



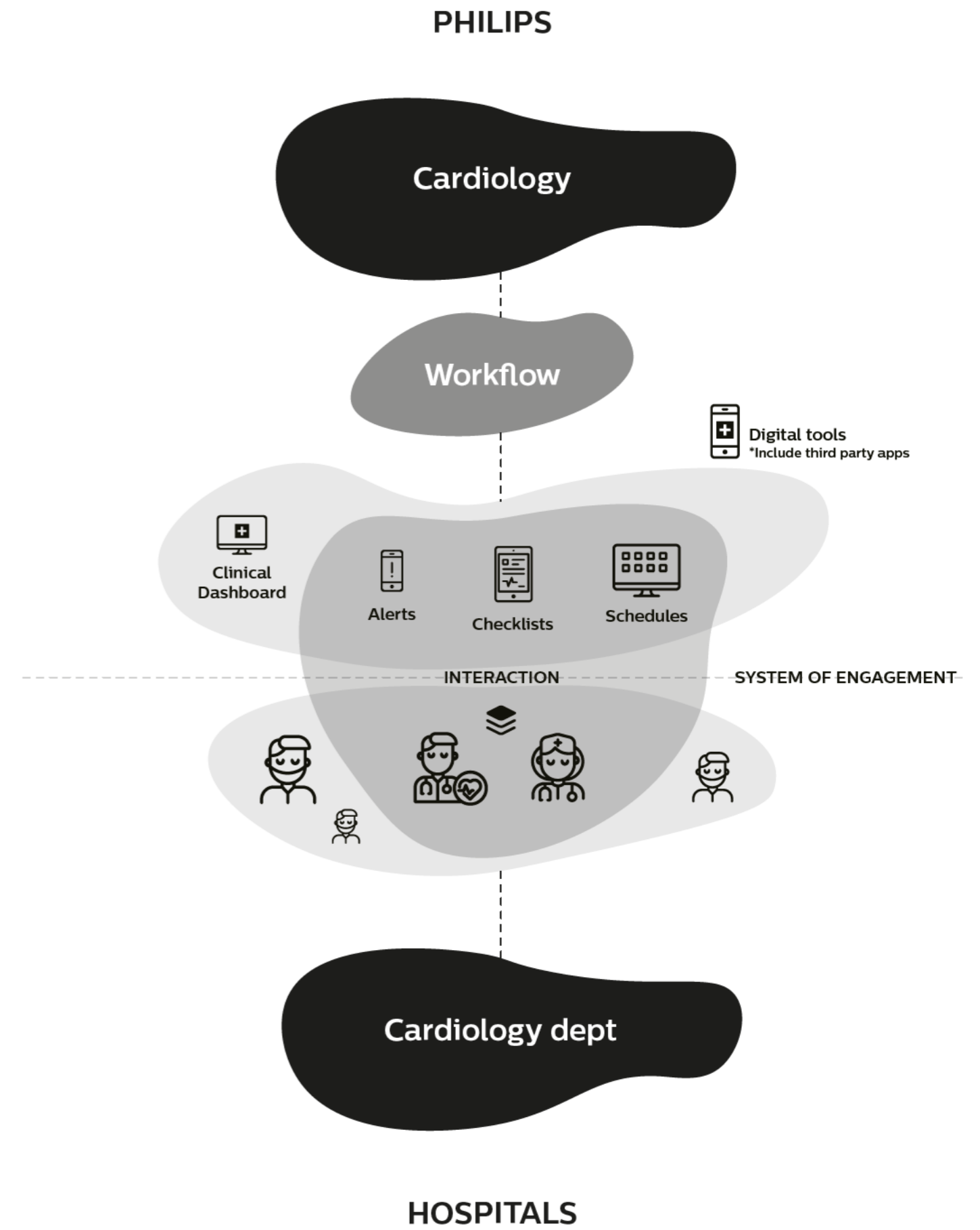
Design For Workflow Intelligence In Cardiology
Prompt User Liaison Service Experience system

Master Thesis Appendix by Hao Liu



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How do the tools support their workflow?
How do they feel?

What is the workflow like?

Assessment - Diagnosis - Treatment planning -
treatment - aftercare - follow up

**System of engagement
in Aviation**

How do staff communicate with each other?

How do systems communicate with each other?

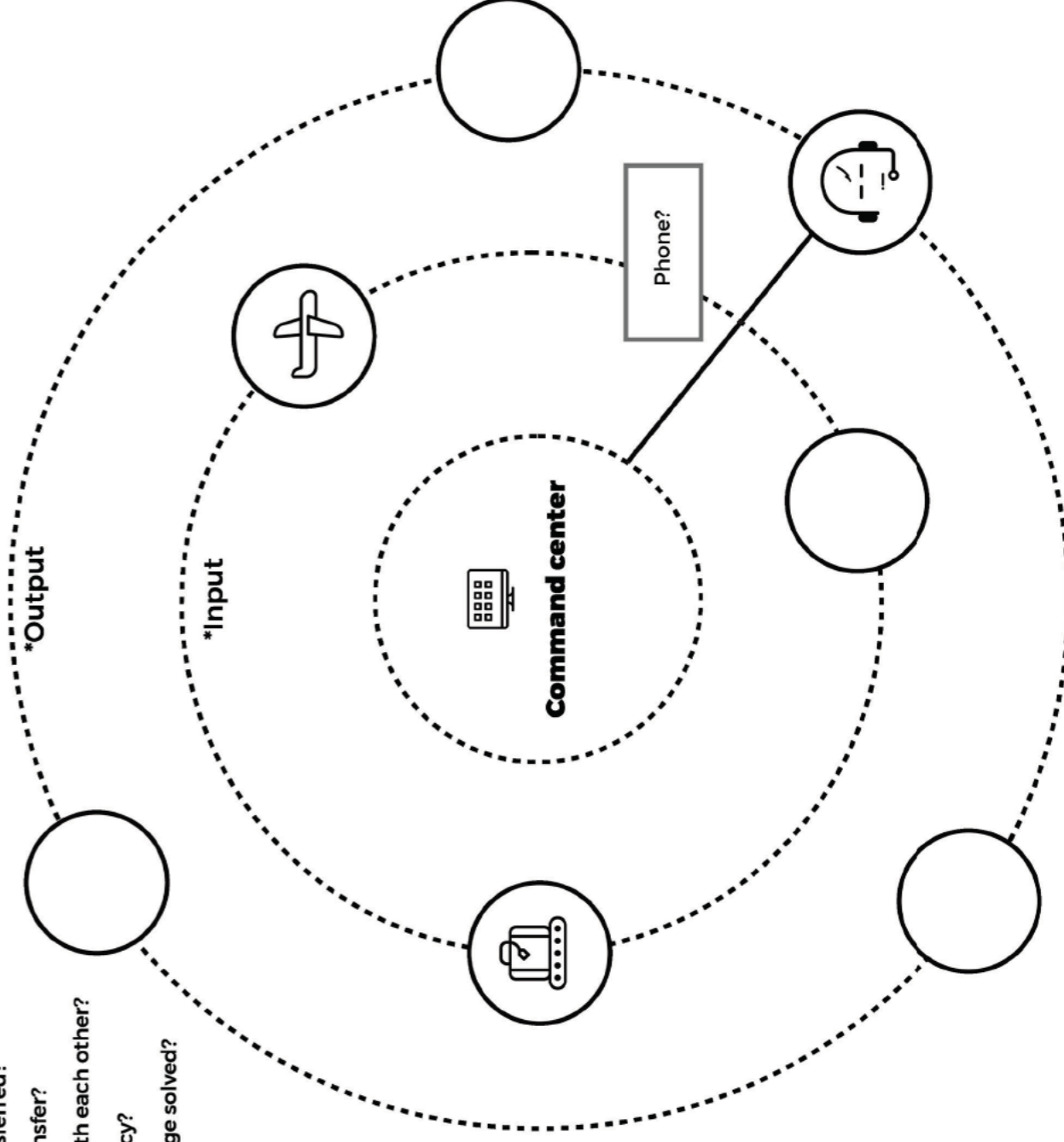
How is information transferred?

Who operates the transfer?

How do staff communicate with each other?

In case of emergency?

How is the logistic challenge solved?



Appendix D

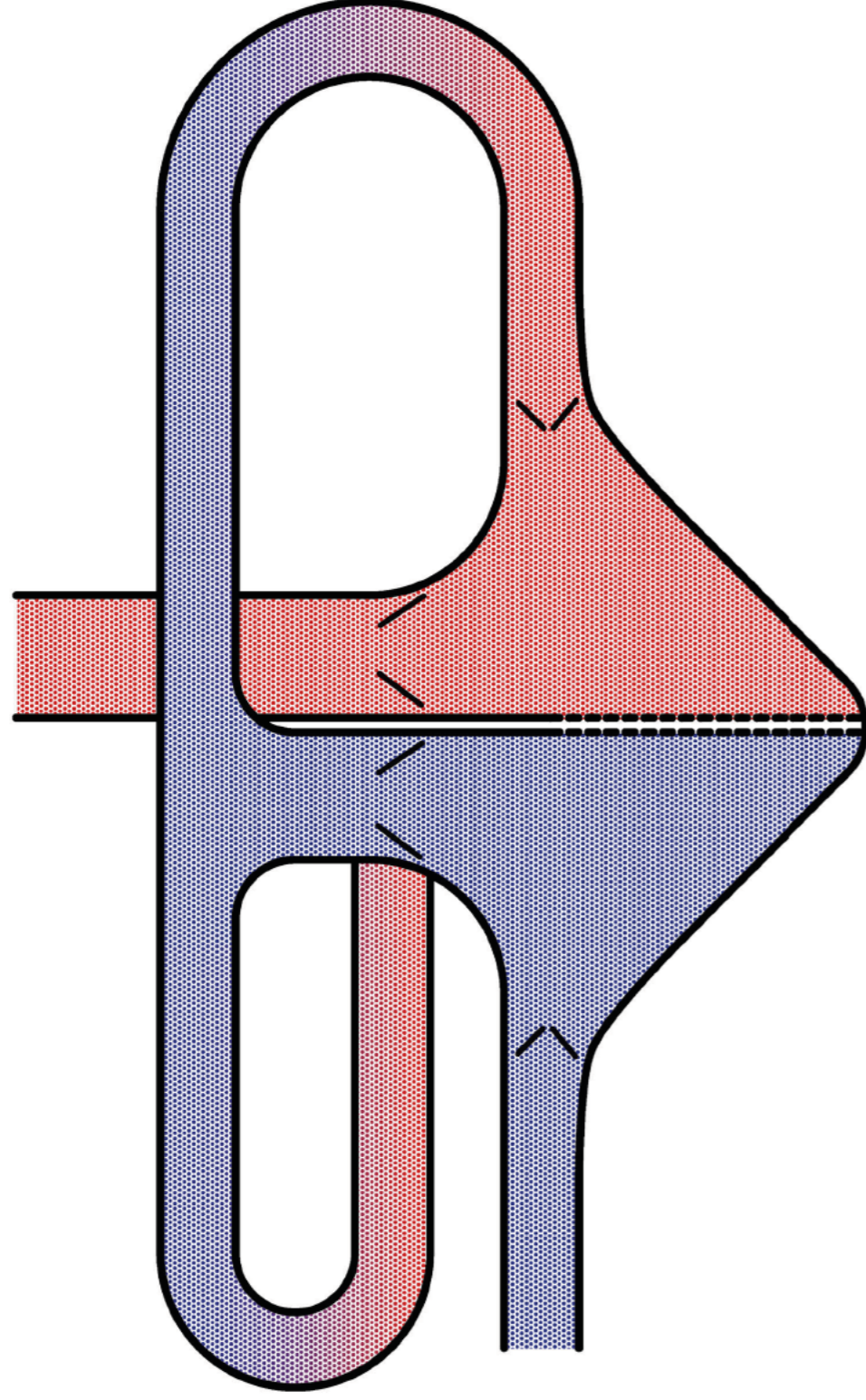


Typical questions could be:

- Can you show me the digital tools that you use?
- How often do you have to interact with digital tools, e.g. Alerts, checklist? What digital tools do you recognize? What are the “stupid” tools that help you perform these activities.
- How often do you interact with digital tools daily?
- How do you feel when you interact with each tool currently on a realtime basis? E.g. Current products (e.g. patient monitoring), IT systems (e.g. EMR, scheduling), communication systems (phones, smartphones, pagers), computer systems (ipad, laptop, desktop PC, in-room fixed screen)
How are they made context-aware/realtime (e.g. barcodes/QR codes)?
- What annoys you when you interact with these digital tools?
- What delights you when you interact with these digital tools?
- What are typical requirements for these tools above, related to your user experience?
- What do you like and/or dislike about any digital tools? How would you work without a digital tool?
- Do you always use this particular tool, or do you take alternatives in case of some emergencies?
- What kind of improvements do you feel that the digital tools bring to you (efficiency, flexibility, ease, precision, etc.), compare to traditional tools that you used?
- Do other people in your team influence the way you interact with these digital tools?

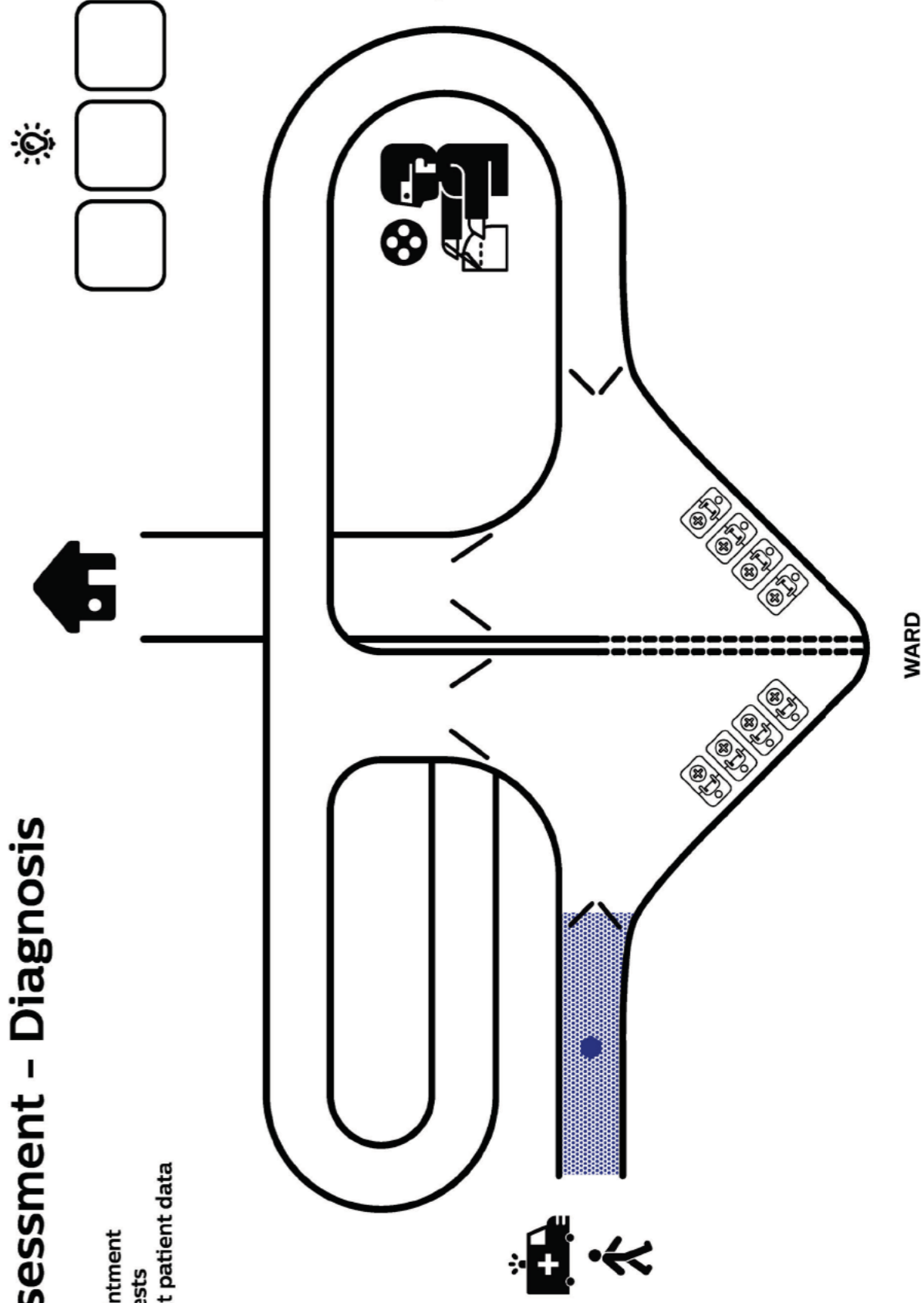
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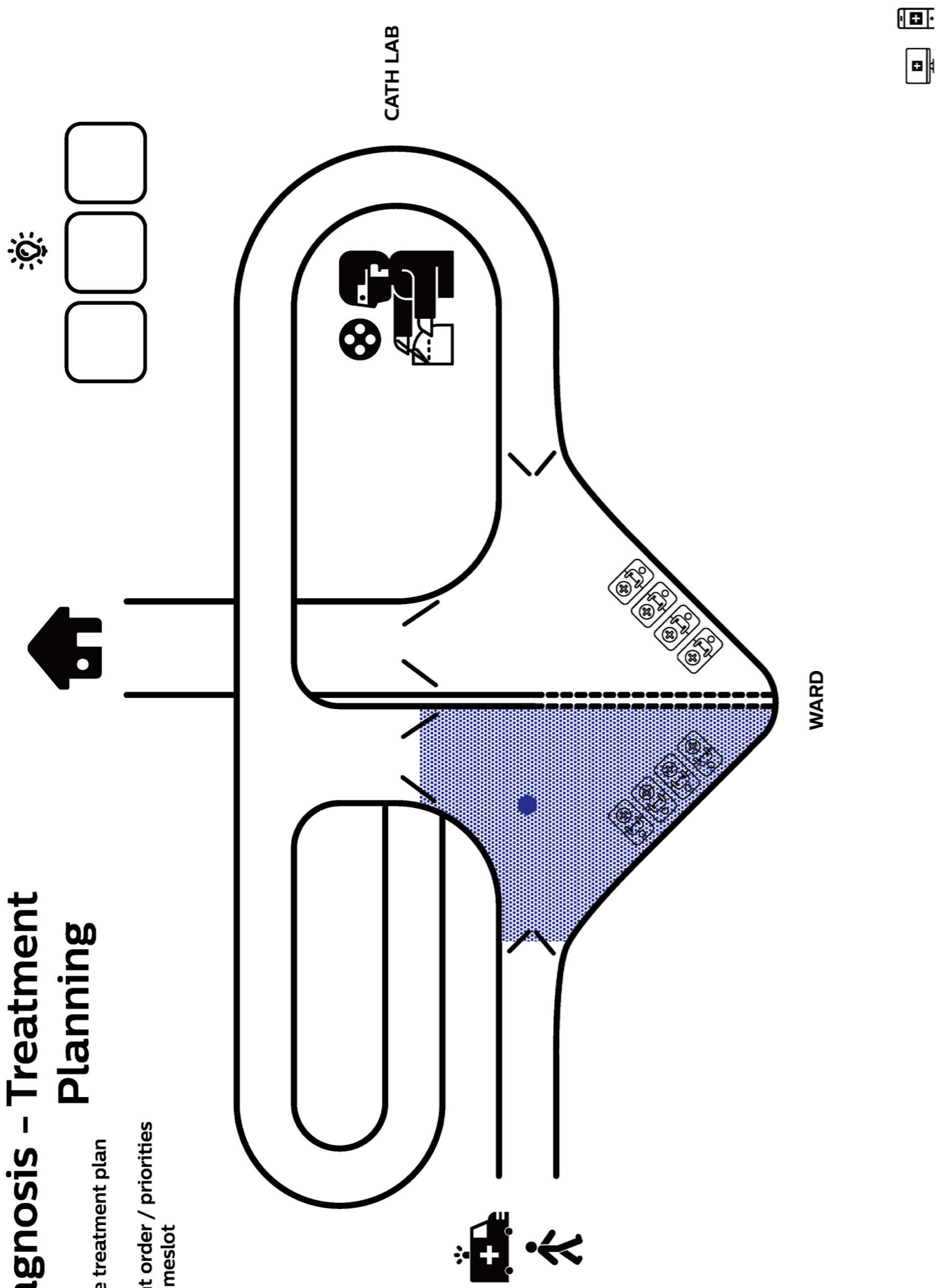
Assessment - Diagnosis

- Appointment
- Lab Tests
- Collect patient data



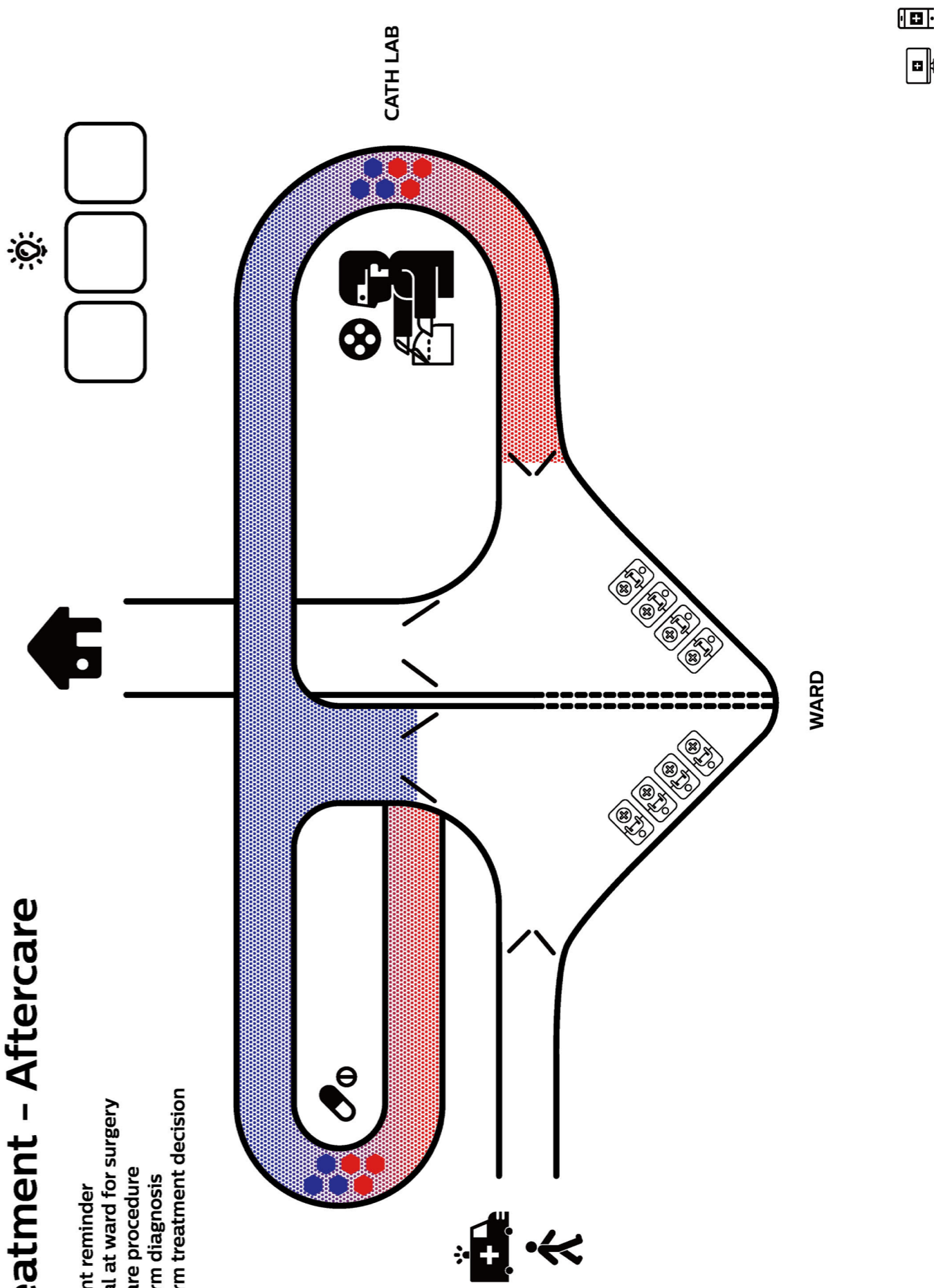
Diagnosis - Treatment Planning

- Decide treatment plan
- Risks
- Patient order / priorities
- Find timeslot



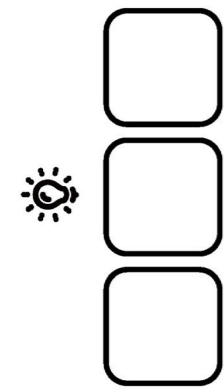
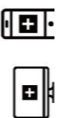
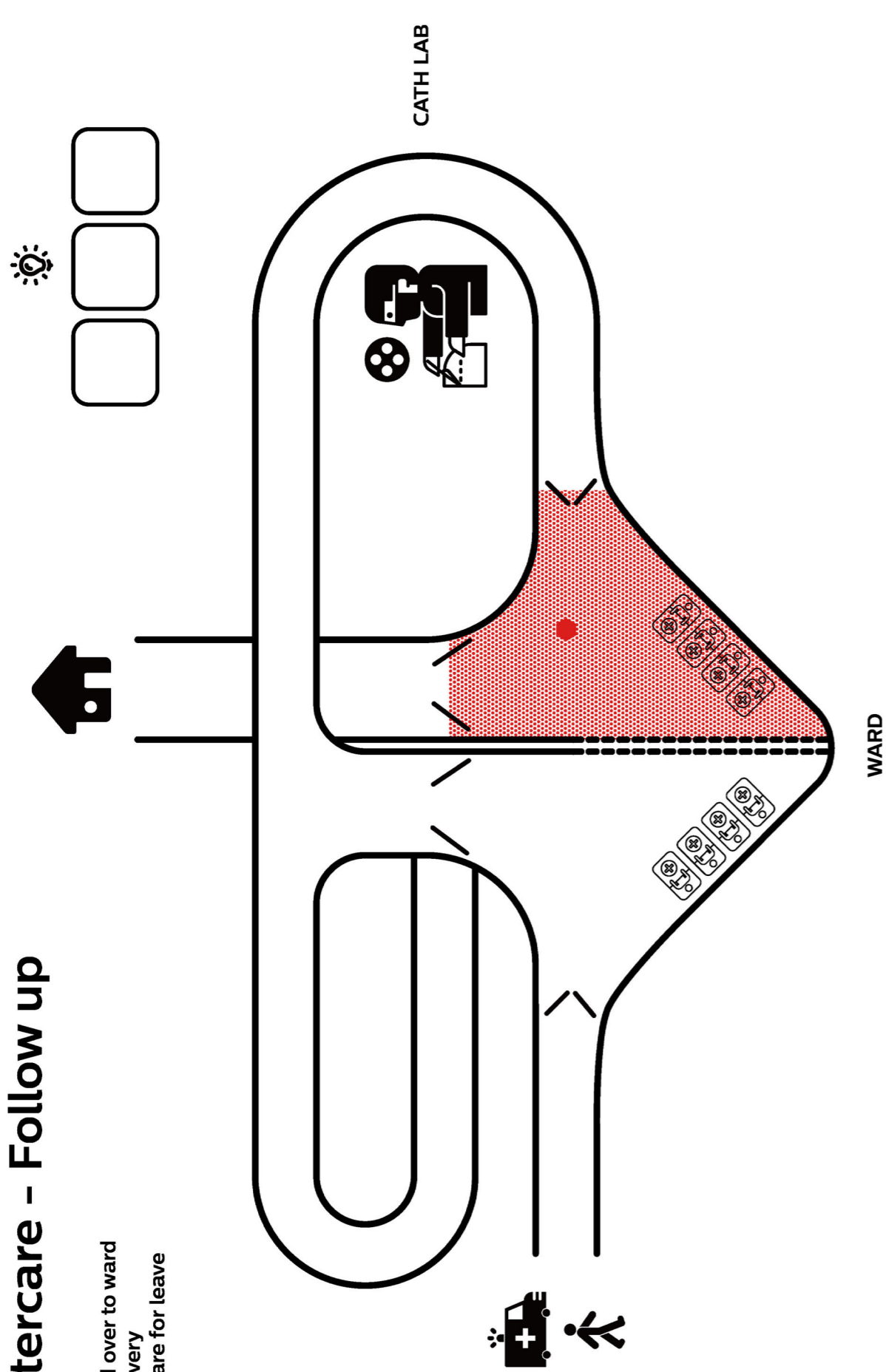
Treatment - Aftercare

- Patient reminder
- Arrival at ward for surgery
- Prepare procedure
- Confirm diagnosis
- Confirm treatment decision



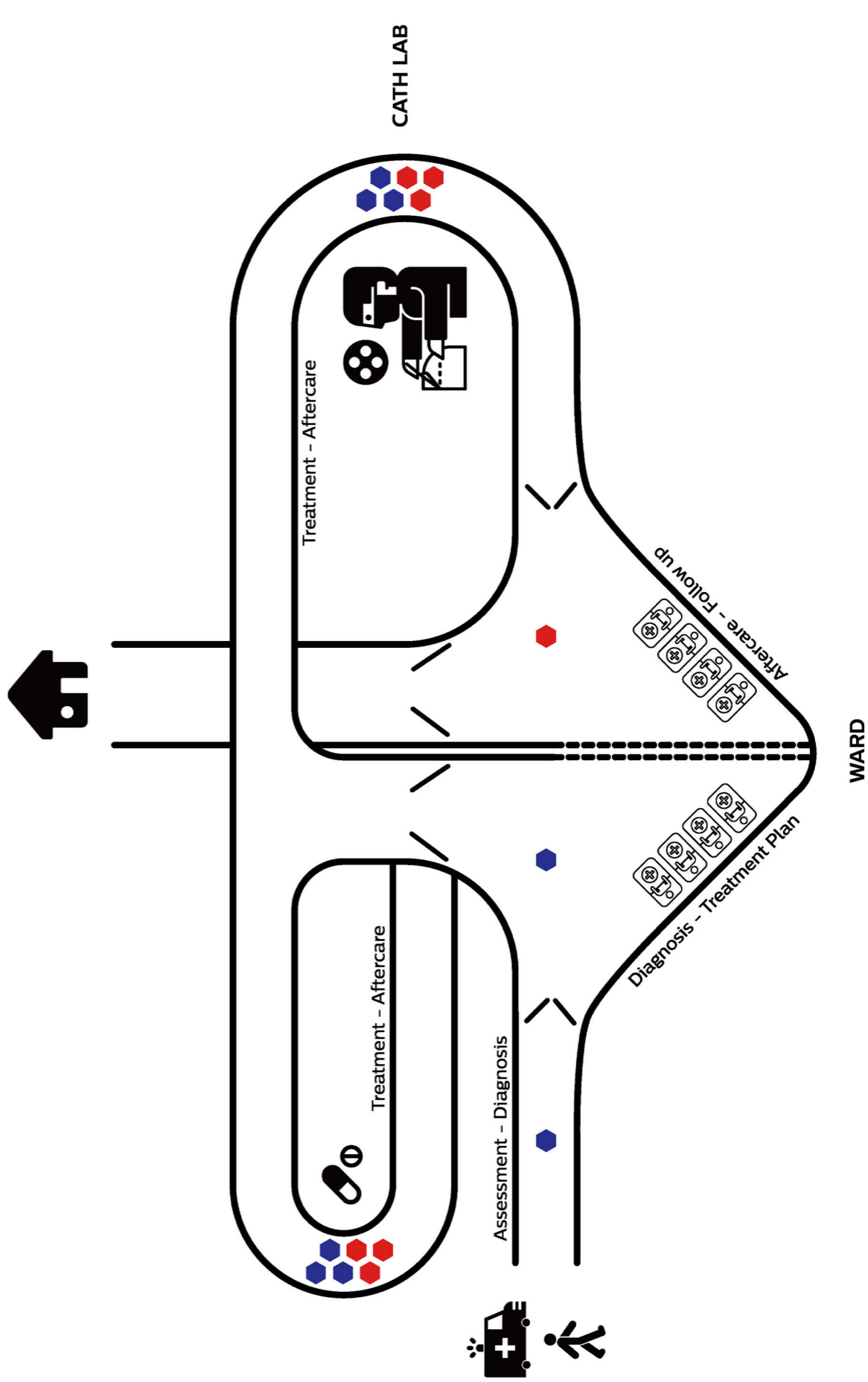
Aftercare - Follow up

Hand over to ward
Recovery
Prepare for leave



Aftercare - Follow up

Hand over to ward
Recovery
Prepare for leave



Appendix F

What I did in a day when ... ?



I start with a morning coffee...



I use...

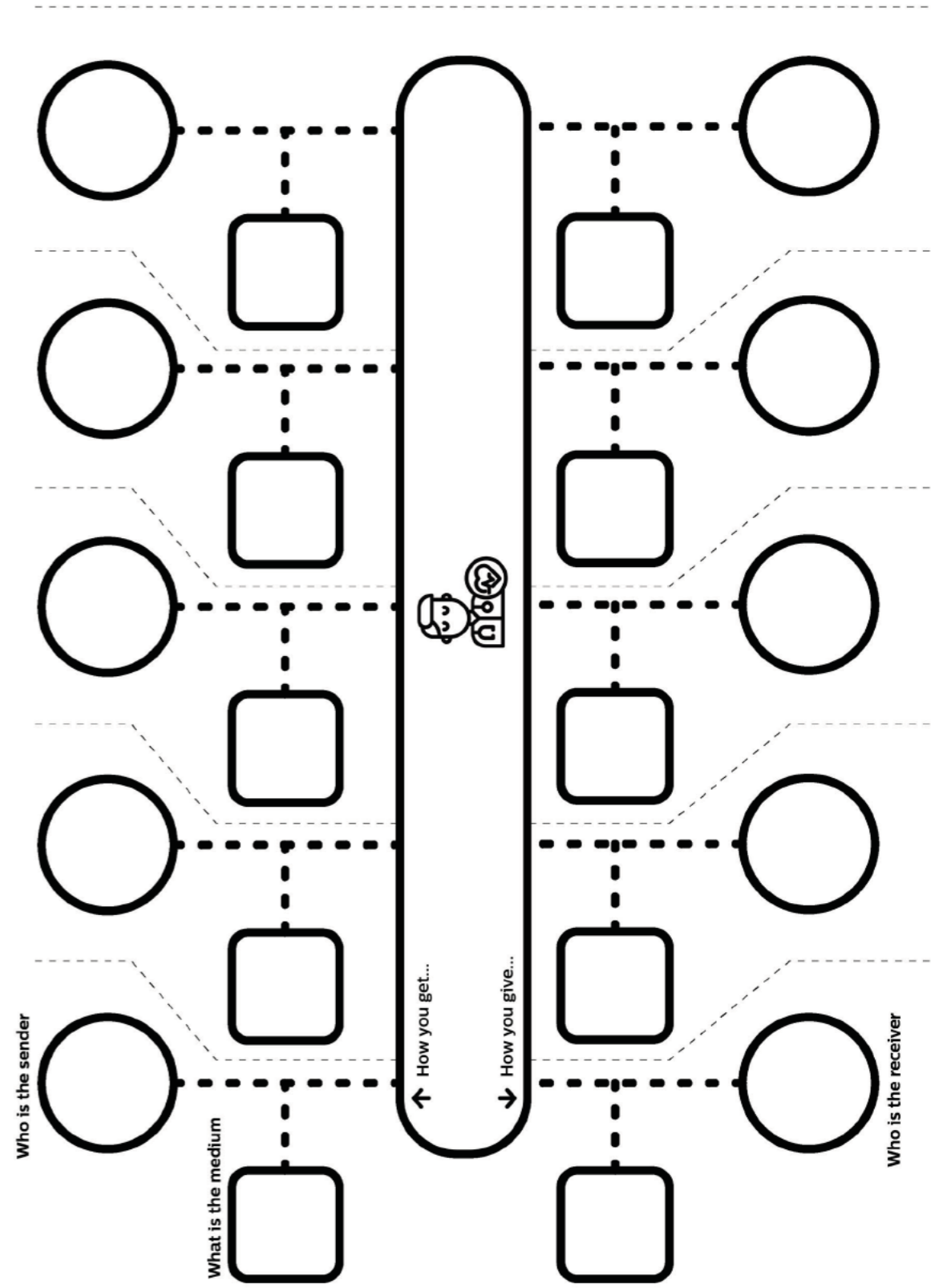


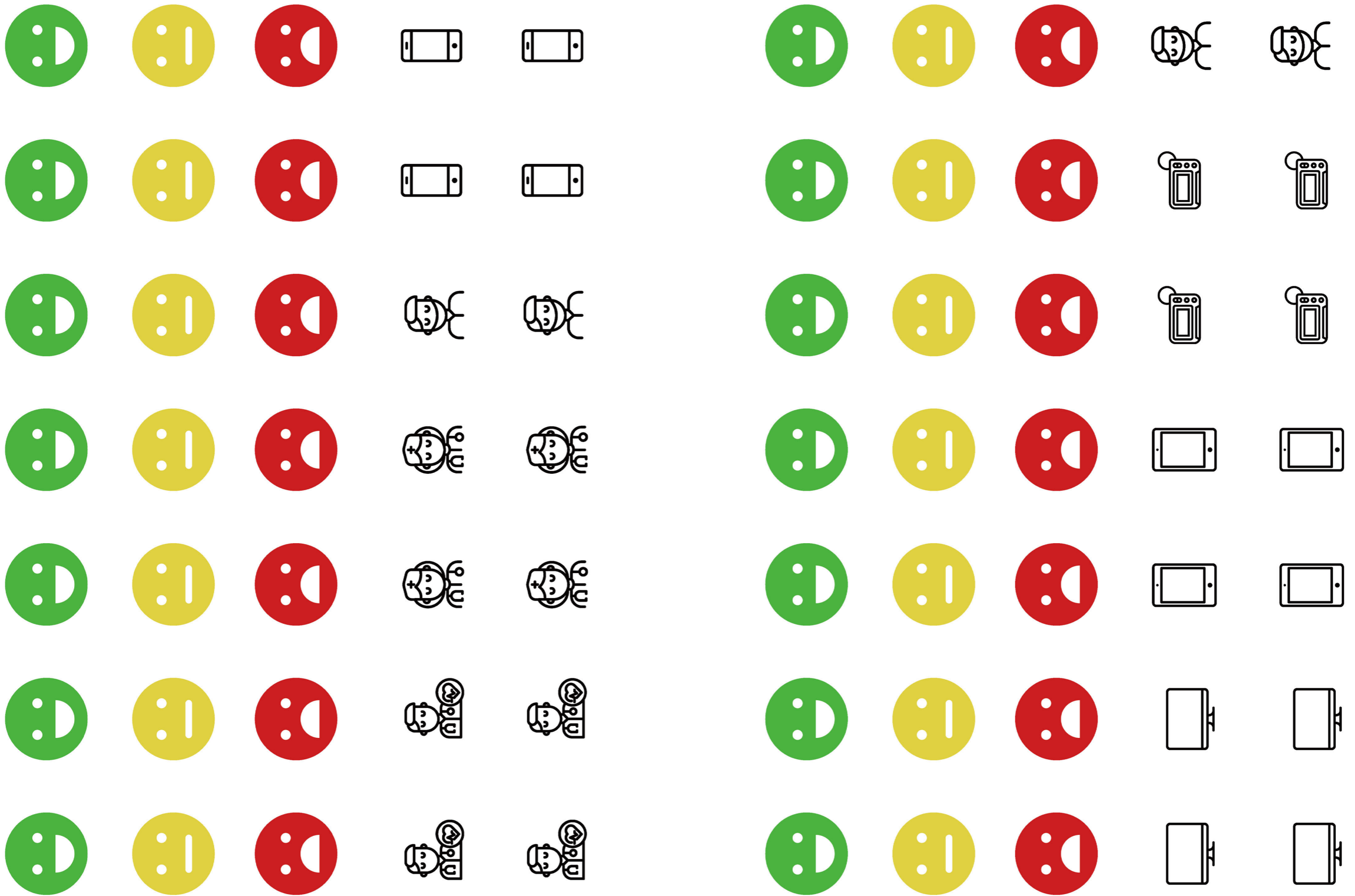
I feel...

What topics of information do you need to be informed to achieve what goal



NOTES





Storyboard 1

Scenario 1: Nursing department [with Resident Doctor. X and Ward Nurse Y]

1. At 8 am, in the staff room, ward nurse Y does verbal reporting with the night shift nurses, and discuss with other morning shift nurses which patients she wants to take care of today, then writes down patient name and ID in her note. One nurse is late, so nurse Y has to keep a paper note for her.

2. At 9 am, resident doctor X starts the shift by talking with the morning shift nurses who carry their notes, to discuss about patient situation. Nurse Y only knows that Dr. X is the one who she's going to work with when she sees him because the doctors' schedule rotates a lot. Dr. X writes down on his own notes from the conversation. He requests a blood test for a new patient #015, and agrees to discharge patient #020, nurse Y notes down on her own notes, keeping as a task list.

3. After the morning briefing, Dr. X goes to the whiteboard and see nurses including nurse Y are on duty for clinical rounds with him. Nurse Y goes and checks on the nursing report about her patients documented by the nurses from previous shifts. The only information she wants to know is the patient name, medical history, and the reason for admittance. Nurse Y then requests for the blood test from the blood taking department.

4. Dr. X then goes to the desktop, check on his email, where he sees a reminder from his supervisor that he has to find a time slot that every doctor is available for a group meeting. However, he can hardly find a good time slot that suits everyone. Nurse Y also checks on her email, sees a reminder from her team leader about information in several medication updates she has to keep in mind.

5. Dr. X then opens the patient EMR file, and searches for the lab result he asked for in the morning. However, the result is not ready because it is not in the patient file yet. Dr. X can only then look at every other patient's file he's responsible for, and prepares a list of problems to solve in his own notes or by head. Nurse Y starts the care for her patients. She notes down patient's weighing, fluid intake and output on paper. She gives medication to her patients once in a while depending on the protocol, and notes down the next medication is in 7 hours.

6. At 11 am, Dr. X starts clinical rounds with nurse Y and other nurses he works with. He focuses on talking with patients #012 to #030, writes down notes on each and every patient in his own notes or by memorizing. Ideally, Dr. X would tell nurse Y what to do and immediately give prescriptions for it. However, after the rounds, Dr. X has to prepare for the meeting so he left without giving verbal orders to the nurses.

Heuristic evaluation 1:

1. At 8 am, morning shift nurses check in by scanning badge. PULSE shows in one big screen in the staff room: all ward patients/new patients and morning shift nurses. Night shift nurses explain patient situation with morning shift nurses in front of the big screen. Ward nurse Y chooses patient #002 #003 #004 #015 #020 ... by dragging patients cards to her card. The nurse who is late will be assigned patients by other morning shift nurses. As soon as the nurse arrives at the hospital, they can see their patients in PULSE. PULSE shows that Dr. X will be present today based on the synced schedule of every staff. Nurse Y knows how to interact with Dr. X before he comes so she can be prepared for the morning briefing.

2. At 9am, Dr. X arrives, scans his badge to a nearby desktop. PULSE knows Dr. X is active, all morning shift nurses knows the morning briefing is starting soon by a notification from PULSE. In the staff room, PULSE shows on the big screen with, ward patient cards: patient name, patient ID, ECG, kidney function, lab test results; for new patients cards (in different color):

patient name, patient ID, reason for admittance, ECG, kidney function, lab test results, patient history. Dr. X orders patient priority by dragging patient cards in PULSE.

3. During conversation, Dr. X orders patient priority by dragging patient cards in PULSE. Nurse Y adds a new task (blood test for patient #015) in PULSE, she sets it to priority. Dr. X agrees to discharge patient #020, he marks patient #020 as "discharge" in PULSE, nurse Y immediately sees the discharge mark on her patient #020 in PULSE.

4. Dr. X logs in the desktop with his badge. PULSE shows: he is in the process of morning briefing to clinical rounds; The nurse list he works with; Bubble with numbers of unread emails; Bubble with numbers of unread messages. Dr. X sends a meeting request to everyone in PULSE, the ones who overlaps their schedule will be asked by PULSE if they can adjust their agenda. Nurse Y logs in the desktop with her badge. PULSE shows: her patient cards with - patient name, medical history, reason for admittance (from the nursing report); Bubbles with numbers of unread emails and messages. Nurse Y adds to the medication tab so whenever a patient has the updated medication, PULSE pops-up a reminder, for 3 days.

5. Dr. X will get a pop-up saying the blood test is ready and a new bubble with new lab results. Dr. X could add his own tasks or problems to solve in PULSE based on his patients. For instance...?

6. Nurse Y does her rounds and types in patients' weighing, fluid intake and output in PULSE in her mobile phone or the cow. PULSE reminds nurse Y to give an IV to patient # 002 and medication (with reminder of the medication update) to patient #004.

7. At 11 am, Dr. X and nurses including nurse Y gets a notification from PULSE, to prepare for clinical rounds. PULSE reminds Dr. X to give verbal orders and prescriptions to nurse Y after seeing all patients so that nurse Y could keep as tasks in PULSE.

Storyboard 2

Scenario 2: Cath lab [with Interventional Cardiologist X, lab nurse Y and CCU nurse Z]

1. At 3pm, at the CCU, an emergency alarm rings and shows on desktop. CCU nurse Z looks into patient vital signs sent by email (via lifenet) from the ambulance staff. Nurse Z then calls the ambulance to ask for specific patient information and writes them down on a checklist. Nurse Z misspelled the patient name because of unclear pronunciation from the ambulance staff. So nurse Z checks on the EMR system and she finds the wrong patient file.

2. After finally confirming to the right patient, and know the patient has a myocardial infarction from the ambulance, nurse Z calls the cath lab. However, the only phone number of the cath lab is often occupied. Nurse Z has to call 3 times until someone from the cath lab answers. The cath lab calls Cardiologist X and lab nurse Y to prepare for the PCI procedure.

3. The patient has arrived at the CCU being taken care of by nurse Z.

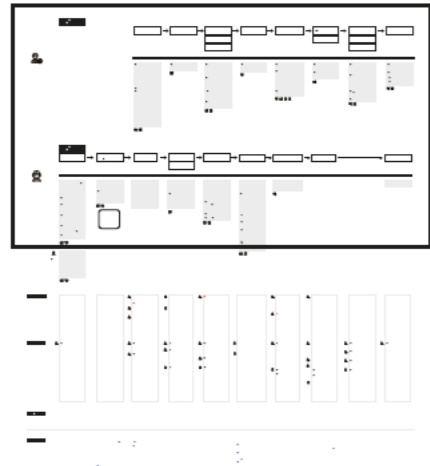
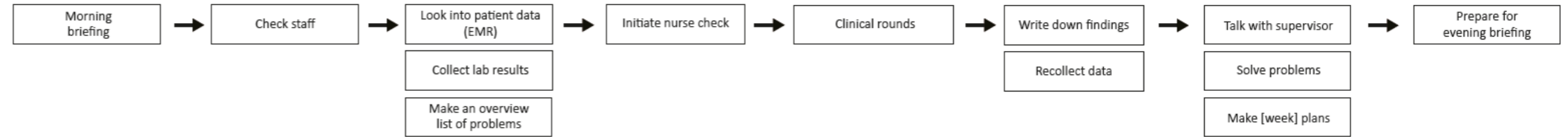
4. Cardiologist X is still on his way.

5. Nurse Y is in cath lab room #2 preparing the table and setting up devices.

6. After nurse Y finishes preparation, he calls the CCU to bring the patient down to the cath lab. Nurse Z brings the patient to the cath lab. Nurse Y wants to make sure from nurse Z what medication and how much did the ambulance staff use on the patient, nurse Z could not answer because she did not record it, her checklist does not have the information.

7. After the procedure, it ends 30 minutes earlier than planned. Cardiologist X sees there is enough time to treat another patient in between the next procedure. He goes to the cath lab control room and ask the secretary to plan in another patient in this free time space. The secretary then calls the responsible physician to ask if the physician can do his procedure now.

Nursing Department



Doctors who are scheduled to work at a day will gather the ward nurses to discuss verbally on

- problems happened last night
- special cases (emergencies)
- priorities of today's patients
- the must-know lab tests, ECG, kidney function.
- Pinpointing things to be done.

Week-weekend-next week
Week doctors discuss verbally with the nurses who work on the weekends, to know what the doctor's tasks are. Goes the same for the weekend doctors.

For new patients who are admitted to a hospital via emergency, the doctor checks

- home condition
- where does the patient come from, create an "image" of a patient
- ECG/lab tests/biomarkers
- patient history

Come up with a treatment plan.

Doctor goes and checks which nurses they are going to work with today.

Doctor checks on the computer, opens the EMR and look into patient data. They know which patients they are responsible for on a day.

Doctor collects lab results of the patient (differs between patients)

- ECG
- Kidney function
- Blood test
- Ultrasound
- X ray
- Pacemaker
- Consult

Doctor writes down a list of problems they have to solve for today on a piece of paper.

Doctor gathers nurses they work with today, discuss problems with them and prepare for clinical round.

Doctor together with nurses start visiting patients one by one.

Doctor starts a conversation with patients, listen to their problems, complaints and note down critical information for the clinicians themselves.

The clinicians input data to the EMR system.

Doctor checks on guidelines for more information on updates, and news.

Doctor finishes clinical round, summarize findings and work on the EMR system.

Doctor waits for new test results from other departments.

Doctor meets with the supervisor, and discuss on the problems and findings with the supervisor.

Doctor notes down several key moments from the discussion and makes a plan for a [week, month...]

*The supervisor determines the care processes of a doctor

Doctor finalises the plan. e.g. Work to release patient X in 10 days

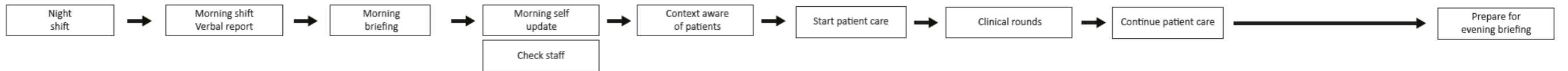
Doctor starts solving problems.

Doctor gathers night shift nurses, discuss on key tasks with them.

Doctor keeps a log of tasks for the care staff

- Night shift nurses
- Weekend doctors
- Week doctors (from weekend doctors)

Nursing Department



Inpatients stay over night. New patients come in because of emergency and would also stay overnight. The ward nurses who works at night take care of the ward patients.

Quick look of the wards, to see if patients are doing okay.

Ward nurse notes down patient condition digitally, except for fluid intake which they note down on paper.

Ward nurses note down only critical information in the digital nursing report, e.g. bleeding, etc.

Ward nurses receive information of new emergency patients from the CCU doctors.

Ward nurse files new patient into the patient EMR system.

Morning shift nurses do verbal reporting to know which patient they have to take care of.

Ward nurses check the protocol for procedures if they are not sure about certain procedures. Then use checklists to confirm the procedure.

Morning update

- Talk about patients what are the things that has to be done (talk about vital signs, things need to be done or ordered, check lab results, blood work)
- Concerns that they don't feel like addressing right away will be moved to the morning rounds.
- Ask for prescription
- Ask for discharge patients

Morning shift ward nurses reads the patient report from the doctors, and possible letters from the GPs.

Ward nurse reads the nursing report, which are the previous reports noted down by the nurses from every other shifts.

Check email for updates of medication from team leaders.

Check on blood pressure, vital signs of patients on the display. Then check lab results of patients, and medication for patients.

Keep reminder on (prominent things)

- Patient name, Mr./Mrs.
- Date of birth
- Patient ID number
- Patient history
- Reason for admittance
- To-do lists (activity, what time)
- Orders (tests, what time)
- Vital signs
- Weight / Height

Give every patient medication, help patients wash, get patients ready for procedure, install new patients in the morning.

Ward nurses note down only critical information in the digital nursing report, e.g. bleeding, etc. They call the doctor or go to the doctor to seek for further instructions.

Things that are urgent happens, they call the attending doctor

- Urine output goes down
- Vital signs worsening e.g. low blood pressure
- Patient has arrhythmia
- New patient admitted to cardiac ER
- Patient has chest pain, worsening ECG
- Need doctor's approval on something

For patients who are back from procedures, nurses check

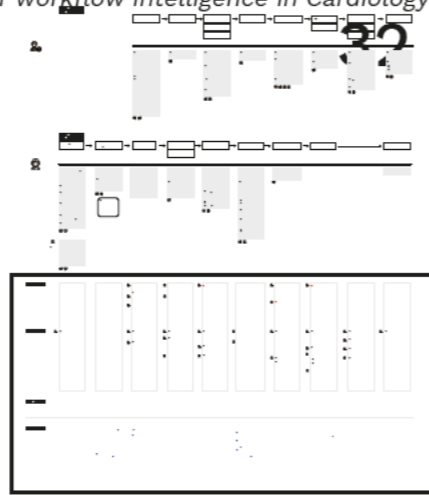
- Vitals
- Wounds
- Make ECG
- Cardiac Telemetry

Ideally, doctors do verbal orders to the nurses telling them what to do, and immediately make prescriptions for it.

Identical to the morning briefing process.

We have to give a type of medication that we don't give that often that we don't we aren't sure of how to like prepare it, then I always look it up.





The emergency doctor receives emergency patients during night. They decide if a patient is regarded as a cardiac patient then send the patient to the Cardiac emergency room to stay overnight. The emergency doctor has to act as a "verlenden arm constructie" - represents as a cardiologist who does the work to stabilise patients.



Painpoints

Requirements

<p>Emergency Doctor</p> <p>The emergency doctor receives emergency patients during night. They decide if a patient is regarded as a cardiac patient then send the patient to the Cardiac emergency room to stay overnight. The emergency doctor has to act as a "verlenden arm constructie" - represents as a cardiologist who does the work to stabilise patients.</p>		<p>There is no instant overview for the doctor to know what has happened to patients last night. Only the nurses knew.</p> <p>There is no instant overview on problems from the days while the doctor was not in duty.</p> <p>It is very important for the doctor to get the latest updates of patients, they get upset and annoyed if there is no data before everything starts at the beginning of a day</p>	<p>Everything we have to check on is in different tabs, it's not very well that we have to keep switching tabs.</p> <p>It is annoying that the nurses only know which doctor is until they see them in the morning because the doctors rotate a lot. They only knew which doctor takes care of which patient when the doctor arrives.</p>	<p>Doctors are waiting for new lab results in front of their computer, and sometimes takes hours to get the result.</p>	<p>Currently patient problems are written down on a piece of paper or by memorizing during clinical rounds. Then would make it more structured afterwards.</p> <p>Not all doctors will get back to us with their new orders.</p>	<p>Doctors are waiting for new lab results in front of their computer, and sometimes takes hours to get the result.</p>			
<p>Doctor needs the emergency doctor to act as a cardiologist and gather the essential and important data from a patient once a patient is identified as a cardiac patient.</p>		<p>Want to understand patient status right away and be prepared for the patients at the beginning of a day.</p> <p>Want to have an interface that shows vividly the problems from the previous weekend from other colleagues while the user was not in duty, to help them keep in mind.</p>	<p>Want the information shown digitally on a big screen.</p> <p>Want to know if the staff are well informed.</p> <p>Want to have just patient name, reason for admittance, patient history, not every notes from the doctors and nurses.</p>	<p>Want to be notified by a pushed message when there is a new lab test result coming, and by a notification when there is an important message from other staff.</p> <p>Want to have a smart and automated way to note down the problems and tasks.</p> <p>Want to know "what is going on" with patients with an overview.</p>	<p>A screen showing a few key points what the questions are so that the doctor could prepare for clinical rounds.</p> <p>Real-time to do lists, or a pop-up visible from any screen.</p>	<p>Want to note down the essence while talking with patients in a smart and automated way.</p> <p>Want to have alerts to remind nurses to give medication. Want to have pop-ups to say lab tests are ready (with a tick on/off getting alert when something specific for a patient is ready).</p>	<p>Want to be notified by a pushed message when there is a new lab test result coming, and by a notification when there is an important message from other staff.</p> <p>Utilize the waiting time better.</p> <p>To have a side bar with information in real-time of</p> <ul style="list-style-type: none"> - Daily weigh in - Fluid monitor - Overview of procedure time slot <p>Categories of information in colors</p> <ul style="list-style-type: none"> - Medication - Extra lab results - Tests appointments (with time) - Medication intake time - Monitor fluids (from night shift) 	<p>Want to note down the key moments with the supervisor in a smart and automated way.</p> <p>Want to have an instant overview of their plan whenever needed.</p> <p>Want to have a digital overview of problems they have noted down.</p> <p>Quick overview of patient reports for other co-workers to be context aware.</p>	<p>Want to have an overview on the log of tasks that were kept by other staff.</p>

Vision

A scenario where mobility and accessibility of information is achieved in a hospital context.

- Telehealth/telecommunication
- Alexa-like personal assistant

Ideas

A service/system of having an overview of listed problems & up-to-date data of patients shown on a screen or device.

The night nurses can already input the problems digitally to the system, and prioritise what is needed for the doctor to know first when they arrive at the hospital.

Doctors can immediately and already see which staff and which patient for that day on a mobile device as soon as they are in the hospital network coverage.

A service/system that shows the staff are "ready, in position".
- Gamification
- RTLS

A function that sends an alert/notification to the doctor when there is a new lab result.

A digital patient card which has hierarchical information of a patient, and has direct link to the databases.

A system that automatically generates a log of tasks for the doctor base on their input.

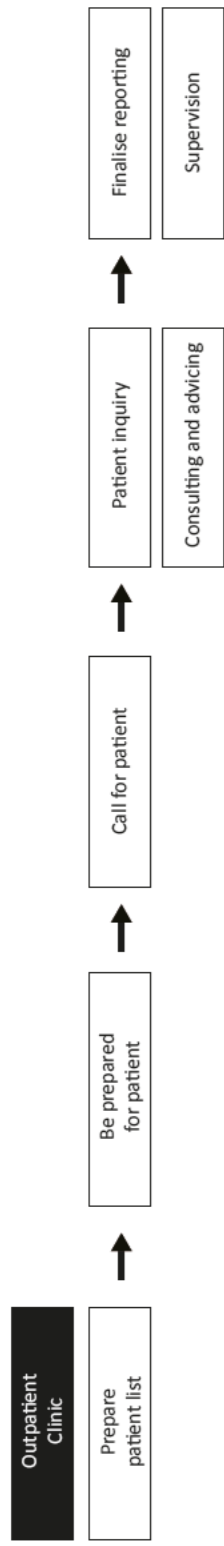
A voice recognition system to capture the essence from the conversation. Highlights important data/information automatically and clustering with AI-powered algorithm.

Doctor gets information support from a smart assistant in real-time and location during clinical rounds. e.g., "Patient X is in room 4 bed 2. Wish patient a happy birthday."

In the future, doctors can access to patients remotely. Nurses bring a tablet to the patient and ask for telecommunication with doctors.

A digital system that shows the problems a doctor has noted down, and their week plan which they have discussed with their supervisor, precisely and briefly on a device.

A service/system showing the tasks for the week/weekend doctors and nurses kept in a digital log. The clinicians can input the task items remotely and whenever they needed.



Doctor prepares a print out sheet with patients they are going to see beforehand.

Doctor checks on the cardiac patient file for echos, ECGs that are taken before patient sees the doctor. They make sure they get the lab results before seeing a patient.
 Doctor would start typing down initial findings from the test results.
 Doctor retrieves the medication used from the pharmacy via the LSP network.
 *The outpatient clinic doctor is the last person a patient sees after all the test are done.

Doctor can see from the desktop whether a patient has arrived at the waiting room.
 Patient will be called by the waiting room screen once the doctor announced the patient with a click on the desktop.

Doctors have only 15-20 minutes for each patient.
 Doctor start by asking standard questions to patients and document them to the patient EMR file:
 - If there is a cardiac problem
 - Palpitation (irregular heartbeat)
 - Asthma
 - Side effects from medication
 - Rehabilitation
 - Mental health problems
 - Sleeping problems
 - Intoxications (smoking, alcohol)
 - Working activities
 - Complaints
 - Any other questions from the patient
 Doctor explains lab test figures to patient and gives advice and suggestions on behavioural lifestyle changes for the patient.

Doctor finalises the report for each and every patient at the end of the consultation period.
 Doctor sends the final report to additional caregivers by mail.
 Young doctors would send the final report to their responsible supervisors.



The secretary accesses the patient at the very beginning of the care process. They would confirm the patient's arrival, and input patient data into the patient EMR.



Technicians will be visited by a doctor if the test results of a patient is not sent to the patient EMR system.

Doctor explains lab test figures to patient and gives advice and suggestions on behavioural lifestyle changes for the patient.

Painpoints

Knowing the patients at night will ease the morning rounds for the doctors.

Has to open multiple screens just to fill in the same figures to another.
 The data is not accessible across systems that the doctor has to type down the same data repetitively every time.
 There is a 2 tier system to look at results e.g., echo. It can happen that the final report of the echo result is not ready for the doctor.
 If there is a lab result already done in another hospital doctors want to have it right away, otherwise they would just ask the patient to do once more in their hospital.

There is no good digital infrastructure in the exchange of data between hospitals.
 Want a smarter and a more automated way in reporting.
 Like to have the GPs know in real time that a disease has been diagnosed from a patient. While the data stays at the hospital but the conclusion is sent out to other places.

Voice recognition could be useful in an offline situation.

Requirements

Accessible patient data with an digital overview of patient details.

Accessible patient test results available across hospitals and GPs.

Video consultation with patients. Patient comes to the hospital for tests, then have the results discussed online with patients at home.
 Network medicine from hospital - patient - GP seamlessly. To stay in contact with everyone involved. "Not just being in the castle and throw people out of the wall."
 Online coaching.

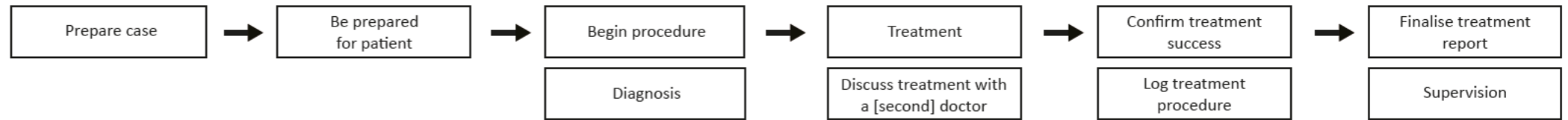
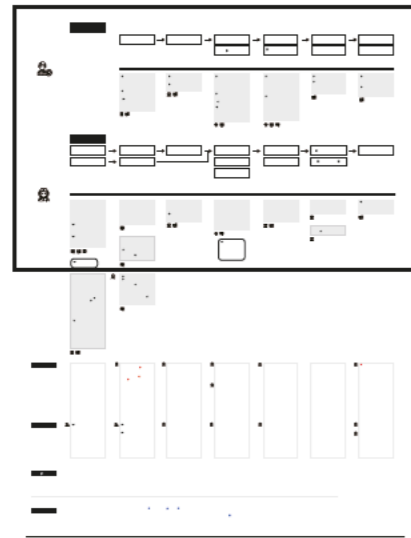
Voice recognition could be useful in an offline situation.

Ideas

Digital patient cards that are shared across hospitals, pharmacies. Accessible to doctors and patients.

Real time information sent to the "bulletin board" of the GP from the hospital.

Catheterization Laboratory



Doctor checks the agenda for tomorrow mostly in the night before. And checks if the schedule is doable.

Doctor reviews the patient file, looks up the context of the patient.

- Who is the patient
- Gender / age
- Co-morbidities
- Risks

Doctor gets the call from the ward nurse and then shows up.

Doctor views the patient EMR file at the control room.

Doctor verbally reads out the actions made, the amount of medication used, to the ward nurse in the control room via speaker.

Doctor looks at the monitor with information of:

- Echo
- Hemodynamics
- File function [Oxygen level]
- [Blood pressure]
- [ECG]
- X-ray (+ live monitor)
- Patient data

Doctor execute the treatment process.

*A temporary stop moment where the physician calls for support from other physician.

Doctor calls for the lab nurse from the control room to reach out to other physician who are available for a discussion on a complex practice. The physician leaves the operating room to the control room, meet with other physician and discuss on the treatment.

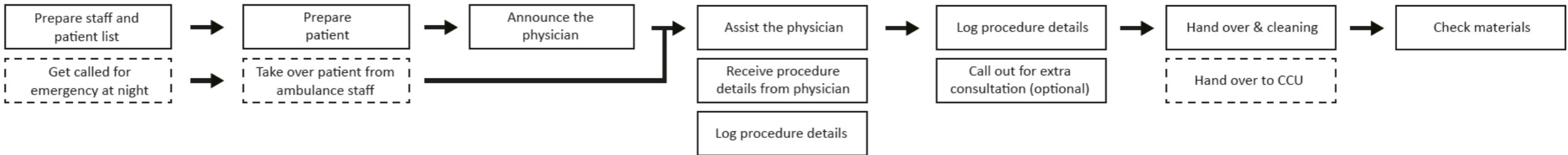
Doctor finalises the treatment.

Doctor enters back to the control room, opens the patient EMR file and start reporting the procedure.

Doctor finalises the report when all patients are seen and treated.

Doctor sends the report to their supervisor at the end of the day/whole treatment.

Catheterization Laboratory



Lab nurse writes down who the patients are for tomorrow and who are the staff that will be present tomorrow, on a whiteboard. They check via the computer for the schedule and written notes from a notebook.

Whiteboard1: Room numbers of the cath lab and the patients to see for each room and the scheduled time.

Whiteboard2: The nurse shift, when to expect the staff and the names of each personnel.



Whiteboards are small learning curves.

Lab nurse takes over a patient that is sent by the staff from the ward.

Lab nurse makes sure the medical equipments are ready and functioning (connects ECG), and gets the medication ready.



Lab nurse takes over patient from the ambulance staff, listen to what they say about the patient, double check on:

- Date of birth
- Allergies
- Medication: Os-Cal, Clopidogrel



Lab nurse calls the doctor by deck phone indicating the patient is ready.

Opens up the patient EMR file. Start filling out content, ticking boxes.



Lab nurse receives the speaking lines from the physician and logs the procedure detailing the time, description of the procedure, and the figures within the procedure.

Lab nurse enters the operating room by the call of the physician, to assist the physician on getting the machines ready.



When it's busy I write down the procedure, medication on a piece of paper on the wall, and then type them down later.

Lab nurse immediately dials to reach out to other physician who is available for a discussion with the physician.

Lab nurse notes down the procedure report of this incident.



Lab nurse dials the nursing department to send people to get the patient back to the ward for recovery and follow-up.



Lab nurse transfer patient back to the CCU for stabilisation.



Organise administrative tasks:

- Check expiration date of materials
- Recheck medical devices



If the lab nurse is scheduled to work for emergency call, in the event of emergency calls, he/she has to arrive ASAP, turn on every systems, open medicine cabinet, prepare the table, etc.

Get called from the CCU about patient syndrome. Depending on the ECG of the patient, the cardiologist will decide whether to call in staff.

Receive patient information from the ambulance about:

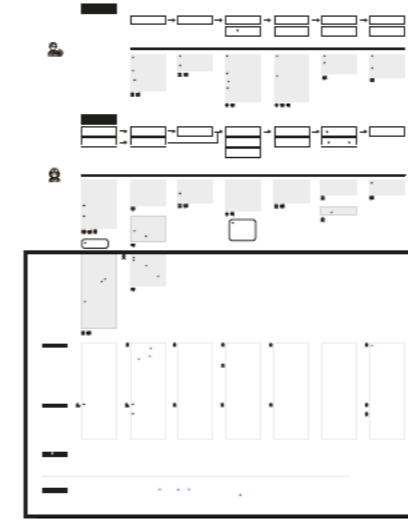
- Vital functions (real-time)
- Chest pain information (origin of pain/how did it occur)
- Medication given / medication patient currently using
- Medical background
- Allergies

Know the location of the ambulance by GPS, and ETA.


 Ambulance staff


Delivers patient to the cath lab. Describe patient information to the doctor and the nurse base on checklist. Hand over to the cath lab and the ambulance staff are done with their job.


Transfer patient to the CCU if they arrive earlier than the cath lab staff.





Painpoints


 Would like a digital dashboard "mirroring" what is happening in the cath lab. And to have multiple sites with information of staff and patient status.


 Miscommunication occurs: 10 % of the time, the CCU does not transfer complete information about medical information, medication used. No checklist for CCU staff.


 Want to know how many nurses, doctors are present. Are there maintenance in rooms. What are the priorities of patients.


 Lab nurse gets annoyed when they don't know where the physician is, even if they called. And this is because the patient is already been waiting on the bed for a long time.


 To know when to expect the arrival of the physician and where they are.

 Lab nurse sometimes forget to log the procedure because they are busy doing something else. They would remember to log it back to the system but it is a hassle.

 Lab nurse logs the timestamp of the procedure base on "gut feeling".

 A smarter way to log procedure details when it is really busy.

 Lab nurse does not know which other doctor is available when the physician calls out for a discussion.

 An overview of personnel status.

 Now everthing gets sent by email. Most of the tasks are discussed during meetings or directly to one another. Sometimes they are forgotten, and the team leaders have to remind them to check if certain tasks are done properly.

 A big environment, an overview of deadlines, to-dos, etc.

 Reminder from tasks assigned from team leaders. E.g., Skill (reserved action, show to be qualified for a procedure); Expiration date of materials on cart (once every two weeks); Things need to do weekly or biweekly; Team events

Requirements

Vision

The ward nurses should be doing actual meaningful things rather than documenting the procedure.

Ideas

A digital dashboard with information connected and accessible through devices.

Access to the database of staff agenda, real time location. Know the availability of the resources in an digital overview. An overview of patient situation that helps the doctor to determine patient urgency.

RTLS of staff showing together with other information in the digital dashboard.

An AI-powered voice recognition system that logs the procedure for the physician. Data of items is needed to train an algorithm.

Start of A Day

On Duty

Understand patients earlier and clear

To be reminded of their own tasks and plans

Hassle-free, intuitive way of interacting with HIT systems

Receive information at the right time

nursing dept.
No instant overview for the doctors to know what has happened to patients last night. Only the nurses knew

Want to understand patient status right away and be prepared for the patients at the beginning of a day.

nursing dept.
No instant overview of the problems from the days while the user was not in duty.

Want to have an interface that shows vividly the problems from the previous weekend from other colleagues while the user was not in duty, to help them keep in mind

nursing dept. outpatient clinic
It is a lot of hassle to fill in lots of stuff in an EMR manually.

The staff needs all information filled out automatically in an EMR at the right time at the right place

The clinician needs the input to be easily filled in the EMR, and to have the latest data of a patient available.

The staff are not triggered to proactively check for new updates or news that are new to them and they should know about.

They need a system that pushes messages about updates or news at the right time.

nursing dept.
It is very important for them to get the latest updates of patients, they get upset and annoyed if there is no data before everything starts at the beginning of a day

Want a head start for a day, get up-to-date information/data, problems of patients (ward patients and new patients) Data: lab tests, ECG, kidney function (Kidney function is critical for cardiologists because a lot of medication used diminishes kidney function of a patient)

nursing dept. outpatient clinic
User set goals at the beginning of a week, e.g., notes taken when meeting with their supervisor, or work towards releasing patient X in Y days. There is no instant overview on the plans the user has made for a week, 10 days, or a month, they have to scroll down to find it somewhere. The key moments with the supervisors/and patients are important because that determines the care process. The plan is what a clinician sticks to throughout the period.

The intuitiveness between Chipsoft (EMR system) and EPD (Cardiology specific) is bad in a way that a lot of repetitive actions should be made

Need seamless engagement with writing briefs (reports) from HIX to EPD, wants intuitive user experience and user interface

nursing dept. outpatient clinic
Doctors are waiting for new lab results in front of their computer, and it sometimes takes hours to get the result

Want to be notified by a notification when there is a new lab test result coming.

nursing dept.
Want to have an overview that lists all the problems of the patients for a day as a start. Could use paper notes, iPad...

Want to have a screen that shows vividly the week plan of a user, get reminders, *and maybe a "progress bar"

Nice for starting physicians

cardiac ER
Demands for free beds and availabilities for free spaces are not well communicated

Want the information of free beds and spaces sent to the cardiac emergency room in a dynamic situation

The staff requires a scheduling app that continuously updates on multiple devices

Use waiting time wisely

End of A Day

nursing dept.
No instant overview for the weekend doctors to know what their tasks are

Need to keep a log of incomplete tasks at the end of a work week, for the weekend doctors to have an overview on their tasks.

nursing dept.
Prefer computers on wheels while doing clinical rounds for quick data entry and good interaction with patients. Tablets are ineffective in typing

Want to use tablets with better intuitiveness in typing.

A lot of waiting time for a staff because preparing a patient and waiting for lab results are time-consuming

They want to utilize the waiting time for patients/lab results more wisely

The degree of happiness from an interventional cardiologist decreases throughout a day, improvements can be made

They want to feel positive at the end of a long day work.

Have an overview on information being at the right place

More time with patients

Nursing Dept.

A lot of times a clinician would not know if other staff has received the messages correctly

Want to confirm and be notified if other stakeholders who need to know the updated information are well informed.

The clinician envisions that the future device for communication can certainly be mobile phones, tablets, and wearables.

The way how the staff communicate about changes in their schedule or agenda has to be improved.

They need a better way to communicate the change in schedules and agendas.

In nursing departments, 70% decisions are made by doctors, 30% are by nurses in general. The nurses usually makes the decision to release a patient.

Need patients who are well to check out as soon as possible.

Currently the problems a patient has is written down in paper or by memorizing during clinical rounds, then make the problems more structured afterwards. Then recollect data and file it to the EPD.

Want to note down the problems the patients have during clinical rounds in a more automated way

They really like to talk with patients verbally in during clinical rounds

Less time spent in reporting and delays means more time can be spent in building relationships with the staff and the patient.

They need the patients to be prepared on time, and they need a better and integrated system to support them in reporting.

No instant overview for the doctors to know what has happened to patients last night. Only the nurses knew

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The Future

Doctors should be data managers in the future, managing patient data and treatments. They will admit patient at home using telehealth control systems, seeing patients using Face-time, exchanging data with patients remotely

Management assistant is an important "asset" for supporting the clinician workflow tasks. Envisioning an Alexa-like assistant for the future.

It is a lot of hassle to fill in lots of stuff in an EMR manually.

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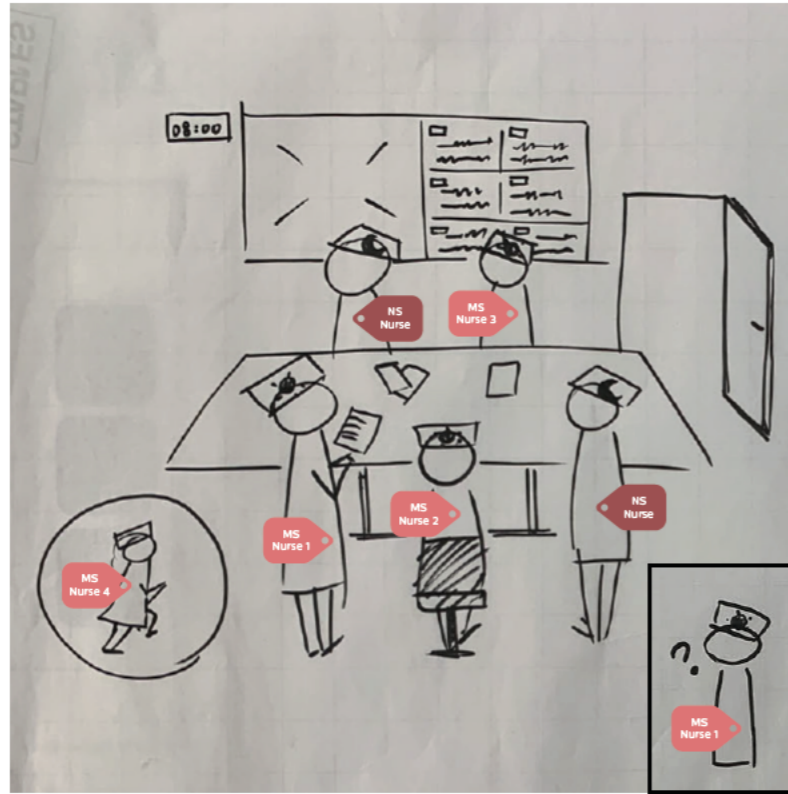
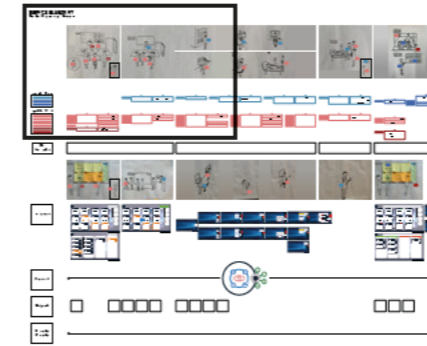
Want to be notified by a notification when there is a new lab test result coming.

Outpatient Clinic

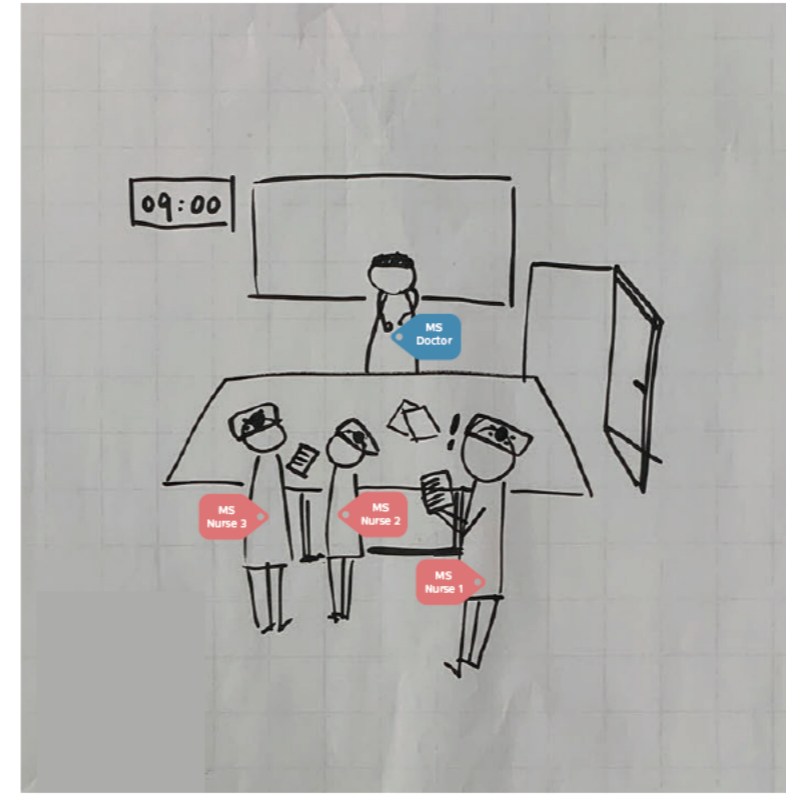
SERVICE BLUEPRINT

Workflow Orchestration in Cardiology

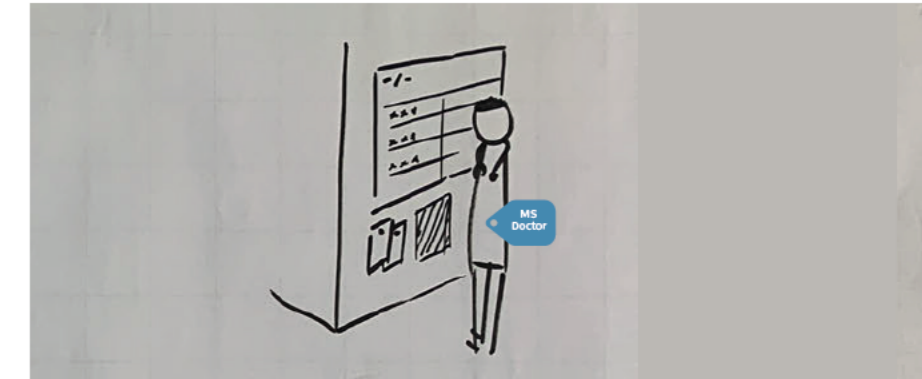
Nursing Department & Cath lab - per shift



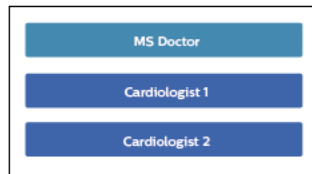
Where: Staff room - Nursing Department
Who: Morning shift nurses & night shift nurses
What: 08:00 Verbal reporting



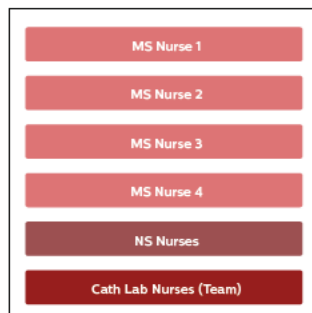
Where: Staff room - Nursing Department
Who: Morning shift doctor & morning shift nurses
What: 09:00 Morning briefing



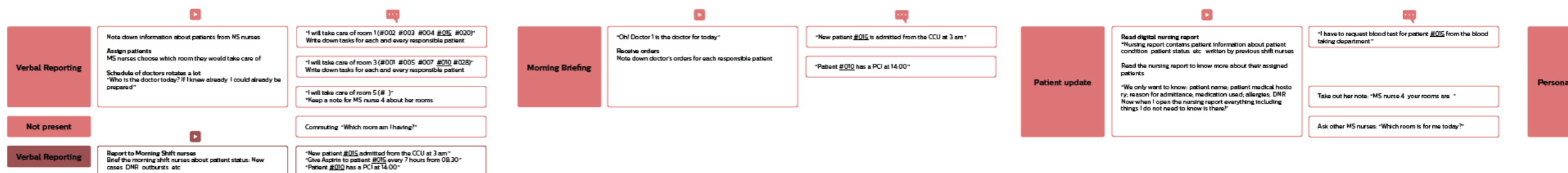
End User - Doctor

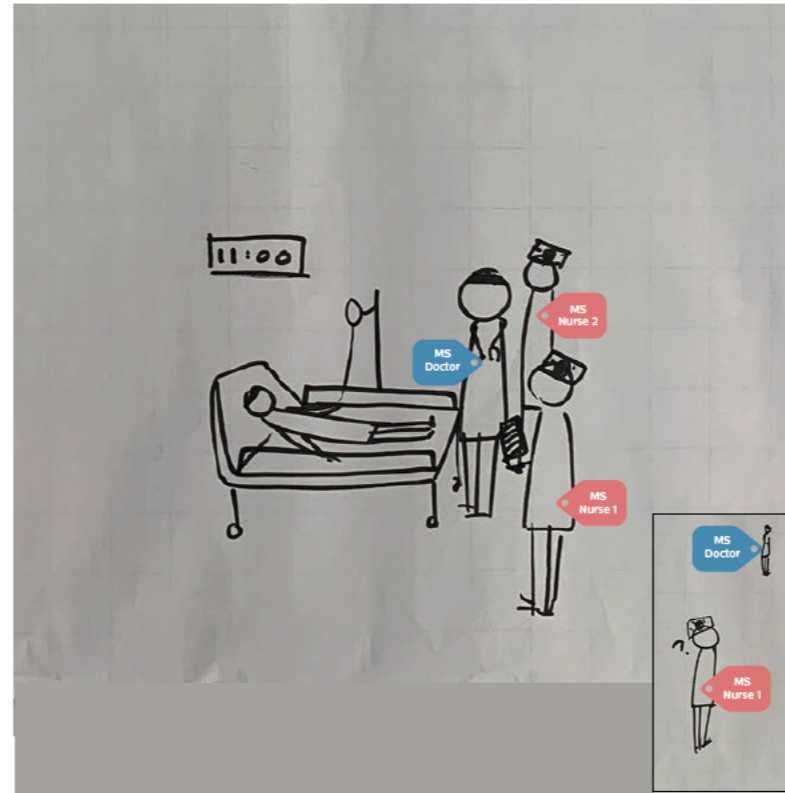
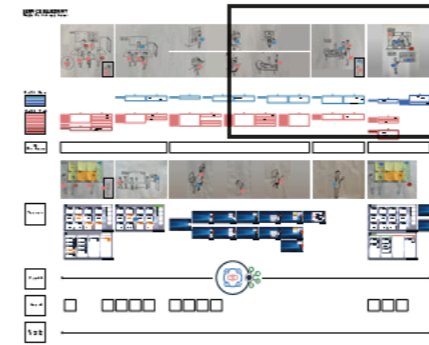


End User - Nurse

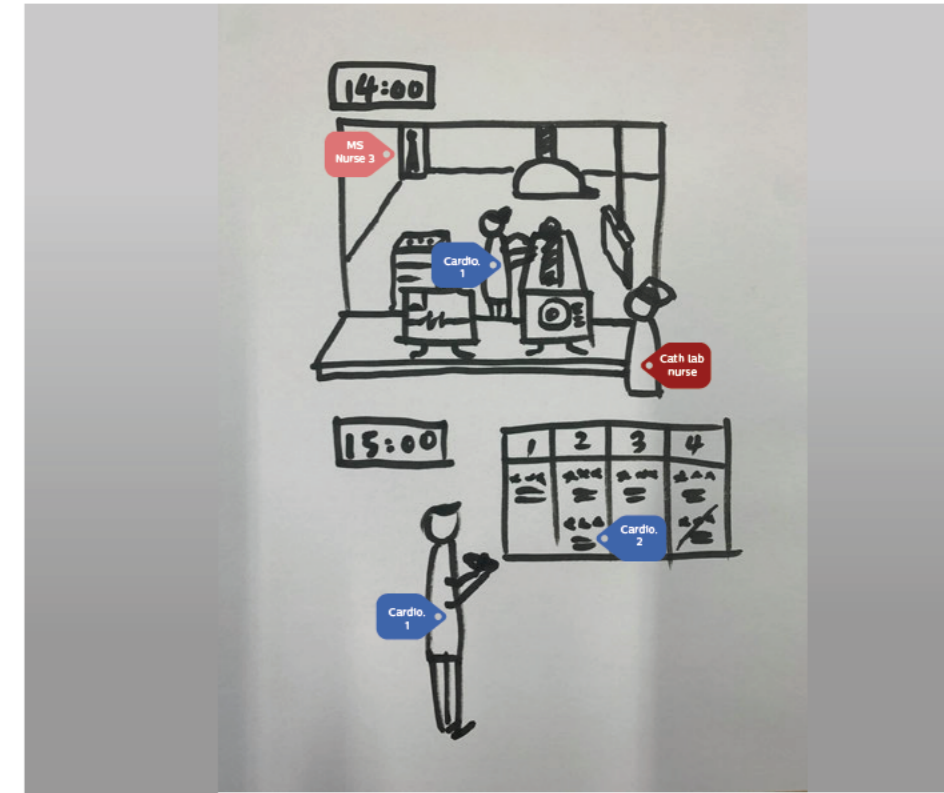


MS Nurse: Morning Shift Nurse / NS Nurse: Night Shift Nurse

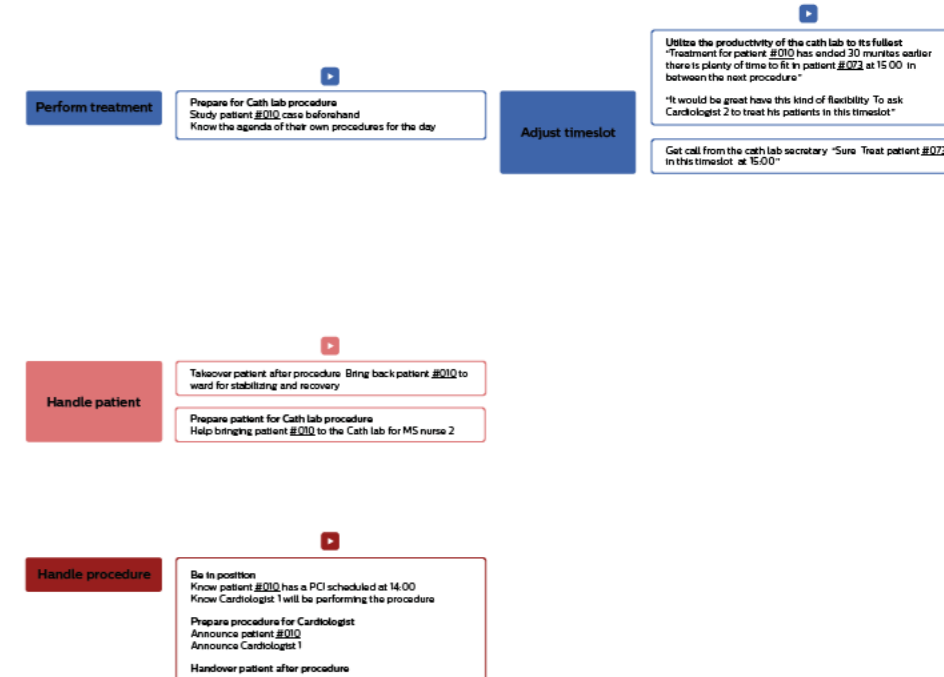
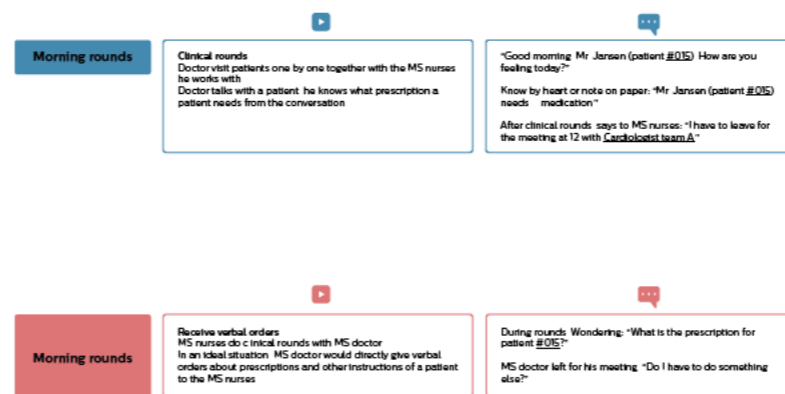
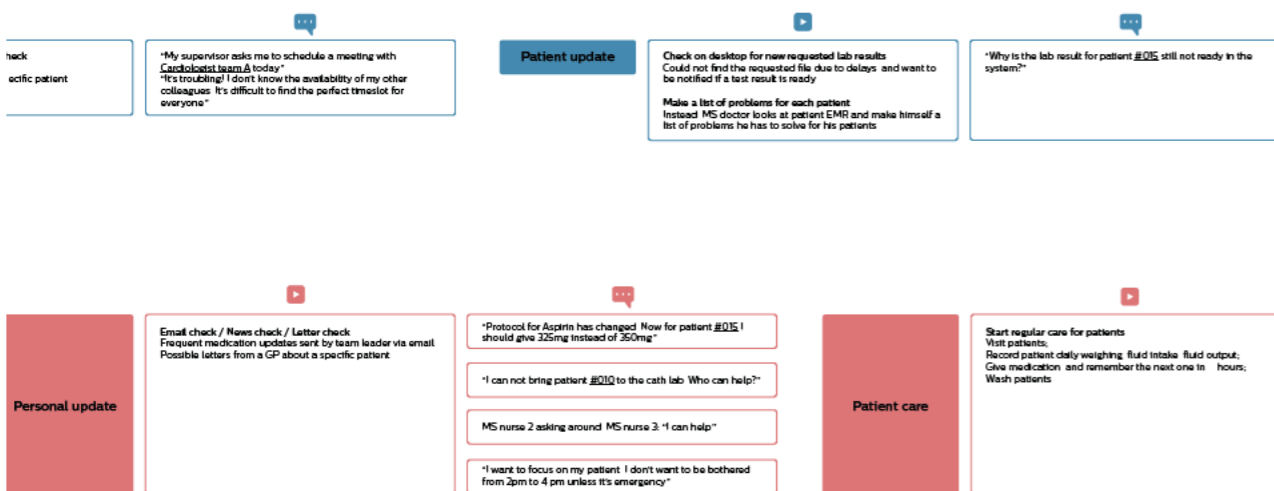




Where: Ward - Nursing Department
Who: Morning shift doctor & morning shift nurses
What: 11:00 Morning rounds



Where: Cath lab
Who: Cardiologists & Cath lab nurses & Morning shift nurses
What: 14:00 Procedure



Key Requirements

To be context aware of the situation happened about patients, even if a personnel is not present. To have a head start for the day
 For the on duty nurses (morning, late night) who are not present because of punctuality issues, or running other errands etc. let them have the right information about the responsible patients in their pocket.
 For the nurses to know every other colleagues, and patients status, who is the doctor? how are the patients? what are the upcoming tasks activities to do?

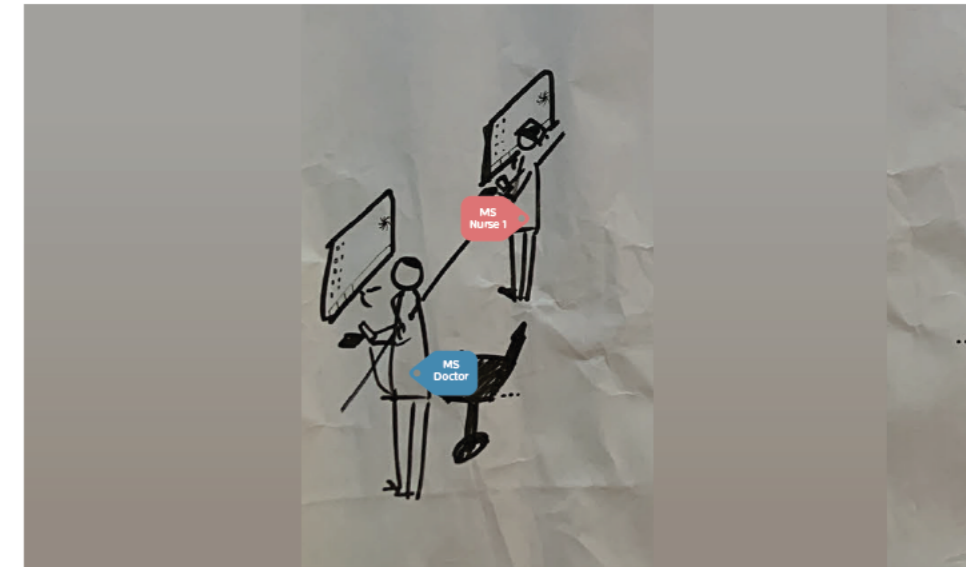
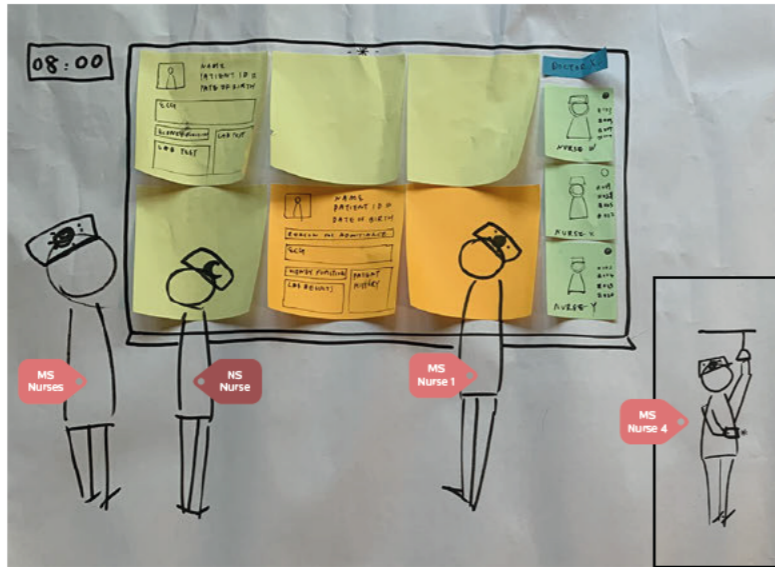
To establish teamwork and automation support in decision making
 For the two of the three shifts (morning, late, night) nurses who work together to discuss patient situation, provide them with an overview of who the patients are, the types of information they want to know about patients, who their colleagues are. And provide them with a platform to more naturally and seamlessly discuss about medical tasks and make individual or joint decisions based upon patients' needs.

To have accessible and usable data with high mobility
 For the staff who do verbal report and morning briefing, to be able to see relevant and focused patient information and data in an overview which the information and data are extracted from the EMR systems they are currently using.
 For the on duty staff to have access to data (relevant patient information, tasks, activities) on their shared working desktop, mobile devices, coveys, and ward monitors wherever they are.

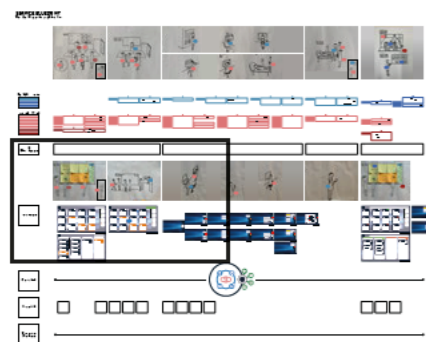
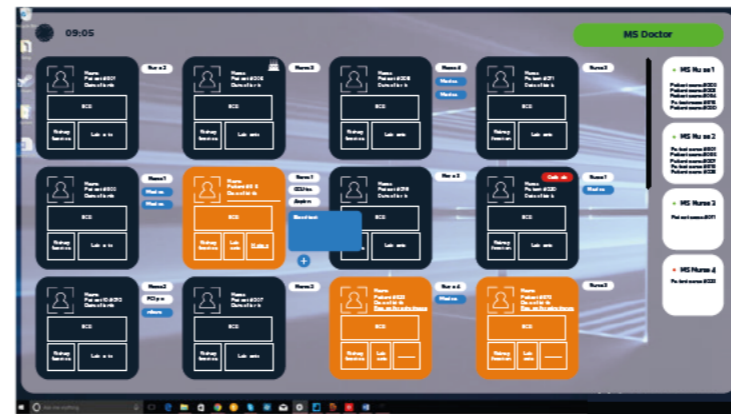
To classify the urgency of tasks and plan the right actions at the right time
 Tasks ranging from emergency incidents to regular routines. Provide a system that understands what an urgent task is and adapts to the staff workflow. e.g. a patient is dying, are the representative staff for the staff to take the right actions in a most efficient and collaborative way possible. Tasks of regular routines are e.g. prescribe medication to patients periodically, assign and receive administrative tasks.

To be proactive to interact with passive information and reduce information overload
 For both the doctors and nurses who regularly checks on medical information, e.g. new lab results, nursing report, static web pages etc. these passive information requires attention from the recipient to re-energize to acquire those information.
 Extract the right information from the databases to the right audience. e.g. a nurse wants to know how her patient status is, provide a system by showing the patient name, medical history, reason for admission.

To have control over their working habits, with a small learning curve to operate and manage a new system
 Provide each clinical staff with the autonomy to block or to manage their working time slots freely.
 Let the staff who are tired to use their current system to help the way they use those systems, e.g. EMR systems. Provide them with a system that is smart in the backend operation whereas intuitive and easy to use.



Touchpoints



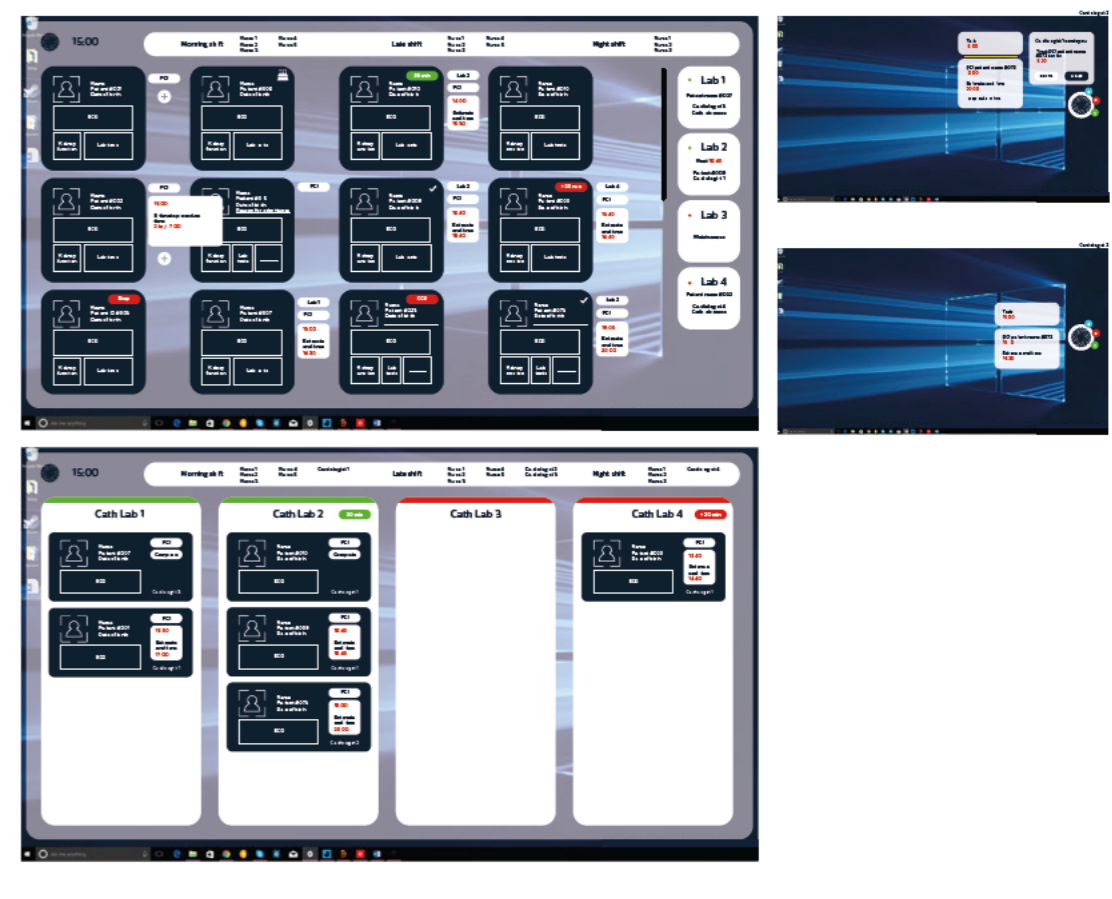
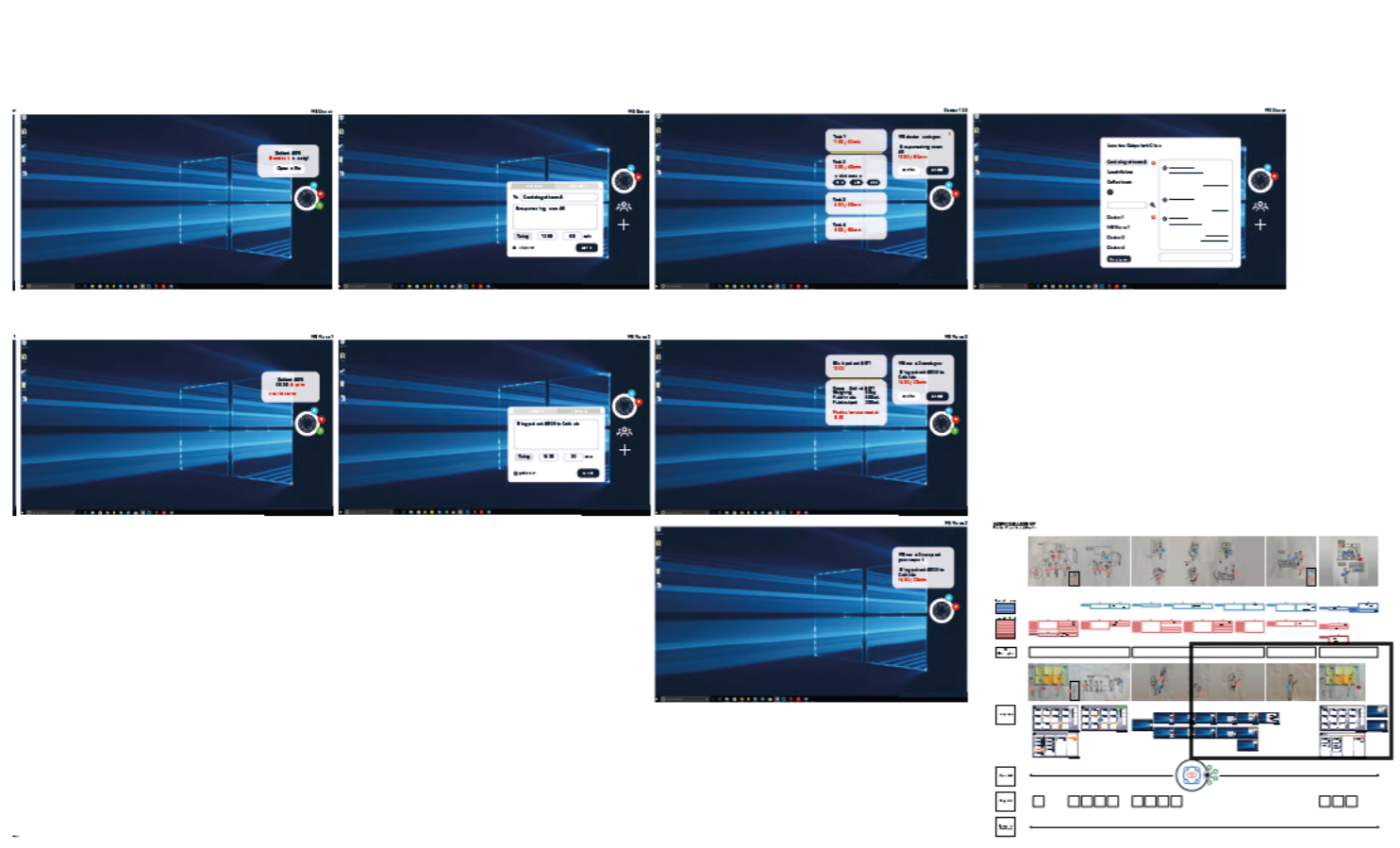
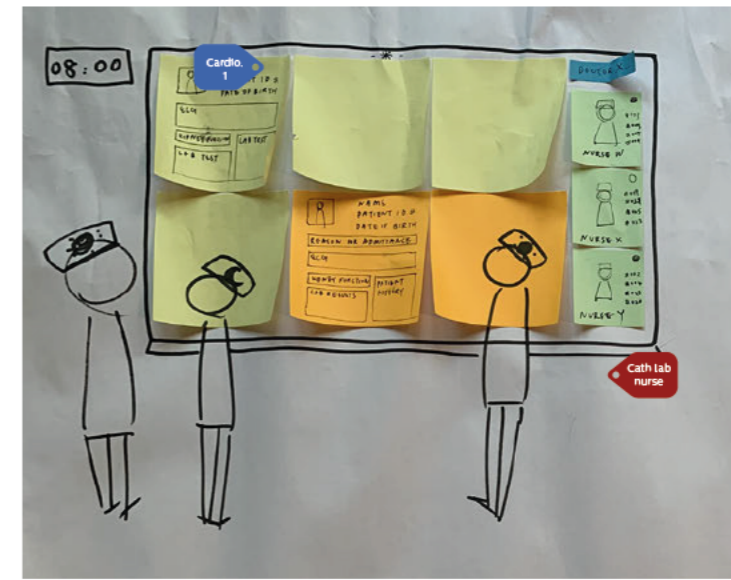
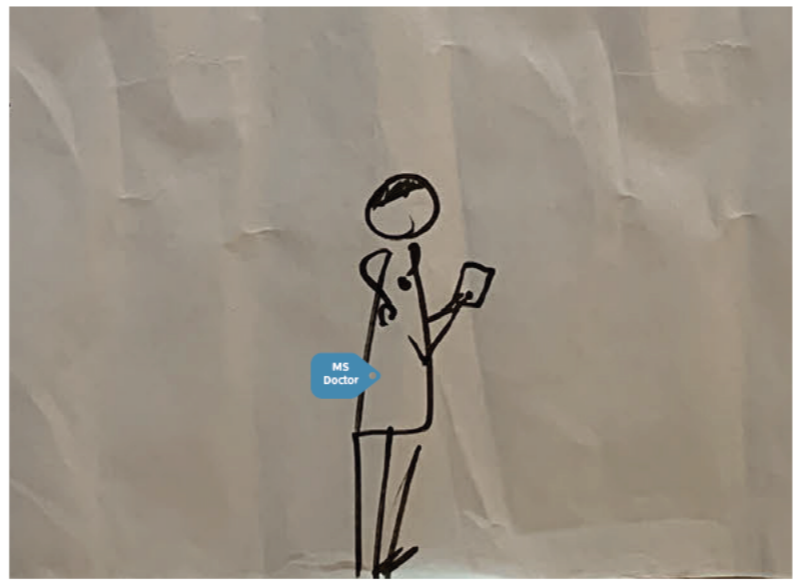
best route to keep the patient alive?
ne another assign and receive medical tasks from one another

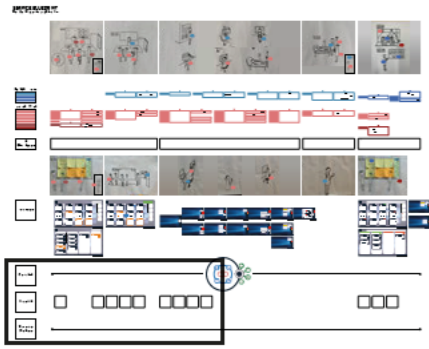
omation and then take further actions. Provide a system showing instant notifications/pop ups to the user which they can therefore take immediate actions to proactively interact with those information without taking extra time and medication used from the digital nursing report to the morning shift nurses. Instead of reading through the whole nursing report and find the information the nurse needs

the frontend that supports the user to interact with the same information without abandoning the use of current systems

To establish teamwork and automation support in decision making
For the doctors and nurses that do clinical rounds provide them with a platform to share prescriptions and orders from doctors which enables the nurses to understand right away what are the tasks and activities they should do for their patients. This prevents the nurses from not getting verbal orders from the doctors. The smartness behind the system arranges their task lists to maximum efficiency that adapts to their workflow. For instance a nurse gets a new task from a doctor to get an MRI scan for a patient. The system tells the nurse it would take approximately 1 hr to get the result. In the meantime her task lists changes and adapts to their decision, and therefore her regular routine (less urgent) tasks conflicted with this new task would be automatically postponed in the system

To be flexible on the fixed schedule from both the personal and its context, to be adaptable to plan the right actions
For the physicians working at the cath lab provide them with the flexibility to maximize the effectiveness of use for the cath lab rooms by having an integrated overview of patients, staff, agenda, room availability and progress. A system in the backend adapts to the changes made e.g. A Cardiologist has completed his procedure 30 minutes earlier than planned. Let the Cardiologist to utilize this extra 30 minutes to plan himself a meeting or fit another patient to be treated in the cath lab room that is doable with the extra 30 minutes





Frontstage

Backstage

Supported Processes



Patient #015 admitted System automatically adds to the list

System automatically distribute information to MS nurse 4 via the phone app

System reads the signal from the badge scanner Then sends notification to the objectives

System reads the signal from the badge scanner Then sends notification to the objectives

MS Doctor scans his badge System switch the interface to another mode

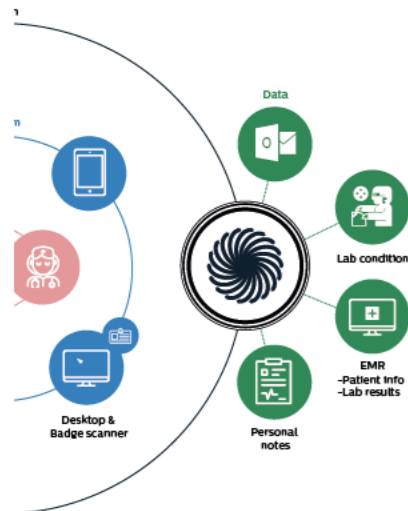
System syncs with the calendar of a user

System reads patient data from the EMR

System syncs information across multiple devices mobile phone desktop screen tablet

System detects signal from lab result departments and prompts notification on multiple devices

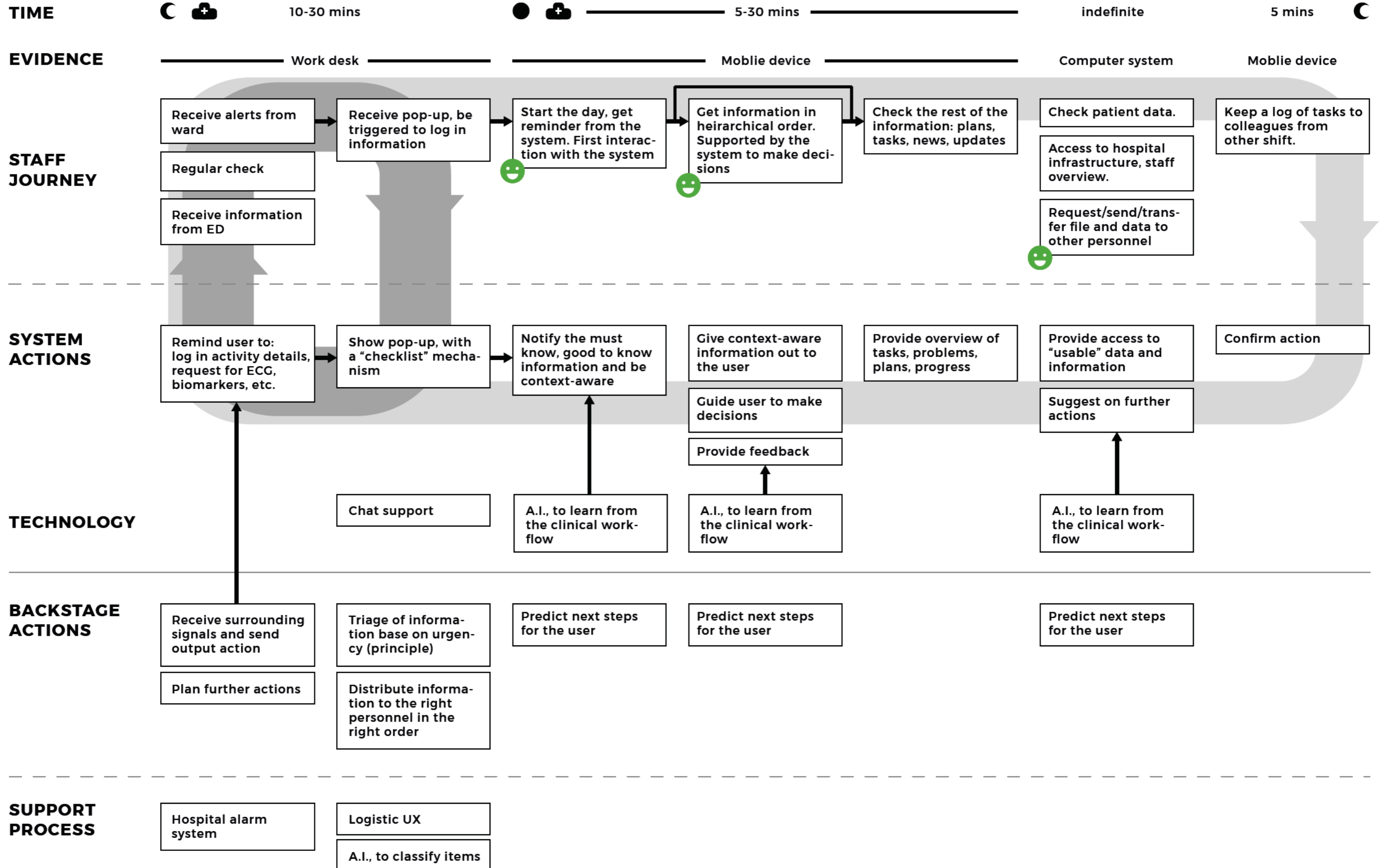




Patient #000 admitted to the cath lab. System automatically adds to the list

System detects if a room is occupied or not

System times the procedure. Calculates the remaining time and extra time needed for procedure



	Statement	Evidence
1	Clinicians are trained well enough to handle such emergency cases that there is no need for a system to tell them what to do .	<p>“When emergencies happen in wards, someone presses a button, sounds the alarm. Then whoever can help will gather.” -- Ward nurse</p> <p>“It will be great if a system supports us and shouldn't give us more work. Because if something goes wrong, we can handle it. We don't need a system to tell us what to do because that's our job.” -- Ward nurse & Cath lab nurse</p>
2	A system could not easily detect if something is wrong with a cardiac patient. Mostly the clinicians would notice the problem based on their experience and their own 'feeling' .	<p>“Bleeding emergencies do not easily get noticed because blood pressure gets higher if its bleeding, but the medication is to keep the blood pressure low.” -- Ward nurse</p> <p>“There's no rationality behind those variations, it's something you feel, see, hear, sense. Even though the patient's condition is completely normal, we can feel that something is not right.” -- Doctor</p>
3	There is no time to check on mobile devices or computers if one is handling an emergency case and needs immediate help . It works better to have all nurses who have also done verbal reporting (kind of knows the condition of every other patient) to come and plan the next steps together.	<p>“We do a lot of transporting patients, so we're not only at the rooms we take care of.” -- Ward nurse</p> <p>“If we have to send out a message to someone with a backstory, that will take us more time than just hitting a 'I need help' right now button.” -- Ward nurse</p> <p>“With voice recognition, that's good, but sometimes we don't know what's going on yet.” -- Ward nurse</p>
4	In addition to being flexible on one's own agenda, knowing other colleagues' agenda affects greatly on the whole planning dynamics . With a shared schedule to check on the availability of other cath lab co-operators allows the leading nurses to plan things effectively.	<p>“If I know that my colleagues are available to do the cases. And I know that they did not plan any meetings with other people, I know that I can plan something.” -- Interventional Cardiologist</p> <p>“I want to see what the activities of my colleagues are at that time. So if they are fully available at the lab, or if they also have meetings with external parties.” -- Interventional Cardiologist</p> <p>“If somebody else put something there that I get a notification that says there's a conflict because your colleague also decided to plan a short meeting during their clinical activities with the suggestion of empty time slots where the other colleagues did not plan anything.” -- Interventional Cardiologist</p>

		<p>“Just have to hope that somebody else doesn't have a lot of appointments on that day. Otherwise, it will pose a problem. And it actually poses problems, we do get issues from that, because the nurses complain that we all have to leave at the same moment.” -- Interventional Cardiologist</p>
5	<p>Digital planning system is crucial to Cardiologists/physicians in the cath lab than it is to the nurses or secretaries. Current planning systems in use are not considered practical to medical professionals in both academic and peripheral hospitals.</p>	<p>“The core activities of the other professionals, like the nurses and the secretaries, they don't have these other tasks as I do. Usually they're not so committed to the type of agenda interaction in the way I do” -- Interventional Cardiologist</p> <p>“And at the end of every day, I always have the feeling that we could have done one or two, or maybe three procedures more, which would reduce the waiting list.” -- Interventional Cardiologist</p> <p>Why not Outlook? “I'm somewhere else. And I would have to go to a computer, open outlook, open the agenda of three to four of my colleagues. And that consumes a lot of time because Outlook is not a very practical program.” -- Interventional Cardiologist</p> <p>“I'm quite sure that non-educational hospitals have similar issues. I guess it goes for most medical specialists, they have these appointments in between, and to help them if they have something available that would aid in their planning.” -- Interventional Cardiologist</p> <p>[Graph] “I fill my day for when it concerns time for 80% with procedures, yes. And 20% of the time is available to do other stuff. Yes. But because there is no synchronization between the two, you end up with, from the activity point of view with 70% today, filling with clinical activities, and 15% of the time filling with other activities. And the rest of the time is just wasted time because the blanks are not synchronized.” -- Interventional Cardiologist</p>

<p>The visualization of patient data in one overview fosters physical engagement with the team, and at the same time being on the same page with the same knowledge so that the staff can easily help each other out when needed.</p>	<p>“So what's good about this design is that you see like a visual image of the patient because you see the patient head photo, you know, and you remind stuff because you have a visual aid. If somebody just blabbers around, nobody is gonna listen. And now everybody slumbers in the back, thinking of just being present.” -- Doctor</p> <p>“It would make so much, the usability would be immense. It will be very intuitive, but also very connected. And now you can see it right on the screen and say, this is what's going on.” -- Doctor</p>
<p>It is good to keep in mind that a system should never add additional work to a staff, unless the call for help to a person or a department is unreachable at the moment. It is then necessary to take extra effort to get attention from others with the help of the system.</p>	<p>“I don't think any nurse would ever take the time to do this. Because I think it will take more time to send tasks than just ask someone, and we see each other so often. It would be easier to just have a timeline, a to-do list for yourself.” -- Ward nurse</p> <p>“What would be useful for the connection between the ward and the cath lab is when the ward brings down a patient, you can also see it in the form of a color.” -- Cath lab nurse</p>
<p>In the context of the same working environment, the usability for the task-assign functionality and the internal messaging functionality has to shift to a cross-department and a cross-position formality instead of between colleagues who see each other every minute.</p>	<p>“I think the only thing you could really use from this is that we give a notification saying we're on our way. I think this would work better between wards than in one ward. And also for communicating with doctors.” -- Ward nurse</p> <p>“There is little chance our staff would use this because people just scream over the fence. It could be useful in certain situations. We wouldn't want to overwhelm my co-workers, we rather speak to them.” -- Ward nurse & Cath lab nurse</p>
<p>Add a timer next to the unchecked results. The time of 'not checking' the lab results is crucial for the staff because after a certain hour, those results would not be viable anymore. Staff are busy and therefore they might lose track of the lab results they are supposed to check.</p>	<p>“Notification for test results is great, because then you have automation. And it would be great to have a number of minutes that you didn't check it, because sometimes somethings wrong, and not to point your finger at anybody, but you can really get people's attention if something's wrong, or something that I really need to check because a patient is dying.” -- Doctor</p>
<p>The idea of blocking time slots should be a shifting of mindset towards a commitment of further actions.</p>	<p>“I think the only situation that would work is if there's some kind of conversation plan, like bad news conversation that should just say, Okay, I'll be there for the next 30 minutes, don't bother me.” -- Ward nurse</p>
<p>The functionality of task distribution by a system in the event of emergencies</p>	<p>“If emergency happens to patients, we hardly ever use the computer, everything is just wearable.” -- Ward nurse</p>

<p>should not be displayed on a static device which would be totally ignored by a user.</p> <p>In the future, with the maturity of algorithms, the push notification from a system could be to report to a user about anticipated deterioration of patient conditions.</p>	<p>“What I would really like to see is an algorithm that says a patient is deteriorating, alert, watch out for this. That would be really cool, but that's futuristic, maybe in 30 years.” -- Doctor</p>
<p>A physician should have the autonomy to plan things themselves with the support of a system that gives suggestions to the physician.</p>	<p>“I think the Cardiologist would do the planning himself because he knows the pacing. And he can make choices and final decisions accordingly. The system could make suggestions about what patients could be put in what time.” -- Cath lab nurse</p> <p>“This could be a real game changer, a life changer, definitely.” -- Cath lab nurse</p>
<p>The system should be an additional support, without adding extra workload to the staff, and is separated from their personal life and their work.</p>	<p>“We use systems that we see a lot of flaws in and that we could have some more support from the system for our work, it shouldn't change your work, it should just help us a bit. So I think these plans are great.” -- Doctor</p> <p>“It's diverted from my work and my personal things. Because we use our own phone for everything. So that works like a second thing you got to do and you want to have to focus on your work.” -- Doctor</p>
<p>All parties envisioning to have portable devices around their working environment. Sterility issues are not considered an important problem for the clinical staff. It is safe to implement such decisions in practice.</p>	<p>“All our ambulances in this region have iPads, we think for other staff it's great to have an iPad as well. The sterile issue is not a problem because you can put like foil on it. And we can put it in our pocket, or put it at the start of the rooms so we won't have to carry it.” -- All</p>

Below you can find the links to each transcript in otter.ai

Interview with resident Cardiology 1-1
<https://otter.ai/s/uSmt3fBASVGc8eEu7TxWQg>

Interview with resident Cardiology 1-2
<https://otter.ai/s/01kk3-FkTPuD0hlgxCwZ7Q>

Interview with Cardiologist/Professor 1-1
https://otter.ai/s/C7SQ9rBCTUyiWJM6_m8Qhg

Interview with Cardiologist/Professor 1-2
https://otter.ai/s/rCP3X_TwS5ixUeZFndq9rw

Interview with Cath Lab nurse
<https://otter.ai/s/G6lALjx2Qse-YbuRy0sGBg>

Interview with ward nurse
<https://otter.ai/s/5FuDiWyGQMuAqREbUGLrHg>

Interview with Cardiologist
https://otter.ai/s/vPxPdN3gTaKzo6Ko_08Ncg

Interview with Coronary Care Unit nurse
<https://otter.ai/s/729t1HewQ9upl7HFIsyLpA>

Co-creation workshop with Resident Cardiology, ward nurse and Cath lab nurse
https://otter.ai/s/7wwt2WgYS3a-sl2Oqiqg_Q

Co-creation workshop with Cardiologist
<https://otter.ai/s/QwTBWAVPRuOTR2xPDkfkXw>

Agenda 14:00-15:00 @LUMC Participant: Resident doctor, Ward nurse, Cath lab nurse	
Explain the goal of this session [3 min]	The goal of this session is to walk you through a 'future' scenario with you working at the nursing department and the cath lab with our design concept.
Step 1 [10 min]	We will illustrate a current scenario from the nursing department and the cath lab with possible incidents based on your input from the interviews. This is to let you to 'reflect' on the current scenario we depicted. <ul style="list-style-type: none"> - Let me tell the story first based on my own interpretation, and because I'm solving this complex problem and don't have much clinical background, so please correct me afterwards. - Please write down your thoughts and questions on the post-its. We will go through them after.
Step 2 [20 min]	We will describe your underlying needs and requirements from what we see in this scenario. <ul style="list-style-type: none"> - Are you familiar with the needs and requirements? - Which ones do you think are the most important? -> rank & elaborate
Step 3 [10 min]	Then we will bring out our design concept with a story about how you can do things differently with our design concept in the future. <ul style="list-style-type: none"> - Please listen and critically comment if the concept solves the needs and requirements. And later I'll ask you to reflect on the concept. - Please don't focus on the design details (shapes, colors), but how the requirements are addressed in the concept.
Step 4 Discussion [35-50 min]	Finally, we will encourage you to think about: <ul style="list-style-type: none"> - How would you do your work differently with our design concept? - How would you do your work differently without our design concept? - What added value do you think our design can bring to your work? E.g., Increase meeting efficiency with 20% speed and 15% less amount of administrative work. Team building, shared decision making support. - Compare to your current workflow, how can our design concept support you differently from your current work and in what way?

	E.g., The dashboard with the patient overview can save us time and effort from looking into patient file in the computer.
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1. Analysis and validation of the requirements.
 - a. Refine the needs & requirements: the participants have described the importance of those requirements.
 - b. Make a rank of the requirements.
 - c. Decide on the core requirements for the concept.
2. Analysis and validation of the concept.
 - a. Evaluate how the concept addresses the requirements. Answers to:
 - i. How would you do your work differently with our design concept?
 - ii. How would you do your work differently without our design concept?
 - b. Evaluate the added value of the concept.
 - i. What added value do you think our design can bring to your work?
E.g., **Increase meeting efficiency** with 20% speed and 15% **less amount of administrative work.**
Team building, shared decision making support.
 - ii. Compare to your current workflow, how can our design concept support you differently from your current work and in what way?
E.g., The dashboard with the patient overview can save us time and effort from looking into patient file in the computer
 - c. Re-define the concept
 - i. Most important requirements
 - ii. Added value
 - iii. Concept elements

Field Research Background - LUMC

The purpose of the visit is to collect valuable insights and feedback of the workflow in the cardiology department for ideas in design principles of a design concept.

Researcher:

- Hao Liu (TU Delft master student, Philips graduate intern)

Brief:

Philips is dedicated to embrace the need of caregivers. The “System of engagement” connects and interprets patient data from various sources to support caregivers with relevant insights at the point of care. To proactively suggests actions and prepares decisions in real time, based on actual patient data, guidelines and rules defined by the hospital staff themselves.

I want to learn how to support cardiology caregivers in your interaction and communication with staff members and IT systems. Identify your pain points and opportunities for future improvements.

Outcome:

Outcome of this observation would be a service blueprint for caregivers.

What to expect after this visit:

- We will organize an interactive workshop, to further discuss on co-creating ideas and solutions for future digital tools.

Approach:

I’d like to do observations throughout the cardiology department. Observations include small interviews in between, on the base of using the “fly on the wall” method.

The observation section will include video recording and written notes. Data including voice records and photos will be collected and processed to be used in a report. The report will be archived in the TU Delft repository and Philips.

Hao Liu
MSc. Strategic Product Design

Consent Form for [workflow orchestration LUMC]*Please tick the appropriate boxes***Taking part in the study**

I have read and understood the study information dated [__/__/2019], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

Yes No

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves:

[For observation, information is recorded in audio and photo format with written notes]

[The audio recordings will be transcribed as texts and will be destroyed at the end of the research project]

[The photos taken will not include patients. Working staff may be involved, however, faces will be blurred. Photos will be deleted at the end of the research project]

 Use of the information in the study

I understand that information I provide will be used for [indigenous knowledge, reports, video]

 Future use and reuse of the information by others

I give permission for the [anonymised transcripts, modified photos] that I provide to be archived in [TU Delft repository and Philips] so it can be used for future research and learning.

 Signatures

Name of participant

Signature_____
Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Hao Liu
Researcher name [printed]

Signature_____
Date**Author**

Hao Liu
liuhao84813@gmail.com

Graduation Committee

Chair **Ir. R.J.H.G. van Heur**
Faculty of Industrial Design Engineering – Coordinator CardioLab Program

Mentor **Asli Boru**
Faculty of Industrial Design Engineering – PhD Candidate

Company Mentor **Koen Noordermeer**
Professional Health Services & Solutions – Business Development Manager at Philips

Second Company Mentor **Marleen van Leengoed**
I&S XD - UX Design – UX Designer at Philips

Cover Design

Hao Liu

August 2019

