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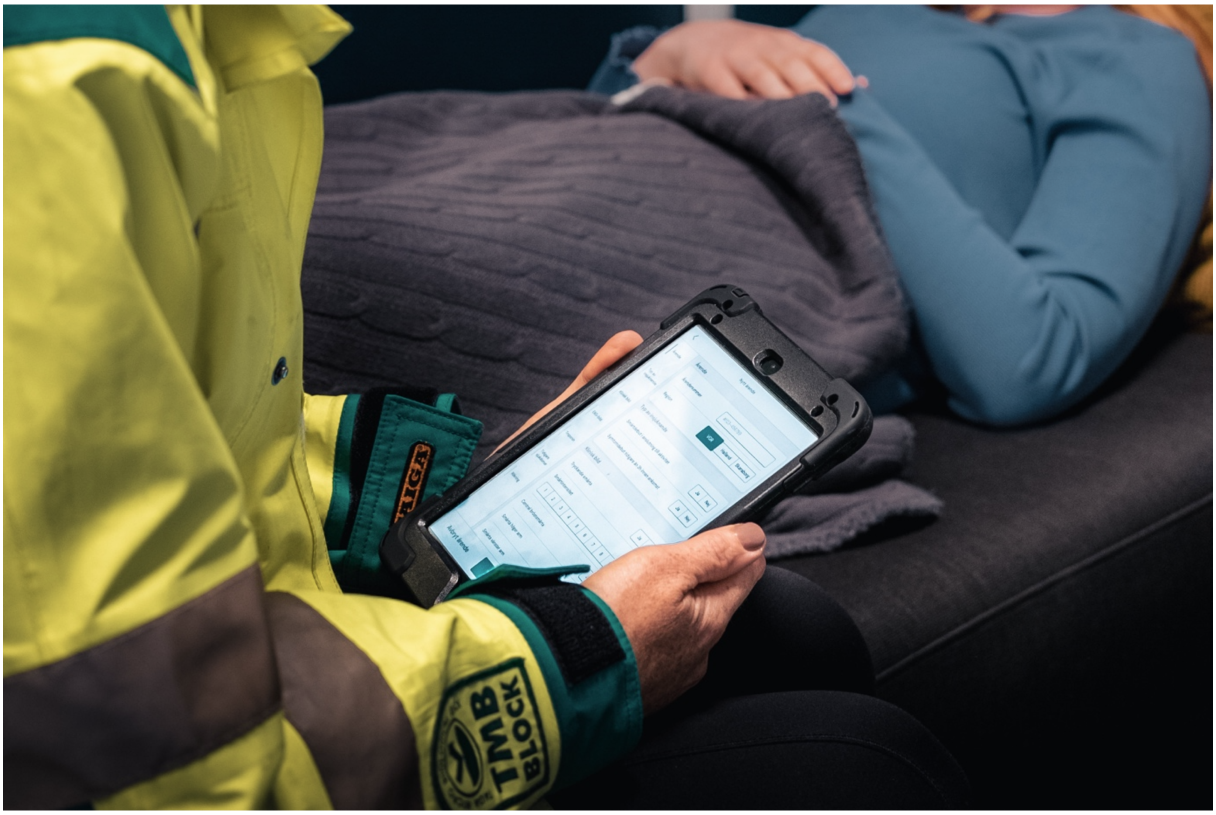

User Interface concept for AI-supported clinical decision making in prehospital emergency care

A study & development project in how to implement new technology for Emergency Medical Services nurses

Master's thesis in Industrial Design Engineering

Jens Andersson
Elin Maxstad

DEPARTMENT OF INDUSTRIAL AND MATERIALS SCIENCE
DIVISION OF DESIGN AND HUMAN FACTORS

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A study & development project in how to implement new technology for Emergency Medical Services nurses in collaboration with PICTA & Sahlgrenska University Hospital.
JENS ANDERSSON & ELIN MAXSTAD

Supervisor and Examiner: Cecilia Berlin
Supervisor PICTA: Fredrik Karlsson

Technical report no xxxx:xx
Department of Industrial and Materials Science,
Chalmers University of Technology
SE-412 96 Göteborg
Sweden
Telephone + 46 (0)31-772 1000

Cover imagine: The UI of the concept of the AI protocol in a fictive scenario.
All imagines by the authors unless otherwise stated.

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Jens Andersson & Elin Maxstad
Gothenburg, June 2022

Abstract

This thesis investigated how new technology could be implemented in the prehospital healthcare with the aim of introducing a digital AI-powered clinical decision support. Through interviews, on-site observation and a focus group of ambulance nurses an idea of the situation was established. With that as a baseline, the development of three different deliverables started; firstly, a digital interface meant for data collection feeding into the machine learning of the AI. Secondly, a representation of how a clinical decision support should be presented and thirdly, a rough interface proposal of how a collection of several existing digital tools could be integrated to one seamless solution, acting as a digital toolbox.
All three concepts were well received amongst the few involved ambulance nurses. A hypothesis for the reason of such positive reception is a combination of multiple things. A few of those being actual good design work, the current situation of poor tools being the only comparison and that some deliverables were very conceptual with fidelity gaps being filled in with hopes and expectations of the perfect tool.

Glossary

Differential diagnoses	Diagnoses with similarity of symptoms.
EMS nurse	Nurses working in the ambulance with pre-hospital care.
Figma	A software for creating digital interfaces and wireframes.
MBS	A medical decision support used by the Emergency Medical Dispatch Centre to prioritise the one calling for help.
Paratus	A medical record and assessment platform, used in Halland e.g.
Patient medical record	A person's systematic documentation of medical history and care across time.
RAKEL	The Swedish governmental system for radio communication used by socially important actors such as the National Defence, Police, Fire Department and the Ambulance.
ST raise	A specific ECG curve pattern.
ST lowering	A specific ECG curve pattern.
Triage	A process for priority of patients based on medical history, symptoms, and parameters. Different triage systems have been developed and used around the globe.
Vital parameters	Measurements of the vital functions of the human body like breathing, oxygen saturation, temperature, blood pressure, pulse and consciousness.

Abbreviations

ECG	Electrocardiography
ED	Emergency Department
EMDC	Emergency Medical Dispatch Center
EMS	Emergency Medical Services
ESS	Emergency Systems and Signs
ETA	Estimated time of arrival
GDPR	General Data Protection Regulation
MBS	Medicinskt beslutsstöd (Medical decision support)
mNhiss	Modified National Institutes of Health Stroke Scale
NEWS	National Early Warning Scale
PICTA	Prehospital Innovation arena
RETTS	Rapid Emergency Triage and Treatment System
SBAR	Situation – Background – Assessment – Recommendation
SU	Sahlgrenska University Hospital
VGR	Västra Götalandsregionen
VP	Vital Parameters

Table of Contents

1. Introduction

This chapter introduces the background, project description, and clients as well as aim, deliverables, limitations, research questions and finally the outline of the thesis.

1.1. Background

One of the corner stones of society is the health care system which is in constant development. This in order to meet the needs of the citizens today but more importantly, the needs of tomorrow. A challenge is how to become more efficient without compromising on the quality and equality of care to every patient.

The work within the ambulance force, which this project focuses on, has changed from solely being a transport service to being a medical assessment and treatment function in a relatively short time. Thus, the routines and tools are not yet fully adapted for this 'new' way of working.

Between 2010 and 2021 the annual number of assignments handled by the Emergency Medical Services (EMS) in the western part of Sweden increased by 25% (Magnusson, 2021). In 2019 it reached 155 000 assignments. 70 000 of these were handled by Sahlgrenska University Hospital (SU). Considerable factors for this increase are the continual progress of medicine and ageing population. This, combined with decreasing spots in the hospitals has pushed this change of EMS nurses being able to provide treatment rather than just being a transport service (Nergårdh et al., 2018). There has been a shifted focus from transporting all patients to the emergency department to a practice of finding alternative ways for treatment. The expectation of competence of the EMS nurses has therefore increased. The EMS patients' need span from very simple care to severe multi-trauma, which means specialities of all practices are needed. This is a challenge for an EMS nurse who often is the first person to make a comprehensive assessment of the patient at the scene. The task to perform a correct assessment and identify the right level of care demands an increasingly precision of assessment.

There is a big difference how the EMS nurses operate depending on the level of emergency of the situation. A patient who is in a life-threatening state is naturally handled in a way different from a patient who is not as critical. For the situations of the later character, a triage system is used where vital parameters, historical medical data and medicines are combined and summed up to a level of urgency of the patient. From time to time there is still very difficult to make the decision of a right level of care. From a study by Magnusson (2021) on patient assessment and triage in EMS, almost 7000 adult patients were assessed by an EMS nurse. The study shows that in total, 19% were under-triaged and 36% were over-triaged.

This project is an extension of the research of Magnusson but also by research carried out by Kristoffer Wibring, on optimisation of the prehospital triage of patients with chest pain. 10-15% of all EMS patients have chest pain as their main condition, representing the most common condition among patients assigned the highest priority (Zakariassen et al., 2010). There is a large variety of age, medical history and symptoms within this patient group which makes it difficult to recognise a medium-risk patient from a low-risk one. On top of this, chest pain could be a symptom leading to severe illness or even death which puts the EMS nurses in a stressful situation.

Conclusions from the research conducted by Wibring (2021) shows that most patients experiencing chest pain who are assessed by the EMS nurses have a low-risk condition. But with the tools available in the ambulance today it is very difficult to determine if the patient is not crucial. Therefore, an AI being able to assess patients is developed and planned to be implemented in a new tool and act as a decision-making support at the scene. The work is carried out by a research group at the department of prehospital emergency care at SU. As of now, the AI is currently solely directed towards handling cases regarding chest pain. However, the work aims to consider many types of symptoms in the future and to be an efficient tool for the prehospital emergency care.

To implement AI-driven decision support tools in the prehospital emergency care is something new and comes with positive expectations for the future but also mistrusts. Ethical considerations must be taken regarding patient data and safety. Ohlsson (2021) states that *how* an AI-driven tool is implemented can be the difference between added value or not. That is one important factor driving this project.

1.2. Clients

The clients of this project are two stakeholders who are closely connected. Together they saw a potential to create this master thesis that could originate from the user perspective of this product.

PICTA

PICTA is a prehospital innovation arena funded by region Västra Götaland (VGR) as a part of Lindholmen Science Park. It is a cooperative platform for organisations within health care, academy, and business. The projects run by PICTA are funded by different governmental foundations, such as Vinnova. PICTA is not involved in the development of this project but have solid knowledge and experience within prehospital settings and implementation of new technology in this field. The expectations of PICTA are none in terms of deliverables and are involved solely by self-interest and will act as a continuous support throughout the project.

Sahlgrenska University Hospital

The project of the decision support tool for chest pain originates from SU. Carl Magnusson together with Kristoffer Wibring will act as the experts on the decision support tool and the work of an EMS nurse and give their input. Carl Magnusson has previously been involved in projects with PICTA, thus a good relationship between the clients is already established.The expectations of SU are in terms of deliverables proposals of UI and functionality for a data collection and decision support tool to be used both for AI-learning and patient assessment.
Their intention is that results from this project will be used as foundation for the development of the actual product.

1.3. Aim

The aim of the project is to design a user-friendly, interactive, digital interface proposal of a future decision support tool within the prehospital setting. Its aim is to increase the precision of the assessments of patients with chest pain done by EMS nurses. Its purpose in the long run is to increase VGR's resource efficiency in terms of reducing the number of patients being wrongly assessed and placed at a hospital unnecessarily but also to increase patient safety.

The usability of the product should be on a level which is suitable for EMS nurses, with preferably recognisable elements from their existing tools and other well-established systems.

1.4. Deliverables

Since SU is the primary client, the deliveries of the project will answer to the current situation of VGR. The general idea is that the AI-powered decision support eventually will be included in a digital, comprehensive medical record and assessment platform, which as of now is not yet existing. To put the decision support tool in a context and create better conditions for a future implementation, a concept of such a platform to be used by the EMS nurses is designed as well.

The process of implementing the decision support tool initially requires a period of data collection from patients before it can be developed to a tool providing actual decision support or recommendations. Therefore, it will come in two versions, one with and one without recommendations.

The deliverables are divided in three parts:

1. Design a user-friendly interface of an **AI-learning protocol** for chest pain.
- A functional, interactive prototype for a couple of predefined scenarios.
- To be used in the early phase of the upcoming project to only collect data.

2. Design a visual representation of how **decision support** could and should be provided.

3. Design a concept of a digital **medical record and assessment platform**.
- A sort of digital toolbox collecting several existing tools and utilities to one place.
- The concept will include a proposal of how the decision support tool could be implemented in the workflow as well as a part of this platform.

A recommendation of the physical format of the device that will be used for the three different solutions will also be suggested.

1.5. Demarcations

The project will primarily focus on a scenario in which VGR is the customer, taking only small consideration to other regions of Sweden due to the differences in the digital infrastructure.

Functionality of all products and solutions delivered will be limited to visual representations of a finished product, to act as a foundation for the future fully functional product.

Physical requirements and medical regulations of a physical product will not be investigated.

The research on which the project is built upon is in itself limited towards patients with chest pain, to keep the context within an apprehendable range. Thus, this project's main deliverables are kept within the same limitations.

The project will be carried out through the perspective of the EMS nurses, targeted as the primary user. Other actors within the prehospital healthcare are briefly investigated but not designed after. The same goes for patients and relatives, whom could be argued to be secondary users, only partly experiencing the usage of the products (Janhager, 2005). This decision was based on keeping the project at a reasonable size.

Primary focus will be on situations which are not time sensitive, and a systematic assessment can be done by an EMS nurse. Situations where a patient is in a life-threatening condition are not included.

The final deliverables will not be tested in real scenarios with real patients.

1.6. Research questions

To reach the deliverables and aim, four research questions are formulated to be answered by this project.

RQ1 How can new technology and tools be implemented in the environment and workflow of the EMS in a successful and user-friendly way?

RQ2 How can a digital interface for an AI-learning protocol look and be well integrated in the current work situation of EMS nurses?

RQ3 How should decision support be presented to be useful and trustworthy?

RQ4 How can a larger digital toolbox, integrating several existing tools and utilities, look and work? And with what features?

2. Context

This chapter explains the context and situation of where the research of this project takes place and where the solutions aim to be implemented.

As explained earlier, every region in Sweden is to some extent sovereign, and the following descriptions will originate from the situation of VGR if nothing else is explained. Most of the information in this chapter is based on interviews with the involved experts on Sahlgrenska, PICTA and EMS nurses but also on own observations.

To describe the context of this project an interpretation of the Activity theory model, by Kaptelinin & Nardi (2006), was helpful. Figure 1 provides a visual representation of the situation in question for this project and the contexts in which it occurs.

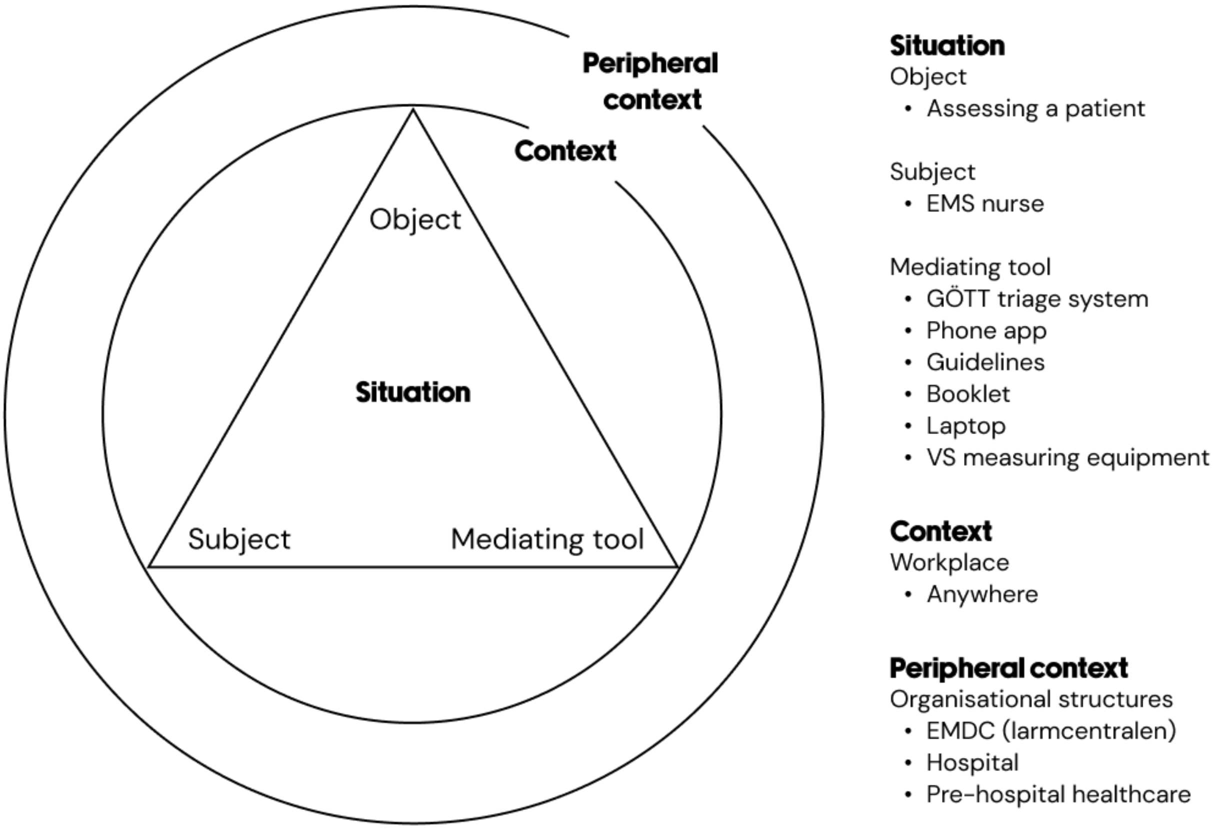


Figure 1 - The context of the project visualised in a model interpreted by the Activity theory model

2.1. The pre-hospital environment and organisation

The pre-hospital care is a unique department of the health care system for several reasons. The patient population is unselected, and the level of care covers the whole spectrum from only a need of a check-up or a painkiller to severe trauma. The working environment shifts throughout the day and so do the conditions of the place where care needs to take place. The EMS nurse meets and treats patients in their homes, at nursing homes, at working places or at schools, but also at public places like restaurants, clubs, gyms, the bus or the shopping mall. It can also be outdoors in the woods, a parking lot, bus station or park.

The most common situation is that every ambulance is manned with two EMS nurses, but it can also be one nurse and one paramedic. The one with the highest medical competence is the one who is ultimately responsible for the decisions and treatment. But the rule of thumb is that both colleagues should agree on the treatment plan and decisions in order to proceed.

In addition to the ambulances, there are assessment cars which can be sent to a patient if the condition of the patient does not seem to be acute and the need of an ambulance is estimated to be low. The EMS nurses can also call to consult with different doctors within cardiology, neurology, or a paediatrician for example.

2.2. The process of an emergency call

When someone makes a call to 112 in VGR the call will be handled firstly by the SOS Alarm central. They make a first assessment if the call is a case for the police, the fire department, or the EMS. If there is a situation with a person in need of care the call gets redirected to the Emergency Medical Dispatch Centre (EMDC).

The EMDC in Gothenburg serves all VGR. Most incoming calls are redirected calls from individuals calling the emergency number 112 in need of care. Every day around 650 calls reach the EMDC this way. There are also calls from different health care units such as hospitals when patients need to get transferred between hospitals for example. The operators at the EMDC are all educated nurses or assistant nurses.

Their job is to collect information about the patient's status. They ask questions based on a protocol and the information are noted and analysed by the support tool “Medical decision support” (MBS).

The MBS summarises the parameters and results in a priority from 1-4, described in more detail below.

- Priority 1 – Acute life-threatening symptoms
- Priority 2 – Acute but not life-threatening symptoms
- Priority 3 – Need of treatment with less acute character
- Priority 4 – No need of treatment during transport, health care transport could be sent out or just supporting the patient with self-care advice

If the situation is prioritised 1-3 there will be an ambulance connected to the assignment by SOS Alarm. When an ambulance has been assigned the EMS nurses receive the basic information about the case. It includes prioritisation, main cause for contact, name and

social security number of the patient, telephone number and address of the location. A shorter description following a protocol called SBAR also comes with the assignment. It includes Situation, Background, Assessment and Recommendation (Sveriges Kommuner och Regioner, 2021).
If the assignment has priority 1 it is always the closest ambulance to the location that gets the assignment.

See Figure 2 for an overview of the described sequence of events.

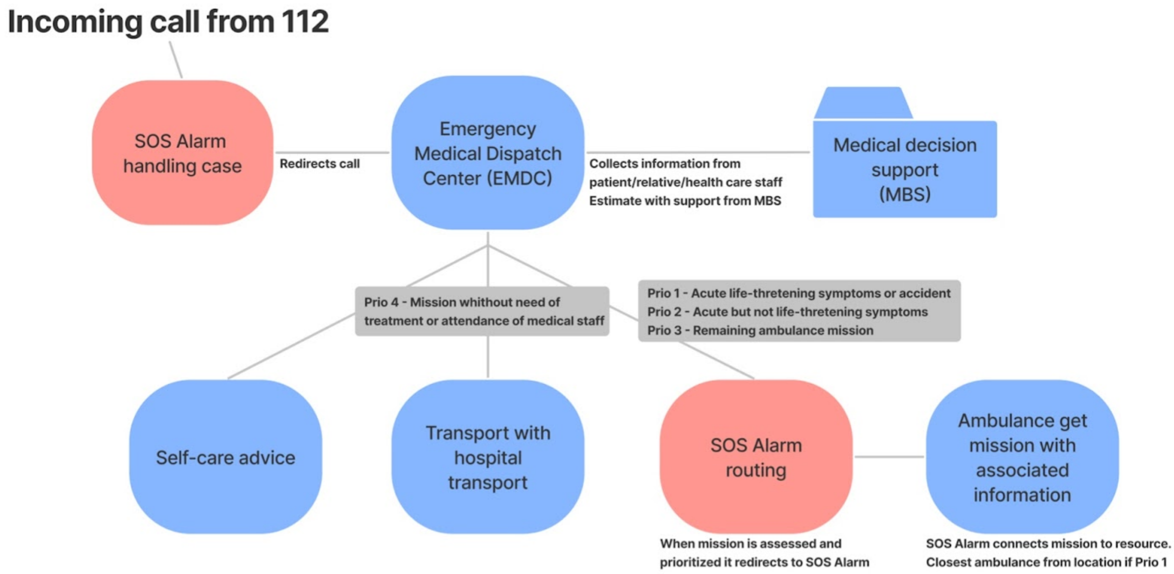


Figure 2 – Flow chart of an incoming call from 112 to assigned ambulance

2.3. The work and tools of an EMS nurse

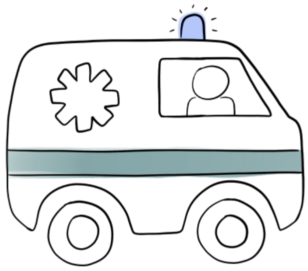
The most common setup for an EMS nurse is to be paired up with one other colleague. The teams of two work in shift and when a shift ends for one team, another takes over and assign themselves to the ambulance. In VGR the most common shift is 12 hours.

The following description of actions of the EMS nurse is representative for most assignments except those with the highest priority where the need to save life decides the actions.

Receive assignment

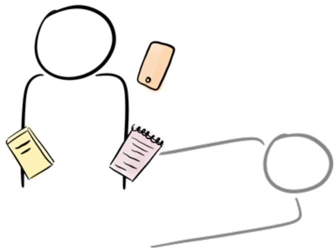
Communication between SOS Alarm central and the EMS is done via the national RAKEL-system, also used by the police and fire department. Every nurse and paramedic carry a telecom tool with this system and every ambulance is equipped with one unit. When an assignment is sent out from the SOS Alarm central through the RAKEL-system, the EMS nurses confirms it, and an estimated time of arrival is sent back to the SOS Alarm central, and the mission is started.

Drive to patient



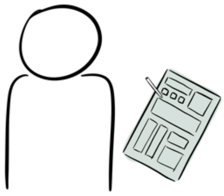
Firstly, they read through the shorter description of the assignment from the EMDC and if there is time, they can check the patient history from the patient medical record system called Melior trough a laptop in the ambulance. With this information they get an idea of what they will meet and can determine what equipment to bring to the patient initially.

Assessment of patient



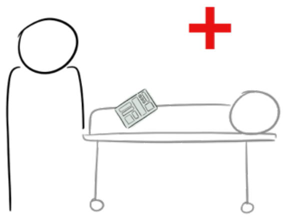
When they arrive at the patient, they start to collect information by asking questions and taking tests. Some of the parameters or symptoms are checked in a handbook they carry. The handbook works as an encyclopaedia as well as a tool to indicate how severe some vital parameters are, based on the triage system Rapid Emergency Triage and Treatment System (RETTS). The parameters are noted and when the investigation is done, a conversation of further actions is made by the EMS nurses in consultation with the patient, relative and or health care staff. The decision of care must be approved by the patient as the EMS nurses cannot force any treatment on a patient.

Treatment of patient



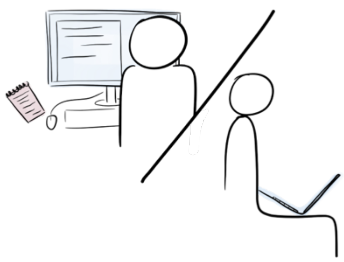
There are four choices of actions; the patient should be treated on the scene, the patient should seek further care at a primary health centre, the patient needs to go to a hospital but can wait for a taxi or hospital transportation to take them there or the patient needs to go to a hospital now and is taken to the ED by the ambulance.

Patient to hospital



If the patient is taken to a hospital an acute patient medical record must be filled in and handed over to the emergency department. It is a pre-printed paper journal based on the triage system GÖTT. Parameters, medical history and status of the patient are noted as well as any medicines given by the EMS nurse on the scene. The parameters are summed up and an outcome of the acute journal is a prioritisation by a number and colour as presented in 2.2.

Write patient medical record



When the assignment is completed and e.g., the patient is relocated at a hospital, the rule of thumb is that the EMS nurse has 20 minutes to finalise writing the patient medical record in the web-based system, Ambulink. This takes place where there is access to a computer, often at the hospital or the ambulance station, but most ambulances are also equipped with a laptop where it can be performed as well.

Usually, the ambulance is assigned a new assignment first after these 20 minutes, however, if there is an assignment with priority 1, it can be assigned directly after the previous is completed. In these cases, the writing of the patient medical record is postponed. Worst case scenario is that a whole shift can go by without having time to transfer the notes on paper to the patient medical record, and thus, all of them has to be done at the end of the shift.

A flowchart of the work of the EMS nurse is visualised in Figure 3.

Figure 3 - Flow chart over the work of an EMS nurse

2.3.1. Additional tools and equipment

Medicine bag
The medicine bag is a backpack that always is brought to a patient equipped with guidelines, standard medicines and other equipment like stethoscope and blood pressure monitor. The medicine bag is shown in in Figure 4.

Figure 4 - Medicine bag

Ambulans Sahlgrenska application
SU has their own application, called Ambulans Sahlgrenska. Start screen and homepage seen in Figure 5. The application holds guidelines and treatment plans, a medicine dosage calculator and are used as an information channel from the organisation to the EMS nurses. Updates regarding treatment, what hospital within the area of Gothenburg will treat what patients at the moment and when there is any event affecting the ambulances.

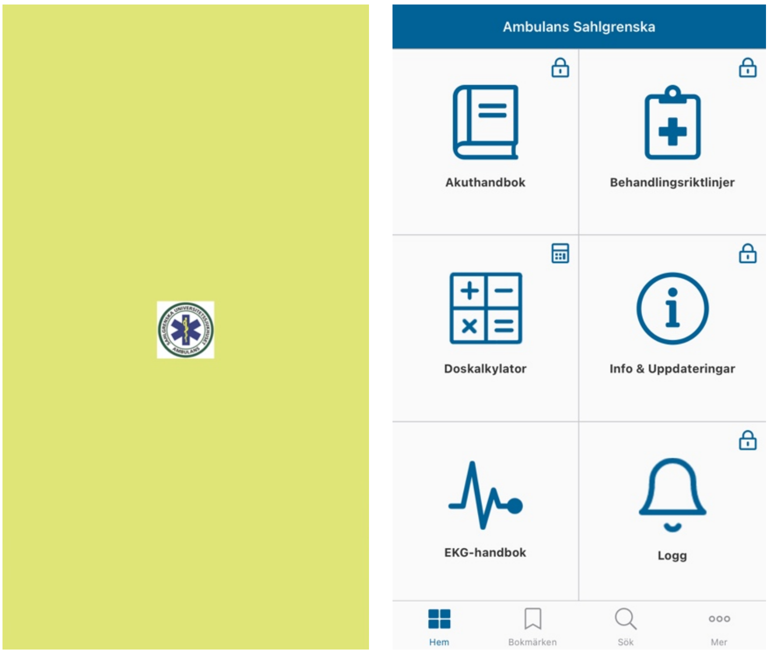


Figure 5 – Startscreen (left) and homepage (right) of the application Sahlgrenska Ambulansen

2.4. Assessment methods

There are some guidelines, acting as a systematic approach of how to immediately assess a patient. The ABCDE model is a well established primary assessment method and is performed by investigating the following factors:

A – Airway (is the airway free?)
B – Breathing (how is the breathing?)
C – Circulation (is there any heartbeat or pulse?)
D – Disability (how is the movement and ability to speak and act normally?)
E – Expose (are there any wounds or fractures?)

The primary investigation is often followed by secondary assessments, being narrower and more specific. SAMPLE and OPQRST are two commonly used models meaning the following;

S - Signs & symptoms
- O - Onset (how it emerged)
- P - Palliation (what makes it increase/decrease)
- Q - Quality (what are the experiences)
- R - Radiation (localisation)
- S - Severity (intensity)
- T - Time (of departure)

A - Allergies
M - Medicine
P - Past medical history
L - Last meal/lifestyle
E - Events prior

2.5. Triage systems

To better prioritise patients at the emergency care in an impartial way, different triage systems have been developed and are established globally. A common triage system used by a large part of the Swedish healthcare is called RETTS - Rapid Emergency Triage and Treatment System (Magnusson, 2021). The system is based on vital parameters (VP), Emergency Systems and Signs (ESS) and medical historical data of the patient.
It is a chart which when filled in results in a priority which indicates how urgent it is for the patient to see a doctor. A colour system is used; green, yellow, orange or red, where red is the most urgent colour. This is the basis for decisions of treatment and level of care. The triage system is used by the EMS nurse at the scene, as the guiding tool for assessment of the patient and a way to communicate what kind of patient they will bring to the EMS.

During 2020, Sahlgrenska University Hospital introduced an adapted version of RETTS called Göteborg Triage Test (GÖTT) (Magnusson, 2021). The system aimed to make even better estimations for what priority and care the patient should get but also to reduce over-triage. This system also has five stages and colours for treatment priority and can be found in Appendix II.

Every region in Sweden is sovereign, to some extent, and determine how the healthcare system should be managed in their region and therefore some differences occur throughout the regions. The level of digitalisation differs and in VGR there is no digital platform with tools for assessment or patient medical record that is designed for the EMS nurses to use in the field. Parameters and values of the patient, comments and observations are written as notes on paper. All of which later are turned into digital documentation, when the nurse has access to a computer. If the patient needs more treatment than can be given on the scene, a triage paper chart is filled in which is to be handed over to the ED with the patient.

This manual system is not the case for all regions. The region next to VGR, Halland, for example have implemented a digital system for the EMS. This system is accessed through a portable tablet placed in every ambulance were all notes and data go directly into the digital medical records. Each assignment can be filled in either on the tablet or on a computer at the hospital or ambulance station. In this system a doctor can read the patient record simultaneously as it is written. There is also support for some of the tools that takes vital parameters, as blood pressure for example, to get transferred directly to the medical record.

2.6. Predefinitions of the decision support tool

As mentioned earlier, the AI which is the foundation for the decision support tool is under construction. Still, there are some predefinitions this project needs to take in consideration.

The **AI-learning protocol** will be used by a targeted group of people in VGR, Skaraborg and Halland. The objective is to collect data from which the AI can learn, making it better and more precise. It is also of importance to test the usability of this new tool, which this targeted group must evaluate as well. To avoid double documentation, the protocol only covers specific questions for chest pain that normally is not covered in the main assessment. Information such as gender, age and medicines will be collected from the ordinary patient medical record in retrospect.

The following questions is what will be in the **AI-learning protocol**:

Assignment

- Case number
- Region (VGR/Skaraborg/Halland)

Medical history

- Kidney failure
- Cardiac fibrillation
- Cardiac failure
- Myocardial infarction
- Diabetes, type 1/type 2
- Hypertension
- Smoking (Never, in the past, active)

ECG image
- ST raise
- ST lowering
- Left branch block
- Right branch block
- Pacemaker
- Arrhythmia
- Troponin value (<40, 40-1000, >1000)

Clinical assessment
- Oppressive pain
- Pain intensity (1-10)
- Central chest pain
- Pain emission right arm
- Pain emission left arm
- Pale
- Nausea/vomit
- Affected breathing

Illness departure
- Pain departure in connection to any activity
- Time from symptom onset to assessment more than 3 hours

Mid-project, after the data entry-workshop (5.6. Focus group session 2), a decision from the client was added that these questions *had* to have the options "yes" and "no" for every question which was not a multiple-choice question.

The plan is that the AI-learning protocol will be launched in the beginning of 2023. If the planned test period is successful, the next step is to introduce the decision support tool that not only collects data but gives a prediction of the status of a patient with recommendation for actions.

3. Theoretical framework

This chapter provides baseline knowledge in selected subjects which can be helpful in putting the content of the report in an accurate context.

3.1 Human processes

Within a human-machine system, the humans and their interactions are affected by different mental processes (Berlin & Adams, 2017). Most of human actions are closely connected to our cognitive ability where our sensory stimulation, perception, focus and memory originates from, leading to decision-making and response. When designing for a human-machine system it is of high importance to consider the cognitive environment of the context. Therefore, some of the relevant aspects, related to the context of this project, of the human cognitive ability are presented below.

3.1.1. Situational awareness

Situational awareness is a cognitive phenomenon based on perception, memory and expertise (Salvendy, 2012). It is described as: "*The perception of the elements in the environment within a volume of space and time, the comprehension of their meaning, and the projection of their future status*" by Endsley (1995).
According to Endsley, Bolte and Jones (2003), situational awareness can be divided into three levels:

- Level 1: Perception of the elements in the environment
- Level 2: Comprehension of the current situation
- Level 3: Projection of future status

The first level is where the perception of the information of the situation occurs. The stimuli could be visual, auditory, tactile or come through taste and smell, or a combination of several factors. Depending on the situation and person, there could be many stimuli contending for attention.

When designing for situational awareness the aim is to create a system that will provide the user with, for the situation, necessary information. The information must be available in an easy manner and be efficiently processed by the user. Endsley et al. (2003) present eight principles when designing for situational awareness, these are:

1. Organize information around goals
2. Present Level 2 information directly
3. Provide assistance for Level 3 projections
4. Support global ("big picture") situational awareness
5. Support trade-offs between goal-driven and data-driven processing
6. Make critical cues for schema activation salient
7. Take advantage of parallel processing capabilities
8. Use information filtering carefully

3.1.2. Mental workload

Mental workload and situational awareness have similarities but cannot be replaced by one other, instead they should be seen as complementary practises according to

(Salvendy, 2012). Mental workload is connected to the tasks and their demand in comparison to the attention resources of the one performing the tasks. Aspects affecting mental workload according to Huey and Wickens (1993):

- Performance criteria: e.g. tolerance for errors
- Task structure: e.g., information flow, multitasking, task difficulty, task duration
- Human-system interface: e.g., poor interface design can increase mental workload
- Individual factors: e.g., years of experience, sleep, accuracy of mental model

Salvendy and Gavriel (2012) argues that the qualitative properties "how much" is more important to consider than the qualitative factors "what kind". Wickens (2008) means that the ideal situation is if the demand is less than the available resources leading to high performance. To have some resources left that could be used if something unexpected happens is argued to increase the perception of control and wellbeing. If the demands conquer the available resources, the performance will naturally decrease.

Berlin and Adams (2017) claims that is complex to measure mental workload due to the many factors of cognition and the surrounding involved that should be taking in consideration. Most of them are furthermore difficult to measure in an objective manner. Their conclusion is that is comes down to the individual's perception of their mental workload. This could still be useful when measuring and evaluating a change in a working environment, comparing the mental workload before and after the change.

3.1.3. Decision making - Dual process model

Croskerry (2009) describes two types of decision-making systems; **type 1** is intuition based, often applied for time sensitive cases where a decision is demanded fast, and **type 2** is process based and performed systematically. Generally, **type 2** takes more time and is often applied only for less time sensitive cases.
The dual process model is shown in Figure 6.

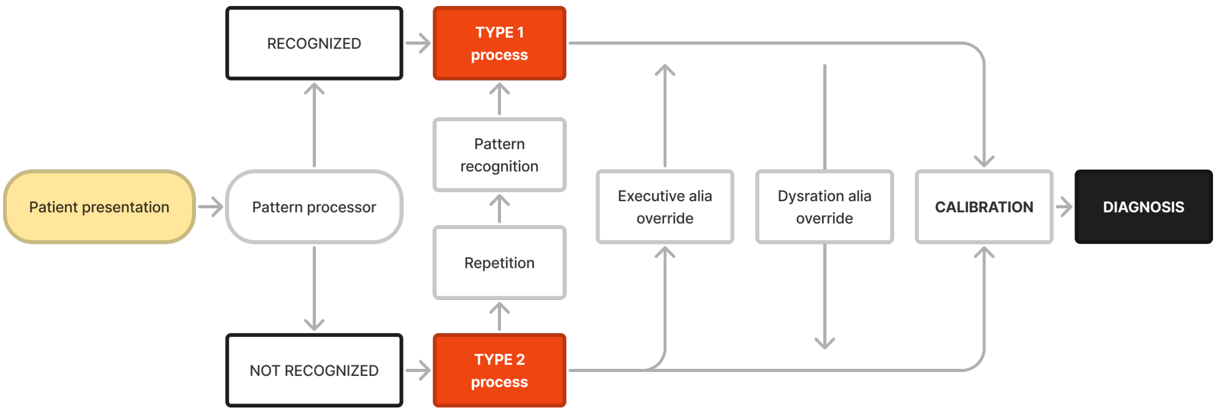


Figure 6 - A universal model of diagnostic reasoning by Croskerry (2009).

Magnusson (2021) describes a risk of **type 1** being utilised more often than necessary as it is a convenient and less demanding assessment method but also more affected by stress, bias and fatigue which could lead to faulty assessments.

3.1.4. Anchoring

Anchoring is defined as: *A cognitive bias or an error in reasoning that affects the decision-making* by Ungvarsky (2020). It refers to a process where too much emphasis is given to the earliest information received when taking a decision. Even if that piece of information is not the most important, it will become the standard which the rest of the gathered information is measured by.

Anchoring and other cognitive biases are a part of the intuitive, type 1 process for decision making presented earlier and to a certain extent, inevitable. Conclusions from a systematic review of cognitive biases associated with medical decisions, Saposnik et al., (2016) bring up the anchoring effect as a reason to diagnostic inaccuracies. They clarify that more research needs to be done in the area and further investigations in how to manage this problem.

3.2 Design subjects

Theory within the design field relevant to the project are presented in this section.

3.2.1. User Experience

User experience, UX, is often used as an umbrella label covering several usability aspects when designing products, services and systems (Cooper et al., 2014).
To further describe what UX means, Cooper et al. (2014) utilizes a Venn diagram to describe the overlapping disciplines that forms UX, see Figure 7 for an interpretation of this.

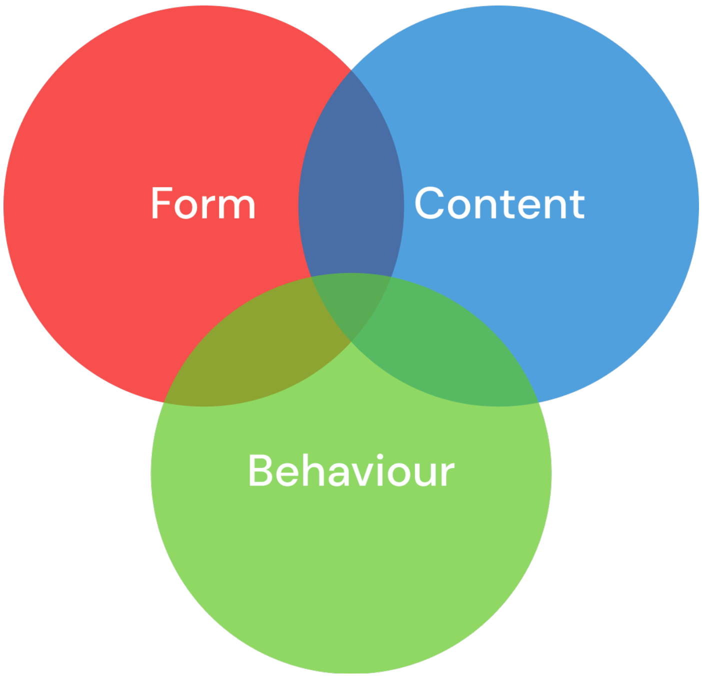


Figure 7 – A Venn diagram visualising UX according to Cooper et al. (2014).

It is a mixture of *form*, *content,* and *behaviour*.
Form is the appearance and style which both provides a sense of personality and hints for interactions.

Content is the stuff, message, and purpose of the product.

Behaviour is the functionality of the product, how it reacts to interactions and what type of usage it allows.

Together they form the totality of a product.

3.2.2. Typologies

Typologies relate to what is expected from a product with certain purpose and context based on what has been learned previously (Rosenfeld et al., 2015).

E.g., as for with buildings, it can be expected that a church's appearance does not stretch too far from the conventional idea of how a church should look. Certain elements will be expected.

In a similar way products, services and systems also have typologies. E.g., in a healthcare service one would expect a certain tone of seriousness, professionalism and reliability as well as certain elements to be easy to access.
If it does not correspond enough with the users' mental typology, a sense of discomfort and alienation can occur.

3.2.3. Calm technology

For situations with limited situational awareness, *calm technology* can be utilised to make products easier to use under stressful circumstances (Kremer, 2018).
To design calm technology means that interfaces and interactions designed relies on gestures and behaviour driven by intuition, and not on actions that have to be learned. This ultimately means that interactions are performed instinctively without having to actively think.

Colour, contrast, layout, fonts and graphic density are all aspects which need to be designed for low cognitive load. It should be easy to navigate through information and a visual hierarchy should be used to give focus only on what is important.

3.3. Artificial intelligence

Since the project originates from a tool based on artificial intelligence, the status of AI within healthcare was investigated.

3.3.1. AI and its role in healthcare

Artificial intelligence, AI, can in general terms be described as the ability of machines to imitate the human intelligence. *"A system that perceives its environment and takes actions that maximize its chance of achieving its goals"* (Wikipedia, 2022). The development within this area has increased rapidly the past 10 years due to more powerful computers and the ability to save and handle data but also more complex algorithms for data processing (Ohlsson, 2021). Machine learning is a discipline within the same area described as the ability of a program to learn from a large amount of data and find patterns within this data. Based on this there is a possibility to some extent create predictive analyses and estimate the probability of future events (Larose, 2015).

Many see the advantages of implementing AI in health care with the hope of making it more effective and safer. Right now, the most common area of use is within image processing of different kinds of skin cancer and orthopaedics (Danielsson, 2017). Advantages AI has compared to humans, besides the capacity to handle huge amount of data, is that the system is consequent and tireless (Ohlsson, 2021). With the same data given to a system, the outcome has shown to be the same regardless how many times the analyse runs. As humans, our actions, analyses and decisions will always be affected by our own physical and mental state. Prejudices and lack of knowledge also play a part, making it difficult to be consequent. Max Gordon, chief physician and researcher in orthopaedics at Karolinska Institutet, is convinced that AI will change the healthcare system and the tasks of caregivers (Danielsson, 2017). He believes that physicians will be able to focus more on meeting the patient and analyse the subjective parameters, which a machine is less good at, and let the AI do more of the diagnostic work.

3.3.2. Critical voices of AI in healthcare

Even if AI is making progress within healthcare there are still not a lot of fully functioning or implemented applications. There are both technical as well as human challenges. Except the complexity of building correct AI algorithms, the ethics of how much mandate could and should be handed over to an AI is discussed.

He et al (2019) bring up data sharing, transparency, and patient safety as three main issues. Patient data could be sensitive and sometimes difficult to keep anonymous when necessary to save and share to develop successful algorithms. This is not always an easy process due to the Data Protection Act e.g. Because of the complexity of some systems, it is rather difficult to make them transparent and understandable by the user (von Eschenbach, 2021). This could lead to the "black-box-problem", when the user cannot get an insight of how the AI reaches its conclusions and therefore has issues trusting it. When a tool is not trusted, it will not be used. Ohlsson (2021) claims that the biggest challenge AI-driven tools need to overcome to create actual value in healthcare is how it is implemented.

4. Methods and execution

This chapter describes how this project was carried out and all its main activities. The activities are presented in a thematic order.

4.1. Double diamond model

Activities and methods were performed in accordance with a double diamond model, see Figure 8. It is a process introduced in 2004 and has become a well-known model for designers, and non-designers, to systematically engage in problem solving (British design council, 2019).

Visually it illustrates a project's workflow through two diamonds which metaphorically shows where to expand the view, focusing on being open minded and creative, and where to narrow down the view to systematically and logically reach conclusions.
The first diamond, including exploration and definition phases, is about understanding the problem and the context, the second, including development and delivery phases, is about creating solutions based on learnings from the first.

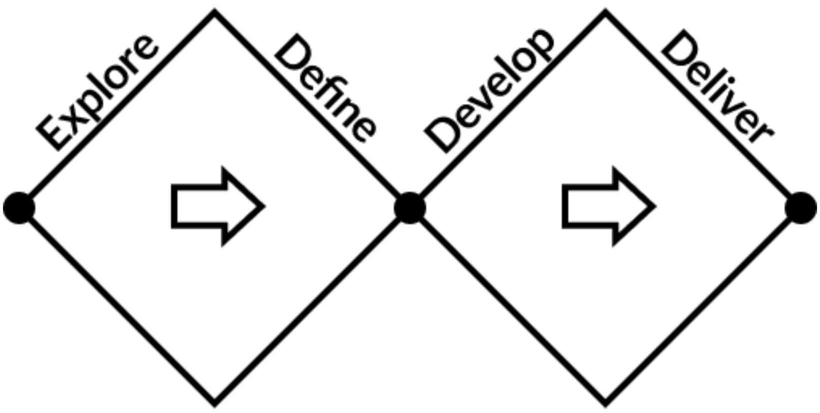


Figure 8 - Visualisation of the double diamond model

The purpose of the exploration phase was to create a baseline of knowledge regarding EMS nurse's tasks, work tools, workplaces and organisations. Further it aimed to benchmark the current market for similar solutions as well as exploring the basics of working with AI-powered tools.
The idea was that this would provide a more defined context of what is dealt with as well as insights in currently known and unknown issues and possibilities.

The definition phase meant to sort and narrow down all findings from the exploration phase to what was relevant, and then to formulate new questions and tasks which would help to better work towards the final goal.

The development phase was about identifying different solutions to an, at this point, well defined problem.

Lastly, the delivery phase was about sorting out the last irrelevant ideas, to formulate the final solution and to deliver it in an appropriate fidelity and format.

The different activities connected to the four phases of the double diamond are presented in Figure 9.

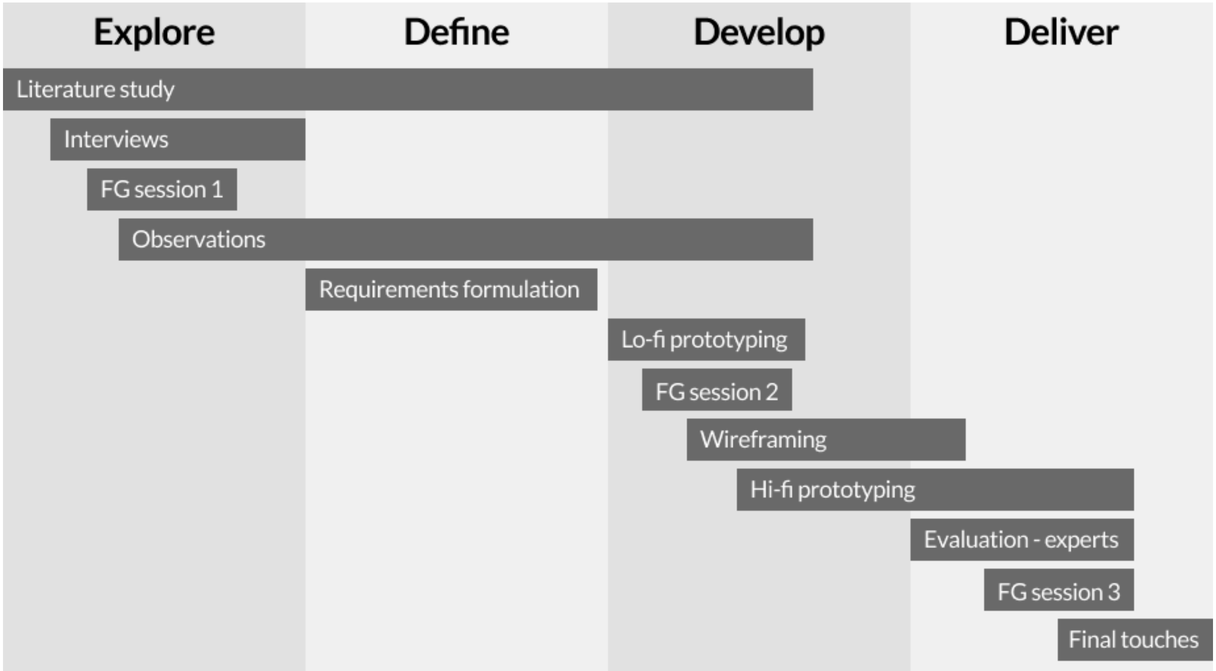


Figure 9 - A visualisation of the different activities in the different phases of the project

4.2. Literature study

Literature was partly found through recommendations of relevant articles, theses and books by supervisors, clients, professors and students. Further it was searched for in Google Scholar and in the Chalmers library database through key words 'healthcare + AI', 'AI + decision making', 'pre-hospital healthcare + AI' and 'healthcare + decision support'.

The study as a whole aimed to provide further knowledge in four main areas;

Pre-hospital healthcare
Insights on stakeholders, routines and tools.

Organisations connected to the pre-hospital healthcare
Insights on what other organisations might affect the pre-hospital healthcare.

Digital UI design
Insights on design choices and their effect.

AI & healthcare
Insights on how AI previously has been used in healthcare how it should be considered.

Results from the literature study are found in chapters 1, 2 and 3.

4.3. Interviews

Interviews were carried out to gain insights from the direct users of the intended solutions, experts of AI-driven products and other actors relevant to the project. The interviews were all semi-structured in order to be able to explore and grasp as much as possible of the users, since the initial understanding of the subject was low. According to Preece, Rogers and Sharp (2015) semi-structured interviews have a greater potential to catch valuable, unknown information from a user. To avoid transcription of the interviews, one asked the questions, and the other took notes.

Since the healthcare system varies throughout the regions of Sweden, it was decided to try to understand a few other regions outside of VGR to see how the EMS nurse's work differ throughout the regions. Stakeholders at SU, Region Halland and PICTA were able to distribute contacts details to EMS nurses.

A total of eight EMS nurses were interviewed from four different regions. The first five interviews followed a similar interview guide but was changed for the last three because some of the areas gave very similar answers and was therefore considered as covered. Some questions were exchanged to new more in-depth questions based on findings in the previous interviews. The interviews were conducted online and lasted around an hour. See questions in Appendix III.

The interviews with EMS-nurses became an earlier activity than planned. The initial thought was to conduct observations before interviews to grasp a bigger picture of the work of an EMS-nurse that way. This was important to establish early on due to the limited knowledge of this profession. However, due to restrictions related to Covid-19 the observations had to be postponed and therefore the interviews became a way to investigate in this. Therefore, the questionnaire includes questions related to the work itself but also about assessment, decision support tools and thoughts about AI-driven products in healthcare.

The project initiators Carl Magnusson and Kristoffer Wibring were targeted as important actors since they had the best understanding and insights about the product. Their research on assessment of patients by EMS nurses makes them able to grasp the bigger picture of the system which was not possible for a user to have to the same extent. They also had insights on the work role of EMS nurse's since they both have long experience in that line of work. Initially some formal interviews were conducted but there has also been ongoing conversations with both Magnusson and Wibring throughout the project.

To better understand interaction with AI-powered products and the development of such products, representatives from the companies Eyescanner and MedField Diagnostics were interviewed. Eyescanner, developing an AI-based software for drug testing and MedField Diagnostics, developing a new AI-driven instrument that can detect a stroke.

4.4. Observations

To observe is said to be a fundamental research skill and an important activity in design work (Hanington & Martin, 2012). The situation, the environment and the user and her behaviour and interactions with artifacts are often of interest. Observations can be casual or systematic depending on the cause. The casual method is typically used in the exploratory phase to get a realistic image of the studied subject early on. When the subject is unknown for the designer it is even more important to carry out observations.

4.4.1. A day as an EMS nurse

Two observations sessions were performed in total. One day in Kungsbacka, Region Halland, and one in Gothenburg, VGR.

The aim was to experience how the EMS nurse´s work is performed as well as how it differed between the two regions. The overall goal was to gain an understanding of the environment and challenges an EMS nurse dealt with. As a baseline for the observations, some questions were prepared prior to the visit focusing on the EMS nurses' workflow, interactions with tools and handling of information.

4.4.2. The work of an alarm operator

A visit to the Emergency Medical Dispatch Centre (EMDC) to observe the alarm operators was also conducted. For this observation the interaction with their medical decision support tool (MBS) was of interest. It also provided additional insights on EMS nurse's work as their tasks are directly linked.

No interviews had previously been performed with the operators, due to that this was borderline out of scope.
This observation session was performed by listening to the conversation between the person calling and the alarm operator, by observing how the operator interacted with their decision support tool during the call and by asking the operator questions between the calls.
Some guiding questions and reminders on areas to observe in more detail were prepared prior to the visit.

4.5. Focus group

Since concepts could not be tested in the real context due to its character, a way to get closer to the users and to test ideas and concepts was to create a focus group.
Focus groups are a qualitative way to find out the opinions, feelings, and attitudes from a group of selected participants, guided by a moderator (Hanington & Martin, 2012). In a well-functioning focus group with good dynamics, the participants are said to be more likely to share experiences, opinions, and desires. This can lead to deep learnings about "themes, patterns and trends".

A group of four EMS nurses working in Gothenburg was gathered to form the focus group. They were all selected and asked to participate by Carl Magnusson. It consisted of two male and two female representatives with a range from 3-10 years of experiences working in the ambulance.

Three sessions with the group were planned altogether. One *ideation session* in the evaluation phase, an *interactive workshop* with low fidelity prototypes in the development phase and a *final testing and evaluation session* in the delivery phase. All three sessions lasted 1-1,5 hour each. The first was conducted online and the following two at the ambulance station on Hisingen, Gothenburg.

4.5.1. Session 1 – Ideation

In this session, a co-design practise was applied. Sanders & Steppers (2008) defines co-design as a method where other actors than the designers have a direct impact of the design work. These *other actors*, users, should be seen as co-designers and be active, as much as the designer, in such a session. The idea is that it should be an ongoing process throughout the whole design process to really get the values and ideas of the user e.g., into the design. The term co-creation is according to Sanders & Steppers (2008) a broader definition where two or more people share ideas and creative actions.

One of two designers took part in the discussions and activities while the other acted as the facilitator of the session. The idea was to discuss and generate ideas on how a new, larger digital toolbox for the work of an EMS nurse could look like. The session was performed remotely through Microsoft Teams and the software Figma was used to present and interact with the workshop material.

First, findings from the project so far were presented to create a common ground and to have something to discuss from.

6-3-5

The main activity of the ideation session was generating ideas from the subjects; "*A solution based on today's situation" – "If the solution was an assistant" – "If the patient was in charge over the solution".* The method used for the idea generation was based on 6-3-5. The idea is that six (6) people write/sketch three (3) ideas in five (5) minutes on a piece of paper. When the time is up, the papers are passed around and the next session is about continue those ideas and contribute with three more within the next five minutes. This will create a lot of ideas to be discussed further. The method was changed to the conditions of the session and applied in digital form for every heading presented above.

4.5.2. Session 2 – Physical and digital interactions

To gain insights on the user's preferences regarding digital input methods and physical form and size of the different products, the second session together with the focus group was an interactive workshop. Lo-fi prototypes were utilised for this session.

This time the focus group were divided into two smaller groups and met in pairs of two. The workshop lasted for one hour and was divided in three parts. It started with four tasks of different digital data entry methods for various purposes and one test for evaluating recommendation representations from a potential **decision support** tool. Further, the participants got to handle physical lo-fi prototypes to evaluate size and appearance. Lastly, the participants got to give their opinion on the information hierarchy of the **AI-learning protocol**. These three parts are described in more detail below.

Data entry

Task 1 – Fill in numbers (keypad, sliding bar, scrolling wheel, dictation)
Task 2 – Fill in text (keyboard, dictation)
Task 3 – Choose one or several options (checkboxes, buttons, drop down menu)
Task 4 – Fill in date and time (keypad, scrolling wheel, classic calendar)

The different screens for each test and input methods are found in 0. The tests were followed by answering a set of prepared question regarding the interface and a discussion on which input method was best suited for which application.

Decision support

Five different representations of how **decision support** could be presented in a digital interface was created. Both static and dynamic representations were evaluated.

Information hierarchy

The set of predefined protocol questions and their associated headers were printed on paper to easily be moved around. The participants were asked to sort the headings in an intuitive order. The order was supposed to correspond to the usual workflow when assessing a patient.

4.5.3. Session 3 – Test and evaluation

A final session was conducted together with the focus group to test and evaluate the final designs in a somewhat realistic environment. To maximise the time and contribution of each participant the session was held individually with each user.

Testing and evaluation of the digital interface of the **AI-learning protocol** was prioritised. The reason for this was both that it was the product planned to be launched first, and also the only prototype which had the most functionality.
The UI of the **AI-learning protocol** was evaluated using an iPhone 12 as well as an iPad mini.

Creating a fictive scenario

To give the evaluation of the **AI-learning protocol** a more realistic context, the user was put in a fictive scenario where a patient with chest pain needed to be assessed. Two patient cases had been prepared, with different symptoms and vital signs. The participants met the two “patients” and had to interview them to get the information they needed to fill in the **AI-learning protocol** concept.

System Usability Scale

The System Usability Scale (SUS) was used to evaluate the level of usability of the AI-learning protocol. It is designed to evaluate digital products and systems (Brooke, 1996). It lets users evaluate different aspects of the system and gives an understanding if there is an overall problem with the design. The scale is argued to give a quick and reliable measurement and can be used even when there are few users in the study.
It consists of 10 predefined questions based on three characteristics: *effectiveness* – *efficiency* – *satisfaction*. The user fills in answers between “Strongly disagree” to “Strongly agree” on a five-point scale for every question which results in a value between 1-5, see Appendix IV for the questions and scoring. A calculating system sums up the total result in a maximum of 100 points. Everything under 68 is considered as an indicator of poorly design and 85,5 and above is excellent, see Figure 10 for a visualisation of the scale.

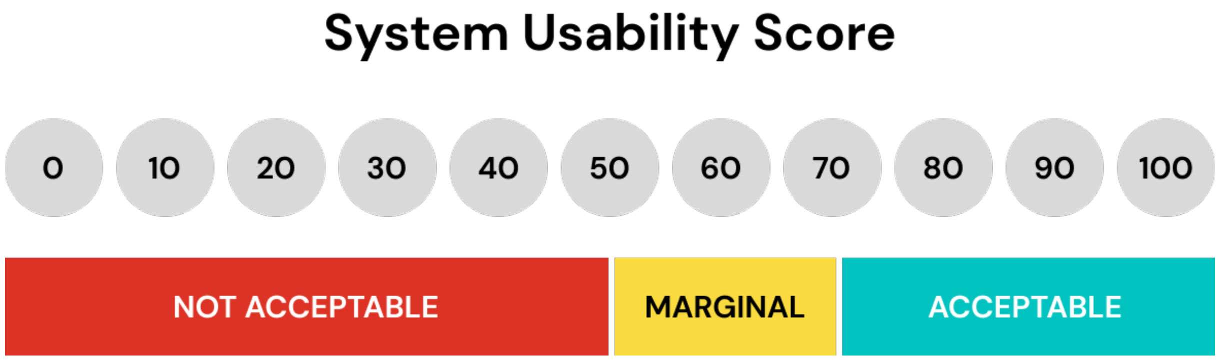


Figure 10 - Visualisation of the SUS and scoring

The UI of the **AI-learning protocol, decision support** and **medical record and assessment platform** was demonstrated and discussed in a more informal manner. A couple of statements were used as evaluation method for the platform and can be found in Appendix V.

4.6. Sorting and definition

When the exploration phase came to an end it was time to systematically sort and narrow down the collected data and pave a path for the actual development and design work.

KJ-assessment

This method was used to analyse and structure the data from interviews and observations. KJ assessment, or affinity diagramming, is a well-known method used by designers to sort and overview information (Harrington, 2015).
Findings were put on digital post-it notes differentiated by colour codes connected to specific subjects. When patterns and clusters of information were identified they were categorized under suitable topics. Eventually the whole assessment was narrowed down to only a few key insights which were used to form a requirements list for the final solution. The assessment was done in the digital platform Figma.

Need specification / requirement list

With the condensed data generated from the KJ assessment a requirements list was formed. This aimed to provide a clear picture of the desired result, to further clarify what the remaining work meant and to formulate something tangible to show the stakeholders.

Debrief with stakeholders

At this point the project was halfway through both timewise and in the double diamond model. It was decided to meet representatives from both PICTA and SU to present the work so far, the planned way forward as well as final deliverables. This was seen as a safety gate to make sure that everybody was onboard with the progress and plan of the project.

4.7. Prototyping

Three main activities of prototyping were carried out throughout the project. This section describes them in the order they took place in the project.

4.7.1. Lo-fi prototyping

As a first step of the development phase, very simple, low fidelity (lo-fi) prototypes were developed to quickly get a sense of how different appearances, sizes and flows of information could work for a solution like this. It also acted as a preparation for the second focus group session.
Lo-fi prototyping is an effective way of realising very rough ideas both time and cost wise (Benyon, 2010). Further it is useful for focusing attention only on relevant features and not getting distracted by fine details too early. Lim et al. (2008) describes that this kind of prototype is just as useful in what it shows as in what it does *not* show. The lack of details acts as a filter to focus solely on what is important at the moment.

Physical prototypes

To get a sense of the size of the physical product cardboard prototypes were created representing different types of tablets. Paper cards were added to the cardboard prototypes as inserts containing visual mock-ups mimicking digital content, to get at sense of placement, information flow and size.

Digital prototypes

Additionally, digital prototypes of simplified, interactive interfaces on different screens were created with the purpose of evaluating different data entry methods.
They were all kept to a very simple and neutral graphic style and all elements had the same size, to keep them comparable.
The designs were made in Figma and could be mirrored to a telephone for more realistic interaction on a device.
It could be argued that this was higher fidelity than lo-fi, but the same principle was used, by scaling down the content and not including any other elements than the actual data entry elements, to keep focus solely on what was being evaluated.

4.7.2. Wireframing

When putting the requirements list and input from the second focus group session to work, initial digital wireframes were established in Figma to try out different ideas.
Wireframing is a method for conceptually creating a framework for interfaces where placement, content prioritisation and basic functionality is established without putting any effort into actual content (Usability.gov, 2022).

Figure 11 provides an example of how a wireframing model can look and which elements often are included.

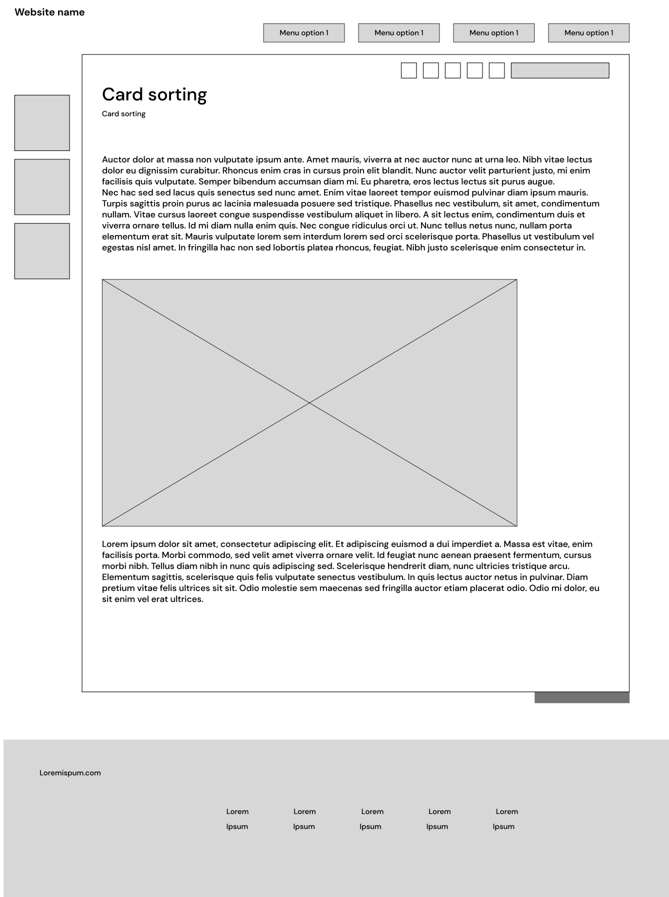


Figure 11 – Example of a wireframing model of a website layout.

Several iterations were generated, all with the goal to provide an effective information architecture with high usability.

Each design was based on a mixture of input from literature, benchmark of highly regarding apps and sites, in terms of UX and information architecture, and medical assessment and record tools already on the market.

The wireframing phase included spontaneous testing sessions for most of the iterations, as a part of ideating and evaluating new concepts.

4.7.3. Hi-fi prototyping

Once a few main concepts had been settled upon, a higher level of prototyping was initiated to make the concepts more realistic and to get a sense of the attributes of an eventual final product.

This meant to take the already established information architecture and add realistic graphics and functionality. Creating icons, applying a colour theme, adding graphical effects, creating functional interactions and animations as well as establishing a brand and logo were some major tasks performed in this phase.

Most of the work was done in Figma.

4.8. Test and evaluation

When the hi-fi prototypes were finalised to an acceptable degree, final test and evaluation sessions were conducted to provide eventual input and comments on the designs. The idea was that findings from these sessions could either be resolved straight away or simply noted as considerations for eventual future development, depending on the magnitude of change the finding would imply.

Osvalder and Ulfvengren (2015) imply that tests with five to six people could be enough to find 75-80 precent of the issues with a product. Preferred is to conduct tests with six to eight users with similar skills in relation to the product to get a reliable result. Norman (2013) states that to identify usable findings regarding a product, only five people can be enough to conduct user test with.

The evaluation was separated into three different main tracks; one where experts in interaction design got to inspect the design and provide input on a detailed level. In the other, potential users got to inspect the design in a similar manner and provide input from their perspective. In the last one, the participants from the user group got to use the products in a fictive, semi-realistic, setting and provide input on their general experience of using the products. The last one was the most comprehensive evaluation session and is described in more detail in 4.5.2.

4.8.1. Evaluation by interaction designers

To gain further insights of the design of the digital interface and its functions, four experts of interaction design tested and evaluated the decision support tool. These tests were somewhat informal and a quick way to process the design before tests with actual users were made. The evaluation concerned all three main concepts: the **AI-learning protocol**, the **decision support** and the **medical record and assessment platform**.

They were given a short introduction of the context, users, and situations where the product aims to be implemented. The tests were held online where the product was demonstrated in Figma and gave the participants a chance to navigate through the product themselves.

They also got to fill out a semantic word scale after the session was done, see Appendix VI.

4.8.2. Evaluation by users

The next step in testing and evaluating was to let two EMS nurses, also working at PICTA, inspect the products. They were asked to fill in the **AI-learning protocol** based on a fictive scenario of a patient with predefined symptoms and values. They were then asked to fill in the semantic word scale, see Appendix VI.

One of them also evaluated the concept of the **medical record and assessment platform** and filled in statements for this product as well, see Appendix V.

5. Results

This chapter holds the results and findings from the project's different phases and will be presented in a chronological order to an extent which is possible, since several activities run in parallel.

Figure 12 shows a schematic view of how each activity fit in the double diamond model both in time and duration.

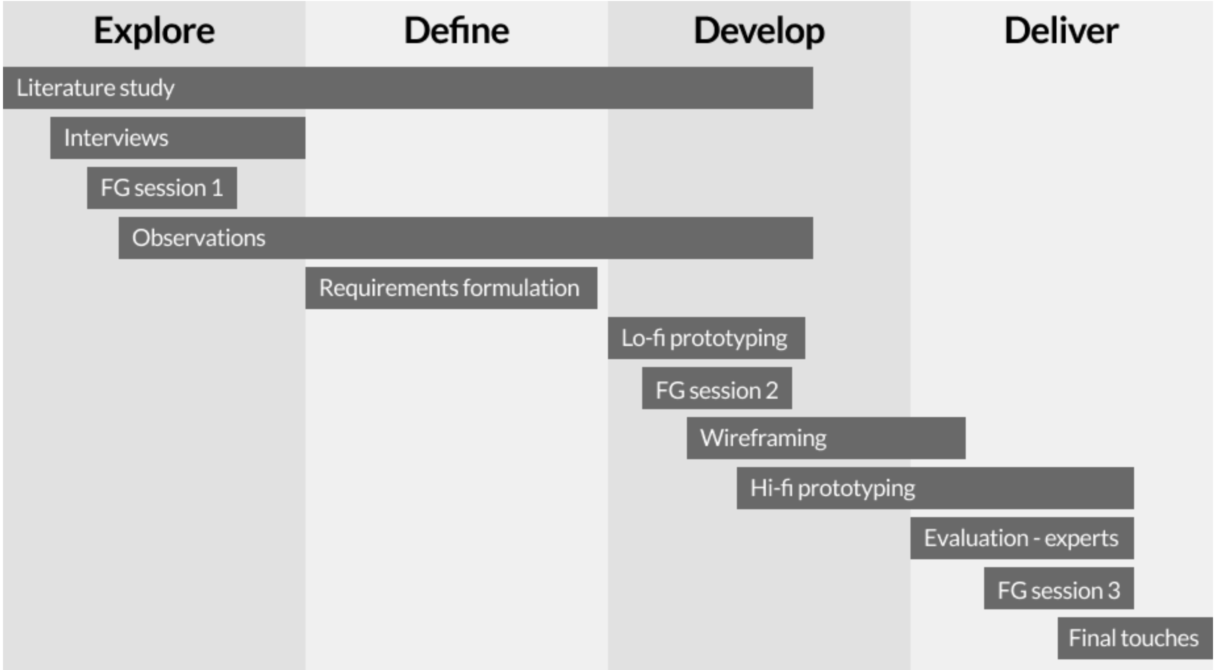


Figure 12 - Schematic view of activities placed in the double diamond model. (FG=Focus group)

The final representations of the final products will be presented in chapter 6. Product presentation.

5.1. Interviews

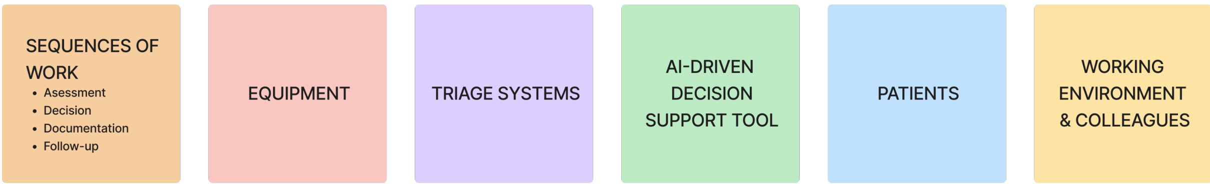
The results of the interviews of both EMS nurses and experts within AI-powered tools are presented in this section.

5.1.1. EMS nurses

A total of eight EMS nurses, from four different regions were interviewed. Basic information about the interviewed is presented in the chart below.

Interviewee	Gender	Age (years)	Years as EMS-nurse
#1	Male	42	10
#2	Male	34	10
#3	Male	45	20
#4	Male	30	2,5
#5	Male	37	9
#6	Female	28	0,5
#7	Male	40	1
#8	Male	-	15

The findings from the interviews were analysed and sorted in a KJ-assessment. It ended up in a couple of subjects listed in the coloured boxes below.



The most relevant findings were narrowed down and are presented in more details below.

Patient assessment

- The expected assessment precision of the patient has increased and therefore become a larger and more difficult part of the job.
- The increasing variety of symptoms and complexity of patients require both deep and wide knowledge within healthcare.
- Access to patient medical record is mostly seen as helpful. It increases the understanding of the patient but could however, also create a biased idea of cause of events.
- Preconceptions, bias and anchoring are experienced to affect both assessment and decisions.
- The continuity of assessments between EMS nurses are low due to high self-determination. It can also shift for the individual EMS-nurse depending on the number of working hours, time of the day, experience etc.
- There is an experience of existing decision support tools being too static. They are too general and rarely fit the specific case.
- It is difficult to detect differential diagnoses with the tools available today.

Equipment and documentation

- The medical equipment and tools for documentation appears in a lot of different formats which are not compatible with one another. This creates a lot of time consuming, unnecessary double work and documentation. A lot of frustration is connected to this.
- To document patient information on paper are experienced to have low patient safety. Notes and emergency medical records have been lost and fluids or bad handwriting have caused problem of readability.
- It is easy to miss the exact time of events or when medicine is given to the patient due to the manual input.
- The smartphone is experienced as an unprofessional tool to use in front of patients by some. A concern of what the patient will think it is used for is the largest obstacle. The smartphone is also considered a too small format to work with sometimes.
- Latex gloves are standard equipment and they do not always work with the touch screens of the medical devices and therefore there is a slight scepsis towards devices with touch screens.

Decision of care

- Guidelines on decision for treatment of a patient is sometimes not particularly clear, which creates insecurity. When guidelines and regulations are more precise and comprehensive it is easier to feel secure with a decision.
- Sometimes a decision is made only to protects oneself, to not risk a faulty decision, even if it is not in the best interest of the patient.
- To leave a patient at home can be perceived as risky and often not a comfortable decision to take.

Writing patient medical record

- There is a lot of double documentation due to the lack of a digital connected system. To write the same thing up to four times is not a preferred way of working.
- Undocumented verbal transaction of patient information between the EMS-nurse and the personnel at the hospital is common. Not all causes of events can be described on the paper medical record due to limitation of space and are therefore transacted verbally.
- If there is a hectic day, writing the medical record of an assignment can be postponed throughout the day with assignments overlapping. The experience is that it is hard to recall everything that was said and done in retrospect and notes can be hard to read.
- The medical record system Ambulink is perceived as time consuming, not user friendly and ugly.

Thoughts on an AI-driven decision support tool

- An AI-driven tool is perceived as an objective, consequent part that possibly could give a better assessment than a human.
- A tool that can handle and sort the large amount of data related to a certain scenario or symptom would be appreciated.

- A tool that could give advice and reminders of questions to ask or tests to take that could give a better prediction of the patient.
- To trust an AI-driven tool does not come too easy. It should be proved to give better results and give explanations on a calculated prediction for example.
- A concern is that a lot of people within the healthcare are tired of change. New tools and guidelines must bring enough added value to be appreciated.
- The “clinical eye” and the gut feeling based on the experience of an EMS-nurse is highlighted to be of importance and not able to be replaced by an AI.
- It could increase continuity in assessment between EMS nurses.

Learnings from other regions:

- A comprehensive digital system is very appreciated and works well in other regions even if exceptions exists where individuals still prefer pen and paper.
- An appreciated feature is that others can get access and follow the patient medical record live. A conversation with a specialist can be more efficient when they have the same information.
- Other digital medical tools can connect with the system where data is transferred directly, like pulse or heart frequency. This minimises the manual inputs.

5.1.2. Experts on AI-powered tools

Both companies Eyescanner and MedField Diagnostics develop products with technologies that can perform things that without it would be impossible for humans to accomplish. Therefore, these products become more similar and comparable to medical tools that already exists today, like a patient monitor, reading activity of the patient and presents a result for the user to read. A difference to the AI-driven decision support tool is that it will make an analysis, not too different from what the EMS-nurses perform today but with much more data to relate to, and with that present an outcome to be interpreted and valued.

Even if the products differed more than was understood initially, several learnings and important takeaways were found. These are presented in the list below:

- There is not only the intended user of the product that will experience the results of the AI but also, in this context, the patient and its relatives. What their thoughts and feelings are should be considered.
- How a result or prediction is presented and phrased is important for the reliability. The right level of transparency is key but also the right amount of understandable data presented.
- Products that are perceived to replace humans in performing some tasks must show to be more efficient to be successfully implemented.
- In the context of doing a medical assessment, AI-based assessments can remain truly objective and unaffected by bias, whereas EMS nurses run a risk of not being that.

5.2. Focus group session 1 – Ideation

Only three out of four participants could attend the session in the end but with one of the designers it became a group of four who participated in activities and discussions.

The discussion about the findings so far in the project was a good way to get the conversation going in the right direction. A few complementary insights were added by the participants:

- Communication is very important and how you communicate to get the right information. It is dangerous to give patients leading questions.
- Language barriers sometimes hinders the work for us.
- It is necessary to be aware that relatives can exaggerate the condition of a patient to make sure he/she gets the right amount of care.

There was only time for two out of three themes in the 6-3-5 model and the results from these are presented below. The bold parts are what was most interesting and what was processed in the ideation phase of the project.

Theme 1: *"A solution based on today's situation"*

Ideas of physical character

- A **tablet larger than a phone** (~6.1") **but smaller than a normal iPad** (~11").
- It must be **robust** & water resistant.
- A tablet with a button for **dictation** at every field so you only **give input with your voice**.
- **A handheld tool** that could be attached to the arm like a smart watch where you could read what a college writes meanwhile you treat the patient.
- A computer/tablet **not too heavy** but simple to bring with you and work with around the patient.
- A device with an **attachable function** to your jacket, backpack, the stretcher and in the ambulance.

Ideas of functionality

- An application **connected to patient medical record** of SU.
- An application with mNhiss, NEWS & possibilities to send measurements from the ECG device.
- When you are done with the patient and finalise the assignment, that **information will be sent automatically to SU**.
- **Simple input function for vital parameters**.
- The possibility to dictate larger chunks of information.
- A software that **will generate a result** based on VP, age, medical history and keywords. The result could include proper care path and a priority to the ED.
- A possibility for **doctors and physician and nurses to follow an assignment** in order to give advice or prepare themselves in order to give the patient fast and safe reception.
- Give **relatives the possibility to send in information in retrospect** if important information would emerge.
- A possibility to **change language** in order to help people with other native language in a better way.

Theme 2: *"If the solution was an assistant"*

- The ability to listen to the conversation between me and a patient and **sort out and document important information automatically**. My job will be to check that information and adjust it so it's right.
- It could be placed in the bag to listen and analyse what we talk about throughout the assessment. After analysing it could connect me to an appropriate physician for example on speaker.
- **When input is given, it could come with suggestions** of questions to ask, methods or treatments to carry out. It could also call a physician if necessary.
- Based on age, medical history and such, **give recommendations** of medicine. If there is a child, also the amount of medicine based on the weight.
- **Automatically give information** and possible treatment plan for given symptoms.
- When vital parameters have been taken and entered them it could give suggestions of possible conditions and diagnoses.
- **The assistant is expected to be friendly**.
- **The assistant has already prepared necessary tools** in the car for the specific patient.

5.3. Observations

The results from the observations, divided in two parts: from the two days with EMS nurses and the day at the Emergency Dispatch Centre are presented in this section.

5.3.1. EMS-nurses

Since the observations was carried out after the interviews of the EMS nurses and later than planned in the project, the observations became a way to verify what had been said in the interviews. The focus was to understand the workflow of the EMS-nurses and to see them interact with their equipment and how they handle documentation.

One day was spent in region Halland and one day in VGR, operating in Kungsbacka and Gothenburg respectively. Notepad, camera, and folding rule were brought to document the experience. Most of the findings noted below goes for both regions, but some are specific to one or the other and are presented in parentheses.

Assessment

- No situation is like the other and the physical conditions affect the possibility for the EMS nurse to carry out their work. Some patients can or need to be treated where they are but sometimes it is better to place them in the ambulance rather than assess them in public for example.
- Any situation where the patient is in a critical state requires completely focus on the patient and little room for checking guidelines or taking notes exist.
- Which questions are asked first differ somewhat between EMS-nurses and everyone works in their own systematic way to some extent.

Equipment and documentation

-
- The medical backpack, see figure 13, is almost always brought. It is quite heavy already, but it could possibly fit a smaller tablet.
- The tablet with the digital system Paratus is 26x18 cm and are experienced to be somewhat too clumsy and heavy and therefore not always brought in to the patient. At times when it is not brought, notes are taken on a notepad and later transferred to the digital system (Halland).
- The features on Paratus to ease grabbing and handling had a quite low functionality and was not used by anyone, see Figure 14.

Figure 13 - EMS nurse equipped with a medical backpack.

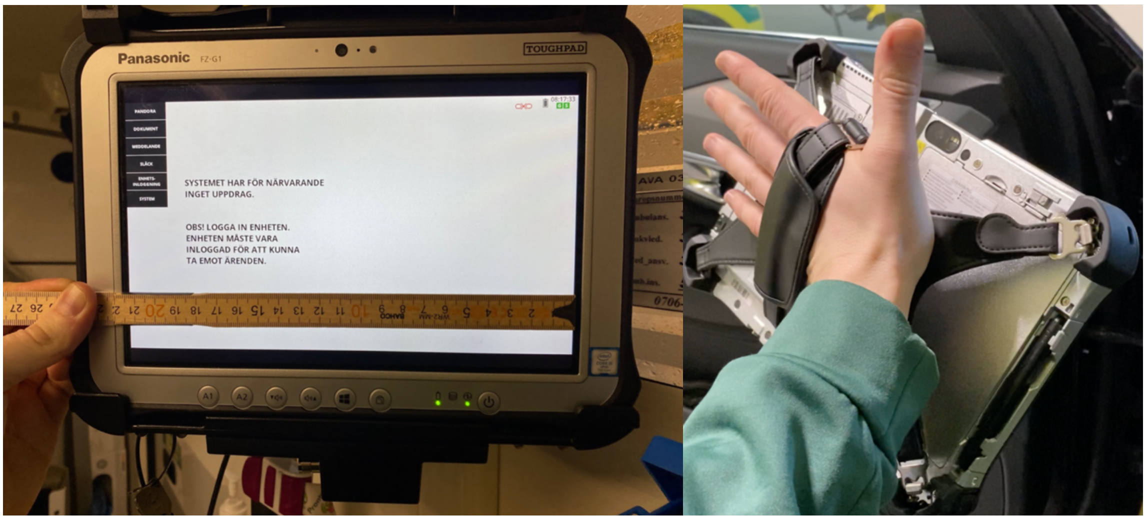


Figure 14 – The Paratus tablet and its hand strap on the backside.

- There is a holder for the tablet in the ambulance where it is charged and where a keyboard is attached, see figure 15. The assigned spot for it is experienced as convenient but to place the tablet in the holder and take it out of it is a struggle. The keyboard is used to write the patient medical record (Halland).

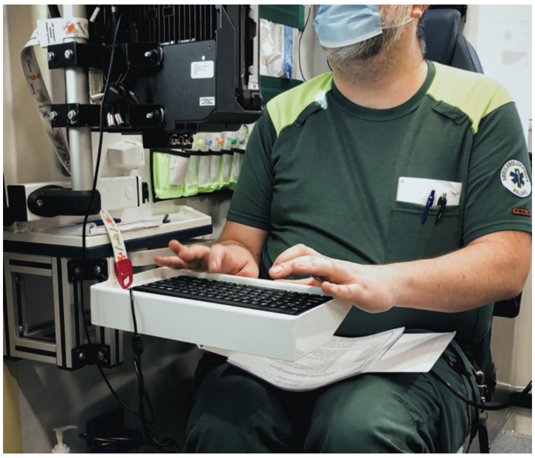


Figure 15 - Paratus setup in an ambulance in Kungsbacka.

- Due to the inconvenient attachment of the tablet, it occurs that it is not brought to the patient.
- A notepad in a size that fits in the pocket of the trousers are used to take notes and write parameters. Later these are transferred to the emergency medical record (VGR).
- The laptop does not have a designated place in the ambulance (VGR).
- An iPad mini 6 (7.9”) fits precisely in a pocket of the trousers but would not fit with a proper case.
- Physical durability and robustness are important attributes for every work tool as they must withstand reckless handling and harsh external factors.
- Bringing several tools to a patient also means a several tools needing sanitising afterwards.
- The GÖTT assessment form was found to not correspond with the order of work of EMS-nurses, see Figure 16. The sections turned out to be placed in an order which is instead preferable for the personnel at the hospital to receive the information. See Appendix II for full-scale GÖTT.

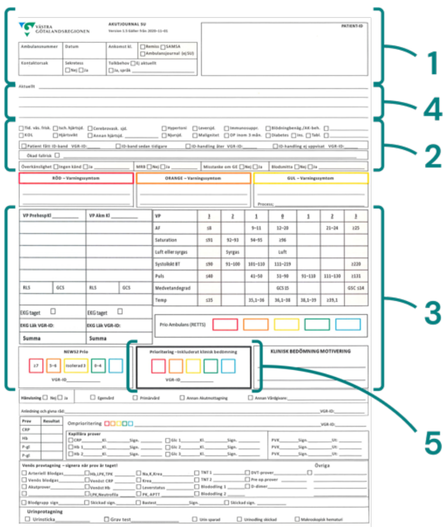


Figure 16 - GÖTT and the order in which sections were observed to be used.

Decision of care

- A conversation between the two EMS-nurses about how to proceed with the patient always takes place before the decision is made.
- The patient is also always well informed or even a part of the process to come to a decision of treatment.
- If there are uncertainties about a condition, symptom or such – guidelines in paper or digital form are used.

Writing patient medical record

- To write on paper in the ambulance while it is on the road is a challenge due to the bumpy ride.
- The final patient medical record is almost always finalised on a computer at the hospital or at the ambulance station, see Figure 18.
- If there is time, the final medical record can be done in the ambulance using the laptop (VGR), see Figure 17.
- Vital parameters are not always noted but drawn from memory when the emergency medical record or the final patient medical record is filled in (VGR).

Figure 18 - Patient medical record filled in at the hospital computer.

Figure 17 - The ambulance laptop in use

5.3.2. Emergency Dispatch Centre in Gothenburg

A half day was spent together with two operators where approximately 20 calls were observed in total. Findings relevant to the project are presented in bullet points below.

- One call is often not like the next and the level of urgency of the calls differ a lot.
- The operator needs to be fully present during every call and therefore has a break every 45 minutes to stay alert.
- There are four tools divided in two main systems. Every tool has its own screen, but the two main systems are not connected and therefore a separate button needs to be pressed so that the mouse can switch from one screen to the other.
- The layout and interfaces of the different systems used differ a lot. Colour themes, information architecture and sizes differ as well between the systems.
- The MBS decision support tool has a system of red and green dots over every parameter that can be filled out by the operator. When the dot is red it indicates that the parameter/question is yet not filled in and turns green whenever it is.

This system is argued to both be helpful but also to be neglected when the system is familiar.

- The information that is filled in are not verified before sent away.
- The information that reaches the assigned ambulance are standardised to the format of SBAR. The rubrics needs to be written manually for every call that gets assigned to an ambulance.
- The prioritisation that MBS recommends can be changed by the operator manually but needs to be commented on why it is changed.
- A new update on the MBS is in development where the protocol changes depending on who is calling. It will be one protocol for an individual, if there is someone within the health care or if it is an ordered case like a patient transportation.

5.4. Requirements list

This section describes what the solutions were decided to include and what not to include; a totality of the products formulated as a requirements list.

Requirements valid for all three concepts

The design shall be:

- designed for TYPE 2 patient cases (less time sensitive).
- adapted for use in the different environments of the ever-changing workplace.
- a handheld tool.
- easy to place in a standing position.
- able to fit in the medicine bag.
- able to withstand ruthless handling, dropping and other harsh external factors.
- functional for only three predefined fictional scenarios.
- in the size of an iPad mini (7.9")
- utilising 'calm design' and be optimised for minimal cognitive load
- having discrete colour theme and a tone of professionalism fit for a medical service.
- designed for readability and have clear borders and good visual contrast.
- saving changes automatically.

The design shall not be:

- designed for TYPE 1 patient cases (time sensitive)
- a fully functional product, but only a prototype generated in Figma and functional solely through the Figma mirror app.
- tested and evaluated in a real context with real patients.

AI-learning protocol

The design shall be:

- a clean scaled down interface limited to collecting data.
- visually representing a finished product.
- offering options yes, no and possibility to *not* pick at all, as well as variable values when needed, for ensuring as high data quality as possible.
- provided as a mobile version as well.

The design shall not be:

- providing a decision support.

Decision support

The design shall be:

- an addon feature for both the **AI-learning protocol** and the **medical record and assessment platform**.
- delivering decision support for chest pain patients only.
- formulating the support as a recommendation with motivation, being a supportive tool, rather than as a 'right answer', being superior to the EMS nurse.

The design shall not be:

- providing 'real' support as the AI is not yet finalised.
- a standalone product.

Medical record and assessment platform

The design shall be:

- a complementary tool to any eventual front and back computers in the ambulance, and not replace them and be detachable (as Paratus).
- presenting its content in an order corresponding to the already established workflow of EMS nurses (ABCDE, OPQRST, SAMPLE)
- a more comprehensive tool offering access to the additional selected features; patient medical record, monitoring of active machines and tools, routines and guidelines and the dosage calculator.
- acting as a visual guideline and basis for how a future real product like this could look and function.
- representing a replacement for GÖTT, Ambulink, laptop, booklets and physical guidelines, notebook and the Ambulans Sahlgrenska-app.
- reducing the actions of manual paper documentation, manual time logging, switching between work-tools.
- allowing free text to be entered both trough keyboard and dictation.

The design shall not be:

- containing actual content on tabs other than the home tab.

5.5. Lo-fi prototyping

This section presents the results from the lo-fi prototyping, divided into physical and digital prototypes.

5.5.1. Physical prototypes

For quick ideation and evaluation, cardboard prototypes were created, see Figure 19. A fully covering backside and a front frame in cardboard taped together and paper inserts containing placeholder wireframes to act as digital screen content formed two concepts of touch tablets.

The measurements corresponded to the sizes of an iPad 12.9" and an iPad mini 7.9" respectively, which were assumed to be appropriately sized tablets for the application. The content on the paper inserts differed between the prototypes as well, to provide more variations on appearance and possible functionality.

They proved to be effective in providing an initial feeling of what it would mean to handle a device for this context.

Figure 19 - Lo-fi prototypes in cardboard, hand for size reference

5.5.2. Digital prototypes

For ideation and evaluation of various digital data entries as well as presentation of decision support, simple interactive screens were generated in Figma. As much for own evaluation these screens were also designed to later be used in the second focus group session, see chapter 5.6.
They were designed in a neutral tone with elements mostly in grayscale, to not give any emphasis to elements not being evaluated.
Additionally, the screens had the same type of layout, font and font sizes to make them more head-to-head comparable. In the top end of every screen a yellow label showing 'test navigation' was placed to both emphasize an incomplete product and to provide the option of quickly switching screens. All screens were made for the size of a smartphone, as a real digital tablet was not available at that time.

The screens were created in correspondence to four different input categories: *number entry, free text entry, date and time entry* and *option picker.* The categories were chosen based on what type of data EMS nurses currently need to enter from patient assessments.

Each data entry method is based on options found in Apple's developer guide (Apple, 2022) and partly on own opinions.

Number entry

For entering numbers four different methods were chosen to be evaluated; *keypad, slider, scroll wheel* and *dictation,* all of which presented in Figure 20.
The goal was to capture a selection of quite different methods for the same action. To create a tangible context, a variety of vital parameters were made subjects of the data entries.

Keypad, utilises the classic internal keypad to enter a number, clicking on each separate subject before entering the number.

Slider, offers a possibility to set a number without selecting subject first, by dragging the handles horizontally. Additionally, the plus and minus on each side of the slider can be used to with more precision step one digit at a time.

Scroll wheel, offers just as slider the option to select value without picking subject first, but vertically instead.

Dictation, provides in addition to the previous keypad method a possibility to click the microphone icon and speak the value instead.

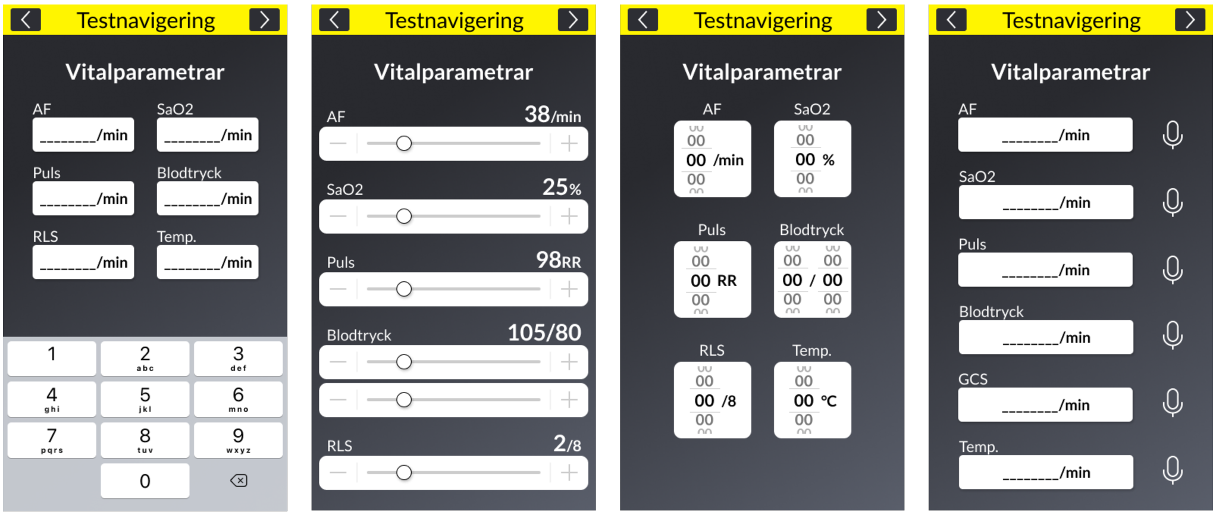


Figure 20 – Different input methods for number entry on different screens. From left: keypad, slider, scroll wheel and dictation.

Free text entry

For free text entry only two methods were created, see Figure 21.

Keyboard, allowing you to select the field in which you want to enter data and use they keyboard to do it.

Dictation, providing the option to dictate by pressing the microphone icon as a complement to the keyboard.

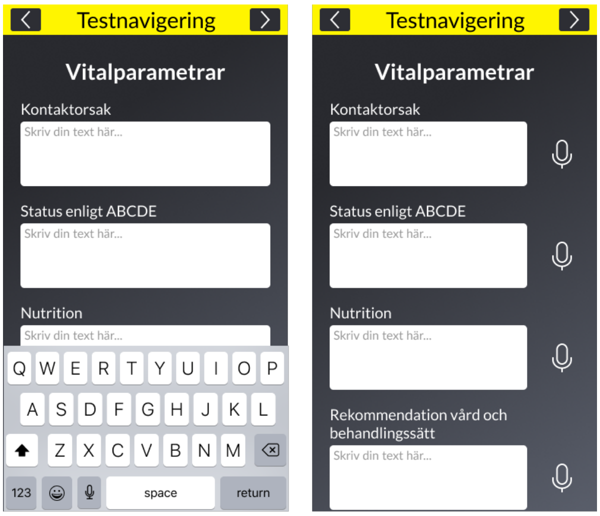


Figure 21 - Screens for different input methods for text. From left: keyboard and dictation.

Time and date entry
Figure 22 shows the three methods created for entering time and date entry.

Keypad, similar to previously it allows to select subject and enter value through a keypad.

Scroll wheel, allows for vertically dragging on respective wheel.

Scroll wheel and calendar, allow to pick date from a calendar view in addition to the scroll wheel.

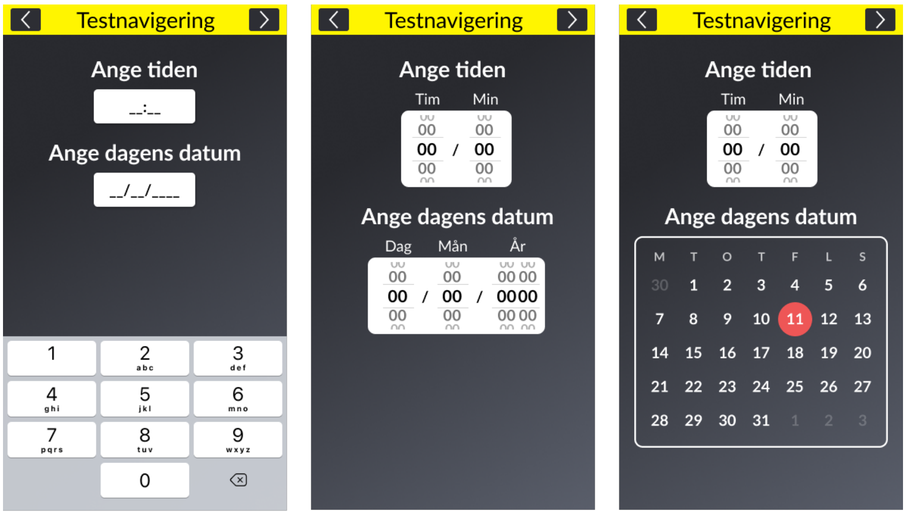


Figure 22 - Screens for different input methods for time and date. From left: keypad, scroll wheel and calendar.

Option picker
For picking from a predefined set of options, three methods were designed, see Figure 23.

Checkboxes, visually similar to a conventional checklist on paper allowing to check each box by tapping.

Buttons, where options are presented as buttons with borders enclosing the whole text it refers to, also allowing picking by tapping.

Dropdown menus, a space effective solution hiding the options under a menu, allowing for clicking the dropdown button and then selecting from the menu.

Figure 23 - Screens for different input methods for picking options. From left: checkboxes, buttons, dropdown menu.

Decision support presentation
For presenting a recommendation in a potential **Decision support** concept five different representations were generated, see Figure 24.

Top banner, an idea of constantly having a fixed banner in the top end which provides a dynamic recommendation continuously updated with each new information entered.

Bottom bar, aims to present the recommendation first when the bottom is reached, where the idea is to not distract the user with ever-changing information until the work is done.

Corner indication, a subtle variant which silently works in the top corner and provides the user with a colour representing a level of severity of the patient once enough data has been entered. This idea was thought to be able to work in combination with the other concepts where you could click the indicator and get more thorough details.

Pop-up window, a summary of the recommendation in details as an almost full screen pop-up to appear either on command or when the form is filled in and finished.

Separate menu, a concept with several menus to select from in a bottom bar where the recommendation would be in one of them.

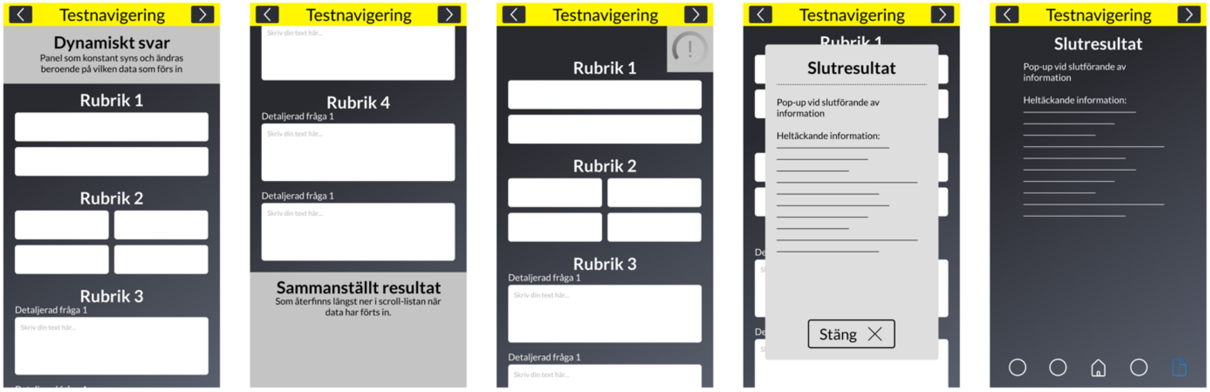


Figure 24 - Screens for presenting decision support. From left: Top banner, bottom bar, corner indication, pop-up window and separate menu.

5.6. Focus group session 2 – Physical and digital interactions

This section will describe the key takeaways from each test during the session. Only two out of four participants from the focus group could attend and therefore an additional informal and less extensive session was held with one of the EMS nurses working also at PICTA.

Figure 25 - Ongoing work from focus group session 2 with two participants.

5.6.1. Data entry

Task 1 – Number entry (keypad, sliding bar, scroll wheel, dictation)

- Since numbers in this context most likely needs to be precise, sometimes on the decimal, an input method that eases this was interpreted as important.
- The keypad and dictation function were those said to meet the needed precision.
- The dictation was said to be useful in those situations where the hands are not as clean.
- The sliding bar and scroll wheel were anticipated to require more concentration to get right.

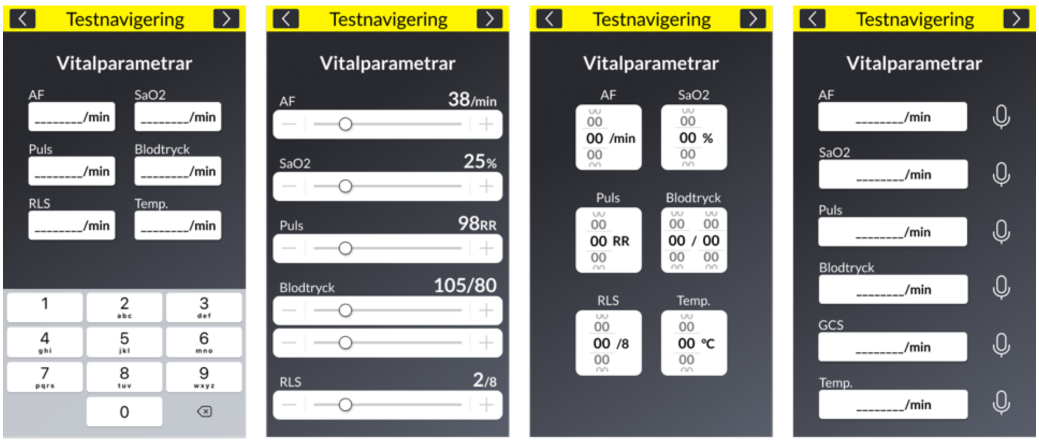


Figure 26 – Screens used for test 1.

Test 2 – Free text entry (keyboard, dictation)

- The format of the phone and the size of its keyboard was understood as too small to write longer texts with but ok to write shorter notes and bullet points.
- The separate dictation button was appreciated and said to be used over the one already existing on the keyboard. To use it would be one click less than the one on the keyboard.
- As a nurse you are not familiar to dictate, and it would perhaps not be something natural in the beginning and never the final text but in need of adjustment afterwards.

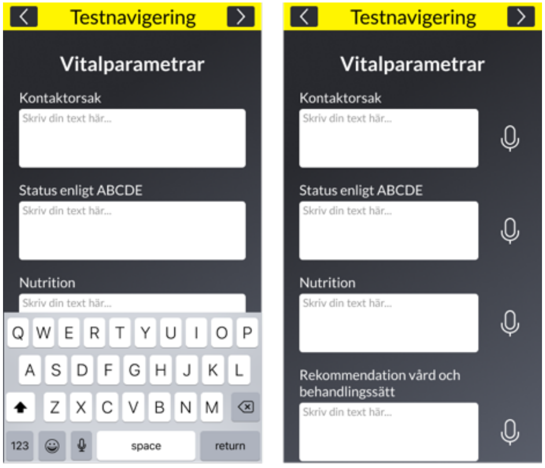


Figure 27 – Screens used for test 2.

Test 3 – Option picker (checkboxes, buttons, drop-down menu)

- The checkboxes were recognised from existing tools, such as GÖTT, and were experienced as positive, easy to interact with and to get an overview in terms of readability.
- The buttons were both experienced as easy to interact with due to the larger interactive surface. Meanwhile they were said to make the options too alike and easy to confuse. Readability was not perceived to be as good as for the checklist.
- The drop-down menu was not appreciated since it hides what you want to interact with, making the process ineffective.

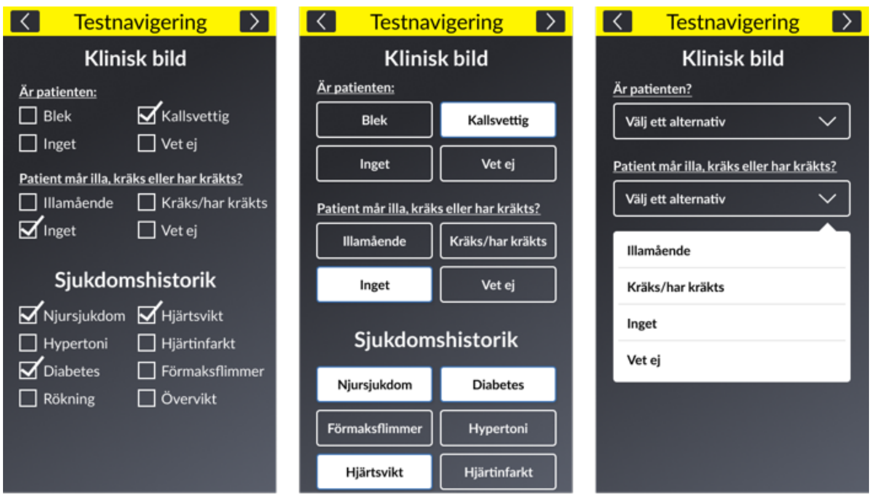


Figure 28 - Screens used for test 4.

Test 4 – Time and date entry (keypad, scrolling wheel, classic calendar)

- The scroll wheel was recognised from other contexts when you are to book something or check departures online. Easy to understand and clear in the differences of day, month and year.
- The scroll wheel was understood to be easy to change the date in situations when an assignment started just before midnight and the predefined date must be changed.
- The calendar was also interpreted as easy to interact with but not said to be easier than any of the other methods.

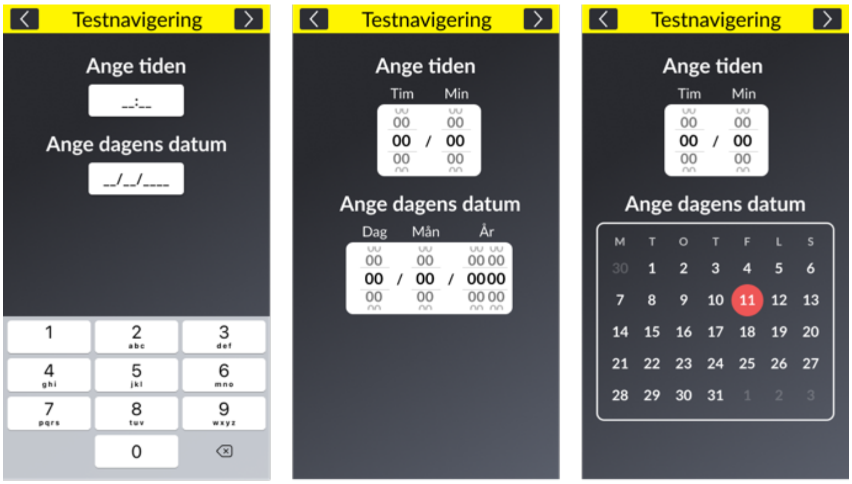


Figure 29 - Screens used for test 3.

When the participants were asked if they in a potential digital protocol would prefer the input methods to be alike or rather to differ from one another, they could not agree on the same answer. It was argued that it would be more interesting, engaging and force observance if the input methods changed throughout the interface, as well as easier to keep track of where you left off if everything does not look the same. Meanwhile arguments for consistency in input methods because of the thought that the overview would increase and make it easier to navigate through a longer protocol where laid out.

5.6.2. Decision support

This part of the session had no tasks per se but aimed only to discuss around the five different lo-fi decision support representations created.

The locations of the decision support elements are marked with a red box in the figures below:

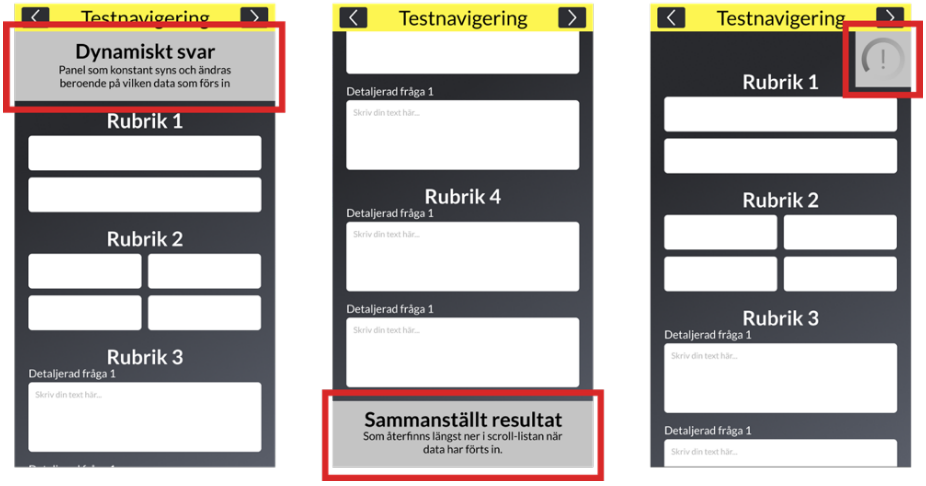


Figure 30 – Decision support representations. From left: Top banner, bottom bar and corner indication.

Top banner

- Said to be a bit too much and perhaps would steal too much of the attention from the assessment and what you are asked to fill in.
- Due to its size and placement, it could make you biased faster than necessary if the decision support would propose what you already had in mind waling in on the assignment.

General reflections of a dynamic decision and live updated representation were both positive and negative. Positive due to an anticipation of that not more work than necessary would have to be done in order to get an indication of action from the decision support. On the other hand, concerns that important knowledge could be lost if an early prediction does not show the full picture and a full assessment is not performed.

Bottom bar

- Interpreted to steal less attention since the decision support are found in the bottom of the protocol.

Corner indication

- Even if the colour would change it did not feel likely to hold the information needed to understand further actions.
- A suggestion that it could be an indicator and that a comprehensive suggestion could appear when interact with it.
- The placement felt enough to be noticed but not to take too much attention.

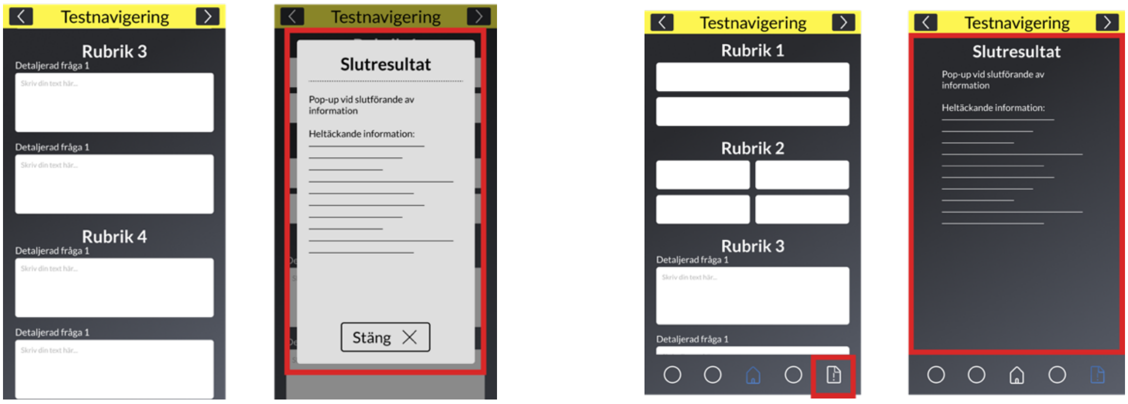


Figure 31 – From left: pop-up window and separate menu.

Both *pop-up window* and *separate menu* was said to be closer to the situation of today and had high recognition rate. To have the decision support presented as a separated feature was understood as good in terms of focus. This way it was thought to be able focus more on the assessment of the patient and be less distracted by the recommendation. None of these layouts were favoured over the other.

A general suggestion was to have the representation colorised according to the colours of RETTS or GÖTT. Further that the colours orange and red should show as soon as enough data is available while the colour green should not show until everything is filled in. This to avoid patients to get under prioritised.

5.6.3. Physical format

The iPad mini was considered the most beneficial format by all the participants. It was interpreted to be large enough to hold a lot of information and have good visibility. At the same time it was argued to easily fit in the medical backpack and perhaps even in a pocket of the trousers. It was appreciated that it could be held in one hand. One participant could envision it have a case with a foldable stand that could easily be placed at a suitable surface in a patient's home.

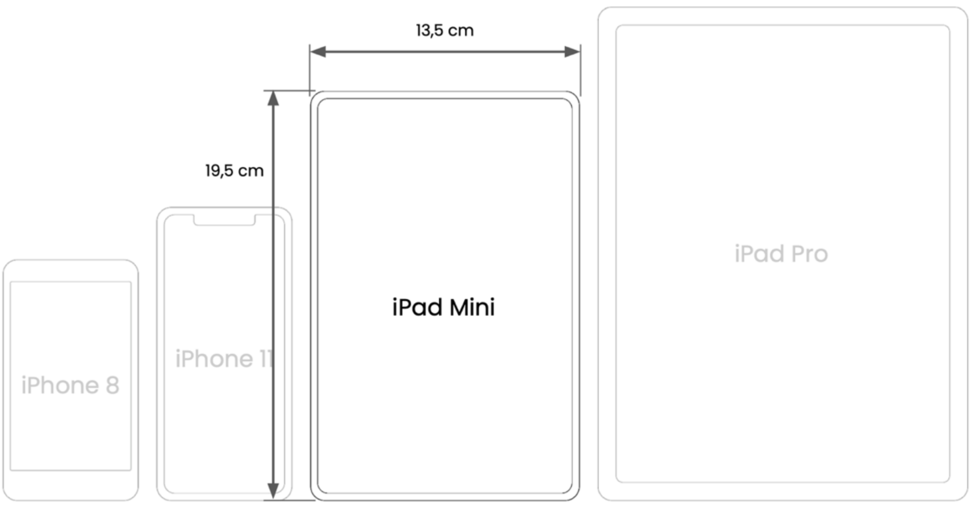


Figure 32 - Evaluated size formats. iPad mini highlighted.

The formats larger and smaller than the iPad mini were not anticipated to be as suitable in the context of the EMS. When the **AI-learning protocol** was discussed, a phone felt more reasonable, since it would serve a relatively small purpose. To carry an iPad or such for that purpose only was not envisioned as preferable.

5.6.4. Information hierarchy

The order of the predefined questions and headings were sorted as seen in Figure 34 by all the participants.

Figure 33 - Participants discussing information hierarchy

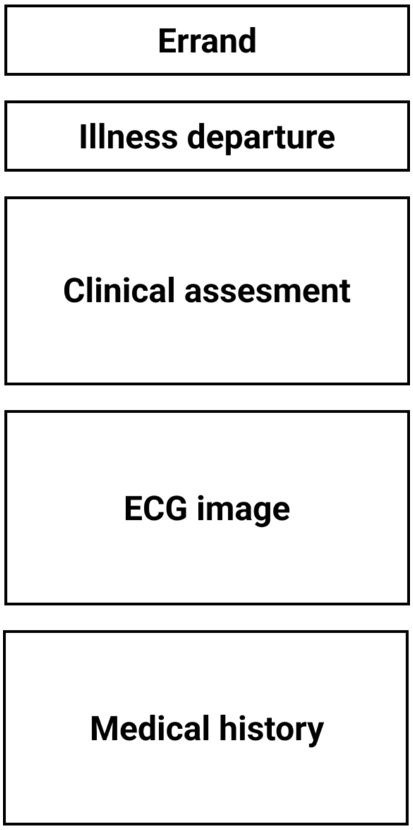


Figure 34 - Visualisation of preferred order of the information hierarchy

5.7. Wireframing

When creating the first wireframes it was all about setting the general framework and ground rules for how the concepts should look and function. Initially all wireframes were kept to the size of a tablet, as that has been deemed the preferable size.

A few elements were identified as key features and created the basis for the content of the concepts:
Bottom navigation, allowing for browsing between menus for quick swapping between tools (primarily for **medical record and assessment platform**).
Page navigation, allowing for quick navigation between destinations within the current menu and providing an indication of current location.
Form, a scrollable page containing content necessary for the current action.
Sections, found in the form, containing clusters of data fields treating the same subject.
Data field, specific questions or data entries necessary for assessment and or data collection.
Decision support, an element representing decision support.
Call to action, available primary and secondary actions for the current task.

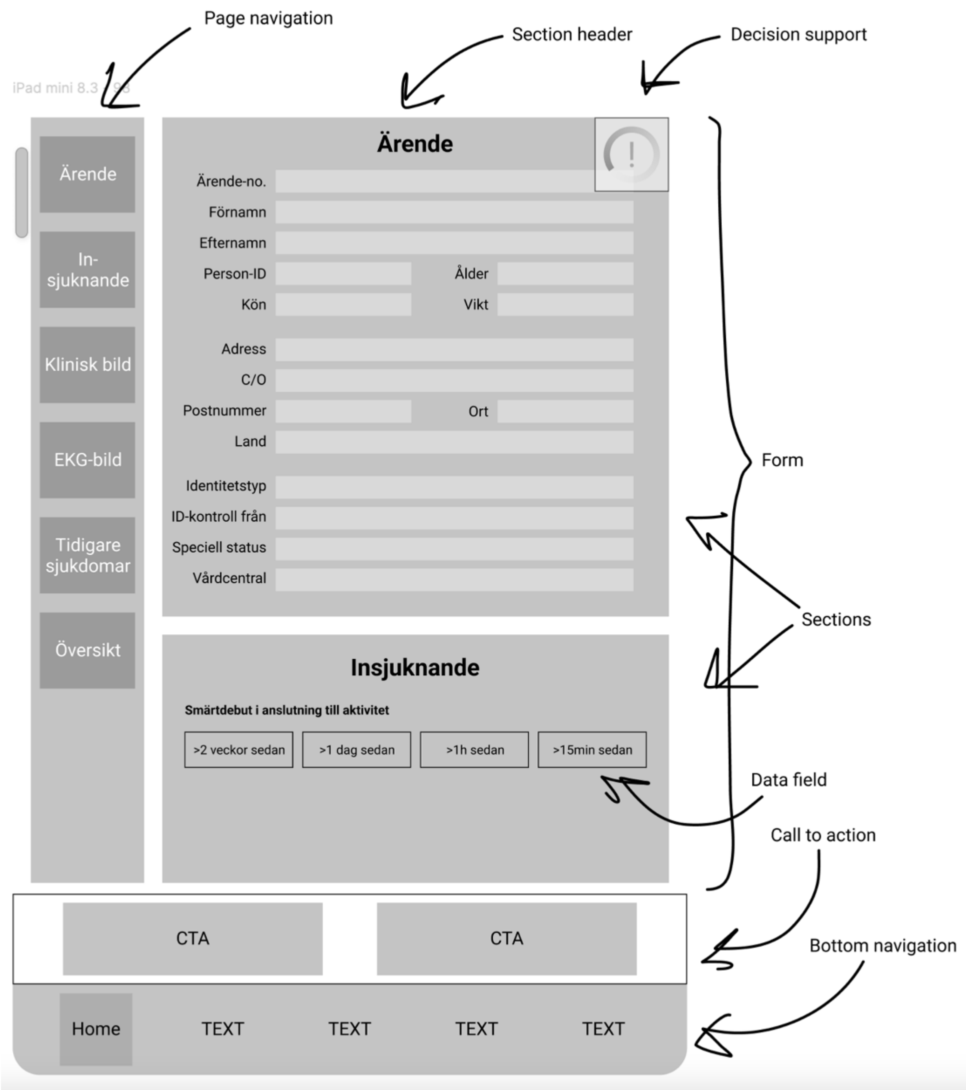


Figure 35 - Example of wireframe containing several key features.

All of the features were never thought to go into all three final concepts, but they were all considered in terms of space and position to be able to maintain a similar layout and functionality throughout all three of them. The idea was to create seamless transitions in potential merges of the concepts.
These features were thrown around to shape different constellations, information- and workflows. Starting from very rough layouts to trying out more detailed looks.

Figures 36, 37, and 38 show how different layouts and data entry methods were iterated and how the actual learning protocol (2.6) were integrated more and more.

Initially all the work was done in grayscale and with raw geometries, to keep focus only on what was important this early in development.

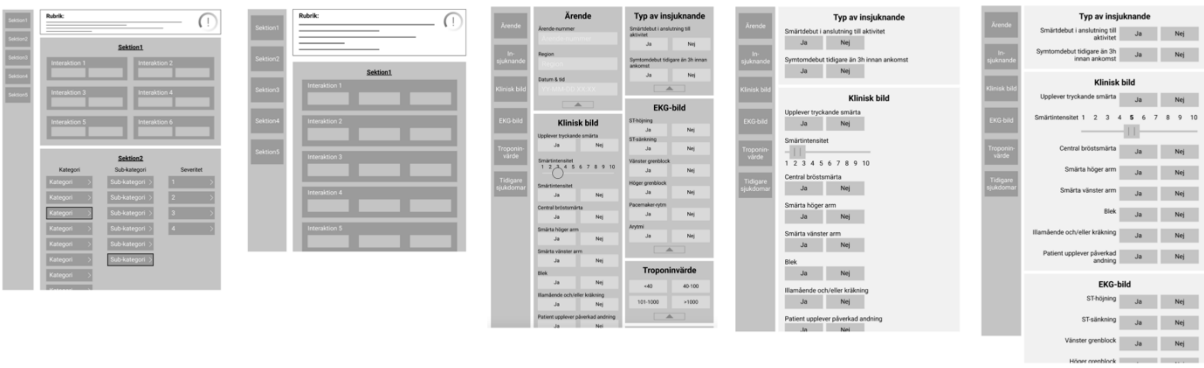


Figure 36 - Examples of wireframes showcasing various layouts.

Successively different types of looks and colours were carefully implemented.

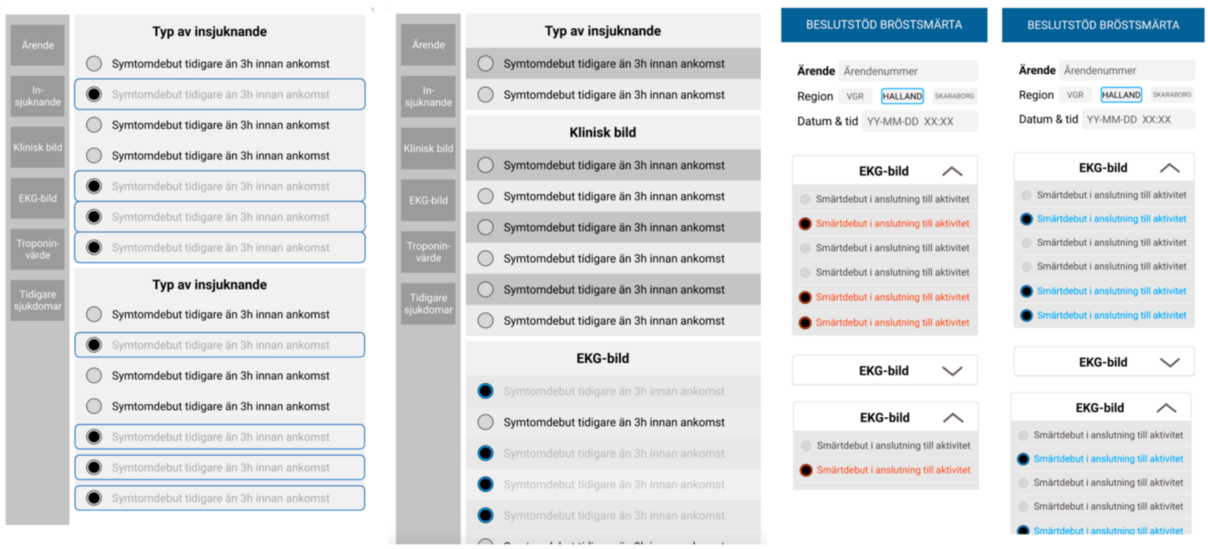


Figure 37 - Examples of wireframes utilising the checklist data entry method.

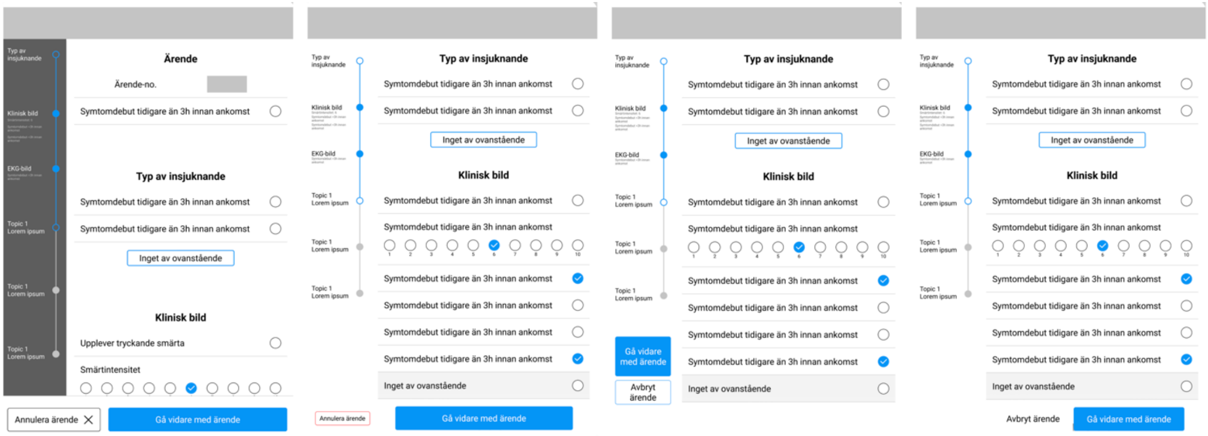


Figure 38 - Examples of wireframes trying out alternate page navigation and CTA's as well as implementing blue colour.

Once a general layout was decided to try out with more details, inspiration was gathered from benchmarking a pick of acknowledged sites and services, examples shown in Figure 39. In addition, mobbing.com, dribbble.com, developer.apple.com and uigarage.net was used as a complement to the benchmark.

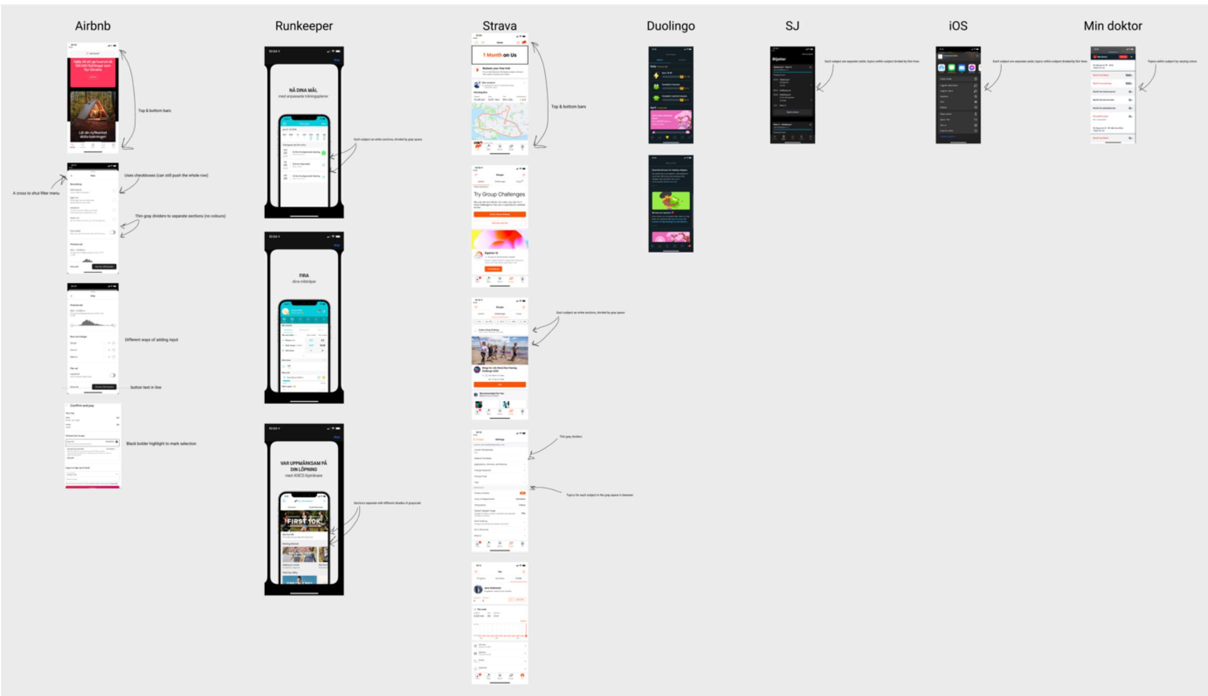


Figure 39 - Example pick of UI benchmarking.

Various borders and transitions between elements were iterated with the aim of being both distinct and very neutral and toned down at the same time.

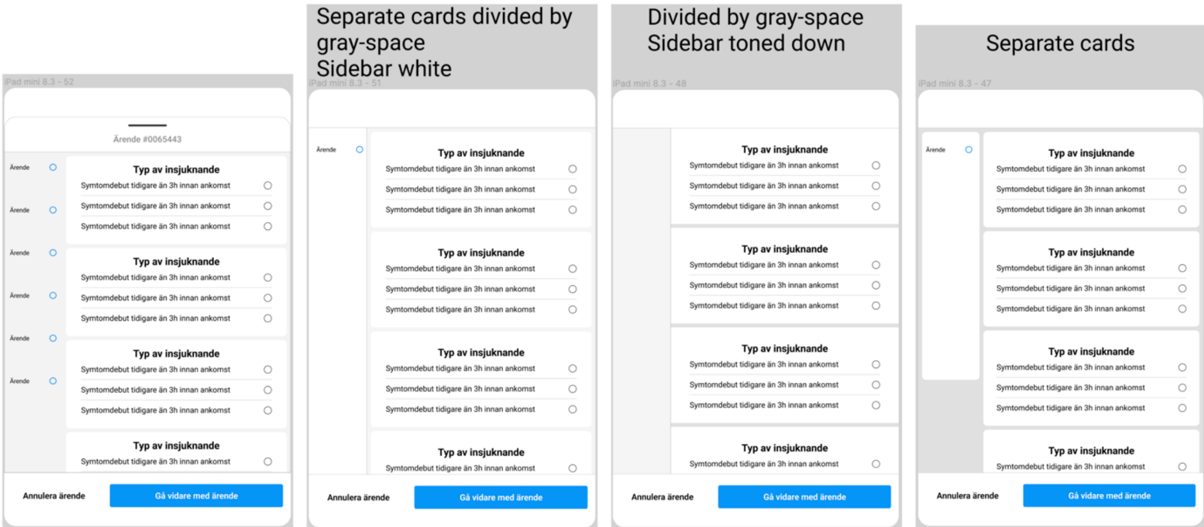


Figure 40 - Examples of borders and definitions between layout elements.

In parallel with working with geometrical borders and separating elements various colour themes were iterated. The goal was to use colours for visually separating elements of the layout, highlighting what elements are interactive and setting the right tone of the concept as a whole.

Colour schemes were both freely improvised and based on colour palette generators, such as happyhues.co, see Figure 41.

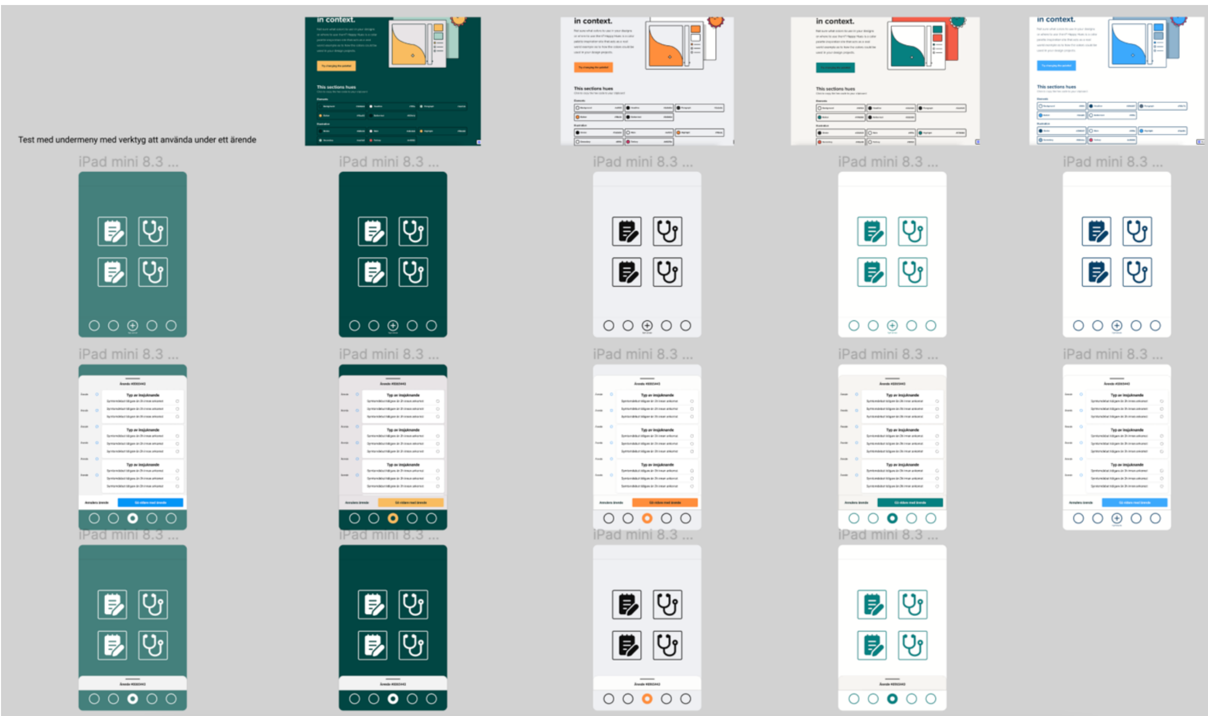


Figure 41 - Example of applied colour schemes and screen shots from happyhues.co.

A preliminary decision on colour theme and a total setup of screens was taken, see Figure 42.

Loading screen, an initial screen when the app is starting up.

Home, the main page from which you can choose to start a new assignment or browse previous ones.

New assignment, where the actual assessment and data collection is performed.

Overview/recommendation pop-up, a confirmation gate of sorts, which provides overview of data entered as well as eventual recommendation of action.

Previous assignments, a collection of previously performed assignments.

What would differ between the three concepts is the content on each screen. E.g., the bottom navigation would only be valid for **medical record and assessment platform**.

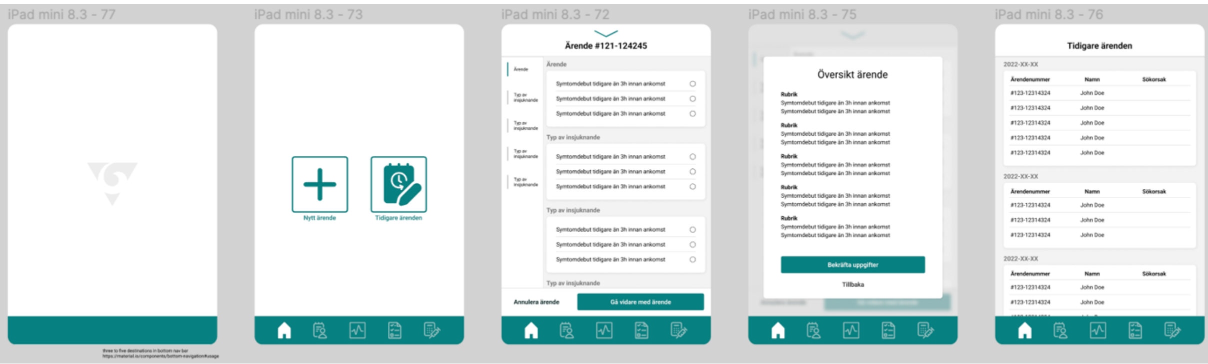


Figure 42 - Total setup of screens. From left: loading screen, home, new assignment, overview/recommendation pop-up and previous assignments.

In addition to this, it was decided to have the **decision support** provide information through the topics *risk, advice* and *motivation. Risk* was already an established way of describing a patient's state or condition through a priority (see chapter 2.2.). Thus it was deemed preferable to take advantage of the fact that this grading system was well known, making the EMS nurses already in line with the assignment's severity. *Advice* was somewhat the core reason of the AI in the first place, to provide recommendation of actions, and was seen as an obvious information topic. *Motivation* was added as an important aspect to create reliability towards the AI in cases where the AI and EMS nurses might come to different conclusions, see chapter 3.3.2.

5.8. Hi-fi prototyping

When wireframing had filled its purpose and different functionalities and looks had been iterated, hi-fi prototyping was initiated.
This meant creating concepts as closely to a real product as possible, both with regard to appearance and functionality. All digital work was performed in Figma.
Final deliverables are presented in detail in 6. Product presentation.

As stated in 5.4. Requirements list a few demarcations had been set to keep the concepts to a level corresponding to the project's time and resources;

- Functional only through the Figma mirror app, and not as a standalone product.
- Fully interactive only for three predefined fictional scenarios.

Three different prototypes were created; **AI-learning protocol** tablet version, **AI-learning protocol** mobile version and **medical record and assessment platform** tablet version.
The start screens of each are shown in Figure 43.
The **decision support** concept was seen as an addon feature implemented to these three prototypes and did not become a standalone prototype of its own.

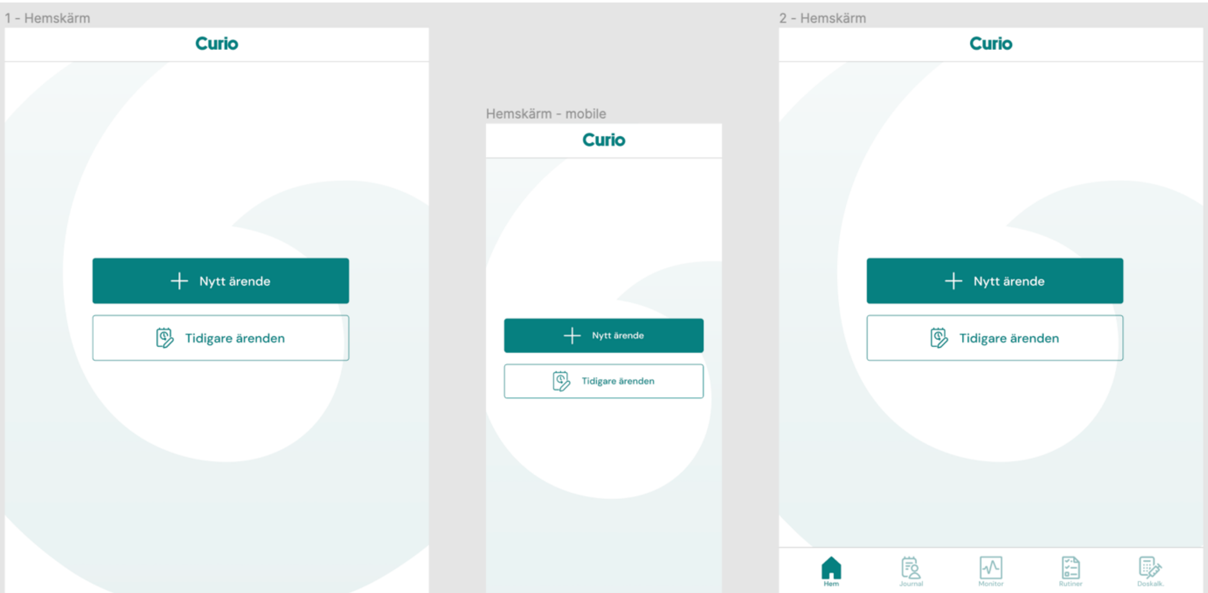


*Figure 43 - Home screen of each prototype. From left: **AI-learning protocol** tablet version, **AI-learning protocol** mobile version and **medical record and assessment platform.***

In this phase, most of the functionality was already set and the work was mostly about graphic design and pixel perfection as well as making interactions and animations work to an acceptable and realistic level.

A finding during the exploration phase was that the **AI-learning protocol** could both be preferred as an tablet and mobile version. Thus, it was decided to develop both formats and provide the option to utilise either one of them or both. Both formats are shown in Figure 44.

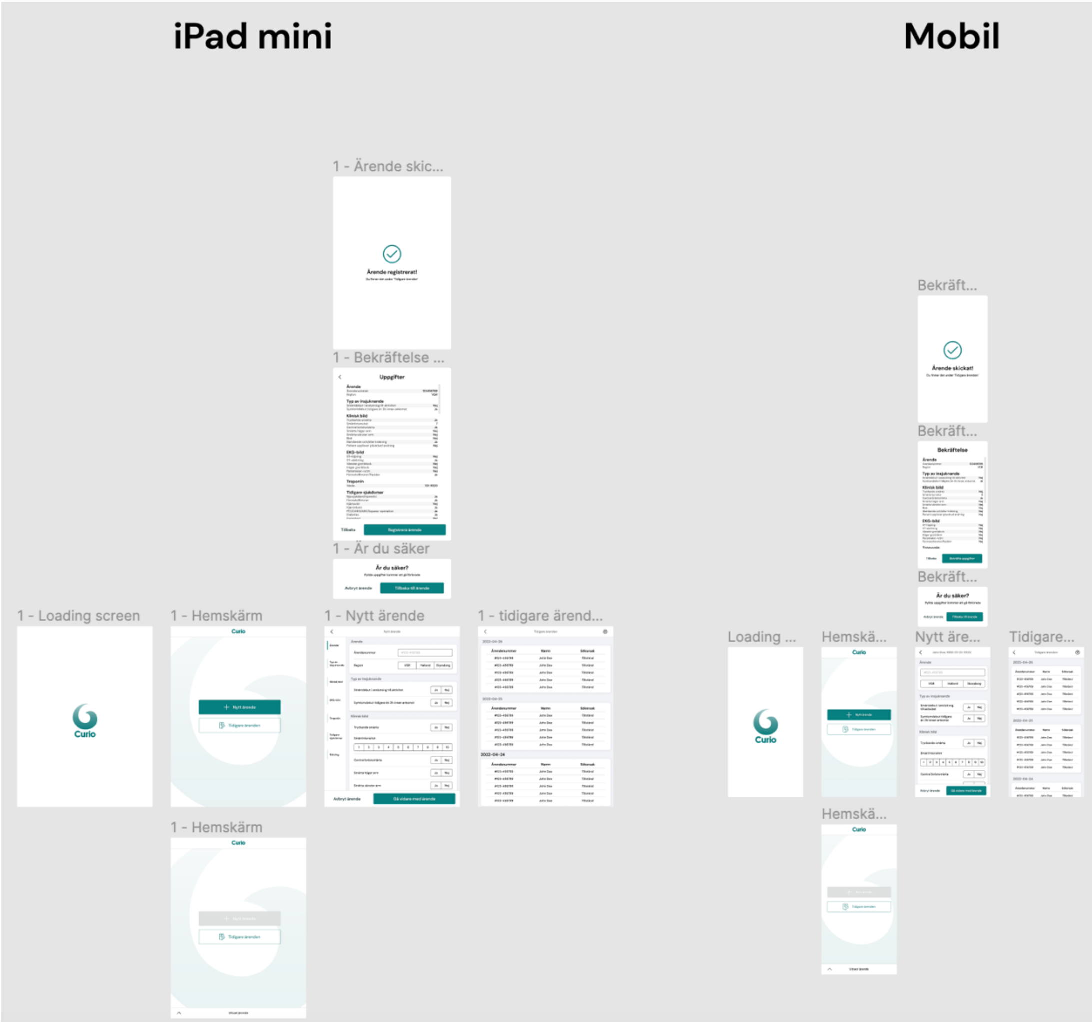


*Figure 44 – Full setup of screens for tablet version and mobile version of the **AI-learning protocol.***

A part of creating realistic solutions was to create a logo and brand. Logo ideation shown in Figure 45.

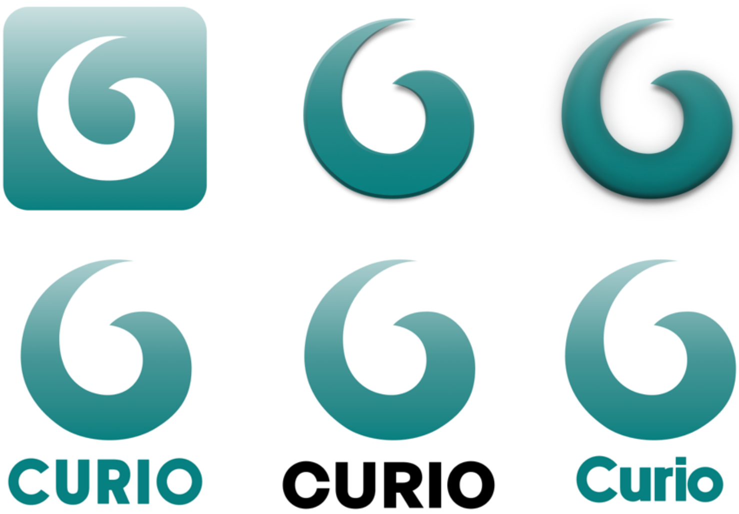


Figure 45 - Logo ideation

All design choices in terms of readability, button sizes, margins and general layout is based on established design frameworks found in Apple's *Interface guidelines* (Apple Developer, 2022), Google's *Design guidelines* (Google Assistant, 2022) and About face (Cooper et al., 2014).

5.9. Test & evaluation

This section presents the results of a design review with experts in interaction design, user tests performed with selected EMS and the focus group session 3.

5.9.1. Review by interaction designers

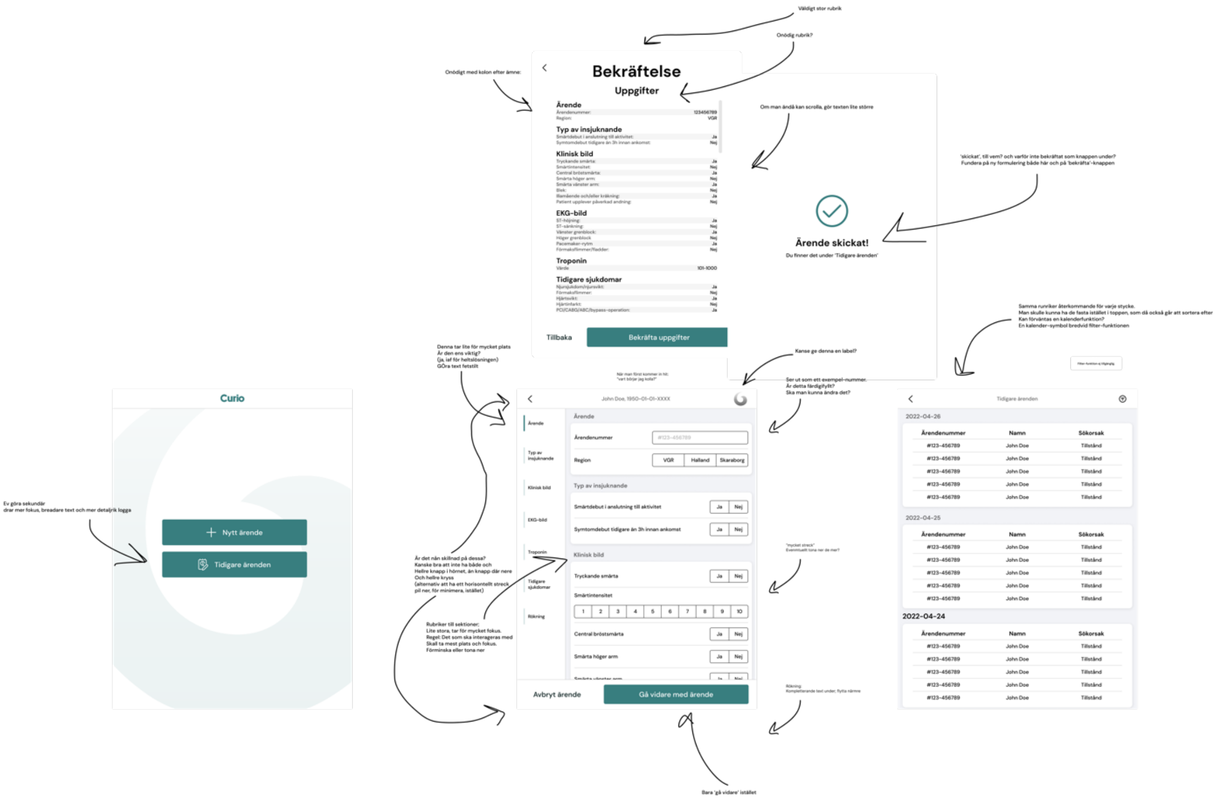


Figure 46 - Overview of pointed out feedback items from the interaction designers regarding the AI learning protocol

Four interaction designers, with various experience and competence, reviewed the **AI learning protocol** and came with feedback mostly regarding placement, spacing and consistency of elements. Figure 46 visualises the elements that were given feedback on by the arrows. The feedback was taken into consideration in the last changes before presenting the final design to the focus group.

The feedback was positive both seen to graphics and information architecture, and they all managed to fill in the **AI-learning protocol**, review the data and "sign it off". One of the most important feedback items was regarding the hierarchy of the two buttons 'New assignment' and 'Previous assignments'. Since they both had the same colour, they were interpreted as equally important. As this was not the case 'Previous assignments' was given the appearance of a secondary action instead, see Figure 47.

Two of the interaction designers had time to fill in a semantic word scale which are to be found in Appendix VI.

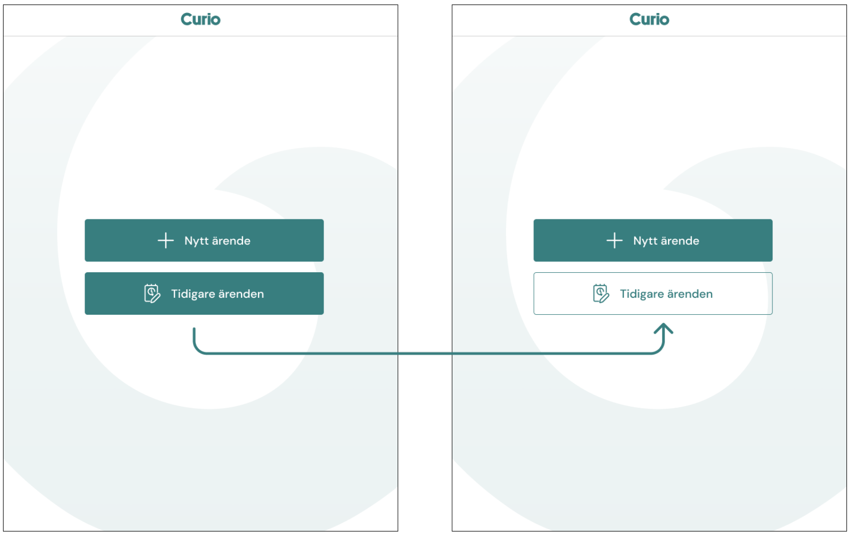


Figure 47 - Visualising the change on the first screen of the AI learning protocol of the button "Previous assignments" as a result from input by the interaction designers

5.9.2. Test with EMS nurses

For full details on the concepts used, see 6.Product presentation.

The two EMS nurses, also working at PICTA, were presented with the **AI-learning protocol**, the **decision support** and the **medical record and assessment platform**.

There was no problem for either of them to fill in the **AI-learning protocol** with the given patient cases. They also found previous assignments without hesitation. They agreed on the phone to be the most usable interface. The semantic word scale was filled in and are to be found in in Appendix VI.

Regarding the **decision support**, the three headlines *Risk, Advice* and *Motivation* were described as appropriate and adequate. *Motivation* was particularly emphasised as a good way to learn something from the AI.
The colour of the icon was said to be a good complement to the text as they recalled the colours from today's triage systems. It was mentioned that the red coloured icon should be more distinct and obvious. One suggestion was to combine the red icon with a red frame on the whole screen.

The concept of the **medical record and assessment platform** was only evaluated by one of the EMS nurses and the overall input was positive. The tablet was experienced as a reasonable size and said to "fit easily" in the medicine backpack. The statements about this solution were filled in and are found in Appendix V. The only thing that is to be commented on, is the statement about *"A solution like this would reduce the stress level in my work"*. On the scale *"Disagree"* to *"Agree completely"* it was closer to *"Disagree"* compared to any other EMS nurse. It was explained by that the documentation and systems for this is not what is experienced as the most stressful part of the work.

5.9.3. Focus group session 3 – Test and evaluation

For full details on the concepts used, see *6.Product presentation*.

In total, three participants from the focus group participated and the session was held individually and lasted for one hour. The participants were put in a fictive scenario where they met a 'patient' with chest pain and filled in the **AI-learning protocol** during the assessment. Their interaction with the concept was observed and documented, followed by a discussion of their experience. Further the **decision support** and **medical record and assessment platform** was tested and interacted with on a more general level without the fictional scenario.

The functionality of the products differed a lot where the **AI-learning protocol** was the most functional and responsive while the **decision support** and the **medical record and assessment platform** was more static and conceptual. Especially the last concept was very difficult for the participants to visualise. It could be due to amount of missing actual interactive content and a mismatch between the very detailed icons compared to the otherwise conceptual layout.

The main findings for each product are presented in bullet points below.

AI-learning protocol

- The mobile was argued to be the most appreciated format due to the fact that in a tablet format it would be an additional device but with a relatively small purpose. The mobile, however, is already a tool which every ambulance is equipped with.
- The colour scheme was experienced as appropriate in the medical context. The green and red colours was interpreted as natural choices with good contrast and made the overview of a filled in protocol easy to read.
- Size of text and buttons was experienced as good for both the mobile and tablet.
- The purpose of the left-aligned page navigation menu on the interface of the tablet was understood but experienced as somewhat unnecessary.
- The protocol was not experienced as too long to scroll through.
- The order of the questions was said to be logical.
- The posture of the participants became slightly more crooked when they sat down next to the "patients" using the mobile compared to when they used the tablet.

The scoring of the SUS for the AI-protocol gave 100 points, 82,5 points and 100 points for the three participants. This results in a total scoring of 94,2 points where the maximum scoring is 100, see Figure 48. This is a high score and is understood as somewhat biased but also a result of the scale being too extensive to use for a system with very few functions. This is to be discussed further in chapter 7.

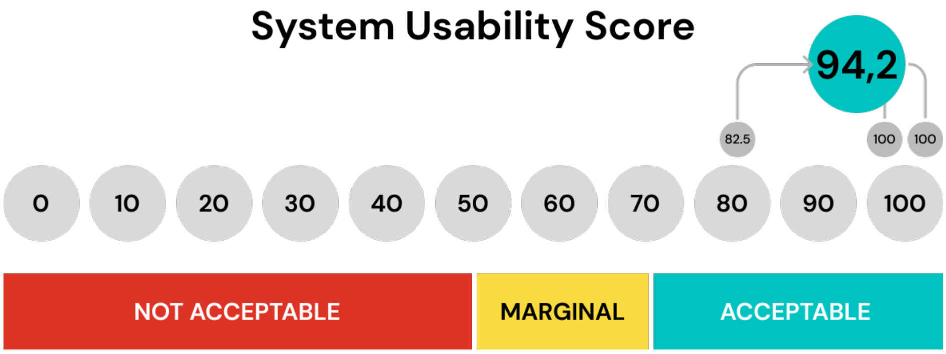


Figure 48 - Visualisation of the SUS and the scoring results from the participants

Decision support

- The recommendation was expected to show up in the end when the protocol was finalised and the understanding of the "AI-symbol" was somewhat vague.
- The content of the recommendation was interpreted as reasonable.
- The simplicity was appreciated and thought to be understood by most users.
- The phrasing of the outcome as *high risk* was interpreted as too vague and subjective.
- The text of the recommendation was experienced as too small.
- The colour of the recommendation symbol was said to be too vague. A fear that it could be overseen when a long shift has caused fatigue of an EMS nurse.

Medical record and assessment platform

- The possibility to hold the tablet with one hand, especially with a case providing a hand strap, was positive.
- The small stand included in the case was interpreted as a useful feature where it could be placed a bit aside the interaction between the nurse and the patient and avoid a barrier between them.
- All the tools in the bottom tab bar were considered very useful except the function *Monitor.* It was argued to be unnecessary since the values already were thought to be easy enough to access.
- Ideas of new features were: *annotations* (possibility to make personal notes which does not end up in the patient medical record), *search function, map of patient distribution*.

The overall response of the **medical record and assessment platform** positive all through. A quote from one of the participants describes it well: "*It would be a utopia!".*

6. Product presentation

This chapter describes all the final concepts of the project's deliverables.
It will provide in-depth details of all design elements and features along with motivations for the choices.

6.1. Brand

The prototypes have been given the name and brand **Curio**, acting as an umbrella label for the whole collection of the different deliverables. This keeps them all under the same visual style, information architecture and functionality allowing one prototype to seamlessly merge with another. The choice was based on the idea of introducing the three main deliverables as three serially connected launches with the **AI-learning protocol** being the first, followed by the **Decision support** being implemented in the already launched **AI-learning protocol**. Lastly the whole **medical record and assessment platform** would be introduced and absorb the two already launched products into the platform. Thus, the different deliverables are designed to fit within one another.

The logo's appearance is an interpretation of the current VGR logo with the spiralling element in the middle being extracted and isolated to stand on its own. Comparison of the two is shown in Figure 49. The idea of picking the spiral as logo was both based on the fact that the project is primarily directed towards VGR and thus, it creates a sense of familiarity to potential users.

The other reason was that the spiralling element was thought to connect well with the concept of AI, that the spiral itself could resemble a thinking or working element, being not too unlike common loading-icons often used in digital services. This, since the spiral has a second purpose in the design, which is to represent the AI and appear at all times when AI-powered recommendations are provided.

The name **Curio** is unlike the logo itself not connected to VGR in the same way but a sort of play with words where a combination of Latin's *curiosis*, meaning inquisitive, is thought to interlink with English's *cure*, both being relevant this product and the application in which it operates.

Figure 49 - Side by side comparison of the Curio and VGR logos.

6.2. AI-learning protocol

The **AI-learning protocol** comes in two versions, one for tablet and one for mobile. This allows for flexibility prior to launch to either introduce a whole new physical tool, the tablet format, or implementing the product in the already existing iPhone which every ambulance is equipped with.

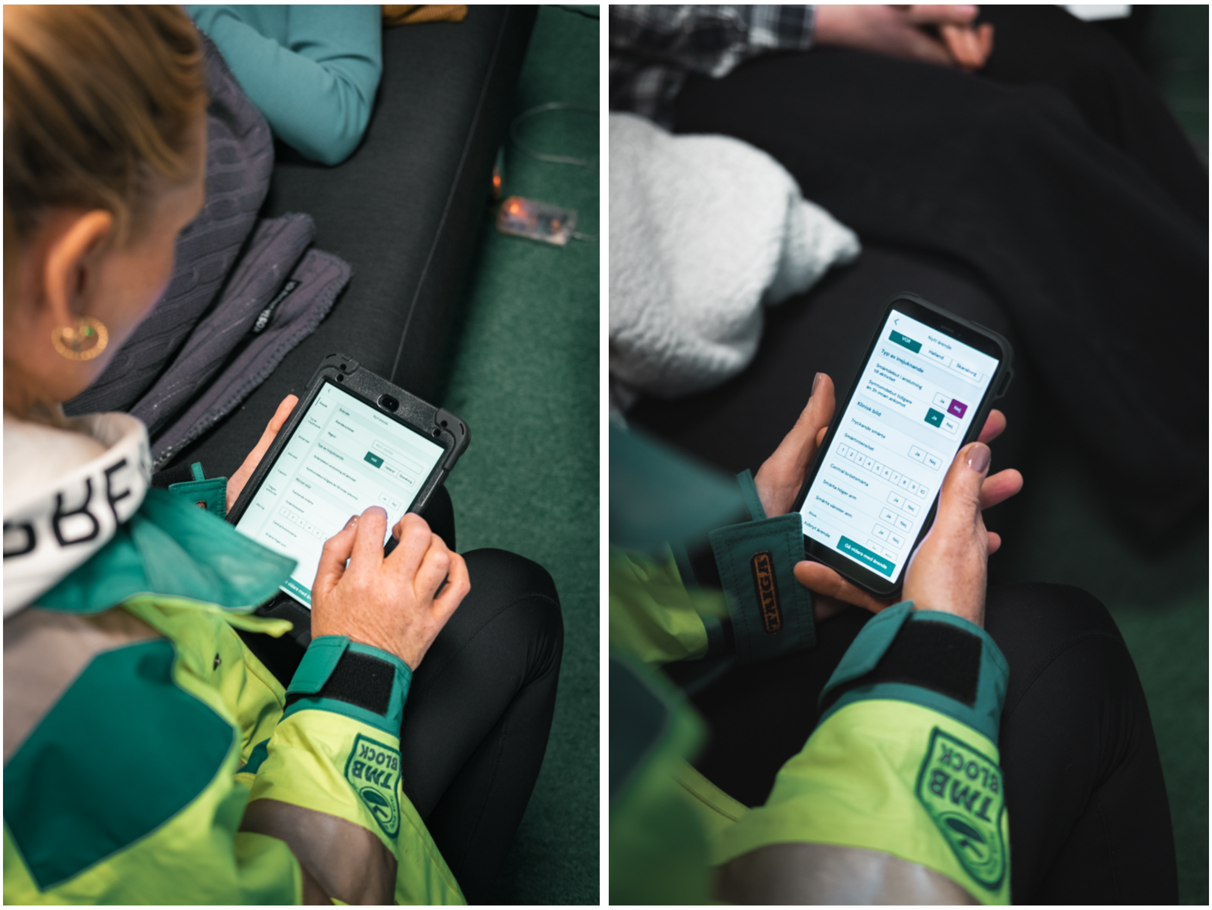


*Figure 50 - **AI-learning protocol** in tablet and mobile version respectively in a fictional context.*

Functionality

When starting up the product, a loading screen is presented to act as a placeholder when the system is working, showing the product's logo and name. After a smaller delay the home screen is presented. Both of which are shown in Figure 51.

On the home screen it is possible to pick one of two options, 'new assignment' as a primary button, as this is seen as the main activity, and 'previous assignments' as a secondary button.

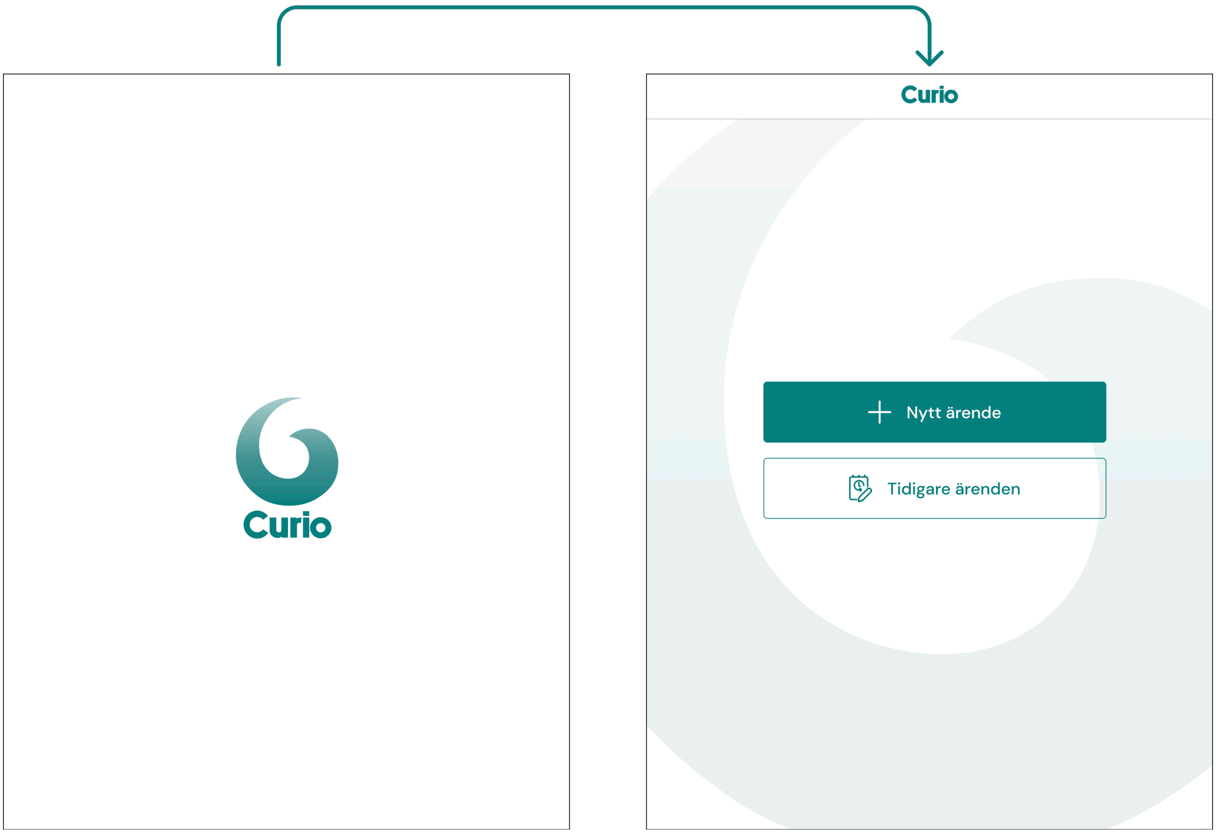


Figure 51 - Loading screen and home screen of ***AI-learning protocol*** *tablet version.*

By tapping 'new assignment' the new assignment screen is presented. This screen contains the full data protocol, in the shape of a scrollable form, and is the only screen where the actual work is performed. Figure 52 shows the new assignment screen with a breakdown of its most prominent elements;

Assignment & support info, both acts as a formality to show who the assignment concerns as well as a friendly reminder to the EMS nurse who often want to address the patient with name and be aware of age.

Card, the cards are what shapes the complete form. Each card holds a cluster of *protocol questions* and *data entries* which relates to similar subjects. The order of the cards follows the proposed one by the EMS nurses, see section Information hierarchy.

Protocol question, description of data collection picked from the predefined protocol questions described in chapter 2.6.

Data entry, interactive options corresponding to associated *protocol questions*.

Page navigation, an indicative element showing the current location which is also interactive to quick jump between subjects.

Primary action, the main action to proceed with once the formed is filled in.

Secondary action, the less frequently used action with which the assignment can be aborted.

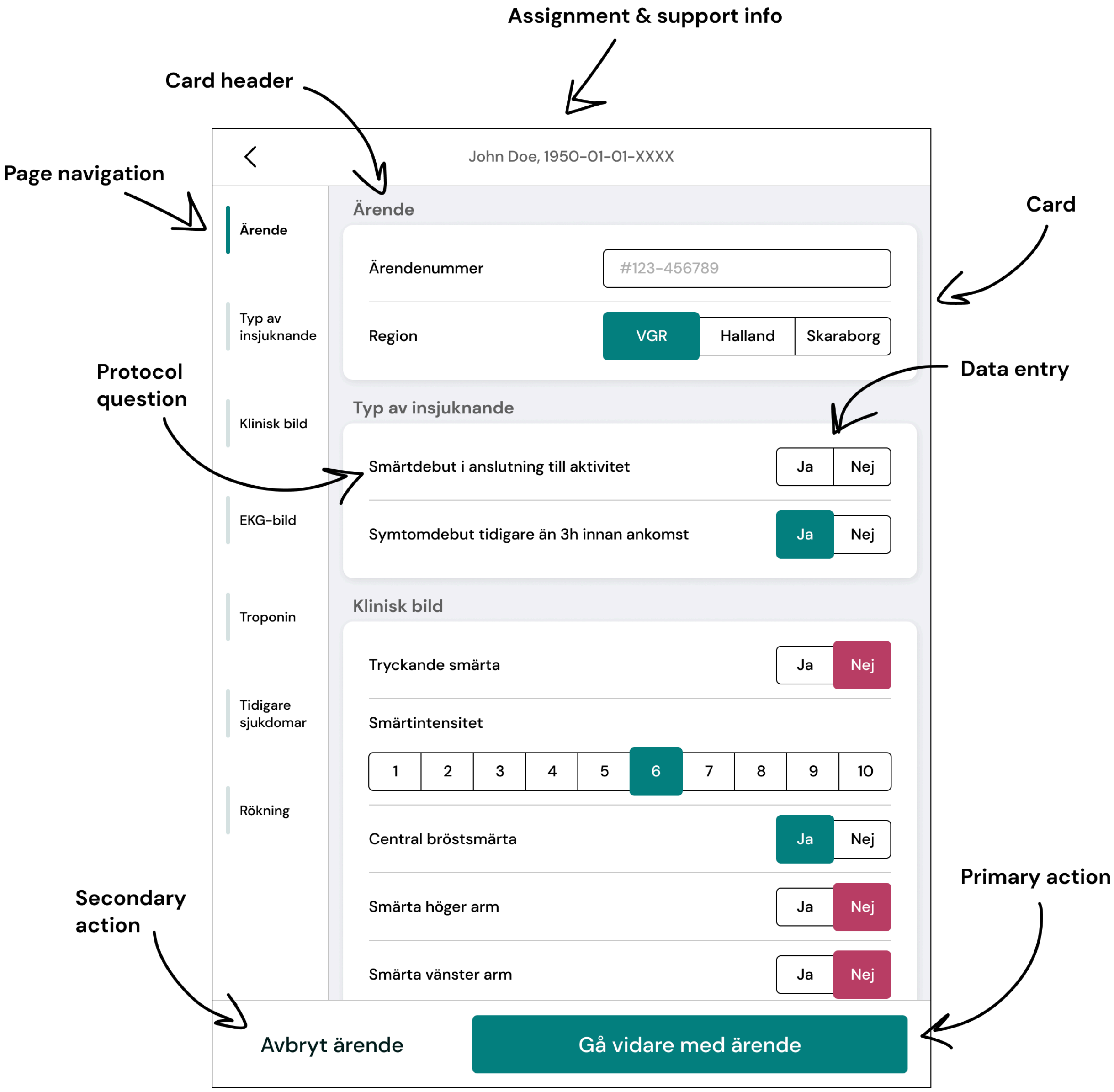


*Figure 52 - 'New assignment' screen on **AI-learning protocol** tablet version.*

Once the form is filled in and the primary action 'proceed with assignment' is tapped a summary of the filled in data is presented providing a final chance to overview the information before signing it off. It contains a scrollable list followed by a primary and secondary action to proceed or abort. Summary and sign-off screens are shown in Figure 53.

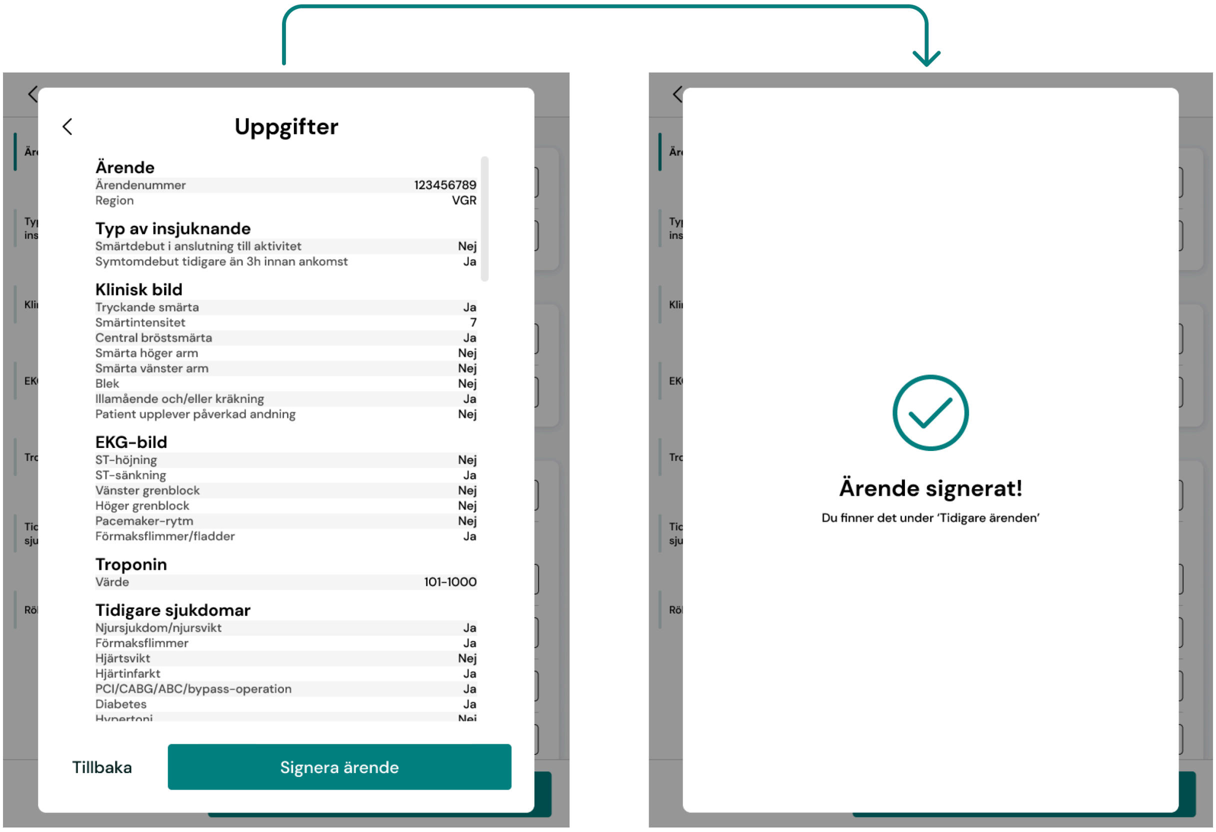


*Figure 53 - Summary and sign off screens of the **AI-learning protocol** tablet version.*

If from the home screen choosing secondary action ‘previous assignments’ instead, the previous assignments screen shown in Figure 54 would present itself. This is more of a placeholder screen for the idea of being able to browse previous assignments.

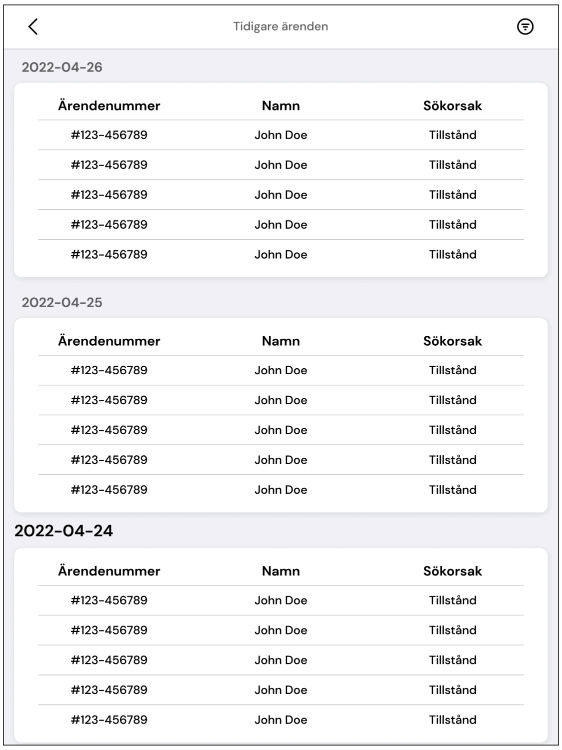


*Figure 54 - Previous assignments screen of the **AI-learning protocol** tablet version.*

The mobile version of the **AI-learning protocol** would provide all the same features, only in different format, with the exception of *page navigation* being removed due to conflicting space priorities.

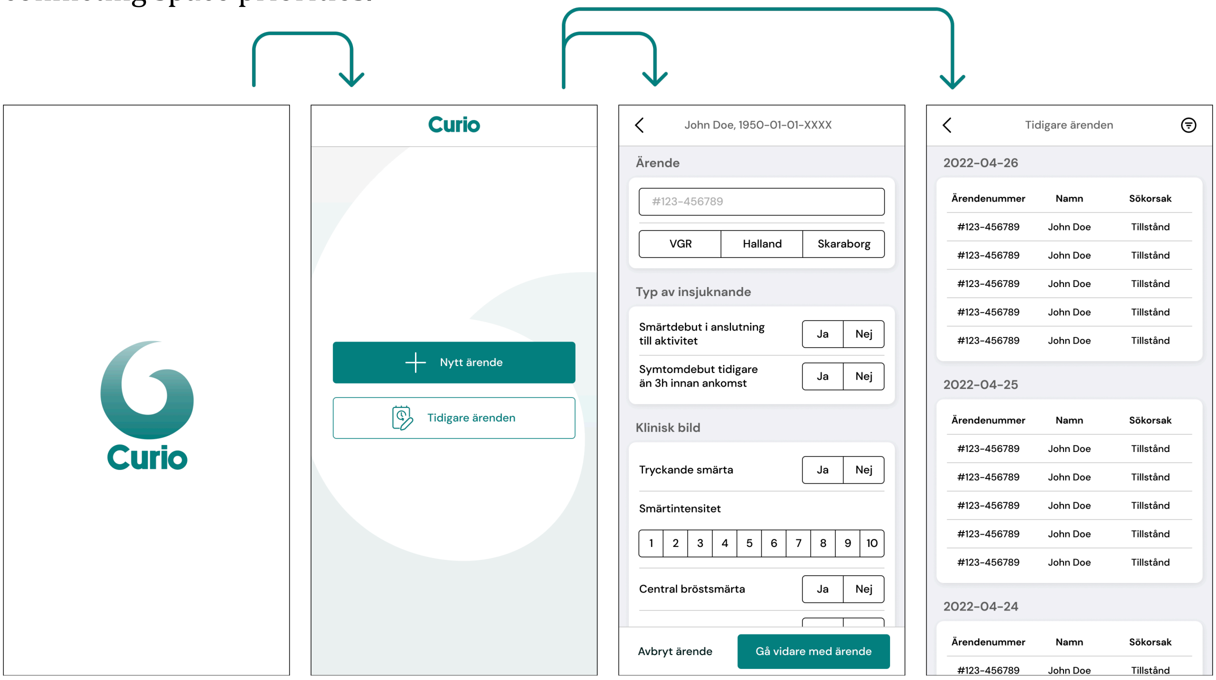


Figure 55 - Loading, home, new assignment and previous assignment screens of the ***AI-learning protocol*** *mobile version.*

6.3. Decision support

As previously mentioned, the decision support is more of an extra feature implemented into the other prototypes, rather than a standalone product. It will be visible in the upper right corner of the prototype, in the shape of the logo, just to establish a presence of the AI, see Figure 56.

*Figure 56 – **Decision support** implemented in the **AI-learning protocol.***

The idea is that the logo will be grey, as long as it does not have enough data to formulate a recommendation. When it has, it switch colour in accordance with the nature of the recommendation to both show that a recommendation is available and provide passive hinting on what it will mean without requiring any interaction, see Figure 57. The colours are based on a priority system the EMS nurses are already familiar with, see chapter 2.5.

Figure 57 - Logo and AI element in the top bar switching colours in accordance with recommendation.

More details on what is recommended by the AI is provided in two ways. One, as a pop-up window showing a preview of the up till then calculated preliminary recommendation, activated by simply clicking the logo. The other, as a combination of a summary and a recommendation in the sign off pop-up which is reached once the form is filled in and proceeded with. Both representations of the detailed recommendation are shown in Figure 58.

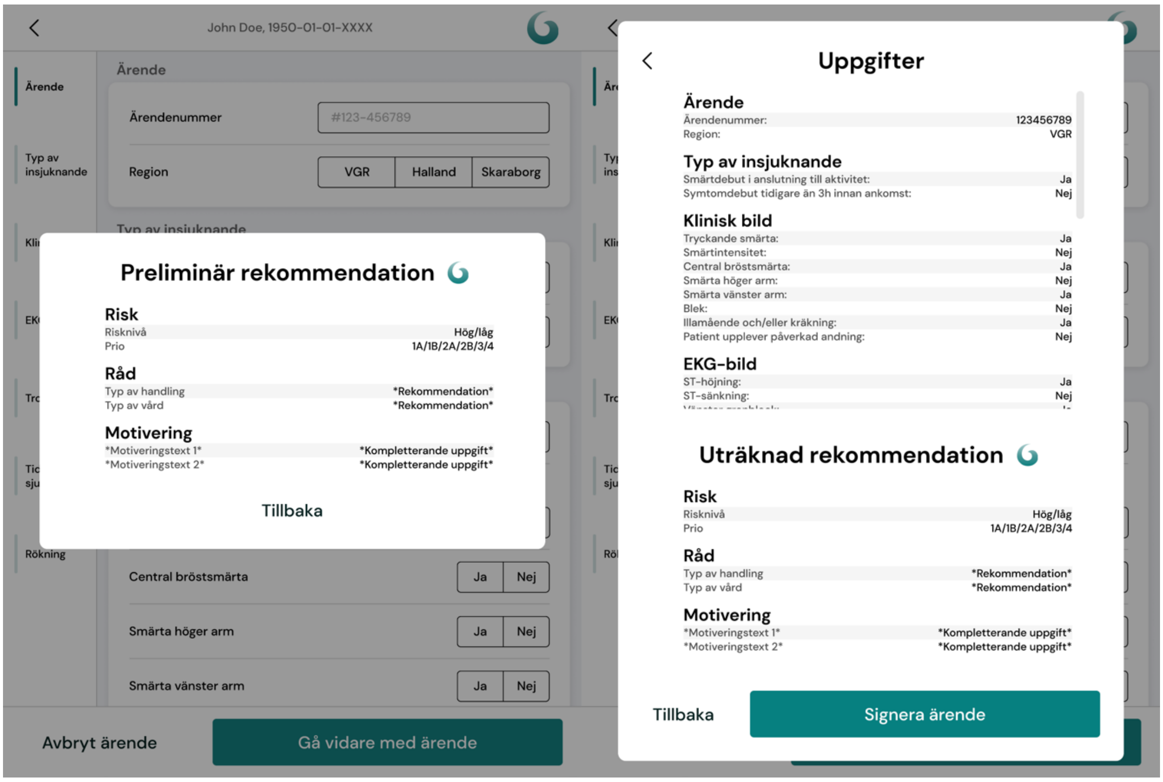


Figure 58 -Representations of the more detailed recommendations. From left: pop-up from clicking the logo and pop-up from proceeding and signing off the assignment.

The primary content of the recommendation is *risk, advice* and *motivation.*

Risk, explaining the risk and providing and 'priority', linking to the already familiar severity grading system which is used today to prioritise patients, see chapter 2.2. This sets the basis of how serious the patient's condition is.

Advice, the idea is that this would provide recommendation of viable and preferable courses of action for treatment and other proceedings.

Motivation, explaining the why and how of the previous two subjects. This links to the important relation between transparency and reliability of an AI calculated outcome, see 3.3.2. Also a desired feature from the EMS nurses in order to learn about different combinations of symptoms.

6.4. Medical record and assessment platform

The **medical record and assessment platform** is thought to be a more comprehensive product than the previous deliverables, a sort of digital toolbox being a collection of some of the most essential tools used by EMS nurses when assessing and documenting patient case. It utilises the visual style of **Curio** and thus, resembling the **AI-learning protocol** in terms of graphic design and information architecture, but with added or changed content.

In contrary to the previous deliverables this is solely designed for a tablet. The mobile version was primarily offered due to the temporary nature of the previous deliverables to simplify the implementation of an addon tool, which is not the case for this. A tablet also emphasises the characteristics of a working tool which corresponds more to the nature of the **medical record and assessment platform,** in contrary to the mobile.

In Figure 59 it can be seen that the loading screen is unchanged but that the home screen now has a tab bar in the bottom with five different menu options; *Home, patient medical record, monitoring of measuring equipment, routines and guidelines* and *dosage calculator.* This tab bar is present on all other screens throughout this concept and contain different tools which have been decided to be accessible at all times.

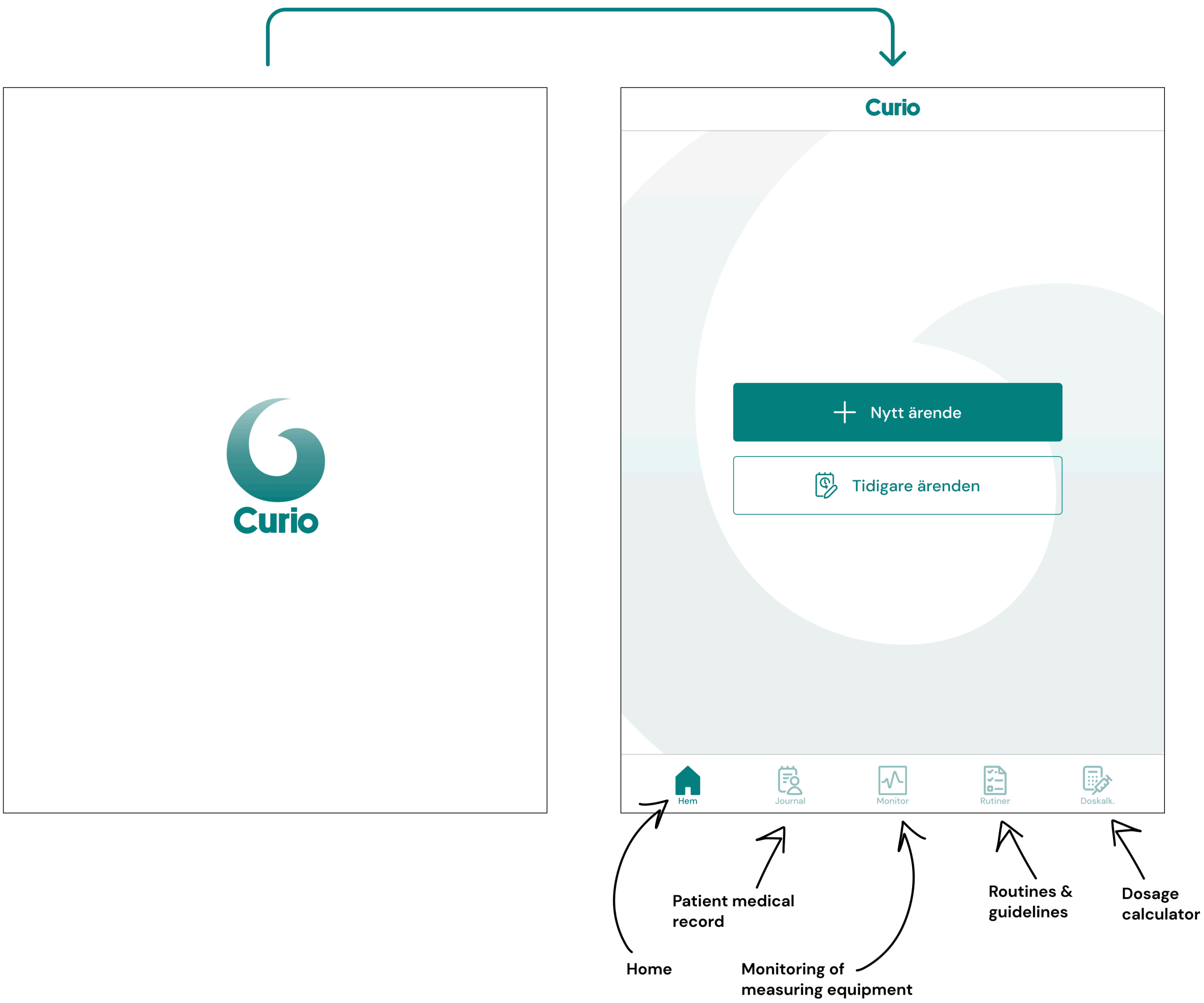


Figure 59 - Loading and home screen with annotations of the ***medical record and assessment platform.***

Home, the default starting point from which you can create new and manage old assignments. These features are recognised from the **AI-learning protocol.**

Patient medical record, where the medical record of the current patient case can be accessed simultaneously to an assessment or where the record of any patient can be searched for at any time.

Monitoring of measuring equipment, a section for full visibility of data from active measuring equipment, e.g., ECG and blood pressure, to collect all measuring data at one and the same place.

Routines and guidelines, a collection of ways of working, booklets, established routines and guidelines which in today's situation are spread out as physical and digital documents found in different locations.

Dosage calculator, a tool for identifying the right amount of medicine doses for specific patient groups.

This collection of menu options has, from the project's research, shown to be some of the most essential features which are helpful to access both prior, during and after an assignment. Having them accessible side by side enabling quick switching between them is thought to increase efficiency as all of them are in today's situation spread out or not accessible to EMS nurses at all.
Additionally, it would reduce the number of tools or items carried by EMS nurses, also meaning fewer things needing sanitising after certain patient cases.

Entering the new assignment screen, see Figure 60, the overall layout can be recognised from the **AI-learning protocol**, but the content differs. This setup is meant to cover more aspects of assessing and documenting a patient rather than only collecting data through chest pain-related questions.
Page navigation now shows general assessment models instead of specific topics. This acts a basis for how the order of content shall be structured to better match the actual order of work, unlike the current GÖTT. This order represents an assessment which funnels the case from being a very wide initially to being narrower and condition-specific towards the end.

Placeholder graphics have taken place in the cards instead of actual content. The idea was to keep the design very general as going into details required a level of medical expertise which was not covered by the scope of this project.

The standout feature is *vital parameters,* an expandable menu in which vital parameters can be logged. The motive for its placement is that it was found that unlike other parts of the assessment, which often happened in a specific order, vital parameters could be entered at any time of the assessment. Additionally, the same parameter could be added more than once at different times of the same assessment. Having this placement makes it accessible at all times but also collapsed and discreetly put aside when not needed, preventing back-and-forth scrolling, would it have a place in the scrollable form instead.

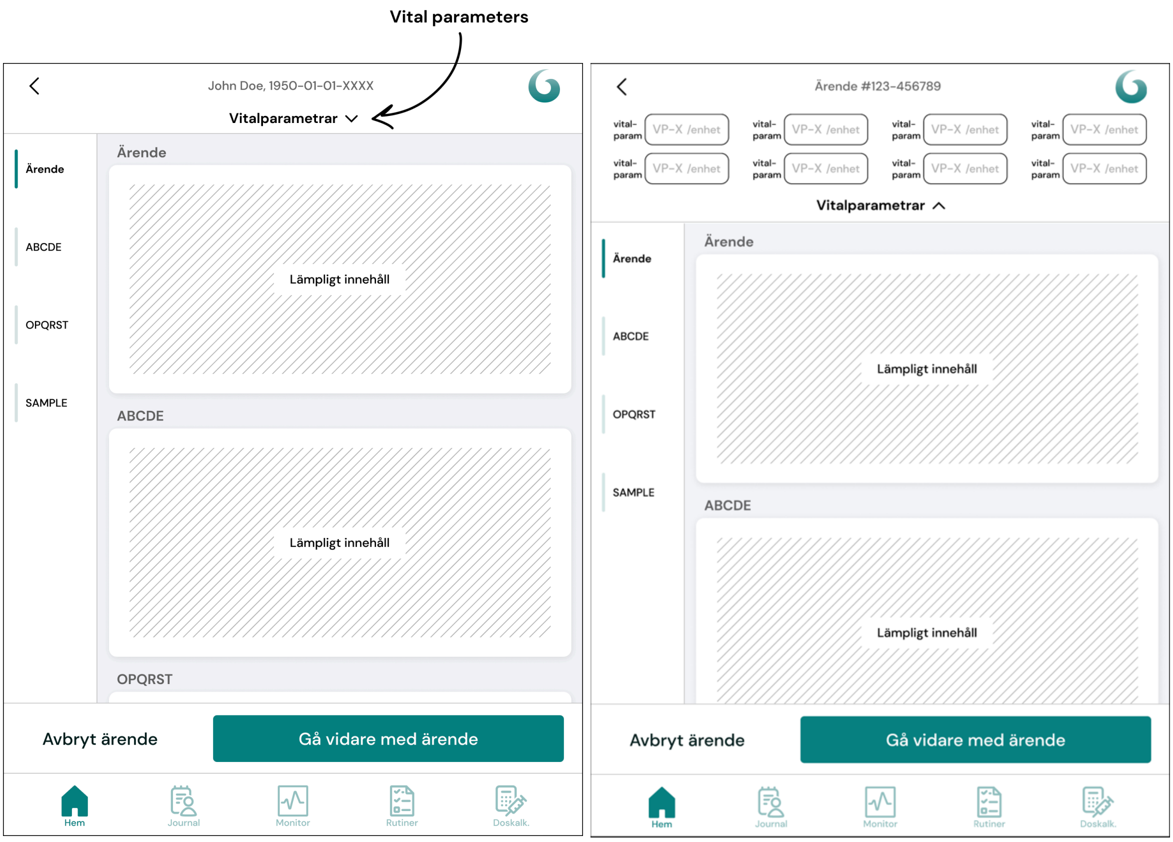


*Figure 60 New assignment screen in the **medical record and assessment platform** with 'vital parameters' collapsed and expanded respectively.*

Other elements such as the recommendation, summary and sign-off pop-up remains unchanged.

Change in workflow

As aimed for, the platform has the potential to replace some of the EMS nurses' tools and by that, changing the workflow.

Figure 61 is a visualisation that shows the workflow of an EMS nurse today in VGR, what mediating tools would be replaced by the **medical record and assessment platform** and lastly what that change would imply on the workflow.

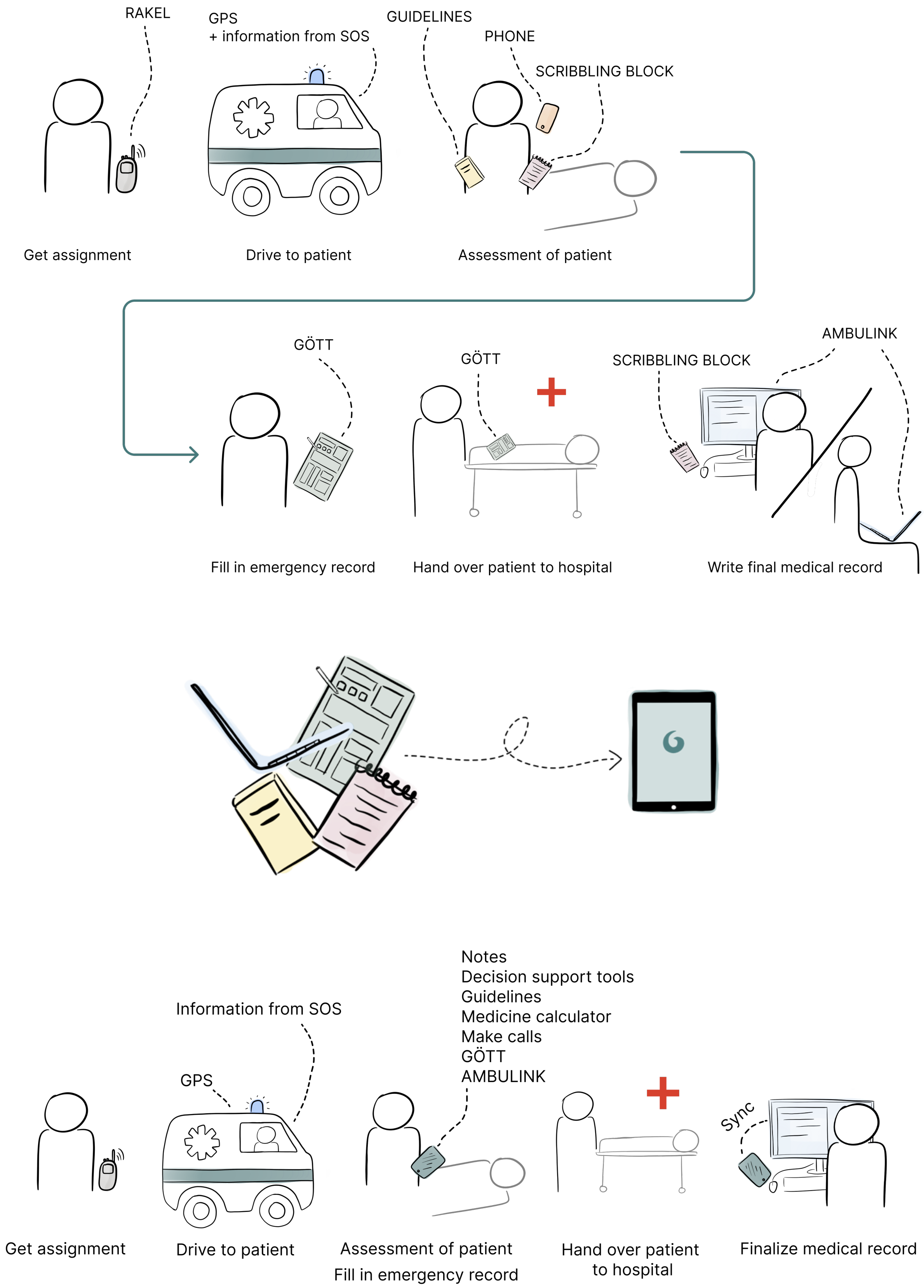


Figure 61 - Visualisation of the change in workflow of the EMS nurse with a new medical record and assessment platform

6.5. Physical features & format

The main format of **Curio** is meant to be a tablet matching an iPad mini 7.9" screen. It could preferably be replaced with an 8.3" screen, which represents a later generation of the iPad mini, but the prior one was chosen simply because that was the format this project could get hold of for testing and evaluation.

The tablet format was found to be an acceptable compromise between screen space and ease of handling. Another important aspect was the perceived professionalism of EMS nurses when using either a phone or tablet format, where nurses expressed that it felt unprofessional to deal with a phone when assessing a patient. The tablet format linked more strongly with aspects of a work tool.

However, it has its advantages to provide the **AI-learning protocol** in a mobile version as well. This would enable easier implementation during the temporary time frame in which this will be used as a standalone product before being merged into the **medical record and assessment platform**. This is because the ambulance is already equipped with a mobile phone. See both sizes in Figure 62.

Figure 62 - Size and format comparison of tablet and phone prototypes.

Both concepts have been provided with tough and durable cases to be able to withstand harsh handling and other damaging external factors.

The tablet has been equipped with a stand which was found to be a very helpful feature in setting up the work environment at a patient and leaving both hands available to dealing with the patient. Additionally, the strap can ease handling of the tablet when needed. Both features are shown in Figure 63.

Figure 63 - Stand and hand strap on the tablet prototype.

6.6. Graphic design

The general aim of the graphical style was professional, serious, toned down, effective and healthcare related yet modern.

Primary colour picked for both logo and the UI in general is inspired from the already used accent colour on EMS nurses' uniform, see Figure 64. The idea was that it would be able to make use of the already established impressions of professionalism and healthcare related to the colour and transfer those values to these products.

Figure 64 - Primary colour of ***Curio****.*

The layout and appearance are meant to be easy on the eye and are designed for long time use without requiring unnecessarily high cognitive workload.
High contrast colours have been used to a minimum while still trying to maintain clear borders and to direct focus where it is needed.

Screen space has been distributed in accordance with what more important and where the actual work is performed.

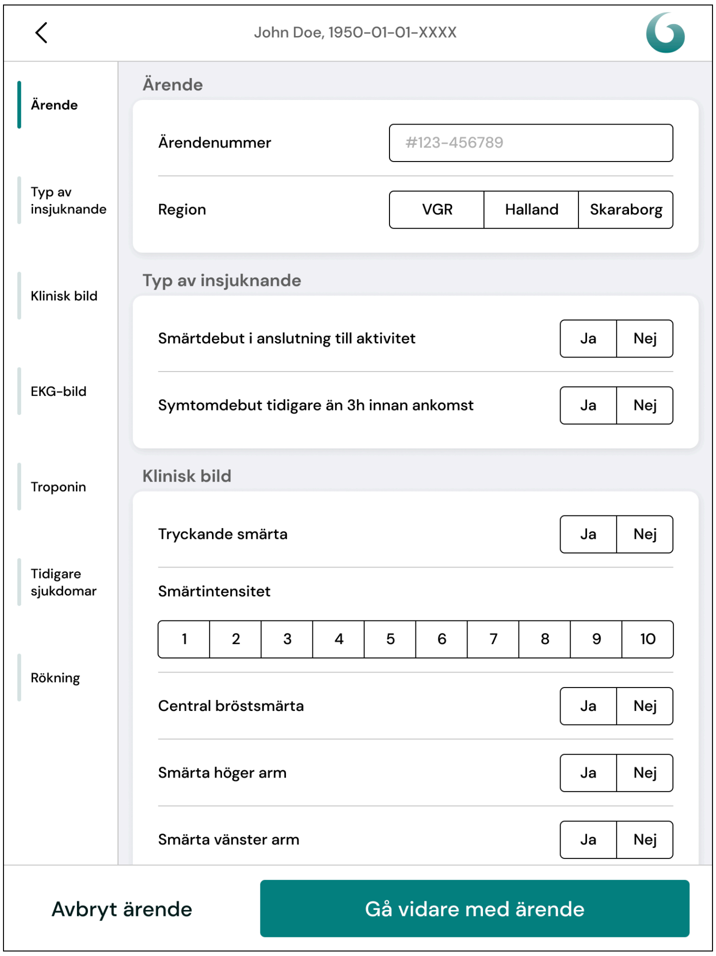


Figure 65 - Example screen showing elements of the graphical design.

7. Discussion

This chapter provides insights from the project and discuss various topics which are considered noteworthy.

7.1. Project scope

We found that the initial mission of providing a standalone UI for an AI data collection product was rather narrow and perhaps *not* too difficult to provide. It would not necessarily need to take other tools into consideration as the idea was that it would be an addon solution to the already existing situation. Thus, we decided to widen the scope and investigate how a potential digital toolbox and working platform could look like, integrating and replacing several already existing tools, as well as investigating how it seamlessly could fit into the current working situation. Within this new direction we discovered many more areas to improve than could realistically fit within the project frame.

In many ways this led to the project being more research focused than initially was thought as each new discovery uncovered leads to a few more. Which got us to investigate areas which were of large interest and of relevance to the project but perhaps not crucial to the final deliverables.

A consequence of this was that the actual development of the digital toolbox suffered in terms of how much effort could be put into it. This led to that menu options other than *home* were not given any content, which also was due to the lack of expertise in the different subjects which each menu option required. Expertise which was not given to time to retain.

7.2. Research questions & answers

RQ1: How can new technology and tools be implemented in the environment and workflow of the EMS in a successful and user-friendly way?

Through interviews and observations, we understood quite quickly the difficulty of implementing new tools into the working environment of EMS nurses. It is a complex and somewhat dysfunctional mixture of different tools which does not co-exist, but rather are very individual tools that has been added on top of each other without a holistic thinking.
In addition to this, EMS is part of a larger chain in which an assignment often starts at EMDC and ends at ED, and the tools of all parts in this chain differ and does not always cooperate optimally. Information can get lost along the way due to inadequate work tools. EMS nurses tend to get squeezed between these two departments and have inherited tools which are in some cases optimised for either of the other departments, and not for the EMS's way of working.
This type of mismatch between tools and departments is one of the key findings in this project, which in turn revealed several other potential projects for further improvement for EMS nurses.

As we came to realise that it would be difficult to implement anything to work with the existing systems, and that realistically a limit had already been reached where no more addon systems or tools should be added, what really was needed was a paradigm shift. The situation would need to be rebuilt from the ground and up. And on this subject, it came to our understanding that a larger holistic system *is* under development, but that no one really knows when or how this will come into effect, putting the whole situation in stalemate.
With this being completely out of our control, we could only try to integrate a solution as seamlessly as possible. Anything which is being added must also make sure to bring added value to the EMS nurse, rather than added workload only.
For this project for example it was easy to state that the added solutions would benefit EMS nurses in the long run, but what was equally important was how the solutions also could benefit EMS nurses *now*.
Lastly, the somewhat obvious but not always the current case, is that tools used by EMS nurses should be developed *for* EMS nurses, and not adapted more for other departments.

RQ2: How can a digital interface for an AI-learning protocol look and be well integrated in the current work situation of EMS nurses?

The AI-learning protocol will be an added standalone product without the possibility to integrate it in the current documentation process in VGR. Therefore, it was important to design a pleasant UX and make it as easy as possible to use. The mobile was identified as a tool which had become more important due to the extensive routine to call a specialist for further recommendation. This is where the **AI-learning protocol** most seamlessly could be integrated as a standalone application, a web-based application or a part of the Ambulans Sahlgrenska application. All these suggestions have been discussed with Carl Magnusson but were too early to make any decisions on.

The UI has been designed according to interaction design guidelines and adapted to the situation of the EMS nurse to create an intuitive protocol. The results from the tests and evaluation shows that it is a very appreciated UI. To take into consideration is that the result may be biased due to the small group of participants, all with a personal desire that this will become a successful project in the long run and their involvement in the project. Only real implementation of the UI will truly tell if it can live up to the expectations.

Our recommendation is that the protocol will be filled in during the patient assessment, rather than after, although it is not necessary at this point. This in order to test the workflow of the future **decision support** tool already at this stage to gain early insights.

RQ3: How should decision support be presented to be useful and trustworthy?

During interviews the subject of trustworthy technology and decision support was touched. The result from the interviews matches the literature regarding the importance of transparency. To be able to trust an AI to provide decision support it was said to require an explanation to its conclusions. What would happen if the decision support did not match the EMS nurses' own thoughts of a patient's status was interpreted as difficult to answer. The importance of acknowledging the ”clinical eye”, meaning the subjective evaluation done by the EMS nurse based on experience, has been brought up by most EMS nurses. Some argue that more automated tools will hollow the knowledge within the EMS. These two factors indicates that automated tools like a decision support may take some time to be accepted and more importantly, they needs to be introduced in a thoughtful way. To be explicit of the purpose and advantage of the decision support are identified as important aspects to communicate when implementing it.

When evaluating the decision support with EMS nurses, different opinions were given on the idea of dynamic and live updated decision support, which would give a recommendation as soon as enough data is available. On one hand, it was experienced as effective and reasonable to not fill in more information than necessary for the AI to give a prediction. On the other hand, it was argued that it could be necessary to fill in the complete protocol in order to better grasp the connections between symptoms and parameters to enlarge the own knowledge and experience of chest pain.

Another important aspect, that this project did not have time to follow up, is the phrasing of the decision support. Some things came up to discussion in terms of the designation of the given recommendation and how it would communicate if this new tool would override current guidelines. This needs to be taken in consideration and further investigation for the future.

RQ4: How can a larger digital toolbox, integrating several existing tools and utilities, look and work? And with what features?

Some of the answer lies in the findings of RQ1, in which we found that to try and implement any new system at all is not quite realistic as the current situation is far from ideal. So, a more comprehensive tool would in reality need to replace many of the major existing tools, which in turn means to change the complete infrastructure of today's systems.

With that said, the study shows a lot of potential for future improvements. One important finding is that a lot of the tools meant for the EMS nurses are not designed for them and their context. They must adapt some of their tasks, like how they receive information about a patient as well as how they transfer new information forward in the chain of health care. The double documentation is understood as the most desired part of the work to be changed and is primarily the effect of an obsolete system in VGR.

A new system must be designed in favour of the EMS nurse and simultaneously be more seamlessly integrated in the chain of prehospital healthcare. It is a challenge to find tools adapted for the changing environment and assignment of the EMS nurse. We believe that a digital system has the potential to be designed in an adaptable manner that could meet these challenges. A changing interface of a documentation function for example, as seen in the interface of a display in the car where different functions can be set to drive mode, designed to better meet the cognitive conditions. The possibilities of different methods for data input also implies adaptability to different scenarios and preferences. If more AI driven tools will be adapted and implemented, a digital system is a must to be realisable.

7.3. Process

The structure of the project, using the double diamond model worked well according to the scope of the project. Perhaps an underestimation of the time needed to carry out the widened scope have made the results somewhat inadequate. The time set for development of three different parts overrode some of the time planned for the delivery phase where the final tests and evaluation took part. This resulted in a reduced time frame to answer to any additional changes that came up during these sessions that could have made the final results somewhat better.

We do not believe the project should have been performed much differently, however, we should have been more realistic or humble from the start about how much time could be put on actual development and delivery of concepts. We had a hope of being both research heavy and still maintaining a high level of actual development for all three concepts, where we should have been more clear on that it was a research focused project with development being kept on very conceptual level.

7.4. User study

Due to the pandemic and restrictions regarding Covid-19 the user study could not be carried out as planned. The observations were intended to be one of the first activities carried out in order to early on get an own experience of what the work of an EMS nurse was like. This activity was postponed several weeks and therefore the character of it, but also the interviews had to be changed. The interviews came to be a way to grasp the work of an EMS nurse and the observation rather a way to confirm what was said in the interviews and investigated further in the topics of tools and organisation. Another change due to the restrictions was that the first session with the focus group had to be held online instead of a physical meeting. This did not enable all of the intended activities but was adapted in a way to still get out valuable input on planned areas.

The interviewees were a selection of people that was known to partners of the project and selected due to their beliefs of the willingness to be involved in the project. All interviewees are people with a positive and open mind which have had effect on the results of the study. The average age of the interviewees is also relatively young, 36,5 years and the perspective of those who are older have therefore not been investigated. It is also a skewed distribution between the genders, only one female was interviewed and therefore the perspective of women is not justly represented in the study. The implications of this are hard to say anything about but should be acknowledged.

The user study perhaps involved too few users in order to claim a reliable result. Norman (2013) claims that five people could be enough while Osvalder and Ulfvengren (2015) asks for six to eight. For the user tests, five EMS nurses was involved to different degrees, where the three participants of the focus group did the most comprehensive test and evaluation sessions. The plan was to involve four participants in the focus group, two males and two females. Unfortunately, one of the female participants could not attend any of the sessions on short notice and if that would have been known early on, perhaps another recruitment could have been made.

Despite changes outside of our control, a solid involvement of the intended user of the products have been the red thread during the whole process of the project. This has made it possible to deliver solid input from the users and therefore the aim of a user centred approach has been fulfilled.

7.5. Tests and evaluation

All the tests have been conducted in a staged environment with fictional cases due to the character of the context. It would not been ethical to carry out any tests of the AI-learning protocol in a real setting, taking time from the EMS nurses when treating real patients. This implies that the results from the tests and evaluation needs to be considered as such.

Even though the SUS is a qualified method to use with few participants according to Brooke (1986) the results are very high. This is understood to be a result of mainly two things. The first is that the SUS perhaps is too extensive when evaluating a product with few features making it difficult for the evaluator to answer some of the questions in a precise manner. The second is that the participants of the focus group are biased since they have been part of the project from the beginning. Furthermore, they are all in favour of an implementation of a decision support tool that the AI-learning protocol could evolve to which probably influences their reasoning.

The results from the statements connected to the medical record and assessment platform are also very positive indicating that the product is almost perfect. Due to the unfinished concept, it can be argued that the evaluation perhaps is done in a dream scenario where everything discussed works seamlessly. Therefore, this is a very subjective result and therefore understood as a way for the EMS nurses to say that this is a desired solution in any form.

7.6. Sustainability

The aim of the project originates from a desire to increase patient safety and resource efficiently leading to an economic sustainable healthcare. Due to the scope of the project, the actual value the resulting solutions could lead to, cannot be measured.
The aspects of social sustainability are valid both regarding patient safety due to better assessment of patients with chest pain. Furthermore, the study indicates an untenable situation in VGR regarding the EMS nurse's documentation and information system. The double documentation is both time consuming and partly not a safe handling of patient data. Changes towards a more cohesive documentation system could increase the sustainability of the working situation for EMS nurses.

No measures have been taken to evaluate the ecological sustainability but should be done before implementing new technology and electronic tools. What are the ecological costs of replacing existing, analogue tools to equip every ambulance with electronic, more resource heavy products? The life cycle of the product must be calculated and measured against the potential value of a more efficient and patient safe way of working.

7.7. Ethical aspects

To implement AI technology within healthcare is understood to be an important development towards a more patient safe, efficient and sustainable health care. On the one hand, the many advantages AI hold regarding data maintenance, sorting and analysing are proven to be greater than the human capacity could ever live up to. On the other hand, to use this technology wisely and in an ethical manner is another important aspect to take in consideration.

Questions that have been discussed throughout the project are about the possible changes of the role of the EMS nurses (and other roles within health care) if more automated decision support tools are to be implemented.

- Could it impact their knowledge, expertise and "clinical eye" if these tools come to use?
- What implications will that lead to?
- Could it jeopardise the patient safety instead of increasing it?
- What other assignments could be addressed to the EMS nurses and what other competences would they have to develop?

Regarding the involvement of users and EMS nurses, documentation has been conducted in relation to the regulations of GDPR. Questions have been optional to answer, and pictures have been taken and used with consent.

8. Conclusion & recommendations

The chapter ties the thesis together and give some final recommendations based on the insights and learnings throughout the project.

It can be concluded that the EMS in VGR is in many ways outdated and that the nurses neither have the tools nor organisation to work in their favour.
This project has merely scratched the surface of how it all connects but still came across more areas with potential for improvements than were of relevance for this project.

Our strongest recommendation is that VGR continue the investigation of the work of the EMS nurses and the chain of actors within the prehospital care. A new, digital comprehensive solution and system needs to take place before implementing new single goal-oriented tools or technology.

When it comes to the **AI-learning protocol**, we believe it will give useful information of future tools if it is used when interviewing the patient and not another protocol to fill in retrospect. Important insights from this trial period could lead to a successful implementation of the **decision support** tool. Regarding the decision support tool, a study should be done about how it will communicate both by phrasing, colouring and placement. We hope our investigations will be something to build upon.

References

Apple Developer (2022, April 15) *Entering data*.
URL: https://developer.apple.com/design/human-interface-guidelines/patterns/entering-data/

Artificial Intelligence (2022, March 23). In *Wikipedia.*
URL: https://en.wikipedia.org/wiki/Artificial_intelligence

Benyon D. (2010). *Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design.* (2nd edition). Addison Wesley.

Berlin, C., & Adams, C. (2017). *Production ergonomics: Designing work systems to support optimal human performance*. Ubiquity press.

British Design Council. (17th of May 2019). *Framework for Innovation: Design Council's evolved Double Diamond.* https://www.designcouncil.org.uk/our-work/skills-learning/tools-frameworks/framework-for-innovation-design-councils-evolved-double-diamond/

Brooke, J. (1996). SUS: a "quick and dirty' usability scale". | *Usability evaluation in industry,* (pp 189-194). CRC Press.

Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About face: The essentials of interaction design*. John Wiley & Sons, Incorporated.

Croskerry, P. (2009). A universal model of diagnostic reasoning. *Academic medicine*, *84*(8)

Danielsson, O. (2017) Smart, smartare, doktor AI. *Medicinsk Vetenskap*

Endsley, M. R. (1995). Measurement of Situation Awareness in Dynamic Systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society 37*(1), pp 65-87
DOI: 10.1518/001872095779049499

Endsley, M.R., Bolte, B. and Jones D. G. (2003) *Designing for Situation Awareness: An Approach to User-Centered Design*, Taylor & Francis.

Google Assisstant (2022, April 15) *Design guidelines*
URL: https://developers.google.com/assistant/interactivecanvas/design

Hanington, B., & Martin, B. (2012). Chapter 43 Focus group. *Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions*. Quarto Publishing Group USA.

Hanington, B., & Martin, B. (2012). Chapter 57 Observations. *Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions*. Quarto Publishing Group USA.

Harrington, H., J. (2015). Chapter 2 Affinity diagram. *Techniques and Sample Outputs that Drive Business Excellence (1st edition).* Productivity Press. https://doi.org/10.1201/b18008

Huey, B. M. and Wickens, C. D. (1993) Workload Transition: Implications for Individual and Team Performance. National Academy Press: Washington D.C.

Janhager, J. (2005). *User consideration in early stages of Product Development: Theories and methods* (Doctoral dissertation, KTH).

Kaptelinin, V., & Nardi, B. A. (2006). *Acting with technology: Activity theory and interaction design*. MIT press.

Larose, D. T. (2015). *Data mining and predictive analytics*. John Wiley & Sons.

Lim. Y. K., Stolterman, E. & Tenenberg, J. (2008). *The anatomy of prototypes. ACM Transactions on Computer-Human Interaction*, *15(2): 1-27*. 10.1145/1375761.1375762.

Magnusson, C. (2021) *Patient Assessment and Triage in Emergency Medical Services. The Swedish EMS nurse in a new role.* [Doctoral dissertation, University of Gothenburg. Sahlgrenska Academy] URL: https://gupea.ub.gu.se/handle/2077/67134

Nergårdh, A., Andersson, L., Eriksson, J., Lundberg, M., Nordström, K., & Lindevall, M. (2018). God och nära vård–En primärvårdsreform. *Stockholm, Sweden: Socialdepartementet*.

Norman, A. D. (2013). The Design of Everyday Things. New York: Basic Books.

Ohlsson, M. (2021). *Artificiell Intelligens.* In En handbok för informationsdriven vård (pp 207-230). Göteborgstryckeriet.

Osvalder, A.-L., & Ulfvengren, P. (2015). *Människa - Tekniksystem*. In M. Bohgard, S. Karlsson, E. Lovén, L. Å. Mikaelsson, L. Mårtensson, A. L. Osvalder, & P. Ulfvengren, Arbete och teknik på människans villkor (pp 353-438). Stockholm: Prevent.

Preece, J., Rogers, Y., & Sharp, H. (2016). *Interaktionsdesign : bortom människa-dator-interaktion* (Edition 1:1). Studentlitteratur.

Rosenfeld, L., Morville, P. & Arango, J. (2015). *Information Architecture for the Web and Beyond* (4th edition)*.* O'REILLY.

Salvendy, G. (Ed.). (2012). Chapter 9: Mental Workload and Situation Awareness, *Handbook of human factors and ergonomics*. John Wiley & Sons.

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-design*, *4*(1), 5-18.

Saposnik, G., Redelmeier, D., Ruff, C. C., & Tobler, P. N. (2016). Cognitive biases associated with medical decisions: a systematic review. *BMC medical informatics and decision making*, *16*(1), 1-14.

Sveriges Kommuner och Regioner. (2021). *SBAR – Kommunicera strukturerat i vården*. skr.se. URL: https://skr.se/skr/halsasjukvard/patientsakerhet/sbarstruktureradkommunikation.748.html

Ungvarsky, J. (2020). Anchoring (cognitive bias). *Salem Press Encyclopedia*.

Usability.gov (2022) *Wireframing.*
URL: https://www.usability.gov/how-to-and-tools/methods/wireframing.html

von Eschenbach, W. J. (2021). Transparency and the black box problem: Why we do not trust AI. *Philosophy & Technology*, *34*(4), 1607-1622.

Wibring, K. (2021). *Development of a Prehospital Decision Support Tool-Optimisation of the prehospital triage of patients with chest pain.* [Doctoral dissertation, University of Gothenburg. [Sahlgrenska Academy]
URL: https://gupea.ub.gu.se/handle/2077/69311?locale=en

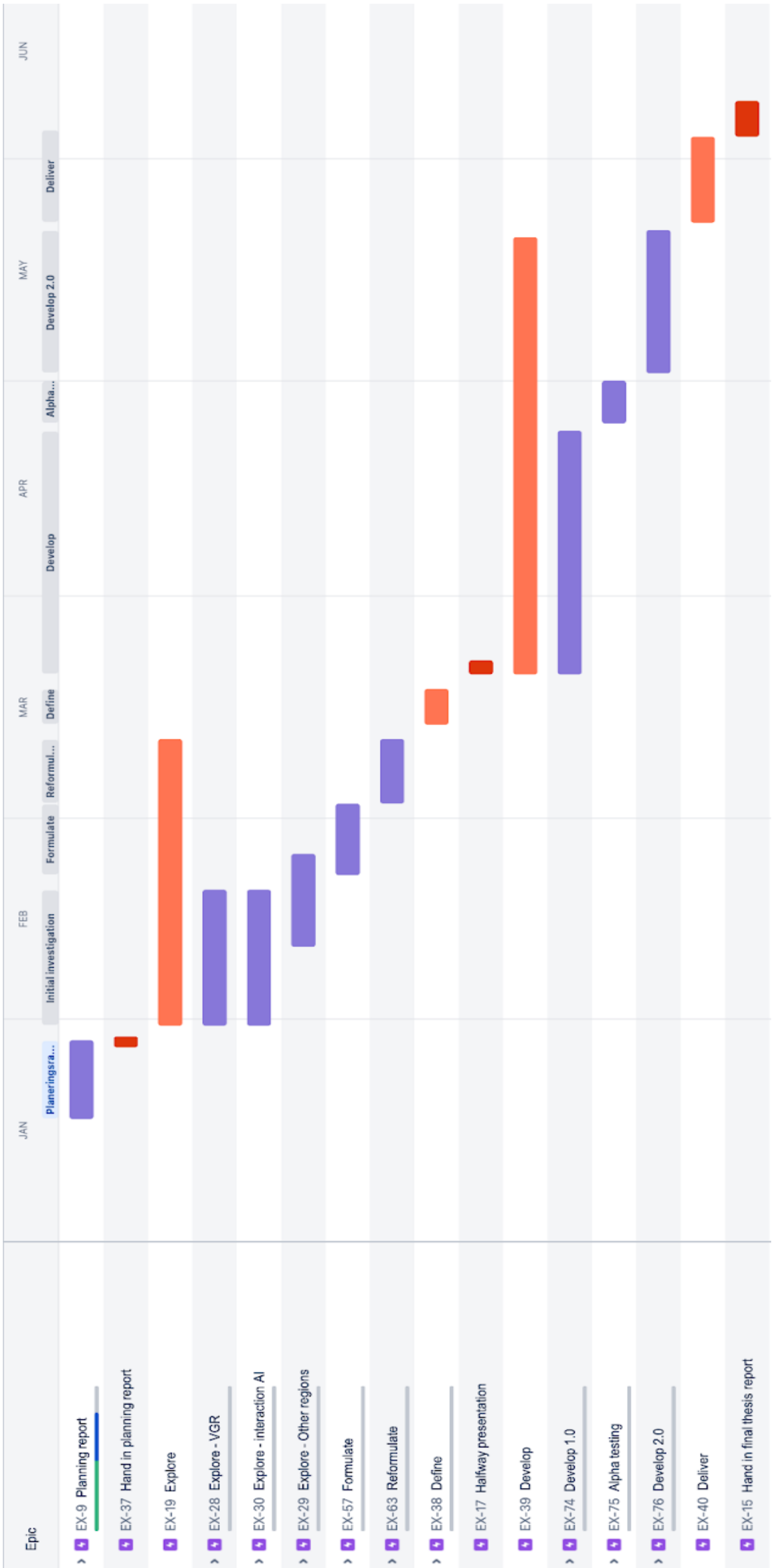
Wickens, C. D. (2008). Multiple resources and mental workload. *Human factors*, *50*(3), pp 449-455.

Zakariassen, E., Burman, R. A., & Hunskaar, S. (2010). The epidemiology of medical emergency contacts outside hospitals in Norway--a prospective population based study. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *18*, 9.
URL: https://doi.org/10.1186/1757-7241-18-9

Appendices

I. The project process as a GANT scheme
II. GÖTT, Triage system developed by Sahlgrenska University Hospital, page 1
III. Interview questions, EMS nurse
IV. System Usability Scale and results
V. Statements and answers regarding the medical record and assessment platform
VI. Semantic word scale and results

APPENDIX I


Epic
JAN
FEB
MAR
APR
MAY
JUN
Planeringsra...
Initial investigation
Formulate
Reformul...
Define
Develop
Alpha...
Develop 2.0
Deliver
EX-9 Planning report
EX-37 Hand in planning report
EX-19 Explore
EX-28 Explore - VGR
EX-30 Explore - interaction AI
EX-29 Explore - Other regions
EX-57 Formulate
EX-63 Reformulate
EX-38 Define
EX-17 Halfway presentation
EX-39 Develop
EX-74 Develop 1.0
EX-75 Alpha testing
EX-76 Develop 2.0
EX-40 Deliver
EX-15 Hand in final thesis report

APPENDIX II

VÄSTRA GÖTALANDSREGIONEN

AKUTJOURNAL SU
Version 1.5 Gäller från 2020-11-01

PATIENT-ID

Ambulansnummer	Datum	Ankomst kl.	☐ Remiss ☐ SAMSA ☐ Ambulansjournal (ej SU)
Kontaktorsak	Sekretess ☐ Nej ☐ Ja	Tolkbehov ☐ Ej aktuellt ☐ Ja, språk ______	

Aktuellt ______

☐ Tid. väs. frisk. ☐ Isch. hjärtsjd. ☐ Cerebrovask. sjd. ☐ Hypertoni ☐ Leversjd. ☐ Immunosuppr. ☐ Blödningbenäg./AK-beh. ☐ ______
☐ KOL ☐ Hjärtsvikt ☐ Annan hjärtsjd. ______ ☐ Njursjd. ☐ Malignitet ☐ OP inom 3 mån. ☐ Diabetes ☐ Ins. ☐ Tabl. ☐ ______

☐ Patient fått ID-band VGR-ID:_____ ☐ ID-band sedan tidigare ☐ ID-handling åter VGR-ID:_____ ☐ ID-handling ej uppvisat VGR-ID:_____

Ökad fallrisk ☐ ______

Överkänslighet ☐ Ingen känd ☐ Ja ______ | MRB ☐ Nej ☐ Ja ______ | Misstanke om GE ☐ Nej ☐ Ja | Blodsmitta ☐ Nej ☐ Ja ______

RÖD – Varningssymtom	ORANGE – Varningssymtom	GUL – Varningssymtom
		Process; ______

VP Prehosp Kl ______		VP Akm Kl ______	
RLS	GCS	RLS	GCS
EKG taget ☐		EKG taget ☐	
EKG Läk VGR-ID:		EKG Läk VGR-ID:	
Summa		Summa	

VP	3	2	1	0	1	2	3
AF	≤8		9–11	12–20		21–24	≥25
Saturation	≤91	92–93	94–95	≥96			
Luft eller syrgas		Syrgas		Luft			
Systoliskt BT	≤90	91–100	101–110	111–219			≥220
Puls	≤40		41–50	51–90	91–110	111–130	≥131
Medvetandegrad				GCS 15			GSC ≤14
Temp	≤35		35,1–36	36,1–38	38,1–39	≥39,1	

Prio Ambulans (RETTS) ☐ ☐ ☐ ☐ ☐

NEWS2 Prio
☐ ≥7 ☐ 5–6 ☐ isolerad 3 ☐ 0–4 ☐
VGR-ID______

Prioritering – Inkluderat klinisk bedömning
☐ ☐ ☐ ☐ ☐
VGR-ID______

KLINISK BEDÖMNING MOTIVERING
______

Hänvisning ☐ Nej ☐ Ja ☐ Egenvård ☐ Primärvård ☐ Annan Akutmottagning ☐ Annan Vårdgivare:______

Anledning och givna råd:______ VGR-ID:______

Prov	Resultat
CRP	
Hb	
P-gl	
P-gl	

Omprioritering ☐☐☐☐☐ ______ VGR-ID:______

Kapillära prover
☐ CRP______Kl.______Sign. ______ ☐ Glc 1______Kl.______Sign. ______
☐ Hb 1______Kl.______Sign. ______ ☐ Glc 2______Kl.______Sign. ______
☐ Hb 2______Kl.______Sign. ______ ☐ Glc 3______Kl.______Sign. ______

PVK______Sign.______Ut: ______
PVK______Sign.______Ut: ______
PVK______Sign.______Ut: ______

Venös provtagning – signera när prov är taget! Övriga
☐ Arteriell Blodgas______ ☐ Hb,LPK,TPK ______ ☐ Na,K,Krea______ ☐ TNT 1 ______ ☐ DVT-prover______ ☐ ______
☐ Venös blodgas______ ☐ Venöst CRP ______ ☐ Krea______ ☐ TNT 2 ______ ☐ Pre op.prover ______ ______
☐ Akutprover______ ☐ Venöst Hb ______ ☐ Leverstatus ______ ☐ Blododling 1 ______ ☐ D-dimer______ ______
☐ ______ ☐ LPK,Neutrofila ______ ☐ PK, APTT ______ ☐ Blododling 2 ______ ______
☐ Blodgrupp sign______ ☐ Skickad sign.______ ☐ Bastest______Sign.______ ☐ Skickad sign. ______

Urinprotagning
☐ Urinsticka______ ☐ Grav test______ ☐ Urin sparad ☐ Urinodling skickad ☐ Makroskopisk hematuri

APPENDIX III

Profil
Ålder, kön
Utbildning
Erfarenhet, antal år, arbetsuppgifter

Hur ser en vanlig arbetsdag ut för dig?
Hur skulle du beskriva din roll som ambulanssjuksköterska i "vårdsystemet"?

Bedömning
Case; en patient som inte är uppenbart skadad eller sjuk. Prio 2-3.

Hur går det till att göra en bedömning av en patient? Vilka produkter/verktyg använder du för att göra bedömningen?

- I vilken ordning görs vad?
- Vad är lätt / svårt?

Hur ofta fullföljer du en hel triagebedömning? Varför? (vad blir ofta uteslutet och varför?)

Hur upplever du att ert nuvarande bedömningsstöd funkar?

- Både sett till GÖTT/RETTS och övriga hjälpmedel för att bedöma.

Ifall du behöver mer information eller stöd till ett beslut, upplever du att detta finns att tillgå? (från handbok, databas, kollega osv).

- Hur är det att ta till sig den informationen? På vilket sätt funkar det bra eller dåligt?

Märker du att ditt sätt att jobba varierar sig över en dag/natt beroende på hur trött du är eller på typ av patient?

Beslut
Hur känner du kring att fatta rätt beslut? Vilka faktorer gör att du känner dig trygg i dina beslut?

I de gränsfall där det är svårt att avgöra ifall personen behöver sjukhusvård eller ej,

- Vilken information/parametrar saknas?
- Hur brukar du gå tillväga i dessa fall?

Hur medveten är du om aktuella resurs-tillgängligheten på sjukhus när du tar beslut? Antal inlagda osv.

Upplever du att beslutet kan påverkas beroende på hur långt ifrån ett sjukhus du befinner dig?

Notering på plats
Hur fungerar det att ta noteringar idag? Vad är bra/dåligt med det?

Vad är det oftast som noteras som inte ryms in i akutjournalen? Finns det något den inte täcker upp för?

Finns det fler journalsystem än akutjournalen och Ambulink?

Journalföring

Hur upplever du att det är att fylla i journalen i Ambulink?

När fyller du oftast i den?

Uppföljning

Hur fungerar uppföljning av patienter?
Är det något du ofta gör? Känns det som en viktig del i ditt jobb?

Är det smidigt eller krångligt? Varför?

Om du fick välja fritt hur du skulle kunna få feedback och uppföljning, hur hade du önskat att det gick till då?

Generellt

Om du fick fria händer att ändra något i hur bedömning och beslut går till, vad?

Om metoderna / verktygen skulle ändras, är det något som du verkligen skulle vilja behålla? (system /arbetssätt som funkar bra osv)

Spridning i format; pappersark, smartphone, färddator, handhållen rakel-apparat, CORPULS3. Vilka tycker du funkar smidigt?

Vilka hade du önskat var ihopsatta?

AI drivet beslutsstöd

AI; Att mha algoritmer som väger in VS, symptom, historik, genetik osv försöka räkna ut vad utfallet och lämplig vårdnivå för behandling är.

Vad är din syn på ifall AI skulle användas i vården för att assistera i beslutsfattning rörande patienter?

Vilka fördelar/nackdelar tror du finns?

Förändras din roll om du har den typen av "hjälpmedel"?

Vad skulle krävas för att du skulle våga lita på ett nytt system som ger rekommendationer?

APPENDIX IV

SUS questions	Participant 1	Participant 2	Participant 3
I think that I would like to use this system frequently.	5	4	5
I found the system unnecessarily complex.	1	1	1
I thought the system was easy to use.	5	4	5
I think that I would need the support of a technical person to be able to use this system.	1	1	1
I found the various functions in this system were well integrated.	5	3	5
I thought there was too much inconsistency in this system.	1	1	1
I would imagine that most people would learn to use this system very quickly.	5	4	5
I found the system very cumbersome to use.	1	2	1
I felt very confident using the system.	5	4	5
I needed to learn a lot of things before I could get going with this system.	1	1	1

Calcuation

Question 1, 3, 5, 7, 9 = (X-1) = new number
Question 2, 4, 6, 8 = (4-X) = new number
Sum of new numbers x 2.5 = SUS score (0-100)

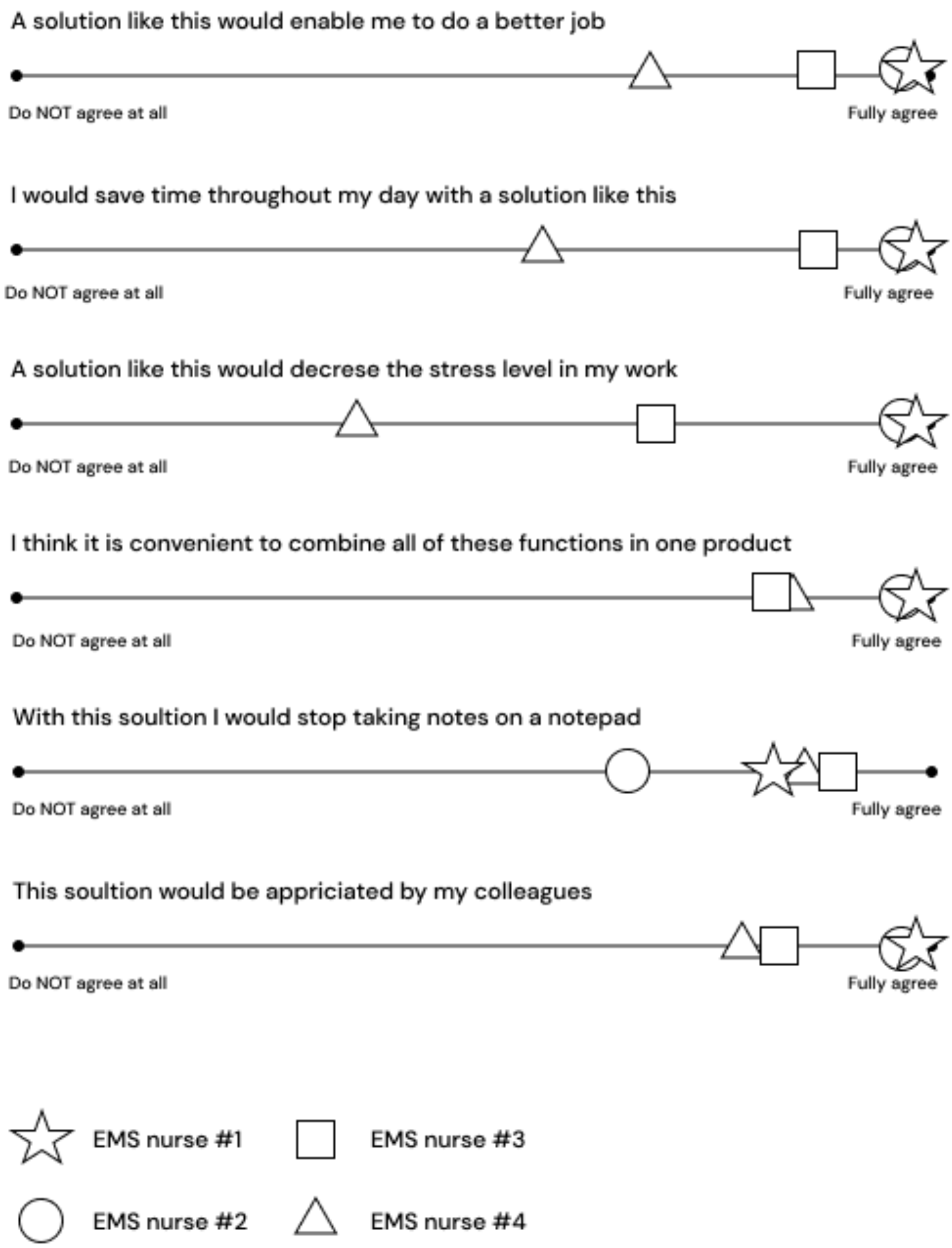
SUS score, Participant 1 = 100
SUS score, Participant 2 = 82.5
SUS score, Participant 3 = 100

Total SUS score = 94.2

APPENDIX V

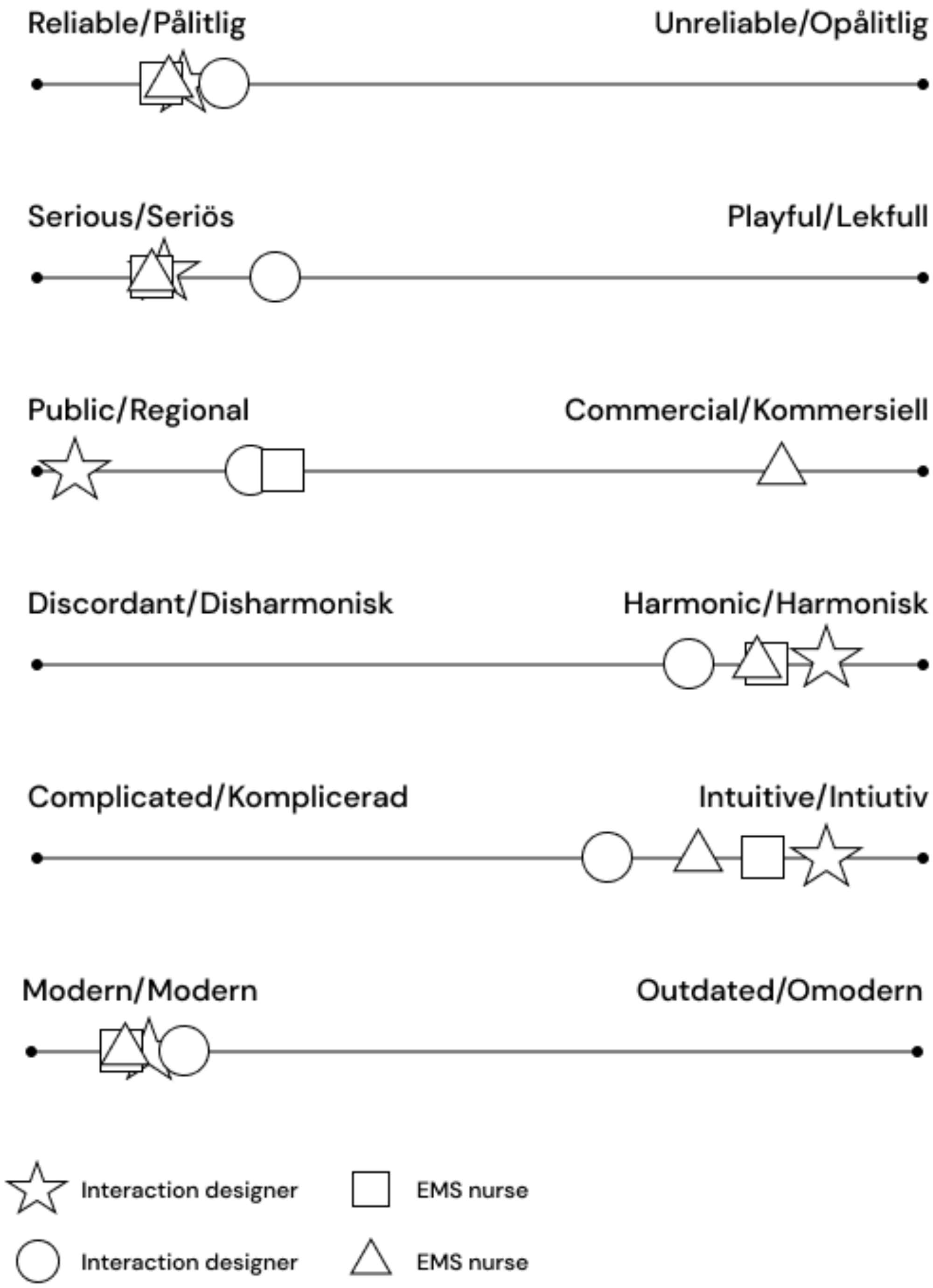
Statements

Medical record and assessment platform



APPENDIX VI

Semantic wordscale/Semantisk ordskala



DEPARTMENT OF INDUSTRIAL AND
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