

Finding hidden sources of new work from BCMA implementation: the value of an organizational routines perspective

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Abstract

It is acknowledged that there is a difference between abstract representations of clinical work and work as it is performed in context. In this qualitative study of the implementation of barcode medication administration (BCMA), hidden work resulting from the implementation of BCMA is described. Organizational routines theory provides the framework for examining the dynamics of key organizational practices. The study documents new cognitive and physical tasks that were required of nurses when BCMA was implemented. Because many of these tasks were not part of the commonly understood workflow of the BCMA system and because they were obscured in problematic interactions between organizational routines, they are characterized as “hidden work”. Categories of hidden work are described and the implications for implementation research and practice are discussed.

Introduction

The introduction of new technology in clinical settings can impact the work of clinicians in unexpected ways (1). Researchers have described and advocated for numerous approaches to understand clinical work to facilitate improvement or automation (2-7). Recently, organizational routines theory (8, 9) has emerged as a potentially powerful framework with which to consider the organizationally situated, structured yet dynamic processes through which health care is delivered (10, 11). Organizational routines are defined as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (12). Organizational routines structure work in health care (13) through shared understandings of how practices are to be carried out, an example being the local practices of medication administration on an inpatient unit. Through the repeated enactment of organizational routines, the routines can evolve and change.

Organizational routines do not exist in a vacuum, but are in constant intersection with other routines (14). For example, the medication administration routine intersects with routines carried out in the pharmacy and provider ordering routines, among others. Intersections of organizational routines are structured, therefore, a nurse administering a medication can make reasonable expectations about actions of the pharmacy in dispensing the medication. Research has shown that when new technology is introduced, stable intersections can be brought out of alignment, and this phenomenon can be difficult to detect (14) through traditional studies of clinical work that focus on specific routines to the exclusion of others (i.e. medication administration *or* pharmacy dispensing). This paper will show that the introduction of new health IT tools can produce *new work* at the intersections of organizational routines, and that this new work can be missed in traditional analyses of work. Using organizational routines theory to understand hidden new sources of work extends existing research on the unintended consequences of health IT implementation (1, 15).

Background

Routines are a key feature of all organizations, and widely recognized as the way most organizational work is accomplished (16-19). Organizational routines are defined as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (20). This definition distinguishes routines from “best practices” or standard operating procedures by its focus on actions that are “carried out by... actors” (20). In other words, organizational routines are the patterns produced by what people actually do, not what is delineated in a procedure manual. Organizations maintain stability through these recurring patterns of collective activity, such as teaching rounds on an inpatient unit, and change occurs as routines are altered in their execution, for example, when rounds begin to occur around a computer that displays the patient record. It is in this way that organizational culture is created and changed. Understanding the maintenance and evolution of routines can provide a powerful lever for health care leaders seeking to implement innovation.

The interaction of routines has been characterized as “embeddedness” (21). With empirical qualitative data on manufacturing routines, Howard-Grenville distinguishes “weakly embedded” routines, which overlap with few other institutional structures, and “strongly embedded” routines that function in the core of the organization, overlapping with many other routines in significant ways (2005). Using Howard-Grenville’s framework, medication administration is a strongly embedded routine at the core of the patient care process, interacting with routines such as medication ordering, documentation and billing. In contrast, a weakly embedded routine in health care might be follow-up on discharged patients. Perhaps a particular clinical group (e.g. a specific cardiology practice) has a routine for calling patients at home after discharge and sending a detailed report to the primary care provider. However, this routine exists not at the core, but at the periphery of hospital routines, interacting with clinics that may not be affiliated with the hospital, contacting the patient at home (and possibly never connecting). Strongly and weakly embedded routines can be assessed with respect to allocation of organizational resources, performance of the routine in terms of adherence to organizational policies, and other important organizational research questions.

Another approach is to examine the sites of “intersection” (14) of routines in order to understand the rules and resources followed by actors when routines cross paths. In previous work, we examined the misalignment that was produced at the intersections of routines when barcode medication administration technology was introduced in an inpatient setting. We examined the work of mediators in resolving misalignments at the intersections of organizational routines. With this paper, I look more closely at the nature of new work created at intersections when barcode medication technology is introduced.

Methods

The methods and setting are presented following the general criteria of the STAMP framework put forth by Zheng and colleagues (22). The setting of the study was an academic medical center. Research primarily took place on 10 adult inpatient units that went live on a new commercial BCMA system and replacement commercial pharmacy system during January through August of 2007. The other clinical systems in the environment, including CPOE and an extant pharmacy system, were a mix of commercial and homegrown systems. The research design was ethnographic, focused on explaining how nurses integrated the new system into everyday work. Subjects included practicing nurses and members of the implementation support team, a group of nurses charged with training and support activities during the rollout of BCMA. Data included:

1. Field notes from non-participant observation of a) nursing work, which included medication-related nursing work activities during all shifts and b) meetings and support activities of the implementation support team. Over 120 hours of observation were conducted.
2. Documents such as meeting minutes and reports.
3. Email communications (n=170) among the implementation team.

This variety of sources enabled triangulation of findings between activities observed, those discussed in meetings and those reported in emails (23). NVivo 9 (24) software, a qualitative data analysis tool that enables coding, or tagging, portions of text, was used to analyze the data. Data were analyzed using iterative open and axial coding methods, in which themes were sought without theoretical constraint, then aggregated into common topic areas. For the analysis presented here, data from two summary themes regarding “work practices” and “new artifacts” provided starting points for identifying new work at intersections, which led to exploration of other themes including “schedules”, “interacting with non-BCMA units”, and “Intravenous medications”. IRB approval was obtained to conduct the study. All names reported in this manuscript are pseudonyms, and statements from subjects in fieldnote excerpts are not direct quotes. A more detailed discussion of the methods is available in (14).

Findings

Medication administration routine

Medication administration is a central organizational routine for all hospitals. Almost every patient is given some kind of medication, including both medications already prescribed and medications ordered by physicians to be administered during the hospital stay. Prior to BCMA implementation a paper medication administration record (MAR), was used as a central source for tracking medication schedules and for documenting medication administrations. When a physician ordered a new medication (or changed an existing one) using the CPOE system, a copy of the order automatically printed on the patient unit and the unit secretary wrote the new order and schedule information on the existing MAR. The pharmacy processed the order by checking it, determining the proper form and amount of the medication and setting up the schedule of doses. Overnight, the pharmacy IT system (which was

interfaced to the CPOE system) printed new paper MARs with updated schedules and these were placed in the patient charts. New or changed medication orders coming through during the day were added manually by the unit secretary as described above. When a nurse was ready to administer medications, she checked the MAR for medications due, obtained the medications, identified the patient and administered the meds to the patient. She also then documented on the MAR that the medication had been administered.

As BCMA was introduced on the inpatient units, the paper MAR was removed. An electronic medication administration record (eMAR) was implemented that was interfaced to the CPOE system. With BCMA, nurses could see a medication order on the eMAR when the physician placed the order in CPOE, but the order only became “active” after the pharmacy processed it. Once the order was active, the nurse could scan the patient, scan the medication, address any alerts (such as wrong dose or early/late administration), scan the patient again, click on the “Confirm” icon, and this would automatically update the eMAR that the medication had been given, including the time. If there was an alert for any variance such as a late administration, the nurse would be signaled with a dialog box. The nurse could override the alert and choose from a list of reasons or type in a reason with free text.

The following sections outline several areas in which the medication administration routine intersects with other organizational routines, and the new work that was performed by clinicians in the intersection when BCMA was introduced. These intersections are described using illustrative quotes and data from fieldnotes. The discussion section focuses on the utility of an organizational routines perspective as a way of potentially avoiding implementation problems related to hidden work.

Intersecting with medication administration in other units: maintaining continuity of the routine

The medication administration routine is instantiated by an order for a medication to be given on a particular schedule (or as needed), regardless of the patient’s physical location. Ensuring that a patient stays on this medication schedule requires that clinicians caring for the patient in different locations share information that would, prior to BCMA, be recorded on the paper MAR, such as the time of the administration or a particular dose being withheld. The paper MAR accompanied the patient in his or her foray through the hospital (e.g. from the Emergency Department (ED) to an inpatient unit, to a procedural unit and back to the inpatient unit). In the study setting, BCMA was rolled out across the institution at the rate of approximately one inpatient unit per week. The ED did not implement BCMA in the project’s initial phase, and at the time of data collection there was uncertainty whether ED would ever implement the system, due to workflow issues. Nurses learning the BCMA system needed also to learn how to manage medications across the technological border with units that were not live on BCMA. A source of frustration was the “confirmation” process in BCMA, in which the nurse electronically acknowledged each medication order coming into BCMA from the Computerized Provider Order Entry (CPOE) system. The process of confirmation moved the order into the nurse’s list of active medication orders to administer. Patients coming from the ED often had medications ordered, but since the ED was not using BCMA, none of the orders had been confirmed or administered in the eMAR. Nurses using BCMA became familiar with an electronic source of information, “the ED order summary” that contained information about orders and actions taken by nurses. In the following excerpts from three separate email reports to colleagues, members of the implementation team described teaching nurses how to access the report from the ED order summary and the frustration experienced by the nurses about this additional work:

Assisted staff in addressing medications administered in ER and showing late in [BMCA]...[and showing them] where to confirm they were given in the ER by using the [ED order summary] report.

We have had no more real issues to speak of just the usual addressing numerous unconfirmed meds from the ED which is very frustrating to the nurses.

Helped staff address orders from patients received from ER, Staff state that it is very time consuming to confirm and address medications that were given prior to arriving on unit. Showed staff how to access... ER medication record to confirm administration of medications prior to arrival on unit.

Intersection with the management of patient location and status

Hospitals track patients through a process referred to as “admission, discharge and transfer” (ADT) that involves computerized tracking of the patient’s status as admitted to the hospital or discharged from the hospital, and during

the stay, which bed the patient has been assigned. Prior to BCMA there was little intersection between the ADT process and the medication administration routine. After BCMA implementation, in order to administer a medication in compliance with the system, the patient must be admitted to the hospital with an active medical record account. The excerpt from a support team email below demonstrates that the seemingly unlikely event of giving a medication to a person who is technically not a patient can easily occur, and underlines the challenge of being faced with surprises when already busy with multiple patients.

Stacy had three patients getting discharged. She was trying to give meds to one of the patients and the schedule was not available – the patient had already been discharged out of [the ADT system] by the unit secretary. This is not supposed to happen until the patient is going out the door.

Intersection with pharmacy dispensing routine

Prior to BCMA introduction, providers entered orders for medications into the CPOE system and the order was processed in the pharmacy, where doses were translated into the proper quantities of pills, creams, diluted chemicals, or other forms. These doses were then sent to the inpatient unit to be administered by the nurse. With BCMA, the pharmacy not only packaged the medications in the proper form, but encoded it into the BCMA system in a way that the nurse could scan and administer. The excerpt from a support team email below describes the complexity of a “range order”, in which the provider chose to have the medication administered in different doses according to a range of pain levels assessed by the nurse.

The Percocet order gets into “range” orders which we have said are not allowed unless specific parameters are given in the comment by the prescriber. In this case the prescriber ordered 2 tabs because [CPOE] does not allow you to type 1-2 tabs. The comments read 1 tab for pain 4-6 Or 2 tabs for pain 7-10 which is an acceptable parameter. The dose in the pharmacy system remained 2 tabs and the comment was displayed. So I can see why an incorrect amount warning displayed when trying to give one tab. The pharmacy would have to manually change to two separate orders (one prn order for 1 tab and another prn order for 2 tabs). This would make scanning process correct and would also allow nurse to choose appropriate order in Pyxis to avoid wasting or creating a discrepancy. I will communicate this to pharmacy staff for range orders with pain scale parameters.

Intersection with pharmacy scheduling routine

In addition to determining the proper form of medication as described above, the pharmacy also set the schedule for medications in BCMA, making alterations as necessary to merge the schedule of the new medication into the other medication schedules already set up for that patient and attempting to bring as many medications as possible onto a standard schedule. However, schedules often needed to be changed, resulting in the nurse making a call or sending a message to the pharmacy to update the schedule in the system, as described in the excerpt below from a support team email that describes the ramifications if the schedule does not get changed. The excerpt also reveals the paradoxical importance of continuity of staffing during an implementation: it is the nurse, not the system, who remembers the correct medication schedule:

Nurses state that Keppra was on a 1000 and 2200 schedule. The nurse from last [afternoon] (who is still here) verified she sent a message to pharmacy to change the schedule to 0800 and 2000. When the day nurse came on she states she [was told] in report that the schedule request had been made. However when she looked in [BCMA] she did not see the Keppra as due at 0800 or 1000 either. Having the patient the day before she knew it was due and verified [by checking the CPOE system]. She scanned the med and got a “too early” pop up. She went ahead and gave with an extra dose [option in BCMA]. I looked in [BCMA] and did not see it as due until tonight at 2000.

During the planning phase, pharmacy informatics staff expressed concern that the most difficult part of BCMA implementation would be the schedules, partially due to the prevalence of unit-level customs and practices related to

the schedule. The following excerpt from fieldnotes is from a discussion of scheduling challenges in an implementation team meeting. In this particular meeting, the Chief Information Officer (CIO) was present, which was not typical.

The group discussed the standard [medication dosing] schedules grid that had been distributed.

John [pharmacy informaticist]: sometimes it is not obvious for the nurse when she should expect a dose to come up from the pharmacy. They might interpret an order differently from the pharmacy. This should help clarify for them the rules that the pharmacy is going by.

Carol [nursing unit manager for the pilot unit]: Standard schedules are a universal, how did the nurses here get away from this?

Sharon [BCMA project manager]: It is more common in the ICUs for them to put the patient on a customized schedule – they have more now/then doses.

Lauren [support team manager] commented that Cardiology has a 6&6 schedule that is not listed.

John replied that he is only listing the commonly ordered schedules.

Mark [implementation team member]: other areas have schedules that are specific to them and this is part of the problem.

Jim [physician advisor] (on phone): It is common that the BID [twice per day] schedule would have to be tweaked because there might be 2 BID drugs that can't be given together, so they would need to be staggered.

Carol: If I need to stagger a dose why can't I just use my critical thinking and not let the whole world in on it?

Gary [CIO] supported her by commenting forcefully that the clinician gets taken out of the picture when you take over the critical thinking with the system. It replaces the clinician.

This interchange highlights the tension that exists between allowing the nurses to exercise “critical thinking” and the control over very specific actions of the nurses that comes with the implementation of a workflow-oriented system such as BCMA. Prior to BCMA, changes to the schedule still went through the pharmacy, but (in contrast to the “Keppra” example above) minor adjustments to the schedule could be written on the paper MAR, and if the pharmacy delayed in making a requested change, written administration times would suffice until the change was made.

Intersection with emergency care routines

Hospitals have procedures for reacting when a patient requires immediate resuscitation following respiratory or cardiac arrest, referred to as code blue or just a “code”. The BCMA system does not physically prevent medications being given to patients without a scan and the routine of responding to a code is not materially impacted by BCMA. However, after BCMA introduction, immediately following a code or any other type of emergency the nurse was required to assemble all of the packaging that had been ripped open during the emergency and scan those medications to ensure they were properly accounted for in BCMA. If this did not take place, the nurse on the subsequent shift was left to attempt to figure out what had been given to the patient during the emergency, as described in this excerpt from a support team email:

...instance of nurse from previous shift not scanning meds--in [BCMA] showing as overdue—on-coming nurse aware they were giving because they are hanging [in intravenous solutions]. Staff reminded that they need to scan or address medications after the emergency to provide documentation of when medication was given.

Intersection with patient routines

Patients in the hospital often have busy days, being shuttled around the hospital for tests, taking medications, nutrition and therapies, and otherwise doing the work of healing. Medication administration was frequently delayed because of the patient being off the unit for a test or procedure. Sleeping is also considered to be an important aspect of healing, and the excerpt from fieldnotes below describes the concern about the invasiveness of BCMA's approach to patient identification (scanning) while the patient is asleep:

Respiratory "while awake" meds were discussed. Sara [Respiratory Therapy manager] wanted to know if they could document the medication "not given" if the patient was asleep without actually scanning the patient. She said they did not want to wake the patient up in order to document that he was asleep!

Throughout the project, nurses were observed altering plans to accommodate patients' activities, including sleep. Several nurses commented that making sure the patients get sleep was one of their priorities, and that sleep constituted a valid clinical reason for giving certain medications late.

Discussion

New work, hidden at the intersections

The vignettes above describe new work, including cognitive and physical tasks, performed by nurses when BCMA was implemented. Because many of these tasks were not part of the commonly understood workflow of the BCMA system and because they were obscured in problematic interactions between organizational routines, I characterize them as "hidden". For example, it is easy to dismiss schedule changes as non-routine, or atypical. However, the data suggest that customized schedules may be very common, and therefore the "exception" of requesting a schedule change may be closer to a rule. Similarly, the BCMA system was not designed to interact with external sources of information about medication administrations, therefore a hospital unit that was not live on the system was not well accommodated in the workflow. It would be surprising if most hospitals implementing BCMA brought every unit onto the system, as there are many exceptional areas, such as the emergency department and units that deliver chemotherapy. Risks to rapid implementation of clinical systems have been discussed elsewhere (25). Assuming the institution chooses a stepwise rollout of the system over time, there will be interactions between live and non-live units during implementation, and this produces additional work and potential risks to patient care.

Examining health care work through the lens of organizational routines affords the opportunity of abandoning traditional ideas of "processes" that have informed automation efforts (such as order entry or documentation), and thinking about how work is accomplished now, given current levels of automation and new coordination work involved in care delivery. Organizational routines theory (12) provides a fresh approach to the examination of workers' attempts to achieve shared goals. It also enables new approaches to the study of interaction, including the concepts of embedded routines (21) and intersecting routines (14).

Finding new ways to characterize work creates new design opportunities for systems and for systems implementations. An analysis of organizational routines can inform functionality requirements of the system (e.g. the real work of medication management includes patient education, therefore the system could be designed to support this component of the work). Organizational routines represent an approach that enables us to move away from traditional views of work for informatics tool design that have tended to present work from the perspective of a particular category of actor. Gorman argued for this departure with respect to orders and the potential inadequacy of the CPOE model, which assumes a linear (26) process initiated by a physician and carried out by others. As pointed out in the exchange regarding scheduling above between the chief information officer and the nurse manager, a reductionist view of medication administration can be deskilling for the nurse by replacing opportunities for critical thinking with additional physical tasks. The bureaucracy involved in implementing a "range order" underscores this issue.

Significance of patient work

Corbin and Strauss brought the concept of the patient's work to light (27) in their study that defined the types of work patients with chronic illness engaged in at home. Others have expanded on that work, relating findings about the development of patient expertise to informatics design opportunities in the clinic (28-30). The data presented here suggest that the notion of patient work may also be relevant in the inpatient setting. Rather than viewing the patient as a passive recipient of care, incorporating the patient's work into the planning of innovations may improve the organization's ability to achieve goals. For example, many patients struggle to learn complex new medication regimens prior to leaving the hospital, and many are not adherent to their prescribed regimens, resulting in morbidity

and readmissions. Incorporating this work into the design of BCMA systems, perhaps displaying or projecting the schedule and picture of each dose on the wall at administration times, may help to impress upon the patient the routine of the medication schedule before they leave the hospital.

Conclusion

Organizational routines theory provides a useful lens for the study of health care work, particularly in the examination of the impact of automation on the micro-processes that, collectively, constitute dynamic organizational cultures. Future work in this area should continue to elaborate the nature of interactions among routines, including further studies of embeddedness and intersections. Also, it is critical to identify effective approaches for representation of organizational routines in a way that can inform software design and implementation design. Finally, a key area in which research is needed is explicating the active role of patients in the inpatient setting, and how the work of patients may be a useful input for the design of systems.

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