ORIGINAL RESEARCH & CONTRIBUTIONS

Designed for Workarounds: A Qualitative Study of the Causes of Operational Failures in Hospitals

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Abstract

Frontline care clinicians and staff in hospitals spend at least 10% of their time working around operational failures: situations in which information, supplies, or equipment needed for patient care are insufficient. However, little is known about underlying causes of operational failures and what hospitals can do to reduce their occurrence. To address this gap, we examined the internal supply chains at 2 hospitals with the aim of discovering organizational factors that contribute to operational failures. We conducted in-depth qualitative research, including observations and interviews of more than 80 individuals from 4 nursing units and the ancillary support departments that provide equipment and supplies needed for patient care. We found that a lack of interconnectedness among interdependent departments' routines was a major source of operational failures. The low levels of interconnectedness occurred because of how the internal supply chains were designed and managed rather than because of employee error or a shortfall in training. Thus, we propose that the time that hospital staff members spend on workarounds can be reduced through deliberate efforts to increase interconnectedness among hospitals' internal supply departments. Four dimensions of interconnectedness include: 1) hospital-level—rather than department-level—performance measures; 2) internal supply department routines that respond to specific patients' needs rather than to predetermined stocking routines; 3) knowledge that is necessary for efficient handoffs of materials that is translated across departmental boundaries; and 4) cross-departmental collaboration mechanisms that enable improvement in the flow of materials across departmental boundaries.

Introduction

In hospitals, operational failures—missing information, supplies, or equipment necessary to complete one's work tasks—can erode staff efficiency[1-5] and contribute to staff burnout[1] and medical errors.[6,7] Despite the seriousness of their impact, the most common response to operational failures is to work around them without expending additional effort to prevent recurrence.[8,9] In fact, studies have found that workarounds to operational failures consume around 10% of nurses' time[4,5]—a significant amount given that nurses account for one-fourth of hospitals' budgets.[10] However, less is known about the causes of operational failures in hospitals. This article reports on a study that examined 2 hospitals' internal supply chains to discover organizational factors that contribute to operational failures. This is an important contribution because understanding the causes of operational failures can aid development of effective solutions to reduce occurrence.

We define an internal supply chain as a set of interdependent departments that provide patient-facing employees with the stream of resources (supplies, information, and equipment—which we will refer to as "materials") that they need to provide service.[2,7,11-13] Materials flow through multiple departments as they make their way from the start of the process to the patient. For example, equipment needed for patient care flows through multiple departments as it is unloaded from delivery trucks, moved to storage, delivered to the nursing unit, used on the unit, and then cleaned after use and returned to service.[14]

To provide a specific example of an internal supply chain in hospitals, let us consider the internal supply chain for medication administration.[7] A physician uses the computerized physician order entry system to order a medication for a patient. This system relays the order to the pharmacy, where a pharmacist verifies the order and dispenses the medication. The medication can be delivered to the nursing unit by a pharmacy technician or a pneumatic tube system. The technician places the medication in one of several locations: a refrigerator, a drawer designated for the patient, or an automated dispensing device. Engineering is responsible for maintaining the refrigerator and the pneumatic tube system. Information technology (IT) is responsible for the computers and the IT systems used to order and to dispense medications. A nurse administers the medication to the patient, often using supplies, such as a syringe, that are stocked on the unit by the central supply department. They also may need food (eg, applesauce), which is stocked by dietary services. Finally, the medication could be administered with a piece of equipment, such as a pump, that is maintained by the biomedical equipment department and cleaned by the sterile processing department. Thus, the internal supply chain for medications consists of nine departments: medical staff, pharmacy, nursing, engineering, central supplies, dietary, IT, biomedical equipment, and sterile processing.

Prior studies[15,16] have found that explicit efforts to map the flow of materials in hospitals can identify opportunities for improvement. Work design principles, such as lean manufacturing's emphasis on standardizing processes, can be used to improve reliability of internal supply

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chains.[17-19] We build on these studies by explicitly examining underlying causes of operational failures in hospitals' internal supply chains.

Methods

The study looked at operational failures related to hospital room turnover, or the rate of getting a recently vacated hospital room ready for the next patient. Reducing room turnover time is important for hospitals because it can increase bed utilization, which lowers the hospital's cost structure.[20] It also enables incoming patients to begin treatment sooner, which improves patient care and reduces length of stay.[20,21] We consider a room to be ready when it has been properly cleaned; it has the appropriate bed, equipment, and supplies needed by the patient; and the nurse is mentally ready to provide care.

Our study was conducted with medical/surgical units at 2 hospitals that were part of an integrated health care organization with 36 hospitals. These 2 hospitals were selected because they are typical hospitals for the organization and were supported by grant funding for this study. We used a human-centered design, which is used in the design process to identify unmet needs and to connect more deeply with the participants.[22] The human-centered design process is conducted in 4 phases: research, synthesis, ideation, and implementation.[23] Research, which is a data- and inspiration-gathering phase, consists of observing and talking with people while they work in their natural environments, with an emphasis on gaining empathy to better understand the delights and frustration that staff members experience in their current work.[24] During synthesis, researchers make sense of the data collected during the previous phase through a process of distilling and connecting the gathered information.[23] Relevant themes and topics are identified as patterns emerge from the data. Frameworks are also created to help communicate key insights and opportunity areas.[23] Ideation involves creating and testing ideas through prototypes to arrive at solutions.[22] Finally, during the implementation phase, an idea is put into practice.[25] This article discusses the framework that resulted from the first 2 phases.

The research and synthesis phases lasted from October 17 through December 14, 2011. Observations and interviews were conducted with the medical/surgical units and departments that provided the units with the materials, medications, equipment, food, and general support services needed for their patients. The departments were informed ahead of time and agreed to participate. To gain a diverse perspective and wide range of insights on the topic, we observed and interviewed people in a variety of roles, including nurses, nurses' aides, assistant nurse managers, charge nurses, unit assistants, pharmacists, pharmacy technicians, engineers, central supply technicians, biomedical engineers, and dietary and IT staff.

Table 1. Details from research phase: observations and interviews

Role	Number observed and interviewed	Total hours of observations and interviews	Person or activity observed
Physician	2	2	Physician
Pharmacy	3	3	Technician, pharmacist
Nursing	47	61.4	Nurse, patient care technician, nurse manager, charge nurse
Engineering	1	2	Responding to calls
Central supplies	1	2	Delivery
Dietary	1	2	Preparation and delivery
Sterile processing	2	2	Technician
Biomedical equipment	2	2.5	Technician (repair)
Environmental services	8	6.25	Cleaners
Information technology	1	0.5	Information technology specialist

We spent approximately 79 hours with 89 different people, of which 22 hours were spent observing support departments. Observations consisted of shadowing participants while they did their jobs, along with having open-ended conversations to understand why they were thinking, feeling, and behaving in certain ways. Each observation lasted about 2 hours, and we conducted 2 sets of observations per day for 4 days at each hospital.

We conducted the observations in conjunction with 22 other people, including support department managers and frontline employees from the 2 hospitals, nurse managers from the nursing units on which we observed, and staff nurses. People observed at a hospital different from the one in which they worked. A large team enabled us to simultaneously be in multiple departments in the same internal supply chain and observe the interdependence between people and departments following standardized instructions. For example, we traced a medication administration problem and the repair process for nonfunctioning vital sign monitors. We used data sheets to collect information about the background of the person being observed, the most common reasons for being taken away from their normal duties, and, for nurses, what supported their remaining at the bedside. In addition, we recorded operational failures; their causes, if known; what actions were taken in response; and the amount of time spent on the failure. We also took photographs to help capture key aspects of each experience.

In addition to the observations, we interviewed managers and staff from all departments in the internal supply chain. We conducted interviews either individually or in dyads, which allowed for more in-depth conversations. We asked about the process of getting a room ready for a new patient, what they considered necessary for a room to be "ready" for patient care, challenges they faced, how departments coordinated their work, how work requests were transmitted across boundaries, and how they felt throughout the process. Table 1 provides details on the number of people who participated in observations and interviews and their departments.

After each observation block, the team members gathered to share stories from their observations. "Storytelling" is a way to transfer information about what a person saw and heard during his/her observations so that it becomes shared knowledge that the entire team can use to envision solutions.[23-25] Following the IDEO Human-Centered Design Toolkit (IDEO: HCD Connect, Palo Alto, CA, 2011),[23] storytelling began with gathering relevant photographs, artifacts, and/or notes collected during the observation to share with the group. The observer then stated who was observed and what her/his role was. The observer then told specific stories that s/he had directly observed. The group succinctly wrote key quotes, thoughts, and observations on sticky notes to document the findings. These debrief discussions were recorded and transcribed using pseudonyms.

The second phase of the process was synthesis. We first coded the transcripts by highlighting sentences that described a problem with the internal supply chains. To establish interrater reliability, we each coded the same transcript and compared which sentences in the transcript we individually highlighted as being important. Our interrater reliability was 0.72, which indicated substantial agreement.[26] Furthermore, we discussed differences until we reached an agreement on what types of issues should be highlighted. This training and high interrater reliability provided confidence that we could divide the transcripts among us to pull out key information for synthesis. We transcribed the main idea from each selected sentence onto a single sticky note, resulting in over 680 notes. This process created a data set of internal supply chain breakdowns, key quotes, and stories that highlighted functioning and problematic chains.

The second step of synthesis was to organize the sticky notes into buckets or themes, using an iterative, grounded theory approach.[27,28] We initially grouped the sticky notes into 13 categories that emerged from coding the transcripts. We then dropped categories that were not useful, recombined the notes to collapse buckets into higher-level themes, and allowed new categories to emerge. We organized the categories to depict relationships between them. The goal of this stage was to create a set of insights and a framework, presented in this article, that summarized key findings and opportunity areas for innovation.

Results

We spent a total of 54.2 hours observing nursing units, during which time we directly witnessed 120 operational failures that interfered with nursing work. Thus, on average, a nurse experienced one operational failure every 37 minutes. For 72.5% of the operational failures (n = 87) we had data on the amount of time spent working around the failure. Table 2 categorizes these 87 operational failures by the department in which they originated. Nursing unit-related failures consumed the most time (24%), followed by pharmacy-related failures (22%) and those related to IT (20%).

To better understand why the nursing unit was the largest source of operational failures, we interviewed 10 nurses about what items they needed when a new patient arrived on the unit and which department was responsible for these items. All of the nurses mentioned 12 items. All but 3 were purchased by the nursing unit and thus were under their budgetary responsibility. However, the responsibility for supplying, cleaning, and maintaining the items fell to other departments. Furthermore, there were no designated storage locations for 5 of the items, nor were there standard stocking levels (periodic automatic replenishment levels) for any of them, making it challenging to know whether the quantities kept on the units and the frequency of cleaning were sufficient. We audited the equipment on one of the units and found that all items had smaller quantities than what nurses felt was required for a unit that was full

Table 2. Summary of the operational failures (n = 87) that had estimates of time spent working around them, categorized by department (54.2 hours observation of 31 nurse observation blocks)

Department	No. of operational failures with time estimates	Total minutes	Minutes per operational failure, mean	Minutes per operational failure, standard deviation	Total minutes on operational failure, %	Cumulative percentage of total minutes	Cumulative percentage of departments
Nursing unit[a]	14.0	106.0	7.6	8.8	24.0	24	10
Pharmacy	15.0	97.5	6.5	6.4	22.0	46	20
Information technology	12.0	88.7	7.4	11.0	20.0	66	30
Other[b]	12.0	48.0	4.0	2.4	11.0	77	40
Environmental services	4.0	8.0	2.0	0.8	1.8	79	50
Biomedical equipment	8.0	24.5	3.1	1.3	5.6	85	60
Engineering	9.0	20.9	2.3	2.7	4.7	90	70
Central supply	4.0	29.0	7.3	8.7	6.6	96	80
Dietary	3.0	12.0	4.0	3.6	2.7	99	90
Space on unit	6.0	5.1	0.9	0.7	1.2	100	100
Average			4.5				
Total	87.0	439.6					

[a] Nursing unit = equipment that is responsibility of nursing unit (chairs, room furniture, intravenous poles).
[b] Other = documentation, discharge/admission process, interruption from people.

with patients. We suspect that the high frequency of failures stemming from the nursing unit resulted from the ambiguity about whether supplies of necessary equipment were sufficient, and if not, which department was responsible for addressing the shortfall. Table 3 lists the patient care items, the responsible units, and the quantities required versus available.

Nurses compensated for the lack of available equipment with workarounds. Seven of the nurses whom we interviewed stated that equipment needed to do their jobs was often unavailable and that it was accepted practice to "go shopping" in the dirty utility room, in other patients' rooms, or on other units. For example, one nurse said, "If you can't find it, you go get it, no matter where it is." Similarly, in response to the shortage of functional items, we observed nurses violating policy by personally claiming shared equipment for their entire shift by putting notes (eg, "Mary's computer") or personal items on computers and vital sign monitoring devices so that other people would feel social pressure to not use these items. We also observed nurses intentionally making functional equipment appear broken. For example, one nurse changed the way text was displayed on a computer screen (rotated by 90 degrees) so that others would find it cumbersome to use and would leave it alone. These compensatory behaviors exacerbated the shortage of functional equipment. Other studies of caregivers in hospitals also document similar behaviors in response to unreliable internal supply chains.[7,29,30]

When reflecting on operational failures, people attributed poor performance to shortcomings of other departments rather than to a suboptimal system design. They also failed to recognize that their own department's routines could be contributing to poor internal supply chain performance. For example, a pharmacy technician blamed the nurse "Jones" who called for a missing medication because Jones didn't know the pharmacy's algorithm for where medications were placed on the unit. The pharmacy technician stated, "The medication could be on a shelf, in a bin, or in the refrigerator. Nurses don't know where things go." Similarly, a sterile processing worker attributed poor performance to a general lack of training in the organization.

No one in the support departments expressed the belief that their department's routines could be changed in a way that would improve overall internal supply chain performance. We spoke with employees from many departments, such as pharmacy, biomedical, sterile processing, environmental services, engineering, and dietary, and everyone expressed satisfaction with their own department's work. Our observations confirmed their assessment. Employees mastered a complex array of technical procedures, worked hard, and completed their assignments according to standard procedure.

Four Actions to Increase Interconnectedness

We propose that the high frequency of operational failures stemmed from a lack of interconnectedness between the supply departments and the nursing units. We define interconnectedness in hospitals as the degree to which departments' routines and performance metrics have been designed to efficiently meet the needs of patients by enabling entities (eg, patients), resources (eg, supplies and equipment), and knowledge (eg, relevant critical patient information) to flow smoothly and swiftly across interdependent departments. Our definition emphasizes the importance of designing department routines to meet patients' needs, rather than to achieve outcomes that are beneficial to the department but may not align with patients' needs. Second, our conceptualization of interconnectedness highlights the importance of smooth, efficient flow of materials through the organization.[31]

We assert that the goal of interconnectedness is to minimize the time required for patients to receive treatment, while balancing metrics of cost,

Table 3. Nurses' responses to questions about equipment and supplies needed to ensure the readiness of patient rooms, n = 10

Response number	Equipment	Purchased by	Repaired or supplied by	Designated location	Quantity needed on unit	Actual quantity stored on unit	Periodic automatic replenishment level
1	Suction canister	Unit	Biomedical	Mid-unit drawers	30	22	None
2	Oxygen flow meter	Unit	Biomedical	Mid-unit drawers	25	15	None
3	Intravenous pole	Unit	Engineering, Environmental services	None	22	19	None
4	Intravenous pump	Unit	Biomedical	None	20	19	None
5	Weigh bed	Hospital/unit	Engineering	None	20	5	None
6	Computer on wheels	Unit	Information technology	None	14	11	None
7	Slip sheet	Unit	Central supply	Mid-unit drawers	22	15	None
8	Pillows	Unit	Environmental services	In room	50+	43	None
9	Clean linens, gown and patient bath kit	Central supply	Environmental services	Linen cart	Unknown	Unknown	Unknown
10	Vital sign machine	Unit	Sterile processing	None	8	4	None
	Thermometer	Unit	Biomedical	Unit office			
	Pulse oximetter	Sterile processing	Biomedical	Cupboard			
	Blood pressure cuff	Unit	Unit	Supply wall			

clinical quality, and patient experience.[21] This goal is appropriate for the hospital system that we studied because it seeks to minimize the time that its patients spend in its hospitals without reducing quality of care. Our study highlighted the importance of four dimensions of interconnectedness: hospital-level metrics, designing processes for the efficient flow of materials and equipment from the beginning of the supply chain to the patient's bedside, knowledge translation across departments to facilitate smooth flow of resources, and mechanisms for cross-departmental efforts to monitor and improve internal supply chain performance. We describe each dimension and develop a proposition to be tested in future research.

Hospital-Level Metrics

Metrics to assess the collective performance of an internal supply chain would facilitate interconnectedness among the departments in the chain. However, we found few such measures in the 2 hospitals we studied. Instead, departments measured their own productivity, such as the number of medications delivered by the pharmacy, the time taken to clean a vacated room, or conformance to a department's labor budget. The delivery time along the entire chain, such as the elapsed time from when a physician ordered the medication until it was administered to the patient, was not tracked. A notable exception was the measurement for the percentage of Emergency Department patients admitted to the hospital who were in their inpatient bed in less than 60 minutes from when the inpatient bed request was made. In general, however, there was limited visibility into internal supply chains' performance. As a result, upstream departments were unaware of ineffective handoffs of materials to downstream departments.

Furthermore, there were few shared rewards for good internal supply chain performance. Research suggests that shared rewards are an important facilitator of improvement in external supply chains.[32] Similarly, we believe that the lack of shared rewards was an impediment to improving internal supply chain performance at the two hospitals. The interdependent, sequential nature of internal supply chains means upstream departments can change their processes to benefit downstream departments' performance but may not receive any benefit from the change themselves.[33] Thus, without shared rewards, departments may be unwilling to make changes that benefit other parts of the organization. For example, a nurse manager responsible for two units commented that the central supply department stocked the same materials in different locations on the two units. This made it difficult for her nurses, who worked on both units, to locate materials. However, the nurse manager was unable to convince the central supply manager to invest staff time in standardizing stocking locations. She commented, "Budget is the big divide."

Design Supply Process to Meet Current Patients' Needs

Processes were designed to optimize departmental performance rather than internal supply chain performance. The underlying assumptions seemed to be that a series of well-functioning departments would make a well-functioning hospital and that the departments' routines were sufficiently connected to meet patients' needs. However, we observed that although an individual supply department could perform its tasks efficiently, its work routines did not make the chain efficient unless they were directly linked to current patients' needs. For example, departments such as central supply, sterile processing, and biomedical engineering restocked what was used by previous patients, but those supplies and equipment did not always match the needs of current patients. We believe the lack of proactive supply was because these departments did not have the clinical information or training to understand what supplies today's patients needed. This made it difficult for nurses to locate necessary equipment, which may not have been available on the unit. Furthermore, some support departments purposely insulated their work from nursing units so that they wouldn't be interrupted. Although reducing interruptions could be helpful to the support department's efficiency, we found that it limited internal supply chain responsiveness. An IT staff person commented, "It's bad if nurses know our names, because then they bypass the national help number." Nurses reported spending up to 20 minutes on hold for IT help when they called the national helpline. Being away from patients this long was not feasible for nurses, so nurses did not call about IT-related problems and instead relied on workarounds. We also observed a lack of a clear description of the step-by-step process flow of equipment for which many departments had shared responsibility. As a result, nonfunctioning equipment could remain on the unit for weeks with no department taking the initiative to repair it because each department assumed it was someone else's responsibility.

… medications can be stored in eight different locations depending on a complex algorithm …

Knowledge Translation

The third action we considered was knowledge translation across department boundaries.[34] Work routines in one department were not always known by the downstream department, making resource handoffs between departments less efficient than they could have been.[35] Consider our observations of the internal supply chain for medications. We observed a nurse spending ten minutes unsuccessfully searching for two bags of intravenous fluid for a patient. She searched in five places for the missing bags before calling the pharmacy for assistance. She was told that the bags had been delivered to the unit, but by the time we left two hours later, she still had not located them. The next day we spoke with the pharmacy technician about the incident and learned that the bags, because of the concentration of an added medication, had been in the unit's refrigerator the entire time. This was the one place the nurse had not looked. The pharmacy technician explained that medications can be stored in eight different locations depending on a complex algorithm, such as whether the medication is topical or compounded, and if compounded, what the added medication is and its concentration. A technician's action of delivering medications to the nursing units reveals his or her knowledge of the underlying rules that determine where the bags belong.[35] Because the storage location information was of primary importance to the technician's thought world[36] and because the medication details were visible to nurses in the patient's electronic medical record, the technician did not think that the phone call about the missing medications was because the nurse did not *know* where to look, but rather that she hadn't taken the time to look in the location to see if the bags were there. As a result of this assumption, the technician did not inform the nurse of the storage location but just told her that it had been delivered.

This story illustrates how communities of practice unknowingly fail to translate pertinent knowledge because they do not know what others do not know.[37, 38] In our example, the pharmacy knew where the medication was located but didn't realize that the nurse did not know where it was. Prior research has found that it is especially difficult to transfer knowledge when one community of practice—such as pharmacy—uses that knowledge so extensively that they are unaware that someone (eg, a nurse) might not possess that same knowledge. Thus, it does not even occur to them that the problem could have been caused by someone not knowing a fact that they consider common knowledge.

Forum for Improvement

Fourth, mechanisms are needed to foster cross-departmental efforts to monitor and improve internal supply chain performance. In the hospitals we observed, communication about internal supply chain breakdowns, such as the missing intravenous medication bags described above, did not trigger improvement efforts. We propose this is partly because the inconvenience caused by the breakdown is not experienced by the department with the largest ability to remove underlying causes. There was also no structure for internal supply chain members to discuss issues and work together to improve performance. The dimensions of interconnectedness are summarized in Table 4.

Figure 1 depicts the lack of interconnectedness in hospitals' internal supply chains. The flow of information about a patient's equipment needs starts with the physician's orders and passes through the nursing unit to the support department that provides equipment. This flow of information has time lags and goes in the opposite direction from the flow of equipment, which starts with the support department and ends with the patient.

Let us first consider the knowledge about the patient's equipment needs. Equipment needs are implicit in physician's orders. However, determining the equipment implications of a physician's order requires both medical and tactical knowledge to translate the medical order into a list of equipment needed to implement that order. The physician has the most knowledge about the patient's orders and therefore could be the first step in the process to distill the equipment implications of the orders. However, physicians are not responsible for executing medical orders or for supplying equipment to the unit, and therefore they do not know the equipment implications of their patients' orders. As a result, the equipment needs embedded in an order set are not translated to the support department responsible for

Table 4. Dimensions of interconnectedness in internal supply chains

Aspects	Lack of interconnectedness	Quote	Interconnectedness
Metrics	No measures of internal supply chain performance	I've seen people be up to help within an hour. But I've also seen broken computers rack up until there's six out in the lobby. So I don't know anything about what they really do. Nick, RN	Measures of hospital-level performance
	Lack of shared rewards	[Explaining why he did not fully repair a nonfunctional vital signs machine] My department would get charged for it [the attachment]. Biomedical engineer	Shared reward for achieving good performance at the hospital level
Process design	Work not linked to patients' needs	It's bad if nurses know our names because then they bypass the national help number. IT engineer	Processes maximize hospital-level performance
	Lack of clear ownership	I don't have time to look for stuff. I let someone else do that. If it's not behind the yellow line, I don't go looking. Anna, environmental services technician The environmental services technician should make sure everything is in the room. Crystal, Unit assistant	Clear ownership of process step
Knowledge translation	Knowledge not translated across boundaries	If you could get to see the orders before your patient gets here, that would be really good. Then we could prepare better. Now we are not able to prepare until they actually physically get here. Phoebe, RN	Knowledge translated across boundaries
Improvement capacity	Communication doesn't trigger improvement efforts	Every patient needs an IV pump, so why there isn't always one at every bedside in every room is beyond me. We ask for this often. Phoebe, RN	Materiality of problems that surface in downstream departments
	No mechanisms for cross-departmental improvement	Positive example: The daily "bedhub" meeting between the nursing unit managers and the bed coordinators orchestrated the flow of patients from surgery and the ED to inpatient units.	Mechanisms for making cross-departmental change

ED = Emergency Department; IT = information technology; IV = intravenous; RN = registered nurse.

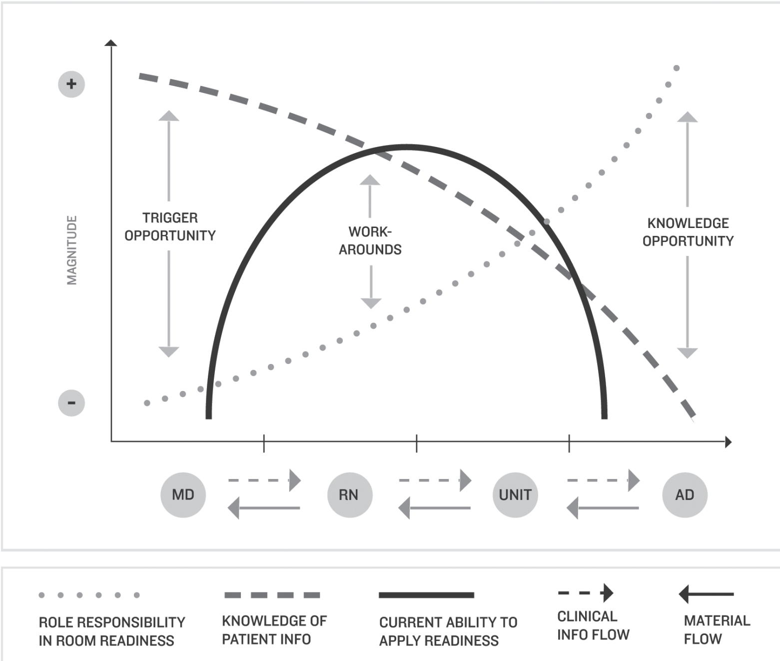

Figure 1. Diagram of disconnect in internal supply chain flow of materials and information. The level of knowledge about a patient's need for equipment (or medications or materials) is shown with the dashed line. The degree of responsibility for supplying equipment to the unit is represented by the dotted line.

AD = ancillary support department; INFO = information; MD = physician; RN = nurse; Unit = nursing unit.

providing the equipment. We call this a "trigger opportunity" because information embedded in the physician order doesn't trigger delivery of the equipment required to implement the care.

Next we consider the responsibility for supplying equipment to the unit. The support department faces a "knowledge opportunity" because it has the most responsibility for providing equipment to the unit but has the least knowledge about what patients need. The support department doesn't have access to the information or the clinical knowledge to translate a physician order into a list of required equipment. As a result, the support department's work routines typically are restocking what previous patients have used rather than anticipating and responding to current patients' needs.

Only nurses have both the medical knowledge to translate the order into equipment needs for their patients and the responsibility for implementing the physician's plan of care. Consequently, nurses compensate for the support department's inability to translate the physician's orders by searching in real time for the necessary equipment to execute an order. This action consists primarily of workarounds where the nurse gathers equipment that was supposed to be provided by support departments.

Discussion

This study examined the causes of operational failures in the medical/surgical units at 2 hospitals. We found that failures stemmed from a lack of interconnected internal supply chains to meet the needs of the current patients. Nurses spent 14% of their time working around failures that arose when equipment and material readiness stalled between departments. This magnitude of wasted time is similar to the findings of other studies.[4,5] Tucker's observational study[5] found that nurses spent 10% of their day working around operational failures, whereas Hendrich and colleagues' work sampling project[4] found that 6.6% of nurses' time was spent on activities classified as "waste," such as looking for supplies, delivering items, or waiting.

We propose that the internal supply chains had low levels of interconnectedness because of how they were designed and managed rather than because of employee error or a shortfall in training. Departments emphasized their own performance, and thus processes were designed to maximize departmental efficiency rather than timeliness of service delivery to patients. Knowledge was not translated across department boundaries, resulting in dropped handoffs of resources between departments. Finally, the managers of the departments in an internal supply chain did not routinely meet to discuss ways to improve chain performance. We assert that mechanisms can be developed to support cross-departmental efforts to monitor and improve internal supply chain performance. Examples would be to create internal supply chain-level measures of performance[39] and to collaboratively design work routines that efficiently move supplies across department boundaries to reach the patient. Although the specific operational failures we observed were likely unique to the two hospitals, the overall finding of a lack of interconnectedness among internal supply departments is a general problem in hospitals.

Our study offers lessons for hospital managers. Workarounds occurred at the interface between supply departments that used predetermined, supply-to-stock routines[8] and nursing units that provided supply-to-order, customized patient care. To avoid workarounds or the need to keep large stocks of materials on the units, caregivers should be able to request and receive patient-specific supplies in a timely fashion. This could be accomplished with technology, such as the use of radio-frequency identification devices for signaling when materials need to be restocked[40] or through dedicated support personnel responsible for frequent restocking on the unit. Although this may seem expensive, it can increase organizational efficiency by avoiding stock outs and reduce compensatory behaviors such as the hoarding of supplies. We believe that the ever-increasing breadth and price of supplies in combination with limited storage space and funds available to nursing units make frequent restocking a more feasible long-term solution than increasing the quantities of supplies stocked on units.

In addition, managers need to create an organizational focus on internal supply chain design and performance. Employees are unlikely to recognize systemic causes of workarounds because they often blame poor performance on the shortcomings of others rather than on poor work-system design.[21] Similarly, uninformed managers might not recognize the need for a hospital-level focus because their hard-working employees are executing required tasks successfully and meeting departmental goals. Unfortunately, such false feedback mechanisms can mask poor hospital-level performance.

Our research suggests that nurses and physicians both possess information that could help improve the performance of internal supply chains. First, up to a quarter of operational failures could be avoided by empowering nursing units to work collaboratively with supply departments to determine optimal stocking quantities of materials and supplies on the units, along with designated storage locations. There would also need to be a system for easily requesting and receiving replenishment when stocks run low, such as the Kanban card system used in manufacturing settings.[16] Second, nurses could codify the equipment and supplies used for high-frequency medication orders and surgical procedures of their units' patients. This may reveal opportunities to work with physicians to streamline equipment or supply needs if equivalent treatment options have differing equipment needs. Building on this database that translates medical orders and patient conditions into equipment needs, a further improvement opportunity could be using historical patient records to forecast seasonal supply needs. This could help supply departments to tailor their work to ensure they can meet predicted patient needs. Finally, it may also be possible to use IT to translate in real time to the supply departments, such as sterile processing and biomedical engineering, the equipment needs of current patients on the basis of their medication orders or surgical procedures.

Future research could expand on this study by determining the costs of operational failures and their impact on patient satisfaction. Such research could help justify investments in improving internal supply chain performance through methods such as those suggested above.

Conclusions

Internal supply chains are important drivers of efficiency, job satisfaction, and quality but are understudied in hospitals. By better leveraging the competencies of the different communities of practices responsible for delivering patient care, hospitals can reduce waste, freeing up staff time to provide care. Achieving this goal will require an explicit emphasis on connecting the routines of the different departments within hospitals. ❖

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The Scientific Method

The fact that disease is only in part accurately known does not invalidate the scientific method in practice. In the twilight region probabilities are substituted for certainties. There the physician may indeed only surmise, but, most important of all, he knows that he surmises … Investigation and practice are thus one in spirit, method, and object.

— Abraham Flexner, 1866-1959, American educator and publisher and creator of the Flexner Report