ENWOUND

Empower the **n**urse when doing **wound** care in private homes

Product report
Industrial Design / MSc04 ID10
Aalborg University / June 2023

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Title page

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Technical supervisor: Mikael Larsen
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Abstract

This report presents the product ENWOUND, which is an integrated design proposal designed by two industrial design students from Aalborg University. The goal of the project has been to develop a new professional solution for home health care nurses when they have to perform wound care in private homes. Current solutions are investigated and deemed inadequate due to limitations in organizing. This project has resulted in ENWOUND, a wound care storage solution that creates a systematic overview of equipment and tools for wound care. ENWOUND divides the nurses equipment into two drawers, and the tools by dirty and clean. All this helps ensure an efficient workflow along with improved safety for the patient. Furthermore, the aim of the solution is to minimize the preparation time for treatment. This helps ensure an increased focus on the treatment and the patient. Due to bacterias and risk of infections, ENWOUND must be placed permanently in the home of the patients during the treatment course.

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”**E**mpower the **n**urse when doing **wound** care in private homes“

ENWOUND

ENWOUND is designed for wound care treatment in private homes, where it improves the workflow for the home health care nurse. Unlike the plastic box currently used, ENWOUND offers a systematic storage system for all the necessary equipment. By placing ENWOUND within arm's reach of the nurse, healthcare professionals can easily access the required tools and equipment, enabling them to focus more effectively on the treatment process. This provides the home health care nurse with more time for the patient, ensuring a higher quality of treatment.

Systematic overview

ENWOUND is designed to create an overview of the equipment for wound care treatment, where it offers flexibility to divide the equipment as preferred by different nursing departments. The numbers of the drawers indicate the order for using the equipment. The spacious drawers make it possible to store various equipment such as bandages, gauze, large band-aids, and more. The transparency of the drawers provides clear visibility, allowing users to quickly locate specific equipment. Additionally, tools such as scissors, tweezers, and curettes are separated, ensuring easy accessibility. This means that ENWOUND will be able to ease up the workflow for the nurse.

Preparation

By having all the equipment in one product together with a holder for a garbage bag, storage surface, and access to gloves, results in a more efficient workflow. It reduces both preparation time and the going back and forth between the equipment and the patient.

Preparing the treatment is a streamlined process that requires only a few simple interactions. Just place ENWOUND near the patient, open the lid and place the garbage bag on the side. With these simple steps, the treatment is already ready to start.

Treatment

ENWOUND collects all the equipment and tools in one product and has its own storage surface for placing equipment during the treatment. The drawers have large grips that make it easy to pull them out, even when wearing medical gloves. During the treatment, the tools are safely secured on the top of the ENWOUND thanks to the elevation of the edge. The small and compact size of ENWOUND makes it possible to place it on the dining chair, and in the bed, even in a single bed, depending on where the treatment is going to happen.

Efficient workflow

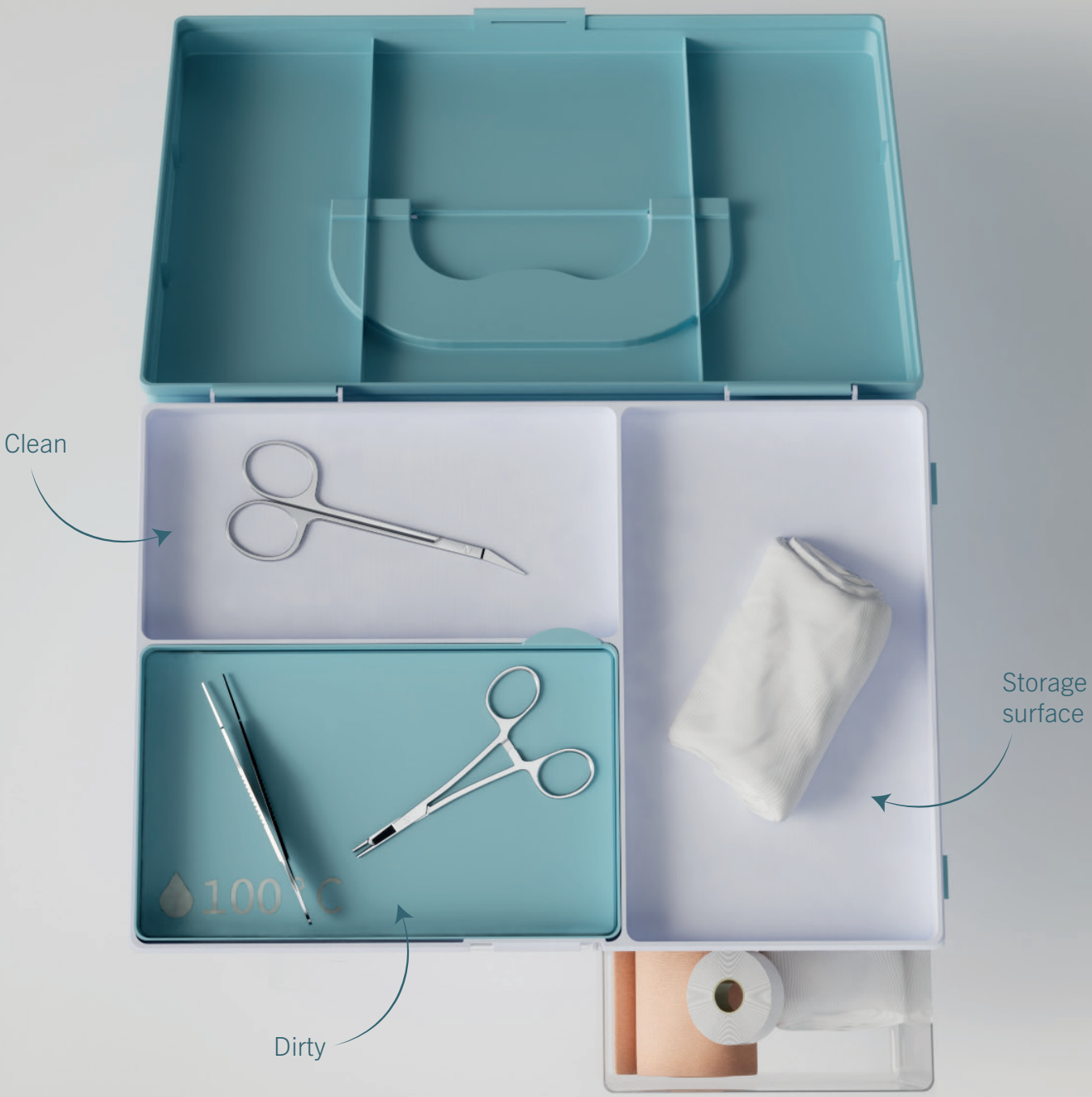
Overview of the equipment

Professional treatment


Handy

Hygiene

Enwound is developed with a focus on improving hygiene to create a professional treatment and prevent infection of wounds. The equipment is placed in closed drawers to keep it secure from bacteria and dust. The tools are separated into two sections, one for clean and one for dirty tools. The section for dirty tools is placed in the front, to avoid infecting the clean tools. Furthermore, the easy access to medical gloves makes it possible to secure clean procedures.

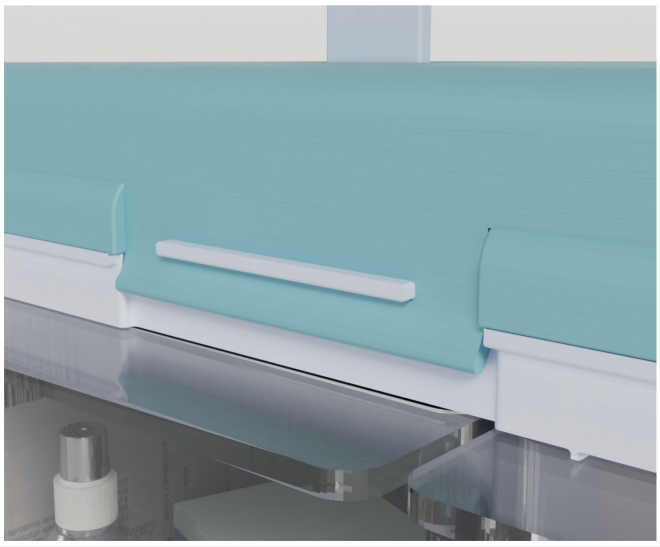


Cleaning

After the treatment is finished the clean up can begin. The small tray with the dirty tools can easily be taken out by using the small grip. The tray indicates it can be cleaned with 100 degrees hot water to kill all bacterias. Therefore the tools and the tray are cleaned with either alcohol wipes or hot water. After the cleaning the tools are placed in the section for clean tools, and the tray is placed in the section.

Lock & lid

The lid is opened like a toolbox which creates a professional look and feel. The lock helps secure the lid when on the go.



Gloves

ENWOUND includes a dedicated space for gloves, with easy access from the side.

Handle

The handle on top of ENWOUND makes it mobile and easy to transport.

Garbage bag

The clips on the side allow for attachment of a garbage bag.

Grip

The drawers in ENWOUND are designed with a large grip, to allow for easy interaction.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Handy

Storage

When ENWOUND is not in use, it can be placed on a table in the scullery or stored in a cabinet. Depending on the patient's preferences, ENWOUND offers the flexibility to be turned around, to hide the equipment inside its drawers. This feature allows ENWOUND to maintain a neutral appearance. By offering a simple design, ENWOUND can go unnoticed when not in use.

Specifications

Weight without equipment and tools: 12 kg.

Dimensions (closed): 177 x 369 x 274 mm

Medical equipment

Provides an overview of the equipment

Separation of clean and dirty tools

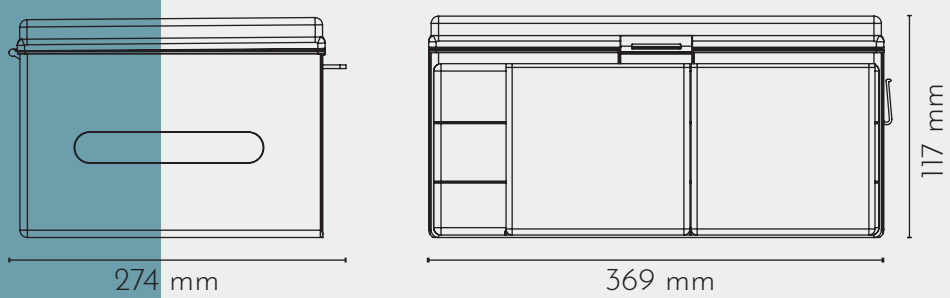
Easy cleaning

Resistant to hot water and alcohol

Easy access to gloves

Closed and secure storage of equipment

Storage surface for equipment



Reusable

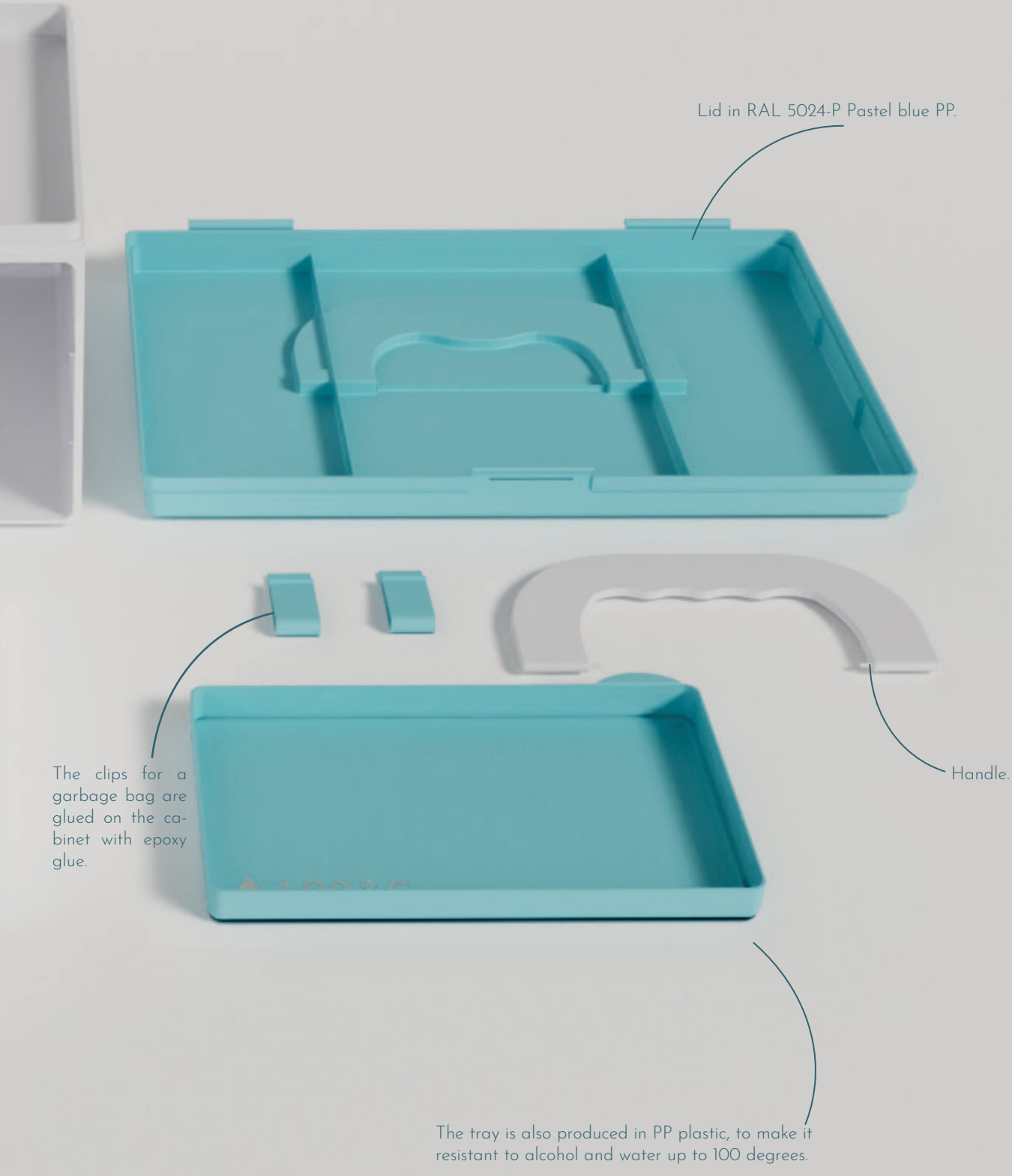
Once the patient's treatment course is completed, ENWOUND can be transported back to the nursing depot for cleaning. At the depot, ENWOUND can be cleaned using an industrial dishwasher, ensuring thorough sanitization. After cleaning, ENWOUND is stored within the depot. Its design features a flat lid that allows for easy stacking and reducing storage space.

Exploded view & materials

ENWOUND is produced in polypropylene (PP) due to its durability and possibility of long-term use. This makes ENWOUND lightweight to transport, even with equipment in it.

Cabinet in RAL 9003-P Signal white PP.

Drawers in transparent PP plastic, with numbers molded in it, which makes it durable when using it..


Lid in RAL 5024-P Pastel blue PP.
The clips for a garbage bag are glued on the cabinet with epoxy glue.
Handle.
The tray is also produced in PP plastic, to make it resistant to alcohol and water up to 100 degrees.

Production cost:
100 DKK

ENWOUND provides:

- Efficient work flow, where the nurses only need to use a limited time for preparation
- Overview of the equipment, so it is easy to find and locate what is missing
- Professional treatment
- Hygienic by separating dirty and clean tools, which gives better safety for the patient

Investment:
1,100,000 DKK

Sales required:
10,000 pcs.

Cost & investment:
As a start-up, the most cost effective way to get started is outsourcing the production. This is beneficial, since the upfront investment will be lower. It is estimated that outsourcing the production would require an upfront investment in molds for 1,000,000 DKK and after that it would cost 100 DKK per unit produced.

Break-even:
2.5 years

Implementation plan

Four highlighted points of the implementation plan can be explored below.

Financing

It is important to get the financing of the project under control from the start. Grants must therefore be applied for and an own investment must be made in the project.

It is estimated that approximately 1,1 million will be needed to start the project, where 1 million is for molds.

Partnership

A business partner who has know-how about the market and the customer segment within the medical industry is wanted to incorporate into the implementation plan. There are three Danish companies; MediQ, OneMed, andAbena, which respectively sell and produce plastic boxes for medicine or wound care, and one of these companies could be a potential partner.

Production Outsourcing

After more development of the product and an established partnership, the production of ENWOUND can be started. This is, as a start, most advantageous to outsource.

Production In-house

After being established and having a healthy business up and running, it might make sense to reinvest some of the profit in in-housing the production. It is estimated that this can happen around year 4, where a total of 20,500 boxes is expected to have been sold.

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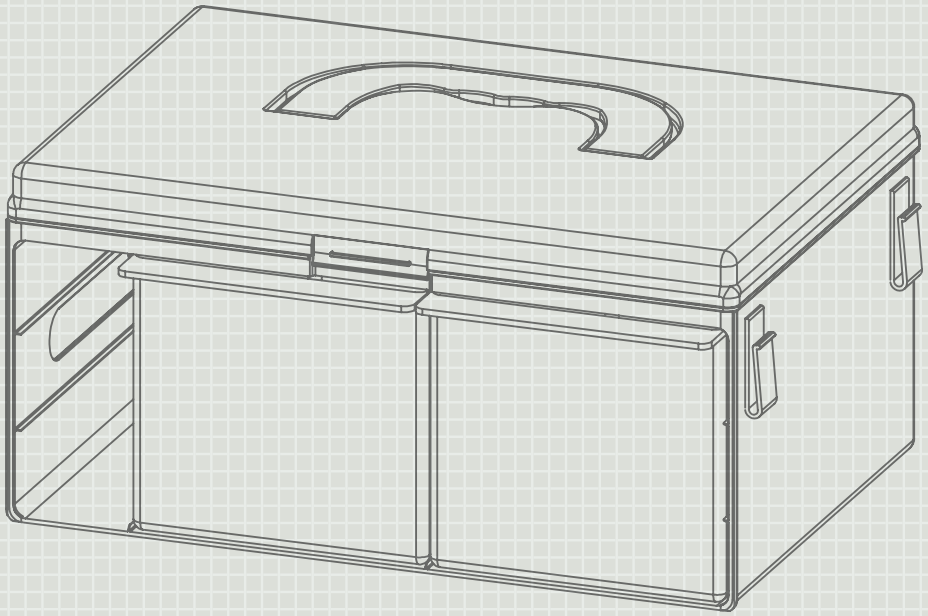
ENWOUND



TYPE

Technical drawings

GROUP

MSc04 - ID10

DATE

June 2023

STUDY

Industrial Design Engineering

UNIVERSITY

Aalborg University

NAMES

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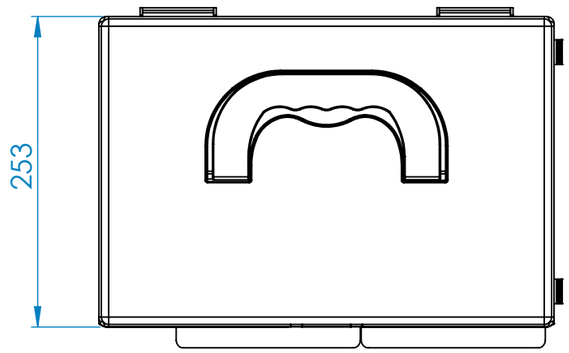
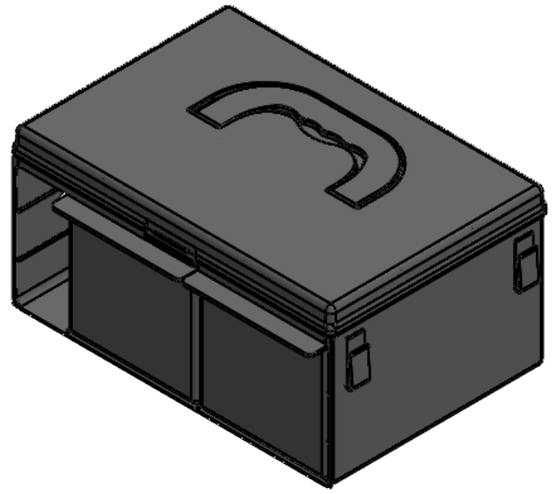
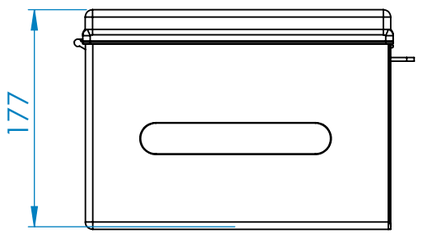
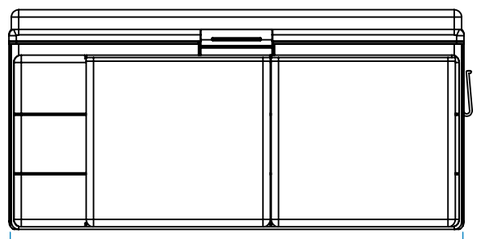
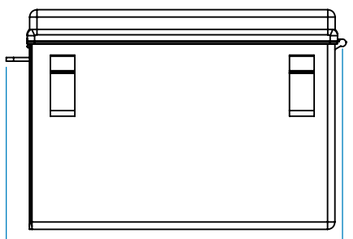


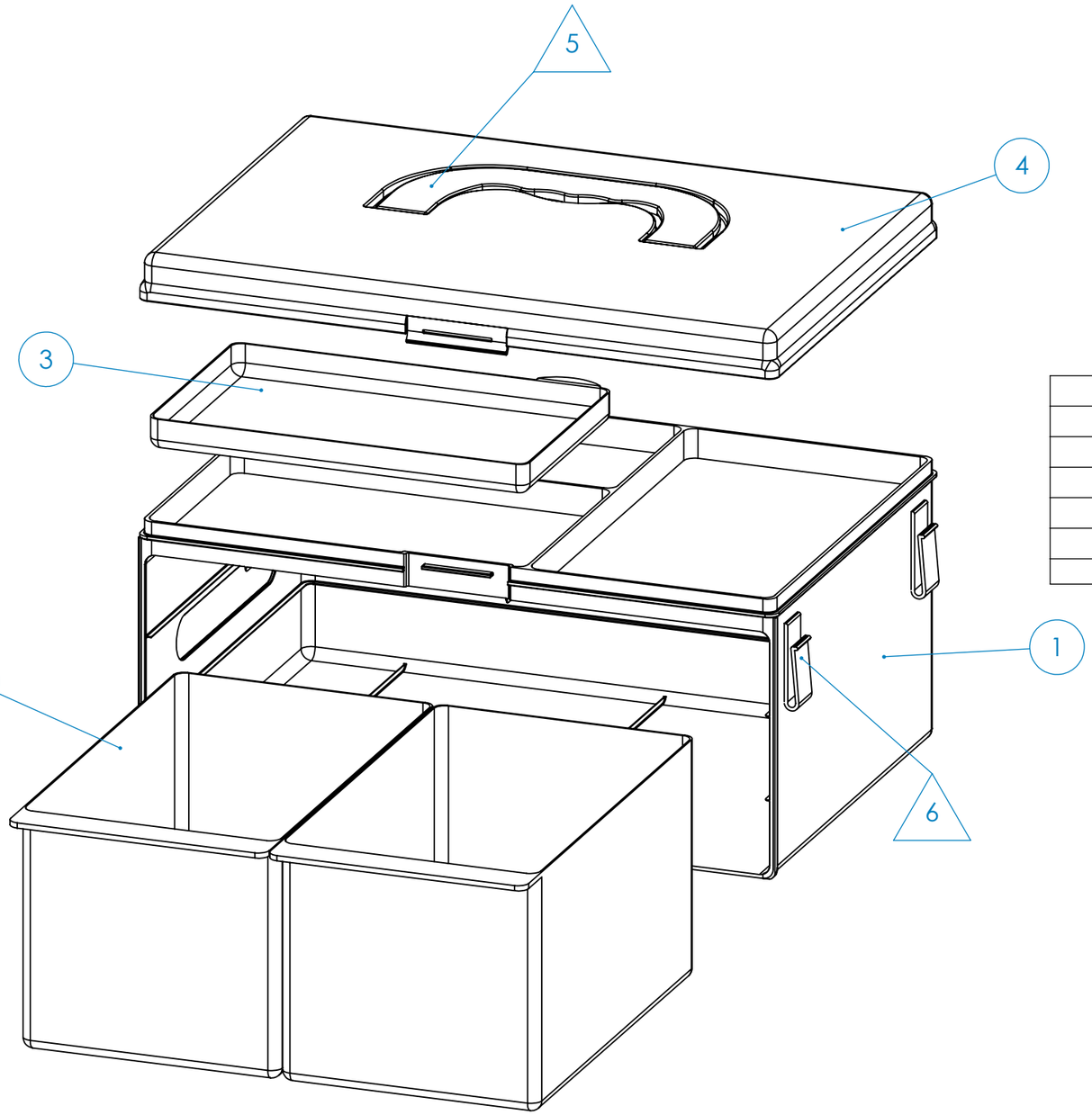








DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: ENWOUND
MATERIALS: Polypropylene (PP)		PART NO. A3
TOLERANCES: DS/ISO 2768-1-m		SCALE: 1:5 — SHEET 1 OF 8



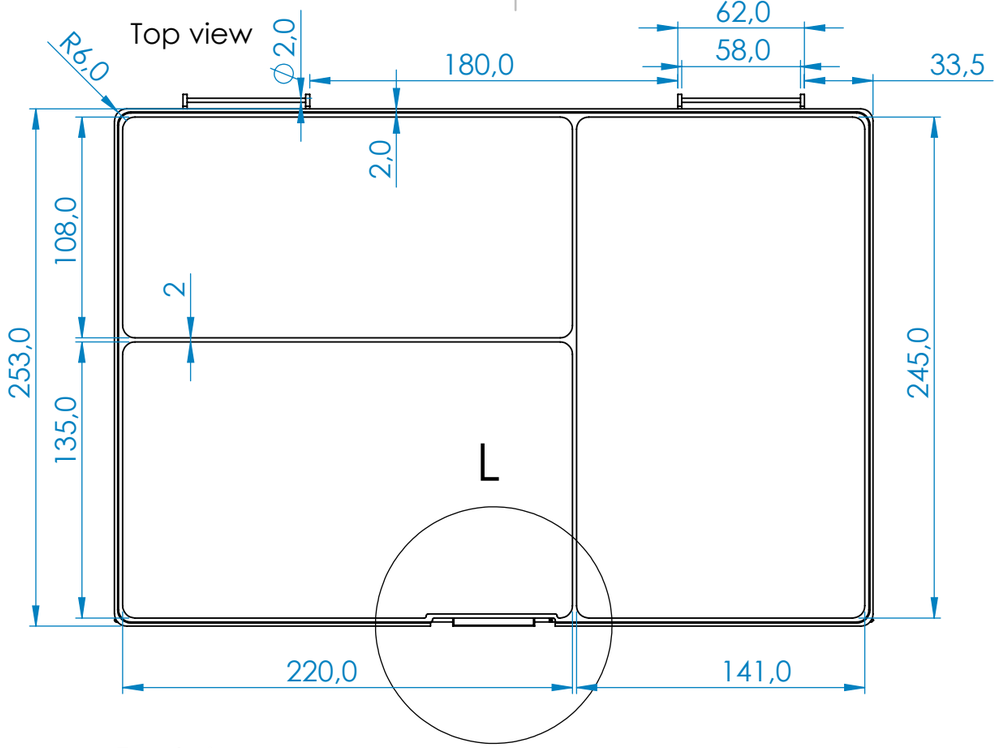
Custom component

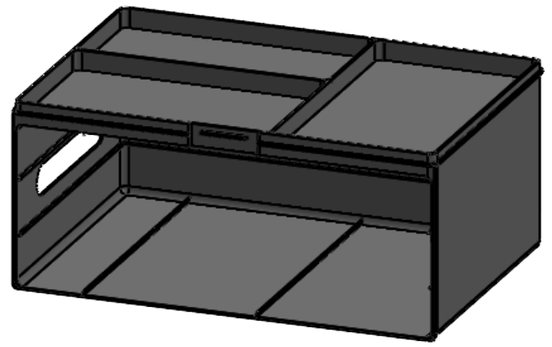
Standard component

PART NO.	PART NAME	DIMENSION	QTY.
1	Cabinet		1
2	Drawer		2
3	Tray		1
4	Lid		1
5	Handel	L:184, H:5, W:27	1
6	Clips	L:47, H:6, W:20	2

DRAWN BY	DATE	PROJECT
MSc04, group 10	8/6-23	ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Exploded view + BOM
MATERIALS: Polypropylene (PP)		PART NO. A3
TOLERANCES: DS/ISO 2768-1-m		SCALE: 1:3 SHEET 2 OF 8

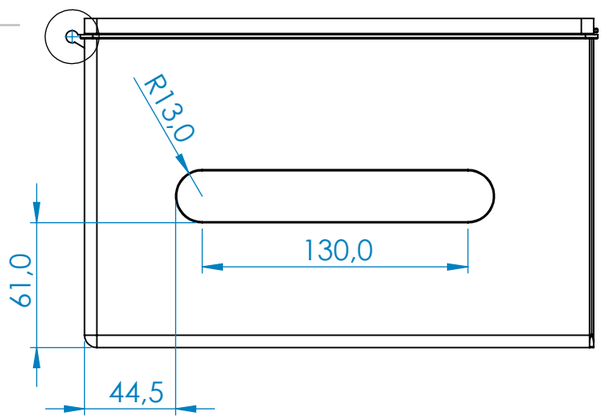
Top view



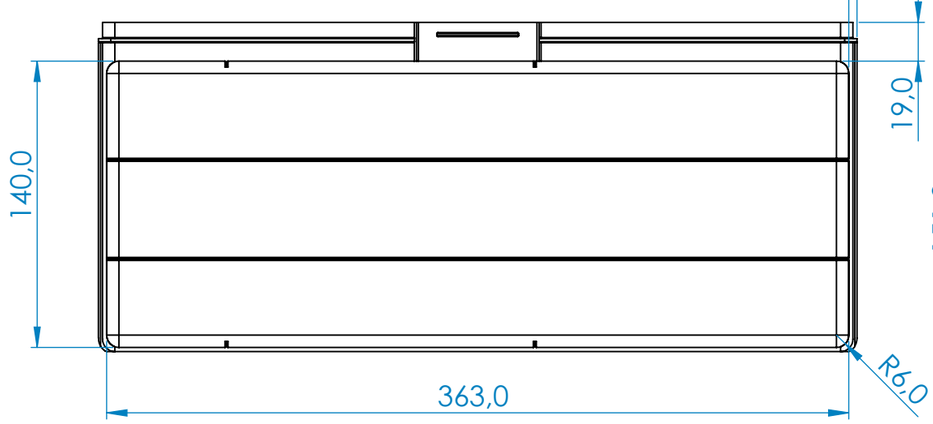


K

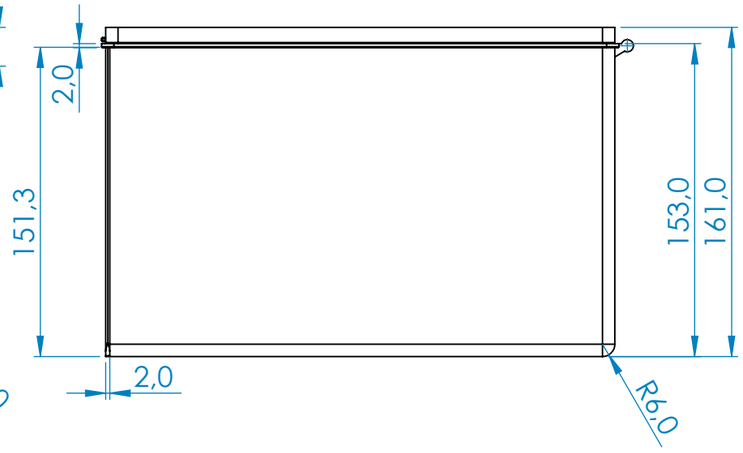
Side view

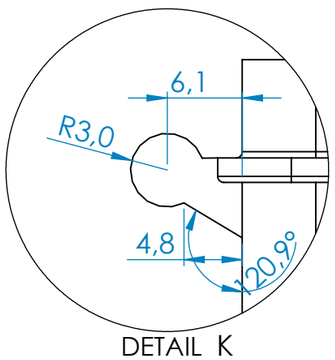


Front view



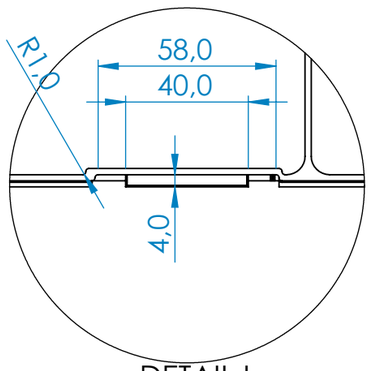
Side view





DETAIL K

SCALE 2 : 1

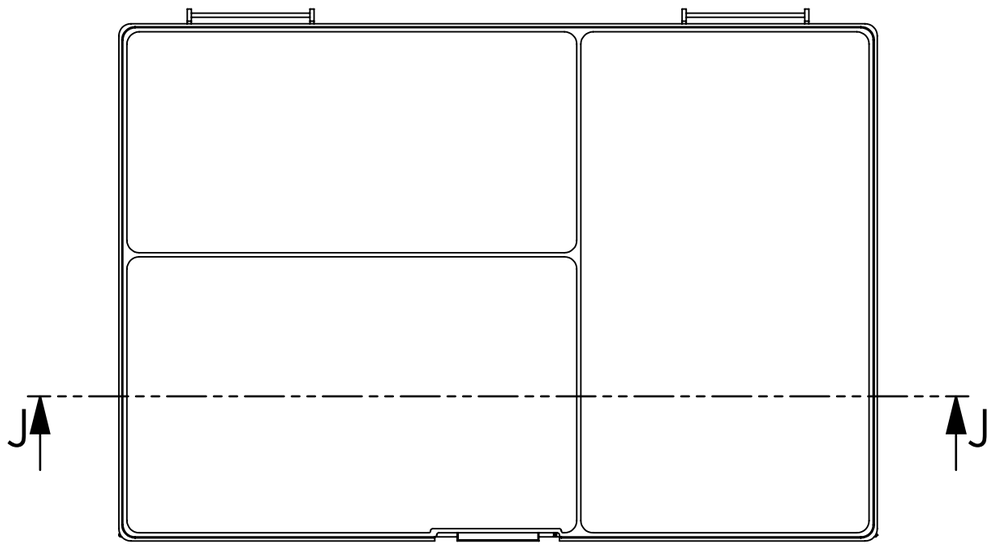


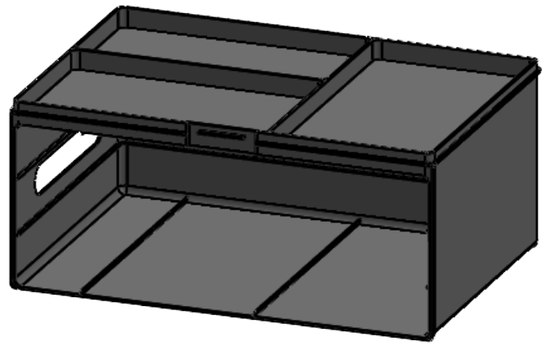
DETAIL L

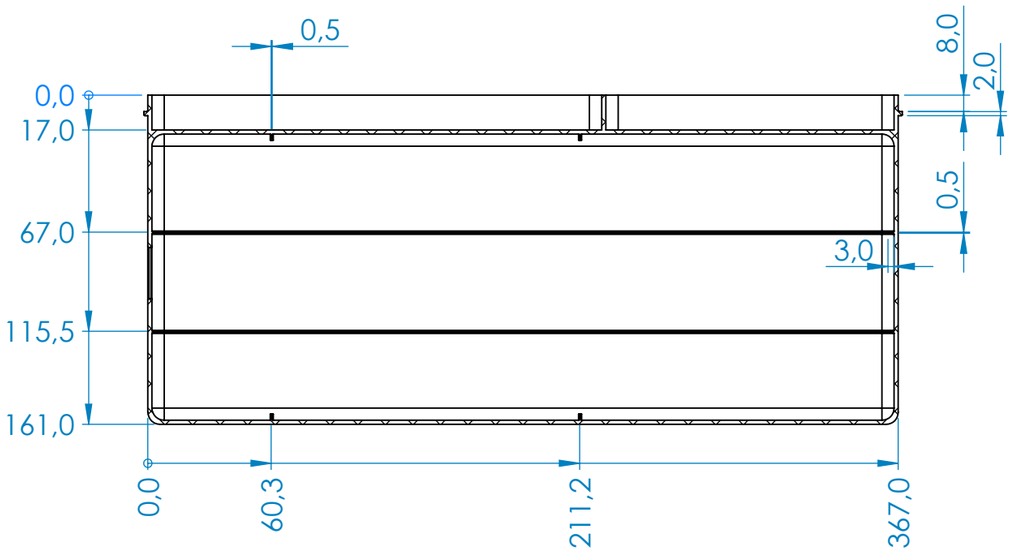
SCALE 1 : 2

DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Cabinet
MATERIALS: Polypropylene (PP)		PART NO.: 1 — A3
TOLERANCES: DS/ISO 2768-1-m	SCALE: 1:5	SHEET 3 OF 8

Top view





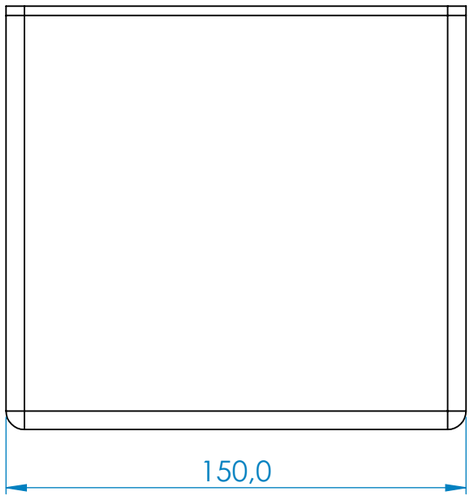


SECTION J-J

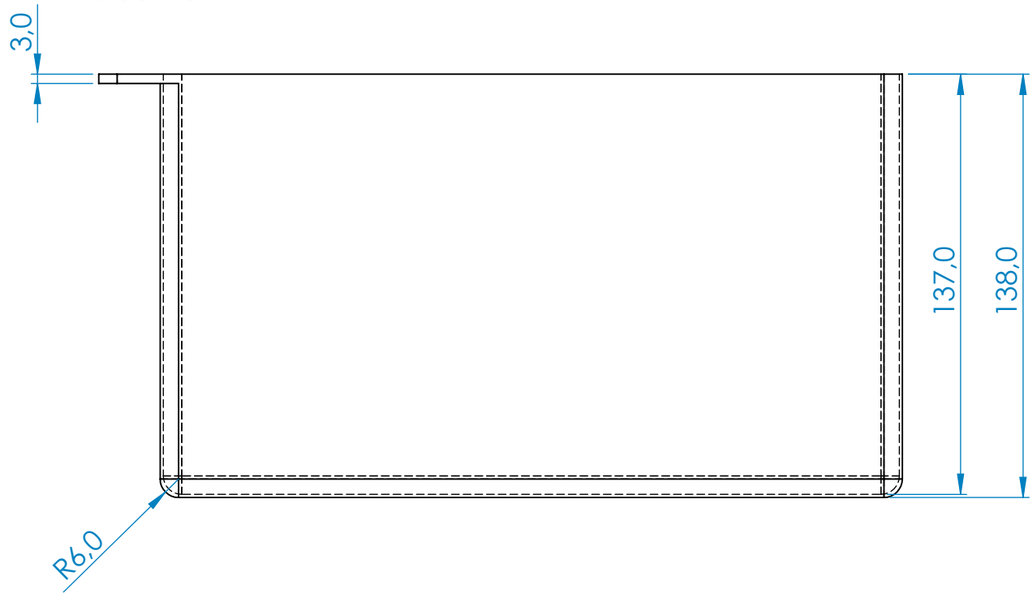
SCALE 1 : 3

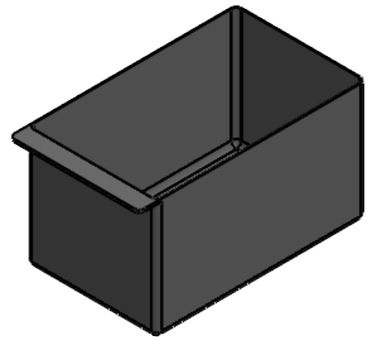
DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Cabinet
MATERIALS: Polypropylene (PP)		PART NO.: 1 — A3
TOLERANCES: DS/ISO 2768-1-m	SCALE: 1:3	SHEET 4 OF 8

Front view

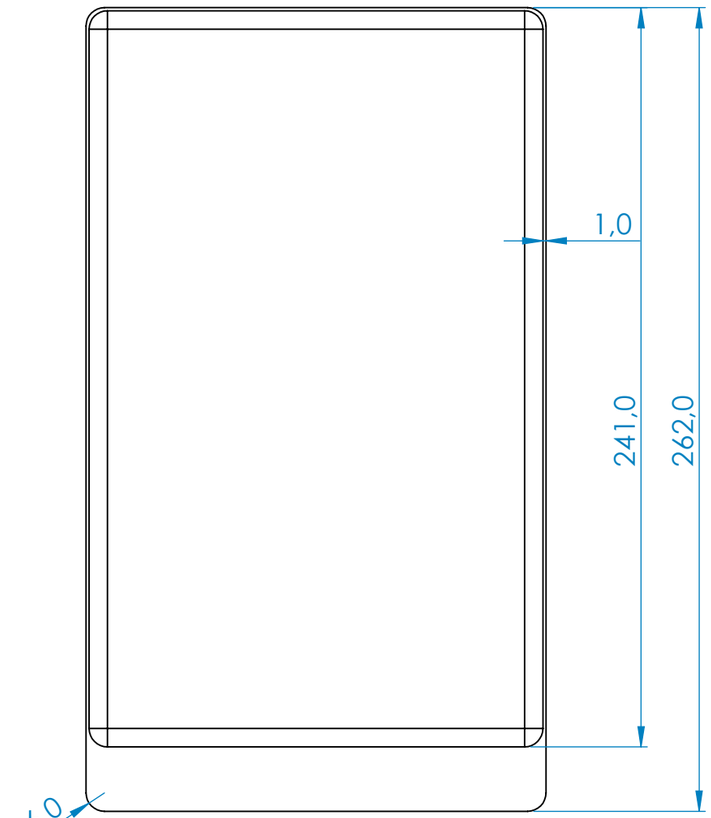


Side view





Top view



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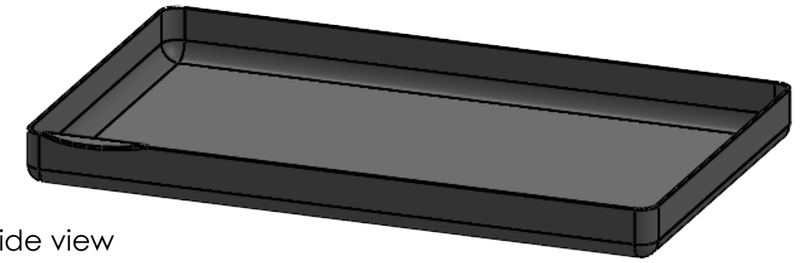
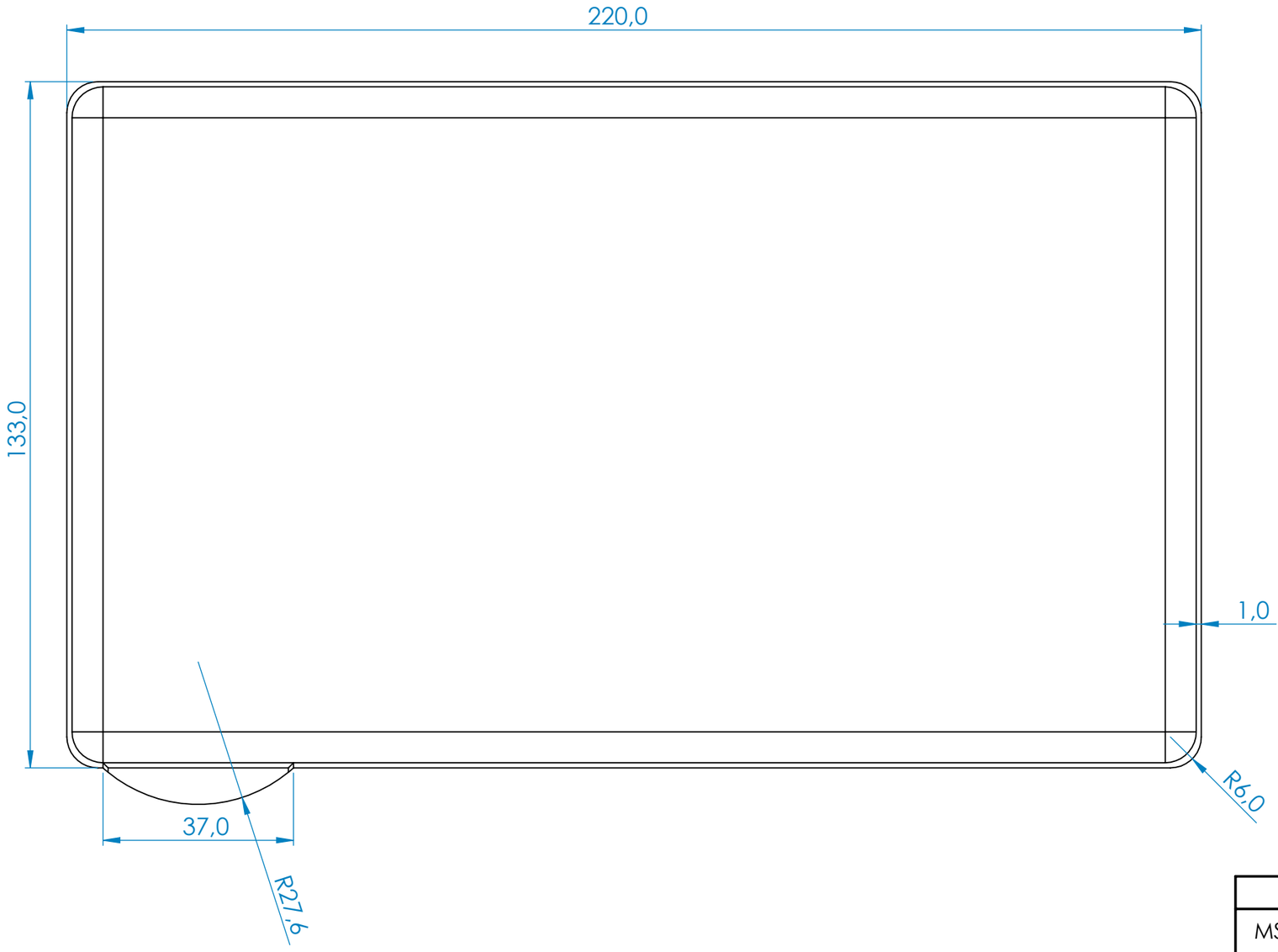
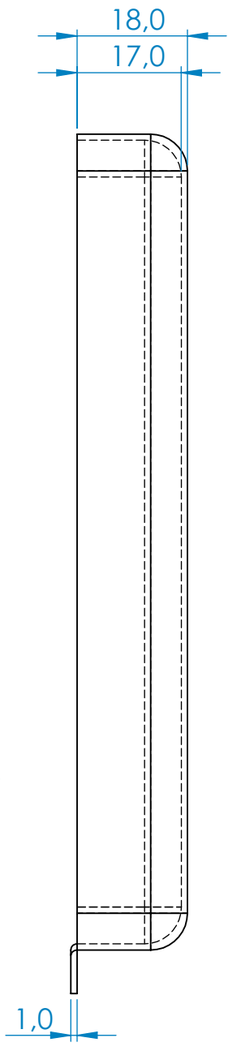
PRODUCTION: Injection moulding		PART NAME: Drawer
MATERIALS: Polypropylene (PP)		PART NO.: 2 — A3
TOLERANCES: DS/ISO 2768-1-m		SCALE: 1:2 — SHEET 5 OF 8



Top view

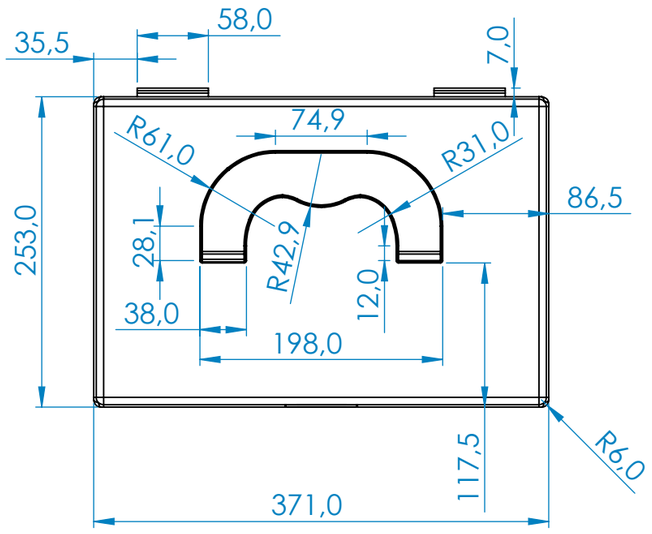


Side view

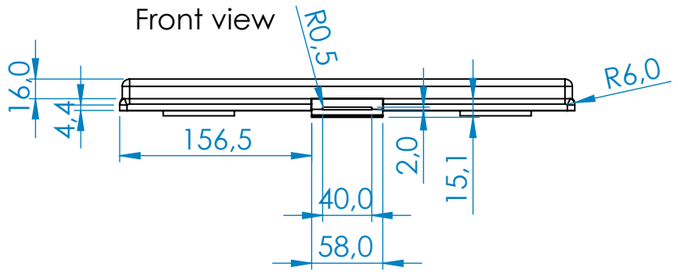


DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Tray
MATERIALS: Polypropylene (PP)		PART NO.: 3 — A3
TOLERANCES: DS/ISO 2768-1-m	SCALE: 1:1	SHEET 6 OF 8

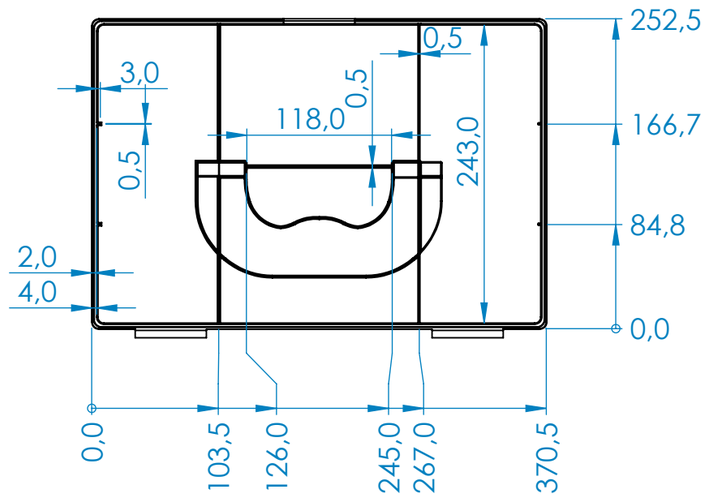
Top view

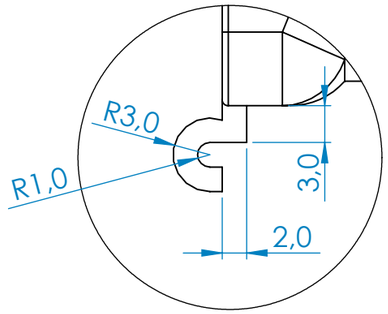


Front view

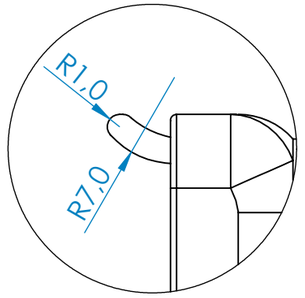


Bottom view

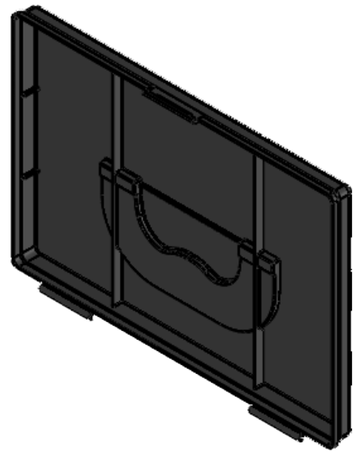




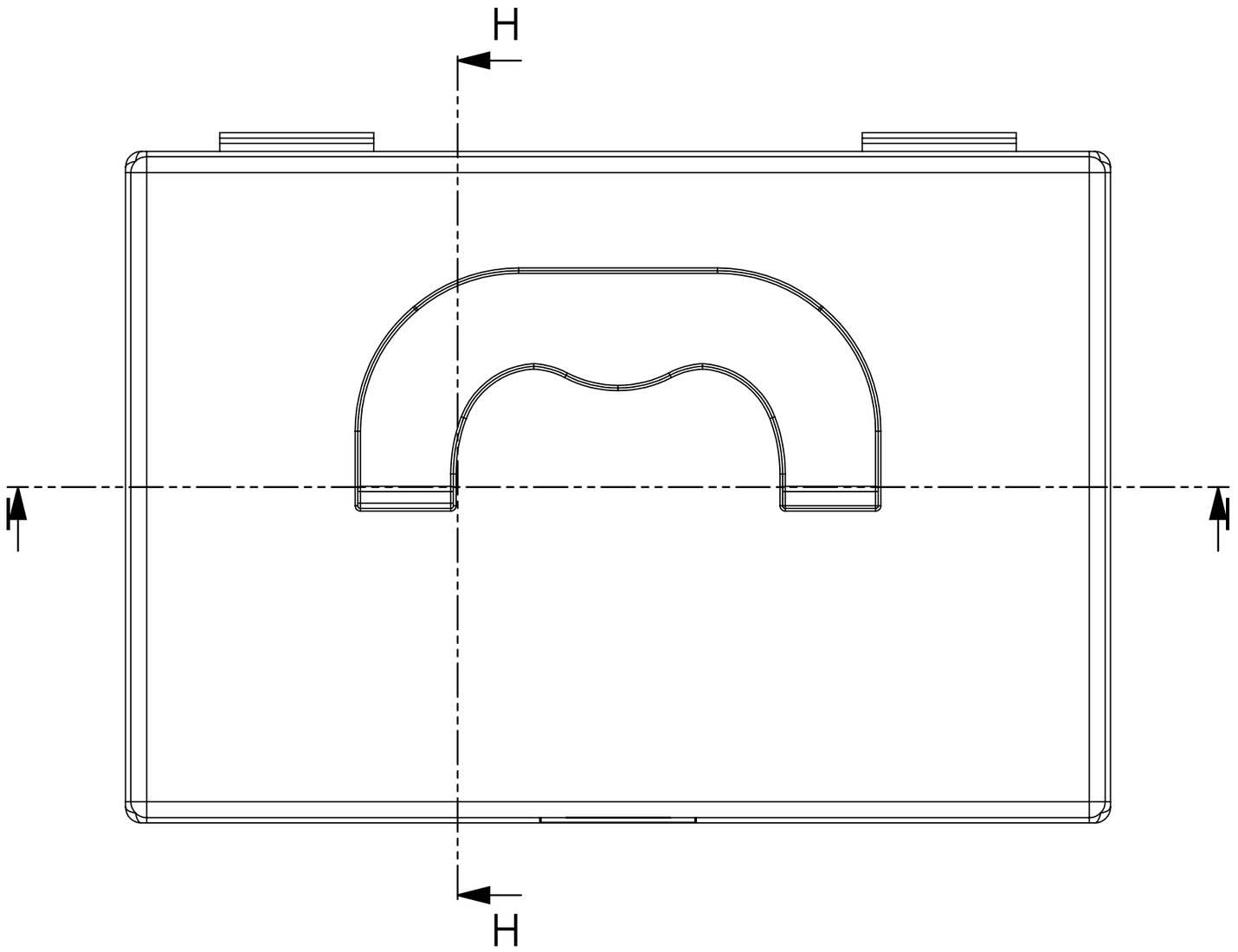
DETAIL A
SCALE 2 : 1



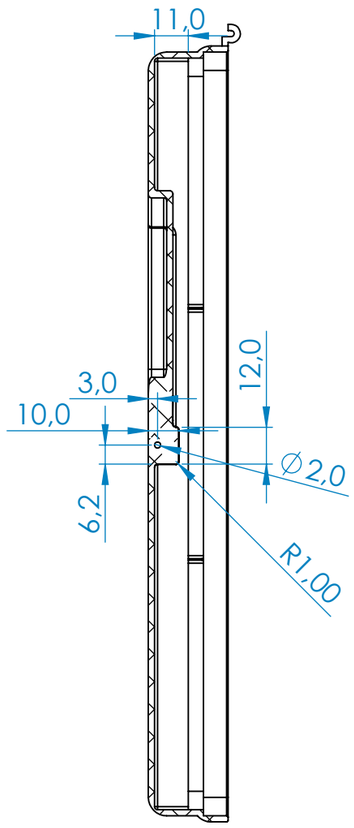
DETAIL O
SCALE 2 : 1

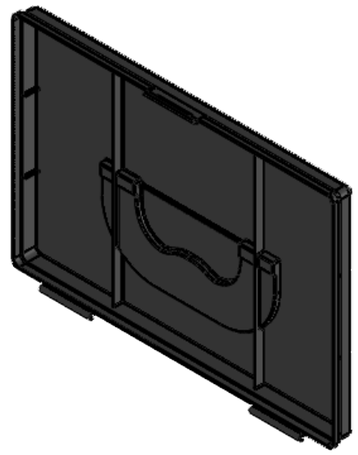


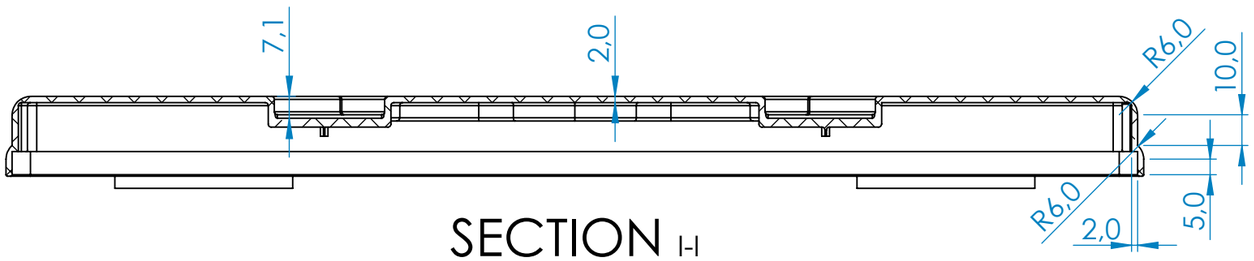
DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Lid
MATERIALS: Polypropylene (PP)		PART NO.: 4 — A3
TOLERANCES: DS/ISO 2768-1-m	SCALE: 1:5	SHEET 7 OF 8



SECTION H-H







SECTION I-I

DRAWN BY: MSc04, group 10	DATE: 8/6-23	PROJECT: ENWOUND Industrial Design, MSc04 Master thesis
PRODUCTION: Injection moulding		PART NAME: Lid
MATERIALS: Polypropylene (PP)		PART NO.: 4 — A3
TOLERANCES: DS/ISO 2768-1-m	SCALE: 1:2	SHEET 8 OF 8

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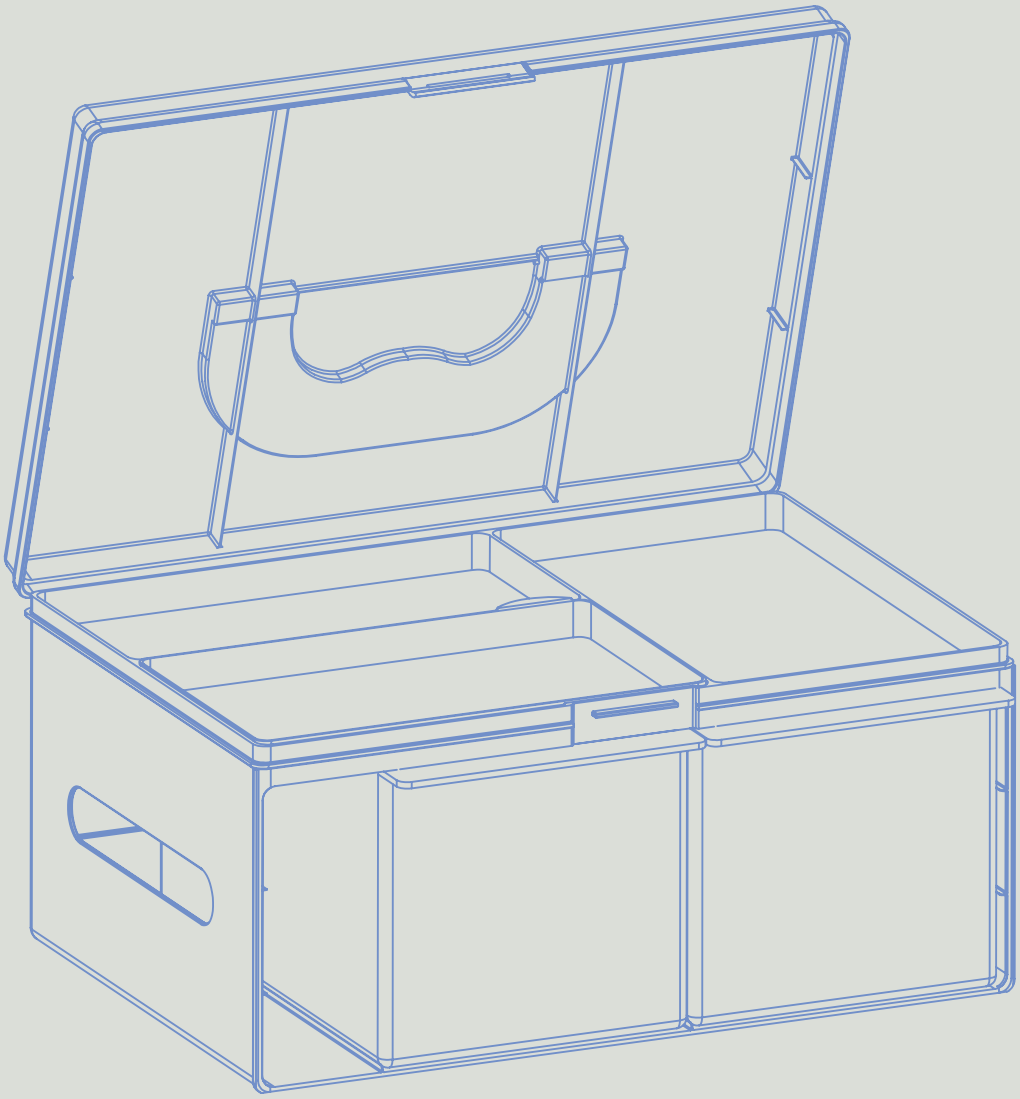
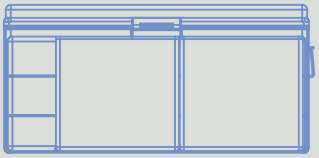
ENWOUND

Empower the nurse when doing wound care in private homes



Cecilie Mørch Korsgaard & Nikoline Voigt Pedersen

PROCESS REPORT



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Title page

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Technical supervisor: Mikael Larsen

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Nikoline Voigt Pedersen

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Pre-phase

This master thesis has been developed by two Industrial Design Engineering students from Aalborg University, Denmark, and took place in the period 01.02.2023 - 08.06.2023. The project is developed in collaboration with health workers from various municipalities in Denmark and the medico company ByLink.

A special thanks to the main supervisor Linda Nhu Laursen for her support, guidance, and pushing through the process. Also thanks to the technical supervisor Mikael Larsen for knowledge, feedback, and guidance.

Abstract

This report presents the process behind the development of an integrated design proposal ENWOUND. The goal of the project has been to develop a new professional solution for home health care nurses when they have to perform wound care in private homes. Current solutions are investigated and deemed inadequate due to limitations in organizing. This project has resulted in ENWOUND, a wound care storage solution that creates a systematic overview of equipment and tools for wound care. ENWOUND divides the nurses equipment into two drawers, and the tools by dirty and clean. All this helps ensure an efficient workflow along with improved safety for the patient. Furthermore, the aim of the solution is to minimize the preparation time for treatment. This helps ensure an increased focus on the treatment and the patient. Due to bacterias and risk of infections, ENWOUND must be placed permanently in the home of the patients during the treatment course.

The design proposal is mainly based on desktop research, observations, and interviews, which has led to a user centered design approach in the project. A business case is constructed on the grounds of analysis of existing solutions, a stakeholder map, and an interview regarding budget. Furthermore, construction and injection molding techniques are investigated to help determine the optimal way of constructing the solution. Tests using ENWOUND have shown an improvement in overview and efficiency when compared to current solutions.

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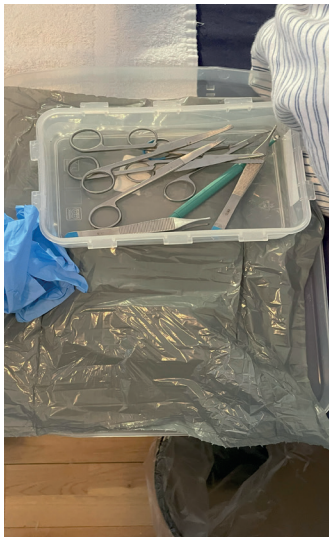
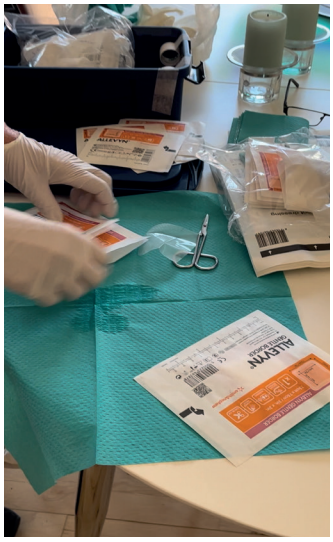
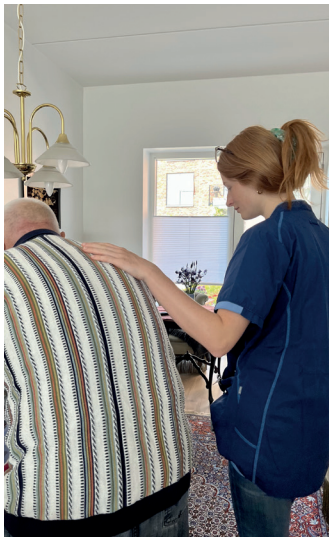






Collaboration & knowledge partners

Throughout the process several municipalities and companies were contacted in order to obtain expert knowledge. The main partners are highlighted below.

The two HHC nurses **Louise Baagøe** and **Louise Sørensen** from Hjørring Municipality have been a collaboration partner during the project. They have provided key insights and expert knowledge, but also constructive feedback on the different concepts. The communication has been physical meetings.

The HHC nurse Anne Mette Rasmussen from Aalborg Municipality has provided expert knowledge in the beginning of the project. A group member was with her on a shift.

The HHC nurse Inge Funder from Mariagerfjord Municipality has provided expert knowledge in the beginning of the project. A group member was with her on a shift.

The nurse student Sofie Pedersen from Horsens municipality has provided expert knowledge throughout the project. The communication has been physical meetings.

The social and health care assistant Marianne Højriis Jensen from Jammerbugt municipality has contributed with expert knowledge, and helped with tests and feedback during the project.

The company **ByLink** has been a knowledge partner during the project. They have provided expert knowledge and constructive feedback on different concepts. The communication has been physical meetings.

Steffen Jensen from the company Unika has provided expert knowledge in the end of the project regarding plastic materials, construction and injection molding. The communication has been an online meeting.

'Thank you' to the municipalities and companies for providing knowledge and feedback to the project. Furthermore, *'thank you'* to Løgstør municipality and other friendly people from Aalborg municipality, who also have contributed with knowledge during the project.

Reading guide

This project consists of both a product report and a process report. It is recommended to read the product report before reading the process report.

Except for the two reports, both technical drawings and appendix are attached, which can be used as reference material while reading.

The Harvard method is used as a source reference, with a reference list at the end of the process report. Afterward, there is an illustration list, which illustration is referred to through the report.

It should be noted that through the report, the home health care nurse is abbreviated as: **HHC nurse**. Furthermore, scissors, tweezers, and curettes are referred to as **tools.** Equipment refers to the rest of the **equipment** used in the treatment such as bandage, tape, etc.

Lastly, insights and requirements are throughout the report marked when they occur, with the following icons:

- Insight

- Requirement

Process timeline

Project start	01/02/2023		
		09/02/2023	Topic selection: bad working position for HHC nurses
Milestone 1	15/02/2023		
		20/02/2023	Follow a HHC nurse in Hobro
Follow a HHC nurse in Aalborg	23/02/2023		
		01/03/2023	Milestone 2
1. Meeting with the nurses from Hjørring Municipality	01/03/2023		
		22/03/2023	Follow a HHC nurse in Hjørring
2. Meeting with the nurses from Hjørring Municipality	22/03/2023		
		29/03/2023	Milestone 3
1. Meeting with ByLink	11/04/2023		
		16/04/2023	1. Prototype of the cushion and testing
Visit to AP Polstring	17/04/2023		
		19/04/2023	3. Meeting with the nurses from Hjørring Municipality
2. Prototype of the cushion and testing	23/04/2023		
		25/04/2023	3. Prototype of the cushion
Milestone 4	26/04/2023		
		27/04/2023	New mapping of user-scenario
New framing: Storage of the HHC nurses equipment in private homes	**28/04/2023**		
		30/04/2023	Interview with nurse student, Sofie
2. Meeting with ByLink	01/05/2023		
		01/05/2023	Concept development
Mock-ups	02/05/2023		
		03/05/2023	4. Meeting with the nurses from Hjørring Municipality
Follow a HHC nurse from Aalborg Municipality	08/05/2023		
		10/05/2023	5. Meeting with the nurses from Hjørring Municipality
Mock-ups	13/05/2023		
		14/05/2023	Feedback from social and health care assistant, Marianne
Test and feedback from nurse student, Sofie	20/05/2023		
		24/05/2023	Online meeting with Unika
Mock-up	29/05/2023		
		29/05/2023	Test and feedback from the social and health care assistant, Marianne
3. Meeting with ByLink	31/05/2023		

Report structure

The focus of the project is to frame a problem, understand the context and the working procedure for HHC nurses. Therefore, the goal is to develop a product solution that fits into the usage situation. This is done by having an iterative process, where new insights and knowledge are gathered throughout the process.

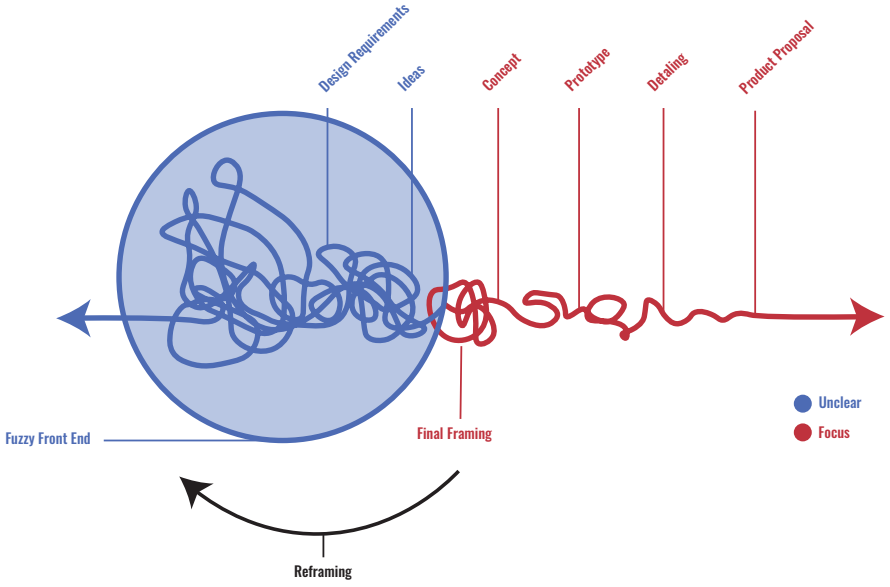
Through the process, the project has been reframed, where collected data is revisited to get a new understanding of the data. The data for the project is mainly collected through observations, interviews, and desktop research, where also expert knowledge is sought out.

The report is structured so that it starts with a final framing, which shows the final focus throughout the project. Based on this, important focus points have been drawn up, which the report is divided according to. These are:

- Treatment
- Storage
- Preparation time
- Easy cleaning

Each phase in the report initially starts with a problem identification and an understanding of the context, where concept development for the subject in question is presented. At the end of each phase, key insights are stated as a sum up of the phase. Finally, the report details the concept, after which various business aspects are presented.

The Fuzzy front end model (Sanders and Stappers, 2008) presents the design process, and how the process has been structured. At the beginning of the process is an understanding of the topic established by understanding patterns and insights. In this phase, the solution space is unclear and broad. Later, the solution space converges by having a more focused direction for the project, which ends up with a detailed product proposal.



Introduction

Today our healthcare system is being pushed to its limit. Nurses are working overtime and harder than ever in order to achieve their daily goals. They have a very limited time to assist the patient, and therefore it is important that they have an overview of the patient, the treatment, and the equipment. Working as a nurse in home health care can be a challenge, as they are working in the patients private home. The routines can be inefficient, unprofessional, and may have a lack of cleaning, which is ultimately in contrast to the working routines found in the hospitals.

The initial idea for the project was to look at the ergonomic problems of the HHC nurse, but it came clear that the problems when working in a private home were many. The scope was therefore decided to revolve around wound care and the workarounds made for it to work in private homes. The problem is especially seen as relevant for the municipalities, due to the increasing population of the elderly in the future, and thus it can help to improve the HHC nurses' working routines.

Framing

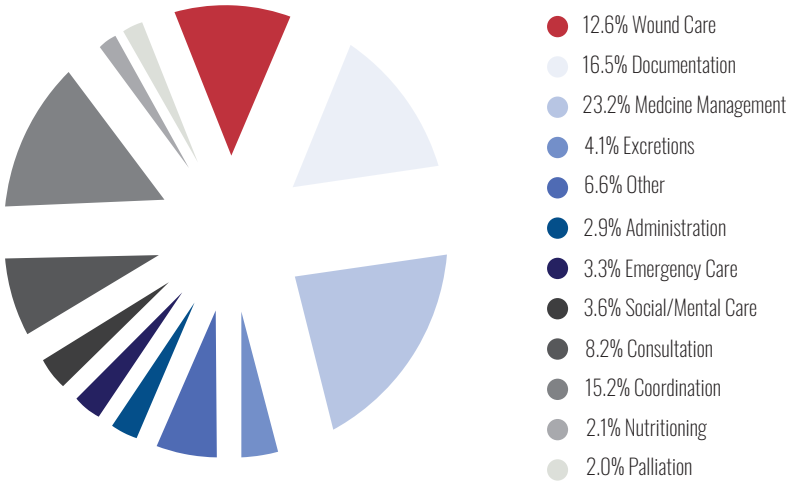
In the following phase, the project scope is defined, where the goal is to get an understanding of the problems involved with the HHC nurses workarounds when doing wound care in private homes. Lastly, the focus points for the project and a problem statement are presented.

Problem framing

HHC nurses experience far from ideal working conditions with too little time for each patient, suboptimal or missing equipment, and poor working conditions. Most of their work is done in the home of the patient, where equipment and cleaning are limited, which in turn leads to an inefficient and unprofessional workflow.

What do HHC nurses spend their time on?

Based on a report from Kommunernes Landsforening (KL, 2010) the workload distribution of a HHC nurse is as seen in the chart below. The primary tasks include medication, documentation, coordination and wound care, of which the only actual treatment is the wound care taking up 12.6% of the nurses time. This project will focus on eliminating the workarounds made by nurses when doing wound care.



Ill. 1: Assignments

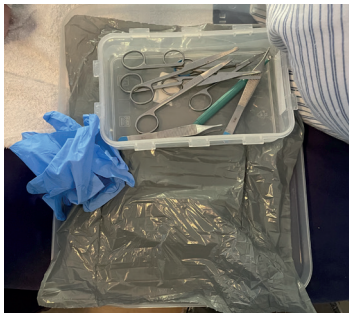
Context

HHC nurses spend most of their time working in the home of the patients, in which they lack the proper work procedure from hospitals that are not incorporated in private homes.

CONTEXT CHARACTERISTICS	RESULT OF CHARACTERISTICS
No streamlined routines	Inefficient use of time
Lacking adequate equipment	Unprofessional working procedure
No tool management	Long preparation - and cleaning time

Inefficient use of time

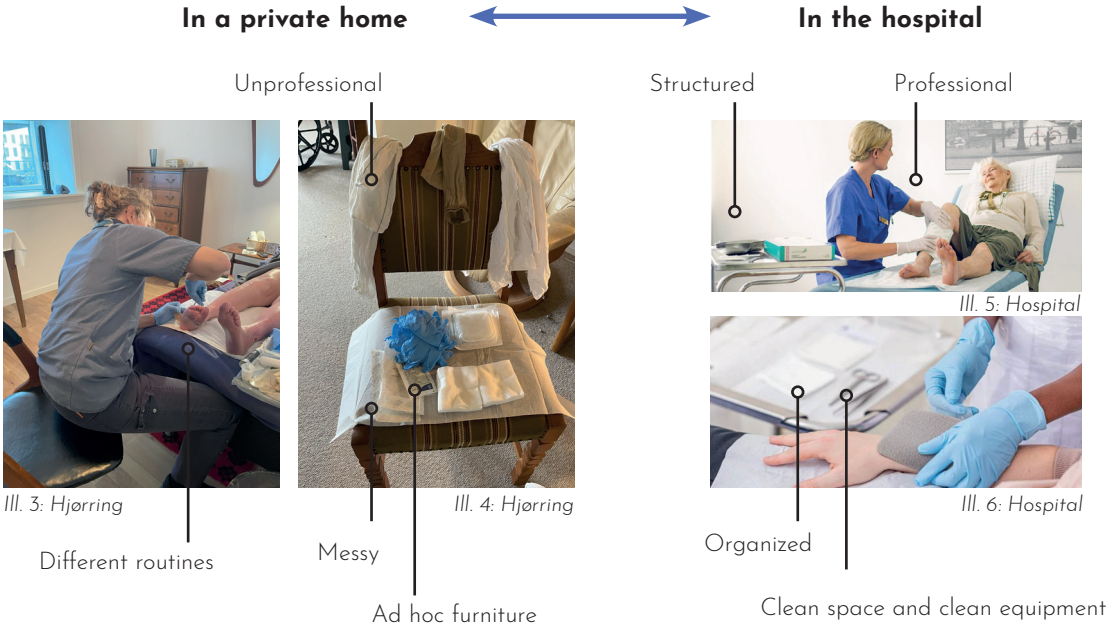
When treatment is taking place a box full of equipment is placed on a table or something similar close to the patient. The box is permanently located at the patients home, and is full of equipment needed for wound care. The HHC nurses will both before and during treatment spend a lot of valuable time searching through the box for the right equipment. They will sometimes resolve to using creative solutions, like using a plastic lid as a tray to organize and transport the tools and equipment from the table to the patient. They will also spend time going back and forth between the patient and the box with equipment. All of this ultimately leads to an inefficient use of time.



Ill. 2: The lid

Unprofessional working procedure

The treatment takes place in the home of the patient. The patient's home is a private home, where the patient has their daily life, full of memories, and where the patient invites guests. Therefore, the private home is not furnished to be the optimal working place. This means that nurses will often use ad hoc equipment or furniture, like hanging bandages on the backrest of a chair. This unprofessional working procedure does not align with the structured and professional procedure that is known from the hospitals.



Ill. 3: Hjørring

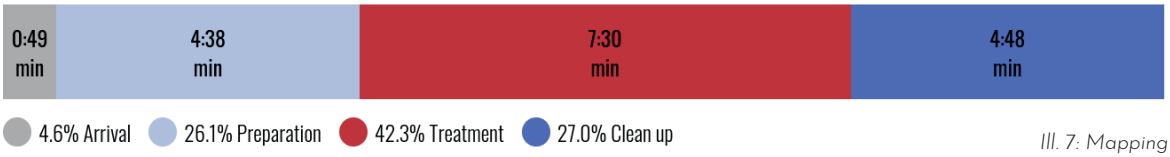
Ill. 4: Hjørring

Ill. 5: Hospital

Ill. 6: Hospital

Long preparation and cleaning time

When doing wound care the HHC nurse spends a lot of time preparing for the treatment. This includes, for instance, finding a place for the equipment, preparing the equipment and tools, and preparing the working surface. A lot of the preparation time is used on getting an overview of all the medical supplies that will be required for the treatment, e.g. bandage, plaster, or medical tape. Furthermore, time is also spent after the treatment, since all of this will then have to be put back in place. Due to time pressure or missing equipment, the HHC nurses skip the cleaning or settle for only cleaning with alcohol. The time spent at an HHC nurse visit was tracked below:



Ill. 7: Mapping

As it can be seen, there is a substantial amount of time spent on setting up and cleaning up after the treatment. In fact the combined setup and clean up lasts longer than the actual treatment. The picture on the next side illustrates the preparation of required supplies before a treatment.

Through observation and analysis of wound care treatments, the framing of the project has become clearer. Therefore, the following four focus points have been listed, which will form the framework for this project.

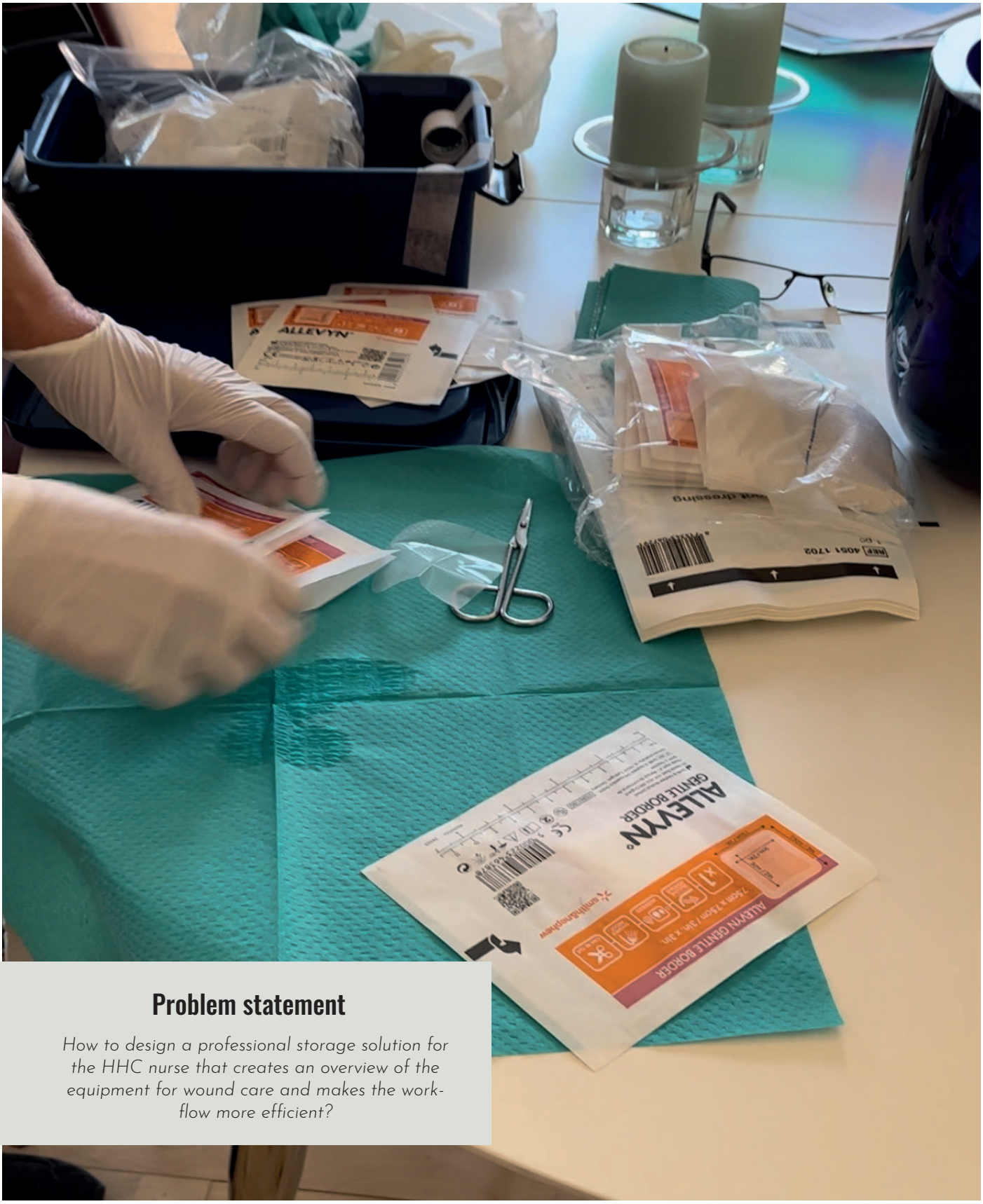
Focus points

Treatment

Storage

Preparation time

Easy cleaning



Problem statement

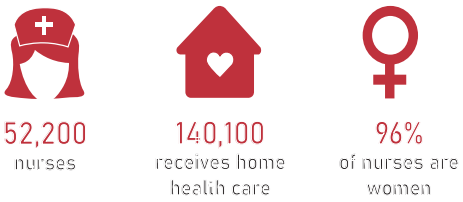
How to design a professional storage solution for the HHC nurse that creates an overview of the equipment for wound care and makes the work-flow more efficient?

The treatment

This phase takes place in the fuzzy front end, where the aim is to get an understanding of the context, user and the insights. This is done through interviews and shadowing of wound care treatment followed by a mapping of the scenario. The phase ends with a summary of the found insight, which makes the foundation for further concept development.

Who performs the treatment?

A HHC nurse can provide clinical and skilled wound care. The difference between a nurse working at a hospital and a HHC nurse is that the HHC nurse provides medical help for patients in their own homes. This is often after surgery, illness, injury, if the patient has bad health or a chronic disease. Some people also start to get help after an end of hospital admission or have been in a rehab center. (Amedisys, n.d.



Ill. 8: Statistics

In Denmark there are 52,200 nurses working in both the private and the public sectors, (Nielsen et. al 2022) (DSR, 2021), where 140,100 persons receive home health care every year (Danmark Statistik, 2022). It is chosen to work with female HHC nurses in this project, due to the fact that 96% of the nurses in Denmark are women. (Berlingske, 2022)

Who are they?

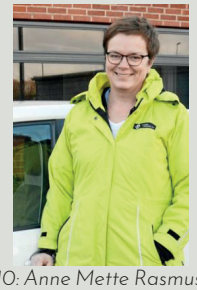
The HHC nurses that have contributed with expert - and insight knowledge throughout the process are presented below. The nurses have many years of expertise and have treated many different patients with various diagnoses. The nurses have been observed and interviewed through a situated interview (Bagger & Sperschneider, 2003). It has been important to follow nurses from different municipalities due to the workarounds varying from different municipalities.

Inge Funder
Mariagerfjord Municipality
(App. 1)

Ill. 9: Inge Funder

- Drives in a car to the different patients
- Have worked as a home health care nurse for the last 30 years
- Have approximately 8 patients during a shift

Anne Mette Rasmussen
Aalborg Municipality
(App. 2)



Ill. 10: Anne Mette Rasmussen

- Dives in a car to the different patients
- Does mainly wound care and medication
- Have worked as a home health care nurse for the last 32 years
- Have approximately 8 to 12 patients during a shift

> *"Someone sits on the floor, stacks cushions, on the dining table, etc. when doing wound care."*

> *"Wound care that takes a long time takes place at a bed"*

The four health care workers below have beside experts - and insight knowledge also contributed with feedback on different concepts though the process.

Louise Sørensen
Hjørring Municipality
(App. 3)

Ill. 11: Louise Sørensen

- Drives in a car to the different patients
- Teach nurse students in wound care
- Treats patient for wound care in private homes and in a nurse clinic
- Have many years of experience

> *"In the patients' homes there are bad working conditions"*

> *"Wound care is not a work where you need to be precise, but it requires a steady hand"*

Louise Baagøe
Hjørring Municipality
(App. 3)

Ill. 12: Louise Baagøe

- Drives in a car to the different patients
- Teach nurse students in wound care
- Treats patient for wound care in private homes and in a nurse clinic
- Have many years of experience

> *"70-80% of the wounds are placed on the legs and feet"*

> *"Cleaning is not that important in private homes, however it should still be possible to sanitize the area where we do the treatment"*

Sofie Voigt Pedersen
Horsens Municipality
(App. 4)

Ill. 13: Sofie Voigt Pedersen

- Soon a nurse
- Has 6 years of expertise from home care and nursing home
- Is currently doing an internship at a hospital where she knows about routines and cleaning

> *"There should be few interactions with a product"*

Marinne Højriis Jensen
Jammerbugt Municipality
(App. 5)

Ill. 14: Marianne Højriis Jensen

- Social and health care assistant
- Expertise from both hospital, nursing home and home health care
- Treat wounds in a nursing home

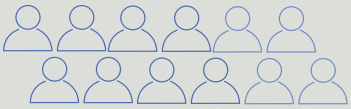
> *"The hygiene is very important for the safety of the patient"*

What is their work day like?

The nurses Inge, Anne Mette, Louise and Louise are followed on different shifts. (App. 1, App. 2, App. 3) The three different municipalities are visited in order to have broader insights. Since the work is based on routines, there can be some differences, from one municipality to another.

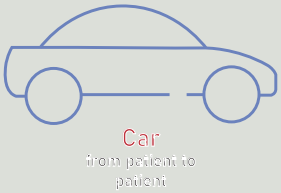
Their day is observed, to gain knowledge about being a HHC nurse.

The HHC nurse visits between 8-12 patients a day.



It is very different what type of treatment the patients need, which means the HHC nurse needs to perform a variety of treatments. However, wound care is taking up 12.6% of their time.

The HHC nurse drives from patient to patient in one of the municipality's cars.



They also have a nursing bag in their car.

The HHC nurses have a nursing bag with equipment for extra treatment.

It has a weight of 3 kg incl. the equipment.

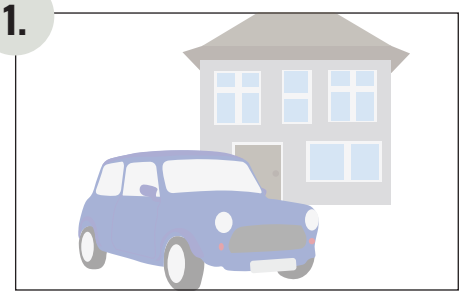
Depending on which treatment the nurse has to make, there is time allocated.

For wound care there is between 20 to 60 minutes.

Ill. 15: Work day

Based on the observation a typical workday is:

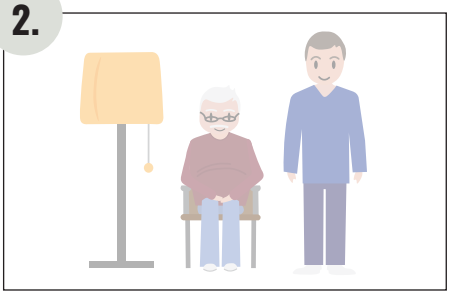
1.



The HHC nurse is driving to the patient's home

3 min

2.



When arriving at the patients home, she brings her tablet, and says hello to the patient, where they talk about how the patient is doing

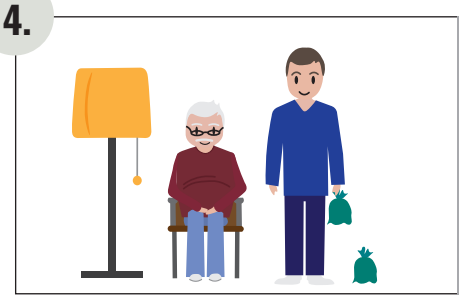
10 - 60 min

3.

The HHC nurse is doing the treatment in the patient's bed

2 min

4.



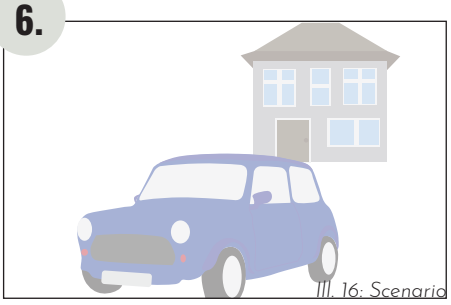
When the treatment is done the HHC nurse clean, and says goodbye to the patient

3 min

5.

In the car the HHC nurse registrate the treatment on her tablet

6.



Ill. 16: Scenario

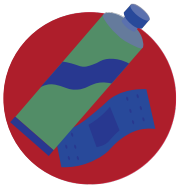
The HHC nurse drives to the next patient

Conclusion:
Based on observations and interviews with HHC nurses, it is established that they have a busy schedule with a lot of visits. They only have a very limited time for each patient along with a packed schedule full of visits. The duration of a regular wound care visit is about 20-60 minutes, and in this time they will have to both prepare, perform, and clean up after the treatment. Phase 3 and 4 in the scenario will be explained later in the process.

- They have a nursing bag in the car that weighs 3 kg.

- Should have a maximum weight of 3 kg.

Wound care



By having an understanding of how the HHC nurse's day is scheduled, it is time to investigate the treatment when doing wound care.

What is wound care?

Wound care is performed by a nurse who starts by diagnosing the wound type(s) and deciding the proper treatment. After the treatment has been determined the right equipment needs to be carried home to the patient before starting the treatment. The treatment typically includes cleaning of the wound(s), dressing changes, and actions to promote the wound healing. (Wisconsin Technical College System, n.d.) The healing time for the various types of wounds is very different and can vary between a few weeks, whereas diabetic wounds can take many years. However, not every treatment is the same, due to the fact that people are different and so are the circumstances.

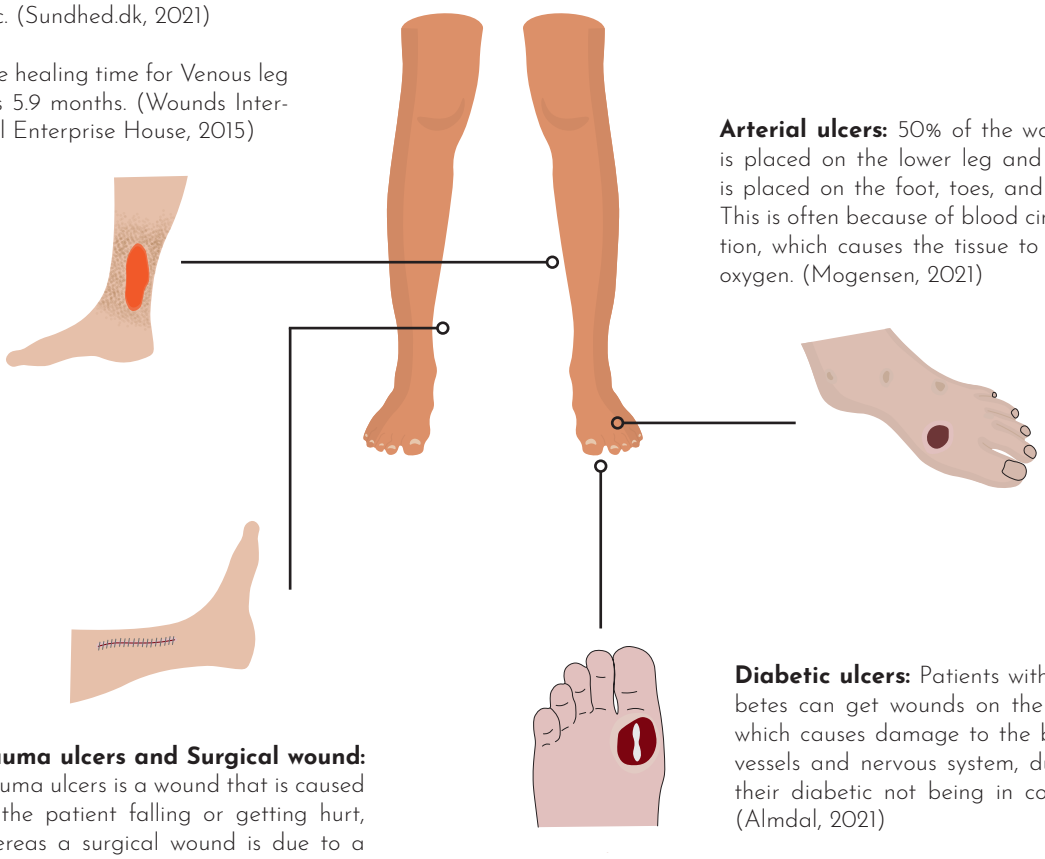
Wound types

Different types of wounds are investigated through the procedure for wound care. This is done to understand the HHC nurse's tasks when treating wounds. The HHC nurses in Hjørring (App. 6) have explained the different types of wounds, what type of equipment they use and how the wounds are typically treated. The section is based on knowledge from the HHC nurses and supplemented with desktop research.

In general, there are five types of wounds that the HHC nurses treat. The nurses stated that around 70 - 80% of the wounds are placed on the legs and feet. Furthermore, patients often have more than one wound at a time that needs to be treated.

Venous ulcers: a wound that is placed on the leg/foot. It occurs often due to varicose veins but can worsen if the patient is immobile, overweight or has hardening of the arteries, or is diabetic. (Sundhed.dk, 2021)

Average healing time for Venous leg ulcers is 5.9 months. (Wounds International Enterprise House, 2015)



Arterial ulcers: 50% of the wounds is placed on the lower leg and 50% is placed on the foot, toes, and heel. This is often because of blood circulation, which causes the tissue to need oxygen. (Mogensen, 2021)

Trauma ulcers and Surgical wound: Trauma ulcers is a wound that is caused by the patient falling or getting hurt, whereas a surgical wound is due to a surgery/operation. (Sundhed.dk, 2023)

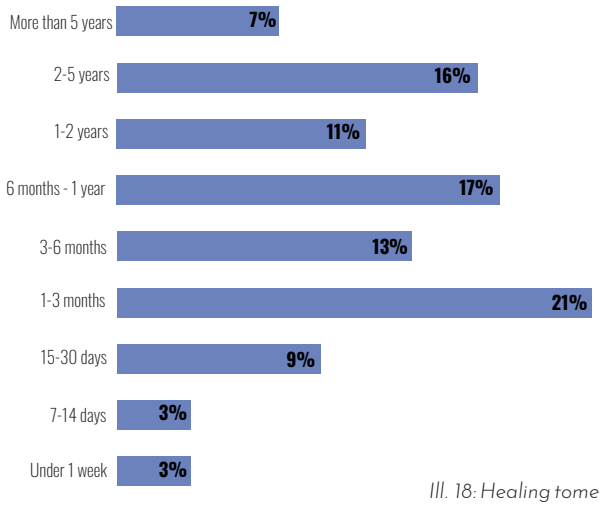
Diabetic ulcers: Patients with diabetes can get wounds on the feet, which causes damage to the blood vessels and nervous system, due to their diabetic not being in control. (Almdal, 2021)

Ill. 17: Wound types

Healing time

Wounds are categories in two. The first is trauma ulcers and surgical wounds, and the second is defined as chronic wounds, because it does not heal after four to six weeks. Below the duration of wound healing is illustrated. (Dansk sygeplejeråd, n.d.)

These numbers show that it is very individual how long time the wounds take to heal, but it often takes 1-3 months and up to more than 5 years. In that period the HHC nurse treats the wound 3 times a week or up to once every day. (Dansk sygeplejeråd, n.d.)



Ill. 18: Healing tome

Wound care procedure

After the right equipment has been found the wound care treatment can begin. When treating wounds, hygiene is very important to prevent infection. Therefore, it is important to use clean gloves, clean equipment and tools, and furthermore all tools should be disinfected after every use. (Fredericia Kommune, 2016)

1.

Firstly, the bandage or patch is removed.

2.

The wound is washed and dabbed.

3.

The fibrin is removed. Fibrin is a yellow layer, which is a protein that is formed when the blood clots

"Wound care is not a work where you need to be precise, but it requires a steady hand"
- Louise Baagøe

4.

The wound is smeared to keep it clean, and the area around the wound is sprayed.

5.

Ill. 19: The precedure

A bandage is applied again and the treatment is done.

- 70 - 80 % of the wounds are placed on the lower legs
- The treatment can take up to more than 5 years

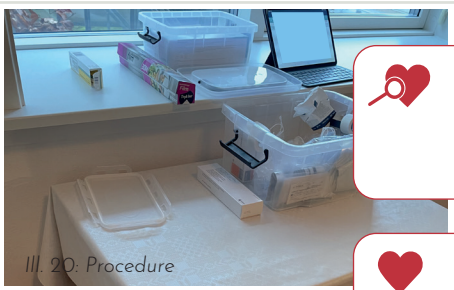
- Should have a lifetime of 5 years

Conclusion:
The understanding of the different wound types and care led to the discovery that most wounds are placed on the legs and feet. The healing time is usually long, 1-3 months and up to more than 5 years, and therefore it is hard to immediately tell how long the healing process will take. The boxes are usually used from 3 days a week up to once every day.

Scenario

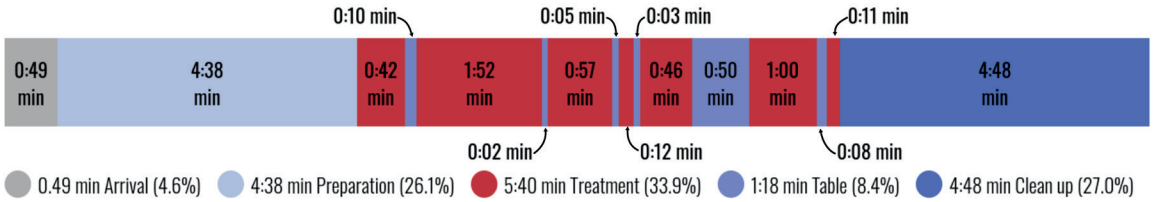
After having the different wound types set in place, the procedure for wound care is explained by the HHC nurses through an interview. Afterwards, the treatment was shadowed (Bagger & Sperschneider, 2003). The patient in the scenario below have both venous and arterial ulcers. (App. 3)

Time	The treatment		Critical observations
00:00-00:49	Say hello to the patient		
00:50-05:28	The first thing is to find the equipment that should be used throughout the treatment. The boxes with equipment are placed at the patient on a table during the whole treatment period, so every HHC nurse knows where to find it.		All the equipment is in disorder in the boxes
	A bin is placed beside the bed so it is easy for the HHC nurse to throw things out during the treatment.		
	Scissor, tweezer, curette and gloves are placed on a lid with a plastic bag to have a clean surface. A towel is placed in the bed. The lid with tools are prepared on the table, and placed on the bed.		She uses the sharp tools placed on the bed
05:29-06:11	The treatment is started, where it is happening in the patient's bedroom. The bandage is removed first from the right leg and then the left.		She uses the sharp tools placed on the bed She uses the bin She sits at the end of the bed
06:12-06:22	Miss equipment		Goes to the table to get the equipment to wash the wounds
06:23-08:16	The wounds are washed and cleaned on both legs.		
08:19-08:21	Put back some equipment		Goes to the table
08:22-09:19	The fibrin is removed on both legs. The nurse needs to have a steady hand when using sharp tools, and get closer to see the wound.		She uses the bin She uses the sharp tools placed on the lid in the bed

09:20-09:25			Goes to the patient's bedside table to get the cream
09:26-09:38	The nurse applies lotion.		
09:39-09:42	Miss equipment		Goes to the table to get equipment to wrap the wounds
09:43-10:29	Bandage is placed on the wounds.		Sharp tools placed on the bed. Uses the bin Sitting in a bad position
10:30-11:20			Go to the table. Got the wrong equipment
11:21-12:21	The bandage is applied on both legs.		
12:58-13:06			Goes to the table to get the socks
13:07-13:18	The last step of the treatment is to put on compression socks on both legs. Here the HHC nurse needs to stand up. The treatment is done.		Standing in a bad position
13:19-18:07	After the treatment, the tools are cleaned, and waste is disposed.		During her treatment the clean tools are separated from the dirty tools.
	The equipment is packed together, so it is ready for the next treatment. The HHC nurse is ready to leave the place.		• The equipment is stored in boxes • The scissor, tweezer and curette are divided in clean and dirty sections • The nurse use a garbage bag during the treatment • Should divided the tools in dirty and clean sections • Should contain a garbage bag

Ill. 20: Procedure

Timeline



Ill. 21: Timeline

The chart above illustrates the activities during treatment and shows that the HHC nurse:

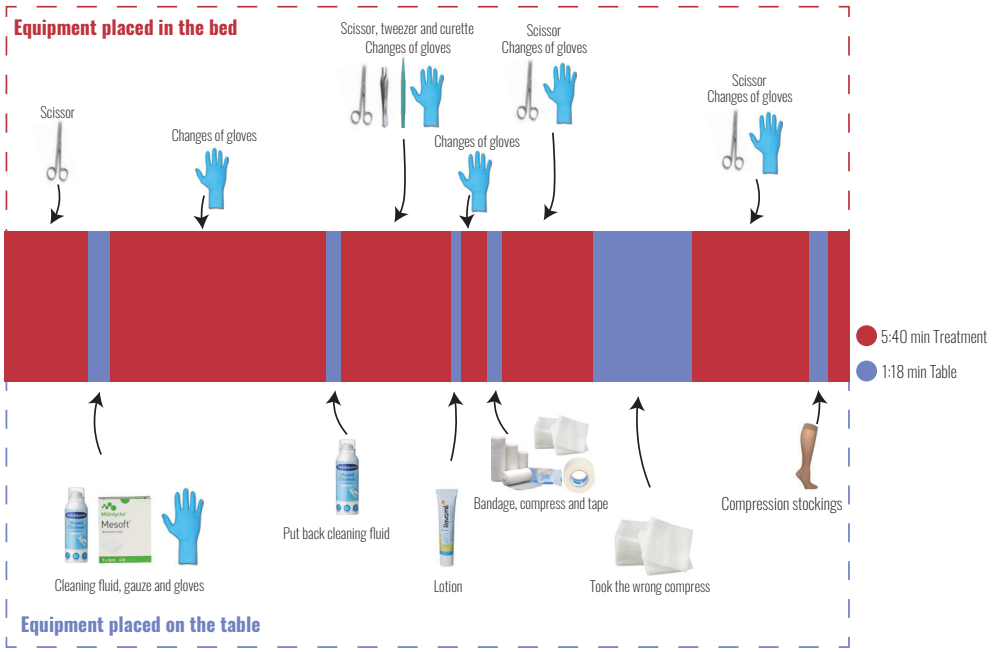
- Uses in total 4 min 38 sec to set up for the treatment
- Uses in total 5 min 40 sec on the treatment
- Uses in total 4 min 48 sec on unpacking and cleaning up
- Spends in total 1 min 18 sec at the table

The nurse context switches a lot by stopping treatment momentarily and going to the table for equipment. All the interruptions are both not very efficient time wise, but also leads to interruptions in the workflow, which will effectively cost even more time as the nurse will have to refocus after each context switch.

- The nurse uses a long time on preparing the treatment and clean up after the treatment

Equipment flow

To get an understanding of what equipment is used at different stages of the treatment, the following chart illustrates the equipment flow when the HHC nurse treats wounds. The top of the chart shows equipment placed in the bed. The lower part shows equipment placed on the table, where the HHC nurse goes back and forth between the bed and the table. The illustration only focuses on the treatment.



Ill. 22: Equipment flow

Conclusion:

Based on the observation it is seen that the HHC nurse:

- Change gloves 5 times during a treatment
- Goes to the table 6 times
- Scissors and gloves are used several times during the treatment

This shows that the HHC nurse uses more time on the preparation and cleaning after the treatment - when during the treatment. A lot of time is wasted on going back and forth between the patient and the table with the equipment. This leads to an inefficient use of time. Therefore, it would be beneficial for the nurse to have all the equipment by hand, to eliminate the need to go back and forth, which will make the workflow more efficient.

- The nurse changes disposable gloves during the treatment

- It should be possible to use the product with disposable gloves

What equipment do they use?

The equipment the HHC nurses are using during a treatment can vary according to the extent of the treatment. However, the equipment below is used during the scenario described in the previous section. (App. 3)

1.

2.

Tape
Ø4.5 cm

3.

Gloves
24 x 13.5 x 5.5 cm

4.

Cleaning fluid
12 x Ø4 cm

5.

Garbage bag
17.5 x Ø5 cm

6.

Curette
24 x 13.5 x 5.5 cm

7.

Surgical tweezers
11 x 1 cm

8.

Alcohol wipes
6 x 7.5 cm

9.

Medical scissors
15 x Ø6 cm

10.

Wound band aid
Up to 25 x 13 cm -
incl. packaging

11.

Gauze (compress)
5 x 5 x 10 cm -
incl. packaging

12.

Lotion and ointment
15 x 4.5 x 4 cm -
incl. packaging

13.

Bandage
6 x 7.5 cm

Ill. 23: Equipment

Conclusion:
By knowing the equipment it shows what the new product solution should contain, and what size of equipment should be held in mind when developing. Based on observation of the wound care procedure and the scenario, the HHC nurse's equipment is divided into four categories. The equipment is divided into which stages of the procedure the HHC nurses are doing.

The four stages of the equipment is:

1. Main use Clean ⟶ dirty	Gloves Surgical tweezers, medical scissors, curette
2. Wash of wounds	Cleaning fluid, gauze
3. Closure	Ointment, lotion, gauze, bandage, tape, wound band aid
4. Cleaning	Alcohol wipes and garbage bag

- The equipment is typically: tape, gloves, garbage bag, curette, surgical tweezers, alcohol wipes, medical scissors, wound band aid, gauze, bandage, cleaning fluid, lotion and ointment
- The nurse uses the equipment in four different stages of the treatment

- Should contain equipment for wounds on legs and feet: tape, gloves, garbage bag, curette, surgical tweezers, alcohol wipes, medical scissors, wound band aid, gauze, bandage, cleaning fluid, lotion and ointment

Key insights

Too little time for each patient
From conducting research and interviews, it is shown that HHC nurses visit many patients during their shift and have limited time.

Inefficient use of time
By shadowing the nurse it was determined that she uses a significant amount of time on preparation and clean up after treatment. The nurse would walk away from the treatment to fetch equipment, since the equipment was not available within arms reach. This would in turn lead to an inefficient use of time. At last it was identified that the most used equipment was scissors and gloves.

Use of different equipment
The HHC nurse uses different equipment and tools for different phases of the treatment, where tools and gloves are used throughout the whole treatment.

Insights	Requirements	Source (page)
They have a nursing bag in the car that weighs 3 kg.	Should have a maximum weight of 3 kg.	Who performs the treatment?
The treatment can take up to 5 years	Should have a lifetime of 5 years	Wound care
The equipment is stored in boxes		Scenario
The scissor, tweezer and curette are divided in clean and dirty sections	Should divided the tools in dirty and clean sections	Scenario
The nurse use a garbage bag during the treatment	Should contain a garbage bag	Scenario
The nurse uses a long time on preparing the treatment and clean up after the treatment		Scenario
The nurse changes disposable gloves during the treatment	It should be possible to use the product with disposable gloves	Scenario
70 - 80 % of the wounds are placed on the lower legs	Should contain equipment for wounds on legs and feet: tape, gloves, garbage bag, curette, surgical tweezers, alcohol wipes, medical scissors, wound band aid, gauze, bandage, cleaning fluid, lotion and ointment	Wound care
The equipment is typically: tape, gloves, garbage bag, curette, surgical tweezers, alcohol wipes, medical scissors, wound band aid, gauze, bandage, cleaning fluid, lotion and ointment		What equipment do they use?
The nurse uses the equipment in four different stages of the treatment		What equipment do they use?

Storage

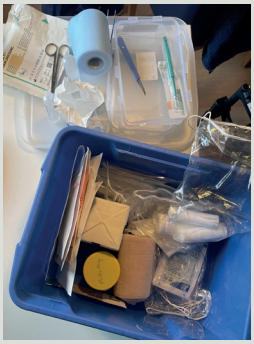
This phase focuses on understanding the current storage solution. To get insights about the storage of wound care equipment both shadowing, research about existing solutions, the life cycle, and photo ethnographic research is made. The initial concept development is started, where expert knowledge from the company ByLink, feedback from a nurse student from Aarhus, and two HHC nurses from Hjørring will contribute to further development of the concept.

The wound care box

To get an understanding of how the equipment is stored the existing solution is investigated. The materials for wound care are stored in a plastic box. The guideline is that the box should always be cleaned up and cleared to only contain equipment for a couple of wound treatments. (Andersen and Lykke, 2021)

This is not what is observed when visiting people during the treatment. The equipment is in disorder and quickly becomes a mess.

Storage of equipment at the patient

No overview	Messy	Too much equipment in the box	Searching for equipment
			

Ill. 24: Storage

This results in the nurses spending valuable time searching for the right equipment. Furthermore, the HHC nurse has no overview of what equipment the box contains, which leads to them missing equipment. This does not align well with the structured storage found at the hospitals, and it gives the HHC nurse an unprofessional workflow.

Ill. 25: Storage

The existing storage solutions

When observing the treatment, it was seen that the patient has different boxes to store the equipment in. By looking at the size of the box, it gives an understanding of how much space is needed for the equipment. The boxes have different sizes and are chosen depending on the scope of the treatment. The boxes that Hjørring and Aalborg Municipality are using are shown below. The prices are based on the fact that the municipalities have procurement agreements. (App. 7)

EXTRA SMALL:
0.9 Liter

Ill. 26: Box

The box is for small tools such as a scissor.

Size: 220 x 140 x 51 mm

Price without VAT: 23.44 DKK

SMALL:
2.5 Liter

Ill. 27: Box

The box is for equipment such as the box with gloves.

Size: 290 x 180 x 113 mm

Price without VAT: 65.99 DKK

MEDIUM:
11.5 Liter

Ill. 28: Box

The box is for the rest of the equipment.

Size: 370 x 280 x 165 mm

Price without VAT: 116.99 DKK

LARGE:
32 Liter

Ill. 29: Box

The box is used for comprehensive wound care.

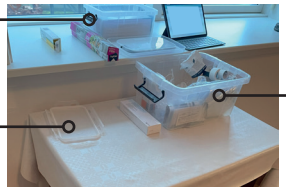
Size: 510 x 390 x 258 mm

Price: ??

Based on the scenario it was observed and explained that for one patient they use three boxes during the treatment period to store the equipment. The three boxes are:

SMALL

EXTRA SMALL



MEDIUM

Ill. 30: Storage

Total price:
206,42 DKK

It is different if the boxes are transparent or blue. Both examples are seen in the different municipalities.

1. Packing the box
When the right treatment has been determined, equipment for the treatment is found in the HHC nurses' depot. The equipment is packed in the boxes, which are stored at the HHC nurses' depot.

2. To the patient
Afterwards the HHC nurse brings the boxes to the patient, where the boxes are placed during the whole treatment period.

3. Refilling
When equipment for the treatment is missing, the HHC nurses pack the equipment in a plastic bag at the depot and bring the equipment out to the patient and refill the boxes again. The boxes must only contain equipment for a few treatments because the equipment must not be used for another patient due to the risk of infection. (Andersen and Lykke, 2021)

4. Disposal of equipment
When the treatment is finished the boxes are brought back to the depot. Equipment that is unused is thrown away, and this is often a lot due to the fact that the HHC nurses do not have an overview of the content of the boxes.

5. Cleaning of the box
The boxes are washed in an industrial dishwasher at 90 degrees, and cleaned with alcohol. (App. 8) However, sometimes the boxes are disposed of if they are damaged after having been at the patient.

6. Storage of the box
After being cleaned the boxes are again stored in the depot, and ready to be used for the next patient.

Lifecycle of the box

It is told that the box is reused when a treatment is finished and therefore the lifecycle of the box is relevant to understand.

Ill. 31: Lifecycle

Conclusion:
Through observations, it was determined that the equipment was stored in the plastic boxes. The boxes that were observed were unstructured and served very little overview and help when determining which equipment should be refilled. This is in strong contrast to how things are done in hospitals where everything is well structured.

The boxes are often reused for new patients when the treatment period is over. The boxes can be washed in an industrial dishwasher before passing it on to new patients. Based on that it is found that the new solution should provide an overview of the equipment and furthermore, the new solution should be reusable.

- After treatment has ended the boxes are cleaned in an industrial dishwasher

Shadowing of the box

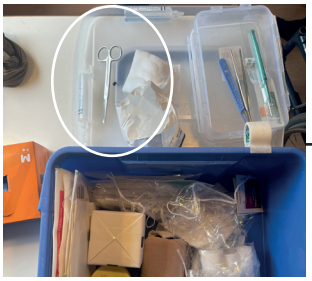
To get an understanding of how the boxes are used, and how equipment is placed, the box is shadowed during a treatment. During a shadowing from a visit in Hjørring municipality (App. 9), it was observed that the boxes were structured in the beginning of the treatment. However, it was something different in the end of the treatment. This patient has two boxes with equipment and tools and a plastic bag for the box with gloves.

1. The box is opened and the lid is turned upside down.

2. The tools are placed on the top of the lid.

3. The treatment is started: the lid is used to store equipment for later use.

4. After using the scissor it is placed together with the equipment for later use.



5. The lotion is placed away from the other equipment because it is the patient's.

6. The equipment in the box gets more and more messy during the treatment.

7. The storage space on the lid gets messy, with equipment for later use and dirty tools mixed together.

8. After the treatment, the equipment was placed back in the box again. The tools are cleansed with alcohol wipes and hot water if it has been used for the wound.

9. The lid is put on the boxes and stacked.

10. The box is placed in the scullery. The tool box is inside the blue box, and the glove box is placed inside the white paper bag.

Ill. 32: Scenario

Conclusion:

When observing the boxes for the equipment it is seen that the HHC nurse uses the lid for storage space, where clean tools, equipment for later use, and dirty tools are mixed together. Even though the boxes were organized in the beginning it became more messy during the treatment, when the nurse was searching for the right equipment. Furthermore, the nurses spend valuable time searching for the right equipment, and have no overview of what needs to be refilled. A need for having a surface for placing the equipment is seen due to all the equipment being mixed up on the plastic lid.

- The lid is used as storage surface
- The equipment is in disorder

- Should have a surface for placing the equipment
- Should provide an overview of the equipment

What is on the market?

Based on research and interview with the two HHC nurses from Hjørring Municipality (App. 8) it is made clear that there are not many solutions on the market. Through desktop research other solutions are found in order to investigate the market, which are described below.

Ill. 33: Wound box

Ill. 34: Wound box

Purpose: a small case for the sharp tools
Price: 300 DKK
Size: 18 x 9 x 3 cm
Amount containers: 1
Material: aluminum

Volume: 14 liter

Ill. 35: Wound box

Purpose: for wound care equipment
Price: 170 DKK
Size: 37 x 28 x 16.5 cm
Amount containers: 12
Material: PE plastic

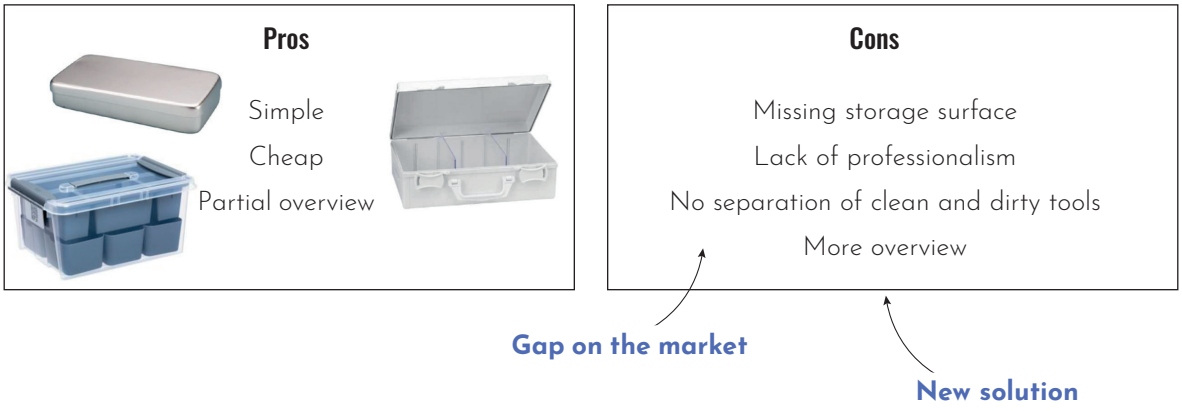
Volume: 17 liter

Ill. 36: Wound box

Purpose: for wound care equipment
Price: 341 DKK
Size: 40 x 28 x 13 cm
Amount container: three
Material: plastic

The metal box has been in use previously, but was dropped due to the price increasing from 60 DKK to 300 DKK. (App. 8) The two other boxes have never been in use by either Aalborg, Hobro or Hjørring municipality.

Pros and cons are listed for the existing solutions above where they are compared with the needs found in the scenario.



Common for all the existing solutions is that they are both simple and cheap. The two plastic boxes provide a partial overview due to the separations inside the boxes. The metal box provides no separation, but is also very small so the need for overview is less essential.

Conclusion:
Based on the analysis, it can be seen that there are not many existing solutions on the market and there is thus an opportunity to develop a product within the blue ocean.

When accounting for the required needs when doing wound care it is clear that all of the existing solutions lack storage surface, and the simplicity generally means that they do not appear very professional. In addition to this the existing solutions also have no direct distinguishing between clean and dirty equipment and tools.

The patient's home

When the boxes with equipment have been packed at the HHC nurses' depot, they are transported in the HHC nurses' car, to the patients' homes and remain permanently until the treatment is completed and their wounds are healed. Therefore photo ethnographic research is done in order to understand how people live and how much space they have for a new solution.

Photo ethnographic research

Typically, wound care treatments take place in the patients' bedrooms, where the patient has the opportunity to lie down. In order to gain an understanding of what the patients' bedrooms are like, a photo ethnographic research (Bagger & Sperschneider, 2003) was carried out. Afterwards, the pictures were analyzed focusing on the space of the bedrooms and sizes of the beds.

The patients' homes

Ill. 37: Patients' homes

The characteristics of the homes are that there is not much space in the bedrooms and the patients have double beds. All the homes that were visited are people living as a couple, which also is why they have double beds. It is known that many elderly people are living alone, which means they have a single bed.

Where is the equipment stored in the patient's home?

In order to get an understanding of where the equipment is stored in the patients' homes when there is limited space in the patients' bedrooms, the HHC nurses were shadowed during wound care treatments.

Ill. 38: Patients' homes

Based on the shadowing of the HHC nurses, it was noted that most of the wound boxes are not hidden, but easy to access.

Conclusion:
During ethnographic research it was found that most patients only have a very limited amount of space in their bedroom. This should be accounted for with certain size requirements in the solution. Most patients store the boxes out in the open, indicating that they do not actively try to hide it, and not necessarily linking it to being sick.

Pre-sketching

Based on the knowledge of the problem scenario and the insights so far, a pre-sketching was done. Here, the method Brain Pool Writing (Tollestrup, 2004) was used, in order to start the concept development with many ideas. The purpose was to open the solution space and get as many ideas as possible for further concept development. The ideas are clustered (Tollerstrup, 2019) into three different categories and afterward discussed. (App. 10)

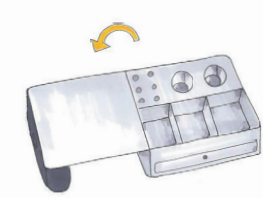
During the sketching, it was especially these insights that were focused on:

Create an overview
Four different containers
Space for preparation
Easy access
Easy cleaning

Concept development of the box

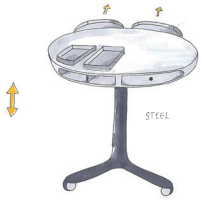
Three different concepts were afterwards developed with inspiration from other industries where they created an overview of equipment. (App. 11) Therefore, all three concepts are based on creating a systematic overview of the equipment.

The box



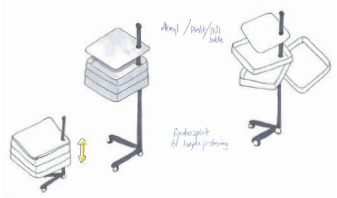
The initial idea was to place the box in the patient's bed. When opening the box there is space for placing the equipment on the lid of the box.

The table



The table can be adjusted in different heights so it fits the HHC nurse. The equipment can be placed on the tabletop and in the drawers.

The wagon



The wagon can be adjusted in different heights and be placed under a table after use. The concept can be moved around in the patient's home.

Ill. 39: Sketches

Expert knowledge from ByLink

In order to get some expert knowledge regarding the project and feedback on the concepts the Danish company ByLink was contacted as they work with products in the healthcare sector. Here contact with Liza Haslund-Larsen was established.

Ill. 40: ByLink

DNA description:
ByLink is a smaller Danish Medico company. Their focus is on user-driven product development and they work closely together with the Danish healthcare staff. (ByLink, n.d.)

ByLink was contacted for the reasons that they make small and well-designed solutions for Danish healthcare. They can provide expert knowledge and feedback on concept direction.

What do ByLink make?
One of the products that ByLink has developed is a product called HangOn Table, which is a table where the patient can place their food. However, the product is also for the health care staff where they can place their equipment when they treat the patient e.g. doing wound care.

Ill. 41: HandOn Table

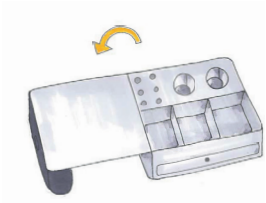
Feedback:
Based on presenting the problem, Liza from ByLink recognizes the problem and has talked with a nurse that experienced the problem. (App. 12) An important aspect of the concept development that Liza contributed with is that many different types of HHC nurses visit the patients with their own systems and routines. Therefore, the equipment must not have a specific place in the containers as the example with a tool box. Instead they need a system for the equipment, so it is easy to see what needs to be refilled.

Ill. 42: ByLink

Ill. 43: Tool box

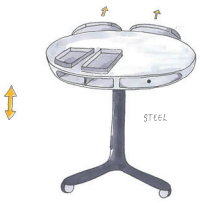
Furthermore, Bylink thinks it is important to have a box that looks nice that the patient wants to place in their home, instead of a cheap plastic box. Lastly, she mentioned the price point, and that many municipalities have a low budget, and therefore it is most likely to have a box.

The box



Fits on a table or in the bed.

The table



Is too big to have in private homes.

The wagon

Ill. 44: Sketches

Is too big to have in private homes.

Feedback from a nurse

In order to gain more knowledge about what the solution should be able to do, an interview was held with a nurse student from Aarhus. (App. 4)

> *"There should be few interactions"*

> *"Remember stability in the product if it is placed in the bed"*

> *"An edge on the top will be a good idea so the equipment will not fall down"*

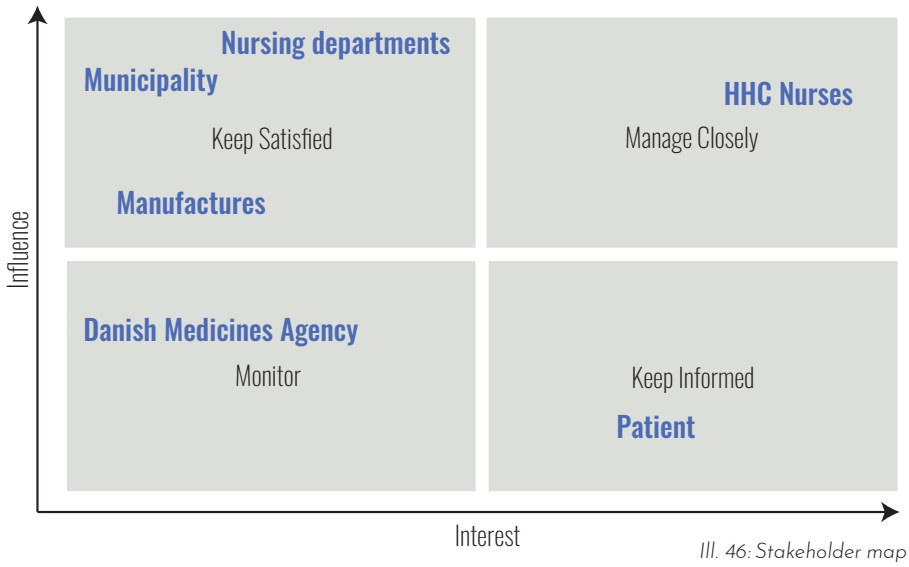
Ill. 45: Feedback

Conclusion:
Due to limited space, the location of use should be within the bed itself. The price along with the ability to easily clean the product are determining factors. Based on this it was decided that the box was the best fit from the initially explored ideas, since it would both be the cheapest to produce. By talking with a nurse student it was also noted that the solution should allow for separation of dirty and clean equipment and tools. However, the solution should not be over separated, i.e. a separate location for each and every equipment. This is in order to preserve the ability to customize the workflow to the individual nurses liking.

Stakeholder map

To create a visual overview of the stakeholders (Hendricks, n.d.) that affect and influence the project a stakeholder map is represented below. The map is important to make as there are different stakeholders with their own wishes and opinions when making a project. Therefore, it is relevant to figure out which stakeholders should have the most influence on the project.

Most of the stakeholders are involved throughout the development process to ensure different perspectives and help with answering assumptions.



Ill. 46: Stakeholder map

Manage closely
The HHC nurses are the only stakeholder that both has high influence and high interest in the project. They experience the problems and the solution needs to be one the nurses want to use. Therefore it is important that the HHC nurses are involved several times throughout the process.

Keep satisfied
Both the municipality and the different nursing departments are important to keep satisfied. They need to sponsor the solution and they take the decision about if the product should be in their assortment. Furthermore, the manufacturers also have some influence on the solution because the price of the solution is important. Therefore, through the process, both the municipality and manufacturers are important to involve in the project.

Keep informed
The patient has only a small influence on the product, but due to the solution being placed in the home of the patient, they have a high interest in the solution.

Monitor
The Danish Medicines Agency has guidelines for medical equipment that the product needs to fulfill. This is taken into consideration through the development process.

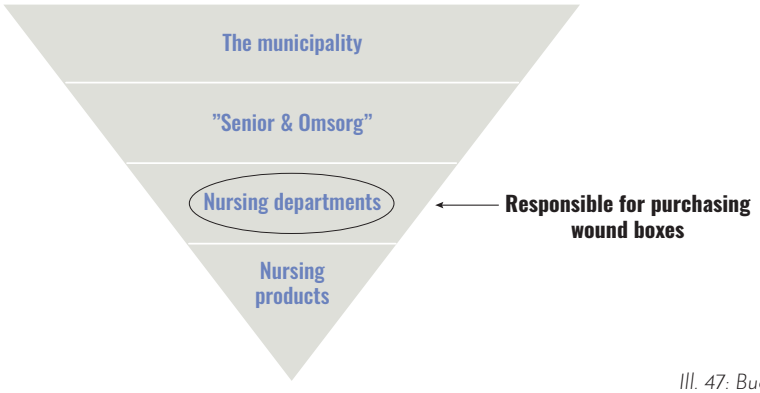
Conclusion:
It can be concluded that it is the HHC nurses who mainly should be involved in this project as they are the ones who experience problems on a daily basis, and who should use the product solution in the future. However, it is still important to keep the municipalities satisfied as they are the ones who determine the budget.

The next step in the process is to investigate who in the municipalities works and decides budgets for wound care boxes.

Budget

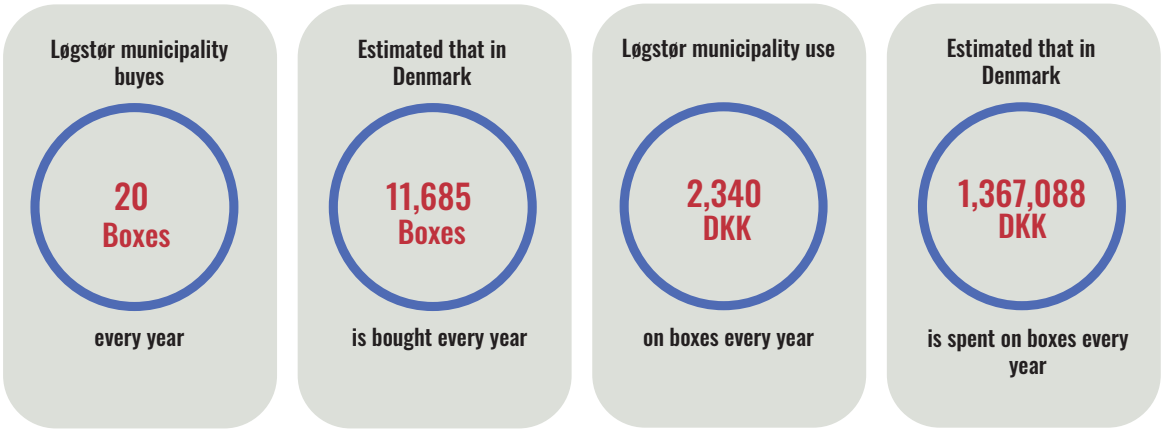
To get an understanding of the business case, the market, and who is responsible for purchasing the wound boxes, research and interviews have been made. Based on a mail interview with a Team Leader (Home and Nursing Care) from Løgstør municipality it was told who determines and is responsible for buying the wound boxes in the municipality. This section is based on appendix 7.

The budget for nursing care is decided by the city council in the municipality. Subsequently, the department in the municipality "Senior & Omsorg" takes decisions on distribution, nursing products, etc. Afterwards, is it the different nursing departments in the municipality who are responsible for purchasing different products and equipment, but have a budget in relation to nursing products (catheter, wound care products, wound boxes, etc.).



Ill. 47: Budget mapping

Furthermore, it was told that they buy 20 pcs. of boxes every year in Løgstør municipality. Based on that an estimation of new boxes brought every year in Denmark is made. This shows that in Denmark 11,685 boxes are brought for wound care in home health care.



Ill. 48:Budget

Based on the numbers of boxes bought every year and the price on a medium size box (117 DKK) an estimation is made to see how much money Løgstør and Denmark are using on boxes every year.

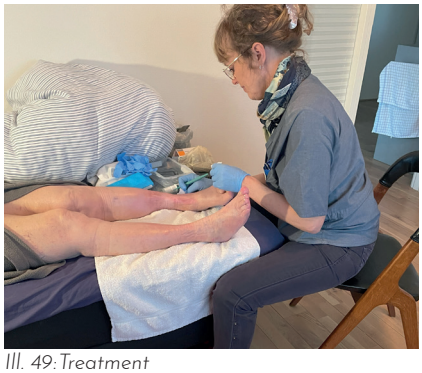
In addition, estimation has shown that 4,883,376,211 DKK was used in 2021 on nursing care in Denmark. (Aabenraa Kommune, 2021)

Conclusion:
Research has shown that it is the different nursing departments in the municipalities in Denmark who purchase the wound care boxes, for which almost 12,000 boxes are purchased per year nationwide. However, these numbers are only based on boxes in home health care and not boxes in nursing homes, where the boxes also are used. Likewise, it has not taken into account the boxes there are already in the municipalities.

Where to place the product?

Based on observations the wound care treatment is typically practiced in the patient's bed or in an armchair. As a result, the HHC nurse is going back and forth a lot of times from the table to the bed or chair.

Treatment in a bed



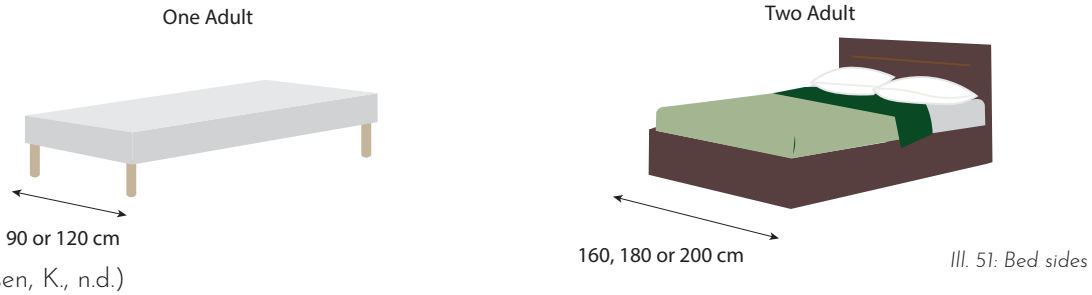
Ill. 49: Treatment

Treatment in a chair

Ill. 50: Treatment

Therefore it was decided that the product should be able to be placed in the patient's bed or on a chair. This is a way to minimize going back and forth. This is why research about the size of chairs and beds are investigated in this section.

Width of beds:



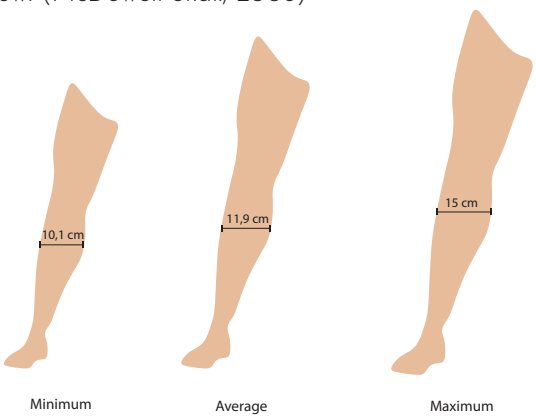
(Pedersen, K., n.d.)

Ill. 51: Bed sides

Width of chairs:
The width typically varies from chair to chair from around 45 to 55 cm for dining chairs. (Jysk, n.d.)

Ill. 52: Width of chairs

Size of legs:
Calf diameter of American population is shown below. (McDowell et.al., 2008)



Ill. 53: Leg size

Conclusion:
Due to the fact that there are two legs placed in a bed, the maximum width for these two legs is 30 cm. In order to have space to work around the legs, a minimum of 20 cm must be given for movement around the legs. In total, there must be 50 cm for legs and workplace - which leaves 40 cm for the product solution in a 90 cm bed. Therefore, the product should be small and compact to be able to be placed in the bed.

- The treatment is practiced in a bed or chair
- Should have a maximum length of 40 cm

How do they do it in hospitals?

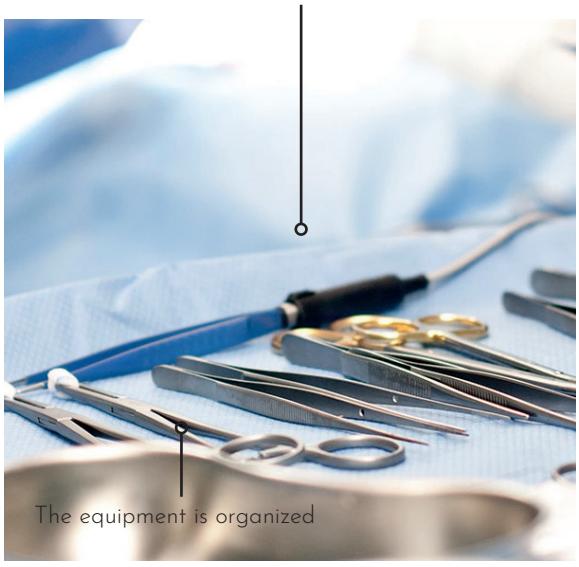
To get an understanding of how the hospital stores equipment, different storage solutions in hospitals are investigated. This is done to get a professional angle on how the staff at Danish hospitals store both clean and new equipment, but also how they do it for a treatment. The investigation was only done for small products to make a more realistic comparison with the product solution.

Storage

Ill. 54: Wagon

Ill. 55: Wagon

Ill. 56: Wagon



Ill. 57: Surface

Treatment

Addition, research has shown that according to Statens Serum Institut clean equipment should be stored in closed cupboards, drawers, or clean boxes for storage in the patient's home. This fits well with the focus that has been on the development of the concept. (Statens Serum Institut, 2020)

Conclusion:
Based on research, it is seen that products in hospitals for storing equipment mainly consist of drawers, on which there is a clean surface to work and place clean equipment. It also showed that clean equipment should be stored in closed cupboards, drawers, or a clean box in the healthcare sector, which shows that the equipment should be stored from dust with more.

- Clean equipment is stored in closed cupboards, drawers or a clean box in the healthcare sector

- Should secure the equipment from dust and bacteria

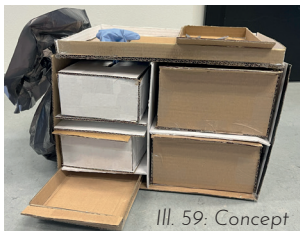
Concept directions - Overview

Besides inspiration from hospital products used for storage, it also looked at how other products for daily use and other professions creates an overview (App. 11).

The inspiration from daily use was used when developing three different concept directions with a focus on making an overview of the equipment. (App. 13) As seen in the hospital products it is important that the equipment is securely stored, which was in mind when developing the concepts.

DRAWERS

Ill. 58: Inspiration



Ill. 59: Concept

Inspiration from IKEA TROFAST

- Easy to pull out, move and put back in place
- Overview of drawers
- Modular
- Use different containers

The equipment is separated into different drawers.

There is space for a garbage bag on the side of the box.

HAY - Stackable

Ill. 60: Inspiration

Ill. 61: Concept

Inspiration from HAY Colour Crate

- Stackable
- Multifunctional
- Place where you want to
- Modular
- Overview of many drawers

The equipment is separated into different containers. It is possible to separate and stack the containers.

Get an overview of all the equipment all at once.

TOOLBOX - Foldable

Ill. 62: Inspiration

Ill. 63: Concept

Inspiration from tool boxes

- Foldable
- Overview of all equipment at once
- Few interactions

The equipment is separated into three different boxes, where the boxes are separated into two.

In order to determine which of the concepts creates the best overview while during the treatment an acting out (Bagger & Sperschneider, 2003) was made, where it also was tested whether there is space for the boxes in a bed (size 90 cm).

DRAWERS


Ill. 64: Concept direction

- Equipment is packed away in closed drawers
- Organization
- Overview in separate containers

HAY (stackable)


Ill. 65: Concept direction


Ill. 66: Concept direction

TOOLBOX - Foldable


Ill. 67: Concept direction


Ill. 68: Concept direction

It can be seen that both the stackable and foldable principles give a good overview of the equipment, due to it being possible to see it all. The downside is that all the equipment is exposed to dirt during the treatment, and can be dirty from used equipment.

Conclusion:
It is decided to work with the drawers due to the equipment being packed away, which is good for not infecting the equipment and it is possible to have it in the bed. The drawers are also seen in other products for hospitals. It is furthermore decided to incorporate having few boxes from the foldable and stackable principles to get a better overview of the equipment in the drawers concept. This is due to having many drawers which can lead to losing the overview of the equipment.

Presentation of the concept direction

After choosing the concept direction, the equipment used for wound care treatment was built and purchased to achieve an understanding of what the product should contain and how many containers there should be. The amount of equipment varies a lot for different types of wound care treatments. Therefore, further concept development is based on the volume of the current plastic box, where all the equipment, except the glove box is stored.

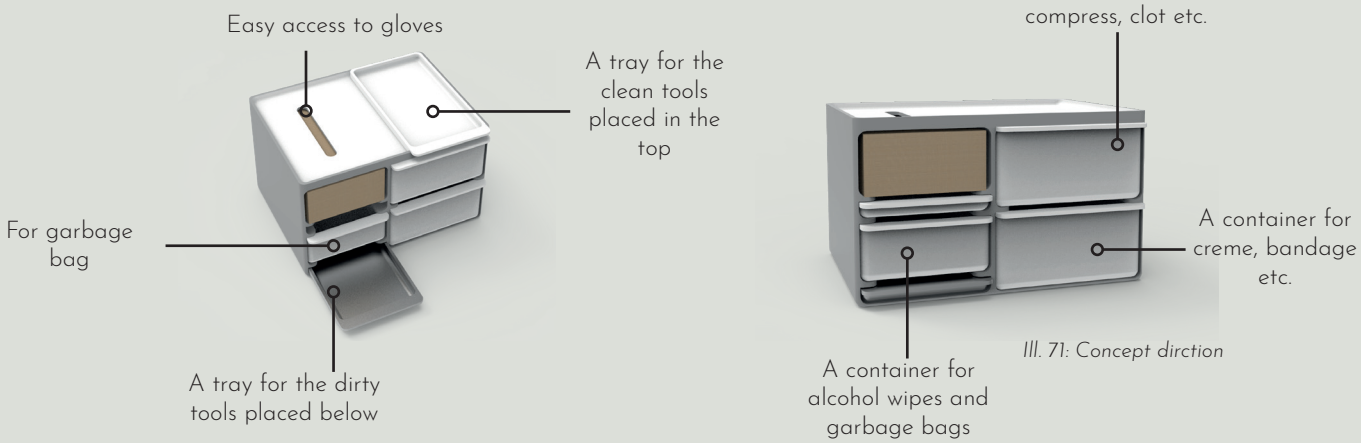
MEDIUM: 11.5 Liter

Ill. 69: Wound box

Amount of equipment

Ill. 70: Equipment

Concept direction (DRAWERS)



Ill. 71: Concept dirction

Feedback form the HHC nurses

After choosing the concept direction a meeting with the HHC nurses from Hjørring was held in order to get feedback on the concept. (App. 8)

> *"It has a good size"*

> *"We have 5 minutes to clean the boxes each month"*

> *"The sections of the different containers are just fine"*

> *"Cleaning is very important - how is it cleaned? There are many small rooms"*

Ill. 72: Feedback

Conclusion:

Based on the feedback from the HHC nurses it is made clear that cleaning is important and should be easy to do. Furthermore, the two nurses were positive about the concept and think the sizes and sections of the containers are fine. However, the team was concerned if the product is too big, if there are too many interactions and if there is enough storage space. These concerns need to be reflected upon.

- The HHC nurses have 5 minutes to clean the boxes each month
- The equipment is stored in a 11.5 L box (excl. the box with disposable gloves)

- Should be cleaned within 5 minutes
- Should contain 11.5 L

Concept development

After choosing the concept direction of the drawers, a new mock-up was prepared with a focus on minimizing the number of interactions (App. 14) Furthermore, it was investigated how a holder for a box of disposable gloves is in hospitals and nursing homes.

Ill. 73: Gloves at hospital

Ill. 74: Gloves at nursing home

Here it was noted that the box with gloves is placed so they are easy to grab and no dirt can enter. Therefore, it was decided to place the box with gloves on one side of the box.

DRAWERS 2.0

Ill. 75: Concept

Ill. 76: Concept

After the development of the box different consideration was made:

One or two drawers?

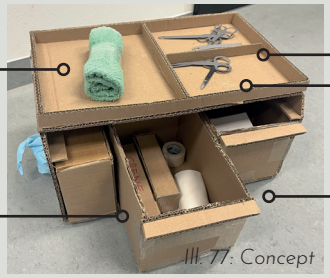
- One drawer: the concern is, that the drawers will never be closed, because the nurses need the equipment in the drawers all the time. The equipment is therefore exposed during the whole treatment.
- Two drawers: the equipment is not exposed all the time, because you will close the drawer that you are not using. However, there are more interactions.

Based on the consideration, it was decided to make a new mock-up with two drawers and one tray for the tools. A new mock-up was built with the new positions and numbers of drawers to test it.

Organization and numbers of drawers

A new mock-up was developed, where the focus was on making the concept smaller, simpler, and with a larger storage surface. (App. 15)

DRAWERS 3.0



Ill. 77: Concept

Conclusion:
The new concept has minimized the number of drawers both with the focus on minimizing the interactions, but also to have a more cost-beneficial product. Also, the size of the drawers is minimized to have a volume similar to the current plastic boxes. Furthermore, the dirty tools are placed in the front to avoid the clean tools from being infected and for easy cleaning, it is placed in a removable tray.

Key insights

No overview of the patient's wound care equipment
The patients' equipment for wound care is stored in several sizes of plastic boxes located in the patient's home. The boxes are messy and the HHC nurses have no overview of the contents and what is missing for the next treatment. Furthermore, the boxes are often reused for a new patient.

Placement of the equipment
The equipment is often placed on the lid of the box in order to use the lid as a clean storage surface during the treatment. When using the lid as a storage area the clean and dirty tools are mixed during the treatment.

Price is important
Based on feedback from Liza from ByLink and interviews of the two HHC nurses from Hjørring it was made clear that the solution must be a cheap solution, due to the fact that the municipalities have a tight budget.

Limit space in the bed
The product solution should be placed in the patient's bed or chair, because the treatment is practiced in these areas in the patient's home. Research has shown that the product should be small in order to be placed beside the patient in the bed.

Unprofessional working procedure

The HHC nurses perform treatment in the private home of the patients. This does not allow for the same professional workflow as is known from the hospitals. Therefore it is desired to create a professional storage solution that will empower the HHC nurses to perform professional and efficient treatment in the private homes.

Interaction vision:
In order to create a common understanding of the direction of the project, and what values the product proposal should possess, the following interaction visions (Pasman et. al., 2011) are created for the nurse and for the patient.

Ill. 78: Efficiently

Efficiently,
as having a structured plan for the day

Ill. 79: Organized

Organized,
as mom always know where the things are

Ill. 80: Efficiently

Professional,
as the feeling of being qualified in the job

Insights	Requirements	Source (page)
After treatment has ended the boxes are cleaned in an industrial dishwasher		The wound care box
The lid is used as storage place	Should have a surface for placing the equipment	Shadowing of the box
The equipment is in disorder	Should provide an overview of the equipment	Shadowing of the box
The treatment is practiced in a bed or chair	Should have a maximum length of 40 cm	Where to place the product?
Clean equipment is stored in closed cupboards, drawers or a clean box in the healthcare sector	Should secure the equipment from dust and bacteria	How do they do it in hospitals?
The HHC nurses have 5 minutes to clean the boxes each month	Should be cleaned within 5 minutes	Presentation of the concept direction
The equipment is stored in a 11.5 Liter box (exclusive the box with disposable gloves)	Should contain 11.5 Liter	Presentation of the concept direction

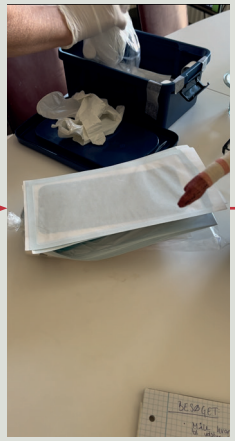
Preperation

In the following section, the preparation phase of the treatment is investigated. To understand the preparation phase shadowing of HHC nurses and comparison of their preparation procedure have been investigated. The concept development revolves around interactions to minimize the preparation time, where different tests have been carried out. Lastly, the preparation of the concept proposal is tested through acting out by staff working in healthcare.

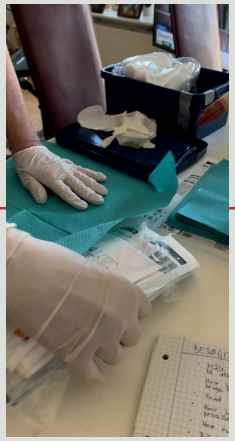
Scenario: Preparation

As a part of understanding the workflow when doing wound care, it is important to understand the preparation phase as well. Therefore, the preparation was observed when doing wound care.

The HHC nurse only prepared the equipment for the beginning of the treatment - and found the other equipment partial during the rest of the treatment. Here, there is only one box for the treatment.

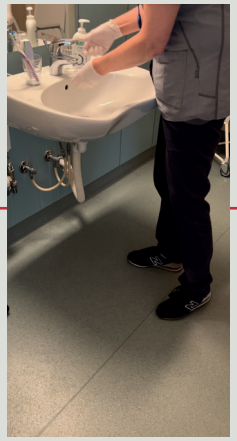


She finds the box in the cabinet. She opens the box and places a few gloves on the lid. Furthermore, the plastic bag with refill equipment from the depot is found in her nursing bag.

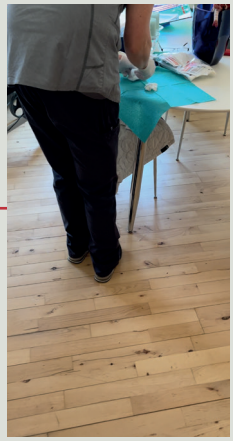


She uses a drape sheet to place equipment on.

Afterwards, she is finding a stool and putting a drape sheet underneath the patient's leg.



She is making the gauze wet, which should be used for cleaning the wounds.



And she places some of the gauze on the drape. The treatment has started.

Ill. 81: Scenario

The observation showed that the HHC nurse uses a lot of time to find the right equipment for the treatment in the box. Furthermore, she used a lot of time on creating an overview of the equipment in the box she should use during the treatment, and what she needs to bring for the next treatment.

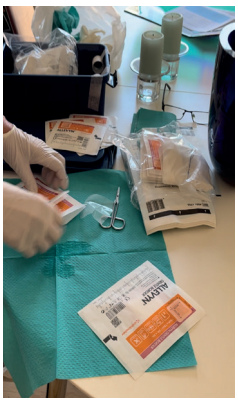
In total, the HHC nurse used 4 minutes and 38 seconds of preparation for the treatment, where she found the box, placed a drape underneath the treatment area, and got the gauze wet. Besides the 4 minutes and 38 seconds, the nurse also uses time during the treatment to find and prepare the equipment.

- The nurse moves the box from the storage place to the treatment area
- The preparation takes 4 minutes and 38 seconds

- Should be possible to lift around in the house
- Should take less than 4 minutes and 38 seconds to preperate the treatment

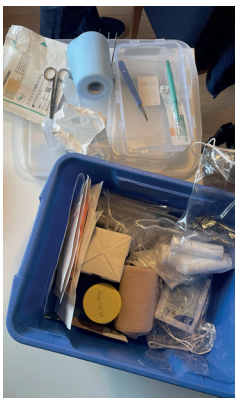
Where is the preparation happening?

By observing different wound care treatments, it was noted that the equipment during the treatments was placed in different places, which are shown below. Some nurses prepare all the equipment on a chair, some prepare the equipment on a table, where others place some of the equipment on the bed. It shows that the nurses have different routines, and use what is near the treatment area to treat the wound.



On a table

In the bed



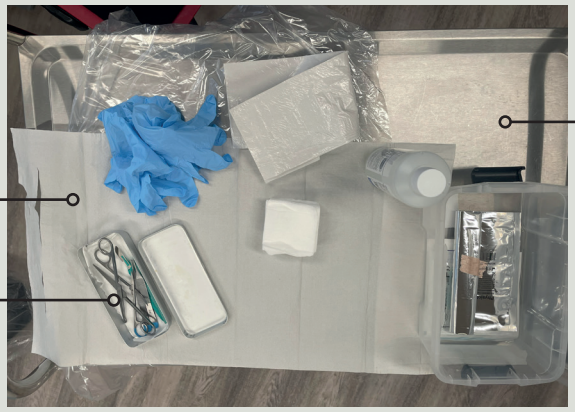
On the lid on a table

On a chair

Ill. 82: Preparation

However, the workarounds for the preparation is not professional, and differs a lot from what they do in the hospital or in nursing clinics, which are shown below.

Nursing clinic



Ill. 83: Nursing clinic

In nursing clinics and hospitals, they only line up the equipment for one treatment to keep the other equipment clean. The equipment is placed on a shelf trolly, so it is within arm reach. If there is equipment left, it is disposed of after the treatment to avoid infection to other patients.

Conclusion:
It can be concluded that the observed HHC nurse used 4 minutes and 38 seconds of preparation for the treatment. Besides the 4 minutes and 38 seconds, the nurse also uses time during the treatment to find and prepare the equipment.

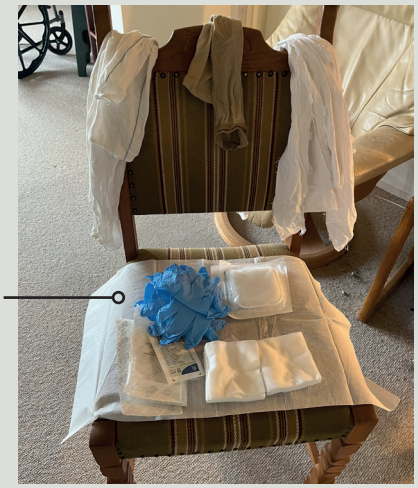
Furthermore, it can be concluded that it is very different where the preparation is happening depending on the context and the nurses' routines. However, the preparation differs from how they do it in nursing clinics.

- In the nursing clinic the equipment is within arm reach

How do the HHC nurses create an overview?

When observing the preparation phase for the wound care treatment, two different ways of how the HHC nurse is creating an overview of the equipment are spotted.

All equipment:



All the equipment is placed on a clean surface next to the nurse and the treatment

Ill. 84: Overview

Spent a lot of time lining up the equipment in the beginning of the treatment in order to minimize going back and forth from the table to the patient.

Few equipment:

Some of the equipment is placed on a clean surface, and the rest of the equipment is placed in the box on a table

Ill. 85: Overview

Spent a lot of time on getting the equipment during the treatment. She goes back and forth from the table to the patient.

Again, this shows that the HHC nurses have different ways of preparing the treatment. During an interview with the HHC nurses from Hjørring, they said that the routines depend a lot on the context of the treatment, and they use whatever is available in the patient's home. Furthermore, it is not the same HHC nurses who come to the patient every time, and therefore, they do not have an overview of the equipment, because it becomes messy. (App. 8)

What is typically difficult to find in the box?

In some cases, it is seen that the tools are not placed in a separate container. In these cases the surgical scissor is typically difficult to find between all the equipment in the box. Therefore, the HHC nurses often tape the scissor back on the lid so they know where it is for the next treatment. (App. 16)

Taped on

Ill. 86: Equipment

In the box

Ill. 87: Equipment

This proves that it is necessary to separate the tools from the other equipment, due to making an overview of the equipment and tools, and making the preparation phase faster.

Conclusion:

Based on observations it is seen that the HHC nurses have different ways of preparing the equipment for the treatment. Furthermore, it showed that they have difficulty with finding the scissor when it is not placed in a separate box. The challenge is to make a solution that makes the preparation more structured for the nurse even though they have different procedures.

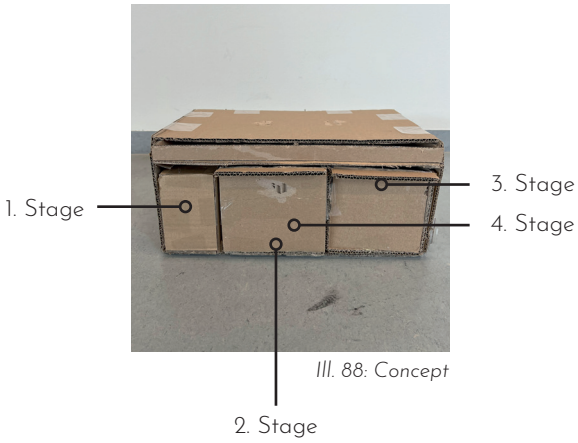
- The sharp tools are separated from the other equipment

Minimizing of the preparation time

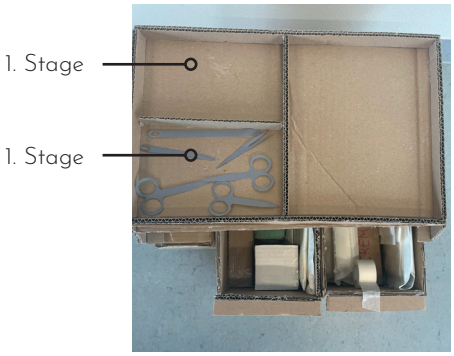
When understanding the preparation phase it shows that it takes a lot of time to find the equipment for the treatment. It also shows that the HHC nurses have different ways of preparing. However, in the nursing clinic, they have all the equipment within arm's reach.

This together with the understanding of the treatment and the storage has led to the concept presented below.

DRAWERS 4.0



Ill. 88: Concept



Ill. 89:Concept

The box is dividing the equipment into two phases with two drawers to get a better overview of the equipment. The equipment is divided into two phases because of minimizing the interactions and furthermore, the garbage bag is actually a part of the preparation. Therefore phase 4 is combined with phase 2.

The tools are placed in a tray, where it is separated into clean and dirty, where there also is a surface for storage. The gloves are placed on the side of the box, to make it easy to access. The size of the box is minimized to make it possible to place it both in a bed or on a chair.

The stages of the equipment are:

1. Main use Clean → dirty	Gloves Surgical tweezers, medical scissors, curette
2. Wash of wounds Cleaning	Cleaning fluid and gauze Alcohol wipes and garbage bag
3. Closure	Ointment, lotion, gauze, bandage, tape, wound band aid
~~4. Cleaning~~	~~Alcohol wipes and garbage bag~~

How does the box minimize the preparation time:

- The box is placed in the bed or on a chair, so the equipment is within an arm's reach
- There is no need for lining up the equipment before the treatment, due to it all is next to the nurse
- The equipment is divided into drawers to get an easy overview

Further work:

Next step in the process is to work further with the concept especially regarding minimizing interactions. Furthermore, the minimizing of the preparation time is going to be tested in an act out with a nurse.

Concept development: interactions

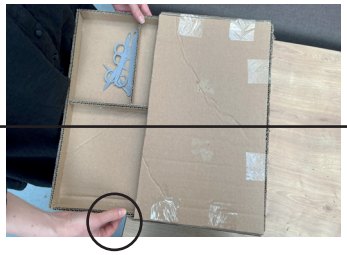
The decision with a tray

Due to the wish about minimizing the preparation time, it needs to be easy to find the equipment with a few interactions. Therefore, a test was carried out regarding the preparation of the tray with the tools in. Here, the focus was on the interaction with the tray, to make it quick to prepare.

Step by step of interacting with the tray in order to prepare the tools is shown below:

Grib is at the corner of the tray

Support from the fingers is added on the tray for a better grip



The hands are moved to take the tray out of the box

Ill. 90: Tray

The tray are placed on the top of the box

The hand are placed in the middle of the tray to create support

When testing the interactions with the tray it was experienced that taking out the tray and placing it upon the box required many interactions including that the grip on the tray changes during the placement. This is not preferable. Therefore the idea of having a lid instead arose, and it did not require any changes in the hand position, and it eliminated interactions.

The decision with a lid

A test was made with placement of the lid in order to investigate whether the lid should be removable or fixed to the box. The test is also made to minimize the preparation time. (App. 17)

Inspiration: removable lid

Ill. 91: Box

Inspiration: Fixed to the box

Ill. 92: Box

The two different directions were tested in a 90 cm wide bed. (App. 17) First, it was tested to have a removable lid. The test shows different ways to place the lid.

Removable lid

Up against the wall

The lid was placed against the wall. It is not alway a possibility to place the lid against the wall e.g. if the bed is a double bed.

On the floor

The lid is placed underneath the box, which creates a lot of interactions and is a bit troublesome.

Underneath the box

The lid is placed underneath the box, which creates a lot of interactions and is a bit troublesome.

In front of the box

Ill. 93: Test

The lid takes up a lot of space, and blocks easy access to the drawers.

Afterwards, a test was made with a lid fixed to the box.

Fixed lid

270 degrees

The lid is not in the way and it is easy to see the patient.

90 degrees

The lid was placed 90 degrees, which did affect the view and contact with the patient.

180 degrees

The lid was placed 180 degrees, which took up a lot of space.

On a chair

Ill. 94: Test

On a chair it was not possible to flip the lid more than 90 degrees otherwise there is not enough space for the box on the chair.

Conclusion:
It is decided to have a lid that is fixed to the box in order to minimize the lid being exposed to dirt and bacteria when placing it on the floor or in the bed. Having a removable lid can be difficult to know where to place in the home.

A fixed-lid, as seen on tool boxes, gives a more professional feeling for the nurse to have a special "tool box" for the equipment that is ready when opening it.(App. 18)

Inspiration from a toolbox:
Handel in the top

Ill. 95: Tool box

Inspiration from a box:
Placed at nursing homes where medicine is placed in

Ill. 96: Box

Based on the test it is decided to have a fixed lid that is to be turned 270 degrees. This is chosen to have contact and view of the patient during the treatment.

How to lift the product?

In order to investigate how to lift and transport the product from the depot to the patient's home, but also lifting the product around in the patient's home as a part of the preparation, a test was made with different placement of handles. The test is only made with women due to the fact that 96% of the nurses are women.

The box was placed in the trunk and in front of a car in order to test different ways of placing the box when transporting the product. The test person was asked to try the handle at the top and the handles on the side and which one they prefer. (App. 18)

Lifting the box:

Handles on the side of the box

She thinks the handles on the side were unnecessary because you only lift heavy things like that.

Handle on the top of the box

Ill. 97: Test

Preferred to go with it on the side, it was easier to walk.

Taking it out from a car:

In the front of the car

Handle on the top

Easy to reach the handle in the top

Handles on the side

Difficult to get it out of the car, because it takes up a lot of space

In the trunk

Handle on the top

Prefer the handle in the top

Handles on the side

Ill. 98: Test

Need to bend over a lot to get the box

Conclusion:

Based on the test it was seen that the test persons in general prefer the handles on the top. It was easy to grab the box, and it was more ergonomic because they did not need to bend over when grabbing the box. The test persons mentioned that the handle on the side was associated with heavy things, which was not the case.

- The boxes are transported in the HHC nurses' cars

- Should fit into a trunk of: 80 x 105 cm

Acting out - Test of the preparation time

An acting out was done in order to test the preparation time of the treatment. The test was done with the nurse student Sofie and a testperson in a private home. (App.19)

00:00

She is lifting the product from the table to the bed.

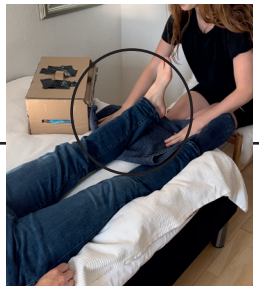
00:08

She is placing the box in the bed and she sits down.
The box is placed with an angel to provide a better overview of the box.

00:16

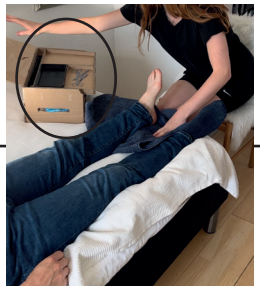
After placing the box in the bed she starts with taking the socks of the patient.

00:23



She is placing the towel underneath the patient's leg.

00:35



She is cleaning her hands with hand sanitizer and then she is opening the box.

00:38

She starts with finding the equipment she is going to use. She is opening the container in the middle.

01:08

While she is finding the equipment she has a good overview of the equipment.

01:28

Ill. 99: Test

Lastly, she is putting on gloves and she is now ready to do the treatment.

Conclusion:
Based on the acting out it can be concluded that the preparation time has been minimized from 4 minutes and 38 seconds to 1 minute and 28 seconds. Furthermore, it was noted that the nurse does not use time on going back and forth and can concentrate on doing the treatment without interruptions.

However, the nurse mentioned that there are many ways to do the treatments and how they will do the preparation.

Key insights

Unstructured preparation
The preparation of wound care treatment is unstructured and is carried out differently depending on the HHC nurse and her own routines. However, the preparation differs a lot from how they do it in nursing clinics, where it is a professional setting.

Interactions
When looking at the preparation phase to minimize the time, the interactions are an important part. Many interactions are time-consuming and therefore the interaction was reduced. Now the solution should be carried in the handle to the bed, where after the lid is opened, and the treatment can begin.

Professional feeling
To provide a more professional feeling for the HHC nurse, the product solution should be associated with a tool box, where the tools and equipment are organized and ready for the task.

Insights	Requirements	Source (page)
The nurse moves the box from the storage place to the treatment area	Should be possible to lift around in the house	Scenario: Preparation
The preparation takes 4 minutes and 38 seconds	Should take less than 4 minutes and 38 seconds to preperate the treatment	Scenario: Preparation
In the nursing clinic the equipment is within arm reach		Scenario: Preparation
The sharp tools are separated from the other equipment		How do the hhc nurses create an overview?
The boxes are transported in the HHC nurses' cars	Should fit into a trunk of: 80 x 105 cm	Concept development: interactions

Cleaning

The following section revolves around the cleaning phase after the treatment. To understand the cleaning, the importance of cleaning, and the steps involved in it, both desktop research, shadowing, and interview with the HHC nurse have been conducted. Furthermore, tests and acting out have been constructed, to ensure a hygienic solution that is simple and easy to clean.

How are the HHC nurses cleaning today?

The HHC nurses are responsible for the cleaning of both the box and the tools used on the patients' wounds. The procedure for cleaning is observed and described through interviews. When observing the cleaning phase it is seen that most of the time is used to clean up the equipment, which makes the nurses pressed on time when cleaning the tools. The cleaning procedure for both the box and the tools is described below.

Procedure for cleaning the box:
Once a month the boxes for equipment and tool storage are cleaned. Through interviews with the HHC nurses, it was told that they have 5 minutes for cleaning the boxes. Within 5 minutes, the nurse must clean up the box to sort out which equipment is needed and disinfect the box with alcohol wipes. (App. 9)

Ill. 100:Precedure

The equipment in the box is in disorder

The date of the equipment is checked and placed on a table

The box is cleaned with alcohol wipes

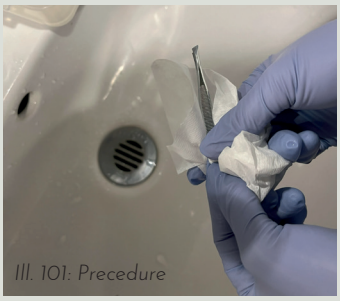
The equipment is systematically placed in the box

Procedure for cleaning the tools:
The nurses stated that the tools are cleaned after each treatment. Tools that have been in direct contact with wounds should be poured over with boiling water. Afterwards, the tools must be wiped with paper and placed back in a clean, closed box. (App. 9)

Direct contact

1. Add hot water on the tools

2. Dry the tools

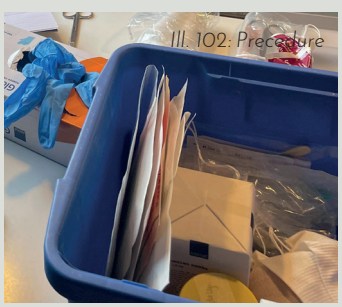


Ill. 101: Precedure

Tools that have not been in direct contact with the wounds should be cleaned with alcohol wipes.

1. Cleaned with alcohol wipes

2. Placed back in the box



Ill. 102: Precedure

Not direct contact

However, it has been noted during some observations of the treatments, that the dirty tools are placed back in the boxes without any cleaning. This is due to no overview of the equipment, which leads to missing equipment for instance alcohol wipes and as a result they can not do the cleaning afterwards. This affects the safety of the patient. Furthermore, even though a lot of wound care treatments are observed, it is not seen that the nurses clean the tools with boiled water.

Ill. 103: Box

The tools are not cleaned, but just placed back in the box!

Feedback from a social and health care assistant

DRAWERS 5.0

To get feedback on the concept a helper was involved in the project. The social and health care assistant, Marianne recognizes the problem with the plastic boxes for wound care from the nursing home: Here they also use the box and experience the same problems with equipment being in disorder. She experiences that the boxes are not cleaned that often, which is not that hygienic. (App. 5)

In general, she thinks that the hygiene in drawers 5.0 is much better, due to the separation of clean and dirty tools. It raises the safety for the patients, because there are lower risks of infection which makes the wounds worse. If the things in the current plastic box are not hygienic, she thinks there is a risk of infection.

Ill. 104: Box

Ill. 105: Feedback

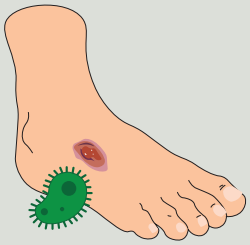
"The safety of the patient is improved with this solution"

"We can also use the box at nursing homes"

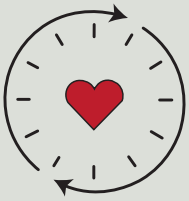
Problems when not using clean tools

When treating a wound it is important to keep the wound clean. If the wound is not kept clean, the healing process can be prolonged, or in the worst case, the wound can be infected. (Sunhedslex, n.d.)

Infection of the wound



Prolong the healing time

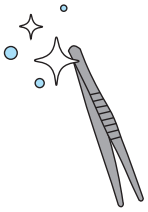


Ill. 106: Illustrations

Therefore it is important to have a clean procedure where the tools are clean, handled with clean hands, and placed on a clean surface. The infection can be transferred through blood, secretion, and infectious material. Therefore, it is also important to separate clean from dirty. This is done to secure against the risk of infection, which is followed by the hospitals. (Statens Serum Institut, 2017)

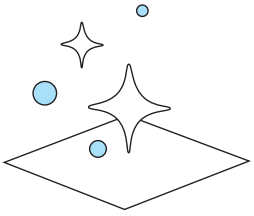
Clean procedure

Clean tools



Clean hands

Clean surface



Ill. 107: Illustrations

When treating wounds in a private home there are not the same strict rules for clean routines as in hospitals. This is due to it only being the patient's own bacteria that can infect the wound. However, it is still important to keep good hygiene and clean the tools after use to secure the wound. (App. 4)

Conclusion:
By observing different treatments it was noted that there is a lack of hygiene due to the fact that the HHC nurses often are missing equipment for cleaning the tools. As a result, they are placing back the dirty tools in the boxes. When comparing this to the routines of hospitals it is seen that the clean procedure is very important to reduce the healing time. Due to feedback from the social and health care assistant, Marianne it was stated that the safety of the patient is improved in the new solution as the clean and dirty tools are better separated.

- The boxes are cleaned with alcohol wipes
- The small box is cleaned with boiling water
- There is not the same strict rules at private homes as at hospitals

- Should be resistant to alcohol at 75%
- Should be resistant to water at 100 degrees

Test: What is easy to clean?

Due to the fact that the boxes need to be cleaned once a month within 5 minutes, and hygiene is an important factor, it needs to be fast and easy to clean the solution. Therefore different shapes and edges are tested to find a suitable solution. The test is made to make sure that the box and the container for the dirty tools can be cleaned without difficulties. (App. 20)

First, they are greased with mustard, soy, and curry paste. This represents oily products and liquids that can appear when making wound care. The containers are cleaned, just like the HHC nurses do it with the boxes.

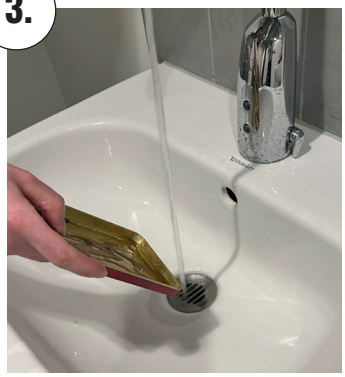
1.

Different shapes and edges of containers are lined up.

2.

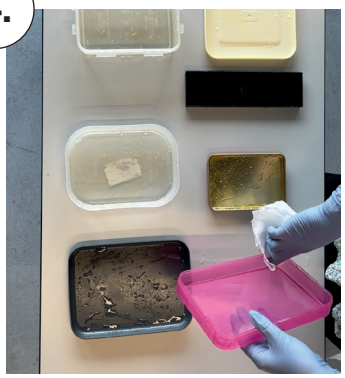
The containers are greased.

3.



The containers are rinsed with hot water in a sink.

4.

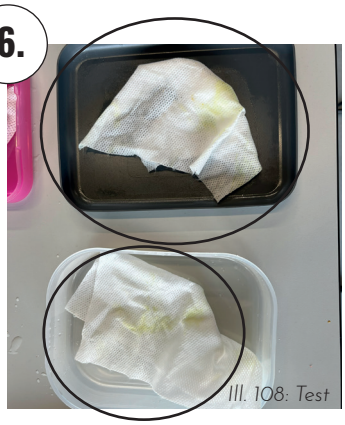


The containers are wiped with alcohol wipes.

5.

Done cleaning.

6.



Ill. 108: Test

These two containers were easiest to clean due to the fact they have round corners.

When cleaning the containers it is seen that sharp corners are difficult and time-consuming to clean, due to the dirt that collects there.

Conclusion:
The two containers highlighted in the test are the ones that are easiest to clean. The development of the product and the containers should have rounded edges in order to make it simple and easy for the HHC nurses to clean the product.

- Containers with round corners are easy to clean

Types of grips

To find the grip for the two drawers different types of grips were investigated. It is important that the equipment is secured from dirt in the drawers, but also that the grip is easy to clean.

For inspiration, hospital storage was investigated in order to choose the direction for the grip. Hospital storage was looked at to get a professional and clean association with the product.

Inspiration: grips used in hospitals

Ill. 109: Storage

- Well-know handle
- Closed and big drawers

Ill. 110: Storage

- Difficult to clean the handle
- Closed and small drawers

Ill. 111: Storage

- The handle is made out of steel
- Closed and big drawers

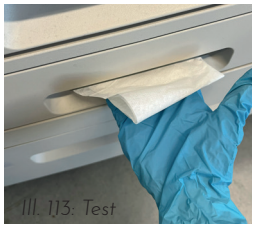
Ill. 112: Storage

- Closed and big drawers
- Easy to clean

In all the solutions the different drawers were fully closed, where the grips were surface with a large interaction area. Based on the found solution different types of grips were tested out.

The different grips are evaluated on two parameters:
1. How the grip is when opening the drawers when using gloves
2. How cleanable they are in both to protect the equipment from dust and how they can be cleaned. (App. 21)

Grips test: inspiration from hospital storage



Ill. 113: Test

Easy to open and clean, but the type of grip does not fit to the size of the containers.

To open and clean the grip it requires using the fingertips. Dirt collects in the grip, which is not hygienic.

The grip has a big surface which makes it easy to open. Due to the flat surface, it is easy to clean.

To open drawers it needs to turn the hand. When cleaning it also requires wiping all around by twisting the hand.

Conclusion:
Based on inspiration from hospital storage and the test of grip, it is decided to implement the grip with a large flat surface. The large surface makes it easy to open with gloves on furthermore, to wipe over when cleaning. The grip is seen as a simple and cheap solution that can be implemented on the drawers.

Acting out - where to place the garbage bag?

During observations of the treatments, it was noted that a garbage bag was placed beside the treatment area to make easy access for disposing garbage. Again the nurses have different routines for the garbage bag, depending on what is available in the patient's home.

Placement of the garbage bag:

Hung on a chair

Placed on the table

Placed on the bed

Ill. 114: Garbage bag

Based on the observations an act out was initiated in order to figure out where a garbage bag should be placed during the treatment to provide easy access, better hygiene and to avoid the HHC nurse going back and forth during the treatment. (App. 17, App. 22)

The box placed on a chair

A garbage bag placed on the front of the box.

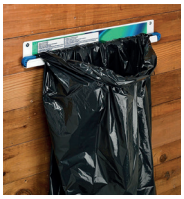
The box placed in the bed

Ill. 115: Concept

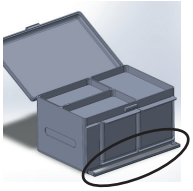
A garbage bag placed on the side of the box against the wall.

The test showed that it is most suitable with the garbage bag on the side or in the front of the box. With inspiration from other solutions, different options for a small garbage stand/placement were investigated and afterwards tested.

In front of the box



Ill. 116: Inspiration

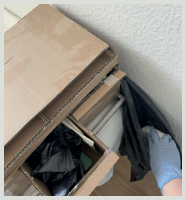


Ill. 117: Concept

It can be a bit difficult to place garbage in the bag if the bag is in the front due to the drawers. The stand will be in the way when transporting the product.

On the side of the box

Ill. 118: Inspiration



Ill. 119: Concept

It is possible to place garbage in the bag, also when the box is placed against the wall.

Conclusion:

It is decided to continue with the solution on the side of the box, because it makes easy access to the bag and because the solution is not in the way when opening the drawers. However, the stand should be made smaller in order to not create any problems when transporting the box or placing it against the wall.

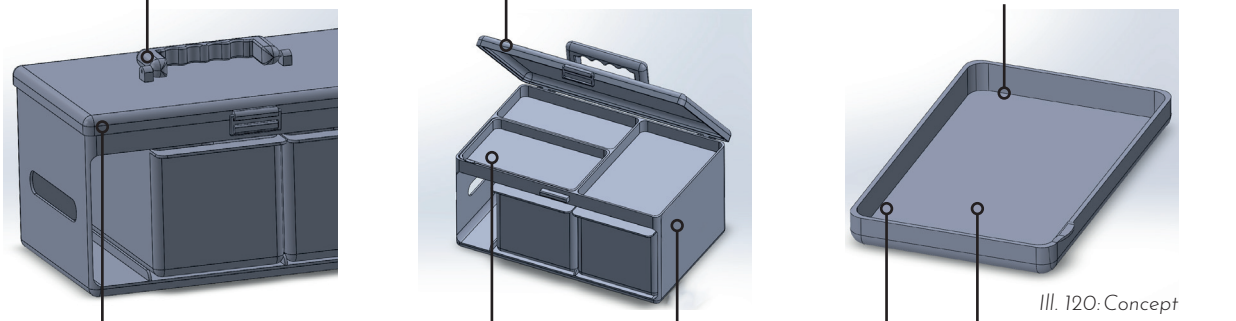
Cleaning

As stated it is very important to have good hygiene during wound care to prevent infection. Therefore it is also recommended to have clean and dirty tools separated, which is implemented in the solution.

The handle on the lid makes it possible to transport the box

The lid opens like a toolbox to make the box more professional.

The dirty tools are placed in a removable tray, which makes it possible to clean the tray and the tools.



Ill. 120: Concept

The dirty tools are placed close to the nurse to avoid spilling on the clean tools when moving them.

The garbage bag is going to be placed on the side

The size of the tray for the dirty tools is bigger than the clean to secure it is placed in the outer position.

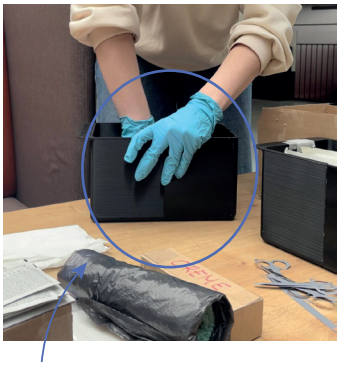
The tools are stored on the top and are separated into clean and dirty tools.

The length of the tray is similar to the current plastic box, to ensure space for curette, tweezer, and scissors.

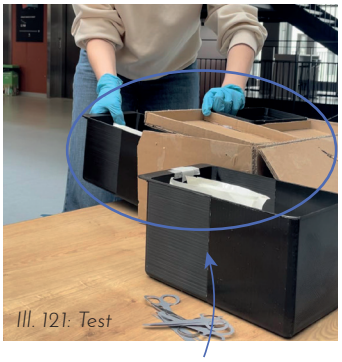
Test: cleaning under 5 minutes

Based on the knowledge that the HHC nurses have to clean the boxes once a month at each patient within 5 minutes, a test was initiated in order to test how long it is possible to clean the product solution. (App. 23)

The box and the drawers were emptied of their contents.



The box and drawers were afterwards cleaned with alcohol wipes.



Ill. 121: Test

Lastly, the contents were organized and placed back in the drawers. The drawers were placed back in the box.

Conclusion:
It can be concluded that it is possible to empty and clean the box in less than 5 minutes. Compared to the existing solution, the HHC nurse only needs to clean one box instead of three boxes.

It should be noted that the test persons did not use time on checking the content to see if any equipment should be disposed of, which the HHC nurses sometimes do in home health care.

Does it fit into a dishwasher?

As mentioned earlier, the solution needs to be washed in an industrial dishwasher at 90 degrees after the patient's treatment is finished, as the current plastic boxes. (App. 8) Therefore, the size of the tray for the dishwasher is investigated to make sure the solution can fit into it.

Hjørring municipality told through an interview, that when washing the current plastic boxes it is possible to have five extra small boxes, three small, or two medium sizes in one tray in one wash. That means cleaning the three boxes used for one patient requires washing two trays, which means two washes.

Existing solution placed in the diswasher

EXTRA SMALL x 5 | SMALL x 3 | MEDIUM x 2

Ill. 122: Box

OR

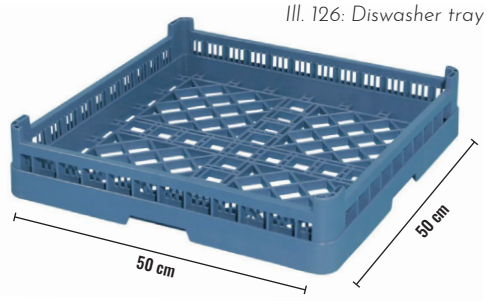
Ill. 123: Box

OR

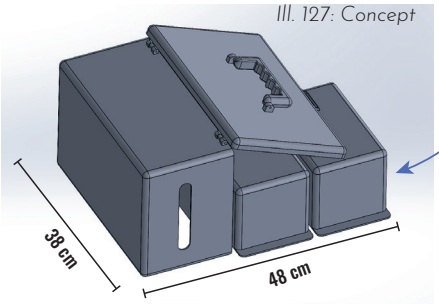
Ill. 124: Box

Ill. 125: Diswasher

Through research it is found out that the common size of the tray is 50 x 50 cm. This means that the solution should fit into the measurements. Below is illustrated how the box can be placed into the tray to fit into the dishwasher.



Ill. 126: Diswasher tray



Ill. 127: Concept

How to place it in the tray

Conclusion:
Based on the knowledge about the current plastic boxes it is known that they are washed in an industrial dishwasher. Therefore the new storage solution can fit into the dishwasher tray as well, and be washed in a single wash instead of two washes. Furthermore, the cleaning time is investigated, where it is proved that it can be cleaned within 5 minutes.

In addition, a material that can be washed at 90 degrees needs to be investigated, to make sure it can be cleaned.

- Should fit into a dishwasher tray at 50 x 50 cm

Key insights

Lack of cleaning
When the HHC nurses have to clean the tools after finishing wound care treatment, they often cannot clean the tools, as they lack equipment to clean it with. This is caused by the fact that they have no overview of the wound care boxes, which results in them not being able to clean the tools. Therefore, the tools are often just placed back in the boxes after the treatments.

The safety of the patient
When there is a lack of cleaning of the tools, it goes beyond the safety of the patient. A wound must be kept clean to avoid infection and to reduce the healing time, which dirty tools counteracts. Generally, there must be clean routines like in a hospital with clean tools, clean hands and clean surfaces.

Insights	Requirements	Source (page)
The boxes are cleaned with alcohol wipes	Should be resistant to alcohol at 75%	How are the HHC nurses cleaning today?
The small box is cleaned with hot water	Should be resistant to water at 100 degrees	How are the HHC nurses cleaning today?
There is not the same strict rules at private homes as at hospitals		How are the HHC nurses cleaning today?
Containers with round corners are easy to clean		Test: What is easy to clean?
After end treatment the boxes are cleaned in industrial a dishwasher	Should fit into a dishwasher tray at 50 x 50 cm	Cleaning

Detailing

In the following section, the detailing of the solution is presented. Here materials are investigated together with the construction of the concept, and help from expert knowledge are provided. Also, the expression of the product proposal is explored in order to indicate professionalism and associate the product with medico and hospital equipment. Lastly, the phase ends with final requirements.

Material and construction

Materials

Throughout the process, different materials have been considered, as price and cleaning have been a major factor in the development of the product. (App. 24) From the beginning of the project, plastic has been considered due to the properties of the material. Therefore, ABS, PE, HDPE and PP have been investigated.

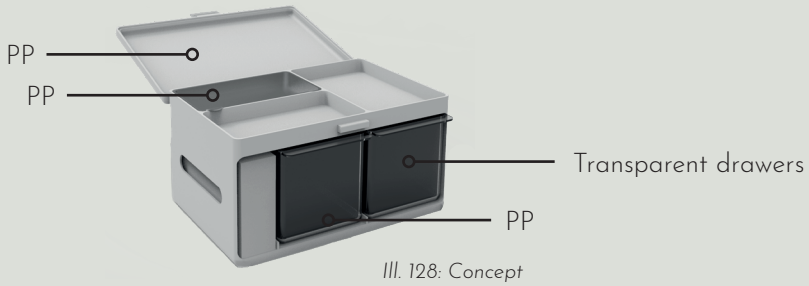
Based on the requirement that the product should be resistant to alcohol at 75%, water at 100 degrees, and the insight regarding that price is important, different types of plastic have been evaluated. Likewise, the different types of plastic are also evaluated based on their transparency as it has been considered if the drawers should be transparent.

Due to the price, ABS has been deselected. Furthermore, PE is deselected due to the fact that it is not resistant to 100 C, and it is not that good against alcohol. In addition, it is decided to chose the material PP instead of HDPE due to the fact that it is:

- A bit cheaper
- Have a higher E-module, which makes it possible to have a low thickness
- Have a lower density, which makes it more lightweight (Bay, B. & Larson, L., 1991)

Furthermore, PP is normally used for plastic containers and buckets, and therefore it fits well into the purpose.

DRAWERS 5.0:



Ill. 128: Concept

Constructions

Due to the price being an important factor when selling to the municipality, it is looked at how to minimize the cost. It is known that molds for injection molding are expensive and therefore the molds raise the production price. A way to lower the price of the molds is to focus on the part size and the complexity. (Fanthom, 2022)

By looking at inspiration for products that are injection molded, two sources of inspiration are chosen. The first is the cabinet molded in one, which means only one mold is needed. Both the complexity and use of the material are high. In the second inspiration, the cabinet is molded in two parts, which means the complexity is lower and the use of the material is less. Instead, two molds are needed.

Ill. 129: Inspiration

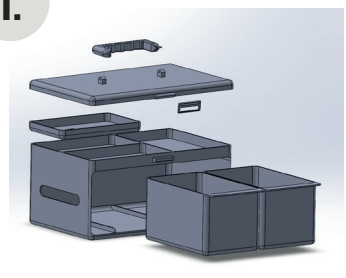
- Price: 252.99 DKK
- Cabinet in one = more stable and not exposed to dirt
- More material
- Higher complexity
- One mold

Ill. 130: Inspiration

- Price: 137.39 DKK
- Cabinet in two = cheaper price
- Less material
- Low complexity
- Two molds

Based on that, three different solutions for the cabinet are developed.

1. Cabinet in one

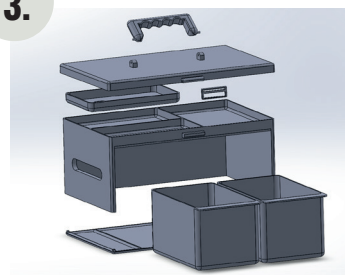


The cabinet is one complex part.

2. Cabinet in two

The cabinet is separated in two and the material is reduced.

3. Cabinet in two



The cabinet is separated in two, but with the use of more material compared to number 2.

Ill. 131: Concept

Lowering the complexity and separating the cabinet in two creates an extra mold. Therefore it needs to be investigated if it is cost-beneficial to have a cabinet in one complex form or to split the cabinet in two, which requires an extra mold. Furthermore, it investigated the difference between the use of materials.

To find out which of the three solutions is cost-beneficial to produce, an injection molding company is contacted to get expert knowledge.

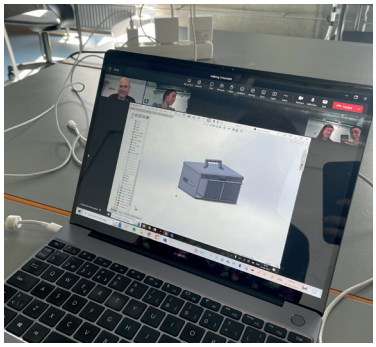
Expert knowledge from Unika

DNA description:
Unika is a Danish company that has experience with both the production of injection-molded plastic and related tools. Here, they guide companies in optimizing design through their tooling department so that it is ready for production, afterwards they produce, assemble and package the product. The company has more than 50 years of experience with plastic. (Unika, n.d.)

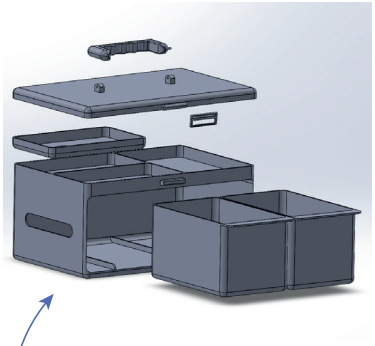
UNIKA
DANMARK A/S
PEOPLE · PROCESS · PERFECTION

Ill. 132: Unika

Feedback:
Through an online meeting with Steffen Toft Jensen from Unika (App. 25), the three solutions were presented. He was very clear that the cheapest solution would be the cabinet in one, due to it requiring fewer molds. Furthermore, he did not see any complications with producing the product. Based on his experience he would recommend that the cabinet and lid have a thickness of 2 mm, whereas the tray and the drawers have a thickness of 1 mm. The materials were also discussed, and he recommended using PP because it is rigid and does not shrink much.



Ill. 133: Feedback



Ill. 134: Concept

Cabinet in one

Production method

With the knowledge and feedback from Unika, injection molding is further investigated. Through the research different design commandments for injection molding are found, which is considered in this section.

Considerations

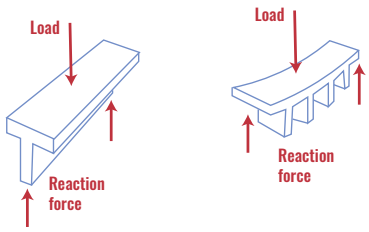
Constant wall thickness:
To avoid the material from shrinking in an uncontrollable manner it is important to have a constant wall thickness. Furthermore, it reduces the cooling time if you have a thinner wall thickness. (EastWestMfg, 2018) If the walls are not a constant size, then the thin walls will cool first, and afterwards, the thick walls will cool and shrink. This can cause yield stress that can make the area crack. (Stratasys, 2018)

Therefore, it is ensured that the construction has the same wall thickness at 2 mm, which is based on feedback from Unika (App. 25) and a study of plastic products (App. 26).

Before **After**

Ill. 135: Concept

Utilize ribs:
Instead of increasing the thickness, a common way in injection molding is to support the structure by adding ribs. A rib is a small surface that is extruded from the surface to reinforce the structure in an area and increase the bending stiffness. (EastWestMfg, 2018) Therefore, the orientation of the ribs is important to increase the bending in a product's critical point, which is illustrated in the picture below. (Plasticmolddesign, n.d.)



Ill. 136: Plastic molding

To construct the ribs for the concept, similar plastic products are investigated to get inspiration. The fishing case is similar to the cabinet and the screw box's lid is similar to the lid.

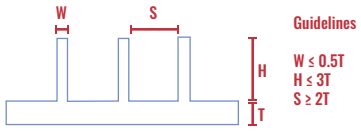
By looking at the fishing case, it can be seen that the ribs are oriented horizontally by having ribs placed at a 6.6 cm distance. Furthermore the fishing case has two ribs running along the vertical axis on the sides of the front in order to increase overall stability and stiffness. For the screw box, it is seen that the lid has ribs in two orientations. One between the handle, and two in the opposite direction.

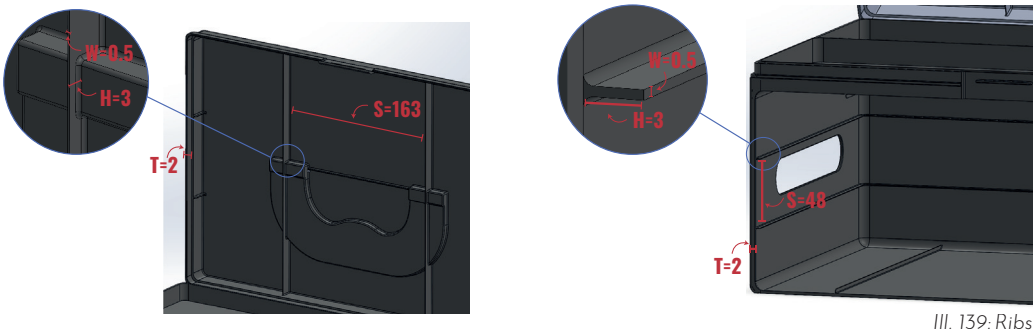
Fishing Case - cabinet **Screw box - lid**

Ill. 137: Fishing case

Ill. 138: Screw box

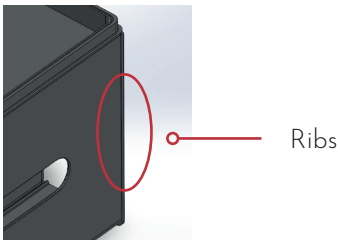
Based on the inspiration source, ribs are constructed in the concept, where the size of the ribs is determined based on the guidelines. (Plasticmolddesign, n.d.)





Ill. 139: Ribs

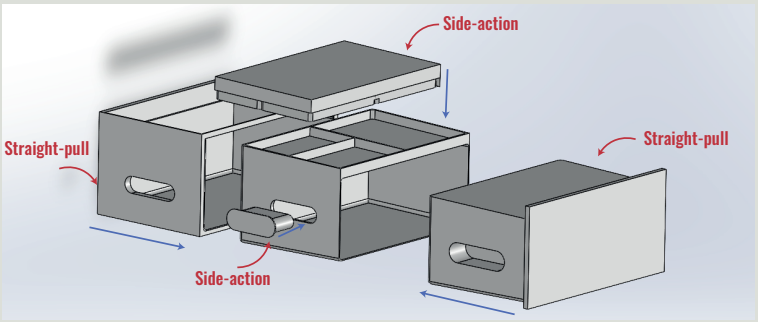
On the lid, ribs are placed in both directions, to support it from bending. Especially in the area where the handle is placed. On the cabinet, ribs are placed horizontally inside both on the side but also on the top, and the bottom to support against deflection. Also, a rib is placed on the front of the cabinet on the vertical axis in order to increase overall stability and stiffness.



Ill. 140: Ribs

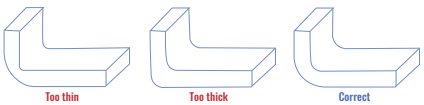
Molding:
When constructing the ribs the principle of injection molding should be held in mind. Injection molding uses straight-pull where two molds close together when forming the part.

More complex parts as the cabinet use side-action to create undercuts. (Protolabs, 2019) Based on the feedback from Unika the mold for producing the cabinet is shown in the illustration. Where the direction of the straight-pull is in the same direction as the ribs, and side-action is used on the side for the hole for the gloves, and to create the top of the cabinet.



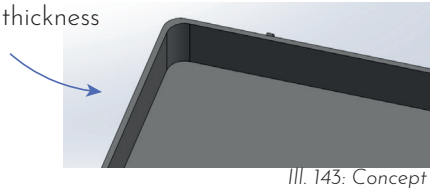
Ill. 141: Concept

Avoid sharp corners:
When using injection molding the corners need to be round and with the same wall thickness both to minimize stress and avoid the corners shrinking differently. (Team Fictiv, 2021) (EastWestMfg, 2018) This is taken into consideration when creating the soft corners of the concept, where the corners have constant wall thickness.



Ill. 142: Corners

Corners has a constant wall thickness

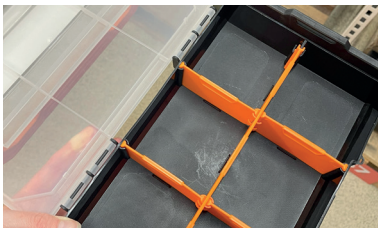


Ill. 143: Concept

Assembly

Existing products are investigated in order to find out what assembly techniques are generally used in plastic products. These types of principles are implemented for the assembly of the product solution. (App. 26)

The lid

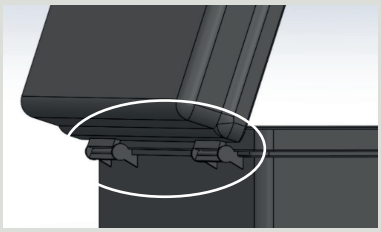


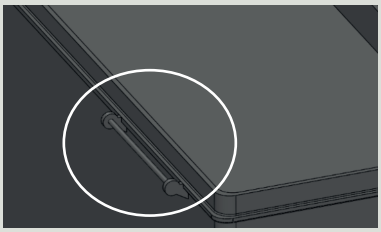
The handle

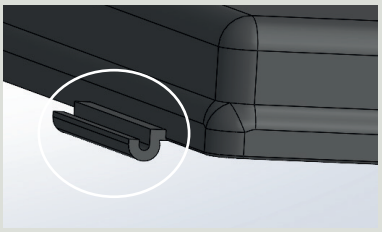
Ill. 144: Inspiration

The lid

The lid and the cabinet are clicked together and do not require any glue. This method utilizes the plastic's ability to warp and yield a little bit. This principle is seen in one of the existing tool boxes in the appendix. 26.



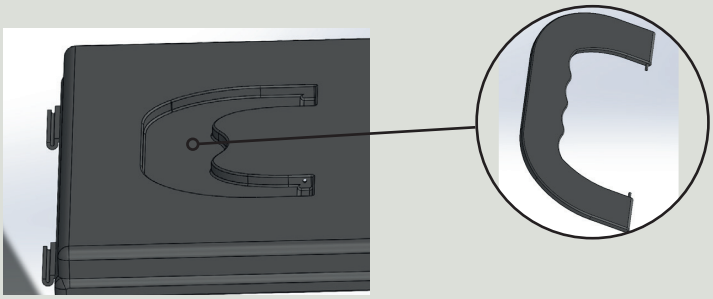




Ill. 145: Concept

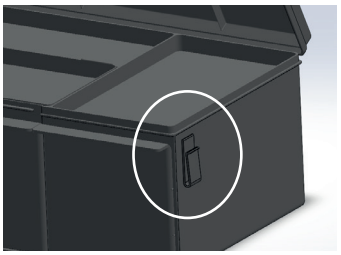
The handle

The handle is fastened to the lid with two splits that are inserted in each side of the indentation on the lid. This is again possible since the handle can be stretched a little, allowing the handle to be inserted.



Ill. 146: Concept

The clips for the garbage bag are glued onto the cabinet. For this an epoxy glue could be used since it is very strong and suitable for PP plastic. Furthermore, it is also water and alcohol resistant. (Pattex, n.d.)



Ill. 147: Concept

Reflection

Based on the meeting with Steffen Toft Jensen from Unika, recommends using the plastic PP. However, he added that recycled plastic is in high demand, especially from municipalities today, as the public sector wants to minimize its CO2 footprint. He said that due to the high demand, recycled plastic is more expensive than PP right now, but it may be an option in the future to produce the box in recycled plastic when the price for recycled plastic is lower. It will be a good sales parameter.

Product expression and style

As a part of the solution, the style is investigated. The focus of this project has been especially on the functionality, so it is easy to use for the HHC nurse, but the product should also indicate that it is a working tool for medical use. Inspiration was therefore found in hospital products, HHC nurses equipment and medicine containers, together with the knowledge from interviews with the nurses about the cleaning is an important factor. The intention is to develop a product that indicates a professional working tool for a HHC nurse.

How to indicate professionalism?

To figure out how the product can indicate professionalism, the HHC nurses bag with equipment was investigated. This was used as inspiration for the further development.

Ill. 148: Nursing bag

The nursing bag is systematically divided, where different equipment is placed in small transparent bags that give an overview of where the different equipment is placed. This is seen as everything is under control, which indicates professionalism.

Style board

Afterward, a style board was developed to get inspiration from existing products that are used at the hospital and by the HHC nurses. The products are all very simple in their style, with light colors and a focus on functionality. (App 27)

Clean surface

Ill. 149: Storage

The clean surface is associated with hospital equipment, where the surface is smooth and simple.

Clear interaction

Ill. 150: Thermometer
Ill. 151: Scissors

Clear interactions are seen on products that have a color change in where to interact used as a feedforward.

Soft corners

Ill. 152: Box

Soft corners are good for cleaning as dirt can not be collected as in sharp corners.

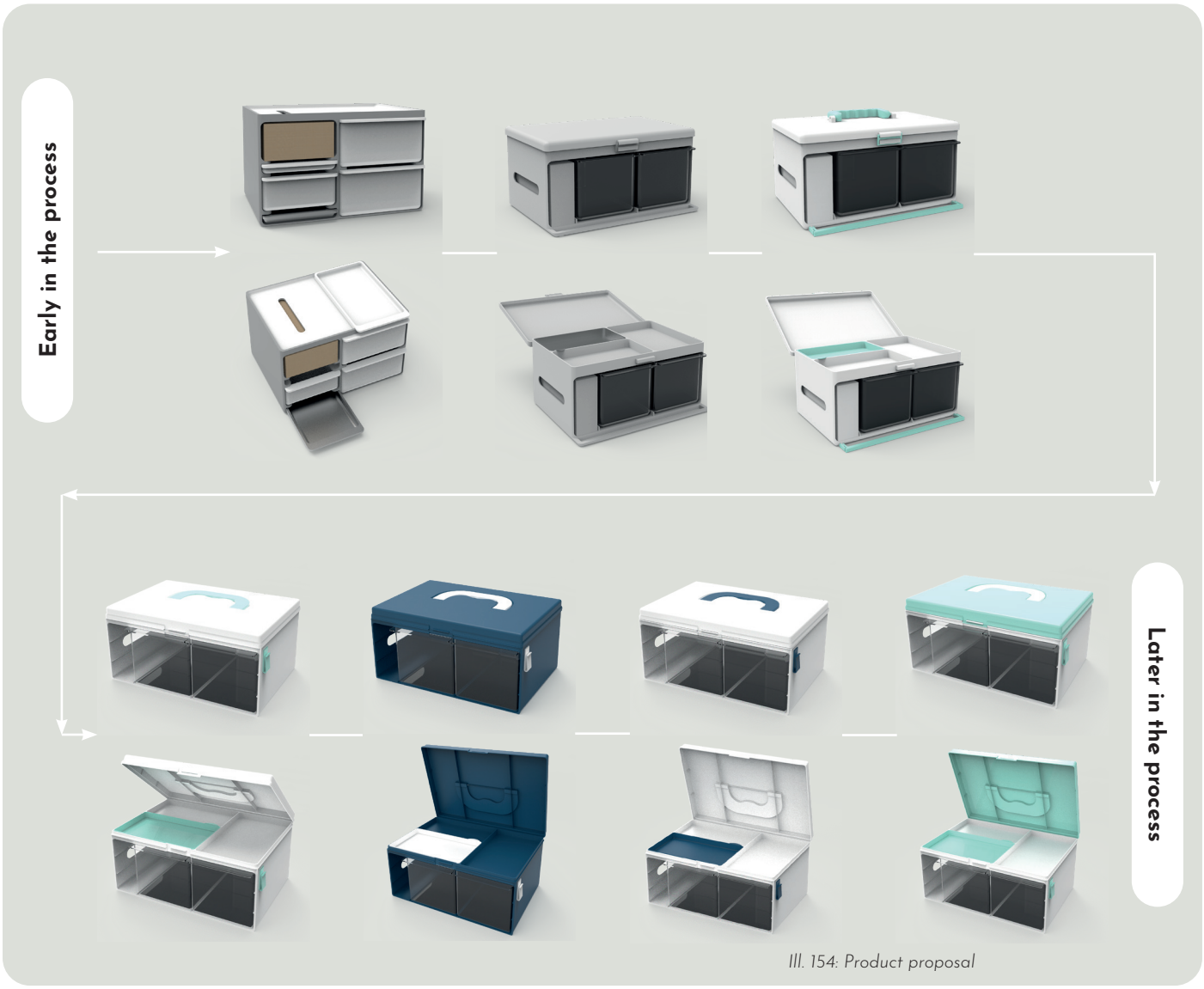
Transparency

Ill. 153: Storage

Transparency gives a quick overview of what is in the containers.

Final expression

Based on the inspiration from both the nursing bag and the created style board the different suggested solution was made. This was done to investigate the colors, due to the fact that the shape has evolved and been a part of the whole concept development phase. Below different proposals are illustrated, where the last four are focusing on the color combination.



Ill. 154: Product proposal

With the knowledge from the HHC nurses regarding that cleaning is an important factor, dark colors are not seen as the best solution due to it can be difficult to see if the box or the tray are dirty. Furthermore, the white color indicates cleanliness and gives associations with hospitals. The transparent drawers give an overview of the equipment, which also is seen in the nursing bag. Lastly, the contrast in the colors gives an indication of where to interact with the solution. Based on these criteria the final expression is decided, which is shown below.

Ill. 155: Product proposal

Having determined the construction and the expression, ENWOUND is born, which is a further development of DRAWERS 5.0.

Final feedback ByLink

To get an expert's point of view on ENWOUND ByLink was visited to have some final feedback from Liza. (App. 28) She thinks the solution provides a good overview of the equipment, especially by having a few drawers that are transparent.

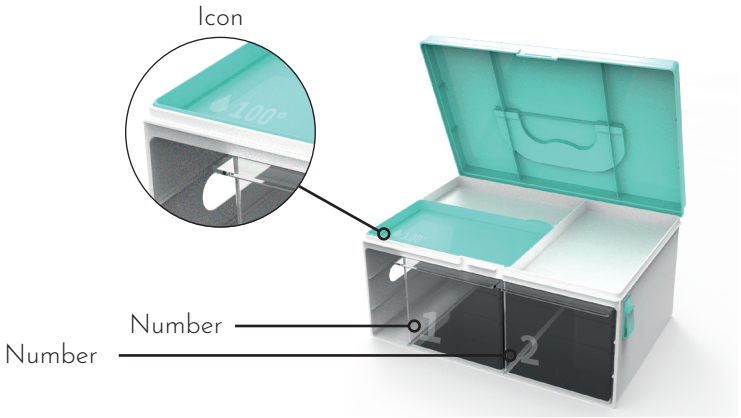
> *"I think it is a very nice and good solution. It is a functional solution with good overview"*

Ill. 156: Feedback

She also mentioned that the nurses love dymo marks, so it could be beneficial to incorporate icons, numbers or text on the drawers to indicate what is in them and how the system is. Together with Liza the different option was discussed.

Text:	**Icons:**	**Numbers:**
Having a text to tell what the drawers consist of can provide flexibility of equipment, but the text is not understandable in all countries.	Can be understood in every language, but it shows very precisely what the drawers contain. This is not seen as advantages due the nurses have different routines.	Is seen as a good solution because each nursing department can make their own system, but still it shows the order of using the equipment.

Furthermore, it was discussed with Liza how to indicate that the tray should be cleaned with water at 100 degrees. It was decided to have an icon that shows that it can be cleaned with hot water, due to the fact that it should nudge the nurses to clean the tray.



Ill. 157:Product proposal

Conclusion:
Based on the feedback from Liza, it is decided to incorporate numbers on the drawers. This indicates a system but does not lock the placement of each piece of equipment, and it is easy to understand. Furthermore, the nurses are nudged to clean the tray by having a symbol that indicates cleaning at 100 degrees.

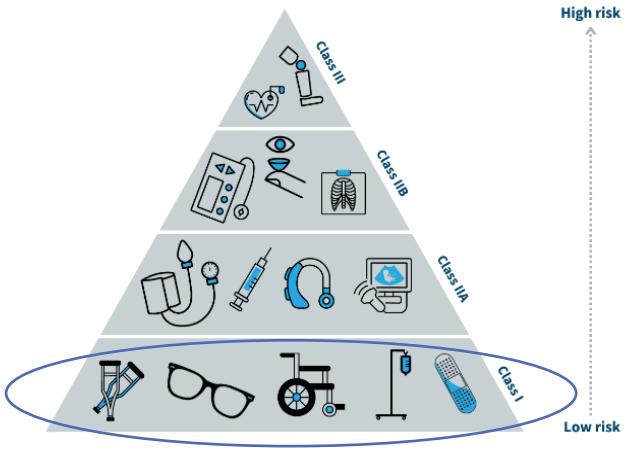
Furthermore, Liza mentioned that we should be aware that it is important to get a CE certificate. This will be investigated in the next section.

Medical equipment

As presented in the stakeholder map the Danish Medicines Agency has rules for medical equipment, which need to be fulfilled in order to get the ENWOUND on the market. These are risk classes and CE marking.

Risk classes

The purpose of the rules for medical equipment is to secure the safety of the patient. The equipment is divided into a different class of risks, which tells about the safety and performance of the product. (Lægemiddelstyrelsen, 2023a)



Ill. 158: Risk classes

ENWOUND fits into the lowest class of risk, which is class I. (Lægemiddelstyrelsen, 2023a) These products are seen as medical equipment used as an aid that is not directly in contact with the patient. (Hounisen, n.d)

For medical equipment in class I the cleaning rule is that the product is able to be cleaned with a cleaning agent and disinfected with alcohol. (Hounisen, n.d) These rules fit with the procedure that was presented by the HHC nurse for cleaning the boxes.

CE certification

A CE certification is needed in order to get ENWOUND approved for sales within the EU. The certification is needed as it shows that the product meets EU requirements for safety, environmental protection and health - in order for people to use the product. (Europa, 2023)

By obtaining a CE certificate, ENWOUND shows that it has a high level of safety and is suitable for its purpose as medical equipment. Furthermore, the certificate also shows that ENWOUND meets requirements with regard to e.g. material safety and product stability. (Lægemiddelstyrelsen, 2023b)

What does a company do to acquire a CE certificate for medical devices?
Before a company can place a CE certificate on its medical device, the company must be able to document that the product meets various requirements given in the legislation. These are security and performance requirements. (Lægemiddelstyrelsen, 2023b)

A CE certificate does not cost anything, but can be a long process. Therefore, in some cases it can be advantageous to have an external company in to help with the process. (Startup Central, n.d.)

CE

Ill. 159: CE certificate

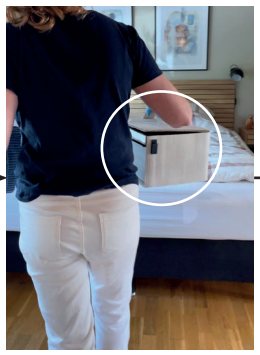
Final acting out

A mock-up of ENWOUND was built and tested by the social and health care assistant, Marianne. (App. 29) The test is carried out in a private home, with the same equipment as Marianne normally uses, where the procedure is followed. Furthermore, it is done to get a close real life scenario, when treating wounds.

ENWOUND is going to weigh 1.2 kg. without equipment.

Ill. 160:Equipment

The scenario is illustrated below:



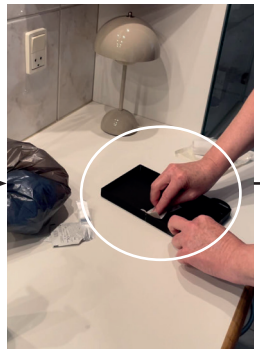
Transporting ENWOUND to the bed

Set up the garbage bag in the clips

Find equipment in the drawers

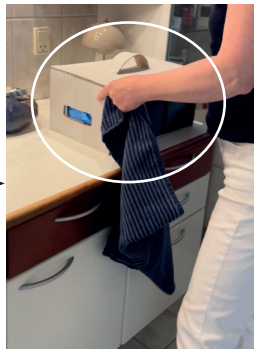
Equipment is placed on the top of ENWOUND, and dirty tools in the tray

Taking out the tray with dirty tools



Cleaning the scissor and the tray with alcohol

Placing the tray back



Ill. 161: Acting out

Placing ENWOUND in the bathroom for cleaning

The social and health care assistant Marianne has placed ENWOUND, so she can stand on the side of the patient. This is the opposite of what is observed beforehand in previous acting outs, and therefore the other way was also tested in the acting out below.

Ill. 162: Acting out

The garbage bag is placed on the side

Gloves were taken. It is noted that the garbage bag fell off.

Equipment in the drawers was found

After the treatment the tray was taken out

Conclusion:
The test shows how ENWOUND is used in a scenario, but is tested without actual wounds. It shows proof of concept, due to ENWOUND working as intended. The feedback from Marianne was that it gives a better overview of the equipment than in the current boxes. She also states:

> *"I think this solution is time-saving due to everything being placed near me, and I do not have to walk back and forth. For instance, normally I always take too few gloves, so I miss some, but with this solution, I will always have enough gloves"*

Both the time-saving was seen when timing the treatment, where she used 0:58 min on the preparation, 4:47 min on the treatment, and 2:01 min on the cleaning.

The only concern she had was that it is difficult to know what is inside the drawers, but she will quickly learn it when using the solution. This also is the reason why the drawers are opened during the treatment.

An improvement to make, when observing the scenario is that the garbage bag fell out of the clips, which lead to making the clips more narrow in order to hold the garbage bag. Also, it can be beneficial to incorporate one more clip in order to secure the garbage bag from falling off.

Final requirements

Throughout the report requirements have been generated, whereas they are in this section specified.

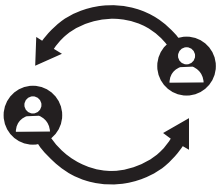
Issue no.	Requirements	Unit	Source (page)
1	Should have a maximum weight of 3 kg.	Kg.	Who performs the treatment?
	- Total weight without equipment: 1.2 kg.		
2	Should have a lifetime of 5 years	Years	Wound care
3	Should divided the tools in dirty and clean sections	Binary	Scenario
4	Should contain a garbage bag	Binary	Scenario
5	It should be possible to use the product with disposable gloves	Binary	Scenario
6	Should contain equipment for wounds on legs and feeds: tape, gloves, garbage bag, curette, surgical tweezers, alcohol wipes, medical scissors, wound band aid, gauze, bandage, cleaning fluid, lotion and ointment	Cm	Wound care + What equipment do they use?
	- Gloves box size: 24 x 13.5 x 5.5 cm		
	- Curette size: 20 x 3.3 cm		
7	Should have a surface for placing the equipment at 14.1 x 24.5 cm	Cm	Shadowing of the box
8	Should provide an overview of the equipment	Binary	Shadowing of the box
9	Should have a maximum length of 40 cm	Cm	Where to place the product?
10	Should secure the equipment from dust and bacteria	Binary	How do they do it in hospitals?
11	Should be cleaned within 5 minutes	Minutes	Presentation of the concept direction
12	Should contain 11.5 Liter	Liter	Presentation of the concept direction
13	Should be possible to lift around in the house	Binary	Scenario: Preparation
14	Should take less than 4 minutes and 38 seconds to preperate the treatment	Minutes	Scenario: Preparation
15	Should fit into a trunk of: 80 x 105 cm	Cm	Concept development: interactions
16	Should be resistant to alcohol and at 75%	%	How are the HHC nurses cleaning today?
17	Should be resistant to water at 100 degrees	Degrees	How are the HHC nurses cleaning today?
18	Should fit into a dishwasher tray at 50 x 50 cm	Cm	Cleaning

Business

The following section revolves around the business aspects of ENWOUND. This includes setting a price, cost calculations, and strategies for getting ENWOUND on the market.

Business plan

To develop a business plan for ENWOUND, a business strategy, cost calculations and potential market expansion need to be investigated.



Ill. 163: Business

B2G:
Based on the knowledge that the different nursing departments in the municipalities are the buyers of the wound boxes, ENWOUND can be sold through the B2G market. The products have benefits for the municipality due to the nurses getting a more professional workflow with a better overview of the equipment. Today, the municipality is buying plastic boxes, which is the only solution on the market. B2G is seen as the biggest market for the solution, but as a start-up company it may not be seen as the most cost beneficial.

B2B:
The B2B market is also seen as an opportunity due to different medico companies already having a procurement contract with the municipality. This is seen as the most cost-beneficial ENWOUNDfor a start-up company, even though it reduces the revenue of the products. After being established on the market it is possible to switch to the B2G market.

Value for money

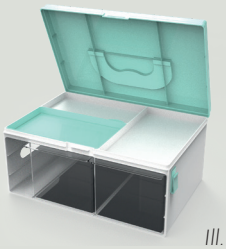
Setting the cost:
Based on an interview with a nurse from Aalborg municipality it was stated that a nurse cost 15 DKK per. minutes to have on a shift in home healthcare. (App. 30) Therefore, it is possible with the new solution - ENWOUND to save money when having a more efficient workflow.

Existing solution

Ill. 164: Boxes

Price: 206 DKK

New solution - ENWOUND



Ill. 165: New box

Price: 499 DKK

The new solution gives:
- An efficient work flow, where the nurses only need to use a limited time for preparation
- Creates an overview of the equipment, so it is easy to find and locate what is missing
- A professional treatment
- Focus on the hygienic by separating dirty and clean tools, which gives better safety for the patient

This along with the production costs, which will be covered in the Cost Calculation section, sets a unit price of 499 DKK. This price is higher than the current solution enough that it will be possible to give discounts for high volume purchases, or to retailers.

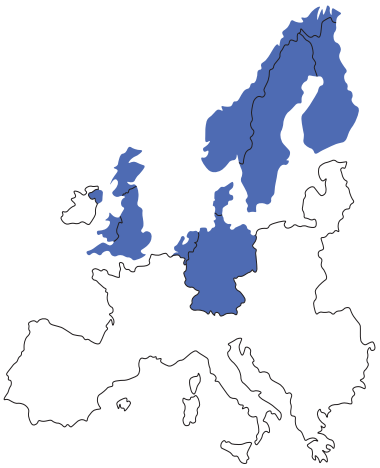
The fact that the price for ENWOUND is more expensive than the current ones, is justified by the added value for money in the new solution. The current plastic boxes are not designed for wound care treatment, but instead they are designed for storing the equipment. ENWOUND is designed with the reasons of making wound care treatment more professional.

Potential market expansion

With the knowledge that Denmark buys around 12.000 boxes for wound care every year in home health care (see page 36), other opportunities for expanding the marked have been investigated.

From an interview with the social and health care assistant, Marianne (App. 5) she made it clear that they also use the boxes in nursing homes for wound care. Therefore, it could be relevant to sell ENWOUND to nursing homes. Furthermore, an opportunity could be to sell the product for other treatments both in home health care and nursing homes, as it is known that the elderly population will increase in the future. In Denmark there are 950 nursing homes. (Sundhedsdata-styrelsen, 2018)

Other countries that Denmark often compares themselves to regarding the healthcare sector can be considered as a way for expanding the market. These are countries such as Sweden, Norway, Great Britain, The Netherlands, Finland, and Germany. (Sundhedsstyrelsen, 2010)



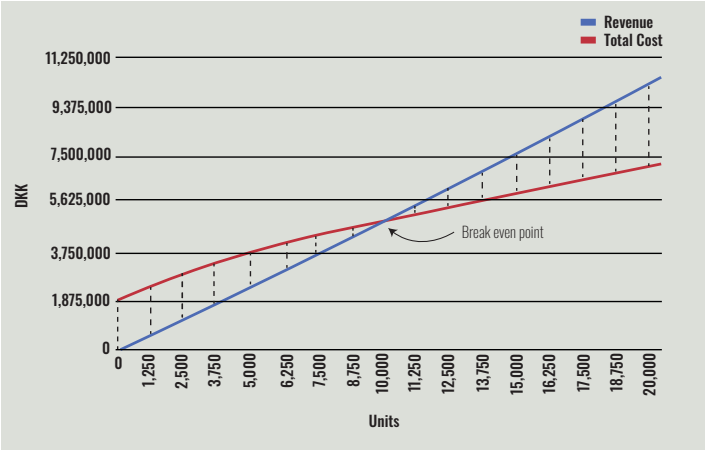
Ill. 166: Map of Europe

Cost calculation

Based on knowledge from the interview with Steffen Toft Jensen it was told that the molds are going to cost around 1 million DKK. (App. 25) These insights are relevant to have in mind when making cost calculations. (App. 31)

As a start-up, the most cost effective way to get started is outsourcing the production. This is beneficial, since the upfront investment will be lower. From the interview with Steffen Toft Jensen it was estimated that outsourcing the production would require an upfront investment in molds for 1,000,000 DKK and after that it would cost 100 DKK per unit produced. (App. 25) The expected sales growth rate of the box is expected to be mildly exponential.

Break even analysis:
A Cost-Volume-Profit (CVP) has been calculated based on the cost calculations and the aforementioned box price of 499 DKK. The CVP is calculated starting with an outsourced production. The chart below shows when the break-even point has been reached. The break even point is reached after selling just over 10,000 units, which is estimated to take about 2.5 years.



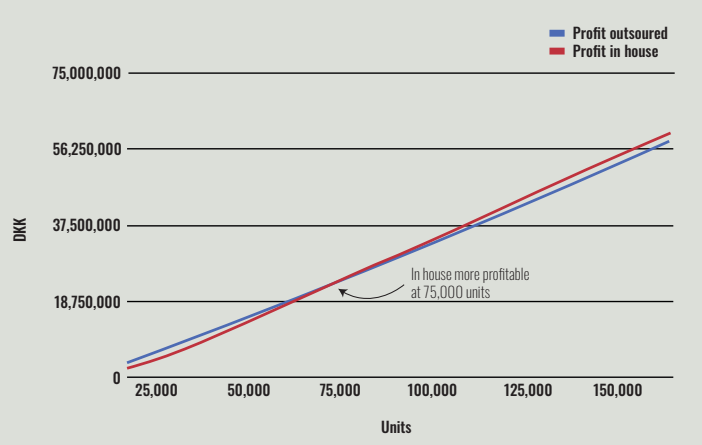
Ill. 167: CVP

After being established and having a healthy business up and running, it might make sense to reinvest some of the profit in in-housing the production. It is estimated that this can happen around year 4, where a total of 20,500 boxes is expected to have been sold. Cost estimation has been developed for each component to find the material price, mold cost, operating cost, etc. The calculation is based on the rough estimation for both the cycle time and mold cost. It is expected that the molding cost along with machines would be roughly 1,450,000 DKK. After that the table below illustrates the cost is per ENWOUND:

Variable cost	Total material cost per unit	**17.10 DKK**
Variable cost	Standard component: trash clip	**6.83 DKK**
Variable cost	Standard component: handle	**30.00 DKK**
Fixed cost	Total operating cost	**6.38 DKK**
Fixed cost	Overhead cost	**3.98 DKK**
Variable cost	Assembly cost	**9.00 DKK**
	Total cost per unit	**73.72 DKK**

Ill. 168: Cost

This means that the per unit cost of ENWOUND is brought down. However, since some of the profit is used as a reinvestment, it means that it will be a while before there is a return on investment. The chart below shows profit of the outsourced method vs profit from shifting to in house production.

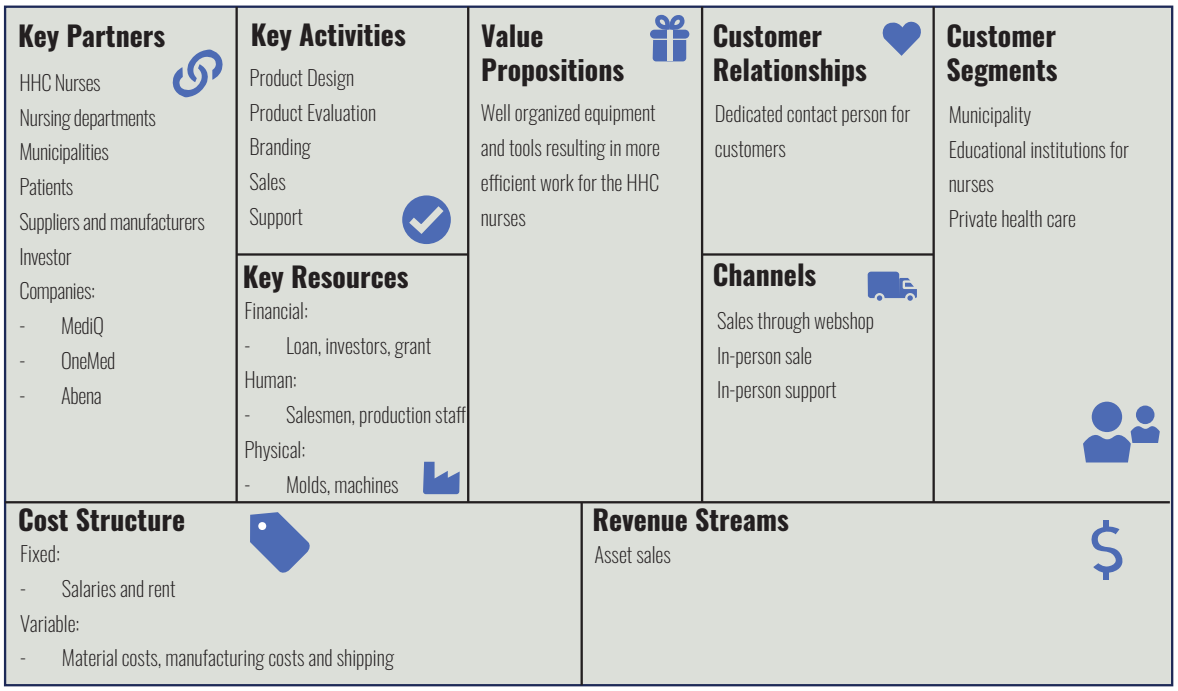


Ill. 169: Calculations

As it can be seen, a return on investment will happen after a total of about 75,000 units, that is approximately 54,000 units produced with the new equipment. This is expected to happen at the end of year 6 - 3 years after the reinvestment. Being a 3 year return on investment period makes it a long term investment, but it will eventually end up being more profitable.

Business Model Canvas

The Business Model Canvas (Osterwalder and Pigneur, 2010) is used for start-up companies in order to provide an visual overview of the different aspects of a business plan. The purpose with the model is to provide insights regarding different parts of a start-up company and how they can interact and influence each other. The insights about the business plan are illustrated below. (App. 32)



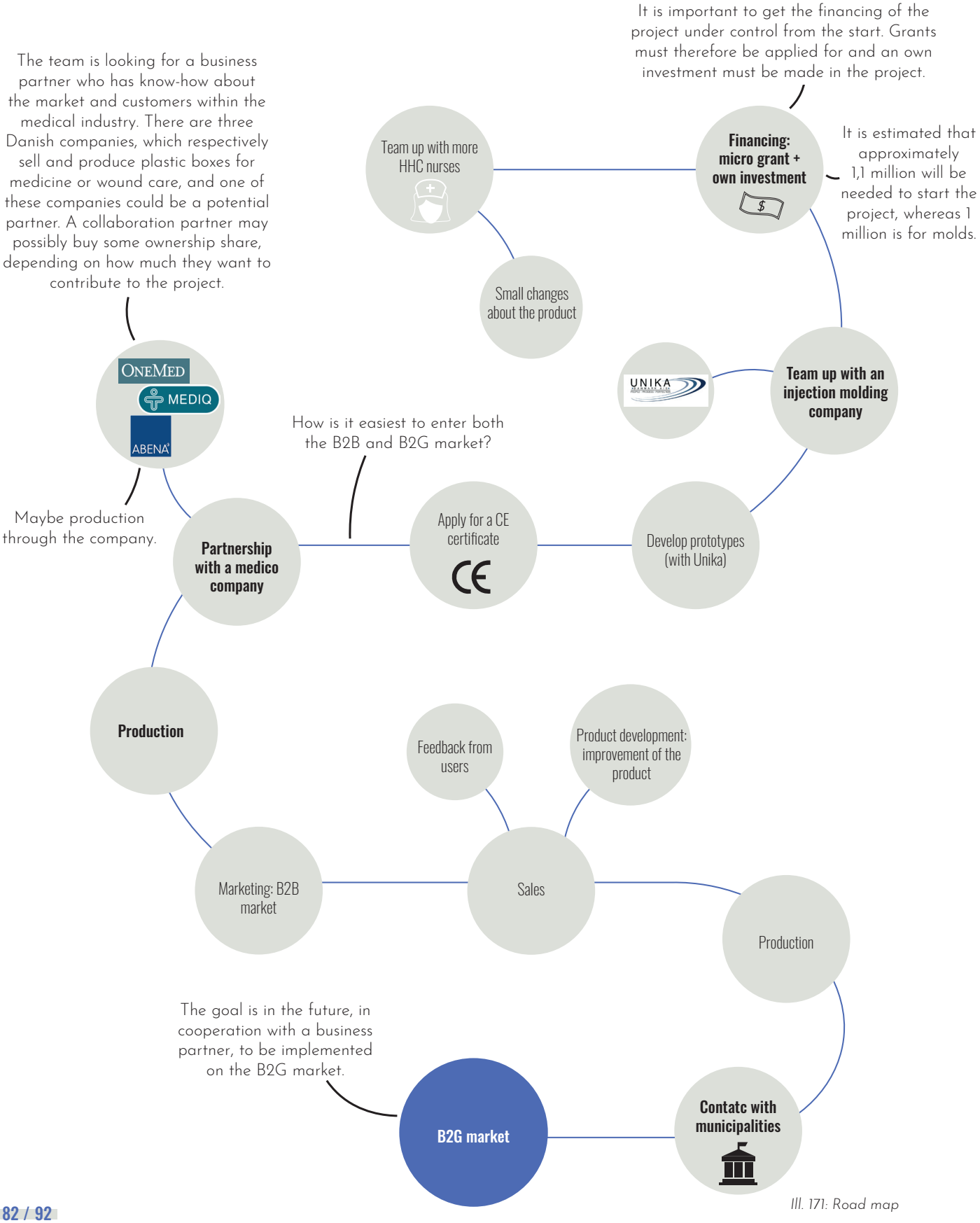
Ill. 170: Business model canvas

Conclusion:
The business model canvas has shown that it is important to create a partnership with more HHC nurses. Furthermore, municipalities can help with regulations and information useful for future sales. Investors and companies should be contacted to achieve a partnership or collaboration. In addition, the model has shown that it is important with key resources as loan, investor and grant to get the business started.

The goal of the business is to become the new wound care box on the market and having the HHC nurse and nursing departments as the main partners.

Road map

After gaining an understanding of the market, competitors, stakeholders and cost price, the next step is to make a plan for implementation on the market. Therefore, the following road map has been drawn up as an extension of the illustration of the Business Model Canvas on the previous page. This road map provides an overview of the overall steps from the exam of this project to implementation on the B2G market.



Ill. 171: Road map

Product family

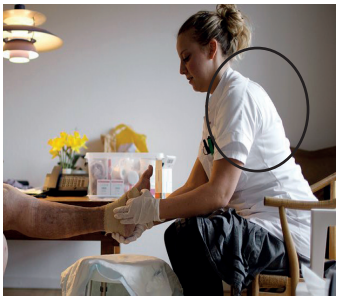
When ENWOUND has ensured a profit, it is possible to expand the product portfolio and hit a broader target group by initiating a product family. Another problem that was discovered during the shadowing of the different HHC nurses was their bad ergonomics during the treatments. Therefore, a way to expand the product portfolio could be to design a 'wound care kit'.

Bad ergonomic

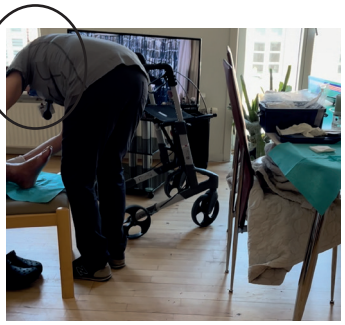
When the HHC nurse is working in the home of the patient, they are forced into uncomfortable working positions, if the patient has not been granted a care bed. They may have to sit or bend in ways that will put unnecessary strain on their bodies. Such cases can be seen in the pictures below. Furthermore, the nurses will often resolve aforementioned workarounds of using the patient's furniture for e.g. elevation support to alleviate the bad ergonomics, that could otherwise lead to pain or even injury.

Ill. 172: Bad working position

Ill. 173: Bad working position



Ill. 174: Bad working position

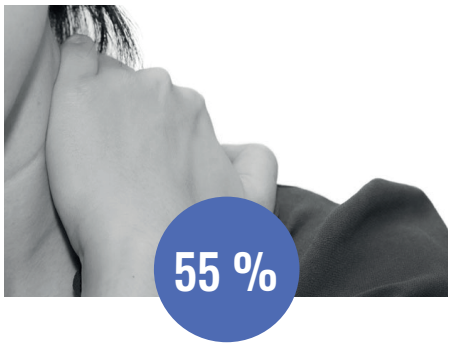


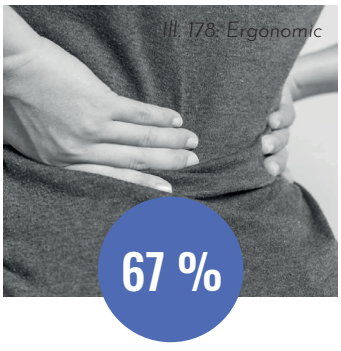
Ill. 175: Bad working position

Ill. 176: Bad working position

Ill. 177: Bad working position

Pain and injury is a significant challenge for Danish nurses, as 54% experience shoulder problems, 55% have neck issues and 67% have loin discomfort. These numbers are higher compared to the average wage earner where it is 47%, 29% and 45% respectively. (Guldmann Consulting & Region Sjælland, 2010)



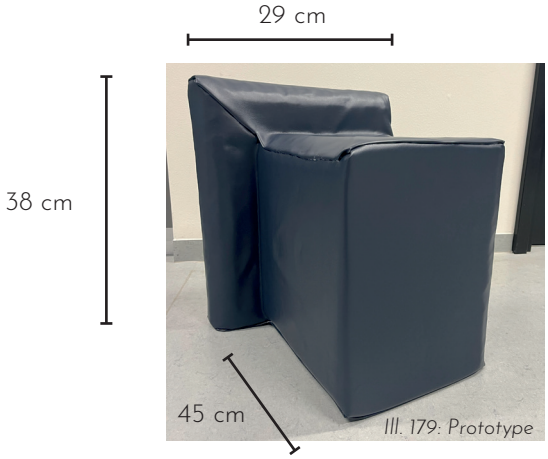


Ill. 178: Ergonomic

Replacing the care bed

Based on the research and interview with HHC nurses (App. 33) a cushion has been developed, where it can be placed in the patient's bed or couch and thereby replace the care bed. The only solution today is a care bed. The disadvantages of a care bed are that it stigmatizes the patient and the patient's home, and requires a lot of space.

The aim of the cushion is to elevate the legs of the patient in order to have a standing working position for the nurse, as this is the best ergonomic working position. (Nielsen, b. n.d.) Furthermore, two armrests are incorporated on two sides of the cushion, so the shoulder can be relaxed and support the nurse having a steady hand.



Ill. 179: Prototype

Based on calculations (App. 34) , a biometric analysis (App. 35) and studie upon heights of beds and couches (App. 36), the three sides are determined to be 29, 38 and 45 cm in order to cover as many nurses as possible. Afterwards, the three heights have been tested to see how the heights fit the patient's mobility and length of the leg.

29 cm

38 cm

45 cm

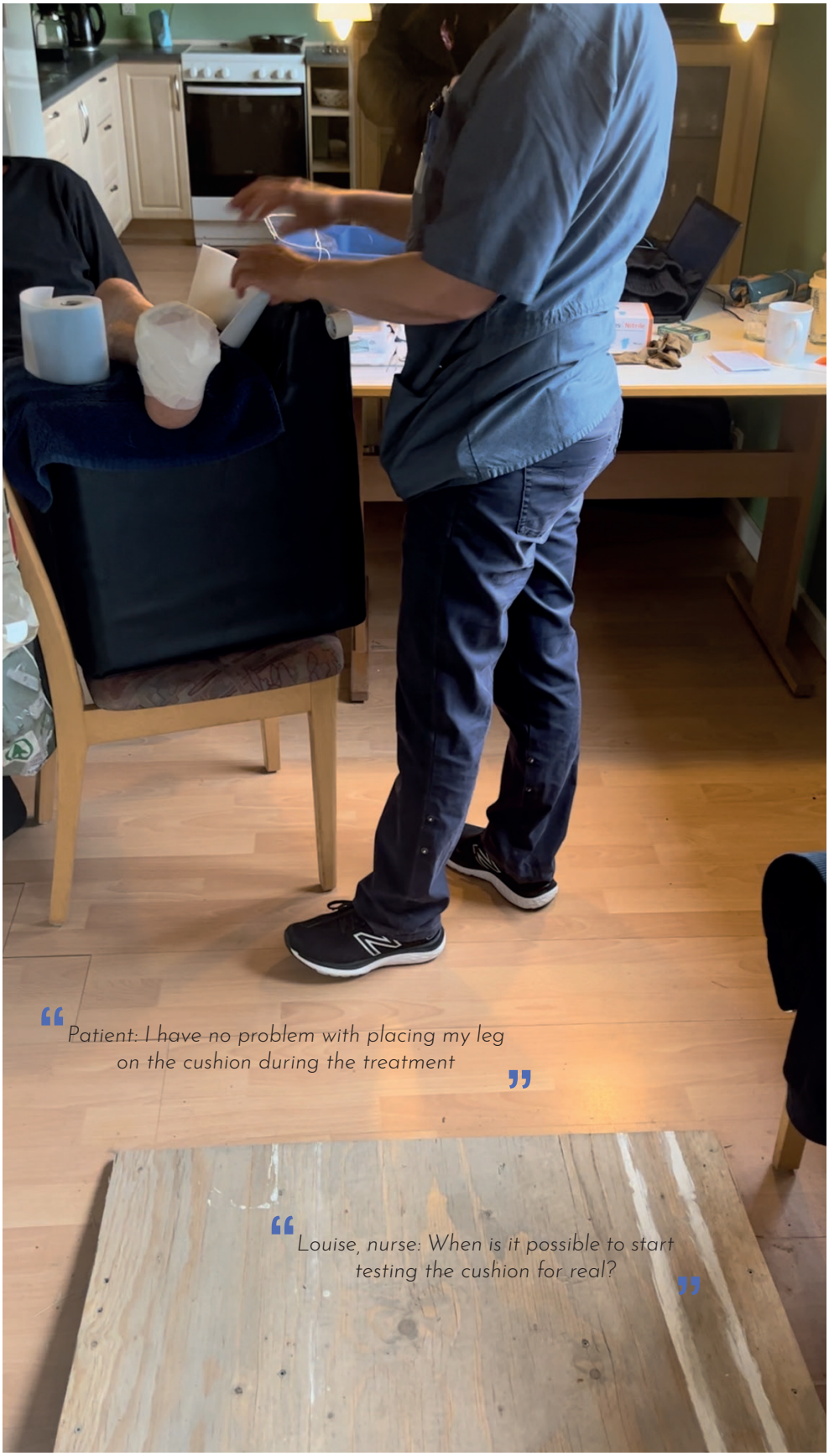
Ill. 180: Test

Testing

The cushion has been tested on a dining chair during a normal wound care treatment. (App. 9)

Ill. 181: Test

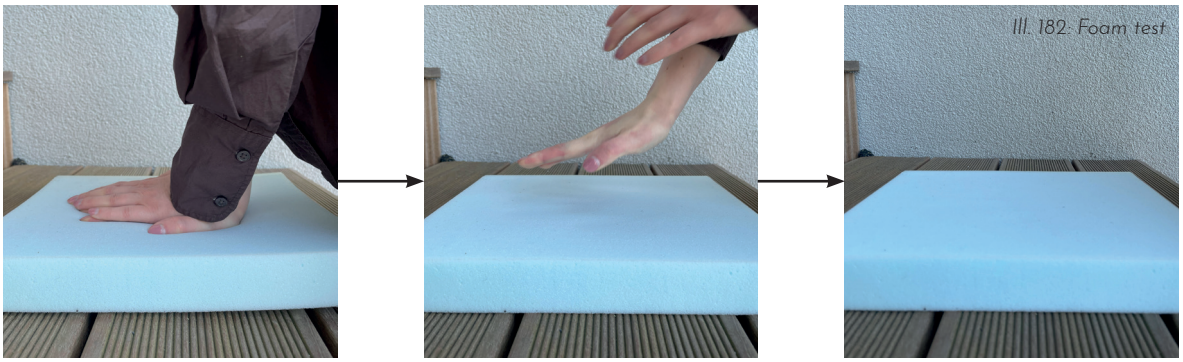
Based on the test with the cushion, there was positive feedback. The HHC nurse thinks it is better compared to sitting in a chair during the treatment, because she has a good ergonomic position. However, she thinks that the medium height could be a bit higher. Furthermore, she did not use the armrest in particular during the treatment - and she thinks it was because the wounds were on the feet. She thinks she will use the armrest if the wounds were on the leg and if she should use the curette, where she needs to have steady hands.


"Patient: I have no problem with placing my leg on the cushion during the treatment"
"Louise, nurse: When is it possible to start testing the cushion for real?"

Production and material

A meeting with AP Polstring was initiated in order to get expert knowledge regarding material and production. It was recommended to use High Resilience foam. (App. 37)

HR50 250 foam



Ill. 182: Foam test

Furthermore, AP Polstring suggests various textiles used in hospitals, all of which can be disinfected.

Illusion PU - Nevotex

Ill. 183: Fabric

The fabric is an artificial leather with a little structure.

AP Polstring recommended Illusion as it is thinner in fabric and can therefore be shaped more easily.

The fabric is going to be welded together in order to avoid seams and joints, where liquid and bacteria can enter. This production method is normal to use for products for the healthcare industry.

Further work

For further development, more tests in the right context need to be made in order to make sure it meets the needs and to see if the armrest is usable. Also, the business aspect that revolves around the cushion needs to be investigated, in order to see if the product has a potential on the market. In relation to the business, it could be an idea to integrate the cushion and the storage solution to make a complete set for wound care treatment that supports the nurse in being professional.

Epilogue

The last phase will provide a conclusion on the project and problem statement. Secondly, a reflection about the process and project will be presented.




Conclusion

The HHC nurse's current working conditions are far from ideal when doing wound care. Their work requires creative and ad hoc solutions as workarounds when they are doing treatment in private homes. These workarounds are performed in every step of the treatment, both when preparing the equipment, when doing the actual treatment, and afterwards when cleaning up. The existing solution is a plastic box for storing the equipment, where there is no overview of the content. This results in them often spending time searching for equipment, or even missing equipment for e.g. cleaning.

Through collaboration with different professionals in the health sector, here among HHC nurses from Hjørring, end users have been involved in the development process, and their feedback has been collected through various methods, such as interviews, shadowing, and acting out. This is done to create an understanding of how to design a product specific to HHC nurses when doing wound care. Due to the wound care taking place in the patient's own home, the working conditions are different from treatment to treatment. Therefore it was important to create a professional solution, with an overview of the equipment with inspiration from how things are stored at hospitals. Based on the knowledge gathered, ENWOUND was designed, with a systematic storage of the equipment for wound care. ENWOUND can be placed in beds, on a table, or anywhere else such that the equipment is always within arms reach. ENWOUND is designed based on the problem formulation:

How to design a professional storage solution for the HHC nurse that creates an overview of the equipment for wound care and makes the workflow more efficient?

ENWOUND fulfills the problem formulation as the separation of the equipment provides organized storage. By having all the equipment together with space for garbage bags, storage surface, and access to gloves, the workflow is made more efficient. It reduces both preparation time and the going back and forth between the equipment and the patient. ENWOUND divides the equipment into two drawers, and the tools into clean and dirty. The drawers with the equipment are transparent to create an overview of the contents. All this results in an empowerment of the nurse.

Reflection

As a closure on this project, it will be reflected upon the process of the project and the product proposal in relation to what could have been done differently.

Process

Reframing:
The entire project has involved developing a product for the healthcare sector. In the first 2.5 months, the project dealt with developing a cushion for HHC nurses when during wound care, which has its purpose of replacing a care bed. The topic is relevant and important both for the HHC nurses and the municipalities. However, it was chosen to reframe the project, as the simplicity of the product will become too simple and thus not possible to develop an integrated design proposal.

Due to the project's reframing, more time has been spent in the fuzzy front end as the project has been in this phase twice. Time has been spent on understanding the user-scenario and context, which has subsequently helped to reframe the project and ultimately an innovative product proposal. By understanding the context and the work procedure it gives requirements to base the design on.Therefore, it has been made clear that a good and thorough understanding of the context and scenarios are necessary, which can only be achieved by getting out to the users and the real world - and not just sitting at the university.

Prototyping approach:
Throughout the process, the prototyping approach has been used. It gives a physical understanding of the concept which a 3D modeling can not give. It was important for the concept development to have an understanding of the size and the systematic overview of the concept due to it being important factors to develop on. Therefore, many rapid prototypes in cardboard were created, which made it possible to test the concept in the real world. Working with this approach is time-consuming, due to the many models generated through the process. It is believed that this method was beneficial for development, because it gave new inputs to develop further on.

Through the process, the prototypes could have been refined more than they have been. Since, it could have created a higher level of expression. However, it was only chosen to refine the drawers and the tray through 3D printing. 3D printing is a slow process, where the cabinet and the lid have a size that makes it difficult to 3D print.

Collaboration with different professionals:
Throughout the project, various expert knowledge and feedback from different professions working in the healthcare sector have been included. This has been included in order to embrace broadly in connection with insights and feedback. The involvement of different professionals has been particularly noticeable, as there are many different routines, nurses and patients, whereas each treatment is not the same. This had to be taken into account in the development of ENWOUND and a focus has therefore been made on a typical wound care treatment that has been worked on in this project. In addition, further work could be to develop a larger or smaller box in relation to other sizes of wound care treatments.

Product

Overview:
Creating a good overview is one of the main elements of the project proposal. An overview has therefore been created by the division of equipment and tools and the drawers are transparent. To create a good overview numbers are also added on the drawers. However, it needs to be further tested whether the transparency and the numbers are actually helpful during the treatment. Here a test could be beneficial to see if the system with the number is too vague or if icons are needed to create a more specific placement of the equipment.

Limitations:
Throughout the project, there have been some limitations in relation to cleaning and price, which have affected the design proposal. Cleaning has set some restrictions in relation to the choice of materials, as the product must be able to fit into an industrial dishwasher. In addition, there must not be too many parts and unnecessary trinkets, as the box must be quick to clean with alcohol wipes.

The price has also set some limitations for the project, as this is an important aspect for the municipalities. In addition, the thickness of the product could well have been changed, which would increase the price of the product, but where ribs are avoided and thus maybe the cleaning will become easier.

Blind spots:
During a prolonged process period, there are some aspects that would be interesting to work further with. This could for instance be to test the final solution with a HHC nurse treating a real wound to see if that had any different outcome. This was not possible due to the reframing late in the process, where the HHC nurses were not available.

Furthermore, it could be interesting to test if the drawers are secured enough during transport. To test that it requires a mock-up in the intended material with the right surface, due to the idea of securing the drawers by having friction between them and the cabinet.

For the business aspect it would be relevant to dive deeper into the prices of the product, but also look at the expansion. This could for instance be to investigate what they use for storage of equipment for other treatments or in other countries, to see how many it is possible to sell.

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