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Smart Solutions for Wellbeing Service Development and Management

– Winternational 5.0

Leinonen Rauni, Moisanen Kirsi, Kuhn Peter (ed.)

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Contact:

Kajaani University of Applied Sciences Library

PO Box 240, 87101 KAJAANI

Tel. +358 44 7157042

Email: amkkirjasto@kamk.fi

http://www.kamk.fi

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Foreword

The Smart Solutions for Wellbeing Service Development and Management (5 credits) course was organised for the sixth time in the academic year 2022–2023 in cooperation with teachers from Kajaani University of Applied Sciences and Neu-Ulm University of Applied Sciences.

As a result of technology and digitalisation, distances have become less important. It can be said that, in the digital society, everyone is at the centre and no place or participant is marginalised. There will be no return to slow, outdated and resource-intensive services and systems. The COVID-19 pandemic further accelerated the digital leap. This means that future working life will require digital learning skills, collaborative skills and contextualisation, which were made possible for both teachers and students in a joint course between Kajaani University of Applied Sciences and Neu-Ulm University of Applied Sciences.

Researcher of the future, Hatva (2023), notes that, even before the COVID-19 pandemic, organisations understood the importance of technological solutions. These organisations were called technology organisations. Before the pandemic, the technological dimension was also emphasised in how students applied for education. Students who applied to the social and health care sector wanted to avoid technology in their work, while students who applied to fields such as technology were interested in technology. COVID-19 promoted the uptake of technological solutions and increased the supply of digital services. There is no longer work in organisations where technology has not been adopted while, since the pandemic, any organisation with people can be called a health organisation. In health organisations, the emphasis is on health security as every organisation has to take responsibility for health problems if they occur. The COVID-19 pandemic triggered a wave of innovation in health technology. Among other things, 11 different types of breathing air analysers were developed worldwide to measure health-threatening particles in indoor air. Such analysers can be used in terminals and canteens, for example.

Social and health services are also going digital. Digitalisation is a megatrend that also affects the lives of individuals. The way we write texts, listen to music or watch films or series, deal with tax issues or social relations, or work for a living, has changed. This change is particularly evident in the way we work, which creates new needs for skills. (Dufva & Rekola 2023.) It should also be noted that vulnerable people such as some older people, people with mental health problems, immigrants, people with great needs for services, marginalised young people and the long-term unemployed, are not able to access digital services in the same way (Kaihlanen et al. 2021).

The pursuit of wellbeing has been mainly about economic success, but now we need to think about people's wellbeing in terms of life management and coping. On the other hand, a welfare society delivers long life expectancy, which reflects the success of society in supporting the health of the population. High life expectancy is reflected in an increase in morbidity and the number of older people, leading to a growing shortage of staff. (Hatva 2023.) Can this problem be eliminated without technology? There are not enough workers to cope with the growing demand for social and health services, which is why technological solutions and their deployment are needed. Technology offers a significant opportunity both to improve healthcare and to solve the sustainability crisis (Lehto & Malkamäki 2023, 7).

The main problem with technology adoption is workers' negative attitude towards it, their fear of losing their jobs and their feeling of a lack of technological skills. Their fear that technology will bring coldness, non-interaction and distance to the service is a distorted one, which is also reinforced by the media. In reality, what is needed is increasingly human-centred interaction and a more human life, which, according to Hatva (2023), is also made possible by collaborative robots, or cobots. The cobot seeks and gives gentle answers, learns how to interact and is on the customer's side when it answers. Its way of talking to people is gentle and empathetic. The change requires a 180-degree shift in thinking from staff to move away from negative narratives around robots. For example, a cobot can be an inspiration for an elderly person's everyday life, as well as an imaginative and activating tool. In 2021, around 27,000 cobots were sold worldwide, about 10,000 of which were sold in Europe, with the largest number in Germany. In Finland, 425 were sold.

Society is experiencing a technological revolution and everyone, including students, is called upon to be the architect of its service development. Various countries have prepared visions to strengthen the growth and competitiveness of the health sector. These visions emphasise better use of health and social data, digital solutions and new technologies. (see e.g. Lehto & Malkamäki 2023). The challenge of service development was addressed through innovations designed in the joint Smart Solutions for Wellbeing Service Development and Management course. The students' innovations were related to supporting the health and well-being of social and health care clients and patients, both in hospital and at home, not forgetting the digital development of safety and security culture in the workplace for care staff. Innovations were developed in student teams.

Despite the development of digital services in the welfare society, access to a variety of local services must be ensured. With an ageing population and an increasing prevalence of memory disorders, multiple national diseases and multiculturalism, there are also an increasing number of clients for whom access to local services is important and the only option. (Kaihlanen et al. 2021; Virtanen et al. 2022.)

Kajaani, 21 April, 2023.

Rauni Leinonen, Kirsi Moisanen, Aleksander Würfel and Peter Kuhn

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1 YBO – The social care robot combating loneliness: How technology can help elderly or disabled people to deal with everyday challenges

Räsänen Antti, Master of Health Care student, KUAS, Finland
Aslaner Deniz, Master of Arts student, HNU, Germany
Kienzle Franziska, Master of Arts student, HNU, Germany
Kejonen Jaana, Master of Social Care student, KUAS, Finland
Moisanen Kirsi, Principal Lecturer, KUAS, Finland
Leinonen Rauni, Principal Lecturer, KUAS, Finland
Würfel Alexander, Professor, Dr., HNU, Germany

Abstract

Loneliness in the elderly population, especially among those receiving outpatient care at home, is a pressing issue given the growing proportion of elderly individuals. The strain on healthcare systems due to demographic changes necessitates innovative solutions. This article explores the potential of digitization and robotics, utilizing technology to address loneliness and enhance the well-being of elderly and/or disabled patients. Specifically, it focuses on the development of a social care robot named "YBO" (Ystävä robot). YBO leverages various technological approaches, including communication screens, calendar functions, and cognitive games, to foster social interaction, improve mobility, and provide mental stimulation. The development process involved complex research methods such as literature review, expert interviews, and user journey simulations. The article highlights the benefits of YBO for individuals and the healthcare sector, while also acknowledging challenges in areas such as privacy, data security, and ethics. It concludes by offering a balanced comparison of arguments, weighing the advantages of digitization and robotics against the potential drawbacks. By embracing technology, particularly robotics, YBO presents a promising solution to combat loneliness and leverage digitization to enhance the well-being of elderly and/or disabled patients in need of care.

Keywords: loneliness, digitization, robotics, technology

1.1 Introduction

Loneliness in the elderly population is a widespread problem that can have serious effects on the well-being and health of older people. Even more affected by this problem are the subgroups of elderly and/or disabled patients who receive outpatient care in their home environment.

Multiple ways exist to achieve the state of healthy and happy aging. One possible way includes all activities that are traditionally based on direct face-to-face exchanges. Another person is required for this type of interaction, which is normally not a problem for a healthy, mobile person. For a patient who has limited mobility due to advanced age and/or several disabilities the simplest form of communication and interaction poses a problem. Many inhabitants of Finland are in rural areas. This creates another problem for older residents, as they have difficulties maintaining social contacts due to their limited mobility. The spatial distance is a major hurdle.

The second more modern way of carrying out activities and being socially active is based on digitization. Digitization in forms of smart technologies, robotics, etc. may offer new supportive possibilities to solve these problems. Global digitization has undergone significant changes in recent years. The Covid-19 pandemic was a decisive driver for the strong digital development process. Approval has risen in many areas, which is why digital innovations are being pushed ever harder. Digitization in medicine opens new opportunities that need to be exploited. In addition, this leads to an improvement in the quality of care and a reduction in the workload of the medical staff. Therefore, it is important to take advantage of the digital progress in medicine in order to work more efficiently, but at the same time ensure the safety of patients. (May 2021.)

Digitization in healthcare is multifaceted. These include robotics, mobile applications, telemedical therapy services, AI applications, etc. In an international comparison, Finland is one of the pioneering countries in the field of digitization in healthcare (Kriedle 2023). As an example, since 2003, care processes can be documented quickly, securely, and reliably with the help of the electronic patient record (Finnland: eHealth und Gesundheitszentren 2022). Furthermore, the development of the Finnish e-health system was started as early as 2006 and is nowadays an integral part of the Finnish healthcare system (Brüggmann 2021). Likewise, nursing care is also already benefiting from the high level of digitization. Despite the high level of digitization prevailing in Finland, the use of robotics, especially in outpatient care, is not yet as advanced as in other (e. g. Asian) countries (Bronner 2011).

Based on the described situation, the aim of this article is to investigate the use of social care robots that help elderly or disabled people to cope with various challenges of daily life through digitalization. The purpose of the article is to describe a social care robot, as a potential solution to the problem of loneliness of elderly and disabled individuals receiving outpatient care in their homes. Based on existing innovations, the idea for "YBO" was developed. "YBO" is Finnish and means "Ystävä-Robot" and translated: "Friend-Robot". The following chapters will address the benefits from YBO for the affected people, but also the nursing and health care sector. Furthermore, challenges such as ethical issues or the field of data protection and data security are critically considered.

1.2 Background

Due to demographic change, the proportion of the elderly population is growing increasingly which is why the described problem of loneliness among the mentioned population group gains even more importance. In Finnish society, the growing proportion of the older generation (65 years and older) with a population share of 23.3 % is becoming extremely significant (Urmersbach 2023). This is accompanied by a growing need for care services and the resulting strain on caregivers (RKI 2015). This change places a high burden on the Finnish healthcare system, as fewer nurses must care for more and more elderly and/or disabled patients. Accompanied by unpredictable scenarios like the Covid-19 pandemic this may result in the risk of supply bottlenecks that jeopardize adequate care.

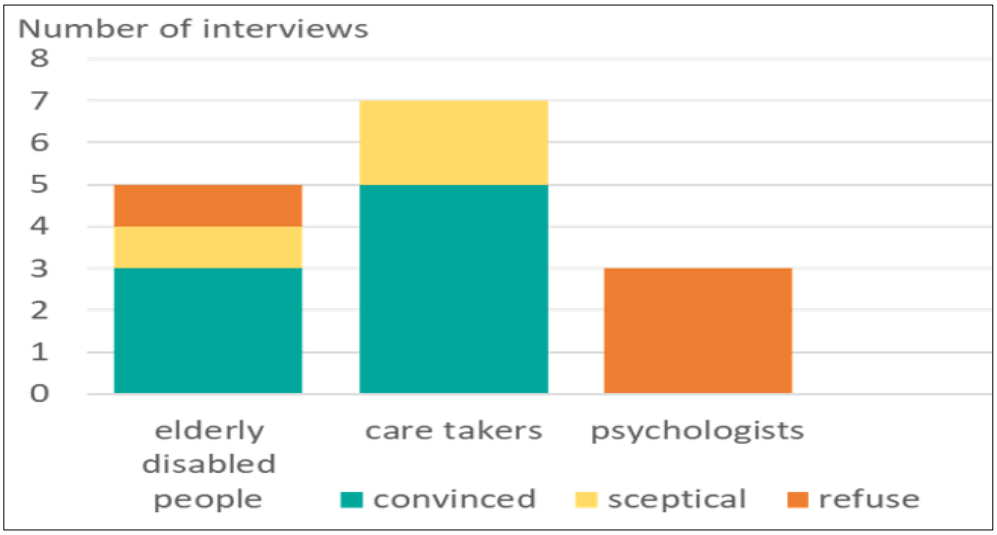
Even though the pandemic is largely considered as over, it has really shown that there may be unexpected obstacles for everyone involved, e. g. because of the forced limitation of social contacts. Also, most of the society understood the importance of maintaining social contacts to prevent loneliness and psychological problems. (Hennala et al. 2017.) Loneliness in the elderly is a complex and multifaceted phenomenon that can have significant impacts on their well-being and quality of life. Loneliness is commonly defined as a subjective feeling of social isolation or lack of companionship, often accompanied by a sense of emotional distress or dissatisfaction with one's social relationships. It is important to note that loneliness is distinct from social isolation, which refers to the objective state of having limited social contact or a small social network. (Courtin & Knapp 2017, 806-808; Perissinotto, Stijacic Cenzer & Covinsky 2012, 6-8; Shankar, McMunn, Demakakos, Hamer & Steptoe 2017, 184-186; Valtora & Hanratty 2012, 518.) There are several theories which describe the aspect of loneliness specifically among elderly people. As an example,

the so-called “activity theory” states that aging people want to be active and strive for social participation. The hypothesis is: Whoever is active, is also going to be satisfied. Activities that must be given up such as employment because of the retirement age must in some way find replacement to maintain the feeling of being needed and having an active function in the society. The theory therefore assumes that a specific aging person should continue to be socially active and participate in social life. Therefore, only those who remain socially active during life will age “successfully”. (Neu & Müller 2020, 36.) This theory is also applicable to the group of disabled patients.

1.3 Method

For the development of the innovation idea YBO different tools and methods were used. Literature research was conducted to obtain an overview of the prevailing market situation. This research aimed to identify existing technologies, solutions, and initiatives in the field of robotic supported caregiving. Those existing innovations (e. g. The seal robot “Paro” or the humanoid robot “Pepper") were carefully examined and analyzed to identify potential areas for enhancement and refinement in the development process of YBO. Therefore, YBO is classified as an incremental innovation. Incremental innovations, in the context of product development, refer to iterative improvements made to existing products or processes. This means that small, gradual changes and enhancements to functionality, efficiency, or performance are undertaken without fundamentally altering the underlying concept or design. (Broadbent, Stafford, & MacDonald 2009, 320-322; Knäbel & Wente 2015, 75-76.)

Accompanying the literature research various expert interviews were carried out to obtain different opinions in the field of caregiving, robotics but also psychology. Experts were purposely selected to represent their perspectives on the requirements and needs of the target population as well as the technical aspects of the robot’s development. These experts include Finnish caregivers, IT-specialists, psychologists, and members of the affected target group. The results can be seen on the given diagram (Picture 1). It shows that there is an increased convincement. About 71 % of caregivers and 60 % of the target group would use such technology, if it did not create more expense.



Picture 1. Expert Interview results regarding the acceptance of YBO

The results of these expert interviews were summarized in the so-called Miro Board and were considered in further steps of the product development. By creating diagrams, maps, and brainstorming notes (e. g. how-might-we-questions), a deep understanding was gained on how to develop YBO in an efficient way that fulfills all needs of the users. Additionally, user journeys were utilized to analyze aspects such as the value chain of YBO. Key steps starting from the financing & reimbursement to final steps like the installation and usage of the robot were illustrated extensively.

At the end, through the adoption of these different methods a first prototype of YBO was developed and gradually adjusted over time. The final product with its functionalities and a picture of it is presented in the next chapter.

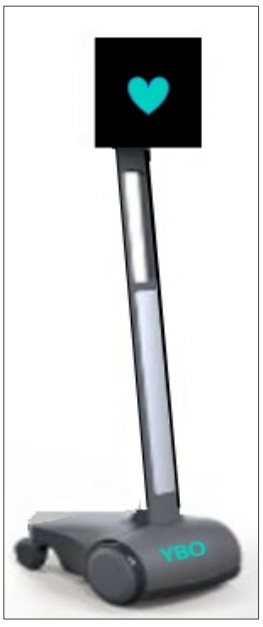
1.4 Social care robot YBO

Firstly, it's important to define the term "social robot" in general. Social robots are machines that interact with humans by following the rules of social communication. In addition, they are designed for social interaction with people in social environments, e. g. at home, at hospitality environments or in schools for educational tools (Beer et al. 2014, 2-4; Broekens, Heerink & Rosendal 2009, 94-100; Park & Whang 2022, 5-6; Heerink, Kröse, Evers & Wielinga 2010, 362-365.) There is also a capability of learning behavior patterns through the application of Artificial Intelligence (AI) (Rößler 2019). The additional integration of AI into a social care robot is connected to

a variety of data protection conditions due to working with sensitive data in healthcare. To get around these, YBO is not designed to apply AI.

Old and/or disabled people are restricted in their mobility by various factors. This circumstance has a negative impact on mental and physical health. The physical effects are mostly cardiovascular diseases or an increased risk of stroke. Psychological consequences are mostly social isolation and loneliness. In addition, mental well-being suffers, the risk of dementia increases and according to a 2013 study by Steptoe and colleagues, socially isolated people die earlier than integrated peers. Mobility as a prerequisite for participating in social life is no longer possible for the target groups. Therefore, the quality of life decreases enormously. (Heebing 2022.)

Outpatient care also plays a major role in the Finnish healthcare system. Following on from this, it can also be stated that outpatient care brings many positive factors, such as patients being able to stay in their home for longer. However, this is accompanied by long distances between the individual places of residence. As a result, on the one hand, this may increase the potential loneliness of the elderly and/or disabled patients due to irregular availability of a reference person. On the other hand, the nurses are also fundamentally affected in their daily work: Nurses must travel long distances from patient to patient, spend relatively less time with each patient, and experience stress, dissatisfaction, and strain.



Picture 2: YBO prototype

Starting from the described problem, the aim and purpose of YBO is to create a functioning social care robot with which elderly and/or disabled people can easily interact. Independent mobility and the ability of interaction enable the target group to connect better and more easily with their social environment both physically and socially. Since nursing staff must travel long distances to get from one outpatient to the next, the use of YBO is also intended to relieve this group of people in their daily work. YBO is meant to be a supportive solution that reflects its innovation rationale in both its structure and modes of operation. All functionalities are explained detailly in the following.

The main part of YBO consists of a screen connected by a height-adjustable bar to a wheeled trolley as shown in picture 2. This makes YBO suitable for patients of all heights, as well as applicable in various situations and positions. Standing, sitting and for e. g. bedridden patients. There are two different battery-powered chassis to accompany and support the user both indoor and outdoor. The chassis shown on the right is intended for indoor use.

It is sensor-controlled and can thus move independently. In order to enable the patient to move independently outside as well, the body part of YBO can be exchanged for a frame reminiscent of a rollator. The rollator body has a compact chassis that is ideal for outdoor use. Two attached handles provide support for the user and an integrated seat allows for sitting. Thus, it is possible for older people to move a little more freely outside, as YBO provides them with both a walking aid and a seat. In addition, a navigation aid is ensured by means of the attached screen. This enables patients to move around outside independently to a certain extent without the help of a nurse.

According to the activity theory, interactivity and occupation are particularly important for a healthy aging process (Neu & Müller 2020, 36). However, YBO is not only intended to make patients more mobile, but also to connect them with their social environment. To promote this looming deficit of the user, for example phone calls or appointments with friends can be made with the help of the attached screen application. To ensure all-encompassing medical care, it is also possible to conduct telemedical sessions with the attending physician. In this context, YBO provides an auditory and visual interface to human nurses and physicians, respectively. All these appointments can be saved in the integrated calendar together with other relevant information such as the medication. In this way YBO supports the reminder of important information and thus also relieves the responsible nursing staff. This aspect is enormously important as age-related forgetfulness, a process in which memory performance declines due to the death of nerve cells, is a widespread problem among the target group. To counteract all this preventively, mental challenges and an active social life are beneficial. (Klöckner L. 2021.) To help the mentioned group of patients with this problem, YBO also acts as the physical occupation for the patients. Various games are stored, such as different brain training games.

Moreover, YBO has a basic voice feature that can be run in different languages. All manually executable functions can also be called or performed by voice command through YBO. This enables patients in different situations to use the robot. Patients who do not have the necessary fine motor skills or are impaired in their vision, for example, can therefore still interact with YBO. However, conversation with YBO is only possible to a limited extent, as it can only respond with

previously stored voice commands and answers. YBO cannot give independent answers or respond to patients individually because, as mentioned before, the use of AI was waived for data privacy reasons. The voice function is also useful in emergency situations, for example, if the patient falls and can no longer get up on their own or has injured themselves. In such a case, YBO can be activated by a voice command and alert the emergency physician shortly or can give tips on how to behave properly in such a situation.

Support concept

To be able to use YBO effectively, regardless of where YBO is used or who it is used by an easy-to-understand training concept is also integrated. The YBO training is designed to be understandable for all possible contact persons. It is tailored to the different needs of e.g., patients' relatives, caregivers, or the patients concerned. Elderly and/or disabled patients can thus easily use and understand YBO, further relieving the burden on the responsible nursing staff. YBO does not have to be explained by the manufacturer to the nursing staff or by the nursing staff to the patients. YBO takes over this activity itself and thus enables the various contact persons to benefit from it independently. The training consists of different modules and imparts both theoretical and practical contents, such as instructions for use, guidelines for interaction with YBO, or everything to do with the maintenance/cleaning of YBO. Should any unanswered questions arise despite the program, a 24/7 support-program for questions and problems is also integrated. Both the training concept and the support-program can be started using the voice function. Thus, all groups of people are enabled to use the supporting tools, regardless of their physical or mental condition.

1.5 Framework conditions

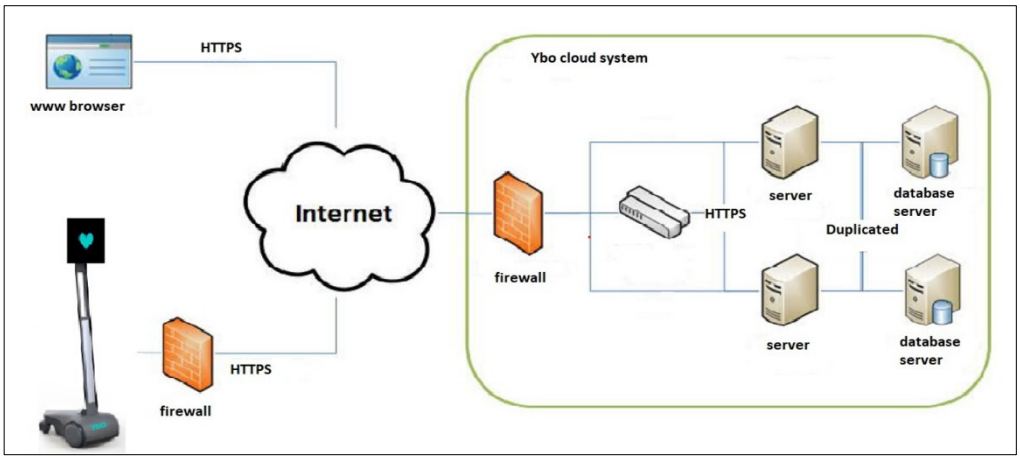
In an increasingly digitized world, data protection, data security and ethical aspects are of great importance. Personal data must be adequately protected to prevent misuse and privacy violations. At the same time, the security of IT systems must prevent cyber-attacks and data loss. In addition, ethical aspects should be considered when processing data to ensure that the rights and dignity of data subjects are respected. (Vandemeulebroucke, Dierckx de Casterlé, Welbergen, Massart & Gastmans 2020, 1997; Sharkey & Sharkey 2012, 28-30.)

Ensuring both data security and ethical considerations is vital for organizations and individuals alike. A breach of data security can result in serious consequences. Ethical violations, on the other

hand, can result in loss of trust and credibility and potentially severe legal penalties. (Basil, Ambe, Ekhator & Fonkem 2022, 2-5; Mehrtak et al 2021, 449-52; Solimini, Busardò, Gibelli, Sirignano & Ricci 2021, 7-9; Thissen & Mason 2019, 58-60.) In the following sections, these frame conditions topics will be discussed.

Data Security

Smart innovations like robots are becoming increasingly integrated into work and daily life. With this integration comes the need for strong data security measures to protect confidential data and prevent hacking or cyber-attacks. (Basil et al. 2022, 2-5; Jain & Doriya 2022, 2429-35.) YBO works using sensors, cameras, microphone, and speakers. As a result, a lot of personal data is recorded, and the topic of data security needs to be clarified. (Kreis 2018, 217.) Data security is important because it prevents sensitive information from falling into the wrong hands, ensures the privacy of individuals, and helps to maintain the integrity and trustworthiness of organizations. (Basil et al. 2022, 2-5; McGraw, 2015 28-30; Mustafa & Garcia-Alfaro 2018, 65-70; Mehrtak et al. 2021, 449-52; Thissen & Mason 2019, 58-60.)



Picture 3: YBO cloud system

The basic structure of YBO's data security system is shown in picture 3. By placing several firewalls, one directly in the robot and another one between the internet and the cloud system of the robot, an additional layer of security is provided. The firewalls can also monitor incoming traffic from the internet and filter out any malicious traffic, preventing it from reaching the sensible data. All data collected and transmitted by the social robot should be encrypted to prevent unauthorized access and be stored in a secure manner to prevent unauthorized access. Using component such as HTTPS (enhance the system's data security) helps YBO's work seamlessly and

securely. (McGraw 2015, 28-30; Mustafa & Garcia-Alfaro 2018, 65-70.) Another crucial element of data security is user authentication. Social robots should only allow authorized users to access the data they collect. This can be achieved through user authentication measures such as passwords, biometric authentication, or other forms of identity verification. (Basil et al. 2022, 2-5; Mehrtak et al. 2021, 449-52; Thissen & Mason 2019, 58-60.)

By establishing strict policies for handling data, and having a recovery plan in place, organizations can effectively protect against the risks associated with data breaches. As technology continues to advance, staying vigilant and proactive in addressing data security threats will be key to safeguarding sensitive information. All these details are summarized in a privacy policy which must be signed by the user or authorized relatives. Additionally, the individual user has the autonomy to decide which data is stored and how it can be used. (Basil et al. 2022, 2-5; McGraw 2015, 28-30; Mehrtak et al. 2021, 449-52; Thissen & Mason 2019, 58-60; Mustafa & Garcia-Alfaro 2018, 65-70; Solimini et al. 2021, 7-9.)

Ethical aspects

One ethical aspect of using robots is ensuring that they are programmed to comply with privacy laws and regulations, such as the General Data Protection Regulation (GDPR). This means that robots must ensure that personal data is collected, processed, and stored in a lawful and transparent manner. (Mondschein & Monda 2018, 57-58.) To perform the described functions and to support the patient in his home environment, YBO works by means of sensors, cameras, loudspeakers. As a result, however, it also generates a lot of data that was not accessible in traditional face to face care. The sensitivity of the data increases dramatically, making it important to clarify how this data is filtered or who has access to the data. (Kreis 2018, 207.)

There are several ethical aspects to consider when it comes to the use of social robots, particularly in the context of elderly care. Autonomy: Social robots may be used to assist elderly people with daily tasks, but it is important to ensure that the user maintains their autonomy and control over their own lives. The robot should not take over decision-making or limit the user's ability to make choices. Safety: Social robots should be designed and programmed in a way that ensures the safety of their users. This includes avoiding physical harm, preventing the spread of infection, and protecting against cyber threats. Equality: The use of social robots should not exacerbate existing inequalities among different groups of elderly and disabled people. For example, if social robots

are only available to those who can afford them, this could create a new form of social stratification. (Andtfolk, Nyholm, Eide, Fagerström 2022, 521-522; Vandemeulebroucke et al., 2020, 1997; Sharkey & Sharkey 2012, 28-30.)

In addition, various questions arise in the application of social care robots that need to be resolved. A clear responsibility can no longer be determined. Clear responsibility can be established in conventional care when, for example, the attending nurse makes a medication error. If a robot only reminds the patient, i. e. no nurse is directly involved, and as a result the wrong medication is administered, it is questionable who is responsible for the error. Following on from this, competition may arise between the nursing robots and the nursing staff. (Kreis 2018, 207.)

1.6 Conclusion

Social care robots have the potential to improve the quality of life for elderly and disabled people in many ways. These robots can provide companionship, assist with daily tasks, and even help to monitor and manage health conditions. However, there are also concerns about the use of social robots, particularly in terms of privacy, autonomy, and ethics.

In general, elderly people prefer to live as long as possible in their own homes. As a result, they face loneliness due to limited mobility, long distances, and missing reference people. One possible solution for this circumstance is the use of social care robots. Research has shown that social robots can help reduce feelings like loneliness and improve the mental well-being among older adults. Social care robots can assist with daily tasks such as cooking, cleaning, and mobility. For example, a robot might remind an elderly person to prepare or warm up a meal or remind them to take their medication as described in chapter 3. This can help older adults maintain their independence and activities in their own homes for longer. In addition, these robots can help to monitor and manage health conditions. For example, a robot might remind an elderly person to check their blood pressure or blood sugar levels, or even help them perform simple physical exercises. This may prevent or manage chronic conditions, improve overall health outcomes and also reduce costs. (Andtfolk et al. 2022, 521-525; Beer et al. 2014, 2-4; Broekens et al. 2009, 94-100; Broadbent et al. 2009, 325-327; Dautenhahn 2007, 679-684, 698, 700-701; Mordoch, Osterreicher, Guse, & Roger 2013, 15, 18-19.) Applied on YBO a wide range of these functions are already ensured. Nevertheless, it must be stated that YBO is not all-knowing or an all-rounder. YBO is based on a modular approach which means that the intention is to expand its capabilities based on

specific needs in the future. For instance, during its initial release, the robot can perform previously enumerated tasks like reminding the user to measure their blood pressure. Viewed in perspective, the modular approach should enable the robot to receive and medically evaluate data collected by a blood pressure monitor through technical interfaces. Of course, this scenario leads to new or additional regulations which is why YBO will continuously develop.

However, there are also concerns about the use of social robots with elderly populations. For example, a robot may collect data about an elderly person's daily activities or health status, which could be used for commercial purposes or shared with third parties without their consent. Another concern is that the use of social robots may reduce elderly people's autonomy and agency. For example, if a robot is programmed to provide reminders for medication or appointments, an elderly person may become overly reliant on the robot and lose the ability to manage these tasks independently. (Andtfolk et al. 2022, 521-525; Beer et al. 2014, 2-4; Broekens et al. 2009 94-100; Broadbent et al. 2009, 325-327; Dautenhahn 2007, 679-684, 698, 700-701; Heerink et al. 2010, 372-373; Mordoch et al. 2013, 15, 18-19.) It is always important to mention that despite aspects like privacy regulations which are signed by the affected people or relatives, still there might be a lack of awareness regarding the decisions made which causes a conflict between data security and ethics.

Finally, there are ethical concerns related to the use of social robots with elderly population. For example, if a robot is programmed to provide emotional support or companionship, there is a risk that the elderly person may become overly attached to the robot, potentially leading to feelings of loss or distress if the robot is removed or replaced. Overall, while social robots have the potential to improve the lives of elderly people in many ways, it is important to carefully consider the potential risks and benefits before introducing these robots into elderly care settings. Researchers and practitioners should work together to develop guidelines and best practices for the ethical and responsible use of social robots with elderly populations. (Andtfolk et al. 2022, 521-525; Beer et al. 2014, 2-4; Broekens et al. 2009 94-100; Broadbent et al. 2009 325-327; Dautenhahn 2007, 679-684, 698, 700-701.) Despite the establishment of the described framework, the question of responsibility is still unresolved.

To talk more the aim and purpose of this article, it can be stated that the social care robot may be a helpful addition for managing the everyday challenges of elderly and/or disabled people, but also be a major relief for the nursing staff. The problem of loneliness among these patients can be counteracted with the help of social robots, like YBO. However, it is important to emphasize that the robot is not a substitute for the social tasks of the caregiver, nor for other social contacts.

This is one of the most important conclusions of this project. Despite consistent quality and potential cost reductions, the emotional aspect plays a significant role in the introduction of new technology. Digitization and technologies should always be seen as a support for humans rather than a mandatory replacement. Therefore, the interpersonal aspect is of enormous importance to those affected. The introduction of YBO should in no way contribute to further isolation and ultimately increased loneliness (Broadbent et al. 2009, 320-322, 325-327; Heerink et al. 2010, 372-373; Kreis 2018, 206.)

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2 Don’t panic – Relieve your mind A smart solution to prevent panic attacks

Anttonen Minna, Master of Social and Health Care Student, KUAS, Finland
Jäger Sarah Digital Healthcare Management, HNU, Germany
Kraiß Sophia, Digital Healthcare Management, HNU, Germany
Leinonen Rauni, Principal Lecturer, KUAS, Finland
Moisanen Kirsi, Principal Lecturer, KUAS, Finland
Würfel Alexander, Professor, Dr., HNU, Germany

Abstract

Many people suffer from panic attacks and are limited in their everyday life as a result. The Covid 19 pandemic has increased mental stress in the global population. Panic disorder belongs to the anxiety disorders and can manifest itself without a specific trigger based on various symptoms. For sufferers, there are several ways to treat panic attacks. So far, there are many traditional treatment methods, such as the classic psychotherapy. "Don’t panic", on the other hand, represents a digital way of treatment. The aim of the article is to develop individualized support to people with panic attacks using a digital solution. In this context, the innovation "Don't panic" is an application to prevent panic attacks and to support people in coping with stressful situations.

The purpose of this article is to describe how patient empowerment can be promoted by developing a digital health application to manage and prevent panic attacks. For this purpose, a literature review and interviews with subject matter experts were conducted, and existing apps in the field of panic attacks were also considered. The app is based on existing digital health applications that are optimized and described in the innovation. This app includes features such as a fun way to learn about panic attacks, a diary, a chat function and a playlist.

Keywords: prevention, panic attacks, gamification, digital solution, patient empowerment

2.1 Introduction

Nearly one-third of adults have experienced panic attacks in their lifetime or have gone through one themselves (Kessler, Chiu, Jin, Ruscio, Shear & Walters 2006, 419). The disease usually begins most often at the age of 18-64 years. Women are affected about twice as often as men (Locke, Kirst & Shultz 2015, 617). The Covid-19-Pandemic in particular has increased mental stress in the population (Bundes Psychotherapeuten Kammer 2021).

Panic disorder is an anxiety disorder in which sufferers experience sudden panic attacks. The panic attacks occur out of the blue without any trigger. A panic attack is manifested by various symptoms, which can occur with varying intensity, so that in some cases the sufferers believe they are going to die from it, even though they are healthy and not outwardly threatened. (Morschitzky 2009, 3.) A panic attack occurs unexpectedly and in sudden waves of anxiety and discomfort. In the process, the affected person has the feeling of losing control. This can happen without a clear trigger. Many people with panic attacks are afraid of having to go through such a situation again. Because of this, they try to avoid panic-triggering situations and adapt their everyday life accordingly. These restrictions can reduce their quality of life. (National Institute of Mental Health 2022, 2.) Due to the increase in mental health problems such as anxiety and depression, there is a need for effective and easily accessible ways to get help (Gomes, Pato, Lourenço & Datia 2023, 2).

On the one hand, people with panic attacks can find help in Germany in free telephone conversations with professionals such as counselors (Stadt Kempen n.d). There are also digital applications on the German and Finnish market, which are mentioned in chapter three. In addition, there is the possibility of classic therapy with a psychotherapist. In Finland, a patient can get conversational help from a psychiatry outpatient clinic or a specialized hospital, free of charge. Online therapy is also available in Finland, for these treatments you need a doctor's referral (Nettiterapiat 2022).

The innovation “Don’t panic” is an application to prevent panic attacks and to help people to deal with stressful situations. The app "Don't panic - Relieve your mind" is to provide individual support for people with panic attacks using a digital solution. The purpose of this article is to describe how patient empowerment can be promoted by developing a digital health application to manage and prevent panic attacks. Patient empowerment means encouraging citizens to take an active role in managing their health (Guy & Kent 2009, 375). This is done by patients coming to terms with their illness and being empowered through personalized learning and exercise sessions. This gives

the affected person the opportunity to deal with the disease independently before, during and after the classical therapy.

The idea for this innovation was born out of practical experience to give patients an earlier start in therapy or for sufferers who do not wish to undergo classical therapy. In this way, waiting times in the healthcare system can be successfully bridged. Psychotherapists can also benefit from the innovation, as they can incorporate the information collected from the app into therapy and connect to it. The goal is to empower people suffering from panic attacks by using digital solutions.

2.2 Theoretical facts about panic attacks

Panic attacks can be divided into three different types. The unexpected (non-triggered) panic attack occurs spontaneously without a situational trigger, like out of the blue. The situational (triggered) panic attack on the other hand, almost always occurs when confronted with a stimulus or trigger. For example, this may be triggered by a ride on a particular mode of transportation or by a social situation. The third type, situation-favored panic attack, is favored by objects or situations but is not triggered immediately after the confrontation. For example, the panic attack is not triggered directly while driving a car, but only after a certain period. Not every car ride must necessarily lead to a panic attack. (Morschitzky 2009, 45.) All three types of panic attacks involve sudden onset of severe anxiety or discomfort, which can peak within minutes. The following symptoms often occur, which are listed in Table 1 (Locke et al. 2015, 620).

TABLE 1. Possible symptoms of a panic attack (Locke et al. 2015, 620; National Institute of Mental Health 2022, 3)

Physical Symptoms during a panic attack
- Palpitations, pounding or racing heart, or accelerated heart rate - Sweating - Trembling or shaking - Sensations of shortness of breath or smothering - Feelings of choking - Chest pain or discomfort - Stomach pain - Nausea or abdominal distress - Feeling dizzy, unsteady, light-headed, or faint - Chills or heat sensations - Paresthesia's (numbness or tingling sensations) - Derealization (feelings of unreality) or depersonalization (being detached from oneself) - Fear of losing control or "going crazy" - Fear of dying

To treat panic attacks, the current state of science offers a variety of options. In practice, national institute of mental health drug treatment, psychotherapeutic treatment, or a combination of both is often used (National Institute of Mental Health 2022, 4; Pull & Damsa 2008, 779).

TABLE 2. Treatments of panic attacks

Form of treatment	**Description of treatment**
Medication mainly antidepressants and benzodiazepines	Treatment method effectively stops the physiological symptoms (Pull & Damsa 2008, 779-780).
Psychotherapy	Cognitive behavioral therapy (CBT) is most often used to treat panic disorder. The affected person learns to think differently, to behave differently and to react differently to the feelings during or before a panic attack. (National Institute of Mental Health 2022, 4).
Self-education	Engage with the disease on their own could help to reduce panic attacks (Shearer 2007, 497).
Meditation and progressive muscle relaxation	Focus: Prevention of physiological symptoms (Wells 1990, 273).
Complementary and alternative medicine therapies	For example: music therapy, aromatherapy, acupuncture, and massage (Locke et al. 2015, 622).
Biofeedback with breathing training	That is one of the most studied biofeedback techniques for treating panic attacks (McGinnis, O'Leary, Gurchiek, Copeland & McGinnis 2022, 2).
Net therapy to people who suffers panic attacks	Cognitive-behavioral therapy via internet, facing the difficult situations, awareness on panic attacks, practicing to relaxation and breathing (Paniikkihäiriön nettiterapia n.d).

Through the Covid 19 pandemic, there has been a strong focus on digital health offerings, such as smartphone mobile apps, chatbots, and emerging technologies. There has been a push to use telemedicine. In addition to traditional treatment options, digital health technologies are also getting more attention. These complement traditional care by providing accessible and scalable interventions. (Torous, Bucci, Bell, Kessing, Faurholt-Jepsen, Whelan, Carvalho, Keshavan, Linardon & Firth 2021, 318.) In addition, they promote patient empowerment to a greater degree than the treatment options previously described.

Digital health services enable patients to influence the course of their treatment in a self-determined way and to be individually supported in their empowerment. The patient gets a say about health care, which additionally increases patient satisfaction. Patient empowerment facilitates the exchange of information, but also improves doctor-patient communication. This enables shared decision-making. (Guy & Kent 2009, 375-377.)

2.3 Material and Methods

The innovation project "Don't panic - Relieve your mind" started in November 2022. The aim is to give people with panic attacks a tool to deal with their fears and face their panic. In this way, patient empowerment is to be achieved. The app is intended to be available to sufferers as a preventative or complementary treatment. It was based on an extensive literature review and an analysis of existing applications for the field of panic attacks in Finland and Germany, as well as on qualitative interviews with experts and patients at hospital in Helsinki. This allowed new aspects and perspectives to be included for the further course of the project (Opdenakker 2006, 4). Since many digital applications already exist in the field of panic attacks, the original idea of developing a new application was discarded. Therefore, existing applications were analyzed and enhanced with complementary features that would optimize the digital health application. The project resulted in the design of a first prototype, which can be further developed at a later stage.

Databases that we searched were SpringerLink, Thieme and National Library of Medicine. Article were searched with keywords which were prevention, panic attacks, gamification, digital solution, patient empowerment. Inclusion criteria was not older than 10 years for full text and free web-based articles. There is a large body of literature about panic attacks. (Niela-Vilén & Hamari 2016, 25-26; Lehtiö & Johansson 2016, 39-42) Various databases were searched for relevant literature using the following terms: panic attacks, treatment, symptoms, prevention, gamification, digital

solution, and patient empowerment. The authors were able to find numerous suitable literatures in the library catalog of Neu-Ulm University. Several e-books were also found via databases such as SpringerLink, Thieme and the National Library of Medicine.

In this innovation project, some experts like doctors, nurses and patients were interviewed in a hospital in Finland (4 experts and 9 potential users). The interviews took place in a personal face-to-face setting (Opdenakker 2006, 3). The interviews were not recorded and were a very informal discussion about what function should be included and which values should be tracked. At first the innovation was presented based on a first prototype, then the interviewees gave their opinion in an open interview setting (Sofaer 1999, 1103). The prototype was previously designed based on literature research and consideration of existing technologies. The interviews were conducted to optimize the prototype through feedback from the expert.

During the project process, various technologies were tested by the authors of this article. With the help of test accesses for the corresponding apps, the various functions could be tested. These were recorded in writing and compared with each other in terms of their functionality. During an evaluation, features were filtered out that should be added in the innovation. Further information was also collected from the individual websites of the technologies. On the Finnish market side, the apps Chillaa and Chatpal were analyzed, whereas in the German healthcare sector the digital application Mindable was considered. In the field of mental health applications, we also found the Mood Prism application, which also contains educational elements, it also utilizes information from other applications (Rickard, Arjmand, Bakker & Seabrook 2016).

This innovation is based on the integration of wearables and gamification. Both topics are described in more detail below. Technologies are increasingly being used in healthcare to improve quality and enhance patient care. 95% of caregivers rate technology as improving the quality of care, according to (Orhan & Serin 2019, 418-421). Also, in a study by Koltsida and Jonansson (2021), nurses perceived an improvement in the quality of healthcare. Information technology was as helping in patient-centered work, improving the efficiency and personalisation of patient care, and thus developing the quality of care. May, Jonas, Fehler, Zahn, Heinze and Muehlensiepen (2021, 4-6) found that electronic visits increase continuity of care which may also indirectly affect the quality of care. Not least, the Covid 19 pandemic has contributed to the acceleration of technical support in medicine. In this context, so-called wearables are coming into focus. These are sensors that are worn on the body (Gomes et al. 2023, 1), for example as watches or bracelets (Gomes et al. 2023, 8). Panic attack monitoring has been common for many years, what is new

here is the use of wearables (Gomes et al. 2023, 8). This makes health monitoring possible outside of the hospital and can be used alongside therapy (Dunn, Runge & Snyder 2018, 429).

Especially in the field of mental health, the use of wearables is increasing. Using wearables, physiological parameters such as heart rate can be measured. This allows conclusions to be drawn about mental health and changes can indicate stress or anxiety (Gomes et al. 2023, 1-2; Dunn, Runge & Snyder 2018, 433). Heart rate variability has been shown to be a reliable measure for predicting panic attacks (Gomes et al. 2023, 12). Furthermore, behavioral parameters such as sleep quality and physical activity can be monitored. Real-time feedback is possible through wearables, so that users are alerted when their heart rate increases and personalized preventive measures are suggested (Gomes et al. 2023, 1-2). "Don't panic," for example, would advise users to use their breathing exercises to avert the panic attack. This supports the purpose of our application to promote patient empowerment. By using wearables, a variety of data is generated that complements traditional psychosocial interventions, such as therapy (Gomes et al. 2023, 2).

Gamification describes the use of game design elements in a game-free context, such as our "Don't panic" application. Gamification is used to convey information about health in a playful way. As a result, it serves as a mental health and well-being intervention (Cheng, Davenport, Johnson, Vella & Hickie 2019, 2). Gamification uses elements of intrinsic motivation, such as feedback, rewarding with points, badges, certificates, and more. The gamified approach can increase motivation and engagement and ultimately improve users' health behaviors (Al-Rayes et al. 2022, 2-5). "Don't panic" uses this approach to teach knowledge and coping strategies related to panic attacks through play. In addition, gamification also promotes the fun factor so that the user is motivated to use the application again (Cheng et al. 2019, 10).

2.4 Results

Results of the interviews and tested technologies

This section first discusses the key findings from the interviews and provides an overview of existing applications in the field of panic attacks. In the Interviews the experts were interested in the innovation and, on the one hand, suspicious, as the physical sensations of fear and panic are difficult to detect, according to several interviewees. On the other hand, they were open-minded and interested in how the app can be implemented and used in practice. Potential users found

this type of technology interesting but doubted that the exercises would be useful in practice and whether they could prevent panic attacks. On the other hand, the diary, and the fact that the professional can also see the information filled in by the patient in the app and how the patient uses it to feel better and prevent panic attacks were considered positive.

The following section presents the main results of testing existing technologies. Chillaa is an application developed together with young people for all Finnish young people. It helps to reduce stress and tension and develop self-confidence. Chillaa includes relaxation and mindfulness exercises (Chillaa n.d). ChatPal is a chatbot which is used in rural and sparsely populated areas to support and promote mental well-being (ChatPal n.d). Mindable is a digital health app for panic disorder in Germany, prescribed as a prescription and paid for by health insurance. With the help of the app, sufferers learn to understand their fears and go through life without panic. (Mindable Health GmbH n.d.) Mindable was considered as the basis for the present innovation. Through test access, the functions could be tested in detail and improvement possibilities could be worked out.

Functions of the application “Don’t panic”

The person affected has two options for accessing the application “Don’t panic”. Either he has already become aware of the app through various contact points, such as aid organizations or by searching for panic attacks on the Internet. They then have the option of registering for paid access or contacting their family doctor for free access. The latter issues a prescription for existing complaints relating to panic and anxiety, with which the patient can contact his or her health insurer to ultimately obtain free access to the "Don't panic" app. The respective health insurance company assumes the costs for the digital health application (Guth, Wiebe & Philipsen 2023, 251, 255-256).

The app "Don't panic" is strongly oriented towards existing applications in this field. Existing functions were implemented in the innovation in an optimized way and supplemented with new important features. In the context of knowledge generation, attention has been drawn to the integration of wearables and gamification. These have a positive influence in the handling and prevention of panic attacks (Gomes et al. 2023, 1-2), as already explained in chapter three. The following figure clearly shows the functions of the innovation. At the same time, it represents the prototype of the home page.

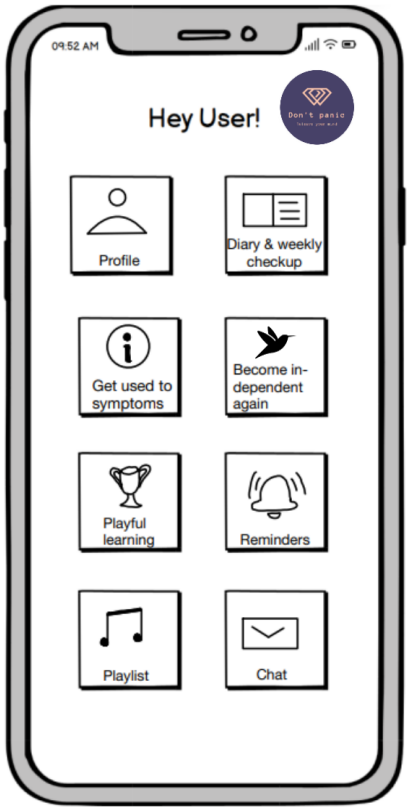

Figure 1. Prototype “Don´t Panic” Application

At the top right of the prototype is the logo of the innovation. The various functions can also be seen here, which are described briefly below. Profile contains personal data and information, as well as basic settings of the application and data protection information. Behind the "Diary & weekly checkup" button, the user has the option of indicating his or her emotional state with the help of smileys daily and reporting on his or her day with a free text function. Weekly the user is asked to give more detailed feedback (Guth et al. 2023, 253). In addition, the link to the wearables is stored there, which allows the user to see his step count so far. Likewise, readings such as heart rate, blood pressure and movement patterns can be measured in this way and displayed in the app.

In this way, situations that trigger panic can be identified by an increased heart rate. In this way, panic attacks can be tracked and evaluated in conjunction with the diary and integrated into therapy. Through numerous exercises and animations, "Get used to symptoms" helps the patient to deal with symptoms of a potential panic attack, to be able to react to them preventively and thus to get his body used to panic symptoms. "Become independent again" aims to confront the affected person with anxiety-provoking situations and places to overcome them. In the process, the patient is given tips and exercises tailored to his or her individual needs. A person who frequently

suffers panic attacks while riding the bus is guided step by step to approach this fearful situation and overcome the panic. Small feelings of success are used to help him approach the situation (Guth et al. 2023, 253).

The gamification aspect is behind the button "Playful Learning" to increase the motivation, the performance and commitment of users. Here, the person affected is taught knowledge about panic attacks in general, symptoms, preventive measures, and tips in a playful way. The knowledge is divided into different learning units, for which there are various videos and mediating texts. Afterwards, the patient is quizzed on what he has learned through various quizzes and is rewarded with a sense of achievement (Tolks, Lampert, Dadaczynski, Maslon, Paulus, & Sailer 2020, 699). "Reminders" refers to the user's prevention and well-being. Here, the user is reminded to exercise sufficiently or to perform exercise sessions. Behind the next button, "Playlist," the user has the option to create different playlists for different emotional states with their favorite songs. Likewise, the app offers ready-made playlists for calming down. For this purpose, “Don't panic” has planned a cooperation with Spotify and Apple Music, so that users with an account can also add their favorite songs to the “Don't panic” app. With the help of the chat function, the affected person can contact professionals such as cooperating doctors if they have questions or wish to exchange information. It is also possible to get immediate telephone help in acute panic situations. Various contact points such as public telephone counselors help the person seeking help (Stadt Kempen n.d).

Young people find mobile phone technology more interesting, anonymous and less stigmatizing than other ways of getting help, so they may prefer to use technology like this. Evidence-based emotional health monitoring includes mobile phone apps, along with built -in features, like music, videos etc. can provide an effective and flexible method for coping with emotional health (Rickard et al. 2016). It is important to protect the privacy and confidentiality of patient data. In one systematic literature review figured out that apps can collect a large amount of data, and some apps collect user data unrelated to the purpose of the app (Miralles, Granell, Díaz-Sanahuja, Van Woensel, Bretón-López, Mira, Castilla & Casteleyn 2020). All data of the user and the connected wearables are stored in the cloud of the “Don't panic” app. Authorized persons in the healthcare sector, such as doctors and therapists, can access this data and incorporate it into the treatment process. According to the 2017 EU Medical Device Regulation (A745/2017.) mobile applications intended for medical purposes require CE marking. For example, new safety standards for wireless radio equipment are being developed, and by autumn 2024, wireless devices will have to

meet harmonized safety requirements across the EU. Digital solutions also require regulatory reform (SFS 2022).

Gamification is used in this innovation to provide information about health and panic attacks to patients in a fun way (Tolks et al. 2020, 702). This gamified approach can increase patient motivation on the one hand and patient empowerment on the other, ultimately improving user health behaviors (Al-Rayes et al. 2022, 2-5).

2.5 Conclusion and reflection

Smartphones have become an everyday commodity in our society. Not only has the use of smartphones increased, but so has the number of digital health apps. There are now 100000 health apps worldwide (Edwards et al. 2016, 1). For this reason, "Don't panic" is a smartphone app so that the user can access it flexibly and quickly. In panic-inducing situations, the affected person can react quickly and control the situation with the help of his learned knowledge.

The goal of the "Don`t panic" app, to empower people suffering from panic attacks, is realized through the innovation presented in this paper. "Don`t panic" offers users a digital platform where they can track their panic attacks and learn how to prevent them. Advantages of prevention apps are seen in the time- and location-independent availability, the target group-specific access, the immediate supportive function, the anonymity, the individually tailored content, the lower costs as well as growing service offers, and the efficiency. For patients, digital offerings also offer the opportunity to deal with health-related development topics and issues. Emphasis is placed on the motivational possibilities of such offerings, which exhibit a certain degree of gamification (Tolks et al. 2020, 704-706).

The use of digital health applications has the potential to positively change healthcare and medicine. The digital solutions are developed from the perspective of the patients and focus on their needs. The use of digital health applications will fundamentally change the utilization of healthcare services in the future (Bundesministerium für Gesundheit 2023). For the detection, treatment, and prevention of diseases, such as panic attacks, this will open a wide range of possibilities and users will have a digital helper at their side. (Bundesinstitut für Arzneimittel und Medizinprodukte 2023).

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3 LAPPSI - Children’s health app

Borenius Janita, Master of Social and Health Care, KUAS, Finland
Leser Anna, Digital Healthcare Management, HNU, Germany
Reimer Rebecca, Digital Healthcare Management, HNU, Germany
Thumm Dominik, Digital Healthcare Management, HNU, Germany
Leinonen Rauni, Principal Lecturer, KUAS, Finland
Moisanen Kirsi, Principal Lecturer, KUAS, Finland
Würfel Alexander, Professor, Dr., HNU, Germany

Abstract

Maternity and child health services in Finland are used by almost all families which means that services cover more than a fifth of Finland's population. Maternity and children's clinics have not developed uniformly throughout the country, and there has been a discussion about whether the services in their current form promote the health of families in the right way. Children’s health has improved in recent decades, but there are many new threats that threaten their health. With digitalization, information is sought more and more often from online, but professionals are also trusted as reliable sources of information.

The following article describes one possibility parents and expecting parents can learn more about their child's development and can be supported in maintaining health. For this purpose, an app called LAPPSI was developed to provide knowledge in a playful way to the people involved in the parenting process.

The LAPPSI app is a cross-platform application that works on iOS and Android devices and is built as a client-server system. Health data is stored on a secure server and protected by data protection laws. Gamification, the use of game-based mechanisms, is included to motivate people and promote learning.

The aim of this article is to promote the health and well-being of children and families. The purpose beyond that is to describe how the welfare of children and families can be increased using the LAPPSI app in counseling services in Finland.

Keywords: children’s health, maternity and child health clinic, application, gamification

3.1 Introduction

The first maternity and child health clinics in Finland were established in the 1920s. From the beginning, their goal has been to strengthen parenting skills and reduce child mortality. (Riihonen, Hakulinen & Luomala 2021, 2567.) Services include all pregnant parents, families expecting a baby and children under school age and their parents (Ministry of Social Affairs and Health 2023). This means that maternity and child health services cover more than a fifth of Finland's population (Hakulinen-Viitanen, Hietanen-Peltola, Bloigu & Pelkonen 2014, 17). Since 1944 services have become statutory and five years later health clinics could be found all over the country (Riihonen et al. 2021, 2567).

Over recent decades there has been improvement in children's survival, education and nutrition (WHO 2020). Perinatal mortality and morbidity are still a major public health concern in Europe (European Perinatal Health Report 2022, 4). New threats children face today are for example climate change, unhealthy lifestyles and diets, injury and violence, conflict and inequality (WHO 2020). In practice, counseling work has changed from the original from reducing infections and malnutrition to more and more to prevent children's developmental and mental health problems (Riihonen et al. 2021, 2567). For example, overweight in children and adolescents is an ongoing significant international health problem (Styne, Arslanian, Connor, Farooqi, Murad, Silverstein & Yanovski 2017, 1) and it is connected in many ways to the physical and psychosocial health and well-being of children and young people (Lihavuus 2023).

Generating health care information online is increasing in an era of digitalization. Medical information can be found in many different ways such as medical forums, dictionaries and health portals. (Hahn & Sissel 2018, 119.) Studies show that a large proportion of parents seek information on children's healthcare online (Walsh, Hamilton, White & Hyde 2015, 2; Pehora, Gajaria, Stoute, Fracassa, Serebale-O'Sullivan & Matava 2015, 9). Reasons therefore are acquiring knowledge about identifying and handling explicit child health conditions. As well as getting advisory and assistance on parenting topics and children's evolvement. (Bernhardt & Felter 2004, 3.) Although parents get easy and quick information on the internet, most of them are still following the advice they get from their pediatrician (Moseley, Freed & Goold 2011, 53). Parents want health care providers to focus on enhancing access to secure, accurate, and reliable information (Pehora et al 2015, 9). This is due to the missing trustworthiness of the information found online (Bernhardt & Felter 2004, 4).

The well-being of the families with children is connected with the functionality of the service network, and various services support children's development and the role of parents as educators. Current service structures in Finland do not fully respond to the service needs of families with children, which is due to, among other things, the cutting of resources for basic services and the fact that the focus areas are increasingly on remedial work instead of preventive work. (Rautio 2016, 9.) Due to the fact that the maternity and child health clinics in Finland do not fully cover the needs of families and a lot of information about the topic of children's health is circulating on the net, the need for an app regarding children's health care arose. With discovering those needs the application LAPPSI was created. LAPPSI is a word composition of the words “lapsi” (Finnish word for child) and App (abbreviation for application). LAPPSI is an app which helps (expecting) parents to learn about children's health and development. The app is based on scientific medical information, which is displayed in a gamification feature.

The purpose of this article is to describe how the well-being of children and families can be increased using the LAPPSI application in counseling services in Finland. The aim is to promote the health and well-being of children and families.

3.2 Framework conditions

Children’s health

According to the parents, the health status of almost all four-year-old children was good in Finland. This was despite the fact that every eighth child had a long-term illness or health problem. In many children's lives there had been burdensome factors - for example, every third child had been bullied. (Vuorenmaa 2019, 1-2.) For the babies and their new parent’s good perinatal outcome sets the stage for a positive lifelong trajectory of physical and mental health (European Perinatal Health Report 2022, 4). Most of the families with babies was satisfied with their life, their parenting and their family's everyday life. Still, some of the parents had challenges coping with depressive symptoms before and after childbirth, mild and severe symptoms of exhaustion as well the experience of loneliness. (Klemetti, Vuorenmaa & Helakorpi 2021, 1.)

Health clinic visits during pregnancy and in the child's first years of life, helps to maintain health and to detect health problems early enough (Riihonen et al. 2021, 2567–2568). Over 50 % of parents needed support for parenting from professionals during the pregnancy. After the birth of

the baby, one third of the parents who gave birth and one in five of the other parents were left without adequate professional support regarding the baby's crying. Of the parents who needed support from a professional to help their baby sleep, parents who gave birth lacked adequate support more often than other parents. Most of the parents who needed support from a professional to feed their baby had received sufficient support. (Klemetti et al. 2021, 7, 10.)

Families with four-year-old boys and families where the parents lived apart were, according to the child health clinic nurses, more likely than others to need additional support. Almost nine out of ten parents of a four-year-old child needed support from professionals in at least one matter. Parents most commonly need support for the child's growth and development, the child's behavioral or emotional problems, the parent's own coping and parenting. (Vuorenmaa 2019, 1, 8.) Most children have two parents, and Finland appears to be a two-breadwinner society, as most mothers work like fathers. Over the past decades, both mothers and especially fathers have spent more time caring for young children. (Karvonen , Kestilä & Saikkonen 2022, 133.)

Maternity and child health clinics

The functions of the maternity and child health clinics are based on several laws and regulations, such as the Health Care Act (L 1326/2010) and the Government Decree on maternity and child health clinics, school and student health care services, and preventive oral health care services (A 338/2011). Maternity clinics are focused on following up the pregnancy and the growth and development of the fetus. They also follow up the health of the pregnant parent before and after the delivery. Child health clinics aim is to advance the physical, mental and social health of children under school age. They give vaccinations and support parents in rearing their child. (Ministry of Social Affair and Health 2023.) In addition to maintaining health, the goal is to detect health problems early enough. The effectiveness of the maternity and children's health clinic services was visible almost immediately as a reduction of maternal and infant mortality and infectious diseases. (Riihonen et al. 2021, 2567–2568.)

Giving birth in Germany differs from other countries in several ways. The fifth book of the German Social Code regulates that women are entitled to medical care and midwifery assistance during pregnancy, childbirth, and postpartum. In addition, there is a right to outpatient or inpatient delivery. (SGB 2022, §24d.) The insured person can give birth on an outpatient basis in a hospital, in a facility led by a midwife or obstetrician, in a midwifery practice, or in the context of a home birth (SGB 2022, §24f). In Germany, women can choose to give birth in a hospital or a

“Geburtshaus” (maternity and childcare center). Both options are staffed by trained midwives, who provide support and guidance to expectant mothers throughout the entire birthing process (GKV-Spitzenverband 2023). The primary goal of care for women, as well as the unborn child or newborn, by the participating professions must be to preserve the health of the mother and child and to minimize the risk of harm as much as possible (Arnold 2016, 7).

The strength of maternity and child health services in Finland is that almost all children and their parents use the services regardless of their socio-economic status or situation (Riihonen et al. 2021, 2568). The challenge is that maternity and child health clinics have not developed uniformly throughout the country and there are many regional differences in them. In terms of fairness and equality, it is necessary that every child and family in different parts of Finland has a possibility to receive these services and that the services are of the same quality. (Hakulinen-Viitanen et al. 2014, 17, 138.) This means for example that the information given in the health clinics and in the hospitals should be consistent, up-to-date and correct (Raussi-Lehto, Regushevskaya, Gissler, Klemetti & Hemminki 2011, 5). During the past years there has also been a discussion if the maternity and child health services are still working in the current form and does the support given by the health clinic target the population in the right way to generate health benefits (Riihonen et al. 2021, 2567).

Laws and regulations

The innovation will be published in Finland. That is why the focus is on the Finnish laws and regulations. Information security, patient safety and reliability play a central role in the spread of mobile applications in healthcare (Holopainen 2015). Mobile applications concerning health can bring considerable benefits to both individuals and society. Challenge is that health data is highly privacy sensitive, and the data protection needs to be optimal when designing health apps. (European Commission 2017, 1.) Citizens must have strong confidence that their data will be used correctly and that their privacy will be preserved (STM 2016, chapter 3.5). This means that users need to trust the LAPPSI app or otherwise they might not want to use it.

The EU General Data Protection Regulation (A 679/2016) must be followed in all processing of personal data. Personal data should be processed in such a way as to ensure the appropriate security and confidentiality of personal data, which, among other things, prevents unauthorized access to personal data or the equipment used to process it, as well as the unauthorized use of

such data or equipment. (A 679/2016). The service provider must collect log data per customer register for all use and disclosure of customer data for monitoring and supervision (L 784/2021).

The information system meets the essential requirements when it is designed, manufactured and operates in accordance with the laws on information security and data protection and the regulations issued pursuant thereto, as well as national specifications on interoperability (L 784/2021). In addition to own data security, providing a service also requires establishing a safe and reliable data transfer connection between the service provider and its user (Liikenne- ja viestintäministeriö 2016, 24). The user of the LAPPSI app logs into the application with the help of a strong identification service, which is used in Finland in all public administration positioning services where the user's identity must be verified. Using electronic services is secure once the user has been identified. (Suomi.fi 2022).

The service provider must provide the customer with information about his rights and the national information system services related to his customer data and their general operating principles. The information must be given to the customer at the latest in connection with his first transaction. (L 784/2021.) Consent should be given by an act clearly expressing consent, such as a written, including electronic, or oral statement, which shows the data subject's voluntary, individualized, informed and unambiguous expression of will by which she accepts the processing of her personal data. (A 679/2016.) For this reason, it is important that when customers start using the LAPPSI app, one of the first steps is to ask for their consent to the processing of personal data.

Technical Specifications

In order for customers to use the LAPPSI app, it is important to clarify the technical specifications in advance. The following chapter presents information about the technical implementation of the application. In order for users to give consent to the processing of personal data in the first place, as it was described in the previous chapter, the technical structure must be clarified. The LAPPSI app is designed as a cross-platform application that works on iOS and Android devices (Oltmanns 2012, 217).

As a modern designed app, LAPPSI is built as a client-server architecture, where the client part runs on the user's device and the server part runs on a remote server on the Internet. The client-server system is a distributed data processing between two types of independent and autonomous entities known as server and client. This architecture offers many advantages, including the

ability to access a variety of devices and easily update app functionality without the user having to update their app. (Kumar 2019, 33858.)

When it comes to app security, this is an increasingly discussed topic with many facets (Watanabe, Akiyama, Kanei, Shioji, Takata, Sun, Ishi, Shibahara, Yagi & Mori 2017, 14-24). The user should be central to security. This includes encrypted data transmission, secure storage of user data, or the ability to completely delete user data. In order to protect users from unauthorized access to personal data and the subsequent processing of the same (A 679/2016).

There will likely be various types of technical communication in the LAPPSI app we expect to enable smooth and effective use of the app. To ensure the security of the app and user data, the app will likely also require authentication and authorization. The app will download data from the server, such as child development information, health data, and game progress. To ensure that the data is transferred reliably and securely, the app may use HTTPS encryption and Secure socket layer (SSL) certificates. (Kumar 2019, 33858.)

Various data is stored in the app. User data, this is stored on a secure server and protected by appropriate security measures, such as encryption and access control. Profile and progress data are usually stored on a server to ensure that they can be accessed from any device on which the user uses the app. Health data which contains information about child health and development may also be stored in the app, such as the child's date of birth or information about vaccinations or doctor visits. This data should generally be stored on a secure server and protected by appropriate privacy measures, such as compliance with data protection laws. The secure routing protocol used to protect the communication channel between the devices and the cloud is essential. (Ramasubbareddy & Sasikala 2018, 325-327.)

The app will also be able to respond to errors that may occur while using the app, such as when there are connection problems or server failures. Here, the app will send notifications to the user and possibly offer troubleshooting. (Ramasubbareddy & Sasikala 2018, 325-327.)

Reinforcement Learning (RL) is a machine learning approach in which an agent learns to perform a specific task by interacting with an environment. The agent's goal is to maximize a certain reward it receives from the environment by performing certain actions. The personalized progress indicators and rewards improve motivation by giving the user a sense of accomplishment and progress. (Korn & Tietz 2017, 209.)

The State defines the context in which the agent makes decisions. Thereby this state is a snapshot of the environment. The Reward is a signal transmitted to the agent by the environment to evaluate its performance. It can be positive, negative, or neutral. The agent's goal is to obtain a higher overall reward over time by optimizing its actions. The Action is the decision that the agent makes based on the current state. The agent's goal is to choose the action that has the highest expected reward. That is, to filter the right information from the information pool and propose it to the user at the right place. This cycle repeats until the agent successfully completes the task or the system is terminated. The RL process is used to optimize decisions by using information about the state, the reward, and the action to develop a strategy to obtain a higher total reward. (Li 2022, 17.)

Gamification

Gamification can be defined as "using game based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (Kapp 2012, 14) or more succinctly, as "the use of game design elements in nongame contexts". Gamification consists of various elements, the most popular game mechanisms are points, badges and leaderboards. (Deterding, Dixon, Khaled & Nacke 2011, 9.)

At LAPPSI, we have the task of facilitating the central knowledge transfer, which serves as the core element of our application, through tools such as the integration of gamification. The added value for the users is in demand as well as the exchange of information. Through a playful way, a knowledge transfer can happen easier and more sustainable (Becker & Metz 2022, 61). The central idea of integrating gamification is to strengthen the motivation of the users. Here, a distinction can be made between the two types of motivation, extrinsic and intrinsic. Gamification aims to actively support the intrinsic motivation of the user. (Korn & Tietz 2017, 209-214.)

The advantage of intrinsic motivation is the longer lasting and more stable type of motivation. Since it is not externally imposed on one but through the conscious promotion of creativity better results can be achieved. (Korn, Schulz, & Hagley 2022, 45.) The importance and fundamental meaningfulness of gamification can be based on the so-called flow theory according to Csikszentmihalyi (Csikszentmihalyi 1975). This shows that an activity with energetic concentration and commitment can offer more joy and active participation in the learning process. A so-called flow state can be achieved through the visualization of progress indicators (e.g. ranks, badges and virtual medals) in real time. (Korn & Dix 2016, 57.)

Basic human needs play an important role when it comes to the mechanisms, structure and selection of elements. The basic principle of gamification is to give feedback to the user of the application through small visual successes. Especially referencing the overall goal is of central importance. (Korn, Schulz & Hagley, 2022, 61.)

LAPPSI is about simplifying the central knowledge transfer to the user and introducing the user to the subject area with fun through the use of mini games. Points, badges, leaderboards are often abbreviated by PBL in English-language literature on gamification. These are the most common and best accepted elements among users. Points make success measurable and comparable. Ascending in levels visualizes to the user new levels he has reached as well as which are still attainable. Badges offer the animated and graphical reward for performance of a very different kind in comparison with points. And leaderboards animate the user and show what is possible. In addition, they put the score in reference and show the score of the users in descending order. Progress visualizations are the central point when it comes to gamification. Only if the player earns something fictitious, he stays motivated and can get a meaning out of the mini-games (Korn, Schulz, & Hagley 2022, 53).

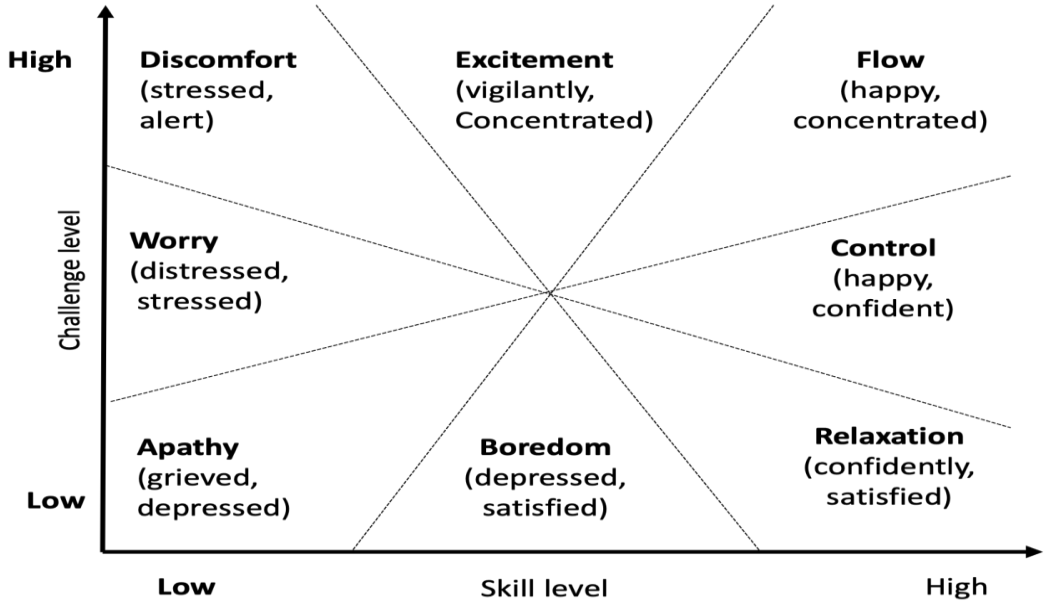

Figure 1. Flow theory according to Csikszentmihalyi (1975) in relation to challenges and abilities (Own representation according to Csikszentmihalyi 1975)

The figure 1 shows the flow theory according to Csikszentmihalyi. When reaching the flow state, people are so absorbed in their activity that they unconsciously block out environmental stimuli and their sense of time. Two central factors are especially important. The *challenge level* and the

skill level. If the two factors converge, the flow state is possible. A deviation, i.e., a too low or too high demand can cause an over- or under challenge of the playing person. (Csikszentmihalyi 1975.)

Individual personality traits of people in a group such as parents or relatives of the child are also an important factor when it comes to application development. Different gamification elements are perceived differently by different personality types. Therefore, defining the user group is important to identify a profile of the player and thus different player types. In Bartle's model of player types, a subdivision of 4 types is made. (Bartle 1996, 19.)

Achievers refer to players who aim to achieve specific goals within the game and maximize performance. Unlocking achievements is especially important to you. New knowledge sections in the app could be an impulse to bind this type to the app in the long term. Whereas explorers are players who love to explore and discover the game's world. One use case scenario in our app could be users who like to have lots of new information about children's health. Focused on mutual interaction is the speller type of socializers who prefer social interaction in the game. Here, a knowledge forum integrated into the app could be a good starting point. Challenges and competition are loved by the killer type, who like to compete and compete against other players. (Bartle 1996, 19.)

3.3 Innovation description process and functions

Process

The basic idea of the innovation is to create an app that helps parents, parents-to-be and all people involved in the upbringing of a child to learn more about its developmental process and health with the help of digital solutions. This knowledge transfer should take place among other things in the form of mini-games. Medical scientific information is the basis for the given knowledge. Medical professionals should also be involved in the process and thus be relieved by the app. The innovation that was developed is an app called LAPPSI. Main and also the long-term goal of the app is to improve the health of children in an easy, effective and playful way. LAPPSI aims to support the intrinsic motivation of users to achieve sustainable knowledge transfer. The app contains the features and designs shown below.

The starting point for the development of the innovation was the first idea with the basic functions. This was then further developed using various methods. Among other things, an innovation workshop was held in which the smart solution was worked on in different design sprints. This resulted in the long-term goal, the greatest risks and design proposals for the appearance. In addition, literature research was conducted in which it was important to find out framework conditions such as relevant laws, technical requirements and background information on gamification to be able to take these into account later in the development of the innovation.

Additionally, expert interviews were held to obtain further relevant information on the development of the innovation. Midwives, pediatric nurses, young parents, and IT specialists were interviewed as these groups of people were considered important to the app. In this case, they are people who could use the innovation, be relieved by it or specialists who could contribute important framework information related to the development. Periodically, the results were discussed and developed to make the idea innovative and appealing to potential users until it was finalized with name, logo, design and specified functions.

Innovation description

When developing the app, it is important to consider the legal regulations, particularly those relating to data protection as described in section 2.3. In addition, the technical framework conditions from section 2.4 also play a major role. The LAPPSI app should therefore be built as a cross-platform application according to these specifications.

Accessibility is an important point for our innovation. In order not to exclude users such as people with disabilities, the user interface is designed barrier-free, or provide voiceover support for the visually impaired. The mini-games provided as part of gamification could also be usable by visually impaired people through special sounds in the game. (Archambault, Gaudy, Miesenberger, Natkin, Ossmann 2008, 2.)

Moreover, the user interface should be responsive and user-friendly to ensure that it looks good on different screen sizes and resolutions and is easy to use. Care should also be taken to ensure that the app is understandable and appealing for all persons of our target group. (Archambault et al. 2008, 6.)

When it comes to the use of the app, the first step in the app is registration or, after successful registration, login. To access the app, a registration code is required, which can be issued by the

respective physicians, for example a nurse. This step is included to make sure that only authorized people have access to the science-based information in the app.

The first page that is reached after successful login is the start page. On the start page, users will see a different screen depending on their status. If the app is already used during pregnancy, the pregnancy week of the mother can be seen and a belly in the approximate size it should have according to the pregnancy week. What this might look like is shown in Figure 2. Furthermore, important vital signs such as blood pressure and pulse can be displayed.

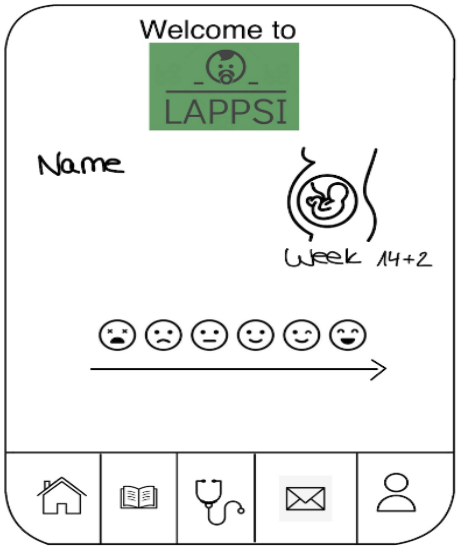

Figure 2. Start Page Pregnant

Once the child is born, an avatar for the child is displayed that grows with age and development. Next to it, there are the name, age, and other important parameters such as height. If multiple children are entered in the app, this page can also display more children. This variant is shown in Figure 3.

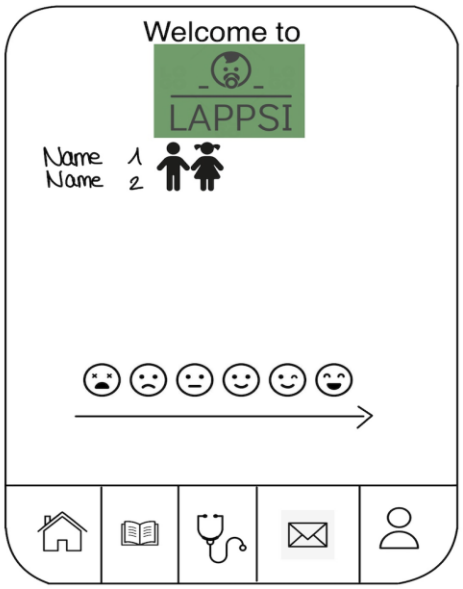

Figure 3. Start Page Child

In addition to this information, the start page in both variants also contains a mood tracker to query the mood of the app users on a daily basis. This can be seen in both illustrations. On the one hand, the mood tracker is intended to give users an overview of their daily mood, and on the other hand, it can be used to achieve a commitment to the app so that it is used regularly. The tracker can therefore contribute to LAPPSI being opened at least once a day so that the mood is entered. (Singh, Drouin, Newmark, Rozenblum, Lee, Landman, Pabo, Klinger & Bates 2016, 5-6.)

Also, at the top is the logo of the app and at the bottom is a menu that gives the possibility to access all pages. The logo is designed with the name of the app and a child's head to show directly that it is about children or babies. The green color was chosen because it is neutral and fits all genders and is not too bright, but still easily recognizable. In addition, the color green stands for health, confidence and safety, which are qualities that should be expressed by LAPPSI, so that users feel comfortable. (Bartel 2003, 64.) The rest of the app should also be designed in this style.

The start page is designed like that to have a fast overview of all important information and to make it attractive for the parents and parents to be. The two different versions enable the usage in different life situations and therefore for more people.

The symbols and icons on the different pages were chosen to be as self-explanatory as possible, making the app intuitive for its users (Darvishy, Hutter & Seifert 2021, 43-82). In total five different pages can be visited. These are:

- Start page via the house icon,
- Knowledge transfer via the book Icon,
- Appointments via the stethoscope icon,
- Messages via the letter icon,
- Profile via the person icon.

The knowledge transfer page contains the science-based information that is the main function of the app. This page can be accessed via a book icon. The book was chosen at this point because it symbolizes information and knowledge. (Günter & Joachim 2021, 98-101.) There are three sub-pages.

The first sub-page contains scientific information about the health and development of newborns and children. These are divided into different categories, such as nutrition, health, safety, physical activity and sleep. Here, different lessons can be completed for these categories, each ending with a mini-game to rehash the information learned in a fun way.

Gamification is incorporated at this point to motivate users to use the app. As describe in chapter 2.5, the gamified approach increases intrinsic motivation to use the app. Therefore, this is included in LAPPSI to motivate people to use the app regularly and keep them in the long term, so that they recommend it to others or even use it for other children. (Korn & Tietz 2017, 209-214.)

On the second sub-page, the games for learning important information about the child can be accessed directly without having to read a theoretical lesson beforehand. The games can be integrated in the form of a quiz, interactions or assignment tasks. In addition, the gamification elements should pop up when users open the app or update relevant information about themselves and the children. In this regard, virtual medals, badges, points, leaderboards and rankings shall help motivate users to use the app regularly and thereby increase their knowledge. Rewards can be achieved, for example, by answering questions correctly. These elements are used to achieve a flow state because they are well accepted by most users. (Korn & Dix 2016, 57.)

In the future, it is also planned to actively integrate children into the process of using the application once they are old enough to learn something or acquire physical routines, for example. Care should also be taken to ensure that the content is easy for children to understand and illustrated with child-friendly animations or illustrations.

Also on the knowledge page, there is a third sub-page that contains experiential knowledge from other parents as an additional source of information. This will allow parents to get a more practical perspective on parenting. Here, reinforcement learning will be integrated to personalize and optimize the user experience to improve the learning process. One way to apply the technology here would be to train a model that can predict the best behavior for the current question based on its experience with previous questions and answers. The model could be based on a reward function that has the goal of providing the most accurate and helpful answers possible. The information can be unlocked at LAPPSI only when the reward system offers a percentage above 99 %. This ensures a very high quality of information and reduces the risk of incorrect information. With an active feedback loop from the parents, the model can be continuously improved by taking user feedback into account. Reinforcement learning could also help with a knowledge pool of questions from parents by enabling the system to filter out the correct and meaningful answers. (Korn & Tietz 2017, 209.)

Especially for the gamification part it is important to describe the target group of the app to address the right people. The user group, which was primarily addressed to both parents, is very diverse. An application scenario is also conceivable with other relatives of the parents such as grandparents or aunts as well as uncles. This criterion should be considered when designing a gamified environment. Additionally, with regard to Bartle's graphical model of player types, the user target group was defined. The app's users move between the three types: Achiever, Explorer and Socializer. Achievers could be parents for whom it is very important to always learn new things and unlock new sections in the process. To motivate this group, it is important that new knowledge sections are always made available, and they get rewards like medals for successfully completing the mini-games. Socializers can be addressed in LAPPSI especially in the area where the knowledge can be shared with other parents. The third type, the Explorer, focuses on the game world. These users can also be motivated by the constant discovery of new knowledge about their children. Here, each user group must be consciously picked up through a deliberate integration of the playful elements to encourage the use of the application.

The third page is accessed via the stethoscope icon and offers a calendar function. Upcoming appointments and a history of past visits can be viewed to give an overview of all. There is also

the option to make appointments with pediatricians, gynecologists or nurses. And that's why this icon was chosen because it symbolizes medicine or medical professionals best. (Wolff 2018.) For upcoming consultations, patients and physicians can write down notes or questions to be answered when they meet. This offers the advantage that questions can be clarified in advance and both parties are better prepared for the meeting. This can save time, but also reduce anxiety and worry for the parents. Additionally, reminders can be set up for the appointments through the app. This ensures that they are not forgotten.

The page accessible via the letter icon provides a message function between users and medical professionals. The letter icon was chosen because it symbolizes best that written messages are exchanged (Günter & Joachim 2021, 91-94). This feature has been integrated to enable even better contact between doctors, nurses and the patients, so that medical care can be provided in an even more organized and smooth manner.

On the last page with the person icon, the user profile is stored. There, account information can be viewed, added, deleted or updated. Information to be stored can be: Name, E-mail address, Date of birth, Vital Signs, Pregnancy Week, Children with age or date of birth and vital signs. The information that is entered here can be used to personalize the app experience so that users are even better addressed.

3.4 Conclusion

The purpose of this article was to describe how the welfare of children and families can be increased using the LAPPSI app in counseling services in Finland. The aim was to promote the health and well-being of children and families. The central goal of reforming welfare services is to improve the citizen's opportunities to take care of their own health on their own and, if necessary, with the support of professionals. Here, reliable well-being information and electronic services play an important role. (Sosiaali- ja terveysministeriö 2014, 4.) Maternity and child health services have a variety of applications in use locally, but their features are limited. LAPPSI app offers up-to-date and reliable information about the child's growth and development to help parents to support their child's health. Digitalization makes part of public services available outside of office opening hours, at least for those who have the prerequisites to do business electronically (Karvonen et al. 2022, 13). Electronic solutions also ensure that services are equally available in sparsely populated areas and for special groups (Sosiaali- ja terveysministeriö 2014, 5). Through the

LAPPSI app, parents can find information concerning their child's health from a reliable source around the clock.

The operating environment of social and health care is constantly changing, and customers are even more active actors (Sosiaali- ja terveysministeriö 2014, 13). The importance of the individual as a producer, user and ruler of information is undergoing a revolution. In addition to data collected by social services and health care, information is also constantly generated as a product of our own activities (e.g., collecting well-being and activity data). (Lehto & Neittaanmäki 2017, 1.) LAPPSI offers parents one easy tool for managing their child's health. Parents are better able to influence their child's treatment and can write down things they would like to discuss with the professional before the visit. Parents can also see from the LAPPSI app what the professional has documented from previous visits and check what they have agreed together for the future.

Socially, it is significant that with the regular help of health monitoring and counseling, it is possible to prevent the next generation's problems and promote its well-being. The chain of problems passed from generation to generation and the prerequisite for breaking the development of inequality is that parents' problems are already contracted from the time of pregnancy and the children of the family are supported in the long term. (Hakulinen-Viitanen ym. 2014, 20.) A significant proportion of parents need support from a professional during the pregnancy and after the birth of the child in matters related to the health of both the child and the parents (Klemetti ym. 2021, 7; Vuorenmaa 2019, 1). LAPPSI app was developed to answer these needs both for parents and the health care professionals. In stressful life situations most of the parents however, do not have the resources to seek help (Riihonen et al. 2021, 2571). The LAPPSI app is a low threshold service for parents to find up-to-date information and to ask help from professionals.

The advantages of the app, such as accessibility in rural areas, relief for healthcare workers and reliability of the provided healthcare information were discussed in this article. In the future, the application should also include a chat function with specialists. Furthermore, machine learning (see chapter 2.4) is expected to reach an even larger number of parents who provide information about their children's health and improve the personalized recommendations. In this way, it may also be possible to provide users with a diagnosis of illnesses in the future and give them an even better user experience. The integration of children into the gaming process has also been considered and may take place at a later stage.

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4 Wireless solutions in the patient journey and intensive care

Ala-Hiiro Marika, Master of Social and Health Care Student, KAMK, Finland
Denk Kolya, Digital Healthcare Management, HNU, Germany
Schneider Natalie, Digital Healthcare Management, HNU, Germany
Vordenbäumen Vanessa, Digital Healthcare Management, HNU, Germany
Leinonen Rauni, Principal Lecturer, KAMK, Finland
Moisanen Kirsi, Principal Lecturer, KAMK, Finland
Würfel Alexander, Professor, Dr., HNU, Germany

Abstract

The shortage of health workers is significant all over the world. We need more health technologies and new innovations to support health services. In this article, health technology refers to medical devices used in social and health care. The development, deployment, use and decommissioning of health technology products must take into account the perspectives of users, patients and health professionals.

The aim of this study course was to develop a smart solution that measures the patient's vital signs wirelessly. Purpose is to describe how wireless patient monitoring in the ICU and throughout the care chain can improve patient safety.

Patient safety is the foundation of healthcare, and it is also a sign of high-quality healthcare. The patient's basic vital functions must be taken care of at all stages of the care chain, but monitoring the vital functions of a critically ill patient is particularly important and necessary in order to intervene in time if the patient's condition deteriorates. In intensive care units in particular, reliable monitoring of vital signs is essential for patients. Wireless vital signs monitors are the next step towards optimal patient monitoring, but their deployment needs to be carefully planned in order to integrate them into clinical workflows and protect patients from harm. Laws and regulations aim to ensure that medical health technology devices placed on the market are safe for both users and patients.

The concept has focused on creating interoperability through a centralized platform for managing and accessing vital signs data and describing what patient safety issues need to be taken into account. The topic is of global interest and that research is ongoing, but still requires research and design work to ensure that devices are safe and reliable for patient use.

Keywords: patient monitoring, interoperability, intensive care unit, patient journey, patient safety, wireless vital signs monitoring

4.1 Introduction

Health technology is part of modern healthcare (Rajaniemi 2018, 5). Health care suffers from labor shortages and not all nursing-graduates are sufficient to fill the labor shortage. We need more health technologies and new innovations to support health services. (Nylund & Ruokoniemi 2018, 9.) The shortage of health workers is significant all over the world. Finland has a greater shortage of health professionals than Germany. In 2019, the Finland density of physicians was 32.4 (95% UI 26.5 – 39.5) per 10000 population, whereas Germany has physician densities of 46.9 (95% UI 41 - 53.4). In 2019, the Finland density of nursing and midwifery personnel was 150.8 (95% UI 128.0 – 176.7) per 10000 population, whereas Germany was nursing and midwifery personnel densities of 176.1 (95% UI 155.6 - 196.3). (GBD 2019 Human Resources for Health Collaborators 2022, 2136, 2143.)

Health technology refers to medical devices used in social and health care. The equipment must bear the CE marking, which indicates that it meets the requirements laid down for it. Although Finland has a good procurement law, it is still often the case that only price is considered and not enough attention is paid to other aspects when purchasing equipment. (Nylund & Ruokoniemi 2018, 6–8.) The development, deployment, use and decommissioning of health technology products must take into account the perspectives of users, patients and health professionals. Workers need to have the skills to use the equipment and to change their working practices. Equipment must be user-friendly and reliable. The introduction of new health technology is primarily about improving the service or activity. (Juvonen & Immonen 2022.)

Technological advances have made it possible for each of us to monitor our own vital functions wirelessly in everyday life. There are many different products on the market, such as smart rings and smart watches. New innovations and product development are needed to bring wireless vital signs monitoring to hospitals. Intensive care units are among the most advanced technical environments in the hospital, concentrating the expertise and technology needed to monitor and maintain vital functions (Meriläinen 2012, 21–22). Most monitoring devices today are still based on technologies from the 1970s (Poncette, Spies, Mosch, Schieler, Weber-Carstens, Krampe & Balzer 2019, 2). Therefore, this article is focusing on giving an introduction of wireless technologies in the patient care journey, to ensure patient safety for the whole process.

The aim of this study course is to develop a smart solution that measures the patient's vital signs wirelessly. This smart solution's purpose is to describe how wireless patient monitoring in the ICU and throughout the care chain can improve patient safety. As patient safety increases so does

patient wellbeing. This article describes the innovation process and how patient care can change when wireless patient monitoring is used in the patient treatment journey and especially in the ICU. The learning objective of the course is to identify the needs for the development of intelligent solutions for health care and the regulations and legislation on health technology. The learning objective is also to be able to implement and report on a development project.

4.2 Patient safety and Wireless vital signs monitoring

Fundamentals of care for the critically ill patient

Patient safety is the foundation of healthcare, and it is also a sign of high-quality healthcare. Patient safety is defined by the patient according to his or her own subjective experience and the patient must be treated in agreement with the patient. Patients must be adequately informed about their treatment and care must be based on evidence. (Niemi-Murola & Mäntyranta 2011, 21, 23; Welling 2018.)

Critically, it is important that the whole care chain of the critically ill patient functions without problems. The care chain needs to work quickly and seamlessly, and cooperation must be practiced avoiding delays. The patient's basic bodily functions are taken care of from the emergency room to the emergency department and from there to the control or intensive care unit. (Hyppölä 2021, 21–22.) Excample a wireless sensor for basic vital functions, which would be placed on the patient already in the field by the primary care, could reduce delays by not having to interrupt the monitoring of the patient and spend time putting cables in. Once set, the same sensor would accompany the patient throughout the care chain. This would also require a reader that would travel with the patient. The function of the reader would be to display the values and give alarms when the values exceed or fall below the permissible limits. The reader would need to be connected to monitors and central monitors used in the emergency room, control rooms, operating theaters, and intensive care units.

Wireless vital sign monitors are the next step towards optimal patient monitoring. They provide continuous information on changes in the patient's condition. As wearable monitors are more widely adopted in healthcare, there is a need to carefully plan the deployment of the devices to promote their integration into clinical workflows and protect against patient harm. (Kowalski, Capan, Lodato, Mosby, Thomas, Arnold & Miller 2017, 623.)

Patient journey

Patient journey describes multiple terms in healthcare. The term patient journey used in this article wraps up around the healthcare treatments and history of a patient. This includes the whole care cycle and not only specific inpatient or outpatient care. The patient journey (figure 1) contains all the possibilities of a patient treatment process individually. Meaning for a critically ill patient who must be picked up by an ambulance and brought into the emergency room of a hospital and is experiencing hospitalization, the patient journey also concludes the outpatient care such as the discharge, the post-discharge - chronically ill patients reconnect with the ambulance. (Girerd et al. 2018, 273–285.) About this patient journey, some hospital patients are sent into the intensive care units.

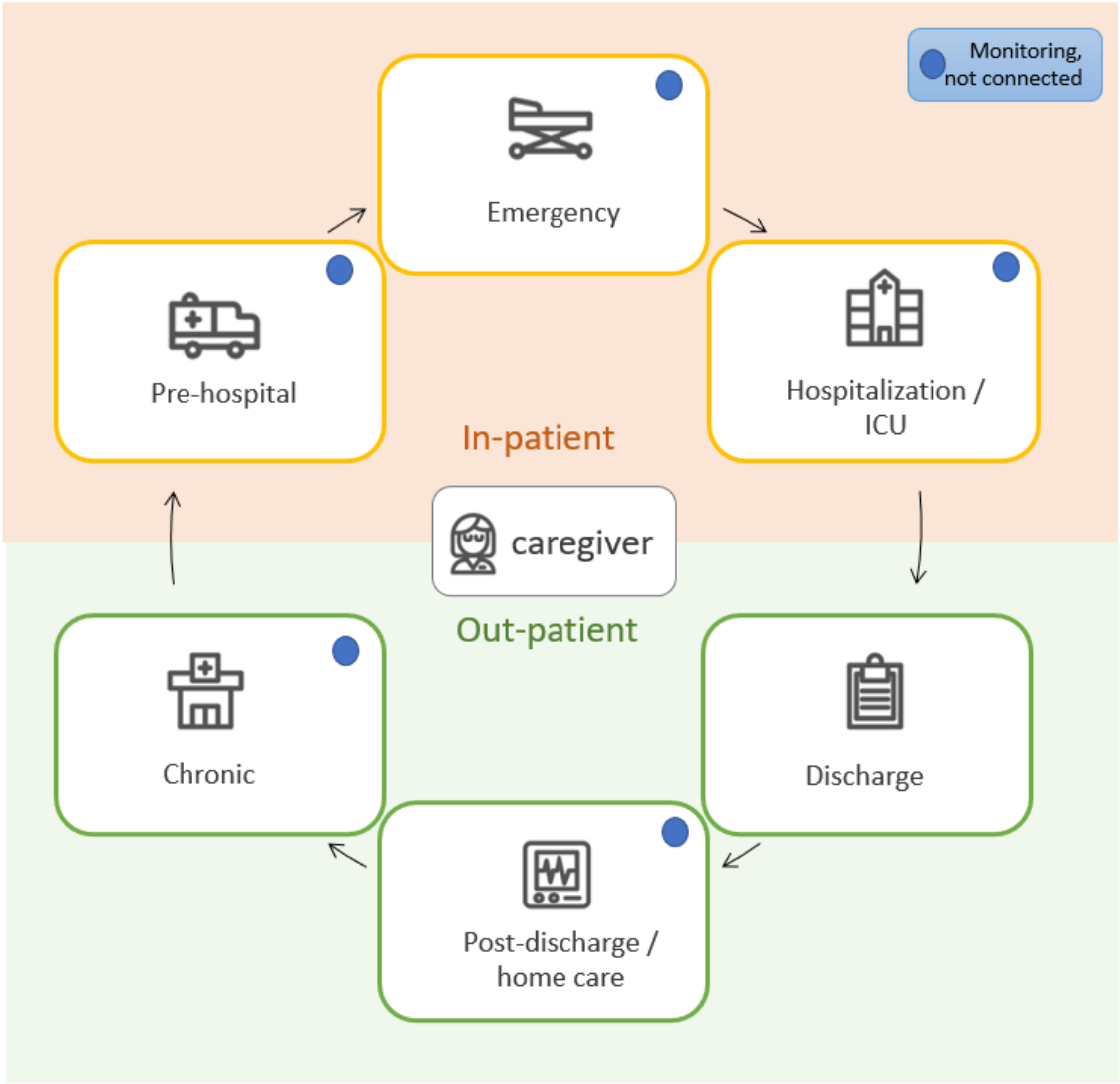

Figure 1. Patient journey and monitoring (own graphic as Girerd et al. 2018, 279)

As the figure 1 shows, the patient journey contains more than just one visit to the doctor's office. Furthermore, this seems like a never-ending cycle, it is also possible to access the patient journey in different stages. So, it can be possible to go directly into hospitalization for planned surgery or get diagnosed with a chronic disease that introduces and starts the patient journey.

Patient monitoring in the intensive care environment

The intensive care unit treats patients with a temporary serious disorder or a high risk of such a disorder. The impairment may be in one or more of the basic organ functions. The most common reason for ICU admission is respiratory, circulatory or consciousness disorders, or a combination of these. (Reinikainen & Varpula 2018.) The treatment of ICU patients requires continuous care and observation (Blomster, Mäkelä, Ritmala-Castrén, Säämänen & Varjus 2001, 57). In intensive care units, the intensity of care is higher than in control level care. In inpatient wards, there is no possibility of extensive and continuous monitoring of basic body functions. (Niittyvuopio 2021, 18.)

The aim of acute care patient monitoring is to monitor vital signs, detect changes in vital signs quickly, interpret them correctly and monitor response to treatment. The most common monitoring parameters in acute care patient monitoring are cardiac electrical activity monitoring (ECG), oxygen saturation (SpO2) and non-invasive blood pressure (NIBP). For intensive care patients, in addition to basic parameters, more detailed monitoring of haemodynamics, arrhythmias, respiratory mechanics, gas exchange and metabolism is needed. (Ala-Kokko 2013, 8–10.)

Intensive care equipment is needed for continuous monitoring of vital functions. Data must be recorded so that they can be reviewed later and the direction of change in variables can be assessed. Fluctuations and changes in measured values tell more about the evolution of a patient's condition than a single reading. In intensive care units, the results of the patient's vital signs measurements should be transmitted to central monitors so that all patients' measurements can be viewed simultaneously. Critical care work is a professionally demanding job and competence must be maintained even as technology advances. (Blomster et al. 2001, 9–10,12, 63.)

Patients' experiences of intensive care are individual (Corner, Murray & Brett 2019), and common causes of distress include the inability to move and the various tubes, cables and measurements (Blomster et al. 2001, 57). Patients' inability to move affects their experience of autonomy (Corner et al. 2019, 8). In the ICU, patients experience a loss of autonomy and a sense of control over themselves. Complications and slowed recovery also contribute to these feelings. Therefore, it is

important to increase the recovery of the sense of control. (Cuzco, Torres-Castro, Torralba, Manzanares, Muñoz-Rey, Romero-García, Martínez-Momblan, Martínez-Estalella, Delgado-Hito & Castro 2021, 9-10.) Tubes and cables also cause pain to the patient, which may remain in the patient's mind (Blomster et al. 2001, 57). Figure 2 shows some of these cables that need to be connected to the patient.

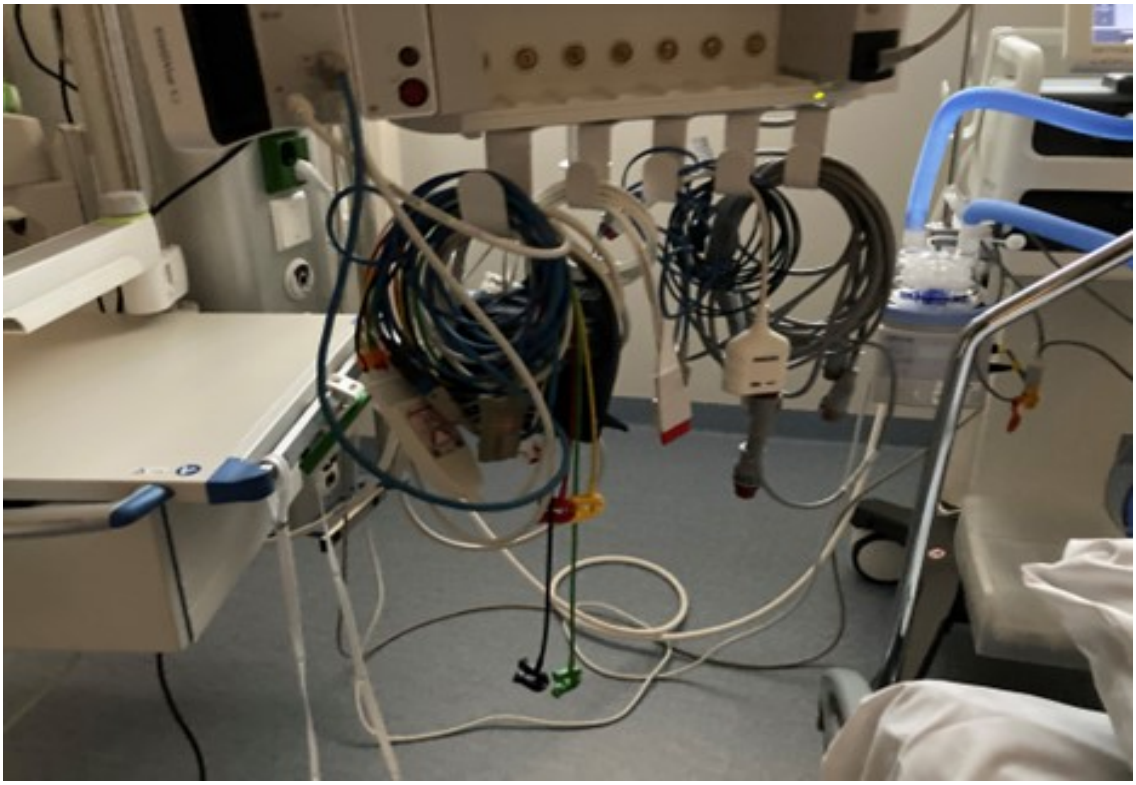

Figure 2. Cables in the intensive care unit

Keeping the intensive care patient mobile can contribute to comfort and reduce complications. Patient immobility affects the patient's breathing and circulation, muscle mass reduction, joint stiffness, nerve damage and pressure ulcers. Patient movement is restricted by wires, for example, and care must be taken not to dislodge them. (Blomster et al. 2001, 109–110.) Prolonged immobilization is a risk factor for intensive care-associated muscle weakness (ICUAW). ICIAW is associated with almost double the mortality during a one-year follow-up period. (Niittyvuopio & Pikkupeura 2017, 276.) Delirium is a major problem in intensive care and reduces the patient's chances of recovery (Loisa 2006, 269). Delirium is associated with increased mortality, increased length of hospital stay, loss of functional independence, increased hospital costs, and an independent predictor of death 10 years postoperatively (Pagad, Somagutta, May, Arnold, Nanthakumaran, Sridharan & Malik 2020).

The prognosis of the ICU patient is also affected by infections, which may be acquired outside the ICU or during intensive care (Blomster et al. 2001, 86). Medical devices can cause pressure ulcers in adults and children (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance 2014, 31). Pressure ulcers can become infected and the treatment of ICU patients can be complicated by infection (Blomster et al. 2001, 92). The medical device should cause as little pressure and stretching of the skin and subcutaneous tissues as possible. Medical devices should be of appropriate size and well secured so that they stay in place without causing rubbing and additional pressure. (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance 2014, 31–32.)

Monitoring requirements

In accordance with Poncette et al`s (2019, 4) proposal, the majority of survey participants acknowledged the importance of utilizing advanced technology to upgrade patient monitoring systems in the ICU. The implementation of such technology would not only simplify routine processes but also elevate patient safety, quality of care, staff satisfaction, and overall post-discharge quality of life for patients. As proposed by Flohr, Beaudry, Johnson, West, Burns and Ansermino (2018, 2), ICU personnel require patient monitoring devices that can easily integrate with other medical devices, allowing for a comprehensive comparison of vital parameters, trend analysis, and assessment of medication, ventilation, fluid balance, and other relevant factors.

The ICU staff called for a more interoperable and intuitive patient monitoring system that could accommodate advanced and individual features based on patients' or users' needs. Poncette et al (2019, 6) also identified the need for more specific vital parameter measurements and alarms that are noninvasive and less obtrusive, such as wireless devices. The use of mobile phones with large screens as a remote patient monitoring device was also proposed to reduce noise pollution, enhance patient safety, and increase job satisfaction.

Interoperability and wireless solutions

It is widely agreed that healthcare in the 21st century will necessitate extensive utilization of information technology and clinical informatics to gather and handle data, convert data into useful information, and distribute this information to enhance patient care. This is particularly crucial in the ICU, where data management is crucial to improving patient outcomes. Critical care involves intricate decision-making, and by its very nature, it requires a significant amount of data. In the

case of a critically ill patient, it is common for multiple physiological parameters to be constantly monitored, resulting in an extensive amount of data that reflects the complex and dynamic nature of physiology. (De Georgia, Kaffashi, Jacono & Loparo 2015, 1, 4.)

However, comprehending these dynamics necessitates data integration and clinical context. The majority of these parameters originate from independent devices that lack easy integration with one another. Although some devices connect directly to the bedside monitor, several others do not, or they do so partially, leading to incomplete data capture. The absence of functional interoperability among medical devices is a significant limitation in healthcare presently. For instance, over 90% of hospitals reported utilizing six or more types of medical devices, yet only about a third of them integrate these devices with each other. (De Georgia et al 2015, 1, 4.)

A new wireless technology has the potential to increase surveillance of patients' status without the need for physical attachment to immobile monitoring systems, allowing patients to move around their bed spaces, rooms and floor areas with ease. Recent advancements in electronic circuits, computer technology, batteries, and radio systems have made it possible to develop a low-cost and unobtrusive surveillance system that can be attached to numerous hospital patients. (Hernandez-Silveira, Ahmed, Ang, Zandari, Mehta, Weir, Burdett, Toumazou & Brett 2015, 2.) Table 1 gives an overview of some of these existing technologies and what they can measure.

TABLE 1. Existing wireless technologies (The Surgical Company 2023; Isansys 2023; VitalConnect 2023; Athena GTX 2023; GE HealthCare 2023; Sotera 2023; Philips 2023)

Device	Manufacturer	Vital Signs	Location
Sensium Patch	The Surgical Company	heart rate, respiration rate, axillary temperature	chest
Lifetouch	Isansys	heart rate, respiratory rate, heart rate variability, ECG	chest
VitalPatch	VitalConnect	Single-lead ECG, heart rate, heart rate variability, respiratory rate	chest
Wireless Vital Signs Monitor	Athena GTX	blood oxygen saturation, heart rate, blood pressure, ECG	Upper arm
Portrait Mobile	GE HealthCare	Blood oxygen saturation, heart rate, respiratory rate	chest
ViSi Mobile	Sotera	Blood pressure, blood oxygen saturation, heart rate, pulse rate, respiratory rate, body temperature, ECG	Upper body
IntelliVue Cableless Measurement	Philips	ECG, blood pressure, blood oxygen saturation,	Upper body

There are already wireless technologies on the market, but not in use in ICU. These systems can capture and record data on heart rate, respiratory rate, temperature, and other significant biological signals, and transmit them wirelessly via low-power radio to receivers within 10 meters for onward transmission to central stations. This can potentially accelerate clinical response and improve patient outcomes. (Hernandez-Silveira et al. 2015, 2.)

Medical device laws and regulations

The new EU regulations on medical devices entered into force in 2017, and the regulation is more detailed and stricter than before (Holmalahti 2018, 11-12). Medical device means an instrument, apparatus, appliance, software, implant, reagent, material or other article intended by the manufacturer to be used in human beings for the diagnosis, prevention, prognosis, observation, treatment or alleviation of disease or injury, or for the study, replacement or modification of an anatomical, physiological or pathological function or condition. The device must bear the required markings and have the required instructions for use. The device must bear the CE marking, which means that the device complies with the requirements. (A745/2017.)

A device can only be placed on the market and put into service if it complies with the MD Regulation when properly delivered, installed, maintained and used for its intended purpose. Before placing the device on the market, the manufacturer must carry out a conformity assessment of the device. The device must meet certain safety and performance requirements, taking into account the intended use. The device must bear an identifier that allows it to be registered, identified and traced. (A745/2017.) In Finland, Fimea is responsible for health technology supervision. Fimea supervises the conformity of devices, industry operators, marketing and handles reports of incidents involving devices. (Mukula 2022.) In Germany, the responsibility for health technology supervision lies with the Federal Institute for Drugs and Medical Devices (BfArM). The BfArM is the competent authority that oversees the conformity assessment and surveillance of medical devices, including their manufacturing, marketing, and post-market surveillance. They ensure that medical devices meet the necessary safety and performance requirements to protect patient health and safety. (Bundesinstitut für Arzneimittel und Medizinprodukte 2023.)

New safety standards for wireless radio devices, such as wearable devices, are being developed in Europe to improve safety. Wireless devices will have to meet EU harmonized safety requirements by autumn 2024. (SFS 2022.) The Radio Equipment Directive 2014/53/EU provides the regulatory framework for placing radio equipment on the market and ensures a single market for

radio equipment by setting essential requirements for safety and health, electromagnetic compatibility and efficient use of radio spectrum. The reform will improve market surveillance, in particular as regards traceability obligations, and ensure that data in information systems are not unlawfully altered and are protected against unauthorized use. (Radio Equipment Directive n.d.)

4.3 Innovation description process

Basics of innovation design

The innovation lies within ensuring the patient's safety not only via increasing the mobility but also with making sure the status of patient vital signs is continuously monitored not only at the general ward (Weenk, Bredie, Koeneman, Hesselink, van Goor & van de Belt 2020), but during the whole patient treatment journey. The concept is based on the ability to overthrow the disconnection of vital signs monitoring in order to prevent deterioration in any of the vital signs endangering the patient. To control and monitor the patient and its wellbeing, also the response to drugs or interventions, it is crucial to have a course of the patient's vital signs.

In retrospect to these thoughts, the technological inventions and the ongoing digital transformation form the best grounds to take this problem upon a solution. With new wearable devices, interoperable connectivity, and standards for either monitoring and sending and exchanging data the innovation has found its way into the healthcare market. (Leenen, Rasing, van Dijk, Kalkman, Schoonhoven & Patijn 2022, 1–4.)

Innovation idea

As shown in the background section patient safety is endangered by taking valuable time off nurses when they have to attach or reattach new monitoring devices before being able to take care of the patient. Furthermore, the lack of connectivity and the lack of continuous monitoring (during the patient journey) put patients in danger. If patient deterioration is not detected in time and rapid response is delayed, it can lead to increased in-hospital cardiac arrests and mortality (Han, Sohn, Hwangbo, Park, Kim, Choi, Shin, Lee, Jeon, Ryu, Yoon & Kim 2022, 4).

The solution of these problems can only be a full-time-monitoring solution that covers the whole patient journey. The following section proposes an overall solution throughout the whole patient journey using wireless technologies to monitor patient vital signs.

The concept

The concept of this innovation can be defined as monitoring as a service. The innovation is built up as a monitoring ecosystem. Figure three below shows the locations of the sensors and how the information is transmitted from the platform.

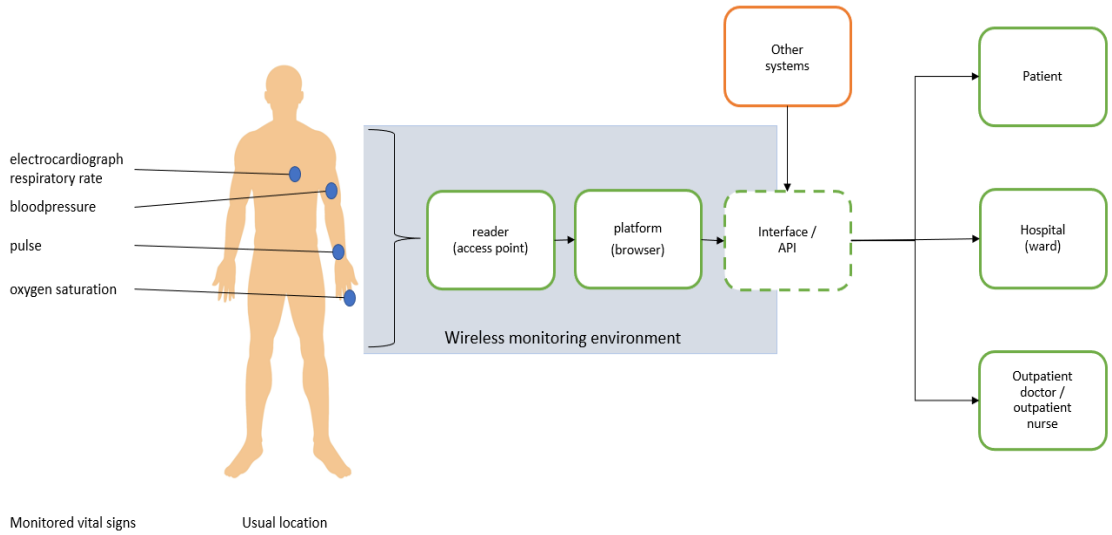

Figure 3. Concept of the innovation: sensors, platform and data distribution

Wireless vital signs monitoring is a rapidly developing field of clinical applications that can improve the quality and accessibility of medicine (Liu, Liu, Bai, Zhang, Liu & Zhu 2020, 19). The monitoring devices cover different vital signs of the patient. Figure 3 shows the sensors and their usual position and the value they track. All of this is connected and sent to the reader (which could also function as one of the monitoring devices). Furthermore, it should be an easy to access monitoring tool so in case there are errors or buttons to be pressed, the reader is easily accessible. In addition, the reader includes the internet connection to the platform and could have its own display to show vital signs just directly next to the patient. This ensures patient safety if the internet connection is lost during transport because of dead spots. In an optimal case the reader is also offering different cable inputs and a possibility to connect other devices via Bluetooth if there are more and different vital signs to monitor. Liu et al. (2020, 19) have found in their study that new

emerging materials play an important role in solving technical problems. Many methods and applications will emerge and evolve in the future, with bright prospects for diagnosis, treatment, and public service.

The platform is able to manage different devices, their monitoring capabilities and the connect ability of certain devices. The platform itself gets the data from the reader, the main part of the monitoring devices. This reader connects all the sensors and delivers data via the internet to the platform. By synchronizing all data from the reader and sending it to the platform that is able to display the monitored data, every healthcare provider or the patient himself is able to read the data just by connecting to the platform. As a conclusion, the platform gives the possibility to monitor the patient, by accessing the platform via browser. Furthermore, the platform is accessible over an API, so different systems (e.g., the digital documentation in hospitals) can directly receive the data and use it directly. If hospitals want to use the live monitoring of vital signs it is either possible via browser or in the hospital system when both solutions are connected. (Chesbrough 2003, 5-9.)

4.4 Conclusion and discussion

In conclusion, this article focuses on developing a smart solution that enables wireless monitoring of vital signs in patients. The aim of this study course was to develop a smart solution that measures the patient's vital signs wirelessly. The purpose of this solution was to highlight the potential improvements in patient safety the care chain, particularly in the ICU. With the proposed solution healthcare providers get a different perspective on the patient's health, because of the possibility for a detailed vital signs history. The concept is focusing on the aspect of creating interoperability via a central platform to manage and access vital signs data. With the base concept and the ability to also integrate cable-based solutions (e.g., in emergency situations, or because of a lack of monitoring devices) the solution aims for a full-time and all-round monitoring of patients. With the data also available for the patient himself the platform has huge potential to overcome doctor shortage in rural areas if local doctors can monitor the patient via browser and in the next step give advice via phone or video call.

As patient safety increases, there is a direct positive impact on patient well-being. Patients will be happier if they can use equipment that allows them to move around more easily. The Lounasheimo (2022) article states that wireless vital signs monitoring frees the patient from wires and

gets them moving, improves patient safety and improves patient well-being. New technology allows patients to move around and have their vital signs monitored at the same time (Hernandez-Silveira et al. 2015, 2). Health technology is important for monitoring patient vital signs in the ICU and the use of advanced technology also increases patient safety and staff satisfaction (Poncette et al. 2019, 4). The integration of wireless monitoring technology has the potential to revolutionize the way healthcare professionals deliver effective and efficient care, ultimately leading to improved patient outcomes and overall satisfaction.

In healthcare, information must be used in decision-making to improve patient care. This is particularly important in the intensive care unit, where a lot of data is available. Integrating devices with each other makes it easier to collect data. (De Georgia et al 2015, 1, 4.) Interoperability of equipment is important to consider during the deployment phase. Continuous wireless monitoring of vital signs can provide a high level of monitoring, where patients' physiological status is measured continuously and objectively (Steinhubl, Feye, Levine, Conkright, Wegerich & Conkright 2016, 9).

Wireless wearable monitoring systems present risks that should be identified and anticipated. The expertise of researchers, clinicians, nurses, engineers and computer scientists is needed to prevent problems and make products usable. Good usability is key to deployment, unnecessary alarms cause alarm fatigue which in the worst case can lead to deterioration of the patient's condition without response. Problems with communication can also lead to a threat to patient safety if reliable information does not reach the nurse. (Kowalski et al 2017, 628.) Patient safety is about reducing and preventing harm and errors. Devices used in healthcare must be approved medical devices that meet safety standards. Scientific and technical expertise is needed to improve patient safety, but empirical knowledge is also needed to achieve the best results (World Health Organization 2021, 7, 10, 37). The evidence shows that the topic is of global interest and research is ongoing. During this project, we have discovered that wireless patient monitoring is a future trend, but still requires research and design work to ensure that the products are safe and reliable for patient use. (Kowalski et al 2017, 623; Steinhulbl et al. 2016, 9; Liu et al. 2020, 1, 19.)

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5 HospiSafe – Smart safety and risk management application for develop hospital safety culture

Pesola Jari, Master of Business Information Technology and Business Competence student, KUAS, Finland
Hülsman Henrik, Master of Digital Healthcare Management student, HNU, Germany
Lemke Vanessa, Master of Digital Healthcare Management student, HNU, Germany
Moisanen Kirsi, Principal Lecturer, KUAS, Finland
Leinonen Rauni, Principal Lecturer, KUAS, Finland
Würfel Alexander, Professor, Dr., HNU, Germany

Abstract

This article deals with safety, risk management, methods of reporting hazards in healthcare and how the aforementioned can be influenced by improving the safety culture of healthcare. The focus of the article is the safety culture and risk management of healthcare organizations, especially in hospitals. Theoretical background of the article three modules Critical Incident Report System, Learning and Feedback system. The safety application we designed aims to meet the growing challenges of safety by facilitating the means of reporting hazards, by teaching how to identify hazards better and how to prepare for the identified hazards with training.

The development of the HospiSafe application is an innovative solution. The application is designed to facilitate the ease of reporting hazards and to generate information about risks. It contains three different modules: Critical Incident Report System (CIRS), Learning and Feedback system. Together, these separate modules produce a functional whole. The research methodology included literature reviews, expert interviews and the use of tools such as diagrams, user journeys and brainstorming notes based on application development.

The article presents the potential benefits of the application for the healthcare sector and improvement to their safety culture. However, the conclusions of the article acknowledge the challenges, such as whether the informant is unknown or an identified informant and who owns, manages and utilizes the information. Implementation of the application requires comprehensive training of employees, regular support and maintenance to ensure efficient and safe use. In addition, the article emphasizes activities in accordance with risk management and quality systems, such as the continuous development model.

In this article, application is proposed as a possible solution for improving workplace safety and safety culture in hospitals. The article highlights the benefits, challenges and necessary measures for the successful implementation of such innovations in the healthcare system and hospitals. Our smart solution aims to increase hospital safety culture. The aim of this article is to develop hospital workplace safety culture. Purpose of this article is to describe continuous safety and risk management to increase hospital safety culture.

Keywords: Hospital safety culture, Hospital safety application, Critical incident report system (CIRS), risk management, learning, feedback system

5.1 Introduction

Working must be healthy and safe. Since work is constantly changing, occupational safety management requires continuous development. Along with traditional risks, new loads, disadvantages and danger factors also arise. Factors such as hot work, biological exposures and human-caused risk factors. (Ihmisen toiminta turvallisuudessa ja inhimilliset tekijät 2023). According to Finnish laws and regulations, it is the duty of every employer to monitor the work environment continuously and systematically. In addition, the employer must find out the dangers caused by the work and assess the risks to the health and safety of the employees. In this way, the employer can find out if there are deficiencies in the working conditions that need to be corrected. Hazard assessment is also the most cost-effective way to act. (Vaarojen arviointi 2023.)

According to the European Commission's Framework agreement on harassment and violence the workplace violence refers to incidents in which persons are verbally insulted, threatened or abused in their work-related conditions and which directly or indirectly endanger their safety, well-being or health. Workplace violence can take the form of physical violence, threats of violence, bullying or harassment. (Framework agreement on harassment and violence at work 2007.)

Safe and healthy work conditions create well-being. The dangers, disadvantages and load factors related to work tasks must be identified. As a result of this investigation, we understand better the overall picture, based on which goals are set and operations are corrected in a planned manner. A good overall picture includes clear descriptions of, for example, responsibilities and duties, the safety of work and the work environment, and the management of workplace violence. (L 738/2002.)

One way to develop and improve safety is an application. A good example of this kind of innovation is the 112 Suomi application. The 112 Suomi mobile application helps in emergencies in other parts of Europe. Through the application, you can call the common European emergency number 112, in which case the call is always connected to the emergency center of the destination country. The caller's location information is transmitted using the application to the emergency center in those countries that belong to the Pan-European Mobile Emergency Apps (PEMEA) project. (112 Suomi sovellus 2023.)

This article presents our innovation, the mobile application. Application is a tool to improve workplace safety management and culture in hospitals. Our innovation is today's equivalent of a paper made pocket safety card. The paper pocket safety card contains important contact information

and operating instructions for dangerous situations. Paper pocket card can easily be carried in a pocket, just like a mobile phone. Our innovation brings hospital safety to today's level. The digital application is designed specifically for the whole hospital staff. Aim of this article is to develop hospital workplace safety culture. Purpose of this article is to describe continuous safety and risk management to increase hospital safety culture.

5.2 Safety culture in healthcare workplaces

According to Finnish Statistics the three most risky occupations to face harassment and violence are healthcare and nursing work (top in the figure 1), nursing work in the social sector (in the middle of the figure 1) and guarding and protection work (lowest in the figure 1). In figure one is those who experienced workplace violence among the employed by gender in high-risk occupations in 2007. (Piispa & Hulkko 2009.)

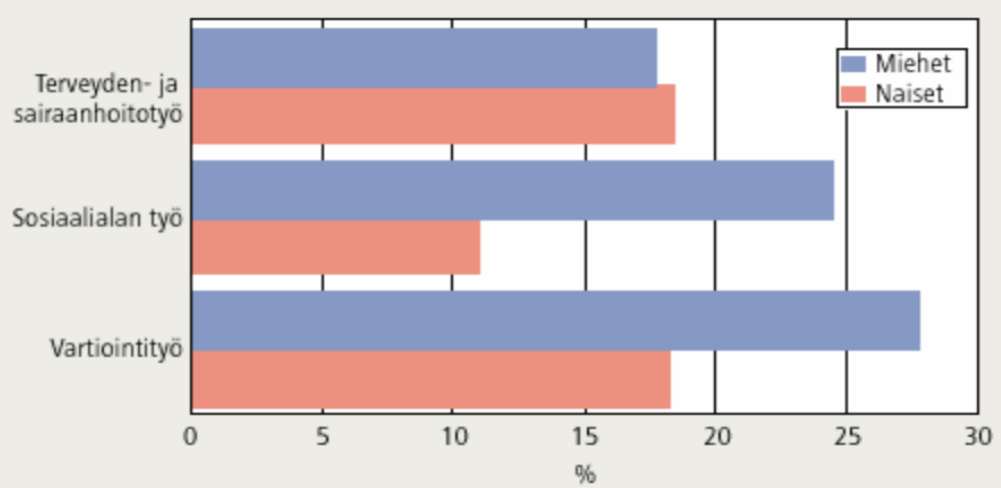

Figure 1. Three risky occupations to face workplace violence (Piispa & Hulkko 2009)

The perceived risk of being the target of violence or the threat of it at work weakens well-being at work. The experience often also reflects real experiences of workplace violence. This connection is particularly strong in occupational violence risk groups: healthcare and nursing work, nurses and counselors in the social sector, and guarding and protection work. In these occupations, being the target of workplace violence was 2-3 times more common among those who had assessed the risk of violence as higher than usual. (Piispa & Hulkko 2009.) According to the Finnish Institute of Occupational Health's Kunta10 survey, in the year 2016, 58,3% of the nursing workers

in the municipal sector faced harassment or violence from a client, and 38% of those who responded to the survey had encountered hitting or kicking by a client (Kunta10-tutkimus 2016).

In table 1 we see the changes in the United States healthcare security over the years. In the beginning 20th century, healthcare safety has mainly been fire safety and property maintenance. As we enter the 21st century we can see the changing challenges of healthcare security. New technologies, patient-related violence and threats related to terrorism are included in healthcare security. These changing security conditions must be taken into concern when today's security is made in healthcare. (York & MacAlister 2015, 24-26.)

Table 1. U.S healthcare security changes (York & MacAlister 2015)

Table 2-2 Summary of Changing Characteristics of U.S. Healthcare Security by Time Period

Period	Basic Changes/Characteristics of Healthcare Security
1900–1950	Primary duty was a fire watch as a function of maintenance and engineering.
1950–1960	A general law enforcement approach evolved.
1960–1975	The development of in-house security departments with expanded duties and responsibilities.
1975–1990	The security function was viewed as an integral part of management and the function became a valued component of the patient core team. Outsourcing of security increased.
1990–2000	Security continued to expand services while at the same time safety was generally separated into its own department. As risk management developed, security took on a greater role in prevention of incidents and improving emergency response capabilities. Somewhat in response to reduced police resources/response.
2000–2014	Increased patient-generated violence, terrorism concerns and organization demand for increased security services prevailed. New technology both aided security and created new and often complicated security risks. Increased violence and lack of mental healthcare resources created increased security support of patient care issues, downgrading overall protection levels.

The safety culture creates the basis for the organization's risk management. The safety culture is formed based on the organizational culture and the values, attitudes, experiences and views of the management and personnel. (Riskienhallinta ja turvallisuussuunnittelu 2011, 8). In the perspective of the hospital professionals, weakness in the values, attitudes, skills, competencies, and behaviors that determine the safety culture in a healthcare organization. Detachment from the hospital management and the unit management, in relation to professionals are related to poor working conditions and negative safety culture. Consistent interventions in these aspects provide a safe environment for both professionals and patients. (Carvalho, Göttems, Pires & Oliveira 2015, 1047.)

5.3 Theoretical foundation of our smart solution

In our article, we present three independent modules. These modules are the theoretical foundation and the basis of our innovation and this article. Each module is its own independent entity, which form a functional whole. We present these theoretical foundations in this section as their own sub-headings. Risk management and quality systems are the basis of these modules. We present this foundation as its own sub-heading.

Risk Management and quality system (PDCA) as a core of a safety

Risk management is management and activities at all levels of the organization, which everyone carries out in their own role. With the help of risk management, it is ensured that the organization has sufficient information about the risks of operations, actors and the operating environment. The organization management must have the necessary information about significant risks and plans to manage the risks. The organization must have adequate processing systems to handle damages. Risk management is the ethical and social responsibility of the organization. It's about people's mental and physical health as well as business and social interests. The goal of risk management is to improve safety. (Riskienhallinta ja turvallisuussuunnittelu 2011, 8.)

According to quality standard 9001, a process-like operating model (Plan, Do, Check, Act) and risk-based actions are effective for organization operations. The PDCA model can be used to ensure sufficient resources, management and opportunities for improvement. With risk-based thinking, preventive action models can be introduced (Laadunhallintajärjestelmät (ISO standardi nro 9001) 2015). Every organization must have a risk management process. The good risk management process should include risk assessment, risk identification, risk analysis and risk handling. One of the main purposes of risk management is to create and preserve value. In addition, risk management improves performance, supports innovations, and helps to achieve goals. Risk management is a process that requires continuous improvement. In the same way as the quality system. (Riskienhallinta (ISO standardi nro 31000) 2018.)

Figure 2. Hospital risk management (York & MacAlister 2015)

According to the York & MacAlister (2015, 28) hospital risk management, the typical form contains 14 different components (Figure 2). The hospital's risk management must consider all the risks of the organization. Naturally, the hospital's core function, the treating of patients is at the center of the hospital risk management. The health and safety of the staff is considered as part of these components.

(Non-medical) Critical Information Report System (CIRS)

In today's world, hospitals and healthcare facilities are constantly striving to improve their quality of care and patient safety. One key component of this effort could be the implementation of a non-medical Critical Incident Reporting System (CIRS). This system is designed to capture and report incidents that occur within a hospital or healthcare facility that are not related to medical treatment, but that could impact patient and hospital staff safety. For example, the most common type of workplace violence takes place between the clients which also includes family members or visitors of the patient and the healthcare workers. (D'Ettorre, Caroli, Pellicani, Ceccarelli 2020, 99.)

Non-medical CIRS could be an important tool for hospitals because it enables staff to report incidents such as equipment failure, falls, or other safety-related incidents. As non-medical CIRS are practiced in non-medical industries sowing the need of the CIRS to create a safe environment. By

collecting this information, hospitals can identify trends and areas for improvement, and implement targeted interventions to prevent similar incidents from occurring in the future. (Barach & Small 2000, 759.)

To enhance the effectiveness of non-medical CIRS, hospitals can also utilize a safety application. This application can be used by staff to report incidents in real-time, allowing for immediate action to be taken to address the issue. A study showed that the phenomenon of under-reporting can be partly reduced by using a user-friendly system for reporting incidents. (Ramacciati, Guazzini, Caldelli & Rasero 2021, 78.) The application can also be used to track the progress of incident resolution and provide feedback to staff on the status of their reports. The data which is collected by the CIRS software should be illustrated in the form of a dashboard which could be used by the hospital management or the security officers in the hospital to monitor for example the progress of safety measures. This system allows staff to report incidents without fear of retribution, ensuring that all incidents are captured and addressed. Additionally, the system provides hospital leadership with valuable data that can be used to make informed decisions and improve patient safety. (Morag, Gopher, Spillinger et al. 2012, 195.)

Learning as a part of the smart solution

Instructions serve to identify safety and health hazards and are intended to enable employees to take the planned measures. They are therefore an important part of occupational health and safety and are also legally binding (Unterweisen im Betrieb – ein Leitfaden 2008, 8). There are a variety of instructional topics in the hospital. These include, for example: behavior in the event of accidents and fire, preventive fire protection, skin protection, skin care and the wearing of gloves, the risk of infection and prevention, immunization options, the use of aids, the handling of hazardous substances, dangerous medicines, operating resources and machines (Sicheres Krankenhaus 2023, 108), behavior in emergencies, health at work, personal protective equipment, work routes and work organization (Unterweisen im Betrieb – ein Leitfaden 2008, 12-13.)

In principle, the instruction must be documented. The training topic and content must be specifically described, and reference must be made to the training bases used, such as operating instructions and skin protection plans. The instructed person must then confirm with his signature that he took part in the instruction and understood the content. At the end, the date for the repeat instruction can also be set, because they must be repeated regularly, usually annually and in the case of young people every six months. (Sicheres Krankenhaus 2023, 109 & 111.) Other

reasons for instruction can be the start of hazardous activities, new hires or transfers, changes in responsibility or in work processes, new work equipment, materials or processes, the results of factory inspections, accidents, near misses or other damaging events. (Sicheres Krankenhaus, 2023, 108.)

Good safety awareness, awareness of protection needs, simulation, training and staff motivation are essential to a successful safety program as safety officers are the first line of defense for patients and staff. The staff must react correctly in safety-endangering situations, such as aggression, evacuations, workplace violence and active shooters, and be trained in assuming their safety responsibilities. The security awareness offering should be tailored to the facility and include, for example, department-specific training, aggression management, de-escalation management, sensitivity training, restraint training, reporting, pandemic and disaster training, and personal safety. The main driving force behind the development of health care safety officer training has been litigation in the US and claims that healthcare organizations have failed to provide the necessary training, but a trained safety officer is at least twice as productive. To achieve effective training, on-the-job training should also take place, in which training takes place on the job and practical experience is imparted. In addition, a competency assessment should also take place to identify information and skills and present them in a learning objective concept. (York & MacAlister. 2015, 114, 225-226, 229, 233, 239, 242 & 250.)

In addition, playful elements can be used in the design of internet interventions or mobile health applications to increase their attractiveness (Dadaczynski & Tolks 2018). This is known as gamification. Examples of gamification techniques include digital rewards such as reward points, awards, medals; socially oriented techniques such as B. Avatars; Competitions between individual users or teams as well as feedback on what has been achieved, e.g., B. Progression in different performance levels, rankings or leaderboards. (Christmann, Hoffmann & Bleser 2017; Lehr & Boß 2019, 160.)

Apps allow learning environments to be used digitally and profitably. The app enables low-threshold access and use, as well as offering a high degree of interactivity. In addition, thanks to their modular design, they enable a high degree of flexibility and customization. The content can be edited autonomously and self-regulating, which can be supported by various auxiliary systems, and success control is made possible by the adaptivity and interactivity of the tasks. Other advantages of a digital learning environment are temporal efficiency, freedom from context and freedom and openness in design and use. (Kardas & Ludwig 2021, 24.)

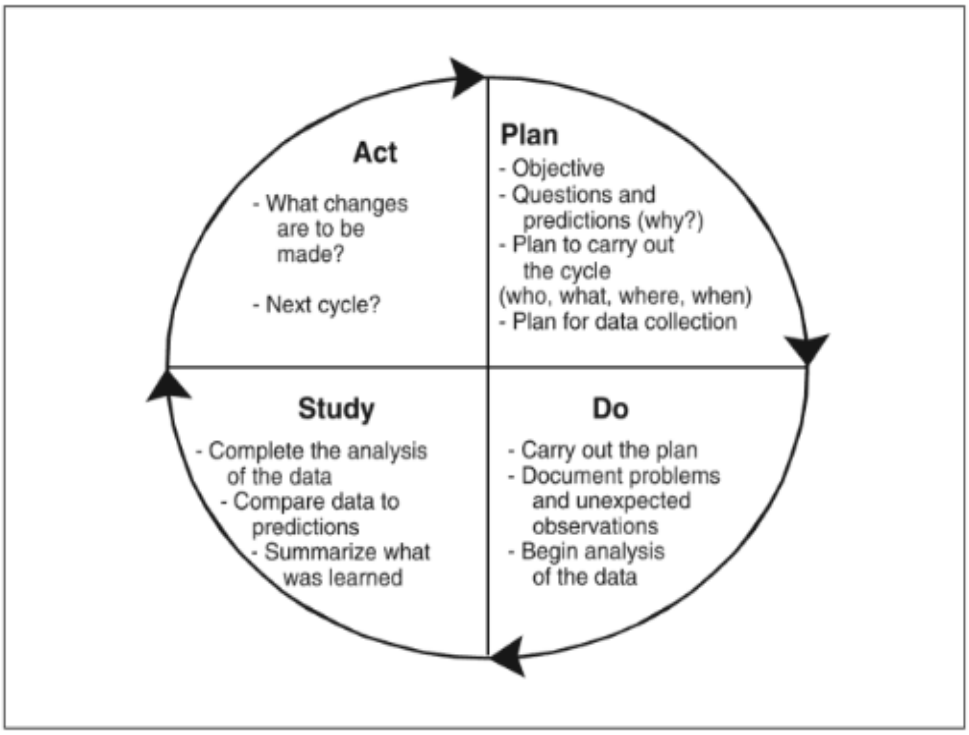

Figure 3. The PDSA cycle (Lloyd & Murray 2022)

The PDSA cycle from Lloyd and Murray is an efficient trial-and-learning methodology for Improvements and Learning (Figure 3). The PDSA cycle (Plan-Do-Study-Act) is an efficient trial and learning method for improvement and learning. The first step is the planning and the preparation of the prediction of the results. Planning is then carried out and data is collected. In the next step, the collected data is compared with the predictions and finally measures are taken based on the new knowledge. This process of knowledge generation is iterative and based on data. In order to receive learning and improvement, numerous small PDSA cycles are necessary, which ultimately have a large effect through synergy. This allows learning, the improvement of processes and the generation of feedback. (Lloyd & Murray 2022, 9-10 & 29.)

Feedback system

A central factor for the ability of high reliability organizations to act is a pronounced learning from experience and from mistakes in the work process. Permanent and conscious reflection and feedback serve as the basis for continuous learning from experience. (Mistele & Tolle 2006; Brandenburg & Faber 2008, 235.)

To sustainably increase the motivation to report errors and to achieve lasting success, regular feedback to the employees is of enormous importance. Because only if the feedback shows the

employees that their commitment has consequences and they notice that something is changing because of their reports, they will continue to be motivated by the success of their actions to uncover grievances and talk about mistakes. Another suggestion can also be to publish implementations to the employees. Feedback to employees can be given in different ways. To achieve shared learning through an incident reporting system, it is important that the reporting threshold of the feedback system is low. It shouldn't take a lot of effort to send a message. In addition, there must also be a culture of openness and the opportunity to talk about mistakes. The employees must also be continuously trained in the feedback system and be able to recognize the benefits. Furthermore, the voluntariness, confidentiality, non-punitiveness, responsibility and sustainability, compliance with the legal situation and ultimately the noticeable change are other important criteria of the feedback system. (Hofinger, Horstmann & Waleczek 2008, 215, 219.) The decisive factor for the efficiency of such systems is the quality of the reports and not the quantity, because an analysis of the incident can only take place with sufficient information (Neuhaus, Holzschuh, Lichtenstern & St. Pierre 2020).

It should also connect all stakeholders and involve them in a sustainable loop of seamless information flow. Furthermore, it should contain receiving the inputs, introducing changes and then evaluating the impact through the inputs received from the same system. By crowdsourcing innovative ideas and suggestions and the perspective of users, new insights can be gained that might otherwise be overlooked. In order to continue to maintain an efficient feedback system, it is important to give proper recognition to feedback in order to increase user confidence in the system. In addition, the feedback system itself must be dynamic and change over time to maintain traction. Publicizing the system widely and raising awareness of it can further increase participation and feedback. Consistent responses can be used as an indirect indicator to assess the effectiveness of interventions. The feedback system itself must be continuously evaluated and improved in line with the PDCA quality improvement cycle. The results and analyzes of the feedback, as well as the qualitative information, must be made available to everybody involved as soon as possible. The staff perceive timely information as more valid (Brown, Davidson & Ellins 2009; Gowda, Wankar, Arya, Vikas, Narayanan & Linto 2020.)

5.4 Innovation: HospiSafe – Hospital Safety Application

Our innovative and smart solution is an application for the entire hospital staff. As part of this article, we present our innovation. Our smart innovation process was guided by the question: is it possible to make hospitals safer for all with the hospital safety application? The objective was to make a modular application with separate modules and these separate functions complete each other and make the application as a functional whole. The aim of the application is creating an effective safety and risk management application for hospitals. The purpose of the application is to improve the hospital safety culture.

Innovation process

In the beginning of the smart solution process, we searched open sources on the internet. We founded different mobile solutions in the field of safety and security. We learned that there were already several different solutions and innovations as we see in table 2. Applications were available for the use and needs of individuals, companies or communities.

Table 2. Existing technologies

Existing technologies	
Vontra	Mobile application for healthcare workers
NWP Safety App	Mobile application with for example alarm function and instructions in different hazardous situations
SaferWatch Mobile Application	Mobile safety application for different industries
SafeTapp	Personal safety training and compliance application
PSAgress	Registered app to report violence against emergency nurses

In table 2 we have gathered a few of those safety applications from the open sources. This benchmarking was a part of our background information search in this smart solution. This search was made by google search with the word's safety application.

One method of getting to know the subject was discussions with experts. We had a discussion with a multinational company that makes, among other things, nurse call system solutions and personal safety systems. We also discussed the use and existence of hospital safety applications

in Finland with representatives of the security services of the Finnish HUS corporation. Discussions were also held with HUS's personnel management unit. In discussions with them, there were subjects such as challenges in the integration of education systems and personnel management systems. These conversations were open confidential discussions about the smart solutions topic, not interviews.

Conversations with the experts were not recorded or notes were not taken. These discussions could be characterized as a method expert interview, but these open discussions were not prepared in advance with questions, pre-experiments or training like an interview as in a research method. (Anttila 2023.) These discussions were open discussions on the topic and their repeatability and reliability as a research method mostly corresponded to general opinions.

Third method was literature research. The criteria for the literature search were the following: the material was full texts, boolean, free, the oldest article can be from 2006. The databases we used were Academic search complete (EBSCO-portal), Finna, Medic, PubMed Central and Google scholar. This search found 28 articles. The titles of the found articles were read and the most relevant were selected. Abstracts of these were read. In the end, only one of the articles from the literature review was selected for our article. We also used material found in other ways and with open searches, such as standards, in this article.

The content and functions of the application

The safety app for hospitals consists of three modules which are a CIRS for non-medical cases, a feedback system and an advanced form of safety instruction learning via app (figure 4). The process starts with the selection of a suitable safety app, making sure interoperability with the hospital information system is given, which is then integrated into the hospital's IT system and made available to employees. Employee training is crucial to ensure that everyone understands the new safety tools and how to use the safety app. This includes explaining the benefits of using the CIRS, feedback system, and advanced form of safety instruction learning.

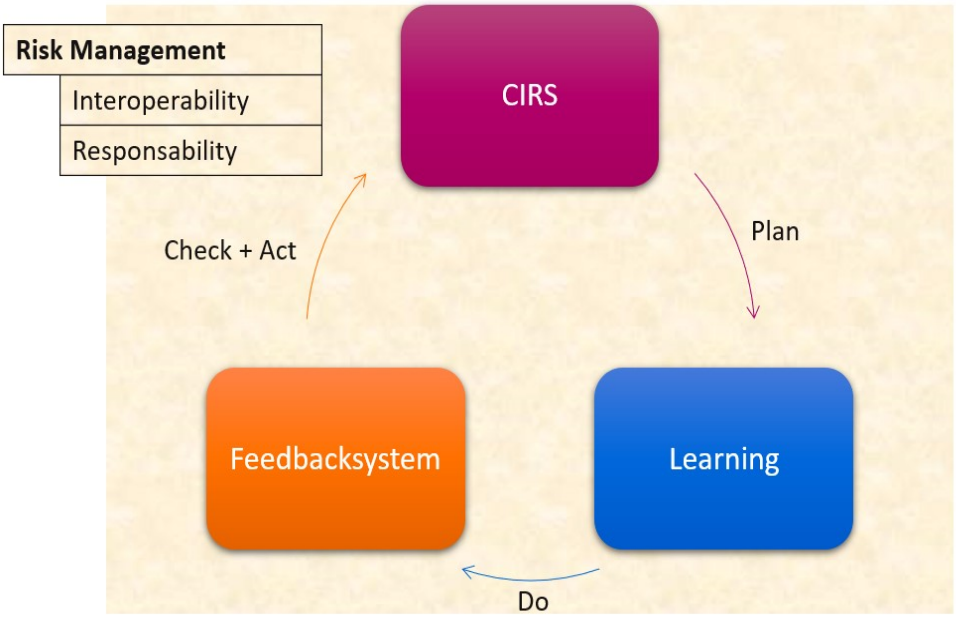

Figure 4. Innovation description process and the modules of the application

The CIRS is a key component of the safety app that enables employees to report non-medical incidents and safety problems. This reporting system helps the safety team identify safety risks and take appropriate measures to prevent similar incidents from occurring in the future. By providing a systematic approach to reporting incidents, the CIRS ensures that all incidents are documented and analyzed, allowing hospitals to identify trends and develop strategies to prevent incidents from occurring in the future. Once employees are trained, they are prompted to report any non-medical incidents or safety problems they notice in the hospital through the safety app. Details such as the location, nature of the incident, and the people involved could be provided.

To achieve a sustainable cycle of learning and to reduce risks for patients and employees, a feedback system is also integrated in the HospiSafe app. The collected reports are analyzed by a safety team in the hospital, who identify the root causes of incidents and take appropriate measures to prevent similar incidents from occurring in the future. Regular feedback is provided to employees on reported incidents and the measures taken to address them. The feedback system is an essential tool for communicating with employees about the effectiveness of the safety app and its impact on safety practices in the hospital. The system should enable employees to report feedback easily, quickly, uncomplicated and anonymously. Regular feedback on reported incidents and the measures taken to address them can help employees understand the importance of their role in maintaining safety standards. Additionally, sharing success stories can encourage employees to continue to report incidents and to take an active role in improving safety practices.

The safety app also offers an advanced form of safety instruction learning, such as access to training videos, tutorials, and other materials to improve employees' understanding of safety requirements and procedures. The Learning module in the HospiSafe app should enable individual safety training for every employee. The app should also remind you of the training and document it as soon as it has taken place. This should simplify the documentation and make it clear for the employee. Various games for the training should increase the motivation of the employees in the training and make it sustainable. Stars can also be awarded for completed training courses and thus a ranking and a small competition among employees or between departments can take place, which should serve as a further incentive. This ultimately results in efficient and sustainable training, which is fun for the employees and sustainable. The learning features of the app can be tailored to meet the specific needs of different departments or roles within the hospital, which were identified throughout the CIRS and the feedback-system ensuring that employees receive the training they need to maintain high standards of safety. The entire process is regularly reviewed and adapted to the hospital's needs, considering new insights from the analysis of reports and employee feedback.

A feedback report can also be sent to employees so that they can recognize the value of the reports and the resulting improvements and implementations as well as feedback statistics can also be created and viewed. These feedback statistics show, for example, how many reports were made in a defined period of time, for which area they were submitted and which group of people they affected. As a result, there should be a constant analysis of the efficiency of the system and a sustainability, optimization and early detection of risks, which in turn can be integrated into the learning, so that an efficient cycle of reporting risks and the resulting training to avoid and reduce risks. Risks and then feedback regarding the training and the risk reports can be given, and at the same time risks can be identified from the feedback and the feedback statistics and remedied through targeted training.

5.5 Discussion and conclusion

As stated earlier in the article, the healthcare safety culture creates the basis for the organization's risk management. Organizational culture is a phenomenon that expresses the way how feelings, perception and thinking are shared in the organization. Organizational culture affects how people interact, what information and things they consider important, and how they perceive the organization's goals and the means and how the goals are achieved. (Riskienhallinta ja

turvallisuussuunnittelu 2011, 8.) Our innovation aims to develop the organization's interaction, as well as the collection of important information and the management of important issues. These are part of the hospital's safety culture.

The risk management policy is a principal document drawn up by the management from a strategic point of view. To complement the documents, action programs related to the implementation and enhancement of safety, preparedness and risk management methods are also needed. These programs describe the means, actions and timetables by which the guidelines of the risk management policy are put into practice. (Riskienhallinta ja turvallisuussuunnittelu 2011, 9.) CIRS module is the risk gathering factor in HospiSafe application. It is the operation that gathers the staff's notes, safety deviations. We see that CIRS is one of the important previously mentioned means in the hospital risk management policy.

While developing a hospital workplace safety culture throughout a continuous risk management system our focus in case of hardware and software options was to identify several applications used in healthcare sector and non-medical sectors. In the following discussion, some specific opportunities and threats about the selected existing technologies in Table 2 are illustrated. Vontra is known for the “panic button” which is useful for hospital staff to report direct emergencies. Moreover, it has the ability to get access to emergency procedures documents and includes a chat function where photos or videos can be shared to the security forces to learn more about the situation. Also, a map is integrated which shows the location of defibrillators or medical equipment. (Chad Salahshour 2023.) This type of app is used to improve real-time events. The NWP Safety App follows the functions of Vontra, but also includes a more precise formulation of the incident through an improved reporting system which can be connected to the risk management system. (NWP Safety App nd.)

The SaferWatch app for hospitals offers a clearer structure in comparison. This user-friendliness is a crucial factor in increasing the number of reported events and thus reducing the phenomenon of underreporting. Only through a sufficient amount of data correlations and insights can be gained. This kind of system allows staff to report incidents without fear of retribution, ensuring that all incidents are captured and addressed. Additionally, the system provides hospital leadership with valuable data that can be used to make informed decisions and improve patient and staff safety. (Morag, et al. 2012, 195.) But as mentioned in a study about a user-friendly system (a smartphone app) for reporting violent incidents towards emergency nurses in the Emergency

Department, the accessibility and the user-friendliness cannot stand alone to avoid underreporting. Therefore, all stakeholders must be involved, to create a workplace safety culture. (Ramacciati et al. 2021, 78.)

One aspect of revitalizing this culture is through a more exciting and continuous form of training and learning of safety concepts. The app SafeTapp offers the possibility to do exercises, visualize progress and create certificates. In order to draw more attention to the topic of security, the gamification factor could also strengthen this area. In comparison to a pocket card which only shows instructions and important emergency numbers, a holistic safety app could strengthen the safety culture.

Learning from data will continue to increase due to increasing digitization and networking and the rapidly growing availability of data. The problem is that the data is often only used within departments and others have no transparency about the data and don't receive it. Frequently, this is made even more difficult by the fact that data is offered in proprietary formats and no comprehensive data use is permitted, so that it is absolutely necessary to create a company-wide data management structure in order to be able to improve processes, communication and quality. (Hoffmann 2023, 68-69.) The whole thing can be optimized through innovative solutions such as big data, machine learning and artificial intelligence, which develops, evaluates, analyzes and makes new data available so that new insights are gained that lead to improvements and greater efficiency. And this is where healthcare is lagging behind and many essential sources of data remain untouched. (Rüping & Sander 2019, 28; Auer, Hollenstein & Reumann 2019, 45.)

A good effective feedback system, which has already been pointed out, is crucial for any organization to improve hospital quality and keep up with ever-changing demands should be interactive, dynamic and lively (Murante, Vainieri, Rojas & Nuti 2014). But what are the advantages of an efficient feedback system and how does it have to be designed to be successful? A robust feedback system is essential to capture users' perception pulse and consequently improve service quality. Through the on-site experience, a hospital-specific feedback system can be designed and formulated, which offers a clearer added value for the hospital as if the basis is merely literature research. Efforts are currently being made to develop a real-time feedback system, because a dynamic feedback system based on machine learning and artificial intelligence tools can provide valuable data. Such a robust feedback system would be essential for overall quality improvement in healthcare. (Gowda et al. 2020.)

The conclusion of our article is that the application we designed meets today's safety challenges in hospitals. Safety and risk management with the application is significantly more versatile than with a paper pocket security card. With continuous risk management and safety management, the hospital's safety culture is improved, and our application enables this development. CIRS, which collects data, learning and a feedback system have been assembled into the modules of the application. The continuous risk management and quality system behind these guarantee an up-to-date reaction to safety situations and observations. We see that this entity develops the hospital's safety culture.

Since safety and safety culture in a hospital is a broad issue and there are many factors involved and to be considered, hospital safety is an activity that is constantly being developed. The next step in the development of the innovation could be, for example, solving the following questions: Is information collected from unidentified or identified users (anonymous or non-anonymous)? Who owns the collected data and how is it managed?

According to preliminary results, a decision support system (DSS) based on machine learning can support occupational health and safety (OHS) decisions by predicting accidents and incidents and evaluating the effectiveness of OHS measures. (Koklonis, Sarafidis, Vastardi & Koutsouris 2021.) It would also be good to implement the benefits of artificial intelligence and machine learning in the application. The goal of such an activity is naturally to make all functions and resources of the application actively available to the users of the application and the administrators of the information produced by the application. This kind DSS also supports our application to develop the safety culture of the hospital.

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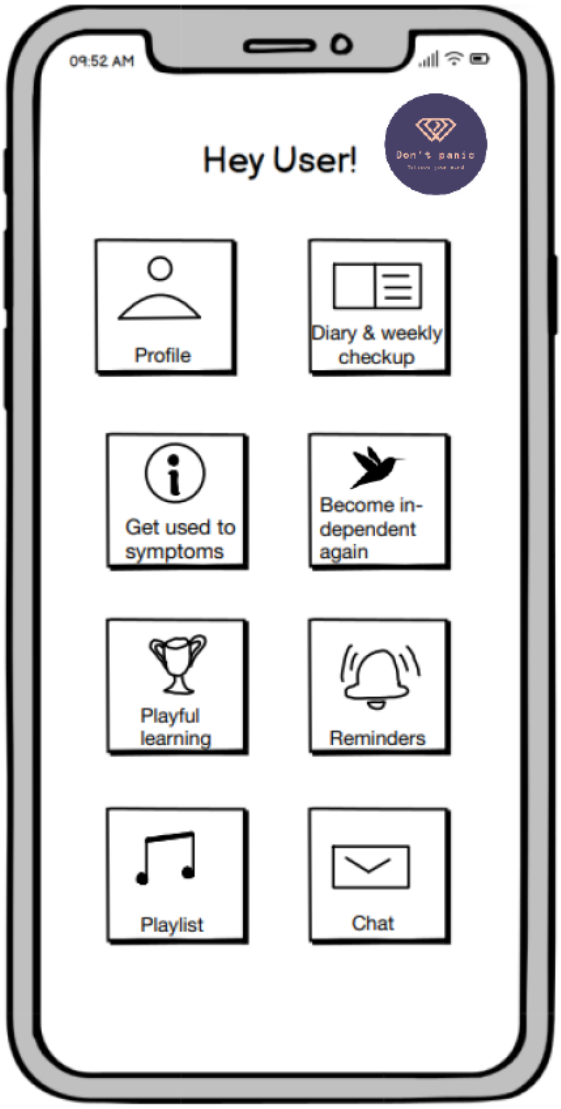
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