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Information sharing across instances

A case study of implementing an EHR in an emergency room

Master's thesis in Master of Science in Informatics

Supervisor: Babak A. Farshchian

June 2023

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Abstract

This study examines the implementation of the new electronic health record (EHR) Helseplattformen (HP) at the emergency room (ER) in Trondheim. The study aims to understand how access to shared information between different healthcare instances affects the physicians' work at the ER, and how it contributes to an information overload for physicians. A case study was conducted at the ER on the implementation of an EHR system in an ER setting. The HP project is based on the overarching national objective "one citizen - one health record", and serves as a national pilot project with the aim to introduce a common EHR system for primary and secondary healthcare in Central Norway. Many other comparable EHR implementations have shown several benefits and barriers, with varying degrees of success. However, the implementation of EHR systems in the setting of Norwegian healthcare and ERs is an area less explored. The implementation setting is very complex, with a broad specter of challenges, from patients with trivial cases to much more complex ones, in addition to some more acute situations. In addition to the standard in-house physician, the ER in Trondheim includes the ambulating car, which offers completely different challenges. Adapting the new EHR system to fit all the different settings and information needs at the ER is anything but simple, and a deeper understanding of the benefits and problems would be helpful for the ER, and likely other instances, or upcoming system implementations of HP.

At the ER in Trondheim, the new HP system has been in use for over a year, and the new EHR system with access to shared information from other healthcare instances has been shown to cause challenges. The findings from this research show that access to shared information is recognized as valuable in several cases. However, information overload limits the physicians' possibilities to utilize the system to its full potential, and access to quick information is limited. The responsibility for filtering out irrelevant information is put on the user, instead of the system presenting the user with the information needed.

Keywords Electronic health record, emergency room, information sharing, information chaos, information overload

Sammendrag

Denne studien undersøker implementeringen av den nye elektroniske helsejournalen (EPJ) Helseplattformen (HP) ved legevakten i Trondheim. Studien tar sikte på å forstå hvordan tilgang til delt informasjon mellom ulike helseinstanser påvirker legenes arbeid ved legevakten, og hvordan det bidrar til en informasjonsoverbelastning for leger. En case-studie ble utført på legevakten om implementering av et EPJ system i en legevakt situasjon. HP-prosjektet er basert på den overordnede nasjonale målsettingen ”én innbygger – én journal”, og fungerer som et nasjonalt pilotprosjekt med mål om å innføre et felles EPJ-system for primær- og sekundærhelsetjenesten i Midt-Norge. Mange andre sammenlignbare EPJ-implementeringer har vist flere fordeler og barrierer, med varierende grad av suksess. Implementering av EPJ-systemer i norsk helsevesen og legevakt er imidlertid et område mindre utforsket. Situasjonene rundt implementeringen er svært kompleks, med et bredt spekter av utfordringer fra pasienter med trivielle tilfeller til mye mer komplekse, i tillegg til noen mer akutte situasjoner. I tillegg til leger på selve legevakta, inkluderer legevakten i Trondheim en ambulerende legebil som byr på helt andre utfordringer. Å tilpasse det nye EPJ-systemet slik at det passer alle de forskjellige situasjonene og informasjonsbehovene på legevakten er alt annet enn enkelt, og en dypere forståelse av fordelene og problemene vil være nyttig for legevakten, men også for andre enheter, eller i kommende implementeringer av HP.

Ved legevakten i Trondheim har det nye HP-systemet vært i bruk i over ett år, og det nye EPJ-systemet med tilgang til delt informasjon fra andre helseinstanser har vist seg å skape utfordringer. Funnene fra denne studien viser at tilgang til delt informasjon er anerkjent som verdifull i flere tilfeller. Informasjonsoverbelastning begrenser imidlertid legenes muligheter til å utnytte systemet til sitt fulle potensial, og tilgangen til rask informasjon er begrenset. Ansvar for å filtrere ut irrelevant informasjon legges på brukeren, i stedet for at systemet presenterer brukeren den informasjonen som trengs.

Søkeord Elektronisk helsejournal, legevakt, informasjonsdeling, informasjonskaos, informasjonsoverbelastning

Preface

This report is a master's thesis written in the spring of 2023 as a final project of the study Master of Science in Informatics at the Norwegian University of Science and Technology (NTNU).

The research in this thesis was a part of the PlatVel research project, which looks at the implementation of Helseplattformen in municipal healthcare services in Central Norway.

I would like to thank everyone involved in this research from the emergency room in Trondheim for their time and participation through planning and organization, observations, and interviews.

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Abbreviations

Care institution	=	Omsorgsinstitusjon
Electronic health record (EHR)	=	Elektronisk helsejournal
Emergency department (ED)	=	Akuttmottak
Emergency medical communication centre (EMCC)	=	Akuttmedisinsk kommunikasjonsentral (AMK)
Emergency network	=	Nødnett
Emergency room (ER)	=	Legevakt
General practitioner (GP)	=	Fastlege
Healthcare instance	=	Instans innen helsevesenet
Healthcare sector	=	Helsesektor
Healthcare service	=	Helsevesen
Home care	=	Hjemmetjeneste
Out-of-hours medical service	=	Legevaktsteneste
Outpatient clinic	=	Poliklinikk
Primary care	=	Primærhelsetjenesten
Safety patroll	=	Trygghetspatruljen
Secondary care	=	Spesialisthelsetjenesten
Summary care record (SCR)	=	Kjernejournal
Targets of impact	=	Effektmål

1 Introduction

1.1 Background and motivation

In today's society, we all are surrounded by and use more and more digital platforms to solve different tasks, communicate, and share information with each other in our everyday life. This is no different in the public sector, where the Norwegian government communicated through the government initiative "One digital public sector" (Moderniseringsdepartementet, 2019) that the goal of digitalization is to contribute to a more efficient public sector, higher value creation in the Norwegian business community, and a simpler every day for the Norwegian citizen in general. To achieve this, the different units within the public sector must communicate and share information, especially within the healthcare sector and between different healthcare instances.

In the central-Norway region, the new electronic health record (EHR) system Helseplattformen (HP), has been implemented and in use for just over a year in the municipality of Trondheim, at St. Olavs Hospital since November 2022, and has been taken in use in several other municipalities up until today. The overarching goal for the HP project is the national objective "one citizen - one health record" (ehelse, 2021), and to introduce a new EHR system for all the healthcare services in Central Norway, including healthcare institutions, municipalities, General practitioners (GPs), and private operators, to establish a more coherent healthcare sector for both patients and staff throughout the region. Sharing information between the different healthcare instances is a central part of this vision of "one citizen - one health record" and the introduction of the EHR system. This sharing and access to new information can simultaneously come with new challenges, information overload being one of them. For healthcare workers, the new EHR system should mean a shared health record of patients with access to timely shared information from other healthcare instances, providing physicians with easy access to clinical patient information and laying the ground for more informed decisions without requesting information from externals. However, this has proven not to be entirely the case. *"The biggest concern is perhaps that one gets such an 'information overload', it is impossible to find what we need"*, was stated by a physician during interviews.

Access to timely information and sharing patient health data between different health instances are required for safe care (Wilson et al., 2021). However, implementing EHR systems in healthcare has shown to be challenging, with varying success and benefits achieved, facing several barriers on the way. Access to more information has shown not always to be as straightforward as one could think, as "EHRs can transform the quality, comprehensiveness, timeliness, and accessibility of information in both positive and negative ways" (Beasley et al., 2011). The strategies for deciding which information is relevant have not evolved at the same pace as the means of producing information (Klerings et al., 2015). Finding the balance between too much, or too little information, is critical for an EHR record to be viable (Jenkins and Wilson, 2007), and finding this balance is seen to be a challenge in the new HP system.

This research project therefore focuses on the sharing of information across different healthcare instances, looking at the situation at the ER in Trondheim. Investigating the access to and use of available information at the ER, the research tries to answer why an information overload occurs among physicians using the new HP system in an ER setting.

1.2 Scope

This case study focuses on the Helseplattformen project in Central Norway, introducing a new common health record system aiming to include every instance of healthcare in the region. The study aimed to go deep rather than broad, and to be able to do so and concentrate the research, a scope was set. The scope and focus of this research were set to focus on the implementation of HP at the emergency room (ER) in Trondheim. The setting around the ER sometimes includes huge workloads and time pressure. It contains patients with a broad specter of challenges, everything from patients with trivial cases to much more complex ones, in addition to some more acute cases. A central part of the ER is also the ambulating car which, in addition, offers completely different challenges, making the introduction of the new EHR system at the ER a complex and challenging case. The research is a snapshot of the situation at the ER from mid-January 2023 to the beginning of June 2023.

1.3 Research questions

The purpose of this study is to understand how the new EHR system contributes to access to shared information, how the physicians at the ER perceive and use this information, and why the issue of information overload occurs. To contribute to this understanding, two research questions were defined:

RQ1: How is access and use of information at the ER?

RQ2: How does the EHR contribute to an information overload for physicians?

1.4 Method

The strategy chosen to answer the research questions is a short-term exploratory case study, utilizing data collection through observations and interviews. The research question was answered by qualitatively analyzing the generated data.

1.5 Contribution

This research will contribute to the topics of implementation of EHR systems, information sharing in the healthcare sector, and the topic of information overload. Hopefully, the findings from this research can contribute to knowledge about how the introduction of shared information affect the work of physicians at the ER, and how the new EHR system could be further adapted to support their work and information need. The findings show that implementing an EHR system at an ER in Central Norway can cause challenges to physicians when dealing with an information overload. The findings also show that access to shared information is recognized as valuable in several cases, but information overload limits the possibilities of utilization.

1.6 Outline of thesis

Chapter 1: Introduction

This chapter introduces the thesis. It includes a brief description of the background and motivation behind the study, the scope of the research, the research questions and the method chosen to answer them, the contribution, and lastly, the structure of the thesis.

Chapter 2: Background

The second chapter consists of all necessary background theories for the case study and to discuss the findings. The background is divided into seven main sections: electronic records, EHR, earlier implementations of EHR systems, EHRs in an ER/ED setting, sharing and access to information, information chaos, and information overload. In the end, the chapter includes a Summary of background theory.

Chapter 3: Case description

The third chapter presents the case under study and the needed background information to be able to understand the findings.

Chapter 4: Method

This chapter presents the conceptual framework and the research strategy used in the study. It presents information on the pre-study leading up to this thesis, the methods used for data generation and analysis of data, and concludes with a reflection part around the method.

Chapter 5: Findings

This fifth chapter presents the findings of the case study.

Chapter 6: Discussion

This chapter contains a discussion of the findings from Chapter 5 in light of the theory from Chapter 2, along with some implications from the findings and the limitations of the research.

Chapter 7: Conclusion

The last chapter contains the conclusion of the study and the answers to the research questions based on what was discussed in Chapter 6. At last, it contains a section on future work.

2 Theoretical background

This chapter will present relevant background theory to understand what an electronic record is, what an EHR system is, and how it differs from other record systems. It will present previous experiences of similar EHR implementations in general healthcare settings and other ER and ED settings, with related benefits and barriers discovered. The following sections highlight the benefits of implementing an EHR system, such as information sharing and access, along with the challenges of information chaos and information overload. In the end, a summary of the most important points from related background theory is presented.

2.1 Electronic records

An Electronic Record is an information system used within healthcare containing digitized medical information. There are several different terms used on such electronic record systems, often used interchangeably and regarded as the same thing. (Smolij and Dun, 2006) said that although *Electronic Patient Records* (EPR), *Electronic Medical Records* (EMR), and *Electronic Health Record* (EHR) have differences between them, "all these terms describe systems that provide a structured, digitized and fully accessible patient record" (Smolij and Dun, 2006).

(Garets and Davis, 2006) highlights some of these differences, and said that the terms EHR and EMR are often used interchangeably and regarded as the same thing, but describe two different concepts. Garets and Davis explained EMR systems as an application environment composed of several elements, among them clinical data repository and decision support, and support the patient's EMR across inpatient and outpatient environments. Hence an internal organizational system that healthcare practitioners use to document, monitor, and manage healthcare delivery within a care delivery organization (CDO). "The data in the EMR is the legal record of what happened to the patient during their encounter at the CDO and is owned by the CDO" (Garets and Davis, 2006).

Garets and Davis continue by defining EHR systems as a subset of each CDO EMR summarised, it is owned by the patient and has patient input and access that spans episodes of care across multiple CDOs (Garets and Davis, 2006). The EMR system spans multiple CDOs within a community, region, state, or in some cases the entire country. One prerequisite for an EMR system to exist is that the various EMR systems from CDOs have evolved to the level that can create and support the exchange of information between different stakeholders. Heart et al. summarize it by saying "Whereas EMR is usually considered an internal, organizational system, the EHR is defined as an inter-organizational system" (Heart et al., 2017). Gunter and Terry highlight one other important concept as well with their definition: "EHR is an evolving concept defined as a longitudinal collection of electronic health information about individual patients and populations" (Gunter and Terry, 2005).

2.2 EHR

An alternative definition of an EHR defined by the International Organization for Standardization (ISO) in ISO/TR 14639-1:2012(en) (International Organization for Standardization, 2012), presented in the study by (Tsai et al., 2020) is as follows:

”Information relevant to the wellness, health and healthcare of an individual, in computer-processable form and represented according to a standardized information model, or the longitudinal electronic record of an individual that contains or virtually interlines to data in multiple EMRs and EPRs, which is to be shared and/or interoperable across healthcare settings and is patient-centric.” (International Organization for Standardization, 2012)

The definition by ISO and the one we previously saw from (Garets and Davis, 2006) are not identical but contain the same core concept. An EHR contains a patient-centric collection of information from several EMR/EPR systems over time, to be shared across several healthcare instances.

Although an EPR system, according to ISO/TR 14639-1:2012(en) (International Organization for Standardization, 2012) is defined as an “electronic record of an individual in a hospital or health care facility, which is typically in one organization and is facility-centric,” the terms EHR and EPR are several times used interchangeably and regarded as the same thing. Priestmain et al. presented the procurement process at Great Ormond Street Hospital as a ”procurement process for a comprehensive electronic patient record/electronic health record (EPR/EHR) system” (Priestman et al., 2018). Because of the similarities in the definitions of an EHR and an EPR, where both emphasize the factors of a record for a person in an organization and not a single CDO, and the interchangeable usage in literature. In this thesis, we will therefore regard EPR and EHR as the same system type but refer to them as only an EHR.

2.2.1 Epic electronic health record

Epic is one such EHR system developed by the American Epic Systems Corporation. Implementing the Epic EHR system in Central Norway through the project Helseplattformen involves a new system covering all functionality for patient records and patient-related administrative functions in the healthcare sector (Helseplattformen, 2023c). An essential part of the Epic software that Helseplattformen is built on, and is one of the critical functions making it an EHR system, is what Epic calls *Care across the continuum* (Epic, 2023a). This part of the software has the primary goal of facilitating ”A connected team with the patient at the heart, driving quality and safety across settings” (Epic, 2023a). Focusing on continuing care beyond the walls of the care instance, providing a holistic view of a patient’s story for primary and specialty care providers, and patients with acute needs in the hospital, emergency room, and long-term care facilities. Help care providers understand each patient’s needs and surface the most important information from routine to complex cases (Epic, 2023a).

The Epic EHR system has been implemented in several leading hospitals and other health institutions in the USA, including healthcare in countries like Australia, Denmark, Finland, Netherlands, Switzerland, and the United Kingdom (Epic, 2023b).

2.3 Earlier implementations of EHR systems

Implementing new EHR systems into existing health organizations is a complex task and has had different outcomes, from successful to not-so-successful implementations. Success is hard to measure in many cases. Therefore, another way is to consider benefits, challenges, and/or barriers related to implementations instead.

2.3.1 A one-way view from within existing system

The paper by Wilson et al. presents the successful establishment of the Great North Care Record (GNCR) in the UK, a new EHR system (Wilson et al., 2021). The GNCR approach connected existing health IT systems in the region, building on previous investments in technology. The new system was built on the installed technical base and used a modular approach, where the first step was to give secondary care staff a one-way view of an attending patient’s primary care record. It allowed this access with one button click from within the context of the secondary care electronic patient record (EPR). It gave the hospital clinicians a richer picture of the healthcare record than they had previously had. It was stated that ”sharing of personal health data between primary and specialist healthcare is required for safe care” (Wilson et al., 2021).

The study found that the direct beneficiaries of this new way of working were those specialist healthcare practitioners and the patients and service users themselves. GPs reportedly benefitted from fewer phone calls from other care delivery organizations seeking additional information (Wilson et al., 2021).

2.3.2 Literature review on success, failure, and implications of EPR system implementations

Priestman et al. conducted a literature review of published peer-reviewed literature on factors related to success, failure, and implications of electronic patient record (EPR) system implementations (Priestman et al., 2018). The review results found that EPR implementation, in general, is associated with ”improvements in documentation and screening performance and reduced prescribing errors, whereas there are minimal available data in other areas such as effects on clinical patient outcomes” (Priestman et al., 2018).

One outcome presented was that EPR use is associated with improved laboratory safety and patient identification, less labeling and requesting errors, and shorter response times. One reviewed paper by Raval et al. found that EPR-based handover between staff is associated with reduced clerical errors, greater satisfaction, and improved efficiency, accuracy, and safety (Raval et al., 2015). Another paper reviewed by Reed et al. stated that ”electronic health records increase access to timely and complete patient information at the point of care, with the potential to improve the quality and efficiency of care delivered, including improved care coordination” (Reed et al., 2013). While examining the association between implementing a commercially available outpatient EHR and emergency department (ED) visits, hospitalizations, and office visits for patients with diabetes mellitus, they found that ”in patients with diabetes, EPR use results in significantly less emergency visits, overall doctor visits and hospitalisations” (Priestman et al., 2018). However, this study is limited by just looking at the benefits of EHR systems and the benefits for patients with diabetes mellitus.

2.3.3 Implementation of organization-wide EHR systems in five outpatient clinics

A case study by Vos et al. looked into how the implementation of organization-wide EHR systems in five outpatient clinics in a Dutch hospital influenced collaboration among medical specialties, in terms of facilitating and constraining (Vos et al., 2020). It presents several challenges pointing at how EHRs can limit collaboration, information sharing, and

information flow between healthcare professionals. The study used a framework for collaborative affordances to demonstrate how an EHR facilitates and constrains collaboration among specialties and disciplines, highlighting why affordances were not fully actualized. Vos et al. identified six collaborative affordances where the EHR facilitated and/or constrained collaboration within and between disciplines and medical specialties: portability, co-located access, shared overview, mutual awareness, messaging, and orchestrating (Vos et al., 2020).

One factor Vos et al. found important to provide high-quality care was the importance of integrated information resources. Interviewees stated that the medical history and problem lists were highly important since these clinics often treat patients with extensive medical histories (Vos et al., 2020). On the other hand, several constraints were also found with the EHR implementation.

Some constraints were related to an information overload and the effect on the quality of the shared overview provided by the EHR. "A very large number of notes were created in the EHR, in part because these could only be changed by their owners. Concerns [...] about the quality of the shared overview since this was complicated by dozens of notes by various specialists. [...] The large number of notes negatively affected the quality of the shared overview. [...] Since data were ordered on priority and not on the chronology of events, all the interviewed medical specialists felt impeded in easily understanding what had occurred in the medical timeline of their patients." (Vos et al., 2020). Another constraint mentioned was that the EHR did not include adequate search functionality, impeding users from connecting the correct diagnosis with an appropriate code. "Many physicians also argued that entering and reading large amounts of patient information is time consuming, creates information overload" (Vos et al., 2020).

The way the EHR had an inward-looking focus on the hospital was seen to complicate collaboration and information sharing with healthcare providers outside the hospital. "This study showed that shared data can be difficult to use when the user interfaces differ among work units" (Vos et al., 2020). A factor constraining mutual awareness in the EHR was that information was not clearly represented. Vos et al. presented two reasons: (1) the shared overview was not clear because each specialty entered the data differently, which negatively influenced the mutual awareness between medical specialists of different specialties, and (2) the data in the EHR were sorted on priority what impeded specialists in seeing what had happened in the medical timelines of their patients (Vos et al., 2020).

One paper referred to pointed out that the ability to find necessary information is a key element in data accessibility. They found that "data quality and accessibility issues have been found to threaten the EHR's usefulness for multidisciplinary relationship building, communicating, coordinating, and collaborative decision-making" (Chase et al., 2014).

2.4 EHRs in an ER/ED setting

The ER/ED setting within healthcare can differ somewhat from other instances. Mullins et al. said that EHR and cross-institutional or national repositories that support the electronic exchange of health information play an important role in the transformation of healthcare, "particularly in the emergency setting where clinicians make decisions without prior information" (Mullins et al., 2021). However, the information needed in the emergency setting can differ from what is essential in other instances. Miles et al. shared the problem that communication channels between healthcare providers and across different

settings are often suboptimal, with the potential that this problem "leaves a potential gap in which accurate details of a presenting patient's history may not be readily available at the point of care" (Miles et al., 2019).

2.4.1 Towards routine use of EHR in Australian EDs

The paper by Miles et al. highlighted barriers and benefits related to the project "My Health Record in EDs" in Australia, an implementation of an EHR record (Miles et al., 2019). The main finding from the study was that the use of My Health Record supported ED clinicians by providing timely and secure access to previous patient information and reducing the time taken for clinical decision-making (Miles et al., 2019). The ED staff could ease access to patient info external to the ED by substituting existing time-consuming methods such as fax and phone. The user interface access and design were found to be a factor that could affect the record's usability, and the lack of content in the record was said to be a factor contributing to the records not being accessed.

The paper concluded that My Health Record could support healthcare providers in EDs by providing timely and secure access to a patient's clinical history. In addition, the project is likely scalable to other clinical disciplines outside the acute setting, as many of the barriers and enablers regarding EHR usage are also familiar to other healthcare providers (Miles et al., 2019).

2.4.2 Physicians' and pharmacists' use of My Health Record in the emergency department

Mullins et al. studied the usage of Australia's national personally controlled EHR, My Health Record, in the emergency department. Focusing on perceptions of use, barriers to use, and healthcare outcomes among pharmacists and physicians (Mullins et al., 2021). Physicians in this study were found to access the records mainly for problematic cases and on an as-needed basis.

One highlighted benefit for the physicians in the study was the reduced time spent by patients in the ED due to the avoidance of unnecessary tests and scans. The efficiency of especially after-hours care, when the patient's GP or pharmacy may be closed, and the patients fail to communicate their current medication, was another example of particular benefits of EHR use.

The study found that physicians used the available records to replace other sources of information, considering it a valid and trustworthy information source that is best used on an as-needed basis. A quote from one physician in the study said that: "if it's a straightforward problem... I usually don't go and check it [EHR]. But, if it's [a problem like] I've had dizzy turns before, and a couple of years ago I was seen by a neurologist, but I can't remember his name now, and he did some tests, but I can't remember what tests they were - then I might look in it [EHR]" (Mullins et al., 2021). The EHR was useful to the physicians in cases where historical data could bring some value or other stored information such as discharge notes, the patient's medical history, radiology or test results, or anything that might be seen as helpful.

Along with the benefits of EHR usage, several barriers to use were found, the most frequently occurring barrier being the presence of incomplete or irrelevant information in the EHR. One physician in the study said valuable information was hard to obtain when

checking patients during a shift and found in only a few cases (Mullins et al., 2021). The issue of trust was also raised, and trust-related concerns were associated with the timeliness of information within the records. Many records were said to contain old information only, and the exclusion of things initiated and tried but later discarded was not necessarily done.

2.5 Sharing and access to information

The study by Jerkings and Wilson gathered data from healthcare staff on the topic of EHR implementation and sharing of information throughout ten focus groups (Jenkings and Wilson, 2007). Their findings from these focus groups and discussions about EHRs resulted in the topics of sharing information, access to information, record content, confidentiality, patient consent, and implementation.

The findings presented that electronic sharing of information could have the effect of significantly reducing duplication of work. This included reducing the considerable amounts of computer-based information that was shared by being printed onto paper and sent to other instances by hand, post, or fax. At the same time, this could reduce the need for data to be re-keyed or re-entered into the receiving instance's information system. Another advantage of EHR implementation and its information sharing was eliminating patients having to retell their medical histories at every healthcare instance they meet. The study found that more information sharing between healthcare instances, such as between primary and secondary care, was a positive development. From the group members' various experiences of information sharing, the instance of out-of-hours GP services was found where major improvements could be made by information sharing.

On the other side, some issues were found when it came to the content of the EHR. They found that defining the content of the record to suit specific instances in a systematic way would be problematic. The issue of the need to find the balance between too much, or too little, was critical for such a record to be viable (Jenkings and Wilson, 2007).

2.6 Information chaos

Beasley et al. said that "EHRs can transform the quality, comprehensiveness, timeliness, and accessibility of information in both positive and negative ways" when talking about the implementation of EHR implementation in primary care (Beasley et al., 2011). Beasley et al. talked in their paper about information chaos in primary care and identified five specific information hazards that arise and can lead to information chaos: information overload, information underload, information scatter, information conflict, and erroneous information. It is stated that "Information chaos is more than inconvenient, annoying, and frustrating; there are operational implications that can impair physician performance, increase workload, and reduce the safety and quality of care delivered" (Beasley et al., 2011). The hazard of information overload "occurs when there are too many data (e.g., written, verbal and nonverbal, physician's memory) for the clinician to organize, synthesize, draw conclusions from, or act." (Beasley et al., 2011).

Beasley et al. list three main factors that affect the magnitude of the problem in dealing with information chaos and the impact it has on the quality of care delivered by physicians: interruptions, expertise, and time (Beasley et al., 2011). Interruptions risk shifting the physician's attention away from the primary task, like interruptions in the EHR system

and memory of the primary task decaying as a result. A lack of expertise can affect the physician's ability to handle information chaos, reducing situational awareness and increasing mental workload, potentially impacting the less experienced clinician. "When information chaos occurs in a time-constrained environment (e.g., during a 15-minute visit for a patient with several chronic conditions and medications to manage), the impact on physician performance is exacerbated. Time is perhaps the most important resource available to deal with information chaos" (Beasley et al., 2011).

Reducing the risk of information chaos "requires mechanisms to ensure that the necessary information is available and presented in a useable manner at the right time" (Beasley et al., 2011). Beasley et al. propose two strategies, preparation before a visit and EHRs. In relation to the EHRs, it is highlighted that even tho they contribute to timely and available information, caveats exist. "As more and more data are available in an EHR, there is an even greater need for improved search methods and display techniques to present the data needed at the time of the patient visit" (Beasley et al., 2011).

2.7 Information overload

In this thesis, we adopt the definition by Hall and Walton on the concept of information overload (Hall and Walton, 2004). They define the concept and sum it up by suggesting that "information overload occurs when information received becomes a hindrance rather than a help when the information is potentially useful" (Hall and Walton, 2004). They also provide another perspective on the concept, saying that "the problem of information overload is not so much as an actual overload but as symptom of the failure to create 'high quality' or 'value added information' from the large amounts of information available" (Hall and Walton, 2004).

This concept of information overload is not new within the healthcare setting, and "information overload is present at every level of the healthcare system" (Klerings et al., 2015). Klerings et al. used the concept of "filter failure" introduced by the American journalist Clay Shirky to frame the problem. He stated that: "From this perspective, the "problem" of information overload is not that there is too much information, but that the strategies for deciding which information is relevant have not evolved at the same pace as the means of producing information" (Klerings et al., 2015). According to Klerings et al., the problem, when adapting this view of information overload, is not that there is too much information present but is the individual's ability to actually use the information at their disposal and is depending on the performance of their "information filters" (Klerings et al., 2015). One aspect pointed out contributing to the problem of information overload is that it "arises from the proliferation of information about the individual patient, for example, in using electronic health records that mix data needed for billing and legal protection with that needed for clinical care" (Klerings et al., 2015).

2.8 Summary of background theory

From the literature on relevant background theory, it has been seen that several different types of record systems exist. In many cases, terms are used interchangeably and regarded as the same thing, but important differences exist between them. To avoid further confusion, this study defined what we mean by the different terms EHR and EMR and why we regard EHR and EPR as the same type of electronic records.

Previous implementations of EHR systems, with different approaches and implementations in different settings, have had varied results. Several benefits and barriers have been seen in healthcare organizations in general and the setting of ER/ED. EHR systems and the sharing and access to information it provides can both provide considerable benefits and, at the same time, cause problems and barriers to use. Previous implementations have also seen information chaos and information overload challenges when implementing EHR systems. A summary of the main points from the literature on relevant background theory can be seen in Table 1.

Theme	Findings from literature
Electronic record	An information system used within healthcare containing digitized medical information.
Electronic medical record (EMR)	An internal organizational system that healthcare practitioners use to document, monitor, and manage healthcare delivery within a care delivery organization.
Electronic health record (EHR)	A patient-centric collection of information from several record systems over time, to be shared across several healthcare settings or institutions, an inter-organizational system.
Epic EHR	The EHR system Helseplattformen is built on. An EHR system to facilitate care across different healthcare instances and provide access to shared and timely information.
Found benefits with EHR implementations	Access on an as-needed basis of patient records was found to be valuable by (Wilson et al., 2021), (Miles et al., 2019), and (Mullins et al., 2021). Reduced use of other communication such as phone, fax, or retelling information was found in the studies by (Wilson et al., 2021), (Miles et al., 2019), and (Jenkins and Wilson, 2007). Increased access to timely and complete information, and previous medical history (Wilson et al., 2021), (Reed et al., 2013), (Priestman et al., 2018), (Vos et al., 2020), (Miles et al., 2019), and (Mullins et al., 2021). Improved satisfaction, safety, quality, and response time, and reduced errors, visits, and hospitalizations (Priestman et al., 2018). Avoidance of unnecessary tests and scans (Mullins et al., 2021).
Found barriers with EHR implementations	Information overload and limited quality of shared information, lack of search functionality, complicated information sharing with externals, and lited overview (Vos et al., 2020). User interface access and design, and lack of content in records (Miles et al., 2019), (Mullins et al., 2021). The presence of irrelevant information and lack of exclusion of old information about started and discontinued treatment (Mullins et al., 2021). The ability to suit specific instances, with a balance of too much and too little information (Jenkins and Wilson, 2007).
Information chaos	Caused by information hazards such as information overload, information underload, information scatter, information conflict, and erroneous information and can cause impair physician performance, increase workload, and reduce the safety and quality of care delivered. Interruptions, expertise, and time can further affect the magnitude of the problem.
Information overload	Too much potentially useful information leads to a hindrance rather than help, reducing the ability to create high-quality information that adds value. It can be viewed as a failure to filter out what is perceived relevant from all the presented information.

Table 1: Summary of background theory

3 Case description

In this chapter, an introduction to the case under study in this research and master thesis is presented. The first section will look closer at the new EHR system Helseplattformen (HP), which went live in Trondheim municipality, including the emergency room in Trondheim and two GP offices just over a year ago in May 2022. It describes the HP project in general, the implementation process, the goals of the system, and how preparations leading up to the new EHR system were handled. The following section goes more into the tasks of an emergency room (ER), and how ERs are organized, first on a general level and then more specifically for the ER in Trondheim. In the last section, we will look at what the practice of "assessing a health condition" looked like before the introduction of HP, and what the desired situation would be like after the implementation of the new EHR system.

3.1 Helseplattformen

In 2012 the Norwegian government published the initiative *Én innbygger - én journal* (ehelse, 2021), or translated *One citizen - one health record*. The goal was to ensure that necessary health information follows you throughout the entire patient process, and with that give patients and residents safer and better treatment, and healthcare personnel easier working days (ehelse, 2021). The origin of the Helseplattformen project dates back to the same year, 2012 when a board meeting in Helse Mid-Norge RHF decided they were going to acquire a new medical record system (Helseplattformen, 2021a). In the decision from the board, it was stated that: "... [The care record system should] emphasise interaction with the municipal health service and GPs, as well as other public and private actors in the further work" (Helseplattformen, 2021a). Two years later, in 2014, the program Helseplattformen was established with Helse Mid-Norge and Trondheim municipality as owners. In 2016 the Norwegian Minister of Health at the time, Bent Høie, gave Central Norway through the Helseplattformen project the status as a regional testing arena for the national initiative (Helseplattformen, 2021a). This was the start of the procurement project, where a tender process was conducted to choose the supplier of the new system.

The company *Helseplattformen AS* was formed in 2019, then owned by Helse Midt-Norge and Trondheim municipality (with arrangements made for other municipalities to become co-owners in the long term). As of 12. May 2023 Helseplattformen AS has 28 owners and ever increasing, as 26 new municipalities in Central Norway have joined, and several are still in the process of deciding (Helseplattformen, 2023a). The company was established to handle the process of acquisition and implementation of the new medical record system, more specifically, an Electronic Health Record (EHR) system. The contract with the chosen system supplier Epic Systems was signed in March 2019 (Helseplattformen, 2021a). In Figure 1, a timeline of Helseplattformen and related important events from 2012 to the signing of the contract in 2019 is shown.

3.1.1 Implementation

After the contract with Epic Systems was signed, the acquisition and implementation process started. This process included introducing the EHR system, with the associated adaptation processes needed to fit the Norwegian model and organize the new system's future management. Figure 2 shows a timeline of the different phases from the contract

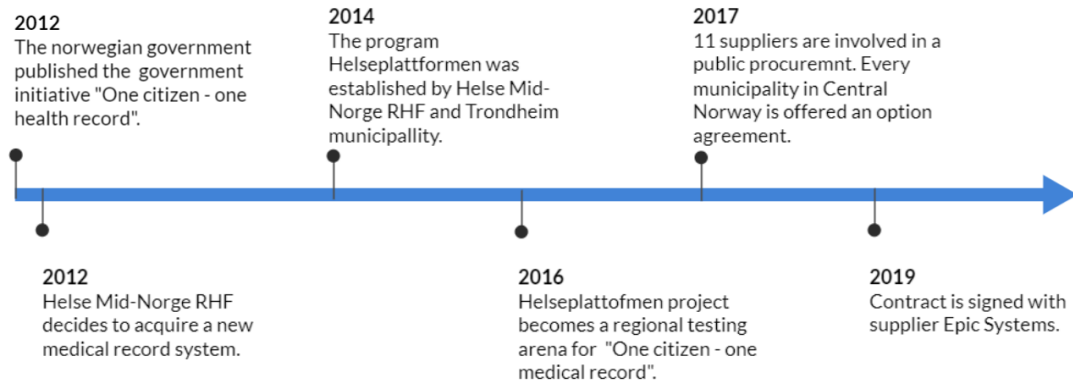


Figure 1: Timeline of Helseplattformen from 2012-2019

with the supplier was signed in 2019 until the end of 2023. It includes the different phases during the development and testing, and the completed and planned deployments.

The plan for the project is to gradually implement and go-live in several different phases. Trondheim municipality was the first to take the new HP system into use and went live 7. May 2022 (Kommune, 2023). This included Trondheim's emergency room and every other municipality service.

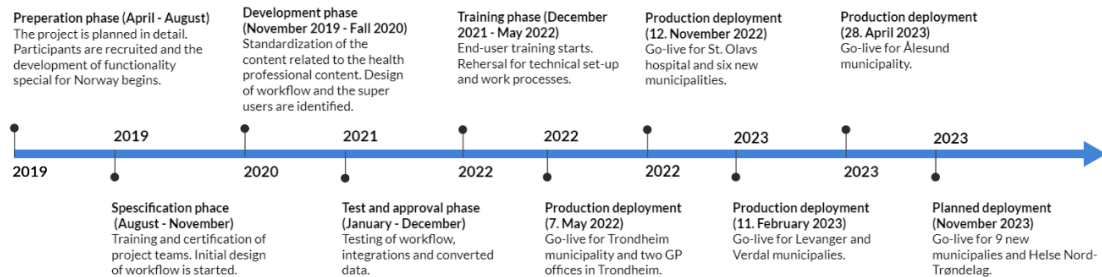


Figure 2: Timeline showing implementation phases of Helseplattformen from 2019-2023 (Helseplattformen, 2023b)

3.1.2 Goals for the new system

The overarching and grounding goal for the HP project is the national initiative "one citizen - one health record". More specifically, the goal is to introduce and manage the common new EHR system for all the health services in Central Norway, which includes healthcare institutions, municipalities, General practitioners (GPs), and private operators, to establish a more coherent health service for both patients and staff throughout the region (Kommune, 2023). As presented by Trondheim municipality, before HP went live several different medical record systems which did not communicate were in use in the municipality. As a patient, you had to repeat your medical history each time you encountered a new person in the service (Kommune, 2023). "It is a national goal to build a common patient record that follows the health information in all meetings with the health

service - with the GP, in the home service, at the health center, emergency room and with the specialist in the hospital” (Helseplattformen, 2022d). The new system aims to fix this problem by sharing health information in one common patient record across all instances within healthcare in Central Norway. Another important goal of the project is to provide citizens with access to their medical records and to have the possibility to influence their own treatment and health situation. This will be made available through the new citizen portal HelsaMi, where citizens have an overview of their healthcare information and dialogue with healthcare personnel (Helseplattformen, 2022c).

Through 11 targets of impact, Helseplattformen AS aims to present the ambitions for the beneficial effect the program will create for health organizations and the health service in Central Norway. The targets of impact were used throughout the procurement project and in the work process with requirements for the solution and for evaluating offers leading up to supplier selection. The targets of impact are listed in Table 2.

- Increased treatment quality and fewer patient injuries
- Access to continuously updated clinical knowledge based on best practice
- Provide the citizens with easy access to their own health record and more influence on their own course of treatment
- Increased interaction in and between the primary and specialist health care services
- Improved data and information for use in research and innovation
- Increased efficiency and better use of resources
- Improved management information to aid quality and improvement work in daily operations
- Reduced time spent on documentation and searching for health information
- Compliance with national standards and requirements
- Reduced need for municipal services based on comprehensive assessment of the patient’s functional abilities through generic pathways
- The citizens shall be supported to live longer independently in their own homes

Table 2: Targets of impact for the HP project (Helseplattformen, 2021b)

3.1.3 Preparation for HP

When the contract with Epic Systems was signed in 2019 the common introduction project was officially started 1. April 2019 and the company Helseplattformen AS was established (Helseplattformen, 2022e). The role of the common introduction project was to serve as an intermediary between the supplier and the four organizations: Trondheim Kommune, St. Olavs HF, Helse Nord-Trøndelag HF, and Helse Møre og Romsdal HF. Within each of the organizations local implementation projects were built to prepare the respective organizations for restructuring and adaptation to the new system.

3.1.4 Introduction project Trondheim municipality

Prior to the implementation of HP, Trondheim municipality had a project called “The introduction project” (Kommune, 2018a) where the aim was to take care of all implementation activities and ensure that the organization was well prepared to adapt to the new system. The project contained five sub-projects, Organizational Development, Health, Care, Information and Communication Technology (ICT), and Data Governance. All the sub-projects had a common project manager, but their own project leader and area of responsibility. Organizational Development focused on benefit realization of the implementation, organizational development to be ready to take the new system into use, and testing. The sub-projects Health and Care worked closely together to design and establish the functionality of the solution. They also worked in cooperation with the hospitals to ensure professional experience in the established decision-making structure. ICT was to ensure technological needs and solutions would function together with already implemented solutions in the municipality, and Data Governance was making sure data in the solution could be utilized for reporting, analysis, management, and research.

3.1.5 Sub-project Health and Care

The aim of the sub-project was to make sure that the solution was adapted to the users’, the employees and patients, needs. This in addition to making sure along with the rest of The introduction project that the users were ready to take the new system into use.

As a part of this work, and as a preparation to build and configure the new system, a mapping of all workflows in all the different municipality service areas was conducted in the spring of 2018 (Kommune, 2018b). The project also focused on ensuring that the processes were designed in line with national guidelines and thereby valuable and usable for all the municipalities in the region. The workflows mapped were then used to form the basis for a good dialogue between the subject matter expert groups and the supplier Epic to build the new workflows and develop the new system Helseplattformen.

The work of mapping and quality assuring the workflows in the different service areas of the municipality that were to be supported by HP was done by having several employees describe their practices, what they viewed as time thieves in their working day, and suggestions to improvements for the new system. The mappings of the workflows for the in-house (Figure 9) and ambulating physicians (Figure 8) at the ER can be seen in Appendices A.

3.1.6 Solution for GPs

The HP project has the goal to get the GPs in Central Norway to use the new HP system as well. As we saw in Section 3.1, the decision from Helse Midt-Norge RHF to acquire a new medical record had the ambition to “emphasise interaction with the municipal health service and GPs, as well as other public and private actors in the further work” (Helseplattformen, 2021a). A study conducted by Ellingse, Hertzun, and Melby in the preparations leading up to the implementation of the HP system highlighted the importance of the GPs adapting and taking HP into use. “If a key user group such as the GPs opts out, the touted end-to-end seamless workflow will suffer ...” (Ellingsen et al., 2022).

Helseplattformen AS said in a news article in September 2022, 4 months after two GP offices went live with HP, that further implementations at GP offices are set on hold. They further explained: "The health platform places a high priority on ensuring a good and efficient solution for GPs, and recognizes that there are aspects of the solution that need improvement to increase user-friendliness" (Helseplattformen, 2022a). In November 2022 HP shared in a new news article that: "Work [with the GP solution] is now underway to develop both functionality and increased user-friendliness" (Helseplattformen, 2022b). At the time of this study, the new GP solution is not finished and still under development.

3.2 The emergency room

In Norway the municipalities are responsible for providing emergency room services according to the Norwegian law; "Helse- og omsorgstjenesteloven" (Lovdata, 2011). The municipal emergency room in Norway is regulated by "akuttmedisinforskriften" (Lovdata, 2015), and agreements between Kommunenes Sentralforbund (KS) and Den norske lægeforening (norske legeförening, 2013). *Akuttmedisinforskriften* states that "The municipals have a responsibility for organizing an emergency room arrangement that ensures the needs of the population for immediate help around the clock ..." (Lovdata, 2015). Physicians are through "Forskrift om fastlegeordning I kommunene" (Lovdata, 2012), obliged to provide immediate help and participate in the municipal emergency room. The emergency rooms throughout the municipalities in Norway consist of 51 percent inter-municipal emergency rooms, where two or up to 12 municipals cooperate to provide the service (Allertsen and Morken, 2020). These inter-municipal emergency rooms are expected to increase the quality of the work at the emergency rooms and attempt better problems such as recruitment problems, high duty load, and lack of support for the service (Nieber et al., 2007).

3.3 Emergency room in Trondheim

The inter-municipal emergency room in Trondheim is after 15:30 on weekdays, and around the clock on weekends and public holidays, also serving the municipalities Malvik, Melhus, and Midtre Gauldal (Kommune, 2022). It is operated by physicians with permanent positions and GPs from the applicable municipalities, who are obliged to participate in this scheme with some exceptions for exemptions. Physicians who are not GPs are employed in full or part-time positions in the emergency room. In addition to the physicians with permanent positions and the GPs, there are nurses with several different roles working in the emergency room, such as in the expedition with registration, on the floor, and one coordinating nurse. In addition, there are other roles as nurses working at the call center, secretaries, and different administration and leader roles.

3.3.1 Nurses

The three different roles of nurses, working at the main ER where patients are handled, are registration nurses who work in the expedition in the other section of the ER. It is the first person the patient meets when visiting the ER. When arriving at the waiting room and taking a line ticket, the patients are called into the expedition to see the registration nurse in the outer section of the ER. Here, the nurse registers the patient's information into the system. An evaluation of the patient according to the triage system is done and tests or measurements are performed if necessary. From this, the nurse evaluates if the

patient needs to see a physician, or give the patient some advice and send them home. The ones to see a physician are given an urgency rating from the triage system to help prioritize patients when needed.

The next role is the coordination nurse. The nurse in this role may be referred to as a “shift leader”, and have control over the patient flow. The coordinating nurse has the responsibility to call patients in from the waiting room, select a room for them to wait in if necessary, assign patients to the physician for evaluation or treatment, and assign tasks to the Floor nurse. The role has the control of what patients are at the ER, where they are, and who is going to see them next.

The last role is the floor nurse. This role includes following up with patients in the inner part of the ER. They get assigned tasks which could be giving medication and vaccines, performing tests and scans, giving light treatment, or other necessary tasks at the ER.

3.3.2 In-hous physician

At the ER there are two main types of physicians, in-house physicians who work at the ER itself, and ambulating physicians who work in the ambulating physician car.

The in-house physician sees and treats patients in the different rooms at the ER. For a normal medical evaluation, standard doctor’s offices are used. In these offices, the physician has a pc with the HP system, which he uses to read up on the patient and document the visit before, during, and after. If special treatment is needed, the ER has special treatment rooms where the physician can go and treat the patient. The physician then first starts by the computer in the regular office and reads up on the patient and the situation. Thereafter going to the treatment room to see the patient, before returning to the office with the computer to complete the documentation afterwards.

3.3.3 Ambulating physician

The ambulating physician works from the physician’s car, which is operated by one physician and one paramedic who drives the car. The car receives tasks from the ER call center and the Emergency Medical Communication Centre (EMCC). Tasks from ER call center could originate from other instances as well such as the safety patrol, homecare services, different care institutions, the prison, municipal chief medical officer, etc. The physician and the driver have the emergency network radio and get notified of all EMCC tasks. All tasks from the ER call center and from EMCC appear on a mounted screen in the car running the Transmed system. Each task includes a description with necessary or known information about the patient, the situation, and the location. It is the ambulating physician who decides which tasks they take and moves out on. It is always based on the physicians’ assessment and is based on several different and complex factors. This could be severity, current location, prioritization of tasks, etc.

The physician on duty in the ambulating car is “the right arm” of the municipal chief medical officer, having responsibility for all patients outside the hospitals in the coverage area of ER. The paramedics in the ambulances have authorization for a lot, but where it stops the on-duty ambulating physician takes over. For example, this includes giving certain medications or taking certain decisions. He/she is the one deciding in the end and has the last word. If the paramedics have questions it is the ambulating physician on duty they call to ask.

3.4 Assess a health condition

Assessing health conditions is a crucial part of what both nurses and physicians do on a daily basis and a central part of what the ER does. As a part of the preparation for the development of HP, Functional Requirements (Helseplattformen, 2017b) were developed to define both what the current situation before looked like, today the previous situation, and what the desired situation with the new HP system would look like. This document presented this through enterprise capabilities the solution should support, user scenarios, and functional requirements. *Assess a health condition* is one of these enterprise capabilities the requirement document described. We will have a closer look at this process of assessment and related user stories to describe the situation at the ER before implementation, and what a desired situation with the new HP system preferably would look like.

3.4.1 Previous situation

To *assess a health condition* is a practice carried out in all healthcare services at various levels, and thereby assessments of various degrees. Therefore the ability to capture and render information to achieve a coherent picture of a patient's history and current health situation is time-consuming and inefficient. Various units of care have local processes and use different templates, plans, and checklists to do this work. Various degrees of support in the process of undertaking assessments for diagnosis, prioritization, treatment, care, and evaluation exist, such as support for comparisons of health data over time as one example. Patients do not have the ability to contribute to their own treatment in the existing EHR systems. This is by, for example, using self-documentation and self-monitoring.

An *assessment of health condition* is defined by the Requirement document from HP as "The ability to obtain all necessary information about the patient's health condition and overall situation, assess this, determine the diagnosis, plan and coordinate treatment and care, as well as considering the impact and outcome of initiated measures" (Helseplattformen, 2017b). To in the best way perform this practice, obtaining all relevant patient information is valuable. Relevant information could be the patient's own perception of current health problems, medical history, medication usage, lifestyle, living situation, the patient's own measurements and observations, special needs, wishes, resources, and knowledge. Other relevant information could also be in the form of various types of diagnostic examinations, observations, measurements (e.g., blood pressure, temperature, blood sugar, and ECG), tests, and obtaining evaluations from other health professionals.

A vital part of the assessment of health conditions is the assessment and diagnosis itself. After gathering all the information on the patient's health condition and overall situation, it needs to be assessed and compiled. Further, determine if any additional diagnostic initiatives are needed, then establish a diagnosis or description of the patient's symptoms as the basis in order to plan a course of treatment.

During previous practices of a medical evaluation from a physician at the ER, there were several different and separate sources of information to deal with. There were local sources such as the ERs EPR system with historical data, notes made by nurses, from phone calls or on arrival, located in the registration system, previous admissions referred from the ER, and information from national systems such as Summary Care Record and e-prescription. As mentioned various units use different templates for information, which does not always easily compare to local information at the ER.

Each of these sources of information and interactions was presented and had to be managed in their own separate systems. One result of this, which was highlighted in the *Preparatory projekt* (Kommune, 2018b) as a time thief was a lack of updated health information in the ERs EPR system. The Manchester Triage system (MTS), a system for clinical risk management, are not integrated with the EPR and there was a general lack of decision support (in term of both process and decision support). Other medical technical systems which contribute information in the form of, e.g. blood pressure or x-ray images, were not integrated either, an overview of the patient's other contact point with health care (previous or upcoming appointments, current services, e.g.).

GPs and ambulance personnel preferably provide medical treatments for acute care or trauma outside of the hospital. This includes treatment on an accident site (mainly ambulance and the ambulating physician), home visits by health personnel, or treatment at the emergency municipal ward. Patient information and medical event information are recorded in several systems and documents. Communication between different instances is carried out by phone and/or radio, and with paper-based documentation. Difficulties this may lead to are in terms of comparing medical results, with the risk of losing information and misunderstandings could occur. This situations and the related challenges are very relevant for the ER as they receive many of these patients and have to handle the communication and transfer of information. This previous situation with the highlighted problems and challenges have with the implementation of HP been used to describe the new desired situation and how it could be improved upon. One example is presented in *User scenario 7: An emergency scenario* (Helseplattformen, 2017a) from the functional Requirements document. This scenario describes how Helseplattformen will support the given process and hopefully eliminate challenges and provide new value.

3.4.2 Desired situation

As talked about in the previous situation, communication across different instances is an important part of the chain of emergency care (CEC), shown in Figure 3. To ensure important patient information is communicated and shared in real-time, with the opportunity to compare, and eliminated the loss and misunderstandings of information. This access to shared information was desired to be implemented in the new EHR solution. As we see from figure 3, the ER, also called Out of Hours Central (out-of-hours service), is one of two care providers at the end of the CEC. For the ER to have real-time information in their systems at the time, or possibly before, the patient arrives, without having to communicate it over the phone and/or radio, verbally at arrival, and with paper-based documents would improve the ability to give the patient the best possible treatment. The desired solution was defined as; "A solution that makes sure that the EHR information is available at all times for the health professionals within emergency care. Information downloaded whilst online shall stay available offline and any changes to the EHR shall be synchronized immediately after connecting to the network again" (Helseplattformen, 2017b). The last part of this definition of the desired situation applies especially to an ambulance carrying a patient to the ER or the emergency department (ED). Upon arrival, when the systems connect to the network again, all the information entered in the EHR by the ambulance personnel should be synchronized and available for the medical personnel taking over the patient.



Figure 3: The chain of emergency care (Helseplattformen, 2017a)

If we again look at the *User scenario 7: An emergency scenario*, it describes a patient history with an example of how the situation with the new EHR implemented preferably would look like. When the GP orders a home visit from the municipal emergency team, a part of the ER, all the communication and the needed information goes through the new EHR system Helseplattformen. When they arrive at the home visit, they have access to the patient’s health record digitally and can assess the situation with relevant and updated information accessible. The HP system also alerts that some test results are outside the normal reference range. These alerts could be based on standard reference ranges, the patient’s previously recorded data, and its ”normal” in the EHR. From the conducted tests and clinical information of the patient’s health condition recorded in the EHR, HP provides the physician with clinical decision support by suggesting potential diagnoses and treatment options.

From this situation, we see that the medical personnel assessing and choosing potential treatments and medication for the patient have access to important health information and clinical decision support. This was not the case in the previous situation where only the ERs own records and information from national systems, such as the Summary care Record and e-prescription, but with the risk that the medication list from e-prescription could have been outdated. This is due to, e.g., recent medication updates from the patient’s GP not being present or registered in e-prescription yet.

At a later point in the same scenario, when the patient arrives at the ER, all the previous health information registered from the home visit, along with given medication and further treatment, are available in the EHR on arrival. Further along, when the patient is transferred by ambulance and air ambulance, both have instant access to updated health information through HP. The same applies to the emergency ward at the hospital that starts to prepare for the patient’s arrival, staying updated on the current situation through the HP system. When the patient arrives at the hospital emergency ward, all clinical information logged by medical personnel and medical devices throughout the medical journey from the home visit to the air ambulance is available. The information is used to provide clinical decision support to the health personnel.

None of the specific scenarios describe the process of a physician’s medical examination at the ER clinic, but the situation is to be seen as an ”Assessment of health condition” as we talked about in the previous situation chapter. As the case in *User scenario 7: An emergency scenario* includes several situations where an assessment of health condition is applied, the same process is expected to be used by physicians at the ER. This makes access to the new HP system and the EHR just as relevant for them. With the new EHR, more relevant health information would be available to prepare for a patient visit, during an assessment, and when deciding on possible treatment and/or medication, with integrated clinical decision support. This new system with shared clinical information and data aims to support the medical personnel better in their work by giving direct access to more timely and precise clinical information, eliminating miscommunication and the potential of losing information in transfer.

4 Method

This chapter first presents the conceptual framework used to design and write this thesis, along with an overview of the research using this framework. The research strategy is then described, the pre-study leading up to the research, the data generation methods used in this study, and the methods used to analyze the generated data. Lastly, a part with a reflection on the methods used is presented.

4.1 Conceptual framework

As a tool to guide the design and writing of this research, the framework described in the article "Designing Engaged Scholarship: From Real-World Problems to Research Publications" by Lars Mathiassen (Mathiassen, 2017) was used. The framework aims to help researchers make sense of, and manage, the research process by offering an approach on how to approach it. Key components of a study are designed, the resulting publication is designed, and then these two designs are iteratively revised in light of the problem setting and the relevant literature, illustrated in Figure 4. This iterative process is then ongoing throughout the research, and Mathiassen states that "These documents should be continually updated and revised until the research has converged toward a stable and consistent design" (Mathiassen, 2017).

The design approach Mathiassen suggests to engaged scholarship is a creative process where the researcher discovers and evaluates different ways to frame and publish their research. This includes that knowledge and evidence are iteratively collected and interpreted, ideas are explored and tested, and different alternatives are discovered and evaluated. This builds on the core idea of engaged scholarship, which is

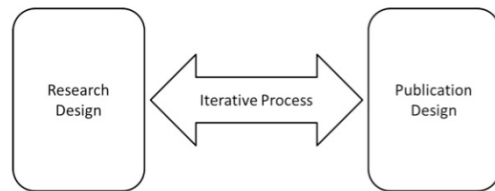


Figure 4: Designing Engaged Scholarship (Mathiassen, 2017)

"to draw on the perspectives and understandings of key stakeholders in real-world problem situations to frame research according to related knowledge areas and, in turn, to leverage theory and empirical findings to help address the problem situation" (Mathiassen, 2017).

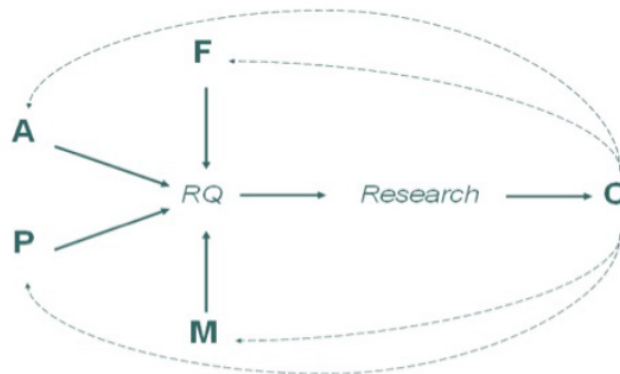


Figure 5: A Generic Structure of Engaged Scholarship Study (Mathiassen, 2017)

The research design Mathiassen suggests for an engaged scholarship study is illustrated in Figure 5. In table 3, the components presented by Mathiassen and present in Figure 5 are further defined, along with the final research design for the conducted research and used to guide the writing of this thesis. This approach presented by Mathiassen to conduct a research study was selected as the framework for this study. Using the knowledge and understanding of the people working in the emergency room, and getting their perspectives of the situation, these ideas of engaged scholarship can be utilized. These perspectives can then be used to frame the research to related knowledge from theory, thus leveraging theory and empirical findings to address the situation.

Component	Definition	Specification
P	The problem setting represents people's concerns in a real-world problematic situation.	At the Emergency Room in Trondheim, a new digital platform for a common electronic health record in hospitals and municipalities, Helseplattformen, has been implemented and provides access to shared information between all users. At the ER, the HP system has been implemented and used for a year. The challenge is to know how successful the introduction of shared information has been. How accessible is it, how is it used, and what impact has it had on the physicians?
A	The area of concern represents some body of knowledge in the literature that relates to P.	Influence of implementing an EHR system (HP) in the ER in Trondheim: Impact of information sharing across instances.
F	The conceptual framing helps structure collection and analyses of data from P to answer RQ; FA draws on concepts from A, whereas FI draws on concepts independent of A.	F_A : Information overload and access in EHR systems F_I : Empirical evidence from observations and interviews at the ER.
M	The method details the approach to empirical inquiry, specifically to data collection and analysis.	Short-term, qualitative case study of how the new EHR system implemented and the sharing of information between instances affects the physicians at the ER in Trondheim.
RQ	The research question relates to P, opens for research into A, and helps ensure the research design is coherent and consistent.	RQ1: How is access and use of information at the ER? RQ2: How does the EHR contribute to an information overload for physicians?
C	Contributions influence P and A, and possibly also F and M.	C_P : Knowledge of how access to shared information affects the work of physicians at the ER, and how the new EHR system could be further adapted to cope with the information overload and to support their work and information need. C_A : An empirical account of how shared information between instances is utilized by implementing an EHR system in an ER in Central Norway, describing its value and the challenge it introduces with information overload.

Table 3: Components of Engaged Scholarship Research (Mathiassen, 2017)

4.2 Research Strategy

A case study is by Oates defined as a strategy where it "focuses on one instance of the 'thing' that is to be investigated" (Oates, 2006). He explains that this 'thing' could be anything from an organization, a department, a decision, an information system, a project, and so on. Further, he says that this case is studied in depth with "the aim to obtain a rich, detailed insight into the 'life' of that case and its complex relationships and processes" (Oates, 2006). This is obtained using one or more of the data generation methods; interviews, observations, document analysis, and/or questionnaires. "The aim is to obtain a rich, detailed insight into the 'life' of that case and its complex relationships and processes" (Oates, 2006). A case study investigates the case, or the instance, in a natural setting where the focus is to obtain a deep understanding with as much detail as possible. To support this aim of a deep understanding, the main type of data, or evidence, generated from case studies is qualitative.

As a case study aims to explain *how* and *why* the specific cases have certain outcomes or certain outcomes occur in particular situations. They tend to create very specific knowledge on one particular case. Even if the focus in a case study is on depth in one particular instance, Oates states that "insight can be gained and knowledge generated that might also be relevant to other situations" (Oates, 2006). Broader conclusions can be generated that could be relevant beyond the case itself as well, which Oates refers to as 'generalizations'. He states that "some factors in the case may be unique, other factors will typically be found in other cases too" (Oates, 2006).

To answer the research questions to the study presented in this thesis, a short-term, contemporary exploratory case study was selected. As case studies vary in their approach to time, Oates explains a short-term study as "examines what is occurring in the case now: The researcher observes what occurs and asks people to talk about and explain what is going on" (Oates, 2006).

The case, or the 'ting', to be studied in this research project is the implementation of Helseplattformen at the Emergency room in Trondheim. The researcher aims to study and examine what is occurring now, about a year after the implementation of the new EHR system went live.

4.3 Pre-Study

To lay the ground for this thesis, a pre-study was conducted in autumn 2022. The aim of this study was to establish a problem area, or the case, and provide a literary basis to justify further research in spring 2023. The first part of this pre-study was used to gain the necessary understanding and knowledge of the case and the setting. This included gaining knowledge of the Helseplattformen project first on an overall level, then more specifically for the municipality and the emergency room. Understanding how emergency rooms are organized and operated was necessary, both in general and for the specific situation in Trondheim. This work laid the foundation for the "A" component, the area of concern, in Table 3 in the research framework used in this thesis. It provided the initial area of concern at the start of the research period, which have later developed and changed as new data have been collected and new insight has been gained.

Relevant literature in focus was on similar implementations of EHR systems, publications on Helseplattformen, and other comparable implementations in the Norwegian healthcare

context. A concept in focus was literature on practices and practice change, but other concepts such as re-infrastructuring, information infrastructures, and standardization were also explored. As a result of the first implementation of the Helseplattformen system first went live in Norway in May 2022, research on the system in an ordinary operational environment and its influence on practice changes was limited to non existing at this point.

The second part was to identify a problem area to conduct a study on the new Helseplattformen system on. During the pre-study one area stood out and seemed to be a good candidate for conducting a study, the emergency room in Trondheim, which had gone live with Helseplattformen in the spring of 2022. Findings from the pre-study indicate the implementation of Helseplattformen there has caused friction and challenges to the work practices of the people working with the system, and that practices have changed as a result of the introduction. The changes seem to have had an impact on all three aspects of practices, the meaning, the competence, and the material. Based on this, the starting point for the thesis in the spring of 2023 aimed to investigate work practices and the change of these as the effect of the HP implementation.

4.4 Data generation

This section presents the different data generation methods used in this research. As case studies mainly generate qualitative data, the methods used in this research include documents, observations, and interviews.

4.4.1 Documents

(Oates, 2006) divides documents into two different types: *found documents* and *researcher-generated documents*. Found documents are documents that already exist prior to the research, such as production schedules, job descriptions, procedure manuals, and so on. Researcher-generated documents on the other hand are documents put together solely for the purpose of the research task. This could be field notes and sketches from observations or a summary of conversations related to the research.

As an additional source of data, both found documents and research-generated document has been used. The found documents used in this study include public information and news, documents from and about the Norwegian healthcare system, the municipality, and the Helseplattformen project. They include how these entities are organized and structured, and their visions and goals. These documents have not been directly used as a data source in the research to answer the research questions but rather used as a source of information to better the understanding of the case and the Helseplattformen project and its setting as a whole. They have helped the researcher as an outsider, with little prior knowledge about the healthcare system and the Helseplattformen project, to set the frame for the research by providing and creating a holistic understanding of the complex circumstances.

In addition to these documents, news articles and debate posts published in newspapers were read and used to keep updated on the project in the media picture. Some of these news articles and debate posts were used as data sources in the pre-study and contributed to the initial problem-setting and research questions at the start of the project period in the spring of 2023.

During the research period, researcher-generated documents were created. These documents were the results of notes by the researcher from meetings, conversations, observations, and interviews during the research period, an overview can be seen in Table4.

Title	Source	Description
Meeting room in Trondheim 12.04.2023	Emergency Researcher	Meeting Summary by the researcher after first meeting with the head of department at the ER in Trondheim.
Meeting room in Trondheim 02.05.2023	Emergency Researcher	Meeting Summary by the researcher after a second meeting with the head of department at the ER in Trondheim.
Observation report from Emergency Room 03.05.2023	Researcher	Notes taken by the researcher after observations at the ER in Trondheim and in the ambulating physician's car at the ER.
Observation report from Emergency Room 04.05.2023	Researcher	Notes taken by the researcher after observation in the ambulating physician's car at the ER.
Sketch of HP system	Researcher	A sketch illustrating an overview of documents on a patient and the viewing of them from one observation in the ambulating car, see Figure 7.

Table 4: Researcher-generated Documents

4.4.2 Observation

Observation as a data generation method is used by researchers to find out what people actually do, rather than what they report they do when questioned (Oates, 2006). The data generation method is commonly used in case studies, it can in combination with other methods, for example, interviews, contribute to a good triangulation of methods. When conducting observation Oates says there is a wide range of approaches. One important difference is to differentiate between *overt* and *covert* research. In covert observation, the researcher acts like a spy and the people being observed do not know it (Oates, 2006). Overt observations on the other hand observe people that know they are being observed. With this approach, people can give consent and it becomes more ethical. At the same time, the researcher has to be aware of the possibility of whether all people being observed really are able to give or refuse consent. In the setting of this research, the emergency room, the researcher has to be aware of the possibility of encounters with patients in potentially vulnerable and sensitive situations, not being able to give or refuse consent. Even though situations including patient encounter is not supposed to be a part of the research and observations, such situations could unintentionally occur.

Oates presents another important disadvantage of overt research, the *Hawthorn Effect* (Oates, 2006). He further explains that this phenomenon involves people adapting and modifying their actions when they know they are being observed, having to figure out how they should treat the researcher, and needing time to get used to being observed. This could be stressful for the people under observation, potentially making them uncomfortable and defensive toward the researcher.

Another difference in approach when conducting observations is if the research is doing systematic observations or participant observations. "Systematic Observation is where you decide in advance the particular type of events you want to observe, and use a pre-designed schedule to note their frequency or duration" (Oates, 2006). In this research, participant observation was used, which allows the researcher to take part in the situation and experience it from the point of view of the people in the setting. Instead of having pre-defined observation schedules as with systematic observation, the researcher notes down what occurs and produces a rich description of life in the setting (Oates, 2006).

Participant observations can again be divided into four types: complete observer, complete participant, participant-observer, and participant-researcher. These types differ in how involved the researcher is in the proceeding. A complete participant uses covert observation and tries to become a member of the group being observed, a practitioner-researcher is someone who already has a job and decides to put on a researcher's hat, and a participant-observer shadows someone and can be used if they do not have the necessary credentials to be a complete participant (Oates, 2006). The last type, complete observer, is the approach used for observations in this research. The observer observes everything that occurs but takes no part in the proceeding.

During observations, the researcher documented by taking field notes. These notes were fine-tuned and supported by a summary of the observation with initial thoughts and initial analysis shortly after completion. The observations aimed to be non-selective, observing everything going on and exploring options. The notes and data generated from the observations were further coded, analyzed, and used to update the research questions and the interview guide. By doing this we follow the approach of engaged scholarship that Mathiassen suggests (Mathiassen, 2017), and a process where the researcher discovers and evaluates different ways to frame the research in the research process.

Before the first observation started a non-disclosure agreement between the researcher and the Municipality of Trondheim representing the ER was signed. This non-disclosure agreement covered sensitive information the researcher witnessed that was out of the scope of the research, for example, patient encounters and other overheard information.

Observed actor	Activity	Location	Duration
None specific	The ER in general and the office/break room	The Emergency Room	2 hours
Phy1	Physician work and use of HP	The ambulating car	6 hours
Phy2	Physician work and use of HP	The ambulating car	5 hours

Table 5: Observations

4.4.3 Interview

Oates defines an interview as a particular kind of conversation between people, containing a set of assumptions that do not apply to "normal" conversations (Oates, 2006). The conversation and the topics discussed are not randomly selected but have been planned to different degrees by the researcher. "The researcher will steer the discussion onto their topics of interest"(Oates, 2006). In this way an interview differs from a normal conversation, resulting in what Oates refers to as a *tacit agreement*. "The researcher has the right to control both the agenda and the proceedings and will ask most of the questions"(Oates, 2006).

Using interviews as a data generation method can be suitable in situations where the researcher wants to obtain detailed information, often by asking complex or open-ended questions. They can help the researcher explore emotions, experiences, or feelings that cannot easily be observed or described via pre-defined questionnaire responses. In addition, they can investigate sensitive issues that respondents might not be willing to write about on paper for a researcher they have not met (Oates, 2006).

Semi-structured interviews were chosen for this research. They allow the researcher to have a list of themes to cover and questions to ask during the interview, but at the same time be open to changing the order of questions and follow the flow of the conversation as it evolves. Additional questions could be asked if new issues or themes not planned for arise, and thereby interesting paths could easily be followed straight away. "Semi-structured interviews allow interviewees to 'speak their minds' and so are used where the primary purpose is 'discovery', rather than 'checking' "(Oates, 2006).

Table 6 shows the number of interviews, in addition to the role, type of employment of the interviewee, and the topic of the interview. The table includes the two first meetings with the head of department at the ER, which could also be regarded as interviews, but in a slightly different setting than the interviews with the physicians. From these meetings, summaries were made, and the data contributed to forming the research. An interview guide where formed at the beginning of the project, and the guide used in the first interview was a result of the findings from the prior observations, see Table 5. During the interview process, an iterative approach, as illustrated in Figure 6, where the interview guide was continuously updated was used. This iterative approach made it possible to adapt to new information and knowledge gained during interviews and contained the five steps: update the interview guide, interview, transcribe, code, analyze, then repeat the first step.

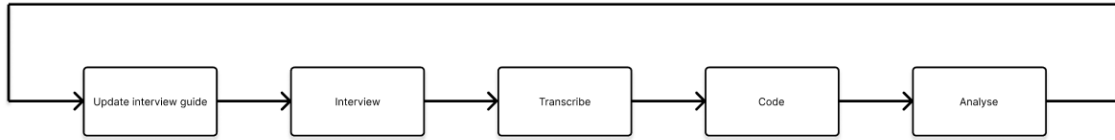


Figure 6: The iterative interview process

The interviews took place at the offices of the physicians interviewed and were scheduled in advance. Before each interview, consent was obtained and the interviewer informed the interviewee about the projects, both the PlatVel project and the specific master project, together with a distributed information letter. The interviewee signed one copy of the information letter with a declaration of consent, which was stored by the researcher and handed over to the supervisor and project manager of the PlatVel project. Each interview lasted 30 to 40 minutes and was audio recorded for further transcribing and analysis. All the interviews were held in Norwegian, as it was the native language for all the interviewees and the interviewer.

Interviewee	Role at ER	Employment	Topic
Co1	Coordinator at the ER	Fulltime employee at the ER	General about the ER and plan for research.
Co1	Coordinator at the ER	Fulltime employee at the ER	Different roles at the ER and the start of data collection.
Phy3	In-house Physician	Fulltime employee at the ER	Use of, and experiences with the HP system at the in-house ER.
Phy4	Ambulating Physician with previous experience at the in-house ER	Takes shifts at the ER	Use of, and experiences with the HP system in the ambulating car.
Phy5	In-house and Ambulating Physician	Fulltime employee at the ER	Use of, and experiences with the HP system at the in-house ER and in the ambulating car.

Table 6: List of interviews

4.4.4 Recruitment of informants

The initial contact with the Emergency room in Trondheim to find out if they were interested and willing to be part of our research project, was carried out by the supervisor

of the master's student and researcher. The supervisor, Babak Farshchian, is the project manager for the PlatVel project as well, which the research in this thesis is a part of. A contact person at the ER was provided and served as the researcher's point of contact for communication and recruitment of informants throughout the research period.

The two first meetings at the ER, the two first documents in Table 4 and *Co1* in Table 6, were with the contact person at the ER where the research was further discussed and planned. At the first meeting, both the master's student and the supervisor were present, and the goal was to discuss the project more in detail and explore options, whereas the second meeting was just between the master's student and the contact person. The focus of the second meeting was the recruitment of informants for the research, which resulted in two scheduled observations.

After the observations were conducted, it was agreed that for the project interviews with physicians at the ER were of interest, and recruitment was started. The recruitment was done through the contact person at the ER. The main method was an information email about the project, and the question of interest for participating was sent out to potential interview objects. In addition, some direct inquiries from the contact person to potential informants were made. The aim of recruiting physicians was to get informants with various experiences from work at the in-house ER and physicians working in the ambulating car, regular users of the system, and users that occasionally use the system. Due to the interviews taking place at the very end of the research period and time constraints, and the fact the healthcare sector and the ER are under high pressure with a high workload, we could not be selective in the recruitment of informants. The researcher conducted the interview possibilities that emerged when informants showed interest until the end of the research period.

4.5 Data analysis

All the data generated were processed and prepared shortly after collection to capture all relevant information and to conduct a simple preliminary analysis. This included writing summary reports of meetings and observations, and transcripts of interviews. To ensure the anonymity of informants, names and sensitive information that could be used to identify informants were kept out of the reports and transcripts.

The first step in analyzing the data was to open code documents and transcripts of interviews in NVivo, an analysis software used to code and organize qualitative data. Oates explains *Open coding* of qualitative data as "the initial process of labelling units of data, based on terms and concepts found in the data, not those found in the literature or a pre-existing theory" (Oates, 2006). By using this way to analyze data, an inductive approach where used. An inductive approach is defined as when "categories observed in the data, such as those used by your respondents or the authors of the documents you are studying, or that occur to you as you read the material" (Oates, 2006). Oates further explains that the idea is to have a completely open mind and allow the data to 'speak' to you, but in practice no people can totally empty their mind of all previous experiences, learning, and prejudices (Oates, 2006).

The reports from the first two meetings and the two observations, see table 4, were open-coded in NVivo. The open coding of the data created a personal set of codes for the researcher to use for further analysis. By organizing the codes into different categories, these categories were used for a thematic analysis to explore different interesting themes,

patterns of reoccurring topics, and connections between different themes in the data. The thematic analysis of the first documents was used to define further and specify the direction of the research, update the research questions, and the interview guide. As interviews were conducted, the interviews were transcribed, coded, analyzed, and used to update the interview guide as illustrated in Figure 6. Given that the research aimed to be exploratory, interviews were transcribed in their entirety as the whole dialogue could be relevant. Interviews were coded and analyzed using the same process. The codes were categorized and divided into themes as new data was coded. As data relevant to existing or new themes were discovered, related quotes, examples, and relevant notes were added under each theme in a document to build patterns and connections continuously.

The coding of all the data in Table 5 and 6 was done in the same project in NVivo and resulted in 98 codes being created. These codes were sorted into 12 different categories, where some codes became categories during the process. These categories of codes were organized into five different themes. The list of created codes and their categorization can be seen in Appendices B. The categories and how they are divided into different themes can be seen in Table 7. This way of categorizing and sorting the categories into themes is one way to analyze qualitative data. This approach provided the researcher in this study with an overview of what topics and themes emerged during the interviews and guided the further data collection to come.

Theme	Category
Patient handling	Evaluation Documenting
System challenges	Barriers Limitations Stopping points
System use	System interaction Workflow Functionality
Information flow	Communication Sharing
User factors	User of system Adapting

Table 7: Theme analysis

4.6 Reflection on method

The found documents used in this study were used to help the researcher understand and gain knowledge about the case and were not systematically analyzed during the process and used as data to help answer the research questions. These documents were used

when developing the case described in this thesis, and this chapter is partly built on knowledge gained from these documents. Because of the researcher's lack of previous knowledge and experience within the healthcare sector, and limited knowledge about the Helseplattformen project, the found documents have been important to help understand how the Norwegian healthcare sector is built and connected, and what role and effect an EHR system like Helseplattformen have.

The pre-study in the autumn of 2022 that led up to this thesis was somewhat limited in its extent. The term pre-study is possibly a bit misleading, as the work done was more of a comprehensive and detailed research plan where the researcher learned about the case and explored different possible framings and angles to study the HP implementation. It gave the researcher insight and time to build some knowledge about the HP project, and the healthcare sector's functions, structure, and organization. The pre-study mainly focused on the concept of practices and practice change, but this later changed during the spring of 2023 as the data collection started. In this way, the main takeaway from the pre-study was only the knowledge the researcher gained about the case.

The method used to analyze the data could be argued to be a grounded theory approach as presented by Oates (Oates, 2006). The data analysis used in this research follows the same steps as open coding of generated data, followed by axial coding where relations between codes are found and they are grouped together under broader headings, where some codes are found to be more important than others. Lastly, selective coding of the core codes. The important ones that can be used for explanation of the phenomenon and linked to theory. The approach used partly meets the requirements for selecting people and instances mentioned by Oates. It is said that a grounded theory approach starts with just one person or instance, generates data, analyzes it, and based on the first emerging ideas of the data decides who or what to look at next (Oates, 2006). This approach was partly followed in this research as based on the first two observations conducted, the decision to focus the research on physicians' work and use of HP was decided. However, the applied approach in this thesis does not meet all the requirements as Oates states that this process of data generation, data analysis, and data analysis again continues indefinitely. In this study, this iterative process stopped after four cycles of data collection and analysis due to the nature of the research period and did not stop by itself when new data no longer affected the emerging theory, as explained by Oates (Oates, 2006). The research in this thesis therefore used the approach of analyzing the qualitative data inductively for themes instead, and can not be said to have used grounded theory.

5 Findings

This chapter will present the findings from the analyzed data generated in this case study through meetings, observations, and interviews at the inter-municipal emergency room in Trondheim. The data in this study and the findings represent the current situation at the time of collection, a short period of three months in the spring of 2023, and therefore represent only an excerpt from the case in an ongoing project where the situation is constantly changing. All the quotations in this chapter are translated from Norwegian, and the corresponding translations can be seen in Appendices C.

5.1 Access to information

With the implementation of the new EHR system Helseplattformen, the physicians working at the ER gained direct access to much new data and information not available in the previous system. The new information now accessible comes from other units which have taken the HP system into use, including the hospital in Trondheim, St. Olavs Hospital, municipality units from several municipalities in the region such as the safety patrol, home-care services, different care institutions, and different specialist services. Certain units like ambulances, where the HP system is not implemented, can share information made accessible in the system as well. In addition, through the HP system, the physicians have direct access to information from the external national-wide system, the Summary Care Record (SCR). One physician explained the situation before the new HP system was introduced.

At the emergency room, we were missing most of it [access to shared information] [...], and it's clear, yes, we had to make a lot of calls. EMCC had something, something we had to call the physician on duty, or perhaps a coordinating physician at the [hospital] reception to ask: "Does the patient have this and this from before?" And it is suboptimal. It is unnecessary. So having a sharing there, or the ability to look up [is an advantage]. (Phy4)

The same opinion that access to shared information could be valuable in many situations was pointed out during observations in the ambulating car and shared by other participants interviewed. One physician explained the benefit of accessing a patient when getting calls from or visiting nursing homes. Instead of having to rely on what information nurses share over the phone or orally during a visit, the physician now has access to notes from nurses, the hospital, tests, measurements, and lab results.

At least, now we have a better overview of the patients at nursing homes. The emergency room has to go to nursing homes a lot. We also get a lot of calls from nursing homes in the evening and at night, and instead of bad phone calls where you don't get any quality assurance, you now have access to documents. (Phy5)

Even though access in many cases was seen as beneficial, the current access to shared information was not always considered good. When asked if access to information had changed after the implementation of HP and led to a reduced need for calls to seek additional information, one physician said:

I think we call just as much, and the reason is that we can't get hold of it. In other words, we can't find what we're looking for, and that's because very, very much of what we need to get hold of is not structured. (Phy4)

The physicians explained that before the new system was introduced, they had access to the internal patient record at the ER and external systems like the (SCR), but not integrated like it is in HP now. This internal ER record was still said to be working well but pointed out to be, to some degree, more challenging to access than before. Internal notes are presented in the same list as every other shared note, but there are options to filter and view just internal notes from the ER or the physician itself. However, when reading up on a patient, the physician is interested in the patient's contacts within the health sector, not just with the ER. When trying to get this overview, a lot of information is available.

It is not so easy to orientate because there is so much in previous [notes] during the journal review. So you have to use your eyes quite a bit to filter yourself with your eyes. (Phy3)

Searchin in the new system is said to be a challenge as well.

Before, it was a bit different. Then it was easy to search for, for example, previous diagnoses. [...] Then we could quickly see what was interesting as if they had been here before for chest pain, but now it's not like that, now it's a bit more complicated. (Phy3)

Different lists and overviews are made to give physicians quick access to the most essential information on a patient. Some of these include lists of medicines, allergies, surgical history, and a list referred to as a "problem list," which mainly contains diagnoses. These lists and overviews are by physicians said to be used to very different degrees, from using them as a starting point to not using them at all. Problems include lack of trust due to experiences where the lists of medicines and diagnoses do not match, experiences with lists not being up to date or incomplete, or problems finding and using them. In a conversation about the overview of previous diagnoses, a physician said it was known to exist but is not used.

It is too hard to find and ends up not getting used. It is too complicated. No one uses it, it is so little available and difficult. (Phy2)

Others found the lists and overviews useful, but always used them with a critical eye.

These lists are the most essential for us. And then you have to know they aren't always right, so you can't completely trust them. (Phy5)

Finding information that dates further back in time can bring challenges as well. Information previous to the HP implementation is not always present in the new system, where it was stated that data is present in some cases but not all. This was said not to be the biggest problem as the ER's primary concern is getting an overview of the current

situation and not so much in-depth knowledge. However, when information originated before the HP implementation was found, challenges related to poor data conversion were mentioned as a problem.

On another side, access to real-time information is still lacking in some situations at the ER, especially when receiving patients from the ambulance. When receiving patients from the ambulance, information from their systems is not transferred and shared in HP before they finish the patient. This often does not happen until after the patient has been handed over. The sharing between the ambulances and the ER still relies on verbal communication at handover to the nurses or the physician, possibly including a printed version of their note. When the ambulance note is finished and signed, it is shared with the HP system. But accessing them in the HP system and knowing they are there and where to look is not that obvious. The notes from external systems, such as ambulances are presented under a different tab in the system than other notes and documents, they are located under media.

This is also a bit like that, it is very variable how well people know. I don't think everyone knows it shows up like that. [...] But then it's under the media tab, right? So there are a lot of things that are not sorted per visit. (Phy5)

5.1.1 The problem of quick access and overview

Several participants recognized the access to shared information and the possibilities this provided, but at the same time, challenges related to access were mentioned. Access to quick information and the possibility to get a quick overview is challenging in the new system. One of them being the ability to search in the new record system is more limited, as stated by physician number three above. Other limitations related to easy access were difficulties finding previous information like medication lists, history of previous illness and diagnosis, and poorly converted data creating noise. During observation, one physician was reading up on a patient before a visit and tried to find if there were any previously registered diagnoses. When failing to find anything in HP, the physician continued to the SCR but could not find anything in the external system either. Another physician was asked how he solved the same problem and how searching for the patient's previous medical history was conducted.

You have to use your eyes and then look down the list. But of course, there is a lot of filling there, from home nursing and such. So there may be several pages with things you don't want to see every now and then. (Phy3)

A lot of manual filtering has to be done by the physicians in the search for the information they actually want or find valuable. During the observations, it was demonstrated in the HP system how it was possible to filter on specific roles as documents from physicians, home care, physiotherapists, etc. But this does not always solve the problem or make it any easier as explained by one physician.

There are lots of filtering options. We still feel that we are not getting what we should be getting. And part of that is, of course, because the conversion quality has been, in my opinion, far too poor. If it had been ensured that all doctor's notes, or all notes that were actually notes from an old system, had been stored as notes, coded doctor, nurse, or something else, it could have been filtered out. (Phy4)

Another point mentioned during the demonstration was that filtering out was not an easy fix always because important information could be present in notes from everyone, not just physicians or nurses. This point was later supported by others during interviews as well.

Notes by nurses are very relevant to know what the nurse talked to the patient about before you take them to the emergency room, but everything nurses wrote about, for example, during a 10-day stay in the hospital, may not be so relevant for the doctor who has to form a picture of the last 6 months medical history. Because there it says a lot about how the person ate, how the person drank, whether they inserted a catheter, and so on, or the home care nurse writes a lot about whether the patient has had a little more trouble moving across the living room floor and so on, which is in some cases very relevant, but in other cases, it becomes very, very much information. (Phy4)

When trying to obtain a quick overview and gather information quickly, there are a lot of different places in the system for the physicians to look. As mentioned previously, they are presented with different overviews and lists related to medicines, problems, allergies, and such. In addition, the system contains tabs with several other lists of information as the list of notes, contacts, media, etc. The organization highly depends on the physician to know where to look for what.

I work here every day and am well familiar with where everything is and such. But if I came here one evening a month and then you have to click under 4 different tabs to find what is relevant for that visit, then it would be cumbersome. (Phy5)

The tab with contacts contains the list of contacts and appointments the patient has had within the health sector. This list does not ease the problem of quick information any further, providing the physicians with a lot of information to filter through to gain an overview of where the patient has been and what contacts it has had recently. The same problem applies to the list of notes under the note tab where all notes made by various healthcare personnel are displayed. Both lists contain a lot of fragmented information, and adding to the challenge the lists have the presence of lots of insufficient and poorly converted data creating noise.

We find it so difficult to find what you actually need. Before you find a physician's note, you find 3 notes with only one line of text, because on the first a doctor had a signed epicrisis, second was a new line of text where it says that I sent out epicrisis. New line, a new document where there is a line, you can have 10 documents on one contact. It is because the old journal was very text-based, and so it has ended up that one contact has become the x number of documents in the new [system]. [...] You don't see the difference between them because they are converted on the same premise. They come from an unstructured journal, and it has become a soup. [...] A lot of database junk has become a note where you risk finding only formatted, data format text, which has no clinical value that appears as if it were an important document. (Phy4)

All information is presented in the same lists, where each line appears as a new document with the same terms and importance. The only way to know if it is something relevant or not is to view it and check. One example is in the list of notes, which contains a lot of notes from nurses from home care with no value due to the nurse's documentation obligation and generation of notes with no clinical value.

Sometimes it looks like, if there are 2 people, both people have to write a note, and somehow it doesn't hold that one person has written it. So that there are thousands of notes where it only says "other people on visit, dot". [...] This results in absolutely extreme amounts of data that are actually completely meaningless. (Phy5)

5.1.2 Presentation of information

The difficulty of obtaining a quick overview and finding quick information is a reoccurring topic with each person met during the study. During the second observation the physician, in several cases, searched for information in preparation for the patient visit during the drive or before entering to see the patient. Figure 7 is a sketch made by the researcher to illustrate what the physician was working with on the laptop in the car. Each field in the view, both the list of documents to the left and the preview of the selected document to the right, "fought" for the same place and had the need to be scrolled along both axes to view the full content. Having to scale to be able to read better also further increased the problem and need for scrolling.

Changing the text size is not supported in the system, but one can scale the size of the window to make things bigger. (Phy1)

But what happened was that the program did not scale. It just got bigger, everything got bigger, so you had just as little space and you scroll sideways. [...] Scroll sideways, it's like standing and looking around a corner and wondering what's over there. (Phy3)

To overcome the problem of small text, scaling, and scrolling, the physician in some cases moved the divider between the two fields to the left and right depending on what field it was read in. Doing this in the car while driving was a challenge requiring lots of effort, with several misclicks involved while struggling to "catch" the divider, leading to much unnecessary time spent fiddling.

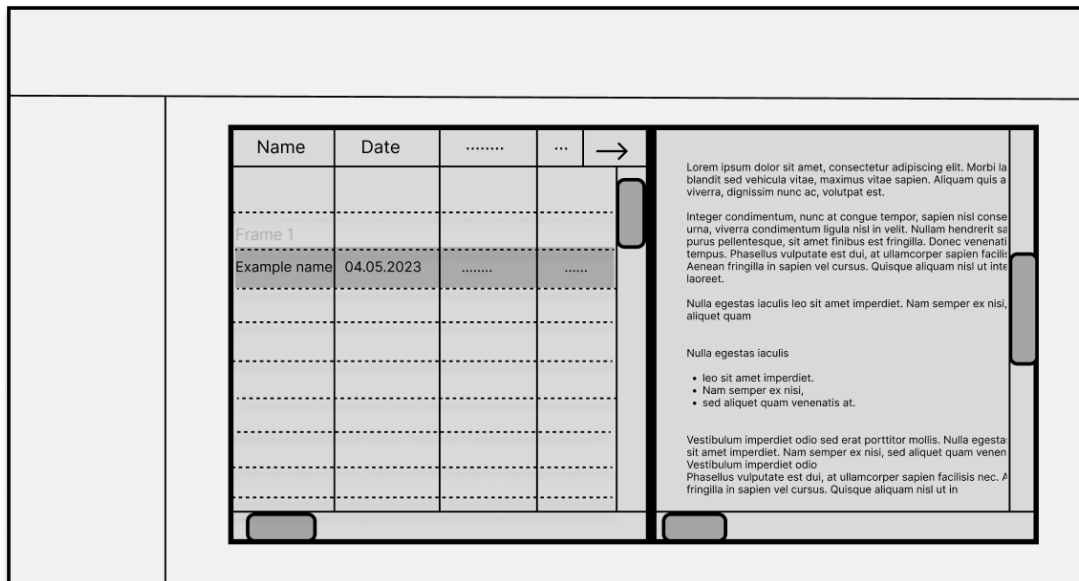


Figure 7: An sketch of document list and view of a document in HP in the ambulating car

The presentation and viewing of information in the HP system are said to not be the best in any of the settings, but because of the circumstances with the small laptop and the use in a mostly driving car, it becomes a lot more challenging for the ambulating physician. At the in-house ER the physicians have a much bigger screen with a proper keyboard and mouse to help them, and the program ends up not having the same challenges as illustrated in Figur 7. When viewing an epicrisis in the HP system, these can not be previewed and have to be opened in a new window. At the in-house ER this is no problem with the big screen, but a bigger challenge in the car.

It is not possible to have a preview on it, you have to open it as a separate media type that is placed in a separate window. Here [at the in-house ER], I can drag it to the side so that I can write my note in the patient record at the same time as I look. While in the car, there is such a small work surface, and I type in my note, the whole picture disappears. So you have to read, close, then write, so very cumbersome. (Phy5)

5.2 Use of information

Access to information and being able to prepare before seeing a patient, reading up on medical history regarding previous illness, conditions, and treatment, and having access to a current diagnosis, medication, or other relevant information is essential to provide the best medical care and is perceived very valuable.

The advantage is that you see [information from other units],[...]. Of course, those are the benefits. It is the principle that every journal system would benefit from, but how they have done it is unfortunately not very successful. The program itself, but the general aspect of getting access is of course a huge advantage. (Phy3)

5.2.1 Variation in use between in-house and the ambulating car

Although having the possibility to read up and prepare to see a patient is valuable in any case, the extent of use and how often there is a need to spend time familiarizing with the patient's medical history and situation varies. At the in-house ER, the need seems to be not quite as often as in the ambulating car, as the type of patients and their situation and severity in many cases is less critical and complex. It is not all situations where background information is that relevant.

It varies by type, what they came for [what is the reason for the visit] and how much you need to find out in the journal. (Phy3)

The in-house physician's work consists of many more trivial cases than the ambulating physician's.

In the in-house emergency room, there is a very large specter [of events]. There are a lot of trivial respiratory tract infections, urinary tract infections, cuts, and such. The prehistory is really not that relevant there. Because it's mostly a current problem, fix it, then we'll write a sick note, which eventually works, we usually get a prescription off, and then we get epicrisis sent, it works fine, that's it been in order. So the flow in there is very good. (Phy4)

In the ambulating car, on the other hand, the situation is often very different. During the observations, most of the visits and situations handled were emergency responses and accidents, or patient visits dealing with more complex situations. The complex situations involved elderly patients with comprehensive health situations or situations related to psychiatry where an assessment of the patient's mental state had to be evaluated by the physician, and decisions if actions were needed or not had to be taken. The physician had to carry out these psychiatry-related evaluations and decisions with little to no knowledge of the patient from earlier. One physician summed up the work in the ambulating car as follows.

After all, most of it is immediate help in some form, then we have to touch, find a solution, and quality-assure that we are not doing anything wrong, and then we have to move on. (Phy4)

It is not always one have the time needed to look thoroughly for what could be relevant or important in every situation. It is constantly an ongoing evaluation of how much time one should use, how much information one need, and very dependent on each individual situation. This applies to both the in-house work and the work in the car.

You have to cut through because either it's psychiatry, where you actually have to find a solution. They create a problem for themselves or for the surroundings, or we have the police waiting for us. There may be urgent cases we drive to, so blue light cases were on the way out, then we need to know: Does the patient have heart disease or not? So maybe we have to ask AMK to call someone while we figure something else out, or we have to, we have to use those resources to get quick answers and sometimes we don't have answers, and then we have to assume the worst. (Phy4)

In other cases, the physician has to use the time it takes to gather the information needed.

Sometimes you realize that, yes, but the whole mission is solved more slowly if you don't read up. Then you prioritize to quickly gather the information one need, but not as much right? If you are lucky, there is an epicrisis from the hospital where everything should be fairly summarized and up-to-date. [...] If it is an assignment where we have to assess the risk of violence, then we have to set aside a little time for our own safety. (Phy5)

5.2.2 Preperation for patient visits

Throughout the observations, it was observed how the physicians handled preparing for a patient visit or an emergency call-out on different occasions. During call-outs, the time was short, and often the patient's identity was not known in advance, leading to the physician just being able to gather information through the mounted info screen in the car displaying messages from the EMCC and what is communicated through the emergency network radio. In the cases where the patient was known in advance and the urgency was not so critical, the process differed. Most of these cases involved more complex situations, where available internal and external documents were utilized to read up on the patient and determine if there was some relevant information to aid the evaluation, decisions, and potential treatment and medication. Before the HP implementation, if the physician needed additional information, it had to be requested by themselves by calling to ask or requesting notes to be shared. The new access through HP allows them to gather much of this information, but it does not ultimately eliminate the need to call and seek additional information.

In those cases where I need to consult with a specialist or someone who is more experienced in the field, I may want to do so anyway. So then it may be that I could have asked more qualified questions or have been better prepared because I had more information. (Phy4)

In one case, the physician found a note from an external specialist after a patient visit and called to check if the current case with the patient could have any connection, potentially affecting the choice of treatment and medication to prescribe. It was said that without access to external notes, the decision would have only been based on the physician's assessment. Finding and consulting with other healthcare providers involved with the patient could increase the quality of the care given. Access to information can, in many cases, impact the decisions made by physicians and is seen as valuable for them to be able to provide the best care possible.

I think that it is primarily about having good background information and what has been done before to be able to provide better treatment. (Phy4)

For example, in the event of a cardiac arrest, you were able to look up the medical record. Then you would have seen that, but this is someone who has a short life expectancy, perhaps a month left from severe cancer. So you will make completely different judgments than whether someone is healthy. (Phy5)

It was pointed out that having this possibility comes with benefits, but the time is often short for searching, and preparation often has to be limited to the minimum. If you do not find what you are looking for, you have to continue.

You kind of have to limit yourself and try to be a bit quick to see what you find relatively quickly. (Phy3)

The same situations with preparations before seeing patients occur at the in-house ER, but under different circumstances and not as often due to differences in cases. Available information is used to read up on the patients before seeing them. In situations with patients having complex issues, it is regarded as very useful at the in-house ER in the same way it is the ambulating car. But the pressure and challenges are not considered the same because of more trivial cases without the same urgency and under entirely different circumstances.

It is more that it is a disadvantage for the ambulance physician because it is more vulnerable when you have to quickly orientate and retrieve [information]. It is the fact that they are more vulnerable in general at [use of] Helseplattformen than we who sit inside. Because they have simultaneities, and they have to orientate themselves while driving a call-out and so on. (Phy3)

But in cases where patients have a more complex health situation, regardless of location, one physician explained.

It is obvious if people are short of breath, and have, for example, been hospitalized with heart failure, then it is useful to see how they have thought, for example, if they have had a recent admission to the hospital, so it is useful. (Phy3)

With access to all this new information, new concerns also arise. The fears of possibly overlooking important information available for the physician but not considering it because it was not found in the system or there was not enough time for a thorough enough search was shared.

You're a little curious about the fact that you might be met with that, "yes, but this was available to you. Why haven't you looked at, or used it in the assessment?" But you don't always have the chance to do that.

5.3 Information overload

Building on the findings related to the access to information from Section 5.1 and Use of information from Section 5.2 and the combination of these two, the issue of information overload appears. The physicians experience that they have too much information, consuming a lot of unscary time, and causing problems and frustration.

The biggest concern is perhaps that one gets such an "information overload", it is impossible to find what we need. (Phy4)

The challenge is that it can take some time to go through, right? And also, getting it sorted, there is an enormous amount of information in here, so that can occasionally be the problem. Then there is too much, and it takes some time to filter away. (Phy5)

The users of the new EHR system at the ER, have access to lots of information. However, access is limited when it comes to having access to the information they need and regard as essential and relevant. This is due to the overload of what is regarded as noise from irrelevant data of different kinds and, at times, poor presentation. The findings from the analysis of the collected data in this research categorize this problem into three main factors contributing to this information overload, being an overload of irrelevant clinical information, the presence of information with no quality, and a view containing too much and being difficult to navigate.

What we experience is that if you have a full hospital record, then you have to start swimming and floating again because then you have to know what is relevant. (Phy4)

Both physicians working in the ambulating car and at the in-house ER share the view that the new system is not adapted to the situation and the needs of the ER. It causes challenges for the physicians trying to gain a quick overview before seeing the patient, especially in the ambulating car where time can be a limited resource.

Retrieving it easily and quickly is the most important thing. It is not so easy with such a large system. (Phy3)

It's a little complicated [the access to quick information] and it takes a little more time than you might have hoped for. [...] So it works, but one could have hoped that it could have been even more functional. (Phy3)

Another physician described access to quick information in relation to the old system.

I find that we don't, where you in old traditional journal system you could quickly scroll, you could use, you could quickly find epicrisis, you could quickly find previous illnesses, you could quickly get a good overview. Now you have to go around a lot more, a lot more in and out of the menu, in and out of the tab. Also, it's a very, very chaotic user interface because there are tabs, there are also subtabs, etc. (Phy4)

5.3.1 Challenge to gain an overview

While observing in the car, physician one showed that one of the patients visited had dozens of lines with different documents in the last couple of months alone. The opinion was that the system contains too much information in the same picture at least at once. Not becoming any easier being used on a laptop in a driving car. This situation was explained in Section 5.1.2 and the point illustrated in Figure 7. All these documents had to be viewed one by one and gone through by clicking and scrolling sideways to read

and filter out what's irrelevant, as many of these documents contain little to no relevant information for the physicians. As highlighted in Section 5.1.1, there are a lot of data containing irrelevant clinical information, but with no way to automatically know which and filter them out by role, for example. It results in the physician having to go through every document in the list and manually filter out what is essential and what is not. The list of documents contains a lot of information from various roles within healthcare, where everything seems to be prioritized equally.

Just as important as the previous one, which was actually a physician's note or a nurse's note, it is also sauced together with the fact that we see a lot of information from other professional groups, for example, homecare which we feel is given the same priority if home homecare was there and served dinner, or if there has been or you have had a visit from the ambulating car. (Phy4)

It was seen during observation that the physician could use several minutes filtering through and looking for information before leaving to see the patient. In one case, a lot of time was used trying to find if the patient had any diagnosis, but could not find anything and concluded that either there was no set diagnosis or it was that he or she could not find it among all the other information. The patient had several involvements with different care institutions, leaving the physician with many documents where such information could be located. While the physician was searching, he or she navigated back and forward in different tabs, lists, and between views on the small laptop, while struggling to find what was actually wanted. One challenge became to know where it was already looked and not, given there were several possibilities for the location of the sought information. A clear overload of information and possibilities was seen. Another physician acknowledged the same problem and said that at some point, whatever the root of the problem is, you have to move on.

If you are unable to locate it within a reasonable time, whether it is rooted in user competence, whether it is rooted in where it is located, or whether it is actually not there. Then you don't spend more time because you have to move on. (Phy4)

5.3.2 Information without quality

The problem of information overload is not made any better by the presence of a lot of data of low quality or with no value at all, as mentioned in Section 5.1.1. Participants explained that from the conversion of data, lots of metadata have been added to the different lists of documents on a patient and creating a lot of noise. This leads to many additional lines in the lists to look through, adding to what the physician has to look through while trying to find what he or she needs.

It [Metadata such as a signature] has become a journal note in such a way that you don't see the difference between one line of text and a full journal note or an epicrisis. Everything looks the same and you have to scroll through one by one to find something. So I've seen an example of this happening to a patient with 100 contacts in the last year or two where I can't find a single medical note. (phy4)

This overload of poorly converted data is experienced when searching through patient history going some time back and has shown to be a problem, at least compared to more recent events. The longer back in time one has to search, the more obvious the overload becomes.

If they have just been there [in the hospital] and can see the latest epicrisis[...] obviously that has a strength. And if it is very close in time, then it is easy to find. Because then you can see that, this is some of what has happened recently. But finding things backward in time is what it is, as of now it has very little value because there is so little real history there. It's just a lot of noise really. And the emergency room record is just full of converted, somewhat poorly converted text that is difficult to navigate. (Phy4)

5.3.3 Influence of experience

During observations and interviews, one thing that was found to be repeating was that the more experienced physicians with the new HP system, those who use the system daily, were affected a little less by this overload of information compared to less experienced users. The information overload was not reduced among these users, but they have found a way to cope with it to some degree. They have managed to find some ways of gathering information that works for them and help to do their work in the fastest and most efficient manner with the system they have. A joint statement repeated by all of these users was that they have learned to use it over time and that they think the problems are more significant for the users seeing it only once in a while.

The reason it works is because one has learned to use the system over time. (Phy1)

The more you use it, the less uncomfortable it becomes to use. But it will never quite hit the mark when it comes to user-friendliness. (Phy3)

6 Discussion

The findings presented in Chapter 5 will be discussed in this chapter. The findings will be discussed and explained in relation to the literature and background theory presented in Chapter 2 and the research questions of this thesis. The chapter contains four parts, where the first part discusses access to information at the ER, how this access has changed with the implementation of the new EHR system, and factors limiting access to information. It also contains a discussion on how the available information is used, what information is seen as most valuable and in what situations, and how the use differs between the in-hous ER and in the ambulating car. The second part discusses the occurrence of an information overload for the physicians, and how factors and aspects of the access and use of the new HP system and the shared information it provides contribute to this overload. The different topics and the main findings from Chapter 5 used in the discussion are summarized in table 8. The third part presents some implications from the findings and the discussion, providing possible alternatives to tackle the challenges. At the end of this chapter, the limitations of this research will be addressed.

Theme	Findings
The value of access to information, but lack of organization.	The implementation of the new EHR system and the value of having access to shared information is recognized among the users. There is a lot of irrelevant information which a physician working at the ER regard as having little to no clinical value. The presentation and organization of information are not the best, especially the user interface not being adapted for the situation of using HP on a laptop in an ambulating car. Access to quick information and overview is challenging.
Variation in extent of use among in-house and ambulating physicians.	The use of the information provided varies to some degree between the in-house ER and the ambulating car. At the in-house, a lot more trivial cases are handled, while the car has more emergency situations and complex cases. In complex cases where patients have multiple contacts within the healthcare sector such as elderly patients, or involving psychiatry the value is seen as great. The time to search for information is often short, at some point, one has to set the limit of how much information one needs and continue.
The effect of a lot of information presented causes an information overload, further complicated by a view containing too much.	The users of the HP system experience the situation of information overload. The overload is caused by access to a lot of irrelevant clinical information and data with no clinical value. The lack of organization and structure when presenting the data further enhances the problem.

Table 8: Main findings

6.1 Information access and use

Access to timely information and sharing patient health data between different healthcare instances are required for safe care (Wilson et al., 2021). In the case of out-of-hours work, like at the ER, information sharing is recognized to have possibilities for making significant improvements (Jenkins and Wilson, 2007). Electronic records are an essential part of facilitating this information sharing. The national initiative "One citizen - one health record" (ehelse, 2021), where the Helseplattformen project originates from, had the goal of forming one coherent healthcare sector to ensure that necessary health information follows the patient throughout the entire patient process. The Helseplattformen project builds on the same idea. Providing shared information between the different healthcare instances a patient encounter is essential to provide the best medical care possible. For the ER, an instance of urgent out-of-hours care, having direct access to timely and updated clinical health information is very beneficial.

At the ER in Trondheim, previously to the HP implementation, there was no direct access to clinical information from other healthcare instances. If additional information was needed, it had to be manually requested by phone or other communication channels. This was because each separate healthcare instance in Central Norway previously had its own isolated internal EMR systems, with no way of direct sharing between them. Each EMR system was designed to handle healthcare delivery within a care delivery organization (CDO), and not span episodes of care across multiple CDOs (Garets and Davis, 2006). As the definition for an EHR says, an EHR system is an inter-organizational system (Heart et al., 2017). The new HP system has the aim to be one such common EHR among all the different healthcare instances in Central Norway and, in that way, facilitate the desired information sharing.

The value of access, and increased access to timely and complete information such as previous medical history as a result of EHR implementation, were found in several other studies as well (Wilson et al., 2021), (Reed et al., 2013), (Priestman et al., 2018), (Vos et al., 2020), (Miles et al., 2019), (Mullins et al., 2021). This supports the findings from this case study, which showed that physicians at the ER found access to shared patient information valuable, especially when handling more complex cases such as with elderly patients with comprehensive health situations, or psychiatry-related situations. Access to shared information means they can prepare better before seeing patients and, hopefully, make better and more informed decisions. In situations related to psychiatry, for example, easy access to information on the patient could have a significant impact. Having the ability to access notes from other people involved with a patient to establish what is "normal" or not, could mean the difference between deciding to use unnecessary force or underestimating the severity. The physicians at the ER have little to no familiarity with most of the patients, and therefore shared information from those who do when having to decide in a relatively short time, can have a big impact on their evaluations and help them provide the proper care in the right situations. This translates to many other situations as well. Access to find information that a patient with shortness of breath was recently in the hospital and checked for heart issues could lead to the physician making completely other decisions than without such knowledge.

Other EHR implementations found reduced needs for communication through phone, fax, or having to retell information as a benefit (Wilson et al., 2021), (Miles et al., 2019), (Jenkins and Wilson, 2007). This was also experienced at the ER, but the implementation did not eliminate the need as much as one might have hoped. Challenges to access information lead physicians, in some cases, to go back to the previous practices of calling

to request information, especially in the ambulating car. But the same situation occurred at the in-house ER as well when receiving a patient from the ambulance, for example. The ambulance system has no direct integration with the new HP at the ER, and only shares information after documentation is finished and signed. This could and often does happen after the patient has been handed over, leading the communication to go by mouth or printed documents during handover. This is a result of the ambulating services not being included in the new EHR system, and in that way, they do not facilitate real-time sharing of data in the way possible between other instances where the HP system is used on both ends. In the ambulating car, the problem was rooted in the setting of the ambulating car being very challenging, where a lot of things are happening at the same time, and the user surface of the system on a laptop is far from ideal. Quick information is needed, and in many cases, they have limited time for searching.

6.1.1 Variation in access and use

The other cases of EHR implementations presented in the background theory involved implementations at EDs such as (Miles et al., 2019), (Mullins et al., 2021), and (Reed et al., 2013), with secondary care staff (Wilson et al., 2021), secondary care in outpatient clinics (Vos et al., 2020), and EHR implementations in general (Priestman et al., 2018), (Jenkins and Wilson, 2007). Even though no one of these was in an ER-specific instance, all these settings include providing medical care and involve a similar assessment of medical conditions that are conducted at the ER in Trondheim but with some variations. However, one main difference is the organization of the ER in Trondheim and the fact that it consists of two parts, the in-house ER and the ambulating car. The findings presented the differences between the ambulating car and the in-house physician's setting and their different use of the system regarding the variation in tasks. While the in-house setting for the physician can be related to much of the settings seen in other cases, the ambulating physician's setting is entirely different. It might be reminiscent more of what an ambulance does.

Because of the ambulating car's setting where there are many more acute situations, and the patients often have more complex cases, the most important and relevant information must be easily and quickly available. Finding important health information on a patient can have a big impact on providing the best medical care. A quick overview is needed, and using time to search for what might be relevant is not possible in many cases. The tradeoff between what information is needed and how much time one has is constantly evaluated. This need for quick information and overview is also important in other settings, including the in-house ER, where the pressure can be high. But with more trivial cases and in a more controlled setting, the challenges are not as significant.

All noise, distractions, and other challenges in HP related to access to information, the effects of how it is organized and presented, and the problem of information overload are affecting the whole ER. But this more complex situation in the ambulating car, with the higher time pressure and acute setting along with more complex cases they have become more prominent. These will be further discussed in detail later in the Chapter.

6.1.2 Organization of information

There are no set rules for implementing an EHR system, and several different approaches exist. In the case of the Australian *My Health Record* (Miles et al., 2019) (Mullins et

al., 2021) and the *Great North Care Record* (GNCR) in the UK (Wilson et al., 2021), a modular approach where access on an as-needed basis was implemented. The Australian My Health Record was an external system in addition to the existing record system. The UK Great North Care Record was made available for the users with one button click from within the context of their existing record system, similar to how access to the national Summary Care Record (SCR) has been implemented in the new HP system today. In both these cases, the users reported that they found it valuable to have this access to shared information on an as-needed basis. The HP project decided to go with the EHR solution from Epic, where all the existing systems in the different healthcare instances were replaced with one new system, the HP. This approach makes all information accessible and integrated into the same system. The interface and setup were through a configuration process adapted to each separate healthcare instance to fit the different user's needs.

These two different approaches, where HP provides everything to the users within the same system and the My Health Record and GNCR have it available to the user when needed, have both upsides and downsides to them. The My Health Record and GNCR users find it very valuable to access information as needed, as it is not every case where access to additional information is considered important. The situation is the same for the ER in Trondheim, where physicians say the use and need for additional information varies greatly. It depends on the type of situation and the previous patient record from the ER is often considered as enough. In the Australian and the UK situation, these internal records are not affected at all by this new implementation of an EHR, as these are external systems. This is not the case at the ER in Trondheim, as the new shared information is mixed in the same system as their previous health records. This HP approach leads to all the information being present within the same views, and the filtering of what is regarded as relevant is put over on the user.

In the UK and Australian approaches, the user seeks what it regards as necessary additional information, while the users of HP have to filter out what is unnecessary. This has led to a problem at the ER with the system containing much information and the organization of this information seems to create challenges for the physicians. The ERs old internal record has now been mixed with records from everyone else, and overviews and lists with patient contacts and notes have, in several cases, become very long and challenging to navigate. This HP implementation is nearly the opposite of access on an as-needed basis, and easy access seems to have come with more challenges because of this. Physicians at the ER pointed out how they liked the SCR integration in HP, which they could use as needed. Following this approach, like the My Health Record and GNCR approach, implementing access to shared information might have been better and could have reduced these challenges.

6.1.3 Overload of irrelevant and lack of clinical information

Challenges related to outdated or irrelevant information have been a barrier highlighted in earlier EHR implementations, as well as the lack of historical data. Mullins et al. found the presence of irrelevant information, and the lack of excluding old information containing started and later discontinued treatment to be a problem, along with problems obtaining valuable historical data (Mullins et al., 2021). Vos et al. found that numerous notes by various specialists complicated the overview, and their prioritization complicated the understanding of the patient's medical history. The constraint of not including an adequate search functionality was also a big barrier (Vos et al., 2020).

The findings from the case study in this thesis found similar barriers related to EHR implementation on several occasions. The medicine overview present in the HP was said by physicians to not be entirely trustworthy, as in several cases mismatch between the listed medication and medical problems were found along with the presence of medications for discontinued treatments. Historical data were sometimes seen as a challenge at the ER, where the main problem was not always the lack of historical data but the challenge of insufficient and poor data conversion from old systems. The search functionality within a patient's record was seen as challenging and complicated. The new HP system had problems with the overviews of patient contacts and notes containing much information the physicians found irrelevant. When searching through recent notes to find what could be helpful for evaluating a patient, where several healthcare instances are involved, the list of notes could be overfilled with notes from home care and other similar care providers which provided little relevant information to the physicians. For the physician preparing to visit a patient dealing with chest pain and shortness of breath, a note from their three daily visits to a patient saying that the patient showered last Thursday, or the nurse's notes before an operation at the hospital is not what they need.

Regardless, these notes are presented to the physician with the same priority as a note from the hospital the week before. The reason for this is, as we discussed in Section 6.1.2, every document or note is shared in the same system. The work is put on the physician to filter out what he or she finds relevant. This work becomes very challenging and time-consuming when there is a presence of a lot of irrelevant information of different kinds and everything is presented with equal prioritization. But even tho the first note from the home care stated that the patient had taken a shower, the next one can include important information for the physician. Because of this, it is not just to use the option to filter away everything but notes from other physicians either. Everything can include something important, but physicians constantly have to evaluate their information need up against their time usage. Something that is especially challenging in the ambulating car at times, where information can be of great value but available time can be very short and the circumstances for searching are challenging as well. By then having to filter out irrelevant information and other present data without quality, doublecheck medications and medical problems, and having to wonder if the information is lacking or it is not just found yet, it adds complexity to many already stressful situations.

6.1.4 Presentation of information

An important factor is how the user interface is designed and how information is presented to the user. Miles et al. found that the user interface access and design could affect the record's usability (Miles et al., 2019). The finding from this research shows that such problems, related to the user interface and how information is presented to the users, were found to cause challenges to physicians' use of the HP system as well. The findings found that there are some challenges related to users at both the in-house and in the ambulating car, but the most significant problems are linked with the use of the HP system in the ambulating car.

The user interface of the new EHR system is found to be chaotic and contains a lot of information in one view and on small surfaces. But when we look at the system and its use on the laptop in the ambulating car, this becomes extremely prominent. We saw in Figure 7 from Section 5.1.2 a sketch of how the viewing of different documents and notes were presented on the laptop. From this sketch, it is possible to imagine how the use of the HP system in the ambulating car becomes a lot more complicated than in any other

setting where the system is used. Because the list containing the different documents, and the preview of the documents fight for the same space on the screen, physicians are forced to scroll both up and down, and side to side, to be able to read the whole rows and documents. This, in many situations while the car is driving, holding the laptop on their lap while using the touchpad. When we compare this to the same physician sitting in an office with large monitors and a decent mouse, where opened epicrisis can be dragged to the side and read while typing a note, it is not difficult to understand why using the system in the car takes more time.

For the ambulating physician, the challenge with a user interface that is time-consuming and challenging to navigate comes in addition to it already being packed with a lot of available information. Quick information and overview are what physicians at the ER need, but how the available information is presented to the users have made this challenging. The different overviews that are available, where the most important information on a patient is presented, such as the problem list, medication list, allergies, etc, are used by physicians to varying degrees. They are said to be difficult to trust and not to provide the information that is needed. When such overviews are present in a system and users do not trust them, or find them to contain missing or outdated information, it causes problems. It becomes additional information they have to deal with, possibly providing them with wrong and incomplete information.

6.2 The occurrence of an information overload

In the study by Jenkins and Wilson, the topic of having to find the balance between too much, or too little, information when designing an EHR record was mentioned to be critical for such a record to be viable (Jenkins and Wilson, 2007). Beasley et al. said as well that "EHRs can transform the quality, comprehensiveness, timeliness, and accessibility of information in both positive and negative ways" (Beasley et al., 2011).

When adopting a patient record to be used in the ER, the most important is to provide relevant medical history and other important clinical information, which can help a physician make decisions regarding the patient's health fast. The ideal record would provide just what is needed to do so, but the problem then is that what is relevant in one situation might not be as relevant in another one. This is the same as Jenkins and Wilson found and has shown to be a challenge at the ER. The weighting between too much or too little information is critical, and at the ER at the moment, the findings point in the direction that there is too much information present. Jenkins and Wilson said that defining the content of the record to suit specific instances in a systematic way would be problematic (Jenkins and Wilson, 2007). This is the same issue we are now experiencing and dealing with in the HP system at the ER. The HP record is not defined to suit the ER instance, and the presented information is not balanced with the information needed. The implementation of the new EHR and the presence of too much information seems to have affected the accessibility, supporting the findings of Beasley et al. (Beasley et al., 2011).

6.2.1 Perspectives on information overload

Hall and Walton presented a definition of information overload which states that when available information potentially useful becomes a hindrance rather than a help, an information overload occurs (Hall and Walton, 2004). They provided another perspective on the problem as well saying that "the problem of information overload is not so much as

an actual overload but as symptom of the failure to create 'high quality' or 'value added information' from the large amounts of information available" (Hall and Walton, 2004).

These definitions explain very well the experienced situation with the HP system at the ER at the moment. Much of the information the physicians have access to in the HP is potentially useful for them. But the way it is organized and presented at the moment makes it more of a hinder preventing them to find what they need because it is so much and it is difficult to filter through. In the same way, the second definition applies. The information in the system is not the problem, but it is the system that fails to present it to the user in a way that it can easily be used. If the different overviews in HP had contained what they were supposed to of medicines, diagnosis, allergies, and so on, the system could have used all its available information to create this 'high quality'.

The concept from Klerings et al. of *filter failure* was used to frame the problem in another way. It was stated that "the problem with information overload is not that there is too much information, but the strategies for deciding which information is relevant have not evolved at the same pace as the means of producing information" (Klerings et al., 2015). A filter failure occurs as a result of the technology of producing and sharing information have evolved faster than the technology for filtering and deciding which information is relevant for the user. EHR systems have the main goal of making information from separate healthcare instances accessible and shared between several instances, and at the moment it can look like this has been the only priority from the implementation of the HP system as well. The access to the information is mostly good, but the quality of the access, or the failure to filter the information before presenting it to the user seems to not have been prioritized. It seems that no filtering at all has been done to the shared information presented to the physicians at the ER, as physicians said that even nurse notes with a few words stating they were the second person on a patient visit or data formatted text with no clinical value appear in document lists of patients.

6.2.2 The effect of the interruptions, expertise, and time when dealing with information chaos

The findings from this case study can be seen in relation to what Beasley et al. referred to as information chaos which could come from EHR implementations. The three factors of interruptions, expertise, and time could further affect the magnitude of the problem in dealing with information chaos and the impact it has on the quality of care delivered by physicians (Beasley et al., 2011). When dealing with these hazards of information chaos, such as information overload, additional factors such as interruptions, expertise, and time can make it more challenging for physicians.

At the ER, both in-house and in the ambulating car, time is a constant factor. The pressure is often high, and the physicians do not always have the time they might feel they need. At some point, they must quit searching and continue with what they already have of information and knowledge of the patient. For this reason, dealing with information overload does not become any easier. In cases when the time might not be as critical and the physician could take the needed time, especially in the car, the challenge of navigating the big mass of accessible data becomes more manageable. The problem is that this is not the norm, and time for the most part plays an critical role.

The user's expertise is another factor that could either increase or reduce the chaos experienced. The ER is a place where a lot of GPs are required to take shifts occasionally. These users might work at the ER and encounter the HP system as seldom as once every

month, thus having limited experience. This is experiences related to the use of the HP system, but to work in the ER as well. The role of being an ambulating physician at the ER can, at times, be very different from regular GP work. Therefore, these variations in experience are important to consider when looking at information overload and how it affects different users.

Both in the setting of the in-house ER and the ambulating car, interruptions occur regularly in the form of other cases needing immediate attention, simultaneities the physicians have to deal with, or disruption from within the HP system itself as warnings and pop-up messages. The interruptions related to the ER setting are factors that always will be there and is a natural part of the work, and where the best way to tackle them is to reduce the problem of information chaos. Beasley et al. mentioned that "as more and more data are available in an EHR, there is an even greater need for improved search methods and display techniques to present the data needed at the time of the patient visit" (Beasley et al., 2011). Many factors, such as time, expertise, and interruptions, can be tried and tackled in various ways, but they will never solve the problem of information overload or chaos. To do so, one needs to attack it as Beasley et al. suggest, with better methods for displaying and finding what is needed.

6.3 Implications

The setting of the ER and the work there, especially in the ambulating car, are sensitive to issues like information overload. The pressure is often high, and gaining a quick overview and finding the most important information is often essential. The new EHR system does not make this easy for the physicians, as a lot of data is presented and lacks proper organization. Much of it is seen as irrelevant and with little to no value, and historical data seems to lack in some cases. The system is not adopted for use in the ambulating car, facing several challenges but mainly the interaction with the user interface and the presentation of information. The rest of this section presents some alternatives on how the challenges from the findings could be addressed and improved upon.

To reduce the information overload problem, the structure and organization of information in the HP system need to be addressed. Looking at alternative ways to organize and present information, for example, to differentiate the information by what instance they originate from, adapting an approach more like the access on an as-needed basis previously discussed can be one option to consider. It was highlighted by several physicians how access to the SCR, which uses a similar as-needed approach, was seen as satisfying and can be built further on for other aspects as well.

The HP system needs to address the issue of filtering information. The first step would be filtering out everything with no clinical value as presented in the findings, such as empty documents or the ones containing just formatted text or database junk, notes present as a result of documentation obligation with no value, etc. The second step is to filter out what is important and prioritize this information to be shown to the physicians first. With this important information, the overviews presented to the users must be up-to-date, trustworthy, and easy to find, understand, and use. This provides the physicians with the quick access and overview they need.

The last issue that needs to be addressed is the user interface, mainly focusing on using a laptop in the ambulating car. The user interface, and the use in cases like illustrated in Figure 7, need to be adapted to the setting of a laptop used in a car in motion. The

system needs to be scalable without the increased need for scrolling, and with buttons that are easy to click. A simple view with just the essential functions could be a possibility to consider, where the physicians could choose to see the simple car-adapted interface or the standard one as needed.

The points presented above are the immediate thoughts of the researcher on how the challenges presented in the research findings and discussed in this chapter could be addressed. They do not aim to go into any depth or details, but rather an alternative approach could look like.

6.4 Limitations

This section presents the limitations of the conducted research. The limitations can be split into two categories and concern the number of observations and interviews conducted, and the timeframe of the project.

First, the number of observations conducted in the project was limited to only two, where the first observation was split into two parts. The first part was a two hours observation at the ER in general, followed by six hours of observing in the ambulating car. The second observation was a five-hour observation in the ambulating car, limiting the observation time in the ambulating car to a total of 11 hours. Ideally, observing for a longer time could have provided a deeper understanding of how information in the HP system is accessed, used, and how the problem of information overload affects the physicians in their work. Additional observation at the in-house ER and how physicians use the HP system there could have contributed to a deeper understanding from another angle. The number of interviews in the project was limited to five, where the first two were with a person in a coordinator role and the three last with physicians with different experiences from both in-house and ambulating work and with backgrounds as full-time employees and GPs having shifts at the ER. Ideally, conducting more interviews with physicians could have contributed to a deeper understanding in the same way as with the observations.

Secondly, this case study is only a snapshot of a much large project with the implementation of Helseplattformen. The project was conducted from mid-January 2023 until the beginning of June 2023. The primary data collection was limited from mid-March 2023 until the end of May 2023. The Helseplattformen project is a large ongoing project where changes constantly happen, and this case study only captures a short time frame of it. This short time frame might result in a loss of understanding of how information overload affects physicians over time.

7 Conclusion

This chapter will first present the answer to the research questions raised in Chapter 1 as a conclusion of this research, and then present suggestions for future work at the end.

7.1 Conclusion by research questions

The research conducted in this thesis was a qualitative study aimed at investigating the implementation of the new EHR system Helseplattformen at the emergency room in Trondheim. The motivation was to understand how access and use of shared information was at the ER, and how the new EHR system contributed to an information overload.

RQ1: How is access and use of information at the ER?

In the Helseplattformen system implemented at the ER in Trondheim, access to information varies depending on how one views it. When it comes to access to all shared information from other healthcare instances using the HP system, access is, for the most part, good. Access is more challenging if one looks at access to information regarded as valuable and needed in the ER setting. It is difficult to obtain a quick overview and access to essential information on a patient because of poor organization and presentation of information, the presence of a lot of irrelevant information in the HP system, and user interface-related challenges. This new access to shared information is valuable to physicians, but usage depends on the situation. For the available information to provide the value it potentially can bring, it must be easily accessible, as time is essential. This has been found in previous research as well, but the setting of the ambulating car at the ER in Trondheim highlights the importance from another perspective.

RQ2: How does the EHR contribute to an information overload for physicians?

Information overload occurs when too much information is presented, and the presented information becomes a hindrance rather than a help to the extent that it becomes a problem to get hold of the needed information seen as valuable. The new EHR contributes to this problem by presenting all the shared information available in the system to the user, with no form of filtering out what the physicians at the ER would find irrelevant and view as not useful information. A user interface not being adapted to the users' needs, further complicates the challenge with information overload in the HP system, especially in the setting of the ambulating car. Factors contributing to information overload in the EHR system HP, support what has been previously found as several of the same factors are found in other cases. Balancing the amount of information by filtering out what is not regarded as important, is an essential part of preventing information overload in an EHR system. In the case of HP, this balancing and filtering have not been good enough.

7.2 Future work

The findings from this research are just the first look at the challenge of information overload as a result of the implementation of the new EHR system Helseplattformen. The findings from this study highlight the challenge of one single instance in the healthcare sector in Central Norway, and similar problems of varying degrees are likely to be ex-

perienced in other healthcare instances using the HP system as well. This leaves room for further research on the topic, to understand the problem of information overload at a deeper level in the context of EHRs and ERs, and to investigate if it is an occurring problem elsewhere.

By Helseplattformen AS, a new and better module for the GPs is under development, including a major update of the current system in use at the ER. Further investigations when this new major update is implemented, and if it addresses the problems found in this research could provide more knowledge and deeper understanding of EHR implementations and the effect of information sharing in a complex ER setting.

During the interviews and observations, it was learned that the new HP affects many other roles at the ER as well but fell outside of the scope of this research. The work of the nurses has changed a lot, potentially affecting the physicians and the sharing of information internally at the ER. As findings from this study indicate that access to shared information from other instances external to the ER contributes to an information overload, it is possible that internal information sharing can also play a role and contribute to this information overload.

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Appendices

A Mapped practices

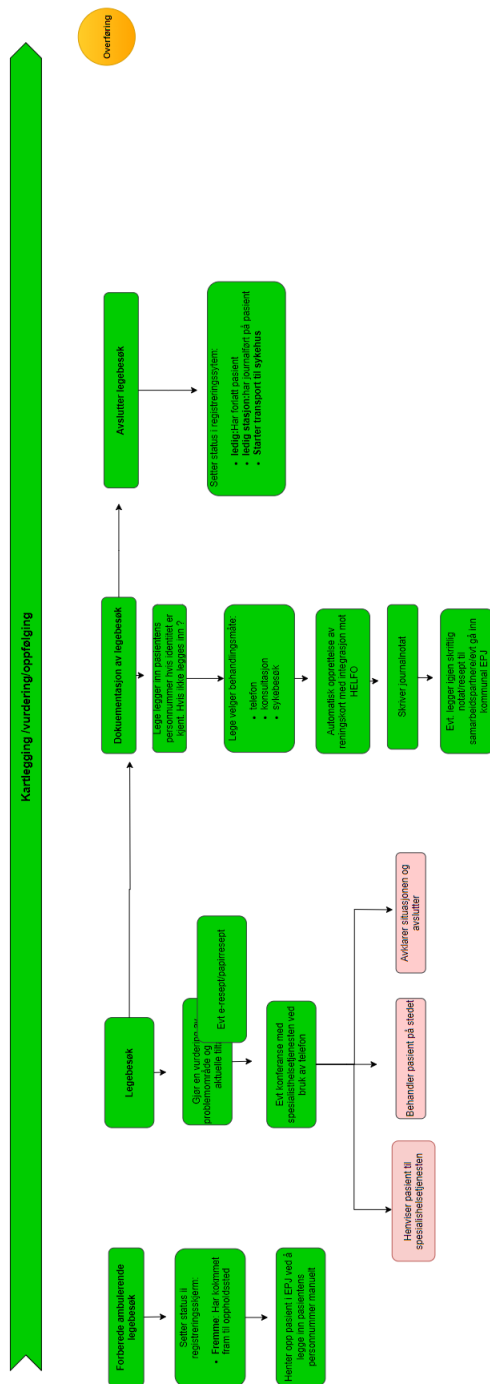


Figure 8: The practices for an ambulating physician at the emergency room in Trondheim during mapping, assessment, and follow-up, mapped by the introduction project (Kommune, 2018b).

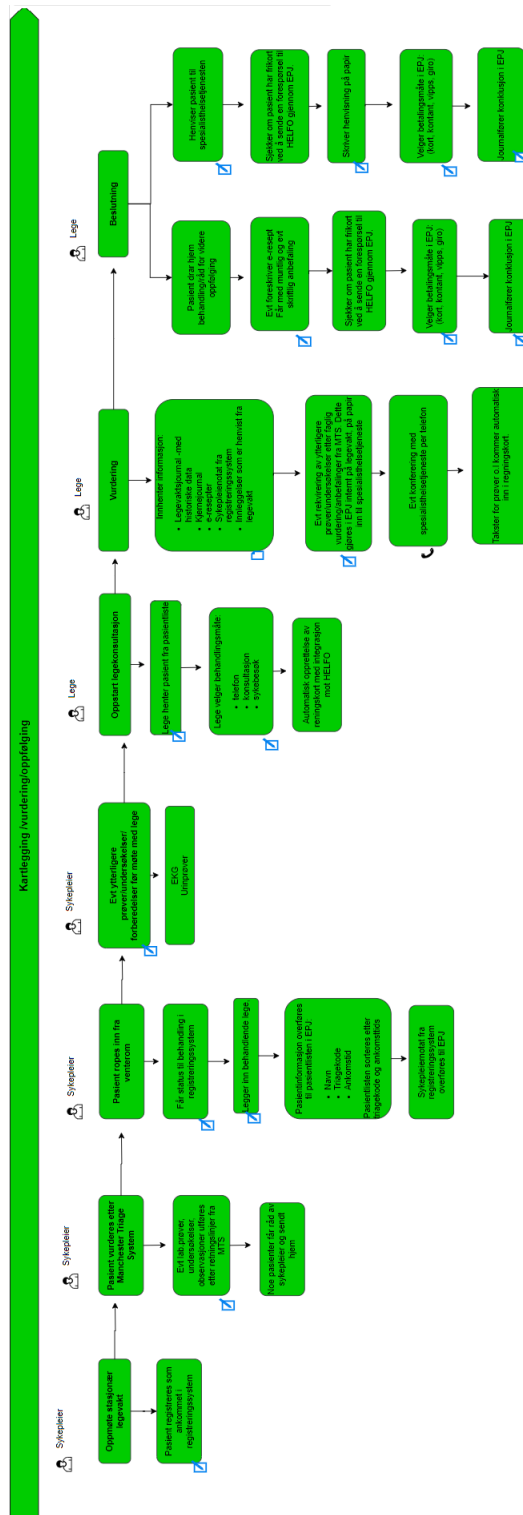


Figure 9: The practices for a physician at the in-house emergency room in Trondheim during mapping, assessment, and follow-up, mapped by the introduction project (Kommune, 2018b).

B Code and Categorisation

Category	Code
User of system	Individual factors User background Experience Universal design Privacy Education and training Other experiences Motivation Consent Active user Expectations Ambulating physician Previous systems Job position
System interaction	Challenge of use Difficulty of use Ease of use Repeating tasks Scrolling User interface Learned to use
Barriers	Challenges Bottleneck Distraction Disadvantages Increased workload Technical or system errors Time-consuming Problematic Noice

Adaptation	Development Customization User experience Potential for improvement Shift in responsibility Training
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Evaluation	Preparation Provide best medical care Evaluation of patient Decision Time critical Information overload Complex situation
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Documenting	Consistency Documentation error Patient visit Treatment Registering Medication Format
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Workflow	Workload Prioritization Patient flow Patient pathway Searching for information Overview Waiting time Additional work
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Communication	Communication external systems Orientation Referral
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Sharing

Cooperation
Double work
Duplicate information
Information flow
Quick access
Advantages
Improvement
Important information
Situational value

Functionality

Pop-ups
Integration
Action required
Access
Messages
Workaround
Journal notes
Support
Core journal
System modules
Similarity

Limitations

Missing information
Lack of access
Lack of attention
Trust
Lack of support
Lack of systematization
Reliable
Guidance
Filter information
Conversion of data
Different information value

Stopping points

Confusion
Frustration
Misunderstanding
Uncertainty
Demanding
Problem differentiating
Relevance of information
Lack of structure

Table 9: Code categorisation

C Quotations

Norwegian

English

Det meste er jo en ø-hjelp [øyeblikkelig hjelp] i noen form, så skal vi touche, finne en løsning, og kvalitetssikre at vi ikke gjør noe gærent, og så skal vi gå videre.

After all, most of it is immediate help in some form, then we have to touch, find a solution, and quality-assure that we are not doing anything wrong, and then we have to move on.

På legevakt så manglet vi jo det meste [...]. Og det er klart, ja, vi måtte ringe en del. Noe hadde AMK, noe måtte vi ringe vakthavende, eller kanskje en samhandlingslege i mottak [sykehus] for å spørre: ”Har pasienten sånn og sånn fra før?” Og det er suboptimalt. Det er unødvendig. Så det å ha en deling der, eller muligheten til å slå opp [er en fordel].

At the emergency room, we were missing most of it [...], and it’s clear, yes, we had to make a lot of calls. EMCC had something, something we had to call the physician on duty, or perhaps a coordinating physician at the [hospital] reception to ask: ”Does the patient have this and this from before?” And it is suboptimal. It is unnecessary. So having a sharing there, or the ability to look up [is an advantage].

Jeg synes vi ringer akkurat like mye, og grunnen er jo at vi ikke klarer å få tak i det. Altså vi finner ikke det vi er på jakt etter, og det er jo fordi at veldig, veldig mye av det vi skal ha tak i ligger jo ikke strukturert.

I think we call just as much, and the reason is that we can’t get hold of it. In other words, we can’t find what we’re looking for, and that’s because very, very much of what we need to get hold of is not structured.

Det forresten ikke så enkelt å orientere seg fordi at det er såpass mye i tidligere [notater] under journalgjennomgang. Så du må bruke øyene ganske mye å filtrere selv med blikket.

It is not so easy to orientate because there is so much in previous [notes] during the journal review. So you have to use your eyes quite a bit to filter yourself with your eyes.

Før var det jo litt annet, da var det lett å søke på for eksempel tidligere diagnoser. Det kunne en gjøre på System X. Da kunne vi fort se hva som var interessant, som om de har vært her før for brystmerter, men nå er ikke slik, nå er det litt mer kronglete.

Before it was a bit different. Then it was easy to search for, for example, previous diagnoses. [...] Then we could quickly see what was interesting as if they had been here before for chest pain, but now it’s not like that, now it’s a bit more complicated.

Du må bare bruke øynene og se nedover lista. Men klart det er jo mye fyll der, det er alt fra hjemmesykepleien og sånt. Så det kan jo være flere sider med ting du ikke vil se innimellom.

You have to use your eyes and then look down the list. But of course, there is a lot of filling there, from home nursing and such. So there may be several pages with things you don’t want to see every now and then.

Det brukbart tilgjengelig, men det er litt tungvint og du må liksom orientere deg og du må bruke litt tid på det.

It’s usable, but it’s a bit cumbersome and you kind of have to orientate yourself and spend a little time on it.

Det er jo masse filtreringsmuligheter. Vi opplever likevel at vi ikke får tak i det vi skal ha tak i. Og det er noe av det er jo selvfølgelig fordi at konverteringskvaliteten har vært, etter min vurdering altfor dårlig. Hvis man hadde sørget for at alle legenotat, eller alle notat som var faktisk et notat fra et gammelt system hadde ligget som notat, med kode lege, sykepleier, et eller annet å kunne vært filtrert ut.

There are lots of filtering options. We still feel that we are not getting what we should be getting. And part of that is, of course, because the conversion quality has been, in my opinion, far too poor. If it had been ensured that all doctor's notes, or all notes that were actually notes from an old system, had been stored as notes, coded doctor, nurse, or something else, it could have been filtered out.

Sykepleienotater er veldig relevant for å vite hva har sykepleieren snakket med pasienten om før du tar den inn på legevakt, men alt sykepleiere skrev om for eksempel under en 10 dagers innleggelse på sykehus er kanskje ikke så relevant for legen som skal danne seg bilde av siste 6 måneders sykehistorie. For der står det veldig mye om hvordan vedkommende spiste, hvordan vedkommende drakk om de la inn kateter og sånn eller hjemmesykepleien skriver veldig mye om pasienten har hatt litt mer strev med å bevege seg over stuegulvet og sånn som i noen tilfeller er veldig relevant, men i andre tilfeller blir veldig, veldig mye informasjon.

Notes by nurses are very relevant to know what the nurse talked to the patient about before you take them to the emergency room, but everything nurses wrote about, for example, during a 10-day stay in the hospital, may not be so relevant for the doctor who has to form a picture of the last 6 months medical history. Because there it says a lot about how the person ate, how the person drank, whether they inserted a catheter, and so on, or the home care nurse writes a lot about whether the patient has had a little more trouble moving across the living room floor and so on, which is in some cases very relevant, but in other cases, it becomes very, very much information.

Opplever vi at det er så vanskelig å finne det du faktisk har bruk for. Før du finner et legenotat, så finner du 3 notat med bare en linje med tekst, for der hadde en lege en signert epikrisen, der var en ny linje med tekst der det står at jeg sendte ut epikrise. Ny linje, et nytt dokument hvor det står en linje, du kan ha 10 dokument på en kontakt. Det er jo fordi at den gamle journalen var veldig tekstbasert, og så har det endt opp med at en kontakt har blitt det x antall dokument i det nye [systemet]. [...] Du ser ikke hva som er forskjellen på dem fordi dem er konvertert inn på samme premiss. De kommer jo fra en ustrukturert journal, og har det blitt en suppe da.

We find it so difficult to find what you actually need. Before you find a physician's note, you find 3 notes with only one line of text, because on the first a doctor had a signed epicrisis, second was a new line of text where it says that I sent out epicrisis. New line, a new document where there is a line, you can have 10 documents on one contact. It is because the old journal was very text-based, and so it has ended up that one contact has become the x number of documents in the new [system]. [...] You don't see the difference between them because they are converted on the same premise. They come from an unstructured journal, and it has become a soup.

Veldig mye database skrot som har blitt til notat som egentlig bare du kan risikere å finne da formatert, dataformater tekst, som ikke har noe klinisk verdi som vises som om det var et viktig dokument.

A lot of database junk has become a note where you risk finding only formatted, data format text, which has no clinical value that appears as if it were an important document.

Endre tekststørrelse er ikke støttet i systemet, men en kan skalere størrelsen på vinduet for å gjøre ting større.

Changing the text size is not supported in the system, but one can scale the size of the window to make things bigger.

Men det som skjedde var jo at programmet skalerte jo ikke. Det ble bare større, alt ble større, så du fikk plass til akkurat like lite og man skroller jo sideveis. [...] Også skrolle sidelengs, det er som å stå og kikke rundt et hjørne og lurer på hva som er borti der.

But what happened was that the program did not scale. It just got bigger, everything got bigger, so you had just as little space and you scroll sideways. [...] Scroll sideways, it's like standing and looking around a corner and wondering what's over there.

Det er for vanskelig å finne og ender opp med å ikke bli brukt. Det er for innfløkt. Ingen bruker det, det er så lite tilgjengelig og vanskelig.

It is too hard to find and ends up not getting used. It is too complicated. No one uses it, it is so little available and difficult

Inne på legevakt, så er det jo et voldsomt stort speil. Det er jo veldig mye trivielt luftveisinfeksjon, urinveis infeksjon, kutt og sånn. Der er jo egentlig forhistorien veldig lite relevant. For det er stort sett et nå problem, fiks det, så skal vi skrive en sykemelding, det fungerer etter hvert om sider, og resept får vi av gårde som regel, og så får vi epikrise sendt, det fungerer greit, det er blitt i orden. Så den flyten der inne er veldig grei.

In the in-house emergency room, there is a very large specter [of events]. There are a lot of trivial respiratory tract infections, urinary tract infections, cuts, and such. The prehistory is really not that relevant there. Because it's mostly a current problem, fix it, then we'll write a sick note, which eventually works, we usually get a prescription off, and then we get epicrisis sent, it works fine, that's it been in order. So the flow in there is very good.

Det vi opplever er at hvis du har et fullt sykehusjournal, så må du på nytt begynne å svømme og flyte fordi at da må du vite hva er relevant. En, det siste epikrisen kan være et veldig godt sted å starte før den har du gjerne oppsummert det du har av sykdom og legemidler og sånn, og begynner å skimme gjennom.

What we experience is that if you have a full hospital record, then you have to start swimming and floating again because then you have to know what is relevant. One, the last epicrisis can be a very good place to start, that you have summarized what you have of illness and medicines and such, and start skimming through.

De gangene jeg klarer å finne det for eksempel på et sykehjem, så kan jeg se epikrisen, for han ble skrevet ut i går eller forrige uke, så sparer det deg for en telefon, det er åpenbart at den visjonen, det målet hadde vi vært der, så hadde det vært helt topp. Men per nå så er det, er der ikke en god måte vi løse det på.

The times I manage to find it, for example, in a nursing home, then I can see the epicrisis, because he was discharged yesterday or last week, then it saves you a phone call, it is obvious that that vision, that goal we had been there, then it would have been perfect. But as of now, there isn't a good way to solve it.

Det handler jo ofte om å vite, er det her en ny problemstilling? Er det kjent? Har vedkommende vært behandlet for det før? Har vedkommende oppfølging i spesialisthelsetjeneste? Har de kommunale oppfølging? Hva har dem? hvis jeg klarer å finne ut at ”ja pasientene har, det kjent problem, vi har god behandling, bord i bolig med god omsorg” såne ting, så er det veldig nyttig. For det gjør at vi setter inn kanskje helt andre tiltak enn at hvis vi ikke klarer å finne ut av det.

It is often about knowing, is this a new problem? Is it familiar? Has the person been treated for it before? Does the person have a follow-up with a specialist health service? Do they have a municipal follow-up? What do they have? If I manage to find out that ”yes the patients have, the known problem, we have good treatment, tables in housing with good care” and things like that, then it is very useful. Because that means that we may put in completely different measures than if we are unable to find out.

I de tilfellene hvor jeg trenger å konsultere med en spesialist eller en som er mer erfaren innenfor fagområde, så vil jeg kanskje gjort det uansett. Så da handler det kanskje om at jeg kunne stilt mer kvalifiserte spørsmål eller ha vært bedre forberedt fordi at jeg hadde mer opplysninger.

In those cases where I need to consult with a specialist or someone who is more experienced in the field, I may want to do so anyway. So then it may be that I could have asked more qualified questions or have been better prepared because I had more information.

Jeg tenker jo at det handler jo primært om at det å ha god bakgrunnsinformasjon, hva som har vært gjort før for å kunne gi en bedre behandling.

I think that it is primarily about having good background information, and what has been done before to be able to provide better treatment.

Det varierer jo med type hva de kom med for [hva er årsaken til besøket] og hvor mye du trenger å orientere deg i journalen.

It varies by type, what they came for [what is the reason for the visit] and how much you need to find out in the journal.

Det er klart om folk som er tungpusta, og for eksempel vært inne med innlagt med hjertesvikt, så det er fint å se hvordan de har tenkt for eksempel om de har hatt en nylig innleggelse på sykehuset, så det er jo nyttig.

It is obvious if people are short of breath, and have, for example, been hospitalized with heart failure, then it is useful to see how they have thought, for example, if they have had a recent admission to the hospital, so it is useful.

Fordelen er jo at du ser [informasjon fra andre enheter], [...] Det er klart det er jo fordelene. Det er prinsippet som et hvert journalsystem ville hatt nytte av, men måten de har gjort det på er dessverre ikke så veldig vellykka. Altså selve programmet, men det generelle ved det å få tilgangen er selvfølgelig kjempepluss.

The advantage is that you see [information from other units],[...]. Of course, those are the benefits. It is the principle that every journal system would benefit from, but how they have done it is unfortunately not very successful. The program itself, but the general aspect of getting access is of course a huge advantage.

Du må på en måte begrense deg og prøve å være litt rask å se hva du finner på en relativt rask måte.

You kind of have to limit yourself and try to be a bit quick to see what you find relatively quickly

Det er mer at det er en ulempe for den kjørende legevakta, fordi at det er mer sårbart når du skal raskt orientere og hent fram [informasjon]. Det er jo det at de er mer sårbare generelt ved [bruk av] helseplattformen enn vi som sitter inne. Fordi de har liksom samtidigheter, og de skal orientere seg mens de kjør kanskje utrykning og så videre.

It is more that it is a disadvantage for the ambulance physician because it is more vulnerable when you have to quickly orientate and retrieve [information]. It is the fact that they are more vulnerable in general at [use of] helseplattformen than we who sit inside. Because they have simultaneities, and they have to orientate themselves while driving a call-out and so on.

Også er det kanskje det aller største som er en bekymring at en sånn "information overload", det er umulig å finne det vi har bruk for.

The biggest concern is perhaps that one gets such an "information overload", it is impossible to find what we need.

Like viktig som det foregående, som var faktisk var et lege's notat eller et sykepleiernotat, også sauses det også sammen med at vi ser jo da veldig mye informasjon fra andre yrkesgrupper, for eksempel hjemmesykepleie som vi opplever jo at får samme prioritet om hjemmesykepleie har vært der og servert middag, eller om det har vært eller du har hatt legebilen på besøk.

Just as important as the previous one, which was actually a physician's note or a nurse's note, it is also sauced together with the fact that we see a lot of information from other professional groups, for example, homecare which we feel is given the same priority if home homecare was there and served dinner, or if there has been or you have had a visit from the ambulating car.

Hvis du ikke klarer å lokalisere det innen rimelig tid, om det da bunner i brukerkompetanse om det bunner i hvor det er plassert, om det faktisk ikke finnes der. Så bruker du ikke mer tid fordi at du må videre.

If you are unable to locate it within a reasonable time, whether it is rooted in user competence, whether it is rooted in where it is located, or whether it is actually not there. Then you don't spend more time because you have to move on.

Å hente den frem enkelt og greit og raskt er det viktigste. Det er ikke bare med et såpass stort system.

Retrieving it easily and quickly is the most important thing. It is not so easy with such a large system.

Det er litt kronglete og det tar litt mer tid enn du kunne ha håpa på. [...] Så det fungerer jo, men det er liksom sånn at en kunne ha håpet at det kunne ha vært enda mer funksjonelt.

It's a little complicated and it takes a little more time than you might have hoped for. [...] So it works, but one could have hoped that it could have been even more functional.

Jeg opplever at vi ikke, altså der du i gamle tradisjonelle journalsystem raskt kunne scrolle, du kunne bruke, du kunne raskt finne epikriser, du kunne raskt finne tidligere sykdommer, du kunne raskt få en god oversikt. Så må du mye mere rundt, mye mer inn og ut av menyen inn og ut av fanen. Også er det veldig, det er veldig kaotisk brukergrensesnitt, fordi at det er fane også er det underfaner, osv.

I find that we don't, where you in old traditional journal system you could quickly scroll, you could use, you could quickly find epicrisis, you could quickly find previous illnesses, you could quickly get a good overview. Now you have to go around a lot more, a lot more in and out of the menu, in and out of the tab. Also, it's a very, very chaotic user interface because there are tabs, there are also subtabs, etc.

Du er nødt til å skjære igjennom fordi at enten så er det psykiatri, hvor man må faktisk finne en løsning. De skaper et problem for seg selv eller for omgivelsene, eller vi har politi som står og venter på oss. Det kan være akutte ting vi kjører på, så blålys ting hvor på vei ut, så må vi vite: Har pasienten hjertesykdom eller ikke? Så kanskje må vi be AMK ringe noen mens vi finner ut av noe annet, eller vi må, vi må bruke de ressursene for å få raske svar og av og til så har vi ikke svar, og da må vi anta det verste.

You have to cut through because either it's psychiatry, where you actually have to find a solution. They create a problem for themselves or for the surroundings, or we have the police waiting for us. There may be urgent cases we drive to, so blue light cases were on the way out, then we need to know: Does the patient have heart disease or not? So maybe we have to ask AMK to call someone while we figure something else out, or we have to, we have to use those resources to get quick answers and sometimes we don't have answers, and then we have to assume the worst.

[Metadata som signatur] har blitt et journalnotat sånn at du ser ikke forskjellen på en på en linje med tekst og et fullt journalnotater eller en epikrise. Alt ser likt ut og du må bla igjennom en og en for å finne noe. Så jeg har jo sett eksempel på at det her rykket ut til pasient med 100 kontakter siste år eller 2 hvor jeg ikke finner et eneste journalnotat.

[Metadata such as a signature] has become a journal note in such a way that you don't see the difference between one line of text and a full journal note or an epicrisis. Everything looks the same and you have to scroll through one by one to find something. So I've seen an example of this happening to a patient with 100 contacts in the last year or two where I can't find a single medical note.

Hvis de akkurat har vært der [på sykehus] og kunne se den siste epikrisen [...] åpenbart det har en styrke. Og hvis det er veldig sånn nært i tid, så er det lett å finne. For da kan du se at det her er noe av det siste som har skjedd. Men det å finne ting bakover i tid er det som er, per nå så har det veldig liten verdi for at det er så lite reell historikk der. Det er bare masse skvalder egentlig. Og legevakt journalen er jo bare full av konvertert, litt dårlig konvertert tekst som er vanskelig å navigere i.

If they have just been there [in the hospital] and can see the latest epicrisis[...] obviously that has a strength. And if it is very close in time, then it is easy to find. Because then you can see that, this is some of what has happened recently. But finding things backward in time is what it is, as of now it has very little value because there is so little real history there. It's just a lot of noise really. And the emergency room record is just full of converted, somewhat poorly converted text that is difficult to navigate.

Nå har vi jo hvert fall bedre oversikt over sykehjemspasientene. Legevakten må jo mye ut på sykehjem. Vi får også en del telefoner fra sykehjem på kveld og natt, og i stedet for litt sånn dårlige telefon samtaler der du ikke får kvalitetssikret noen ting, så har du nå tilgang på dokumenter da.

At least, now we have a better overview of the patients at nursing homes. The emergency room has to go to nursing homes a lot. We also get a lot of calls from nursing homes in the evening and at night, and instead of bad phone calls where you don't get any quality assurance, you now have access to documents.

De her listene er egentlig det mest essensielle for oss. Og så må man bare vite at det er ikke alltid de stemmer, så du kan ikke stole helt på dem.

These lists are the most essential for us. And then you have to know they aren't always right, so you can't completely trust them.

Det her også er jo litt sånn, det er veldig varierende hvor godt folk vet altså. Jeg tror ikke alle vet at det dukker opp sånn. [...] Men da ligger det under medier, ikke sant? Sånn at det er veldig mange ting som ikke er sortert per besøk.

This is also a bit like that, it is very variable how well people know. I don't think everyone knows it shows up like that. [...] But then it's under the media tab, right? So there are a lot of things that are not sorted per visit.

Jeg jobber jo her hver dag og er jo godt kjent med hvor alt ligger og sånn. Men hadde jeg kommet hit en kveld i måneden og så må du på en måte trykke under 4 ulike faner for å finne det som er relevant for det besøket, så blir det tungvint da.

I work here every day and am well familiar with where everything is and such. But if I came here one evening a month and then you have to click under 4 different tabs to find what is relevant for that visit, then it would be cumbersome.

Noen ganger ser det ut som at, er det 2 personer så må begge personene skrive et notat, og holder liksom ikke at en person har skrevet det. Sånn at det finnes tusen notater der det bare står "andre personer på stell, punktum". [...] Det blir jo helt ekstreme datamengder da som egentlig er helt intetsigende.

Sometimes it looks like, if there are 2 people, both people have to write a note, and somehow it doesn't hold that one person has written it. So that there are thousands of notes where it only says "other people on visit, dot". [...] This results in absolutely extreme amounts of data that are actually completely meaningless.

Den går det ikke an å ha forhåndsvisning på, den må du åpne som en egen mediatype som legger seg i et eget vindu. Her [inne på legevakt] har jeg mulighet til å dra den til siden sånn at jeg kan skrive mitt notat i pasientjournalen samtidig som jeg ser. Mens i bilen, så er det så liten arbeidsflate, og med en gang jeg trykker inn i notatet mitt, så blir hele det bildet borte. Sånn at da må du i tillegg på en måte lese, lukke det, skrive, altså veldig sånn tungvint da.

It is not possible to have a preview on it, you have to open it as a separate media type that is placed in a separate window. Here [at the in-house ER], I can drag it to the side so that I can write my note in the patient record at the same time as I look. While in the car, there is such a small work surface, and I type in my note, the whole picture disappears. So you have to read, close, then write, so very cumbersome.

Noen ganger så skjønner du at, ja men hele oppdraget løses saktere hvis du ikke leser deg opp. Da prioriterer man å lese seg kjapt opp, men ikke like mye ikke sant? Er man heldig, så finnes en epikrise fra sykehuset der skal alt være ganske oppsummert og oppdatert.

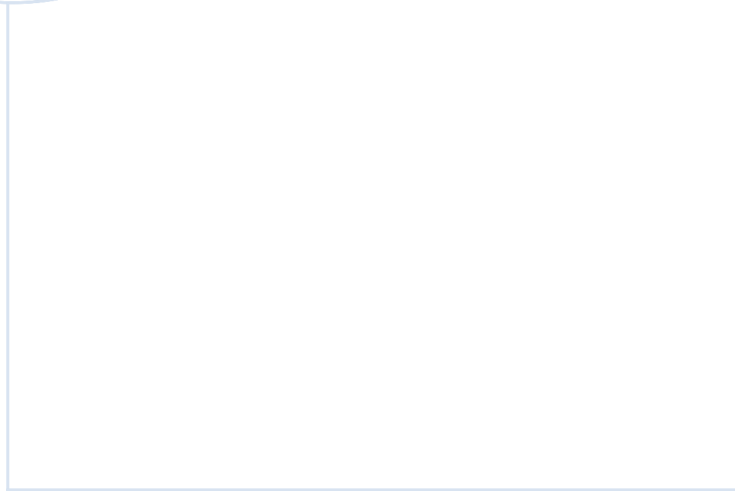
Sometimes you realize that, yes, but the whole mission is solved more slowly if you don't read up. Then you prioritize to quickly gather the information one need, but not as much right? If you are lucky, there is an epicrisis from the hospital where everything should be fairly summarized and up-to-date.

Er det et oppdrag der vi må vurdere voldsrisiko, så er vi jo nødt til å sette av en liten tid for vår egen sikkerhetsskyld.

If it is an assignment where we have to assess the risk of violence, then we have to set aside a little time for our own safety.

<p>Før eksempel ved en hjertestans, og så hadde du fått slått opp i journal. Så hadde du sett at ja, men det her er noen som har kort forventet levetid, kanskje en måned igjen av alvorlig kreftsykdom. Så vil du gjøre helt andre vurderinger enn om det er noen som er frisk.</p>	<p>For example, in the event of a cardiac arrest, you were able to look up in the medical record. Then you would have seen that, but this is someone who has a short life expectancy, perhaps a month left from severe cancer. So you will make completely different judgments than whether someone is healthy.</p>
<p>Man jo litt spent på det at man kan bli møtt med at, ”ja men det her lå jo tilgjengelig for deg. Hvorfor har du ikke sett på, eller brukt det i vurderingen?” Men det har man ikke alltid sjans til da.</p>	<p>You’re a little curious about the fact that you might be met with that, ”yes, but this was available to you. Why haven’t you looked at, or used it in the assessment?” But you don’t always have the chance to do that.</p>
<p>Utfordringen er at det kan ta litt tid og bla gjennom, ikke sant? Og også det å få sortert på, det ligger jo helt enorme mengder informasjon inne her, sånn at av og til kan være problemet. Så er for mye og at det tar litt tid å filtrere bort.</p>	<p>The challenge is that it can take some time to go through, right? And also, getting it sorted, there is an enormous amount of information in here, so that can occasionally be the problem. Then there is too much, and it takes some time to filter away.</p>
<p>Så jo mer du brukte det, jo mindre ubehagelig blir det jo. Men det kommer aldri godt i mål når det gjelder brukervennligheten.</p>	<p>The more you use it, the less uncomfortable it becomes to use. But it will never quite hit the mark when it comes to user-friendliness.</p>

Table 10: Translation of quotations



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Science and Technology