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ORIGINAL ARTICLE

Regularly irregular: how groups reconcile cross-cutting agendas and demand in healthcare

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Abstract The flow of technical work in acute healthcare varies unpredictably, in patterns that occur regularly enough that they can be managed. Acute care organizations develop ways to hedge resources so that they are available if they are needed. This pragmatic approach to the distribution of work among and across groups shows how rules can be used to manage a response to irregular demands for care. However, no rule set can be complete enough to cover this setting's variety of care demands. Expertise is also needed to tie together the loose ends of conflicts that remain where rules no longer suffice. Many informal solutions to systemic problems go unnoticed unless they are the subjects of study. Naturalistic decision making (NDM) methods such as observational study, interviews, and process tracing reveal the activities of workers in their natural settings. Results of findings from such explorations of technical work can improve understanding of large scale work processes and, ultimately, patient safety. We have explored how practitioners cope with the demands that the system presents to them. While not all succeed, successful initiatives workers have developed demonstrate how their solutions create resilience at large scale.

Keywords Cognition · Cognitive systems engineering · Resilience · Technical work · Healthcare

1 Introduction

Acute healthcare work is performed by highly constrained teams of clinicians who are organized into specialized departments that collaborate around the clock. Their work flow is driven primarily by the demand for patient care, which varies in predictably unpredictable patterns. Which patient arrives for treatment, when the patient arrives, how the patient presents, and how treatment evolves all vary considerably. However, the number and kind of cases is anticipated from previous experience.

The staff, facility, and equipment resources that are needed to meet the demand for care are necessarily limited. Acute care organizations develop techniques in order to reconcile demand for care and resources to provide care. Methods are used to control how resources are distributed so that they are available if and when they are needed. This pragmatic approach to the distribution of resources shows how formal organizational rules can be developed and used to manage a response to uncertain demands for care. However, no rule set can be complete or precise enough to cover the wide variety of care demands in this setting. When these formal rules no longer suffice, human workers

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must grasp and tie together the loose ends of conflicts that remain unresolved.

This paper describes how rules and expertise have been developed to coordinate work at large scale, between and among groups, in an acute care setting. It shows how clinicians have created a consensus approach to managing their complex work domain without managerial intervention. Some approaches such as the duty call schedules are fairly formal, which others such as between-shift sign-outs are less so. Some are very successful, while others are less so. The varied results of these rules provide insights into the ways that clinicians manage the complexity of their work domain. It also sheds light onto the ways that operators create a resilient, feasible work setting at large scale.

2 Background

Hospitals are designed to provide services for those whose need are most serious, or acute. Acute care facilities are typically organized by specialty practice in order to provide the highest quality care in the most cost-effective manner. Division into care units requires synchronization of staff, materials and equipment in time and location (Bardram 2000) that makes acute care large in scale. Patient care is routinely conducted among care organizations such as primary care clinic, physicians offices, long term care facilities, or other hospitals that may refer a patient for treatment. Specialized care units such as the intensive care unit (ICU) have clinicians with unique qualifications, as well as equipment, to treat the most seriously ill patient groups. Patients are routinely transferred among units to receive care that is appropriate to their needs and course of diagnosis or treatment. For example, a surgical patient may be moved from a bed in a patient ward to Pre-Operative Holding, to an operating room, to the Post-Anesthesia Care Unit, and back to the patient ward. Even when a patient is in one room such as the OR, multiple specialties, equipment, and supplies are synchronized in order to provide the exact surgical care the patient needs. Both examples are large scale coordination in action in healthcare.

Technical work (Barley and Orr 1997) in healthcare includes the daily planning and management activities that are intimately related to medical care and exert real influence on decisions regarding who provides care and who receives it. Medical care is the diagnostic and therapeutic activity that clinicians provide in order to improve an individual's health. Medical care plays out patient-by-patient. Technical work is the unit-level planning and management that is necessary to balance resources with demand for care. The domain of cognitive systems incorporates individuals, groups, cognitive artifacts and information systems that interactively collect, share, and use information to provide care across time and varying locations. Figure 1 uses the question of whether a patient will receive a diagnostic test to demonstrate the relationship between technical work and medical care. Whether a patient undergoes a particular test depends on a number of considerations beyond its clinical features. Will staff, equipment and facility resources be available? How long is the queue to receive the test? Are other suitable tests available? Each of the interactions matters, because each has clinical consequences.

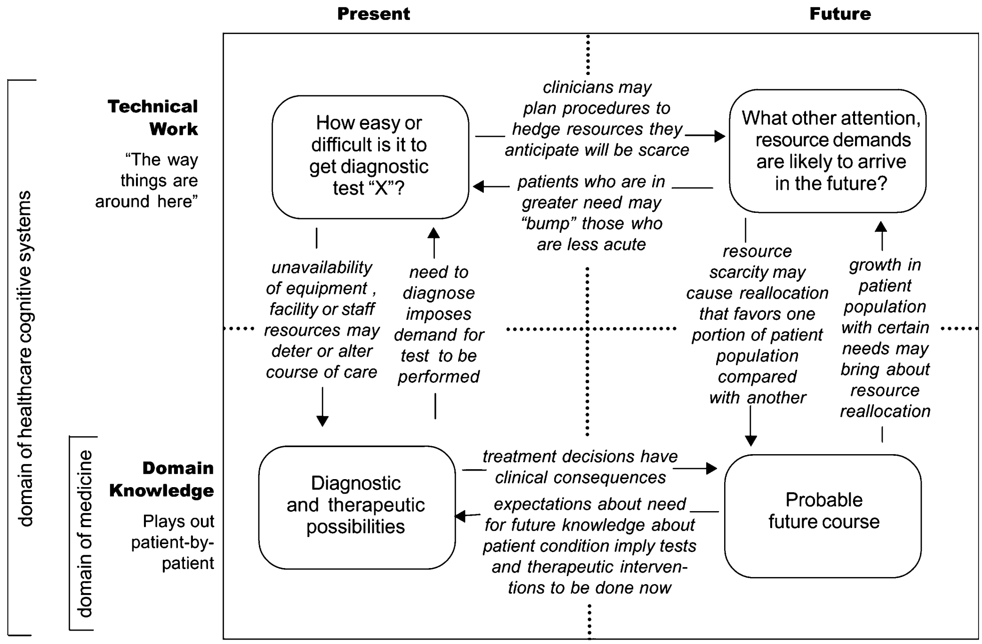
The needs of clinical care shape technical work, just as technical work shapes clinical care. The cyclical uses of clinical resources influence the clinicians' expectations about resource use and allocation. Healthcare practitioners and those who coordinate their work tend to anticipate future possibilities at part of their clinical judgment. Their view of future prospects for available resources and of the uncertainty that attends projections of the future influence how they act in the present. Clinicians appreciate these interactions and use them to make decisions about their daily work. Through each work period (shift) over time, clinicians observe needs and develop procedures to deal with them. For example, a service such as Pediatrics needs to ensure that a clinician is available who is qualified to provide anesthesia for children. Or, the clinical staff need to fairly assign one or more individuals to stay overnight at the hospital. The collective wisdom about how to do this has been embodied in procedures that are intended to guide interactions among clinicians and among departments. This is large scale coordination at work in healthcare.

3 Methods

Research for the three examples in this paper was conducted at a major urban teaching hospital in the US, using an ethnographic approach to field studies (Patton 2002) and cognitive systems engineering (Woods and Roth 1998).

The study of hand-offs employed three methods: direct observation in a pediatric intensive care unit (PICU), process tracing (Woods 1993) and conversation analysis (Drew and Heritage 1992). During regular operations we observed and recorded twelve unit-level exchanges as pediatric fellows handed off a 13-bed PICU and 20-bed step-down unit (SDU). On the same day, the researcher (MB) also completed a unit floor

Fig. 1 Technical work and medical care are contingent on each other



plan diagram to identify patient location, condition, and level of demand for care. Review of all recordings in the context of the floor plans made it possible to extract common traits among the hand-offs and discover deeper insights. Another member of the research group (JK) observed hand-offs to become familiar with their nature and the PICU context, viewed videotapes of the process tracing sessions, then performed conversation analysis on eight of the 12 exchanges using Computerized Language Analysis (CLAN) software.

Study of the call schedule and patient transfers employed direct observation and informal interviews with clinicians.

4 Three examples of large-scale coordination

Three examples demonstrate how acute care practitioners have developed rules to deal with predictably unpredictable circumstances: between-shift hand-off conversations, the call schedule, and transfers of patients between units.

4.1 Hand-offs

Transitions between shifts, which typically occur twice a day, create potential gaps in the continuity of care (Cook et al. 2000). Practitioners necessarily rely on distributed cognition (Hutchins 1995) to prevent the formation of gaps during transfers between departments or during work-cycle shift changes. Clinicians transfer responsibility for the patients in a unit using what is referred to as a hand-off, or sign out. Clinicians use hand-offs to coordinate clinical work, authority, and responsibility while managing transitions between shifts. In addition to verbal exchanges, clinicians occasionally use conversational props such as medical charts and lab reports (Matthews et al. 2002, p. 1513). The complexity of medical interventions, as well as complexity, uncertainty, and rapid changes in patient condition, make effective sign outs both essential and difficult. Coordination is large in this instance, because it includes AM and PM shifts; attending physicians, consulting physicians, fellows, and nurses. It also includes various departments that have a relationship to a unit, as well as various facilities outside of the hospital that provide or receive patients.

Patient care in the ICU varies across a predictable number of features, including patient population, level of acuity, arrivals and departures, and needs for medication and therapeutic interventions. The composition of demand for patient care varies within individual patients, as well as among a number of similar (e.g., cardiac) patients, and across a units (e.g., Pediatric Intensive Care Unit). While clinicians employ a variety of different communication patterns to manage transfers, Matthews et al. (2002) could find no controlled process to handover patients. Patterson et al. (2005) described ‘‘large variability’’ in hand-off strategies across wards, and Kerr (2002) noted ‘‘flexibility in managing competing demands and tensions.’’ is a trait of effective handovers.

Brandwijk et al. (2003) studied between-shift hand-offs among Pediatric Intensive Care Unit (PICU) fellows over 8 days, then transcribed, analyzed them and found that practitioner communication styles vary depending on a number of criteria, including what is going on in the unit. The language that PICU practitioners use to conduct these exchanges reflects H. P. Grice's (1975) Cooperative Principle by maintaining the closest possible relationship between the subject that they discuss and the way that they discuss it. This is because acute health care is too big to be easily portrayed, too complicated to be simplified, changes too rapidly to be fixed, and is too uncertain to convey mere facts. Kowalsky (2004) and Kowalsky et al. (2004) reported that clinicians have developed versatile strategies for hand-offs that can be adapted to fit work setting constraints such as time limitations.

The regularities that can be predicted in this setting include routine medical treatment, unstable patients whose condition can rapidly degrade, patients in multiple locations (ICU, step-down unit, patient ward, elsewhere in the hospital undergoing tests or treatment), and the likelihood that patients will be transferred into, within, and out of the unit. Irregularities include substantial differences in the length and outcomes of treatments, significant changes in patient condition that require immediate attention, and changes to required activities (such as rounds starting early or running long). All require clinicians to adjust their hand-offs. Clinicians use two forms of conversation to conduct this exchange: variations of soliloquy (monologue) and colloquy (dialogue). Both forms demonstrate the same variable, emotion-laden, dynamic, and complex traits as the work domain that they are used to manage. These traits reflect the law of requisite variety: that a regulator must necessarily be as complex as the system it controls (Ashby 1956; Conant and Ashby 1970).

Hand-offs are negotiated exchanges between off-going and on-coming staff members to maintain continuity of patient care in the face of uncertainty. They are not limited to one-way bursts of facts regarding patient vital signs and lab results. Instead, they take many forms from a single speaker monologue to a multi-participant dialogue. Probe questions are used to seek further information. Topics are nominated for attention. Agreement is reached on how much time to spend on a patient or subject. Social comments set a frame of discussion and build relationships between speakers. When uncertainty about a topic has reached a manageable level, the pair agree and the conversation can move on.

Clinician ability to develop, adjust and employ different strategies reflects expertise in effectively sharing information. As the following examples show, hand-offs by junior clinicians tend to include discrete data related to each patient. More experienced clinicians use less discrete data in favor of more general descriptions of condition, expectations, and plans. Figure 2 shows the first dialogue excerpt, which is a dense exchange of discrete data.

As junior clinicians develop a sense of what matters, their ability to perform hand-offs improves. Their hand-offs become more efficient. They also develop greater facility with responses to interruptions, distractions, delays, and emergencies. Figure 3 shows how hand-offs between the most experienced clinicians are conversations about patients.

As important as between-shift hand-offs are, clinicians only learn how to conduct them through apprenticeship. They observe and participate with others who are more experienced, rather than taking any formal training.

4.2 Call schedule

The assignment of staff members to work assignments is one aspect of technical work. Recent interest in call assignments has dealt with the effects of fatigue on task

Fig. 2 Dense exchange of discrete data (source: Kowalsky 2004, p. 22)

R: Uh P62 okay P62 is six years old (0.6) uhm (0.6) an:d he was in this (.) apartment fire (0.6) He: (.)aparently arrest- was down for fifteeen minutes (.) in the field (0.5) and when he got to South Shore Hospital he was down uh He got Epi in the field and then he came back (0.7) And I don't know what he got at South Shore they didn't tell us (0.5) No no medications Okay so (.) alright (0.8) Uh:m (1.1) his carboxyhemoglobin outside was thirty-two percent (1.6) Uhm (.) when he got here (1.2) uh (.) we got an a- axillary art line He has a triple lumen central line in his groin (0.6) He had one episode of his blood pressure going down to the thirties but that was a cuff pressure before we got all the lines in He got about two hundred cc's of volume (1.1) uh: His first blood gas here showed a carboxyhemoglobin of four (0.5) and a methemoglobin of one point four which is normal We ordered thiosulfate anyway and we decided to give it anyway (0.7) uh: (0.6) These are his vent settings (.) uh PRVC two twenty (.) and a hundred percent FiO2 His PaO2 was good (.) Five eighty-eight (0.8) uh:m (1.3) So the plan o[kay]

J: [What was] his initial pH

Fig. 3 Conversational hand-off between experienced clinicians (source: Kowalsky 2004, pp. 35–36)

M: Uhm but the eitology of all of this (.) we don't know She had (.) really high fevers (.)
throughout the night like [thirty]-nine something rectal
J : [umhm]
: (1.0)
M: Uh She's on the epi- anti- you know broad (0.5) broad coverage but (0.8)
w- we don't know [uhm]
J : ((yawning)) Hm [that's we]ird
: (1.8)
M: So: (.) it is weird Her vital signs mostly stable She is- is on a little bit of Milrinone
and dopamine cause her perfusion was poor (0.8) uhm (1.3) and (1.4) that's (.)
basically (0.7) basically it but (.) I mean (0.6) really like (0.5) just (.) getting worse
like (1.2) really [she was like]
J : [(It's) very str]ange
: (0.7)
M: the (.) the posturing (.) that [was] really strange
J : [Yeah]
(stran-) ((laugh))
M: Especially with (.) the normal CT
J : Yeah
: (0.7)
M: i- i- um- (0.7) after like (0.5) D25 (.) and D60 both could not explain it
J : Umhm [yeah]
M: Why did (this) happening (0.7) be- be[cause] it's a sign int- increased
intracran[ial pressu]re (0.6) [and]
J : [Yeah] [and he]r fundi were normal?
: (1.2)
M: Well (.) D25 thought there was a little bit (0.5) maybe a little bit (a) mild
papilledema (0.8) But the CT they looked at it They don't (0.6) they- they don't (.)
think it's (.) uhm (0.5) explainable.

performance (Hendey et al. 2005; AORN 2005) and efforts to manage resident work schedules (Goldstein et al. 2004; Mittal et al. 2004; Sawyer et al. 1999; Andorre-Gruet et al. 1998).

The assignment of anesthesia services at the authors' research site relies on the coordination among multiple groups across the acute care organization:

- Three overlapping eight hour work shifts: days, long days, and nights
- Multiple anesthesia specialties: pediatrics, transplant teams, pain service, and cardiac service
- Attending physicians, residents, Certified Registered Nurse Anesthetists (CRNA), nurses, and technicians
- Departments related to anesthesia services: Anesthesia, Surgery, Nuclear Medicine, Obstetrics and Gynecology, Gastrointestinal Endoscopy, Interventional Radiology, Diagnostic Radiology, and Psychiatry.

Decisions about who will perform anesthesia for each case are made by a senior anesthesiologist who acts in the role of anesthesia coordinator (AC). The AC uses cognitive artifacts such as a Daily Availability Sheet and a Master Schedule to minimize assignment planning uncertainty (Nemeth 2003) and assign specific responsibilities for clinicians on the day that procedures are scheduled to take place. However, a clinician may become ill and not be able to fulfill an assignment. Or, one or more patients may need immediate attention that could not be foreseen. The possibility that such changes may occur compels the organization to make alternative plans to cover those contingencies. In fact, managing those changes requires multiple alternatives to ensure that demands for anesthesiology care will be met. This is because the cost of organizing a team to provide procedures is so high, and the care demand is so variable and uncertain. These multiple alternatives are made possible by the Call Schedule.

The Call Schedule is a routine agreed-upon procedure that each clinical department uses to allocate primary responsibility for specific assignments to individual clinicians. Experience shows that demand level and type can be anticipated. This regular feature of the work domain forms the basis for a block schedule that the Department of Surgery uses to reserve time in the operating room (OR) suite for each day's procedures. Anesthesia skills that will be needed, from pediatric cases to cardiac cases, are already known. Teaching needs, for residents from first through fourth year, are also known. It cannot be known in advance, though, if a liver or heart will become available for transplant, if emergent cases will overload the scheduled staff, or if one or more clinicians who are scheduled will call in sick.

The anesthesia department employs various types of call assignments in order to cover what cannot be predicted. Table 1 shows the twelve types of call assignments that are assigned toqualified anesthesia staff members each day. Five of the call assignments (E6, At Risk, E1, E2) cover shift-related work assignments. E6 is OR potential, who must be available at 7:00AM and has no further clinical obligation if not called by 8:00AM. At Risk needs to be available from 7:00AM until early afternoon, in case one or more scheduled anesthesiologists are unavailable during the day shift. The E1 remains at the hospital overnight and relieves other clinicians until just the overnight team is left. The E2 may leave at the end of the clinical work day but can be called back to the hospital in case the workload exceeds what the E1 can manage. Infinity is the last clinician to be relieved by the E1 or E2. Five call assignments (E3, E4, OB, P1, and P2) cover contingencies that are related to clinical specialties. E3 handles heart transplants, emergency cardiac surgeries, and late cardiac cases. E4 is available in case a liver becomes available for transplantation. OB is available in the event of a need for an epidural or Caesarean section. P2 covers anesthesia for children and adolescents and is the second last to leave the hospital (the pediatric equivalent of the E2). P1, pediatrics call, is the last to leave the hospital and needs to be available to return to the hospital if needed. Two call assignments (C1, PC) cover clinic responsibilities. C1 covers the perioperative clinic, assessing each patient as they prepare for surgery that is planned for the following week to 10 days. PC covers anesthesiologist services for inpatients who are being treated for acute or chronic pain.

The call schedule allows the coordinator a set of options to exercise for these and similar contingencies. This arrangement is not evidence of inefficiency, but is instead a rule that has been developed over time as a hedge against uncertainty. The use of similar call schedules in different departments across the hospital creates an elastic web of action and interaction as clinicians respond to continuous fluctuations in the type and volume of demands they must meet.

4.3 Patient transfer

The acute care setting is comprised of multiple groups, or units, that must act in concert to accomplish their goal of providing care to patients who have a wide range of needs. In order to receive services, patients are transferred through units that include patient wards, pre-operative holding (Pre-Op), the emergency department (ED), operating room suite (OR), Post-Anesthesia Care Unit (PACU), intensive care units (ICU), and patient transportation. Clinicians strive to minimize gaps in patient care in a manner that is similar to between shift hand-offs. Unlike hand-offs between shifts within a single unit, patient transfer relies on communication across organizational boundaries. From outside the walls of the hospital, this may appear to be a trivial matter. From inside the hospital, it is not.

Instances of patients who have been misplaced, or ''lost,'' within a medical center are evidence of the complex, fragile, and fungible nature of relationships and coordination among units. Escalating demand, escalating production pressure, and decreasing resources at facilities that are running at full capacity make it certain that problems coordinating care will get harder to manage and more common.

In the organization that we studied, several of the ICUs were recently changed from open units to closed units. Open ICUs rely on the admitting physician to attend to patients whose condition is unstable and needs intensive care. A closed ICU is manned by

Table 1 Call schedule assignments

Code	Assignment
E1	Overnight call (relieves all other clinicians until just overnight team is left)
E2	Back-up to E1 (in event of exceptional workload, may be called back, last to leave for the day)
E3	Cardiac call (heart transplant, emergency cardiac surgeries, and late cardiac cases)
E4	Liver transplant call
C1	Pre-Op clinic
E6	OR potential (be available at 7:00AM, if not called by 8:00AM, free to proceed)
OB	Obstetrics call
PC	Pain consultation. (caring for inpatient pain service)
P1	Pediatric call (last to leave, take calls from home and return if needed)
P2	Pediatric call (second last to leave, pediatric equivalent of E2)
∞	Infinity (last clinician to be relieved by E1 or E2)
@	At risk (be available from 7:00AM until early afternoon)

physicians who are intensivists (typically internists or anesthesiologists with specialized critical care training). While many contend that closing ICUs significantly improve patient outcomes, it also has consequences. One consequence is that the patient must transfer service and physician when moving into and out of the ICU. As a result, patients who are transferred to the patient wards or to a rehabilitative facility must be accepted by another service at the same time as their change of location.

In the current transfer procedure, intensivists identify patients who are sufficiently stable that they no longer need to be cared for in the ICU. The intensivist on a shift identifies the unit to which the patient needs to be transferred and writes a transfer order. Four attending physicians are on rotating call to accept patients who are to be transferred to hospital wards. The transfer itself seems simple. The ward nurse calls Patient Transport, which dispatches a staff member to the sending unit to wheel the patient to the receiving ward. The receiving unit ward clerk calls the transferring unit and confirms that the patient has arrived. Physical transportation, though, is only part of the transfer. It can take days for a ward bed to become available. This prevents the transferring intensivist from identifying the service that will eventually receive the patient, and from ‘‘signing out'' the patient to them. Such long waits also make it unlikely that the physician who wrote the transfer order will be available and aware of the transfer when it finally occurs.

Over 3 years, the hospital has experienced eight instances of patients who have been misplaced within the facility. Four of these patients have become ‘‘lost'' during transfer out of the ICU and were ‘‘found'' when the need for care arose. In one case, a patient with gastrointestinal bleeding got hungry and asked for a meal. Another patient who had been treated for gastrointestinal bleeding resumed bleeding internally. In a third case, a patient with sepsis developed internal bleeding. In another, a patient who had been treated for respiratory failure experienced a recurrence of that failure, with sepsis. Nurses attempted to determine who was responsible for care and realized that no physician had assumed care of these patients. (Anesthesiologist Michael O'Connor, personal communication, 2006) Issues with tracking patients are not unique to this facility, and have been previously described in the literature (Fisne 1999; Wainwright 2003; DeRosier and Taylor 2005).

In the events noted here, patients simultaneously changed location and service. For example, a cancer patient is transferred from the cancer ICU to a medical ward. This requires handing the patient off from an intensivist to an oncologist. The problem of being misplaced does not occur when patients are transferred from a surgical service ICU (e.g., cardio-thoracic ICU), because members of that ICU team also attend to patients on surgical service wards.

The intention is to directly transfer patients from or to the ICU. However, these examples show that the reality of transfer is occasionally different. This is because of resource constraints, time pressure, and running the facility at or very near capacity. The intensivist on duty may write a transfer order and leave at the end of a shift. Services can easily reach their limit of patients because the facility is routinely running near maximum capacity. The patient might be scheduled to be transferred, but a bed may not yet be available in the receiving unit because it can take as long as 12–48 h before one becomes available. A bed that is available may not be on the ward to which a patient is normally assigned. By the time Patient Transport moves the patient from the ICU, the staff on duty may have little on no knowledge about the transfer. Ward clerks are typically in short supply on weekends, cover two to three wards, and may not be aware a patient has arrived. All of these factors increase the chances of a patient that may become misplaced within a hospital.

5 Discussion

Call schedules, between shift hand-offs, and patient transfers are examples of large scale coordination. Each example demonstrates the difficulty of coordination among and across groups when activities are complex and resources are constrained.

Clinicians are compelled to act in the interest of the patient, while management seeks the greater good across the organization. This is first-hand evidence of Rasmussen's (1998) observation that sharp (operator) end initiatives outstrip organizational efforts to develop policies and procedures. In all three examples, clinicians have taken the initiative to make the daily workload feasible. The call schedule is a consensus that all clinicians agree to in order to ensure their department delivers services in spite of obstacles such as illness, increased workload, and unforeseen cases. Hand-offs are used in flexible ways to adjust for changes in the work setting such as one or more patients whose condition is perilous or daily rounds starting earlier than expected. Patient transfers are accomplished by clinicians making continual adjustments to match resources such as beds and staff to demand such as the type, acuity, and number of patients who need care.

Resilience (Hollnagel et al. 2005) is the ability of a system to withstand challenges and return to normal operation with a minimum decrement in performance and we have previously contended that workers create resilience (Cook and Nemeth 2005). Rules for coordination have been worked out to guide some activities, but not others. When rules are no longer are sufficient, worker expertise must intervene to ensure a successful outcome. This is resilience in action. In the between-shift hand-offs example, the size of the group is small and rules are few. Interaction and informal signals that are shared among members of a small group accomplish what needs to be done. In operating room scheduling, the size is much larger. There are more rules but they are often bent in order to accomplish the day's work. The ''bending'' is typically done by the anesthesia coordinator, who relies on deep domain knowledge to know what will and will not work.

The practice of transferring patients spans the entire facility. Person-to-person contact is minimal, and rules are all that are available. Without personal attention by qualified staff, the transfer procedure is vulnerable to many factors such as distractions and interruptions. Hand-offs and call schedule management are performed synchronously among smaller groups. Breakdowns are easy to observe and action can be taken to rectify problems. Transfers, though, are asynchronous and difficult to observe. Breakdowns may not become evident until days later.

This suggests a scale effect when it comes to coordination. What works well at one level does not necessarily work well at another level. Activities progress so quickly that individuals cannot intervene and change the outcome. At some point, individuals are not able to take action that will, in itself, make up for shortcomings.

This poses questions for further research. For example, where are the transitions from one type of coordination to the next? This also begs the question of how well healthcare handles coordination. Most organizations use hierarchy to coordinate the activities of smaller groups. However, healthcare is heterogeneous and has essentially no hierarchy. How well can a flat organization handle coordination at large scale?

Even when they are located within the same organization, groups can have incompatible, or cross-cutting, agendas. For example, the need for surgeons to generate revenue can conflict with anesthesia's need to manage resources most efficiently. The resolution of conflicts between these two agendas relies on deep knowledge about the work domain and diplomacy. Success in resolving such a conflict results when one or more clinicians can anticipate and diffuse conflicts in advance of a confrontation. For example, an anesthesia coordinator might foresee a potential problem with a surgeon who underestimates operating times in order to maximize revenue. This can create disorder across the operating room suite, as schedules are typically tightly coupled (Perrow 1999). Rather than confront the surgeon, the AC might inform the anesthesiologist who has responsibility for At Risk call that there may be a need for her services later in the morning. This will avoid confrontation, and make more resources possible without requiring the At Risk anesthesiologist to come to the operating room suite and stand-by for an assignment.

The case of misplaced patients reveals the gaps that separate groups within the same institution. Bridging those gaps requires the expenditure of effort and time that are in short supply due to the need to run near or at full capacity using constrained resources. Continuity of care relies on the maintenance of relationships among units. Coordination *must* succeed in an environment in which boundaries between units are poorly defined, time and resources are constrained, procedures and policy evolve asynchronously, and multiple cross-cutting agendas blur lines of responsibility. Evidence of this need occurs more clearly in the issues that are related to patient transfers. Even though they are performed within a single facility, patient transfers are large in scale, as they occur *among* and *across* groups and require maintenance of a distributed cognition in order to be accomplished. A recent meeting at the research site attempting to resolve the problem demonstrates why it continues to exist. Even though the hospital's risk manager called the meeting, clinicians dominated the discussion. During the meeting, participants were disoriented on the issue. More than one mentioned ''I thought this was fixed.'' Solutions were nominated before any attempt to develop a consensus on the actual nature of the problem. Attention of the participants was focused within, not across, services. Knowledge about what actually occurred on the floor was difficult to come by, as some junior staff members do not divulge knowledge for fear of reprisal. That the ''lost patient'' problem is known and continues to exist for years says much about how difficult such issues are to resolve.

6 Conclusion

Many of these informal solutions to systemic problems go unnoticed unless they are the subjects of study (Nemeth 2005). Naturalistic decision making (NDM) (Klein 2000) methods such as observational study and interviews (Nemeth 2004; Patton 2002), and cognitive systems engineering methods such as process tracing (Woods 1993) can be used to reveal the systemic aspects of worker in natural settings. Results of findings from such explorations of technical work can improve understanding of work processes and, ultimately, patient safety.

Care providers have devised their own means to cope with the complexity of their work setting through adaptations that are visible and audible such as call schedules, verbal hand-offs, and patient transfers. The complexity and variety of these approaches to cognitive work matches the complexity and variety of the acute care setting. Although much of the work is mundane and regular, its details are consistently irregular. Management can create rules to handle regularity. However, irregularity requires the judgment of individuals who work in concert to fill in the gaps that such irregularities create, in order to accomplish common goals each day.

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