

THE OPTIMAL NEONATE INTENSIVE CARE UNIT DESIGN FOR THE WILHELMINA CHILDREN'S HOSPITAL

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Master Thesis

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ABSTRACT

The Neonate Intensive Care Unit (NICU) is the place where babies go when they are very ill or delivered preterm. The hospital is adding an extra wing to facilitate better care at the NICU. A redesign of the NICU for the Wilhelmina Children's Hospital will optimise the work processes in a single-room setup. In-depth field research has focused on stakeholder analysis, work processes and unit utilisation. The fast-paced design process ensured quick design changes combined in two iterations and the final design. Co-design sessions have been performed to improve stakeholder engagement and design usability. The final design has been validated through scenario re-enactment. The NICU unit design is divided into a hospital and a parental section. The hospital section has one wall with all appliances. All materials and medication are primarily focused on the left side of the incubator from where the nurses and doctors will work. The parents have a sleeping couch where they can work, relax, or stay during the night. LEDs are used to ensure long usability and the correct lux of the lights to differentiate between the parental and hospital area. The contact between the parents and the hospital has been improved by altering the existing patient portal. A medical diary, the option to plan a visit and expand the provided information, have been added. More scenario re-enactments are needed, and the LED requirements need to be reconsidered. To conclude, the new design solves all problems found within the current open-bay setting and the new single-room setup. The optimal NICU design can help the caretakers take care and help the parents be parents to ensure the best care for the neonate.

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0. GLOSSARY & ABBREVIATIONS

ICU: Intensive Care Unit

NICU: Neonatal Intensive Care Unit

OR: Operation Room

PICU: Pediatric Intensive Care Unit

WKZ: Wilhelmina Kinder Ziekenhuis (Wilhelmina Children's Hospital)

1. INTRODUCTION

1.1 Assignment Description

The Wilhelmina Children's Hospital (WKZ) in Utrecht has facilitated care for children since 1888. It started as a children's hospital with a capacity of 9 children. Nowadays, the hospital has over 5000 hospitalisations, 3000 births, and 48.000 visits to the clinic each year (UMC Utrecht, 2022). Next to the increased capacity and ability to help more and more children, the WKZ added different types of care. In 2013 the WKZ expanded by adding a Neonate Intensive Care Unit (NICU) to the hospital (UMC Utrecht, 2022).

Since the addition of the NICU, the WKZ has been growing. Currently, the parents cannot sleep with their newborn (UMC Utrecht, 2022). Therefore, the WKZ is working on a plan to renovate the NICU and Pediatric Intensive Care Unit (PICU) by adding a new wing to the hospital. As the architectural design for the new wing is starting to be finalised, the design aim for this project arises:

Redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to optimise the work processes in a single-room setup.

In other words, a design must be created considering the work processes of all the stakeholders involved in neonate care. The room should be set up so that the people involved with the neonate's care will not get in each other's way. The room should consist of two sections, the emergency section, where the neonate will be lying with all appropriate equipment, and a more informal section where the parents can sleep, work, spend time with their newborn and relax.

1.2 Design Scope

This master's graduation project aims to design the optimal NICU for the WKZ. All different stakeholders of the NICU will be studied, and their customer journey will be mapped to ensure that everything they need is quickly within reach. The design will also ensure that everybody will work as efficiently as possible by decreasing unnecessary interaction and creating a relaxing and homely feel for the parents. The assignment is seen as successfully finished when there is a visualised final design that the stakeholders approve.

1.3 Methodology

1.3.1 Planning Methodology

The different methods described in this chapter are used throughout the project. In Figure 1, the overall planning of when which methods are used can be seen. All methods are described as why they are used within this project. The project is divided into three phases: Research, Concept Design, and Final Design. The first phase focuses on understanding the current situation in the WKZ and other NICUs. The second phase focuses on different solutions for what the optimal situation might look like. The last phase combines the concept designs created in phase 2 to create the optimal NICU design for the WKZ. A detailed description of the different methods can be found in Appendix A.

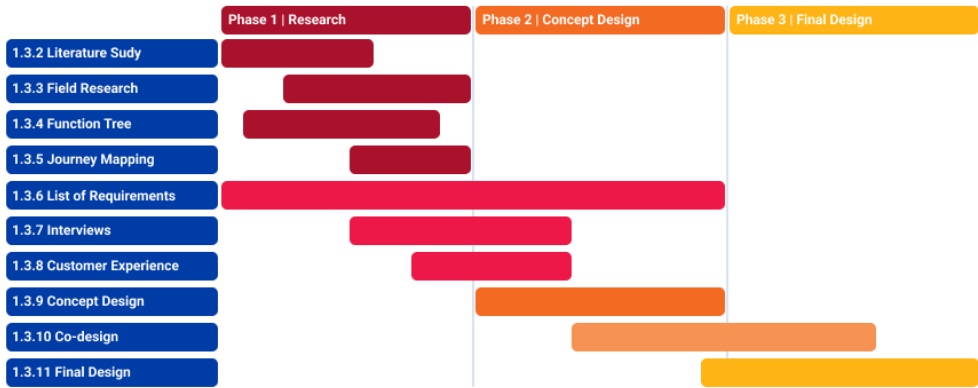


Figure 1, Methods used throughout the project.

02

RESEARCH

2.1 What is a NICU

NICU stands for Neonate Intensive Care Unit. A NICU is always located at a hospital. However, not all hospitals contain a NICU. Of all newborn babies, 6.3% need to go to the NICU (Haidari et al., 2020). If a baby needs to go to the NICU, they have either been delivered in preterm labour, or they themselves or their mother are ill. When a baby is brought to the NICU, the nurses try to involve the parents as much as possible. This is important for emotional bonding and to de-stress the parents (Cox& Bialoskurski, 2001; Franck et al., 2005).

Furthermore, an environment that helps decrease stress benefits the parents and the hospital caretakers (Caporali et al., 2020). The baby is attached to different appliances and tubes, and the fragile look increases the stress (Franck et al., 2005). Some NICUs only provide regular care to newborn babies, others provide neurological care and in some, surgeries can be performed on newborn babies.

The length of stay varies significantly from a few days to multiple weeks. The nurses start with a complete examination of the babies. The babies are connected to many different lines and sensors. The goal of the NICU is to improve the baby's health, which is reflected in the number of lines and sensors surrounding the baby. The lower the number of wires a baby is attached to, the better they are able to survive independently

The NICU at the WKZ specialises in (neuro)surgery and neurological monitoring. In other words, the WKZ is allowed to operate on the babies. To be allowed to conduct surgeries, the hospital needs specific licenses and experts.

2.2 NICU design

A NICU can have an open-bay setup or a single-room setup.

2.2.1 Open-bay NICU design

The current NICU at the Wilhelmina Children's hospital consists of four open-bay units. Three units are in use, whereas one is not used due to the limited number of nurses. Each unit can hold up to eight babies needing intensive care, as shown in Figure 2. Most of these spots are constantly used. The unit also contains a central post. Here the nurses read up on their patients, go through their mail, create appointments, and do their administration. There is also a row with storage space and two sinks where people can disinfect their arms and hands.

Furthermore, there is a designated area where all medication is stored and prepared. As visible in Figure 2, the baby in room 1 has a room that can be closed off from the rest of the unit. The other spots can be closed off using curtains. The most critical babies are placed in room 1. Finally, every unit has an office for the doctors. The doctors create the treatment policies here and can discuss the status of a baby with experts or surgeons in private. All medical appliances are attached to moveable arms because they need to adapt quickly to different situations. Babies are placed where there is room sometimes, this means that twins are placed in two different hospitals.

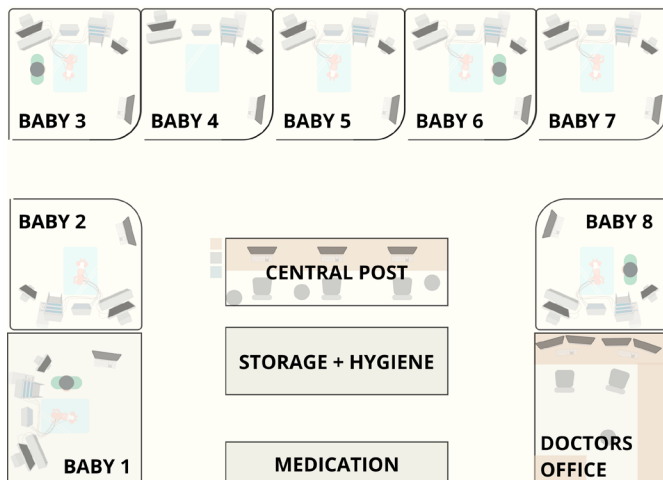


Figure 2, Floor plan NICU unit 3 at the Wilhelmina Children's Hospital (WKZ)

2.2.2 Single-room NICU design

The new situation at the WKZ will consist of single room NICU's, designed to give all newborns and their parents more family-centred care, and privacy. There are also rooms for twin babies to be cared for together. Also, the light and sound can be controlled per room (Aita et al., 2021). A single room contains the same medical appliances as in an open bay unit. One of the differences between an open-bay unit and a single-room unit is that the nurses need to walk to a separate room to get medication and medical appliances that are not located within the room. Furthermore, the communication between the nurses needs to be better in a single-room unit. Whenever a nurse is taking care of a baby, they cannot turn around to ask someone else to help them. Therefore, when a nurse goes to a baby, they already need to know where the other nurses are to get a fast response. In the single-room NICUs, the nurse can use the intercom to ask their second responsible for help. However, they do not know whether that person is also in a complicated situation.

A single room has a different setup than an open-bay unit. All devices are located on one side of the room and focused on where the nurse will take care of the baby. Only the monitor and computer are completely moveable, whereas the rest can only move horizontally. The right side of the baby is the designated area for the parents. The parents have their place which they can decorate with cards and pictures. They also can sleep or work in the NICU.



Another difference is the information received at the central post. In an open-bay unit, one can view the monitors of all babies from the central post. In the single-room unit, the information on the monitors cannot be read directly. Therefore, a monitor is added at the central post showing the vital information for all babies. An example of a single-room unit is visible in Figure 3.

Figure 3, Picture of the Single Room setup at the LUMC (Nieuwe Intensive Care Voor Allerkleinste Patiënt, 2017)

2.3 Devices in NICU

Within a NICU, there are different appliances with different functions in supporting the baby. As stated by Martin et al. (2008), “Advanced medical products are often used by multiple users with different backgrounds and goals in differing situations.”

There are two different categories of devices. Direct care medical devices are needed to care for the baby, and indirect care devices are used to support the caregivers. This can be seen in Figure 4 and Appendix B. The direct care medical devices can be divided into the surveillance monitor, breathing, beds, food and intravenous drip categories while indirect care devices can be divided into the devices for the central post, the data connection and devices placed in storage.

As visible in Figure 5, the devices in direct care are all prominently placed around the baby. The devices are all visible and accessible for the medical staff to ensure the health and safety of the newborn (Garde & van der Voort, 2008). Most of these devices are attached to the baby by wires and lines, which are visible and very chaotic (Garde & van der Voort, 2008). The devices are attached to the roof using modular arms, which can be moved horizontally and vertically, making it possible to move the devices anywhere the nurses require. This system is visible in Figure 6.

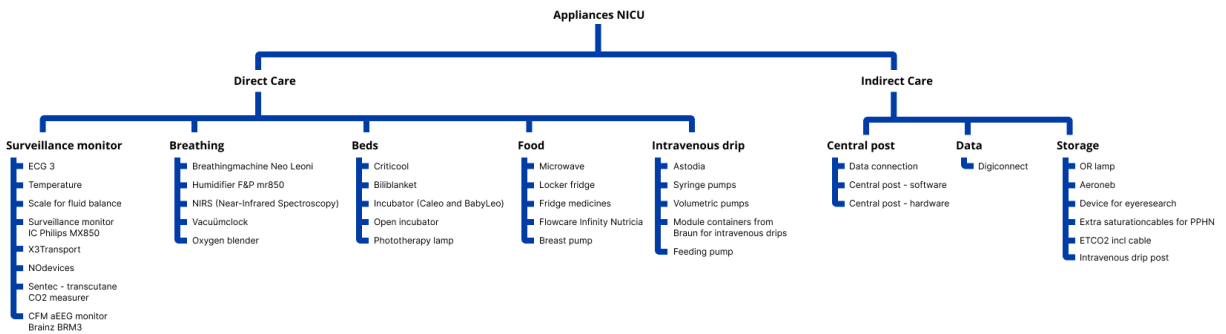


Figure 4, Function analysis devices used in the NICU

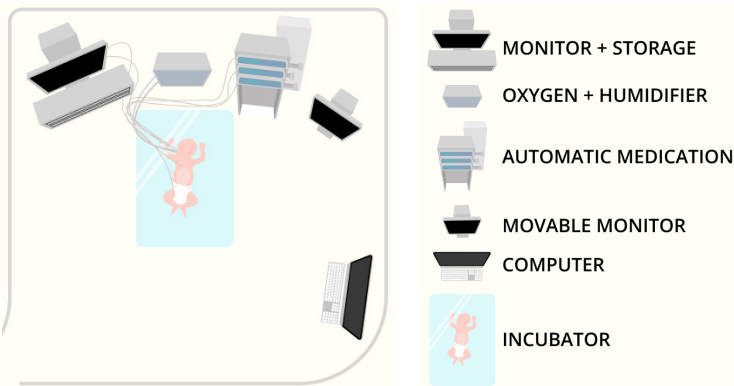


Figure 5, Floor plan space per baby at the current NICU in the Wilhelmina Children’s Hospital (WKZ)



Figure 6, Attachment system of Devices at the NICU (Neonatologie - Wilhelmina Kinderziekenhuis - UMC Utrecht, 2012)

2.4 Contact moments in NICU

Parallel to providing exemplary care to newborn babies, much information must be presented to the caregivers. A focus was put on mapping out the current ways of contact through interviews with the medical staff which is visible in Figure 7. This visualisation presents the patient journey of a family with a newborn. The patient journey shows all the contact moments with the hospital and the type of information gathered through what channel. There are currently many contact moments, during which different information is exchanged. Raghu Raman mentions (1997) that parents can be educated through booklets, pamphlets, and pictures. Giving them reading material in combination with visualisations improves their understanding of the situation and gives the parents the ability to support their children by giving care. The different contact methods currently used are visualised in Figure 8.

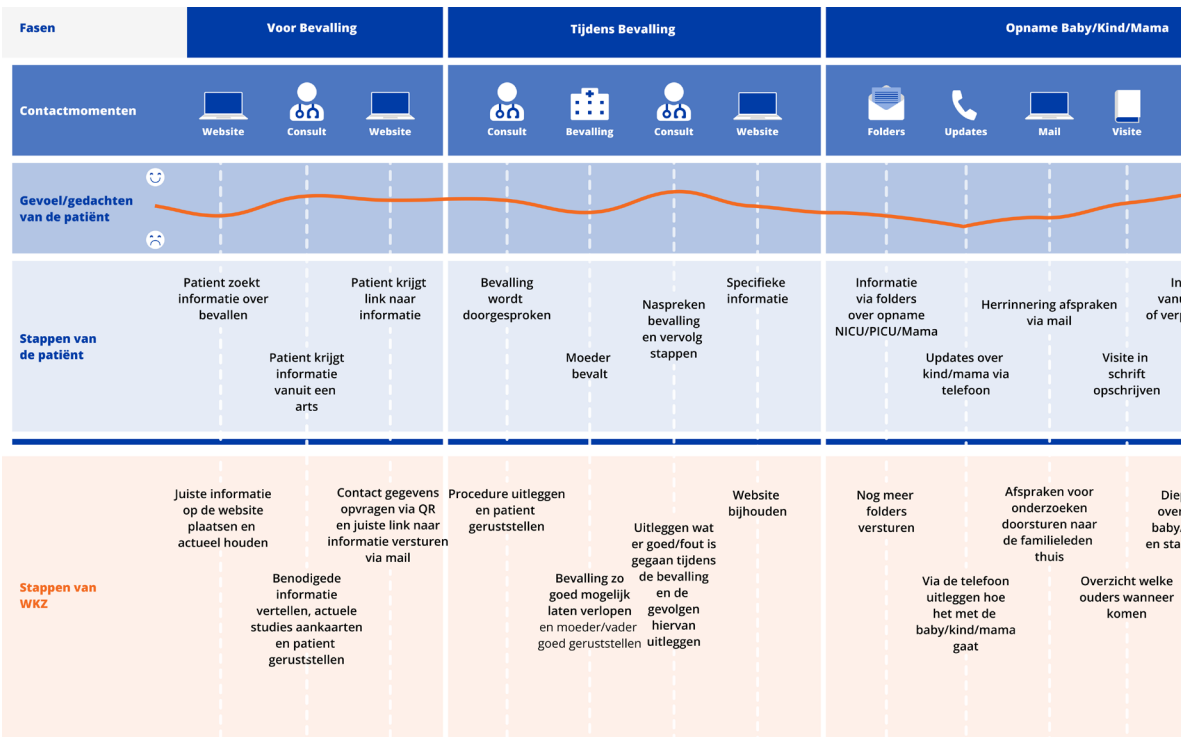


Figure 7, Patient Journey concerning the contact moments between the hospital and parents

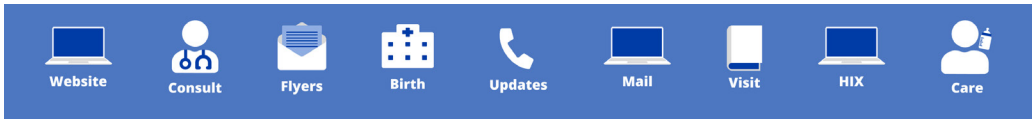


Figure 8, Communication channels between the parents and the hospital

The patient journey shows an orange line mapping the patient's emotional experience during their stay at the hospital. This line shows at what points the patient's mood is decreased and where the most significant change can be made to improve the contact. A complete description can be found in Appendix C.

2.5 Stakeholders in NICU

There are many different stakeholders in the NICU. Some of the hospital stakeholders stay at the NICU, and some people only work at the NICU when their expertise is needed. These stakeholders are all important when looking at the design of the new NICU for the WKZ. In combination with the stakeholders from the hospital, there are also other stakeholders. As Garde and van der Voort (2008) mentions, "the patients themselves could obviously not be actively included in the design process for they have not learned to utter their opinions and ideas yet." The parents will be included and asked to express their opinion and represent the interest of their baby. All stakeholders will be contacted to see whether they want to help with the research on the NICU. In this sub chapter, one can find a short description of the stakeholders and their involvement in the NICU. A detailed description of the stakeholders can be found in Appendix D.

2.5.1 Neonatologist

The Neonatologists are the doctors with experience in the NICU. They create medical plans and ensure that the babies get the best treatment possible. Whenever a complex procedure needs to be done, neonatologists will be the ones to conduct it. Figure 9 shows that neonatologists primarily work on creating the Medical Care Plan for the babies. They do this by consulting with experts. They also check how the babies respond to their current treatment policy together with the nurses during the visit preparation meetings.

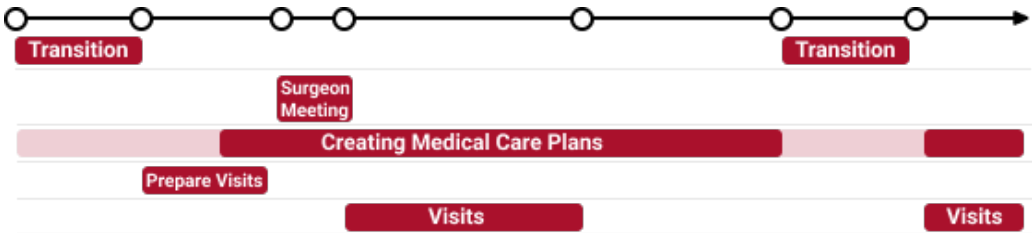


Figure 9, Timeline showing a day at the NICU for a Neonatologist

2.5.2 Nurses

The nurses check the babies and give them the care they need. They are the people who follow the treatment policy, and they alarm the doctors whenever the baby's health decreases. Each nurse takes care of two babies to ensure their full attention. Only when there are no other options the nurses will take care of three babies. The nurses also mix the medication and feeding formula, which they cannot get from the pharmacy. In Figure 10, the timeline of the nurses is displayed. It shows that the nurses are constantly occupied with the babies. They can sit at the

desk inside the unit, allowing them to see what is happening with the babies and work on the administration.



Figure 10, Timeline showing a day at the NICU for a Nurse

2.5.3 Nurse assistants

The nurse assistants help the nurses take care of the babies. They are not responsible for any of the babies but will calm a baby when they are in distress and assist the nurses when needed to conduct a particular procedure. In Figure 11, a typical day for a nurse assistant is visible. It shows that the nurse assistants are constantly taking care of the babies.



Figure 11, Timeline showing a day at the NICU for a Nurse Assistant

2.5.4 Parents

The parents can visit their baby for two-time slots per day due to covid. They are encouraged to help care for their baby as much as possible. This includes feeding their baby, cleaning their baby, and giving them the correct medication at the correct time and amount. Caring for their baby is encouraged to make the transition from the NICU to home more manageable. Furthermore, caring for their baby increases the emotional connection between them and helps with the traumatising effect of the situation. The parents are critical stakeholders. As visible in Figure 12, parents could visit their baby twice a day for two hours. Parents are slowly allowed to be at the NICU during the entire day and night.



Figure 12, Timeline showing a day at the NICU for a Parent

2.5.5 Babies

The babies are also important stakeholders. They undergo all procedures and usually feel very bad. They are fighting for their lives when they are lying in the NICU. The babies are only moved to a different location when their health is improved, for medical check-ups, surgery, or when they have passed away.

2.5.6 Surgeon

The surgeons are at the NICU during their daily meetings with the neonatologists. Furthermore, they join the NICU whenever a baby needs surgery. They are available for operations during the entire day. The worst-case scenario is that a baby needs emergency surgery at its unit because they are too sick to be moved. This is when the surgeons conduct surgery inside the NICU.

2.5.7 Surgery staff

The surgery staff only joins the NICU whenever there is an emergency operation. They are constantly preparing the operations rooms, and they assist the surgeons during the surgeries. Whenever an emergency operation occurs, the surgery staff gathers all appliances and medication needed and prepares the unit where the baby will get surgery. They all perform their specific task. The most significant difference with surgery in a unit instead of the operation room (OR) is the lower number of materials available.

2.5.8 (Ultrasound) Expert

The (ultrasound) experts only visit the NICU whenever needed. Some expertise is needed almost every day and night, others only once every few days. In other words, how often an expert is needed depends on how often the test or expertise is needed.

2.5.9 Ambulance personnel

Like the (Ultrasound) experts, the ambulance personnel will only visit the NICU whenever a baby is transferred from another hospital or when a baby will be transferred to a different hospital. A transfer can occur during the entire day and night.

03

FUNCTION ANALYSIS

At the NICU, all babies are different and therefore require different treatments. Some need to be monitored thoroughly and need medication. Others are nearly ready for a transfer to medium care. Within this chapter, different critical scenarios are visualised and explained shortly. These scenarios describe and map critical situations that should be possible within the new NICU. The complete description can be found in Appendix E.

3.1 (Extensive) Monitoring / Care

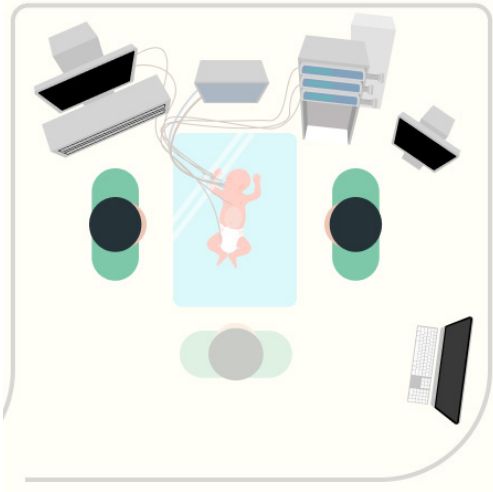


Figure 13, Floorplan (extensive) monitoring / care

3.1.1 General Scenario

All babies located in the NICU need to be monitored 24/7. Sometimes, this entails merely monitoring the heart rate and blood oxygen. For other babies, this means daily occurring procedures and constant monitoring of all vitals.

3.1.2 Appliances Needed

Monitor, oxygen + humidifier, medication syringes, computer, and the incubator.

3.1.3 Stakeholders Involved

1 nurse, 1 nurse assistant, (1 doctor)

3.1.4 Needed Data

Different vitals are monitored depending on the baby's health. The two vitals constantly monitored are the heart rate and the oxygen saturation.

3.1.5 Problems

There are a few problems during (extensive) monitoring/care. The first problem is the monitoring of the babies in a single-room unit. The second problem is the space surrounding the baby. Another problem is the decrease in moveability due to the wires and lines connected to the babies.

3.2 Transfer to MC / Operation Room / different NICU / MRI

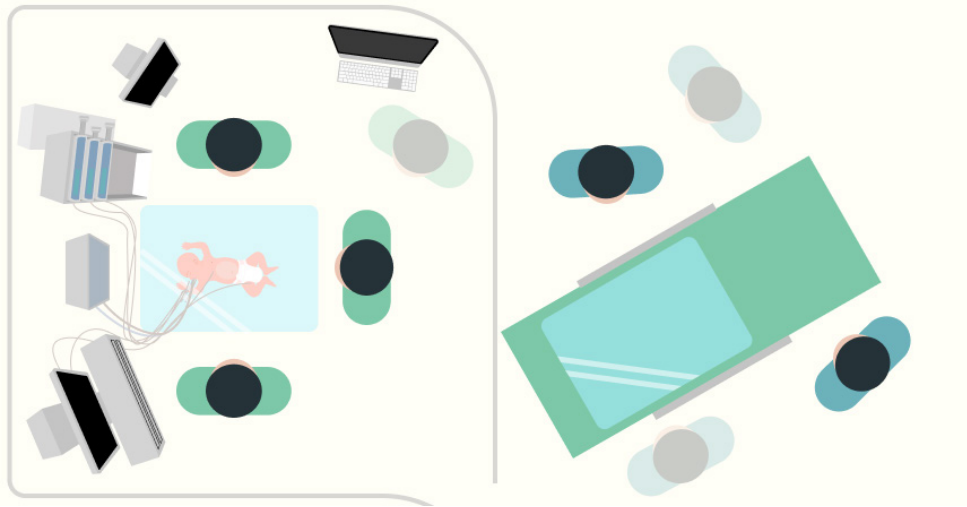


Figure 14, Floorplan transfer to MC / operation room / different NICU / MRI

3.2.1 General scenario

There are different reasons why a baby needs to be transferred. When a baby is transferred, they need to be put in a specific incubator to be moved as safely as possible. Sometimes, it is necessary to give the baby specific medication before the transfer, or the baby is not allowed to eat or drink. Some babies also need new lines before they can be moved because the old lines almost fall out.

3.2.2 Appliances needed

Trolley with medical syringes, oxygen + humidifier, movable monitor, NO₂, and an AED.

3.2.3 Stakeholders involved

1 nurse, 1 nurse assistant, 1 doctor, 1 operation assistant/doctor, 1 surgeon (1 doctor, 1 nurse, 1 ambulance driver)

3.2.4 Needed data

The baby must be monitored thoroughly to ensure a smooth and safe transfer. The baby's oxygen saturation, heart rate, blood pressure, and CO₂ saturation must be monitored.

3.2.5 Problems

The transfer trolley is enormous. It is hard to reach the second baby with the trolley whenever two babies are in one room.

3.3 Emergency Operation



Figure 15, Floorplan emergency operation

3.3.1 General scenario

An emergency operation only occurs when a baby immediately needs surgery and is too ill to be transferred to the operation room. The baby will get the surgery on the unit where all the other babies are also located. To make this possible, all visitors need to leave the unit, and all other parents are called to let them know they will not be able to visit the unit for a while.

3.3.2 Appliances needed

8 new carts full of appliances are transferred to the unit. 1 large lamp, 2 tables with sterilised appliances, 1 cart with other medical appliances, 1 cart with medication, and 1 ultrasound.

3.3.3 Stakeholders involved

2 nurses, 1 doctor, 2 surgeons, 1 surgeon assistant, 1 surgical technician, 1 surgical technician assistant, 1 anaesthetist, 1 anaesthetist assistant, 1 anaesthetist employee, 2 spectators, (1 expert surgeon + 1 surgical technician + 2 surgical technician assistant)

3.3.4 Needed data

During the emergency operation, all vitals are checked to understand whether the baby's vitals are not critical, whether the baby gets enough oxygen in its blood, and whether the blood pressure and heart rate are stable during the emergency operation. The anaesthetist will check the vitals together with the doctor and nurse to ensure the baby stays stable.

3.3.5 Problems

All equipment and everybody involved with the operation will need to be in the room and have the space to conduct their task. This will be one of the most significant challenges for the new setup.

3.4 Visit from parents

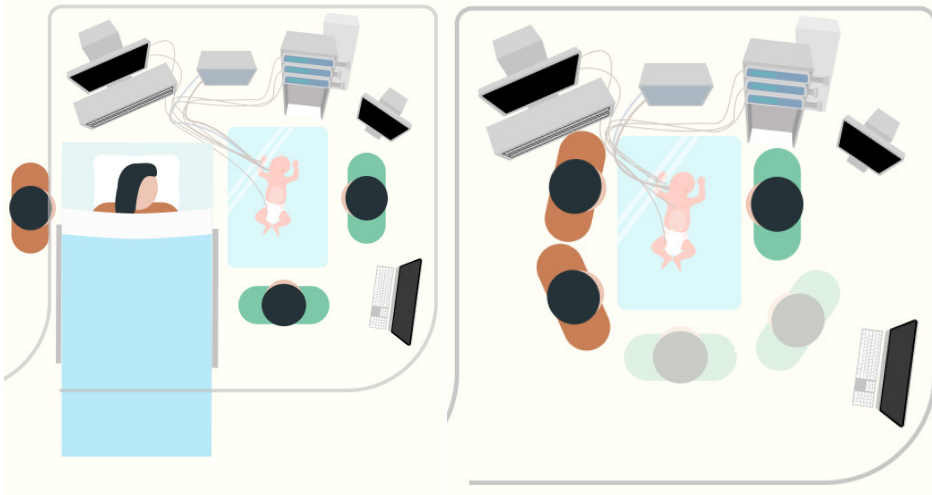


Figure 16, Floorplan visit from parents, shown in two scenarios'

3.4.1 General Scenario

The parents can visit their baby twice a day, due to covid, once during the morning and once in the afternoon. Sometimes the mother is in a hospital bed because she just gave birth or is sick. Currently, only two visitors per baby are allowed, meaning either the parents or one parent with one visitor. The parents are asked to do most of the babies' caretaking to practice when the babies are allowed to go home, even though they feel insecure. They feed the baby, clean the diaper, give medication, and cuddle the baby. During this moment, the nurse or the doctor explains the baby's development and whether another treatment procedure is advised.

3.4.2 Appliances Needed

Breast milk pump, bottles, towels, a heater or cooler, medication syringes, computer, monitor.

3.4.3 Stakeholders Involved

2 parents, 1 nurse, (1 doctor + 1 nurse)

3.4.4 Needed Data

No specific data is needed for when the parents visit their baby. Only the already needed data is gathered. This data is used to check whether the baby is healthy or not.

3.4.5 Problems

There is very little space surrounding the baby, especially when the mother is in a hospital bed. All the noises and lights increase the overwhelming feeling of the parents. The contact between the parents and nurses will decrease in the new situation. The contact decreases because the nurse cannot turn around and help the parents.

3.5 Transfer to different NICU Unit

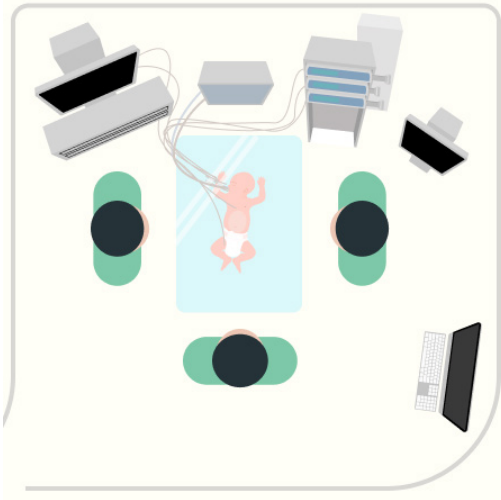


Figure 17, Floorplan transfer to a different NICU unit

3.5.1 General Scenario

Sometimes either a baby is doing well or a baby from a different unit experiences a health decrease. The baby will be transferred to the designated unit. Currently, all the units are connected by a door. Therefore, they can be wheeled towards their new spot while staying in its incubator. The nurses will ensure that the new location is ready for the baby.

3.5.2 Appliances Needed

Moveable monitor, oxygen, and humidifier.

3.5.3 Stakeholders Involved

2 nurses, 1 nurse assistant

3.5.4 Needed Data

Blood pressure, heart rate, and oxygen levels.

3.5.5 Problems

Babies need to be transferred when their health decreases, this problem is resolved in the new situation.

3.6 Echocardiogram

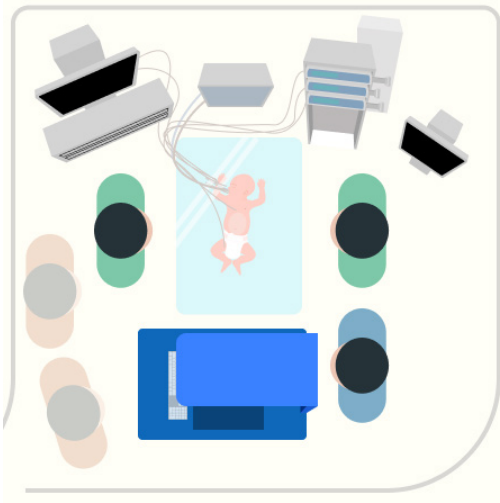


Figure 18, Floorplan echocardiogram

3.6.1 General Scenario

A moveable device is wheeled towards the baby's incubator whenever a baby needs to get an ultrasound. The echocardiogram device can be sculpted in multiple angles, making it possible to keep the baby safely in its incubator. Incubators are created, so the baby does not need to move to make an echocardiogram.

3.6.2 Appliances Needed

Portable ultrasound, protective clothing.

3.6.3 Stakeholders Involved

1 nurse, 1 nurse assistant, 1 ultrasound expert, (2 parents)

3.6.4 Needed Data

The expert needs information to show which views and angles are needed. The nurse or the doctor provides this information. During the echocardiogram, the baby will stay in its incubator to keep all lines and sensors.

3.6.5 Problems

There is very little space surrounding the baby, resulting in space for two persons standing next to the baby.

3.7 Newly born

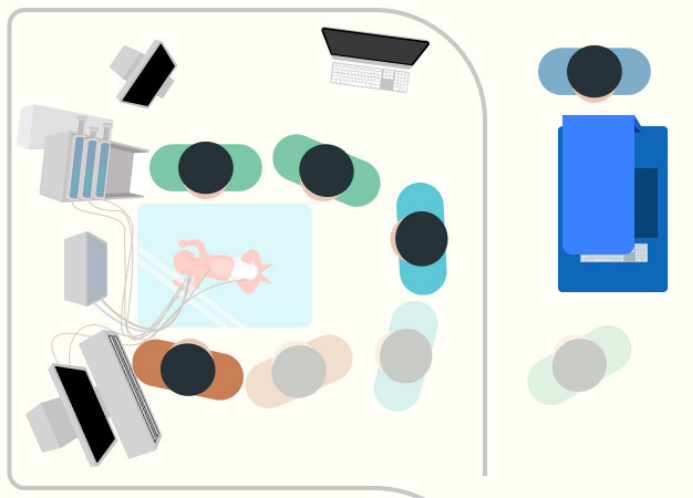


Figure 19, Floorplan newly born

3.7.1 General Scenario

Some babies are born during an emergency surgery. In such a scenario, the NICU gets notified when the mother is either prepared for birth or is already in the operating room. The NICU gets between 10 minutes to 2 hours to prepare a new spot for the newborn. The nurses prepare all appliances to check everything on the baby. All vitals will be monitored, and the oxygen machine will be started. All appliances are checked to ensure that they work correctly. The ultrasound specialist will also be called to ensure a quick newborn screening.

3.7.2 Appliances Needed

Monitor, medical syringes, oxygen + humidifier, computer, extra medication, incubator, ultrasound machine.

3.7.3 Stakeholders Involved

1 or 2 nurse(s), 1 nurse assistant, 1 ultrasound expert, 1 surgeon, 1 surgeon assistant, 1 or 2 parents, 1 doctor

3.7.4 Needed Data

All vitals need to be monitored when a baby is newly born. It is unknown yet what the health situation of the baby is. The initial data of the vital signs are also used to determine what medication needs to be given.

3.7.5 Problems

Sometimes babies will arrive at the unit within 10 minutes of notice. Having 10 minutes makes it difficult to ensure that the place is inspected and ready to be used.

3.8 Conclusion

To conclude, the problems that occur during the scenarios are mostly connected to the space surrounding the baby. Other problems are connected to the flexibility of the nurses. The flexibility is in connection to their communication and moveability. Another problem which becomes apparent is the insecure feeling of the parents due to the environment and the decreased interaction with nurses.

The problems identified within the function analysis will be entered in the problem analysis. The designs made within this report will be focused on solving important problems. The emergency operation will be the most challenging problem and, therefore will be a good test to see whether the final design is feasible.

04

**PROBLEM
ANALYSIS**

4.1 Problem definition

To tackle the problems currently found in both the open-bay unit (current situation) and the single-room unit with rooms for one baby and twins (new situation), they should first be clearly defined. The problems found during the functional analysis of the NICU are the base for this problem definition.

As said in the conclusion of Chapter 3, the main problems arising from the scenarios in the current NICU situation are connected to the space surrounding the baby. There is very little space for nurses to work properly or for parents to visit their babies. The parents already feel very insecure during the first few days of taking care of a newborn. All the noises and lights increase the overwhelming and insecure feelings of the parents. Having a nurse close by who can answer questions helps decrease that insecure feeling.

Another problem arising from the scenarios is the decrease in the moveability of the baby due to the number of wires connected to the baby. Furthermore, the limited time to ensure the room is inspected and ready to be used when a new baby is born also causes problems.

Other problems have been identified during unscripted interviews taken at the WKZ. Parents feel as if they have no privacy. Having curtains to separate them from the other people in the room makes them feel uneasy. The curtains do not enable the ability to control the environment per baby. Some babies are already affected by a slight sound or need a warmer environment. Having all parents in one room increases the logistical challenge of an emergency operation. During surgery, parents are not allowed in the room and therefore need to leave the NICU. The increased disturbance caused by the emergency operation negatively affects the babies' stress levels.

A Likert scale is used to measure perceptions from the different stakeholders. Unscripted interviews were used to understand the problem severity and perceived solvability according to the stakeholders. The solvability of the problem, vertical axes, is graded between 1 (unsolvable) and 5 (easily solvable). The problem severity, horizontal axes, is graded between 1 (no problem) and 5 (big problem). These problems are visualised in Figure 20.

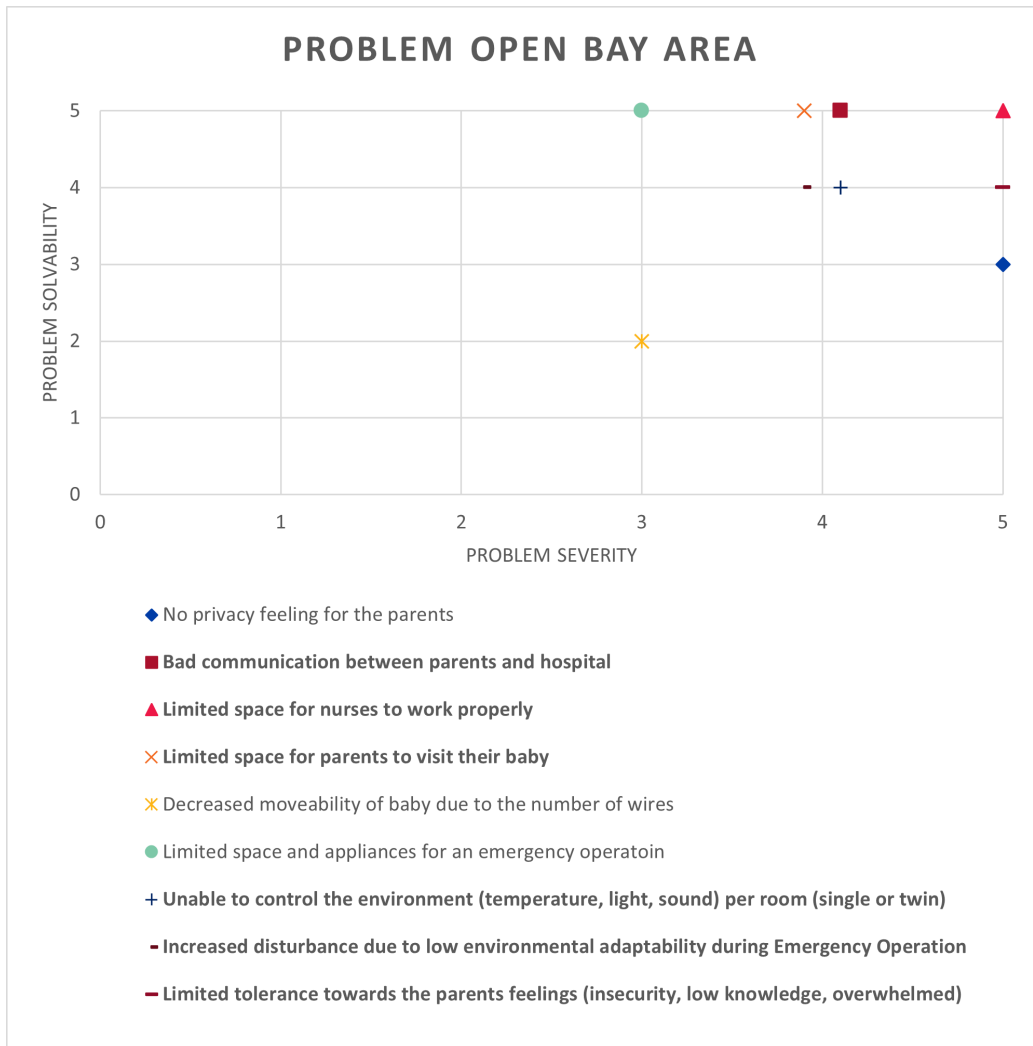


Figure 20, Problems occurring currently at the open-bay NICU at the WKZ

Considering already existing single-room units, most problems from the scenarios are connected to the flexibility of the nurses. The flexibility is in connection to their communication and moveability. The separate rooms, with either one baby or twins, make the monitoring of babies more difficult. When the nurse is in one room, they are unable to see the visual changes of the baby, for example, a change in colour. A baby's health can decrease within 10 seconds. If the nurses are not close by, they do not recognise what is happening and cannot immediately provide the proper care. The inflexibility will also decrease the contact with the parents. The parents get less personal time with the nurse. Furthermore, the distance between the nurses is a problem. Whenever a nurse is doing a specific procedure, they sometimes need extra materials or help from another nurse. That nurse might be on the other side of the unit.

Also, for this problem analysis, a Likert scale is used to measure perceptions from the different stakeholders. Unscripted interviews were used to understand the problem severity and perceived solvability according to the stakeholders. The solvability of the problem, vertical axes, is

graded between 1 (unsolvable) and 5 (easily solvable). The problem severity, horizontal axes, is graded between 1 (no problem) and 5 (big problem). These problems are shown in Figure 21.

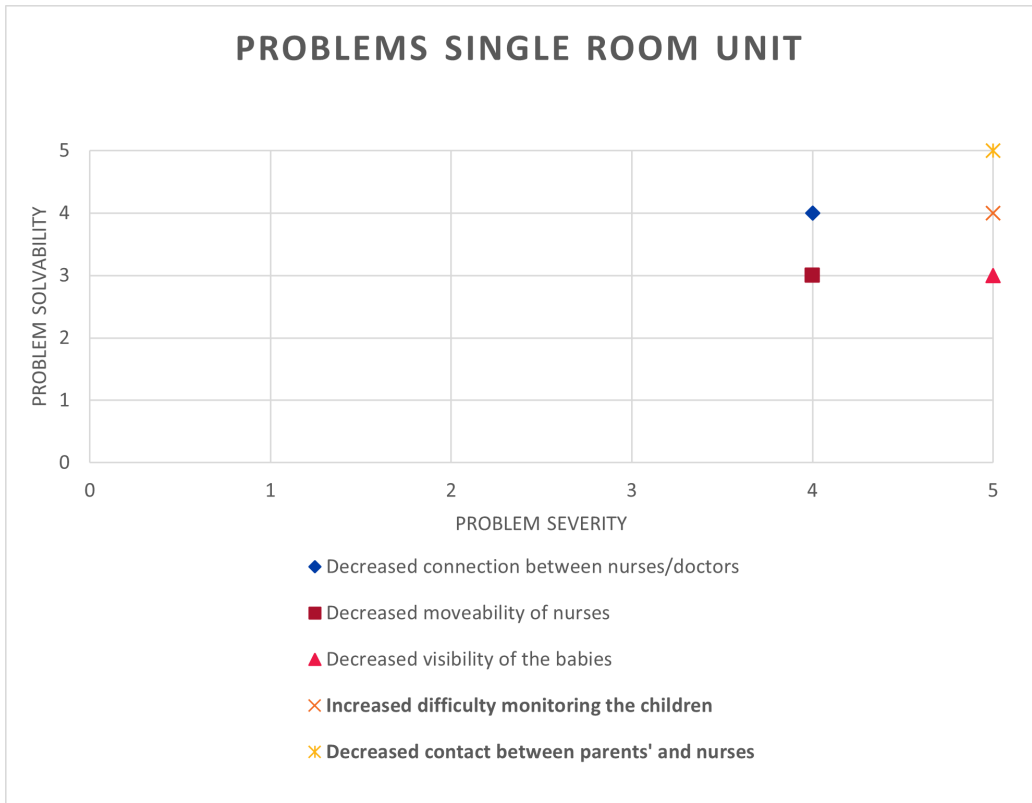


Figure 21, Problems occurring in a single-room NICU

Both graphs show the severity against the solvability of the different problems. In the risk matrix shown in Figure 22, the probability is changed into the solvability, in other words, how certain the problem can be solved. Therefore, the problems in the upper right cells with scores 8 and 9 are the problems with the highest severity and the highest chance of being solved. The problems with the highest scores are made bolt within the Figure 20 and Figure 21.

Probability	Almost Certain	5	6	7	8	9
	Likely	4	5	6	7	8
	Possible	3	4	5	6	7
	Unlikely	2	3	4	5	6
	Rare	1	2	3	4	5
		Negligible	Minor	Moderate	Major	Catastrophic
Severity Rating						

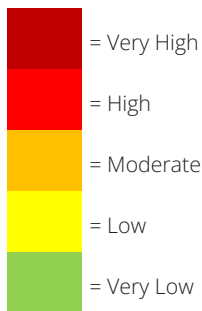


Figure 22, Risk matrix showing the cells with the highest risk based on (Ossama et al., 2013; Maxiah Munirah et al., 2019)

4.2 Design assignment

4.2.1 Design challenge

The problems with the highest scores in Figure 20 and Figure 21 are the basis for the design assignment within this project. The problems with the highest scores are:

- Bad communication between parents and hospital;
- Limited space for nurses to work properly;
- Limited space for parents to visit their baby;
- Unable to control the environment (temperature, light, sound) per room (single or twin);
- Increased disturbance due to low environmental adaptability during emergency operation;
- Limited tolerance towards the parents' feelings (insecurity, low knowledge, overwhelmed);
- Increased difficulty monitoring the children;
- Decreased contact between parents and nurses.

These problems can be divided into two main categories, environmental adaptability and contact with parents. For these main categories, design assignments were formulated. These design assignments support the aim of the project.

The aim of this project is to redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to optimise the work processes in a single-room setup.

The sub design assignments that will be used as guidelines within this project are:

1. Redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to improve to environmental adaptability. This will be done by fulfilling the following statements:
 - a. Design the improved Single room unit facilitating one neonate.
 - b. Design the improved Single room unit facilitating twins.
 - c. Design the improved light environment for the Single room unit.
2. Redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to improve the contact between parents and the hospital.

4.2.2 Boundaries

The design challenge has some boundaries to consider. The design must use the back wall method. The back wall method means that all appliances need to be located on one wall in the room. The wall will have a hanging mechanism where appliances will be connected to. The hanging mechanism allows appliances to be moved from left to right and rotate around the Z-axis. In addition, the appliances that will be used in the new design are already defined. Furthermore, the colour palette and overall look of the design are also already defined. The hospital is working on creating a baseline throughout the entire hospital and the NICU needs to fit within that baseline.

The architectural floor plan is finished and cannot be altered. Therefore, the design needs to be created within the limits of the floor plan. All the scenarios need to be possible within the floor plan. In other words, all appliances need to fit and all people needed for the scenarios need to be able to conduct their tasks. The regulations connected to hospital design and processes within the hospital are not within the scope of this project. Because the design is in collaboration with architects and people from the hospital, they will ensure that the regulations are achieved.

The design will be focused on the rooms. The hallways and work processes connected to other parts of the hospital are not within the scope of the design assignment. With design assignment two, the focus will be on the NICU and what the parents at the NICU need.

A proposal will be created for the contact between the hospital and the parents. The full functionality or maintenance of a possible design system is not within this project's scope.

4.3 Requirements

Requirements are used to determine whether the designs are feasible. Requirements have been created for the different design assignments. The requirements are based on field research and desk research. During unscripted interviews with stakeholders, many requirements were mentioned. These requirements have been categorised by type of requirement and design assignment. The different types of requirements are general, utilisation, safety, integration, and maintenance. The first group of tables present the requirements for the first design assignment about environmental adaptability. The second group of tables present the requirements for the second design assignment about the contact between parents and the NICU.

4.3.1 NICU General

Number	Requirement
NICU.GENERAL.01	The NICU shall provide space for 17 people and 14 appliances needed during an emergency operation
NICU.GENERAL.02	The NICU shall provide complete visibility concerning the neonates
NICU.GENERAL.03	The NICU shall provide the complete care of the neonates
NICU.GENERAL.04	The NICU shall provide a dedicated area for parents to be able to stay with their newborn
NICU.GENERAL.05	The NICU shall provide controls which change the temperature and lights per specific room

Number	Requirement
NICU.GENERAL.06	The NICU shall store all standard medication in all separate rooms
NICU.GENERAL.07	The NICU shall provide privacy for the parents
NICU.GENERAL.08	The NICU shall maintain a temperature of 24 degrees Celsius
NICU.GENERAL.09	The NICU shall have all standard appliances integrated into one wall
NICU.GENERAL.10	The NICU shall provide monitors which are visible on both sides of the baby
NICU.GENERAL.11	The NICU shall provide a day and night light setting (Mann et al., 1986)
NICU.GENERAL.12	The NICU shall provide ambient lighting with a maximum of 600 lux for the operating area (Aita et al., 2021)
NICU.GENERAL.13	The NICU shall provide ambient lighting with a maximum of 300 lux for the parental area (Aita et al., 2021)
NICU.GENERAL.14	The NICU shall provide a light setting of 1000 lux during an emergency operation (Aita et al., 2021)
NICU.GENERAL.15	The NICU shall provide LED lights with a CRI above 90 % (Montes de Oca, 2021)
NICU.GENERAL.16	The NICU shall provide lights with 3000K warmth for the parental area (Montes de Oca, 2021)
NICU.GENERAL.17	The NICU shall provide lights with 5000K warmth for the operating area (Montes de Oca, 2021)

4.3.2 NICU Utilization

Number	Requirement
NICU.UTIL.01	The NICU shall provide space for 14 appliances needed for an emergency operation
NICU.UTIL.02	The NICU shall provide constant monitoring of the neonates' vitals

4.3.3 NICU Safety

Number	Requirement
NICU.SAFETY.01	The NICU shall be completely cleanable by the cleaning service
NICU.SAFETY.02	The NICU shall provide the materials to sterilise the hands in every room
NICU.SAFETY.03	The NICU shall ensure that the transfer trolley fits next to the incubator
NICU.SAFETY.04	The NICU shall facilitate that one nurse can take care of two, with a maximum of three, neonates
NICU.SAFETY.05	The wires at the NICU shall not pose a trip hazard
NICU.SAFETY.06	The NICU provides a dedicated area for the parents to prevent them from getting in the way of the nurses
NICU.SAFETY.07	The NICU shall contain an emergency button
NICU.SAFETY.08	The NICU shall contain guiding lights to counteract tripping hazards

4.3.4 NICU Integration

Number	Requirement
NICU.INTEG.01	The NICU shall consist of appliances that are already used
NICU.INTEG.02	The NICU shall be compatible with other single-room NICU designs

Number	Requirement
NICU.INTEG.03	The NICU shall support hardware, power, and data connections of other companies
NICU.INTEG.04	The hospital shall provide scenario training for the nurses to adapt to the new environment

4.3.5 NICU Maintenance

Number	Requirement
NICU.MAINT.01	The NICU appliances can be changed in 1 hour
NICU.MAINT.02	The appliances at the NICU can be checked within ten minutes
NICU.MAINT.03	All subsystems of the NICU shall be accessible for inspection and maintenance according to the hospital specification
NICU.MAINT.04	All LED lights can last for 50,000 hours (Montes de Oca, 2021)
NICU.MAINT.05	All LED lights can be replaced within an hour

4.3.6 Contact Platform General

Number	Requirement
CONT.GENERAL.01	The Contact Platform shall provide all needed information for the parents
CONT.GENERAL.02	The Contact Platform shall provide a clear overview of all appointments and meetings
CONT.GENERAL.03	The Contact Platform shall provide insight into the healthcare plan of the neonate
CONT.GENERAL.04	The Contact Platform shall provide daily updates concerning the babies

4.3.7 Contact Platform Utilization

Number	Requirement
CONT.UTIL.01	The Contact Platform shall be able to support the parents from becoming pregnant, going to the hospital to give birth, giving birth, the admission to the hospital and the release from the hospital
CONT.UTIL.02	The Contact Platform shall be usable day and night to establish contact between the parents and nurses

4.3.8 Contact Platform Safety

Number	Requirement
CONT.SAFETY.01	The Contact Platform shall automatically register changes made by the health care employees and alert the parents
CONT.SAFETY.02	The Contact Platform shall automatically register changes made by the parents and alert the health care employees

4.3.9 Contact Platform Integration

Number	Requirement
CONT.INTEG.01	The Contact Platform shall consist of programs that are already used
CONT.INTEG.02	The Contact Platform shall be compatible with all divisions within the child hospital
CONT.INTEG.03	The Contact Platform interface requirements shall be compatible with the needs of the parents and health care employees

05

FIRST DESIGN ITERATION

The designs are created by looking at the needs of the stakeholders in combination with the functionality of the different aspects. A focus was put on the principle of healing design (Stichler, 2001), which implies that the design should positively affect the recovery of patients. As Norman (2002) mentioned, hospitals often neglect the aesthetical aspect. According to Garde & van der Voort (2008), creating a calming surrounding can distress the patients and increases the efficiency of procedures.

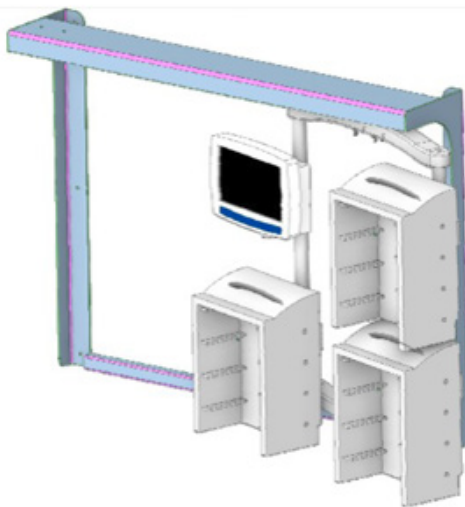
5.1 Single room

5.1.1 Design

The current NICU design at the WKZ has all devices connected to a moveable arm connected to the roof. The moveable arms provide complete flexibility when helping a baby. The moveable arms help ensure better hygiene. Having no appliances on the floor makes the room easier to clean.

One of the main requirements from the hospital is that all devices are placed on the back wall (NICU.GENERAL.09). Multiple NICUs in the Netherlands already use the 'back wall' method. Some NICUs can move the devices from left to right. Others have incorporated hanging arms within the back wall. The decision on whether a hospital uses hanging arms or only the incorporated hanging mechanism is based on whether they want a 'clean' parent area. Having moveable arms counteracts the idea of providing the space for the parents. That is because the hanging arm can be moved towards the parent area.

For the NICU of the WKZ, a mechanism for the devices has already been designed and selected, see Figure 23. This mechanism ensures a horizontal displacement and a rotation of 15 degrees, over the Z-axis, in both directions. The rotation was added to provide complete visibility of the screens and devices attached to the mechanism.



The other devices needed at the NICU are in a stationary area. The oxygen supply is always needed behind the incubator. The computer and monitors are always located on the left side of the incubator.

The monitors are connected to the wall and cannot move. A small monitor is placed on the hanging system and is connected to the large monitor. When settings are changed on one of the monitors, they automatically change on both. This monitor ensures that the nurse can work on both sides of the baby and can alter the monitor as needed.

Figure 23, Back wall mechanism for the WKZ to hold medical devices

The parental furniture has been selected but not presented, and the optimal location in the room is still unknown. Therefore, a couch is added to the design as a placeholder. The room has more space in length than in width. The decision is made to place the couch on the right side of the baby, against the wall with windows. The parents also have a closet and light on the baby's right side.



Figure 24, First iteration design for the single room unit facilitating one baby shown from the left side of the incubator



Figure 25, First iteration design for the single room unit facilitating one baby shown from the right side of the incubator

5.1.2 Validation

A first iteration for the single-room unit based on the hospital's wishes has been created. The stakeholders have been asked to give feedback on the iteration design. The feedback is given during unscripted interviews. Several nurses raised many concerns about the usage of a static back wall design in the new unit. Especially concerning the monitor, "Hoe kom ik bij de computer als ik de medicatie aan de linker kant van het bed aan het controleren ben? (How do I reach the computer when I am checking on the medication on the left side of the bed?)" (Unscripted interview at WKZ, 2022). There are also concerns about whether the oxygen vacuum could reach the other side of the incubator when a baby is held by their mom or dad on the right side of the incubator (Unscripted interview at WKZ, 2022).

The doctors did not share these concerns. They help design the room and therefore find it easier to imagine whether the oxygen will reach to the right side of the incubator..

The main feedback gotten from the parents was about the privacy. The parents are happy that they will have more privacy. Another positive feedback point from the parents was the ability to visit their own child whilst seeing the other children less.

The requirements reached within this iteration are:

NICU General

Number	Requirement
NICU.GENERAL.02	The NICU shall provide complete visibility concerning the neonates
NICU.GENERAL.04	The NICU shall provide a dedicated area for parents to be able to stay with their newborn
NICU.GENERAL.06	The NICU shall store all standard medication in all separate rooms
NICU.GENERAL.08	The NICU shall maintain a temperature of 24 degrees Celsius
NICU.GENERAL.09	The NICU shall consist of one wall with all standard appliances integrated into that wall

NICU Utilization

Number	Requirement
NICU.UTIL.02	The NICU shall provide constant monitoring of the neonates' vitals

NICU Safety

Number	Requirement
NICU.SAFETY.03	The NICU shall ensure that the transfer trolley fits next to the incubator
NICU.SAFETY.05	The wires at the NICU shall not pose a trip hazard
NICU.SAFETY.06	The NICU provides a dedicated area for the parents to prevent them from getting in the way of the nurses

NICU Integration

Number	Requirement
NICU.INTEG.01	The NICU shall consist of appliances that are already used
NICU.INTEG.02	The NICU shall be compatible with other single-room NICU designs
NICU.INTEG.03	The NICU shall support hardware, power, and data connections of other companies

5.2 Twin Room

5.2.1 Design

The layout for the twin room should be primarily the same as the room for one baby. However, the rooms are larger in length and must contain double the number of appliances. This first iteration focused on where the oxygen should be located and whether two incubators could fit next to each other with nurses working between them.

After the size of the room was altered, a smaller hanging system of 1 meter wide and an extra incubator were added. However, in this situation, the space between the incubators was too

tiny for a nurse to work in. Therefore, the parental couch has been moved to the back wall. The parental closet has been placed next to the couch. The result is more space between the incubators for the nurses to work.

The second incubator also requires monitors and an oxygen supply. The newly obtained space can be used to place these devices. Also, a small desk area can be created between the incubators for the nurses to put appliances on when providing care. The rest of the design does not need to be altered for the twin room and, therefore, remains like the single-room design for one baby.

Improved hanging system



Moved parental furniture

Figure 26, First iteration design for the single room unit facilitating twins shown from the left side of the incubator



Figure 27, First iteration design for the single room unit facilitating twins shown from the right side of the incubator

5.2.2 Validation

During the feedback on the twin rooms, the biggest concern raised by the stakeholders from the hospital was about the size. The stakeholders all doubted whether both incubators would fit inside the room, with enough space for them to work. The question of whether there would be room for two kangaroo chairs was also voiced. The current model already removes part of the concern. However, many appliances are still missing or have not been visualised in the correct size. Another concern voiced was about all the different appliances that could be needed. “Alle kinderen onder 32 weken moeten minimal 3 dagen aan de neuro. Krijgt die ook een vaste plek? (All children under 32 weeks need to be connected to the neuro for a minimum of 3 days. Will the neuro get a static location?)” (Unscripted interview NICU, 2022).

The parents did not raise any concerns about the twin room.

The requirements tackled during this iteration are the same as in the single room design.

5.3 Light settings

5.3.1 Design

As Aita et al. (2021) said, it is essential to have the correct light levels at the NICU to promote the growth and development of newborns. Every small change creates physiological instability as well as disruption of sleep (Aita et al., 2021).

As visible in Figure 28, the following six lighting elements were created. They have been implemented in the model of the twin room to visualise different options, as visible in Figure 29 and Figure 30.

5.3.1.1 Main light

Function: ensures good visibility of the appliances and the baby and has an surgery setting.

The main light is changeable from a day to a night setting to an emergency operation setting. Some nurses prefer automatic settings. Other nurses want to be able to alter the light by themselves.

5.3.1.2 Medical closet light

Function: shine a light on the drawers with supplies to help nurses see the available tools.

Nurses want a light that can be moved to shine on the syringe and volumetric pumps.

5.3.1.3 Hygiene light

Function: provide light on the hygiene furniture where the nurses will clean their hands before entering and leaving the room.

The hygiene light does not need to be bright. It needs to be an orientation light and ensure visibility on the trash bins and the hand sanitiser.

5.3.1.4 Parent area light

Function: provide enough light for the parent to be able to read a book or use their laptop.

The parent area light does not need to be very bright. It should not disturb the baby.

5.3.1.5 Parent closet light

Function: enlighten the inside of the parent closet.

A wish was formed that it would be luxurious to have small spotlights within the parental closet. The parents would not need to turn on the parent area light to look inside the closet or use the flashlight on their phones.

5.3.1.6 Spotlight at the back wall

Function: extra light to look at the syringe and volumetric pumps during the night without needing larger lights

Nurses wish to have a small spotlight to move around. This spotlight will lighten the appliances to make it possible for the nurse to check whether the different settings are correct. They would mainly use this light at night when the overall light settings are shallow.

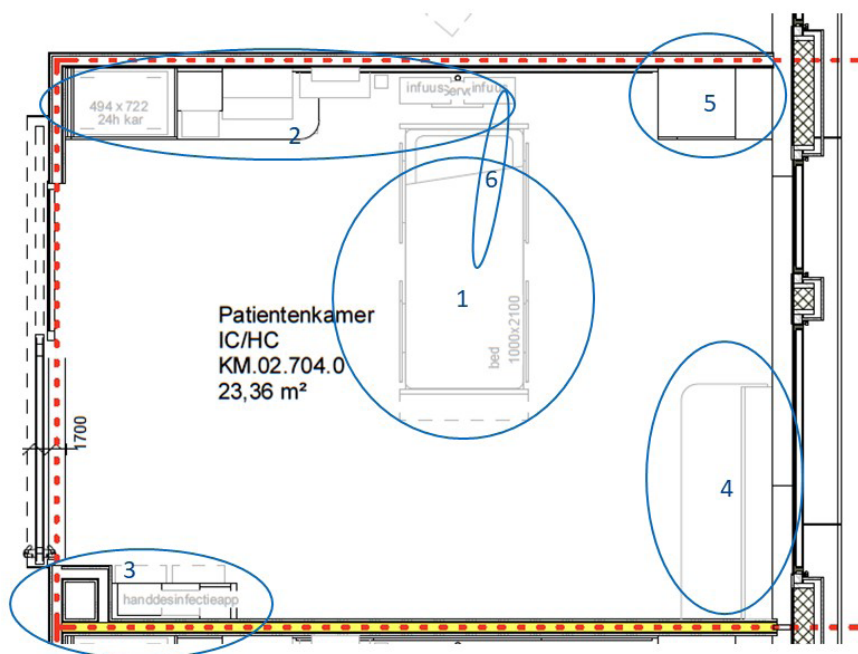


Figure 28, Sketch showing the required lights for the NICU at the WKZ



Figure 29, First iteration of the lights design for the Single Unit room shown from the front of the incubator



Figure 30, First iteration of the lights design for the Single Unit room shown from the back of the incubator

5.3.2 Validation

The nurses were content with the lights already existing in the current situation. However, after a while, more possibilities became apparent and were added to the design. The most significant discussion point about the design of the lights focussed on the function of the lights. Why do people need the light, and where should lights be located. The spotlight back wall (chapter 5.3.1.6) raised some questions to whether it was necessary. The medical spotlights located at the back wall will provide enough light to read the syringes. However, the location of those spotlights does need to be altered to shine on the syringes instead of on the top of them. Furthermore, the strength of the lights needs to be determined, keeping the requirements in mind.

The doctors and surgery stakeholders are concerned about whether the main lights would submit enough light to conduct an emergency operation. They are also concerned about the colour of the light to ensure that they can see the accurate colour of the baby. They need to be able to see the colour of the baby to understand the status of the baby.

The parents did not raise any concerns about the design of the light.

One requirement has been achieved during this iteration. For the other requirements, the specific lights need to be known. This will be a focal point for the next iteration.

NICU General

Number	Requirement
NICU.GENERAL.11	The NICU shall provide a day and night light setting (Mann et al., 1986)

5.4 Contact Platform

5.4.1 Design

The current contact moments between the hospital and the patients are through many different channels. The parents are already overwhelmed by the experience of having a child in the NICU (Garde & van der Voort, 2008), and having multiple contact platforms increases this feeling. The hospital already uses a platform with many requirements integrated, see Figure 31. The patient portal consists of a mailing platform, a page for the information, a page with a calendar where meetings can be planned and the patient file. From the patient journey, the list of requirements and unscripted interviews it is known that there are three important moments to improve.

The first moment of contact that needs improvement is the website. There is much information available however, the first articles that are shown are about total ruptures and other negative symptoms which can occur during birth. Another point of improvement are the folders. Many folders are available, but it is unknown where or whether they are digital or physical. The last moment of improvement is HIX. HIX is the program through which the results of tests are presented to the parents. The comments from the experts and doctors/nurses, which are not always encouraging, are also sent to the parents. There is also the wish for a baby's diary. Figure 32 shows the first iteration of the contact platform.

The parents' information page has been altered within this first iteration. The information for preparing for the baby's delivery only describes what the patient needs to bring. There is much information incorporated on the website of the hospital. However, it is not easy to find the correct information. As shown in Figure 32, a proposal has been made to incorporate more information into the patient portal to help patients find what they need. The information is altered to include everything the parents need to know about the division of birth. Another improvement of the patient portal is the medical file. All feedback from the doctors and nurses on conducted tests can now be found in the patient portal. Combining all information about the patient and in general within the patient portal.

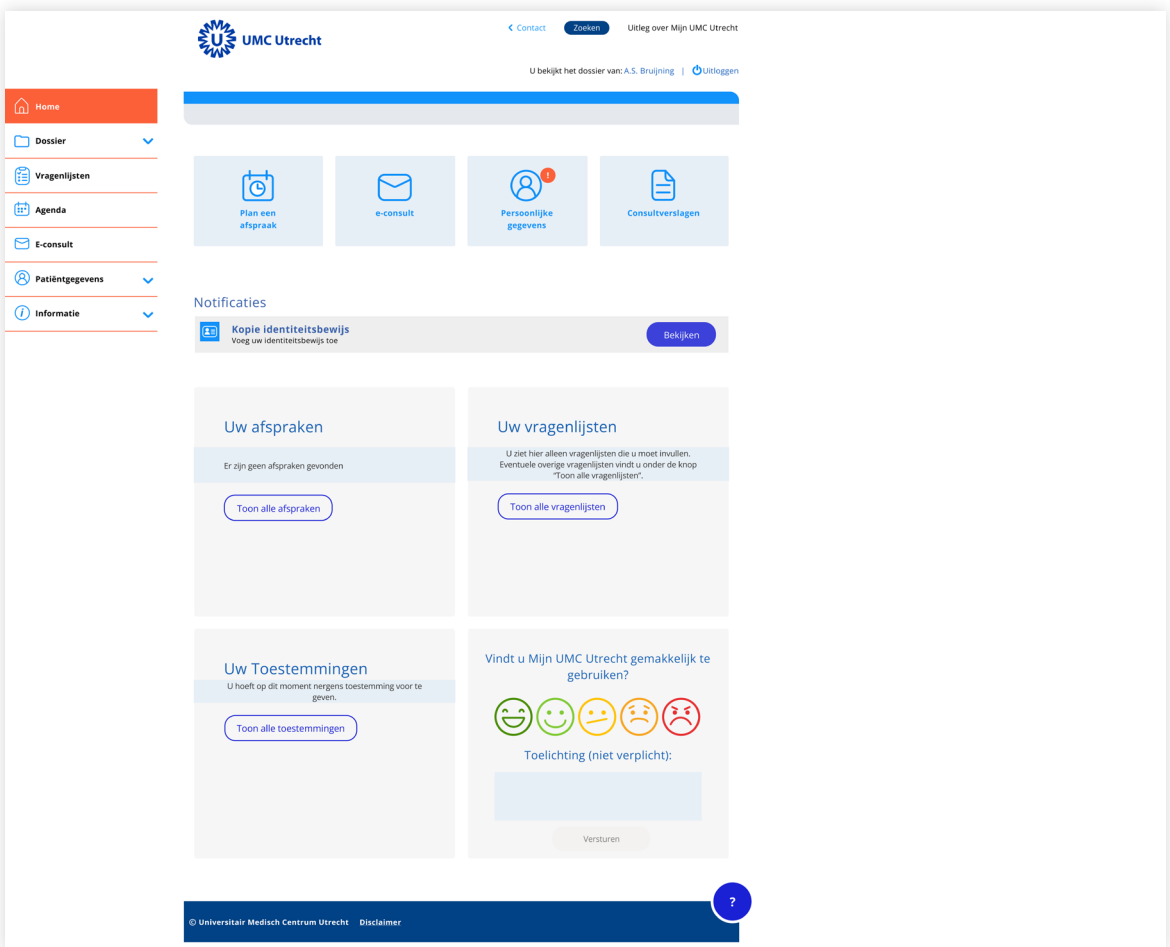
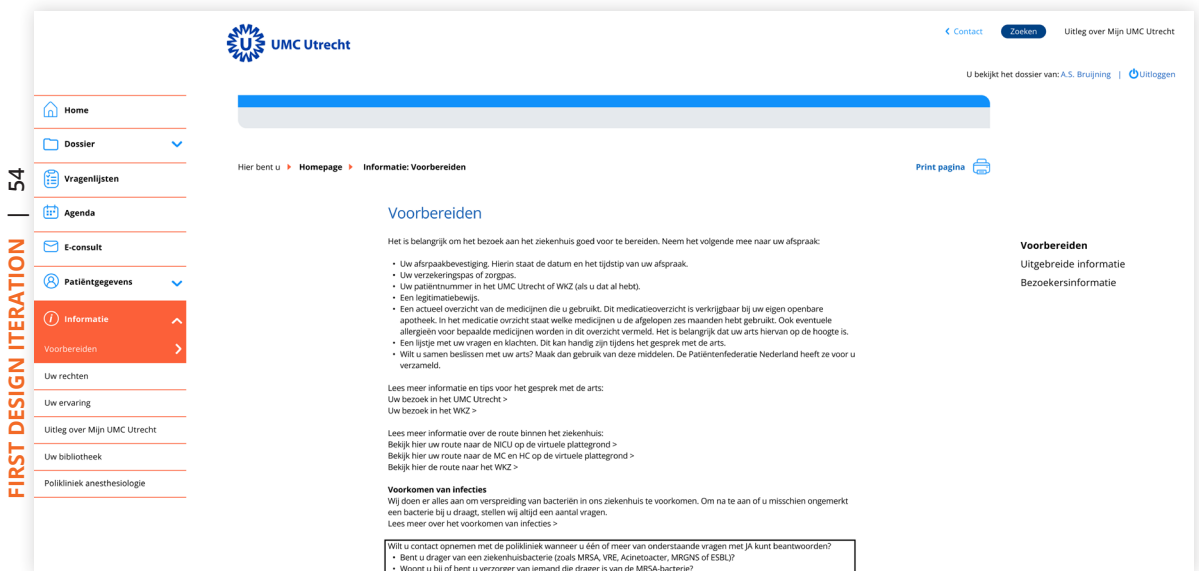


Figure 31, Current patient portal used at the WKZ



FIRST DESIGN ITERATION | 54

Figure 32, First iteration of the patient portal incorporating all needed information for the patients

Another change to the patient portal is the calendar function. Currently, it shows the planned examinations and tests. The new patient portal will provide the option to plan the parents' visits online. In this way, the patients can plan their visit at home and do not need to write their visit in the physical booklet located at the unit. The iteration on the calendar is visible in Figure 33.

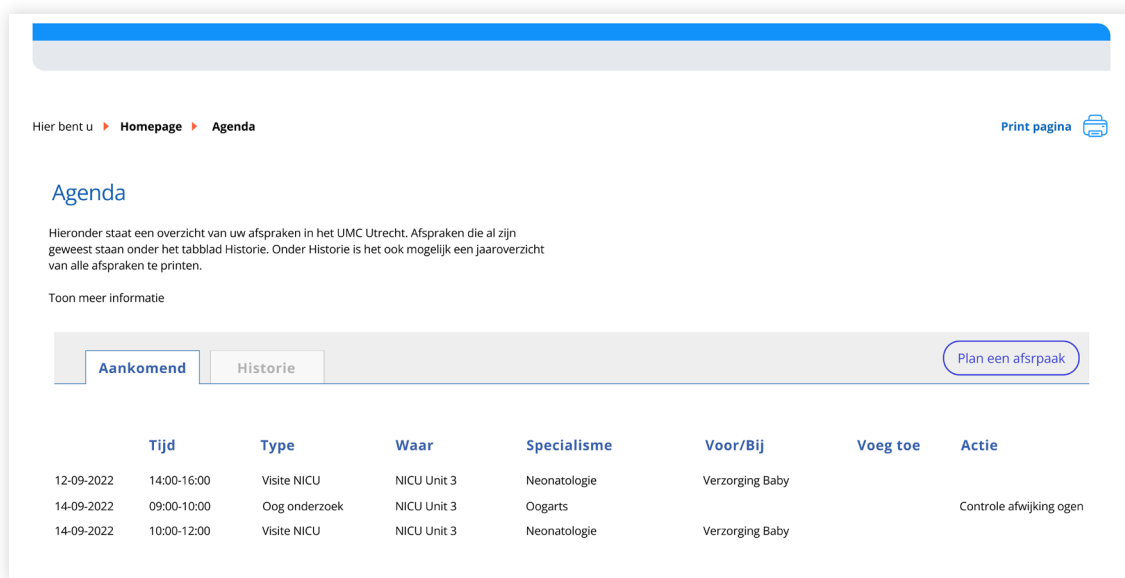


Figure 33, First iteration of the patient portal incorporating a visit option in the calendar

5.4.2 Validation

The patient portal will be altered to facilitate the needs of the stakeholders in the communication. Most communication issues arise when people look at the website for the first time, when the parents get short updates over the phone and when they get information through HIX.

The stakeholders from the hospital felt offended when they heard that the parents felt stressed by the information presented on the website. This is one of the hospital's biggest concerns that should quickly be improved. Furthermore, they were pleased with the proposed improvement and were wondering whether sending the information folders through this platform was possible.

The parents find it very important that the information is written down clearly. 'Ze heeft een zeldzame ziekte, als ik informatie vind, dan luisteren de artsen daar naar. (She has a rare disease, when I find information, the doctors are listening to me)' (Unscripted Interview at WKZ, 2022). In other words, information is valuable, having more information helps the parents think of tomorrow and next week.

The requirements achieved for the contact platform during the first iteration are:

Contact Platform General

Number	Requirement
CONT.GENERAL.01	The Contact Platform shall provide all needed information for the parents
CONT.GENERAL.02	The Contact Platform shall provide a clear overview of all appointments and meetings

Number	Requirement
CONT.GENERAL.03	The Contact Platform shall provide insight into the healthcare plan of the neonate

Contact Platform Utilization

Number	Requirement
CONT.UTIL.01	The Contact Platform shall be able to support the parents from becoming pregnant, going to the hospital to give birth, giving birth, the admission to the hospital and the release from the hospital
CONT.UTIL.02	The Contact Platform shall be usable day and night to establish contact between the parents and nurses

Contact Platform Safety

Number	Requirement
CONT.SAFETY.01	The Contact Platform shall automatically register changes made by the health care employees and alert the parents
CONT.SAFETY.02	The Contact Platform shall automatically register changes made by the parents and alert the health care employees

Contact Platform Integration

Number	Requirement
CONT.INTEG.01	The Contact Platform shall consist of programs that are already used
CONT.INTEG.02	The Contact Platform shall be compatible with all divisions within the child hospital

06

SECOND DESIGN ITERATION

The 3D visualisations of the twin room and a mock-up of the single room are evaluated during this session. The actual mock-up, located at the WKZ, is used for the NICU and the Pediatric Intensive Care Unit (PICU) interior design testing. The mock-up has been built using the sizes of the PICU room. Therefore, it is missing 30 cm in length to be the exact single NICU room size. The mock-up room is built in another room, making it impossible to alter the sizes into an actual representation of the twin room. A model has been created for single and twin rooms to ensure proper testing. According to Brandt (2005), having both models be the same level of detail makes it easier for the stakeholders to focus on the appliance placement instead of the type of appliances in the model. Altering the model helped make the ideas visible to everybody, which according to Garde & van der Voort (2008), decreases the possibility of misunderstandings.

6.1 Single room

6.1.1 Design

The monitors have been attached to a moveable arm. The arm increases visibility by creating the possibility to place the screen in such a way that it is visible in the hallway. Furthermore, the ease of use during a procedure increases by moving the monitor towards the incubator. All needed controls for the lights, temperature and emergency contacts are added next to the computer.

The hanging system has been improved. It contains a rotational angle with no limitation, and the mount has been decreased in size to create more space for other devices. This way, the caregivers can still use the devices on the hanging system from both sides of the incubator and place different devices next to the incubator.

Furthermore, the number of wall outlets has been increased to support different devices. The outlets are placed in a case to protect them from fluids and to minimise the amount of light projected by these outlets.

Finally, the correct hygiene device has been added to both sides of the room to ensure hygiene at the entrance of the room and next to the medical appliances.

All improvements are visible in Figure 34 and Figure 35.



Figure 34, Second iteration design for the single room unit facilitating one baby shown from the left side of the incubator



Figure 35, Second iteration design for the single room unit facilitating one baby shown from the right side of the incubator

6.1.2 Validation

The stakeholders are satisfied with the current design of the NICU. They are very excited about the extra space around the baby. They are concerned about the balance between having parents in the room and being an intensive care.(IC) That means that the babies are very ill and change rapidly. They are also asking whether the Brainz will be statically placed inside the wall or whether it can move.

The parents perceived the parental furniture as too low. Mothers who just gave birth will have trouble with the height. Moreover, the parental furniture is short in length. The average Dutch person will not be able to fit on the parental furniture when lying down.

The requirements achieved within this iteration are:

NICU General

Number	Requirement
NICU.GENERAL.05	The NICU shall provide controls which change the temperature and lights per specific room
NICU.GENERAL.10	The NICU shall provide monitors which are visible on both sides of the baby

NICU Safety

Number	Requirement
NICU.SAFETY.02	The NICU shall provide the materials to sterilise the hands in every room
NICU.SAFETY.04	The NICU shall facilitate that one nurse can take care of two, with a maximum of three, neonates
NICU.SAFETY.07	The NICU shall contain an emergency button

NICU Maintenance

Number	Requirement
NICU.MAINT.03	All subsystems of the NICU shall be accessible for inspection and maintenance according to the hospital specification

6.2 Twin room

6.2.1 Design

Within the second iteration of the twin room, the back wall was improved by adding more appliances and extra wall outlets to ensure enough power. Visual separation is created by adding wall outlets between the incubators. The visual separation helps with understanding what appliances are for which baby. Furthermore, the hanging system has been improved by decreasing the width, which creates more space for other necessary appliances.

Another improvement is the parental furniture. It now contains a place to sit and work on a desk and the possibility of being altered into a bed where one parent can stay for a night. The improved design is visible in Figure 36 and Figure 37.

6.2.2 Validation

The stakeholders were wondering whether two kangaroo chairs would fit between the incubators. This has already been checked by adding placeholders in the model and it is possible..

The parents were wondering where the second parent would need to stay. The current parent furniture only sits and sleeps one person. Especially when the parents have gotten twins, they need to work together and stay together when taking care of their babies.

The same requirements achieved at iteration 2 of the single room are achieved during iteration 2 of the twin room.



Figure 36, Second iteration design for the single room unit facilitating twins shown from the left side of the incubator



Figure 37, Second iteration design for the single room unit facilitating one baby shown from the right side of the incubator

6.3 Light settings

6.3.1 Design

The second iteration is an improvement on iteration one, and the architects' proposal, including the chosen materials, is visible in Appendix F.

The main light has been improved. The shape of the light is now a square. This way, the climate-controlled roof has minor interruptions and works optimally. Furthermore, these square-shaped lights provide enough lux for a day setting and during an emergency operation.

The light located at the hygiene station is improved. It is shaped into a spotlight which gives enough lux for the hygiene furniture without shining too bright. This is also the case for the light located in the parent area. A wall outlet was added in the parent area to provide a small plug-in reading light.

The light in the parental closet is removed because it only provides extra lux in the room, which should be kept to a minimum, and the parents will primarily use the closet during daylight.

The spotlights on the back wall are improved by changing the location. They are mounted above the computer screen, the patient and next to the moveable devices. For the twin room, two more spotlights are located above the patient and to that baby's moveable devices.

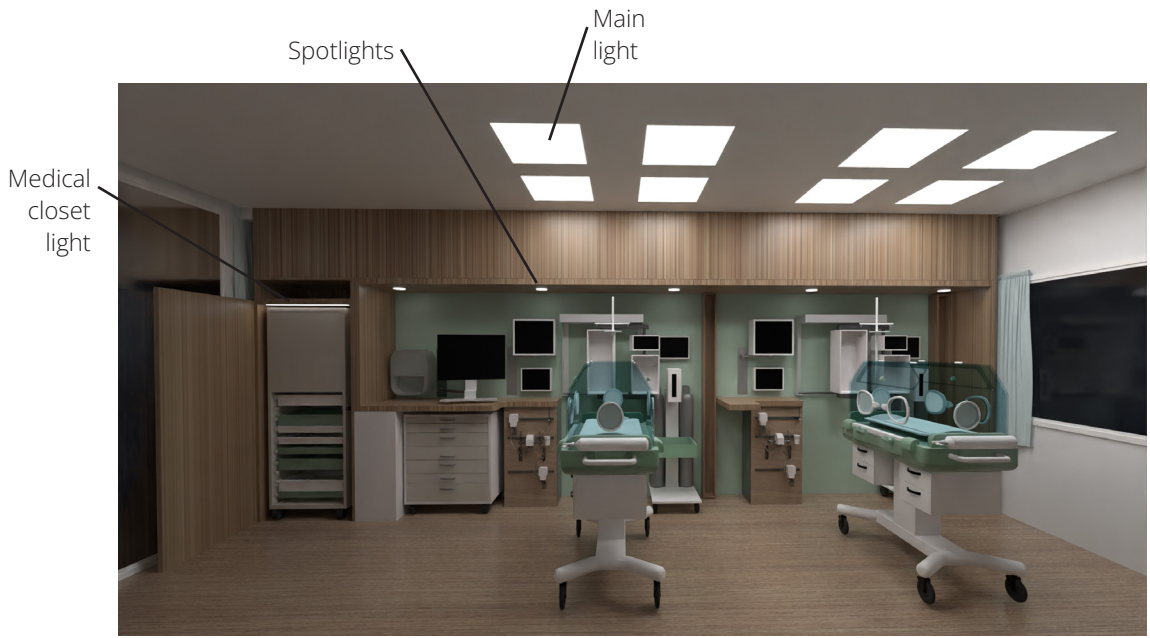


Figure 38, Second iteration of the lights design for the single room unit shown from the front of the incubator



Figure 39, Second iteration of the lights design for the single room unit shown from the back of the incubator

6.3.2 Validation

The stakeholders are enthusiastic about the design of the lights. The main concern is whether the spots are dimmable, just like the main lights. The reason for that concern is that the nurses want to use the spots at night to look at the syringe pumps.

The parents are happy with the light design for their area. They have no concerns about removing the light in the parental closet. Their only concern is whether the light in the parental area will be too bright and influence their baby.

During this iteration, the following requirements have been achieved.

NICU General

Number	Requirement
NICU.GENERAL.12	The NICU shall provide ambient lighting with a maximum of 600 lux for the operating area (Aita et al., 2021)
NICU.GENERAL.13	The NICU shall provide ambient lighting with a maximum of 300 lux for the parental area (Aita et al., 2021)
NICU.GENERAL.14	The NICU shall provide a light setting of 1000 lux during an emergency operation (Aita et al., 2021)
NICU.GENERAL.15	The NICU shall provide LED lights with a CRI above 90 % (Montes de Oca, 2021)
NICU.GENERAL.16	The NICU shall provide lights with 3000K warmth for the parental area (Montes de Oca, 2021)

NICU Maintenance

Number	Requirement
NICU.MAINT.04	All LED lights can last for 50,000 hours (Montes de Oca, 2021)

6.4 Contact Platform

6.4.1 Design

During the second iteration, the patient portal was improved by adding submenus per information category, which is visible in Figure 40. Adding submenus to the information portion of the patient portal gives a good overview of where the patient can find the needed information. It also reduces the overwhelming feeling when only portions of the information are shown per submenu.

Furthermore, a page for the diary of the newborn is added, as visible in Figure 41. This page will be used to log all memorable events concerning the newborn, for example, the first scan or weighing. The wish to have a medical diary incorporated into the patient portal was revealed during the presentation of iteration 1. This diary enables the possibility to share pictures of the newborn with the parents and keep them saved online.

All information on the patient portal helps the caretakers point out what information is essential for the patient. The caretakers currently need to go into their portal and thoroughly look for the folders to send them to the correct patient. Having the folders located in the patient portal saves time for the caregivers. The patient can find the correct folder even when the caregivers forget to send them.

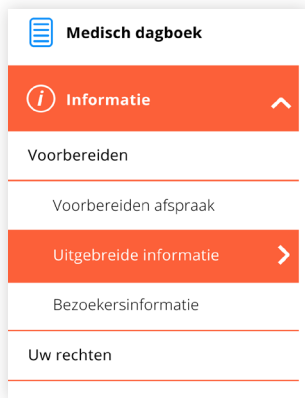


Figure 40, Second iteration of the patient portal, including submenus for information categories

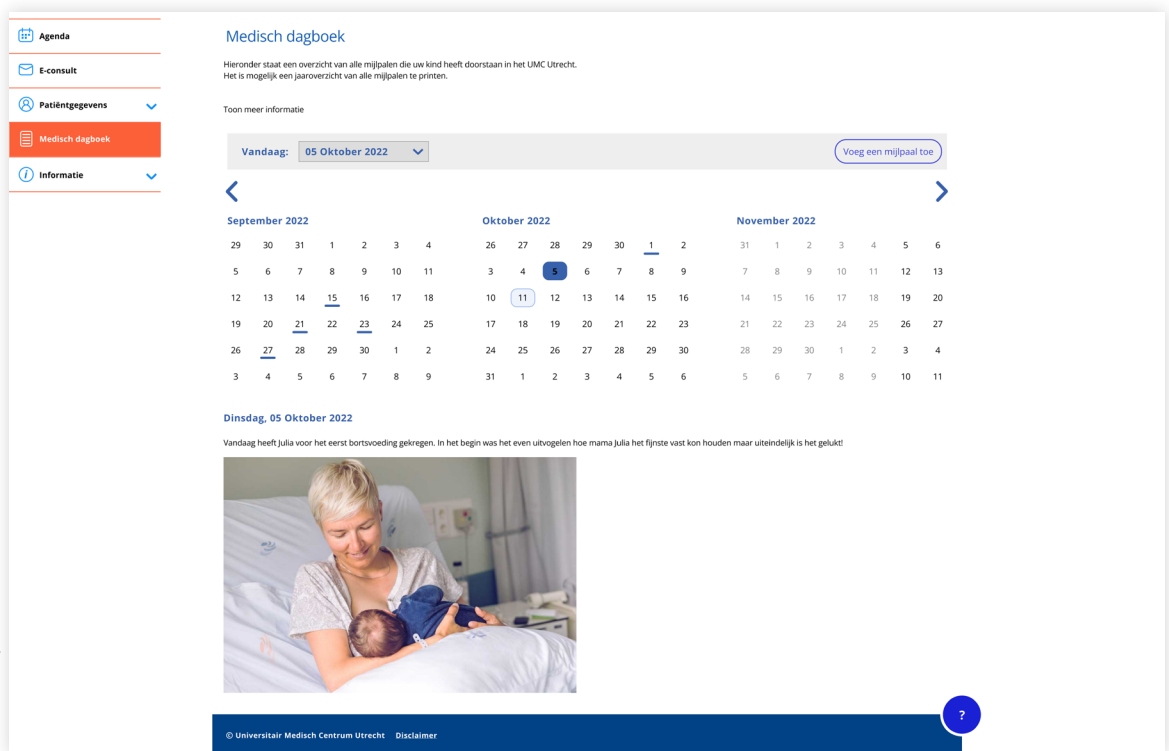


Figure 41, Second Iteration of the patient portal, including a medical diary to log the milestones

6.4.2 Validation

The stakeholders are enthusiastic about the patient portal. The added information and folders help the users to find the needed information. Having the medical diary added to the patient portal is received very positively. The parents are excited about having the pictures of their baby digitally.

One point of improvement is the way the information is currently presented. For some users, seeing this much text is very overwhelming. It makes it more challenging to find the information needed. However, adding general images to break the text does not get users excited.

The requirement that has been achieved during this iteration is:

Contact Platform General

Number	Requirement
CONT.GENERAL.04	The Contact Platform shall provide daily updates concerning the babies

07

FINAL DESIGN

7.1 Single room

7.1.1 Design

The single room has significantly changed from the starting design to the final design. It consists of a medical, parental, and hygiene side. The hanging system has decreased to 80 cm wide, allowing more room for additional appliances. A holder for the oxygen has been added to the hanging system. The holder can move in the left and right directions. A holder for the infusion bag is added above the syringe pumps. The holder enables the intravenous drip as a method to provide more fluid to the baby.

The small medicine trolley is improved by adding a workspace to the sides. The workspace can be unfolded when working on a procedure at the incubator and can be folded down to fit the trolley under the desk.

Furthermore, a small cabinet has been added to the right side of the parental closet. In this small cabin, the Digiconnect will be placed, which gathers all data from the sensors and machines and presents it on the monitor and at the central post of the nurses. The wall outlets have been moved down to fit under the Digiconnect cabinet. Another row of outlets has been added to provide electricity for even more appliances, especially during an emergency operation.

The oxygen cabinet has been improved. An extra vacuum has been added to the lower rail, and an extra rail has been added to the left side of the cabinet to add a bottle of water for cleaning purposes. The middle rail has been removed to enable more space for the tubes.

Another improvement to the single room is the curtains. The space between the closet and the wall explicitly added for the curtains is removed. These spaces would only collect dust and are difficult to clean.

Moreover, the hygiene furniture has been improved. Extra storage space for clean clothing and gloves has been added. An extra bin has been added for needles to be thrown away, and a water bottle is added to clean appliances.

The parental furniture has been improved. There is no room for storing the bedlinen inside the furniture itself. There is room for two people to sit simultaneously, and an outlet and lamp are implemented into the furniture.



Figure 42, Final design for the single room unit facilitating one baby shown from the left side of the incubator



Figure 43, Final design for the single room unit facilitating one baby shown from the right side of the incubator

7.1.2 Validation

Stakeholders from the hospital entered the mock-up and expressed their opinions. For some of the nurses, the second vacuum, which will be used to clean the thorax drain, was placed very low. However, the thorax drain is only cleaned a few times a year. The stakeholders from the hospital were also questioning whether the Brainz (brain activity) information could be integrated into the monitor. The Brainz is now added as an extra screen placed next to the syringe

pumps. It is not visible when working on the baby. However, a nurse assistant can look at the Brainz monitor whenever needed.

The parents were very excited about the large space of the new rooms. However, the first concern was that the room looked very chaotic. The dark colour of the wall, used in the mock-up, emphasises the number of wires and appliances. Another concern of the stakeholders was that the patients had very little room to express themselves. The rooms are designed as a baseline for the entire hospital. The baseline design uses calming colours. There is no room within the baseline design for bright colours or busy visualisations. Adding coloured bars where parents and children can add drawings/cards would help to make the rooms more personal.

NICU General

Number	Requirement
NICU.GENERAL.03	The NICU shall provide the complete care of the neonates
NICU.GENERAL.07	The NICU shall provide privacy for the parents

NICU Safety

Number	Requirement
NICU.SAFETY.01	The NICU shall be completely cleanable

NICU Integration

Number	Requirement
NICU.INTEG.05	The hospital shall provide scenario training for the nurses to adapt to the new environment

7.2 Twin Room

7.2.1 Design

Similar improvements are made in both the single and twin rooms. The hanging system, the hygiene furniture, the parental furniture, the oxygen cabinet, and the curtains have been improved similarly. In the twin room, two cabinets have been added for the Digiconnects of both babies. One of these cabinets is located above the wall outlets of the right baby. The other cabinet is under the desk in the middle of the room. This is done to keep the Digiconnect close to the appliances.



Figure 44, Final design for the single room unit facilitating twins shown from the left side of the incubator



Figure 45, Final design for the single room unit facilitating twins shown from the right side of the incubator

7.2.2 Validation

The concerns raised at the single-room validation are the same for the twin room. Adding the information from the Brainz into the monitor would provide space for other appliances. Adding more options to personalise the space would be a big wish.

The same requirements for the single room in the final design are achieved for the twin room.

7.3 Light settings

7.3.1 Design

The light design has been improved. The spot above the patient is dimmable and has a specific setting for the night. A light under the desk is added to provide light on the small medical trolley. This light is like the strip in the medicine cabinet. Another similar light strip is added to the hygiene cabinet.

Furthermore, the parental light is improved to a hanging lamp. The hanging lamp increases the cosy feeling in the parental area. This light has a smaller light radius, decreasing the impact on the newborn. The book light provided for the parents is improved. The book light is incorporated into the parental furniture.

One more important improvement to the design of the lights was conducted. The square lights have been changed once more into rectangular lights. However, this time the rectangular lights are smaller and are placed next to the incubator instead of right above. Having the lights next to the incubator means the baby will not look at the lights when staring at the ceiling. Having the rectangular lights helps light the entire baby and the entire child's bed in the children's room.

With the new storage space above the hygiene furniture, the light design has been improved. A small strip of LED lights has been integrated underneath the storage area. This light is added to provide guidance in the dark and increase the materials' visibility in the closet.



Figure 46, Final lights design for the single room unit shown from the front of the incubator



Figure 47, Final lights design for the single room unit shown from the back of the incubator

7.3.2 Validation

The stakeholders from the hospital are pleased with the light design. They can conduct their procedures and surgeries with the correct light strength. The guidance light is the right amount of visible to guide but not too intrusive.

The parents would like to have the possibility of controlling the lights from their parental area. With this switch, the parents would be able to turn on their area light or book light. Furthermore, they are very enthusiastic about the guidance lights.

NICU Safety

Number	Requirement
NICU.SAFETY.08	The NICU shall contain guiding lights to counteract tripping hazards

7.4 Contact Platform

7.4.1 Design

The design is improved by adding graphics which emphasise the information page. In this way, people who have difficulties with reading can find the information better. Having the graphics added also supports the written information.

Uitgebreide informatie

De afdeling neonatologie bestaat uit:

- Een medium care (MC). Uw kind gaat na de bevalling naar de MC als het extra zorg of behandeling nodig heeft.
Lees meer over de MC in de folder >
- Een high care (HC). Op de HC liggen kinderen die niet langer de zorg van de intensive care (IC) nodig hebben.
Lees meer over de HC in de folder >
- Neonatologie intensive care (NICU). Op de NICU worden kinderen opgenomen die na de geboorte intensive zorg en/of bewaking nodig hebben.
Lees meer over de NICU in de folder of bekijk de video over de opname van uw kind op de afdeling >



Verblijf tijdens NICU

Dichtbij uw kind blijven

Indien de toestand van uw kind zorgelijk is, kunnen wij ons voorstellen dat u in de nabijheid van uw kind wilt blijven. In deze bijzondere situatie bieden wij de mogelijkheid om de dag en eventueel de nacht door te brengen op een ouderkamer van de afdeling. Wanneer u op de kraamafdeling van het WKZ geboortecentrum ligt, is het soms mogelijk voor uw partner een nacht bij u op de kraamafdeling door te brengen.

Ontwikkelingsgerichte zorg

De omgeving van de afdeling neonatologie van het WKZ geboortecentrum is niet alleen onnatuurlijk voor de ontwikkeling van uw kind, maar kan ook als ouder overweldigend zijn. Het is belangrijk om de baby's te beschermen tegen negatieve invloeden vanuit de omgeving en om positieve invloeden in de vorm van steun en comfort te geven. Ontwikkelingsgerichte zorg richt zich op de zorg die past bij de ontwikkeling van uw kind.
Meer over ontwikkelingsgerichte zorg op de neonatologie >

Ronald McDonaldhuis Utrecht

Het Ronald McDonald Huis (RMD) zorgt ervoor dat u als ouders dichtbij uw kind kunt verblijven. De afdeling bepaalt of u in aanmerking komt voor een kamer in het RMD huis. Er is geen mogelijkheid om zelf te reserveren.
Lees meer >



Contact momenten

Informatieverstrekking over de situatie van uw kind

Het is belangrijk geïnformeerd te blijven over de situatie van uw kind. Wanneer u op de afdeling bent, krijgt u informatie van de verpleegkundige die voor uw kind zorgt. Ook kunt u het verpleegkundig dossier van uw kind inzien. Naast de aanwezigheid op de afdeling raden wij aan een paar maal per dag telefonisch contact met de afdeling op te nemen om te horen hoe het met uw kind gaat. U krijgt de verpleegkundige te spreken die voor uw kind zorgt. Telefonisch wordt informatie alleen aan ouders gegeven. Wanneer u nog opgenomen bent op de kraamafdeling zal de verpleegkundige ook een contactmoment hebben met de afdeling neonatologie.

Er vindt 1x per week een artsengesprek plaats en indien wenselijk vaker.

Wanneer u de Nederlandse taal niet goed beheerst kan een tolk u ondersteunen. Dit kunt u aangeven bij de verpleegkundige of behandelend arts. De afdeling zorgt via het Tolkencentrum voor een telefonische tolk (tolktelefoon) of voor een tolk die bij het gesprek aanwezig is.



Overplaatsing

Mijn kind wordt overgeplaatst binnen het WKZ

Wanneer uw kind om een bepaalde reden in een academisch centrum moet verblijven, maar geen IC zorg meer nodig heeft, wordt het overgeplaatst naar de HC of MC neonatologie of een kinderafdeling in het WKZ/UMC Utrecht.
Van de IC/HC naar de MC >
Naar de afdeling Papegaai >

Mijn kind wordt overgeplaatst naar een ander ziekenhuis

Wanneer uw kind zover hersteld is dat hij/zij geen intensieve of academische zorg meer nodig heeft, wordt uw kind overgeplaatst naar de couveuseafdeling van een ziekenhuis in uw direct woonomgeving. Wij proberen de overplaatsing vooraf te plannen. Soms is dit niet mogelijk en zal de overplaatsing op korte termijn plaatsvinden.



Naar huis

Ontslag naar huis

Het kan voorkomen dat uw kind vanaf de Medium Care wordt ontslagen om naar huis te gaan. De verpleegkundige bereidt u voor op dit ontslag en zorgt ervoor dat u uw kind zelfstandig kan verzorgen. Soms komt u in aanmerking voor uitgestelde

Uitgebreide informatie

Verblijf tijdens NICU

Contact momenten

Overplaatsing

Naar huis

Figure 48, Final design of the patient portal including visualisations to support the information

7.4.2 Validation

The concerns for the contact platform were about how the back end needs to be used. The users are very enthusiastic about the design and the implemented functions. They are concerned that it is unclear who is responsible for communicating part of the information. How will they know what information is presented in this patient portal and what will stay private. Another discussion was about whether this format would provide all information needed for nurses at the policlinic to make the patient transfer more efficient.

Contact Platform Integration

Number	Requirement
CONT.INTEG.03	The Contact Platform interface requirements shall be compatible with the needs of the parents and health care employees

08

**DESIGN
EVALUATION**

8.1 Scenario test

To check whether the rooms for the new NICU will work as intended, a scenario test has been conducted. The requirements are met when the important scenarios from Chapter 3 are possible. These scenarios are also incorporated within the requirements. Due to the planning of the hospital design team, the technical design needs to be almost finished. Therefore, the scenario tests should give a good representation of the new situation and to what extent the work processes need to be altered or the design changed.

8.1.1 Method simple scenario

The scenario test was conducted at the WKZ, Utrecht. To start, a doctor was asked to conduct a standard procedure of bringing in a line. All materials were present at the mock-up. After the scenario, unscripted questions were asked to retrieve the most information as possible. During the scenario, the doctor was asked to give a detailed description of all the activities conducted. All activities that were not possible to conduct in the mock-up or were not prepared correctly were mentioned. These comments were used to create recommendations for the hospital design.

8.1.2 Results simple scenario

The unscripted interview was used to understand the needs of the users. The questions were helpful to understand whether the mock-up was incomplete or whether the preparation of the scenario missed a step, but the mock-up was fine.

During the first try of the scenario, the doctor started by washing his hands instead of grabbing all the needed materials. Therefore, during the procedure, many materials were missing. The nurse assistant would be able to grab them. However, ensuring that the suitable materials are grabbed is part of the procedure. The doctor also used his sterilised hands to grab materials from a semi-sterile trolley. The nurse assistant should do that, but the trolley was facing in the wrong direction.

During the second try of the scenario, all materials were gathered and placed on the small medicine trolley. The medicine trolley was facing the nurse assistant with the drawers. The procedure of putting in the line for the baby did not cause any problems. The doctor wanted to throw away the needle when the line was entered. However, the location of the needle bin was not reachable from the doctor's position. It should be either moveable or located closer to the front of the desk. Having the needle bin in front of the desk can cause possible danger. Another solution for the needle bin needs to be discovered.

Another observation made during the scenario was connected to the rest of the trash. Most of the used materials were placed back on the small medicine trolley. After finishing the procedure, the used medication needed to be thrown away in the medication bin. The medication bin was not present in the mock-up nor in the design of the room. That would mean that the used medication should be thrown out a few rooms further in the hallway. Having to throw out the used medication bottle at a different location result in a longer time per procedure.

No problems occurred when the doctor ordered the echocardiograph and when the medication was checked. Having the parents in the room also did not pose a problem. It was observed that the doctors need to sterilize their hands in the hallway. When they have sterilised their hands, they need to open the door to the room with their foot.

8.1.3 Method difficult scenario

The second scenario test was conducted at the WKZ, Utrecht. A team of experts and surgeons were asked to conduct an imaginary operation. All materials that should be in the room were present at the mock-up. After the scenario unscripted questions were asked to retrieve the most information as possible. During the scenario the team was asked to give feedback on the situation. These comments were used to create recommendations for the hospital.

8.1.4 Results difficult scenario

The experts are used to bring most of their own equipment when performing an emergency operation. They also brought their own equipment during the scenario test. One of the first improvements of the new design is the added desk space and extra work desk attached to the small medicine trolley. The stakeholders were able to use those to put the appliances on.

Another improvement found in the new situation is that the oxygen appliances are in each room. Having the oxygen appliances in the room means that the experts do not need to bring their own. Another big improvement is being able to control the temperature and light settings per room. However, the concern has been raised that the room should not be too warm. The surgeons do need to stay focussed, which is easier in a cooler environment.

The surgeons are very excited about the light settings at the NICU. They will bring their surgery lamp for very specific procedures. However, having lights implemented which are bright enough for resuscitation is nice.

8.2 Design verification

The scenario tests help with figuring out whether all requirements have been achieved or not. In this sub chapter the list is shown with the status of the requirement. In chapter 9.2 the requirements that are unexpected or not achieved are discussed.

8.2.1 NICU General

Number	Requirement	Achieved
NICU.GENERAL.01	The NICU shall provide space for 17 people and 14 appliances needed during an emergency operation	Yes
NICU.GENERAL.02	The NICU shall provide complete visibility concerning the neonates	Yes
NICU.GENERAL.03	The NICU shall provide the complete care of the neonates	Yes
NICU.GENERAL.04	The NICU shall provide a dedicated area for parents to be able to stay with their newborn	Yes
NICU.GENERAL.05	The NICU shall provide controls which change the temperature and lights per specific room	Yes
NICU.GENERAL.06	The NICU shall store all standard medication in all separate rooms	Yes
NICU.GENERAL.07	The NICU shall provide privacy for the parents	Yes
NICU.GENERAL.08	The NICU shall maintain a temperature of 24 degrees Celsius	Yes
NICU.GENERAL.09	The NICU shall consist of one wall with all standard appliances integrated into that wall	Yes
NICU.GENERAL.10	The NICU shall provide monitors which are visible on both sides of the baby	Yes

Number	Requirement	Achieved
NICU.GENERAL.11	The NICU shall provide a day and night light setting (Mann et al., 1986)	Yes
NICU.GENERAL.12	The NICU shall provide ambient lighting with a maximum of 600 lux for the operating area (Aita et al., 2021)	Yes (500 lux)
NICU.GENERAL.13	The NICU shall provide ambient lighting with a maximum of 300 lux for the parental area (Aita et al., 2021)	Yes (300 lux)
NICU.GENERAL.14	The NICU shall provide a light setting of 1000 lux during an emergency operation (Aita et al., 2021)	Yes (1000 lux)
NICU.GENERAL.15	The NICU shall provide LED lights with a CRI above 90 % (Montes de Oca, 2021)	Yes
NICU.GENERAL.16	The NICU shall provide lights with 3000K warmth for the parental area (Montes de Oca, 2021)	Yes
NICU.GENERAL.17	The NICU shall provide lights with 5000K warmth for the operating area (Montes de Oca, 2021)	No (4000K)

8.2.2 NICU Utilization

Number	Requirement	Achieved
NICU.UTIL.01	The NICU shall provide space for 14 appliances needed for an emergency operation	Yes
NICU.UTIL.02	The NICU shall provide constant monitoring of the neonates' vitals	Yes

8.2.3 NICU Safety

Number	Requirement	Achieved
NICU.SAFETY.01	The NICU shall be completely cleanable	Yes
NICU.SAFETY.02	The NICU shall provide the materials to sterilise the hands in every room	Yes
NICU.SAFETY.03	The NICU shall ensure that the transfer trolley fits next to the incubator	Yes
NICU.SAFETY.04	The NICU shall facilitate that one nurse can take care of two, with a maximum of three, neonates	Yes
NICU.SAFETY.05	The wires at the NICU shall not pose a trip hazard	Yes
NICU.SAFETY.06	The NICU provides a dedicated area for the parents to prevent them from getting in the way of the nurses	Yes
NICU.SAFETY.07	The NICU shall contain an emergency button	Yes
NICU.SAFETY.08	The NICU shall contain guiding lights to counteract tripping hazards	Yes

8.2.4 NICU Integration

Number	Requirement	Achieved
NICU.INTEG.01	The NICU shall consist of appliances that are already used	Yes
NICU.INTEG.02	The NICU shall be compatible with other single-room NICU designs	Yes
NICU.INTEG.03	The NICU shall support hardware, power, and data connections of other companies	Yes
NICU.INTEG.04	The hospital shall provide scenario training for the nurses to adapt to the new environment	Yes

8.2.5 NICU Maintenance

Number	Requirement	Achieved
NICU.MAINT.01	The NICU appliances can be changed in 1 hour	Yes
NICU.MAINT.02	The appliances at the NICU can be checked within ten minutes	Yes
NICU.MAINT.03	All subsystems of the NICU shall be accessible for inspection and maintenance according to the hospital specification	Yes
NICU.MAINT.04	All LED lights can last for 50,000 hours (Montes de Oca, 2021)	Yes
NICU.MAINT.05	All LED lights can be replaced within an hour	Yes

8.2.6 Contact Platform General

Number	Requirement	Achieved
CONT.GENERAL.01	The Contact Platform shall provide all needed information for the parents	Yes
CONT.GENERAL.02	The Contact Platform shall provide a clear overview of all appointments and meetings	Yes
CONT.GENERAL.03	The Contact Platform shall provide insight into the healthcare plan of the neonate	Yes
CONT.GENERAL.04	The Contact Platform shall provide daily updates concerning the babies	Yes

8.2.7 Contact Platform Utilization

Number	Requirement	Achieved
CONT.UTIL.01	The Contact Platform shall be able to support the parents from becoming pregnant, going to the hospital to give birth, giving birth, the admission to the hospital and the release from the hospital	Yes
CONT.UTIL.02	The Contact Platform shall be usable day and night to establish contact between the parents and nurses	Yes

8.2.8 Contact Platform Safety

Number	Requirement	Achieved
CONT.SAFETY.01	The Contact Platform shall automatically register changes made by the health care employees and alert the parents	Yes
CONT.SAFETY.02	The Contact Platform shall automatically register changes made by the parents and alert the health care employees	Yes

8.2.9 Contact Platform Integration

Number	Requirement	Achieved
CONT.INTEG.01	The Contact Platform shall consist of programs that are already used	Yes
CONT.INTEG.02	The Contact Platform shall be compatible with all divisions within the child hospital	Yes
CONT.INTEG.03	The Contact Platform interface requirements shall be compatible with the needs of the parents and health care employees	Yes

8.2.10 Contact Platform Maintenance

Number	Requirement	Achieved
CONT.MAINT.01	The Contact Platform shall be able to perform automated diagnostics for fault detection	Yes
CONT.MAINT.03	All subsystems of the Contact Platform shall always be accessible for inspection and maintenance	Yes

09

DISCUSSION

This chapter discusses the status of the development per design category. This chapter also discusses the design verification and the process of this project. This chapter finishes with the recommendations for future work.

9.1 Design status

The aim of this project was to redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to optimise the work processes in a single-room setup. The aim was divided into two categories for which different design assignments were formulated. The design assignments and the connecting statements are answered in this chapter.

9.1.1 Redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to improve to environmental adaptability.

The Neonate Intensive Care Unit design for the Wilhelmine Children's Hospital can be optimised considering the adaptability of the environment through three sub design assignments. All design assignments focus on a different part of the environmental adaptability. The focus of the question is whether the environment is adaptable for the separate scenarios.

A. Design the improved single room unit facilitating one neonate.

The optimized design for the single room unit design facilitating one neonate is built up from the parental and the hospital area. The parents at the NICU feel much stress and need a place where they can destress and make them feel more at home. The parental area provides a sleep couch where the parents can work or relax. This couch sleeps one person, providing the possibility for the parents to stay with their baby during the night.

The other area is the hospital area. The design is based on the backwall method and fits with the original wishes from the hospital. All appliances used in the direct care of the neonate are fitted into the back wall. Appliances that are needed during specific procedures are in the storage of the department. The oxygen is placed on a moveable platform providing enough room for the baby to be held by their mother.

The general design of the single room unit design for one neonate is very similar to other hospitals. The main difference are the appliances used and the hanging mechanism connected to the back wall. The single room unit design facilitating one neonate is designed such that the environment can be used for different scenarios. All functions of the NICU are possible.

B. Design the improved single room unit facilitating twins.

The optimized design for the single room unit design facilitating twins is very similar to the design facilitating one neonate. This room also consists of a parent area and a hospital area. The parental area is moved to the backwall increasing the space where the neonates are located. The parental closet is also moved to the backwall.

The hospital area is like the single room unit design facilitating one neonate. The backwall is made longer to fit the appliance needed for the second neonate. The row of wall outlets creates a visual barrier between the two babies. The row of outlets emphasizes what appliances are for which neonate. The design is created with as much space in between the incubators to fit two kangaroo chairs.

The Single Room unit design facilitating twins is designed such that the environment can be used for different scenarios. All functions of the NICU are possible.

C. Design the improved light environment for the single room unit.

The optimized light design for the single room unit consists of multiple layers. The main lights are placed next to the incubator to ensure enough light for both normal monitoring as for operations. The main lights are designed as small and long lights, creating a larger surface that is well lit. The lights are also designed as small and long lights to keep the impact on the climate-controlled roof as low as possible. The spotlights located at the desk area provide enough light for the nurses to work. The light in the medicine closet ensures clear visibility on what medicine is grabbed. The guiding light underneath the desk is very subtle and gives precisely enough light to understand where in the room the nurse needs to be. All lights have a day and night setting as a guide for the nurses to use. They can overwrite these settings when an emergency operation needs to be done.

The parental area is designed with less light. It provides a cosy feeling with enough light to work on a laptop or read a book. The light will not affect the baby due to the small bundle.

The light design for the single room unit is designed such that the environment can be used for different scenarios. All functions of the NICU are possible.

9.1.2 Redesign the Neonate Intensive Care Unit for the Wilhelmina Children's Hospital to improve the contact between parents and the hospital.

The optimal contact between parents and the Wilhelmina Children's Hospital is through the already used patient portal. There are three points where the hospital can improve their contact with the parents, as visible in the patient journey. These points are the website, the folders and HIX. The hospital provides much information however, it can be a challenge to find the information needed. Furthermore, there are many people that are responsible for sending the correct information, and therefore, no one knows who sends the information. The patient portal already provides part of the information needed for the parents, making this section more elaborate solves this problem. The other problem with the contact is HIX. It should be clear for the hospital stakeholders what information is private and what information is visible for the parents. The patient portal will show only the notes for the parents.

The patient portal also improves the contact with the parents by incorporating a medical diary for daily updates and an online calendar. The patient portal can combine all functions. Improving the experience of the parents and making the work of the nurses more efficient.

9.2 Design verification

In chapter 8.2 the list of requirements was presented. The list showed which requirements were achieved and which are not. All requirements needed to be met due to the status of the design process of the WKZ. As visible in the list of requirements, only one requirement is not met. The requirement that is not met is:

NICU.GENERAL.17 - The NICU shall provide lights with 5000K warmth for the operating area.

The warmth of the lights used is up to 4000K. However, this is too low for the perfect operation requirements. The lights chosen cannot be changed in warmth and therefore, a concession has been made. The rooms are mainly used for monitoring that can be done with light with warmth

3000K. As a compromise, the surgeons will bring their own operation light which has the right warmth.

9.3 Reflection on the process

The design process was approached by finding solutions for the design requirements. The different iterations all needed to be tested and verified by the different stakeholders. Due to the covid restrictions and the effect of covid on the babies it was not possible to be at the hospital very often. The validations that were received were either through unscripted interviews whenever there was the possibility or through summaries from the hospital's supervisors. The validation from the parents on the iterations needed to be retrieved from the summaries of the parental meetings. In the beginning there was no room for the evaluation within those meetings and therefore the hospital did not find it important for me to attend.

The problem was defined through observational studies using the scenarios and work processes conducted at the Wilhelmina Children's Hospital. Using a scenario-based design method was new to the hospital. Doctors and nurses created the design within multiple work groups. Adding scenario tests to the design created a challenge. The designers were not used to conducting scenario tests when the design was not finished. They were apprehensive that small details would interfere with the tests. Therefore, in the beginning stages of the design, 3d models were used as a facilitator for the co-design sessions. After convincing the designers to do a scenario test, new insights into the design became apparent. The insights helped to improve the design and to get a better understanding of the possibilities and limitations.

Another challenge within the process was finding the right people for the right questions. This was especially the case in the beginning phase of the project. Much information was presented as a base for the project. However, a considerable amount of information was not presented. When the patient journey was created to understand all the different contact moments between the parents and the hospital, a meeting with the person responsible for a big part of the information could occur only after the second iteration. In addition, there is an obvious hierarchy within the hospital. Everybody responds to the designs from their personal interests. Sometimes these interests are based on the budget or politics, which was not explained. Keeping an overview and filtering what information is essential for the design posed a challenge. It did not intend to undermine people or respond inappropriately by not using their complete feedback.

Because most of the conversations were with the hospital stakeholders, the parents were sometimes almost neglected. Understandably, the NICU is intensive care; therefore, the parents are less critical than the baby. However, keeping the parents in mind when designing the room by using healing design thinking helps is crucial for the baby's healing process. As a result, to respect the hard work of the designers, the scenario tests were only conducted with the final design. At the start of the project, it was the idea to conduct a scenario test when a rough design was created.

Being able to contribute to such a high pace design problem was very interesting. Where people in health care usually have trouble with change, everybody at the WKZ is excited about the changes. The different stakeholders were connected to the design challenge during the start-up phase. In this phase, people were allowed to dream about the possibilities. After a while, the stakeholders were not as engaged as they were at the beginning of the design process. This is the point where this project started. It was a struggle to keep people interested in helping with

the design. Showing 3D models of the proposed design helped the stakeholders feel engaged. Moreover, using design questioning helped the stakeholders to look at the designs from a different perspective. Towards the end of the project, people became involved and were happy to give their opinion. Using models and design questioning as the base of co-design sessions helped the stakeholders visualise the design.

In the end, the mock-up and the model were not completely similar. The mock-up is being created as a combination of the NICU and the PICU. Many devices from the PICU are in the mock-up and some of the devices for the NICU are not yet implemented. This made the scenario tests a bit more difficult to do. Luckily, the doctor who conducted the scenario is very well known with the procedures and the design and could easily explain the details which were truly missing.

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RECOMMENDATIONS

Next steps for the design to really be finalized include conducting a scenario test with nurses and nurse assistants. The mock-up is very close to being finished. All small details which are added in the model need to be added to the room. Adding those small details will help with creating a truthful representation of the new situation. In the previously conducted scenario, it became clear that the bin for sharp materials was located too far from where the nurse/doctor will be taking care of the neonate. Other bins for the medication were not located in the room design and should be added. When the mock-up is completely built it is possible to check whether the chosen lights are correct. It is necessary to check whether the warmth of the main light needs to be changed to 5000K warmth to fit the requirement.

Another step that should be taken is creating the mock-up for a twin room. Currently, all possibilities are created within a model. This gives a good indication but to really understand whether the design is feasible, the stakeholders need to walk through the room. In addition, the scenario test of a simple procedure, like inserting a line, and a difficult procedure, like an emergency operation, need to be conducted. After the recommendations gathered with this design process, the official design will be sent to the architects.

For a similar project in the future, the stakeholders should be involved even more. The stakeholders from the hospital will have to work in the new situation. They know what needs to improve from the current situation. In addition, when the stakeholders are involved with the design process, they are more eager to work in the new situation and enthusiastic about the final design.

Parents should be asked for feedback more often than once every two to three months. They have experienced the overwhelming stress and are often very capable in explaining their needs. To be a good hospital, it is not only important to provide good care but also take the time to level with the patients.

The next steps that need to be taken for the patient portal are to test whether all options are feasible to be programmed in the back end. When the patient portal is improved, it should be presented to the different stakeholders and tested to understand whether it relieves or increases the workload.

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CONCLUSION

The optimal Neonate Intensive Care Unit design for the Wilhelmina Children's Hospital consists of the design of the rooms, the lights and the communication with patients. The design of the separate rooms provides space for the parents. The space for the parents will help them with destressing and starting to live again instead of being lived.

The area for the stakeholders from the hospital still contains the same appliances that are currently used. The stakeholders are still located close to the neonate however, their room to move has changed.

The designs are at the end of the design process. The technical design is ready to be sent to the architects. The discussions with the architects have already started and they are finalising the official design drawings. This means that the hospital will start working on building the new wing in one year. The NICU will be operational in the new wing within 3 years if everything goes as planned.

The contact between the hospital and the parents is another important aspect how the NICU design is optimised. The parents can find the necessary information and understand how they can contact the hospital. The updates and pictures of their baby help with coping with the situation.

Future work should focus on finalising the mock-up and adding the necessary functions to the patient portal. Having all details in the mock-up will save time and money during the actual construction of the hospital wing.

In conclusion, the optimal NICU design can help the caretakers take care and help the parents be parents to ensure the best care for the neonate.

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APPENDIX

APPENDIX A, DESCRIPTION USED METHODS

A.1 Literature Study

As Snyder (2019) states, 'Building your research on and relating it to existing knowledge is the building block of all academic research activities, regardless of discipline.' In other words, using other people's research is essential for new research. Therefore, within this research, conducting a literature study will be done. The literature study will determine the current situation concerning NICUs worldwide.

A.2 Field Research

Field research helps understand the interactions within the environment of interest (Bezanson & McNamara, 2019). At a NICU, there are many advanced devices used by multiple users. These users have different interests in using the devices and look at the data from different perspectives. (Rahim et al., 2020) Field research will determine the logistics of which stakeholders are conducting what tasks. During the field research, there will be an emphasis on what devices are used during which scenario's. Furthermore, field research is used to determine which information is needed by which stakeholders.

A.3 Function Tree

Bonnema et al. (2015) stated that an inventory of functions within the system is needed to improve it. This inventory starts at the highest level, using a function tree model, and works to the desired level of detail (Bonnema et al., 2015). The function tree will be used to determine the hierarchy between the functions of the devices as well as their connection, looking at the data flow. The connection will be important for the placement of the devices.

A.4 Journey Mapping

Journey mapping allows the visualisation and analysis of processes involved in complex domains, such as healthcare (Kushniruk & Parush, 2020). Especially in a NICU, the health and safety of the newborns depend on the accessibility of the devices (Garde & van der Voort, 2008). Hence, understanding the situation of the NICU by mapping all the stakeholder's actions is essential for the final design. Therefore, journey mapping is used to determine the current situation at the NICU.

A.5 List of Requirements

Having a list of requirements and prioritising it correctly improves the engineering process (Hudaib et al., 2018). The requirements all need to be embedded into the solution. During every codesign session, a check will be conducted to determine whether the design aligns with the requirements.

A.6 Interviews

Interviews can be used to understand the issues faced by stakeholders (Tanwir et al., 2021). It is essential to conduct these interviews to see how these issues should be fixed to optimise the NICU Design. However, the issues will be discussed, and the stakeholders will also be asked what they perceive as essential factors of the NICU, which need to be kept, and what wishes they have for the optimal NICU. The interviews are also used to determine the activities of the different stakeholders and how these can be optimised.

A.7 Customer Experience

One of the most important aspects of high-quality health care is that it should be person-centred (Larson et al., 2019). Understanding how the different stakeholders perceive their experience at the hospital will enable immense improvements. The stakeholders' needs, expectations, and values can be shaped to improve their experience (Larson et al., 2019). Therefore, understanding the stakeholder's experiences and using those within the final design will be used during this project.

A.8 Concept Design

Multiple concept designs will be created. The design assignments will be explored. The field and desk research will be used to create concepts.

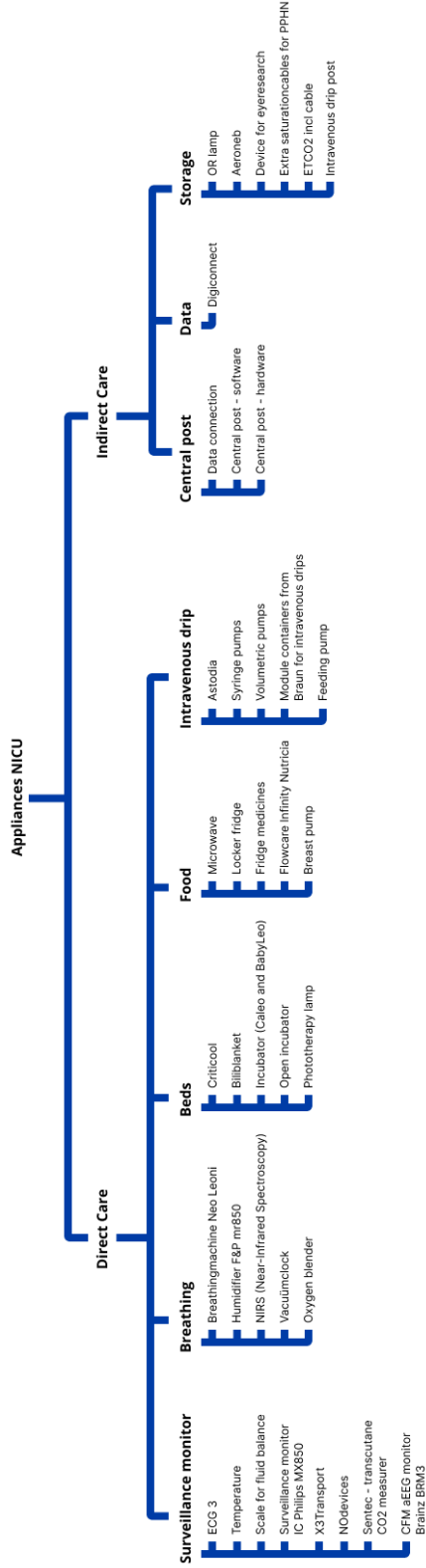
A.9 Co-design

As Castro et al. (2018) state, "Patient participation is increasingly being recognised as a key component in healthcare." The patients' and professionals' knowledge and experience are essential during the design process. Co-design is a method in which both the patients and the (healthcare) professionals act as designers of the (healthcare) service (Castro et al., 2018). As Garde and van der Voort (2008) mention, "The involvement of end-users is important since, particularly in medical design, few designers are familiar with and can therefore anticipate the specific use situation of the product and the demands that arise from it." Furthermore, the designers cannot anticipate the emotional situation of the parents with a child in the NICU (Garde & van der Voort, 2008). Using Co-design to optimise the current NICU is essential in knowing every detail needed for the change.

A.10 Final Design

The design proposals will be combined into the final design proposal with excellent visualisation. This final design will then be presented to the stakeholders, and another optimisation round will be conducted.

APPENDIX B, FUNCTION ANALYSIS DEVICES



APPENDIX C, PATIENT JOURNEY

This patient journey presents the entire process of being pregnant, giving birth and needing to stay at the hospital until being released.

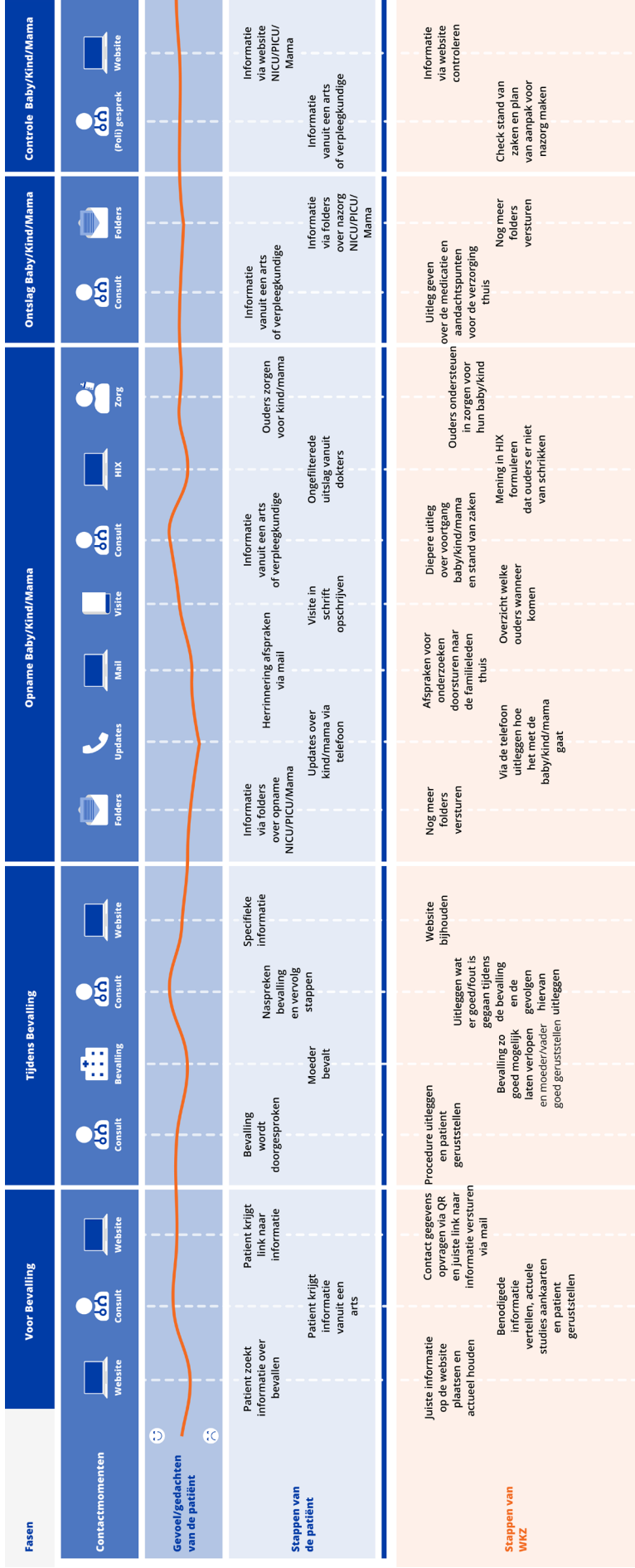
During the first phase of the patient journey, the patient will look at the internet to find tips on what to do and especially what not to do during pregnancy. Currently, when looking at the hospital website, the first articles presented are all about complications concerning pregnancy and problems that can occur. During this first phase, the patient will have a consult with a doctor to determine the course of action and the current state of the pregnancy and the baby. After which, the doctor will send the patient a link to the website where they can find the correct information.

During the second phase of the patient journey, giving birth, the patient will have a consult with the doctor to discuss the process of giving birth and the possible complications. During the delivery, the doctor will keep the patient up to date and can answer all necessary questions. After birth, the patient will discuss with the doctor what the follow-up process will be. During this patient journey, the baby must go to the NICU, and the follow-up meeting with the doctor will consist of bad news. The patient can look at the website for in-depth information on the complications.

During the third phase of the patient journey, the hospitalisation, the patient will receive relevant flyers from the hospital to prepare for the coming weeks. Furthermore, the patient can call the nurses and doctors to summarise their child's state. They get a mail confirmation/reminder of all meetings and research appointments. When a test has been conducted, the information from that test and the feedback from the experts, nurses and doctors can be found within the patient file. Furthermore, a physical booklet is available where the parents can write down when they will be at the hospital. During the discussions with the doctors, the patients receive a complete explanation of their child's state and the action plan. All questions are answered, and the parents clearly understand what is happening with their child. During these sessions, the parents also receive information on how to take care of their child, considering the complications.

During the fourth phase of the patient journey, the discharge, the patient will talk to a doctor to discuss the care plan at home. During this meeting, all tips and points of attention are discussed to ensure that the parents will leave the hospital feeling confident. The parents will receive flyers with information of tips concerning the discharge and care of a newborn baby from the doctors.

Sometimes the patient will receive a check-up after discharge. However, this is only when the child needs to be checked consistently. Whenever the parents and the child are healthy when they leave the hospital, this phase of the patient journey will not occur.



Fasen	Voor Bevalling	Tijdens Bevalling	Opname Baby/Kind/Mama	Ontslag Baby/Kind/Mama	Controle Baby/Kind/Mama
<p>Contactmomenten</p>	<p>Website Consult Website</p>	<p>Website Consult Bevalling Consult</p>	<p>Zorg HX Consult Visite Mail Updates Folders</p>	<p>Folders Consult</p>	<p>Website Consult</p>
<p>informatie waar de patient naar zoekt</p>	<p>De folders zijn er zodat de patient later nog een keer kan teruglezen wat de arts allemaal heeft verteld. Ook krijgen ze folders met nieuwe informatie.</p> <p>Hoe gaat het met mijn baby, Hoe gaat de bevalling eruit zien, Wat moet ik meenemen naar de bevalling, Kan ik iets doen wat de bevalling beter laat verlopen, Wat kan ik verwachten</p> <p>Hoe werkt een bevalling, Hoe kan ik mijn zwangerschap goed laten verlopen, Waar moet ik opletten tijdens mijn zwangerschap, Wat moet ik meenemen naar mijn bevalling</p>	<p>Als er iets mis is vanuit de bevalling of met de baby, Extra informatie over de zorg voor een baby</p> <p>Hoe is de bevalling gegaan, Waar moet de patient nu rekening mee houden, Wanneer mag de patient weer actief doen, Welke complicaties zijn er, Waar moet de patient opletten bij de zorg voor de baby</p> <p>Wat moet de patient doen, Wanneer moet de patient druk geven, Gaat het goed met de baby, Gaat alles volgens plan.</p> <p>Nog een keer de bevalling doorspreken, Waar moet de patient op letten, Wat gebeurt er als de patient bevallen is</p>	<p>Hoe gaat het met onze baby/kind, Hoe houd ik haar/hem goed vast, Welke medicatie heeft ze/hij nodig, Hoe moeten we de medicatie toedienen.</p> <p>Wat is de conclusie van de uitgevoerde testen en onderzoeken, Wat betekent dit voor ons kind/baby, Wanneer is een volgend onderzoek gepland.</p> <p>Hoe gaat het met de baby/kind, Gaat de baby/kind vooruit/achteruit, Zijn er nieuwe afspraken ingepland, Is het behandelplan veranderd, Wanneer kunnen we weer langkomen.</p> <p>Wanneer kan ik weer langkomen,</p> <p>Wat waren de nieuwe afspraken voor de baby/kind,</p> <p>Hoe gaat het met de baby/kind, Gaat de baby/kind vooruit/achteruit, Zijn er nieuwe afspraken ingepland, Is het behandelplan veranderd, Wanneer kunnen we weer langkomen.</p> <p>De folders zijn er zodat de patient later nog een keer kan teruglezen wat de arts allemaal heeft verteld. Ook krijgen ze folders met nieuwe informatie.</p>	<p>De folders zijn er zodat de patient later nog een keer kan teruglezen wat de arts allemaal heeft verteld. Ook krijgen ze folders met nieuwe informatie.</p> <p>Waar moeten we thuis opletten, Hoe vaak moeten we welke medicatie geven, Wanneer moeten we bellen of langkomen</p>	<p>De website van EOP - TOP is er om de begeleiding voor premature kinderen te ondersteunen op het moment dat ze thuis zijn.</p> <p>Hoe moeten we omgaan met deze problemen waar we tegen aan lopen, Hoe gaat het nu met onze baby/kind, Waar moeten we meer opletten, wat is het vervolgplan.</p>
<p>Informatie aangeboden door het WKZ</p>	<p>De folders beschikbaar zijn: Intensive care (IC) neonatologie, High care (HC) neonatologie, Medium care (MC) neonatologie</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>https://www.hetwzkz.nl/nl/ziekenhuis/behandeling/inleiding-van-de-bevalling/folder https://www.hetwzkz.nl/nl/ziekenhuis/verpleegafdeling/neonatologie</p>	<p>https://www.hetwzkz.nl/nl/voorlichting/zwangerschap-en-bevalling/folder</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p>	<p>De verpleegkundige kan alle vragen beantwoorden die de patient heeft.</p> <p>Hierin is op dit moment de ongefilterde mening van de experts en artsen te lezen over de resultaten, Ook zijn de vervolg afspraken duidelijk weergegeven.</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>Het visite boekje geeft aan wanneer er plek is voor de ouders om te komen, de ouders schrijven zich ook hier in voor een moment om langs te komen.</p> <p>Afspraken gemaakt zijn via de mailbox verstuurd door de verpleegkundigen</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>De folders beschikbaar zijn: Overplaatsing van de IC/HC naar de MC neonatologie, Overplaatsing neonatologie naar afdeling Papegaaï</p>	<p>De arts kan alle vragen beantwoorden die de patient heeft.</p> <p>De folders beschikbaar zijn: Richtlijnen en adviezen bij ontslag naar huis</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p>	<p>https://www.top-eop.nl/</p> <p>De arts kan alle vragen beantwoorden die de patient heeft.</p>

APPENDIX D, STAKEHOLDERS

D.1 Neonatologist

These are the experts at the NICU. They create medical plans and ensure that the babies get the best treatment possible. They are also the ones that explain the treatment policy of the baby and the medical history whenever the baby is being transferred somewhere. They oversee all babies and discuss the changes in health with the nurses to create the next policy. They also discuss all babies with the surgeons and experts to ensure the treatment plans are in line with their opinion. Whenever a difficult procedure needs to be done, the doctors will be the ones to conduct it.

As visible in Figure 49, the neonatologists are mostly working on creating medical care plans for the babies. They do this by consulting with experts and checking how the babies respond to their current treatment policy. Currently, the transition and surgeon meetings are in the meeting rooms. The rest of the tasks are conducted in a dedicated room for the doctors within the unit.

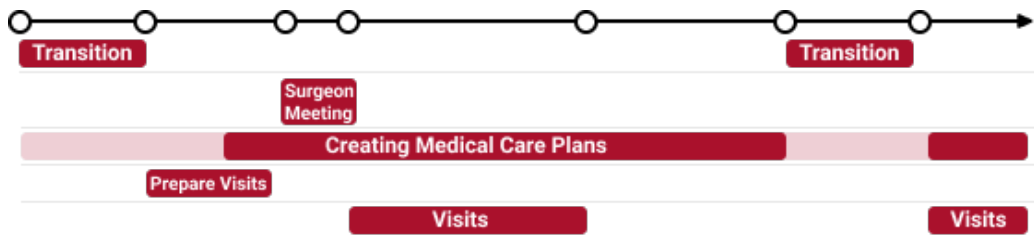


Figure 49, Timeline showing a day at the NICU for a Neonatologist

Problems might arise at the new location depending on how many designated rooms there are for the neonatologists/doctors. The babies are far away whenever there is only one room and checking specific settings will be more difficult. In addition, it could become harder to concentrate on the policies because everybody is discussing different babies simultaneously at the designated location.

D.2 Nurses

The nurses constantly check the babies and give them the care they need. They are the people who follow the treatment policy, and they alarm the doctors whenever the baby's health decreases. The nurses usually take care of 2 babies to ensure their full attention. Only when there are no other options, the nurses will take care of three babies. The nurses also mix the medication and feeding formula, which they cannot get from the pharmacy.

In Figure 50, the timeline of the nurses is visible. It shows that the nurses are constantly with the babies. They can sit at the desk inside the unit, which allows them to see what is going on with the babies. This will be different when the babies have their separate rooms. During the transition, they discuss the babies with the nurses responsible for them during the previous shift. This information, in combination with what is written in the patient records, is used during the Prepare Visit meeting. The nurse explains who the baby is and what has changed, and together with the doctors, a new plan will be created.

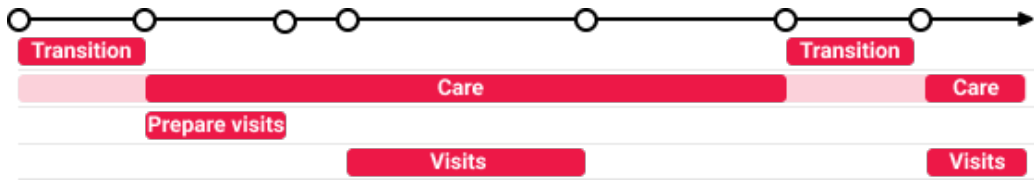


Figure 50, Timeline showing a day at the NICU for a Nurse

A possible problem at the new location is that the nurses must go into a baby's room to know how the baby is doing. This needs to be considered when creating the optimal NICU for the WKZ.

D.3 Nurse assistants

The nurse assistants help the nurses take care of the babies. They are not responsible for any of the babies but will calm a baby when it is in distress and will assist the nurses when they are needed during a particular procedure. This could be putting in a new line, draining brain fluid, or anything else that the nurses do.

In Figure 51, a typical day for a nurse assistant is displayed. It shows that the nurse assistants are constantly taking care of the babies. Unlike the nurses, the nurse assistants do not need to attend the Prepare Visit meetings. They ensure the babies are all right and help the nurses whenever needed.



Figure 51, Timeline showing a day at the NICU for a Nurse Assistant

Problems that may occur when the NICU is transferred to a new location are that it becomes harder to see where the nurses are; therefore, the nurse assistants might be helping a baby when needed somewhere else.

D.4 Parents

The parents are allowed to visit their baby for two-time slots per day, due to covid. They are encouraged to help care for their baby as much as possible. This includes feeding their baby, cleaning it, and giving it the correct medication at the correct time and in the correct amount. This is encouraged to make the transition from the NICU to having their child at home more accessible. The parents are critical stakeholders. This is due to the high stress they perceive having their baby lying in the NICU.

As visible in Figure 52, parents are allowed to visit their babies twice a day. This will change completely when the NICU is moved into the new building wing. Currently, there is no space for the parents to sleep next to their baby. That is why they are not able to stay during the night at the NICU.



Figure 52, Timeline showing a day at the NICU for a Parent

One of the main problems for parents is that the only option for privacy in the current situation is to close a curtain. However, when the mother gives her baby breastmilk using a kangaroo chair, there is almost no room for the father to be in the 'closed-off space'.

D.5 Babies

The babies are also important stakeholders. They undergo all procedures and usually feel very bad. They are fighting for their lives when lying in the NICU. The babies are only moved to a different location / NICU whenever they feel better, for medical check- or surgery or when they have passed away. This can be seen in Figure 53.



Figure 53, Timeline showing a day at the NICU for a baby

D.6 Surgeon

The surgeons are at the NICU during their meetings with the doctors/neonatologists or whenever a baby needs to get surgery. The worst-case scenario is that a baby needs emergency surgery at its unit because it is too sick to be moved. This is when the surgeons come into the NICU. The meeting is in a meeting room next to the units.

Figure 54 shows that surgeons are available for operations the entire day. They attend the surgeon meeting to review the babies who just underwent surgery and those who will need surgery soon.



Figure 54, Timeline showing a day at the NICU for a Surgeon

The entire unit must be closed off when the surgeons need to perform an emergency operation. They need much room and many specific appliances. They have enough space because they use the entire unit as their operating room. However, in the new building wing, they will have to fit everything and everybody in the baby's room. All the parents are asked to leave the unit. Therefore, surgeons can operate in privacy. It is not sure whether there is enough space at the new location to fit everybody and be able to close off the room.

D.7 Surgery staff

The surgery staff only join the NICU whenever there is an emergency operation. They are constantly preparing the operations rooms, and they assist the surgeons during the surgery. Whenever an emergency operation occurs, the surgery staff gathers all appliances and medication needed and prepares the unit where the baby will get surgery. They all perform their

specific task. The most significant difference with surgery in a unit instead of the OR is the lower number of materials available and the environment is less sterile.

As visible in Figure 55, the surgery staff is nonstop working on surgeries and only visits the NICU when necessary.

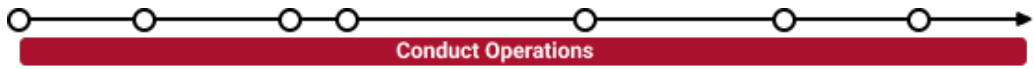


Figure 55, Timeline showing a day at the NICU for the Surgery Staff

Problems that occur for the surgery staff during an emergency operation are that the space cannot be sterilised. They take over the entire unit and need to work around all appliances already at the location. They need to fit into the new rooms of the babies.

D.8 (Ultrasound) Expert

The (ultrasound) experts only visit the NICU whenever needed. Ultrasounds are made almost every day and night, MRIs are not created every day. In other words, how often an expert is needed depends on how often the test or expertise is needed. This is also visible in Figure 56.



Figure 56, Timeline showing a day at the NICU for the (Ultrasound) Experts

No problems are occurring for the experts. Everything will be all right when they have room to move around with the needed appliances.

D.9 Ambulance personnel

Like the (Ultrasound) experts, the ambulance personnel will only visit the NICU whenever a baby is being transferred from another hospital or when a baby will be transferred to a different hospital. This can occur during the entire day, as shown in Figure 57.

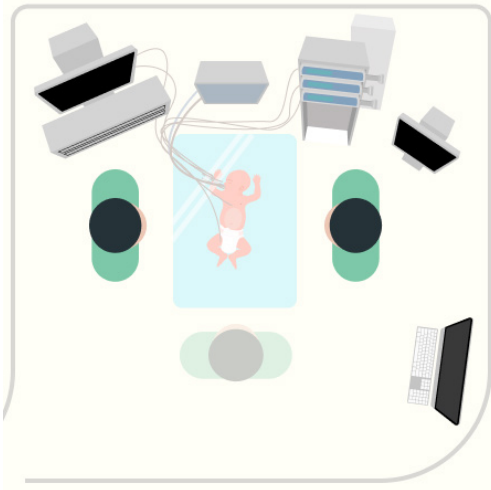


Figure 57, Timeline showing a day at the NICU for Ambulance Personnel

The only important factor for the ambulance personnel is that their trolley can fit into the room and easily stand next to the incubator to make the transfer for the baby even more smooth.

APPENDIX E, USER SCENARIOS

E.1 (Extensive) Monitoring / Care



General Scenario

All babies at the NICU need to be monitored the entire time they are present. In some cases, this entails merely the monitoring of the main vitals. For other babies, this entails a long list of vitals. (Heart rate, number of breaths, pulse ox, blood pressure on two sides, temperature). Furthermore, not all babies can be breastfed and therefore need food through lines. Furthermore, some babies need extra energy or specific foods given through lines.

Appliances Needed

To monitor all needed vitals, the babies are connected to multiple sensors, lines, and other appliances. These appliances are all connected to the data connection and the monitors.

Stakeholders Involved

1 nurse, 1 nurse assistant, (1 doctor)

When the baby is cared for whilst being monitored, one or two nurses are on both sides of the incubator. The number of nurses is dependent on the difficulty of the procedure. Whenever the baby is having trouble, a doctor may join the nurses in checking the baby. In other situations, it sometimes is necessary for the doctor to put in a line, which would be too difficult for the nurses. Think of a line through the inner side of the leg.

Needed Data

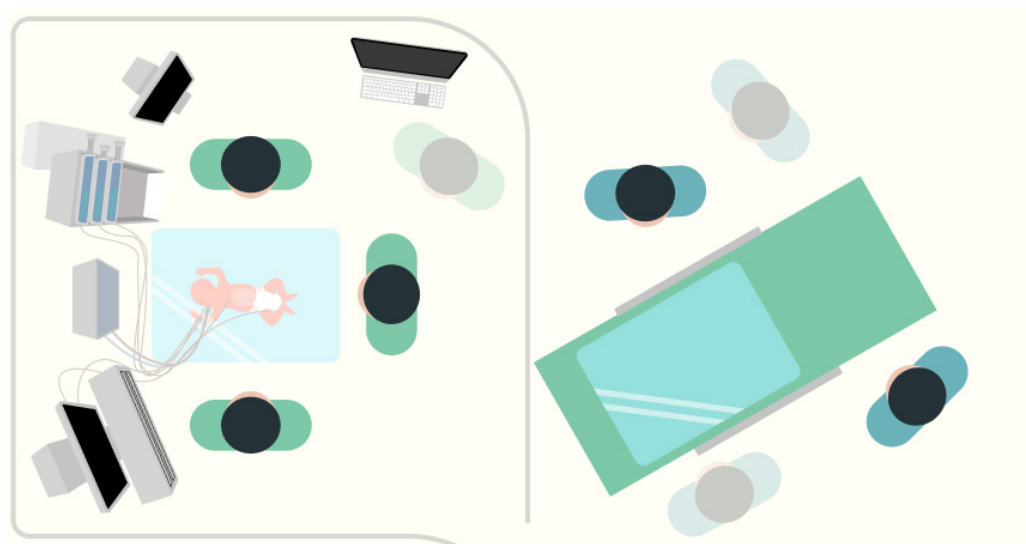
Different vitals are monitored depending on the baby's illness severity. The two vitals constantly monitored are the heart rate and the blood saturation. This data is collected to help the nurses know whenever they need to give extra attention to one of the babies. The monitor presents a slow beeping sound whenever one of the vitals reaches a dangerous level. The monitor makes a fast and high beeping sound whenever the vital exceeds thresholds. The nurses only rush to a baby when the high alarm is active. The levels for when the alarm is sounding can be altered

per baby. Some babies are known to have a high heart rate. This information will be entered into the system.

Problems

During the babies' daily care, the nurses have gotten into a routine on what things are possible and what they need to alter. They have been doing it for quite some time, leading to the fact that they do not see the problems anymore. Right now, there is no option to take the data of the babies with you when you are going for lunch or grabbing a cup of coffee. Whenever all babies have a separate room, monitoring their health becomes harder. When all nurses focus on one baby, they should be able to check another baby's vitals to know whether they need to go to them immediately. Another issue is the space the nurses have. Currently, there is only space for a maximum of three persons surrounding the baby. When other materials are needed on a sterilised table, it gets tricky how the space will be used. Another problem is that many wires and lines are connected to the baby. These wires are used to monitor the baby and cannot be removed when the baby is being carried or picked up by its parents.

E.2 Transfer to MC / Operation Room / different NICU / MRI



General scenario

There are different reasons why a baby needs to be transferred. It is possible that a baby needs to get surgery or needs to be relocated to a different NICU. It is also possible that a baby needs to get an MRI or that it is released from the NICU and can go to Medium Care. All these scenarios mean that the baby needs to be put in a specific incubator to be moved as safely as possible.

It is necessary to prepare the baby correctly. This could mean that the baby needs medication before it can be transferred, or it is possible that they are not allowed to eat or drink anything before the transfer. Sometimes new lines need to be connected to ensure the baby gets enough medication into the system and that the old lines do not get loose.

Appliances needed

To transfer a baby to a different location, the baby needs to be put into a unique incubator attached to a trolley. This trolley consists of everything, which is also located at the NICU spot. This means there are medical syringes, oxygen, humidifier, monitor for all vitals, different lines, NO₂ and even an AED. All these appliances are there to ensure the baby's health during transfer.

Stakeholders involved

1 nurse, 1 nurse assistant, 1 doctor, 1 operation assistant/doctor, 1 surgeon (1 doctor, 1 nurse, 1 ambulance driver)

Whenever a baby is transferred, there are many people involved. The nurse and the nurse's assistant prepare the baby. When the baby is put into its new incubator, the doctor will join to update the operation assistant and surgeon on the last changes, and medication is given. Whenever a baby is being delivered at the NICU, an extra nurse, doctor and ambulance driver are needed to ensure a smooth transfer.

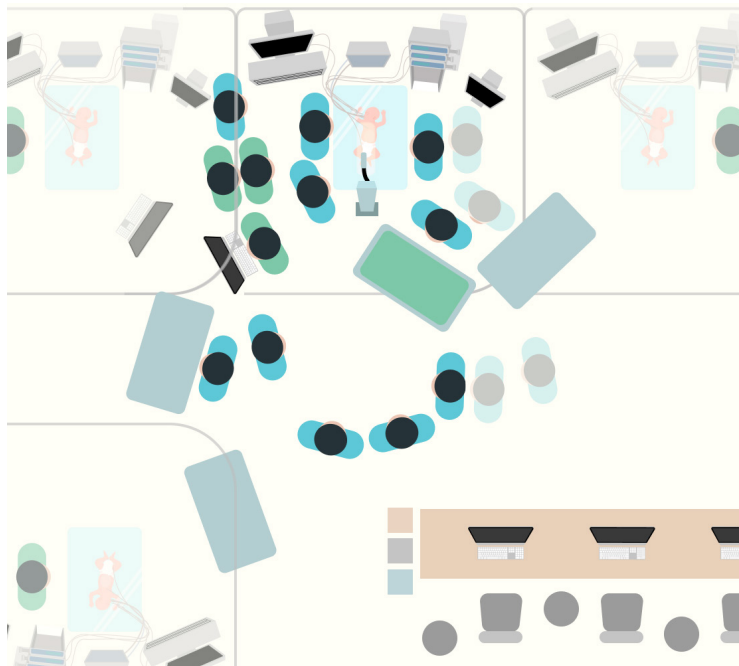
Needed data

The baby must be monitored thoroughly to ensure a smooth and safe transfer. This means that the baby's blood oxygen saturation, heart rate, blood pressure and CO₂ saturation need to be monitored. These are checked by the operations assistant when the baby is being transferred.

Problems

The transfer trolley is enormous. It is hard to reach the second baby with the trolley whenever two babies are in one room. This is due to the low amount of space available as well as the size of the trolley.

E.3 Emergency Operation



General scenario

An Emergency Operation only occurs when a baby needs surgery immediately and is too ill to be transferred to the operation room. This means the baby will get the operation on the unit where all the other babies are also located. In addition, all visitors need to leave the unit, and all other parents are called to let them know they will not be able to visit the unit for a while.

Appliances needed

8 new carts full of appliances are transferred to the unit. 1 large lamp, 2 tables with sterilised appliances, a cart with other medical appliances, a cart with medication, and ultrasound.

Stakeholders involved

2 nurses, 1 doctor, 2 surgeons, 1 surgeon assistant, 1 material assistant, 1 omloop, 1 anaesthetist, 1 anaesthetist assistant, 1 anaesthetist employee, 2 spectators, (1 expert surgeon + material assistant + omloop)

Together with all these materials, at least 10 people join the operation. Two students are visiting the surgeon who are learning the procedure. Furthermore, there is the leading surgeon with their assistant, who hands the sterilised tools, and one person who retrieves all the appliances from the carts and, when needed, from the different units in the hospital ('de omloop'). There is also an anaesthetist who oversees what medication will be given to the patient and makes sure all the vital signs are stable, their assistant, who gives the medication to the patient, and the anaesthetist employee who gives the medication to the assistant. Then there is one more surgeon and one surgery assistant when extra hands are needed. Whenever something unexpected happens during the surgery, higher-ranked surgeons and experts are called to the unit. This can lead to up to 16 people purely for the surgery.

Furthermore, at least 2 nurses and 1 doctor are always needed during the surgery because they know the most about the baby and their (medical) history. Sometimes, even more nurses and doctors are consulted. One of the nurses ensures that all the actions taken, and medication given is entered correctly into the baby's medical record. The other nurse helps to prepare the baby and helps with the decision on what steps should be taken in combination with the lead doctor.

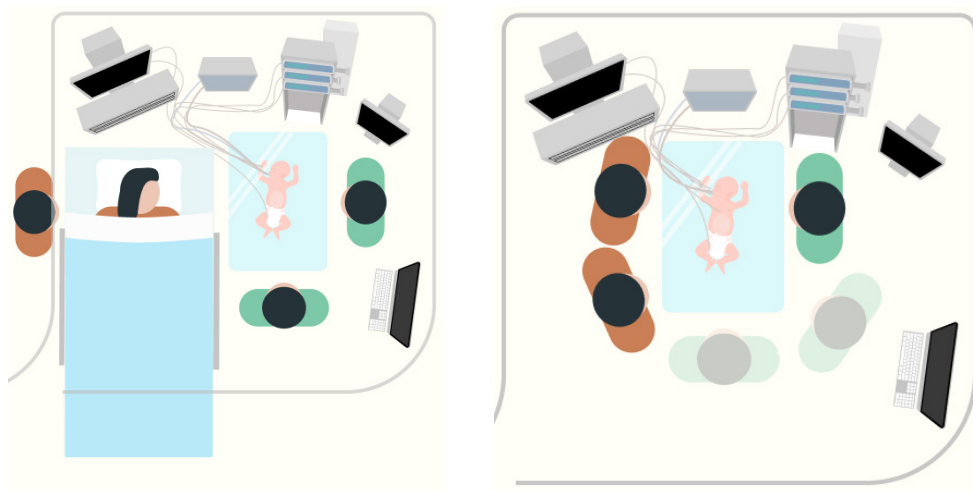
Needed data

To understand whether the baby is stable, whether the baby gets enough oxygen in its blood and what the blood pressure and heart rate are, are within limits, those vitals are monitored. The anaesthetist will check the vitals with the doctor and nurse the baby to ensure that the baby stays stable. This can be done by giving medication or changing the angle of the incubator where the baby is lying.

Problems

When a baby needs an emergency operation, all operations staff and all the extra materials need to be transferred to the space where the baby is. Currently, only the nurses of that unit are allowed to be in the room. Babies will have their room when the NICU is in its new location. This means that all equipment and everybody involved with the operation will need to be in that room and have the space to conduct their task. This will be one of the most significant challenges for the new room.

E.4 Visit from parents



General Scenario

The parents can visit their baby twice a day, due to covid. Once during the morning and once in the afternoon. Due to corona, only two visitors per baby are allowed, meaning either the parents or one parent with one visitor. The parents are asked to do most of the babies' caretaking to practice when the babies are allowed to go home. They feed the baby, clean their diaper, give medication, and cuddle the baby. This is usually also the moment when the nurse or the doctor explains the baby's development and whether another treatment is advised.

Appliances Needed

Usually, the parents give the baby milk, which is also the moment for the mothers to pump milk to save up some extra food for the baby. Therefore, the pump, bottles, towels, and a heater are needed. When the baby needs medication, this will be provided in combination with syringes. The rest of the appliances stay the same as when the baby is being monitored.

Stakeholders Involved

2 parents, 1 nurse, (1 doctor + 1 nurse)

During the visit, one nurse is usually around to start up with the parents and discuss how everything is going. After that, depending on the severity of the baby's health problems, the parents are left alone with their child. When the baby is very sick and needs thorough monitoring, a nurse (sometimes in combination with a doctor) will support the parents.

Sometimes the mother has just given birth or is on bedrest and therefore comes to the NICU in her hospital bed. This is very difficult, mainly because of the low amount of space in the units. The incubator needs to be moved, and the father sometimes does not fit in the baby's space.

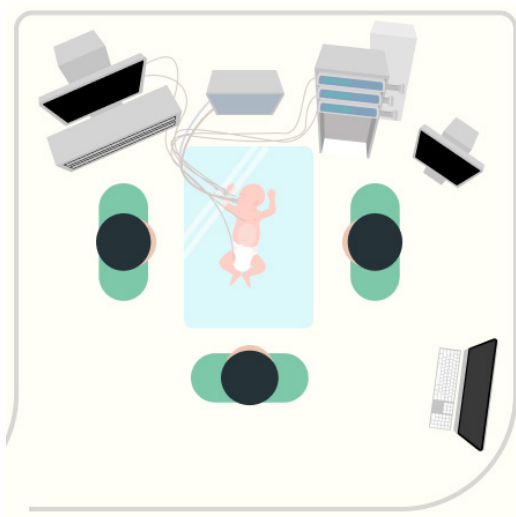
Needed Data

No specific data is needed for when the parents visit their baby. Only the already needed data is gathered. This data is used to check whether the baby is healthy or not. The parents nurture the baby, and it is possible that the baby forgets to breathe or is lying on its belly even though its lungs are not strong enough yet to keep breathing. Then the nurses will hear something is wrong and help the parents care for the baby.

Problems

There are a few problems within this scenario. When the mother needs to stay in her hospital bed, there is very little room left in her space. Another problem is that currently, the nurses can turn around and help the parents with another baby. In the new situation, this is not possible. Therefore, finding a solution to making nurses more mobile is essential. This also results in that the parents cannot be helped the entire time because other parents might also need that supervision.

E.5 Transfer to different Unit



General Scenario

Sometimes either a baby is doing well, or a baby from a different unit is getting worse. This means that the baby will be transferred between the different units of the NICU. Currently, all the units are connected by a door. Therefore, when a baby is transferred to a different unit, it can be wheeled towards its new spot whilst staying in its incubator. Before the transfer is made, the new nurse will set up the babies' new location and ensure that all the medication settings, food settings, monitor settings and needed appliances are at arm's length.

Appliances Needed

Because the baby only needs to be transferred to another unit, no transfer trolley is needed. This means that most appliances already attached to the baby will stay. The baby will stay connected to the moveable monitor and oxygen when possible.

Stakeholders Involved

2 nurses, 1 nurse assistant

The current nurse and assistant will prepare the baby for the transfer during this procedure. A nurse in the new unit will also be working on preparing the babies' new spots. When the actual transfer happens, these two nurses and assistant work together to move the baby.

Needed Data

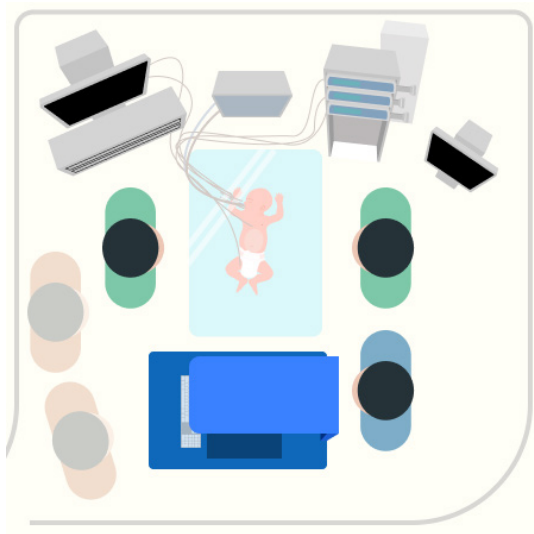
The most critical data from the baby whilst being moved is their blood pressure, heart rate and oxygen levels. These are needed to ensure the health of the baby. Some babies can breathe

independently, which means they can be moved to another unit without needing to be attached to all the machines. Other babies need to stay attached to the monitor and receive extra oxygen.

Problems

Babies are usually transferred to a different unit when another baby worsens rapidly. This will not be a problem when there are no more separate units in the NICU but one large NICU with separate rooms.

E.6 Echocardiogram



General Scenario

There is a moveable device which is driven towards the baby's incubator. This device can be sculpted in multiple angles, making it possible to keep the baby safely in its incubator. After consulting with the nurses, the doctors decide what images are needed. This usually is a top view echocardiogram and a side view. The incubators are created so the echo's backplates can be inserted into the incubator without needing to move the baby.

Appliances Needed

To make an ultrasound, the nurses need a specialist to come to the unit with a portable ultrasound. This specialist is wearing protection for radiation. The portable machine has an extra protection outfit and the needed backplates for the ultrasound.

Stakeholders Involved

1 nurse, 1 nurse assistant, 1 ultrasound expert, (2 parents)

When an ultrasound is created, the primary nurse and sometimes an assistant join the specialist to ensure the baby keeps still and the correct ultrasounds are created. When the ultrasound is created, the doctors will join immediately to check the pictures, or the pictures are sent to the doctors. This depends on the severity of the reason why the ultrasound is being created.

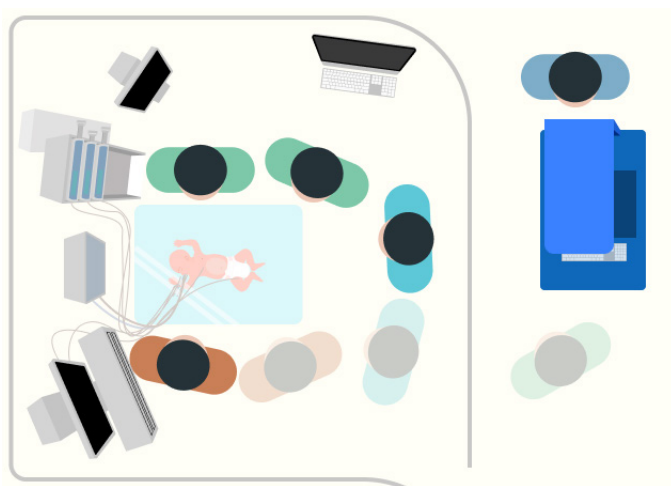
Needed Data

The data for the accurate ultrasound is the information on which images are needed. Next, the pictures will be sent to the doctors when the ultrasound has been done. In an emergency, the doctors may quickly look at the new pictures. Furthermore, when the pictures are taken, the baby is still lying in its incubator and is still attached to all its sensors. These sensors must stay on the baby, and the lines for medication will be left the same. The nurse that helps during the procedure of making an ultrasound will keep an eye on the baby's vitals. When anything changes, either due to moving the child or in general, the nurse will change the medication, the oxygen levels, the tilt of the incubator etc., to ensure the baby's health.

Problems

One of the common problems within the NICU is also applied here. The ultrasound machine is relatively moveable, considering its size. When pictures are taken, there is only room for two people. The third person has only a little room left in the designated area for the baby.

E.7 Newly born



General Scenario

Some babies are born during an emergency operation because the mother is getting sick, or something is wrong with the baby. In such a scenario, the NICU gets notice when the mother is either prepared for the birth or is already in the operating room. This gives the NICU between 10 minutes to 2 hours to prepare a new spot for the newborn. Most of the time, it is unclear what is wrong with the baby. This means that the nurses prepare all appliances to have the possibility to check everything on the baby. All vitals will be monitored, and the oxygen machine will be started. All appliances are checked to ensure that they work correctly. This is all done to ensure the baby gets all the help it needs. Most of the time, the ultrasound specialist will also be called to ensure a quick newborn screening.

Appliances Needed

All appliances that are available for the babies in a NICU are prepared at the point a newborn arrives. This means that the monitors are started, the medication syringes are tested, the oxygen and humidifier are tested and prepared, the medication cabinet is checked, the computer

is started, and the incubator is prepared for the newborn. The ultrasound machine is ordered, and everything needed to put in a line is checked.

Stakeholders Involved

1 or 2 nurse(s), 1 nurse assistant, 1 ultrasound expert, 1 surgeon, 1 surgeon assistant, 1 or 2 parents, 1 doctor

When a baby is born, some people are involved in the process. The nurses and assistants are preparing the area. The ultrasound expert is getting ready to come to the unit. One surgeon and one assistant who helped with the baby's birth join the transfer of the baby, and a doctor and sometimes a nurse will help transfer the baby from the operation room to the NICU.

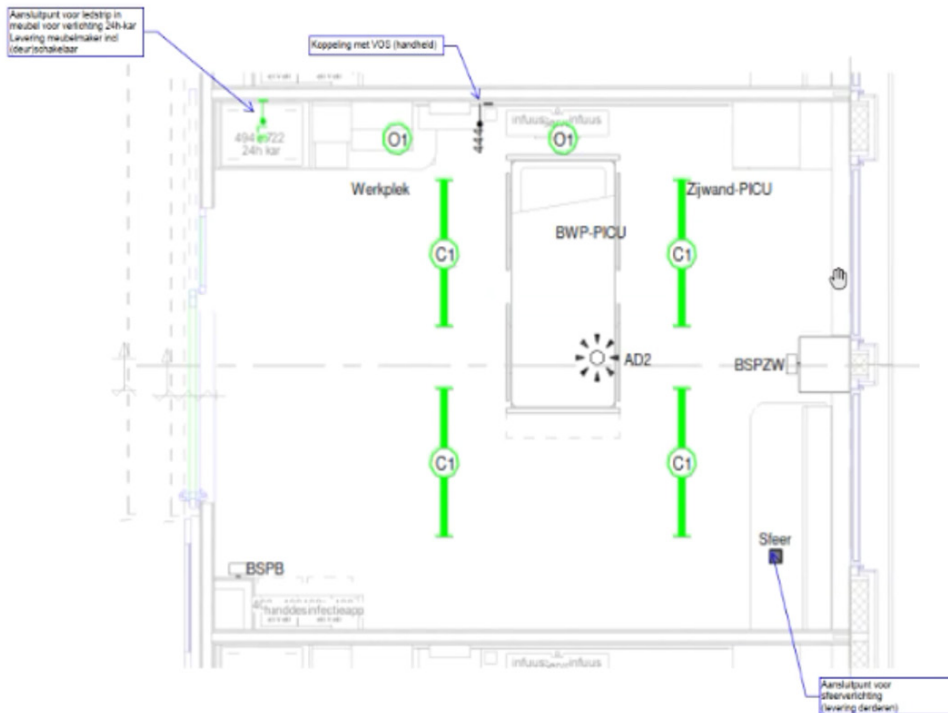
Needed Data

Before the newly born baby is brought to the NICU, all appliances are checked by the nurse to ensure everything is fully operational. The needed sensors and lines are already laid out to make the inspection of the newly born baby as smooth and efficient as possible. All vitals need to be monitored when a baby is newly born. It is unknown yet what the health situation of the baby is. The specialists can make a reasonable estimation; however, the actual situation still needs to be determined. The lines and sensors that need to be connected to the baby are established depending on the baby's birth. The initial data of the vital signs are also used to determine what medication needs to be given.

Problems

Whenever the NICU hears that a baby is being born, they do not know when the baby will come to them. It could take ten minutes, or it could take 2 hours. This makes it sometimes challenging to ensure that the place is inspected and ready to be used whilst taking care of the other babies.

APPENDIX F, DESIGN ARCHITECT LIGHTS



Lights design created by the architectures from the WKZ

(23343-402 Multilume Hydro LED, n.d.)



Specification	Technical data
Rated supply voltage V	220-240
Lumen maintenance at 50 000 h	1
CLO time, h	100 000
CRI	90
CCT, K	4000
Light source	LED

(73053-402 Pleiad G4 165, n.d.)



Specification	Technical data
Rated supply voltage V	220-240
Lumen maintenance at 50 000 h	1
CLO time, h	100 000
CRI	80
CCT, K	3000
Light source	LED

(84252-402 Touch Mini Gimble, n.d.)

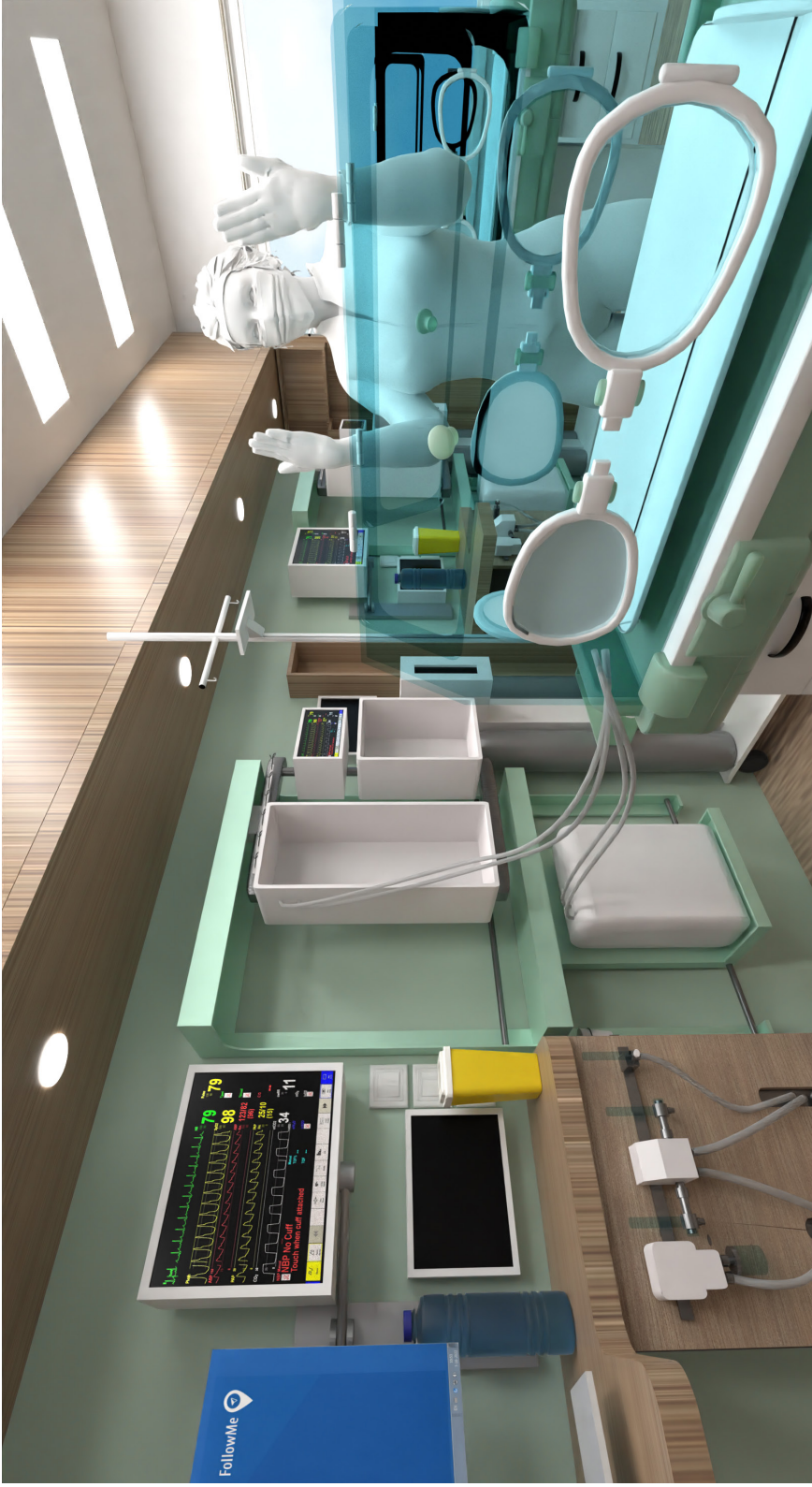


Specification	Technical data
Rated supply voltage V	220-240
Lumen maintenance at 50 000 h	1
CLO time, h	100 000
CRI	90
CCT, K	3000
Light source	LED

APPENDIX G, FINAL DESIGN



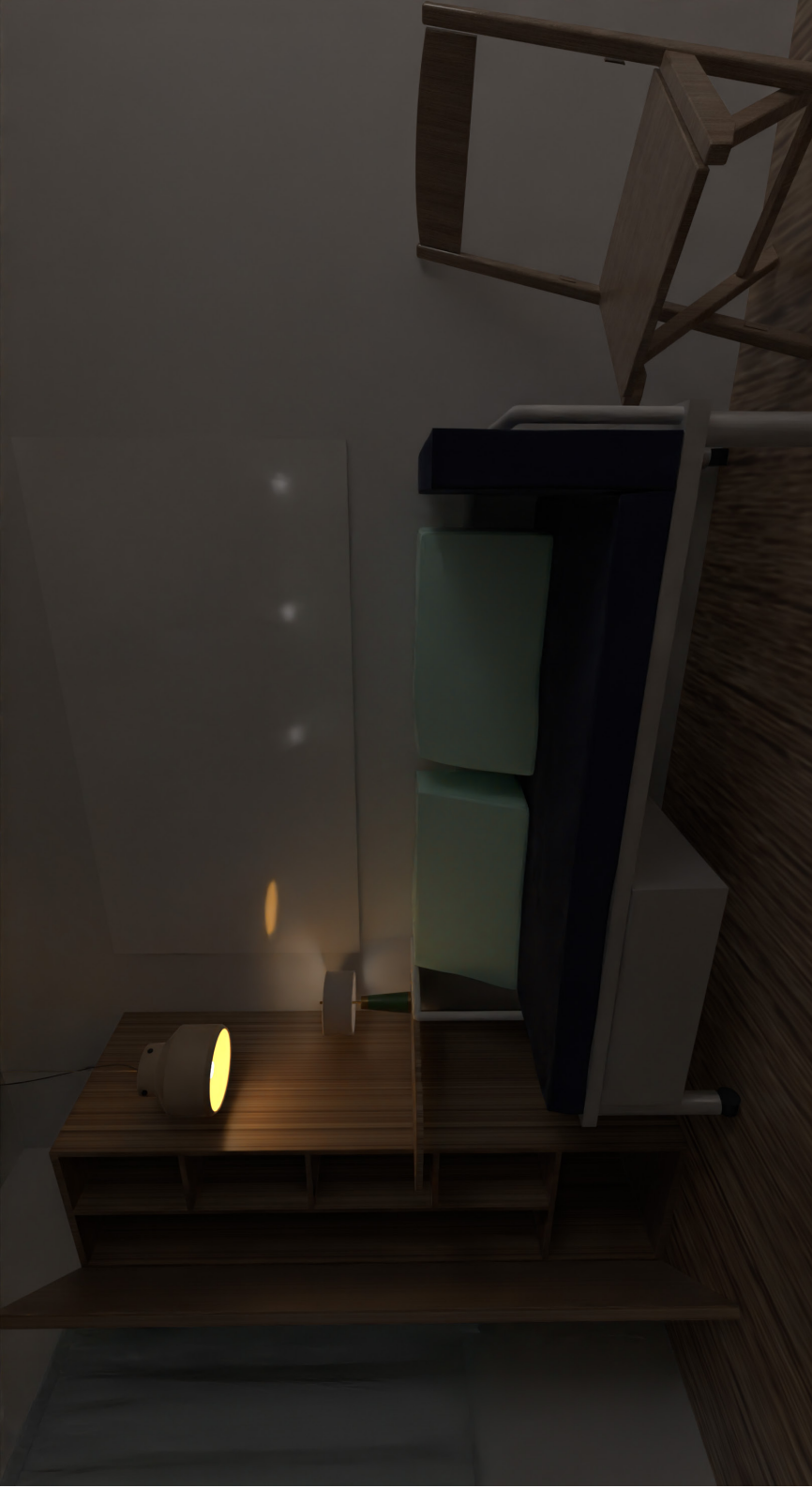
















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Consultverzoeken

Notificaties

Kopie identiteitsbewijs
Vraag aan identiteitsbepaler

Bekijken

Uw afspraken

Er zijn geen afspraken gevonden

Toon alle afspraken

Uw vragenlijsten

U ziet hier alleen vragenlijsten die u moet invullen. Eventuele overige vragenlijsten vindt u onder de knop "toon alle vragenlijsten".

Toon alle vragenlijsten

Uw medisch dagboek

Onderzoek toegevoegd aan dagboek

Toon complete dagboek

Belangrijke informatie

Er zijn geen belangrijke informatie's gevonden die voor u op dit moment van belang zijn.

Toon belangrijke informatie


Vindt u Mijn UMC Utrecht gemakkelijk te gebruiken?



Toelichting (niet verplicht)

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Plan een afspraak



e-consult




1
Persoonlijke gegevens



Consultverlagen

Notifications

 Kopie identiteitsbewijs
Vraag aan identiteitsbepaler

Uw afspraken

Er zijn geen afspraken gevonden


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Uw vragenlijsten

U ziet hier alleen vragenlijsten die u moet invullen. Eventuele overige vragenlijsten vindt u onder de knop "toon alle vragenlijsten".

[Toon alle vragenlijsten](#)

Uw medisch dagboek

 Onderzoek toegevoegd aan dagboek




[Toon complete dagboek](#)

Belangrijke informatie

Er zijn geen belangrijke informatie's toegevoegd die voor u op dit moment van belang zijn.

[Toon belangrijke informatie](#)

Vindt u Mijn UMC Utrecht gemakkelijk te gebruiken?

[Toelichting \(niet verplicht\)](#)

[Versuren](#)

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[Print pagina](#)

Voorbereiden

Het is belangrijk om het bezoek aan het ziekenhuis goed voor te bereiden. Neem het volgende mee naar uw afspraak:

- Uw afspraakbevestiging. Hierin staat de datum en het tijdstip van uw afspraak.
- Uw versieringspas of zorgpas.
- Een identiteitskaart met UMC Utrecht of WKZ (als u dat al hebt).
- Een legitimatiebewijs.
- Een actueel overzicht van de medicijnen die u gebruikt. Dit medicatieoverzicht is verkrijgbaar bij uw eigen openbare apotheek. In het medicatie overzicht staan welke medicijnen u de afgelopen zes maanden heeft gebruikt. Ook eventuele bijwerkingen en klachten. Dit kan handig zijn tijdens het gesprek met de arts.
- Een lijst met vragen en klachten. Dit kan handig zijn tijdens het gesprek met de arts.
- Willt u samen beslissen met uw arts? Maak dan gebruik van deze middelen. De Patiëntenfederatie Nederland heeft ze voor u verzameld.

Lees meer informatie en zie voor het gesprek met de arts:

[Uw bezoek in het UMC Utrecht >](#)

Lees meer informatie over de route binnen het ziekenhuis:

[Bezoekersinformatie - UMC Utrecht >](#)

Bekijk hier uw route naar de MC en HC op de virtuele plattegrond >

Bekijk hier de route naar het WKZ >.



Voorkomen infecties

Wij doen er alles aan om verspreiding van bacteriën in ons ziekenhuis te voorkomen. Om na te aan of u misschien ongemerkt een bacterie bij u draagt, stellen wij altijd een aantal vragen.

Lees meer over het voorkomen van infecties >



Contact

Wil u contact opnemen met de polikliniek, wanneer u één of meer van onderstaande vragen mist? Ja kunt beantwoorden?

• Waar kan ik terecht voor informatie over de afdeling? (Vraag de polikliniek voor de naam van de afdeling.)

• Woort u bij of bent u verzorgd van iemand die draagt is van de MRSA bacterie?

• Bent u de laatste twee maanden opgenomen geweest in een ander Nederlands ziekenhuis en was er op die afdeling een uitbraak met een ziekenhuisbacterie?

• Bent u de laatste twee maanden in een buitenlandse ziekenhuis of buitenlandse zorginstelling geweest voor opname.

• Woort u of werkt u op de afdeling met varkens, vleeskalveren of vleesoplumvee?

Het kan dan namelijk zijn dat u ongemerkt bepaalde bacteriën bij u draagt en wij voorzorgsmaatregelen moeten nemen.

Bij vragen kunt u bellen met 088 75 55 55 en vragen over de betreffende polikliniek of afdeling. Als uw kind wordt opgenomen

kunt u contact opnemen met het patiëntgebruik 088 75 34 45.

Wordt uw behandeling vergoed?

De meeste zorg wordt in het UMC Utrecht en WKZ alleen via een basisverzekering. Daar voor wordt u verzekerd vergoed door uw zorgverzekeraar. Hebt u alleen een basisverzekering en geen aanvullende verzekering? Dan kan het zijn dat u bepaalde medische kosten gedeeltekijk zelf moet betalen.

Lees meer over verzekering en de kosten van de zorg in het UMC Utrecht >



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Uitgebreide informatie

De afdeling neonatologie bestaat uit:

- Een medium care (MC). Uw kind gaat na de bevalling naar de MC als het extra zorg of behandeling nodig heeft. Lees meer over de MC in de folder >
- Een high care (HC). Op de HC liggen kinderen die niet langer de zorg van de intensive care (IC) nodig hebben. Lees meer over de HC in de folder >
- Neonatologie intensive care (NICU). Op de NICU worden kinderen opgenomen die na de geboorte intensieve zorg en/of bewaking nodig hebben. Lees meer over de NICU in de folder of bekijk de video over de opname van uw kind op de afdeling >

Verblijf tijdens NICU

Dichtbij uw kind blijven

Indien de toestand van uw kind zorgelijk is, kunnen wij ons voorstellen dat u in de nabijheid van uw kind wilt blijven. In deze bijzondere situatie bieden wij de mogelijkheid om de dag en eventueel de nacht door te brengen op een ouderkamer van de afdeling. Wanneer u op de kraamafdeling van het WKZ geboortecentrum ligt, is het soms mogelijk voor uw partner een nacht bij u op de kraamafdeling door te brengen.

Ontwikkelingsgerichte zorg

De omgeving van de afdeling neonatologie van het WKZ geboortecentrum is niet alleen ornatuurlijk voor de ontwikkeling van uw kind, maar kan ook als ouder overweldigend zijn. Het is belangrijk om de baby's te beschermen tegen negatieve invloeden vanuit de omgeving en om positieve invloeden in de vorm van steun en comfort te geven. Ontwikkelingsgerichte zorg richt zich op de zorg die past bij de ontwikkeling van uw kind.

Meer over ontwikkelingsgerichte zorg op de neonatologie >

Ronald McDonaldhuis Utrecht

Het Ronald McDonald Huis (RMD) zorgt ervoor dat u als ouders dichtbij uw kind kunt verblijven. De afdeling bepaakt of u in aanmerking komt voor een kamer in het RMD huis. Er is geen mogelijkheid om zelf te reserveren.

Lees meer >



Contact momenten

Informatieverstrekking over de situatie van uw kind

Het is belangrijk geïnformeerd te blijven over de situatie van uw kind. Wanneer u op de afdeling bent, krijgt u informatie van de verpleegkundige die voor uw kind zorgt. Ook kunt u het verpleegkundig dossier van uw kind inzien. Naast de aanwezigheid op de afdeling raden wij aan een paar maal per dag telefonisch contact met de afdeling op te nemen om te horen hoe het met uw kind gaat. U krijgt de verpleegkundige te spreken die voor uw kind zorgt. Telefonisch wordt informatie alleen aan ouders gegeven. Wanneer u nog opgenomen bent op de kraamafdeling zal de verpleegkundige ook een contactmoment hebben met de afdeling neonatologie.

Er vindt 1x per week een artsengesprek plaats en indien wenselijk vaker.

Wanneer u de Nederlandse taal niet goed beheerst, kan een tolk u ondersteunen. Dit kunt u aanroepen bij de verpleegkundige of

Uitgebreide informatie

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[Contact momenten](#)
[Overplaatsing](#)
[Naar huis](#)

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Uw ervaring

Uitleg over Mijn JUMC Utrecht

Uw bibliotheek

Polikliniek anesthesiologie

Uw kind, thuis, komt vanzelf van verpleegkundige op zijn/haar plaats. Het is belangrijk dat u als ouders dichtbij uw kind kunt verblijven. De afdeling bepaalt of u in aanmerking komt voor een kamer in het RMD huis. Er is geen mogelijkheid om zelf te reserveren. Meer over ontwikkelingsgerichte zorg op de neonatologie >

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Er vindt 1x per week een artsengesprek plaats en indien wenselijk vaker.

Wanneer u de Nederlandse taal niet goed beheerst kan een tolk u ondersteunen. Dit kunt u aangeven bij de verpleegkundige of behandelend arts. De afdeling zorg via het Tolkencentrum voor een telefonische tolk (tolkentelefoon) of voor een tolk die bij het gesprek aanwezig is.



Overplaatsing

Mijn kind wordt overgeplaatst binnen het WKZ

Wanneer uw kind om een bepaalde reden in een academisch centrum moet verblijven, maar geen IC zorg meer nodig heeft, wordt het overgeplaatst naar de HC of MC neonatologie of een kinderafdeling in het WKZ/JUMC Utrecht. Van de IC/HC naar de MC >
Naar de afdeling Papagegal >

Mijn kind wordt overgeplaatst naar een ander ziekenhuis

Wanneer uw kind zover hersteld is dat hij/zij geen intensieve of academische zorg meer nodig heeft, wordt uw kind overgeplaatst naar de couveuseafdeling van een ziekenhuis in uw direct woonomgeving. Wij proberen de overplaatsing vooraf te plannen. Soms is dit niet mogelijk en zal de overplaatsing op korte termijn plaatsvinden.



Naar huis


Ontslag naar huis

Het kan voorkomen dat uw kind vanaf de Medium Care wordt ontslagen om naar huis te gaan. De verpleegkundige bereidt u voor op dit ontslag en zorgt ervoor dat u uw kind zelfstandig kan verzorgen. Soms komt u in aanmerking voor ingestelde kraamzorg. De wijkverpleegkundige en uw huisarts worden op de hoogte gebracht dat u naar huis gaat met uw kind. Naar huis >

Ondersteuning thuis met het Top programma

Als u naar huis mag, is het fijn om nog de nodige ondersteuning te krijgen. De Top kinderfysiotherapeut helpt u als ouder om de signalen van uw kind te herkennen en hierop in te spelen om zo de ontwikkeling van uw kind te stimuleren. Zo geeft u de veiligheid en steun die precies bij uw kind past. Het Top programma is voor kindjes die onder de 32 weken geboren zijn en/of minder dan 1500 gram wogen. Alle ziektekostenverzekeraars vergoeden het Top programma. Een verwijzing van de arts is niet nodig. Neem contact op met een Top fysio >





Utrecht over Mijn UMC Utrecht

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Agenda

Hieronder staat een overzicht van uw afspraken in het UMC Utrecht. Afspraken die al zijn geweest staan onder het tabblad Historie. Onder Historie is het ook mogelijk een jaaroverzicht van alle afspraken te printen.

[Toon meer informatie](#)


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Aankomend

Historie

Plan een afspraak

Tijd	Type	Waar	Specialisme	Voor/Bij	Voeg toe	Actie
12-09-2022 14:00-16:00	Visite NICU	NICU Unit 3	Neonatologie	Verzorging Baby		
14-09-2022 09:00-10:00	Oog onderzoek	NICU Unit 3	Oogarts			Controle afwijking ogen
14-09-2022 10:00-12:00	Visite NICU	NICU Unit 3	Neonatologie	Verzorging Baby		



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Medisch dagboek

Hieronder staat een overzicht van alle mijlpalen die uw kind heeft doorstaan in het UMC Utrecht. Het is mogelijk een jaaroverzicht van alle mijlpalen te printen.

Toon meer informatie

Vandaag: **19 September 2022**

[Voeg een mijlpaal toe](#)

September 2022

29	30	31	1	2	3	4			
5	6	7	8	9	10	11	12	13	14
19	20	21	22	23	24	25	26	27	28
26	27	28	29	30	1	2	3	4	5

Oktober 2022

26	27	28	29	30	1	2			
3	4	5	6	7	8	9	10	11	12
10	11	12	13	14	15	16	17	18	19
17	18	19	20	21	22	23	24	25	26
24	25	26	27	28	29	30	31		


November 2022

31	1	2	3	4	5	6			
7	8	9	10	11	12	13	14	15	16
21	22	23	24	25	26	27	28	29	30
5	6	7	8	9	10	11	12	13	14

Recent toegevoegd

05 Oktober 2022 Julia heeft voor het eerst borstvoeding gekregen.

01 Oktober 2022 Julia heeft haar oogonderzoek gehad.



UMC Utrecht

Uitlog over Mijn UMC Utrecht

[Zoeken](#)

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U bezijkt het dossier van: A.S. Bruijning | [Uitloggen](#)

Hier bent u > [Homepage](#) > [Medisch dagboek](#)

Medisch dagboek

Hieronder staat een overzicht van alle mijlpalen die uw kind heeft doorstaan in het UMC Utrecht. Het is mogelijk een jaaroverzicht van alle mijlpalen te printen.

[Toon meer informatie](#)

[Print pagina](#)

[Voeg een mijlpaal toe](#)

Vandaag: **05 Oktober 2022** ▼

September 2022

29	30	31	1	2	3	4	26	27	28	29	30	1	2
5	6	7	8	9	10	11	3	4	5	6	7	8	9
12	13	14	15	16	17	18	10	11	12	13	14	15	16
19	20	21	22	23	24	25	17	18	19	20	21	22	23
26	27	28	29	30	1	2	24	25	26	27	28	29	30
3	4	5	6	7	8	9	31	1	2	3	4	5	6

Oktober 2022

29	30	31	1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	10	11	12	13	14	15	16
19	20	21	22	23	24	25	17	18	19	20	21	22	23
26	27	28	29	30	1	2	24	25	26	27	28	29	30
3	4	5	6	7	8	9	31	1	2	3	4	5	6

November 2022

29	30	31	1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15	16	17	18	19	20	21

Dinsdag, 05 Oktober 2022

Vandaag heeft Julia voor het eerst borstvoeding gekregen. In het begin was het even uitvogelen hoe mama Julia het flijtze vast kon houden maar uiteindelijk is het gelukt



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