Information and Organization 33 (2023) 100475

Contents lists available at ScienceDirect

Information and Organization

journal homepage: www.elsevier.com/locate/infoandorg

Walking the line: Mindfulness with IT in hospital medication routines

Valentina Lichtner [a,*], Stan Karanasios [b], Federico Iannacci [c]

[a] Leeds University Business School, University of Leeds, Leeds, UK
[b] University of Queensland Business School, Business Information Systems, The University of Queensland, Brisbane, Australia
[c] University of Sussex Business School, University of Sussex, Brighton, UK

ARTICLE INFO

Keywords:
IT use
Mindfulness
Mindlessness
Information processing
Health information technology
Routines
Medication safety

ABSTRACT

This paper addresses the dilemma that organizations face when they introduce information technology (IT) to standardize and guide operations and improve performance, while also supporting staff mindfulness in using IT and questioning it, to safeguard against errors. People are warned to be mindful in using the information provided by IT, yet IT may contribute to their mindlessness. Organizational operations involve routine work, where work is distributed across roles, in space and time. To fully understand mindfulness or mindlessness with IT at work it is necessary to consider the routines in which they are embedded. We sought to investigate what factors might influence mindfulness or mindlessness with IT in the context of organizational routines. We carried out an in-depth study of clinicians using technology during medications routines in a UK hospital. The IT in this context aimed to guide and standardize clinical work to improve medication safety. The study uncovered several factors influencing mindfulness and mindlessness with IT: not only the IT design but also task design, individual experience and history of IT use, distribution of work, and the situation at hand. These are interacting influences on mindfulness and mindlessness with IT, each embodying a tension, as each may influence both mindfulness and mindlessness. The distribution of work and the dynamics of the routine over time mean that individuals in the routine may (mindlessly) entrust mindfulness in using IT to others, or to other moments in time. The study highlights the complexity of achieving mindfulness with IT in organizations, and a nuanced relation between mindfulness and IT in a routine work context.

1. Introduction

Organizations face a dilemma. On the one hand, to improve reliability and safety, they standardize operations by implementing information technology (IT), and expect employees to follow the IT system guiding their actions in operational routines. Employees may then respond automatically and unquestioningly to the information provided by the IT system – that is, use it mindlessly (Langer, 1992, 2014a). On the other hand, organizations face unexpected situations that require employees to be mindful when using IT and to question the information provided by the technology. Using information from an IT system mindlessly, when mindfulness is required, can lead to safety and operational problems.

This dilemma is particularly felt in healthcare organizations, where efforts to reduce variation in clinical care and improve patient

* Corresponding author at: Leeds University Business School, University of Leeds, LS2 9JT Leeds, UK.
E-mail address: v.lichtner@leeds.ac.uk (V. Lichtner).

https://doi.org/10.1016/j.infoandorg.2023.100475
Received 23 April 2020; Received in revised form 22 February 2023; Accepted 1 July 2023
Available online 14 July 2023

safety by having IT standardize and guide work procedures (Burton-Jones et al., 2020; LeRouge, Mantzana, & Wilson, 2007; Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996; Timmermans & Berg, 2010) must also constantly be balanced with patient circumstances and situated decision-making, in the knowledge that 'what characterizes the care of patients is contingency' (Montgomery, 2005, p. 4).

With regard to safety, medications are a particular concern for hospitals, and IT systems to support prescribing and administering medications are increasingly deployed in hospitals worldwide so as to reduce errors and harm from incorrect medication (Rinke et al., 2014; Westbrook et al., 2022, 2012). Electronic prescribing and administration systems are enterprise systems (Rinke et al., 2014) and, like other enterprise systems, they are a 'collective information system' (Negoita, Lapointe, & Rivard, 2018), embodying the interdependencies between roles and tasks in the medication process, and supporting communication and coordination along this process (Davidson & Chismar, 2007). These systems have played a critical role in building efficiency, reliability and safety into organizational routines (Berente, Lyytinen, Yoo, & King, 2016; Pentland & Feldman, 2008; Westbrook et al., 2022). However, they also have unintended consequences, such as introducing new sources of error (Koppel et al., 2005) and disrupting routines (Malaurent & Karanasios, 2020; Novak, Brooks, Gadd, Anders, & Lorenzi, 2012).

One contributor to errors may be when individuals follow the information embedded in the system without questioning whether things may be otherwise – i.e. when they do not critically interpret the information provided by the IT. Weick et al. (1999, pp. 36–37) refer to the 'reluctance to simplify interpretation' when making sense of information and events, as a key contributor to safety in high-reliability organizations. In their work, they draw on research by Langer (1989b, 1997) and her concepts of individual mindfulness. Langerian mindfulness refers to individuals critically interpreting the context and content of information (Langer, 1992, 2014b). Its opposite, mindlessness, refers to the interpretation of information based on categories and distinctions drawn in the past, the individual being oblivious to novel (or alternative) aspects of the situation (Langer, 1989b, 1992). While mindfulness and mindlessness may be considered at the individual level, in organizations individual action occurs as part of routines, with work activities that are distributed across people, space and time. Accordingly, an individual's single task with IT (e.g., entering health data, updating medication orders) relates to others' individual tasks across the routine process. Thus, from a Langerian perspective, we consider that users of IT show mindfulness when they critically interpret information provided by/through technology – and, in the workplace, about doing so in view of specific situations occurring during their routine work, that is, work distributed between people, in space and time.

Then, to understand mindfulness with IT[1] in organizations, it is necessary to analyze IT use during the unfolding of routines. Although the existing literature has shown that routines are embedded within a variety of institutional, organizational and technological factors (Howard-Grenville, 2005; Howard-Grenville & Lodge, 2021), little is known about what factors influence individuals' mindfulness or mindlessness with IT in organizational routines, leaving both a theoretical gap and a practical challenge for organizations dealing with the dilemma we mentioned at the start of this paper.

Here, we present a theory-building case study of distributed medication work routines in a hospital. We took a healthcare organization as a case that may be relevant to a variety of settings where systems and information guide routines. The healthcare setting is relevant to our theorizing in two important ways. First, healthcare involves information-intensive work that also has potentially safety-critical implications; to put it differently, the information and its interpretation matter (LeRouge et al., 2007). Second, clinicians working with IT on patients' medications provide an exemplary case of the use of IT during a routine made up of individuals (belonging to specific groups – doctors, nurses, pharmacists), distributed in space and time, contributing to a collective work process. Accordingly, in this paper, we ask the following question: *what factors influence mindfulness (or mindlessness) with IT in the practice of distributed routine work in hospitals?*

We draw on data from a large hospital in the UK where an organization-wide electronic prescribing and medication administration (EPMA) system was implemented. We undertook interviews with pharmacists, nurses, doctors and patients, observations of pharmacy stores, dispensaries and eight clinical wards, and documentary analysis relating to policies and procedures for the supply and use of medications.

Our findings explain how mindfulness with IT is influenced by an ensemble of factors: not only the IT but also the distribution of work, an individual's role, task design, personal background (knowledge, experience) and the situation at hand. We show how each of these factors embodies a tension, influencing IT use in the direction of mindfulness and/or mindlessness. The temporal dynamics of the routine also influence how these factors manifest and interact.

The remainder of the paper is structured as follows. In the next section, we make explicit our assumptions and understanding of mindfulness and routines, with specific reference to the healthcare context; we also review relevant work in the fields of information systems and management on whether and how IT may influence mindfulness or mindlessness, and what other factors may influence mindfulness with IT. We then describe our methods for the case study, and the process of analysis that brought mindfulness with IT to the surface and shaped our understanding of it. Next, we provide a brief background of the hospital context, the medication process, and the IT in use for medication work. We then outline our findings with regard to how mindfulness and mindlessness with IT manifest in this context, and the factors at play. In the discussion, we draw implications for theory and for a more general understanding of the relation between mindfulness and IT, as well as reflect on implications for practice. We conclude the paper with a summary of the key theoretical and practical insights.

[1] To be precise, in this study we are examining the use of the information available in the IT system. For brevity, we are simplifying and encapsulating this idea into the expression 'mindfulness (or mindlessness) with IT'.

2. Theoretical background

2.1. Mindfulness and mindlessness at the individual level

Langerian mindfulness is about people interpreting information by taking into account the 'context and content of information' (Langer, 1992). More precisely, Langer (2014b, p. 1) defines mindfulness as 'an active state of mind characterized by novel distinction-drawing that results in being (1) situated in the present; (2) sensitive to context and perspective; and (3) guided (but not governed) by rules and routines'.

Its opposite, mindlessness, is when 'the individual mindlessly forms a cognitive commitment to the information and freezes its potential meaning. Alternative meanings or uses of the information become unavailable for active cognitive use' (Langer, 1992). In this state of mind, 'rules and routines govern rather than guide our behavior' (Langer, 2014b, p. 1).

In healthcare, Langerian mindfulness is deeply rooted in the practice of modern medicine and constitutes a lynchpin of the 'evidence-based medicine' debate (Greenhalgh, Howick, & Maskrey, 2014; Sackett et al., 1996; Timmermans & Berg, 2010). Evidence-based medicine is translated into protocols and guidelines but, if these are interpreted and applied mindlessly, they risk creating harm (Greenhalgh et al., 2014; Greenhalgh, Snow, Ryan, Rees, & Salisbury, 2015); real evidence-based medicine is patient-centered, individualized, '*expert judgment* rather than *mechanical rule following*' (Greenhalgh et al., 2014, our emphasis). Mindfulness is then also at the root of medical reasoning, which involves interpretation based on experience, value judgements and specific observations, as well as guidelines (Epstein, 1999; Groopman, 2008; Montgomery, 2005). This mode of reasoning is also referred to as 'clinical judgement', the 'flexible, interpretative capacity […] to determine the best action to take when knowledge depends on circumstances' (Montgomery, 2005, pp. 4–5; see also Festila & Müller, 2022, p. 8).

Langerian mindfulness is thus a mode of information processing (1992; 2014b). An information processing perspective of individual mindfulness does not preclude a conceptualization of the cognition involved as embodied, emergent and situated (Suchman, 1987), compatible with a view of routines as performative accomplishments (Feldman, Pentland, D'Adderio, & Lazaric, 2016). From a situated perspective, individual mindfulness is shaped by the situation at hand (Suchman, 1987) and action potential (the repertoire of actions, Weick et al., 1999).

For the purpose of this study, we summarize and operationalize Langer's definition of mindfulness in terms of 'questioning the information'. In our data, clinicians, by asking questions about the information provided by the IT, show no premature cognitive commitment, and in asking the question 'is this information right?' they may show how they take content/context into account when using the IT. We take 'questioning the information' as an umbrella concept that also facilitates studying and observing mindfulness in practice, as it is otherwise methodologically difficult to observe and capture mindfulness in action.

2.2. Routine work and mindfulness

Healthcare practices manifest through routines, which may be more or less formalized, mediated through IT, accommodated or resisted (Greenhalgh, 2008; Greenhalgh, Voisey, & Robb, 2007; Veinot, Bosk, Unnikrishnan, & Iwashyna, 2012). The theory of routines has emphasized the ostensive and performative aspects of routines (Feldman & Pentland, 2003). While the ostensive aspects capture the routine in principle, the performative aspects embody the microcosm of actions that bring the routine to life.

During the enactment of routines, individuals' sensemaking and decision-making processes are framed by personal experience, including experience of past enactments of the routine (Feldman et al., 2021). From a Langerian perspective, this can be understood as 'drawing on past categories' when interpreting information. It is in this sense that routines have often been associated with mindless behaviors (Weick & Sutcliffe, 2006). For example, in everyday conversation, when one refers to routinized actions as mindless actions 'on autopilot', one is implicitly associating routines with mindlessness (Feldman et al., 2021). However, actions in the enactment of routines can be either mindless or mindful; that is, they do not necessarily have to be performed mindlessly (Feldman et al., 2021). Or, as Weick and Sutcliffe also point out, 'mindfulness and routine can operate simultaneously' (Weick & Sutcliffe, 2006, p. 522) and – taking routines as ongoing accomplishments (Feldman, 2000) – routines 'now appear to be more mindful and more variable and to consume more attention than was first thought' (Weick & Sutcliffe, 2006, p. 522).

Routines also support mindfulness by providing a frame through which events and information are noticed (Greenhalgh, 2008; Veinot et al., 2012). For example, when medications routinely prescribed in the IT in certain doses are ordered outside of this routine practice, they may be identified as a variation that needs to be checked. That is, past experience with the routine provides the background against which 'the unexpected' – errors or 'misfits' – can be mindfully interpreted. As Butler and Gray (2006, p. 214) note, 'from this perspective routines are a double-edge sword. They are helpful when they provide options, but detrimental when they hinder detection of changes in the task environment.'

Furthermore, Langer reminds us of a misconception of mindfulness taking more cognitive effort than mindlessness; being mindless does not save scarce cognitive resources (Langer, 2014b). Thus, there is not necessarily a trade-off between mindfulness and efficiency or speed in the enactment of routines. For example, driving a car mindlessly on a familiar road may give the driver the impression of being faster than when paying attention, but the journey may actually take longer than if the driver mindfully tunes into surroundings and traffic, finding opportunities to avoid roadblocks or potential alternative routes. Similarly, the mindless use of IT at work may not necessarily make the work routine faster or more efficient.

2.3. Information systems and mindfulness: Mindfulness with IT

Interest in mindfulness with IT has grown among information systems (IS) scholars over the years (Aanestad & Jensen, 2016; Butler & Gray, 2006; Carlo, Lyytinen, & Boland Jr, 2012; Dernbecher & Beck, 2017; Roberts, Bennett Thatcher, & Klein, 2006; Swanson & Ramiller, 2004; Thatcher, Wright, Sun, Zagenczyk, & Klein, 2018). Much of this research has mostly privileged the application of Weick et al.'s collective mindfulness concept (Weick et al., 1999). Collective mindfulness is explained as a 'collective mind', emerging from the interrelating of social activities (Weick & Roberts, 1993) and the enactment of aggregate mental processes (Sutcliffe & Vogus, 2014; Weick & Roberts, 1993). From a collective mindfulness perspective, groups, teams or organizations are the unit of analysis (e.g., Aanestad & Jensen, 2016; Carlo et al., 2012).

Nonetheless, some IS research applies Langerian mindfulness to study IT *development* (e.g. Matook & Kautz, 2008; Vidgen & Wang, 2009), *implementation* (e.g., Teo, Srivastava, Ranganathan, & Loo, 2011) and *adoption* and *acceptance* (e.g., Sun & Fang, 2010) and in a more limited way in relation to IT *use* (Dernbecher & Beck, 2017). In light of our research question, we are interested in the IS-related literature exploring factors that may influence individual mindfulness or mindlessness in using IT, and whether/how the IT itself may be a factor influencing mindfulness when using IT. We see this body of literature as characterized by three overarching positions on the interplay between IT and mindfulness. We make a clear distinction among these positions, although we acknowledge that this neat separation is not always reflected in the literature.

The first position views mindfulness or mindlessness as directly influenced by the IT. From this perspective, IT influences or determines the behavior of its users, making users mindful or mindless when using the IT (Curtis, Dennis, & Hilmer, 2017; Valorinta, 2009). For example, research indicates that specific IT designs can induce users to share information, discuss decisions, and support collaborative work (Curtis et al., 2017). Thus, this view is more concerned with what it is about the IT that makes users mindful or mindless. For instance, IT may negatively affect users' capacity to be mindful when over time they become over-reliant on IT and less inclined to reflect on environmental cues or question ways of working (Valorinta, 2009). This matches evidence in other fields such as human factors, or reliability engineering, of the effects of automation on individuals' understanding of the work they are engaged in (Backman, Bayliss, Moore, & Litchfield, 2017; Goddard, Roudsari, & Wyatt, 2011; Lyell & Coiera, 2016). This 'automation bias' may then lead users to being less open to novelty, less alert to distinction, less sensitive to contexts, less aware of multiple perspectives and less oriented to the present (i.e. they will be induced into mindlessness). On the flip side, Butler and Gray (2006) argue that poor IT designs (more specifically, unreliable systems) may induce mindfulness: 'in the extreme, reliable performance may actually be enhanced by [unreliable systems] that […] encourage individuals to seek out multiple information sources and critically evaluate the data' (p. 221). Thus, unreliable IT systems drive users to question information and decisions.

Overall, regardless of whether IT encourages mindfulness or mindlessness, this position only offers partial insights on the factors that contribute to the mindful or mindless use of IT because it fails to account for the experiences of the individual, as well as the wider context.

The second position offers an alternative view of mindfulness and mindlessness with IT that privileges individual character traits (Dane, 2011; Järveläinen, Sell, & Walden, 2021; Thatcher et al., 2018). This view is more concerned with the individual than with the IT. This links to the broader research on mindfulness that indicates how, because of dispositional tendencies, some people may be mindful more often than others (Dane, 2011). In this view, personality traits (e.g., agreeableness, openness to experience, neuroticism) are given prominence for their influence on behavior with IT, and individual predispositions to mindfulness or mindlessness will determine the quality of IT use (Thatcher et al., 2018). This is made explicit in Thatcher et al.'s (2018) definition of 'IT mindfulness' as an individual trait that influences a person's 'willingness to consider other uses' of the IT, and their 'interest in investigating IT features and failures' (pp. 832–834). Following this viewpoint, IT use is different depending on the traits of the individuals involved (Roberts et al., 2006). However, individuals' traits in relation to mindfulness and mindlessness are not fixed; rather, they can be changed through training towards mindful use of IT (Dane, 2010; Jensen, Dinger, Wright, & Thatcher, 2017). To promote mindfulness, Dane (2010) also suggests that experts should focus their attention more widely towards tasks and activities not only within but also outside their domain. By performing tasks in other domains, individuals are likely to encounter doubt-inducing exceptions to what they believe to be true about their domain of expertise, thus preserving their potential for flexible thinking within their expertise domain.

While the focus on the individual moves away from the focus on the IT, it is also limited because it ascribes mindfulness or mindlessness with IT to personality traits or predispositions, or training, without considering how cognition is influenced by the situations or contexts of IT use (Howard-Grenville, 2005; Howard-Grenville & Lodge, 2021; Suchman, 1987).

A third, less-explored position considers mindfulness or mindlessness with IT as influenced by a combination of contextual factors (Carlo et al., 2012; Kudesia, 2019; Ramiller & Swanson, 2009; Reina & Kudesia, 2020). This can include technological and organizational factors and the dynamic nature of the work, as well as the professional role and experiences of the individual (Carlo et al., 2012; Kudesia, 2019; Ramiller & Swanson, 2009; Reina & Kudesia, 2020). Taking a more integrative stance, from this perspective, an individual's mindfulness or mindlessness with IT is influenced by organizational conditions *and* the IT *and* the individual.

This situated view of mindfulness and mindlessness with IT overcomes the limitations of the two perspectives discussed above. However, this perspective is still loosely conceptualized and relatively unexplored in the literature, especially with regard to enterprise systems and organizational routines. As a result, we lack a comprehensive understanding of the factors contributing to mindfulness and mindlessness with IT. As noted, ascribing mindfulness or mindlessness to the IT or to individuals' traits only provides partial insights. In hospitals, such a narrow view is problematic because it may worsen the quality of care. Accordingly, a broader examination of the range of factors that contribute to mindfulness or mindlessness with IT is warranted, to produce new insights on how to reduce mindlessness in clinical work in hospitals, especially medication-related work. With this in mind, we address the following research question in this paper: *what factors influence mindfulness (or mindlessness) with IT in the practice of distributed routine medication work in*

hospitals?

3. Research design and methods

3.1. Study design

We took a field case study approach, in order to explore in depth the use of IT in the context of distributed routines. Our investigation was focused on hospital medication processes and in particular the role of pharmacists in this process. A 'tracer approach' (Combey, 1980) was employed that involved 'following the drug' across a hospital. Methodologically, drugs – or medications (we use the terms interchangeably) – were considered the tracers that can reveal phenomena within and across organizations (Combey, 1980; Hornby & Symon, 1994). In following the drugs, we learned about clinicians' IT use across hospital contexts – at the bedside with the patient, in the clinical ward, in the hospital dispensary, in management offices. We also learned about the many IT (and paper-based) systems in place. Importantly, we were able to understand mindfulness or mindlessness in terms of individuals' networks of activities over time and the broader context in which those activities are embedded (Dernbecher & Beck, 2017). We describe here the methods used to gather the data, the process of analysis that brought mindfulness with IT to the fore, and how we used this lens to explain the relationship between mindfulness and IT in this setting.

3.2. Data collection

Data collection was carried out in one of the largest teaching hospitals in the National Health Service (NHS) in the UK, with about 2500 inpatient beds. At the time of the study this hospital was implementing a new, organization-wide EPMA system (with initial deployment in a small number of wards) that would replace paper-based medications charts. A number of other standalone IT systems for medications, including a system for pharmacy dispensing and stock control, were also in place.

Data were collected between February and September 2016. A mix of qualitative data collection methods was used, including 34 interviews, 103 h of observations, and a range of documents. The NHS Research Ethics Committee granted ethical approval for the study. The hospital R&D office reviewed the study and gave consent for the research to take place on its premises. Participants were informed, gave their written consent for interviews to be recorded, and gave verbal consent during observations.

3.2.1. Interviews

Semi-structured interviews were conducted with a variety of stakeholders involved in the supply and use of medications (Table 1). They included: pharmacists, prescribers (mainly doctors), clinicians involved in the administration of medications to patients (mainly nurses), pharmacy staff, and patients who had been given permission to take their own medications. Pharmacists and pharmacy staff were the majority of our research participants. Among the different clinicians involved in the medication process, pharmacists have greater knowledge and expertise in medications; they have a specific responsibility to check and validate the orders, and they play a key role acting as the 'glue' in the collective medication process. In this hospital, they also led the implementation of the EPMA system.

Interviews averaged 40 min and were audio-recorded and professionally transcribed. Participants were asked to explain their work in relation to medications. Conversations mainly revolved around their information needs, their decision-making processes, their use of tools, their views and experiences with new technologies and digitalization, and the organization of hospital services aimed at supporting the supply and use of medications. (See interview guide provided in Supplementary data: Appendix A).

3.2.2. Observations

The interviews were supplemented by observations carried out in order to capture situated practices. Observations were conducted in various areas of the hospital: pharmacy stores, two dispensaries, eight clinical wards (four with and four without use of EPMA), and while shadowing a delivery person from the pharmacy to a clinical ward. They were conducted at different times of the day, including at the start of a night shift. A training session was also observed, in which a pharmacist instructed a doctor on the use of the new EPMA system, explaining rationales for use of its different functionalities in relation to different medications and patient needs. During observations of IT in use, participants were asked to 'think aloud' (Ericsson, 2006), to articulate and give insight into their choices and decision-making processes. Whenever possible, and with permission, these observations were audio-recorded and then transcribed.

Table 1
Summary of interviews.

Role	No. of interviewees
Ward pharmacist/Pharmacist specialists	8
Pharmacy support worker/Pharmacy technician	2
Information technology manager and staff (Pharmacy service)	4
Risk manager and quality performance manager (Pharmacy service)	2
Contracting, procurement, inventory (Pharmacy service)	3
Doctors in training/Medical consultants	4
Matron/Nurse manager/Ward staff nurse/Nurse specialists	9
Patients (with permission to self-administer medication)	2
Total	**34**

3.2.3. Document analysis

Hospital documents relating to policies and procedures for the supply and use of medications were also collected and analyzed. For example, (i) the hospital online formulary provided insights into listed medications available for use, those not to be used, guidance for use etc.; (ii) posters on walls regarding the implementation of the EPMA reminding staff to use the system with clinical decision-making provided evidence of management's attempts to have staff be mindful with the IT; and (iii) paper charts used for prescribing medications, ordering from the pharmacy, and administration to patients provided insights into processes. (See examples in Supplementary data: Appendix B).

Table 2
Factors influencing mindfulness/mindlessness with IT in medication routines.

Influencing factors/ high-level categories	Description			
	Influences mindfulness with IT through:	Exemplary quotes	Influences mindlessness with IT through:	Exemplary quotes
Technology design	Information availability/ 'visibility': widens the scope of attention and interpretation and brings greater awareness of others' work	*…[color coded drugs on EPMA] we can still prescribe them so the patient can have them, but it's just a bit of indication to a prescriber that if you prescribe this you might not be able to get it straight away…*	Reduced face-to-face communication; lessens scope of interpretation	*…I think a lot of the problem that you find is that people start to move away from patients more and more, the more electronic…*
	Decision support 'questioning' clinicians' actions	*…[a popup] can come up […] 'are you sure this is the medicine that you want'…*	Actions allowed by IT assumed to be correct	*… the assumption is 'well if the system lets me do it, then you should be able to do it'…*
	Information in the IT assumed to be incomplete	*… whilst EPMA might suggest an order level quantity based on historical data, my team in there will actually think, 'You know, we need a bit more of this, because we've got a bank holiday coming up, so we'll order an extra 30%,'…*	Information in the IT assumed to be complete	*… have you looked at the patient and actually physically looked at the product', 'well no', and there was almost a disconnect between the medicine and getting it into the patient, and the electronic prescription…*
Task design	Task design requires expanded information use	*…Level two [review] you'll be looking at the drug chart, […] at the patient's notes, you'll be looking at the bloods, just the patient as a whole, you might have to talk to the patient…*	Task design suggests limited information use	*… Level one [review] […] you're just taking it at face value…*
Distribution of work	Different roles bring different perspectives	*…I'm a prescriber as well as a traditional pharmacist, when you ask me to look at a patient and prescribe something you look at a patient in a completely different way…*	Different roles create expectations about others' actions that may lead to mindlessness	*…the pharmacist has signed [the prescription] […], so it doesn't really matter too much…*
	Individual as part of the collective: Awareness of others' work	*…I queried this one […], the doctors have done bloods today …*	Individual as part of the collective: Leaving mindfulness to others	*…I suspect […] nurses will just go down the list [on EPMA screens] with only one eye on the drugs looking for what's due then [not questioning the prescription] Because […] we've got pharmacists going around and doing that now…*
The individual knowledge and experience	Experience guides information use	*… you use those drugs more regularly, […], you understand how [they work], but then we might get a new antibiotic […] and it's the first time we've used it, so that's why, then, everyone would […] check…*	Lack of experience governs information use	*… more junior members of staff […] [without] years of [clinical] experience […] hadn't built the relationships with the doctors and the interpersonal skills, […] they would communicate through an electronic note…*
	Knowledge of the IT/ History of using the IT influences mindful information use	*You get used to [with experience, learning about the system]… Sometimes […] it doesn't recognize a certain sequence, so you've got to kind of split it down and then handwrite it.*	Knowledge of the IT/ History of using the IT influences mindless information use	*…certain people, especially if they're new, […] they'll just double click that, […] [if it's a re-dispensing/not a first dispensing], the warning don't get put onto it [must be aware of how the system works]*
The situation at hand	Patients/medications considered high risk	*…[for lack of time] I'm not going to worry about unless […] it's a high-risk patient…*	Patients/medications considered low risk	*[low risk patients' prescriptions] they won't get seen today 'cos I haven't got time…*
	Having time to be thorough	*I do consciously have to make the effort now and say, right, actually 'I've decided to review this patient [prescription] today', … [I am going to spend some time, talk to the patient, check more information]*	Being in a hurry	*…doctors 'cos they're in a hurry [they] just do that, copy without engaging brains…*

3.3. Data analysis procedures

We carried out the analysis by iterative immersion in the data, reviewing the literature, consulting existing content categorization schemes (Dane, 2011, 2013, 2015; Howard-Grenville, 2005; Valorinta, 2009; Weick et al., 1999) and building theory (Eisenhardt & Graebner, 2007), through conceptual leaps between data and theory (Sarker, Xiao, Beaulieu, & Lee, 2018) – a process known as abductive analysis (Tavory & Timmermans, 2014). As explained below, the process unfolded through line-by-line open coding, followed by a directed analysis.

Open coding involved immersion in the data through repeated line-by-line coding of field notes and transcripts with qualitative analysis software (NVivo v11). Codes were generated across a number of different themes and dimensions pertaining to objects, sensemaking and decision-making tasks, processes, and organization of work. In trying to make sense of these, and addressing the study's original interests, we initially focused on the medications. We found medications to be objects with inherent tensions: they are both therapies and poisons; they have value and costs. This means that working with medications is about dealing with trade-offs and managing risks for patients.

We then shifted our attention from the medications to the activity – the routine – by mapping the work, people and tools involved (Constantinides, Chiasson, & Introna, 2012; Howard-Grenville, 2005; Pentland & Feldman, 2008). Hospital medications work is an activity distributed among different people and roles – mainly doctors, pharmacists and nurses – each with their own responsibilities and understandings of a patient's medications. Their work is organized so as to deliver safe and effective treatment to each patient, but it is also delivered under time pressure, financial constraint, and with limited resources. As a result, care goals are balanced against prioritization of patient needs. Against this background of tension, pressure and dilemmas, practically all interviewees expressed

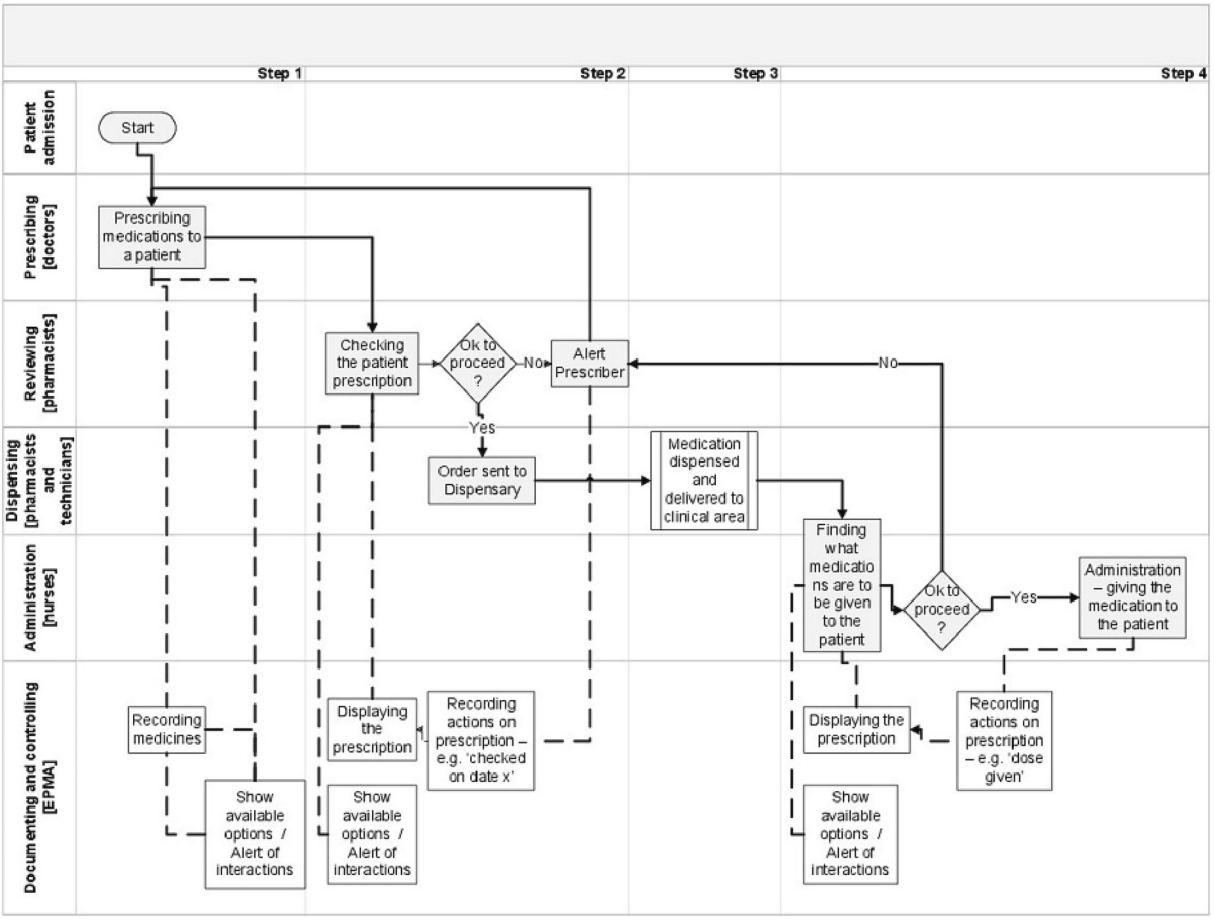

Fig. 1. Hospital inpatient routine. Note: The dotted lines indicate interactions between staff and the system. The steps (1–4) in the diagram are repeated over time during a patient's period of hospitalization, from admission to when the patient leaves the hospital (discharge). Step 1 (prescribing) includes: 'medication reconciliation at admission' (prescribing a patient's usual medications), prescribing medications to be given during hospitalization (repeated periodically during a patient's stay), and prescribing medications to take away after discharge. Step 2 (reviewing) is done at admission, then more or less frequently during hospitalization (depending on assessment of risks), and again before discharge. Step 3 (dispensing) is done any time a new medication is needed in the ward for the patient. Step 4 (administration) is done multiple times a day, depending on when a patient must take the medications, until the patient is discharged. To simplify, we did not describe the process of dispensing and delivery (Step 3).

concerns for medication safety and suggested that one of the main goals of implementing the new EPMA system was to improve safety. Reflecting on this, we noticed that in the medication activity unfolding in this hospital, especially among pharmacists, there was a reluctance to simplify interpretations of a patient's medications. Importantly, this process helped uncover that there were occasions for both mindful and mindless use of information about patient medications; that IT contributed to both mindful and mindless interpretation of this information and behavior; and that the organizational context – specifically the distribution of work, the pressures and constraints in terms of time and resources, and the work over time with a patient medication – all influenced mindfulness with the IT. We considered how mindfulness with IT may feed back to individuals over time, as individuals gain experience with medications or the IT.

Informed by the literature on routines as process and performance (Feldman et al., 2016; Feldman et al., 2021; Howard-Grenville, 2005; Howard-Grenville & Rerup, 2016; Pentland & Feldman, 2005), we then revised our initial analysis by coding the data into high-level categories: 'technology design', 'task design', 'distribution of work', 'the individual' (their knowledge and experience) and the 'situation at hand'. These worked as a rudimentary framework for an in-depth analysis of contributing factors to mindfulness with IT. We did not consider the categories to be self-exclusive (e.g., technology design embodies organizational rules for distributed work). In line with routines as performative accomplishments, and cognition as situated, we considered mindfulness with IT to be a complex sociotechnical achievement stemming from the combination of factors in these categories. In grouping the data around these high-level categories, we were able to identify factors that influenced either mindfulness or mindlessness with IT. We identified tensions across each of these categories, where IT influenced either mindfulness or mindlessness or both (as shown by parallel columns for each category in Table 2).

4. Hospital medication routines and the IT

The patient medication process is an overarching routine that is performed through a number of sub-routines, or micro-routines, at an increased level of granularity. For example, it includes a nurses' medication administration routine and, within it, one micro-routine of preparing the medication for administration and another of giving the medication to the patient. We describe here the overarching medication process and the context of distributed work and use of the IT, as a background to the analysis that follows. Based on our data, in Fig. 1 we provide a schematic representation of the medication routine, highlighting the different roles played by various

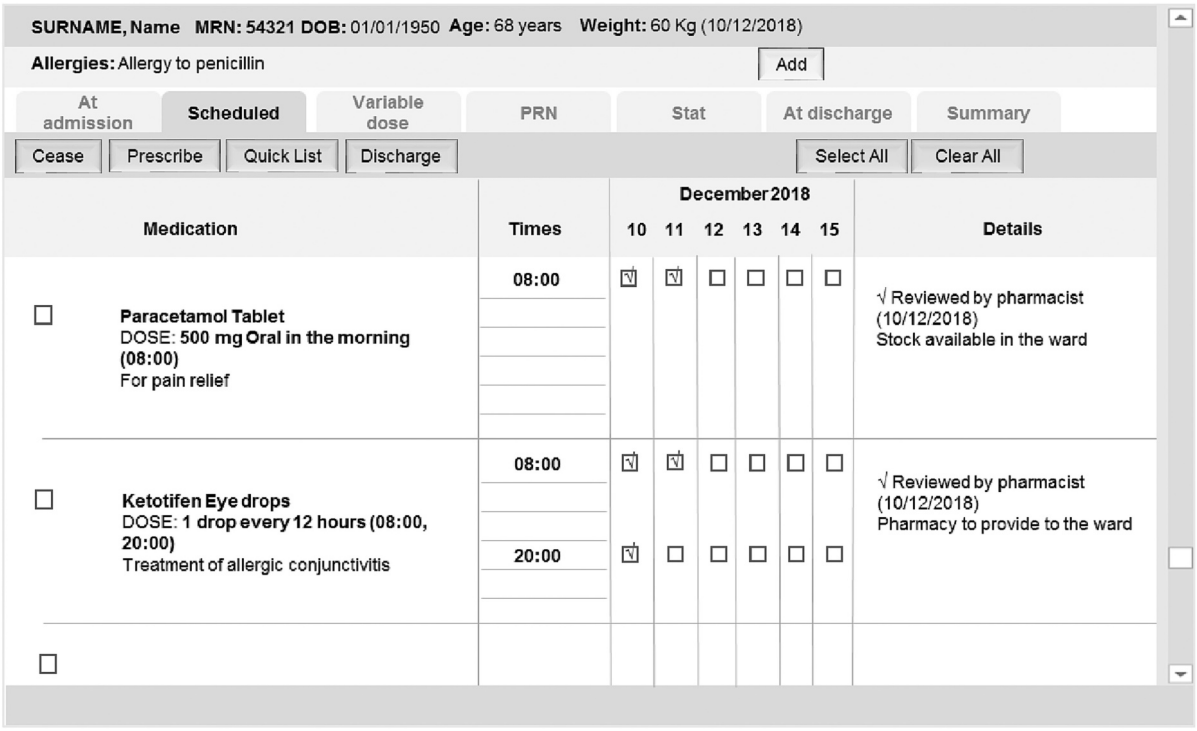

Fig. 2. The electronic prescribing and medication administration system (EPMA).
Abbreviations: PRN = '*pro re nata*', i.e. as and when needed; stat = '*statum*', i.e. to take immediately, once-only medications. Note: The image shows the head banner, a patient's scheduled medications to be taken during their hospital stay, and tabs to access other screens. The actual system is in color (e.g., using red for alerts regarding allergies), displays extra information about the patient and about each medication, and has additional buttons to access functionalities. Each dose is recorded in single boxes, showing whether the patient has been taking their medication and which doses are still to be given. A pharmacist review is annotated with a green tick and free text on the side. Information regarding availability of the medication on site provides insight into dispensing needs.

clinicians and the role of the IT – the EPMA system – across different tasks, with the dotted lines indicating interactions with the system. The steps depicted in Fig. 1 may be considered to represent sub-routines, and activities in boxes as further micro-routines. For the sake of brevity, we do not delve into the embedded routines within this wider process.

The medication routine is distributed across doctors, pharmacy staff, and nurses. Their work revolves around the prescription of medications and other patient clinical information, which is recorded either on paper or on the EPMA system.

During a patient admission, during treatment, and finally in preparation for discharge from the hospital, medications are prescribed (mainly) by doctors, checked by pharmacists, dispensed by pharmacy staff, and given to patients by nurses after a further check (a task known as administration). Thus, the hospital routine has repeated checks designed to capture any errors that might have occurred in previous steps in the process. The EPMA system is used multiple times over the process, to enter medication information, or to follow the information provided on screen (e.g., to give a medication as ordered).

The routine we explained above is information-intensive and revolves around *information about a patient's medications*. This is structured data, including, for example, the name of the medications, doses, routes, formulations, number and frequency of doses, dates and times of administration, and status of the medications (e.g., active, paused, ceased). Each patient record may have one or more medications prescribed. There will be medications the patient is using regularly outside the hospital (called 'medicines at admission'), and those added during hospitalization.

The medications are organized in the patient record across different screens – e.g., those used regularly, those currently used, those to be used after discharge from hospital. The EPMA system provides features for prescribers to add (prescribe), and delete (cease) medications (sometimes based on ordering templates pre-set by pharmacy), automated scheduling functionalities to display medications 'due' at any given time, and screens and features for nurses to document their act of giving (or not giving) each dose. Thus, the system also provides a history of clinicians' work with a patient's medication. Fig. 2 presents a simplified (black and white) schematic version of one of the screens.

Medication data are factual and often standardized. However, as medications are potentially dangerous and 'interacting' objects, the data in the electronic order require interpretative work if safety is to be achieved. Mindfulness is required when reading and writing this apparently straightforward information, as the same information may have different meanings and repercussions for the specific patient and/or at specific times and in different contexts of use.

For example, a doctor's prescription for the painkiller tramadol is reviewed on screen (in the EPMA system) by the pharmacist checking medications that have been moved by doctors to the patient discharge screen. The pharmacist is questioning the prescription by the doctor, in the context of the patient leaving the hospital and being then able to access the medication:

> *…tramadol - we normally use codeine 'cos that [tramadol] is a CD [controlled drug], it's not wrong it's just more difficult for when they [the patients] go home. (id22, ward pharmacist, think aloud observation transcript).*

In the quote above, the pharmacist is taking the 'out of hospital' context into account (the likely difficulties patients may encounter in getting the medication when they go home), while also considering the typical practice ('*we normally use*…'). The pharmacist is mindfully reading the EPMA system and the information it provides.

In summary, across the distributed routine, the handling of medication information requires mindful interpretation and avoidance of mindless compliance or acceptance of the information provided by the IT. In Table 1 above we identified a range of factors that contribute to either/both mindfulness and mindlessness with IT. We explain and discuss each factor in the following section.

5. Mindfulness and mindlessness with IT

5.1. How IT design (and functionalities) influences mindfulness/mindlessness with IT

IT design may influence the mindful use of medication information in hospital routines in two main ways. First, the EPMA facilitates access to patient information for staff across different roles in the medication process, adding transparency or visibility to the process. Having more information at the time of need (e.g., when prescribing) widens the scope of attention and interpretation, which is part of being mindful. This may be information of clinical content, such as patient diagnostic tests, or guidelines on use of medications. But it may also be information about the hospital medication process that was not previously apparent, such as which medications are available in the dispensary and those that are not (administration may be delayed otherwise). For instance, in the EPMA system, the pharmacy IT department set up the ordering interface with color coding to communicate to prescribing physicians which medications were more readily available in inventory. As this pharmacist explained:

> *So when [prescribers] go in, and look at a drug, they will see the ones that are black are actually drugs that we keep […]. Ones that are gray are ones that we don't. […] We can still prescribe them so the patient can have them, but it's just a bit of indication to a prescriber that if you prescribe this you might not be able to get it straight away. (id13, pharmacist, IT project lead, interview transcript).*

Clinicians may then be mindful with their EPMA orders, influenced by these modifications to the IT design, which give more information and visibility of the process beyond doctors' prescribing tasks, such as inventory supplies and dispensing tasks. However, while pharmacists may hope that the medication supply process is mindfully taken into account by the doctors in making their prescribing decisions, in practice there may be other factors influencing mindlessness in their choice of medication, as we later explain.

Another example of how IT provides transparency over the process, inviting mindfulness, is in relation to nurses' documentation at the time of administration. When a dose cannot be administered to the patient because, for example, the medication is out of locally held stock, nurses should document this in the system and make sure an order is in place to avoid the problem being repeated at the

next dose. With paper medication charts, mindlessly recording 'not available' (but not doing anything about ordering it) would remain opaque to others in the hospital, as the chart is less 'clear' and available only to one or a few individuals (e.g., other nurses) in the ward. Instead, when actions are documented on the EPMA system, a pattern of missing doses is clearer and more visible to everyone, and this should invite more attention to the operational context on the part of the nurses.

> *… medicines were not in stock and, you know, [the nurses] they're physically adding [into the EPMA] 'medicine not available', but then not doing anything about ordering it. […] It's just with the electronic medicines it's become more visible 'cos the records are so much clearer [compared to paper], aren't they? (id14, ward pharmacist, interview transcript).*

A second important way that IT may influence mindfulness is by providing warnings or alerts. Through its automated decision support (e.g., alerts for interacting medications), the EPMA system contributes to questioning clinicians' actions on a patient prescription while they are entering the orders. By 'questioning it', the EPMA system invites users to reconsider their choices. In this way the EPMA system invites mindfulness.

> *A little pop-up thing can come up and say 'are you sure this is the medicine that you want'. (id19, pharmacist, risk manager, interview transcript).*

> *I think I had another doctor saying […] a medication flag up for an allergy and you tried to prescribe it, that is really helpful because it [the EPMA system] is just automatically stopping you right then and there from doing that. (id20, ward pharmacist, think aloud observation transcript).*

As noted in the quotes above, both doctors and pharmacists refer to the value of the alerts, though we must also remember that alerts and pop-ups are often disregarded (Backman et al., 2017). As we later explain, there are other factors at play that may affect mindfulness with the IT, such as a lack of time and resources. Nonetheless, overall, these quotes provide suggestive evidence of how the EPMA system may influence mindfulness, either by enhancing the transparency and visibility of information and processes or by questioning clinicians' actions.

While IT may facilitate mindfulness, it can also influence mindlessness (Goddard et al., 2011; Lyell & Coiera, 2016; Valorinta, 2009). We found two main ways the EPMA may facilitate mindlessness.

First, we found that use of the EPMA system can be associated with over-reliance on the information it provides, for example in templates with ready-made orders. Clinicians may assume that, if prescriptions are 'allowed' by the EPMA system, they are correct for the patient.

> *I think that probably the assumption is 'well if the system lets me do it, then you should be able to do it' […] or the medicine should be able to be given in that way. (id24, pharmacist, IT, interview transcript).*

Managers reported '*a bit of a battle*' to make sure clinicians critically (or mindfully) assess the information provided by the EPMA system – '*that if you see something that looks odd then it probably is odd*'.

> *It's a bit of a battle for us because we have to ensure that people understand that the system is a tool, it doesn't tell you everything, you use it as a tool to help you with your clinical decision making […] [we are] walking the line, trying to help people understand how it will help them, but also that if you see something that looks odd then it probably is odd… (id12, pharmacist, IT project lead, interview transcript).*

In these situations, when information from the IT is accepted uncritically, the rules and routines embedded in the EPMA system govern (rather than guide (Langer, 2014a)) behavior.

Posters were placed in the clinical areas reminding clinicians to apply '*clinical decision-making*' in their use of the EPMA system, as in the example below.

> *Please note: use of any clinical information system does not replace clinical decision making to prescribe and administer drugs safely in line with [hospital] policy and procedures. (EPMA 'top tip for prescribers', field notes, poster on a computer bench).*

Second, within the context of hospital medication routines it is easier for clinicians to focus on the information provided by the EPMA system than to seek face-to-face communication with patients or other clinicians. This, in turn, may lead to less information about the patient or the work context, and thus a mindless reliance on the information provided by the IT.

> *I think a lot of the problem that you find is that people start to move away from patients more and more, the more electronic, that's how it felt and how it seems. […] [After EPMA roll-out, you have to consciously] just to have in the back of your mind that, you know, keep the patient the focus, not the computer screen. (id24, pharmacist, IT, interview transcript).*

In other words, having the (electronic) patient record 'at your fingertips' may contribute to hide some of the 'unknown unknowns' (Aven, 2015), if clinicians accept the information in the EPMA without reflection on other potentially relevant data – that is, if they mindlessly assume that the IT provides all there is to know about the patient medications.

5.2. How distributed work and task design influence mindfulness/mindlessness with IT

Doctors, nurses and pharmacists bring to the hospital medication routine different perspectives on use of medications with patients. They are influenced by their role – i.e. their training and professional background – and the responsibilities they have in supplying medications or giving them to patients.

A pharmacist who worked across roles, being a prescriber too, was able to explain differences in how a patient prescription may be understood – *'a mindset shift'* from focusing on medications as interacting objects (a pharmacist's role) to focusing on the disease (a doctor's role). As the pharmacist explained, pharmacists may traditionally approach a patient prescription by focusing on the medications: *'what's wrong with the prescription, let me check it for this, this, and this.'* Instead, prescribers may approach a patient prescription by focusing on the disease they are treating, in the context of the patient's other conditions.

> *[As a prescriber, my] focus is on the disease that you're trying to treat and the patient's other conditions, certainly for me it's different [than looking at the prescription as a pharmacist]. […] It's a mindset shift I think. (id26, hospital pharmacist, interview transcript).*

All clinicians involved in the medication routine have a responsibility for checking that the order and medications are correct and safe for the patient. However, pharmacists have also been explicitly assigned the role and responsibility of validating and double-checking doctors' prescriptions ('pharmacy review'). It is their explicit task to question it, ask for clarifications, and suggest alternatives (although in practice challenging doctors may not be an easy task (Lambert, 1996; Rixon, Braaf, Williams, Liew, & Manias, 2015)). Their review of the prescription involves carefully reading medication information (the prescription/order) and placing that information in the context of the patient and the context of the hospital medication supply. They may have to look for information beyond the EPMA system's screens, on sections of a patient's records such as blood test results that monitor a patient's response to treatment, and speak with colleagues and patients. This, in turn, facilitates mindfully noticing and questioning the information provided by the EPMA system.

The pharmacist review process is more time-consuming than just looking at the data on the prescription (either on EPMA or on paper), and there may not always be adequate time available for it. As a result, different levels of attention and different levels of checking are designed into pharmacists' work, enabling them to cope with their workload. A '*level 1*' prescription review is limited to the data written in the prescription, with each item reviewed on its own as well as in relation to other items in the prescription, but without further investigation into the patient context (i.e. the data are taken *'at face value*'). A '*level 2*' review will go into more depth, seek more information and look at the patient as a whole. A summary description of each, with evidence, is given in Table 3.

The way the task is designed and organized suggests to the individual pharmacist how mindful they should be in performing it. In a level 2 review, the task design is to guide behaviors towards a more detailed examination of the prescription, questioning it rather than 'taking it at face value'.

A pharmacist's choice of how to complete the task – whether it is a level 1 or level 2 review – also depends on what review has been done recently. It is also dependent on signalling from other staff, for example at handover, of a patient being at risk or having special medication needs. If a patient's medication information has been checked and questioned before, it is more likely to be 'taken at face value' and not questioned again at the next review task, as in the quote below.

> *…I did a drug history for him [the patient] yesterday, so I know that I asked the doctors to write the morphine [so I don't need to do a thorough review/question it today]. (id23, ward pharmacist, think aloud observations transcript).*

Likewise, a nurse manager told us that nurses doing the 'medication rounds' might just focus on the EPMA system screen, which automatically lists what is due at a specific time, without questioning it, taking for granted the instructions provided by the technology in the knowledge that a pharmacist has most probably checked it already.

> *I suspect what you find now is that most nurses will just go down the list [on EPMA screens] with only one eye on the drugs, looking for what's due then. [Questioning the prescription – i.e. being mindful about it] That layer of [questioning] 'should they [the patient] be on'? 'Do they need'? […] doing that comprehensive [interpretation of the doses due], I would be surprised to find that in most cases. Because also, let's remember, that we've got pharmacists going around and doing that now, more than we ever […] [Nurses would think they can rely on pharmacists to be mindful, they can think] it's safe if I don't do it with that degree of rigor because somebody else is going to come and do it. (id25, nurse manager, interview transcript).*

5.3. How individual knowledge and experience influence mindfulness/mindlessness with IT

Within this distributed work, different individuals have different knowledge of medications. After working for months or years in the same hospital ward, a nurse would, for example, get to know the regularly used, '*run-of-the-mill*' medications, while the same medications might be unfamiliar to a nurse new to the ward, or nurses might be unfamiliar with new medications. As a result, different nurses may check certain medications on the EPMA system differently, and they may check some medications more mindfully than others.

> *… you use those drugs more regularly, […] a kind of a run-of-the-mill, let's say, cardiac medication, so you've seen it a few times, you understand how it works, but then we might get a new antibiotic that's come through to the [hospital] and it's the first time we've used it, so that's why, then, everyone would […] check. (id16, nurse, interview transcript).*

Individual clinicians have different knowledge of and experience with specific patients, whether those new to the ward or returning to the ward. They also have different knowledge of and experience of working with colleagues. Novices' lack of experience of engaging with patients or clinicians may lead to their over-reliance on the EPMA system. For example, some junior members would feel more comfortable interacting with senior staff through the EPMA system rather than questioning or clarifying information with a doctor face to face (especially as there may also be issues to do with seniority and status (Farrell, Bochatay, & Kim, 2021)). They are therefore not able to have those conversations with the doctor to pick up issues, and are more susceptible to working mindlessly with the system.

Table 3
Task design for pharmacists reviewing medication orders.

	Description	Example
Level 1	• Review limited to the data written in the prescription. Each item reviewed on its own and in relation to other items in the prescription. • No further investigation into the patient context.	*Level 1 [review] is basically just looking at the drug chart, you're just looking for like interactions, if anything's dangerous, you're just taking it at face value. (id23, ward pharmacist, think aloud observations transcript)*
Level 2	• Review will check item on its own and in relation to other items in the prescription. • More detailed examination and seek more information; look at the patient as a whole.	*Level 2 [review] you'll be looking at the drug chart, you'll be looking at the patient's notes, you'll be looking at the bloods [test results], just the patient as a whole, you might have to talk to the patient. (id23, ward pharmacist, think aloud observations transcript)*

This is an example of how experience influences how people use the system, and how it might then generate less information for them to critically question the order.

Similarly, individuals may also have different levels of familiarity with the IT. Experienced users may be better able to recognize (and be mindful of) where the IT may fail (e.g., the dispensing function may not generate a warning label if the same medication has been dispensed before for that patient). Inexperienced users could be unaware of the limitations of the IT and rely uncritically on the system; for example, they might *'just double click'* without checking that a label with warnings is printed at the time of their dispensing.

> *… people, especially if they're new, […] they'll just double click that, and re-dispense it, but then the warnings [to place on the medication label] don't appear, when you do that. (id11, pharmacy technician, think aloud observations transcript).*

5.4. How the situation at hand influences mindfulness/mindlessness with IT: Assessing risk and 'being in a hurry'

Whether information will be assessed mindfully also depends then on how much time is available to complete the task. Clinicians can feel the pressure of not having enough time to complete their work, of seeing all patients that need seeing on the day, and of doing it all with care.

> *…you're always working under pressure, you've always never got enough time on the ward than you would ideally like, so you always end up prioritizing and, yeah, there are some people [patients] that you're just signing off an order [without questioning it]. (id15, ward pharmacist, interview transcript).*

In a context of time scarcity, mindful attention will be paid to prescriptions belonging to patients who are most at risk, or with most error-prone/risky medications. The EPMA system is most useful for this prioritizing task because it provides an overview across all patients in a clinical area. However, prioritizing also means that some prescriptions (and patients) will not be receiving a mindful check.

> *…[with EPMA] you can assess which patients you want to see, like if you're short of time obviously you'll go through and go, 'right, well there's five with question marks or whatever, they want seeing', but the ones with ticks [in the tick box that says someone has already checked this prescription] I'm not going to worry about unless on the handovers [document] it's a high risk patient, they won't get seen today 'cos I haven't got time. (id22, ward pharmacist, think aloud observations transcript).*

Time scarcity may also lead to being in a hurry and this may contribute to mindlessness with IT, such as, at the time of a patient's discharge from hospital, not reordering medications that have been temporarily stopped and instead just copying *'without engaging brains*' from one EPMA system screen to the other (inpatient medications, discharge medications) whatever medications are displayed on screen.

> *…doctors 'cos they're in a hurry [they] just do that, copy without engaging brains… (id15, ward pharmacist, interview transcript, emphasis added).*

6. Discussion

This research set out to explore the factors that influence mindfulness and mindlessness with IT within the practice of routine work in hospitals. Theorizing these factors matters because organizations struggle with the dilemma of how to introduce IT that will enable reliability and safety through guiding and standardizing operations but also encourage staff mindfulness with IT to safeguard against errors. The dilemma was aptly expressed by the IT project lead of the hospital we studied, who said that the organization was '*walking the line'* of attempting to have clinicians follow the EPMA system's instructions while also maintaining clinical judgement (Montgomery, 2005). The posters displayed in the clinical areas reminding clinicians to use the EPMA *'with clinical decision-making*' are a sign of the organization '*battling'* with the risk of clinicians' mindlessness with IT.

At the start of this paper, in setting the scope of our study, we articulated mindfulness with IT as *an individual critically interpreting information provided by/through technology, in view of specific situations occurring during routine work, that is work distributed between people, in space and time*.

As summarized in Table 2, we found multiple factors influencing individual mindfulness and mindlessness with IT: IT design, task

design, individuals' knowledge and experience, the distribution of work and the situation at hand. Each factor has an implicit tension, as each may influence both mindfulness and mindlessness with IT (Carlo et al., 2012). These factors also interact with and influence each other.

How do these findings explain more generally the relation between mindfulness and IT? To answer this question, in what follows, we return to the relation between mindfulness and IT in the context of work routines, and discuss the theoretical implications of our findings. Before concluding, we draw implications for practice.

6.1. Theorizing the relation between mindfulness and IT

In Section 2.3 we identified three main views of the relation of influence between mindfulness and IT, focused on: the IT itself, individual personality traits, and the wider context, each seen as a main contributor to mindfulness/mindlessness with IT. Our findings have implications for each of these views, as we now explain.

The first view proposes that IT (e.g., its design) influences mindfulness. We identify an underlying implicit assumption in such a view: that individuals have previously used the IT when they show mindfulness with IT. For example when Butler and Gray (2006) suggest that unreliable IT may lead to mindfulness (and reliable IT to mindlessness) – they implicitly assume this must be because people have experienced problems with the IT, they know it can be unreliable, and they bring this knowledge and experience to their interpretation of the IT in the moment. In our case, for example, pharmacy staff told us how their experience with the limitations of the IT system informed how they used it to dispense repeated medication orders, checking that the system would print a medication warning. Similarly, it may not be the single use of the IT that induces automation bias, or over-reliance on the IT but its repeated use over time. While this might appear obvious in retrospect, it is often not made explicit in studies of mindfulness or mindlessness with IT. A dynamic routine perspective that includes history of use in the unit of analysis sheds a new light on this relation.

Regarding the second view, suggesting that personality traits determine mindfulness with IT (e.g., Thatcher et al., 2018), we found that (at least in healthcare organizations) mindfulness with IT at work is not a matter of individuals' personality per se but of their knowledge and experience (history of use, experience of errors, or with the routine or with the IT, etc.). To this, the literature may add training as also having a role (Dane, 2010; Jensen et al., 2017). Our study shows how knowledge and experience are also embodied in individuals' professional role. For example, pharmacists and prescribers have a different take on patient prescriptions, influenced by their training and professions, and by the tasks they perform on the EPMA system in their professional role. Thus, we agree with the view that sees individuals as having an influence on mindfulness or mindlessness with IT, but for their history of use and what they do (Reina & Kudesia, 2020), or are expected to do, rather than their individual character traits.

Finally, in the continuum of views on the relationship between mindfulness and IT, our main theoretical contribution is directly clarifying and enriching the complex view of mindfulness with IT that we identified as ‘a third view’. This view considers mindfulness with IT situated and dependent on organizational conditions or contextual factors (Carlo et al., 2012; Kudesia, 2019; Ramiller & Swanson, 2009; Reina & Kudesia, 2020). We bring to this view not only an organizational context but also a routine context, i.e. a context of repeated, processual (Pentland, Recker, Wolf, & Wyner, 2020) and distributed work where technology design, task design, distribution of work, individual experience and situation at hand may influence both mindfulness and mindlessness with IT.

Our findings suggest that we should look more closely at the relation between mindfulness (or mindlessness) with IT and routines, considered from both ostensive and performative perspectives. Through the design of IT, the design of tasks and their sequence, and the resourcing of the routine (staff numbers and time), the *ostensive routine* influences individual mindfulness and mindlessness with IT. Through the performing of tasks, the recurrence of tasks over time and the dynamics of distribution of work across people and time, the *performative routine* also influences individual mindfulness and mindlessness with IT. Through this process of mutual influence, individuals' mindfulness (or mindlessness) with IT then contributes to the overall performance of the routine.

Mindfulness and mindlessness with IT may then manifest and be understood at the routine level,[2] in addition to the individual (Langer, 1989a) and collective levels (Weick et al., 1999; Weick & Roberts, 1993), in line with the idea of mindfulness as a multilevel construct (Sutcliffe, Vogus, & Dane, 2016). This perspective also brings to the fore the importance of organizational structures in influencing individual cognition and behavior with IT, in contrast with the traditional view of mindfulness, even at the collective level, centered on cognition (e.g., in terms of information processing, preoccupation with failure, or organizational learning).

Traditionally, the analysis of how phenomena at each level may emerge from activities at other levels assumes some ways of ‘aggregating’ from micro to macro (Morgeson & Hofmann, 1999). In proposing a routine level of mindfulness, we are suggesting a two-way direction in the relation between the different level constructs, from the routine (macro) to the individual (micro) and vice-versa. Further research may map out the relation between individual- and routine-level mindfulness with IT in both directions, and explore whether the movement from micro to macro level is contested (i.e. in case of conflicting interpretations of the ostensive routine by the people involved in the routine (Howard-Grenville, 2005), or status issues at play (Farrell et al., 2021)). To this aim, researchers can draw on Burton-Jones and Gallivan's (2007) study of IT usage as a multilevel construct, in which they provide warnings and guidelines about ‘studying systems usage constructs in a multilevel fashion’ (p. 662). Based on their guidance, mindfulness (or mindlessness) with IT at the routine level may be analyzed ‘in a user-centered fashion’, in terms of patterns of cognitive (mindful or mindless) engagement with the system, or ‘in a holistic fashion’, examining patterns of both tasks and cognition, over time (Burton-Jones & Gallivan, 2007, p. 668).

[2] We thank Professor Elizabeth Davidson, editor-in-chief, for suggesting this point.

6.2. Implications for practice

In this section, we reflect on our findings, in view of the organizational concern for outcomes (medication safety). Organizations are 'walking the line' and making efforts to steer clinicians towards a mindful use of IT to achieve safety. However, mindful use of IT, such as with the EPMA system, may not be sufficient on its own to achieve organizational outcomes of safety. Errors or issues may be mindfully noticed in the IT, but further actions have to be taken to correct them. For example, pharmacists may alert doctors of errors in the prescription, but, to achieve safe outcomes, doctors may have to correct them – and in a timely fashion, before nurses administer them to patients.

Conversely, it is possible that mindlessness with IT, such as using IT *'without engaging brains'*, or delegating mindfulness with IT to others, is not problematic for safe performance where there are no mistakes, no issues with the orders or with the information in the IT (i.e. there would not be negative consequences). In our case study, mindlessness with IT only seemed to be problematic in terms of outcomes when there were issues with the medication orders and the IT should have been questioned, clinical judgement applied and effective action taken (e.g., asking doctors to change the prescription).

Organizations may be tempted to accept some mindless use of the IT in the confidence that the routine has been otherwise designed to capture issues at other points in time/place. For example, when pharmacists check prescriptions, it may be more efficient for nurses to accept the prescription at face value without further questioning.

The problem we see with this approach is that it discounts how mindlessness with IT may feed on itself – i.e. it may influence further mindlessness in the future, in situations where the routine may not guard for errors/issues. We learned, from the pharmacists experiencing the EPMA in this hospital, of the risk of the 'screen' (the IT) becoming the focus, rather than the patient. The individual learns to limit their actions to the IT, and focus on the IT task, rather than the organizational goal of achieving safety. In other words, a single, situated, mindless use of the IT may be unproblematic in the present moment but it may influence individuals' future use of the IT. An example of this may be a doctor mindlessly selecting the first medication in a list, which happens to be suitable for the present patient (unproblematic), but then uncritically learns to select that medication also for future patients when that medication may be harmful. In this sense, considering the dynamics of influences over time, mindlessness with IT would always be problematic for organizations.

Additionally, as we have seen in the hospital we studied, the medication routine is organized with a number of repeated checks (by doctors, pharmacists and finally nurses), designed to capture any mistakes that may have occurred and gone unnoticed during the medication process. When users happen to be mindless with the IT (e.g., the medication order), they are nullifying the redundancy (safety) feature of distributed checks. In other words, mindlessness with IT undermines the organizing of safety as imagined by management.

6.3. Strengths and limitations

In building and reporting this study, we addressed recommendations for conducting research on mindfulness in IS (Dernbecher & Beck, 2017). We made explicit our scope and our assumptions. The strength of our research is a methodology that allowed for in-depth study of an organizational routine, as well as the perspectives of health professionals' interactions with IT. Most of our participants were pharmacists, and we often drew on their views of physicians and nurses' medication work. Involving more of these other roles may have enabled us to identify other factors at play in mindfulness or mindlessness with IT. However, in hospital medication routines, pharmacists have a special role to play, as a 'glue' in the routine. As one of the participants said, *'pharmacy plays a really interesting role in kind of linking up all the specialities'* (id34, pharmacist, management/aseptic unit, interview transcript). By drawing on pharmacists' experiences we captured several aspects of this distributed work. We have relied on self-reported data; as noted by others in the study of mindfulness or mindlessness, personal accounts are vulnerable to bias, memory errors, and incomplete representations (Dane, 2013). We addressed these limitations by observing activities and capturing decision-making 'in the moment': asking people to verbalize their thinking while working with the IT ('think aloud' techniques, Ericsson, 2006). We focused on patient medication information as the object of work, and caution that the findings presented may not be applicable to other IT and other work activities, or, indeed, outside of hospital settings. While this setting is specific, we see parallels with other organizational routines in which individuals work in distributed processes and where errors may carry high consequences; the discovery of influencing factors in this hospital organization can be the starting point for the study of mindfulness with IT in other contexts.

7. Conclusion

In this study we examined factors contributing to individual mindfulness and mindlessness with IT in routine work in hospital. We identified relations of influence across individuals, the IT, and the broader organizational context. Thus, we 'constructively complicate' (Cornelissen, Höllerer, & Seidl, 2021) the explanation of mindfulness and mindlessness with IT in organizations and provide support to the argument that understanding the phenomenon of mindfulness and mindlessness with IT in organizations requires going beyond reductionist lenses. We propose and demonstrate that mindfulness with IT is situated, emergent from a combination of interacting factors with implicit tensions, and also influenced by the temporal dynamics of the routine over time. Individual mindfulness and mindlessness with IT happen in the context of routine distributed work and they thus emerge as multilevel constructs, at the individual and routine levels.

Routines are directed at the accomplishment of particular tasks; routines focus on action sequences; routines are recurrent action patterns. Lastly, routines are often managed by means of standard operating procedures (Feldman et al., 2021). The key lesson that emerges from the routines literature and our study is that, contrary to the task-focused character of routines, interventions towards

mindfulness with IT in hospitals should be directed at patient safety and greater engagement with the patient, rather than task completion. In order to support mindfulness with IT, efforts should focus on incentivizing modalities of use that keep the patient at the center. People should not try to accomplish 'tasks' (done, tick, move on) but to accomplish goals and objectives beyond the single tasks, such as safety.

We acknowledge that mindfulness with IT in organizational routines is necessary but not sufficient for safe and reliable performance. Other aspects of the organizational context may determine the safe and reliable outcomes of a routine, despite mindfulness or mindlessness with IT.

Author statement

All authors have seen and approved the final version of the manuscript. They warrant that the article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere.

The authors have no interests to declare.

Declaration of Competing Interest

None.

Acknowledgements

We are grateful to the hospital staff and patients who gave their time to participate in this study. We thank the anonymous reviewers for their time and insightful comments. The senior editor was instrumental in the refining of the final version of this paper – we are especially grateful for her detailed and constructive review.

Data collection was supported by Research Councils UK (EP/L021188/1). Analysis and writing of this paper was done in part during a fellowship that received funding from the European Union's Horizon 2020 research and innovation programme under the Marie-Skłodowska Curie Grant Agreement number 740131.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.infoandorg.2023.100475.

References

Aanestad, M., & Jensen, T. B. (2016). Collective mindfulness in post-implementation IS adaptation processes. *Information and Organization, 26*(1–2), 13–27.
Aven, T. (2015). Implications of black swans to the foundations and practice of risk assessment and management. *Reliability Engineering & System Safety, 134*, 83–91.
Backman, R., Bayliss, S., Moore, D., & Litchfield, I. (2017). Clinical reminder alert fatigue in healthcare: A systematic literature review protocol using qualitative evidence. *Systematic Reviews, 6*(1), 255.
Berente, N., Lyytinen, K., Yoo, Y., & King, J. L. (2016). Routines as shock absorbers during organizational transformation: Integration, control, and NASA's Enterprise information system. *Organization Science, 27*(3), 551–572.
Burton-Jones, A., Akhlaghpour, S., Ayre, S., Barde, P., Staib, A., & Sullivan, C. (2020). Changing the conversation on evaluating digital transformation in healthcare: Insights from an institutional analysis. *Information and Organization, 30*(1), Article 100255.
Burton-Jones, A., & Gallivan, M. J. (2007). Toward a deeper understanding of system usage in organizations: A multilevel perspective. *MIS Quarterly*, 657–679.
Butler, B. S., & Gray, P. H. (2006). Reliability, mindfulness, and information systems. *MIS Quarterly, 30*(2), 211–224.
Carlo, J. L., Lyytinen, K., & Boland, R. J., Jr. (2012). Dialectics of collective minding: Contradictory appropriations of information technology in a high-risk project. *MIS Quarterly, 36*(4), 1081–1108.
Combey, P. (1980). A tracer approach to the study of organizations. *Journal of Management Studies, 17*(1), 96–126.
Constantinides, P., Chiasson, M. W., & Introna, L. D. (2012). The ends of information systems research: A pragmatic framework. *MIS Quarterly, 36*(1), 1–20.
Cornelissen, J., Höllerer, M. A., & Seidl, D. (2021). What theory is and can be: Forms of theorizing in organizational scholarship. *Organization Theory, 2*(3), 26317877211020328.
Curtis, A. M., Dennis, A. R., & Hilmer, K. M. (2017). From monologue to dialogue: Performative objects to promote collective mindfulness in computer-mediated team discussions. *MIS Quarterly, 41*(2), 559–581.
Dane, E. (2010). Reconsidering the trade-off between expertise and flexibility: A cognitive entrenchment perspective. *Academy of Management Review, 35*(4), 579–603.
Dane, E. (2011). Paying attention to mindfulness and its effects on task performance in the workplace. *Journal of Management, 37*(4), 997–1018.
Dane, E. (2013). Things seen and unseen: Investigating experience-based qualities of attention in a dynamic work setting. *Organization Studies, 34*(1), 45–78.
Dane, E. (2015). Mindfulness and performance: Cautionary notes on a compelling concept. *Industrial and Organizational Psychology, 8*(4), 647–652.
Davidson, E. J., & Chismar, W. G. (2007). The interaction of institutionally triggered and technology-triggered social structure change: An investigation of computerized physician order entry. *MIS Quarterly*, 739–758.
Dernbecher, S., & Beck, R. (2017). The concept of mindfulness in information systems research: A multi-dimensional analysis. *European Journal of Information Systems, 26*(2), 121–142.
Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25–32.
Epstein, R. M. (1999). Mindful practice. *JAMA, 282*(9), 833–839.
Ericsson, K. A. (2006). Protocol analysis and expert thought: Concurrent verbalizations of thinking during experts' performance on representative tasks. In K. A. Ericsson (Ed.), *The Cambridge handbook of expertise and expert performance* (pp. 223–241). Cambridge University Press.
Farrell, S. E., Bochatay, N., & Kim, S. (2021). Embracing or relinquishing sources of power in interprofessional communication: Implications for patient-centered speaking up. *Journal of Interprofessional Care*, 1–8.
Feldman, M., & Pentland, B. (2003). Reconceptualising organisational routines as a source of flexibility and change. *Administrative Science Quarterly, 48*, 94–118.

Feldman, M. S. (2000). Organizational routines as a source of continuous change. *Organization Science, 11*(6), 611–629.
Feldman, M. S., Pentland, B. T., D'Adderio, L., & Lazaric, N. (2016). Beyond routines as things: Introduction to the special issue on routine dynamics. *Organization Science, 27*(3), 505–513.
Feldman, S., Pentland, T., D'Adderio, L., Dittrich, K., Rerup, C., & Seidl, D. (2021). What is routine dynamics. In M. S. Feldman, L. D'Adderio, T. Pentland, K. Dittrich, C. Rerup, & D. Seidl (Eds.), *Cambridge handbook of routine dynamics* (pp. 1–18). Cambridge University Press.
Festila, M., & Müller, S. D. (2022). Coordinating knowledge work across technologies: Evidence from critical care practices. *Information and Organization, 32*(2), Article 100411.
Goddard, K., Roudsari, A., & Wyatt, J. C. (2011). Automation bias: A systematic review of frequency, effect mediators, and mitigators. *Journal of the American Medical Informatics Association, 19*(1), 121–127.
Greenhalgh, T. (2008). Role of routines in collaborative work in healthcare organisations. *BMJ, 337*, Article a2448.
Greenhalgh, T., Howick, J., & Maskrey, N. (2014). Evidence based medicine: A movement in crisis? *BMJ: British Medical Journal, 348*, Article g3725.
Greenhalgh, T., Snow, R., Ryan, S., Rees, S., & Salisbury, H. (2015). Six 'biases' against patients and carers in evidence-based medicine. *BMC Medicine, 13*(1), 200.
Greenhalgh, T., Voisey, C., & Robb, N. (2007). Interpreted consultations as "business as usual"? An analysis of organisational routines in general practices. *Sociology of Health & Illness, 29*(6), 931–954.
Groopman, J. (2008). *How doctors think*. Houghton Mifflin Harcourt.
Hornby, P., & Symon, G. (1994). Tracer studies. In C. Cassell, & G. Symon (Eds.), *Qualitative methods in organizational research: A practical guide* (pp. 167–186). Sage.
Howard-Grenville, J., & Lodge, J. (2021). Context, embeddedness and routine dynamics. In M. S. Feldman, L. D'Adderio, B. T. Pentland, K. Dittrich, C. Rerup, & D. Seidl (Eds.), *Cambridge handbook of routine dynamics* (pp. 229–243). Cambridge University Press.
Howard-Grenville, J., & Rerup, C. (2016). A process perspective on organizational routines. In A. Langley, & H. Tsoukas (Eds.), *The SAGE handbook of process organization studies* (pp. 323–337). Sage.
Howard-Grenville, J. A. (2005). The persistence of flexible organizational routines: The role of agency and organizational context. *Organization Science, 16*(6), 618–636.
Järveläinen, J., Sell, A., & Walden, P. (2021). The impact of IT mindfulness on complex task performance. In *Proceedings of the 54th Hawaii International Conference on System Sciences*.
Jensen, M. L., Dinger, M., Wright, R. T., & Thatcher, J. B. (2017). Training to mitigate phishing attacks using mindfulness techniques. *Journal of Management Information Systems, 34*(2), 597–626.
Koppel, R., Metlay, J. P., Cohen, A., Abaluck, B., Localio, A. R., Kimmel, S. E., & Strom, B. L. (2005). Role of computerized physician order entry systems in facilitating medication errors. *JAMA, 293*(10), 1197–1203.
Kudesia, R. S. (2019). Mindfulness as metacognitive practice. *Academy of Management Review, 44*(2), 405–423.
Lambert, B. L. (1996). Face and politeness in pharmacist-physician interaction. *Social Science & Medicine, 43*(8), 1189–1198.
Langer, E. (1989a). *Mindfulness*. Addison-Wesley.
Langer, E. J. (1989b). Minding matters: The consequences of mindlessness–mindfulness. In L. Berkowitz (Ed.), *Vol. 22. Advances in experimental social psychology* (pp. 137–173). Elsevier.
Langer, E. J. (1992). Matters of mind: Mindfulness/mindlessness in perspective. *Consciousness and Cognition, 1*(3), 289–305.
Langer, E. J. (1997). *The power of mindful learning*. Addison-Wesley.
Langer, E. J. (2014a). *Mindfulness*. Da Capo Press.
Langer, E. J. (2014b). Mindfulness forward and back. In A. Ie, C. T. Ngnoumen, & E. Langer (Eds.), *The Wiley Blackwell handbook of mindfulness* (pp. 7–20). Wiley-Blackwell.
LeRouge, C., Mantzana, V., & Wilson, E. V. (2007). Healthcare information systems research, revelations and visions. *European Journal of Information Systems, 16*(6), 669–671.
Lyell, D., & Coiera, E. (2016). Automation bias and verification complexity: A systematic review. *Journal of the American Medical Informatics Association, 24*(2), 423–431.
Malaurent, J., & Karanasios, S. (2020). Learning from workaround practices: The challenge of enterprise system implementations in multinational corporations. *Information Systems Journal, 30*(4), 639–663.
Matook, S., & Kautz, K. (2008). Mindfulness and agile software development. In *, 58. ACIS 2008 Proceedings*.
Montgomery, K. (2005). *How doctors think: Clinical judgment and the practice of medicine*. Oxford University Press.
Morgeson, F. P., & Hofmann, D. A. (1999). The structure and function of collective constructs: Implications for multilevel research and theory development. *Academy of Management Review, 24*(2), 249–265.
Negoita, B., Lapointe, L., & Rivard, S. (2018). Collective information systems use: A typological theory. *MIS Quarterly, 42*(4).
Novak, L., Brooks, J., Gadd, C., Anders, S., & Lorenzi, N. (2012). Mediating the intersections of organizational routines during the introduction of a health IT system. *European Journal of Information Systems, 21*(5), 552–569.
Pentland, B. T., & Feldman, M. S. (2005). Organizational routines as a unit of analysis. *Industrial and Corporate Change, 14*(5), 793–815.
Pentland, B. T., & Feldman, M. S. (2008). Designing routines: On the folly of designing artifacts, while hoping for patterns of action. *Information and Organization, 18*(4), 235–250.
Pentland, B. T., Recker, J., Wolf, J. R., & Wyner, G. (2020). Bringing context inside process research with digital trace data. *Journal of the Association for Information Systems, 21*(5), 5.
Ramiller, N. C., & Swanson, B. E. (2009). Mindfulness routines for innovating with information technology. *Journal of Decision Systems, 18*(1), 13–26.
Reina, C. S., & Kudesia, R. S. (2020). Wherever you go, there you become: How mindfulness arises in everyday situations. *Organizational Behavior and Human Decision Processes, 159*, 78–96.
Rinke, M. L., Bundy, D. G., Velasquez, C. A., Rao, S., Zerhouni, Y., Lobner, K., … Miller, M. R. (2014). Interventions to reduce pediatric medication errors: A systematic review. *Pediatrics, 134*(2), 338–360.
Rixon, S., Braaf, S., Williams, A., Liew, D., & Manias, E. (2015). Pharmacists' interprofessional communication about medications in specialty hospital settings. *Health Communication, 30*(11), 1065–1075.
Roberts, N., Bennett Thatcher, J., & Klein, R. (2006). Mindfulness in the domain of information systems. In *, 2. DIGIT 2006 proceedings*.
Sackett, D. L., Rosenberg, W. M., Gray, J. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: What it is and what it isn't. *BMJ, 312*(7023), 71–72.
Sarker, S., Xiao, X., Beaulieu, T., & Lee, A. S. (2018). Learning from first-generation qualitative approaches in the IS discipline: An evolutionary view and some implications for authors and evaluators (PART 1/2). *Journal of the Association for Information Systems, 19*(8), 752–774.
Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge University Press.
Sun, H., & Fang, Y. (2010). Toward a model of mindfulness in technology acceptance. In *ICIS 2010 Proceedings*.
Sutcliffe, K. M., & Vogus, T. J. (2014). Organizing for mindfulness. In A. Ie, C. T. Ngnoumen, & E. Langer (Eds.), *The Wiley Blackwell handbook of mindfulness* (pp. 407–423). Wiley.
Sutcliffe, K. M., Vogus, T. J., & Dane, E. (2016). Mindfulness in organizations: A cross-level review. *Annual Review of Organizational Psychology and Organizational Behavior, 3*, 55–81.
Swanson, E. B., & Ramiller, N. C. (2004). Innovating mindfully with information technology. *MIS Quarterly, 28*(4), 553–583.
Tavory, I., & Timmermans, S. (2014). *Abductive analysis: Theorizing qualitative research*. University of Chicago Press.
Teo, T. S., Srivastava, S. C., Ranganathan, C., & Loo, J. W. (2011). A framework for stakeholder oriented mindfulness: Case of RFID implementation at YCH group, Singapore. *European Journal of Information Systems, 20*(2), 201–220.
Thatcher, J., Wright, R., Sun, H., Zagenczyk, T., & Klein, R. (2018). Mindfulness in information technology use: Definitions, distinctions, and a new easure. *MIS Quarterly, 42*(3), 831–847.

Timmermans, S., & Berg, M. (2010). *The gold standard: The challenge of evidence-based medicine*. Temple University Press.
Valorinta, M. (2009). Information technology and mindfulness in organizations. *Industrial and Corporate Change, 18*(5), 963–997.
Veinot, T. C., Bosk, E. A., Unnikrishnan, K. P., & Iwashyna, T. J. (2012). Revenue, relationships and routines: The social organization of acute myocardial infarction patient transfers in the United States. *Social Science & Medicine, 75*(10), 1800–1810.
Vidgen, R., & Wang, X. (2009). Coevolving systems and the organization of agile software development. *Information Systems Research, 20*(3), 355–376.
Weick, K. E., & Roberts, K. H. (1993). Collective mind in organizations: Heedful interrelating on flight decks. *Administrative Science Quarterly*, 357–381.
Weick, K. E., & Sutcliffe, K. M. (2006). Mindfulness and the quality of organizational attention. *Organization Science, 17*(4), 514–524.
Weick, K. E., Sutcliffe, K. M., Obstfeld, D., & (Eds.).. (1999). *Organizing for high reliability: Processes of collective mindfulness* (Vol. 21). JAI Press.
Westbrook, J. I., Li, L., Raban, M. Z., Mumford, V., Badgery-Parker, T., Gates, P., … White, L. (2022). Short- and long-term effects of an electronic medication management system on paediatric prescribing errors. *npj Digital Medicine, 5*(1), 179.
Westbrook, J. I., Reckmann, M., Li, L., Runciman, W. B., Burke, R., Lo, C., … Day, R. O. (2012). Effects of two commercial electronic prescribing systems on prescribing error rates in hospital in-patients: A before and after study. *PLoS Medicine, 9*(1), Article e1001164.