

A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in Hospitals

Abstract. The use of digital technology in the healthcare sector, and in hospitals in particular, has an impact on daily routine and on the quality of patient care. In dynamic organizations like hospitals, where urgent needs have to be met, employees develop workarounds for different reasons, which in turn can have a negative impact on the quality of patient care. While the existing literature focuses mainly on the consequences of IT mismatch to work practices in hospitals and classifications thereof, a holistic understanding of the underlying reasons for workers' deviating behavior is missing. This article begins to close this research gap with a systematic literature review on antecedents of workarounds. The structured analysis provides a valuable contribution for both research and practice, as measuring root causes for behavior enables organizations to understand and develop control mechanisms.

Keywords: *Systematic Literature Review, Workarounds, Hospital, Information Systems, Healthcare System*

1 Motivation

The hospital sector faces a variety of challenges, which adversely affect the predominant care supply situation. As our society ages, the demand for medical services and resources is rising dramatically. This is due to the proven expansion of years of life with multimorbidity, parallel to the life span [1]. Growing demand for medical care across both the inpatient and outpatient health sector is mainly rooted in increased life expectancy and the simultaneous drop in birth rates [2]. This change, which affects a majority of developed countries, will increase the number of medical cases and need for hospitalizations in the upcoming years. Meanwhile, the number of people of working age is declining continuously, making the shortage of skilled workers significantly larger [3]. As a result, the provision of an adequate level of nurses and physicians to cope with the volume of demand represents a challenging task for hospitals as service organizations [4]. As hospitals struggle to provide a sufficient staffing level, the ones that suffer directly, are the employees and patients involved in the medical services. The increased demand for inpatient care services, combined with limited personnel capacities, causes a tension that can result in the poor execution of underlying processes, thus impairing the quality of care [4].

Within this field of tension, digitalization must be able to assist workers in their core and supporting processes and serve as a countermeasure to the imbalance. The misalignment of supply and demand can cause implicit rationing of services. Both patients and medical staff are confronted with rationing as a change in their daily care routine. This causes an unwanted rejection of established, patient centred concepts, due to the lack of time and the overstraining of staff, there may be significant neglect of patients [5]. The use of Hospital Information Systems (HIS) for the transparent collection and provision of data, the connection of users and thus, the support of workflows, is needed [6]. Incorporating new technologies for the improvement of patient safety and the quality of care frequently involves voluntary or involuntary changes and sometimes blockages in the workflow [7]. Daily medical and nursing routines lack sufficient time to initiate structured error analysis processes and to question existing processes critically [8], which also affects patient safety. Unreliable or unavailable health data can lead to expensive repetitive tests, which pose an emotional and physical burden. Notably, the availability and reliability of clinical data are vital to ensure efficient processes, precision of diagnoses and high-quality care. Insufficient transparency on medication plans may cause wrong dosages or harmful drug interactions, which aggravate the patient's health status, or at worst, can be fatal [9]. If comprehensive HIS-support is not available and the clinical staff faces hurdles or lacks inner motivation, for example due to non-intuitive system operation or poor data availability, technology can equally pose a threat to timely and appropriate patient care [10]. Not only does this neglect potentially impair the quality of care. More than that, it adversely affects workers' well-being, as they are in the constant struggle to meet the rising demands, all well aware, that their performance is or might be insufficient and harmful [11].

In these scenarios, the acceptance of users towards the given technology suffers, which is why the IT-systems in question are intentionally by-passed and workarounds

developed [12]. When confronted with blockages in the delivery of care, nurses create workarounds in 93% of cases [13]. Only 7% of all cases are reported to superiors and management, which allows for the analysis of contributing factors and problem-solving efforts. The normalization of workarounds can lead to the evolution thereof into unofficial standards that are initially established without conflict. If no critical factors are added, workarounds can provide benefits as a positive process deviation. Should, however, other critical factors accumulate, then the abandonment of established standards can trigger a series of adverse events [14]. In this situation, bypassing processes and the associated information systems clearly poses a greater threat and leads the actual gain in efficiency through digitalization ad absurdum. The human factor as the system developer and the frontline user determines the suitability of the HIS in use [15]. Thus, knowing the root causes that lead nurses and physicians to distrust the use of HIS and develop workarounds is essential for patient safety. The only way to resolve problems is having reliable information on their antecedents and being able to quantify them. This leads us to the following research question: *What antecedents to workarounds related to Hospital Information Systems are described in existing literature?*

The aim of the study is the identification of commonly reported antecedents for workarounds, giving researchers and managers alike the opportunity to understand and control deviant behavior. First, the main process structures in hospitals are described, to create a profound understanding of the situational context in which the studies are settled. This is followed by the description of HIS, their functionalities and the involvement of users within. A theoretical overview of workarounds provides insights into the deviation of norm processes related to IS and prepares for the analysis through the Systematic Literature Review, which follows. Subsequently, the results are presented and discussed, and conclusions are drawn.

2 Theoretical Background

2.1 Process Structures in Hospitals

Hospitals are an essential component within the healthcare sector, as they provide the majority of health services for acute and complex diseases [16]. From the perspective of organizational theory, hospitals are among those institutions characterized by the typical features of service providers, such as customer interaction, personalization, and dynamic variation in processes [17]. The pull principle of lean management [18] illustrates how production is geared to actual demand, a principle based on consumer-oriented flexibility [19]. This principle is generally applied to hospital performance, as medical treatment is executed according to the "uno actu" principle, which means that production and consumption take place simultaneously [20]. Given these circumstances, the predictability of potential disruptions to medical service provision and the prevention thereof is limited [21]. This demand-driven approach presents hospital organizations with the task of ensuring performance flexibility throughout the entire workflow, including the various participants and resources [22]. To gain an understanding of workflows in hospitals, we exemplarily introduce the elective clinical

patient pathway, consisting of six segments [16]. The starting point is the patient's referral to the hospital by a physician. This is followed by the administrative admission to the hospital. After that, the medical processes of diagnostics, surgery and nursing care on the wards take place. Lastly, the patient is discharged. Among the priorities of the hospital organization, medical and nursing service provision rank highest, as they represent the core of value creation and provide direct benefits to patients. The involvement of medical personnel into core processes (diagnostics, surgery and nursing care) implies that nurses and physicians as the main providers of patient-centered services are required to ensure the necessary versatility and resilience [21]. Other processes, which do not directly serve the core service, represent support processes (e.g. referral, admission, and discharge). The aim of supporting processes is to ensure that the primary services run smoothly and that the necessary resources are available at the required time and place [23]. Hospital processes incorporate a multitude of stakeholders, for example medical and administrative staff, patients, relatives, but also insurance companies, associations, and governments [24]. As healthcare represents an information-based science, all these participants and their interests require networking and mutual support. In this context, reliable communication channels and the availability of data are vital for successful care [25].

2.2 Hospital Information Systems

For individuals and organizations alike, digital services have become essential to their daily activities. As technologies influence interactions within our society, individuals, and organizations, it is necessary to challenge existing processes and seize the opportunities that digital technologies provide [26]. Within the healthcare domain, one of the promises of information technologies is the ability to leverage a continuous flow of health-related information. HIS comprise the total of information processing systems for collecting, processing and sharing of data in hospitals [10, 27]. HIS features are manifold and adapted to differing extents by the individual organizations. Common key features supporting the core and support processes include data provision (administrative and medical documentation and reporting), results management (e.g. laboratory and radiology reports) and electronic order transmission via computerized physician order entry (CPOE). Decision support for service providers, patients or relatives based on guidelines, recommendations and workflows play an important role as HIS features in the fight against process errors [28]. The core elements further cover the administrative planning of admissions, procedures, and discharges. Further features, such as reporting and population management are aimed towards external stakeholders, for example governments [29]. The benefits offered by these technologies include the improvement of care quality, efficiency, cost reductions and higher levels of patient [10, 27]. Previous assessments on the impact of health IT revealed evidence supporting the usefulness. Albeit, health IT utilization depends on user behavior, as the 'human element' is critical to the successful implementation [27]. Therefore, the systems need to fit the purposes of all the stakeholders involved [12]. Unfortunately, frontline users do not report HIS processes, if these do not fit or even hinder their requirements in day-to-day workflow. Noncompliance often triggers individual deviations, which can lead to adverse events, a great impairment of patient safety.

2.3 Workarounds

Workarounds are of great importance within the hospital and IS domains, as to their possible outcomes. If employees avoid predefined IS workflows and these variations influence medical and support processes positively, their adaptation to new standards should be encouraged. However, if the deviations show negative results, they must be prevented and investigations on the causes of the deviations, as well as the role of the HIS in use, must be carried out [7]. To grasp the antecedents beneath the actions, a comprehensive definition of workarounds themselves is needed. Attention must be paid to the numerous variations and understanding of the core elements of workarounds related to IS in hospitals. Many general definitions focus on the description of workarounds as harmless deviations from standard processes. According to these descriptions, they depict practices of informal and temporally limited nature, dealing with exceptions to the routine workflow [30, 31]. Often triggered by lack of IT fit, due to the discrepancy between IT system designs and actual workflows, they occur, when system configurations and corporate policies do not accurately capture users' real working practices [32]. The occurrence of workarounds is a form of adaption to the lack of fit through non-standard procedures, based on laws governing user interactions or integration factors for man-machine communication [33]. Such measures are typically used to compensate deficiencies in either system or workflow design to achieve whatever the system prohibits them from doing [34]. They represent alternative approaches providers create to avoid failures in the usual routine [31]. Following these understandings, workarounds are a reaction to actual or perceived rules, beliefs, policies, or intentions that create a restriction within a technological system. Deviating behavior is seen as an essential measure for the performance of tasks, which generally occurs without the need for inevitable changes to standard working practices [33].

Aside, a harsher perspective exists, where workarounds are considered as situations, in which employees oppose a real blockage in the flow of work, not only restrictions or exceptions [7, 11]. In addition, as strategies or schemes that override existing rules in order to improve efficiency or productivity, they may add to the potential risk of error [35]. We adopt the point of view that workarounds should be considered from a rather consequence-oriented perspective, focusing on the adverse effects of these deviations. While some workarounds appear to be positive or harmless, as mentioned above, others are considered negative, as they can lead to inefficient or potentially dangerous patient care. The potential violation of patient safety, as well as organizational policies and government regulations, are harmful results of HIS-related workarounds and call for countermeasures [32]. The majority of hospitals tend to maintain a workaround culture where employees avoid process disruptions by creating their own solutions, instead of complaining and suggesting improvements. This behavior is known as 'first-order problem solving' [36]. Rather than contributing to system redesign, first-order problem solving amplifies the occurring problems mentioned above, as proactive countermeasures to HIS failures are missing. Hence, the core and supporting processes of hospital care are not supported adequately, and the involved stakeholders suffer. In order to take actions against negative workarounds and to enhance the use of positive ones, knowledge of the antecedents for deviating behavior in terms of HIS usage is

needed. While articles often mention workarounds, a full comprehension of their causes is fairly limited, although the relevance due to potential troubling outcomes cannot be denied [7].

2.4 Five Sources of Blockages to Workarounds in Healthcare

It is necessary to grasp the understanding of workflow blockages, which encourage employees to avoid standard processes. One example for a classification approach for blockages to workflows in health care [7], introduces five categories for blockages to workflows in health care settings, which we want to embed into our assessment of antecedents for workers' deviating behavior. According to the classification scheme, occurring workarounds can be sorted into five categories, titled the 'sources for blockages'. **(1) Policies, Laws and Regulations** sometimes create barriers, especially if they are considered random rather than specific to the situation of a particular patient. In healthcare settings, clinical **(2) Protocols and Guidelines** have been designed and implemented in order to improve the quality of care provided to patients. Yet, there are numerous reasons why practitioners simply cannot follow protocols and guidelines. Physicians may regard protocols and guidelines as hindering and therefore bypass them to avoid delays in medical care delivery. A common source of workarounds resides in the design of tasks [7]. Poor **(3) Procedural Designs and Flows** may block working routines. Such blockages often arise from a lack of technology fit, poorly designed process steps or process inefficiencies [7]. Besides, **(4) Technology** can be a source of workarounds. By bypassing technology, they can have much more serious consequences, especially as healthcare organizations are becoming undoubtedly dependent on technology. Workflow deviations can lead to significant risks, which necessitate additional resources to monitor appropriate technology usage [7]. Organizations use bureaucratic structures and authorizations to limit individual **(5) People's** choices. This is done for greater reliability and quality of work processes. However, it can potentially create an obstacle in the workflow, which is especially wasteful in the combination of small scale, yet complex approval processes. This category of workarounds might also be associated with the coordination of care between a large number of healthcare professionals [7].

Most publications focus on the consequences of workarounds, not their origins [7]. It is important, however, to give a high priority to the identification of causes of deviations, before potential problems emerge. Therefore, we seek to review existing studies to help broaden the general understanding and eliminate specific research gaps.

3 Method

We use the methodology of a structured literature review to answer the research question, as this allows us to reflect the body of already published research. Systematic literature reviews are of great importance in the field of IS research, as this area includes a large number of scientific studies [37, 38]. To date, systematic literature reviews on the causes of workarounds in hospitals are not widely spread. Following a structured

protocol [39], we identified and narrowed down the set of existing contributions to summarize what is reported and also, yet unexplored. From the given research question, two content clusters were derived for the database search. The first cluster (“*work around*” OR *workaround* OR *deviance*) represents the differing behaviors in terms of workarounds. The second cluster depicts the hospital setting, as well as the directly involved stakeholders of medical services (*hospital* OR *patient* OR *nurse* OR *physician* OR *doctor*). A combination of these two clusters accounted as our search string. We detected five databases relevant to both healthcare and IS research, namely AIS eLibrary, EbscoHost, JSTOR, PubMed and Scimedirect. The search was conducted in May and June 2019, and the search string was applied on title, abstract and keywords (if available), which resulted in 382 articles. After searching the five databases mentioned above, we discovered duplication listings, which led us to refrain from adding further databases. After extraction from the databases and removing of duplicates, 211 articles remained for further examination. All articles published prior to the year 2009 were excluded, as we were able to identify a significant and constant increase in the number of published articles from 2009 onwards, which indicates rising attention towards the issues of user centricity and accuracy of process fit regarding HIS. This exclusion narrowed our set down to 136. Following, we reported the widely established quality criteria Impact Factor and H-Index and excluded all articles, which did not report an H-Index, as well as all articles with an associated Impact Factor smaller than 2.0 to receive articles of high relevance and journal citation performance only [40]. Following this exclusion process, inclusion criteria were applied to the remaining 77 articles. We performed title and abstract screening on them in order to thoroughly check their suitability for the research topic. Title screening resulted in 51, abstract screening in 19 remaining articles. After performing a full-text screening, 17 articles were selected that included the most relevant content for our research aim.

4 Results

4.1 Descriptive Results

Table 1 provides an overview of the key data. We report the study designs and whether pretesting was performed prior to data collection. Interviews, case studies and questionnaires represent the most frequently used method for data collection. Out of the 17 articles, only five authors/ author teams performed pretesting to find causes for and thus, prevent possible failure of the study design in advance. We also depict the studies’ country settings and summarize the main findings of each article. US-American research settings accounted for the largest share with 8 out of 17 contributions. Our assessment revealed that ten articles [12, 21, 32, 33, 41–46] did not analyze the fit of their developed research model. Further, we depicted which of the five sources of blockages to workflows the individual papers mentioned and found references to four out of five categories.

Table 1. Descriptive Results

Study Design	Article	Pre - testing	Study Setting	Main Findings	Mentioned Categories
Questionnaire	[41]	✓	IRN	Determinants of physicians' attitudes towards EMR adoption	5
	[47]	✗	TWN	Model on user acceptance, user resistance, technological challenges and users' concerns regarding EMR	5
	[11]	✓	USA	Influence of emotional exhaustion as antecedent to workarounds	4, 5
Case Study	[12]	✗	UK	Implications for management and frontline staff regarding the design of IT systems	3
	[43]	✗	USA	System and practice frames for analysis of IT fit	3
	[46]	✗	SGP	Process framework on antecedents and consequences of workarounds regarding new HIS implementations	3, 4
SLR	[48]	✗	Global	Key Themes for computerized physician order entry system (CPOE) prescribing errors	4
Lab. Exp.	[36]	✗	USA	Measures of employee behavior regarding (non-) policy-compliant workarounds and proactive solving behavior	3
Obs.	[33]	✗	USA	Extension of classification scheme for paper-based workarounds into digital context	3, 4, 5
Interviews	[49]	✓	USA	Taxonomy of emotional and behavioral user responses on mandatory IT use	1, 5
	[15]	✓	NL	Conceptual framework on workarounds associated with EMR system usage	1, 3, 4, 5
	[32]	✗	USA	Design recommendations for EMR in terms of patient privacy	1, 3
	[42]	✗	NL	Evaluation of problems and root causes due to CPOE use	3, 4
	[21]	✗	ITA	Explanation of role of knowledge and technologies regarding resilient practices	5
	[44]	✗	USA	Categories of workarounds, paper persistence and communication problems	3
	[45]	✗	SWE	Root causes for workarounds in terms of EMR documentation	4, 5
	[50]	✓	USA	Disconnection between documentation workflows and the design of IT systems	3

SLR = Systematic Literature Review; Lab. Exp. = Laboratory Experiment; Obs. = Observation

4.2 Categorization of Reported Antecedents of Workarounds

According to the classification approach mentioned in Chapter 2.4, the identified papers were examined. We collected relevant statements and sorted them into the five categories of blockages to workflows in hospitals by extending them to their relevance

and impact on HIS. A sole focus on the overarching topics of the individual categories is not sufficient for our purposes, as we consider the relation to information systems as indispensable for the design of customized HIS. After all, practical and sustainable utilization of technology within the personnel-intensive medical sector depends on the comprehensive support of the medical provision.

Within the range of **(1) Policies, Laws and Regulations**, we find determined that employees have explicit instructions on how to use IT for specific tasks and workflows. Under these conditions, IT use is not on the voluntary side of the continuum between willingness and mandatory use. Especially strong resistance can occur when managements command or compel employees against their will [49]. Data protection policies issued in the healthcare sector tend to be overly vague and superficial for translation into daily work. Since these guidelines are very general and purpose-oriented, they do not specify the exact design of the processes. Often the specific working practices of the various groups within a hospital are not covered, and therefore it may not be possible to implement consistent policies across the group. Thus, hospital system configurations, privacy policies and procedures determine the user's working practices. If the goal orientation towards the actual work environment is not given, workarounds are generated [32]. This is exemplified by data migration guidelines. If direct access or permission to integrate other systems for obtaining the required historical data is not permitted, users develop ways to circumvent them. Since the data cannot be imported into the current EMR from previously used systems, there is no reliable level of knowledge unless workarounds are used [15].

Regarding the category of **(2) Protocols and Guidelines**, none as such were reported as HIS-related antecedents to workarounds in the total of analyzed papers.

Given **(3) Procedural Design and Flows** as a source of blockages to workflows, various statements were extracted. Various authors [15, 33, 46, 50] claim that workarounds are used as a means to increase the efficiency of tasks and also for convenience and speed [32, 42]. This improvement can either be an actual improvement, but employees also participate in the creation of workarounds with the hope for an increase in efficiency. The difficulty in preventing process inefficiencies determines the occurrence of workarounds. A trivial workaround will emerge more frequently than a time consuming one, which will more likely encourage preventative measures against its root causes [36]. Physicians, for instance, share login accounts to avoid the slow login process, while nurses share passwords with each other, simply to co-sign medication, as they feel the process of doing it as the workflow dictates, is too tedious. The mismatch between the development and application of IS in hospitals is another sub-theme in the field of work process design. If the needs of the nurses, physicians and administrative workers, the end-user, are not taken into account, the HIS, which is intended to support the workflow, is a hindrance to the daily routine of the ward [12]. The rationale for this mismatch is manifold. Current healthcare IT tools do not cover all clinical practices and may be perceived as obstacles to good patient care [33]. The example of data protection within a HIS illustrates the disparity between what system developers think, users do and what users actually do [32]. This is an area of collision in priorities and understanding of practice that remains unresolved, requiring end users, groups and organizations to adapt to various activities at short

notice [43]. In the case of this unfavorable collision between the IT frameworks and the operational workflow, physicians, for example, adapt to situations by relying on outdated processes and resources. Limited will for interaction and a lack of standardized ways of communication between the developing and supporting IT staff and the end-users on the wards accounts for the existence of workarounds. A lack of feedback from users, be it right after the implementation phase or even in established settings, does not allow for the redesign and alignment with work processes [32]. A further reported cause for the development of workarounds is the complexity of the given tasks, as this dictates the workflow, the HIS design and consequently, the related functionality issues [33, 44].

Regarding **(4) technology**-related causes for workarounds, flexibility is a key requirement of information systems. Inflexible or complex frontend features are reported as particularly restrictive when entering non-standardized orders or requests. For example, users were forced to select a standard set of drug instructions and add a contradictory comment advising the nurse to give different dosages [48]. Usability as the gap between effort and outcome in the achievement of a task is a major reported antecedent for IS-related workarounds in hospitals. Whenever the system does not allow the user to work with it intuitively, usability issues arise that challenge the ability to perform. Excessive logging in, clicking, difficulties in finding necessary patient data and complex order entry and retrieval processes are reported challenges [33, 42, 45]. Enforced data entry, where it is not needed, can cause distress among users [15]. The inability to perform multiple tasks at once within a HIS, as well as the inability to support longitudinal data processes, which require access to multiple data points across time, push the development of workarounds onward [15]. Usability is accompanied by the visualization of the data. If the presentation of the data is insufficient, for example due to small screens, low resolution or the data view (e.g. charts, graphs, free text), personnel might not be informed correctly and will try for alternative ways to visualize [33]. The basic prerequisite for user-friendliness is system performance as such. Workarounds commonly occur when a system slows down, freezes or crashes due to hardware or software problems [15, 46]. A further antecedent is the so-called alert fatigue, which leads users to intentionally override the system if an excessive amount of alerts indicates that scheduled interventions are not performed [11].

Another important aspect when considering the causes of workarounds are the **(5) People** involved. Participants of hospital organizations possess knowledge, which is a major determinant of behavior. This knowledge ranges from education and training to experience and ease of use in the handling of the HIS [33]. Such knowledge does cover not only standard routines but also tacit knowledge regarding the dynamics of organizations, as well as unwritten practices and unique characteristics [21]. Besides the antecedents mentioned above, doubts on the reliability and intention behind the systems account for workarounds, as stated by a variety of authors. Organizational contextual factors are of great importance for the prevention of workarounds [41]. User rejection is, as proved by prior research, the majorly reported cause of system failure [47]. A (perceived) lack of autonomy and resources can cause the loss of psychological empowerment and engagement of healthcare professionals [11]. Employees may consider information systems a menace to their autonomous work if they reduce the

(perceived) level of patient interaction, process control, and operational flow. With their resistive attitude, they want to negate change and reject IT [15, 49]. In addition, HIS often contain control elements, which force users to confirm that they have initiated actions and met specific objectives. These control elements can be offensive, causing it to be regarded as surveillance of their performance [12]. Resistance research shows that users oppose IT when they view it as a threat to their workplaces or organizational status or consider the consequences of IT use to be unjust. Therefore, they want to prepare the best possible representation of their work with the patients, even if they condone ‘workarounds’ that do not reflect actual events [49]. Furthermore, physicians and nurses may simply lack the intention to use the system. This may be due to individual preferences on data presentation or greater trust in outdated techniques, for example paper-based documenting [33]. Moreover, the extra effort for learning the system usage not being reflected financially can also trigger the unwillingness for system usage [47]. A missing appreciation for employees' proactive problem-solving behavior by the management further contributes to process deviations. If the given feedback is not or not sufficiently taken into account, design problems and their related workarounds persist [45].

4.3 Limitations

Given the nature of our research, several limitations apply to this study. Firstly, we did not include a content cluster regarding the topic of information systems into our search string. This was not done, as articles focussing on specific features of HIS (such as CPOE or EMR) do not necessarily mention terms related to information systems or technologies in their titles and abstracts. A more differentiated search string that includes a content cluster covering terms related to HIS might have enriched the obtained results to a more specific article set. Forward and backward search patterns for the identification of relevant prior and citing articles could have given a broader insight into the published body of knowledge [39]. Due to the applied inclusion- and exclusion criteria, we removed articles from our study set, which might have proven themselves to be suitable in terms of content. Regarding the theoretical foundation of our study, we solely focused on the definition of workarounds and used the term deviation as a synonym, regardless of the motivational dimensions. Given the obtained results, we argue that the hierarchical distinction between the categories Policies, Laws and Regulations and Protocols and Guidelines might account for the lack of content in the category of Protocols and Guidelines. Policies, Laws and Regulations rely on state-of-the-art knowledge and dictate organizational policies and guidelines, which is why antecedents to policy-related workarounds might also account for protocols and guidelines, leaving this category blank.

5 Conclusion and Further Research

In this paper we investigated the antecedents behind the development of workarounds in hospitals related to HIS. Based on a systematic literature review [39], we analyzed a

study set according to five sources of workflow blockages in healthcare settings [7], which we adapted to our objectives by focusing exclusively on HIS-related antecedents. This was aimed towards the identification of the underlying reasons for hospital staff to question existing process flows of HIS and the establishment of related workarounds.

Our results demonstrate the reasons that lead health care professionals to engage in workarounds. Within our analysis, we were able to identify antecedents to four out of five categories. Within the category of Policies, Laws and Regulations, we were able to determine the role of willingness and mandatory usage as antecedents, which can be dictated by explicit instructions on how to use IS. Regarding the procedural design of workflows, efficiency and the mismatch between system design and the requirements of day-to-day work accounted as the main antecedents to the creation of deviating behavior. Technology-related workarounds were commonly rooted in missing flexibility, usability and data visualization of the HIS. Further, the category of people involved, types of knowledge, the role of autonomous decision-making and the appreciation of human engagement into HIS processes are relevant antecedents.

The lack of results in the category of Protocols and Guidelines calls for further examination. Future studies should extend the focus on behavioral patterns, such as shortcuts and error handling. Moreover, the evaluation of the extent of HIS-related workarounds needs to be taken into account. Further, the consequences that follow the identification of antecedents, such as user-centric design recommendations for HIS or structured possibilities for feedback appreciation, call for further analysis. The differences between user acceptance and the creation of workarounds need to be worked out precisely, as we consider these to be inversely related. Antecedents, which cause the intention to use (user acceptance), also cause the intention to avoid (creation of workarounds) and serve as a counterpart to each other. Thus, they require closer attention. In addition, an analysis of the strategic component and intention behind the current HIS design and the user intentions, as well as resulting challenges in the day-to-day routine, needs to be performed. Recommendations for adjustments to that represent an interesting goal for further research.

References

1. Tetzlaff, J., Muschik, D., Epping, J., Eberhard, S., Geyer, S.: Expansion or compression of multimorbidity? *International journal of public health* 62, 679–686 (2017)
2. van Baal, P., Morton, A., Meltzer, D., Brouwer, W.: Future unrelated medical costs need to be considered in cost effectiveness analysis. *The European Journal of Health Economics* (2018)
3. Buck, H., Kistler, E., Mendijs, H.G.: Demographic change in the world of work. Opportunities for an innovative approach to work. Fraunhofer - Gesellschaft zur Förderung der angewandten Forschung e.V, Stuttgart (2002)
4. Weissman, J.S., Rothschild, J.M., Bendavid, E., Sprivulis, P., Cook, E.F., Evans, R.S., Kaganova, Y., Bender, M., David-Kasdan, J., Haug, P., et al.: Hospital workload and adverse events. *Medical care* 45, 448–455 (2007)

5. Hufnagl, C., Doctor, E., Behrens, L., Buck, C., Eymann, T.: Digitisation along the Patient Pathway in Hospitals. Proceedings of the 27th European Conference on Information Systems (ECIS) (2019)
6. Georgantzas, N.C., Katsamakas, E.G.: Information systems research with system dynamics. *System Dynamics Review* 24, 247–264 (2008)
7. Halbesleben, J.R.B., Wakefield, D.S., Wakefield, B.J.: Work-arounds in health care settings: Literature review and research agenda. *Health care management review* 33, 2–12 (2008)
8. Halbesleben, J.R.B., Savage, G.T., Wakefield, D.S., Wakefield, B.J.: Rework and workarounds in nurse medication administration process: implications for work processes and patient safety. *Health care management review* 35, 124–133 (2010)
9. Agrawal, A.: Medication errors: prevention using information technology systems. *British journal of clinical pharmacology* 67, 681–686 (2009)
10. Beglaryan, M., Petrosyan, V., Bunker, E.: Development of a tripolar model of technology acceptance. *International journal of medical informatics* 102, 50–61 (2017)
11. Rathert, C., Williams, E.S., Lawrence, E.R., Halbesleben, J.R.B.: Emotional exhaustion and workarounds in acute care. *International journal of nursing studies* 49, 969–977 (2012)
12. Eason, K., Waterson, P.: Fitness for purpose when there are many different purposes: Who are electronic patient records for? *Health informatics journal* 20, 189–198 (2014)
13. Tucker, A.L., Edmondson, A.C.: Why Hospitals Don't Learn from Failures: Organizational and Psychological Dynamics That Inhibit System Change. *California Management Review* 45, 55–72 (2003)
14. Price, M.R., Williams, T.C.: When Doing Wrong Feels So Right: Normalization of Deviance. *Journal of patient safety* 14, 1–2 (2018)
15. Blijleven, V., Koelemeijer, K., Jaspers, M.: SEWA: A framework for sociotechnical analysis of electronic health record system workarounds. *International journal of medical informatics* 125, 71–78 (2019)
16. Kriegel, J.: *Krankenhauslogistik*. Gabler Verlag, Wiesbaden (2012)
17. Dobrzykowski, D.D., McFadden, K.L., Vonderembse, M.A.: Examining pathways to safety and financial performance in hospitals. *Journal of operations management* 42/43 (2016)
18. Womack, J.P., Jones, D.T.: *Auf dem Weg zum perfekten Unternehmen. Lean thinking*. Campus-Verl., Frankfurt (1997)
19. Brunner, F.J.: *Japanische Erfolgskonzepte*. Hanser, München (2008)
20. Meffert, H., Bruhn, M.: *Dienstleistungsmarketing*. Gabler Verlag, Wiesbaden (2009)
21. Rubbio, I., Bruccoleri, M., Pietrosi, A., Ragonese, B.: Digital health technology enhances resilient behaviour: evidence from the ward. *International Journal of Operations & Production Management* 39, 594–627 (2019)
22. Reijers, H.A., Russell, N., van der Geer, S., Krekels, G.A.M.: Workflow for Healthcare: A Methodology for Realizing Flexible Medical Treatment Processes. In: van der Aalst, W., Mylopoulos, J., Sadeh, N.M., Shaw, M.J., Szyperski, C.,

- Rinderle-Ma, S., Sadiq, S., Leymann, F. (eds.) *Business Process Management Workshops*, 43, pp. 593–604. Springer Berlin Heidelberg (2010)
23. Rohner, P.: Achieving impact with clinical process management in hospitals: an inspiring case. *Business Process Mgmt Journal* 18, 600–624 (2012)
 24. Döring, A., Paul, F.: The German healthcare system. *The EPMA Journal* 1, 535–547 (2010)
 25. Johnston, M.J., King, D., Arora, S., Cooper, K., Panda, N.A., Gosling, R., Singh, K., Sanders, B., Cox, B., Darzi, A.: Requirements of a new communication technology for handover and the escalation of patient care: a multi-stakeholder analysis. *Journal of evaluation in clinical practice* 20, 486–497 (2014)
 26. Gimpel, H., Hosseini, S., Huber, R., Probst, L., Röglinger, M., Faisst, U.: Structuring Digital Transformation: A Framework of Action Fields and its Application at ZEISS. *Journal of Information Technology Theory and Application* 19, 31–54 (2019)
 27. Buntin, M.B., Burke, M.F., Hoaglin, M.C., Blumenthal, D.: The benefits of health information technology. *Health affairs (Project Hope)* 30, 464–471 (2011)
 28. McCullough, J.S., Casey, M., Moscovice, I., Prasad, S.: The effect of health information technology on quality in U.S. hospitals. *Health affairs (Project Hope)* 29, 647–654 (2010)
 29. Saluvan, M., Ozonoff, A.: Functionality of hospital information systems: results from a survey of quality directors at Turkish hospitals. *BMC medical informatics and decision making* 18, 6 (2018)
 30. Koppel, R., Wetterneck, T., Telles, J.L., Karsh, B.-T.: Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. *Journal of the American Medical Informatics Association : JAMIA* 15, 408–423 (2008)
 31. Kobayashi, M., Fussell, S.R., Xiao, Y., Seagull, F.J.: Work coordination, workflow, and workarounds in a medical context. In: van der Veer, G. (ed.) *CHI '05 Extended Abstracts on Human Factors in Computing Systems*, p. 1561. ACM, New York, NY (2005)
 32. Eikey, E.V., Murphy, A.R., Reddy, M.C., Xu, H.: Designing for privacy management in hospitals: Understanding the gap between user activities and IT staff's understandings. *International journal of medical informatics* 84, 1065–1075 (2015)
 33. Flanagan, M.E., Saleem, J.J., Millitello, L.G., Russ, A.L., Doebbeling, B.N.: Paper- and computer-based workarounds to electronic health record use at three benchmark institutions. *Journal of the American Medical Informatics Association* 20, e59-e66 (2013)
 34. McGann, S., Lyytinen, K.: The Improvisation Effect: A Case Study of User Improvisation and Its Effects on Information System Evolution. In: *ICIS 2008 Proceedings*, 209
 35. Hakimzada, A.F., Green, R.A., Sayan, O.R., Zhang, J., Patel, V.L.: The nature and occurrence of registration errors in the emergency department. *International journal of medical informatics* 77, 169–175 (2008)

36. Tucker, A.L.: The Impact of Workaround Difficulty on Frontline Employees' Response to Operational Failures: A Laboratory Experiment on Medication Administration. *Management Science* 62, 1124–1144 (2016)
37. Tate, M., Furmueller, E., Evermann, J., Bandara, W.: Introduction to the Special Issue: The Literature Review in Information Systems. *Communications of the Association for Information Systems* 37, 103–111
38. Watson, R.T.: Beyond being Systematic in Literature Reviews in IS. *Journal of Information Technology* 30, 185–187 (2015)
39. Webster, J., Watson, R.: Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly* 26, xiii–xxiii (2002)
40. Zupanc, G.K.H.: Impact beyond the impact factor. *Journal of comparative physiology* 200, 113–116 (2014)
41. Abdekhoda, M., Ahmadi, M., Dehnad, A., Noruzi, A., Gohari, M.: Applying Electronic Medical Records in Health Care: Physicians' Perspective. *Applied clinical informatics* 7, 341–354 (2016)
42. Niazkhani, Z., Pirnejad, H., van der Sijs, H., Aarts, J.: Evaluating the medication process in the context of CPOE use: The significance of working around the system. *International journal of medical informatics* 80, 490–506 (2011)
43. Novak, L.L., Holden, R.J., Anders, S.H., Hong, J.Y., Karsh, B.-T.: Using a sociotechnical framework to understand adaptations in health IT implementation. *International journal of medical informatics* 82, e331-e344 (2013)
44. Saleem, J.J., Russ, A.L., Neddo, A., Blades, P.T., Doebbeling, B.N., Foresman, B.H.: Paper persistence, workarounds, and communication breakdowns in computerized consultation management. *International journal of medical informatics* 80, 466–479 (2011)
45. Stevenson, J.E., Israelsson, J., Nilsson, G., Petersson, G., Bath, P.A.: Vital sign documentation in electronic records: The development of workarounds. *Health informatics journal* 24, 206–215 (2018)
46. Yang, Z., Ng, B.-Y., Kankanhalli, A., Luen Yip, J.W.: Workarounds in the use of IS in healthcare: A case study of an electronic medication administration system. *International Journal of Human-Computer Studies* 70, 43–65 (2012)
47. Lin, C., Lin, I.-C., Roan, J.: Barriers to physicians' adoption of healthcare information technology: an empirical study on multiple hospitals. *Journal of medical systems* 36, 1965–1977 (2012)
48. Brown, C.L., Mulcaster, H.L., Triffitt, K.L., Sittig, D.F., Ash, J.S., Reygate, K., Husband, A.K., Bates, D.W., Slight, S.P.: A systematic review of the types and causes of prescribing errors generated from using computerized provider order entry systems in primary and secondary care. *Journal of the American Medical Informatics Association* 24, 432–440 (2017)
49. Bhattacharjee, A., Davis, C.J., Connolly, A.J., Hikmet, N.: User response to mandatory IT use: a coping theory perspective. *European Journal of Information Systems* 27, 395–414 (2018)
50. Mamykina, L., Vawdrey, D.K., Stetson, P.D., Kai Zheng, Hripsak, G.: Clinical documentation: composition or synthesis? *Journal of the American Medical Informatics Association* 19, 1025–1031 (2012)