An Invisible Burden: An Experience-Based Approach to Nurses’ Daily Work Life With Healthcare Information Technology

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Abstract

Information and Communication Technology (ICT) has been an increasingly pervasive component of most workplaces throughout the past half century. In healthcare, the turn to the digital has resulted into the broad implementation of Healthcare Information Technology (HIT). The impacts of ICT on work life have been investigated predominantly through surveys, although some researchers have advocated for the use of a qualitative, experience-based approach. Meanwhile, the existing body of research on the impacts of HIT on clinicians has painted a mixed picture of digitalization. Despite some clear benefits, HIT has indeed been found to have unexpected, unintended adverse consequences for hospital staff. Typical issues include loss in efficiency, extra effort to carry out routine tasks, and the creation of new, HIT-induced work activities. Simultaneously, research outside of the healthcare domain has shown that ICT could require extra effort from some users in order for the sociotechnical system to function properly - extra work often invisible to developers.

Based on observation, interview and focus group data collected at a large Swedish hospital, this thesis set out to investigate the impact of HIT on hospital nurses from an experience-based perspective, resulting in four main contributions. First, a method supporting experience-based data analysis, the HolisticUX method, is introduced. Second, 13 forms of HIT-induced additional tasks in nurses’ workload are identified, five of which are not acknowledged in previous research. Third, task avoidance is identified as a consequence of nurses’ increased workload, negatively affecting patient safety, care quality and nurses’ professional satisfaction. Finally, four factors are argued to contribute to a suggested invisibility of the HIT-induced time burden in nurses’ work life to management and developers: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work.
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List of Papers

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Chapter 1

Introduction

Information and Communication Technology (ICT) has been an increasingly pervasive component of most workplaces throughout the past half century, inducing far-reaching changes in ”how, when and where we work” [36, p.238]. In healthcare, the turn to the digital has resulted into the broad implementation of Healthcare Information Technology (HIT), such as the electronic health record. Nordic countries, i.e. Sweden, Norway, Denmark, and the United Kingdom, are leading this digitalization effort [21, 50].

The impacts of ICT on work, workers and work context have been the object of an ever increasing interest from researchers since the 1960s [15]. Surveys have been, by far, the preferred method to investigate the question, including in the healthcare domain [31] (paper I). While some researchers have argued that analyzing the relationship between people and technology through the lens of lived experience was the only way to ”do justice to the wide range of influences that technology has in our lives” [34, p.12], few studies have applied such an approach in a work-related context [57].

The existing body of research on the impacts of HIT on clinicians and patient outcomes has painted a mixed picture of digitalization [20, p.610]. In spite of the great hopes that have been placed into HIT’s potential to increase the efficiency, cost-effectiveness, quality, and safety of care [24, p.w282], it indeed shows that, although some of the issues associated with paper-based information management have been solved, HIT has simultaneously brought about unanticipated, often negative, impacts. Those are generally referred to as unintended adverse consequences (UACs) [10, 16, 40]. Recurring UACs in the literature include, among others, loss in efficiency [14, 20, 25, 58], extra effort to carry out routine tasks [8, 9, 20, 58, 22], and the creation of new, HIT-induced work activities [8]. These negative side effects of HIT are perceived by nurses as threats to patient safety and care quality [9, 16].
Simultaneously, research outside of the healthcare domain has pointed at developers often overlooking the extra effort that some ICT applications require from certain users in order for the sociotechnical system to function in practice [26]. This overlooked extra effort can thus be considered as a form of "invisible" work - tasks carried out by employees despite not being recognized as a legitimate part of their workload [44].

1.1 Aim and Research Questions

The current thesis investigates the impact of HIT on hospital nurses’ daily work. It does so by applying a qualitative, experience-based methodology to data collection and, to some extent, to data analysis.

The three research questions (RQs) at the core of this thesis can be formulated as follows:

RQ1: How can a humanities-based approach to experience be applied to work life data?

RQ2: How does HIT use affect nurses’ work life?

RQ3: What factors may hinder management’s ability to see HIT’s negative impacts on nurses’ work life?

The findings from Paper I, a review of the literature examining the impacts of ICT on work life, set the background for the thesis. Paper II and Paper III are the basis for the current work. RQ2 is common to both papers, while RQ1 is the focus of Paper II, and RQ3 at the core of Paper III.

1.2 Thesis Outline

The key concepts and background knowledge needed to understand to the current work and its context are provided in chapter 2. In chapter 3, the methods used for data collection and analysis are described in detail. The findings, and answers to RQ1-3, are presented in chapter 4. Results are discussed and the contributions of the thesis outlined in chapter 5. Finally, chapter 6 briefly summarizes the main findings of the thesis and presents plans and suggestions for future work.
Chapter 2
Background

2.1 Information and Communication Technology in the Workplace

Information and Communication Technology (ICT) is "a contemporary term that describes the combination of computer technology (hardware and software) with data and telecommunications technology (data, image, and voice networks)" [52, p.104]. Its rapid development in the second half of the 20th century has propelled Western society into a "digital age" [40], in which "digital technology is rapidly becoming as infrastructural as electricity" [12, p.350]. The characteristic of this new era is that "the generation and trading of products and services" is based on "digitalized data, information, and knowledge" [12, p.351].

This turn to the digital has provoked a "major transformation in the workplace" [29, p.314] and altered the "very nature of work life" [36, p.238], redefining "how we interact and communicate" [12, p.350] as well as "how, when, and where we work" [36, p.238]. The scope of these far-reaching changes induced by ICT in work life led Danziger [15, p.3] to argue that "its impacts on society merit the most extensive and thoughtful empirical study".

2.1.1 Research on the Impacts of ICT on Work Life

The first studies on the impacts of ICT on work, workers and work context date back to the first half of the twentieth century [15]. The field has known a steady increase in interest since the 1960s [15] and, in 1990, a "significant body of research [on the social impacts of technology]" could be reported [31, p.592]. Complex and multifaceted - like its object of study [49], the research area addressing the impacts of ICT on work life has developed without
any well-defined scholarly community or any clear disciplinary home [15]. Researchers contributing to the field are dispersed both geographically and disciplinarily [15]. Sociology, political science, administrative and management science, economics, computer science, history, philosophy, and law [15] are some of the disciplines involved in researching the topic.

The research on the impacts of ICT on work life has been the object of several reviews. The earliest example may be Kraemer and Danziger’s 1990 [31] effort, assessing the research on the social impacts of technology from between 1985-1990. The more recent reviews identified as being closely connected to the topic have a slightly different aim and scope. For instance, Sawyer and Eschenfelder [39] focus on the area of social informatics, while Cascio and Aguinis [11] and Githens et al. [23] limit their scope to a specific discipline, respectively industrial and organizational psychology and human-resource development. In order to fill this gap, Paper I assessed the focus, amount, and nature of the modern research (2000-2017) examining the impacts of ICT on work life. The following conclusions could be drawn from this endeavor:

A wide range of impact areas related to ICT and work life has been investigated during this period.

The impact of healthcare systems on workers’ mental health, i.e. intrapersonal factors such as wellbeing, stress, burnout, sleep, emotions, cognitive workload, cognitive functioning, and coping strategies, has been the main research focus.

Studies usually have a broad scope, and typically focus on more than one impact area.

Surveys are the predominant data collection method.

A variety of different standardized data collection tools and theoretical frameworks have been used to tackle the topic. These tools and frameworks come from a range of different disciplines, including psychology, behavioral science, cognitive science, management science, information systems and human-computer interaction.

The research trends regarding the investigated impact areas and the data collection methods applied have essentially been steady throughout the development of the field - no fundamental change or shift has taken place since Kraemer and Danziger’s 1990 [31] review. These findings suggest that the existing research on the impacts of ICT on work life has favored breadth over depth and top-down (e.g. surveys, typically quantitative) over bottom-up (typically qualitative) approaches. More qualitative, exploratory studies investigating particular impact areas in depth are needed. Furthermore,
as the vast majority of studies within the field are based on self-reports (workers’ subjective assessments), studies investigating the impact of ICT on more objective indicators could bring valuable new input into the research domain.

2.1.2 ICT and the (In)visibility of Work

The notion of “invisible work” builds on the commonly observed discrepancies between formal task descriptions and actual work practice [44]. In other words, “invisible work” refers to tasks carried out by employees despite not being recognized as a legitimate part of their workload [44]. As such, (in)visibility is not an attribute of the work itself, but rather depends on the perspective of the viewer [35]. Work may thus be invisible to, for example, management, but not necessarily to the workers’ themselves, or to other groups [35]. The aspects of work that are invisible may also vary depending on who is “watching” [3]. This means that, “when we speak of “invisible work”, it is [...] crucial to ask, ‘invisible to whom?”’ [35, p.49].

There are different types of invisible work. Work can, for example, literally be performed “out of sight” due to spatial or temporal organization [44]. It can also be carried out by “invisible” workers - employees that are no longer seen as human beings by their employer, but as machines [44]. Assumptions leading to the work being considered as natural (requiring skills that are inherent to the workers) or routine (not requiring any skill) and as such, effortless, can also render it invisible [44]. This particular form of invisible work is referred to as “background work” by Star and Strauss [44]. For Suchman [45, p.59], one cause behind this type of invisible work in organizations is that “work has a tendency to disappear at a distance, such that the further removed we are from the work of others, the more simplified, often stereotyped, our view of their work becomes”. At the extreme, work can be reduced to a number of quantitative indicators, which is yet another way with which work can be made invisible [44]. In that case, both work practice and workers disappear behind quantitative descriptors such as, in the healthcare domain for example, number of patients, operation duration, length of hospital stay, etc.

In their seminal 1999 paper, Star and Strauss [44] demonstrated the importance of “invisible” forms of work for the design and successful implementation of ICT applications. First, successful design builds on an understanding of users’ actual work practice, which can often be, to some degree, informal and thus invisible [44]. Second, the consequences that ICT use can have on the (in)visibility of a worker population and their work routines must be understood in order to ensure successful implementation [44]. Indeed, visibility is not inherently positive - it can be synonym of increased
accountability and surveillance - and invisibility not inherently negative, as it can allow for more autonomy [44]. These two points have been addressed in the healthcare domain as well, e.g. [8, 7].

The concept of work (in)visibility in system design and implementation is also important in relation to the invisible work that the system itself can create for (at least some of) its users. In his 1998 paper, Grudin [26] pointed to designers’ lack of consideration for the extra effort required of some user groups (e.g. secretaries) in order to keep the system (e.g. a shared calendar application) running smoothly (i.e. up-to-date) once implemented. He argued that this oversight led many ICT systems to fail, as those users having to put in extra effort into the system were not those benefiting from it.

2.1.3 Experience in Work Life Research

Some researchers have criticized the lack of consideration given to ”lived experience” in research on people’s interaction with technology [34]. For McCarthy and Wright [34, p.12], interpreting ”the relationship between people and technology in terms of [...] the felt or emotional quality of action and interaction” indeed is the only way to ”do justice to the wide range of influences that technology has in our lives”.

Two different approaches to experience co-habit within HCI, or rather UX, research: a humanities-based, ”holistic” approach, and a psychology-based, ”reductive” one [5]. The former, e.g. [34], looks at experience as individual and contextual. As such, it makes no attempt at identifying general components (in terms of values, needs, desires, and goals) of an experience [5]. Meanwhile, the latter, e.g. [28], seeks to do just that, namely determining a generalizable model of what needs, desires, and goals a (positive) experience fulfills based on psychological research. Both approaches have proved useful in a work-related context [55, 56], although the psychology-based perspective is slightly more represented than the humanities-based one [57]. However, studies looking at experience in a work-related context are on the whole rather few [57].

One possible reason why the humanities-based, holistic approach to experience has not been more used in a work-related context is that it is unclear how one should proceed when doing so. McCarthy and Wright [34] have proposed a framework ”to analyze user experience with emerging technologies” [55, p.46], but have not provided guidance on how to apply this tool in practice.

The framework is composed of two parts. The first one focuses on disentangling the different dimensions of experience, and identifies four so-called ”threads” of experience: the compositional thread (the narrative of an exper-
2.2 Healthcare Information Technology

In healthcare, the turn to the digital has been conducted through the development and implementation of Healthcare Information Technology (HIT) [2]. The Scandinavian nations, i.e. Sweden, Norway, and Denmark, and the United Kingdom, are currently leading this healthcare digitalization effort [21, 50]. HIT is an umbrella term referring to different types of systems used within healthcare for clinical and administrative purposes [47, 52]. Other designations, such as health care IT, health management information systems, health information systems or healthcare information systems are also in use, although there are subtle differences in their meaning [47]. The electronic health record (EHR), which contains "all the data acquired and created during a patient’s course through the health care system" [48, p.447], is HIT’s flagship system [20]. Other examples include, for instance, Computerized Provider Order Entry (CPOE) systems - allowing physicians (or their surrogates) to submit medication orders electronically to pharmacies, labs, and nurses [10, 58], laboratory systems, operation planning systems, or nursing care plan systems [20]. Beyond these management systems, which primarily serve "the acquisition, storage, transmission and display of patient administrative or health information" [33, p.13], HIT also encompasses various types of communication systems, computerized decision systems (often embedded in the EHR [10]), and information systems (e.g. web-based clinical information portals) [33]. However, the different systems in use at a hospital are seldom fully integrated [20]. This is partly because "many software products have been built and acquired from heterogeneous sources during a long period of time, and the systems have differences in implementation technologies and architectures" [20, p.613].
2.2.1 Mixed Impact of HIT

In a healthcare domain that is, in essence, very fragmented (e.g. composed of many different professions and specializations) [13], HIT implementation has been expected to improve "efficiency, cost-effectiveness, quality and safety of medical care delivery" [24, p.w282]. Indeed, computer-mediated "data visualization, collaboration, and clinical decision support" [50, p.2182] were to overcome the limitations of paper-based information management, bringing "what was informal and impermanent into permanence and formality with the promise of accountability [and] safety" [58, p.44]. However, in spite of these great hopes surrounding HIT implementation and use, several reports and studies point to the expected benefits not having come into full realization. In their extensive review of CSCW healthcare literature, Fitzpatrick and Ellingsen [20, p.610] note that "while there has been considerable hype and momentum around the potential of ICT in healthcare, a series of recent reports based on experiences to date [...] have started to paint a more realistic picture". Of course, this does not mean that HIT has not had any benefits on healthcare practice and delivery. Rather, as we will see below, while HIT has solved several of the problems and drawbacks related to paper-based information management, it has also brought about new ones. This ambivalence is omnipresent in the existing literature on the impact of HIT on clinicians and on nurses more specifically. Indeed, research points to most of nurses’ work life dimensions - such as patient care, working conditions, and professional development - being in some ways positively affected, and in other ways negatively affected by HIT implementation [19].

On the one hand, HIT has thus been found to, from nurses’ perspective, increase the quality of patient care, improve patient safety outcomes (by reducing medical errors), increase the administration of preventive care (such as vaccines) [16, 46], improve communication, and increase efficiency [16]. Medication administration is for instance seen as safer thanks to HIT [16], and its perceived benefits regarding communication are multiple. Communication with doctors is more effective thanks to the increased readability of their notes - nurses no longer need to decipher handwritings [16] - and communication with patients is facilitated, as nurses can provide them with up-to-date information they can both see on the computer screen [16]. Nurses furthermore feel that they are able to communicate patient information more quickly [16], and that their access to up-to-date information about their patients’ status is made easier and more efficient [16, 17]. Nurses’ ability to care for patients at transfer also seems to be perceived as easier by nurses thanks to HIT applications [17]. Finally, a benefit of HIT is in its providing "increased opportunity to study care delivery at an aggregate level through
queries across groups or populations of patients, which is nearly impossible in paper-based systems” [17, p.42]. Data integration is thus perceived as capable to make benchmarking of clinical performances more efficient, and to improve care protocols, resulting in a higher quality of care [46]. On the other hand, a broad range of negative consequences has been identified in relation to HIT implementation and use.

2.2.2 Unintended Adverse Consequences of HIT

The various ways in which HIT can negatively affect clinicians’ work life, the quality of clinical practice and patient safety outcomes are often unintended and unanticipated [27]. These negative (and typically unanticipated) impacts of HIT (and ICT in general) on work life have commonly been referred to as Unintended Adverse Consequences (UACs) [10, 16, 40] in the literature. In healthcare, studies on the UACs emerging from HIT implementation originated as early as 1998 with the advent of Computerized Provider Entry (CPOE) systems [22]. Today, there exists a significant body of research on the unintended, negative impacts of HIT on clinicians’ work life - although many studies directly or indirectly addressing the topic do not use the term UACs.

In a 2006 paper, Campbell et al. [10] investigated five successful CPOE system implementations and identified nine major categories of UACs. A decade later, Sittig et al. [42] added six more items to this list, based on literature and field research around EHR implementation in general. The 15 UACs identified are 1) more/new work for clinicians, 2) unfavorable workflow issues, 3) never ending demands for system changes, 4) problems related to paper persistence, 5) untoward changes in communication patterns and practices, 6) negative emotions; 7) generation of new kinds of errors, 8) unexpected changes in the power structure, 9) overdependence on the technology, 10) full record unavailable at the point of care, 11) frustrating user experiences, 12) inadvertent disclosure of patient-specific information, 13) negative impact of computer-based quality measurement on clinical workflows and patient-provider interactions, 14) information overload from computer-generated data, and 15) decline in the development and use of internally-developed EHRs. This list shows that the UACs that can result from HIT implementation are far-reaching and extremely diverse.

Their cause can be of technical (system functionality) or organizational (how clinicians are expected to use the system) nature [16] or a combination of both. Mismatches between clinicians’ workflow and HIT design are frequent [16], but it is important to remember that ”the results of HIT innovation can never be fully determined by the technology” [27, p.543]. As Harrison et al. [27, p.542] note, ”many harmful or otherwise undesirable
outcomes of HIT implementation flow from [...] the interplay between new HIT and the provider organization’s existing social and technical systems, including their workflows, culture, social interactions, and technologies”. Furthermore, an open question in the literature on the impacts of HIT on clinicians seems to be whether the negative impacts of HIT are permanent or temporary and, in the latter case, ”how long the negative consequences of implementation will last” [54, p.510].

### 2.2.3 Clinicians’ Increased Workload Following HIT Implementation

A recurrent finding in the literature on the impact of HIT implementation on clinicians, i.e. studies including both physicians and nurses, is loss in efficiency [14, 20, 25, 58] and extra work needed to carry out routine tasks [8, 9, 20, 58, 22]. Indeed, HIT has been recognized as introducing more cumbersome workflows for nurses and other end users [9, 22]. However, few studies have taken a closer look at the exact actions or tasks that make work with HIT more cumbersome.

In relation to their identified UAC ”more/new work for clinicians”, Campbell et al. [10] mention three different types of HIT-induced (or, in that case, CPOE-induced) additional tasks: a) documentation of additional information, i.e. information not previously required, b) repeated interactions with unhelpful alerts and prompts from the system, and c) extra time needed for placing non-routine orders. Other sources of an unintended increase in clinicians’ workloads following HIT implementation identified by Campbell et al. [10] include more work needed to get an overview over a patient, more work required to complete documentation and orders, duplicate data entry, time and attention required to learn to use the new system, and repeated logins. UACs such as work shifting, unexpected redistribution of work, use of paper (either to compensate for lack of HIT or as a cognitive aid), and redundant phone communication can also be considered as causing new work for clinicians, although the authors do not explicitly make that connection [10].

In their 2014 study of medical secretaries and, marginally, nurses and physicians, Bossen et al. identify further sources of extra work. Transcribing, one of medical secretaries’ routine tasks, was for instance found to take longer post-EHR implementation due to excessive scrolling and clicking and slow hardware. Transcribing, another routine task for medical secretaries, was also increased in complexity because of EHR use, allowing tasks and responsibilities to drift between physicians, nurses, and medical secretaries (what Campbell et al. [10] referred to as work shifting). This created extra work for medical secretaries, as they increasingly needed to correct the
mistakes made by physicians and nurses when entering data into the record. The authors for example found that medical secretaries had started maintaining a list of patients incorrectly discharged by nurses, and sometimes had to correct a patient’s time of admission belatedly entered into the system by a nurse. Medical secretaries also occasionally had to check patient records in order to see if they had been updated by nurses. Nevertheless, it is important to note that Bossen et al. [8, p.95] were unable to assess whether medical secretaries’ workload actually had increased, as HIT both made some work tasks obsolete and created new ones. Their findings imply that HIT-induced additional tasks do not necessarily lead to an increased workload.

Some additional forms of HIT-induced extra work can be found in the literature focusing specifically on nurses, such as an increase in mobility work [4], i.e. nurses walking longer distances during a shift. It is worth stressing that HIT implementation itself, and the new knowledge, skills and adjustments it requires, has explicitly been described as ”extra work on top of an already overbearing workload on the hospital floors dealing with direct patient care, medical documentation, and other nursing-related duties” [46, p.8].

2.2.4 Consequences of Nurses’ Increased Workload

For nurses, the consequences of their increased workload include a perceived increase in documentation time [30, 43, 54] and decrease in direct patient care [16, 30, 54]. Interestingly, time studies investigating the question have produced mixed results [16, 37, 53]. Nurses nevertheless report that HIT implementation forces them to choose between providing high-quality patient care and fulfilling the new documentation requirements [9, 16, 58]. The loss in efficiency induced by HIT is also perceived as a threat to patient safety [9], a concern that is recurrent in literature on the topic (e.g. [8]). An increase in nursing overtime can of course also result from the loss in efficiency induced by HIT [14]. In order to avoid disruptions and delays in their work, nurses thus frequently resort to workarounds [9, 16, 22]. This can however cause them to feel distressed, as they knowingly deviate from organizational policies [9].

2.3 Nursing

In Sweden, a certified nurse is ”autonomously responsible for clinical decisions that provide people with increased possibilities to improve, keep or recover their health, [...] and achieve the best possible wellbeing and quality of life until death” [1, p.4]. Nevertheless, defining nursing work is a
difficult endeavor. First, nursing encompasses a broad variety of tasks, including several different specialties, such as anesthesia (nurse anesthetists) and operation (surgical nurses). This complicates the development of "a conceptual frame and professional identity [that] encapsulates the diverse range of activities that nurses do” [3]. Second, there is a lack of consensus around what nurses’ ”real work” is (or should be) [3]. On the one hand, some argue that nursing is all about direct, hands-on patient care. On the other hand, others consider nurses’ role as coordinators and integrators of care - ”at the hub of communication” between patients, relatives, and interdisciplinary healthcare providers [18, p.507] - as an integral part of the profession [3]. This naturally fuels the debate around how nursing should be formally defined [3]. However, regardless of what definition is preferred, the centrality of hospital nurses within the healthcare system is undeniable [3, 18]. They form one of the largest groups of healthcare professionals [6, 16, 30], and ”there is very little that moves in healthcare without passing through the hands of a nurse” [3].

In spite of their centrality for the provision of care within hospitals, nurses have always had to deal with difficult working conditions [51]. According to Urban [51], these precarious work conditions are due to nurses’ low status within the healthcare hierarchy, which dates back to the origins of the nursing profession. At that time, the perceived threat to the status of medical practitioners (all men) that nurses (all women) embodied led to the establishment of the nursing practice as a clearly distinct and subordinate activity ”dependent on the medical profession in designating the patient as patient” [3]. In addition, nursing, as a profession centered around the concept of care, has long been considered as coming naturally to women, making it a good illustration of invisible, background work (see section 2.1.2) [3, 44]. In fact, although many aspects of nursing work are now subject to external scrutiny following the digitalization of healthcare and the implementation of HIT, nursing activities related to ”social transactions, emotions and the creation of a therapeutic relationship” [32, p.166] are not among those. Nurses’ historically low status has naturally affected the power relations between nurses and other roles within the healthcare domain, typically to the disadvantage of nursing professionals [3, 51]. Furthermore, nurses ”are often reduced to persons speaking for others rather than being regarded as persons speaking for themselves” [32, p.167], which often results in their concerns being dismissed.

Recent healthcare and societal developments have furthermore brought new challenges into nurses’ work lives. Some of these challenges and constraints include more acutely ill patients, accelerated patient throughput due to resource containment requirements, higher care specialization, reductions in the number of qualified nurses as well as increased demands for paperwork
and data entry [3]. Nurses’ current everyday work is thus characterized by staff shortages, increased workloads, acutely ill patients with co-morbidities, budget constraints, as well as increased administrative work [3, 51]. These hectic working conditions have however been internalized by both nurses and healthcare organizations as a natural component of nursing [51].
Chapter 3

Research Setting and Methods

The empirical data on which the findings presented here are based were collected through interviews, observation, and focus groups at the Uppsala University Hospital (UUH). Four different data collection episodes took place between February 2017 and February 2018, namely 1) three days of participant observation, 2) nine structured interviews, 3) one group interview, and finally 4) five focus groups. All data collection episodes were carried out in Swedish. The author singlehandedly carried out the first three episodes, while the fourth one was planned and conducted in collaboration with a senior researcher. Different departments and/or divisions at UUH participated in data collection, including the pediatric surgery department, the department for pediatric oncology as well as two different divisions within the surgery department. Different nursing roles, including ward nurses, operation nurses and anesthetic nurses, were represented among the participants of both interviews (incl. group interview) and focus groups, and both nurses and assistant nurses were included. In some instances, other roles were also present during data collection, such as physicians. However, the findings presented here focus on statements from nurses and assistant nurses. Each data collection episode is described in more details in sections 3.2.1-3.2.4.

3.1 Research Setting

The Uppsala University Hospital (UUH) is one of the biggest hospitals in Sweden. It employs about 8300 employees, of whom around 2500 are nurses (incl. midwives) and around 1800 are assistant nurses. UUH also comprises a children’s hospital, of which the pediatric surgery department and the department for pediatric oncology are a part. It contains altogether 940
Chapter 3. Research Setting and Methods

Several hundreds of computerized systems are in use at UUH, but three of them have been particularly predominant in our data collection episodes. The first one is UUH’s hospital-wide EHR for more than a decade, COSMIC. It is the only system used by all hospital units. The second system is ORBIT, an operation planning system whose pilot implementation at the pediatric surgery department was ongoing at the time of data collection. The last system, METAVISION, is a clinical information system intended to support patient monitoring in the intensive care unit and during operations. Its implementation across all relevant units was still ongoing during data collection. In fact, the implementations of ORBIT and METAVISION as well as a significant update of COSMIC overlapped during the data collection period. Consequently, as visible in section 3.2.1-3.2.4, almost all our data collection episodes took place in a context of change. Furthermore, it must be noted that COSMIC, ORBIT and METAVISION are not integrated with each other, requiring clinicians using all three systems to document twice or even three times the same information. At the time of data collection, this constraint mainly affected operation staff (e.g. surgical nurses and nurse anesthetists) working at the pediatric surgery department. Finally, it is worth noting that these three systems are not managed by UUH itself, but by Region Uppsala, the administrative body of Uppsala County.

3.2 Data Collection Episodes

3.2.1 Participant Observation

The first participant observation session took place at the pediatric surgery department in late February 2017. At that time, the pilot implementation of ORBIT at the department was ongoing, and had been launched about six months earlier. The purpose of this first observation session was to educate the author about the nature of nursing work and nurses’ use of computerized systems in an operation setting. The author was assigned to a nursing team made of a nurse and an assistant nurse, and shadowed the team throughout their day shift, from about eight o’clock in the morning to four o’clock in the afternoon. During that time, two different operations were observed, including pre-operation preparations and post-operation clean up work.

In the first half of March 2017, two more days of participant observation were spent at the department for pediatric oncology. Their purpose was to understand nurses’ and assistant nurses’ everyday work and use of computerized systems in a ward setting. The observation sessions covered two day shifts (from about eight o’clock in the morning to three o’clock in the afternoon). The first day was spent navigating freely through the ward,
3.2. Data Collection Episodes

observing and exchanging with different roles (e.g. nurses, assistant nurses, physicians, and heads of division, among others). The second day, the author was allowed to shadow a nurse throughout her shift, without however following her into her patients’ rooms. This choice was made in order to protect patients’ privacy and prevent any discomfort to the patients and their relatives.

Observations were recorded through extensive paper-based note taking while on-site. The notes were then typed into a digital document, a process during which they were (re-)structured and grouped into themes.

3.2.2 Structured Interviews

Nine structured interviews took place in March 2017 at the pediatric surgery department. Their primary aim was to evaluate the pilot implementation of the operation planning system ORBIT, which had taken place about five months earlier. The interviews were arranged by Region Uppsala within the framework of a collaboration with Uppsala University, and were a follow-up of a survey that had been conducted (by a different researcher, without any involvement of the author) right after the launch of the system. Three nurses, three assistant nurses, one physician and two heads of division were interviewed. Out of the three nurses, two were surgical nurses and one was a recovery room nurse. Each interview lasted between 10 and 15 minutes. The topics covered by the interview were interface functionality and functional design, clarity of the patient flow, efficiency and quality of the surgical procedures, as well as planning and communication.

The interviews were recorded through paper-based note taking. The notes were then typed into a table (one column per participant and one row per question) in a digital spreadsheet. A report on the positive and negative effects related to the system’s pilot implementation was then put together.

3.2.3 Group Interview

In January 2018, almost one year after the participant observation episode and the structured interviews, a group interview was conducted at the department for pediatric surgery with members of the anesthesia staff. The aim of this group interview, conducted, like the structured interviews, as part of Uppsala University’s collaboration with Region Uppsala, was to investigate anesthetic staff’s dissatisfaction with ORBIT. At the time of data collection, the implementation of METAVISION, the patient vitals monitoring system, alongside ORBIT, the operation planning system, was a few weeks old. ORBIT had however been in use at the department for more than a year. The interview was semi-structured, and lasted for about 30 minutes.
It focused on the problems perceived around ORBIT, METAVISION and COSMIC. Four nurses and two physicians participated in the interview.

The group interview was audio recorded and then transcribed by the author.

### 3.2.4 Focus Groups

Between November and February 2018, five focus groups were carried out with overall 21 nurses and assistant nurses from seven different wards at UUH. During these focus groups, participants were asked to recount positive and negative experiences relating to the everyday use of their work-related computerized systems. The discussions were semi-structured and roughly divided into two parts, one focusing on experiences with the systems, and the other on their consequences for the people directly or indirectly involved. The participants were encouraged to mention any system they felt was relevant in / for their everyday work. As such, different types of systems were brought up, including management (e.g. COSMIC, ORBIT, METAVISION), communication (e.g. e-mail) and information (e.g. clinical information database) systems. All focus groups lasted for about 90 minutes. Three of them were facilitated by two moderators, while the other two were moderated by only one researcher.

The first two focus groups involved, respectively, five nurses and six assistant nurses from two different wards within the surgery department. They both took place in November 2017, a few weeks after a hospital-wide major update of the health record system COSMIC. This upgrade was considered a significant change in relation to the previous versions of the system as it came with a new user interface [38]. Two researchers were present at both sessions.

The third focus group took place in January 2018 at the pediatric surgery department. A senior researcher moderated the session, in which five nurses and assistant nurses from both the operation unit and the ward participated. At that time, ORBIT had been in use in the operation unit for more than a year, while METAVISION’s implementation there as well as COSMIC’s major upgrade both were just a few weeks old.

The last two focus groups were conducted in, respectively, January and February 2018 at the department for pediatric oncology. Three nurses participated in the first session, which was moderated by the author. The second session, which was facilitated by the author and a senior researcher, included two assistant nurses from different wards within the children’s hospital, including pediatric oncology.

The focus groups were all audio recorded. At the time of writing, the first two focus groups have been fully transcribed, and about half of the
third and fourth workshops has been transcribed.

3.3 Data Analysis

3.3.1 Paper II

An analytical method was developed based on the experience framework proposed by McCarthy and Wright [34] (see section 2.1.3). An exploratory, trial-and-error approach was adopted. Codes based on different components of the framework were created. Efforts were concentrated on the spatiotemporal, emotional and compositional threads, and the appropriating sense-making process, as their operationalization was perceived as more accessible. The different test codes, e.g. ”time”, ”space”, ”emotion”, ”event”, and ”identity”, were then tested on the data from the first two focus groups. During that process, the author took notes on paper of potential sub-themes and connections between the different codes / applied framework components. Affinity diagrams and mind maps were then developed based on the coded data and the notes, and several preliminary findings identified.

The author used the artifacts from the analytical process described above to reflect upon and formalize the procedure that had been adopted, leading to the description of the work-in-progress method presented in section 4.1 (and in paper II).

3.3.2 Paper III

The analysis is primarily based on written material resulting from the different data collection episodes described above (see section 3.2). This written material includes the (structured) notes from the participant observations and the structured interviews, the table and final report presenting the results of those same interviews, and the transcripts of the group interview and of the first four focus groups (whereby only half of the third and fourth focus groups was transcribed at the time of analysis). In the cases where data collection had included other roles than nurses and assistant nurses, only the perspectives of the latter were included in the analysis. Although no written material from the last focus group was available at the time of analysis, it has also had an influence on the work, as it has contributed to shaping the author’s perspective on the gathered data.

The data were coded in two stages. First, all references to time - what cost or spared nurses time - were coded using the software MAXQDA. Second, the coded passages were exported from MAXQDA into an Excel sheet. There, new codes were created iteratively to describe the key element(s) of each of the exported excerpts. Once all excerpts had been coded,
codes referring to any HIT-related, time-consuming activity in nurses’ work were brought into an affinity diagram (drawn on paper). This led to the identification of different types of HIT-induced additional activities (see section 4.2). Another affinity diagram (also drawn on paper) was created for the remaining codes. This led to the identification of consequences ensuing from nurses’ increased workload (see section 4.2), as well as of hints at potential causes for management’s lack of awareness regarding this increased workload. These last elements were kept in the author’s notes and discussed with colleagues, compared with previous research, and otherwise reflected upon in the light of the author’s knowledge of the data collection setting over several weeks. This resulted into the creation of several mind maps and diagrams, which led to the identification of different causes for the invisibility of nurses’ increased workload because of HIT (see section 4.3).
Chapter 4

Results

What follows is a brief presentation of the key findings from papers II and III. More detailed explanations can be found in the two papers.

4.1 The HolisticUX Method

The first research question this thesis sought to answer was: how can a humanities-based approach to experience be applied to work life data? In paper II, I propose a method to apply the humanities-based approach to experience to work life data. As outlined in section 3.3.1 and 3.4, this method seeks to use the experience framework developed by McCarthy and Wright [34] to analyze workers’ daily work life with ICT. The method comprises five steps: 1) high-level experience coding, 2) detail thematic coding, 3) identifying primary themes, 4) mapping themes, and 5) synthesizing findings.

The first step, high-level experience coding, consists in categorizing the data according to the four threads of experience (i.e. compositional, sensory, emotional and spatiotemporal) and the six sense making processes (i.e. anticipating, connecting, interpreting, reflecting, appropriating, and recounting). (See section 2.1.3 for a more detailed explanation of the threads and sensemaking processes as defined by McCarty and Wright [34].) In order to do this, the threads and sensemaking processes first have to be operationalized into specific codes - there can be more than one code per thread / sensemaking process. The aim of this first step is not to reduce the data, but to organize them in a way that allows for an in-depth analysis of each experiential factor. The outcome should indeed make it possible to look separately and in-depth at the data related to, for example, time, space, emotions, or events (among others).

The second step, detail coding, consists in thematically coding each different data set created in step 1, i.e. doing a thematic analysis of the data
related to, respectively, time, space, emotions, or events (to continue with
the examples provided above).

For the third step, identifying primary themes, it is necessary to bring
back the different data sets together, and look for recurrent themes across
experiential factors. These are the primary themes - those themes that set
the tone for the experience.

In the fourth step, mapping themes, the focus lies on the relationships
between the primary themes and the remaining, more minor themes in the
data, like for example a theme that only appears in one data set. Mind
maps can facilitate the relationship identification process.

Finally, the fifth step, synthesizing findings, consists in analyzing the
relationships between the primary themes identified in step 3. The central
question at this stage is how primary themes relate to each other, and how
they either contribute to or hinder the lived experience of the participants.
In that last step, all the pieces of the puzzle are, so to speak, brought
back together in order to describe the participants’ experience in all its
complexity.

4.2 Impact of HIT on Nurses’ Work Life

The second research question the current work sought to answer was: how
does HIT use affect nurses’ work life? A key finding from papers II and
III is that, to some extent, the nature of HIT in its traditional form, i.e.
desktop PCs in a dedicated room, goes against the very essence of nursing
work. Paper II suggests indeed that, while nursing work essentially is a
fast-paced, mobile activity, HIT currently is better suited to slower-paced,
stationary work. This temporal and spatial discrepancy between nursing
work and HIT-based activities has insidious consequences for nurses’ work
life.

For instance, the preliminary findings presented in paper II suggest that
overly time-consuming documentation is a central component of nurses’ daily
experience of HIT at work. Similarly, paper III shows that this increase in
documentation time was perceived as going hand in hand with a decrease
in the time nursing staff could spend with their patients. As such, while the
preliminary findings from paper II hint at nurses experiencing HIT-related
tasks and nursing activities as two separate kinds of work, paper III shows
that the former is even felt to encroach upon the latter.

Taking a closer look at the different uses of time in relation to HIT, pa-
per III presents a wide range of new tasks that HIT has created for nurses in
their daily work. The identified tasks are 1) excessive clicking, 2) additional
workflow steps, 3) redundant oral communication, 4) coordinating system
use, 5) task drifts, 6) computer-induced mobility work, 7) setting up equipment, 8) exploring system functionality, 9) helping physicians with HIT use, 10) troubleshooting, 11) paper routines, 12) finding out new information, and 13) password management.

Beyond a perceived increase in documentation time and corresponding decrease in direct patient care, paper III identifies additional consequences of nurses’ increased workload due to HIT. These are task avoidance, threatened patient safety, decreased quality of care, and professional dissatisfaction. Task avoidance refers to nurses refraining from carrying out non-essential activities due to (perceived) lack of time. The tasks that were found to be thus down prioritized include correcting an erroneous piece of information in the EHR, bringing an extra nutrition drink to a patient, reporting clinical incidents, submitting system error reports, and reporting broken equipment. As nurses are aware that skipping some of these tasks can be detrimental to patient safety and care quality, task avoidance can contribute to a certain professional dissatisfaction among nurses, making some of them feel they are “bad” nurses that do not manage to fulfill all of their duties towards their patients. In this regard, it is worth noting that paper II also suggests that, despite the frustration nursing staff can feel towards HIT and the problems it creates for them in their daily work, these issues also seem to have become part of their collective identity. As such, nurses work together to find workarounds to their systems’ shortcomings, but do not “fight” those systems.

4.3 Invisibility of HIT-Induced Burden in Nurses’ Work Life

The third research question that this thesis aimed to answer was: What factors may hinder management’s ability to see HIT’s negative impacts on nurses’ work life? Paper III argues that the time burden the additional, HIT-induced work constitutes for nurses - and its consequences - goes unnoticed by management and developers. This suggestion is based on the observation that nurses’ work schedule does not seem to accommodate for the additional work induced by HIT. Four factors are proposed as contributing to this potential invisibility of the HIT-induced burden in nurses’ daily work: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work.

Lack of a holistic perspective points to the accumulation of HIT-induced tasks in nurses’ daily work. Indeed, nurses have to carry out several of the HIT-induced activities presented in this paper throughout a shift, and often even several instances of these different tasks. In a context where systems
and modules are managed by a variety of different managers (as it is the case in our data collection setting), this accumulation of tasks and its negative impact on nurses may go unnoticed.

The hidden cost of single click describes how, due to nurses’ use of HIT composed mostly of short use sessions, one click in the system actually might translate into a cumbersome, multiple-step procedure for them in practice. For example, indicating a medication as administered in the system might require a nurse to go to the medication / documentation room, log into the computer, log into the system and navigate to the medication module before she is able to mark the medication as given. These practical issues related to system use may not be visible to managers working away from the floor.

The invisibility of nursing work suggests that, to some extent, the cognitive and temporal demands of nursing work may go unnoticed. The two main elements behind this suggestion is that 1) nurses are expected to document electronically certain items simultaneously to providing direct patient care, and 2) some of nurses’ tasks related to operations, e.g. their pre- and post-operation preparatory activities, are not included in the measurement of the duration of operations.

Finally, ”visible data, invisible work” describes how reliance on user-created electronic data to assess HIT design and implementation may bias management and developers’ perception of nurses’ working conditions, making the HIT-induced increase in their workload invisible. Indeed, one of the identified consequences of nurses’ HIT-induced extra work is task avoidance - nurses not carrying out certain tasks - while management can only see what has been done or documented in the systems. As a consequence, managers have no mean to see that nurses have been unable to carry out certain tasks. This can lead them to draw wrong assumptions about nurses’ work life (such as system implementation being a success while staff are struggling to keep everything together on the floor).
Chapter 5
Discussion

The current thesis set out to answer the three following questions: (1) How can a humanities-based approach to experience be applied to work life data?, (2) How does HIT use affect nurses’ work life?, and (3) What factors contribute to the invisibility of HIT’s negative impacts on nurses’ work life to management and developers in healthcare? Four main contributions have resulted from this endeavor.

First, a method to apply the humanities-based approach to experience to the analysis of work life data has been proposed. Preliminary findings obtained from the application of the method to a subset of the empirical data - itself collected with an explicit focus and emphasis on participants’ everyday experiences with their work-related computerized tools - have been presented, illustrating the types of outcomes the method can potentially lead to.

Second, the current work has taken an in-depth, systematic look at the new tasks that HIT brings about in nurses’ everyday work. Although the creation of new tasks and loss in efficiency are known consequences of HIT implementation, no previous study seems to have attempted to do so before. The adopted data-driven approach has led to the identification of new, HIT-induced tasks that have not been acknowledged in the existing literature.

Third, task avoidance has been identified as a consequence of nurses’ increased workload due to HIT use. No previous study seems to have recognized task avoidance as a potential consequence of HIT implementation on nursing work.

Finally, this thesis has described four factors that may contribute a potential unawareness, on the part of managers and developers, of the identified increase in nurses’ workload due to the new tasks brought about by HIT implementation. This is the most original contribution of the current work.
In the remaining of the section, these four contributions and their connection to previous research are discussed in more detail.

5.1 An Experience-Based Approach

As most studies examining the impact of ICT on work life have relied on surveys, papers using a qualitative, exploratory approach may bring something new to the field (see section 2.1.1). Existing literature has moreover shown that looking at technology use through the lens of experience from a humanities-based perspective can provide valuable insights on the way people interpret and make sense of technology in their daily (work) life [55, 34]. Nevertheless, few studies addressing the use of technology at work have applied such an approach to data analysis [57]. One possible reason for this situation is that there currently does not exist any clear guidance on how to proceed in practice. The HolisticUX method presented in section 4.1 (and in paper II) therefore seeks to fill this gap.

The purpose of the HolisticUX method is to support the identification of the variety of factors that contribute to shaping employees’ experience of their work-related computerized tools. Indeed, it forces the researcher to look at the data from multiple angles and perspectives - different threads of experience and sense-making processes - in a way a more open approach does not. As such, the HolisticUX method has the potential to capture dimensions of experience that could remain unnoticed with a more open - but less demanding - form of analysis.

The method is however challenging to apply, as the concepts it builds on are complex. Furthermore, since the method has not yet been fully tested (not all experiential dimensions and sense-making processes have been included in the preliminary analysis, as explained in section 3.3.1), some questions remain open. For instance, it is unclear whether all experiential threads and, above all, sense-making processes, can meaningfully be operationalized into codes. Another question is whether the codes for each thread and sense-making process should be universally applicable (i.e. anyone using the method should use the same codes), or whether their creation and use should be contextual (i.e. every researcher using the method develops her own codes based on the nature of the data).

5.2 HIT-induced additional work

The existing literature seems to agree on HIT implementation resulting in loss in efficiency [14, 20, 25, 58], extra effort to carry out routine tasks [8, 9, 20, 58, 22], and the creation of new work tasks [8, 10] for clinicians.
However, few studies have taken a closer look at the types of additional work that HIT requires from clinicians or specifically nurses, and the HIT-induced extra activities currently acknowledged in the literature are spread over several studies (e.g. [4, 10, 9, 22]).

The current work thus aims to fill this gap by providing a list of 13 different forms of additional tasks induced by HIT in nurses’ work life based on a systematic analysis of empirical data. These 13 HIT-induced activities are: 1) excessive clicking, 2) additional workflow steps, 3) redundant oral communication, 4) coordinating system use, 5) task drifts, 6) computer-induced mobility work, 7) setting up equipment, 8) exploring system functionality, 9) helping physicians with HIT use, 10) troubleshooting, 11) paper routines, 12) finding out new information, and 13) password management. Among these, five do not seem to have been recognized by previous research on the topic, namely 4) coordinating system use, 7) setting up equipment, 9) helping physicians with HIT use, 10) troubleshooting, and 12) finding out new information.

It is worth pointing out that few of the identified forms of extra work have purely technical causes. Of course, poor design, technical glitches, and obsolete software do contribute to the existence of some of them, like for example excessive clicking, coordinating system use, or troubleshooting. However, the importance of organizational and social factors [27] should not be underestimated. For instance, additional workflow steps, task drifts, setting up equipment, helping physicians with HIT use, finding out new information, and even troubleshooting could be reduced or avoided through a different distribution of work and responsibilities and improved training for physicians.

A limitation of our work is that the quantitative impact these new tasks have had on participants’ workload has not been quantitatively measured. In consequence, as for Bossen et al. [8], it is difficult to assess whether these new tasks actually result in an increase in nurses’ workload, because HIT creates new activities while rendering others obsolete. Nevertheless, the fact that nurses need to - as we have seen - give up on carrying some of the tasks that belong to their profession to keep things afloat points at their workload having become too heavy.

5.3 Task Avoidance: When Work Cannot Get Done

Consequences of HIT implementation on nursing work mentioned in the literature include perceived increase in documentation time [30, 43, 54], and perceived decrease in time spent with patients [16, 30, 54], patient safety [9], and care quality [9, 16, 58]. Our analysis has identified similar issues.
However, it has also brought to light another phenomenon that does not seem to have been acknowledged in the existing body of literature, namely task avoidance.

Task avoidance refers to instances where nurses consciously give up on certain non-essential tasks due to (perceived) lack of time. The activities that thus do not get done include correcting a mistake in the EHR, bringing an extra nutrition drink to a patient, or filling in a system error report (among others). These tasks, although described as non-essential, have their importance - and their not being done has the potential to negatively affect patient safety (if the incorrect information in the EHR is acted upon) and care quality (the patient who does not get an extra nutrition drink recovers less quickly and is less comfortable).

What is interesting about task avoidance is that, in spite of the potentially serious consequences it can have, it is very hard for management and developers to see. Indeed, we argue that task avoidance not only is a consequence of nurses’ increased workload, but also one of the factors contributing to making this increase invisible to management and developers.

5.4 An Invisible Burden

Nurses’ current situation as described in this thesis - an increased workload forcing them to give up on some of their tasks, potentially endangering patient safety and decreasing care quality - has led to the suggestion that the (time) burden that HIT-induced additional tasks constitutes for nurses may be invisible to managers and developers, i.e. those managing HIT systems away from the floor.

The notion of invisible extra work in relation to the smooth functioning of ICT applications is not new - Grudin, in a 1988 paper [26] already referred to this phenomenon, albeit not using this exact terminology, and in a very different context. Grudin was referring to secretaries keeping schedules in a shared calendar application up-to-date, while we have been describing how nurses carry out a variety of different tasks to make HIT-mediated nursing succeed in practice. It is important to stress that we are not solely referring to the extra effort required right after an implementation, i.e. to the extra work needed to adapt to a new system and a new workflow (although some of the new tasks identified, i.e. exploring system functionality, are likely to be somewhat correlated with system change). Rather, as in Grudin’s example, we are suggesting that daily work with HIT constantly requires some forms of new work from users. We are arguing that new routine tasks are inherent to HIT use, and that these new tasks need to be taken into account when designing post-HIT implementation work schedules if work overload or task
avoidance are to be averted. However, since most of our data were collected in a context of change (see section 3.1), it is difficult to determine the degree to which each identified task is due to, respectively, change or to HIT use more in general. This limitation is common to much of the research on the UACs of HIT (see section 2.2.2).

It must also be clarified that we are not referring to the respective (in)visibility of the different forms of HIT-induced additional tasks presented above as separate entities. Some tasks are more visible than others, covering the whole spectrum between visibility (e.g. troubleshooting) and invisibility (e.g. redundant oral communication). What we are describing as invisible is the burden that the combination or accumulation of these sources of extra work builds into in a nurse’s day at work.

Four different factors have been brought forward to explain a suggested invisibility of the HIT-induced burden on nurses’ workload to management: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work.

The two first ones, lack of a holistic perspective and the hidden cost of a single click, suggest a misunderstanding of the nursing practice, i.e. how nursing work actually unfolds in practice. In a sense, these two phenomena are related to the invisibility of nursing work, as they point to nursing practice being a sort of black box to management: what nurses do is visible (in the form of what is documented in the systems), but not how they have done it (e.g. running three times between a patient and the medication room in order to administer a medication). However, we use the expression ”invisibility of nursing work” to describe management’s apparent oversight that nurses actually do something - during operations (when they now are required to enter time stamps into the systems) as well as before and after (though the time they need to make this pre- and post-operation work is not included in the duration of an operation). This observed lack of visibility of nursing is consistent with previous research on nurses’ status in healthcare [3, 51]. Finally, the fourth factor on our list, ”visible data, invisible work”, stresses HIT’s potential to bias management’s picture of nurses’ situation by presenting to them what has been done, but omitting what has not been done.

There is a direct connection between this last factor and task avoidance, as several of the activities that end up undone have to do with electronic reporting (e.g. not reporting system errors, clinical incidents, broken equipment, etc.). As such, HIT-induced additional work is an insidious, self-feeding phenomenon: the worse it gets, the less visible it (seems to) become. A limitation of our research is however that the perspective of management and developers has not been examined. As a consequence, we cannot say for certain whether they actually are unaware of the HIT-induced burden in
nurses’ everyday work, and, if so, to what extent the factors presented here play a role in this phenomenon.
Chapter 6

Conclusion

This thesis has investigated the impact of HIT on nurses’ work life from an experience-based perspective. In doing so, it has focused on nurses’ experience of overly time-consuming documentation. The approach and findings presented in the current work can be summarized in four key contributions. First, a new method supporting the application of a humanities-based approach to experience, the HolisticUX method, has been described. Second, 13 different forms of additional work brought about by HIT in nurses’ work life have been presented, six of which do not appear to be mentioned in previous literature: 1) excessive clicking, 2) additional workflow steps, 3) redundant oral communication, 4) coordinating system use, 5) task drifts, 6) computer-induced mobility work, 7) setting up equipment, 8) exploring system functionality, 9) helping physicians with HIT use, 10) troubleshooting, 11) paper routines, 12) finding out new information, and 13) password management. Third, task avoidance has been uncovered as a consequence of nurses’ increased workload due to HIT use. Finally, four factors have been argued as contributing to the potential invisibility of the HIT-induced time burden in nurses’ work life to management and developers: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work.

6.1 Future Work

The continuation of the work presented in this thesis first includes the full application of the HolisticUX method to the complete set of collected data. The outcome of this effort should demonstrate the full range of the method’s capabilities and limitations, and result in an updated description of the method with answers to the questions currently remaining open about its application (see section 5.1).
Second, conducting a time study aimed at measuring how much time nurses lose to (at least some of) the HIT-induced additional tasks identified here would be meaningful. Indeed, it would enable to provide quantitative support for what has been argued in this thesis, namely that nurses’ workload has increased because of HIT use. Such a quantitative approximation of the time nurses lose to HIT-related tasks would also make it possible to adjust their workload in an appropriate manner. As it is, even though we can argue that nurses’ workload is too heavy, it is difficult to assess by how much.

Third, it would be useful to examine managers’ and developers’ perceptions of clinicians’ and nurses’ workload following HIT implementation, in particular in regard to the four factors this thesis has identified as contributing to the suggested invisibility of nurses’ increased workload due to HIT use (see section 5.4). There is a need to find solutions to the apparent invisibility of these tasks, in order for both technical and organizational solutions to be developed to reduce the burden they represent for nurses.

Finally, adopting a gender perspective to further explore the issues presented in this thesis could provide interesting insights. Indeed, while nursing has long been considered as an inherently female profession and is still a women dominated profession today, HIT is predominantly designed by men [41]. As such, it would be interesting to explore how the integration of technology into nurses’ everyday work affects their role and status in hospitals as well as the (formal and informal) expectations set towards them.
Bibliography


Paper I
The Impact of Information and Communication Technology on Work, Workers, and the Psychosocial Work Context: Research Trends from 2000-2017

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Abstract

During the last twenty years, Information and Communication Technology (ICT) has become a central component of the work environment in many workplaces. This study set out to investigate the amount, focus, and nature of the research carried out on the impact of ICT on work, workers, and the psychosocial work context. Arksey and O’Malley’s framework for scoping reviews was applied, and searches performed in Scopus, World of Science, Science Direct, CINAHL, and IEEE Xplore. Journal papers and conference proceedings from the year 2000 to 2017 were included. Data on the ICT-related systems, processes or phenomena investigated, the work and psychosocial factors addressed, and the methods, standardized data collection tools and theoretical frameworks applied were extracted from 148 abstracts. The data were coded and the codes brought into themes. The implementation of healthcare systems and the impact of ICT on mental health and on work demands have been the main research foci. Surveys are the predominant data collection method, although the body of research was otherwise found to be extremely heterogeneous and multidisciplinary, as no dominant standard data collection tool or theoretical framework could be identified. The vast majority of studies has a broad scope and investigates multiple impact areas.

Keywords

Information and Communication Technologies (ICTs); computerization; workplace; psychosocial work environment; scoping review; literature review

1 Introduction

The emergence and development of Information and Communication Technology (ICT) has propelled us into a “digital era” (Cascio & Montealegre, 2016) and instigated a “major
transformation in the workplace” (Howard, 2013). Indeed, the implementation of ICT in organizations has altered the “very nature of work life” (Nixon & Spector, 2013), inducing far-reaching changes in “how, when, and where we work” (ibid) as well as in “how we interact and communicate” (Cascio & Montealegre, 2016). However, these changes have not all been positive, and the increasing digitalization of work processes has raised concerns regarding workers’ quality of work life (Danziger, 1985; Turnage, 1990). The pervasiveness and ambivalence of ICT’s impacts on work and workers calls for extensive empirical study (Danziger, 1985).

Research on the social impacts of technology emerged in the first half of the 20th century and has been continually expanding since the 1960s (Danziger, 1985; Kraemer & Danziger, 1990). It is a complex, multifaceted and multidisciplinary research domain, which lacks both a clear disciplinary home and a well-defined scholarly community (ibid). In a 1990 assessment of the literature examining the impacts of technology on work and workers, Kraemer and Danziger stressed the lack of shared analytic concepts across studies. The absence of a shared taxonomy was found for each relevant unit of analysis identified by the authors, namely technology, people, tasks, and impacts (ibid). In the conclusion of their review, they stressed the need for comparative empirical studies attempting to reach a consensus on concepts and findings in order to advance the field (ibid).

1.1 Aims and Research Questions

The present study seeks to assess the focus, amount, and nature of the research examining the impacts of ICT on work, workers, and the psychosocial work context produced between 2000 and 2017. The objective of this review is threefold. First, it aims to present the foci of this research domain in terms of most frequently investigated ICT systems, ICT-related processes, and impact areas. Second, it seeks to produce an overview of the applied data collection methods, standard data collection tools, and theoretical frameworks. Finally, its third objective is to identify research contributions needed to advance the research domain.

More specifically, this scoping review focuses on the three following research questions - all referring to the research domain examining the impact of ICT on work, workers and work context:

1. What types of ICT systems and ICT-related processes or phenomena have been most / least frequently addressed?
2. What impact areas have been most / least frequently addressed?
3. What data collection methods, standardized data collection tools and theoretical frameworks have been applied?
1.2 Structure of the paper

This paper is structured as follows. First, some background on the digitalization of the workplace and the existing body of research on the social impacts of ICT on work, workers, and work context is provided (sections 2). Second, the procedure adopted in this review is presented in detail (sections 3). Next, the obtained results are presented (section 4). The results of the search strategy and study selection processes are presented first, providing the number of studies processed at each step of the review (section 4.1). The distribution of the studies over the years is then presented (section 4.2). Thereafter, the content of the studies is described, first in regards to the ICT-related aspects investigated (section 4.3), second in terms of the impact areas addressed (section 4.4), and finally in relation to the data collection methods (section 4.5), standardized data collection tools (section 4.6), and data analysis frameworks (section 4.7) applied. The results are then discussed (sections 5.1 – 5.2), and compared to findings from previous research (section 5.3). A short synthesis of the key conclusions from the review (section 6.1), their implications for future research on the impacts of technology on work, workers, and work context (section 6.2), and the limitations of the study (section 6.3), close the paper.

2 Background

2.1 The Digital Revolution: A Double-Edged Sword

In the second half of the twentieth century, the computer was recognized as “the key technological device producing the third great revolution in human history, as the plow was the key device for the agricultural revolution and the machine was the key device for the industrial revolution” (Danziger, 1985). After the agricultural and industrial ages, the emergence of Information and Communication Technology (ICT) has thus propelled us into a “digital era” (Cascio & Montealegre, 2016). In this new age, where “digital technology is rapidly becoming as infrastructural as electricity” (ibid), “people are focusing on the generation and trading of products and services via digitalized data, information, and knowledge” (ibid).

This digital revolution has instigated a “major transformation in the workplace” (Howard, 2013), where “the widespread use of information technology by non-data processing professionals and growing […] management responsibility for […] information technology have […] increased the potential of [ICT] and its impact” (Torkzadeh & Doll, 1999). As a result, the “very nature of work life” (Nixon & Spector, 2013) has been altered, with ICT leading to far-reaching changes in “how, when, and where we work” (ibid) as well as in “how we interact and communicate” (Cascio & Montealegre, 2016).
These ICT-induced changes have raised both enthusiasm and concerns. On the one hand, digital technology is seen as “the great facilitator” (Danziger, 1985), able to increase productivity (Turnage, 1990) while eliminating “the drudgery of labor” (Danziger, 1985), and thus improving employees’ work life quality (Turnage, 1990). On the other hand, the potential of ICT to dehumanize individuals and go against their intrinsic need for individuality, privacy, meaningful work, and control over their environment is brought forward (Danziger, 1985). Other detrimental effects such as physical and mental problems, loss of employment, and deskilling have also been object of concern (Turnage, 1990).

2.2 Investigating the Impacts of ICT on Work and on Workers

Already in 1985, Danziger remarked that “if the computer truly is a technology of immense and problematic consequence, its impacts on society merit the most extensive and thoughtful empirical study”. In addition, he argued that scientific evidence on the real-life impacts of ICT was needed in order to counteract the idealistic, unverified claims about its benefits made by technology vendors and “producers of culture” (e.g. filmmakers) (ibid). Today, as “the world becomes increasingly connected” (Nixon & Spector, 2013) and considering “the increasing reliance on technologies to get work done within and across organizations” (Cascio & Montealegre, 2016), it appears that investigating the impacts of ICT on work, workers, and work context has become more relevant than ever.

The emergence of the research field examining the impacts of ICT on employees’ work life however dates back to the first half of the twentieth century, and has been progressively gaining in importance since the 1960s (Danziger, 1985). Already in 1990, a “significant body of research [on the social impacts of technology]” could be reported (Kraemer & Danziger, 1990).

Interestingly though, the research on computers in healthcare has been a bit slower in picking up on the trend, and has first more recently started looking into the social impacts of health information technology (Aydin, 2005).

2.3 A Complex and Multifaceted Research Domain

The research domain dedicated to the social impacts of technology is, like the object of research itself, complex and multifaceted (Torkzadeh & Doll, 1999). More than 30 years ago, Danziger noted that “the domain of inquiry has grown to nearly unmanageable proportions” (Danziger, 1985). The absence of a well-defined scholarly community and the lack of a clear disciplinary home (ibid) contribute to the complexity of the field. Researchers looking at the social impacts of technology indeed are dispersed both geographically and disciplinarily (ibid).

The existing body of research on the impacts of technology on work, workers, and work context has thus been examined by several researchers from within different fields. The scope of the
existing reviews with a connection to this particular research topic varies. Some are primarily
dedicated to assessing a research question, for example the impacts of ICT on the work life of
information workers (Kraemer & Danziger, 1990), or a research area, such as social informatics
(Sawyer & Eschenfelder, 2002). These reviews cover publications from several different
research fields, including social science, information science, computer science, and information
systems (Kraemer & Danziger, 1990; Sawyer & Eschenfelder, 2002). Other reviews focus
instead on a specific field, like for example industrial and organizational psychology (Cascio &
Aguinis, 2008), or human resource development, albeit with a focus on technology-related
studies (Githens, Dirani, Gitonga, & Teng, 2008; Oh & Huang, 2018).

2.4 State of the Research Field in 1990

Among the related works we have found, the 1990 review by Kraemer and Danziger is the one
that most closely matches the aim and scope of the current paper. It is also, to our knowledge, the
last paper specifically dedicated to the literature examining technology’s impacts on work and
(information) workers. Publications from between 1985 and 1990 are covered.

The focus of most of the included studies in the Kraemer and Danziger’s 1990 review was found
to fall into one of six impact areas: decision-making, control, productivity, social interaction,
work environment or job enhancement (ibid). Among these dimensions, social interaction and
job enhancement (i.e., job content and skills requirements) were identified as the most common
subjects of research. However, the review revealed that, in spite of this implicit agreement on the
impact areas worthy of study, the selected literature lacked “a shared set of analytic categories”
on which to rely when presenting their findings. The absence of shared taxonomy was observed
not only in connection to the investigated impacts of technology, but also in regards to the
technology, work role(s) and work task(s) under focus. In fact, many studies within the sample
selected by Kraemer and Danziger even omitted to specify “the nature of the computing
technology being studied” (ibid). This lack of shared references in terms of impacts, technology,
people, and tasks was found to make comparisons across studies difficult. In regards to
methodology, self-reports of actors were identified as the predominant data source in the selected
sample of studies. This led the two authors to call for “additional objective measures, especially
of such impacts as productivity and decision making” (Kraemer & Danziger, 1990). They
concluded their review by stating that “the production of high-quality, comparative empirical
studies which attempt to attain consensus on concepts and findings is the most essential
component in advancing our knowledge regarding the impacts of computing on information
workers and on all the social impacts of information technology” (ibid).
3 Method

This study follows Arksey and O’Malley’s (Arksey & O’Malley, 2005) six-stage framework for scoping reviews, which has been reviewed and commented upon by several researchers (Daudt, van Mossel, & Scott, 2013; Khalil et al., 2016; Levac, Colquhoun, & O’Brien, 2010). It has also been found to be the most frequently used approach for scoping studies (Pham et al., 2014). In the following sections 3.1-3.6, the review procedure is presented in accordance with the six stages from Arksey and O’Malley’s (Arksey & O’Malley, 2005) framework: 1) identifying the research question, 2) identifying relevant studies, 3) selecting studies, 4) charting data, 5) collating, summarizing and reporting the results, and 6) consultation exercise.

3.1 Identifying the Research Question

In Arksey and O’Malley’s (2005) framework, identifying the research question is closely related to identifying search terms that match the study’s objectives. Three key concepts, IT use, psychosocial work environment and workers, were identified as relevant to our research questions. The concepts were (iteratively) mapped to a set of search terms, shown in table 3-1 (the table presents the final set of search terms used).

<table>
<thead>
<tr>
<th>IT use:</th>
<th>computer-based work, computer-mediated work, computerization, ICT / IT use, technology use, electronic systems, paperless</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>digitalization, digital transformation, digitization</td>
</tr>
<tr>
<td>Psychosocial work environment:</td>
<td>well-being, quality of working life, quality of work life</td>
</tr>
<tr>
<td>technostress (techno-stress), ICT stress, computer anxiety, IT-induced stress</td>
<td>work engagement, motivation, work satisfaction, job satisfaction</td>
</tr>
<tr>
<td></td>
<td>work-related stress, work stress, work demands, job strain, job control, work control, workload</td>
</tr>
<tr>
<td></td>
<td>professional identity, organizational culture</td>
</tr>
<tr>
<td></td>
<td>collaboration, cooperation, group dynamics, teamwork</td>
</tr>
<tr>
<td></td>
<td>occupational health, work health, worker health, psychosocial health, mental health</td>
</tr>
<tr>
<td>Workers:</td>
<td>cognitive, mental, psychological, psychosocial, emotional, psychodynamic, socioemotional</td>
</tr>
</tbody>
</table>

|                              | worker, employee, workplace (work place), at work                                                                       |

*Table 3-1: Operationalization of the three key concepts IT use, psychosocial work environment and workers (final version used in the search).*
3.2 Identifying Relevant Studies

The search for relevant studies was carried out in five databases: Scopus, World of Science, Science Direct, CINAHL, and IEEE Xplore. The selection of the databases was guided by the wish not to restrict the search to a single research field and the potential relevance of the database for the review topic (i.e., potentially relevant studies should be found in each of the chosen databases).

The search terms and Boolean expression to be used when searching the different databases were iteratively developed during test searches before the actual searches were performed. The final search terms are shown in table 3-1. Placeholders such as “*” or “?” were used at the ending of certain terms (e.g. “computeriz*”) in order to cover a broader range of word combinations. In addition, both American and British spellings were included (e.g. “organization” and “organisation”).

A pilot search was conducted in 2017, leading to the identification of additional search terms. The final search took place on November 2, 2017, whereby the final version of the search expression was entered successively into each one of the five databases chosen. The searches were performed on the title, abstract, and keywords fields. They were also restricted to publications from the year 2000 onwards, as we wanted the review to focus on the modern work environment, i.e., where computers and computer-mediated communication channels such as email are well established. Furthermore, the results were filtered to include journal papers, conference proceedings, or reviews, restricting the search to published scientific literature. This is unusual for a scoping review (Arksey & O’Malley, 2005; Khalil et al., 2016), but was done in order to keep the amount of results manageable without reducing the scope of the review, as well as to increase the quality of the results. In Science Direct, due to the terms of our university’s subscription to the database, the selected filter was even stricter and let through only journal papers. In CINAHL, the results were restricted to peer-reviewed papers. This restriction was not available in the other databases. Where possible, i.e. in Science Direct and IEEE Xplore, articles in press, respectively, early access articles were included. As is typical in a scoping review (Arksey & O’Malley, 2005; Daudt et al., 2013; Khan, Egbue, Palkie, & Madden, 2017; Levac et al., 2010), no quality-assessment was performed post-search.

3.3 Study Selection

Relevant studies were first selected through a double-screening process. Two reviewers (the first and second author) independently screened the articles’ titles and abstracts and marked each article as included, excluded, or uncertain based on the inclusion and exclusion criteria (see table 3-2). The result of the two independent screenings were then compared and disagreements solved.
through discussion. When the eligibility of a study remained uncertain, the study was kept in the selection.

The inclusion criteria were continuously updated during this process. These criteria related to the independent variable(s) investigated, the dependent variable(s) measured, the method(s) used, as well as the “status” of the study (completed or in progress). They are presented in more detail in table 3-2.

<table>
<thead>
<tr>
<th>Independent variable(s)</th>
<th>IT system(s) or aspect(s) related to IT (e.g. implementation, technostress)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IT used for work-related tasks</td>
</tr>
<tr>
<td>Dependent variable(s)</td>
<td>Psychosocial factors and non-physical work environment factors</td>
</tr>
<tr>
<td>Method</td>
<td>Empirical studies or literature reviews</td>
</tr>
<tr>
<td></td>
<td>Studies based on data from year 2000 onwards</td>
</tr>
<tr>
<td>Status</td>
<td>Completed studies</td>
</tr>
</tbody>
</table>

Table 3-2: Inclusion criteria used in the selection of studies

3.4 Charting the Data

The charting of the data started with extracting the following information from the title and abstract of the selected studies: 1) ICT-system(s) or ICT-related process(es) or phenomenon under investigation, 2) work and psychosocial factors measured, 3) data collection method(s) used (incl. standardized data collection tool, if applicable and indicated), and 4) theoretical construct(s) applied. The choice of not resorting to the full text version of the selected studies, atypical in a scoping review (Arksey & O’Malley, 2005; Daudt et al., 2013; Khalil et al., 2016; Levac et al., 2010), was made in order to keep the scope of the review broad. The full text version was retrieved and screened strategically in case the abstract lacked concrete information on the investigated IT system(s) or aspect(s), the measured work and psychosocial factors, or the applied data collection method(s). However, no additional search was done for when information on theoretical construct(s) were missing, as it was not the primary focus of the review.

The data charting process led to the exclusion of additional studies, after discussion between the two first authors.

3.5 Collating, Summarizing and Reporting the Results

Once the needed (and available) information had been extracted from the selected records, each set of extracted data – a) ICT systems and ICT-related processes or phenomenon, b) work and psychosocial factors, c) data collection methods, d) theoretical constructs – was brought into a separate Excel sheet. Each data set was (separately) coded, and related codes were then grouped
into themes. The coding of the work and psychosocial factors was the most complex. The codes from this data set were therefore brought into an affinity diagram in order for themes to be identified, and the themes were finally arranged into relationships following a similar process.

### 3.6 Consultation Exercise

Preliminary findings of the review were presented to four colleagues knowledgeable on the review topic but not familiar with the study itself. The participants provided feedback regarding the presentation of the results (e.g., the choice of themes) and the scope of the results (e.g., the questions being answered by the results). This consultation exercise resulted in an additional iteration of the affinity diagram, resulting in the creation of new themes based on the codes created from the extracted data (see previous section). Additional manipulations were also conducted on the data in order to make the review more complete. For instance, the distribution of the investigated ICT-related aspects and work and psychosocial factors over the years was analyzed.

### 4 Results

#### 4.1 Results and Study Selection

1767 results were identified from the five databases. Following the eligibility screening and data extraction processes, 149 studies were finally included in the review. The detailed study selection process is illustrated in figure 4-1. The full text version of the papers was retrieved for 80 studies. For nine studies, full text was searched for but could not be accessed or found. As a result, no information about method could be retrieved for these nine papers (see section 4.5).
4.2 Distribution of the Selected studies Over the Years 2000-2017

The number of studies investigating the impacts of ICT on work, workers, and the psychosocial work context appears to have been steadily increasing throughout the years. Figure 4-2 shows the distribution of the selected studies over the years 2000-2016. The year 2017 is not included as the results of our searches, carried out in November, did not cover the full year.
4.3 Investigated ICT Systems and ICT-Related Processes and Phenomena

4.3.1 ICT systems, devices, and phenomena

In our review, we distinguish between ICT systems or devices (e.g., email or smartphone) and ICT-related processes or phenomena (e.g., implementation). These two high-level categories are not mutually exclusive, as a study might look at both a specific type of system or device and a specific process or phenomenon involving the system.

When it comes to ICT systems, four different themes were identified: (1) healthcare systems, (2) mobile communication systems, (3) collaborative systems, and (4) management systems. In regards to ICT devices, two different themes were found: a) mobile devices and b) visual display terminals. Table 4-1 below presents the components of codes within each one of these four themes / system types. The number of studies for each theme and code is provided between parentheses. Note that the number of studies provided for each theme always corresponds to the number of unique studies within that theme, i.e., a study described by two different codes within the same theme is not counted twice. The cumulated number of studies within a theme and across themes is therefore superior to the number of selected studies as a study can address more than one code within a theme and across themes.

<table>
<thead>
<tr>
<th>Types of ICT systems and devices investigated</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Themes (number of unique studies)</td>
<td>Codes (number of studies)</td>
</tr>
<tr>
<td>Healthcare systems (42)</td>
<td>Electronic health record (21)</td>
</tr>
<tr>
<td>Clinical information systems (6)</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Computerized provider order entry systems (5)</td>
<td></td>
</tr>
<tr>
<td>Systems supporting communication among healthcare providers (3)</td>
<td></td>
</tr>
<tr>
<td>Telemedicine (3)</td>
<td></td>
</tr>
<tr>
<td>Reporting systems (2)</td>
<td></td>
</tr>
<tr>
<td>Decision support (2)</td>
<td></td>
</tr>
<tr>
<td>Input facilitation (2)</td>
<td></td>
</tr>
<tr>
<td>Communication between patients and providers (2)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobile communication systems (25)</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Email (14)</td>
<td></td>
</tr>
<tr>
<td>Social media (10)</td>
<td></td>
</tr>
<tr>
<td>Instant messaging (4)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collaborative systems (9)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborative systems (4)</td>
<td></td>
</tr>
<tr>
<td>Electronic meeting systems (3)</td>
<td></td>
</tr>
<tr>
<td>Application sharing (3)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Management systems (7)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic document management systems (5)</td>
<td></td>
</tr>
<tr>
<td>Enterprise resource planning (ERP) systems (2)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Devices (21)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile devices (18)</td>
<td></td>
</tr>
<tr>
<td>Visual display terminals (2)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-I: Types of ICT systems and devices investigated in the selected studies (incl. number of unique studies for each theme/system type and number of studies for each code/system subtype)

However, not all studies referred to a specific type of ICT. In 49 out of the 148 selected abstracts, general terms are instead used to refer to ICT. Overall, 19 different expressions were identified. These are presented in table 4.2, along with the number of records mentioning each one of them. Note that the total amount of mentions is bigger than the amount of considered records (i.e., 49) as one record could comprise more than one term. The most frequently used expression within our sample is Information and Communication Technology (in two cases in its plural form), abbreviated ICT.

<table>
<thead>
<tr>
<th>Information and Communication Technology/ies - ICT/s</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Personal) computer/s</td>
<td>7</td>
</tr>
<tr>
<td>Technology/ies</td>
<td>5</td>
</tr>
<tr>
<td>Communication technology</td>
<td>4</td>
</tr>
<tr>
<td>Internet</td>
<td>4</td>
</tr>
<tr>
<td>Computerization</td>
<td>3</td>
</tr>
</tbody>
</table>
In regards to ICT-related phenomena, six different topics were identified: (1) implementation of ICT, (2) ICT-induced stressors, (3) use of work-related technology outside of working hours, (4) frequency of ICT use, (5) ICT-induced problems and (6) telework.

### 4.3.2 Trends

Figure 4-3 provides an overview over the most frequently investigated types of ICT system and ICT-related processes or phenomena. Healthcare systems (42 studies, half of which dedicated to the electronic health record) and implementation (40 studies) are at top of this list. It is interesting to note that these two aspects are closely connected to each other. Indeed, 70% of the studies addressing implementation simultaneously focus on healthcare systems. Less represented are mobile communication systems (25 studies, 14 of which are looking at email), followed by mobile devices (18 studies), ICT-induced stressors (15 studies), and use of work-related technology outside of working hours (12 studies).

<table>
<thead>
<tr>
<th>Term</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information technology – IT</td>
<td>2</td>
</tr>
<tr>
<td>Automated environment</td>
<td></td>
</tr>
<tr>
<td>Automation</td>
<td></td>
</tr>
<tr>
<td>Digitalization</td>
<td></td>
</tr>
<tr>
<td>Communication systems</td>
<td></td>
</tr>
<tr>
<td>Computer-aided technology</td>
<td></td>
</tr>
<tr>
<td>Computer-supported information system</td>
<td>1</td>
</tr>
<tr>
<td>Consumer technologies</td>
<td></td>
</tr>
<tr>
<td>Knowledge management technologies</td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td></td>
</tr>
<tr>
<td>Technological change</td>
<td></td>
</tr>
<tr>
<td>Technological innovations</td>
<td></td>
</tr>
<tr>
<td>Technology-induced changes</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-2: general terms used to refer to ICT in the abstracts that do not specify the exact ICT-related focus of the study, along with the number of mentions for each expression.
At the other end of the spectrum, we find ICT-related aspects that do not seem to have been the focus of much research in relation to their impact on work and psychosocial factors (see figure 4-4). Visual display terminals and telework (two studies each) are at the very bottom of the scale. ICT-induced problems (six studies), frequency of ICT use (seven studies), management systems (seven studies), and collaborative systems (nine studies) are slightly better represented, though all are below 7%.

Looking at the representation of the main system types across the years provides a slightly more nuanced picture (see figure 4-5). It becomes apparent that healthcare systems and
implementation have been under particular focus since 2012. The first apparition of mobile devices dates back to 2009, while a certain interest for mobile communication systems has existed since at least 2000. Globally, the degree of interest for each of these ICT-related aspects has been progressively increasing with the years.

Figure 4-5: Representation of the main ICT-related aspects addressed in the selected studies across the years
4.4 Investigated Impact Areas Related to Work, Workers and Psychosocial Work Context

4.4.1 Impact Areas

Figure 4-6: Relationships on which the impact of ICT has been investigated.

15 different themes were identified based on the investigated impact areas, covering six different relationships (see figure 4-6): (A) ICT-mediated work and intrapersonal factors, (B) ICT-mediated work and interpersonal factors, (C) ICT and work, (D) ICT and the organization, (E) individual worker and ICT, and (F) individual worker and the organization. The themes and codes identified within each relationship are defined and presented in tables 4-3 – 4-8.

<table>
<thead>
<tr>
<th>(A) ICT-supported work – intrapersonal factors (individual worker)</th>
<th>Impacts of ICT on workers’ inner thoughts, feelings, and processes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mental health</strong></td>
<td>Codes: Burnout, sleep, stress, emotions, wellbeing, cognitive functioning, cognitive workload, coping strategies</td>
</tr>
<tr>
<td><strong>Emotional, social and psychological wellbeing</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Work-life balance</strong></td>
<td>Sample factors: permeability of work-home boundaries, work-home conflict, psychological detachment, work-family technology use after hours</td>
</tr>
<tr>
<td><strong>Boundaries between work, technology and individuals’ private lives</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Work attitude</strong></td>
<td>Codes: Work satisfaction, work engagement, professional identity</td>
</tr>
<tr>
<td><strong>Workers’ feelings towards their work, identification with work tasks</strong></td>
<td></td>
</tr>
<tr>
<td>Work performance</td>
<td>Codes: Productivity, job performance, work quality, work accuracy, innovativeness</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Skill development</td>
<td>Codes: Development of professional skills, development of ICT skills</td>
</tr>
</tbody>
</table>

Table 4-3: Themes and codes related to the relationship between ICT and intrapersonal factors

<table>
<thead>
<tr>
<th>(B)ICT-supported work – interpersonal factors (workers with others)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of ICT on how workers are and work with others</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
</tr>
<tr>
<td>(Social) exchange of information, including data access, entry and retrieval</td>
</tr>
<tr>
<td>Sample factors: documentation, access to data, data retrieval, communication breakdowns, communication frequency, daily interactions</td>
</tr>
<tr>
<td><strong>Collaboration</strong></td>
</tr>
<tr>
<td>Teamwork</td>
</tr>
<tr>
<td>Sample factors: team dynamics, coordination, collaboration</td>
</tr>
<tr>
<td><strong>Relationships</strong></td>
</tr>
<tr>
<td>Nature, characteristics and amount of interpersonal relationships at work</td>
</tr>
<tr>
<td>Codes: relationships, social climate, social connectivity</td>
</tr>
</tbody>
</table>

Table 4-4: Themes and codes related to the relationship between ICT and interpersonal factors

<table>
<thead>
<tr>
<th>(C)ICT -- Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of ICT on work characteristics and patterns</td>
</tr>
<tr>
<td><strong>Work demands</strong></td>
</tr>
<tr>
<td>Cognitive and temporal demands of work</td>
</tr>
<tr>
<td>Codes: cognitive work demands, temporal work demands, workload, job breadth, work control, ICT skill requirements, constant changes, dependency on ICT</td>
</tr>
<tr>
<td><strong>Work organization</strong></td>
</tr>
<tr>
<td>How work is carried out in practice</td>
</tr>
<tr>
<td>Codes: work processes, time use</td>
</tr>
</tbody>
</table>

Table 4-5: Themes and codes related to the relationship between ICT and work

<table>
<thead>
<tr>
<th>(D)ICT -- Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of ICT on organizational factors</td>
</tr>
<tr>
<td><strong>Organizational culture</strong></td>
</tr>
<tr>
<td>Socio-cultural behaviors and patterns in the organization</td>
</tr>
<tr>
<td>Codes: organizational culture, organizational hierarchy, recognition of staff’s performance</td>
</tr>
<tr>
<td><strong>Personnel fluctuations</strong></td>
</tr>
<tr>
<td>(Frequency of) changes in staff composition</td>
</tr>
<tr>
<td>Codes: staff turnover, personnel changes</td>
</tr>
</tbody>
</table>

Table 4-6: Themes and codes related to the relationship between ICT and the organization
### (E)Worker -- ICT

**Individual worker’s attitude towards ICT and ICT use**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adoption of ICT</strong></td>
<td><strong>Worker’s use of ICT</strong></td>
</tr>
<tr>
<td><strong>Attitude towards ICT</strong></td>
<td><strong>Workers’ feelings towards ICT</strong></td>
</tr>
<tr>
<td>Samples factors: frequency of ICT use, intention to extend ICT use</td>
<td>Codes: attitude towards ICT, satisfaction with ICT</td>
</tr>
</tbody>
</table>

*Table 4-7: Themes and codes related to the relationship between individual workers and ICT*

### (F)Worker -- Organization

**Individual worker’s relationship with the organization**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational commitment</strong></td>
<td><strong>Workers’ perception of and attachment to their organization</strong></td>
</tr>
<tr>
<td>Samples factors: organizational attachment, perception of the quality of the organization</td>
<td></td>
</tr>
</tbody>
</table>

*Table 4-8: Themes and codes related to the relationship between individual workers and the organization*

#### 4.4.2 Trends

The scope of the selected studies can be measured based on how many different relationships (actors / objects under focus) and themes (impact areas) the selected studies address (see figure 4-7). A vast majority of studies (78%) address either more than one theme within a relationship (16%) or more than one relationship (62%). This suggests that studies investigating the impact of ICT on work and psychosocial factors usually have a broad scope, focusing on multiple factors and objects at the same time.

![Figure 4-7: Scope of the selected records](image)

In regards to research trends, starting at the relationship level (see figure 4-8), we find that the impact of ICT-mediated work on intrapersonal factors is by far the most frequent object of study.
Indeed, it is addressed by 131 out of 148 records (88%). The runner-up is the impact of ICT on work (60%).

Figure 4-8: Number of studies (out of 148) addressing factors within each of the identified relationships.

The same trends are visible at the theme-level (see figure 4-9). Four out of the five themes within the relationship between ICT-mediated work and intrapersonal factors can be found in the top five of the most frequently addressed impact areas. Mental health is clearly dominant with a mention in 76 out of the 148 selected abstracts (51%). Work demands and work performance come next with, respectively, 52 and 50 mentions (35-33%).

Figure 4-9: Most frequently addressed themes in the selected body of records, along with the number of abstracts mentioning them (out of 148)
At the other end of the spectrum (see figure 4-10), one finds organizational commitment (3 mentions), personnel fluctuations (8 mentions) and organizational culture (12 mentions).

![Figure 4-10: Least frequently addressed themes in the selected body of records, along with the number of abstracts mentioning them (out of 148)](image)

The picture looks a bit different when leaving the general trends to look into the research patterns specific to the different types of ICT systems and devices represented in the selected sample. Figure 4-11 shows the representation of the overall most frequently addressed work and psychosocial factors (i.e. mental health, work demands, work performance, work attitude, work-life balance, communication, work organization, and attitude towards ICT) in relation to the main types of ICT systems and devices represented in the selected abstracts (i.e. healthcare systems, mobile communication systems, and mobile devices). This system- and device-specific perspective brings to light differences in research foci between types of systems and devices. Our findings suggest that research on the impact of healthcare systems on work and psychosocial factors has mainly focused on work performance, with mental health relegated to the third position. This contrasts with the general trend identified above, where mental health was found to be the most frequently addressed theme across all selected records. When it comes to mobile communication systems, our results suggest that the main research foci have been on mental health, work performance, and communication. Meanwhile, communication appears to be one of the least investigated factors in relation to mobile devices, where research seems to have mainly focused on mental health and work-life balance.

From a time perspective (see figure 4-12), our findings suggest that the research interest for each of these main themes has been progressively growing over the years. Mental health stands out by
having been the object of a notable surge of interest since 2014, while work-life balance appears to have been added to the research agenda only in 2007, several years after the others.

Figure 4.11: Most frequently investigated themes ordered by type of ICT system or device. The numbers represent the number of studies addressing each theme / code (out of 148).
4.5 Data Collection Methods

Nine different types of data collection methods were identified based on the information available in 139 out of the 148 selected studies. (For nine of the selected studies, no methodological information was included in the abstract, and the full text paper could not be found or accessed. Consequently, these nine studies are not included here.) These different groups of methods are presented in table 4-9, along with the number of studies in which they were used. 36 out of 139 studies (26%) within our sample combined two or more data collection methods.

<table>
<thead>
<tr>
<th>Method</th>
<th>Number of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey, questionnaire</td>
<td>84</td>
</tr>
<tr>
<td>Interviews</td>
<td>41</td>
</tr>
<tr>
<td>Observation, video and/or audio recording, work sampling</td>
<td>23</td>
</tr>
<tr>
<td>Analysis of documentary sources, analysis of written documents/resources</td>
<td>10</td>
</tr>
<tr>
<td>Automated data capture, system logging</td>
<td>10</td>
</tr>
<tr>
<td>Focus groups, meetings, discussions</td>
<td>8</td>
</tr>
<tr>
<td>Bibliographic survey, literature review, meta-synthesis</td>
<td>7</td>
</tr>
<tr>
<td>Informal data collection (job fairs, spending time offs with employees, anecdotal reports of satisfaction)</td>
<td>3</td>
</tr>
</tbody>
</table>
4.6 Standardized Data Collection Tools

The term standardized data collection tool is used here to refer to any data collection template or method developed and validated by previous research. A survey template aimed at collecting a certain type of data or measuring a specific phenomenon is an example of standardized data collection tool according to this definition. Altogether 22 different standardized data collection tools were identified based on the selected records (see table 4-10). Most of them could be assign to a particular relationship (see section 4.4.1). For instance, we found tools to collect data on specifically intrapersonal factors (A - 12 tools), interpersonal factors (B - three tools), and workers’ attitude towards technology (E - three tools). The three last standardized data collection tools identified address factors from within several different relationships. However, no dominant tool to collect data on ICT’s impact on work and psychosocial factors could be identified. The most frequently mentioned standardized tool is the NASA task load index (three studies), used to measure an individual’s subjective workload.
<table>
<thead>
<tr>
<th>Measured factor(s)</th>
<th>Standardized data collection tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Job/workplace) stress</td>
<td>Karasek’s job contents questionnaire [67]; Personnel techno stress inventory (PTSI) [117]; “A Shortened Stress Evaluation Tool” [130]</td>
</tr>
<tr>
<td>Burnout</td>
<td>Maslach Burnout Inventory-General Survey (MBI-GS) (16-item scale) [57]</td>
</tr>
<tr>
<td>Mental health status</td>
<td>12-item General Health Questionnaire [146]</td>
</tr>
<tr>
<td>Sleep disturbances</td>
<td>Athens Insomnia Scale [74]</td>
</tr>
<tr>
<td>(Subjective) workload</td>
<td>NASA-Task Load Index [15,30,44]</td>
</tr>
<tr>
<td>Psychological availability</td>
<td>5-item scale [119]</td>
</tr>
<tr>
<td>Psychological safety</td>
<td>5-item measure [119]</td>
</tr>
<tr>
<td>Psychological meaningfulness</td>
<td>6-item measure [119]</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>Job Descriptive Index/Job In General scales [15]</td>
</tr>
<tr>
<td>Employee engagement</td>
<td>9-item form of the Utrecht Work Engagement Scale [119]</td>
</tr>
<tr>
<td>Partner phubbing</td>
<td>9-item measure [119]</td>
</tr>
<tr>
<td>Trust in supervisor</td>
<td>4-item measure [119]</td>
</tr>
<tr>
<td>Working relationships</td>
<td>Seven-item LMX scale [62]</td>
</tr>
<tr>
<td>Employee satisfaction with ICT use, intention [to use ICT]</td>
<td>Instruments [46]</td>
</tr>
<tr>
<td>Attitude towards ICT</td>
<td>Nurses Computer Attitudes to Technology Inventory [93]</td>
</tr>
<tr>
<td>Technology acceptance</td>
<td>Technology acceptance survey [94]</td>
</tr>
<tr>
<td>Perceived culture of an organization, quality improvement implementation [within the organization]</td>
<td>Culture and quality questionnaire [100]</td>
</tr>
<tr>
<td>Technostress creators and inhibitors</td>
<td>Technostress instruments [46]</td>
</tr>
<tr>
<td>Usage frequency, media skills, technostress, feelings on media usage</td>
<td>Standardized Media Use questionnaire [12]</td>
</tr>
<tr>
<td>(1) Personal/philosophical factors, (2) training, (3) personnel, (4) management issues, and (5) performance, workload, and reward</td>
<td>Instrument consisting of thirty-four multiple-choice questions [112]</td>
</tr>
</tbody>
</table>

Table 4-10: Standardized data collection tools mentioned in the abstracts, categorized according to relationship (if any). The reference numbers refer to the list of selected studies provided in the Appendix.
4.7 Theoretical Concepts and Frameworks

35 out of the 148 selected abstracts referred to one or several specific theoretical frameworks or concepts. Overall, 29 different theoretical frameworks and concepts were identified. These are presented in table 4-11, and crosses indicate the relationship(s) with which the identified concepts are associated in the study. (As above, the relationships are between (A) ICT-mediated work and intrapersonal factors (individual worker), (B) ICT-mediated work and interpersonal factors (workers with others), (C) ICT and work, (D) ICT and the organization, and (E) individual worker and ICT. No theoretical framework was mentioned in relation to the relationship between individual worker and the organization.) It is interesting to note that the different theoretical frameworks and concepts identified here come from a variety of different fields, among which psychology, behavioral science, cognitive science, information systems, human-computer interaction, and management science. This points to the strong interdisciplinary nature of the research topic.

The most frequently mentioned theoretical framework (seven studies) is the transactional model of stress and coping theory [17, 34, 46, 49, 51, 52, 103]1. Across all seven studies, it is used in connection with the themes mental health, development of skills, work demands, work-life balance, attitude towards ICT, and adoption of ICT. Three other theoretical frameworks are worth mentioning here, as each of them is mentioned in three different abstracts among the selected records. First, the job-demands resource model [33, 36, 101]1 is used in connection with the themes mental health, work-life balance, work satisfaction, work performance, and work demands. Second, the concept of technostress [3, 69, 131]1 above is used in relation to mental health, work-life balance, work satisfaction, work performance, work demands, attitude towards ICT, and satisfaction with ICT. Finally, boundary theory / work/family border theory [73, 82, 110]1 is applied in connection with the themes mental health, work-life balance, work satisfaction, work demands, personnel fluctuations, and adoption of ICT. Only one further theoretical framework is referred to more than once in the selected abstracts, namely the socio-technical perspective [129, 143]1. This approach is used to look at the themes work satisfaction, work performance, collaboration, relationships, work organization, and adoption of ICT.

1 These reference numbers refer to the list of selected studies provided in the Appendix.
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theories of transactive memory systems [81]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social construction of expertise [81]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity theory [76]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ego depletion theory [75]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kahn’s model of job engagement [119]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social learning theory [139]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributed cognition [124]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job characteristics theory [131]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job-demands resource model [33,36,101]</td>
<td>XXX</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational paradoxes [101]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work psychodynamics [105]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory of positive emotions [73]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectation-Confirmation Theory [27]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social cognitive theory [27]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J-curve theory of organizational change [127]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job-decision latitude [23]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology transition model [2]</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Historical and dialectical materialism [126]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology acceptance model [94]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technostress [3,69,131]</td>
<td>XXX</td>
<td>XXX</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transactional model of stress and coping theory [17,34,46,49,51,52,103]</td>
<td>XXX</td>
<td>XXX</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Institutional logics [111]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Information Systems Success Model [147]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Socio-technical perspective [129,143]</td>
<td>XX</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Boundary / work/family border theory [73,82,110]</td>
<td>XXX</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Concept of information quality [95]</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Social Translucence of Technology framework [114]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structuration theory [70]</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information system continuance theory [46]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 4-11: Theoretical constructs and frameworks mentioned in the selected records (the reference numbers refer to the list of selected studies provided in the Appendix). The number of crosses represents the number of studies using the theoretical construct / framework to investigate the relationship.
5 Discussion

In this paper, we have assessed research examining the impacts of ICT on work, workers and the psychosocial work context between 2000 and 2017. We have focused on the ICT systems and ICT-related processes or phenomena whose impact have been investigated, the work and psychosocial factors that have been under focus, the data collection methods that have been applied, and the theoretical frameworks that have been used in relation to this particular research topic.

5.1 Research trends between 2000-2017

Based on the abstracts of 148 studies, we found that the focus of the selected body of research was on the impact of healthcare systems on workers’ mental health, i.e. intrapersonal factors such as wellbeing, stress, burnout, sleep, emotions, cognitive workload, cognitive functioning, and coping strategies. A noteworthy characteristic shared by a majority of the selected studies is a broad study scope, in the sense that most studies look at more than one theme and more than one relationship. When it comes to the data collection methods used, surveys were found to be clearly preferred, although no dominant standardized data collection tool could be identified. Only a minority of studies used more than one data collection method, like for example combining a survey with interviews. In regards to theoretical frameworks, a variety of different theoretical approaches and concepts were found, and no dominant framework could be identified.

When it comes to the investigated work and psychosocial factors, workers’ intrapersonal factors and, in particular, mental health, work performance, and work attitude are clearly dominant in the selected records, along with work demands. This makes sense, as these factors are closely intertwined. For instance, cognitive workload (part of the theme mental health) is directly affected by cognitive and temporal work demands (from the theme work demands). As such, the existing body of research on the impact of ICT on work and psychosocial factors appears to have focused on how changes in work itself have been affecting workers’ psychological state, performance at work, and attitude towards their work. It is interesting to note that mental health seems to have known a surge of interest on the part of researchers these last few years in a way that other factors have not (see section 4.3.2).

Interestingly, the predominant impact area under focus varies depending on the type of system or ICT-related phenomenon investigated. Mental health is the most frequently addressed impact area when all studies within our sample are taken together, but when it comes to healthcare systems for instance, mental health is not the most frequently mentioned factor – work performance is. Similarly, work-life balance has not been among the primary foci of healthcare
technology research, but is the second most frequently addressed theme in relation to mobile
deVICES (see section 4.3.2).

Some of our findings were unexpected. For instance, the prevalence of healthcare systems is
rather surprising considering that none of the search terms used was specific to healthcare. The
close connection between implementation studies and healthcare systems is also noteworthy:
within our sample, 70% of the studies investigating the impact of ICT implementation on work
and psychosocial factors focused on healthcare systems. In addition, both healthcare systems and
implementation seem to have been under increased focus since around 2010. A possible
explanation is the somewhat late-born interest of the healthcare domain for the social impacts of
healthcare information technology (Aydin, 2005).

At the other end of the spectrum, management systems were the least frequently addressed class
of systems in the selected abstracts. This result contrasts with the omnipresence of ICT systems
in office settings (see section 2.1). The explanation for this might be that other, more specific
terms than those included in our search expression are usually used to refer to computerized
office systems, or that most of the research on this type of systems to be older than 2000 – the
set time limit for this review. Indeed, research on “office automation” has been around since the
1980s (Schmidt & Bannon, 2013). Therefore, it may be that modern research has naturally
tended to focus more on the newer, emergent types of systems and devices (e.g. mobile
communication systems, collaborative systems, mobile devices) than on the old, established
office management systems.

5.2 A Heterogeneous, Multidisciplinary Body of Research

The picture this review provides of the modern literature on the impacts of ICT on work, workers
and the psychosocial work context is that of a heterogeneous body of research. The heterogeneity
emerges first from the variety of terms used to refer to similar types of ICT and impact areas. For
instance, we found 14 different expressions referring to ICT itself (see section 4.2.1), 13 different
terms corresponding to work-life-balance, and four different word combinations referring to the
electronic health record. Other concepts are also subject to (smaller) terminology variations, like
for example job satisfaction (with alternatives such as work satisfaction and employee
satisfaction), job performance (with the alternatives work performance, employee performance,
and personal performance) or even stress (with alternatives such as e-stress, technostress, job
stress, and work stress). The opposite problem, i.e., similar terms used to refer to different
concepts, is another source of heterogeneity. We found technostress to be one such term, being
sometimes used to describe different ways in which technology can become a stressor (e.g.
techno-invasion, techno-overload, and techno-complexity), and at other times used as a synonym
to stress. Heterogeneity also comes from the wide range of work and psychosocial factors that
have been the focus of research: out of the 148 selected abstracts, 44 different codes were created, and 15 different themes identified. In addition, altogether 22 different standardized data collection tools and 29 different theoretical frameworks or concepts were found in the selected records. These theoretical approaches were also diverse, coming from a variety of different disciplines, such as psychology, behavioral science, cognitive science, management science, information systems and human-computer interaction. The interdisciplinary nature of the selected body of research – and, consequently, of the research topic – might be one of the causes behind this observed heterogeneity of terms, investigated factors, standardized data collection tools and theoretical frameworks.

5.3 1985-1990 vs 2000-2017

As Kraemer and Danziger’s 1990 review, assessing the literature examining the impacts of technology on information workers between 1985 and 1990, is the previous work that most closely matches the scope of the present paper, it is interesting to compare their respective findings. Although such a comparison has limitations due to the differences in aim, scope, and method between the two reviews, it can provide valuable indications as to the evolution of the research on the impacts of technology on work, workers, and work context throughout the last 30 years.

5.3.1 Increasing research amount and scope

In their 1990 review, Kraemer and Danziger mentioned “a steady increase in the number of sound and thoughtful empirical studies of the impacts of computing on information workers”. Our findings suggest that this trend is continuing, as we have observed a steady increase in the number of studies published on the impacts of technology on work, workers, and work context throughout the years 2000s and 2010s (see section 4.2).

The spectrum of themes related to work, workers, and psychosocial work context addressed by our sample of studies appears broader than the one described by Kraemer and Danziger in their 1990 review. Indeed, some of the themes we have identified in the selected body of records, e.g. work-life balance, work organization, organizational culture, personnel fluctuations, adoption of ICT, attitude towards ICT, and organizational commitment are hard to situate among the six impact areas (job enhancement, productivity, control, social interaction, decision-making, and work environment) proposed by Kraemer and Danziger (ibid). However, this dissimilarity might be due to a variation in the scope of our respective reviews rather than to a difference in the scope of the reviewed studies themselves.
5.3.2 Minor Shifts in Research Foci

In regards to the research foci, there seems to have been no fundamental shift in researchers’ interests between the two periods 1985-1990 and 2000-2017, although some differences have to be acknowledged.

Kraemer and Danziger (1990) identified social interaction and job enhancement as the main research foci in their sample of studies. Similarly, we found the related themes work demands and communication to be among the most frequently investigated impact areas in our selection. However, there are two important differences. The first one is that several other themes connected to Kraemer and Danziger’s definition of social interaction and job enhancement, namely collaboration, relationships, and skill development, actually are among the least frequently addressed impact areas in the selected abstracts from 2000-2017. The second difference is that other themes from our selection top the ranking of the most frequently addressed impact areas. As mentioned above, mental health is the dominant theme in our sample, while work performance, work attitude, and work-life balance were all found to be more frequently addressed than communication.

A third, more subtle difference can be found in the treatment of the question of skill variety and skill requirements (part of Kraemer and Danziger's definition of job enhancement). While deskilling, i.e., the lowering of skill requirements for certain work roles, seems to have been a dominant concern in the 1980s (Kraemer & Danziger, 1990; Turnage, 1990), the opposite problem, e.g. skill development and the need for new [IT] skills, is more frequently addressed in our sample.

5.3.3 Continued Overrepresentation of Surveys as Data Collection Method

When it comes to data collection methods, our findings suggest that the situation has remained unchanged since the 1990s: surveys, referred to as self-reports of actors by Kraemer and Danziger (1990), are still, and by far, the predominantly used method in the research domain.

5.3.4 Similar Shortcomings in the Body of Research

The deficiencies identified in Kraemer and Danziger's 1990 review also appear to remain valid in the more recent body of research we have examined. These shortcomings related to the absence of a shared taxonomy to describe impacts, technology, people, and tasks across studies, as well as to the lacking specification of the nature of the ICT being studied in the selected body of research (ibid). Similar observations can be made based on our sample of records. Indeed, as mentioned above (section 5.1), a characteristic of our selection is its heterogeneity, including in the terms used to describe the type of ICT or ICT-related aspect investigated and to present the
impact areas under focus. In addition, we found that a significant amount of records (33%) did not specify the type of the specific systems investigated (see section 4.2.1).

6 Conclusion

6.1 Summary of the results

This review assessed the amount, focus and nature of the research examining the impacts of ICT on work, workers, and the psychosocial work context produced between 2000 and 2017. Based on 148 abstracts, it found that the implementation of healthcare systems and the impact of ICT on mental health were the main research foci. Surveys were the predominant data collection method. The body of research was moreover found to be extremely heterogeneous and multidisciplinary, as no dominant standard data collection tool or theoretical framework could be identified. These results greatly overlap with a similar review published 30 years ago, suggesting that the field has not significantly evolved, though it has kept steadily increasing.

6.2 Implications

Three main implications for research on the impact of ICT of work and psychosocial factors can be drawn from the findings of this review.

First, more interdisciplinary reviews and studies seeking to bring together findings from different fields on a common impact area of interest are needed. The observed terminological fuzziness – different terms used to refer to similar concepts or the use of one term to refer to different concepts – makes it difficult to gather all relevant papers on a specific ICT-related aspect or impacted factor. This is detrimental to high quality and innovative research on the topic (as Kraemer and Danziger argued in their 1990 paper – see section 2.4). As such, studies attempting to provide an overview over the findings different fields have made on a specific impact area (i.e., mental health, work demands, etc.) could create useful bridges between disciplines and potentially increase the cohesion and clarity of the existing research.

Second, when seeking to identify gaps within the research domain, it is important to take into consideration the type of ICT or ICT-related process or phenomenon that is being investigated. This is because one work or psychosocial factor can be well researched in regards to one type of systems (e.g., healthcare systems), and under-researched in relation to another type of systems (e.g., management systems). Naturally, this also has to do with the respective nature of different ICT systems and ICT-related phenomena.

Finally, the examination of our findings suggests that three different types of contribution might contribute to the advancement of the field:
1. Exploratory studies using a qualitative, bottom-up approach to data collection and analysis – as most studies so far have used a top-down approach (surveys).

2. Qualitative, in-depth analyses of a specific impact area – as most studies so far have used surveys to investigate multiple impact areas at once, seemingly privileging breadth over depth.

3. Studies providing “objective measures” (Kraemer & Danziger, 1990) instead of self-reports - as most studies so far are based on participants’ self-assessments.

6.3 Limitations

Two main limitations must be taken into consideration when assessing the results of this review.

First, the set of search terms used has naturally limited the obtained results. This type of limitation is typical of a literature review. As mentioned in section 3.1, we developed a search expression that would catch relevant studies while including as few irrelevant results as possible. This implied compromising on the breadth of some of the search terms used. For instance, we did not use the abbreviation “IT” as it led to too many irrelevant results. This in turn might have led to some relevant studies not being included in our results. Our knowledge of what work and psychosocial factors were also had a great influence of the search terms used, and thus on the results obtained. The inclusion or exclusion of such of the terms chosen might have led to a different selection.

Second, the data used in this review were mostly extracted from the abstracts of the studies, and not from their full text versions. This means that the data we extracted was not fully representative of the content of the studies. This is particularly true when it comes to the work and psychosocial factors addressed by these studies. Indeed, the factors that were not mentioned in a study’s abstract were generally not included in the extracted data. A more thorough data extraction was performed only in cases where the information provided in the abstract did not make it possible to code the data appropriately. Information on the standardized data collection tools and theoretical frameworks used was not systematically retrieved either when it was missing from the abstracts. Consequently, our results must not be interpreted as absolute numbers, but rather as indicators.

7 Acknowledgements

This research was funded by Forte (DNR: 2016-07153) and the project "Digitalization and its effects on nurses’ work environment".
8 References


9 Appendix: List of Selected Studies


49. Gaudioso, F., Turel, O., & Galimberti, C. (2017). The mediating roles of strain facets and


Paper II
Analyzing Work-Related Technology Use From A UX Perspective: The HolisticUX Method

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Abstract
Few studies within HCI have looked at work-related technology use from the perspective of lived experience. However, previous work suggests that such an approach can be valuable to analyze how people interpret and make sense of technology in their daily (work) life. Building on McCarthy and Wright’s experience framework, this work-in-progress proposes the HolisticUX method to analyze work life data through the lens of experience. The five-step method is illustrated and its analytical value demonstrated using a case study on nursing staff’s experience of everyday work-related technology use. Our analysis uncovered that documentation tasks and nursing activities were experienced by nurses as two separate kinds of work.

Author Keywords
experience; framework; method; work-related technology use; HolisticUX method

ACM Classification Keywords
H.5.3 [Information interfaces and presentation (e.g.,HCI)]: Evaluation/methodology

Introduction
The impact of work-related technology use on employees has been researched from multiple perspectives and within several different fields, such as Human-Computer...
Interaction (HCI), Computer-Supported Cooperative Work (CSCW), and Information Systems (IS). This research has shown that the integration of computerized systems into work processes often had a strong impact on a variety of factors, such as the organization of work [8], job performance [2], work engagement [4], job satisfaction [6], health and wellbeing [9] and professional identity [5].

Meanwhile, researchers have criticized the lack of consideration given to “lived experience” in research on people’s interaction with technology [7]. For McCarthy and Wright, the only way to “do justice to the wide range of influences that technology has in our lives” indeed is to interpret “the relationship between people and technology in terms of […] the felt or emotional quality of action and interaction” [7, p. 12].

Few studies have adopted this holistic, experience-based approach when investigating the impact of work-related technology use on workers and their work context. Even within HCI, where a whole community has formed around the concept of User Experience (UX), few studies have looked at experience in a work-related context [13]; and those that do typically use a more reductive approach to experience [13].

One possible reason behind this gap is that it is unclear how UX researchers seeking to take a holistic approach to experience in a work-related context should proceed. McCarthy and Wright [7] have proposed a framework comprising “a set of concepts that can be used as tools to analyze user experience with emerging technologies” [11, p. 46], but they have not provided any guidance on how to make use of the framework in practice.

This work-in-progress thus aims to bring the holistic approach to experience into mainstream work life UX research by providing a method to apply McCarthy and Wright’s framework. The proposed method is illustrated by a case study of nurses’ experience of everyday work-related technology use.

**Background**

Two different approaches to experience co-habit within HCI, or rather UX, research. On the one hand, the humanities-based approach advocates for the adoption of a holistic view of experience and makes no attempt to define the content of experience (e.g., McCarthy and Wright [7]). On the other hand, the psychology-based approach adopts a reductive view of experience, and revolves around providing “a scientifically compelling sense of the “content” of users’ experience” [1, p. 110] based on psychological research (e.g., Hassenzahl [3]). Both the above mentioned approaches to experience have been found to be useful in a work-related context [10, 12], although work life studies are on the whole rather few within UX research [13]. It appears however that the psychology-based perspective is slightly more represented than the humanities-based one [13]. This work-in-progress thus focuses on applying the humanistic approach to investigating workers’ experience of work-related technology.

McCarthy and Wright [7] have proposed a framework that can be used as a tool “to analyze user experience with emerging technologies” [11, p. 46]. The framework is composed of two parts, presented here based on [7] albeit in a very summarized form.

The first part comprises four so-called “threads” of experience, each thread corresponding to a specific dimension of experience: the compositional thread (the narrative of an experience), the sensory thread (the physiological processes taking place throughout an experience), the emo-
The emotional reactions occurring throughout an experience and the time- and space-related aspects of an experience.

The second part of the framework addresses the different sense making processes through which people make sense of an experience - before, during and after an experience. The authors identify six different processes: anticipating (the expectations that are relevant to an experience), connecting (the pre-linguistic reaction to stimuli belonging to an experience), interpreting (the identification of an experience), reflecting (the judgment of an experience), appropriating (the conciliation of the experience with one’s sense of self) and recounting (the narrative of the experience to oneself and others).

The HolisticUX Method
We here propose a five-step method to analyze data on work-related technology use through the lens of experience, using McCarthy and Wright’s framework [7] as analytical lens. We illustrate the described method with preliminary results from a case study on nursing staff’s everyday experiences related to the use of their work-related computerized systems.

The applied analytical approach uncovered a discrepancy between nursing staff’s work rhythm and the work pace for which computerized systems are built. We found that this led to documentation tasks and nursing activities being experienced as two separate kinds of work. In addition, our analysis suggests that coping with the negative consequences of ill-fitted computerized systems forms a part of nursing staff’s collective identity.

Step 1: High-level Coding
This first step includes categorizing the data according to the four “threads” of experience and the six sense making processes proposed by McCarthy and Wright [7]. Those must have previously been operationalized into specific codes, whereby there can be more than one code per dimension / sense making process. The aim of this high-level coding is not to reduce the data, but to organize them in a way that allows for an in-depth analysis of each experiential factor. For example, in our case study we operationalized the spatio-temporal thread of experience into two different codes: space and time. We then went through the data and coded all direct and indirect mentions to space and time as, respectively, “space” and “time”.

Step 2: Detail Coding
This second step involves thematically coding the data within each of the high-level codes created in step 1. For example, going through the data from our case study that had been coded as “time”, we found several different themes, such as “long loading times”, “multiple clicks”, “technical issues” and “troubleshooting”.

Step 3: Identifying “Primary” Themes
Once the content of all the high-level codes created in step 1 has been thematically coded, “primary” themes can be identified. We define primary themes as those themes that are recurrent across experiential factors and that thus seem to “set the tone” for the experience. In our case for instance, the slowness of computerized systems and the long time required to document using the systems are recurring themes in our data. As such, we have identified “overly time-consuming computerized documentation” as a primary theme.

Step 4: Mapping Themes
The fourth step focuses on the nature of the relationships between primary themes and the remaining themes within the data. For example, the primary theme “overly time-consuming computerized documentation” identified in our
case study affects other experiential factors, causing for instance stress (sensory thread) and irritation (emotional thread). It also leads to workarounds or the postponing of documentation procedures until the end of the work shift (compositional thread). However, it also seems to form a part of nursing staff’s collective identity (the “appropriating” sense making process). Though all nurses can relate to the everyday challenges computer-related issues lead to, their coping strategy involves supporting each other in finding workarounds to the systems’ shortcomings, and not fighting the implementation of those systems.

**Step 5: Synthesizing Findings**

This last step includes synthesizing findings and reporting them in writing. This involves taking a step back and not only looking at how primary themes relate to more “minor” themes in the data, but also to how primary themes relate to each other and how they contribute to (or hinder) the experience lived by the study participants. In our illustrative case study, it appears that there is a discrepancy between the work pace for which computerized systems are built (few long-time use sessions) and nursing staff’s actual work rhythm (multiple short-time use sessions). As a consequence, documentation tasks and nursing activities are experienced as two separate kinds of work. Our analysis furthermore suggests that coping with the negative consequences of ill-fitted computerized systems forms a part of nursing staff’s collective identity. As such, nurses work together to find workarounds to their systems’ shortcomings, but do not “fight” those systems.

**Discussion**

As the above mentioned concepts are complex, the proposed method is not straightforward to apply. Indeed, an in-depth understanding of these constructs is needed in order for them to be operationalized in a meaningful way. However, the strength of this method is that it enables the researcher to identify within the data a variety of factors contributing to experience that could be overlooked with a more open approach. The data are systematically analyzed from multiple angles and relationships between the different experiential dimensions can be identified and characterized, leading up to the drawing of a complex and holistic picture of the lived experience of study participants.

This emphasis on lived experience has seldom been used in the context of work-life studies within the UX field [13], although existing analyses have shown that such an approach can provide valuable insights on the way people interpret and make sense of technology in their daily (work) life [10, 7]. However, there exists to our knowledge no guidance on how this perspective on experience can be applied in practice. The current work-in-progress contributes to the field by presenting a method to apply a holistic approach to user experience in a work context. It also illustrates the method’s analytical value using data from a case study on nursing staff’s experience of everyday work-related technology use.

**Future Work**

Future work will be dedicated to fine-tuning the method presented in this work-in-progress by applying it to the whole data set of our illustrative case study. This should enable us to answer some of the still unanswered questions our method raises, as well as to identify some of its potential shortcomings. For instance, we need to find out whether there are aspects of the data that are not addressed by the framework on which our method relies. Since it is a humanities-based method, it would also be interesting to compare the findings it leads to with the results from a psychology-based approach to the same data set. We are also planning a follow-up interview study in order to check
whether nursing staff can relate to our interpretation of their experience of work-related technology use.

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REFERENCES


More Work, Same Hours: Invisible HIT-Induced Tasks in Nurses’ Everyday Work

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Abstract. The emergence of new forms of work due to the use of Health Information Technology (HIT) has been recognized as an Unintended Adverse Consequence (UAC) of HIT implementation. However, few studies have looked into the exact nature of these HIT-induced additional tasks in a nursing context. Simultaneously, ICT-related extra work has previously been found to be invisible to developers, suggesting a connection between ICT and invisible work - tasks carried out by employees despite not being recognized as a legitimate part of their workload. The current study draws on observational, interview and focus group data collected at a Swedish university hospital to examine systematically the HIT-induced tasks that nurses have to carry out in their daily work, identify the consequences of this increased workload, and investigate the factors contributing to its apparent invisibility to management and developers in healthcare. 13 different types of HIT-induced tasks are identified, and four factors are proposed as contributing to the apparent invisibility of the burden these additional tasks represent for nurses to management and developers. Task avoidance is found as being both a consequence of nurses’ increased workload and a factor contributing to its suggested invisibility.

Keywords. Health Information Technology; Information and Communication Technology; Invisible work; Nursing; Unintended adverse consequences

1 Introduction

The digital revolution of the past half century seemed to promise increased efficiency, cost-effectiveness, quality and safety in the delivery of medical care (Chaudhry et al., 2006). However, evidence of such achievements in relation to current Healthcare Information Technology (HIT) is equivocal, showing either minimal improvements or mixed results (Scholz et al., 2018). Simultaneously, research has brought to light Unintended Adverse Consequences (UACs) resulting from HIT implementation, such as the creation of new work for clinicians (Campbell, Sittig, Ash, Guappone, & Dykstra, 2006). However, few studies have looked into the exact nature of this HIT-induced additional work in a nursing context.
Simultaneously, research outside of the healthcare domain has pointed at developers overlooking the extra effort that some ICT applications require from (at least some of) their users (Grudin, 1988). This suggests that the additional work that ICT (or HIT) requires from users often is unanticipated and invisible to management and developers. As such, a connection can be drawn between ICT and invisible work - tasks carried out by employees despite not being recognized as a legitimate part of their workload (Star & Strauss, 1999).

Drawing on observational, focus group and interview data collected over a one-year period at a large university hospital in Sweden, this paper aims at systematically investigating the new types of tasks induced by HIT in nurses’ everyday work, as well as their consequences. In addition, it investigates the link between these HIT-induced additional tasks and invisibility, examining the factors that contribute to making the HIT-induced increase in nurses’ workload invisible to management and developers in healthcare.

In the next chapter, the main theoretical and contextual elements relevant to the current work are introduced. First, the concept of invisible work is presented (section 2.1). Then, nursing work is explained (section 2.2.1), and the concept of (in)visibility in nursing discussed (section 2.2.2). An overview over the key features of the digitalization of healthcare follows, along with a brief state-of-the-art of the known UACs induced by HIT (section 2.3.1). Next, the sources of an increase in clinicians’, including nurses’, work life identified in previous research are presented (section 2.3.2), followed by an overview over the known consequences of this increased workload (section 2.3.3). The causes of UACs in healthcare are then briefly addressed (section 2.3.4). Finally, the (in)visibility of ICT-related activities is discussed (section 2.3.5).

The remainder of the paper is structured as follows: chapter 3 describes our research setting (section 3.1), data collection methods (section 3.2), and approach to data analysis (section 3.3). Chapter 4 presents our findings, the identified types of HIT-induced work (section 4.1), the found consequences of this increase in nurses’ workload (section 4.2), and the factors identified as contributing to the suggested invisibility of nurses’ increased workload to management and developers in healthcare (section 4.3). Our findings are discussed in sections 5.1-5.3, and implications and solutions addressed in section 5.4. A synthesis of the main conclusions of our work and a discussion of its limitations close the paper (section 6).

2 Background

This chapter starts with introducing the concept of invisible work, before defining nursing work and discussing (in)visibility in relation to this particular profession. The last section of the chapter is dedicated to HIT – what it is, its impact on
clinicians, the factors leading to the emergence of UACs, and finally its relationship with (in)visibility.

2.1 Invisible Work

From its inception, research in the field of Computer-Supported Cooperative Work (CSCW) has revealed discrepancies between formal task descriptions and actual work practice (Star & Strauss, 1999). This led to the notion of “invisible work” - tasks carried out by employees despite not being officially recognized as a legitimate part of their work assignments (ibid). It is important to understand that invisibility is typically not meant to refer to an attribute of the work itself, but rather points to an attribute of the viewer (Muller, 1999). Work may thus be invisible from a particular viewer’s perspective, but not necessarily for the workers’ themselves or for other categories of viewers (ibid). The aspects of the work that are invisible may also vary depending on who is “watching” (Allen, 2014). Consequently, “when we speak of “invisible work,” it is […] crucial to ask, ‘invisible to whom?’” (Muller, 1999).

The negotiated and context-dependent nature of work along the visibility-invisibility spectrum implies that there are many different types of invisible work. For example, work can literally be performed “out of sight” due to spatial or temporal organization (Star & Strauss, 1999). It can also be carried out by an “invisible” worker when the employer no longer sees the employee as a human being, but as a machine (ibid). Assumptions of the work being natural (requiring skills that are inherent to the workers) or routine (not requiring any skill) can also lead to its becoming “relegated to a background of expectation” (ibid, p.15) and as such, invisible. This particular form of invisible work is referred to as “background work” by Star and Strauss (ibid). For Suchman (1995, p.59), one cause behind this type of invisible work in organizations is that “work has a tendency to disappear at a distance, such that the further removed we are from the work of others, the more simplified, often stereotyped, our view of their work becomes”. This again points to the perspective-specific nature of invisible work. The abstraction of quantitative indicators of work from the work setting is yet another way with which work can be made invisible (Star & Strauss, 1999). In that case, both work practice and workers disappear behind quantitative descriptors such as, in healthcare, number of patients, operation duration, length of hospital stay, etc.

2.2 Nursing

This section starts with defining nursing work and providing an account of nurses’ status and working conditions in hospitals. In the second part of the section, the concept of invisibility in nursing work is discussed.
2.2.1 Defining Nursing Work

According to the Swedish Society of Nursing (2017, p.4), Nursing is the specific competence of the certified nurse. Nursing comprises both the scientific field of knowledge and the patient-oriented work based on a humanistic view of people. The certified nurse is autonomously responsible for clinical decisions that provide people with increased possibilities to improve, keep or recover their health, deal with health issues, diseases or functional disabilities and achieve the best possible wellbeing and quality of life until death.

Nursing work encompasses a broad variety of tasks, which has made it challenging for the profession to develop “a conceptual frame and professional identity which encapsulates the diverse range of activities that nurses do” (Allen, 2014). Two main components of nursing work can be identified from the literature (ibid): patient care and organizing work (dubbed translational mobilization by Allen). However, this understanding of nursing work is (much) debated. Indeed, Allen (ibid) points out that “although nursing work has always had an organizing component, in recent history this has tended to be regarded as the dirty work of the [nursing] profession and a distraction from nurses’ “real work” with patients”. Yet independent of how nursing work is defined and understood, it is undeniable that hospital nurses are central actors within healthcare, their role as coordinator of care being essential to the quality and safety of care (Dykes et al., 2009). As Allen (ibid) writes:

Nurses are the network builders and principal mediators through which the diverse elements that comprise trajectories of care are aligned and where necessary kept apart. There is very little that moves in healthcare without passing through the hands of a nurse.

But in spite of their centrality for the provision of care within hospitals, nurses have had to deal with difficult working conditions (Urban, 2014). Recent developments in the healthcare system and in the society at large have furthermore brought about new challenges and constraints into hospitals, which have resulted in an increased need for organizing work (Allen, 2014). Some of these challenges and constraints include more acutely ill patients, accelerated patient throughput due to resource containment requirements, higher care specialization, reductions in the number of qualified nurses as well as increased demands for paperwork and data entry (ibid). As such, staff shortages, increased workloads, acutely ill patients with co-morbidities, budget constraints and increased administrative work have become normal components in nurses’ daily work life (Allen, 2014; Urban, 2014).

Urban (2014, p.73) remarks that those issues have been internalized by both nurses and healthcare organizations as a natural part of nursing work:

As nurses have no choice but to work in these circumstances, the conditions in hospitals have simply become part of their work. Many of the hospital’s problems are assumed to be a normal part of nurses’ work requiring mainly perfunctory attention.

Nursing staff’s longstanding precarious work conditions are due to their low status within the healthcare hierarchy, which dates back to the origins of the nursing profession (Urban, 2014). Because nurses, all women, threatened the status of medical practitioners, all men, their practice was made into a clearly distinct
activity, dependent on the medical profession in designating the patient as patient (Allen, 2014). The resulting power relations between nurses and other roles within the healthcare domain has affected, and continue to affect their work (Allen, 2014; Urban, 2014). For instance, Wagner (1993, p.95) found that “surgeon's expertise and time [was] being considered more valuable than the knowledge and time of surgical nurses and assistants”. She dubbed that phenomenon the “hierarchy of knowledge”. As we will see below, this power imbalance also plays a role in the invisibility of nursing work.

2.2.2 The (In)visibility of Nursing

Allen (2014) notes that “nursing work has many features that make visibility problematic”. A first aspect is its gendered nature: nurses have always been and still are predominantly women. As a result, nursing has long been considered as resting on women’s natural caring abilities, making it a good illustration of “background”, taken-for-granted work (see above) (Allen, 2014; Star & Strauss, 1999). Because it focuses on the bodies of others (Twigg, 2011) and in so doing transgresses normal social boundaries, nursing is also work “that cannot be talked about” (Allen, 2014). The difficulties surrounding the establishment of nursing as a unified profession as well as the low social and professional status of nurses (see above) have also contributed to its remaining in the shadow (ibid). Furthermore, because nurses “are often reduced to persons speaking for others rather than being regarded as persons speaking for themselves” (Lydahl, 2017, p.167), their concerns are generally dismissed.

However, this does not mean that all aspects of nursing are (equally) invisible, nor that invisibility is necessarily a bad thing (or visibility necessarily a good thing) (Allen, 2014). For instance, “in common with other health and social care providers, nurses ' work is subject to growing standardization and external scrutiny through new systems of clinical governance and quality improvement” (ibid). As such, “nursing work that is routinized and planned is often depicted as visible” (Lydahl, 2017, p.166) in literature investigating the nursing practice. Visibility can then also have disadvantages, bringing about reinforced control and surveillance as well as an increase in paperwork and process burdens (Star & Strauss, 1999). Nursing work that is, on the other hand, related to “social transactions, emotions and the creation of a therapeutic relationship” (Lydahl, 2017, p.166), has remained invisible.

The invisibility of nursing tasks also manifests in informal care settings, i.e. when relatives are led to take care of the patient at home. The burden that caring for a relative in such a way (also called caregiver burden) has long been overlooked (Schorch, Wan, Randall, & Wulf, 2016).
2.3 Information and Communication Technology in Healthcare

This section is divided in five parts. First, a definition and description of HIT is provided. Then, the new work tasks brought about by HIT identified in previous research are introduced, followed by a presentation of the consequences and causes of this HIT-induced increase in clinicians’ workload. Finally, the concept of invisibility in relation to HIT and ICT is discussed.

2.3.1 Healthcare Digitalization and Unintended Adverse Consequences

The advent of Information and Communication Technology (ICT) throughout the second half of the 20th century has launched a digital revolution and propelled Western human society into a “Digital Age” (Scholz et al., 2018). In healthcare, this digital transformation has resulted in the broad implementation of HIT (Agarwal, Gao, DesRoches, & Jha, 2010).

HIT is an umbrella term that actually englobes a variety of different systems, including management systems, communication systems, computerized decision support systems, and information systems (Mair et al., 2007). Among HIT’s most widely used management systems are the Electronic Health Record (EHR) and the Computerized Provider Order Entry (CPOE) system. While the EHR contains “all the data acquired and created during a patient’s course through the health care system” (Tang & McDonald, 2006, p.447), the CPOE system supports physicians (or their surrogates) with directly placing medical orders (Campbell et al., 2006).

The Scandinavian nations, i.e. Sweden, Norway and Denmark, along with the United Kingdom, currently are the leading countries in terms of healthcare digitalization and EHR implementation (Fragidis & Chatzoglou, 2018; Tresp et al., 2016).

The implementation of HIT has been expected to improve the “efficiency, cost-effectiveness, quality and safety of medical care delivery” (Goldzweig, Towfigh, Maglione, & Shekelle, 2009, p.w282). However, “while the benefits of health information technology are clear in theory, adapting new information systems to health care has proven difficult […]” (Chaudhry et al., 2006). HIT’s positive impact on quality, efficiency and financial performance is as such still equivocal (Agarwal et al., 2010), and some studies even show that “HIT, if improperly applied, might in fact be harmful to care quality” (ibid, p.797). Furthermore, research has found that HIT implementation can also have unintended, often negative, consequences (Campbell et al., 2006; Scholz et al., 2018).

Unintended consequences are outcomes that were not originally planned (Bloomrosen et al., 2011). They can be positive or negative, and anticipated or unanticipated (Bloomrosen et al., 2011; Scholz et al., 2018).

Within healthcare, studies on the Unintended Adverse Consequences (UACs), i.e. the negative, typically unanticipated, consequences surrounding HIT adoption, originated as early as 1998 with the advent of Computerized Provider Entry (CPOE) systems (Gephart, Carrington, & Finley, 2015). In this context, Campbell
et al. (2006) identified nine major categories of UACs. These are: 1) more/new work for clinicians; 2) unfavorable workflow issues; 3) never ending demands for system changes; 4) problems related to paper persistence; 5) untoward changes in communication patterns and practices; 6) negative emotions; 7) generation of new kinds of errors; 8) unexpected changes in the power structure; and 9) overdependence on the technology. A decade later, six new categories were added to the list (Sittig, Wright, Ash, & Singh, 2016), with the difference that these newly identified UACs are related to all aspects of EHR use rather than just CPOE systems. They are: 10) full record unavailable at the point of care; 11) frustrating user experiences; 12) inadvertent disclosure of patient-specific information; 13) negative impact of computer-based quality measurement on clinical workflows and patient-provider interactions; 14) information overload from computer-generated data; and 15) decline in the development and use of internally-developed EHRs. Among these fifteen categories, the first one, i.e. “more/new work for clinicians” is the focus of the current paper.

2.3.2 HIT-induced new tasks in clinicians’ work life

Campbell et al. (2006) list three different types of “new” work required of clinicians following the implementation of a CPOE system: a) documentation of additional information, i.e. information not previously required, b) repeated interactions with unhelpful alerts and prompts from the system, and c) extra time needed for placing non-routine orders. Beyond these three different forms of additional work caused by HIT, Campbell et al. (ibid) identify several other aspects contributing to an unintended increase in clinicians’ workloads. These include more work needed to get an overview over a patient, more work required to complete documentation and orders, duplicate data entry, time and attention required to learn to use the new system, and repeated logins. Throughout their paper, Campbell et al. (ibid) also mention work shifting, unexpected redistribution of work, use of paper (either to compensate for lack of HIT or as a cognitive aid), and redundant phone communication as UACs resulting from CPOE implementation. In our understanding, these can be assimilated as sources of new work for clinicians, although Campbell et al. (ibid) do not explicitly make that connection.

Results from subsequent studies investigating the impacts of HIT on clinicians’ work life back up Campbell et al.’s (2006) findings. They mention for instance decreases in hospital staff’s efficiency (Fitzpatrick & Ellingsen, 2013; Greenhalgh, Potts, Wong, Bark, & Swinglehurst, 2009; Zhou et al., 2010) and extra work needed to carry out routine tasks (Bossen, Jensen, & Udsen, 2014; Fitzpatrick & Ellingsen, 2013; Zhou, Ackerman, & Zheng, 2010). However, they often do not look into the exact actions or tasks that cause this loss in efficiency or require extra effort from users.

Bossen et al.’s 2014 study of medical secretaries and, marginally, nurses and physicians, is more precise. Excessive scrolling and clicking (combined with slow
hardware) were there identified as the factors causing a routine task for medical secretaries, transcribing, to take longer. HIT implementation was also found to have complicated another routine task of medical secretaries, tidying up records. This was because tasks and responsibilities drifted between physicians, nurses, and medical secretaries (what Campbell et al. (2006) referred to as work shifting). This situation resulted in extra work for medical secretaries when physicians or nurses made a mistake that needed correcting. For instance, the authors found that medical secretaries had started maintaining a list of patients incorrectly discharged by nurses, and sometimes had to correct a patient’s time of admission following its belated documentation in the system by a nurse. Medical secretaries also occasionally had to check patient records in order to see if they had been updated by nurses. Bossen et al. (2014, p.95) concluded that it was difficult to assess whether medical secretaries overall had “fewer or more tasks, and less or more work”, as HIT both made some work tasks obsolete and created new ones. This is interesting, since it implies that HIT-induced additional tasks do not necessarily lead to an increased workload.

The UACs more recently identified by Sittig et al. (2016) do not reveal any additional form of HIT-induced extra work than those already cited above. However, their findings stress that structured data entry results in more complicated workflows for clinicians.

The conclusions presented in the literature focusing specifically on nurses’ experience of HIT are, for the most part, similar: HIT has been found to introduce more cumbersome and time-consuming workflows for nurses (Bristol, Nibbelink, Gephart, & Carrington, 2018; Gephart et al., 2015), particularly in regard to data retrieval and documentation, leading to a loss in efficiency (Clancy, 2010). Nurses have reported needing longer time in order to perform their usual tasks, as well as having to put more effort into their work, in particular in order to achieve successful communication (Bristol et al., 2018). More specific sources of an increased workload for nurses following HIT implementation include an increased need for communication (Dykes et al., 2006), and an increase in mobility work (Bardram & Bossen, 2005), i.e. nurses walking longer distances during a shift. Finally, HIT implementation itself, and the new knowledge, skills and adjustments it requires, have explicitly been described as “extra work on top of an already overbearing workload on the hospital floors dealing with direct patient care, medical documentation, and other nursing-related duties” (Szydlowski & Smith, 2009, p. 8).

2.3.3 Consequences of clinicians’ increased workload due to HIT

Different consequences of this increased workload have been identified. For nurses, they include a perceived increase in documentation time (Huryk, 2010; Smith, Smith, Krugman, & Oman, 2005; Ward, Vartak, Schwichtenberg, & Wakefield, 2011) and decrease in direct patient care (Dowding, Turley, & Garrido,
2015; Huryk, 2010; Ward et al., 2011), although time studies have produced mixed results (Dowding et al., 2015; Poissant, Pereira, Tamblyn, & Kawasumi, 2005; Waneka & Spetz, 2010). Nurses nevertheless report that HIT implementation forces them to choose between providing high-quality patient care and fulfilling the new documentation requirements (Bristol et al., 2018; Dowding et al., 2015; Zhou et al., 2010). They also perceive the loss in efficiency induced by HIT as a threat to patient safety (Bristol et al., 2018). The risks slower care processes entail for patient safety are also lifted in other studies, (e.g. Bossen et al., 2014).

Furthermore, this loss in efficiency can result in increases in nursing overtime (Clancy, 2010). Nurses hence frequently resort to workarounds in order to avoid disruptions and delays in their work (Bristol et al., 2018; Dowding et al., 2015; Gephart et al., 2015). However, deviating from organizational policies can make them feel distressed (Bristol et al., 2018).

2.3.4 Causes of UACs in healthcare

Clinicians’ experience of more cumbersome and time-consuming workflows are partly due to technical and design flaws in HIT systems. Indeed, poor design – and the resulting mismatch between system architecture and nursing/clinical workflow, have been identified as problematic by several studies (Bristol et al., 2018; Gephart et al., 2015; Huryk, 2010). This is not surprising, as usability is a rather recent concern in relation to HIT (Boone, 2010). Technical issues, such as slow and unreliable hardware, aggravate even more clinicians’ experience with their work systems (Bossen et al., 2014; Bristol et al., 2018; Gephart et al., 2015; Huryk, 2010). However, research has found that the technical shortcomings of HIT are not solely responsible for HIT-related problems in healthcare organizations. On the contrary, it has been stressed that “many harmful or otherwise undesirable outcomes of HIT implementation flow from […] the interplay between new HIT and the […] organization’s existing social and technical systems, including their workflows, culture, social interactions, and technologies”, as well as their physical infrastructures (Harrison, Koppel, & Bar-Lev, 2007, p.542). This means that even though “there still are technical issues related to functionality and interoperability”, problems in HIT projects are “due to sociological, cultural, and financial issues, and hence, are more managerial in nature than technical” (Kaplan & Harris-Salamone, 2009, p.292). Furthermore, an open question in the literature on the impacts of HIT on clinicians seems to be whether the negative impacts of HIT are permanent (inherent to HIT use) or temporary (due to the adjustment / normalization process naturally following an organizational change) (Ward et al., 2011). In the latter case, it is also unclear "how long the negative consequences of implementation will last" (Ward et al., 2011, p.510), i.e. how much time is needed for that normalization process to take place.
2.3.5 ICT and (in)visibility

The topic of HIT and invisible work has been addressed by previous research from different perspectives. For instance, one focus has been on the consequences of overseeing invisible, background work practices when designing HIT, both for the overlooked workers and the more visible, dependent professions (e.g. Bossen et al., 2014). Another question addressed has been the ways in which HIT makes previously invisible work visible, and on the consequences of this newly acquired visibility (and, often, accountability) for the concerned profession (e.g. Bossen & Foss, 2016). Visibility was found to be a two-edged sword. For example, while providing a previously voiceless profession with more power and independence, it can also bring workers’ performance under management’s scrutiny, resulting in increased competitiveness and stress (Bossen & Foss, 2016).

The focus of the current study is yet another, as it does not directly tackle the ways in which HIT affects the visibility of nursing work, nor the consequences of this (in)visibility. Rather, this paper looks into the new tasks that HIT creates for nurses, tasks that, we will argue, remain invisible to management and developers. As such, our work is more closely related to studies investigating the hidden costs of ICT. For instance, in his paper “Why CSCW applications fail”, Grudin (1988) pointed to issues regarding task and workload distribution in relation to the implementation of certain computerized systems. Taking as example a shared calendar application, he showed how the extra effort required for the system to work was placed on users not benefitting from the system themselves, in this case administrative secretaries. The extra effort required from these secretaries in order for the system to fulfill its function can be looked at as a kind of invisible background work that designers had taken for granted. Although crucial to the good functioning of the system, it had indeed not been taken into consideration in the system’s design and its implementation into the organization.

3 Research Setting and Methods

In the following sections 3.1-3.3, the data collection setting and context are described (section 3.1), followed by a detailed description of our four data collection episodes (3.2) and of the data analysis procedure (3.4).

3.1 Research Setting and Context

The Uppsala University Hospital (UUH) is, with 940 beds, one of the biggest hospitals in Sweden. It has a staff of about 8300 employees, of whom around 2500 are nurses (incl. midwives) and around 1800 are assistant nurses. UUH also comprises a children’s hospital, of which the pediatric surgery department and the department for pediatric oncology are a part.
UUH has been using the same comprehensive, hospital-wide EHR system, COSMIC, for more than a decade. In October 2017, a far-reaching update of the system (version R8.1) was implemented. This upgrade was considered a major change in relation to the previous versions of the system as it came with a new user interface (Region Uppsala, 2017). The implementation of this new version of COSMIC took place shortly before our first focus groups with nurses and assistant nurses (see section 3.2.4 below).

Two other recurrent systems in our data collection are ORBIT, an operation planning system, and METAVISION, a clinical information system intended to support patient monitoring in the intensive care unit and during operations.

It must be noted that COSMIC, METAVISION and ORBIT are not integrated with each other, requiring the clinical staff to document certain items of information in two or all three systems manually. However, not all departments and divisions use the three systems together. For example, the staff working at the pediatric oncology department mainly work with COSMIC and the cytostatic medication management system, but almost never have to deal with ORBIT or METAVISION. COSMIC is the only system that is used by all hospital units. COSMIC, METAVISION AND ORBIT all are commercial systems.

3.2 Data Collection Episodes

This analysis is based on interview, observational and focus group data collected at the UUH between February 2017 and February 2018 during four different data collection episodes: 1) three days of participant observation, 2) nine structured interviews, 3) one group interview, and finally 4) five focus groups. The first three episodes were carried out by the author alone, while the fourth one was conducted by a team of two researchers. These data collection episodes also involved different departments and/or divisions at UUH, including the pediatric surgery department, the department for pediatric oncology as well as two different divisions within the surgery department. Consequently, the data collection included different nursing roles, including ward nurses, operation nurses and anesthetic nurses. Both nurses and assistant nurses were involved. In some instances, other roles were also represented during data collection, like for example physicians. However, the current work focuses on statements from nurses and assistant nurses. The details of each data collection episode are provided in sections 3.2.1-3.2.4 below.

3.2.1 Participant Observations

The first participant observation session took place at the pediatric surgery department in late February 2017. Its purpose was to educate the author about the nature of nursing work and nurses’ use of computerized systems in an operation setting. The author was assigned to a nursing team made of a nurse and an assistant nurse, and shadowed the team throughout their day shift (from about eight o’clock
in the morning to four o’clock in the afternoon). Two different operations, including pre- and post-operation preparatory work, were observed during that time.

Two further days of participant observation were spent at the department for pediatric oncology in the first half of March 2017. As for the first participant observation session, the purpose was to understand nurses’ and assistant nurses’ everyday work and use of computerized systems in a ward setting. The observation sessions covered two day shifts (from about eight o’clock in the morning to three o’clock in the afternoon). The first day, the author navigated freely throughout the ward, observing and exchanging with different staff members with different roles (nurses, assistant nurses, physicians, and heads of division, among others). The second day, the author shadowed a nurse throughout her shift. The scope of the observations did not include the patients’ rooms. This choice was made in order to protect patients’ privacy and prevent any discomfort to the patients and their relatives.

The author’s observations were captured through extensive paper-based note taking while on-site. The notes were then typed into a digital document, whereby they were (re-)structured and grouped into themes.

3.2.2 Group Interview

The group interview took place in January 2018 at the pediatric surgery department. It involved six members of the anesthesia staff: four nurses and two physicians. The interview was arranged by Region Uppsala within the framework of a collaboration with Uppsala University. The author’s primary assigned aim for the interview was to investigate this particular user group’s dissatisfaction with the operation planning system ORBIT. At the time the interview was conducted, the implementation of METAVISION alongside ORBIT was a few weeks old. ORBIT had however been implemented for more than a year. The interview was semi-structured and centered on the problems perceived around ORBIT, METAVISION and COSMIC. It lasted for about 30 minutes. Although the interview involved roles other than nurses, the current work focuses on the perspectives of the nurses.

The group interview was audio recorded and then transcribed by the author.

3.2.3 Structured Interviews

The interviews took place in March 2017 at the pediatric surgery department. The interviews were arranged by Region Uppsala within the framework of a collaboration with Uppsala University. The primary assigned aim of the interviews was to evaluate the implementation of the operation planning system ORBIT, which had taken place about five months earlier. Altogether nine structured interviews were conducted with, respectively, three nurses, three assistant nurses, one physician and two heads of division. Out of the three nurses, two were operation nurses and one was a recovery room nurse. Each interview lasted between
10 and 15 minutes. The interviews covered the following topics: interface functionality and functional design, clarity of the patient flow, efficiency and quality of the surgical procedures, and planning and communication. Although the interviews involved other roles than nurses, the current work focuses on the reports from the nurses and assistant nurses.

The interviews were captured through paper-based note taking. The notes were then typed into a table (one column per participant and one row per question) in a digital spreadsheet. A report on the positive and negative effects related to the system’s implementation was then written based on the notes. Both the table and the final report were used in the analysis (see section 3.4).

3.2.4 Focus Groups

Between November and February 2018, five focus groups were carried out with overall 21 participants from seven different wards. At that time, the upgrade of COSMIC (see above) was from a few weeks to a few months’ old. All focus groups revolved around nursing staff’s recounting of positive and negative experiences in relation to the everyday use of their work-related computerized systems. The discussions were semi-structured and were roughly divided into two parts: one focusing on experiences with the systems, and the other centering on their perceived consequences. No specific system focus was set, and the participants were encouraged to mention any system they felt was relevant in / for their everyday work. As such, different types of systems were brought up, including management (e.g. COSMIC), communication (e.g. e-mail) and information systems (e.g. clinical information database). All focus groups lasted for about 90 minutes. Three of them were facilitated by a duo of researchers, while the other two were moderated by only one researcher.

The first two focus groups involved, respectively, five nurses and six assistant nurses from two different wards within the surgery department. They both took place in November 2017, a few weeks after the upgrade of COSMIC (see above). They were moderated by two researchers.

The third focus group took place in January 2018 at the pediatric surgery department and involved five nurses and assistant nurses from both the operation unit and the ward. It was facilitated by only one researcher. At that time, ORBIT had been in use in the operation unit for more than a year, while METAVISION’s implementation there was a few weeks old.

The last two focus groups were conducted in, respectively, January and February 2018 at the department for pediatric oncology. The first one included three nurses. It was moderated by only one researcher. The second one involved two assistant nurses from different wards within the children’s hospital, including pediatric oncology. It was facilitated by two researchers.

The focus groups were all audio recorded. At the time of writing, the first two focus groups have been fully transcribed, and about half of the third workshop has
been transcribed. As a result, those three first focus groups were the main focus of the current work. However, what was said during the two last focus groups still had an influence on data analysis (see section 3.4), as it naturally affected the way the author looked at the data.

3.3 Data analysis

The analysis is primarily based on the written material produced following the data collection episodes. This written material included: the (structured) notes from the participant observations and the interviews, the final report presenting the results of those same interviews as well as the transcripts of the group interview and the four first focus groups (whereby only half of the third and fourth focus groups was transcribed). Although no written material from the last focus group was available, this collection episode has also had an influence on the analysis as it has contributed to shaping the author’s perspective on the gathered data.

The data were coded in two stages. First, all references to time – what cost or spared nurses time – were marked. This first step was carried out in the software MAXQDA. Second, the coded passages were exported into an Excel sheet, and new codes were created iteratively to describe the key element(s) of each of the exported excerpts. Once all excerpts had been coded, the codes referring to a HIT-related, time-consuming activity in nurses’ work were brought into an affinity diagram (drawn on paper). This led to the identification of different types of HIT-induced additional activities, which are presented in section 4.1. Another affinity diagram (also drawn on paper) was created for the remaining codes. This led to the identification of consequences ensuing from nurses’ increased workload. These different consequences are presented in section 4.2. Remaining codes were found to hint at potential causes for a lack of awareness of this increased workload for those not working on the floor. These last items were kept in the author’s notes and discussed with colleagues, compared with previous research, and otherwise reflected upon in the light of the author’s knowledge of the data collection setting during several weeks. Several mind maps and diagrams were created throughout that period, leading to the identification of different causes for the invisibility of nurses’ increased workload because of HIT (see sections 4.3.1-4.3.4).

4 Invisible HIT-induced Tasks in Nurses’ Daily Work

Our findings are presented here in three parts. First, the different types of HIT-induced additional tasks in nurses’ daily work are introduced (section 4.1). Second, the consequences of this increase in nurses’ workload are described (section 4.2).
Third, the factors identified as contributing to the suggested invisibility of nurses’ increased workload to management and developers are presented (section 4.3).

4.1 HIT-induced additional tasks in nurses’ daily work

The analysis of our empirical data has led to the identification of 13 different forms of additional work induced by HIT implementation and use in nurses’ everyday work. Each form is described in some detail below.

1) **Excessive clicking.** Four different activities were found to contribute to this form of additional work: (a) data entry and retrieval distributed across several panels or screens, (b) double or even triple documentation due to lack of system interoperability, (c) logging in and out of applications and hardware, and (d) form-based communication.

2) **Additional workflow steps.** Authorization-related system constraints can prevent nurses from accessing and making changes to the records of patients that are not marked as staying in their division. This can lead to nurses not being able to enter new information into the record of a patient of whom they have newly become in charge. In such a situation, a nurse from the department in which the patient is marked as residing needs to be reached by phone so that she can open the patient’s record and move the patient to the calling nurse’s department. Only after this has been done can the latter document her work regarding the patient in question.

3) **Redundant oral communication.** Three different types of redundant oral communication were identified: (a) in the operation room, the assistant nurse will call the physician responsible for the upcoming operation to make sure the instructions entered into the system are correct and complete; (b) in the ward, a nurse will place an order in the system and go by the head of division’s office to let her know the order is waiting for her authorization; (c) in the ward, when starting her shift, an assistant nurse will check in with the colleague she is relieving in order to make sure she knows about the latest patient status – in case the nurse she is relieving has not had time to document her latest doings in the system.

4) **Coordinating system use.** In the operation room, the operation and anesthetic nursing staff will agree upon when what application is used by whom – as the system will crash if more than one person is logged in onto the same patient at the same time.

5) **Task drifts.** The term “task drift” was taken from Bossen et al. (2014). In our context, it refers to nurses carrying out tasks for which other groups normally are responsible. For example, a nurse and an assistant nurse will accompany a patient to radiology themselves following the transport unit’s refusal to do so as the required form has not been sent to them (although filling in the form would lead to the patient coming in late at her radiology
appointment). The fact that the nurses need to fill in such forms (instead of the other departments the forms are sent to) can also be seen as a form of task drift. Moreover, nurses sometimes take it upon themselves to solve a technical issue as they feel they would have to wait too long for it to be fixed if they go through the proper channels and have someone else come and fix the problem.

6) **Computer-induced mobility work.** The term “mobility work” was taken from Bardram and Bossen (2005) and describes nurses’ need to constantly walk back and forth between the computers and their patients. This computer-induced mobility work comes on top of the mobility intrinsic to nursing in a hospital setting, which includes moving from patient to patient, from the medication room to patients’ rooms, etc.

7) **Setting up equipment.** For example, in the ward, a nurse will have to set up a group video call to discuss a patient’s treatment with a responsible from the commune and the patient herself.

8) **Exploring system functionality.** When a new system is implemented or updated, nurses need to learn how the system works and reacts while interacting with it. Such exploratory behavior – with the extra clicks and reflection it entails – is also needed in relation to seldom used systems that nurses never get to learn properly, such as, in our case, the shift scheduling system.

9) **Helping physicians with HIT use.** Ward nurses reported that they sometimes had to help physicians with navigating the system, as they typically were more knowledgeable about the system than they were. Helping physicians was presented as a way to avoid time loss due to physicians’ struggle with the system.

10) **Troubleshooting.** Technical issues were reported as frequent by our participants. Nursing staff will typically have to solve the arising technical issues in order to be able to resume their work. The technical failures reported varied in their gravity, and could or not require the nurse to call the support unit.

11) **Paper routines.** Two main uses of paper-based routines were identified: (a) as a cognitive aid to compensate for the shortcomings (e.g. the lack of mobility) of HIT, and (b) as a form of troubleshooting to work around a system crash – such as working with a print-out of the medication list. Both of these uses can entail double documentation, and thus additional work. In addition, it is worth noting that while nurses only had to be familiar with one routine when using paper, they know need to know two, as they still have to remember the paper-based routines when using HIT in case (some of) their systems should become unavailable.

12) **Finding out new information.** Form-based communication can require nurses to know things they did not have to know before, like for example
the number of the building they are working in. Consequently, they need to go and enquire about that information in order to send the form in question.

(13) **Password management**. Authorization-based systems require users to identify themselves with a user name and a password at the start of each session. This requires nurses to (a) remember their different passwords, (b) remember what system requires what user name and password, and (c) change their passwords somewhat regularly.

### 4.2 Consequences of HIT-induced additional work

The time that nurses have to dedicate to the different forms of HIT-induced additional work described in section 4.1 has consequences. In our setting, these consequences were:

1. **Increase in documentation time.** Our participants experienced a clear increase in the time needed to enter and retrieve data into their different HIT systems. In the case of, for operation staff, shorter interventions, and for ward staff, of unexpected occurrences, documentation puts a significant strain on their workday, and forces them to prioritize their tasks.

2. **Decrease in time spent with patients.** Both operation and ward nurses reported that the time they could spend with each of their patients was reduced, and in some cases even disappeared completely, because of HIT use.

3. **Task avoidance.** When time becomes scarce, nursing staff reported prioritizing their tasks. Our data show that this often entails avoiding (down prioritizing) tasks not considered as essential. Both clinical and administrative tasks can be thus avoided, such as correcting an erroneous piece of information in the EHR, providing a patient with an extra nutrition drink, reporting a clinical error or incident (such as a patient fall), sending system error reports or reporting a broken piece of equipment. Task avoidance can also occur on a smaller scale. For example, participants reported hopping over some information sections while reading up about their patients in the EHR to avoid additional clicks when particularly busy.

4. **Decrease in care quality.** Less time spent with patients and the avoidance of tasks aiming at increasing patients’ comfort or speeding up their recovery (such as providing them with an extra nutrition drink) have the potential of decreasing the quality of the provided care.

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1 Note that in our data collection setting, ward nurses used a single sign-on for most of the clinical systems they used, although some applications, like for example the shift scheduling system, still required a different, specific user name and password. Surgical nurses, dealing with three non-integrated systems, had more username and password combinations.
(5) **Decrease in patient safety.** The avoidance of tasks such as correcting an erroneous piece of information in the EHR naturally constitutes a risk to patient safety, as does the incomplete reading of a patient’s record during busy days. The risk of oversights, omissions and miscommunications increases when nurses’ workload increases and their attention is taken by HIT-related issues.

(6) **Professional dissatisfaction.** All the consequences named above can lead nurses to feel some degree of professional dissatisfaction. Several of our participants expressed frustration at not being able to spend more time with their patients. For instance, one operation nurse confided feeling like “a bad nurse who did not have time to look at [her] patient” when documentation duties kept her away from her caring tasks.

4.3 An invisible burden

Our findings suggest that nurses are expected to carry out the same amount of clinical work than pre-implementation, within the same time requirements, in spite of the additional work brought about by HIT use. This is what leads us to propose that this additional work and its consequences may be invisible to managers and developers within the healthcare sector.

At first sight, such a conclusion can seem paradoxical. Indeed, it contrasts with an extreme visibility of some of these new forms of work in terms of infrastructure and outcomes. For instance, form-based communication and troubleshooting can be considered as relatively visible tasks. The former results in the creation of digital records that are routinely used by other hospital staff members to carry out their own work, and the latter has a specific organizational unit dedicated to helping users solve system-related issues. Other forms of HIT-induced additional work are inherently less visible. For example, as redundant oral communication does not leave any electronic “footprint”, it can only be seen if witnessed on the spot.

However, we are not looking here at each HIT-induced additional task separately. Rather, we are arguing that the accumulation of the different types of HIT-induced tasks in a nurses’ daily work turns them into a time burden for nurses, and that this accumulated burden seems, from nurses’ perspective, to go unnoticed by management and developers in healthcare. It must be stressed that this proposition is based on the data we collected on nurses’ everyday experience with their computerized systems and our knowledge of our data collection setting – the perspective of management (and developers) on the topic was not included in the scope of our study.

Four different factors were found to potentially contribute to making the HIT-induced time burden in nurses’ daily work (and its consequences) invisible, i.e. appearing as insignificant, to management: (1) lack of a holistic perspective, (2) the
hidden cost of a single click, (3) the invisibility of nursing work, and (4) visible data, invisible work. In the following section, we elaborate on each of these factors.

4.3.1 Lack of a holistic perspective

As briefly outlined above, the different forms of HIT-induced additional work, when taken separately, do not necessarily have a significant impact on nurses’ workload. Their cumulative effect on nursing staff’s workdays makes them into a burden. Indeed, a nurse or assistant nurse will be confronted to multiple instances of different forms of extra work throughout a single shift. For instance, reading up on her patients will require an excessive amount of clicks; the EHR will crash, forcing her to turn off the computer and turning it back on again; she will help the chief physician print out a document needed for the ward round, copy down some information from the EHR on her notepad, etc. A significant contributing factor to the accumulation of HIT-induced tasks in a nurse’s workday is of course that each nurse is responsible for several patients, and that each patient requires the use of several systems. As such, although single episodes of each of these activities may just take a few seconds, the seconds quickly add up to a significant amount of time when all the iterations of all tasks are taken into consideration.

In a context where different people (managers, project leaders, in-house developers) are responsible for different systems or different parts of a large system (as it is the case in our data collection setting), it may be that this accumulation of tasks and issues goes unnoticed or gets underestimated. Simultaneously, project or system owners at the highest level may not be aware of all the clicks, glitches, and small impracticalities that are associated with system use in practice.

4.3.2 The hidden cost of a single click

For someone testing a system outside of a workday setting, a few additional clicks might not seem significant. However, in their everyday work, nurses are often confronted to a disproportion between the amount of time needed to access a system and the time spent using the system (be it to either enter or retrieve data). For example, after having administered a medication to a patient, a ward nurse needs to go into the system and confirm that said medication has been given. This “single click” first requires her to go to the documentation room, log into the computer and / or system, and then navigate to the page containing the list of prescriptions. Only then can she perform the “single click” marking the medication as administered. In practice, one click in the system can thus take up to several minutes of a nurse’s time. This hidden cost of “single clicks” does not seem to be visible to management and system developers who, in general (in our data collection setting), work without direct connection to nurses on the floor. As such, the practical implications of “single clicks” may go unnoticed. Their impact on nurses’ time should however not be underestimated in consideration of the
cumulative effect described above. Indeed, all of a nurse’s patients require such “single clicks”.

4.3.3 The invisibility of nursing

There are within our data two elements that point to the (continued) invisibility of different aspects of nursing work to management.

First, the context in which nurses are required to use HIT suggests that the concentration- and time-craving nature of patient care are being overlooked. From nursing staff’s perspective, management is prioritizing documentation work over direct patient care. This prioritization, in addition to going against nursing staff’s professional values and identity, also suggests a lack of understanding for the temporal and cognitive requirements related to direct patient care. This could explain the apparent belief that documentation and hands-on patient care can be carried out in parallel without interference, and without requiring a re-organization of the work. Our findings contradict this belief, especially in the context of the operation room.

Second, some parts of nurses’ work are simply not taken into account in the indicators used to “measure” clinical work. Indeed, at UUH, the start and end times of an operation do not include nurses’ pre-operation and post-operation preparatory work (gathering / putting away the instruments, etc.). As these tasks are then not part of the statistics gathered around operations, nurses’ work is effectively made invisible and unquantifiable. As such, it is not / cannot be taken into account in the scheduling of operations. This might explain for example how in short operations the disproportionately high amount of time required for documentation has seemingly gone unnoticed.

4.3.4 Visible data, invisible work

The invisibility of certain aspects of nursing work induced by their exclusion from the data used to create statistical models of clinicians’ workflows leads us to our fourth point: the dependence of the visibility of work tasks on whether these tasks are documented electronically. Indeed, only what is registered in the systems seems to be visible to healthcare managers and developers away from the floor. Consequently, they may not see what is not being done, since only the tasks that have been carried out are documented and, as such, visible in the systems.

Meanwhile, as was mentioned above, one of the consequences of the additional work induced by HIT in nurses’ daily work is precisely tasks not being done – task avoidance. We thus argue that the burden that HIT-induced additional work represents for nurses is invisible because one of its main consequences is invisible.

Our data suggest that this situation creates a significant gap between management’s perception of nurses’ working conditions and nurses’ actual experience of work on the floor. One nurse noted, not without humor:
It is slightly irritating – now that we have talked about COSMIC for an hour – to see [management] writing on the first page of [our intranet] that [the latest update of COSMIC] has worked out great, and that there are not at all that many complaints. [Laughs]. While I can sit down and write a dissertation of 50 pages about what I think does not work. [Nurse, surgery department]

As such, while management assumes that the implementation process is going smoothly based on the low number of error reports they have received, nurses on the floor are experiencing hectic workdays, which is precisely what makes them give up the effort of filling in such reports.

5 Discussion

This paper set out to investigate the different daily HIT-related activities requiring time from nurses, these activities’ impact on nursing professionals, and the factors behind their apparent invisibility to management and developers in healthcare. This research effort has resulted in three main contributions. First, it has presented, based on a systematic analysis of empirical data, a compilation of the different types of additional tasks that HIT use induces in hospital nurses’ everyday work. Second, it has identified task avoidance as a consequence of this HIT-induced increase in nurses’ workload. Third, it has argued that the burden that this additional work represents for nurses and its consequences are invisible to management and developers in healthcare, and proposed four different factors potentially contributing to this suggested invisibility. In the following chapter, these three contributions are discussed in more detail (section 5.1-5.3). Finally, implications and potential solutions are discussed in section 5.4.

5.1 HIT-Induced Additional Tasks in Nursing Work

Based on qualitative empirical data, this paper has identified 13 types of HIT-induced additional tasks in nurses’ daily work. These are: 1) excessive clicking, 2) additional workflow steps, 3) redundant oral communication, 4) coordinating system use, 5) task drifts, 6) computer-induced mobility work, 7) setting up equipment, 8) exploring system functionality, 9) helping physicians with HIT use, 10) troubleshooting, 11) paper routines, 12) finding out new information, and 13) password management.

Eight of these tasks are, according to the studies surveyed in this paper, either explicitly mentioned in previous literature or closely related to already known forms of HIT-induced additional work. These eight tasks and their mentions in previous literature are presented in table I below.
<table>
<thead>
<tr>
<th>Task</th>
<th>Mention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive clicking</td>
<td>Excessive scrolling and clicking (Bossen et al., 2014)</td>
</tr>
<tr>
<td></td>
<td>Documentation of additional information (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Interactions with alerts (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Repeated logins (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Duplicate data entry (Campbell et al., 2006)</td>
</tr>
<tr>
<td>Additional workflow steps</td>
<td>More cumbersome workflows (Bristol et al., 2018; Gephart et al., 2015)</td>
</tr>
<tr>
<td>Redundant oral communication</td>
<td>Redundant phone communication (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Increased need for communication (Dykes et al., 2006)</td>
</tr>
<tr>
<td>Task drifts</td>
<td>Work shifting (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Unexpected distribution of work (Campbell et al., 2006)</td>
</tr>
<tr>
<td></td>
<td>Task drifts (Bossen et al., 2014)</td>
</tr>
<tr>
<td>Computer-induced mobility work</td>
<td>(Increased) mobility work (Bardram &amp; Bossen, 2005)</td>
</tr>
<tr>
<td>Exploring system functionality</td>
<td>Time to learn the system (Campbell et al., 2006)</td>
</tr>
<tr>
<td>Paper routines</td>
<td>Use of paper as a cognitive aid (Campbell et al., 2006)</td>
</tr>
<tr>
<td>Password management</td>
<td>Repeated logins with different passwords (Campbell et al., 2006)</td>
</tr>
</tbody>
</table>

Table I. Identified HIT-induced additional tasks that overlap with previous research. On the left, the tasks we have identified; on the right, their mentions in previous research.

To our knowledge, the five remaining forms of HIT-induced additional work we have identified have not been recognized in the existing literature. They are: coordinating system use, setting up equipment, helping physicians with HIT use, troubleshooting, and finding out new information.

Troubleshooting is an interesting case, as technical difficulties have been found to hinder nurses’ and other healthcare professionals’ work by several studies (Bossen et al., 2014; Bristol et al., 2018; Gephart et al., 2015; Huryk, 2010), without troubleshooting itself being presented as a new task performed by nursing staff. It is also worth noting that, although most of the studies we have surveyed identify loss in efficiency, extra effort or extra work as UACs from HIT implementation, only a few look into the specific sources of these problems in terms of additional actions being undertaken by users (e.g. Bossen et al., 2014; Campbell et al., 2006).

A question that arises when considering these forms of HIT-induced additional work is whether these tasks are due to HIT itself, or whether they are the result of technical and organizational shortcomings in relation to HIT implementation. The extent to which potential technical and organizational solutions could reduce or
even eradicate HIT-induced additional work are discussed in more detail in section 5.4 below. The impact of the implementation itself (as a change-inducing phenomenon) can also be included in this question: will (at least some of) nursing staff’s extra tasks involving HIT disappear once end users have become familiar with their new systems and workflows? Due to the limitations of our study, i.e. the particular characteristics of the setting in which our data were collected, this question cannot be answered with certainty here. Nevertheless, our findings suggest that, although the time taken by some of the tasks identified may diminish as nurses’ (and physicians’) familiarity with their computerized tools increases, it is unlikely for any of them to disappear completely once the normalization process is over. Even such a task as exploring system functionality might be required on the long term for, for example, seldom-used systems. In addition, in a context where new systems are frequently being implemented and old systems often updated (as it was the case in our data collection setting), it might be that the normalization process never ends. More research is needed on the topic (Ward et al., 2011).

A question that can also be asked when addressing the topic of HIT-induced extra work is whether it actually leads to an observable increase in users’ workload. In their study of the changes to medical secretaries’ practice following HIT implementation, Bossen et al. (2014) found it difficult to answer this question, as HIT simultaneously erases some tasks and creates new ones. Since our analysis relies on nurses’ subjective experience of work, it is not possible to quantify the actual increase in their workload. However, nursing staff’s reports to working overtime, prioritizing their work tasks so that non-emergency activities remain undone, and feeling stressed point to a problematic situation. Still, more research is needed in order to determine the exact impact of each task on nursing staff’s workload. A time study looking into the exact amount of time nurses dedicate to the HIT-induced additional tasks identified in this paper would for example significantly contribute to the research field. In addition, it would provide management and policymakers within healthcare with a weighty argument in favor of organizational changes aiming at improving nurses’ working conditions.

### 5.2 Consequences on nurses’ increased workload

Our analysis identified several consequences to this invisible increase in nurses’ workload: 1) perceived increase in documentation time, 2) perceived decrease in time spent with patient, 3) task avoidance, 4) perceived decrease in care quality, 5) perceived decrease in patient safety, and 6) professional dissatisfaction. These findings are consistent with previous research. Indeed, increased documentation time (Huryk, 2010; Smith et al., 2005; Ward et al., 2011), decrease in the time spent on direct patient care (Dowding et al., 2015; Huryk, 2010; Ward et al., 2011), and threats against patient safety (Bristol et al., 2018) have all been recognized as consequences of HIT-induced UACs in the existing literature. Decrease in care
quality and professional satisfaction have been hinted at, too. For example, nurses have reported the need to choose between high-quality patient care and fulfilling documentation requirements (Bristol et al., 2018; Dowding et al., 2015; Zhou et al., 2010), and have been found to feel distress when deviating from organizational requirements (Bristol et al., 2018). Research on the impact of HIT on medical secretaries has also found that the new post-implementation workflows could go against users’ work ethics (Bossen et al., 2014).

However, task avoidance does not seem to have been explicitly acknowledged as a UAC of HIT implementation and use in the existing body of literature. Our analysis has identified this phenomenon as both a consequence of nurses’ increased workload and as one of the causes behind the invisibility of HIT-induced additional tasks to management and developers in healthcare organizations. As such, it is one of the key contributions of the current paper.

5.3 Invisibility of HIT-induced new tasks in nurses’ daily work

The fact that ICT can require extra work from (at least some of) its users – extra work that is overlooked by developers – has already been pointed to by Grudin (1988), albeit in a very different context. To our knowledge, no previous study has associated the additional work induced by HIT in clinicians’ work life to invisible work. Our argument is based on the observation that nurses’ workload post-HIT implementation does not accommodate for the extra work they have to spend on HIT-induced activities. It is important to note that no data were collected on the perspectives of management and developers on the topic. As such, a limitation of our findings is that they only show nurses’ side of the story – more research is needed in order to understand management and developers’ perspective on the ways HIT creates additional work for nurses and the (in)visibility of this increased workload.

Four different reasons have been suggested to explain the apparent invisibility of the extra work induced by HIT use in nurses’ daily work to managers and developers: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work.

The lack of a holistic perspective and the invisibility of nursing work have been explicitly discussed in the existing body of literature. For instance, the cumulative effect we have described above – the burden emerging from the accumulation of HIT-induced tasks in nurses’ daily work - is also mentioned in Campbell et al.'s (2006) paper, albeit in reference to physicians. This suggests that this cumulative effect matters for both clinical roles – and probably for other categories of hospital staff, too.

The invisibility of nursing work is a phenomenon that has been extensively discussed in the nursing literature (see section 2.2.2). This invisibility is mostly due to caring having been considered as a natural ability of women throughout history
(Allen, 2014; Star & Strauss, 1999), which has engendered a perception of nursing as unskilled, undemanding background work (Allen, 2014; Star & Strauss, 1999). This perception of nursing has affected both professional, registered nurses and informal caregivers in the home (Schorch et al., 2016). Hospital nurses being required to document patient care simultaneously to providing hands-on patient care may be a sign that nursing still lacks its due status as a skilled, cognitively and emotionally demanding activity. However, it is also possible that HIT-related activities are seen as less demanding and skilled than they really are. This could explain why nurses seem to be expected to carry out technical tasks such as exploring system functionality, setting up equipment, troubleshooting, or password management without its affecting their other work activities. As such, a combined underestimation of the demands of nursing work and these more technical activities might be one of the reasons why the HIT-induced increase in nurses’ workload has been overlooked by healthcare managers. More research is needed to understand how technical tasks are perceived by managers and developers in the healthcare sector. The oversight of the accumulation of HIT-induced tasks and of the cost of a single click in nurses’ daily work might also be due to the invisibility of nursing. Indeed, it suggests that, in a sense, nurses’ work dynamics are (still) not well understood, or at least not accommodated for.

Visible data, invisible work can to some extent be associated with what Star and Strauss (1999) referred to as abstraction of quantitative indicators of work – the use of statistics to assess work, making both workers and work practice invisible (see section 2.1). However, our reference to “visible data” englobes more than the statistics derived from the data entered into the system. In fact, it refers more generally to all data that can be retrieved from the systems nurses use (and in which they document). We argue that using that information to assess or get an understanding of nurses’ working conditions is biased, as 1) some problems nurses encounter are not documented (e.g. no medical incident report or system error report is submitted) and 2) what has not been done (although it ideally should have been done) is not documented. These two aspects are directly connected to task avoidance, revealing it as one of the factors contributing to the invisibility of nurses’ increased workload because of HIT. Indeed, our findings suggest that the more hectic nurses’ workload gets, the less visible it becomes.

5.4 Implications and Solutions

Implications and solutions can be discussed for two different aspects of the current paper, namely 1) reducing the amount of time nurses have to spend on HIT-induced activities and 2) making HIT-induced additional work, the burden it represents for nurses, and its consequences visible to managers and developers in healthcare.

Potential solutions to reduce the amount of time nurses spend on HIT-related activities have, as we have seen in section 2.3.4, not only technical, but also
organizational / managerial implications. Obviously, technological improvements such as better interface design, context-based display of fields and information, and modern hardware have the potential to reduce some of nurses’ HIT-induced tasks, like for example excessive clicking and troubleshooting. Nevertheless, our findings suggest that organizational changes involving clear task (re)distribution, improved technical support on site, more intensive and adequate training, and the creation of new work roles would be more effective in reducing nurses’ workload. For example, nurses could be allowed to self-assess whether they have time to fill in a form instead of using the phone to order a service from another unit. Each hospital department could have a person on-site responsible to help clinicians with troubleshooting, system use, and setting up equipment. Medical secretaries could be hired to document patient care at the time(s) when nurses currently have to document simultaneously to providing patient care. Furthermore, the attribution of system authorizations could be improved by taking into account inter-departmental dynamics, allowing nurses from different but frequently collaborating departments to access a patient regardless of where the patient is located at a specific point in time.

We cannot say to what extent such measures would reduce the occurrence of the HIT-induced additional tasks identified in this study. There are two aspects to this question. First, could some of these tasks be completely eradicated? This is likely for some of the more technically induced tasks, such as coordinating system use. It is less probable for issues with more complex causes or solutions, such as excessive clicking, troubleshooting, computer-induced mobility work, paper routines, or password management. A second aspect is, could some of these tasks be completely taken over by other (possibly new) work roles? As suggested above, tasks could be (re-)distributed in a way that relieves nurses. Nursing staff could then possibly avoid carrying out such tasks as setting up equipment, helping physicians with HIT use, form-based communication, and finding out new information. More research is however needed in order to determine whether more HIT-induced tasks in nurses’ daily work could be eradicated through technical and organizational improvements, in particular regarding issues like excessive clicking, redundant oral communication, computer-induced mobility work, troubleshooting, paper routines, and password management.

Potential solutions to increase the visibility of HIT-induced tasks in nurses’ daily work, their cumulative effect on nurses’ workload and their consequences involve managers and developers more frequently coming in direct contact with nurses working on the floor (or their representatives). Strategies need to be developed at the highest level of the organization in order to bring together managers, developers and end users. For instance, managers and developers could spend some hours a year shadowing a nurse or simply observing and talking to staff in the divisions (as we have done to collect our data). Holding focus groups with nurses could also be a solution (as we also have done), although it probably would be more time-
consuming and challenging to organize. Maybe more importantly, better communication channels between nurses on the floor and developers and managers need to be elaborated. In our data collection setting, nursing staff typically needed to fill in forms in order to report problems – be it technical or clinical. Our findings have shown that this is not an appropriate communication channel, as nurses do not have the time (and do not want to take the time) to fill in additional forms. Developing faster, maybe even non-computer-mediated ways – for nurses to report the problems they encounter in their daily work is essential to increase the visibility of these issues. More research is needed on how communication between end users and management / developers can be improved in order to increase the latter’s awareness for the practical implications of system use on the floor.

6  Conclusion

This paper is, to our knowledge, the first study systematically investigating the different sources of HIT-related additional work in nurses’ daily work life. 13 forms of new work created by HIT in nurses’ everyday work were identified. Eight of them, namely excessive clicking, additional workflow steps, redundant oral communication, task drifts, computer-induced mobility work, 8) exploring system functionality, paper routines, and 13) password management, have been mentioned in previous research (albeit in different studies). The five remaining ones, coordinating system use, setting up equipment, helping physicians with HIT use, troubleshooting, and finding out new information, do not seem to have been acknowledged in the existing literature. Task avoidance was found to result from nurses’ increased workload due to HIT use, alongside perceived increased documentation time and perceived decrease in time spent with patient, patient safety, care quality, and professional satisfaction. Moreover, we have argued that the time burden resulting from the accumulation of HIT-induced additional activities in nurses’ daily work appears to be overlooked by managers and developers in healthcare. This proposition is based on the observation that nurses’ work schedule does not seem to accommodate for these new tasks. Four different factors potentially contributing to the suggested invisibility of nurses’ increased workload because of HIT have been proposed: 1) lack of a holistic perspective, 2) the hidden cost of a single click, 3) the invisibility of nursing work, and 4) visible data, invisible work. This last factor is closely associated with task avoidance, suggesting that the higher nurses’ workload gets, the less visible it becomes to management and developers, as the more tasks are avoided and the less is electronically documented.

More research is needed in order to explore the extent to which increased end user familiarity with systems and workflows and technical and organizational improvements can reduce the forms of HIT-induced additional work presented in this paper. The quantitative impact of these HIT-induced additional tasks on nurses’
workload also requires further research, for example in the form of a time study. Moreover, management and developers’ perspectives on HIT-induced additional tasks, the proposed factors contributing to their suggested invisibility and the added work demands brought about by technical tasks need to be examined. Potential solutions to increase management and developers’ awareness of the practical implications of system use on the floor also need to be investigated.

6.1 Limitations

Several limitations – beyond those mentioned in chapter 5 - must be taken into account when considering our findings. First, the characteristics of our data collection setting need to be taken into account. As mentioned in section 3.1, our data were collected in a context of change, where different systems were being implemented or upgraded. As a result, our data may reflect the natural challenges characteristic of implementation periods. However, the HIT-induced tasks we have identified were all either reported or observed in several of our data collection episodes, including the observation sessions carried out at the pediatric oncology department prior to any major change to the main systems in use there. This suggests that the tasks in themselves are not bound to implementation processes, although the frequency of certain activities (e.g. troubleshooting) might have been exacerbated by this context of change (as discussed in section 5.1). Other characteristics of our data collection setting include, beyond newly implemented / upgraded systems, a lack of interoperability between key systems and a reported lack of training of both nursing staff and physicians. This might also have resulted in the emergence and intensification of some of the HIT-induced tasks identified, such as duplicate documentation, exploring system functionality, and helping physicians with system use. Moreover, our data collection setting uses commercial (and not in-house) eHealth systems, which has its specific challenges and constraints.

Another limitation of our study is that few nurses and assistant nurses with the same specialization (ward, operation/surgery and anesthesia) were involved in our data collection. On the one hand, this diversity may be positive because it suggests that our findings are somewhat transferable from one nursing specialization to another. On the other hand, it constitutes a limitation as we have brought together statements from nursing staff with very different daily routines and assignments. As such, it might be that some of the included roles may not find themselves in all our findings and examples.

Furthermore, our data collection did not cover ward nurses’ interactions with their patients and their patients’ relatives, nor the interactions between clinical practitioners in the patients’ rooms. We therefore might have missed other HIT-induced tasks taking place in this particular setting.
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