Enacting Computer Workarounds Practices
within a Medication Dispensing System

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Abstract

*Computer workarounds* in health information systems (HIS) threaten the potential for gains in efficiency through computerization aimed at reducing process variability. Eliminating such workarounds is desirable, but information system (IS) researchers tend to treat computer workarounds as black-boxes, while HIS researchers are primarily concerned with descriptive or prescriptive remedies. We propose to open the black-box of computer workarounds and study them as *situated practices* that consist of adjustments to existing computer-based procedures, which are enabled by the negotiated order of a hospital. This negotiative property of a hospital’s organizational environment allows for *interpretive flexibility*, in which physicians stretch certain rules in practice, while inducing others to cooperate in this. We illustrate this conceptual framework with a non-participant observer case study of a medication dispensing system used in a teaching hospital to support a prior-approval policy for anti-microbial drugs. Within these enacted workaround practices, we found significant variety in roles, timing and interactions, which boil down to a pattern of four practices revolving around one function of an HIS. Our research extends the literature on computer workarounds in IS and HIS by proposing a theoretical understanding of workaround practices based on a contextual healthcare study.

**Keywords:** computer workarounds, health information systems, negotiated order, medication dispensing systems, situated practices, interpretive flexibility
INTRODUCTION

Computer workarounds are a post-implementation phenomenon widespread in organizations. They are commonly defined as non-compliant user behaviors vis-à-vis the intended system design, which may go so far as to bypass the formal systems entirely (Koopman and Hoffman, 2003). The literature on the design, development and implementation of information systems (IS) often takes a black-box approach to this phenomenon, resulting in a lack of theoretical visibility (Ciborra, 2002). Indeed, IS researchers have generally focused their theoretical energies on the intended use of information systems, devoting much less attention to computer workarounds (e.g., Burton-Jones and Straub, 2006; Devaraj and Kohli, 2003). Therefore, the theoretical understanding in the IS literature of the inner workings and dynamics of computer workarounds remains rudimentary (e.g., Ciborra, 2002; Boudreau and Robey, 2005; Ferneley and Sobreperez, 2006).

In service industries, the primary impetus for computerization of work and task environments is to reduce variation in organizational processes, thereby increasing output quality (Schmenner, 2004). This motive is nowhere more pronounced than in the field of healthcare, where health information systems (HIS) are expected to produce significant gains in the quality and efficiency of healthcare delivery by reducing process variation (U.S. Institute of Medicine, 2001). However, alongside the increasing computerization of healthcare delivery, there is a parallel increase in the number of computer workarounds (Murray, 2001). These workarounds may ironically result in the persistence of, or even an increase in, process variation, short-circuiting the gain in efficiency that is one of the primary goals of computerization in the first place. Given the precarious balancing act that clinicians must engage in when interpreting and executing physician orders in real-time, workarounds in healthcare impact both efficiency and patient outcomes (Harrison et al., 2007).

HIS researchers are attempting to identify the reasons for such computer workarounds and to develop ways to eliminate them, especially as regards medication
ordering systems (Rochon et al., 2005; Hurley et al., 2006). However, the scope of such research is largely limited to providing a descriptive or prescriptive understanding (Kaplan, 2001) of the factors that may facilitate or inhibit workarounds. For example, Rochon et al. (2005) point out that unique prescribing issues require modifications to medication ordering software. These researchers warn that workarounds will take place, but do not identify their root causes. In general, HIS researchers have devoted little attention to producing a satisfactory theoretical understanding of the complex social-technical aspects of computer workarounds (see an overview by Harrison et al., 2007).

Our research aims to address this potential gap in the IS and HIS literature through a proposed framework that can account for the existence of computer workarounds as situated practices (Orlikowski, 2000, 2002). Within this framework, we conceptualize such practices as being enabled via a distinct social dynamic characteristic of professionally oriented organizational environments, i.e., a negotiated order (Strauss et al., 1963, 1964, 1985/1997). Hospital environments, in particular, afford physicians a degree of latitude in the implementation of rules and procedures. This can result in an enabling environment for the enactment of computer workarounds, an atmosphere that is often lacking in less professionally oriented organizations.

We illustrate this framework of computer workaround practices and their enactment dynamics through a case study of a hospital medication dispensing system in a leading Mediterranean teaching hospital. The dispensing system is meant to support a prior approval policy that is intended as a safeguard against the indiscriminate use of restricted anti-microbial drugs that can encourage the growth of drug-resistant bacteria (see research on similar policies as reported for example in De Souza et al., 2006; Arnold et al., 2006; Thoung et al., 2000).

The contributions of this paper are twofold. First, it helps make IS/HIS workaround practices and their underlying dynamics more visible and transparent by revealing their critical underpinnings, namely, social interaction to elicit or compel collective action and cooperation in their enactment. Second, it adds to IS/HIS design science practice by offering insights into the behavioral underpinnings of existing
workaround practices. These insights can be used to make IS/HIS more workable in the future.

The remainder of our paper is organized as follows. First, we analyze the potential gaps within IS and HIS research on computer workaround practices and present a framework for analyzing them. Second, we go over the details of our research methodology, including the data collection and analysis protocols. Third, we present our findings on the observed workaround practices, highlighting their facets of social interaction. Fourth, we discuss potential extensions of the existing research based on our findings. Finally, we conclude by pointing out how our findings inform the future design of IS/HIS.

THEORETICAL FOUNDATION of RESEARCH

A Black-box Approach to Computer Workarounds within IS Research

Historically, IS researchers have trained their theoretical eyes on the sanctioned usage of systems, while paying relatively little attention to non-compliant or non-sanctioned uses, including computer workarounds (Ciborra, 2002). Recent works significantly extend our theoretical understanding of computer system use (see for example, Burton-Jones and Straub, 2006; Jasperson et al., 2005; Deveraj and Kohli, 2003). Despite the pervasiveness of computer workarounds (McAfee, 2003; Hayes, 2000), they have not received a proportionate level of attention from IS researchers (for exceptions see Boudreau and Robey, 2005; Orlikowski and Iacono, 2001; Orlikowski and Yates, 2006; Wagner and Newell, 2006).

Since Gasser (1986) and Gerson and Star (1986) published their studies, there have been calls for IS scholars to produce more research focusing specifically on how computer workarounds are articulated in practice (Orlikowski and Iacono, 2001). Despite these calls, computer workarounds remain an under-theorized area of research in the IS field (Orlikowski and Yates, 2006). For example, two recent studies shed fresh light on workarounds beyond the IS design and implementation phases of projects. Boudreau
and Robey (2005) studied ERP implementation in a large university and discovered that the project resulted in workarounds that users employed to avoid the work processes that they perceived to be rigidly embedded in the software design. In their study of IS use in a retail store and a public fire department, Ferneley and Sobreperez (2006) proposed that IS resistance is a strong contributor to the presence of workarounds. These two articles offer insights into factors that contribute to workarounds but are less helpful on how such workarounds are enacted in practice. Workarounds, from a research perspective, continue to remain black-boxes in IS (e.g., Orlikowski and Iacono, 2001) and in HIS (e.g., Chiasson and Davidson, 2004). Therefore, a deeper theoretical understanding of the inner workings of workarounds is needed, and may also prove useful in devising solutions to lower their incidence. This view is consistent with Orlikowski and Yates’s (2006) recent call for IT researchers to de-black-box such IT-related organizational phenomena by offering At least some account of what actors (at various levels within and across organizations) are doing with the technology “on the ground” and over time. We believe that such approaches are particularly valuable as they afford the possibility of accounting for the messy, dynamic, contested, contingent, negotiated, improvised, heterogeneous, and multilevel character of ICTs in organizations...[and] everyday practices...to...allow us to articulate relations between work practices, situational contingencies, and organizational patterns (p. 132).

**HIS Research on Computer Workarounds: Description and Prescription**

IT-assisted modifications to medication delivery procedures are intended to reduce process variation, thereby contributing to increased healthcare quality and efficiency. Hospital pharmacy-related information systems in general, and medication ordering and dispensing systems in particular, constitute a distinct class of IT applications, in which medication errors and over-dosage are targets of improvement (Ringold et al., 2000). Although IT applications that control medication ordering and dispensing are in wider use than ever before, there are still design and implementation challenges (Koppel et al., 2005). One important challenge that has been recognized as a fundamental issue facing HIS researchers and practitioners alike (Murray, 2000; Hurley et al., 2006) is the existence of computer workarounds (Murray, 2001).
These workarounds often take place due to specific medication or regulatory contingencies. For example, a regulation in a Canadian province was embedded as a feature in a drug dispensing and ordering system for long-term care organizations. This feature required the health facility to electronically record drug therapies and reorder quantities for each drug at prescribed intervals. In practice, pharmacists and interns banded together to invent a complicated real-time workaround that bypassed this computer-based procedure (Rochon et al., 2005). This workaround entailed printing a form and signing it, rather than merely resetting a flag on the computer. This example shows that workarounds are often recognized but not explained. The existing literature tends to have descriptive or prescriptive emphases, but there is a noticeable dearth of in-depth behavioral studies of computer workarounds within the healthcare environment; and few researchers have yet attempted to provide a satisfactory theoretical understanding of the underlying practices (Kaplan, 2001; Wear and Berg, 2005; Nemeth and Cook, 2005; Ash et al., 2004; Harrison et al., 2007).

**Computer Workarounds Practices: Enacting an Alternative Arrangement**

We propose to open the black-box of computer workarounds in order to make visible both their inner workings and their social aspects (Orlikowski and Iacono, 2001). It is our contention that some computer workarounds often have an important social component alongside their IT component, and that they therefore entail spontaneous collective action (i.e., lack organizational sanction). At least, this appears to be the case in the type of healthcare environment we are focusing on. For this type of collective action to occur, there must be a working agreement (tacit or explicit) among the actors to collectively bypass an existing system and enact an alternative arrangement in its place. For example, assume that a hospital pharmacist is only permitted to dispense a certain drug after receiving a paper approval form and setting the “Form Flag” to “RECEIVED.” However, in some cases he dispenses the drug based only on a phone call with the infectious medicine physician, without receiving a written form. From the standpoint of our research, this practice constitutes an intentional computer workaround, bypassing the officially sanctioned rule. Furthermore, this practice presumes a tacit
working agreement that allows the actors to substitute a verbal agreement for the formal rule requiring receipt of a signed form. This practice can be classified as collective action involving interactions between at least two actors, which entails the enactment of an alternative arrangement to the formal rule.

The presence of such adjustments (Gasser, 1986; Gerson and Star, 1986) to officially mandated computer-based procedures implies that the actors have (explicitly or tacitly) arrived at an alternative working agreement to enact such workarounds. In other words, social actors negotiate to enact a “deviation,” since without such negotiations there is little chance that any deviation would be enacted in practice. We refer to this negotiative property of a rule-in-practice as interpretive flexibility. Here we use interpretive flexibility to refer broadly to the malleability of organizational artifacts, including computer-based procedures, in contrast to the narrower usage of technology features that research on the “social construction of technology” (Pinch and Bijker, 1987) or the “duality of technology” (Orlikowski, 1992) tends to focus on.

In the context of our research, we link this interpretive flexibility of computer-based procedures to the negotiative characteristics of a hospital’s organizational environment or “negotiated order” (Strauss et al., 1985/1997). We accept Strauss and colleagues’ argument that hospitals are negotiated orders wherein relevant professional groupings often regard rules “much less like commands, and much more like general understandings: not even their punishments are spelled out; and mostly they can be stretched, negotiated, argued, as well as ignored or applied at convenient moments.” (Strauss et al., 1963, p. 153) We argue that within hospitals, the actions of physicians best fit the negotiated order model. Thus, they are able in practice to enact the rules in such a way as to stretch their official intent, and to enlist the cooperation of other professionals such as pharmacists and nurses in this process.

RESEARCH METHODOLOGY

A case study using a multi-method research approach (Mingers, 2001) is the basis of this research. In light of our interest in the negotiated order of hospital settings, a qualitative case study method was considered most appropriate (Yin, 2003; Lee, 1989;
Benbasat et al., 1987). The case study was conducted by the two authors, who constituted an insider-outsider research team as recommended by Eisenhardt (1989), an approach that has been successfully employed in IS research (Paré, 2004). The “insider” researcher has intimate knowledge of the medication dispensing system and associated work processes. Because of his direct involvement in the events being analyzed, this researcher was uniquely sensitive to the workaround practices that the key actors were engaged in. The “outsider” researcher had no involvement with the project aside from his participation in a few of the interviews and the conduct of research.

Qualitative case study research is subject to criticism due to potential researcher familiarity bias. However, a series of safeguards was worked out to reduce this potential problem. First, the use of an insider-outsider team can reduce familiarity bias (Eisenhardt, 1989; cf. Montealegre and Keil, 2000), since the outsider researcher serves as a devil’s advocate. Second, to reduce retrospective bias the outsider researcher was an active participant in some of the interviews. Third, as an additional control, feedback was obtained from multiple sources, including two different nursing groups within the hospital—nursing administrators who were participating in a workshop, and nurses from various units of the hospital who were in a classroom setting.

Case Background

In our case study, hospital administrators were interested in process improvement studies, especially those involving the ordering, dispensing and administering of medications. Permission was obtained from both the hospital administration and the institutional review board of the university’s faculty of medicine. The protocol allowed the researchers to shadow anyone in a public area of the hospital, excluding private patient rooms (unless the patient granted permission). Our initial focus was on delivery problems with anti-microbial medications, which are called restricted medications. A secondary concern was tracking the approval of these restricted medications, since there is worldwide concern over inappropriate uses of these antibiotics (Kunin, 1993). These restricted medications are powerful antibiotics that, if used inappropriately, can encourage the growth of antibiotic-resistant bacteria.
The information system studied was the Pharmacy Dispensing System (PDS), which processes orders for all medications, including restricted ones. Hospital pharmacists use it to control the dispensing of medications. It also handles patient billing for medications, as well as refunds for any unused doses. Restricted medications require the approval of an infectious medicine physician, who must sign a “Request for a ‘Restricted’ Anti-microbial Agent,” informally known as a “fill form.”

Inefficiencies in the ordering and dispensing of restricted medications had been noted for some time. Therefore, an enhancement was added to the PDS that allowed clinicians on the units (a.k.a. floors) to check the status of fill forms via a computer interface. However, this was rarely done in practice. A year after our study began; a prototype web-based fill form was deployed on the hospital information system portal to further improve the restricted medication approval process.

**Research Method**

The present research began as an observation study, in which the researchers looked for hospital process improvements that were amenable to computerization. Over 250 researcher hours were spent in the initial observation period, primarily in open surgical units. We used *processual analysis* to identify and map the variations in context and process as key actors interacted and carried out the tasks involved in the restricted medication ordering and dispensing process (Pettigrew, 1997). This approach reflects the social and temporal elements embedded in a process, which a mapping oriented toward tasks or data would not afford. The processual analysis was validated by the aforementioned groups of nurses, who added additional variations during the course of their review. To help understand the context we used convergent interviewing (Driedger et al., 2006) to synthesize our description of computer workaround practices. There were more than 30 informants from the four actor groups, with whom we conducted more than 20 interviews that at times included multiple informants. The data collection approach is summarized in Figure 1.
Our research was guided by three key broad research questions. First, “What were the potential changes to the PDS and its method of use that were outside the norms mandated by the hospital?” This question aimed to reveal the kinds of potential adjustments or adaptations in the use or non-use of PDS that entailed putting into practice a computer workaround. These are described in greater detail below. Second, “What are the practices with regard to the use of the PDS in dispensing anti-microbial drugs that are subject to the prior-approval policy (i.e., when may computer workarounds be used) within the daily work routine, and to what extent are these different from the rules formally mandated by the hospital?” By examining practices through this research question, whether they were situated practices (Schatzki, 2001) or simply practices (Orlikowski, 2000), we aimed to make visible the details of process steps, the temporal order of execution, and the entire range of occupational roles of those who are involved in enacting a computer workaround.
Third, "What are the typical social interactions involved in the enactment of workaround practices to deviate from the mandated rule?" We wanted to know whether and in what way any of the actors (in their professional roles) asked directly or indirectly for consent from others to deviate from the rule. We discovered that this was a rather sensitive issue, and so we changed the thrust of the question to the following: "What are the typical interactions among the actors (i.e., attending physicians, infectious specialists, nurses and the pharmacists) when medication ordering problems arise?" This question was used to probe into the details of workaround practices in two ways. On the one hand, we used this question to launch preliminary inquiries into the world of workarounds, and then delve deeper into the actual details of the practices underpinning them. On the other hand, by studying this question, we meant to uncover the collective actions (initiated primarily through interactions) required to alter the formal hospital requirement that the system flag be set to “approved” before a restricted medication is dispensed to a patient. The terms “action” and “interaction” are defined broadly (see below).

The first research question set our first empirical priority, which was to establish whether computer workarounds were indeed occurring. In a manner of speaking, computer workarounds are the “dependent variable” for our study and their existence had to be established first. We relied on a two-pronged approach. First, we asked the informants to describe the process of using the PDS to dispense anti-microbial drugs. Second, we matched this process against the categories proposed by Gasser (1986). That is, workarounds entail adjustments to an IS and its procedural business rules (this terminology is equivalent to Gasser’s “adjustments to data and procedures”) as well as the usage of completely different procedures. This method of independently verifying the existence of computer workarounds by matching their descriptions against Gasser’s had the added advantage of lowering bias. In other words, we wanted to avoid asking informants directly whether they thought workarounds existed or not! During our shadow work, we had to augment Gasser’s three categories with a fourth one that corresponded to the range of workarounds we came across; namely, the concept of role
adjustment. Having established the existence of workarounds, our overall research task was then to uncover the practices of workarounds based on the processual analysis methodology described earlier.

Insofar as it consists of “stretching the rules,” a workaround adjustment reflects an effort to constitute an alternate social order (Strauss et al., 1963), which in our context means getting antibiotics to the patient regardless of the formal rules. From this perspective, a computer workaround is indicative of interpretive flexibility associated with the focal rule. Our processual analysis establishes the context in which the practices we observed took place. We highlighted how the collective action aspects of the workarounds were enabled through social interactions among the key actors. In this way, we developed an interaction-oriented processual map (see Figure 3 below). Our operational definition of the basis for collective action is that it involves, at a minimum, a dialogical communication (although more than two people can be involved) in two parts: social interaction and information transfer. Social interaction is defined as any communication between two or more parties, either direct or artifact-mediated, that affects an action. Information transfer refers to the informational aspects of communication, and can include attempts to notify, retrieve, collect or transmit information.

**FINDINGS**

The control practices for anti-microbial medications and the social interactions between the relevant actors within the hospital in this case study are expected to influence the process of ordering and dispensing restricted medication (i.e., the fill form). We drew on our understanding of the context to construct an interaction-oriented processual map, which represents the primary tasks, social interactions, and associated information transfers that we observed support the enacted fill form process.

Our findings are presented in five sections. The first section demonstrates the existence of a negotiated order through the identification of an enacted policy called the concurrent approval workaround practice. Second, we distinguish three representative computer workaround practices that revolve around a single information system function.
of the PDS in the fill form process. These workarounds are identified within the context in which they are invoked. Third, the distinguishing attributes of these workarounds are summarized. Fourth, the various interactions among the actor groups are analyzed as each workaround is invoked. Finally, we use a recently deployed web-based fill form prototype to demonstrate the utility of interaction-oriented processual mapping.

**Special Workaround Practice: Concurrent Approval as Enacted Policy**

The back of the current fill form contains the formal rules, dating back to 1985, that govern the use of restricted medications. Rule #2 states: “A physician wishing to prescribe a restricted antimicrobial will contact the infectious medicine specialist and obtain approval for the use of the antimicrobial prior [to] the writing of the order.” Rule #3 states that the form “will be sent to the pharmacy together with the prescription.” The fact that the formal policy requires prior approval is depicted graphically in the top half of Figure 2. If these rules are applied, the pharmacy receives only “approved” orders, after which it dispenses the requested medications automatically for the duration of the order.

The practice we observed in this case study ostensibly does away with this formal approval requirement by temporarily “disconnecting” the ordering and dispensing of a restricted medication from the processing of the approval. That is, in practice the first 24-hour supply of a restricted medication is dispensed without a signed fill form. This temporary disconnection is illustrated in the lower half of Figure 2. The temporary disconnection of the ordering and dispensing from the approval process is only possible due to flexible interpretation by the attending physicians, who receive support from the other actors. Their view is that “the patients’ immediate needs should be met by dispensing the needed medications while the approval process is underway.” This *modus operandi* purportedly satisfies the spirit if not the letter of the formal policy, as long as the physician completes the fill form within 24 hours.

This *de facto* policy of “concurrent approval” has never been formalized, making its existence tenuous and largely invisible to outsiders (i.e., anyone who is not involved day-to-day with the policy). Therefore, the pharmacy supervisor “got worried” and
needed to “ask her boss” when the research team tried to obtain a written copy of the purported policy that allows doses to be dispensed for 24 hours while formal approval is obtained. Later, the chief pharmacist told us: “It is in the policy. The first 24 hours is theirs [the doctors].” The enacted policy of concurrent approval acts as a “meta-workaround,” in that it governs the behavior of the other computer workarounds in the fill form process. In other words, this workaround is expected to contribute in some fashion to the spawning of other workarounds. We observed that rule deviation upstream led to further deviations downstream.

**Other Workaround Practices**

The enacted practice allows initial doses of a restricted medication to be dispensed without prior approval. However, dispensing beyond the first 24 hours is still dependent on the submission of an approved fill form; but at this point, other workarounds come into play. The overall dynamics shown in Figure 3 can be better understood by describing the specific context of each workaround. This goes to show that the efficiency gains promised by advocates of computerization may not be realized
when persistent workarounds underpin interactions. Note that the tasks with a striped background (Figure 3) represent actual work on a computer. The labels for workaround practices are descriptive, in that they signify the underlying behavior and indicate the distinctiveness of these practices.

**Figure 3 — Processual Analysis of Dispensing Anti-Microbial Medications**

**Habitual Workaround Practice.** The context of this practice begins at time $T_0$, when a physician evaluates a patient and orders a restricted medication on the multi-disciplinary order form. The nurse transcribes the medication order to the medication sheet and sends the profile (a carbon copy of the order). A messenger comes by every hour to take all the profiles to the pharmacy. The pharmacist receives the profile and types the order into the PDS (time $T_1$). Since a fill form is usually not included, the pharmacist sets the flag to “do not dispense” for the next dispensing cycle (e.g., the next day). However, for the first 24 hours, the requested doses of the restricted medication are dispensed anyway. This habitual workaround practice draws de facto legitimacy from the concurrent approval workaround. The existence of a negotiated deviation is presumed, so the execution of the habitual workaround can realistically be reduced to a matter of a mere information transfer.
Verbal Signature Workaround Practice. The physician who orders the restricted medication at time $T_0$ is supposed to initiate a fill form at the same time, according to the concurrent approval workaround. Initiation means contacting the infectious medicine attending physician (“infectious attending”), filling out the patient’s demographic information on the form, transcribing the order and adding the reason for ordering a restricted medication. Our real-time observations confirmed that physicians often either forget to initiate the fill form or deliberately choose not to do so. A senior physician said there was widespread sentiment among the staff physicians to the effect that “the fill form process is extremely restrictive and dysfunctional.”

The nurses have assumed the role of getting the physicians to complete the fill forms, but given the professional status hierarchy of a hospital, they can only “remind” a physician of this duty, and are not supposed to fill out the forms themselves. Reminding involves social interaction. A nurse said, “The physicians usually hate the [fill form] procedure and they don’t fill it out unless we [nurses] ask them to do so. Even when nurses tell them they try to escape from it!”

Once the form has been initiated, it is necessary to get an infectious attending to come to the unit. Generally, the infectious attending only comes to the unit during morning rounds, so “calling” and “finding” one implies more than asking him or her to come. A nurse said:

I think there is lots of trouble [with the fill form] because it requires the signature of the infectious attending[s], who are usually difficult to find. Plus there isn’t any proper communication between the departments [that might remind people to adhere to the fill form regulations]. ... It is mainly [left to be resolved] between individual doctors, nurses and pharmacists when taking care of patients.

Once the infectious attending arrives, he or she is supposed to evaluate the patient, review the lab results of the bacteria culture, if any, and complete the fill form. The infectious attending then signs the form. A nurse wrote in an email about the limited availability of infectious attending physicians:

One of our attending infectious physicians doesn’t even come to ask about the fill forms all through the day. I think that he forgets that there is something called fill forms! So whenever we have a fill form to be signed, we have to follow him all around to make him sign the forms.
The clerk in the unit takes the signed fill form down to the pharmacy. The pharmacist then takes the fill form and looks up the patient medication record on the PDS. Since the PDS had been set to “Do Not Dispense” at time $T_1$ because of the absence of a fill form, the flag must be cleared to allow dispensing at time $T_2$.

Many times the fill form approval cannot be completed within 24 hours. A nurse said:

> Usually if I find that the fill form is not filled in, I call the intern to come and write one so when the attending comes he will sign it. But if it’s late and I know that the attending is not coming anymore, then I’ll call the intern and he will call the attending on the phone and will direct the call to the pharmacy department for the attending to give the okay orally, so they can send the doses for the night. Then the fill form will be sent to the pharmacy the next day when the attending signs it. ... I think that we are patients’ advocates, so we can’t leave the patient without doses. This is why I try to follow this procedure, but of course that does not mean I am happy doing it.

One of the pharmacists confirmed this perspective in an email:

> When all these reminders fail and the patient misses his dose, we accept taking the order to resume the antibiotic by phone from the infectious medicine doctor directly. This will cover the patient for 24-48 hours till the infectious medicine doctor signs it.

In this case, the pharmacist decides to override the PDS and dispense the drug anyway, even though the approval is only verbal. This practice is therefore called a verbal signature workaround. Explicit social interaction between the infectious attending and the pharmacist takes place every time a verbal signature is requested.

**Fail-safe Workaround Practice.** When the medications are being prepared for the next 24 hours (prior to time $T_2$) the pharmacist reviews all the orders. Those marked “Do Not Dispense” are not processed. Since the flag on these orders was previously set to “no fill form,” the pharmacist does not have to do anything else. Several reminders are sent to the units warning about this impending “do not dispense” event. Several years ago, an enhancement was made to the PDS to allow staff on the units (e.g. nurses) to check the patient medication records to see if the fill form had been completed. However, nurses often don’t check the PDS, in part because of a
shortage of computers—there are only one or two per unit. When asked why they don’t check the PDS a nurse said:

We should! Instead of calling the pharmacy you should check the AS400. You can just track for how many days the patients have been taking the antibiotics. Doesn’t tell you [when it is expiring]. ...I don’t check the system to see if a fill form is needed.

When the medications do not appear at the unit after time $T_2$, the nurse inevitably calls the pharmacist to check the fill form status. Sometimes, the nurse first tries to find a solution on her own:

Usually nurses try to provide the medications on their own [by borrowing], but when meds are not provided, then doctors are contacted to fill in a fill form and to call the infectious doctor on his mobile phone and transfer him to the pharmacy to talk with the pharmacist to provide the meds for 24 hours until the fill form is sent the next day.

If borrowing is unsuccessful, the nurse attempts to get a physician to call an infectious attending. Some nurses report that a physician may prefer to prescribe a non-restricted antibiotic in this situation. One surgeon admits to “sending out a relative to get an oral pill to get around the fill form.” The fail-safe workaround practice triggers corrective action on the part of caregivers—nurses acting alone or in conjunction with physicians.

**Key Attributes of Workaround Practices**

The computer workarounds described above are situated practices that are enacted through an alternate negotiated order, implying social and collective action. Key attributes of these computer workarounds are summarized in Table 1 and briefly described below. The presence of these attributes indicates the existence of a workaround. However, each workaround consists of a combination of different attributes and is contingent upon its own specific practices.

We found the workaround practices have a time attribute that is critically important to their enactment. The habitual workaround at time $T_1$ makes routine dispensing of the initial 24-hour supply of a restricted medication possible. Verbal signature takes place prior to time $T_2$ to overcome inefficiencies in completing the fill form. After time $T_2$, when the PDS implementation and the practices enacted by the
hospital pharmacists can no longer be avoided, the de facto termination of an order is used to initiate alternative actions (i.e., the fail-safe workaround) to get restricted medications to the patient, whether this is officially sanctioned or not.

Our observations determined that adjustments related directly to computer tasks on the PDS are performed by a single person at the behest of others. This may be done implicitly, through a habitual workaround; explicitly, through a verbal signature workaround; or automatically, as a default action (i.e., the fail-safe workaround). The IS adjustments are generally simple—overriding a rule to permit dispensing. However, the context in which these adjustments are performed is anything but simple. Note that the concurrent approval workaround (also referred to as a meta-workaround) is unique, in that it requires no tweak or adjustment to the computer system, which is the common understanding of what a computer workaround entails.

Role adjustments are also apparent in these practices. For example, the pharmacist’s role shifts—at time $T_1$, during the habitual workaround, he is just a pharmacist, but at time $T_2$, during the verbal signature workaround, he becomes both a pharmacist and an enforcer of the fill form policy. The pharmacist is effectively bypassed as an enforcer when the fail-safe workaround is employed, since he or she has no knowledge of the remedial actions taking place, which may include a physician ordering a different medication. The nurse temporarily gains additional occupational stature during the situated practice of the fail-safe workaround, since she must help the physician find an alternate means of getting medication.

<table>
<thead>
<tr>
<th>Workaround Label Assigned by Researchers</th>
<th>Temporal View</th>
<th>Adjustment to</th>
<th>Indications of Alternate Social Order (Negotiation Traces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitual</td>
<td>Only @ $T_1$</td>
<td>N/A</td>
<td>Allow initial dispensing By Pharmacist Pharmacist does it with the (implicit) agreement of others</td>
</tr>
<tr>
<td>Verbal Signature</td>
<td>Around $T_2$</td>
<td>Pharmacist enforcer of policy Verbal approval for dispensing</td>
<td>By Pharmacist Infectious MD gets pharmacist to do it (explicitly)</td>
</tr>
<tr>
<td>Fail-Safe</td>
<td>After $T_2$</td>
<td>Nurse Physician</td>
<td>By physician Finding fastest and</td>
</tr>
</tbody>
</table>
Collective action is evident in these workarounds. Some are implicit and almost routine, such as the habitual emergency workaround. Others occur less frequently, when the need arises, and are explicitly collective, such as the verbal signature and fail-safe switch workarounds. Nevertheless, all these workarounds are interdependent and lead to a form of collective action. On the surface, a workaround involves only an information transfer (the actual IS adjustment). However, there are other integral elements that are social/collective action attributes, such as role shifts and social interaction (e.g., traces of negotiation).

**Social Interactions: Inducing Cooperation to Enact Workarounds**

Identifying workarounds allows us to glimpse at underlying practices that are not always visible. When a group of nurses in a class was asked if the hospital recognized that there was a problem with timely fill form compliance, they responded, “I don’t think so ... Not as long as we cover for them [physicians].” The implication for IS/HIS designers is that traditional “as-is” and “to-be” process mapping exercises, which are performed over a few sessions, are unlikely to reveal the underlying interpretive flexibility, which is a practical feature of the enacted policy. The underlying social interactions exhibit significant variety while following a repetitive pattern. The variety can be seen in the fact that different workarounds are invoked during the roughly 24 hours that pass between the initial order for the medication and the transmission of the completed fill form to the pharmacy. This variety also reflects, in part, the trajectory of a workaround that involves the changing roles and associated social interactions needed to negotiate a deviation from formal policy. The repetitive pattern appears in the routine aspects of the enacted policy.
The overall process depicted in Figure 3 specifically highlights information transfer tasks, which are intermingled with interaction activities. The workaround is inevitably influenced by what takes place upstream (i.e., the context). The interaction between the actor groups with respect to each workaround is illustrated in Figure 4 and summarized below.

**Concurrent Approval Workaround**

Concurrent approval is allowed as a negotiated deviation from the rule, while other deviations may or may not be allowed. This differential approach illustrates the interpretive flexibility associated with a rule-in-practice that is open to negotiation. The role of the infectious medicine physician in this workaround is, in effect, to give a green light to a working agreement. This is always done by tacit agreement with all the other parties. At the same time, elements of the formal policy are embedded in the PDS, as shown by the rule that bars dispensing medications without a fill form. A nurse spoke about this strict rule: "Like today I forgot to tell her [a colleague] I had Vancomycin 250 – then they [physicians] changed it to 400, but since I didn’t secure a fill form and I didn’t remind her to get a fill form, tomorrow she won’t get the Vancomycin.” Similarly, the physicians’ tacit understanding shows the interpretive flexibility that is associated with this rule. That is, the physicians interpret the rule so as to allow themselves 24 hours to complete the fill form. At least two senior surgeons admitted on the record that they have used the concurrent approval workaround to bypass the fill form altogether, due to the patient care contingencies they have faced.

**Habitual Workaround**

The habitual workaround is the end product of an order for a restricted medication that has been written, transmitted and processed. While Infectious Medicine tacitly agrees to the operation of the concurrent approval workaround, in practice it is maintained due to underlying interpretive flexibility, and is invisible to “outsiders” since it is not instituted as a formal policy. The pharmacy dispenses a restricted medication order for the first 24 hours based on this tacit approval. Since social interaction is not required for every order, the implicit approval may appear to be merely an information
transfer, when in fact it is a workaround to the formal policy. Meanwhile, nurses continue reminding physicians to complete the fill forms, drawing upon the legitimacy of the enacted practice of the concurrent approval workaround.

**Verbal Signature Workaround**

The spirit of the concurrent approval workaround is embodied in the practice of verbal signature. In order to request a verbal signature workaround, the unit must have first made a conscientious attempt, even if unsuccessful, to complete a fill form. The infectious attending is then asked by the attending physician to call the pharmacy and authorize dispensing the restricted medication for another 24 hours. The negotiated order and associated social interaction are apparent, but invisible to “outsiders.” A nurse related this story:

> One intern [was complaining] … I didn’t know I was supposed to call the Infectious doctor. I told her [the intern] why don’t you call her? [The intern continued to complain, so the nurse said], OK, I’ll call them. I didn’t know I’m not supposed to call the infectious doctor. Hello doctor … I need a fill form … The doctor said I’m not going to shout—I leave my shouting to my interns. I always count on my interns to call and I shout at them. So please don’t call me again.

The sanctioned role of the infectious attending is to approve the restricted medication ordered for the patient. If the infectious attending calls the pharmacist, this means that the fill form process has been initiated and has advanced enough to justify a call. This is how the social interaction underlying this workaround appears to be managed. This workaround is not automatic, however, and confrontations may occur, especially if the doctor’s phone call is perceived as a deliberate attempt to get around the absence of a fill form. A physician’s comment is instructive: “Sometimes doctors order by phone and sometimes they get into arguments with the pharmacist. The pharmacist is following the rules, so we can’t fault her.”

**Fail-Safe Workaround**

The fail-safe workaround is different from the others. In this workaround, a physician, together with a nurse, uses the concurrent approval workaround for remedial action. From the vantage point of the infectious medicine physicians and the pharmacy, the actions of the physicians and nurses using this workaround lack transparency. These
actions are therefore depicted as Xs in the lower right-hand side of Figure 4. For example, a common remedy is to “borrow” a dose from another patient. A nurse wrote in an email to us: “... Usually they [other nurses] borrow from other patients, or they use the extra medications that they have on the unit, or they ask on other floors if they have any extra medications that they can take on an [inter-unit transfer].”

![Figure 4 — Interactions to Induce Cooperation in Enactment of Workarounds](image)

**Implications of a Web-based Fill Form**

The IS/HIS designer who knows the context, the key attributes of workarounds and the social interaction among the actors is equipped to make reasonable assertions concerning the efficacy of a new computer feature. We have demonstrated that these workarounds exist because something in the upstream process deviates from the formal policy. In addition, the interactions among the actor groups have a critical influence on the workaround.

The usefulness of this knowledge can be seen by analyzing the impact of the web-based fill form, an application that was recently made available for testing through the hospital information system portal. The chief pharmacist said, “We are moving to
computerized fill forms so no one can claim the form is lost or ask who lost it or where it is. We don’t do data collection now because it is hard copy. When we get computerized forms, we will be able to collect data."

This application is intended to address inefficiencies in completing the paper fill form and the lack of compliance on the part of the physicians. The web-based application has an alert that notifies the pharmacists when a fill form has been submitted. The form simply requires the doctor to type in a patient number or name and executes a search of the database. The form is then completed digitally and submitted electronically.

The interaction-oriented processual map in Figure 3 shows how potential information transfer and social interaction tasks are intermixed to varying degrees for a specific workaround. Information-related tasks are the usual targets for computerization. For example, physicians can be notified to start a fill form when they order restricted medications. It is even possible to make it easier for them by pre-populating the patient demographic and copying the ordering information. But how can they be made to finish the rest of the form or get approval from an infectious attending? How does one summon an infectious attending electronically? A notification can be sent, but could just as easily be ignored. These examples serve as a way of assessing how further computerization might affect the workarounds we have described.

The likely impact of the web-based fill-form on the identified workarounds is summarized in Table 2. In general, the web-based fill-form targets the information transfer aspects of the policy and its workarounds, but leaves largely untouched the interpretive flexibility that physicians tend to associate with it. Therefore, the likelihood of this solution actually reducing the prevalence of workarounds is probably very low.

<table>
<thead>
<tr>
<th>Workaround</th>
<th>Antecedents</th>
<th>Expected Result</th>
<th>Likely Impact of Web-based Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent</td>
<td>Mixed - Social interaction &amp; information transfer</td>
<td>Increased compliance, fewer lost forms</td>
<td>Minimal – fill form interpreted as optional</td>
</tr>
<tr>
<td>Approval</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitual</td>
<td>Information transfer independent of social</td>
<td>Ability to audit</td>
<td>Minimal – stymied by concurrent approval and no linkage to ordering</td>
</tr>
<tr>
<td></td>
<td>interactions for approval</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>Social interaction followed by information</td>
<td>Fewer lost forms and phone calls</td>
<td>Moderate – those filling out forms benefit</td>
</tr>
<tr>
<td>Signature</td>
<td>transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall-safe</td>
<td>Social interaction &amp; failed</td>
<td>Increased compliance</td>
<td>Minimal – doesn’t address social</td>
</tr>
</tbody>
</table>
DISCUSSION

These findings stem from an in-depth non-participant observer case study of a prior approval policy for anti-microbial drugs. This policy is implemented on a hospital computer system. The results provide a rich description of the computer workaround practices related to one function of this system, and how they are enacted. These are in situ practices, and expose the heretofore largely invisible scope of such workarounds. The findings provide a deeper understanding of the emergent quality and variety, as well as the repetitive pattern of these workarounds. These workarounds constitute spontaneous collective action by the key actors, who interact with others to compel their cooperation. These findings may have significant implications for IS/HIS research and HIS design science practice, since there are strong linkages between the IS and the health context, as suggested by Chiasson and Davidson (2004).

This work addresses various calls for a more in-depth understanding of workarounds (e.g., Orlikowski and Iacono, 2001), as well as calls to explore how workarounds are enacted in practice (e.g., Orlikowski and Yates, 2006). Prior IS research treats computer workarounds as black-box phenomena, acknowledging their presence and going on to analyze the factors that contribute to their existence (e.g., Boudreau and Robey, 2005; Wagner and Newell, 2006; Ferneley and Sobreperez, 2006). A practice lens (Orlikowski, 2000; Schatzki, 2001) allows the use of processual analysis (Pettigrew, 1997) to describe these workarounds, focusing on the specific roles, temporal configurations, and interactions observed in their enactment in a hospital.

Within the black-box of this single system function that allows dispensing of a restricted medication, there is a significant variety in roles, timing and interactions, as well as a repetitive pattern of four practices revolving around one function of an HIS. These four practices are concurrent approval (or meta-workaround), habitual emergency, verbal signature and fail-safe. By de-black-boxing the actual practices of computer workarounds in the context of hospital medication ordering systems, two distinct
tendencies become apparent that have not been identified before: complexity/variety and repetitive patterns.

The HIS literature on workarounds has been largely descriptive or prescriptive in identifying factors that may facilitate or inhibit workarounds (e.g., Hurley et al., 2006; Rochon et al., 2005). By taking a more theoretical approach, the present study produces a deeper understanding of the underlying dynamics of workaround practices. Specifically, the policy of prior approval for anti-microbial drugs enforced via a computer-based system turns *de facto* into either concurrent approval or post-approval (at least for the first 24 hours after the drug is initially dispensed). This is possible in a hospital environment where a key dynamic is the presence of interpretive flexibility in enacting such rules on the part of physicians, who temporarily disconnect ordering from approval. In this situation, the medication dispensing system is subject to an anti-microbial prior approval rule that in practice is only loosely enforced, largely because of the deviations instigated by the attending physicians. This interpretive flexibility is characteristic of professionally oriented organizations (e.g., physicians in hospitals), which are thought to function more like negotiated orders (cf. Strauss et al., 1963, 1985/1997) than like strict organizational hierarchies. This autonomy is evident in the practices of attending physicians to flexibly interpret the prior approval rule and infectious disease specialists to flexibly enforce the rules. This autonomy provides a theoretical basis for explaining the existence of these computer workarounds and how they work in practice.

Spontaneous collective action exhibited in this case study is a novel aspect of the underlying practices. Prior IS and HIS research has been silent on whether computer workarounds are individual or collective phenomena (e.g., Boudreau and Robey, 2005; Murray, 2001). Some researchers have presented computer workarounds as largely individual acts of resistance (Ferneley and Sobrepefen, 2006). However, in this hospital organizational environment, there are certain computer workarounds that are enacted via collective action to enable the efficient functioning of the prior approval system for anti-microbial medication. Although workarounds may often be instigated (albeit by inaction) by attending physicians, they require explicit or tacit cooperation by others,
such as physicians who specialize in infectious medicine, nurses and pharmacists. Although it did involve conflict at times, this cooperation was usually induced or compelled through social interactions among these actors.

The dominant perspective on IT applications in healthcare is that they are intended to reduce process variation (Institute of Medicine, 2001). However, there have been calls for thorough cognitive modeling of the healthcare environment, in order to account for the “messy details” of practical contingencies that IT applications are intended to address (Nemeth et al., 2004). A key consideration in developing IT applications, especially those designed to reduce process variation (e.g., medication ordering and dispensing systems), should be to avoid the self-defeating propagation of additional computer workarounds. While the designers of the web form intended to eliminate the computer workarounds associated with the fill form, the assessment in Table 2 suggests that they may achieve the opposite of their goals; they may in fact spawn additional computer workarounds, such as surrogate signing. Such reflections on design practices provide insights into computer workarounds as novel forms of design science practice for both IS and HIS (Hevner et al., 2004).

Practical implications follow from this recognition of the hitherto “invisible” activities that are undertaken to enact such workarounds. Key actors (e.g. physicians) may instigate workarounds, which entail cooperative action by others to enact an alternative to the focal rule. The case study reveals the range of interactions that the key actors are willing to engage in and compel others to join in on, all in order to enact computer workarounds. Interpretive flexibility surrounding a computer-based rule is also unlikely to be impacted by facilitating its information transfer aspects. Thus, a web-based fill form may intend to make it easy for the approval to be signed. However, even with a web-based fill form, de facto concurrent approvals and post-approvals are likely to continue to take place without addressing the reasons for avoiding the approval process. The practices of avoidance and flexible interpretation of the rules involve disconnecting the ordering and dispensing of drugs from the approval process. This interpretive flexibility is consistent with prior research (Ash et al., 2004) that asserts that
communication, especially within a hospital workflow, is more than information transmission.

The single qualitative case study produced certain abstractions as regards the pattern of four workaround practices and the interpretive flexibility that undergirds them. Future research is needed to provide further testing to extend the generalizability of these abstractions. The practices we have studied take place within a teaching hospital, and specifically within its medication ordering and dispensing policies and systems. Such testing should develop the potential applicability in similar environments.

Further research is also needed in at least five more areas directly opened by this research. First, additional cases can be studied in order to address different workarounds in similar settings to ours. Second, research should be done on other ostensibly professionally oriented organizational environments, e.g., brokerage firms, to determine if our findings are unique to healthcare. Third, research can be done on non-professionally oriented organizations, e.g., government agencies or manufacturing firms. Fourth, the current case can become the focus of a longitudinal assessment of computer-based solutions intended to reduce existing workarounds (e.g., plans by the hospital we studied to introduce electronic medication ordering). Finally, additional research is needed to explore in greater depth why the actors engaged in workarounds, because the reasons why the actors enacted workarounds in our study were drawn from opinions volunteered by the informants.

CONCLUSIONS

Computer workarounds are a reality in HIS, but they are seen as being at odds with the process variation reductions that are the goal of IT applications in the first place. This paper contributes to the theoretical understanding of this reality by identifying some situated practices surrounding computer workarounds in order to provide further information on HIS design and use. The existing IS literature treats computer workarounds as aggregate phenomena and focuses on their preconditions, as
well as on the factors that contribute to their existence. The existing HIS literature on computer workarounds is largely concerned with descriptive and prescriptive approaches to their minimization. Although the insights generated are useful, the practices by which computer workarounds are enacted, and the dynamics that drive them, are still effectively treated as a black-box. We have broken open this black-box of a single system function and analyzed its inner dynamics, casting them as spontaneous collective action that enables the enactment of computer workarounds. We have established that computer workarounds consist of social interactions and information transfers that form the underpinnings of this collective action.

Our analysis is grounded in a negotiated order approach to social organization, which helps us provide a more in-depth, realistic understanding of the computer workaround practices we have observed. Using the negotiated order framework, we analyzed the workarounds actually enacted for a prior approval policy for anti-microbial drugs supported by a medication dispensing system in a hospital. These computer workarounds consist of deviations from official policy, which are possible because of the interpretive flexibility applied to rules in a professionally oriented organizational environment. Each workaround practice consisted of a mix of adjustments to the policy, a unique temporal sequence, dialogic social interactions and specific information transfer activities. However, there was also a repetitive pattern to the observed practices—namely, there were four workarounds seen repeatedly: concurrent approval (meta-workaround), habitual emergency, verbal signature, and fail-safe.

The key insights arising from the preceding analysis of workaround practices are as follows. First, computer workarounds exist within this healthcare setting because of the interpretive flexibility of the prior approval policy, which is characterized by the negotiated order dynamics of a professionally oriented organization. Second, the disconnection of drug ordering and dispensing from the approval process, which is the de facto basis of concurrent/post-approval policy as currently practiced, is likely to prove resistant to further computerization, even via web-based fill forms, as long as these measures leave intact the interpretive flexibility of the focal rule.
We conclude with two observations about our findings. First, researchers have called for practice-based development of design science knowledge and know-how. We found that in developing IT applications, especially those designed to reduce process variation in healthcare contexts (e.g., medication ordering and dispensing systems), there is a distinct possibility of triggering computer workarounds that only lead to increased process variation. Thus, our results suggest ways that IT designers can gain a better understanding of computer workarounds, which may contribute to a reduction of their occurrence in the future. Second, by breaking open the black-box that surrounds computer workarounds, we believe it is possible to open up a fruitful area of IS and HIS investigation. Specifically, articulation of the practices that undergird these workarounds allowed us to characterize the role relationships and contingent actions that we observed. The areas of suggested research provide a path towards a richer understanding and theoretical underpinning to workarounds that can guide HIS design science.

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