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Some Promising Areas for IS Research in the Healthcare Industry: Implications from a Case Study of Hospital Operation Room Scheduling

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ABSTRACT

This study investigates the process of operation room scheduling at a Midwestern hospital. A comprehensive process map was developed to illustrate the existing scheduling process. Process simulation was conducted and bottlenecks were identified. Follow-up interviews with hospital administrators provide insights on the urgent need of more IS research in the healthcare industry.

Keywords

Healthcare industry, operation room scheduling, process map.

INTRODUCTION

The hospital industry is struggling with diminishing investment returns. On one side, rising cost of health maintenance, more regulations on government reimbursements for Medicare and Medicaid services, and changing policies from insurers increased the burden on hospital management (Ibold, 1999); on the other side, the public have increasingly criticized the hospital industry for the rising health care expenditures, making it sensitive for hospitals to increase service charges. Thus, hospital CEOs have to place "day-to-day attention to operations and logistics" for improving the bottom line of financial statements (Mango and Shapiro, 2001; p. 77).

Researchers have also pinpointed operation inefficiency as a main obstacle for the development of the hospital industry. For example, the journal of Frontiers of Health Services Management devoted a special issue addressing the patient flow/capacity management problem; the issue concluded that "the repetitive theme that problems initially misconstrued as an apparent limitation of capacity are instead caused by inefficiencies in clinical hospital operations" (Zimmerman, 2004; p. 34). The international management consulting firm McKinsey & Company suggests the hospital industry redesigning its operation processes in order to enhance operation efficiency and boost up the declining profit margin, arguing that "today's challenges demand nothing less than a fundamental rethinking of the health system in the United States" (Grote, Mango, and Sutaria 2007). Given that the evolution of information technology is driven by operation efficiency and collaboration (Pinsonneault and Kraemer, 1997), there is an urgent need for more IS research in the healthcare industry.

This study investigates the operation room scheduling process of typical US hospitals. The surgery department of a Midwestern mid-sized hospital was selected as the research target. Adopting a business process reengineering perspective, the study attempts to conclude a process map to depict the existing scheduling process at the target hospital. The premise is that the process map will identify obstacles and bottlenecks in the investigated operation room scheduling process, enhance our understanding of hospital operations, and provide insights on areas of fruitful research for improving the operation efficiency of hospitals.

The paper is structured as follows. First, the complex nature of hospital operations is discussed with regard to the relationship between hospitals and physicians. Then, employing process map is proposed as the main research method. The resulting process map is presented with brief explanations of key activities. The study ends up with a discussion of the distinct features of the investigated operation room scheduling process, and make recommendations on some promising areas for IS research.

THE COMPLEX NATURE OF HOSPITAL-PHYSICIAN RELATIONS

Unlike other industries, physicians generally are not salaried employees of hospitals; rather, they are largely independent with loose contracts with a given hospital. Therefore, physicians enjoy "privileges" that entitles them to provide medical services

within the respective facility of the hospital. In exchange for these privileges, physicians are often expected to provide certain service on behalf of the hospital (e.g. hospital committees, on-call ER availability). In turn, hospitals are dependent on these physicians as a referral base for patient volume. This arrangement in the US health care system is a long-standing tradition that has only recently shown signs of changing with the rise of hospitalist physicians (Final Report of New Jersey Commission on Rationalizing Health Care Resource, 2008). Under such an arrangement, physicians benefit financially from the facility and services of hospitals but do not bear direct responsibility for the fiscal health of these institutions.

The complex nature of hospital-physician relations has profound consequences on the economics and management of hospitals. For example, in the Final Report of New Jersey Commission on Rationalizing Health Care Resources (2008), it is concluded that "physicians face little accountability for consumption of hospital resources" and "hospital costs are generally unknown to providers and patients." Because hospitals and physicians operate on different sets of practices with incompatible financial concerns with respect to the consumption of hospital resources and the provision of medical service, the cost structure of medical treatment often is not transparent to service providers and patients. This phenomenon is rarely observed in other industries and causes public criticisms to the health care system.

As for the management of operation rooms, the unique hospital-physician relationship adds complexity to the scheduling process. Since physicians are not officially affiliated with a given hospital, they enjoy great flexibility in booking operation rooms without bearing many consequences. The practice inevitably leads to the poor management of operation rooms, one of hospitals' scarce and expensive resources. As pointed out by Grote and colleagues (2007), "the hospitals' common practice of granting doctors block time in operating rooms, with individual surgeons reserving particular rooms on a set day and time each week, imposes large opportunity costs because not all surgeons fill up every minutes of their block time (p. 5)."

RESEARCH METHOD

The first step in gaining control over an organization is to know and understand the basic processes (Deming, 1982; Juran, 1988; Taylor, 1911). The study adopts a business process reengineering approach, and attempts to develop a process map to depict the existing scheduling process at the target hospital. Process map illustrates key activities involved in the target business process. By defining what a business entity does, who is responsible, to what standard a process should be completed and how the success of a business process can be determined, the ambiguity of the business process can be largely reduced or eliminated. A more complete understanding of the process will support further steps such as activity analysis and process reengineering for improving operation efficiency.

Research Site and Process

The surgery department of a Midwestern hospital was selected as the research site. The hospital is of midsize with about 2000 employees. The surgery department employs 26 people, most of whom are registered nurses (RN). For each surgery operation, there will be about 6 RNs assisting the operation.

Like many other hospitals, the investigated hospital contracts with independent physicians for the use of hospital facility and services, including the allocation of operation rooms. Based on personal schedules and preferences, physicians reserve operation rooms for a set of time slots each week. Not surprisingly, certain time slots such as weekday mornings are often overbooked, while other time slots such as late afternoons and weekend time slots always wait to be filled in. The hospital has tried to encourage physicians to take these "unfavorable" time slots for an even distribution and better management of the usage of operation rooms. But with limited incentives to physicians, little improvement on operation room usage has been achieved.

The surgery department has various process flow charts to document and facilitate key activities, such as registration and scheduling for anesthesia tests, involved in the scheduling process. However, these flow charts are fragmented in that they each address a focal activity without connection to others. Several flow charts conflict with others in terms of the timeframe of required paperwork, and some are ambiguous for what documents/activities are prerequisite and what will follow. In addition, the RNs are split into three shifts to assure the availability of operation rooms on the 24X7 basis. Handling of some activities are slightly different from shift to shift. The RNs have never thought these fragmented flow charts as a problem in that they have implicit knowledge of how to deal with different cases.

To develop the process map of operation room scheduling, the authors have visited the surgery department several times, and interviewed all RNs in the department regarding their job responsibilities and relationships with each other in a scheduling process. With generous support from both the top management of the hospital and the department managers (managers of the surgery department are also RNs), we are able to develop a process map that is comprehensive enough to map all scheduling activities. The process map is approved by the department managers as accurately depicting the existing scheduling process in the surgery department.

Results

The research conducted resulted in the development of a comprehensive process map to depict the operation room scheduling process in practice. Figure 1 (a, b, and c) displays main part of the map for illustration.

As demonstrated in Figure 1, the scheduling process is overwhelmingly comprehensive, involving many different parties (physicians, patients and patient families, RNs of the surgery department, other hospital departments, insurers etc.), retrieving information from various sources, and demanding different tests (e.g., allergy tests, anesthesia tests, and cardiac tests).

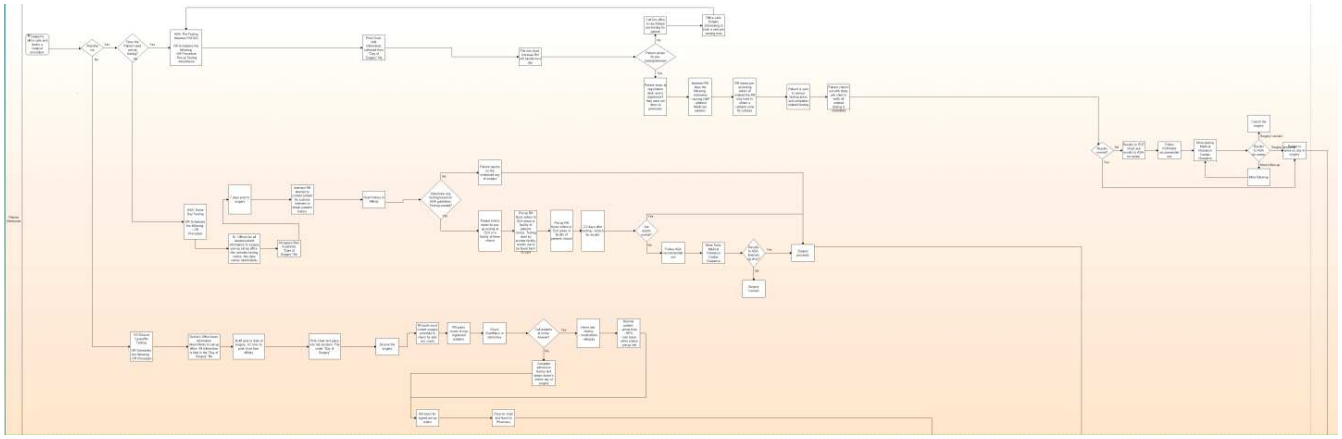

Figure 1a. The Process Map of Operation Room Scheduling – Registration

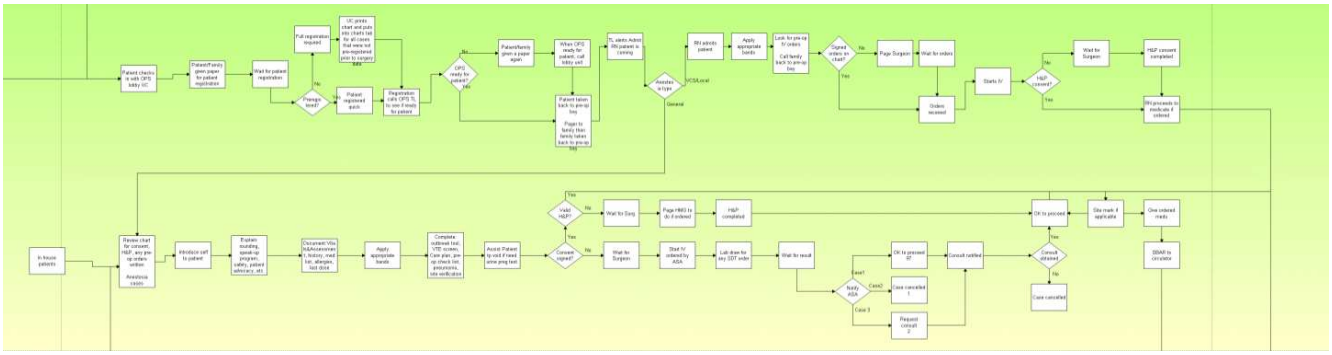

Figure 1b. The Process Map of Operation Room Scheduling – Pre-operation

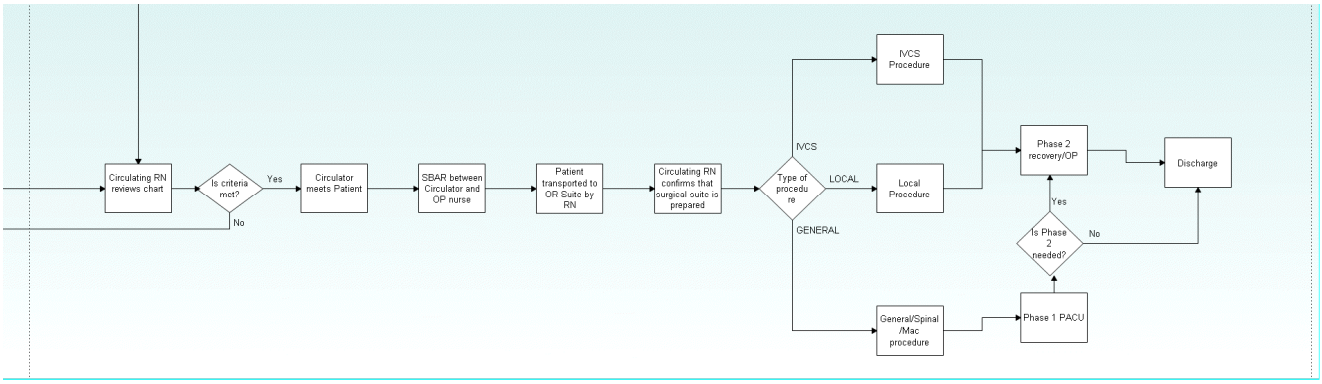

Figure1c. The Process Map of Operation Room Scheduling – Surgery, Recovery, and Discharge

In general, there are three main stages for a surgery operation to be scheduled and completed. Figure 1a shows the process in which a patient gets permission for the surgery; the operation is initially scheduled based on physician's request, the patient's medical history and current health condition (e.g., possible allergies and results of anesthesia tests); Figure 1 b indicates the

steps needed during the 24-48 hours before the scheduled operation, including signing all the necessary documents (e.g., the consent form); and Figure 1c demonstrates the steps in a surgery operation. Upon the discharge of the patient from the recovery room (after surgery), the scheduling process is considered completed.

The process map has been approved by the hospital as valid, accurate, and complete. With the process map, we have conducted a simulation study to identify bottlenecks in the scheduling process. Currently, we are working closely with the surgery department to scrutinize our initial setting of parameter values to assure the simulation results are reliable.

DISCUSSION

The study is still in progress. During the development of the process map, we have identified several areas that IS research can provide solutions or recommendations for enhanced operation efficiency. We have also found that hospital operations have some distinct features that are rarely observed in other industries. Without carefully examining its special operation environment, the hospital industry may not be able to replicate the best practices of other industries with success, such as process reengineering and system integration for improving operation efficiency.

For the investigated operation room scheduling process per se, we have found:

The Need for System Integration

There are different information systems being used in the scheduling process. With a significant overlap in information coverage (for example, all systems provide basic information of patients), these information systems are used for different purposes and are not integrated. Therefore, RNs often print copies from different information systems for patient information, operation schedule, staff availability, or operation room status. Obviously, the coexistence of various systems has increased the workload of RNs and lowered the efficiency of operations. An integrated system will solve the problem.

IS researchers have long recognized the importance of system integration and its derivative of data integration to the success of modern organizations. For example, Goodhue and colleagues (1992) have discussed the benefits of data integration as improved communication and operational coordination across subunits within an organization. Having different systems coexist leads to "informational fragmentation" (Muscatello et al., 2003) or "functional silos" (Beretta, 2002), and results in the loss of operation efficiency as "dysfunction, redundancy, and waste" (Raymond and Uwizeyemungu, 2007; p. 502). The need for system integration has been widely accepted among IS researchers and business practitioners, as concluded by Hasselbring (2000) that "to support the intraorganizational business processes within organizations effectively, the existing information systems must be integrated" (p. 33-34).

In the healthcare industry, however, system integration may have a different meaning. Miller (1996) described four types of system integration in healthcare industry: the creation of integrated firms and contractual networks, clinical integration, physician/system integration, and functional integration. Of the four types, only functional integration suggests an integration of key support functions and activities for coordination across operating units; other types of system integration deal with the collaboration among healthcare networks, hospitals, clinic offices, and other health-service providers. The literature of healthcare system integration has emphasized much on the broad-scope integration beyond the boundary of one hospital or one healthcare facility (e.g., Ogles et al., 1998; Holm and Burns, 2000; Wan and Wang, 2003). In contrast, within-organization system integration has received less attention among healthcare researchers. It will be desirable for IS researchers to study system integration especially in hospital operations.

The Importance of Operation Efficiency

The efficiency of operation room scheduling process is critical to the usage of operation rooms at a hospital. The nature of the hospital-physicians relationship implies that the hospital does not have direct control on the use of operation rooms. Either physicians or patients can easily switch to a different hospital. Therefore, a smooth and efficient scheduling process that facilitates the completion of a surgery operation will unquestionably enhance the usage of operation rooms and increase revenues for the hospital. It is not rare that patients have to switch to a different hospital due to the delay or harassment in the scheduling process.

Clearly recognizing its importance to the overall organizational performance, the hospital of study has spent significant resources on the scheduling process. On average, one patient will receive assistance from 3 RNs and spend more than 90 minutes to go through the scheduling process in addition to any medical treatments. The cumbersomely complicated process, as presented in Figure 1a-1c, may be considered as an industry standard. But from a process reengineering perspective, the scheduling process can be simplified and streamlined for increased efficiency. Introducing process reengineering in healthcare in general, and in the operation room scheduling in particular, is another promising area for IS researchers.

Technology Adoption

In the surgery department of study, we have observed that RNs prefer reading paper-based reports to reading on screen. Although the information can be retrieved from computers that are conveniently located at every corner of the department area, RNs repeatedly print out hardcopies for reviewing patient information or operation room schedules. RNs in the surgery department have even developed and standardized a special practice for handling the print copies: every morning a designated RN print all patient forms and archive them into different folders; these folders are placed in the order of scheduled surgeries in a designated cart located next to the center desk of the department. A folder will be discarded only when the surgery is completed and the patient is discharged from the recovery room.

The trend of information technology suggests that more information will be digitalized in future. Not only does efficient operation require fast and accurate acquisition, process, transfer, and presentation of information through digital media, the increasing concerns of social and environmental responsibilities have driven many organizations to adopt "paperless office" and other "green IT" practices. It can be foreseen that more information technologies will be implemented on the healthcare operation floors and healthcare workers need to adapt their behaviors accordingly. Taking the consumption of paper as an example, print-out copies, if not totally disappear, will see reduced use in workplace.

IS researchers have established a solid tradition of studying the adoption of new technologies. Theories such as technology acceptance model (Davis, 1989; Venkatesh et al., 2003), innovation diffusion theory (Karahanna et al., 1999), and computer self-efficacy (Compeau and Higgins, 1995; Compeau et al., 1999, He and Freeman, 2010) have already served as references for researchers of other disciplines to study the impacts of technology on individual behavior and organizational practices. It should be of interest to many IS researchers the question of how to facilitate the adoption of new technologies among healthcare workers.

In summary, hospital operations are complex and have many distinct features that are not common in other industries. There are lots of promising areas for fruitful IS research. But before committing significant research endeavors, we need to develop a good understanding of the special operations and practices in the healthcare industry.

REFERENCE

1. Beretta, S. (2002) Unleashing the integration potential of ERP systems: The role of process-based performance measurement systems, *Business Process Management Journal*, 8, 3, 254-277.
2. Compeau, D.R., and Higgins, C.A. (1995) Computer self-efficacy: Development of a measure and initial test, *MIS Quarterly*, 19, 2, 189–211.
3. Compeau, D.R., Higgins, C.A. and Huff S. (1999) Social cognitive theory and Individual reactions to computing technology: A longitudinal study, *MIS Quarterly*, 23, 2, 145-158.
4. Davis, F.D. (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13, 3, 319-339.
5. Deming, W.E. (1982) *Out of the Crisis*, Cambridge University Press, Cambridge.
6. Goodhue, D.L., Wybo, M.D., Kirsch, L.J. (1992) The impact of data integration on the costs and benefits of information systems, *MIS Quarterly*, 16, 3, 293-311.
7. Grote, J., Mango, J., and Sutaria, S. (2007) Transforming U.S. hospitals, *The McKinsey Quarterly*, online article at https://www.mckinseyquarterly.com/Transforming_US_hospitals_1937.
8. Hall, J.M., and Johnson, M.E. (2009) When should process be art, not science, *Harvard Business Review*, 87, 3, 58 – 65.
9. Hasselbring, W. (2000) Information system integration, *Communications of the ACM*, 43, 6, 32-38.
10. He, J., and Freeman, L. (2010) Understanding the Formation of General Computer Self-Efficacy, *Communications of the Association for Information Systems*, 26, 12, 225-244.
11. Holm, C.E., Burns, L.R. (2000) The future of physician-health system integration, *Journal of Healthcare Management*, 45, 6, 356-358.
12. Ibold, K. (1999) Ailing hospital industry, *Florida Trend*, 42, 4, p. 26.
13. Juran, J.M. (1988) *Juran on Planning for Quality*, Free Press, New York, NY.
14. Karahanna, E., and Straub, D.W. (1999) The psychological origins of perceived usefulness and ease of use, *Information and Management*, 35, 4, 237-250.

15. Mango, P.D., and Shapiro, L.A. (2001) Hospitals get serious about operations, *The McKinsey Quarterly*, 2001, 2, 74-85.
16. Miller, R.H. (1996) Health system integration: A means to an end, *Health Affairs*, 15, 2, 92-106.
17. Muscatello, J.R., Small, M.H. and Chen, I.J. (2003) Implementing enterprise resource planning (ERP) systems in small and midsize manufacturing firms, *International Journal of Operations & Production Management*, 23, 8, 850-871.
18. New Jersey Commission on Rationalizing Health Care Resources, Final Report, 2008, available online at http://www.nj.gov/health/rhc/finalreport/index.shtml.
19. Ogles, B.M., Trout, S.C., Gillespie, D.K., and Penkert, K.S. (1998) Managed care as a platform for cross-system integration, *The Journal of Behavioral Health Services & Research*, 25, 3, 252-268.
20. Pinsonneault, A., and Kraemer, K.L. (1997) Middle management downsizing: An empirical investigation of the impact of information technology, Management Science, 43, 5, 659-679.
21. Raymond, L., and Uwizeyemungu, S. (2007) A profile of ERP adoption in manufacturing SMEs, *Journal of Enterprise Information Management*, 20, 4, 487-502.
22. Taylor, F.W. (1911) *The Principles of Scientific Management*, Harper and Brothers, New York, NY.
23. Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. (2003) User acceptance of information technology: Toward a unified view, *MIS Quarterly*, 27, 3, 425-478.
24. Wan, T.H., Wang, B.L. (2003) Integrated healthcare networks' performance: A growth curve modeling approach, *Health Care Management Science*, 6, 2,
25. Zimmerman, R.S. (2004) Hospital capacity, productivity, and patient safety – It all flows together, *Frontiers of Health Services Management*, 20, 4, 33-38.