

Sustainable Hospital Erasmus MC

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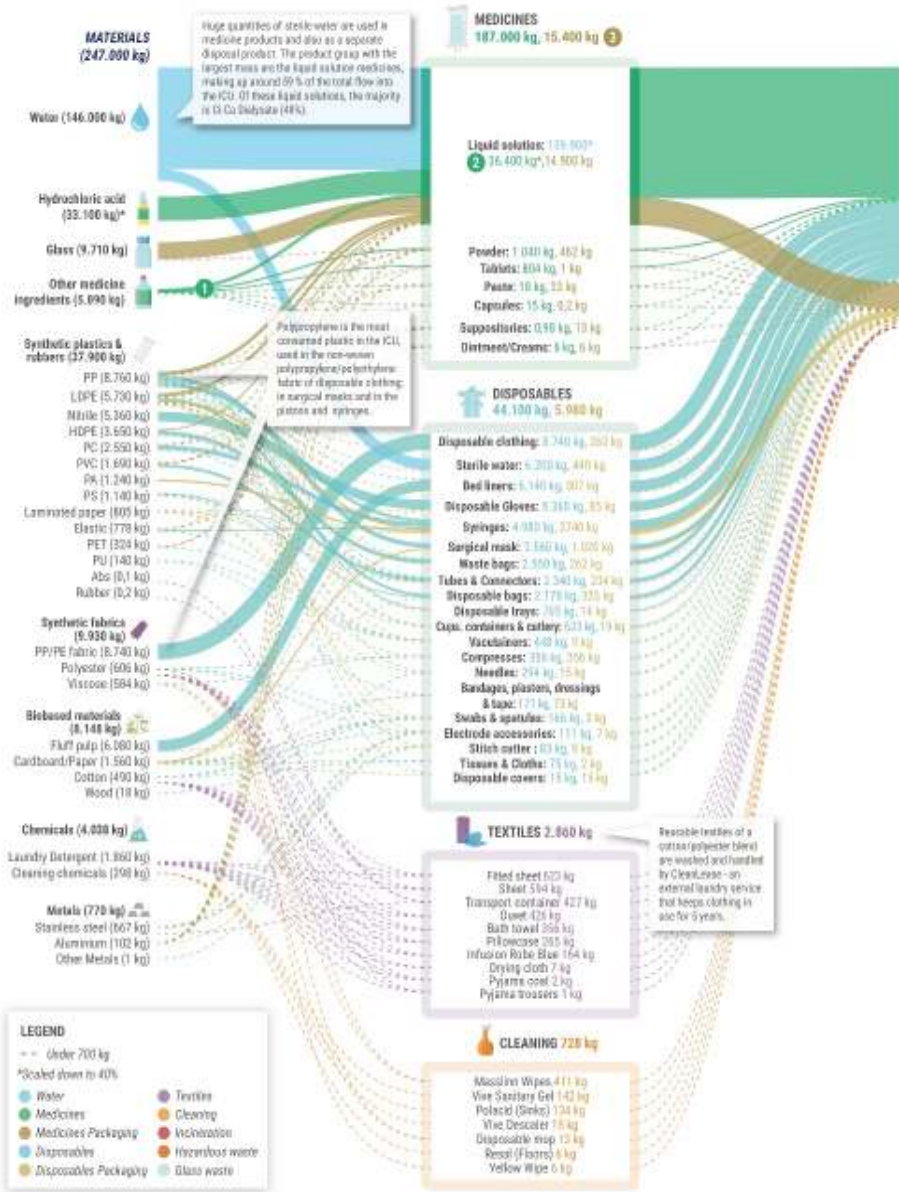
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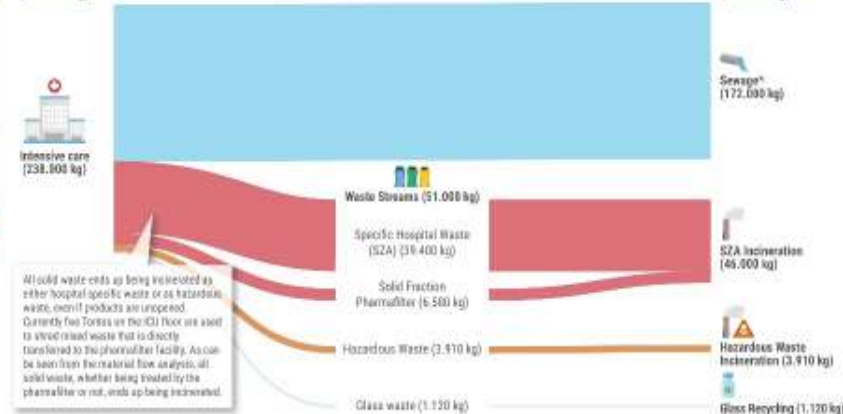
Healthcare sector 7% of national ecological footprint

ICU: 8 waste bags per person per day

Even more visible during Covid



ICU OF ERASMUS MC 2019 (238,000 kg)



Sewage

Incineration

Material Flow Analysis of ICU

Input – Output

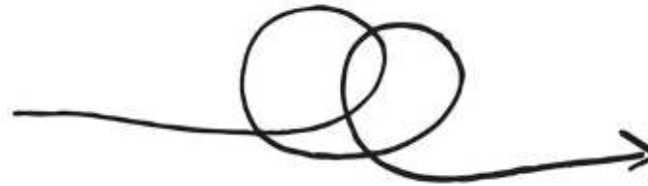
Hotspots

Baseline for measuring improvement

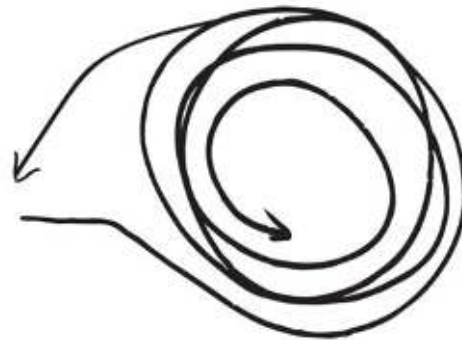
LINEAR
ECONOMY



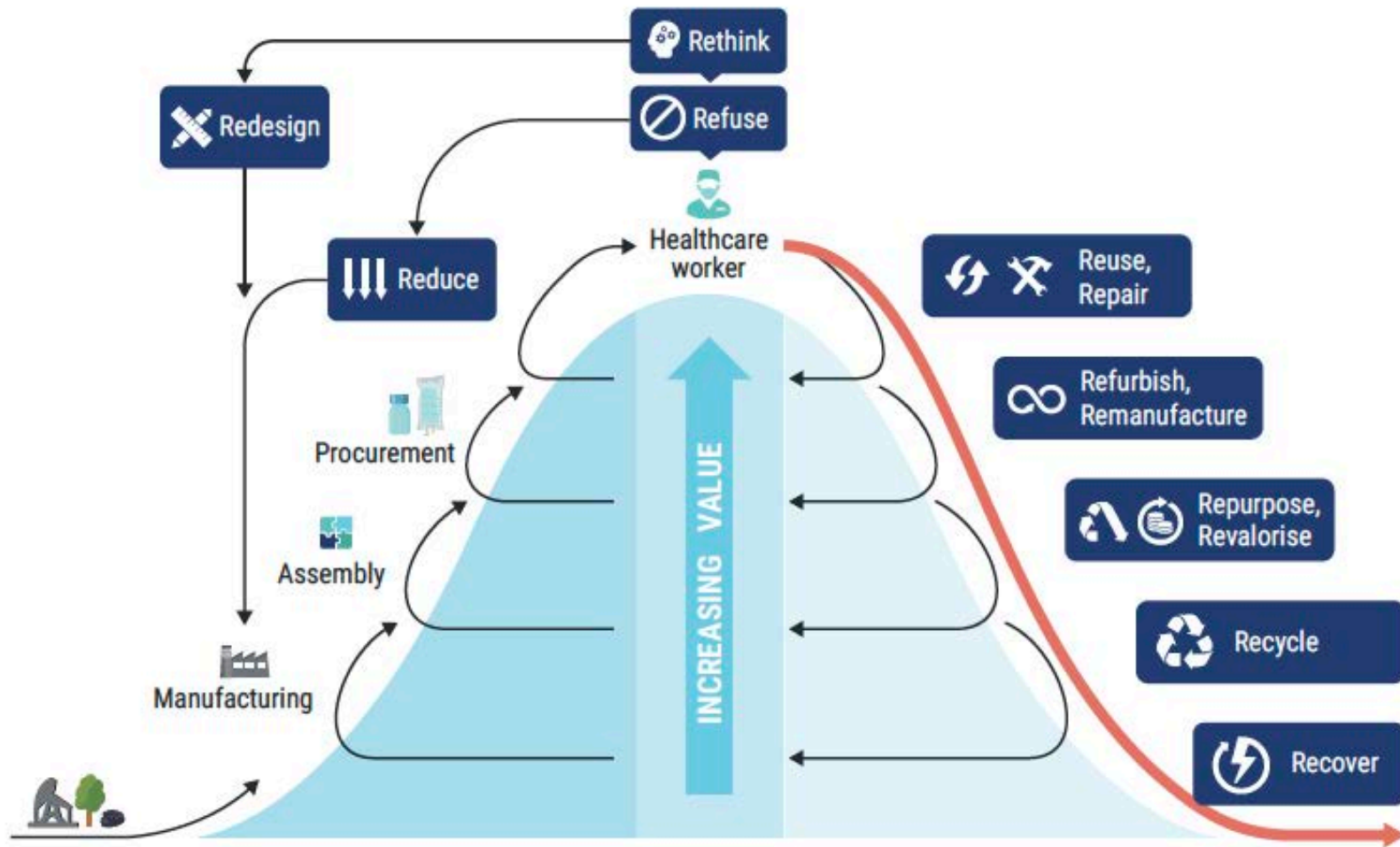
RECYCLING
ECONOMY



CIRCULAR
ECONOMY



Circular Economy “R” Strategies



A black and white photograph of the Erasmus MC building at dusk. The building is a large, multi-story structure with many windows, some of which are illuminated. The sky is dark, and the foreground shows a paved area with some trees and a few people. The text "Erasmus MC" is visible on the top left of the building.

Erasmus MC

How can
Erasmus MC
initiate its path
towards
circularity?



The Green Intensive Care Unit

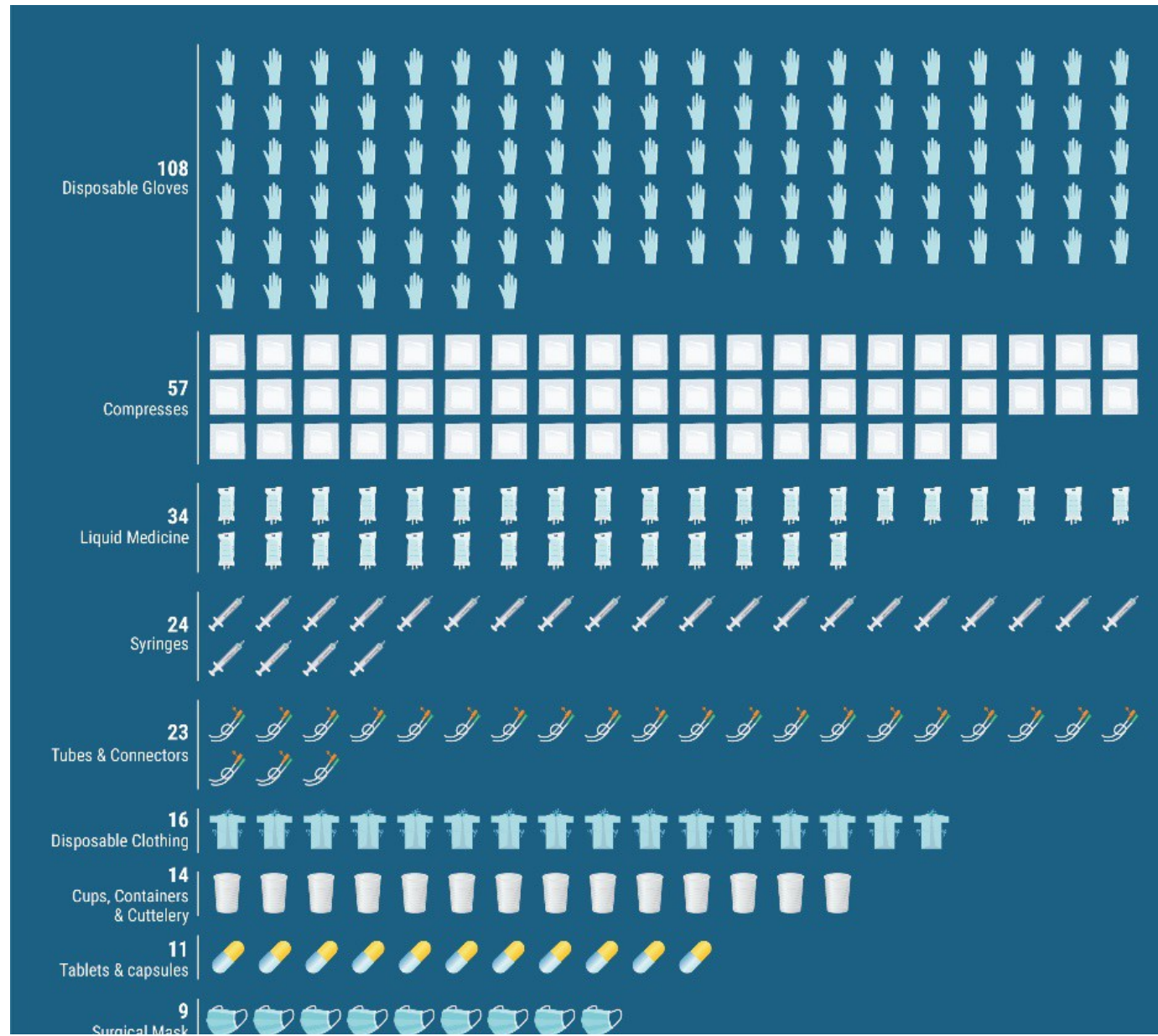


Hotspots, 3 cases

108 Gloves

24 Syringes

Intubation



Multiple perspectives to get an understanding

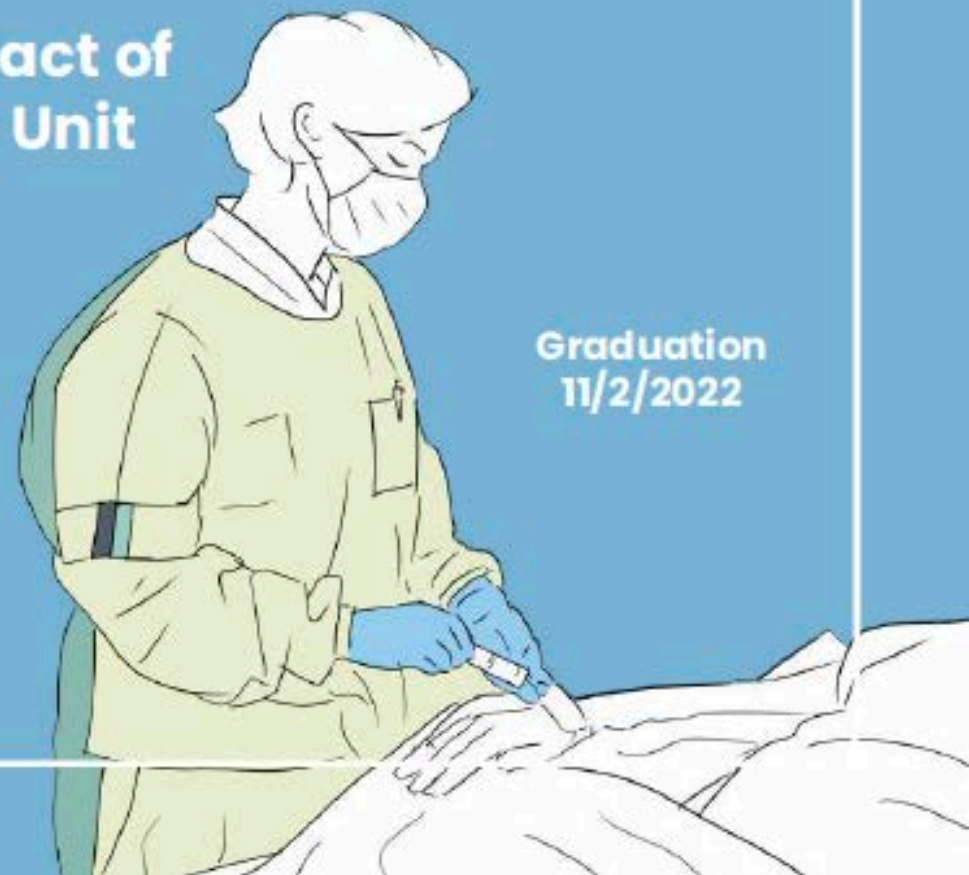
- Environmental impact (CO₂, waste in kg, ...)
- Health safety and protocols
- Healthcare staff and patients behavior
- Direct and indirect costs
- Logistics within and outside hospital
- Procurement and supply chain
- Upcoming sustainable technologies
- etc.

Reducing the environmental impact of gloves used in the Intensive Care Unit

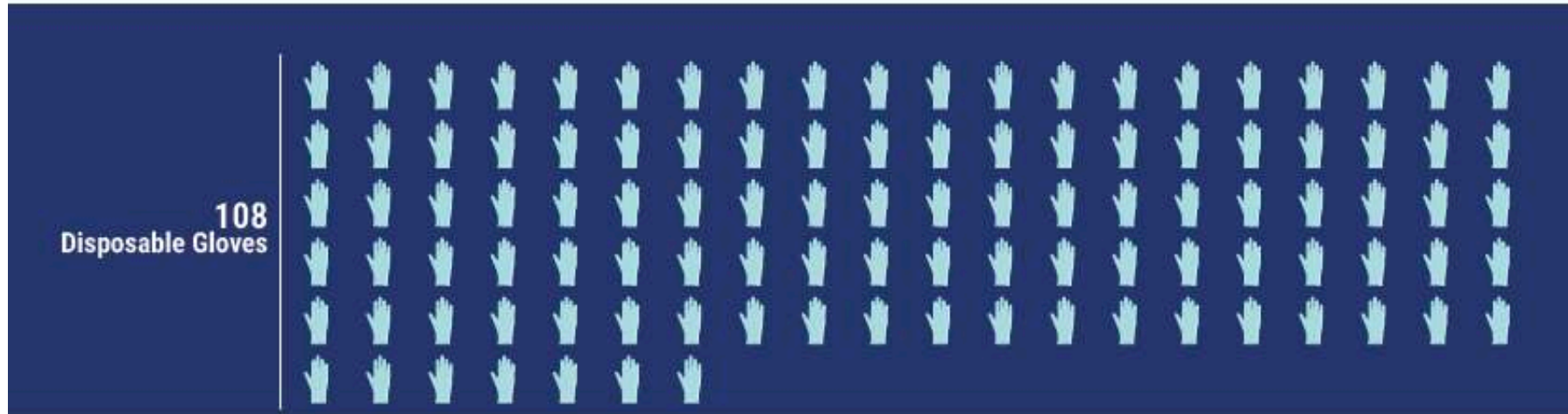
Towards greener ICUs

by Lisanne van den Berg

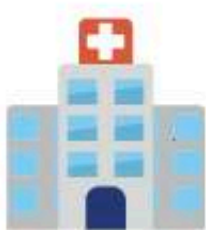
Graduation
11/2/2022



Hotspot disposable nitrile gloves



Erasmus MC



15 million
gloves per year
40.000 per day

Intensive Care

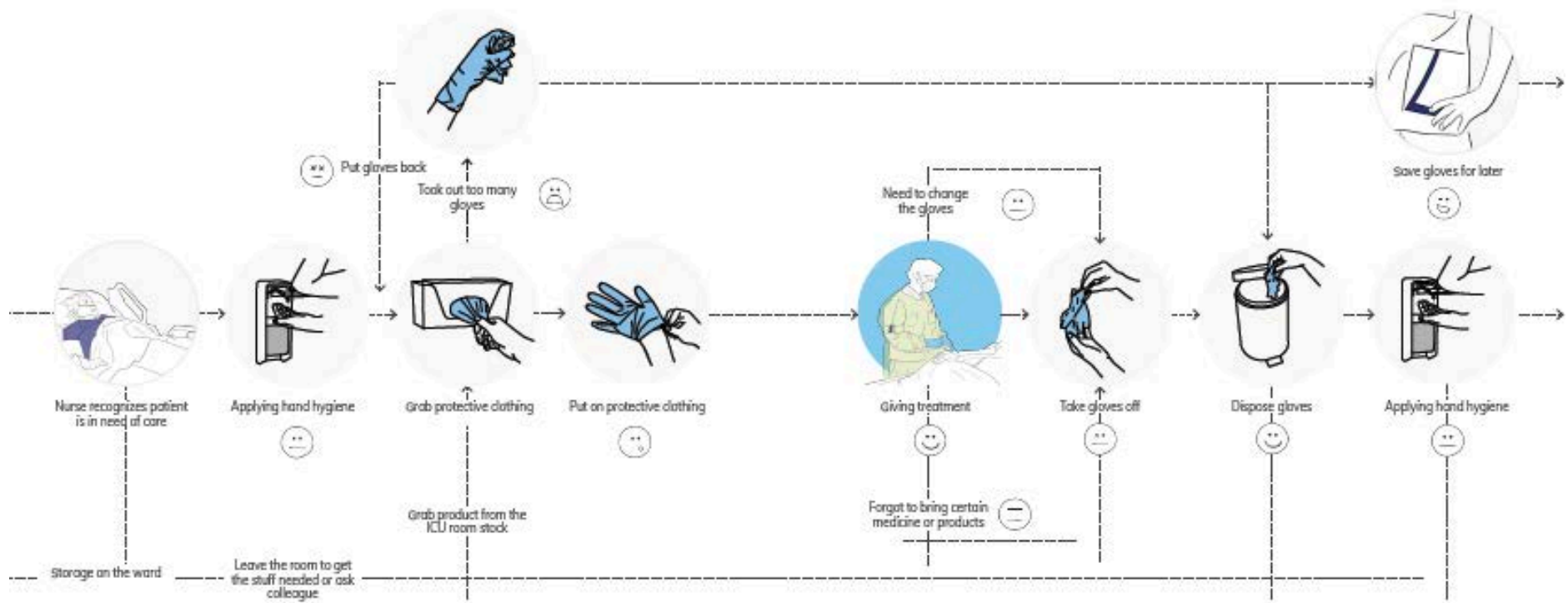


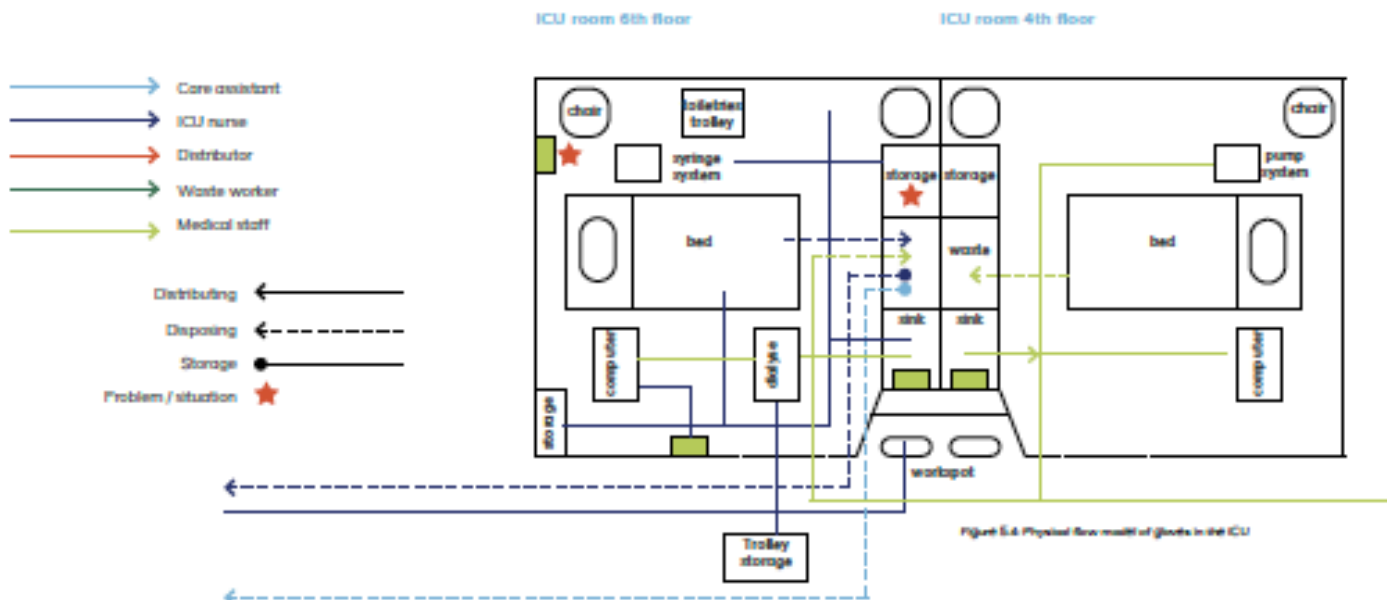
1.5 million
gloves per year
4.000 per day

User journey



Figure 5.3: Influence on the environmental impact by gloves used on the ICU

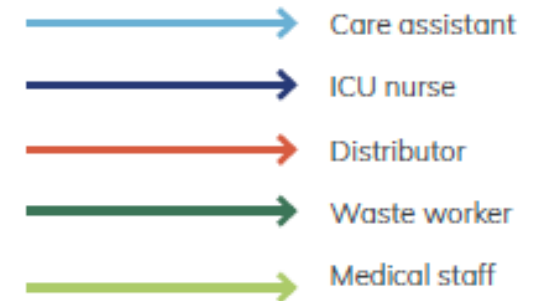
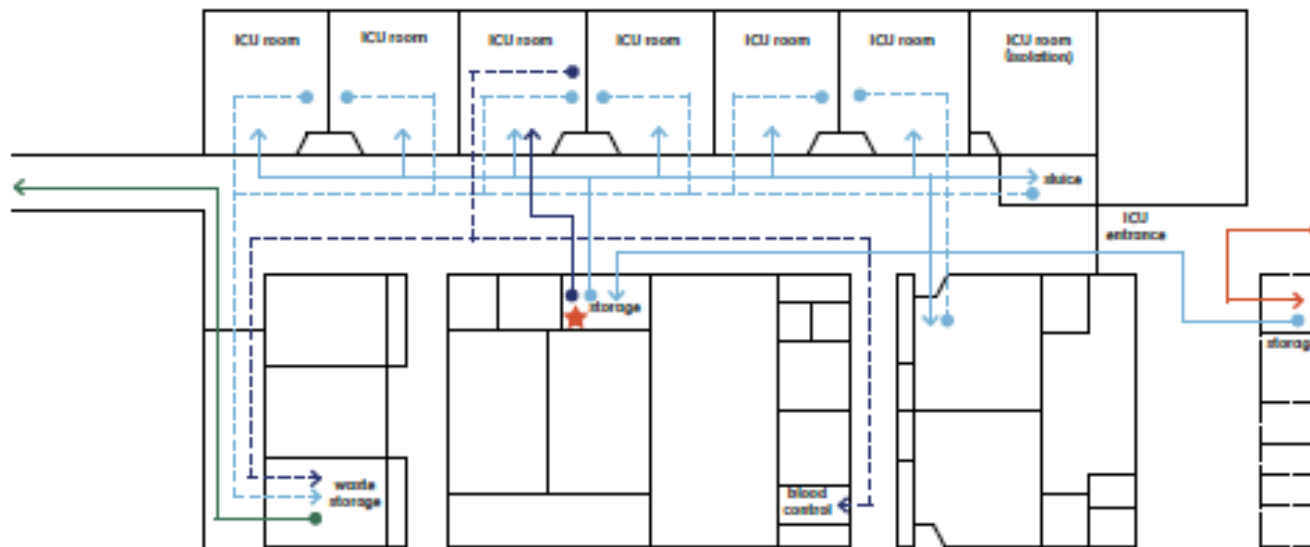




Logistics journey

From entering hospital to disposal

Mapping of where problem occurs



Waste audit PICU

Children's Intensive Care unit

Waste is analysed for 4 days



Unused gloves
10% comes out
unwanted



Brand A - SIZE L



L x W x H: 23.5 cm x 12.4 cm x 6.4 cm



front view



back view



side view

Brand C - SIZE XL



L x W x H: 24.0 cm x 12.0 cm x 7.8 cm



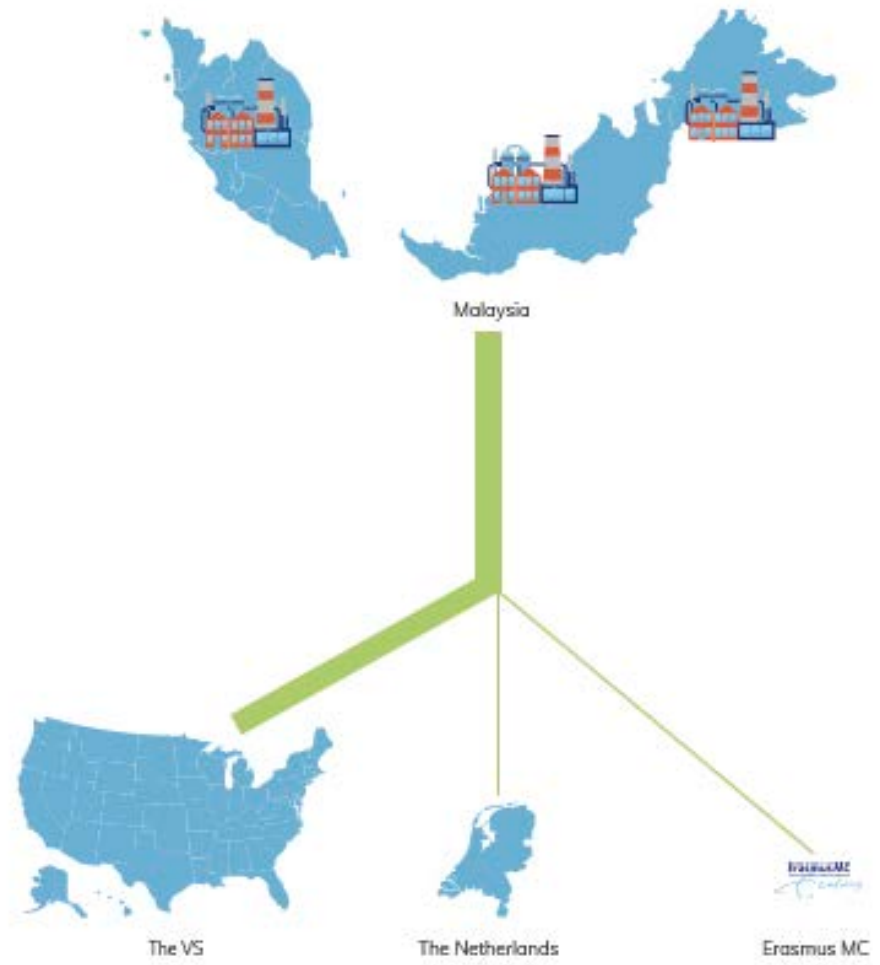
front view



back view



side view

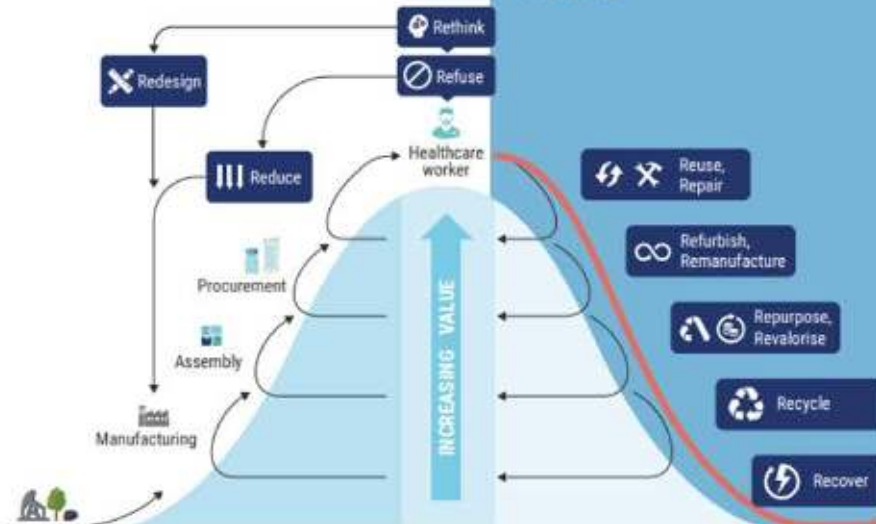


4.5 Conclusion

The field research including observations and interview gave an understanding in different perspectives. The main insights can be listed and divided into three opportunities for improvement. The opportunities are substantiated by the drivers.

1. Rethink the use
2. Reduce unused gloves
3. Reduce glove changes

The opportunities are not focused on the right side of the value hill; the waste is categorized as "hospital specific waste" and is not allowed to be recycled. Also, the focus is not on material change and fabrication process, because that does not fit my knowledge. The solution area is defined from the assembly till the use of the gloves.



1. Reduce glove changes



Drivers

- Many different actions during ICU care
- Unexpected situations
- Need to pick something from the storage
- Protocols
- Ease of use

2. Reduce unused gloves



Drivers

- Amount of glove distribution points in ICU box
- Taking out too many gloves
- Box design
- Packing the gloves
- Contamination
- Throwing gloves after isolation patient leaves

3. Rethink the (unnecessary) use



Drivers

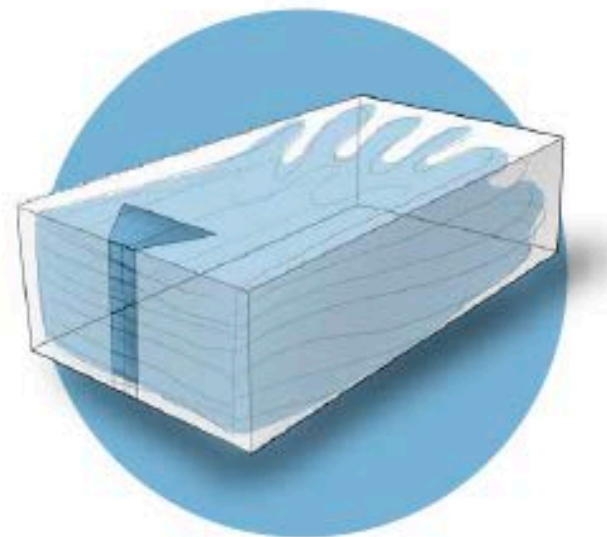
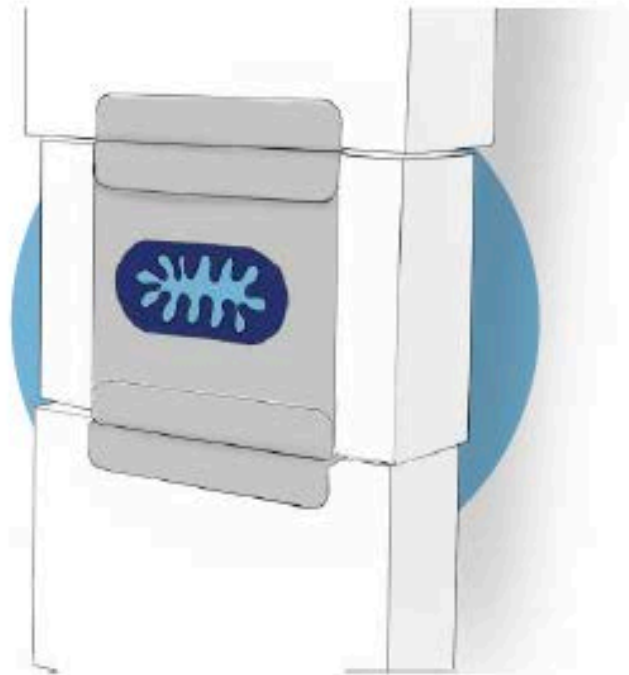
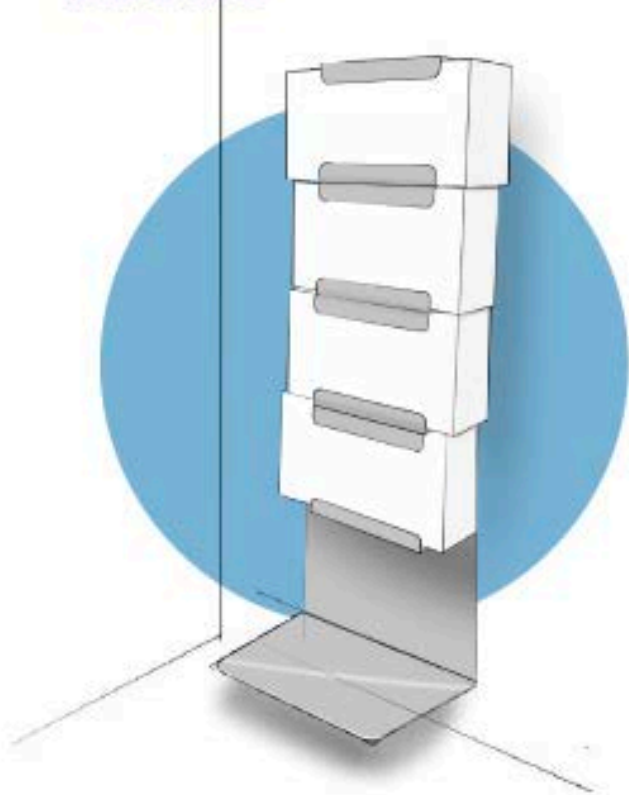
- Putting two gloves over each other
- Distrust in quality
- Replacement for hand hygiene
- Protocols
- Human behaviour
- (mis)interpretation of the policy

Other opportunities



- Bio-based material
- Recycling of the used gloves
- Carton boxes separated in carton waste
- Quality of gloves

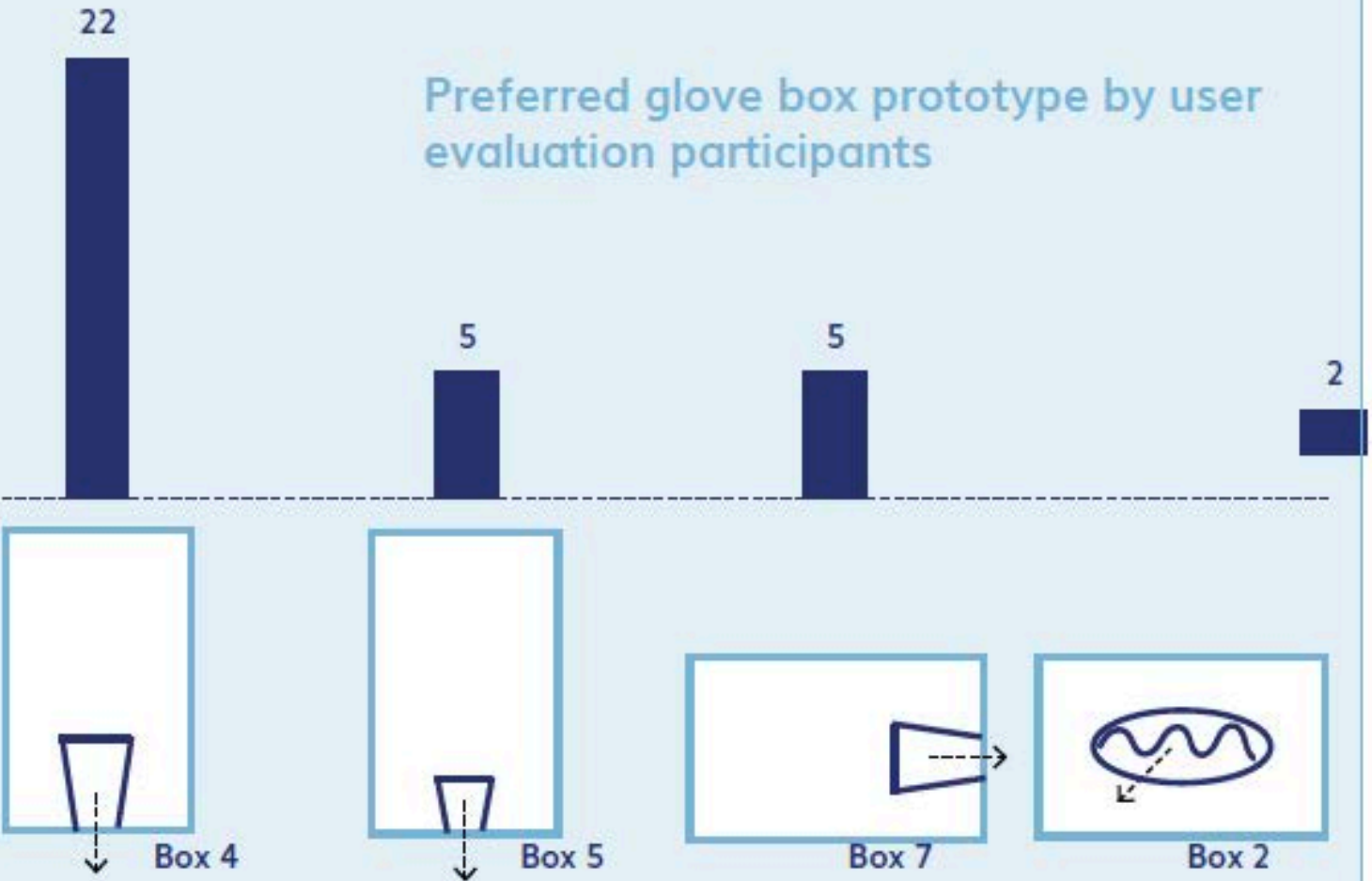
Ideas



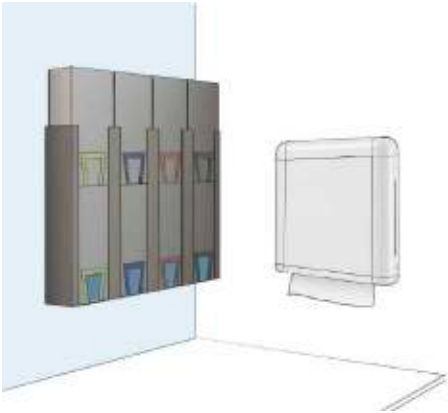
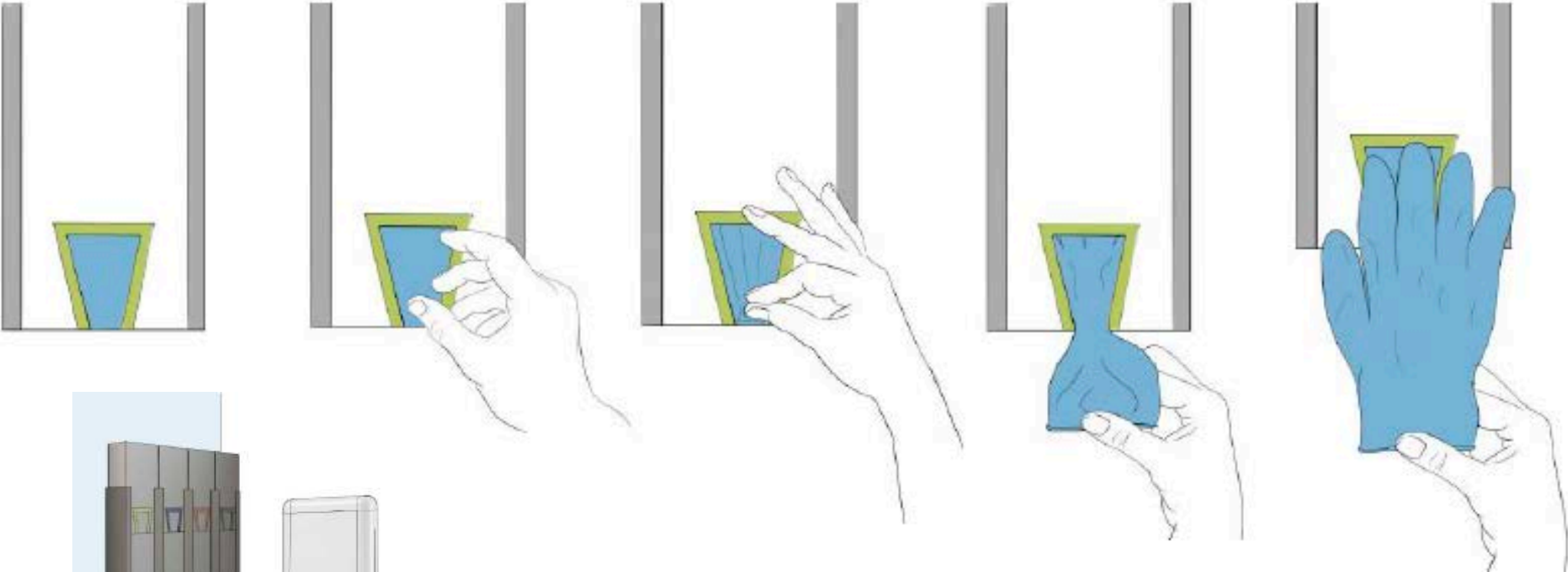
User evaluation

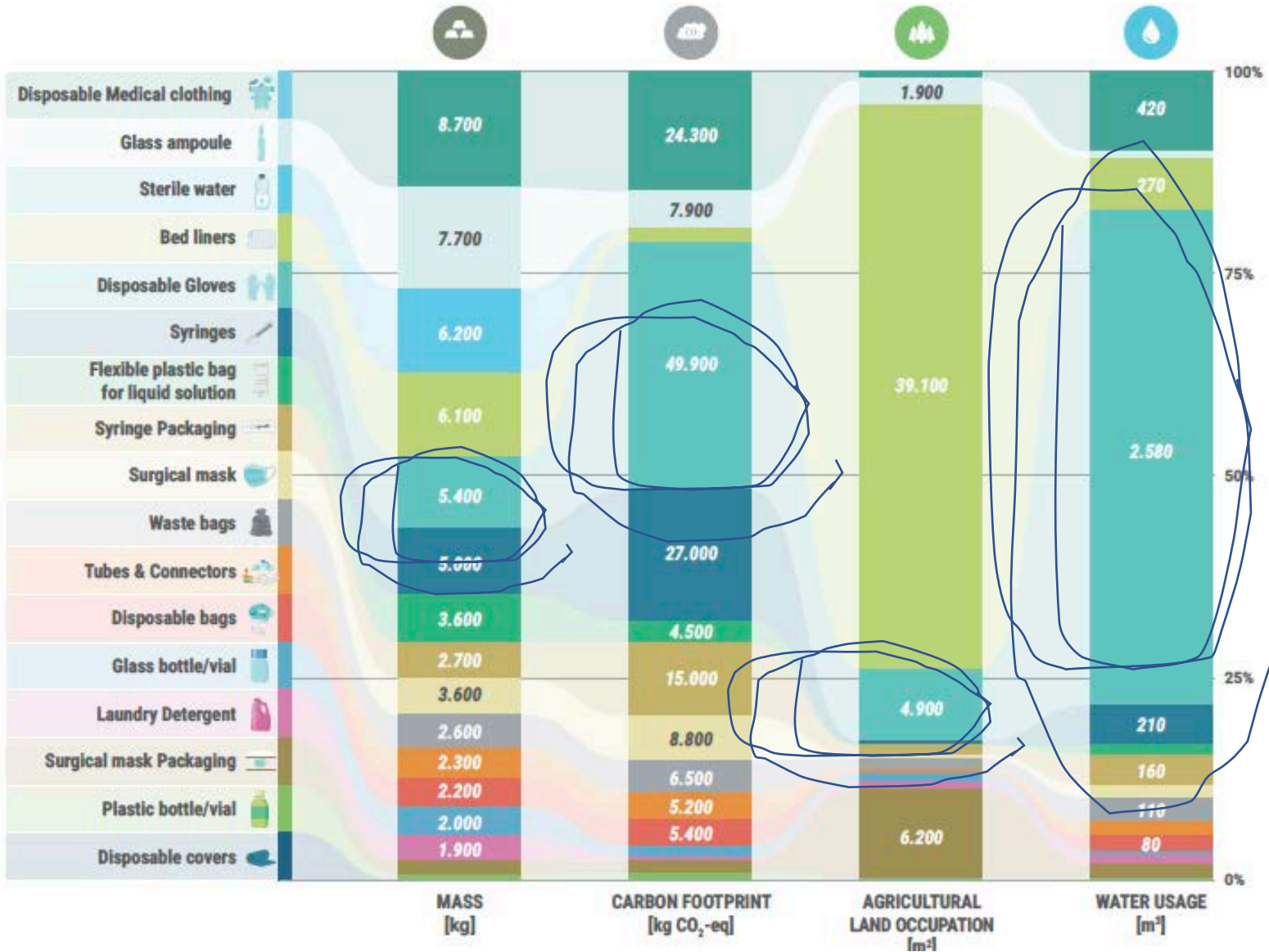


Preferred glove box prototype by user evaluation participants



The use





Gloves production has a large environmental impact

10 percent reduction already serious impact

Towards a circular ICU

Reducing the environmental impact of syringes in the Intensive Care Unit

This graduation project reduces the environmental impact of syringes on the Intensive Care Unit (ICU) of Erasmus University Medical Centre (MC) by designing solutions based on circular strategies.

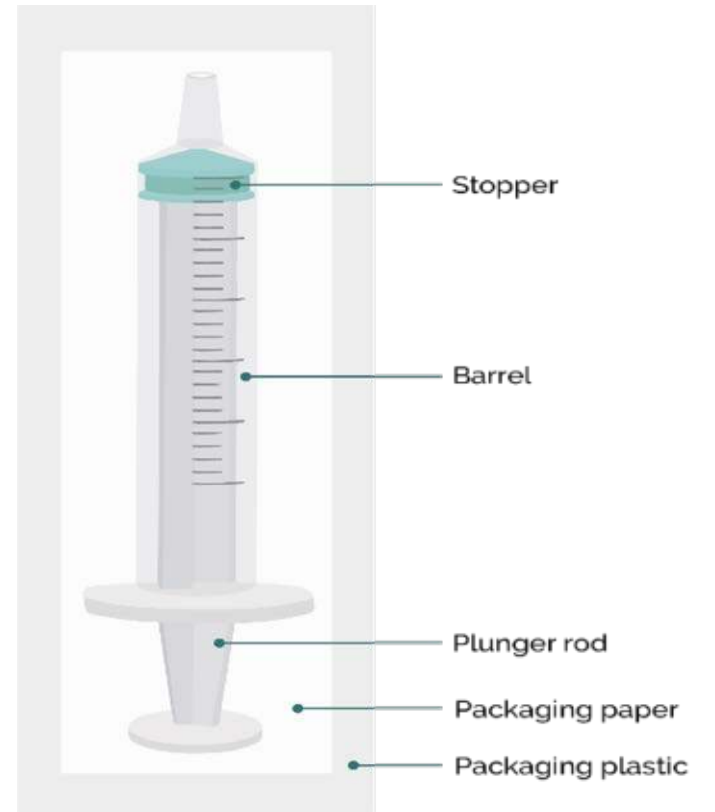


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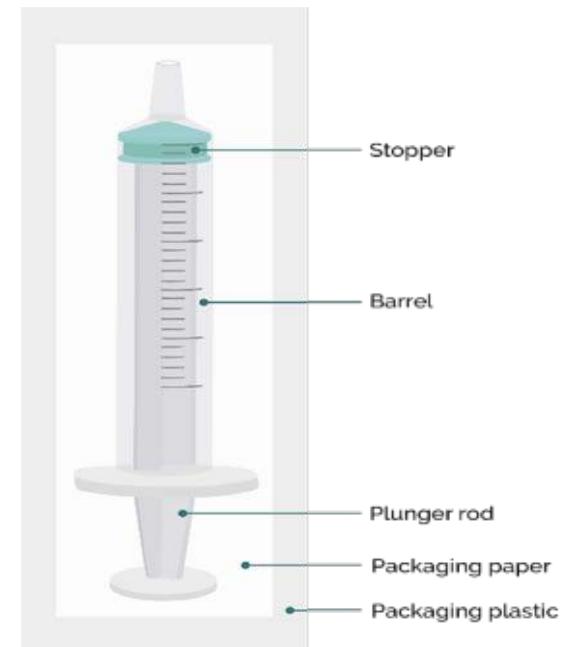
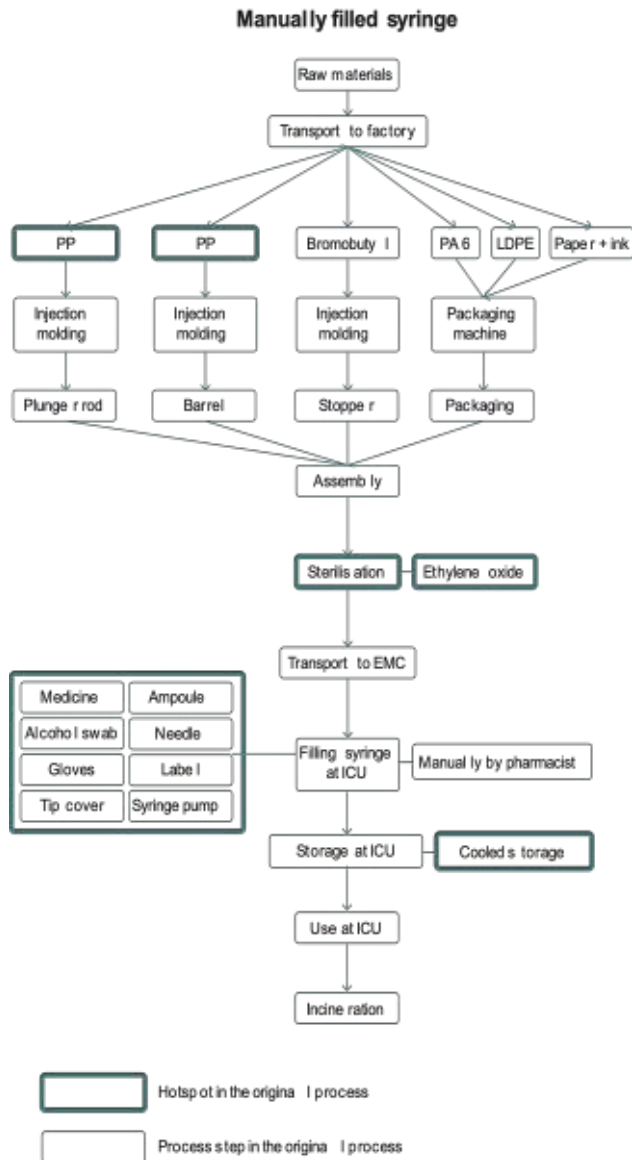
syringes per patient per day

300.000

syringes disposed per year



Life Cycle Assessment



Part	Material	Weight (g)	Percentage %
Plunger rod	Polypropylene (PP)	11.0 g	33%
Barrel	Polypropylene (PP)	17.2 g	51%
Stopper	Bromobutyl rubber formulation (6720GC)3	3.2 g	10%
Packaging: plastic liner	20% Polyamide 6 (PA 6) 80% Low density polyethylene (LDPE)	1 g	3%
Packaging paper	Paper with medical grade, printing ink	1 g	3%
Syringe total	-	33.4 g	100%

Concept 1 modular syringe

Reduce the environmental impact by reusing the plunger and the tip and only replacing the barrel. Designed to separate the materials at the End of Life to enable recycling.

Advantages of modular syringes

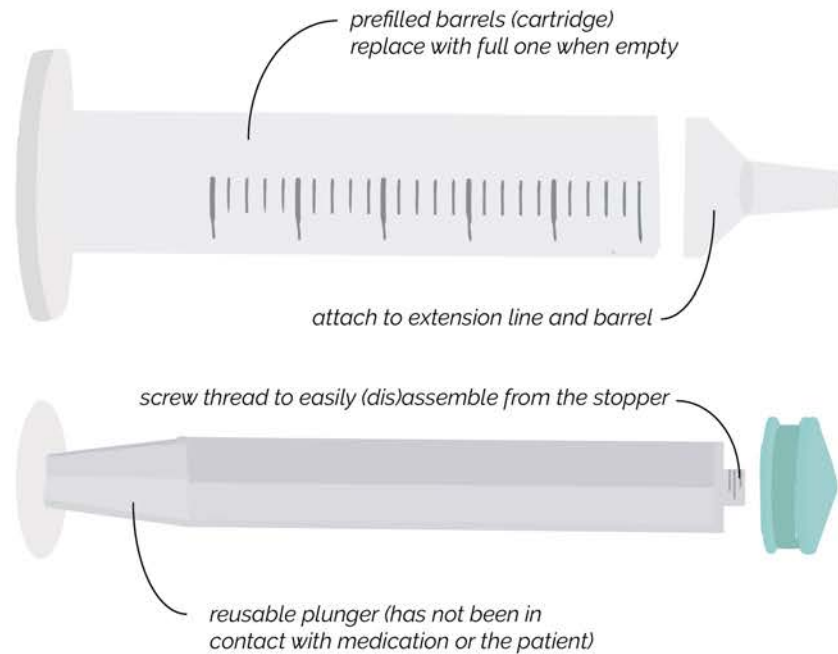
- + Easy separation of materials to be able to recycle
- + Cartridge system (only replacing the barrel for use) saves material
- + Reuse the plungers multiple times

Product improvements to be made

- design components in such a way that they can be assembled and separated easily (screw thread for example)

Influence on stakeholders

- BD: adapt production process
- A15: adapt production process (fill barrels only)
- EMC: adapt workflow (extra work to disassemble and separate waste) + add recycle possibilities



Staff on the ICU



Intensivist



Pharmacist



Pharmacy technician



Nurse



Care assistant



Cleaner



Management



ICU doctor

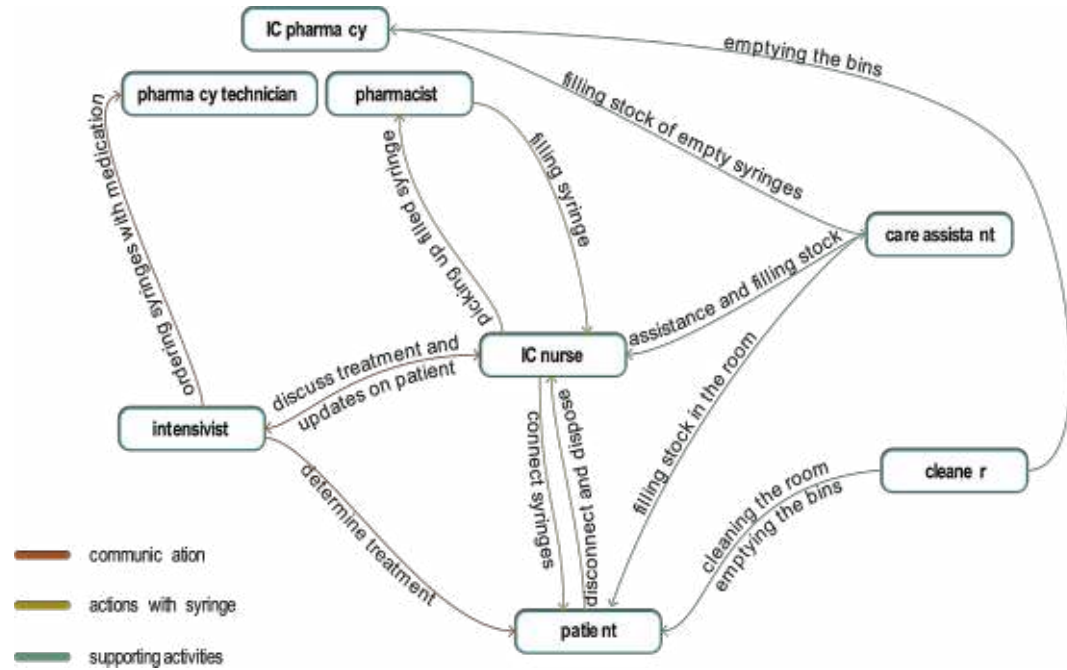


Specialists

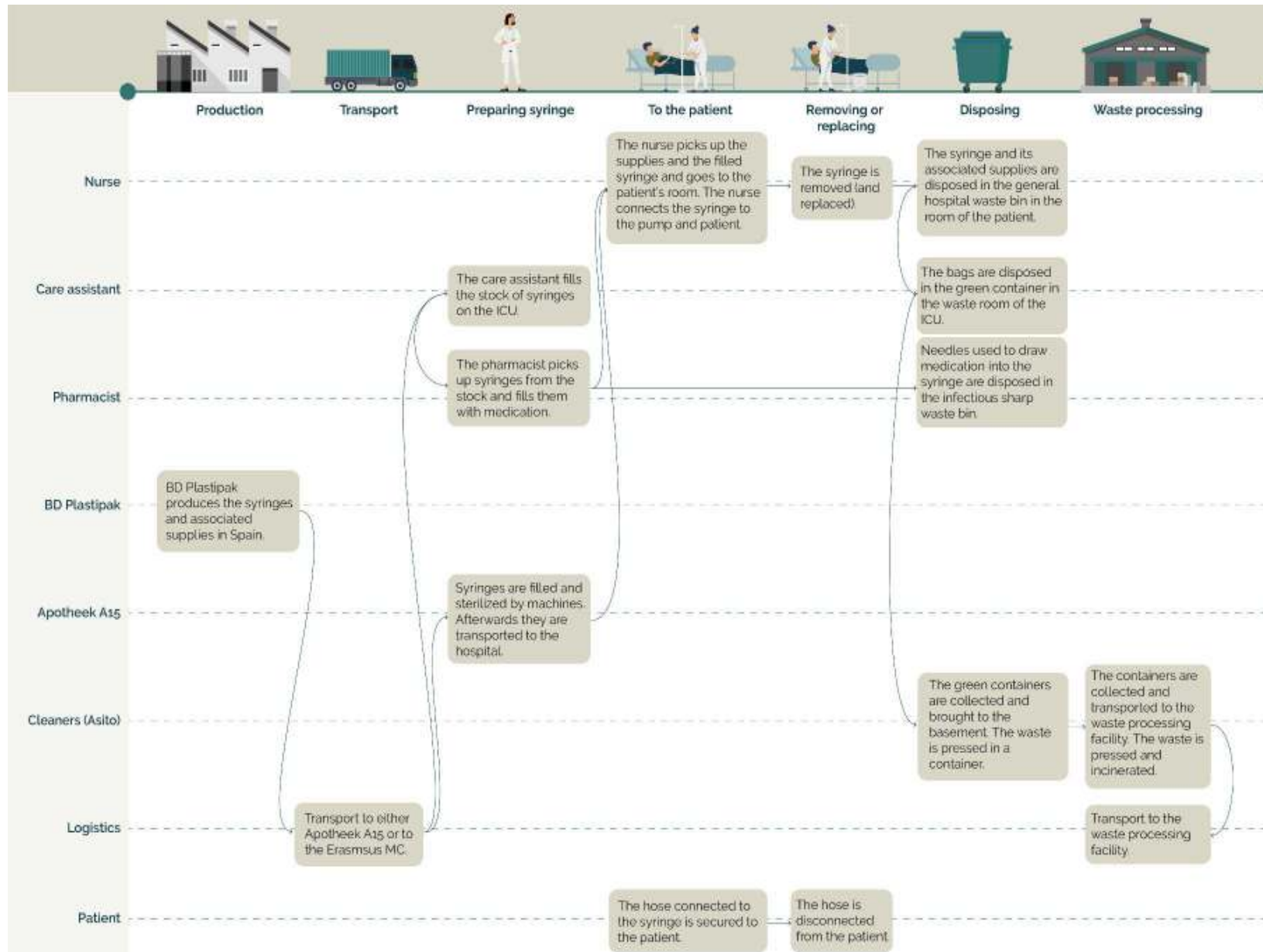


Patient

Family



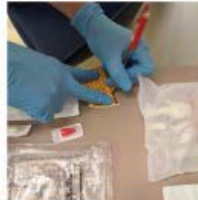
Product Journey



Lots of consumables involved in use of syringe



The table is covered with alcohol. Supplies are laid out on the table.



Sticker is filled in with details about medication, patient's name, date and time.



Packaging with syringe is opened. Syringe is taken out without touching the tip.



Syringe is placed on the table in this way, so that the tip does not touch anything.



Infusion bag is opened.



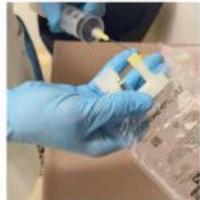
Infusion bag is opened.



Sterile needle is opened, without touching it.



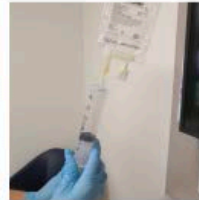
Needle is inserted into the syringe without touching the needle. Only the packaging is touched.



The syringe is placed in the infusion bag.



The needle is secured in the opening of the bag.



The medication is drawn up through the needle into the syringe.



The syringe is full, needle can be taken off.



The needle is removed from the syringe.



The needle is disposed in the sharp/infectious waste bin in the room.



A stopper is opened.



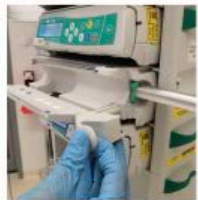
The stopper is placed on the syringe.



The stopper is placed onto the syringe in such a way that you can still see if when it is in the pump.



The red stopper is removed and the tube is attached to the syringe.



Pump is opened to make place for the syringe.



The syringe is placed into the pump.



The pump is closed, and the display shows what type of syringe is in there. Settings can be adjusted.



The waste is collected and thrown away in the waste bin in the room.



The gloves can be taken off, and are disposed in the same bin.



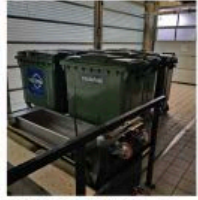
The bin in the room is closed.



The waste bags from the room are placed in the green containers at the ICU by the care assistants.



The needle boxes from the room are placed in a cardboard box.



The containers are collected in the basement of the hospital.

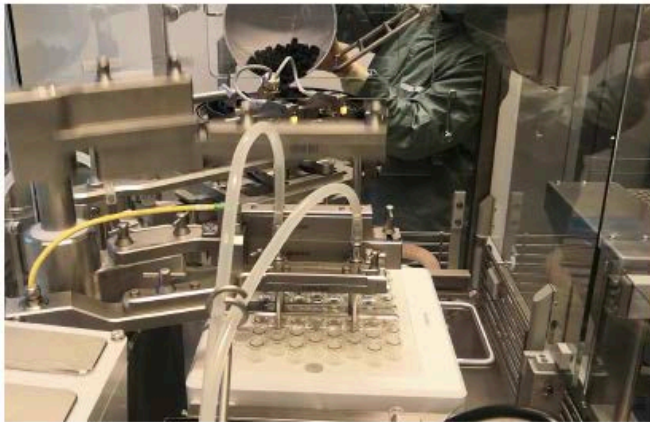


The waste from the containers is pressed together and then incinerated.

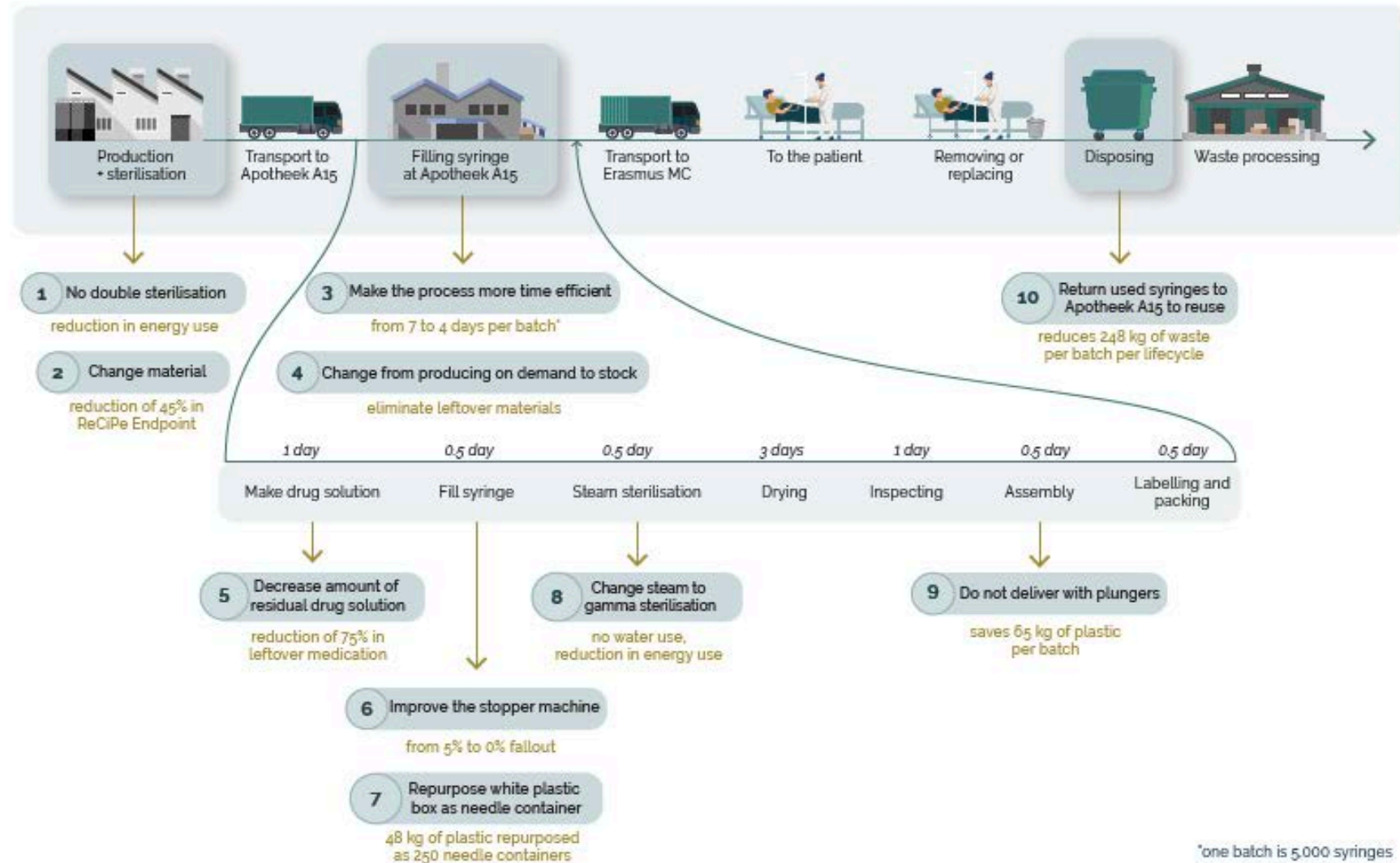
Alternative batches of pre-filled syringes

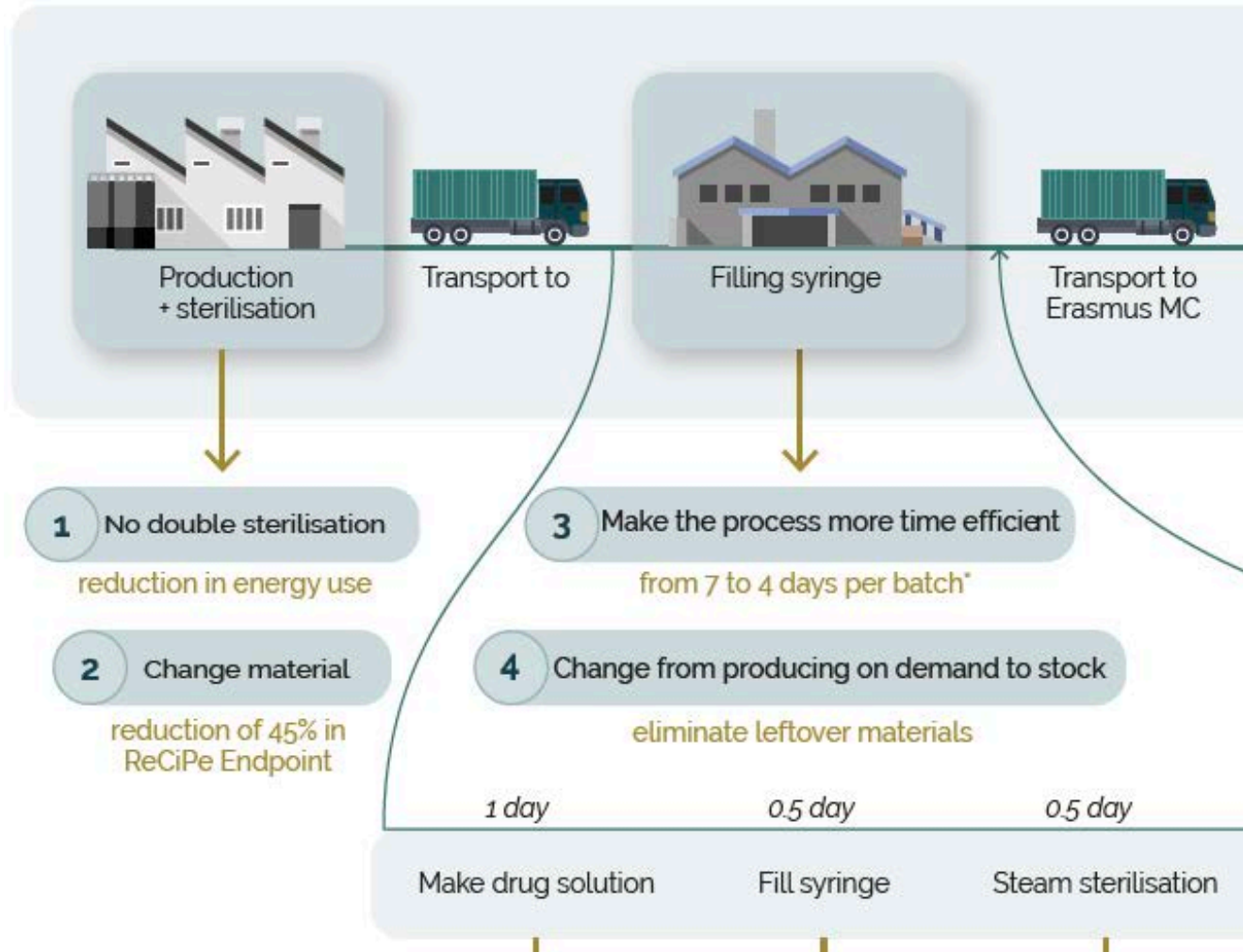
Filling syringes by machine

large batches of prefilled sterilised syringes, fewer by-products



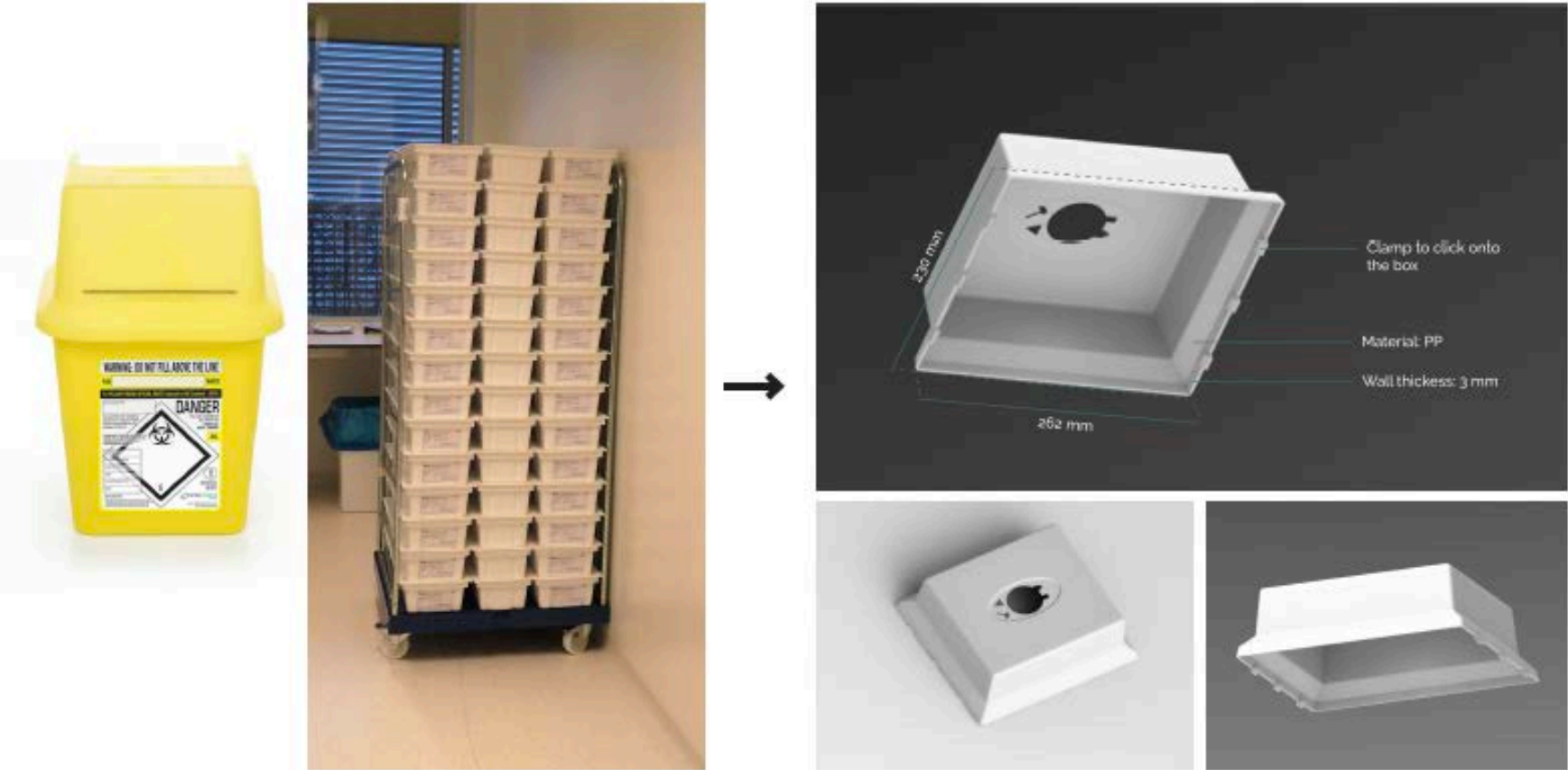
Hotspots in the machine filling process





1. No double sterilization
4. Change from on demand to stock

Repurpose packaging as a sharps waste container



It is not just the syringe that has to be improved
but
the whole 'use system' of the syringe

Form product to system thinking

Some reflections.....

- Multiple perspectives
- Mapping the current situation and make visible
- Co-create and engage
- Beyond the product.... Think in systems

- Still much to learn
- More disciplines needed next to Erasmus MC and Delft Designers

- EUR students behavior and modelling
 - Engage with other hospitals
 - Collaboration with industry
 - Creating open access platform
 - Funding
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Health &
Technology

We are on a mission to improve life-long health for all



ZonMw

