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HOW BAR CODED MEDICATION ADMINISTRATION TECHNOLOGY AFFECTS THE NURSE–PATIENT RELATIONSHIPS: AN ETHNOGRAPHIC STUDY

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Objectives: This study aims to assess how care is mediated through technology by analyzing the interaction between nurses, patients, and a Bar Coded Medication Administration (BCMA) system. The objective is to explore how patients experience care through medication technology, with the main focus of our observations and interviews on nurses rather than patients.
Methods: A qualitative ethnographic study was conducted in an orthopedic ward of a Dutch general hospital.
Results: After analyses, the following two themes were discerned: (i) the use of bar code medication technology organizes double institutionalization, and (ii) nurses frequently need to work around the BCMA, as the system is not always supportive of patient needs.
Conclusions: The results of this study indicate that BCMA is not merely a neutral tool, but an active component within the nurse–patient relationship, as it influences medication administration and profoundly affects patient participation in the care process.

Keywords: Patient, Institutional ethnography, Bar code medication technology, Qualitative research, Hospital, Technology

Central in this research is how technology mediates care and influences nurse–patient interaction. Bar Coded Medication Administration (BCMA) technology is one of many medication administration technologies used in hospitals, and often involves the scanning of patient wristband using a wireless handheld device. According to Young et al. (1), BCMA is used to guarantee and verify the five rights of medication management: right drug, right time, right patient, right dose, and right route. As previously indicated, BCMA has effectively reduced the incidence of medication errors (1).

The majority of studies on medication administration technologies focuses on the reduction of medication errors through elimination of "human factors" (2;3). Franklin indicates that previous studies seemed primarily interested in the pharmaceutical impact of medication on patients, whereas the patient perspective is highly lacking (4). Although some studies reported on the use of BCMA by nurses (5;6), except from our prior research (7), the interaction between BCMA and the relational triangle of technology, nurse, and patient was not yet investigated. However, the use of BCMA not only affects the work of nurses (8), but also standardizes the medication process (2). BCMA, therefore, has the potential to organize and influence patient experiences on their medication use. For instance, Niemeijer et al. showed how monitoring technologies can cause ambivalence, with unforeseen spin-off effects of new technology measures making it difficult to predict patient experiences (9).

In the case of BCMA, there appears to be lack of awareness on the (moral) impact of supplying every new patient with an electronic wristband. Andersson et al. have warned that "technology-based rationality may compromise care-based rationality" (10: p. 1). As Marck has noted, the use of technology provokes moral choices in daily life, necessitating a critical dialectic in nursing. According to this researcher, nurses should develop a (more) critical point of view regarding the meaning of being a nurse in a world of technology (11). To that end, the nursing practice might benefit from an approach that tries to "capture" thoughts in action, hereby using both theory and story. Hence, this article aims to obtain insight into the impact of BCMA on nurses' practices of medication administration, thereby contributing to the discussion on how BCMA implementation might support care practices.

METHODS

Design

For this study, the design was institutional ethnography (IE) as well as insights from practice theory. Using IE allows the researcher to target a "problematic"; in this case, everyday

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experiences of people working and living in an institutional environment. More specifically, in this study, the "problematic" of nurses and patients in a Dutch orthopedic hospital ward were investigated. Crucial to IE, according to Smith, is the understanding that acting subjects in practices either physically, or in their activities, are always connected to one another, either physically or in their activities. Furthermore, these practices are institutionally ruled through texts, such as laws, procedures, manuals, and protocols (12). "Ruling" is also the concept that Smith uses to describe the socially organized exercise of power shaping people's actions (13).

One of the main entry points of IE is the *small hero*. In our case, small heroes were the nurses, whom we regarded as having inside knowledge of their situation, thereby possessing "organizational literacy" (14). Although small heroes are not directly used in the analyses, it is worthwhile introducing the concept, as it is an integral part of ruling relationships. IE offers a valid point of entry, as the method specifically focuses on people and their experiences with organizational policies. Furthermore, IE also is a suitable method for carrying out research on nurses' daily activities. These activities are characterized by their use of both practical and formal knowledge, and their response to managerial attempts, articulated in text, protocol, and institutionalized structure which regulate their actions. Through text and order, BCMA structures the way nurses distribute the medication. The observations, however, brought out a more complex practice than only text referencing.

In addition to IE, insights from practice theory were used. Practice theory provides an alternative means of understanding complex dynamics between the elements that constitute the practice of BCMA, allowing it to be considered as a systemic issue, rather than focusing solely on individual behavior (15). Bringing insights from practice theory into the model of IE created the opportunity to recognize *institutional* discourses as well as nurse deliberations and discourse.

Using the methodological guidelines of IE and insights of practice theory during the analysis, close attention was paid to how institutional ruling manifests itself. This was done on the one hand by analyzing the data of the observations and on the other hand by analyzing several BCMA related documents to see how they as text rule the actual working practices of nurses (e.g., more than 1,500 pages of protocols, manuals, working instructions, reports of meetings). An orthopedic department is a good reflection of an average hospital department. Patients are generally considered to have decisional capacity and tend to be more approachable. This offered the possibility for the researcher to observe and record interaction between nurses and patients. Although the patients' point of view was not our direct point of entry, the direct observations gave insight in actual actions and conversations between nurse and patient in relation to medication distribution. This would not have been the case in interviews or focus groups.

Setting

The research was conducted in an orthopedic ward of a large general hospital in the Netherlands. The hospital has a capacity of 556 beds; with the orthopedic ward accounting for thirty of these beds. The ward has an average admission rate of 124 admissions and monthly, 240 surgeries are conducted. At the start of this research, BCMA was implemented for 2 years throughout the whole hospital.

Participants

In total, twenty-six team members were participating in our study, which included both level 4 (middle-level applied education for approximately 3 years with students being taught to achieve their tasks independently) and level 5 nurses (university of applied science). The age of participating nurses varied between 20 and 60 years old. All nurses received a BCMA training before they started working with the system. Before the implementation of BCMA, participating nurses were already used to work with a digital patient file. We only included the highest skilled nurses (level 4 and 5), as on the ward only they are permitted to administer medication. Therefore, nurses with little or no BCMA-experience (i.e., less than 6 months) were excluded from this research.

Consent

The ethics committee approved this study, hereby stipulating that, even though patients were not directly involved in the study, they had to be fully informed and all data had to be anonymized. However, in the end, we did not retrieve information from patients' medical records, but only used the observational data. Therefore, there was no need to retrieve consent from patients directly. Participating nurses were informed and asked for their consent twice. First, at a team meeting, nurses were informed about the study and provided consent verbally. Second, right before the start of an observation of a shift, nurses were asked again for their consent. In addition, all participating nurses were informed that they could withdraw from the study at any time.

Data Collection

Data were collected between September 2011 and May 2012. Participant observation was conducted, which also entailed spect-acting as a specific strategy (16).

Spect-acting offers the researcher (nurse), who is also a "knower," the opportunity to participate in the process he is researching, in this case, that of medication distribution, thereby making the researcher's presence feel (more) natural.

Consequently, seventeen nurses in total were observed during seven different shifts (observations were transcribed ad verbatim). All shifts (morning, afternoon, evening, and night) were included in the observations to get the best possible

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overview The actual dates of each shift were selected at random, resulting in a different nurse for each observation.

In addition to these observations, semi-structured interviews were conducted (and transcribed ad verbatim) by the first author with nurses who were not observed. During these interviews, vignettes of their personal experience with BCMA, which they had written before the interview, were used to discuss their experiences. Documents such as policies, manuals, working instructions, reports of project-meetings, procedures, and protocols were studied and analyzed regarding BCMA used in the hospital.

Analysis

The data collected were subsequently cut, and grouped into what can be called "scenes," as unit of analysis. The idea of a scene as group or cluster of activities is put forward by Woo et al. Instead of viewing a scene as a linear scenario in a film, they suggest that a "scene" analyzes how action is enabled, mediated, and constrained (17). By using scenes, certain trails could be followed regarding BCMA and also rendered the data discussable and prepared it for further rounds of analysis. The parts of the scenes were thus numbered in ascending order for traceability reasons, given a reference code, and ultimately resulted in 249 unique scenes.

In the scenes, researchers trace types of institutional ruling every time a nurse referred to a form of text (e.g., a protocol, or technological instruction coming from the BCMA). The scenes shed light on the deliberations of the nurse: whether and how much she would follow these rulings to the letter, or whether she would deviate from this and base her decision on her personal knowledge. The research was conducted by the first author, and analysis of the data was performed by the first, second, and third author.

In line with IE, the collected data and concomitant analysis are "given back" to the practice that was researched. Therefore, a first responsive evaluation was done with a multi-disciplinary group including nurses, pharmacists, information communication technology (ICT) staff, vendor, manager, and a physician for the purpose of triangulation The second responsive evaluation was conducted with a group of fifteen nurses from different wards, all working with BCMA, and was intended as member check.

Finally, data analysis was also discussed amongst several methodological experts and scholars ("peer debriefing"). If there were discrepancies in the analysis, these would first be resolved in the research group, and if necessary through consultation with the experts. This increased the quality of our study.

Findings

In this section, two strong examples of scenes will first be described where nurse, patient, and the BCMA form a triangle within medication distribution, thereby allowing us entrance to the observed practices. The data from the interviews showed very similar results. The two scenes will subsequently be discussed because they are representative for the findings in this research. On the basis of our observations, we did not see any noticeable differences between the amount of experience a nurse had and the way she interacted with BCMA.

Scene 56.

When a patient is admitted, an assistant of the pharmacist performs the intake. Home medication is subsequently checked, and data are entered into BCMA. If the doctor afterward, decides to continue the medication, he/she can import the medication data into the order menu, enabling nurse to administer the prescribed medication to the patient.

The nurse enters the room of Mrs. M. It is just past 17.00 hours.

Mrs. M: *"Hello nurse, at this time of the day I normally take Tramal."*

The nurse scans the barcode on the wristband of Mrs. M., sees that the first administration entered by the doctor is 22.00 hours. The nurse then scans the medication and hands it over to Mrs. M.

Mrs. M: *"Excuse me nurse, but this pill has a different color. I am not going to take this."*

Nurse explains that the hospital probably has a different supplier to the formulary, which explains this difference.

The husband of Mrs. M, who happens to be present at the bedside, agrees with the nurse and tries to convince his wife to take the pill. Eventually, he gets Mrs. M. to take the medication.

Scene 99.

Mrs. L. asks for her diclofenac (pain medication).

N(urse): *"Let's see (thinks out loud), how many days after surgery. (Hums)..actually, you are supposed to be discharged today?"*

Mrs. L: *"Yes, but something came up." (talking simultaneously).*

N: *"Yes, but that is why the pain medication has been stopped because you only get this the first…..(doesn't finish her sentence, but N refers to a protocol that prescribes how long patients receive pain medication after surgery)."*

Mrs. L: *"So, I get nothing for the pain?"*

N: *"Three days yes, no, no that's the principle."*

Mrs. L: *"Well that's clear then."*

N: *"Yes…..do you have pain now?"*

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Mrs. L: *"Yes.. I will feel comfortable when I can get one."*

N: *"It gives relief?"*

Mrs. L: *"Yes, sure."*

N: *"Euhm…"*

N: *"You can get these painkillers in every store in town."* N looks at the researcher to see if he agrees.

Mrs. L: *"When I use diclofenac, do I have to take antacids?"* Mrs. L. knows this from the experience of recent days.

N: *"Yes, you'll have to use pantazol. At home I also use diclofenac without pantazol, but it has been found that this can become problematic."* (again talking simultaneously with the patient). *"But if you want I can give you diclofenac right now."*

Mrs. L: *"That would be luxury."*

N: *"Luxury,* (starts to laugh) *We don't do luxury here, just painkilling."*

Double Institutionalization

Using an IE lens allows us to see in the two scenes how both, the two patients, and even the acting nurse(s) are institutionally ruled. This ruling, however, differs with regard to context (i.e., home situation versus hospital situation). For instance, the moment that Mrs. M. points out to the nurse that this is a pill she does not recognize, Mrs. M. appears to partake in the institutionalized ruling of her home situation, where she is confronted with the preference policy of her insurance company to only reimburse designated versions of medication. Of interest, the hospital pharmacy has its own purchase system of medication, which means that as soon as Mrs. M. is admitted, she will enter into a different part of the insurance system which, due to different ways of financing, requires the hospital to provide Mrs. M. other versions of the same medication.

However, it is not the only institutional ruling that dictates the manner of medication distribution with regard to Mrs. M. The fact that at first Mrs. M. refuses to take the pill she does not recognize is also because she is accustomed to the leaflet of her home medication, which contains governmentally issued instruction for people to be responsible citizens, and never take medication you do not recognize. As patient of the hospital, she has also been asked to be vigilant, and take action whenever she perceives potential risks (as instructed per hospital safety card, specifically designed for elderly patients and distributed on admittance).

Mrs. M. does not enact safety through a systemic conception of efficiency, but rather she enacts it by worrying and articulating how her home medication habits differ from the medication habits in and out of the hospital. The reason she left her medication at home is because she automatically assumed that the same medication would be provided by the hospital as soon as she was admitted. The nurse who scanned her bracelet cannot find the right medication in the system, and turns up with a pill with a totally different name, leaving Mrs. M. even more worried. Consequently, by initially refusing the medication, Mrs. M. is also addressing a safety issue in relation to her medication, which appears not be properly valued as such by the nurse. Eventually she agrees taking the other medication, but only after mediation of her husband, and because she does not want to be a burden to the nurse, thereby ultimately partaking in the institutional ruling of the hospital.

With regard to Mrs. L., the nurse is looking for a loophole within the hospital protocol, trying to find legitimization that might solve this practical problem. There are strict rules within the hospital about the use of diclofenac, as the nurse is not allowed to provide Mrs. L. with diclofenac without a doctor's prescription, even though outside of the hospital, diclofenac can be bought in practically every drugstore. Another one of those rules dictates that patients always have to combine the use of diclofenac with antacid, which is (also) not the case outside of the hospital. The nurse even confesses to Mrs. L. that she herself uses diclofenac without antacid at home.

Double institutionalization can thus be traced in both cases. In the context of their home situations, Mrs. M. and Mrs. L. are institutionalized through the rulings of their general practitioner and local pharmacist, and the insurance company that all have a say with regard to the prescribing of their medication. However, as soon as they are admitted to the hospital they are confronted with an additional institutionalization that leads to different rulings (of the same insurance company). Mrs. M. and Mrs. L. seek ways to cope with this form of "double institutionalization." To Mrs. L. it is not only a matter of taking the medication, but also about what meaning the nurse gives to taking diclofenac both within a hospital and within a home situation. In hospital, safety considerations including scientific knowledge (i.e., diclofenac to be combined with antacids to prevent the risk of ulcers) appear to prevail, whereas in the home situation other considerations such as habit, practicality, and extra expenses appear to be more important when combining medication.

In both cases. Mrs. M. and Mrs. L., who are initially part of the institutional ruling of home-care pharmacy, are confronted with the institutional ruling of the hospital after admittance, which ultimately leads to Mrs. M. acquiescing to the institutional ruling of hospital regulations, despite her attempts to stay loyal to her home medication.

Workaround

During observations we frequently witnessed nurses being obstructed by BCMA as the system did not support the patients'

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specific medication needs at that moment. The nurse would then "work around" the system (thereby breaking the rules) to achieve the desired response. With regard to Mrs. L., BCMA as technology only shows the entered orders, despite the underlying discussion between the nurse and Mrs. M. about the difference in medication (specifically in pill color) with regard to the medication she is used to taking at home. The nurse and Mrs. M. thus have to adapt to what the system dictates because not complying would ultimately result in no pain relief.

Due to the late admission of Mrs. M (17.00), the physician does not know whether she has already taken her medication at home, and because it occurs at the end of his shift there is also time pressure to prevent that Mrs. M might take a double dose, he enters "first distribution" to commence at 22.00 hours into the BCMA, to be on the safe side. Fortunately, Mrs. M. points out that she has not taken her medication yet, and due to her experience, the nurse also immediately understands what the underlying intentions of the physician were when she read his directive. So she solves this problem by selecting the admission of 22.00 (even though it is still early, around 17.30), and hands over the medication to Mrs. M.

The nurse subsequently writes down on her printed patient list that the admission of 22.00 (which has now already been given at 17.30) has to be changed into the BCMA as a "one time admission." (thereby not disturbing the initial directive of the physician). This is an alternative route she discovered in the BCMA. If she does not do it this way, official protocol dictates that she has to bother a physician and convince him or her of the fact that the whole order of distribution in the BCMA will have to be re-entered, which is very time consuming.

In case of Mrs. L., the BCMA and the protocol appear to rule the deliberations of the nurse, and leave the patient with a remaining problem: the nonelimination of pain. Technology demands a new order, even though the actuality of the situation might ask for a different intervention. For instance, in the case of Mrs. L. BCMA makes the nurse focus on the protocol instead of Mrs. L.'s message, telling her she is in pain. BCMA indicates to the nurse that it is no longer permitted to provide her with painkillers. However, because Mrs. L. is clearly in pain, the nurse chooses to bypass the system by virtually extending Mrs. L.'s hospitalization, thereby allowing the administering of pain medication. During responsive evaluation sessions, which were primarily intended as means of validation, some nurses would respond to the observed data, offering potential solution to the perceived problem.

The examples clearly resonated among nurses, and they responded by stating that, to meet work demands, it was sometimes necessary to use workarounds. Some examples that were discussed during the responsive evaluation sessions were: (i) administering suppository rather than (the prescribed) oral pain medication due to nausea, but scanning it as oral to save time, and (ii) dealing with screen or system freezes of the BCMA by pulling the plug, even though this is not permitted.

DISCUSSION

Our findings indicate that BCMA appears to follow a linear logic that can contrast with the local "care logic" nurses adhere to, in order to best support their patient. As Mol has pointed out, "logic of care" is not a matter of simply making error-free choices, but is something that grows out of collaborative, continuing attempts to attune knowledge, technologies to diseased bodies and complex lives: "to act without seeking to control. To persist while letting go." (18). BCMA, however, seems to provide barrier when trying to solve a problem or dilemma, which comes to the surface as a result of the institutional ruling that is mediated through the BCMA. Although these problems are partly caused by either institutional policies or human error, they only come at the forefront *because* of how the BCMA interferes with the nurses work. As a consequence, both nurse and patient are constantly looking for opportunities to work *around* instead of *with* the BCMA. Our data have shown that BCMA also has, flaws, but that this is made visible primarily through the workarounds of the nurses.

According to Verbeek, technologies can be the terminus of our experience. This "alterity relation" occurs when interacting with a device as if it were another living being or intelligent actor, as appears to be the case with BCMA (19). Technology is not neutral within this triangular relation, it can be very steering and decisive, as is exemplified by nurses who state: "I cannot give you this medication because the system will not let me." Instead of removing BCMA from the equation, both nurse and patients keep talking with, through, and around the technology; thereby remaining within the relational triangle the whole time. BCMA gives another meaning to even the most mundane forms of taking medication: rather than just being able to follow the instructions of the medication leaflet, protocolled mouse-clicks are constantly involved.

Consequently, BCMA can potentially set back the patient in his or her participation in the caring process, as BCMA becomes leading (i.e., color of the pill and request for pain medication) instead of the (need of) the patient.

According to Pols, users of medical technologies are involved in mutual activity, which shapes different goals that characterize the process, that may eventually lead to domestication, or rejection. In this process of experimenting, none of the actors stays the same (20). Nurses are in some sense dictated by BCMA, but they still also find agency to move around it to provide good care.

Nurses are not able to communicate this with the organization. Moreover, we found that, as reaction to these "workarounds" in nursing care, the hospital had installed a so-called "flying brigade" consisting of managers. The flying brigade would descend to the work floor to point out to

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nurses that they had to follow the technology instead of working around it, even if the nurses had plausible explanation for their workarounds. As was seen in our findings, this can lead to the technology being "the main reference point to interpret and evaluate clinical patients outcome." (21). Consequently, BCMA should not be regarded as mere "instrumental" technology, as it consistently intervenes within the caring relation (19;21). Medication technology makes care safer if viewed from the triangle: patient, nurse, and technology. Although workarounds might be perceived as undermining the technology (supported by literature). In our view, knowledge of workarounds in use, actually can help improve the technology and safety of care. Our findings are supported by the article by Ash et al. on unintended consequences of information technology in healthcare (22). It is good that nurses (sometimes together with the patient) tinker around the technology very carefully to provide care that meets the patient's care needs.

Limitations

A potential limitation might be the setting where the research took place. Would BCMA work the same in all hospital units? Of course, a pediatric unit or an intensive care unit often entails a different nurse–patient relationship, whereby for instance, a surrogate's role becomes more prominent, and might possibly lead to different findings altogether. This however, warrants further study.

Another potential limitation of this study might be the lack of *patients' perspectives,* they were not directly included in our data collection, which might have enhanced the richness of our findings. However, our focus was not on the patient (and his or her experiences of BCMA) but rather on the relational triangle.

In our study, we did not clearly see an empowering side to BCMA as we observed nurses struggling with the system most of the time. It could be that we might have found something else if our focus was different, but as the empowering aspect was not direct object of our focus we have not included any reflection on this.

In conclusion, the use of BCMA is often an extension of institutional ruling, which can profoundly affect the patient's participation in the care process. This results in patients becoming even more dependent on technology than nurses who use it. BCMA on one hand opens opportunities for prevention of errors, but on the other hand data shows that it alters nurse–patient relations as shown in the example of getting acquainted (7). The dominant view within the hospital setting is that reduction of the human factor through the introduction of more advanced technology increases patients safety. This research shows that, while being stuck between the organizational ruling and patient's needs, the processes of nurses deliberative tinkering nevertheless supports safety (7).

As Tronto pointed out, the caring process starts with caring about: "It calls for moral quality of attentiveness, of a suspension of one's self-interest, and the capacity genuinely to look from the perspective of the one in need." (23: p. 34). However, due to its systemic rationality, the use of BCMA inherently involves turning attention away from patients. Or as Achterhuis formulates it: "Technology preordains or at least channels our decisions." (24: p. 20).

Ultimately, any hospital organization wishing to implement new care technology successfully, should take into consideration how new technologies both continuously affect the caring relation and the organization of care in general, rather than viewing it as a relational neutral tool. Using qualitative approaches such as IE and combining it with elements of practice theory might be more fruitful in determining how institutional textual ruling might influence nurses' actions and behavior.

Ideally, hospitals and vendors should invite nurses and patients to participate in the development, preferably *before* implementation of medication technology, so that BCMA is used in such a way that it addresses specific needs of both nurses and patients.

CONFLICTS OF INTEREST

No conflict of interest has been declared by the authors.

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