 2015; accepted: September 2015.

The case is based on a hospital operations improvement project completed by a group of students in a graduate program. The setting is an in-hospital pharmacy, and the focus is the production of compounded sterile products (CSP), e.g., IVs that are custom compounded for individual patients. With the rising cost of medications, pharmacy managers are concerned with medication waste. A physical five-day pharmacy audit finds a significant number of compounded medication doses that have been prepared and delivered to hospital units but not administered to patients, and had to be subsequently discarded. The students in the project group evaluate process changes aimed at reducing such waste.

This is an operations management case examining production batching. A simple EOQ model is insufficient for analysis because the setting is different in several ways: The 24-hour cycle of the hospital day requires that whatever CSP batches the pharmacy makes should repeat in this cycle. The labor costs can vary depending on the shift, so the labor costs associated with production and delivery of medication can depend on how the work is scheduled. The physicians' schedule for hospital rounds determines how medication orders are canceled throughout the day, which affects waste. The result is a problem that qualitatively has the trade-offs of a batching problem, yet exists in a setting very different from the traditional production or ordering problem with costs that are of a different nature than the traditional holding and set-up costs.

Project-based learning is gaining momentum in many business schools (Chua et al. 2014, Danford 2006, Goel and Straight 2005, Hillon et al. 2012, Korfhage Smith 2010, Laughton and Ottewill 1998, Lowe and Armacost 2012, Milne and Zander 2012, Pilotte et al. 2012, Salo 2012, Shearer and Whitaker 2012). For an in-depth discussion on project-based learning please refer to Hmelo-Silver et al. (2007) and references therein. Yet running projects with real companies is an expensive undertaking, requiring resources to recruit industry clients and then to mentor students in small groups (Lopez and Lee 2005). We designed this case to offer some of the benefits of project-based learning in a scalable format. To mimic a project experience, the case is presented in stages so students can go through the steps of problem definition; modeling and problem formulation; and, finally, analysis and recommendation. Working on this case involves: (1) generating a problem statement or objective by asking questions of the manager, (2) subsequently learning the detail of the process and perhaps revising the problem statement, (3) analyzing a substantial data set that requires some choices on how to interpret the data and how to model the situation, i.e., the crucial summary statistics are not provided, and (4) potentially dealing with a solution space that is quite complex.

The case consists of three parts. Part A is a brief description of the basic setting: Hannah Jones is a pharmacist working on a process-improvement project to complete her master's degree. She has decided to focus on waste reduction of compounded medication. Part B provides, in written form, a plant tour of an in-hospital pharmacy. It includes a detailed explanation of the process for compounding and delivering medication. Extensive data, representing a year's worth of patient medication orders (9,000 lines), is also supplied with this part of the case. Part C is optional; it specifies the final deliverable: a recommendation on how to adjust the scheduling of CSP batch production, backed up by a quantitative analysis. An instructor can choose to discuss only the analysis methodology in class without assigning a write-up.

We taught the case five times as part of the core operations course in the full-time MBA program at the Simon School, University of Rochester. By the time the case was introduced, we expected students to be able to generate an objective for an operations improvement project in terms of measures of cost/productivity, timing of delivery, and quality/safety. The case discussion was spread over one-and-a-half 90-minute class meetings.

The discussion of part A took only 20–40 minutes. Its purpose was for students to ask questions about the operations of the pharmacy. We have run the first session in two ways: Either two faculty members came to the class and one played the role of the pharmacy director and answered all the students' questions about the pharmacy while the other played the traditional role of the facilitator of the discussion, or a single faculty member played both roles. Although most of the questions that students asked about pharmacy operations are answered in part B, we found that having students generate the questions and discuss them with a "pharmacy manager" worked well and made for a lively class discussion.

After the in-class discussion of part A, we distributed part B. In addition to describing the pharmacy operations, part B contains extensive data, representing a year's worth of patient medication orders (9,000 lines). The second class discussion, following students' reading of part B, takes a full period (90 minutes). During this second discussion, we generate an analytical model for evaluating the waste-reduction benefit of a different IT system and of a different batch-scheduling solution. We show how the prospective analysis can be done by modeling the situation rather than by experimenting with the real system.

Mathematical modeling of processes may come naturally to faculty in operations management; however, it does not come naturally to most MBA students in their first operations course. Just like the students who worked on the actual project, the MBA students may feel more comfortable with trying (experimenting with) an alternative solution and doing rather expensive data gathering to determine if the new alternative actually improves performance. Using this case, the instructors can help students see the benefits of modeling by pointing out that if the students were to rely only on actual experiments, they would not be able to quantify the benefits of an alternative IT system that needs to be evaluated prospectively. The data set supplied with part B supports the modeling work—it can be used to find estimates for the modeling parameters, yet, similar to the data set provided for part A, the data set for part B is substantial enough to not be easily scanned by eye and understood. The students will need to generate specific questions to process the data and summarize it. The examination of the data gives the students an opportunity to exercise advanced MS Excel functionality, like PivotTables.

Students have found this case to be challenging but rewarding. We believe this is due to the following aspects of case design:

(1) All the information is not provided at once. The goal is to motivate students to think of what a good model for the problem is and figure out what data would be needed to solve the problem.

(2) The data that is provided is not already summarized in a convenient way; it is extensive and cannot be understood simply by inspection.

(3) The application of EOQ thinking is not direct, and a bigger conceptual leap is required to map the EOQ concept to this problem than in a typical textbook problem.

(4) The full set of feasible solutions is quite complex.

The core operations instructor was available for consultations with student teams from the completion of the part B discussion until the submission day of the final deliverable (specified in part C). Because of the complexity of the analysis, most teams were able to complete about 80% of the final deliverable work on their own but were still struggling with the remaining 20%. At this point, the student teams met with the instructor during office hours. We noted that substantial learning occurred in these consultation sessions, because the students had first struggled with the problem, had accomplished what they could on their own, and knew where they were stuck. Usually a small support or scaffold at this point allowed them to proceed. Our suggestions for teaching the case are provided in a teaching note with restricted access (available at http://dx.doi.org/10.1287/ited.2015.0147ca).

This case is intended as a stepping stone between a typical case and an industry project. We hope that this case and experience with teaching it will encourage other faculty to generate similar style cases. Of course, traditional cases serve their purpose. But we believe there is an acute need for the kind of problem-based learning represented by this case and the recently published case by Pachamanova (2015).

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/ited.2015.0147ca.

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