



# The effects of automation of a patient-centric service in primary care on the work engagement and exhaustion of nurses

Åsa Cajander<sup>1</sup> · Marta Larusdottir<sup>1</sup> · Gustaf Hedström<sup>1</sup>

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## Abstract

Digitalising patient-centric services to address society's challenges with an ageing population and healthcare provision is by many seen as important. Studying the effects of the digitalisation on the work engagement of the users of the new systems is vital in this context, especially since previous research has established that the work engagement at work in healthcare is problematic. Work engagement is defined as a positive, fulfilling, affective-motivational state of work related well being, as is closely connected to the experience of resources and demands in the work context. These resources can be for example digital support, experienced demands or empowerment whereas exhaustion is connected to work demand in a workplace. This study contributes to knowledge about the effects of digitalisation on work engagement and exhaustion in the context of patient-centred services and eHealth. Contextual interviews were conducted on site for 5 h with nurses using a new chat function and using telephone for medical advice to patients. Additionally, semi-structured interviews were conducted with all the nurses participating in this digitalisation project to gather more insights into their work engagement in the two work situations. Results were analysed in different themes of areas affected by the digitalisation in the two overarching themes: job demands and job resources. The results show that the change to a chat function when communicating with advice seekers had connection to work engagement in several ways. The nurses experienced less time pressure and emotional pressure, but also a loss of job control and feedback from colleagues working from home.

**Keywords** Automation · EHealth patient-centric services · Work engagement · Healthcare professionals

## Introduction

Automation where humans and computers cooperate on various levels is transforming society. Many jobs are anticipated to be partially or completely automated in the future. OECD, for example, calculate that 14% of current jobs could completely disappear in the next 15–20 years, and they estimate that around 32% are likely to change entirely as tasks are automated [1]. Another well cited calculation estimates that 47% of all jobs in the US will be threatened by technology development in the next 10 to 20 years [2]. This transformation using automation is also seen in the healthcare sector and some areas of automation are clinical development, non-invasive surgeries, robots in the medical pill dispersion and administrative systems [3].

Automation has also recently moved into the area of patient-centric services to address society's challenges with an ageing population and healthcare provision. The goal of the transformation with automation here is to make healthcare more efficient, and to empower patients. However, recent reports by Golay suggests unexpected work and invisible new tasks are being introduced as a result of new technology [4]. Given the work environment problems in healthcare, with a large turnover of especially nurses [5] and recent evidence that suggest digitalisation is experienced as a part of the problem by many healthcare professionals [6, 7], it is vital to investigate the effects of automation and digitalisation on work engagement.

Research on work engagement has emerged as a subfield in human computer interaction in the last decade [8], and within the area of human computer interaction it has been used to connect work engagement with digitalisation. There are several research strands in the area of work engagement and digitalisation, such as Positive design [9], Positive technology [10], and Positive computing [11], which have their origins

✉ Åsa Cajander  
asa.cajander@it.uu.se

<sup>1</sup> Uppsala Universitet Teknisk-naturvetenskapliga Fakulteten,  
Uppsala, Sweden

in positive psychology. Positive psychology promotes human well being and flourishing as the ultimate goal of scientific research. There is also earlier research on the impact of workers and social wellbeing, such as for example research on office workers [12, 13] but without the focus on the positive side of digitalisation and work engagement. Finally, there is some research on how to work with usability and work engagement in software development [14], and in agile software development [15].

User experience (UX) has gained momentum in human–computer interaction and is defined by ISO in the following way: “Person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service” [16]. Researchers agree that UX is a complex concept, including aspects like fun, pleasure, beauty and personal growth. An experience is subjective, holistic, situated, dynamic, and worthwhile [17]. A recent survey on what practitioners think is included in the term UX shows that respondents agreed that user-related factors, contextual factors and temporal dynamics of UX are all important factors for defining the term UX [18]. In parallel to this, a general conclusion of a recent systematic literature review by Roto et al. [19] that calls for more research in the area of user experience, work engagement and automation. Many researchers have also pointed to a lack of focus on user experience research in the work context [20–22], and a recent literature review on work engagement calls for more research on new technologies and work engagement [23].

This paper addresses this research gap and contributes to knowledge about the effects of digitalisation and automation on work engagement of nurses in the context of patient-centred services and eHealth. In this paper we report from a study on a digitalisation of human–human telephone contact to a process where patients first fill in a dynamic and automated electronic form about symptoms, and then describe their symptoms in free text using a chat with nurses and/or physicians. The research question addressed is: *How has the digitalized and automated patient-centric service affected the work engagement of nurses in primary care?*

This paper contributes to the area of Human Computer Interaction through exploring and discussing the use of a well known theory from occupational health related to work engagement in the analysis of patient-centric services and automated work. It further contributes through user experience insights related to the effects of digitalisation on nurses in healthcare and more specifically the effects of digitalisation on work empowerment and stressors for nurses in healthcare advice settings.

## Related work

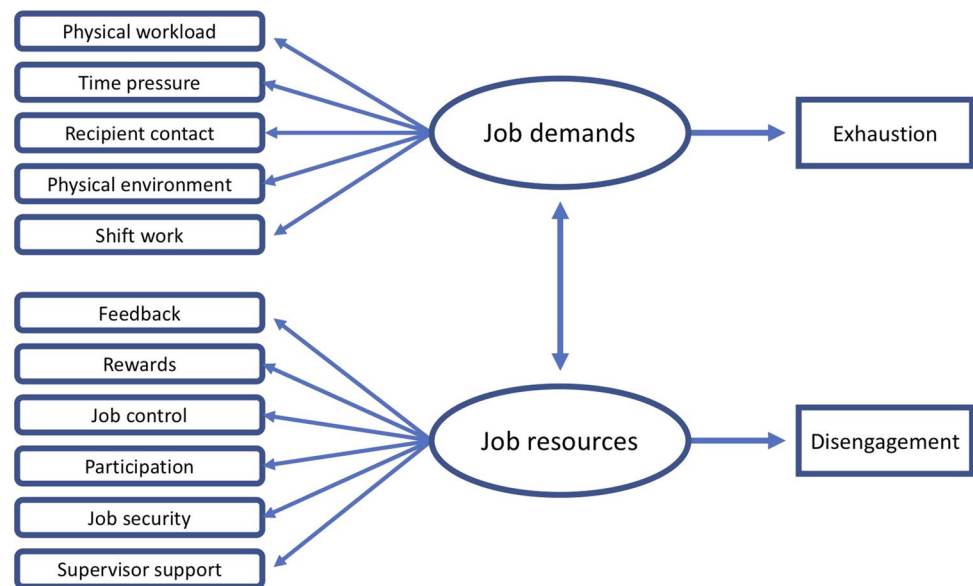
In the section on work engagement we present the background of the concept and especially how the work engagement is in healthcare. Additionally, we present how automation connects to work engagement. This is followed by a section on current trends in patient-centred services.

## Work engagement

Work engagement is often defined as a positive, affective-motivational state of high energy combined with high levels of dedication and a strong focus on work [24]. Work engagement is a complex phenomena connected to many different concepts such as meaningfulness, safety, perception of general change, empowerment, mental health, burn out, workaholism and professional practice [25, 26]. Many studies on work engagement investigate a mean level of work engagement, and differences in work engagement between individuals in relation to working conditions, personal characteristics and behavioral strategies [23]. The job demand resources model is one of the most often used theories to explain work engagement. According to this theory people are likely to experience high work engagement when they have challenging tasks in combination with sufficient job and personal resources available [27, 28]. Work engagement hence is closely connected to experienced resources, demands and control in the work situation. These resources refer to organisational, physical and social aspects of work. They consist of for example social support, performance feedback, skill variety, autonomy and learning opportunities [27]. Personal resources and emotionally demanding conditions at work are also closely connected to work engagement [29].

The Job-Demand-Resources Model Burnout is presented below. As can be seen in Fig. 1, the model consists of two connections: the one between demands and exhaustion, and one between resources and disengagement/work engagement. Workload, time pressure, the physical environment are examples of factors that create demands in the work. If the workload becomes too heavy over time, chronic fatigue can occur. Feedback, participation and support from the supervisor are in turn examples of job resources that affect the engagement of the employees. Their model also stresses that there is an interaction between demands and resources. For example, high demands do not have to lead to a negative burden, but in combination with the right resources can strengthen the motivation and commitment of the employees and instead contribute positively to the work. In our study the interviews have been informed by this model and we investigate the notion of work engagement through looking at how digitalisation has affected the resources and demands.

**Fig. 1** The Job Demands-Resources Model of Burnout [30]



Previous research has established that the work engagement in healthcare is problematic [5]. Simpson did a systematic literature review related to work engagement in the context of nursing and found 32 papers on the topic, most of which focused on the antecedents and/or consequences of engagement at work [26]. In the review it was found that the concept of work engagement emerged around 1995, and the usage moved into nursing around the time of the literature review in 2009. The findings from the literature review suggest that organisational factors, and individual contributors significantly impact engagement at work. Organisational factors and individual contributors are also significant for the onset of burnout syndrome, which could be tracked along three main dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment [31]. A meta-analysis [32] revealed 31% of nurses experienced emotional exhaustion. Among young nurses, every fifth nurse strongly intended to leave the profession 5 years after graduation, and the intention was associated with levels of burnout [33]. Burnout has been associated with decreased levels of patient care, increased numbers of medical errors, infection and mortality rates as well as decreased patient satisfaction [34].

## Automation

One form of digitalisation is automation. Historically people have been sceptical when confronted with automation where operations and functions previously performed by humans have been taken over by machines [35]. Early examples of automation include knitting machinery, and early research studies on automation were focusing on allocation of the basic functions to people or machines, also known as

the Fitt's list with statements about whether a human or a machine performs a function best [36].

Current trends in automation look into fully autonomous systems, including research questions of how to build trust [37, 38], social and ethical dilemmas [39], and security and safety concerns [40]. However, fully autonomous and unmanned systems are rare, and often people have to monitor, intervene and control the automated environments, and hence people have proposed to move from human–machine interaction to human–machine cooperation as a perspective [41].

Autonomous cars have been the focus of research in human–computer interaction with a strong focus on promoting safe driving trying to resolve “the clash with the stringent safety requirements when drinking and the consumption of information and entertainment while driving” [42]. Indeed studies on user experience and acceptance conclude that the highest levels of autonomy in cars are connected with decreased perceived control and fun [43]. Other studies with drivers of Tesla report on experiences with autonomous cars where some drivers adopting to automation do not perceive autonomous driving as risky, even in an environment with regular automation failures [44]. A proposed research agenda for autonomous cars by Kun proposes a shift in the research agenda to transformation of vehicles into places of productivity and fun [42].

However, automation affects the work and working conditions of people and hence also work engagement [45]. One can conclude, for example, that automation has shifted the role of the operator from manual to supervisory control, and that it can perform the tasks of diagnosis, planning and problem solving [35]. A recent literature review concludes that little attention is paid to the user experience

when automating work, and that the “human aspects of those systems might seem less essential” than the classical focus on efficiency, effectiveness and safety [19].

### Current trends with patient-centric services

The first major steps in the digitalisation process of healthcare in Sweden were taken in the mid 1990s when several electronic medical record (EMR)-systems were developed. The major transition from a paper-based medical record system to an electronic system came in the beginning of this millennium. Since then, several other digital systems have been introduced to healthcare professionals, including systems for electronic prescription, surgery planning, automatic patient monitoring, digitalisation of radiology, decision support, and more. Some systems have utilised a new design approach but there are still possibilities to find newly developed systems utilising a more digitisational approach.

Digitalisation projects in the healthcare sector are mainly done with one of four main goals: effectivization, increased availability for patients, increased medical quality, or merely because it is possible. One major trend among politicians with influence over the healthcare system in Sweden, has—over the last years—been to promote easy access for patients to the healthcare system. Such decisions have resulted in several actions improving patients access to healthcare and healthcare information. In 2003 a Swedish telephone nursing service was launched, which now is national reachable 24/7/365, providing medical advice by registered nurses whose’ assessment are supported by computerised decision support (DCS) to secure equal assessment [46]. However, DCS has been found used mainly for assessment and memory help and not for decision aid [47], and the nurses can experience the system both as supportive and inhibiting, when the system is inconsistent with their own assessment [48]. This intersection between evidence based medicine, complex health treatments and design of healthcare software needs to be understood with a patient-centered approach to consider guidelines as architecturally significant requirements in the design process [49]. Patients have also been given online access to their own medical record, which have been met with ambiguous feelings from various stakeholders, highlighting the necessities to consider several stakeholders sometimes conflicting interests in the design process [50].

In recent years, there has also been more debate about the necessary changes the healthcare sector needs to undergo to meet future challenges. One governmental investigation that gained great importance was presented in 2017, stating the necessity of the rather hospital-oriented healthcare sector in Sweden to transform and move more care closer to the patients [51]. A follow-up investigation in Sweden

was presented in 2019, focusing on merging the digital and physical care [52].

In 2016, two private companies entered the Swedish healthcare arena and offered digital doctor consultations to patients all over the country. The reimbursement system was designed for physical doctor visits and not distance online consultation wherefore the cost to these companies were high. This intensified the work in each healthcare region to offer similar services to its own citizens, either via video or chat. The asynchronous chat function can be experienced as more flexible in some health related settings, allowing contact to more smoothly fit into daily life [53], simultaneously providing an opportunity collecting medical information via predefined questionnaires. Some even suggest AI based triage tools could relieve healthcare personal with remaining quality, even though the validity of this claim can be questioned so far [54].

Region Uppsala started in 2019 a project enabling a chat function for patients seeking medical advice. The project ended according to plan at the end of Q4 2019, whereafter the function is to be introduced on a wide front in the organisation. In this paper we report results from a study on that digitalisation case, which is a digital transformation of human–human telephone contact to a process where humans first fill in a dynamic and automated electronic form about symptoms, and then describe their symptoms in free text using a chat with nurses and/or physicians. We compare results from interviews on the effects on the work environment of the nurses using both the chat and the telephone contact.

### Method and materials

This paper reports from contextual inquiries and semi-structured interviews with nurses at Region Uppsala, Sweden. The data gathering was conducted in the fall 2019.

Contextual inquiries [55] were scheduled before the interviews to receive a better understanding of the digital work environment of our informants. One researcher sat beside an informant for around one working day and observed how the work was conducted and work collaborations performed. In between, the researcher asked questions on how the work was done. Contextual inquiries were conducted with five different informants. Researchers took notes during the observations and these were filed after the observations.

All participants that had worked in the system were recruited for semi-structured interviews; in total 9 informants. All the nine semi-structured interviews [56] were conducted at the interviewees office. The interviews lasted 25 to 60 min. All interviews were recorded and transcribed verbatim. Table 1 is a table with the demographic characteristics of the participants in the semi-structured interviews.

**Table 1** Demographic characteristics of interview participants. Gender distribution of interviewed nurses reflects the national gender distribution among nurses in Sweden with 88% female and 12% male nurses [57]

Gender	
Female (n)	8
Male (n)	1
Age	
Mean years (min–max)	49,4 (29–64)
Work experience (years since graduation)	
Mean years (min–max)	21,1 (5–36)
Work experience at 1177	
Mean years (min–max)	3,4 (1–11)

During the interview we asked the informants:

- About their background (4 questions),
- On the chat system and usage (13 questions),
- On the old way of working through telephone and comparing the old way of working to working with the chat system (13 questions)
- Some closing questions (4 questions)

We used the two overarching themes: job demands and job resources from the theory of Demerouti et al. [30] as shown in Fig. 1. Results were categorized in the three different themes related to demands, and six different themes related to resources from this theory. Some themes from the original theory were not used since they were irrelevant in the setting of the study: physical workload, shift work. Instead we added workload more broadly as a theme in the analysis,

## Study setting

In 2003 the national service 1177 was established, initially providing online self-care information and later also healthcare advice via telephone from nurses 24 h a day, all year round. Today the service is well established and is maintained in collaboration between all Swedish healthcare regions and national organizations. Around 1200 nurses are working full or part time, providing service to the 7 million people who call each year (from the 10 million inhabitants in Sweden). Approximately 30–35% of all calls are given self-care advice whereas the rest are referred to a healthcare facility. In Uppsala, about 250.000 calls were made to the service during 2018.

Recently, politicians in Uppsala decided to introduce a digital system to facilitate citizens contact with healthcare providers. As a result, a proof of concept project was started in 2019 enabling asynchronous chat between citizens and

nurses working at 1177 in Uppsala. The chat is manned by 1 to 2 nurses at the time during daytime and evenings, working in the same room with similar equipment for usage of the system, but unmanned during weekend evenings and all nights. In addition, a physician is available during the last 4 manned hours each day. Even though the number of advice seekers has increased from the initial small inflow, the figures had not met the expected number for a normal day at the time of the interviews in this study.

## Results

In this section we first present an overview of the Work Flow in the chat automation system. After this we present an analysis of the experiences of nurses in relation to the automation based on the *job demands* and *job resources* theory by Demerouti et al. [30].

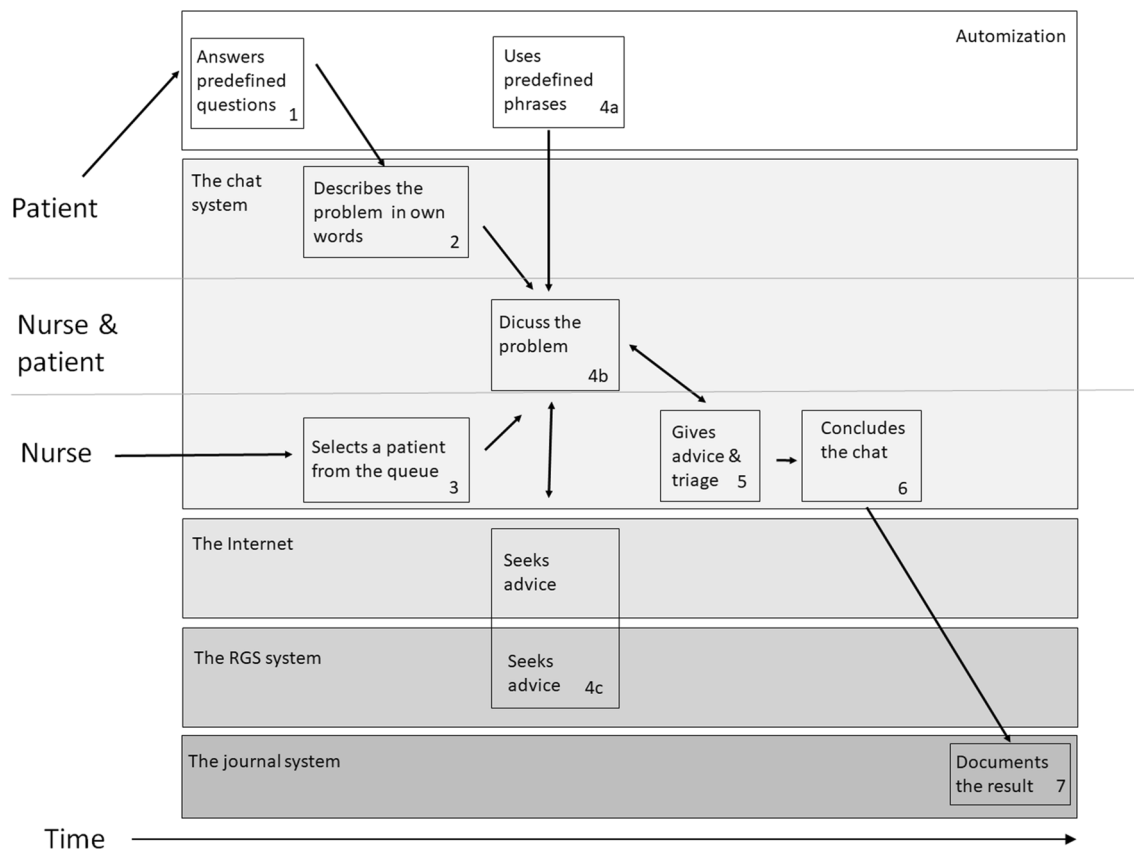
### Workflow

The system requires patients to specify which medical problem they are seeking advice for and answer predefined questions derived for this problem before the nurses handle the case. Even though not implemented in the project, the system provides the possibility to use the initial answers to triage patients before further handling.

In Fig. 2 we illustrate the workflow for the patient and the nurse for finding advice for the medical problem. The workflow is numbered from 1 to 7, where 4a and 4b happen in parallel.

When entering, the patients log in with a national e-identification system. The patient then first answers predefined questions prior to entering the chat system. The nurses can read the answers, but are not able to read the wording of the questions that the patient answers. The nurses have to use three different systems in parallel to give advice to one patient and conclude the conversation in the chat system. The use the Internet, the RGS system which is a medical advice support system for professionals and a journal system to document the results. The nurses also do a triage of the patient, which is a process for sorting and prioritizing patients based on the problems and symptoms that the patients describe such as body temperature, heart beat and pulse. Nurses can have up to 6 or 7 patients simultaneously, each in different steps of the workflow, so a nurse could be concluding a chat with one patient, but keeping a discussion open for the other patients.

The workflow for giving advice on the phone is mostly that the patient explains the health problem verbally and the nurse asks questions to understand the problem and the severity. The nurse serves one patient at a time. When the nurse feels (s)he is ready, (s)he gives advice and concludes



**Fig. 2** The digitalised workflow of giving advice to one medical patient

the conversation. The nurse uses a system to select a patient to talk to and can go online to seek information for the advice.

## Job demands

### Time pressure

Generally, time pressure was not experienced as a problem in the chat. However, a few areas emerged from the interviews and are presented below.

*Experience of Queue* Many nurses find that the queue in the chat is stressful when there are more than 6–7 patients waiting in the chat. This is interesting since none of the interviewees found the queue stressful when working on the phone with patients. Here, the interviewees describe that the queue is a joint queue in the phone, and that it is always there, and you have a shared responsibility with many others while in the chat you do not have the same support from colleagues. During the case study, this has not been a major problem as few patients have used the service, but there is a concern that the problem would be greater if many would use the chat in the future.

“You see the patients coming in all the time and look like okay now we or I have **eight waiting**. Because it’s more personal. In a queue where there are lots and lots of people waiting/.../you let go.”

*Not knowing how many patients are coming in* Several nurses also complain that the so called Onboarding feature showing incoming patients to the chat is not a help, and that part of the systems can be improved.

“It can be said that there are four patients on the way. On boarding. And then there will be no patients. Then it can be the other way around. That it says nothing at all, but that several show up. Eeeh okay.”

*Many patients in parallel* Many nurses find it stressful to have many patients in parallel in the system, and that there is an absolute limit to how many you can chat with at the same time. Also, many think that there should be a limit to how quickly patients should respond.

“For me/.../it gets a little more stressful because we are expected to have several patients at the same time. And we also have to have that, if there is high pressure, to be able to keep this response time for a maximum of one hour/.../and that it is stressful because you con-

stantly see the queue. That's the big difference, on the phone you know the queue is almost constant."

### Recipient contact

*Emotional Work* Some of the nurses described that it is less emotionally difficult to chat with patients than to talk to them on the phone, or to work in a care unit. It is easier to keep a professional distance when communicating via text and some describe that they do not become so emotionally involved in the patient's problems.

"I think it is calmer to sit in the chat because I have time and think about word choice. I can go back and watch the text while I have the patient"

Some nurses experience that working in the chat is slower than working in the phone service, much due to the asynchronous conversation. They describe that sometimes they can conclude the advice quickly with a patient on the phone. Some nurses had a lot of focus on finalising conversations with patients, and mentioned that it could be stressful to wait for patients' answers in the chat since patients have 12 h to answer. The conversation became more fragmented in the chat than in the phone and therefore harder to keep the focus on the particular problem and remember all the details about it.

"You send a question away and it can take everything from two seconds, if the patient is sitting at the screen or has the app open, or 2 h. Sometimes you might not get an answer for a whole day. "

*Automation text support and recipient contact* The chat provides support sentences that can be used in discussion steps with the patient in the chat system. Many people use the very short greeting phrase given as supporting text, but the longer phrases are rarely used by the nurses. Most people we talked to could not explain why they did not use them. Some mention that they feel impersonal, and that they would have preferred to write the lyrics themselves so they would have been more adapted to the style you choose to have in the chat. One of the nurses explains it like this:

"I enjoy not being too controlled. I use the phrase templates very seldom/.../. Because I want to be more personal than it can be/if I use them/. It can easily happen that it becomes too robot-like if you use too many phrase templates."

*Misunderstandings and chat language* Some of the nurses pointed to the difference in using chat language to spoken language. And that there is a greater risk for misunderstandings since the written sentences are quite short and do not contain the nuances of a spoken language. Many also

mentioned that the voice helps them understand the decrease of the person and that this part is missing in the chat.

### Physical environment

The physical environment consists of a shared office space with two people working. Each office space is equipped with two screens and a computer. The nurses do not have their own desk but chooses the one that is available when they start working. There were very few complaints about the physical environment generally in the interviews with the nurses. A few people find it really annoying to work with two screens:

"Well, I do not want to have two screens./.../. I don't want to have two screens in front of me."

The physicians who worked at 1177 were offered to work from home instead of being at the office. The nurses were not given this option, but all the interviewed nurses would appreciate working from home.

"I have 1 h's travel time each morning./.../You can organize your work in a different way. Maybe if you say that you would be stand-by or something too. I know that sometimes we have had a little panic with the staff. It was some weekend [not long ago]. On this occasion we could have worked from home and it would have resolved that weekend."

### Job resources

#### Feedback

*Feedback from physicians* Since many physicians work from home some nurses experience that there is not a lot of feedback between the occupations, and very little collaboration. Also, the physicians work in the evenings and the nurses work both during days and in the evenings.

"I have no collaboration since I only work during day time./.../But it is different for those who work in the evenings. Then there is more contact with the physicians, but then again many physicians work from home"

*Feedback from patients* Moreover, there is very little feedback from patients since the only time the nurses receive feedback on the triage is when things have gone wrong and that happens very seldomly.

"Sometimes someone has interpreted the situation in the wrong way. Often it is when a patient has called several times to 1177. And talked to different nurses"

However, almost all patients expressed their gratitude when wrapping up the chats with the nurses, and there is constant feedback and gratitude from patients. However, some of the nurses feel that the reward that they receive from the patients when helping them is less prominent in the chat. They experience that the connection is more distant, and that there is less contact:

“But you get less of that: “Thank you so much for listening” in the chat”.

### Rewards

There were few extrinsic rewards found in the study with the nurses. One of the things mentioned as a reward is the queue and that a short queue is a reward for them. Also, there is a strong focus on the number of patients, and the nurses keep track of how many they have answered every day. This seems to be a motivation, and a reward in itself. Salary is mentioned as a reward by one nurse only, and this person says that the salary at this work place generally is higher than in hospital care. It seems that these nurses have a strong intrinsic reward system connected to care and with meeting patients. One of the nurses explains it like this:

“Because what I really like is the meeting with the patients”

### Job control

When the users seek help through the chat system, they are asked to fill in a set of predefined and automated questions before typing a particular question in the chat-part of the system. The number of questions can vary depending on the type of health problems the patients have. The nurse receives information on the answers that the patient gives, but does not see what the questions were that the patient answered nor how these were asked. Also nurses did not want to ask again about something the patient had already answered, because they thought that was unprofessional, and also annoying. One nurse explained:

“I would really like to have a better insight and understanding of what the patient fills in”

Another nurse explains that sometimes (s)he would need more information about why the patient has the symptoms described in the answers to the questions.

Additionally, the nurses commented that some questions the users answer are irrelevant for the nurses and they think some of the questions should not be asked. One of the nurses explained that the predefined questions are probably there for trying to receive a better focus on what the patient's problem actually is, but sometimes the questions make it harder for the nurses to find the possible reason for the symptoms.

Other nurses commented that the wording of the questions to the patients from the automated system are sometimes misleading. For example if the patient has a rash, but the question asks if it is problematic for the patient to breathe then the problem of breathing could very well be disconnected to having a rash. In this case the nurse would have liked to see the logic behind the questions to the patients, to know why this question appeared.

Some of the nurses explained that they needed to ask more questions in the chat system than in a phone call, because they did not trust the information to the same degree in the chat system as on the phone. One of the nurses explains:

“It may not belong [in the patient's case], while in the chat they only get the standard questions in the questionnaire and then they have answered yes to many different things, which they probably have [symptoms of] but may not at the moment or do not relate to what they are looking for help right now. So then I have to dig more into it”..

Others said they did not ask any further questions because they had to rely on the information that the patients had filled in before chatting. They have completely the opposite strategy and make an assessment based on the information provided by the patient in the forms they filled out. Many also feel that it is a difference to talk to the patient on the phone and that one can perceive further information from, for example, breathing.

“So purely from a medical perspective for the patient, I think this is that you do not hear the patient, you do not hear breathing or how affected they are and so there. Eh... it's probably like the biggest negative I see it. “

### Participation

The nurses describe that they have felt involved in the introduction of the IT systems and the new working methods. Continuous efforts have been made to collect comments and suggestions for improvement that have resulted in concrete measures. Many describe that they daily evaluate the work processes, and write a short report. Workshops have also been organized with the IT supplier around the systems. This increases the feeling of control in the work situation.

Many were very positive about the digitalisation of their work situation. The nurses describe that they want to participate in and influence the digital change in primary care, and that it motivates them to work for 1177 during the pilot project.

“So I see this as a chance to partly create a health-care that feels resource efficient and secure, but also that I eventually get to choose what my working day



will look like and inevitably these digital tools will come, then I can be just as happy to have the chance to develop them as well.”

There is however some criticism in the participation in the design process, and the nurses explain that the forms and the automation is based on feedback from physicians only and supports the diagnosis of patients—which is something that nurses do not do. Neither nurses, nor patients were actively involved in the design of the system:

“The chat automation templates/the forms/have been developed from the physicians perspective. That means that there are very many diagnoses there/.../. And that is a clash both for us as nurses and for the patients”

### Job security

Many nurses experience very good job security at this workplace, and despite the fact that automation will replace some of the nurses’ work in 1177 there is no one that mentions this in the interviews. Some nurses are very sure of the opposite:

“Well, a robot will never take our work”

They base their feeling of job security on the many errors they see in the automation where patients answer questions about their health.

“No, a robot cannot replace us. And it is the same things as with those forms that the patients fill in. Well, 1 day all patients had palpitation. And I don’t understand that. Why do you have that when you have a rash on your hands?”

Generally in Sweden there is a large lack of nurses, and many of the nurses in the study have worked at the workplace for many years. However, the work environment in nursing has also led to the fact that many burn out or suffer from stress related symptoms such as problems with sleep in traditional nursing occupations. Several of the employees in the chat describe that the work in the chat is an new kind of nursing work, more suitable when you have had stress symptoms:

“Yes, I have been on sick leave and while I was on sick leave with fatigue syndrome I thought I would never work as a nurse again. Eh... I did not fit in the/traditional/work in hospital wards/.../. That’s why I left that and came to this/place/.

### Supervisor support

Generally, all nurses describe that they have had good supervisors’ support during the introduction of the system. This has included formal education in the system, time to practice

in the system and well functioning procedures if something should go wrong with the system. Many mention that they would contact their supervisor if things went wrong in the system:

“Well. I would call the people responsible”

During the interviews it became clear that more inexperienced nurses used decision support to a very large extent and think it works very well as support in both diagnosis and triaging. Those who are more experienced do not have the same need for help. It also became clear that 1177 has good collective learning and that the nurses get good support from each other.

“I fully trust that those who have made the support have thought about and—have—checked on the situation.”

Nurses also describe how the work with the decision support is perceived as scaffolding their development.

“I’ve learned a lot. All of a sudden I feel like I have become very broad [in my medical knowledge]and suddenly I can answer as well as the neighbors’ questions about bones and everything possible”

## Discussion

In this section we discuss the effects the job demands had on exhaustion and the job resources had on engagement. Furthermore we discuss how the chosen theory has guided the analysis and conclude discussing the limitations of the study.

*Job Demands Effects on Exhaustion* The experience of queuing was a stressor for many of the nurses and some even feel that the queue is the greatest stressor in their work. The nurses felt that they had to serve the patients as quickly as possible and they felt stressed if they were chatting to many patients at the same time. The reason is that when serving one patient the nurses know that the other patients were waiting. Additionally, the conversation with each patient can be asynchronous, so the nurses had to wait for the patient’s response and they did not know when the answer would come so the conversation pace is out of their control. The fragmentation of the conversation, and the unpredictability of when patients respond, were described as stressful moments at work. Sometimes the nurses were checking again and again, if the patient has responded. This act of checking for answers could be seen as unexpected work or an invisible task being introduced, similar to the findings reported by Golay in the area of patient-centric services [4].

Nurses wanted to give good service quickly to the patients and because of the asynchronous conversation that became harder for them. They sometimes felt stressed which could

contribute to exhaustion. Possibly the stress would be reduced if the queues and work become more similar to the telephone situation, i.e. a long queue that is constantly present and that many share the responsibility for. The nurses need support on how to handle the fragmentation of the conversation, and the unpredictability of when patients respond, and from a work engagement perspective it would be better if patients are forced to respond within a set time than allowing the chat to extend over an entire working day or several days.

One positive aspect of this digitalisation is that many nurses felt it less emotionally difficult to chat with people writing text than to talk to them, since they did not become as emotionally involved as when talking to the patients. In comparison a meta-analysis [32] revealed 31% of nurses experienced emotional exhaustion, and in the work of nurses at 1177 the experience was quite the opposite. Even though some of the nurses missed this personal contact, many of them commented that they are not as exhausted after 1 day working on the chat as after 1 day working in the telephone service. Given that many people in healthcare suffer from work-related poor health due to unreasonable demands and too high workloads, the digitised form of giving advice to patients could provide an environment with less emotional stress for nurses. Also, this kind of nursing work can be a complement to other forms of nursing where levels of burn-out is associated with an intention to leave the profession 5 years after graduation [33].

*Job Resources Effects on Engagement* In our study we saw two negative effects on the work engagement of nurses. The first is the effect of the predefined questions the patients answers before the nurse is in contact with the patient in the chat system. Many of the nurses expressed interest in knowing what the patient had been asked about before entering the chat system in order to better understand their answers, so they could give better service to the patient. They did not want to ask again about something the patient had already answered, because they thought that was unprofessional. Additionally, they did not want the patient to take more time than needed, so not being able to check which question a particular patient had answers was experienced as disengagement. The second effect is the lack of feedback from the patient and/or the health care professionals after the nurses have given advice and triage the patient. Many nurses also commented that they would like to learn if their advice was good for the patient. In situations when nurses had triaged patients to the physicians, and they were at the same place as the nurses, the nurses were able to check this informally by going to the physician and ask, but they commented that they would never phone them or send messages to check if their advice was good. In both of these situations the nurses felt that they were isolated and did not have enough information on what happened before and after their own job tasks. Both

these issues could be solved by a different design of the new computer system or a different workflow and are caused by the chosen design and workflows in this particular case. One option would be to give the nurses the possibility to look up the questions the patient got, if needed, which would presumably improve their experience of using the new system. A chat window where the nurses could chat with the doctors taking over the patients issues could improve the feedback loop between the nurses and the doctors, so the nurses could easily ask about the issues they are concerned about and thereby learn from the different issues.

Our results show that extrinsic rewards are lacking in the nurses' work situation as a whole in this study. This might be connected to the history of nursing as a profession. Traditionally nurses are expected to be driven by intrinsic rewards, and if we look back in time they were not paid for their work. Other research has pointed out that most nurses desire intrinsic rewards for their work such as helping others [58].

The nurses commented that they gained work engagement by being involved in the introduction of the IT system and they felt engaged by influencing the digital change in primary care. They saw their role of being pioneers in the digitalisation of the patient contact as an important one. Additionally, they all commented that the support from the colleagues, from supervisors and when learning how to use the system was good. This was a positive experience at work and extended their work engagement. However, one can note that when the forms for patients were developed the only user group involved in the design process were the physicians, despite the forms being primarily used by patients and nurses.

*Using the Chosen Theory* In this study we have analysed work engagement of nurses working with advising patients using a new computer system. In our interviews we have studied a new workflow for nurses working with advising and triaging patients. For analysing our results we have used the theory of Demerouti et al. [30]. The factors in the theory have guided us in taking a broad view on the work situation of the nurses looking at factors on job demands and job resources that can lead to exhaustion and disengagement. We investigated how nurses use four types of computer systems to complete their work with one patient, and what happens before and after they have completed their job tasks. Additionally we have analysed other factors like job security and the physical environment.

If the user experience as defined by Hassenzahl [17] of the usage of the chat system had been the focus point of the study, we would probably have analysed data from users on the experience of using this one particular system. In a study, measuring the user experience of a task oriented system used by office workers the user experience was measured right before the usage of the system in a think-aloud

test and right after the test [59]. The results show how the users experienced just that particular system, but not how the system fitted to the whole work situation of the users. The results would give information on how that particular system could be improved to extend the experience of the users and thereby the work engagement of the nurses. But, the complexity of using many systems to solve one job task and how the new system fits the other systems would not be a part of the study and thereby how the whole work engagement is affected by introducing this new system. The theory has given us a broader view than used in studies of the user experience of using a new system.

**Limitations of the Study** The first limitation with the study relates to the statements that nurses have made, complemented with contextual inquiries. We cannot be sure that what they say they do corresponds to their actual doing, as with any interview study. A second limitation is the context of a case study where results are transferable to other settings through the interpretation of the reader, and the results are not widely generalizable to other settings. The third limitation concerns the limited number of patients who used the system during the pilot trial compared to if the system would have been in use for a longer time. We have tried to address this limitation when analysing our data.

**Implications for Design** Based on this study we have found some implications for the design of the system and the design process. These implications are not new within the human computer interaction field. Still these could have been better addressed in this software development project for providing a better user experience and better integration of the new system into the whole work situation. We have seen the following four implications:

1. *The design needs to be based on a holistic work situation.* Systems are not used in isolation, as in this case study where the nurses work in three different systems to finish the task of giving advice to one patient.
2. *The physical situation needs to be taken into consideration in the design process,* as for example the use of several screens or one lap-top when the system will be deployed and used like by the nurses in this case study.
3. *The information interoperability needs to be investigated* as an important part from a work environment perspective. In this case study, the same information exists in several of the systems, and the nurses copy and paste the information for one system to another to make their work efficient.
4. *The workflow for the users of the system should be analysed according to how stressful it might be experienced.* All parts of the work process are not equally stressful. The results in our case study show that the workflow of the queue of patients was experienced as stressful since the nurses had to serve many patients at the same

time. An design alternative would have been to limit the number of patients that each nurse would have simultaneously.

**Author contributions** ÅC and ML designed the study and did the data collection and analysis of the data. All three authors collaboratively contributed in the background sections, writing of the paper, and reviewed the manuscript.

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**Availability of data and material** Not applicable.

## Compliance with ethical standards

**Conflicts of interest** The researchers declare that this study was conducted without any commercial or financial relationships that could be considered as a potential conflict of interests.

**Code availability** Not applicable

**Ethics statement** The study was ethically approved by the national ethical vetting authority with the number 2019-04991.

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