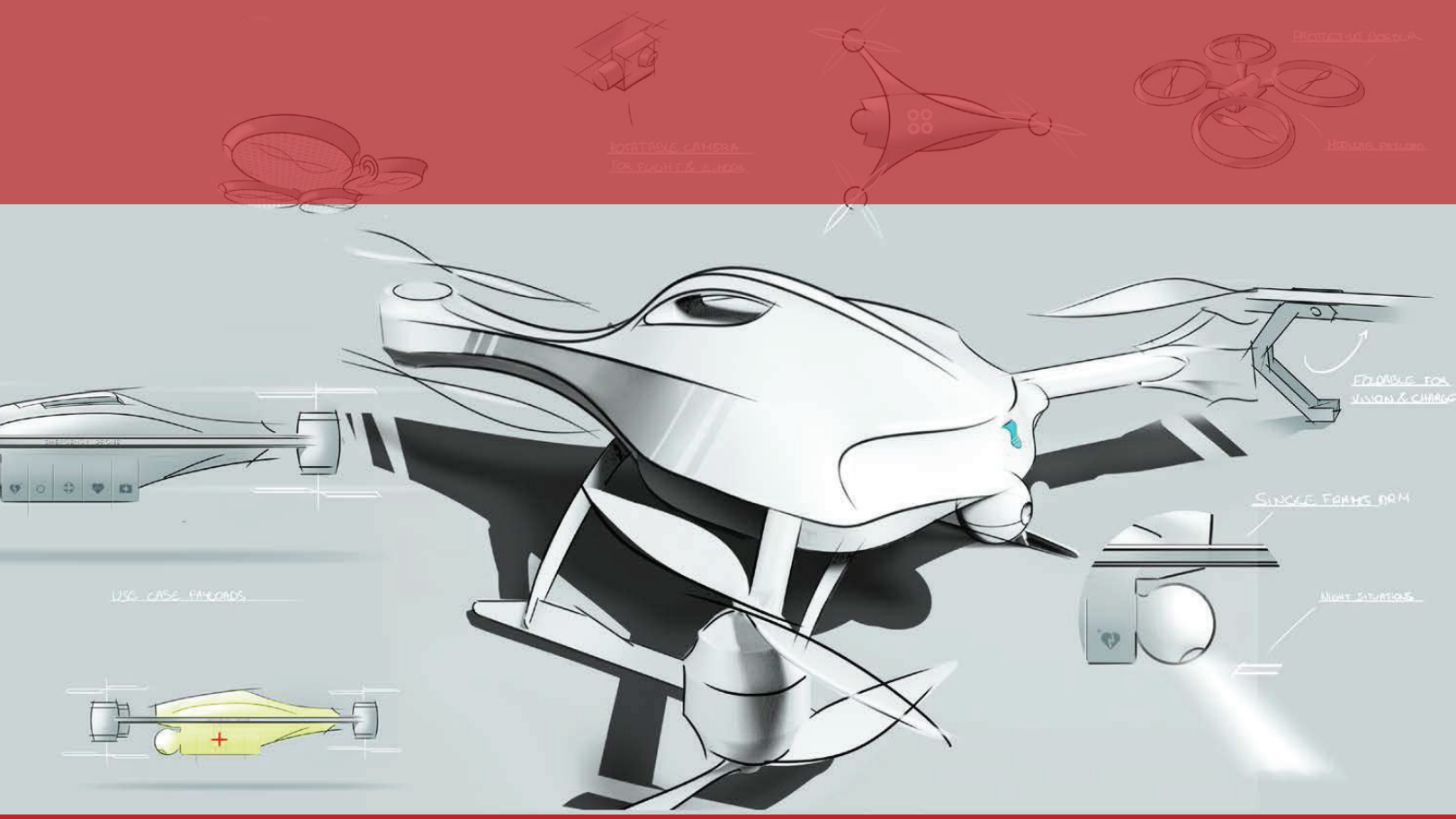

PRODUCTS FOR HEALTHCARE

Medisign graduation projects 2013-2015
TU Delft | Faculty of Industrial Design Engineering

M. Melles, A. Albayrak, R.H.M. Goossens

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Products for Healthcare
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Faculty of Industrial Design Engineering
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Contents

Foreword

Industrial design engineers influence how people behave, how they work, how they make decisions. A well-designed product or service can improve a diabetes patient's medication management, help scrub nurses and surgeons work together better during surgery, or reduce the time between a heart attack and arrival of medical help. It can help young cancer patients cope with their illness, stimulate demented elderly to be more physically active, or optimize the transport of premature babies. In this booklet, we showcase 116 examples of how design can support, facilitate, enhance or even provoke a wide diversity of people, processes and situations in healthcare. All of these projects are healthcare graduation projects completed by Industrial Design Engineering Master's students in the period 2013-2015.

The faculty of Industrial Design Engineering at Delft University of Technology educates designers to make a positive contribution to society. In our Medisign master specialisation programme, we specifically address the topics of care, cure and prevention. Central are the needs of the patients, healthcare professionals, informal caregivers and/or a combination of these. In order to design products or services that suit all user requirements and the often complex context of use, we actively involve users in the design process. Each graduation project therefore starts with an extensive user study, making use of, for example, interviews, observations, and/or contextmapping techniques, which is then followed by the design phase, a process of design iterations and prototypes at different levels of detail. Here again, users are intensively involved in evaluating the different prototypes, each iteration generating more advanced insights into the users, their context, as well as into the quality of the design itself. In this way, the student spends six months working towards a final design that will contribute something new to our healthcare system.

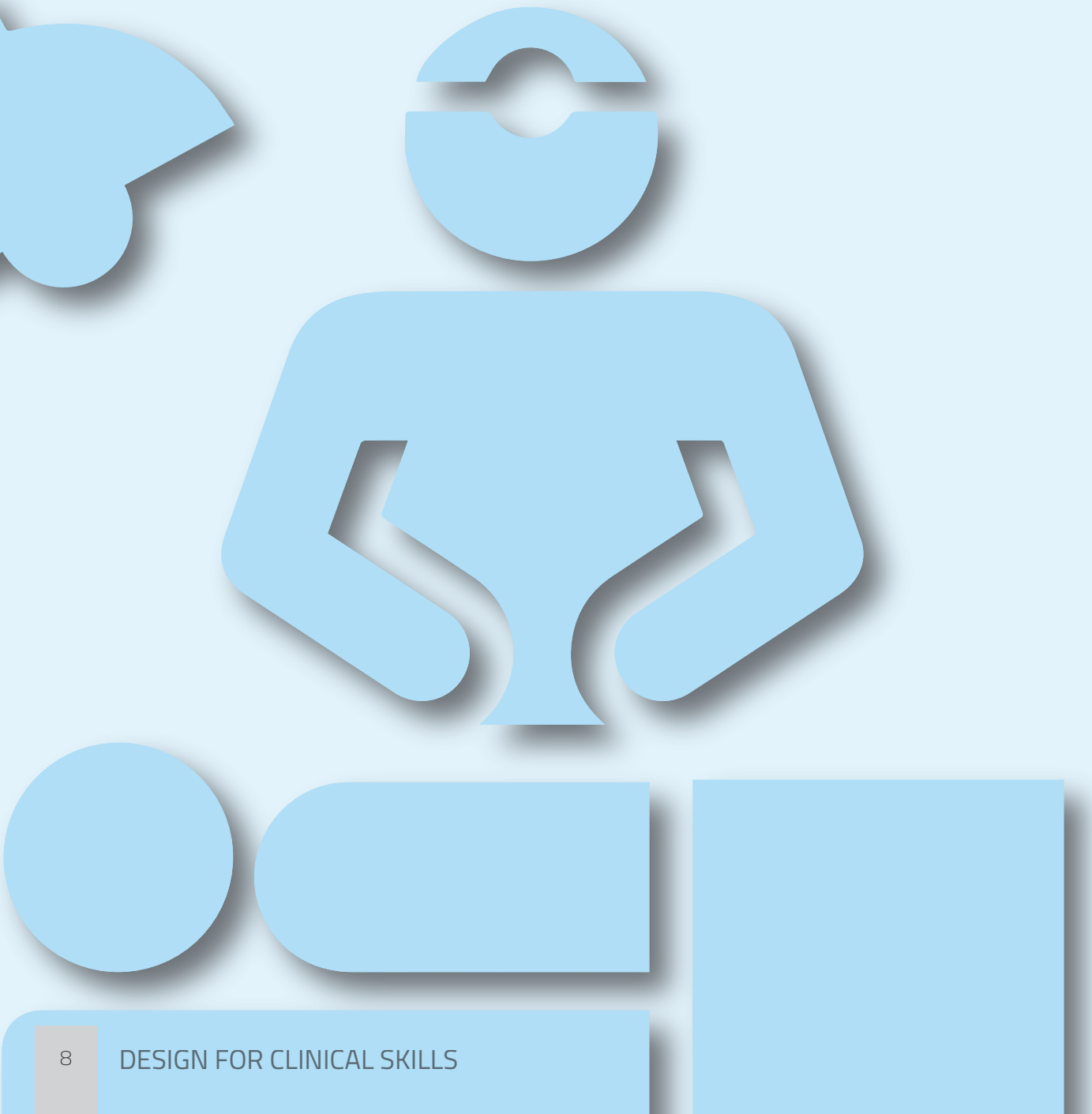
We have divided the projects into twelve categories, reflecting on-going developments in society, healthcare and the design research portfolio at our faculty. The categories range from design for the clinical and professional skills of healthcare professionals, to patient empowerment, design for ageing and developing new business models for healthcare. Many of these projects contribute to our research portfolio; new topics are defined within our research programmes, explored in education projects, and the results are fed back into research. In this way, research and education feed each other with new topics, insights and partnerships.

We are proud to present this sixth edition of a series of booklets showcasing our healthcare graduation projects; the first appeared in 1997. We once again trust that this booklet will inspire you and lead to future collaborations.

dr.ir. Marijke Melles
Coordinator Medisign MSc specialisation

Faculty of Industrial Design Engineering
Delft University of Technology

Delft, October 2016.



DESIGN FOR CLINICAL SKILLS

SPACECREA: CREATING MORE WORKSPACE AND BETTER ACCESSIBILITY DURING HIP ARTHROSCOPY

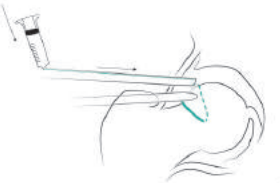
Graduate: C.C. Cornelisse (2014)
Supervisory team: R.H.M. Goossens, A. Albayrak, R. Bloem, G. Kraan
Partner: Reinier de Graaf Hospital

In the last decade, hip arthroscopy has rapidly become a more common procedure in orthopaedic surgery. Hip arthroscopy is a minimal invasive procedure that requires small incisions to perform the surgery. It is a relatively difficult procedure to perform and it has a long learning curve, because the anatomy of the hip joint is complex compared to other joints in the body. The hip joint is a ball and socket joint, surrounded by a capsule of ligaments. Although traction is applied to the patient's leg during the procedure, there is still not much space available for surgery inside the joint. The instruments used during the procedure do not fit well with the complex anatomy. Due to the limited space available, soft tissue of the hip joint capsules has to be removed to create better access and sight for the surgeon.

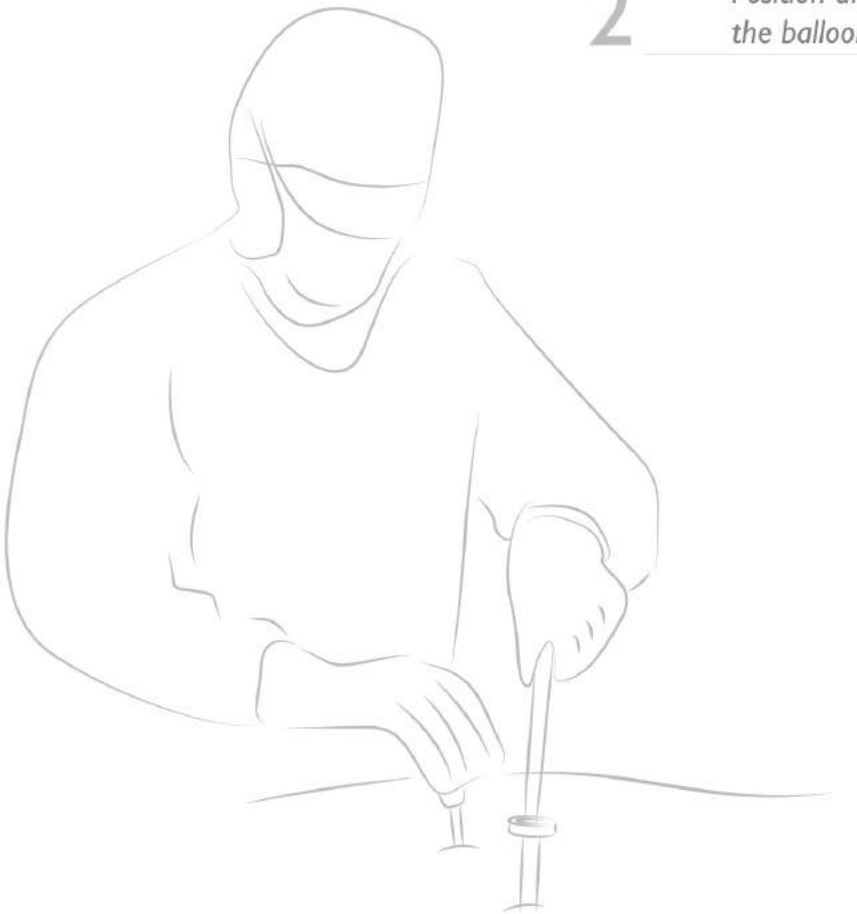
This led to the development of the SpaceCrea. SpaceCrea is a minimal invasive instrument that provides better access in the hip joint during CAM removal, by lifting the hip joint capsule with an inflatable device. An ellipse shaped balloon is inserted through a portal and by pressurizing it with saline, the balloon exerts forces on the capsule and lifts it, providing more space for the surgeon to perform the procedure.

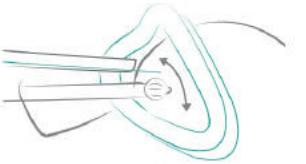
SpaceCrea improves the current procedure of hip arthroscopy by (a) reducing the amount of damage to the capsule: the balloon lifts the capsule therefore it is no longer necessary to remove healthy tissue of the joint capsule and (b) reducing the amount of surgery time: the time needed to remove the soft tissue of the hip joint capsule to provide space is no longer necessary.

1 *Insert the balloon through the portal*

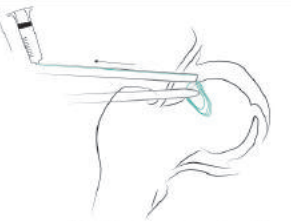


2 *Position and inflate the balloon*





3 *Perform surgery on the CAM injury*



4 *Deflate the balloon*

5 *Remove the balloon through the portal*

PATIENT SPECIFIC PROSTHESIS FOR RESURFACING OF THE DISTAL RADIUS

Graduate: M. Eekhout (2014)
Supervisory team: R.H.M. Goossens, Y. Song, G. Kraan
Partner: Reinier de Graaf Hospital

Pain and limitations in wrist movements are common problems for patients suffering from osteoarthritis. The current treatment options for wrist osteoarthritis are not optimal; a major problem is that the lifetime of a wrist prosthesis is only about 5-7 years, which means that they have to be replaced surgically after this relatively short period. These prostheses often get loose, which makes it necessary to apply a wrist fusion, which in turn reduces the range of motion. The goal of this graduation project was to develop a patient-specific prosthesis for resurfacing of the distal radius and to guarantee pain relief and full motion of the wrist.

The concept is a press-fit solution with a short, hollow stem. The structure of the stem has holes to enable the cancellous bone grow into the stem, ensuring a better and stronger fixation of the prosthesis. The decision was made to replace the entire radius head as replacing a part of the radius head has a high risk of harm and failure. The stem of the prosthesis and resurfacing head are both made of titanium. The entire product will be tailored to each patient and will be produced by rapid prototyping.

CONTROL OF CEMENT PENETRATION IN TOTAL KNEE ARTHROPLASTY

Graduate: R.W.F. Venderbosch (2015)
Supervisory team: R.H.M. Goossens, E.R. Valstar
Partner: Reinier de Graaf Hospital

Total Knee Arthroplasty (TKA) is a successful surgical intervention in which the degenerated articular cartilage layers of the knee are effectively replaced with a metal and plastic knee prosthesis. Survival rates of the knee prostheses are generally in the range of 90% - 95% implant survival after 10 years. With rising numbers of knee prostheses being implanted globally, it is important that the prosthesis' design and the surgical procedure itself be continually improved. In this project, the cement application guide was redesigned to fix flaws in the current cementation techniques. Furthermore, an improved reproducibility and cement penetration was achieved for a minor increase in surgical procedure costs. This makes the new cement application guide an economic solution, as the resulting reduction of implant failures will cover the added costs.

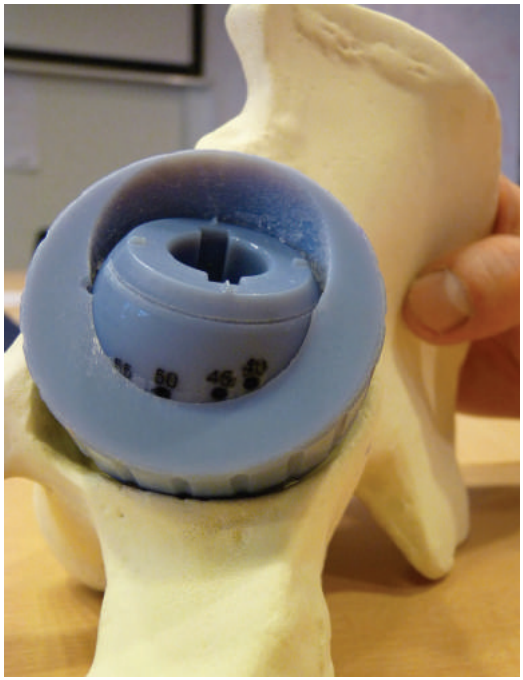
The new cement application guide introduces a distinctive way of applying a predetermined volume of PMMA bone cement. The cement pocket is filled before the tibial component is implanted, keeping the cement guide firmly pressed on the resected proximal tibia. In this way, cement leakage is reduced and the effective pressure on the cement increased. In combination, this allows the cement to irrigate deeper into the trabecular bone structure.

OPTIMIZING COMPONENT POSITIONING DURING HIP REPLACEMENT SURGERIES

Graduate: A. Waring (2013)
Supervisory team: R.H.M. Goossens, M. Melles, J. Lancaster, S.B.W. Vehmeijer
Partners: Zimmer Biomet, Reinier de Graaf Hospital

The most common complication of total hip arthroplasty (THA) or replacement (THR) surgery is post- surgical dislocation of the joint. Surgical factors contributing to dislocation are often due to one or more of the following factors: the combination of components used, the experience of the surgeon, the method of fixation of the acetabular cup, orientation of the acetabular cup, and the surgical approach. Of these factors, incorrect component positioning is the leading cause of dislocations.

The aim of this project was to design a practical and elegant solution for optimizing component positioning for differing patient anatomies during surgical procedures on the human hip. The final concept was designed after returning to the underlying problem, aligning the cup on two different anatomical planes (coronal and transverse), in the specific angle correct for the patient's anatomy. After taking these simple geometries into account, a new, simple, and effective product was developed. The tool was designed to help surgical navigation during THAs. As a result, the tool is a reference guide to ensure that the surgeon places the new cup component correctly. The tool does not replace the surgeons' expertise; it simply serves as a guide when operating.



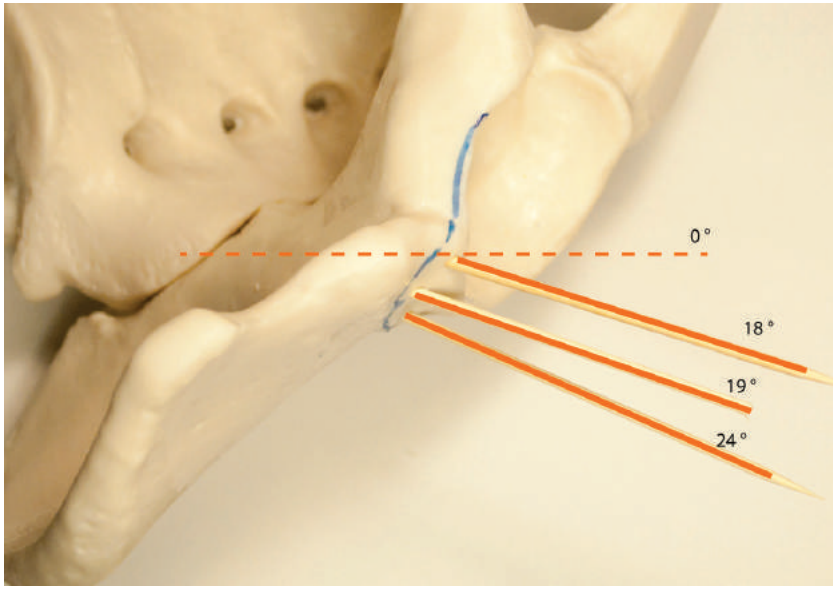
TOTAL HIP GUIDE: A PATIENT SPECIFIC GUIDE FOR TOTAL HIP ARTHROPLASTY

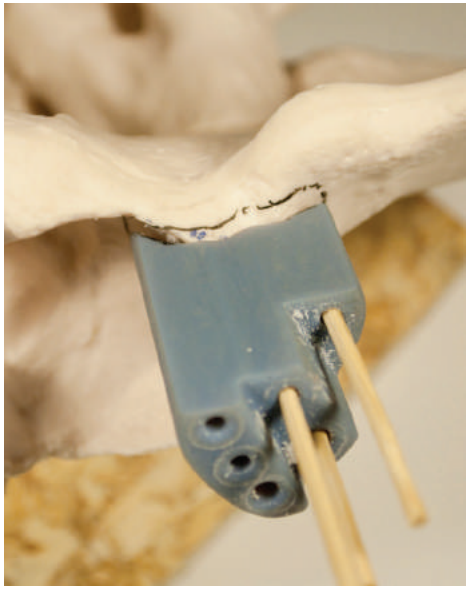
Graduate: R.R. van Dijk (2014)
Supervisory team: R.H.M. Goossens, Y. Song, P. Krekel
Partner: Clinical Graphics

Total hip arthroplasty is the most common surgical operation in the world, with over 1 million patients being treated each year. The prosthesis consists of a ball and socket joint which completely replaces the patient's joint. The two components of the prosthesis have to be accurately aligned: the socket has to be positioned correctly along two axes as well as at the correct depth. This makes the placement difficult, even for skilled surgeons. Incorrect placement can cause complications such as dislocation of the hip joint, chronic pain, or unequal leg length. When using conventional surgical techniques, the surgeon has no means to accurately determine the orientation of the components.

The aim of this project was to design a patient specific surgical guide that helps the surgeon to reproduce a pre-operatively planned orientation. In this way, the surgeon can position the prosthesis optimally for each specific patient.

The final design is a visual reference guide that denotes the optimal orientation of the central axis of the socket of the prosthesis. During surgery, it is positioned next to the hip joint and provides a visual reference for the surgeon. Apart from fixing the guide in place with a screw, the surgical procedure has not been changed.





USER INTERFACE FOR MINIMALLY INVASIVE CT-GUIDED PROCEDURES

Graduate: A.A. Yasynetskyy (2014)
Supervisory team: R.H.M. Goossens, T. Boersema, M. Zuurman
Partner: Philips

In this graduation project, a new user interface (UI) console for use by radiologists during CT-guided minimally invasive procedures was designed. After the problem analysis, the design goal was defined as "to design an in-room table-side device that helps radiologists maintain full control over the interventional CT medical equipment in a safe, intuitive and efficient way". Therefore, the main challenge was to design a product to be used under sterile conditions, while being covered with a plastic drape, and used with gloved hands.

The final design reflects the application of user-centred design methods and several design iterations. During the concept evaluation, the Philips customers noted the concept as being a "very promising" solution. The proposed design with novel UI controls was seen as a product that is easy to use and that can help interventional radiologists perform the procedures faster, safely and intuitively. Thus, it can streamline the clinical workflow and improve both the customer experience and the clinical outcomes.

GESTURE-BASED INTERFACE FOR MINIMALLY INVASIVE IMAGE-GUIDED PROCEDURES

Graduate: M.L.N. Geraets (2012)
Supervisory team: M.H. Sonneveld, D. Gooren, N. Chen
Partner: Philips

This project is about the implementation of a gesture-based interface in a medical context in order to support the quality of care. Literature and field research show that there is potential for a gesture-based medical image browsing design to support intervention radiologists during minimally invasive, image-guided interventions performed in the cath-lab environment.

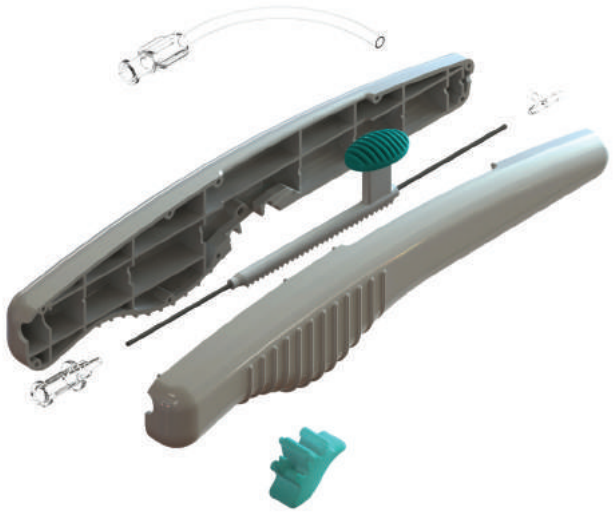
The final design enables the intervention radiologist to recall medical images at any time, using single hand movements, without leaving their position or asking the medical staff for indirect image browsing. This reduces the intervention radiologist's cognitive load, maintains the flow of the medical procedure, and indirectly supports the quality of care. This gesture-based interface may also be applicable to use by medical experts in other domains.

INTUITIVE CONTROLLER FOR THE URECA CATHETER

Graduate: S.L. Lup (2014)
Supervisory team: R.H.M. Goossens, A.L.M. Minnoye, J.F. Remmerswaal
Partner: IQ Medical Ventures

The P.I.E.R. procedure is used for unblocking completely obstructed peripheral arteries in the limbs and it has numerous advantages compared to the classic bypass. However, P.I.E.R. is considered to be difficult for less experienced interventional radiologists to use, and it has a large learning curve. For this reason, Ureca has been developed, a catheter that facilitates the P.I.E.R. procedure, making the P.I.E.R. process easier and faster to learn and use. This graduation assignment focussed on the design of the interface of the Ureca Catheter with the medical user. The main requirements for the new product were that it had to be ergonomic, enable intuitive handling, and that it helps the medical professional operate the two catheter wires (the loop catheter and the guiding catheter) and adjust the contrast medium.

The new design has one sliding controller which controls the dimension of the guide wire loop. When sliding the button forward, the loop is increased, and when sliding it backwards, the loop is decreased, with a 1:1 ratio. The guide wire loop can be locked in any position, using the locking button. The button has two positions, ON and OFF, and offers a clear tactile and sound feedback when being pressed. The two controllers have an intuitive and ergonomic position on the handle, as was confirmed by doctors during the user test. The device also has an entrance for introducing a second guide wire, located in the back, and a contrast medium valve, located on the left side of the handle. A packaging solution was also developed for Ureca.




Ureca
Intelligent loop catheter
STERILE EO
REF
LOT
CE


5F
Ureca

ZIP-XCISION: TREATING SKIN LESIONS FOR GENERAL PRACTICIONERS

Graduate: R.G.W. Janssen (2014)
Supervisory team: R.H.M. Goossens, S.G. van de Geer, J. Jeekel
Partner: Budev

A skin lesion is an abnormal tissue formation on the skin. Examples are moles and skin cancers. Every day, thousands of people have a skin lesion removed. This is either done in the hospital or by their general practitioner (GP). While it is a relatively simple procedure many people are referred to the hospital, where the costs are higher and two staff members, a surgeon or dermatologist and a nurse, are occupied for performing this procedure. In order to decrease the time and cost per procedure, as well as improve the situation for the patient, general practitioners have to be enabled to complete a skin lesion excision on their own. The goal of this graduation was to design a new device that could help achieve this.

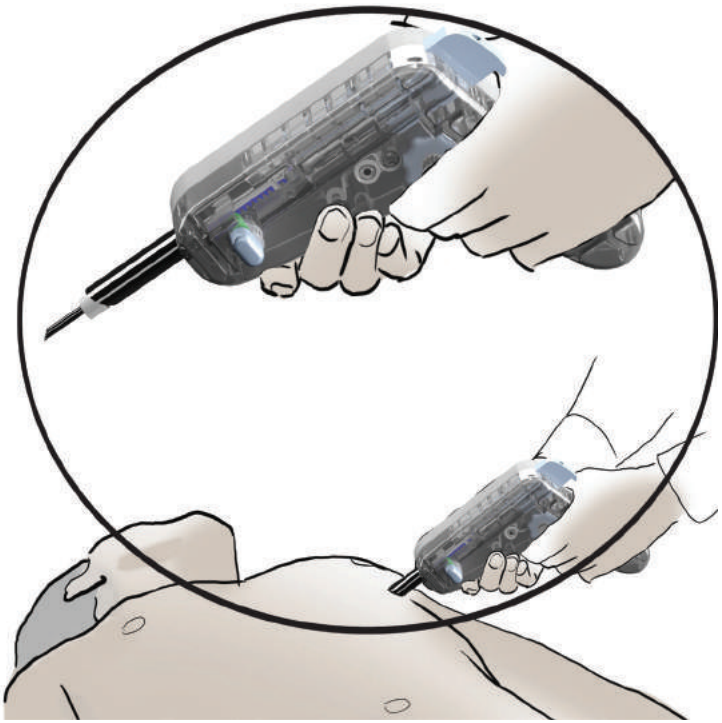
The Zip-Xcision is an adhesive wound closure dressing that simplifies the skin lesion excision procedure. It helps the GP to make the initial incision while also making simultaneous excision and wound closure possible, removing the need for suturing.

PACEMAKER LEAD INSERTION DEVICE

Graduate: R.L. Kassels (2012)
Supervisory team: M. Hajian, A. Albayrak
Partner: Maastricht University Medical Centre

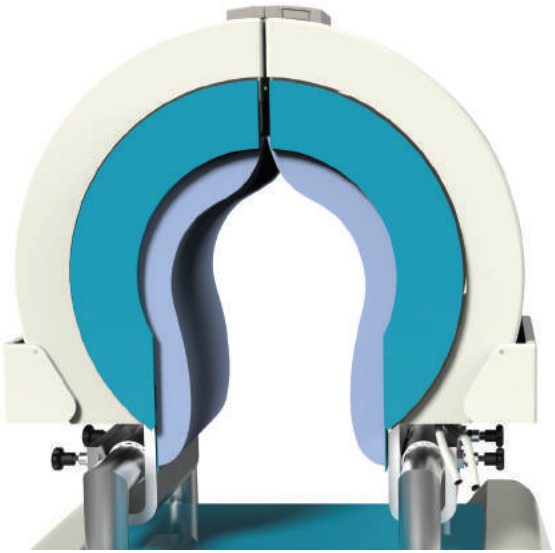
In the Netherlands, approximately 5,000 people are fitted with a pacemaker annually; of these some 3,500 get an Implantable Cardioverter Defibrillator (ICD). A pacemaker intervenes when the heart frequency is too low, while the ICD intervenes if the heart frequency becomes too high. The goal of this project was to design a device which enabled insertion of a pacemaker lead via the apex, while not harming tissue and/or any adjacent organs. The device should ensure that the surgeon accurately places the lead(s) using a minimal amount of movement.

The pacemaker lead insertion device (PLID) can insert a lead via the apex at the epicardium (inside of the heart), as this is preferable from a physiological aspect. Furthermore, this procedure minimises the risk of pneumothorax (deflated lung). Access via the apex also minimises the risk of uncontrolled bleeding, as the wall thickness at this point is quite thick. At the end of the process a prototype was developed. Testing gave valuable results which formed input for further recommendations.



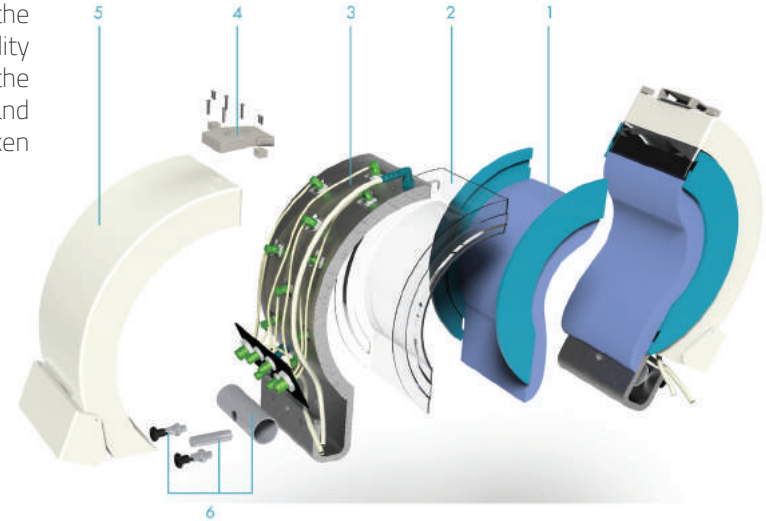
HYPERCOLLAR: CLINICAL HYPERTHERMIA HEAD AND NECK APPLICATOR

Graduate: D. Bi (2014)
Supervisory team: R.H.M. Goossens, M. Hajian, M.M. Paulides
Partner: Erasmus Medical Centre



Hyperthermia is defined as an 'elevated body temperature due to failed thermoregulation that occurs when a body produces or absorbs more heat than it dissipates'. The rationale of hyperthermia in cancer treatment is based on a selective tumour cell killing effect, which can be achieved at temperatures between 40 - 44°C. Currently hyperthermia is applied as an addition to radiotherapy and chemotherapy to increase the treatment quality. At the Daniel den Hoed Cancer Center, patients are usually treated with hyperthermia several times during their period of radiotherapy treatment.

This project is about improving the design of a clinical hyperthermia head and neck applicator, HYPERcollar. HYPERcollar is specially used in treatments for patients who have tumours in the head or neck region. The main problem to be solved was the unsatisfactory treatment ability of the old design in the neck area. In the new design, a water bolus enables extended treatment from the middle neck area to the collarbone area. The functionality of the water bolus was greatly improved based on the test results in the evaluation phase. The ergonomics and the aesthetics of the new water bolus were also taken into account and redesigned.



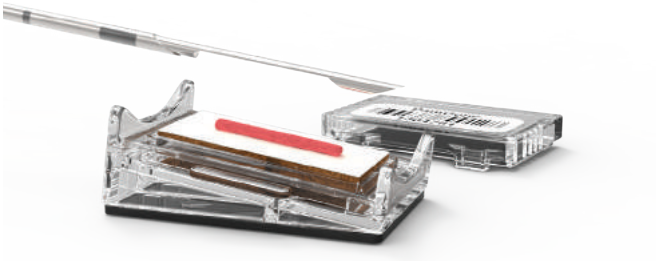
1. Inner water bolus
2. Rigid outer water bolus
3. Back plane (with antennas, cables, water tubes mounted)
4. Opening mechanism
5. Housing of the ring
6. Rotating mechanism

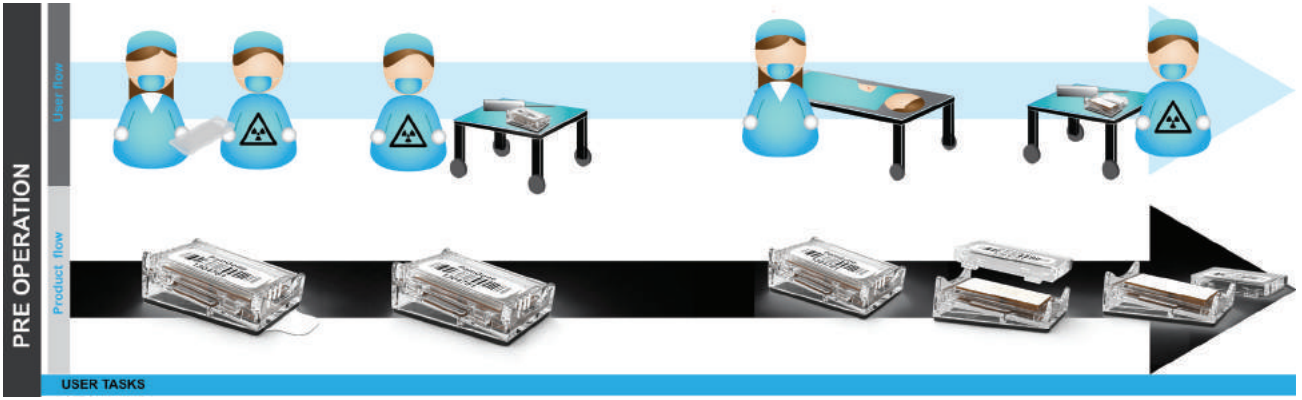
PAMBRANE: A BIOPSY SUPPORTING CONTAINER FOR A NEW SNAP FREEZING PROCEDURE

Graduate: B.H.J. Hegeman (2015)
Supervisory team: R.H.M. Goossens, Y. Song, T. van der Leij
Partner: PamGene

Currently, frozen tissue cannot be used as a routine source for diagnostic testing in clinical practice. There is no simple and reliable solution to collect and process fresh frozen tissue. At the moment, no special containers are available for the handling of fresh tissue intended for molecular research that work together with a core needle, snap freezing and sectioning device.

PamBrane is a concept that enables quick and easy transfer of biopsy specimens from the core biopsy needle to the newly developed product. Biopsies adhere to the membrane by creating a larger surface tension between the membrane and the tissue than the surface tension present between the needle and the biopsy specimen. Instead of shaking the biopsy specimen out of the needle, with all the related problems, the biopsy can be transferred by gently pushing it against the membrane. When the specimen arrives at the pathology laboratory, the PamBrane can be directly frozen in liquid nitrogen. After freezing, the PamBrane is snapped into a special specimen disc, and the tissue is ready for testing.





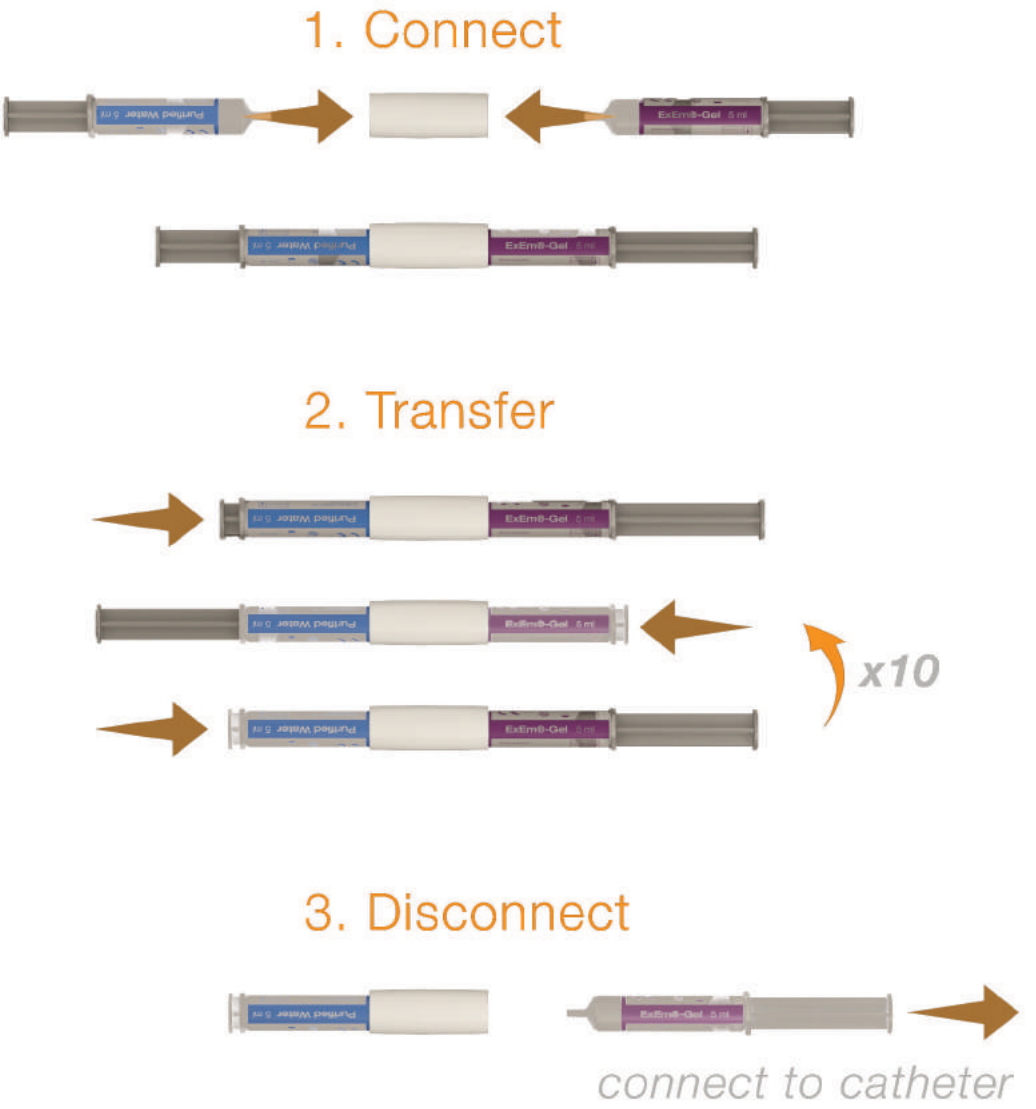
LINQ: APPLICATOR TO TRANSFORM EXEM®-GEL INTO EXEM®-FOAM

Graduate: H. Waars (2013)
Supervisory team: R.H.M. Goossens, H. Kuipers, L. van der Hoek, J.F. Remmerswaal, M.H. Emanuel
Partner: IQ Medical Ventures

HyFoSy (Hysterosalpingo Foam Sonography) is a gynaecological procedure that tests the tubal patency of infertile women. The procedure is performed using a transvaginal ultrasound probe and an intra-uterine foam, ExEm©-Foam. The foam distends the walls of the fallopian tubes and has echogenic properties. The ultrasound waves excite the air bubbles inside the foam, which in turn reflect and emit harmonic vibrations. The pulse inversion mode on the ultrasound instrument processes the returned vibrations into high contrast images.

This graduation project describes the exploration of disposable mixers for the creation of ExEm©-Foam. Several foaming principles were evaluated for suitability, efficiency and feasibility. The final design is an optimization of the existing ExEm©-Foam kit. The new foam kit consists of two 10 ml Farco-Pharma syringes, one filled with 5 ml of ExEm©-Gel and the other with 5 ml of purified water. The syringes are attached to a custom connector, the LinQ. This allows the transfer of the fluids from one syringe to the other. The Venturi effect occurs due to the narrow nozzles of the syringes and causes cavitational forces to split the air bubble inside the syringe. The foam is prepared after ten repetitions of fluid transfer from one syringe to the other.

The LinQ is an addition to the foam kit, and is an inexpensive, disposable connector for the two syringes. The mixing setup has been redesigned to prevent disconnection problems which caused entire ExEm©-Foam kits to be spilled. The LinQ simplifies and strengthens the fixation of the syringes, stabilizes the mixing setup, optimizes mixing efficiency, and gives the foam kit a professional appearance.


1. Connect
2. Transfer
x10
3. Disconnect
connect to catheter

PERICARDIAL FLUSHING DEVICE

Graduate: F. Hulsman (2014)
Supervisory team: R.H.M. Goossens, M. Hajian, D.R. Koolbergen, J.S.J. Manshanden
Partner: Academic Medical Centre Amsterdam

The goal of this graduation project was to design the next pericardial flushing device. The "Post Pericardial Flushing project (PPF)" was initiated by two cardiac surgeons as a clinical study to introduce a new technique to actively flush the pericardial section of the human body after open heart surgery. The key functionality of the device is to flush an infusion fluid through the space around the heart sack to make sure the unwanted body fluids and clots are safely drained. These will not then be able to cause any inflammatory reactions inside the pericardial area in a post-operative state. The scope of this project was to increase the user friendliness of the device and to design a casing to increase the safety and hygiene of the device.

The current prototype did function, however little attention had been paid to the device's user experience. In order to optimize the design, the design process was therefor carried out in close collaboration with all its users: the IC-nurses, the surgeons, the OR-staff and of course the patient itself. The introduction of this approach created a great "positive buzz" inside the AMC. Everyone knew about the developments, and people became increasingly enthusiastic. The result is an almost invisible medical device located on the back of the ICU-bed for the patient, and an intuitive medical assisting device for the medical professionals to work with.

MEASO2: CELLULAR OXYGEN CONSUMPTION MEASUREMENT SYSTEM FOR THE DIAGNOSIS OF SEPSIS

Graduate: J. Qui (2012)
Supervisory team: C.C.M. Moes, S.C. Pont, E.G. Mik, F.A. Harms
Partner: Erasmus Medical Centre

Sepsis is a severe medical condition characterized by a whole body inflammatory state, SIRS, resulting from an infection. Sepsis has a high mortality (30-40%). Any innovation which reduces mortality is extremely welcome. A new technique for improving the diagnosis of sepsis is currently under development. It focuses on measuring the oxygen consumption in skin cells by using the oxygen dependent fluorescing property of Protoporphyrin IX. The technique is being developed by the anaesthesiology department at Erasmus MC (University Medical Centre Rotterdam) and Photonics Healthcare B.V. The focus of this graduation assignment was to design a product that utilizes this newly-developed measurement technique for clinical use.

MeasO2 is an optical cellular oxygen consumption measurement system which aids the diagnosis of sepsis. The measurement system consists of two parts: the lower part has direct contact with the skin surface and is discarded after the measurement. The main part, which contains optical fibres and elements for heating and pressure, can be connected to the lower part by means of a screw system.

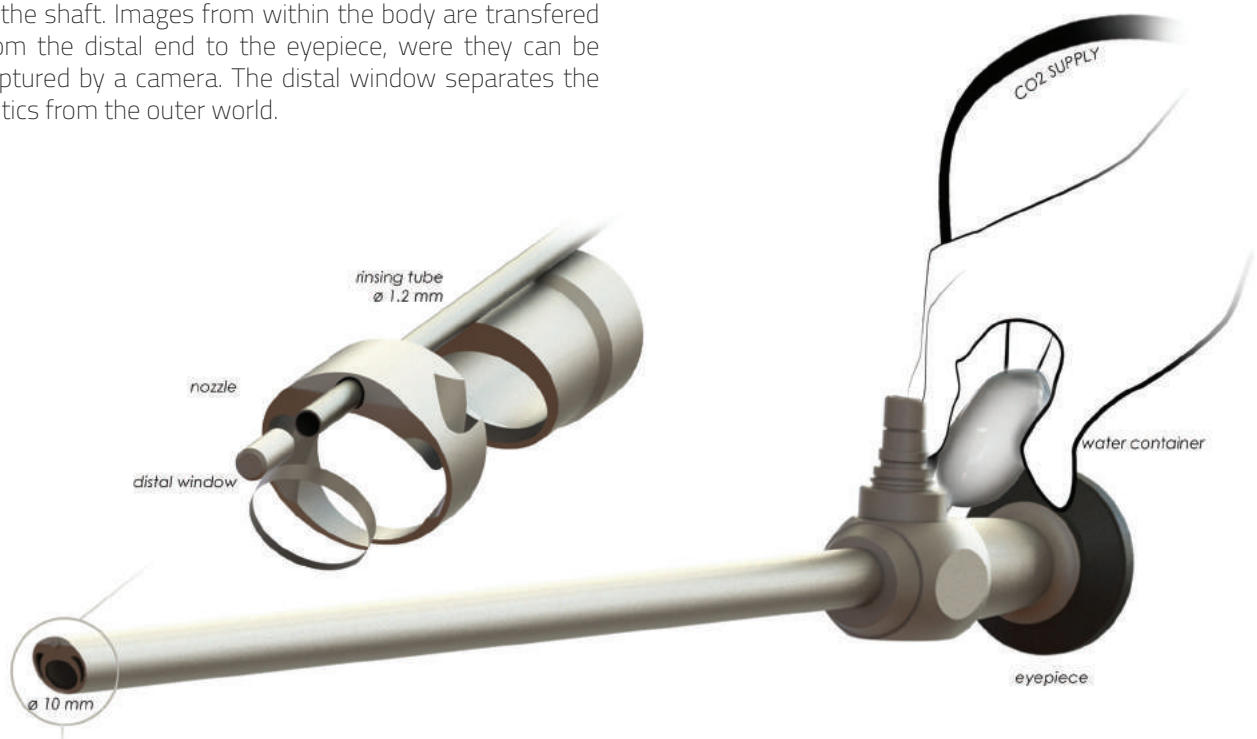
IN-SITU CLEANING OF THE DISTAL WINDOW OF A LAPAROSCOPE

Graduate: S. Aarts (2015)
Supervisory team: J.J. Jakimowicz, A. Albayrak, S. Wagner
Partner: Karl Storz

Laparoscopy is a minimally invasive surgery procedure, in which a device is used to transfer images from within the abdomen to monitors in the operating room. This device is fittingly called a laparoscope. During these procedures, the distal window of the laparoscope can be contaminated by different sources. Currently the laparoscope is removed from the body and cleaned manually. The goal of this project was to create a system in which the distal window can be cleaned while the laparoscope stays in place.

The current laparoscope consists of a lens system, located in the shaft. Images from within the body are transfered from the distal end to the eyepiece, were they can be captured by a camera. The distal window separates the optics from the outer world.

In the new design, the laparoscope is enhanced with a rinsing system consisting of a tube and a nozzle The nozzle is aimed towards the distal tip. When performing a cleaning action, fluid will be sprayed over the distal tip which thus removes the contamination. A CO2 source is connected to the rinsing tube. Activating this tube causes pressurized CO2 to flow through the tube which will remove the contamination from the distal tip. The effectiveness of the system is improved by adding water to the rinsing tube prior to the CO2 activation. This can be done by manually squeezing a water container.

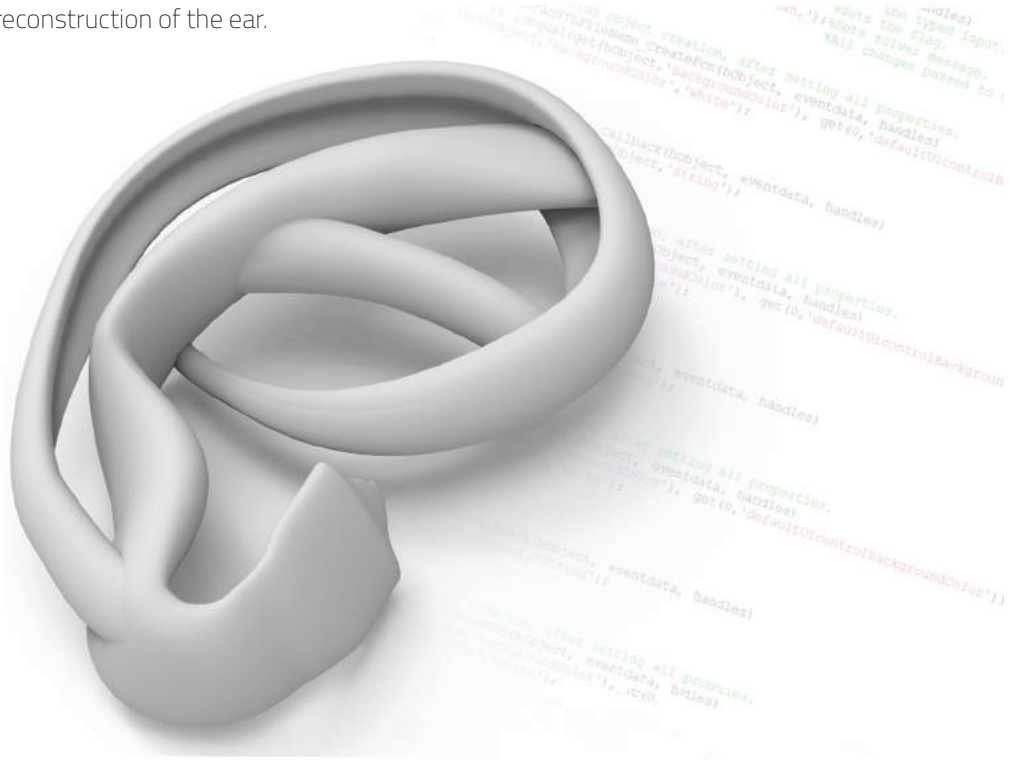


PERSONALISED EAR RECONSTRUCTION

Graduate: C.J. Feenstra (2014)
Supervisory team: R.H.M. Goossens, J.C. Verlinden, Y. Song, E.J. Bos, J. Wolff
Partner: VU University Medical Centre

A new process for total ear reconstruction is being developed at the VU University Medical Centre, Amsterdam. The current ear reconstruction process involves the sculpting of a scaffold which is then wrapped in skin to form the shape of the new ear. This requires the harvesting of large amounts of rib cartilage needed for the construction of the ear scaffold, and only limited personalization of the new ear scaffold is achievable. In the new process, the patient's remaining ear is 3D-scanned, after which a standard parametric implantable model of a scaffold is adjusted to fit the 3D scan. This model is then 3D printed and used in the reconstruction of the ear.

In this project, we developed the scaffold further, focussing on fitting the parametric model to the scan data. Based on an existing model made by a previous graduation student, the parametric model was developed further using the Rhinoceros3D plug-in Grasshopper. We also developed a MATLAB program, along with a simple-to-use graphical user interface.



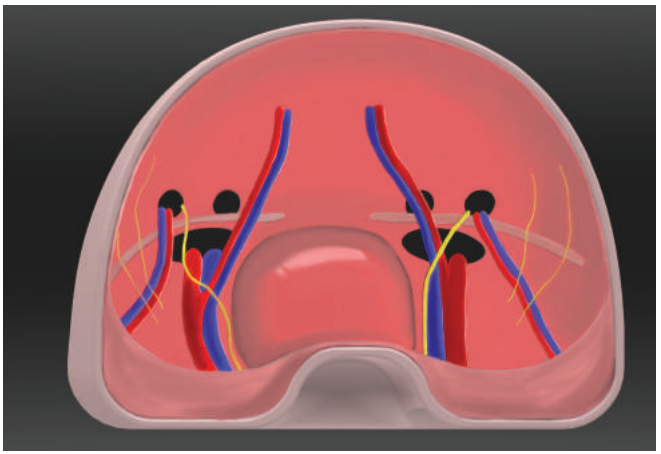

STORZ
WideView

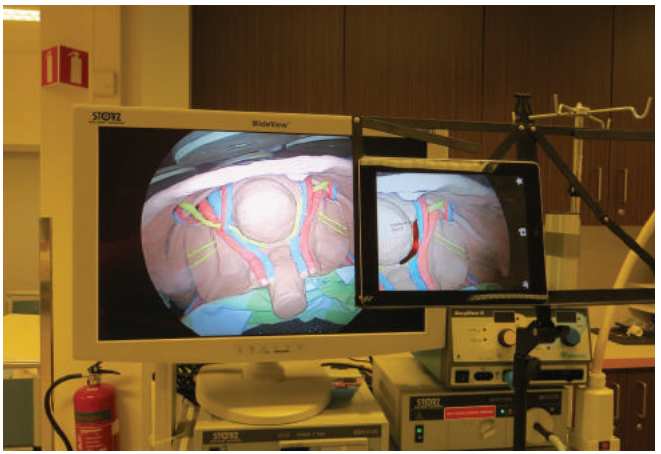
ARTEP: INGUINAL HERNIA TRAINING MODEL USING AUGMENTED REALITY

Graduate: R.W. van Vliet (2013)
Supervisory team: R.H.M. Goossens, M. Hajian, G.J. Kleinrensink
Partner: Erasmus Medical Centre

Currently, it is difficult to train doctors on the most frequently applied techniques for minimal invasive inguinal hernia repair procedures, laparoscopic hernioplasty using the Totally ExtraPeritoneal (TEP) approach. TEP improves recovery time compared to conventional open care methods. Doctors can currently only practice this procedure using training models, simulators and human cadavers, however their availability is limited and the costs involved are high. Most doctors therefore perform their first actual practice directly on patients, although they have limited knowledge of the procedure and limited experience in the use of laparoscopic instruments.

ARTEP is a physical model that represents the human anatomy of the groin region in an abstract way. It provides the user with a physically correct representation of the human anatomy, enabling users to practice the most important aspects of the TEP learning procedure: recognition of the structures and landmarks, movement of laparoscopic instruments and manipulation of structures in the preperitoneal space, practicing hand-eye coordination using 2D feedback provided by the display while doing a 3D manipulation of the laparoscopic instruments, and placement of the hernioplasty mesh. Additionally, ARTEP uses augmented reality to teach the user about important aspects of the structures which are part of the anatomy of the groin region.



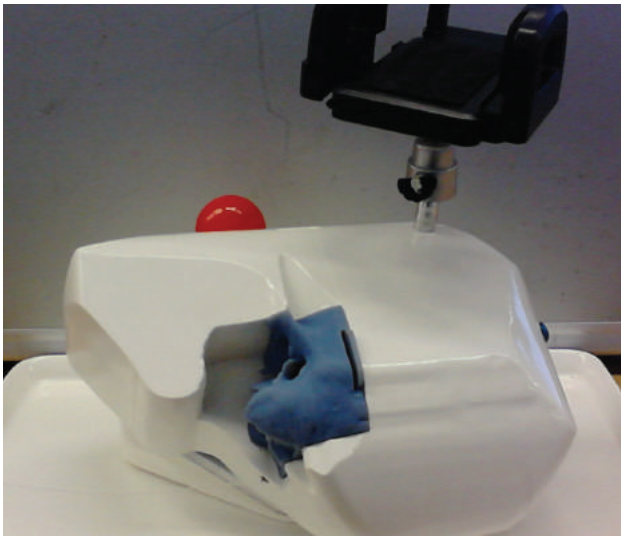


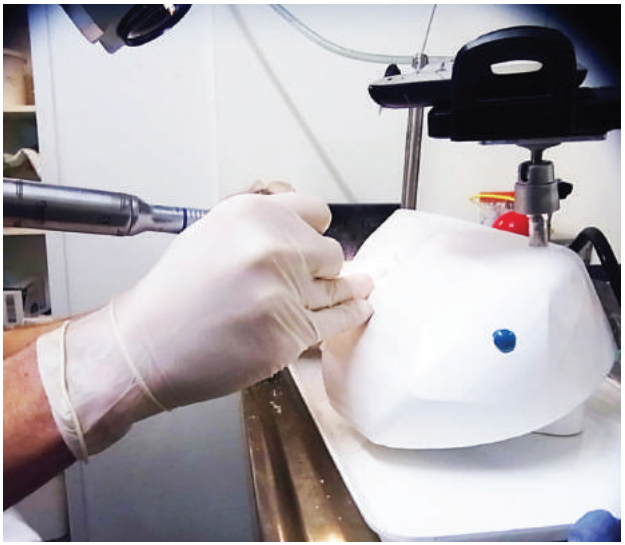
TEMPORAL BONE SIMULATOR

Graduate: A. Füzy (2014)
Supervisory team: R.H.M. Goossens, M. Hajian, R.M. Metselaar, G.J. Kleinrensink, V. Kleinrensink
Partner: Erasmus Medical Centre

This graduation project is about radically re-thinking the approach to presenting patient characteristics in order to support both the learning process and medical procedures of otology residents. The main objectives were to design a product which gives them additional practice opportunities and to provide feedback on drilling skills.

The final concept was designed and developed to discover the advantages of an artificial temporal bone simulator above practicing on cadaveric temporal bones. CT-scans were converted to create an artificial approximation of a temporal bone. The simulator is expected to be useful for both practicing and providing objective feedback on drilling skills. Initial results show that the simulator helps otology residents to practice, in particular at early stages of their residency.



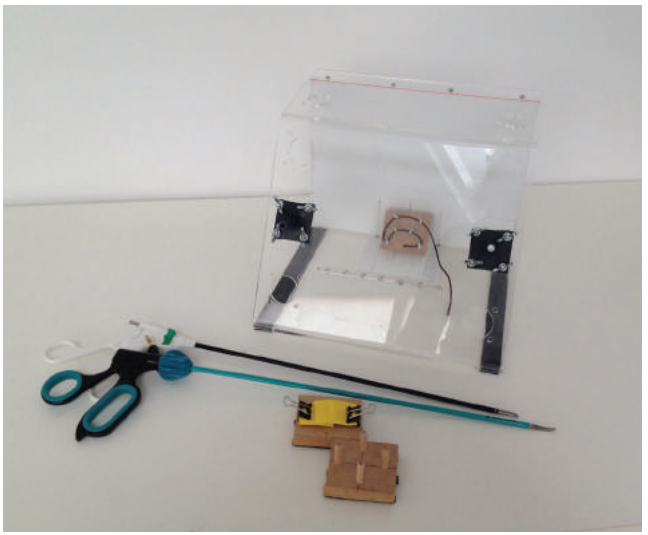


HAPTIC LEARNING TOOL FOR THORACOSCOPIC SUTURING

Graduate: D.G. Feldberg (2014)
Supervisory team: R.H.M. Goossens, M.H. Sonneveld, G.J. Kleinrensink
Partner: Erasmus Medical Centre

Thoracoscopic surgery and laparoscopic surgery are related members of the Minimal Invasive Surgery (MIS) family. Both forms of surgery benefit from simulated practice, and surgical simulation is now part of many surgical programs. The aim of this project was to develop a low-cost box trainer for first year surgical residents.

First, experienced surgeons were interviewed to model the skill of intracorporeal suturing in thoracoscopy. The final design is a simple, low-cost, personal, portable, durable, non-collapsible home-based box trainer made in transparent Perspex. This Haptic learning tool provides a structural process for acquiring skills required for intracorporeal suturing in a video-assisted surgery setting. Trainee surgeons can use the tool to practice either partial and/or complete tasks of intracorporeal suturing. It provides both direct and indirect views of the lesion area, using a smartphone as an imaging source. In this way, the haptic learning tool helps first year surgical residents develop the skills they need to master. The tool includes multiple ports for introducing instruments, and can be used for training both thoracoscopy and laparoscopy skills.



DESIGN FOR PROFESSIONAL SKILLS

IMPROVING TEAMWORK IN ORTHOPAEDIC SURGERY

Graduate: G. Anastasiadis (2013)
Supervisory team: M. Melles, C.C.M. Moes, S.B.W. Vehmeijer, J. Lancaster
Partners: Zimmer Biomet, Reinier de Graaf Hospital

The quality of teamwork during surgery has a huge impact on the quality of cure and, consequentially, on patient outcome. This project is about teamwork during orthopaedic surgery and how products can impact and facilitate teamwork. Starting from preliminary literature and field research a focused design goal was formulated: Advance teamwork during orthopaedic procedures by making the scrub staff work in a more proactive manner, fully anticipating the surgical needs.

The concept is a colour coding system that enables the OR team to be fully aware of each operation phase and the instruments needed per phase. The operation is divided into seven phases and each phase is characterised by a particular colour. The team is familiar with the sequence of the colours and when one is projected in the OR, everyone is aware of the current operating phase. The use of the instruments is also colour coded: the plate on which the instruments are placed lights up according to the colour of each phase. This helps the scrub nurse to know which instruments are needed and the exact moment that they have to be provided to the surgical team.

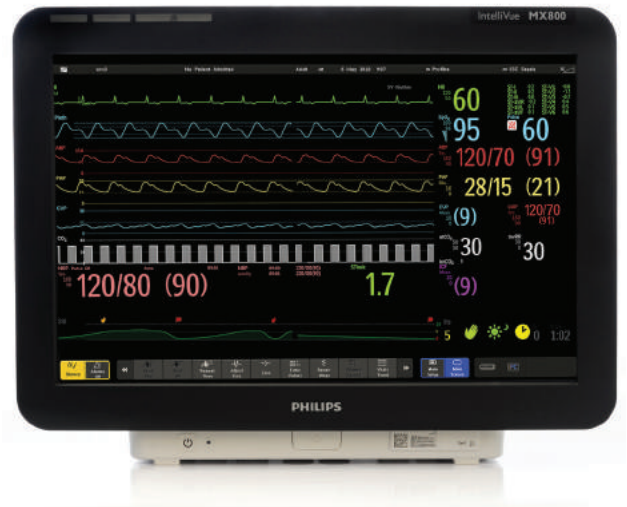
BEING HAPPIER BEING QUIETER: REDUCING NOISE IN THE ICU THROUGH STAFF BEHAVIOURAL CHANGE

Graduate: K. Leuschner (2013)
Supervisory team: M. Melles, P.M.A. Desmet, M. Park
Partner: Philips

Noise reduction in the Intensive Care Unit (ICU) is an important goal as it impacts the health and comfort of critically ill patients as well as the health and concentration of staff. Research shows that a considerable amount of noise produced in the ICU can be influenced by the staff themselves. However, until now no noise reduction interventions are available that sustainably change staff behaviour. In this project, we set out to change this by creating a design that makes ICU staff happier when being quieter.

Field research and iterative design resulted in the final concept, called the Silence Level. Before use, staff are encouraged to reduce noise through education. The concept then enables staff to monitor the silence level during their routine, via integrated and ambient feedback in effective locations.

The silence level motivates staff positively because the focus is on creating silence instead of avoiding noise. Furthermore, the silence level refers to patient health and comfort, which also motivates staff to take different actions to improve the silence level, and gives them the ability to act immediately. The evaluation of a working prototype with ICU staff showed that the design worked as intended. The next step in the development is a long-term test in an ICU.



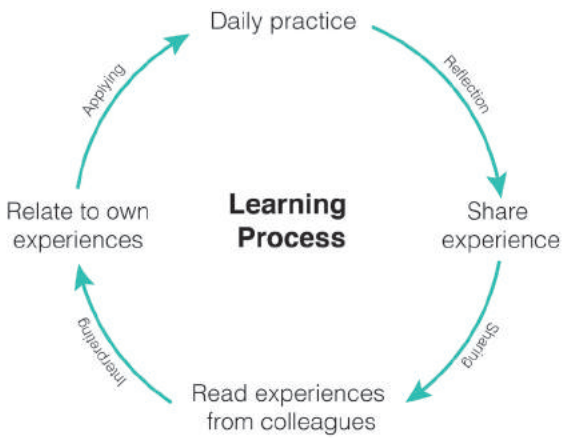
INTERACTING WITH PATIENTS AND PARENTS IN PAEDIATRIC ONCOLOGY

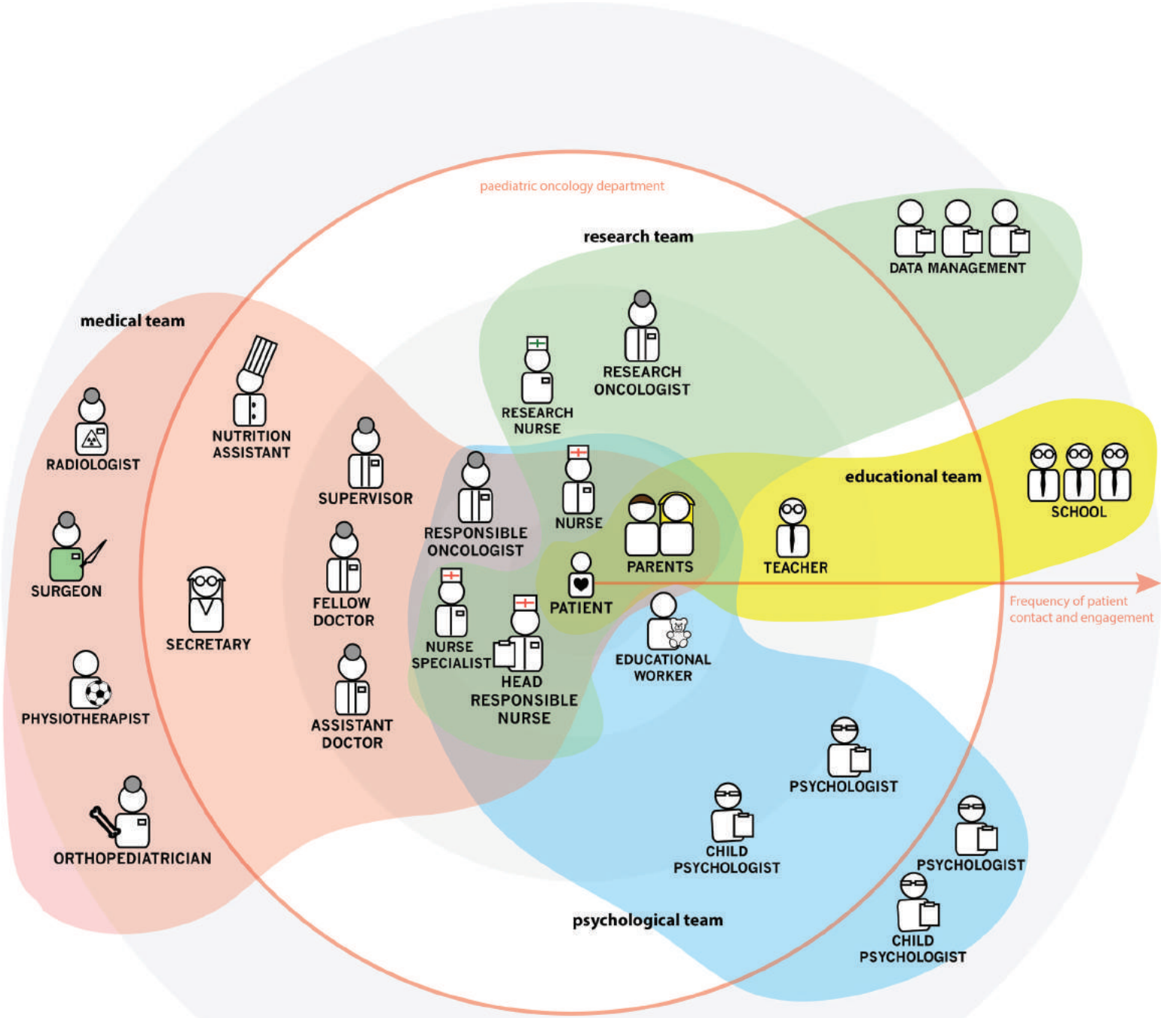
Graduate: A.G. Heikamp (2013)
Supervisory team: M. Melles, C.F. Cuijpers, M. Lakerveld
Partner: Princess Máxima Centre for Paediatric Oncology

In this graduation project, the interaction strategies of paediatric oncology nursing staff in challenging situations were investigated that occur when interacting with patients and/or their parents. The goal of this project was to define design opportunities for supporting the paediatric oncology nursing staff in such situations.

First an overview was created for the nursing staff of all the insights found to make them recognize specific behaviour and present them possible interaction strategies. A second overview was created for designers of situations where and how nursing staff could be supported.

Three design directions are defined to support paediatric oncology nursing staff in their interaction with patients and parents: (a) when explaining the importance of (continued) parenting when a child has cancer, (b) in their communication with patients and their parents from other cultures, and (c) to support novice paediatric oncology nursing staff when learning the strategies needed to handle challenging situations from more experienced colleagues. The resulting directions and requirements for future design aim at supporting the paediatric nursing staff in a way that the child feels physically and emotionally safe, improving the therapeutic process.




paediatric oncology department
research team
DATA MANAGEMENT
medical team
RESEARCH ONCOLOGIST
RESEARCH NURSE
NUTRITION ASSISTANT
RADIOLOGIST
SUPERVISOR
RESPONSIBLE ONCOLOGIST
NURSE
educational team
SCHOOL
SURGEON
FELLOW DOCTOR
PARENTS
TEACHER
PATIENT
SECRETARY
NURSE SPECIALIST
HEAD RESPONSIBLE NURSE
EDUCATIONAL WORKER
Frequency of patient contact and engagement
PHYSIOTHERAPIST
ASSISTANT DOCTOR
PSYCHOLOGIST
CHILD PSYCHOLOGIST
PSYCHOLOGIST
ORTHOPEDIATRICIAN
psychological team
CHILD PSYCHOLOGIST

PARENTAL INVOLVEMENT IN PAEDIATRIC ONCOLOGY TEAMWORK

Graduate: T. Sarri (2014)
Supervisory team: M. Melles, M.S. Kleinsmann, M.D. van de Wetering
Partner: Princess Máxima Centre for Paediatric Oncology

The Princess Máxima Centre aims to be the largest paediatric oncology centre in Europe, with a focus on research, education and, most importantly, excellent care. To achieve this, the care process is envisioned to be built around patients ánd their family. This means that parents should be actively involved with the care team in order to achieve an optimal flow of information and knowledge about their child. But how do you involve people who don't have a medical education in a meaningful way? And, most importantly, how do you get the rest of the team to acknowledge the parents' value?

Different ways to improve teamwork and parental involvement have been explored during this project. Based on literature and user research, problems and issues related to medication intake were taken as starting point for further design work. The final concept consists of a magnetic board which can be hung in the patient's room and a set of magnets in different forms. The magnetic board is a graphical representation of Russell's core-affect model that plots and categorises human emotions. The magnets represent different types of medication that the patient has to take. By placing the magnets according to their child's attitude towards that particular type of medication, parents can communicate the emotional responses of their child. Depending on their expertise, doctors, nurses, educational workers and other members of the team can react on this information. This way the product serves as a communication starter.

PALLAS: INCREASING RESILIENCE OF CAREGIVERS IN PAEDIATRIC PALLIATIVE CARE

Graduate: S.W. Klok (2014)
Supervisory team: M.H. Sonneveld, M. Melles, S. Vallianatos
Partner: Stichting Pal

Each year, 5000-7000 children in the Netherlands with a life-threatening or life-limiting illness are eligible for palliative care. This care aims to improve the quality of life for both the children and their family in these last days, months or years. Providing palliative care and supporting these families is an intensive job. A close and trustful relationship is needed between the caregiver and the child/family to provide good care. Given the physical, psychological and spiritual problems of the children, this relation can be long-lasting, intense and emotional, making providing this care a demanding job.

The Pallas helps caregivers to deal with the issues and challenges of their demanding job by helping them explore their feelings and reflect on them. This is currently often overlooked because of a lack of awareness of the importance of reflecting on emotions. In addition, caregivers often do not know how to properly reflect and where to start. The app consists of small tasks that use a combination of presets, suggestions and open questions to make sure that different types of caregivers with different levels of experience are able to tell their story and explore their feelings.

SUPPORTING NURSES IN PLANNING AND COMMUNICATION

Graduate: R.E. Kooper (2011)
Supervisory team: A. Freudenthal, S.N. Paus-Buzink, M. Melles, H. Jacobs
Partner: helpLine

Nurses who work in care and nursing homes have a high workload as they have to fit a large number of tasks into a relatively short period of time. In addition, this high workload can have a harmful effect on the clients if the nurses who take care of them are in a hurry. The aim of this thesis project was to investigate how an ICT solution could support the nurses in their communication and planning of work, to help them do their work better.

Nurses spend a great deal of their time walking around in large care-homes, as many of the tools they need regularly are stored in different places. For example, the health records of clients are all stored in their individual apartments, and the tools nurses use for administrative work and sharing knowledge amongst each other are located in the nurses' office. Therefore an ICT solution was developed that brings together all the tools the nurses need for communicating and planning their tasks into one web-based application. Nurses carry a tablet computer with them during their shift and use the application for reading and writing information about clients and managing their tasks. The application provides nurses with a better overview of their work and it reduces the time they spend walking. A proper use of the application will reduce nurses' workload, which in turn will also benefit the clients.

FROM DATA TO QUICK DECISIONS: SUPPORTING PAEDIATRIC CRITICAL CARE CLINICIANS IN DECISION MAKING

Graduate: O.A. Thijssen (2015)
Supervisory team: M.C. Rozendaal, G.J. Pasman
Partner: SickKids Children's Hospital

The department of Critical Care Medicine at SickKids Children's Hospital (Toronto, Canada) is a place of continual change. The most vulnerable patients can be found here, surrounded by monitoring devices, intravenous pumps and life support systems. Sudden changes in these patients' physiological states require clinicians to make quick decisions concerning their treatment. However, the wide range of monitors makes it more complex for them to see, analyse and interpret the right data. Clinicians therefore often have to calculate things directly and make quick and efficient decisions, mainly based on their expertise.

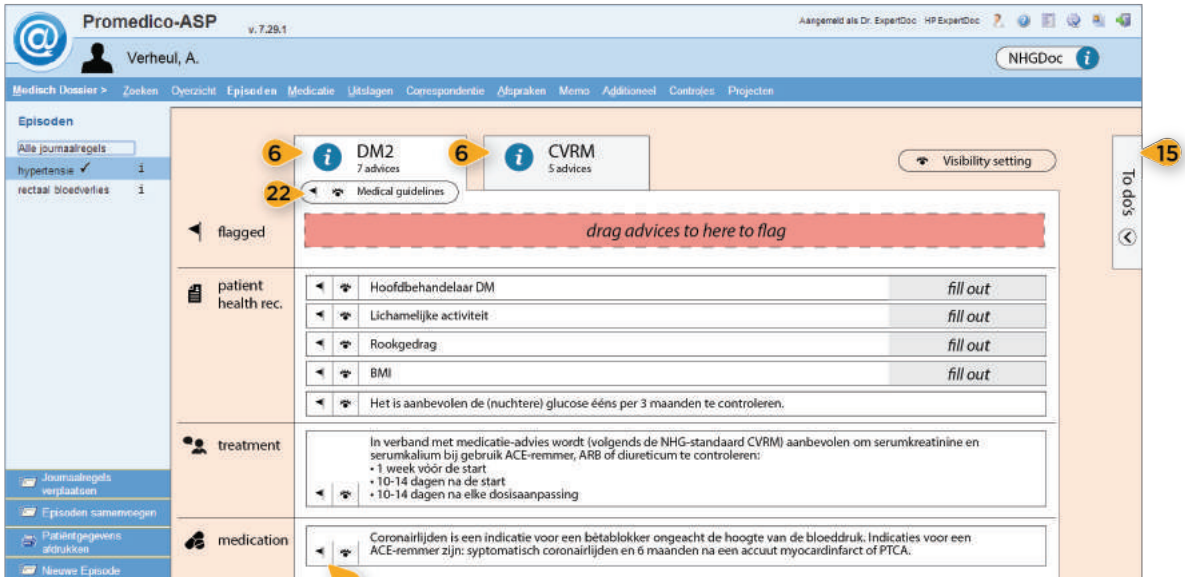
To facilitate clinicians in their decision making, the hospital adopted the T3 system. However, in practice, it is not used by the majority of clinicians. One assumption is that the system is not very user friendly, which resulted in the initial aim of this study: to redesign T3 in such a way that it is easy for the target group to use. Later on, additional goals were added, for example adding more system functions and exploring conceptual scenarios for its future use.

CLINICAL DECISION SUPPORT SYSTEM FOR GENERAL PRACTITIONERS

Graduate: H.J.S. Bakker (2014)
Supervisory team: T. Boersema, E. Haagsman, M. Stavenga
Partner: ExpertDoc

This project describes the redesign of NHGDoc, a clinical decision support system (CDSS) that supports Dutch GPs in their decision making process by providing patient-specific medical advice with regard to medication, treatment and diagnosis. NHGDoc is integrated in the GPs' EHR provider, a supportive computer program to document, transfer and evaluate care that is given to patients. A majority of all potential NHGDoc users are either moderately active and/or inactive users. The main goal of this project was: "Redesign NHGDoc to improve the quality of interaction and user experience, and make the tool fit within the GPs' workflow in order to increase the number of active users."

The design proposal consists of two main features: the NHGDoc medical advice and the NHGDoc To-Do lists. The purpose of the new functionalities is to support the GP in finding information that is most relevant, without spending too much time reading through an extensive list of advice. This is important to make sure GPs are not hindered in their work. By placing an NHGDoc button behind the patient's name in the agenda overview, the GP is motivated to view advice before the consultation starts. This ensures that the GP can focus more on the patient instead of the computer during the consultation. The purpose of the To-Do functionality is to allow GPs to postpone viewing advice, in case there is no time to process it directly. Moreover, the To-Do functionality allows GP's to delegate tasks to colleagues.



CLEAR AND FUDGEABLE ELECTRONIC HEALTH RECORD

Graduate: T. de Bruijn (2015)
Supervisory team: J.I. van Kuijk, M. Melles, J. Gent
Partner: Medicore

In the hospital environment, medical staff are greatly dependent on each other and on external resources. However, physicians' time is limited and they often have to deal with too much data while they only need an overview or a specific insight. To improve the information flow, medical staff require an application that provides a clear overview, and that is fudgeable: allowing the user to do things out of order, or without fulfilling all prerequisites.

The scope of the final concept was based on that of medical staff "doing the rounds": Each morning in the hospital, a physician, resident and nurse visit each patient to plan and discuss what they are going to do to treat that patient. Our application provides physicians or residents with all the information needed per patient, and allows them to note the results of the 'round'.

The new application includes an overview of all relevant patients, details of a specific patient, new data and steps to be taken, and an overview of what still needs to be done.

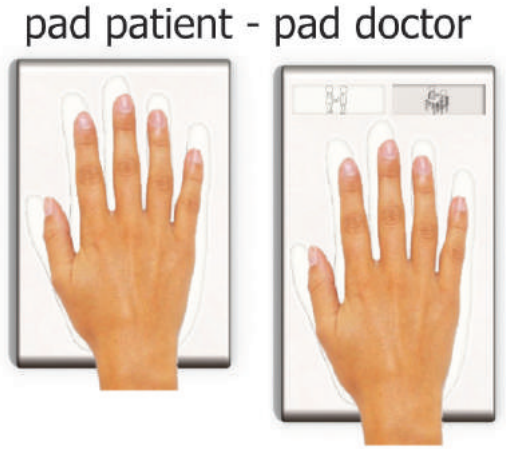
The project design resulted in a small web application that was tested on both desktop and tablet. Although this was something very different from what the test users were used to, the interface and the underlying concepts were quickly understood and worked well, enabling the users to accomplish their goals. It shows that thorough user research together with structural system and information architectural design are the necessary groundwork for creating practical software for use in a complex environment like a hospital ward.

HANDMATE: AFFECTIVE COMMUNICATION IN VIDEO CONSULTATION

Graduate: B. de Groot (2010)
Supervisory team: H. de Ridder, P.E. Esser
Partner: Delft University of Technology (internal research project)

Video communication technology is currently being used for teleconsultations between doctors and patients. This is a promising solution. However, nonverbal behaviours like body posture and touching, are important bearers of emotional messages, but are difficult to achieve or distinguish on video. Therefore, there is a need for a product to enable affective communication in teleconsultations, with a focus on touch.

An important aspect of affective communication between doctor and patient is the handshake at the start and end of a normal consultation. This led to the design of Handmate. The doctor and patient both have a pad, and when the doctor and patient both put a hand on their pad, the screen shows a visualization of two figures shaking hands. The doctor and patient can both initiate a handshake and decide on the duration of the handshake. After the handshake, the doctor can switch to the conversation mode, with a full screen webcam of the patient. Handmate gives the teleconsultation structure and clarity; it helps to establish rules of conduct. The doctor and patient can greet each other which helps to reassure the patient and enables the doctor to show interest and empathy. In this way, the interaction between doctor and patient is stronger and more personal.



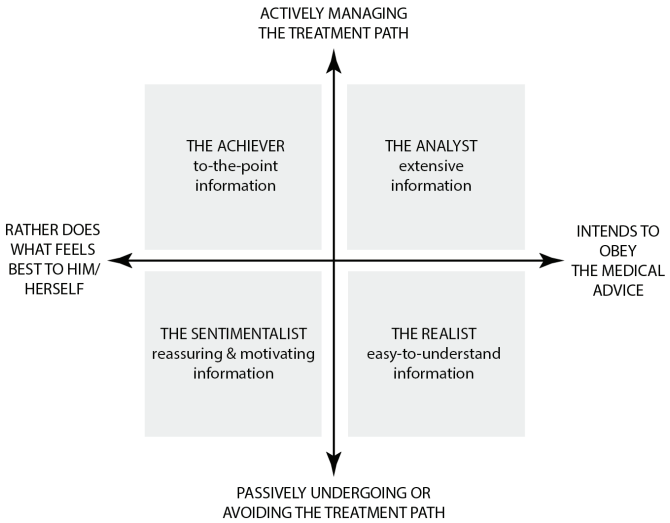
BICONNECT: TAILORING MEDICAL CONSULTATIONS IN ORTHOPAEDICS

Graduate: R.S.A. van den Berg (2014)
Supervisory team: M. Melles, F. Sleeswijk Visser, J. Lancaster, S.B.W. Vehmeijer
Partners: Zimmer Biomet, Reinier de Graaf Hospital

Managing patient expectations within a 10-minute consultation is challenging. The assignment in this graduation project was to develop a product or service that helps orthopaedists and patients effectively discuss the patient's personal expectations of the rehabilitation period. Ultimate aim is to have the patient develop realistic expectations resulting in confident and responsible rehabilitation behaviour.

The BiConnect is an application providing tools and visuals to support the explanation of treatment options and to discuss the patient's personal expectations during orthopaedic consultations. The application is tailored towards four patient types, mainly based on their coping behaviour during rehabilitation: the achiever, the analyst, the realist and the sentimentalist.

The application is used by patients as well as orthopaedists at different touch points throughout the patient experience journey. The patient has a digital intake that contributes to a better preparation of patient and orthopaedist. During the consultation BiConnect serves as a supportive tool for communication and after the consultation patients can review personal advice given during the consultation and look up more information.



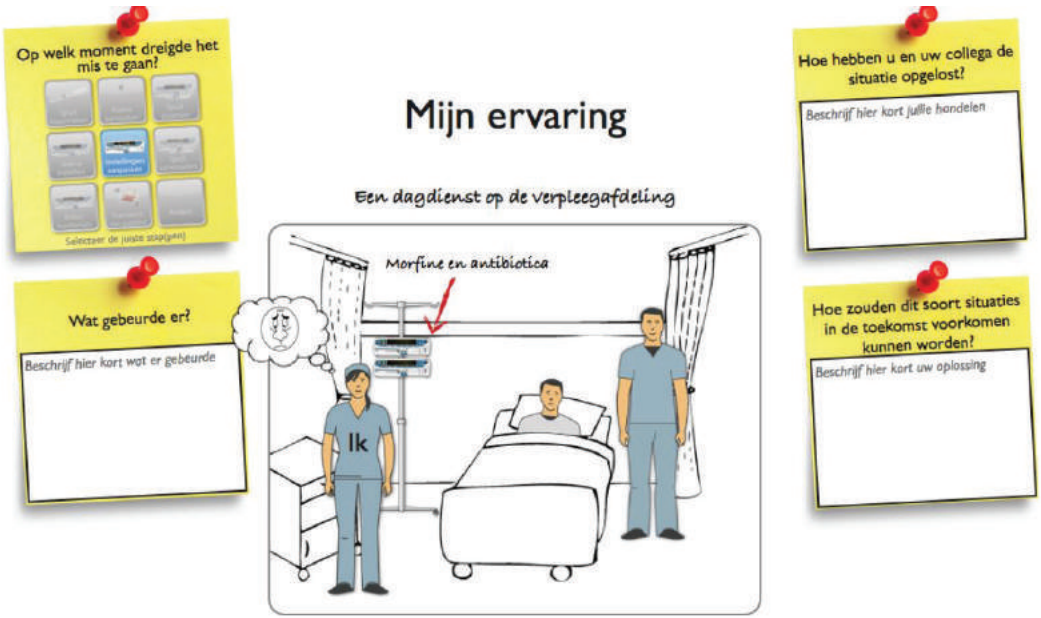

Active lifestyle
High pain level
Moderate physical activity
Moderate desires
CONTEXT
50-65 age group
living together with partner in private house
heavy labour
Police officer
gardening
swimming
PAIN
pain occurs in groin
pain radiates to front upper leg
6-7 pain level
much difficulty with putting on shoes
no pain in back
2012 pain started years ago
PHYSICAL ACTIVITY
<1 exercise time hours/week
controlled fitness
30-90 minutes able to walk without pain
sometimes walks with support
DESIRES
better work situation
gardening
play tennis
sleep without pain
improved social life
SELECT ALL TOPICS

BETTER LEARNING - BETTER CARE: MEDICAL EQUIPMENT E-LEARNING

Graduate: E.R. de Vroome (2012)
Supervisory team: V.T. Visch, M. Melles, P. Bosman
Partner: The Competence Group

Due to legal or institutional requirements, nurses have to take exams to maintain their accreditation, confirming that they are qualified and/or competent to use medical devices. Medical equipment e-learning has been developed to facilitate nurses with the knowledge and skills needed to pass the examination. Most e-learning modules, however, are designed on the basis of protocols, so there may be a gap between the knowledge and skills acquired from the e-learning programme and daily practice. This gap reduces nurses' motivation to use the e-learning programmes, and therefore has a negative influence on the learning effect. The aim of this project was to develop a generic game-based addition to the medical equipment e-learning programme to increase nurses' learning motivation.

'My experience' is a new e-learning module that focuses on sharing personal experiences from daily practice. The learner is asked to choose a medical device and share an experience about a situation that could have had serious consequences, but somehow an intervention occurred, either by the learner and/ or a colleague. The chosen device should play a role in the situation. Sharing the experience can be done using six multiple-choice questions and six open questions. While answering the questions, a visualization of the given answers is shown. After sharing the personal experience, the learner is offered two experiences shared by colleagues about the same device.

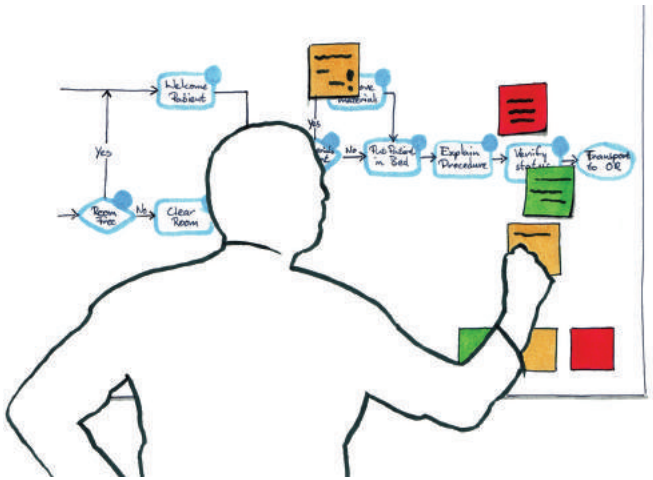


CONTEXTMAPPING IN A HEALTHCARE ENVIRONMENT

Graduate: O. van Biessum (2015)
Supervisory team: J. Buijs, J.R. Mejia Sarmiento, K. ter Borg, M. Stassen
Partner: MEDD

The project 'Contextmapping in a healthcare environment' was conducted for MEDD, a small design agency aiming to improve healthcare by design. The brief for this project was to provide heads of departments in a healthcare institution with a tool to help them create a general overview of the department using contextmapping principles.

The final concept, called Onze zorg beweegt ('Our care in motion'), is a roadmap consisting of three phases. The first is called 'Paper Tools', a thematic guidebook addressing a specific theme chosen by the department. It guides the employees through the theme and helps them give each other feedback. The second phase is called 'On the Wall'; this is a large wall display featuring one of the departments' (sub)processes. It allows both employees and patients to provide feedback on the steps in the process. The third phase is 'Going Digital'. It extends the first two phases into the digital environment consisting of a smartphone and tablet application and a computer front end. This allows the department head to engage with employees and monitor different aspects of the department.



DESIGN FOR PATIENT EMPOWERMENT

ENGAGING BREAST CANCER PATIENTS IN THEIR TREATMENT PLAN

Graduate: M. Lieverse (2013)
Supervisory team: H. de Ridder, M. Melles, P. Dadlani
Partner: Philips

Breast cancer is the most common type of cancer in women. Currently, it affects 1 in 8 women in the Netherlands, and this number is slowly rising. The literature shows that patients experience a higher satisfaction about their treatment pathway if they were highly involved in the process. The underlying aspects that support this statement are the feeling of control and empowerment. Another indicator that influences the satisfaction rate of the patient is the quality of their relationship with the medical staff.

BCAid aims to increase patient involvement by supporting the patient in the diagnosis phase. User studies pointed out that in particular preparation and guidance affect patient involvement during this phase. BCAid enables the patient to prepare at home by providing access to a webpage which visualises the patient's appointments and provides practical information about the treatment. In addition, a 'personal profile', 'messages' and 'notes' menu options have been added. Patients can review their medical team and are able to send messages to them. On the day of diagnosis the patient is offered a tablet for use by the hospital. The 'navigator' function guides the patient throughout this day by sending reminders, notifications, receiving messages from the mamma care nurse, and by showing the patient where she is.

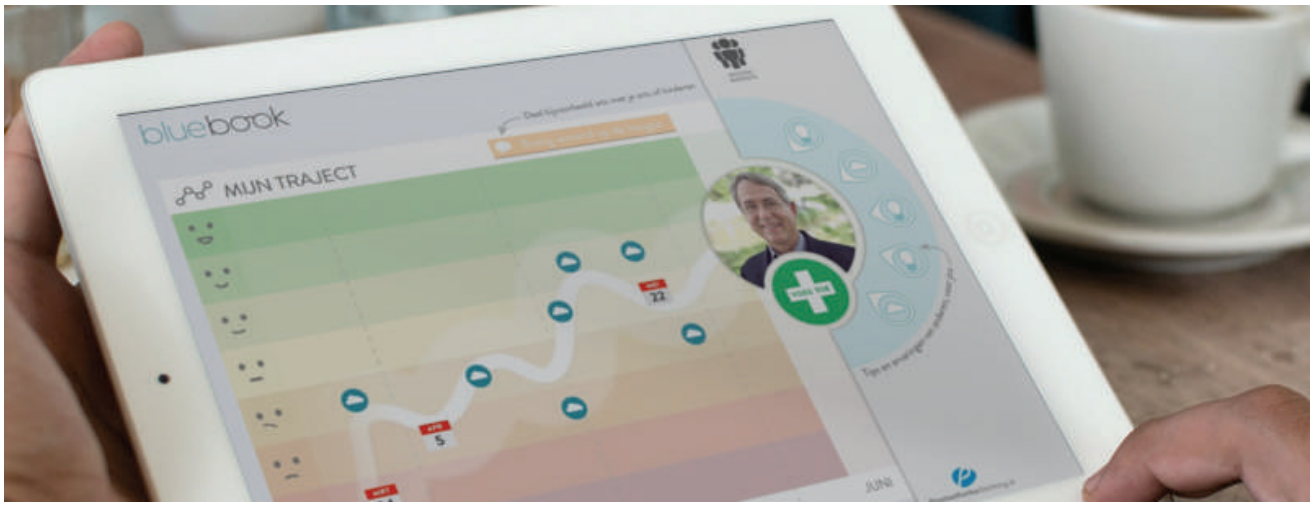
BLUEBOOK: AN INTERACTIVE JOURNAL FOR THE EMOTIONAL WELL-BEING OF PROSTATE CANCER PATIENTS

Graduate: J. van Kruijssen (2013)
Supervisory team: G.J. Pasman, J.C. Jimenez Garcia, B. Corporaal
Partner: User Intelligence

Prostate cancer is the most common type of cancer among men. Every year, approximately 10,000 men in the Netherlands are diagnosed with prostate cancer. If the emotional well-being of prostate cancer patients is enhanced, the likelihood and significance of emotional distress, depression and anxiety can be reduced, greatly improving their overall quality of life. Reducing the emotional disruption could also prevent any need for additional psychosocial care, which could lead to a reduction in healthcare utilization and costs.

The main goal of this project was to develop a successful eHealth solution that could reduce the emotional disruption among men with prostate cancer and support them by giving them a sense of control. User research showed that patients greatly appreciate physician empathy. Patients also appreciate sharing prostate cancer experiences with peers; it supports them in making decisions. Another issue is that the quantity of information received was found to be overwhelming.

These insights led to the creation of the Bluebook, an online journaling platform for prostate cancer patients. It enables them to record, collect and reflect on their cancer related experiences, inform others about these experiences, and discover relevant experiences from their peers. With Bluebook, the patient is able to inform his care provider(s) about the ins and outs of his personal situation anytime, anywhere. Patients are able to share (parts) of their collected experiences with family and friends, and thereby more easily recount the bigger picture to different people.



IMPROVING THERAPY ADHERENCE

Graduate: J.A. Vlieland (2014)
Supervisory team: H. de Ridder, T. Wiegers, O.W.R. van Dijk
Partner: Medicine Men

Therapy non-adherence can be defined as the extent to which the patient's behaviour does not match that of the agreed recommendation made by the prescriber. Non-adherence can result in reduced health and can even cause death. In addition, non-adherence adds to health care and industry costs, and wastes resources. The design goal was to develop a smart watch application to improve therapy adherence of chronic patients by supporting patients who experience difficulties in remembering to take their medication and/or fitting their intake moments into their daily routines.

Emma is a medication monitoring system which consists of three components: a smartwatch app (watchapp), a smartphone app and an online dashboard. The Emma watchapp alerts users when they should take their medication. The smartphone app is mainly used as a bridge between the smartwatch and online dashboard. It transfers the data received from the smartwatch (via Bluetooth) to the cloud server (via an internet connection). The main functions are available using the iPhone. Via the online dashboard, both the patients and their family or healthcare professionals (e.g. general practitioners and pharmacists) can access the patient's medication data, provided permission has been given.

PREVENTING SOCIAL LONELINESS AMONG PEOPLE WITH CHRONIC HEART FAILURE

Graduate: S. Shen (2015)
Supervisory team: A.P.O.S. Vermeeren, M.M.M. van Dooren, E. van de Garde-Perik
Partner: Philips

Philips is developing a people-centred, technology-empowered "Hospital to Home" ecosystem to improve people's well-being and enable them to live healthy lives at home as long as possible. This design project was initiated to focus on the aspect of preventing social loneliness, a risk in home healthcare, as patients may have less social encounters. The project's target group was chronic heart failure (CHF) patients.

Research was performed to answer the two main questions: (a) What causes social loneliness in relation to chronic heart failure? and (b) What is the design space for the support to tackle these causes? Patients and experts from different domains were involved in the research. The research findings show that social loneliness cannot be prevented by tackling a single issue; it is related to both the individual and society.

The final design, 'Goedendag', is a product service system which enables patients to better manage their daily activities by being active within their capability zone and getting to know their energy levels. In addition, the system can give activity inspirations based on users' personal interests and beliefs in order to help them 'be themselves' while coping with the limitations of their condition.

PREPARING HOSPITALISED HEART FAILURE PATIENTS FOR THE ANAMNESIS INTERVIEW

Graduate: R.J.C. Görtz (2013)
Supervisory team: H. de Ridder, A.P.O.S. Vermeeren
Partner: Philips

Heart failure patients suffer from a complex chronic condition and require specifically tailored care to improve or maintain essential treatment adherence and active self-management of their health condition. By achieving this, they will have an increased life expectancy and their hospitalisation costs will be lower. The goal of this project was to design an interactive system that increases patient involvement in the development of their personal care plan during hospitalisation.

Through an iterative process and close cooperation with medical staff, an application was developed to demonstrate how hospitalised patients could be better involved in the nursing anamnesis interview. The most important design challenge was to find a balance between simplicity of exercise and meaningful sensitisation of the user. The final design can be used by patients independently and directly from their beds, on the interactive terminal in their hospital room. The application helps to sensitize the patient for the personal subjects included in the anamnesis interview, and supports them when discussing their narrative with the nurse. The design facilitates these goals by providing specific self-reflection exercises that help the patient to understand and communicate their personal perspective in an easily accessible manner.

In comparison with the current anamnesis approach of asking explicit questions, patients can now discuss personal information more freely and from their own interpretation of the anamnesis subjects. This leads to a more natural, in depth conversation with the nurse. With this input, the care team is able to provide care that better suits the patient's personal situation.

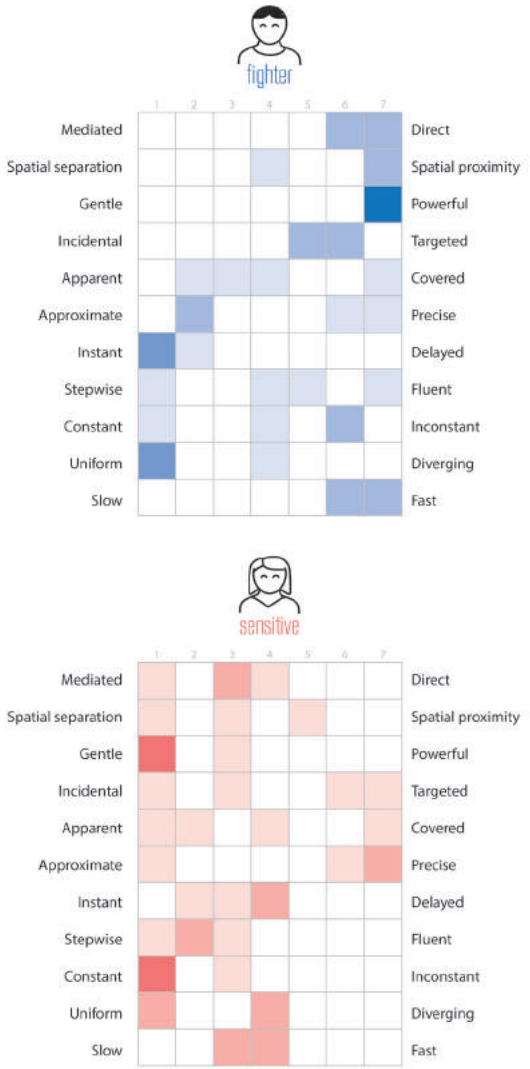
TAILORED REFLECTION AND INTERACTION FOR COPD PATIENTS

Graduate: F.M.M. den Blanken (2014)
Supervisory team: H. de Ridder, N.A. Romero Herrera, T. Visser
Partner: Philips

Western healthcare systems are currently facing the challenge of improving therapy outcomes while, simultaneously, managing costs. Finding effective ways of engaging patients in their own health practices is the main ambition of the Patient Engagement project within the Philips Research Healthcare Program.

This project focuses on patients who suffer from chronic obstructive pulmonary disease (COPD) and aims to improve their therapy adherence and experienced quality of life. The vision of the project is that therapy adherence can be improved by tailoring the instructions and therapy feedback to the patients' individual motivational drivers and communication preferences. To enable a large-scale tailored therapy, Philips has identified five types of patients, and has described the principles for effective communication for each type. The resulting method, called BIG (Behavioural Influence Gear), has become the main philosophy of the Philips' Patient Engagement project. In this study, the student explored the interaction principles towards the different profiles identified by BIG. These interaction aesthetics describe eleven dimensions on which an interaction can differ.

The final design is an application that helps patients to plan their day according to the amount of energy they have for that day. By planning their day and reflecting on their planning, the COPD patients learn to cope with their disease at different levels. From the different user type evaluations, we can conclude that communication plays a greater role than does interaction aesthetics. However, the two complement each other well, as was illustrated by the final design.



FROM EMERGENCY DEPARTMENT TO ACUTE MEDICAL UNIT: OPTIMIZING THE PATIENT EXPERIENCE JOURNEY

Graduate: A.T. Langeveld (2015)
Supervisory team: M. Melles, F. Sleeswijk Visser, F. Boer, C. Lagers-Dresselhuys
Partner: Leiden University Medical Centre

The awareness that hospitals have to focus on patient experience and satisfaction as well to improve their services is growing more and more within the healthcare domain. This project aims to generate insights into how patients experience their hospital stay and how design can contribute to patient satisfaction. The focus was on patients entering via the Emergency Department (ED) and who subsequently are transferred to the Acute Medical Unit (AMU).

First, a patient experience journey was created which showed that patients can feel helpless when they are not provided with information about their treatment and care path, a finding supported by the literature. Next, a service blueprint was generated to understand how patients are currently provided with information about their treatment. This showed that the information given greatly depends on the care provider and, if provided, this is done verbally. The planning of medical procedures is not communicated well and many of these procedures are invisible to patients. As a consequence, patients can feel insecure about their treatment.

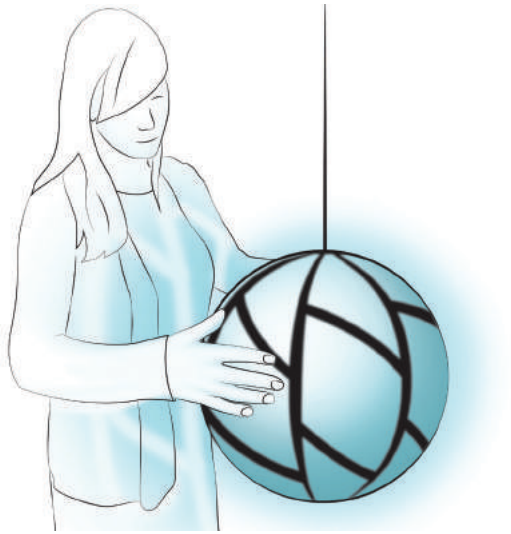
Careline is an application that visualises the patient's care path. It shows the previous, current and next touchpoint steps in a patient's therapy as well as what the patient needs to wait for, as it indicates what is happening 'backstage' in the hospital. For example, it indicates that a blood test has been analysed and that the doctor has evaluated the results. In addition, Careline shows within which time period a touchpoint takes place and it provides substantial medical information in order for patients to know what their treatment path will be.


MS. DEKKER
MY TREATMENT AT THE AMU
CHECK-UPS
EXPLANATION
FLUID BALANCE
TEMPERATURE
BLOOD PRESSURE

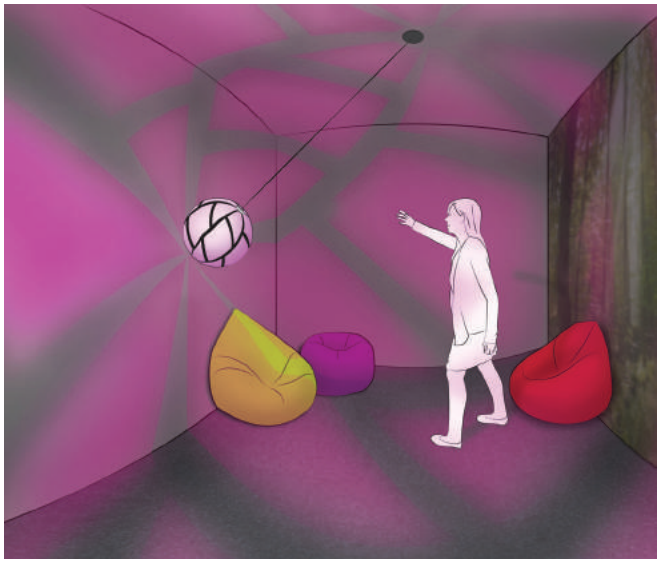
SUPPORTING PSYCHIATRIC PATIENTS IN A PSYCHOLOGICAL CRISIS

Graduate: M. de Rooij (2015)
Supervisory team: M.H. Sonneveld, S.C.M. Brand-de Groot, J. Boots
Partner: Karakter Kinder- en Jeugdpsychiatrie

Karakter, a child and adolescent psychiatric hospital in Nijmegen, the Netherlands, is currently implementing a new work form: high & intensive care (HIC). HIC offers the most intensive treatment when ambulatory care no longer works; patients are admitted when they become a danger to themselves and to others. A new room will be created at the new HIC department: the comfort room. This is where patients can use calming techniques on their own initiative in order to cope with a psychological crisis. The goal of this graduation project is to design a product for the HIC department's comfort room that helps patients to cope with a psychological crisis.



The resulting product enables a patient to punch a ball against the wall, releasing negative energy. The ball reacts to this by making a noise, bouncing back and lighting up brightly. The patient's attention is expected to shift from their negative thoughts to the returning ball. The light enhances this interaction because it changes the whole environment. When the patient focuses on the light pattern, this is expected to bring structure in his or her thoughts. The light eventually fades away if the patient does not interact with it, giving the patient a moment to evaluate their mental state and decide whether they have regained stability.

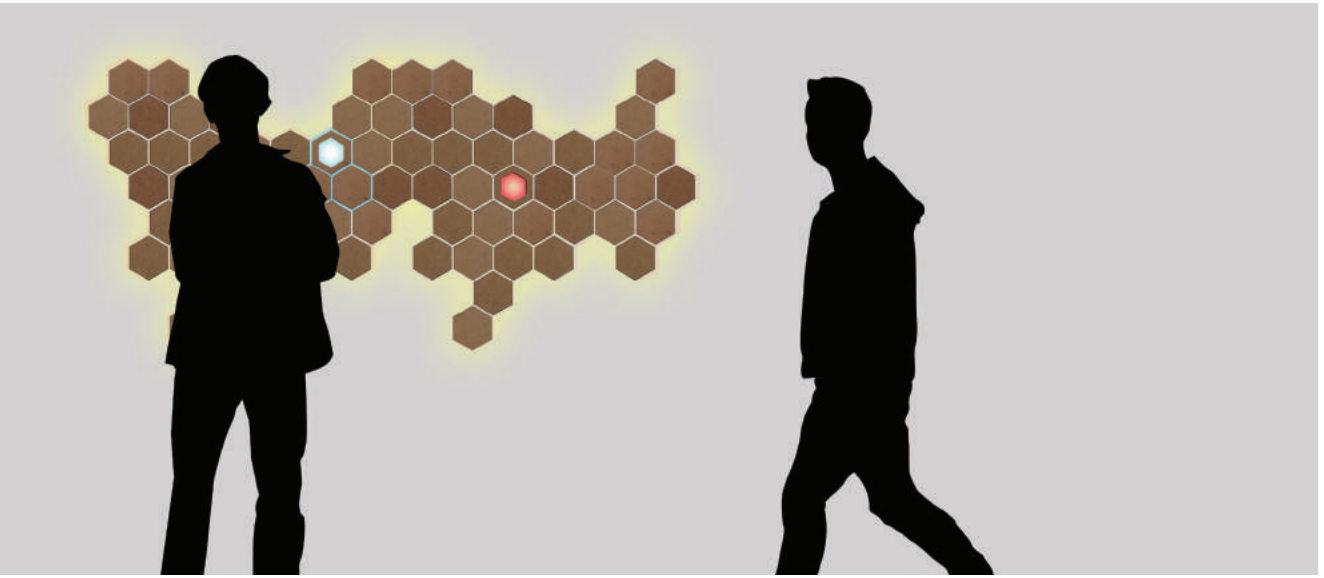


PATIENT EXPERIENCE IN HOSPITAL ARCHITECTURE

Graduate: E. van Dam (2015)
Supervisory team: M. Melles, C. Hao, R. Bouwmeester
Partner: De Jong Gortemaker Algra

This project was started to gain more knowledge on how to design an environment that would contribute to patient-centred care. Patient journeys were created with the help of two hospitals, focusing on the influence of the built environment on the experience of patients visiting an outpatient clinic. Using these journeys, guidelines were developed to provide architects and hospital management with points of improvement when developing a more patient-centred environment. The patient journeys also resulted in the formulation of different directions for product design. We chose to focus on making the patient feel more noticed when visiting the hospital. Hospital staff are often busy and do not always have the time to provide patients with the personal approach they need.

Fade was created to make patients feel welcome when walking into the waiting room. When Fade notices someone entering the waiting room, it lights up and pulses, attracting patients to come over and explore its function. Patients can scan their patient card to check-in. Fade shows them information about their appointment and once they have confirmed this, it displays the waiting time. This is calculated allowing for possible delay, so the time shown to patients is up to date. The panels with information slowly fade towards a different panel on the product. This panel remembers the patient's information and stays lit until the patient enters the doctor's office.



PATIENT EXPERIENCE IN CANCER CENTRES

Graduate: P.J. Verlaan (2015)
Supervisory team: M. Melles, L. Goto, E. de Wilde, P. Kuipers
Partner: Antoni van Leeuwenhoek Centre for Oncology

The incidence of cancer is increasing each year. In order to keep up with this growing group of patients, the Antoni van Leeuwenhoek hospital (NKI/AVL) is currently undergoing a renovation. Patient satisfaction is a primary consideration of this renovation process. The hospital wants to move from a clinical-focussed-design to a patient-centred-design, where the emotions, well-being, peace of mind and satisfaction of the patient are central. 'Integration of after-care' and 'information services for patients' were found to be important areas of improvement.

The Vijver provides patients with a tool to be more in control of their own after care process, without being dependent on the knowledge and skills of their specialist. The Vijver is an interactive floor projection of a pond, in combination with an application. The application can be used on permanent touch screens next to the projection, as well as on the patient's own smart phone and tablet. Stepping stones in the pond each show a dilemma that is experienced as being difficult by cancer patients, for example: 'How do I tell my children about my diagnosis?' With the application, the patient can read about experiences of others, for example how they dealt with the situation, and more information is given about the help or support available.

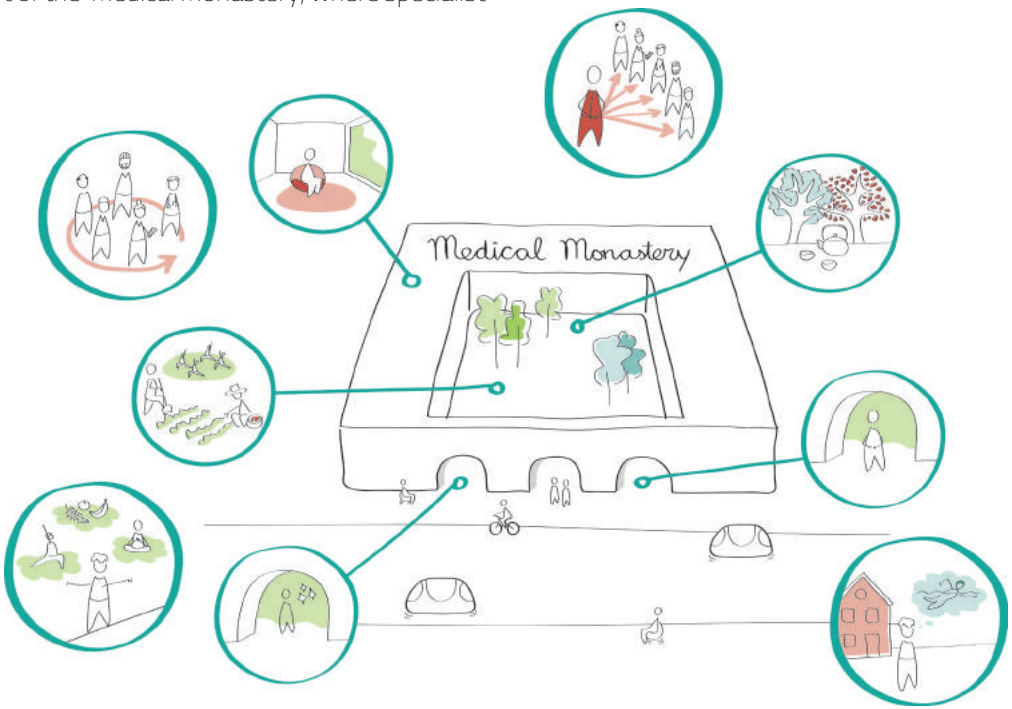
DESIGN FOR PATIENT EMPOWERMENT

EXPLORING THE FUTURE EXPERIENCE OF HEALTHCARE

Graduate: H.J.M. Keizer (2015)
Supervisory team: P.J. Stappers, E. Sukirman, A.Q. Beekman
Partner: 4 Building

This project was set up to explore the future experience of healthcare, with the aim for healthcare organizations and construction consultancies to be able to address the patient experience and anticipate on this while developing a building's environment. The project was approached from both the perspective of the patient as well as by taking the future context into account. The resulting vision can be used to inspire and confront healthcare organizations and other stakeholders.

The future patient experience of healthcare is envisioned in the concept of the 'Medical Monastery', where specialist medical healthcare is provided for patients with chronic conditions. Multiple healthcare providers co-operate in order to provide patient-centred holistic healthcare. The fixed contact person, the 'Medical Mentor', aims to align the provision of healthcare provided with optimal support for each individual. Patients seek for a balance within their lives, between ambition and acceptance. The 'Medical Monastery' is a place where patients can learn how to improve their lives, both physically and mentally; they can come to terms with their illness and reload before re-entering modern society.

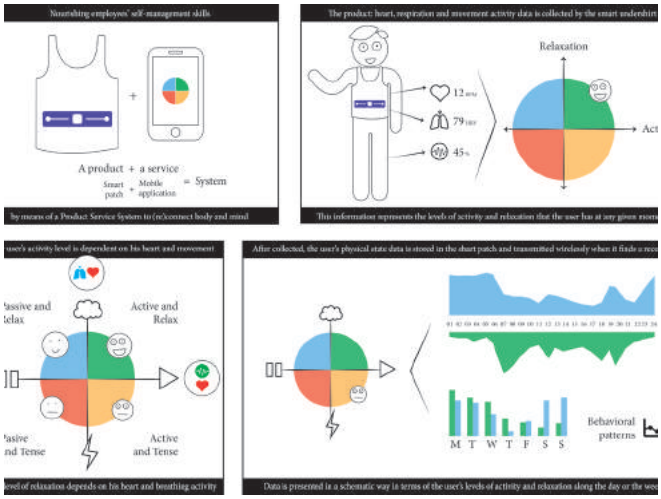


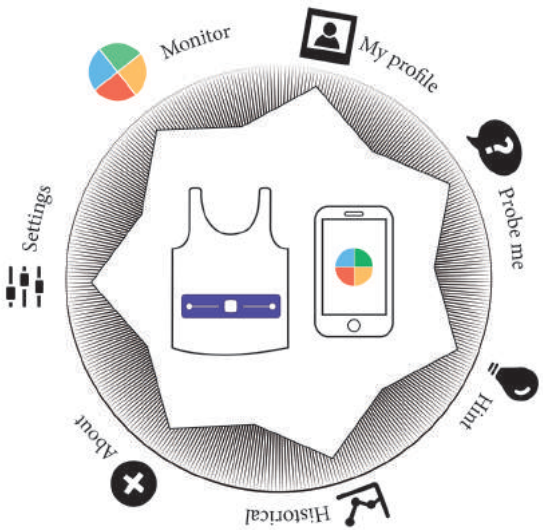
NOURISHING SELF-MANAGEMENT SKILLS TO (RE)CONNECT BODY AND MIND

Graduate: D. Alatorre Guzmán (2013)
Supervisory team: M.H. Sonneveld, N.J.H. Vegt, A.H.M. Bakker
Partner: Balans en Impuls

In contemporary professional life, we have to take stress for granted; it is not just necessary but an essential part of our lives. Stress is not a problem in itself, without it, we wouldn't feel any motivation to improve our daily lives, but when it starts to reach the limits of our tolerance, it can begin to affect our every day life, making us feel sick, anxious, unhappy, or fatigued. This project translates two recognized psychological tools into a consumer product which brings the experience of in-house, face-to-face traditional therapy into the office context.

The project is constructed around the finding that engineers tend to be very much driven by their brain, as opposed to by their emotions or intuition. In order to nourish the target group's self-management skills, a product service system (PSS) was designed enabling users to keep track of their physical and emotional state, with the intention that they are motivated to carry out 'wholesome' activities. By monitoring themselves, users can gain a better understanding of their performance. The PSS includes two components: an electronic wearable device which, attached to an undershirt, keeps track of the user's physical activity throughout the day. The data collected is then transmitted wirelessly to an interface device, e.g. a smartphone. An interactive application on the receiving device – compass – processes the information and presents it back to the user. The compass combines real time biofeedback (heart rate, breathing and physical activity) with personal and psychological information in order to create a tangible link between the mind and the body, promoting self-reflection and giving users personalized feedback to improve their lifestyles.



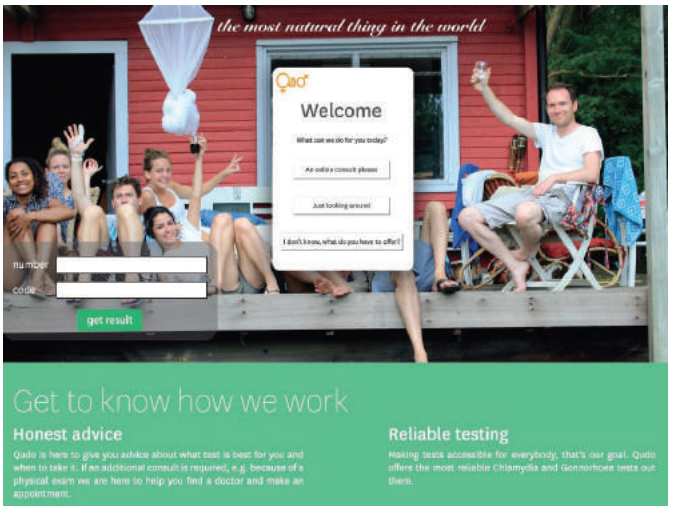


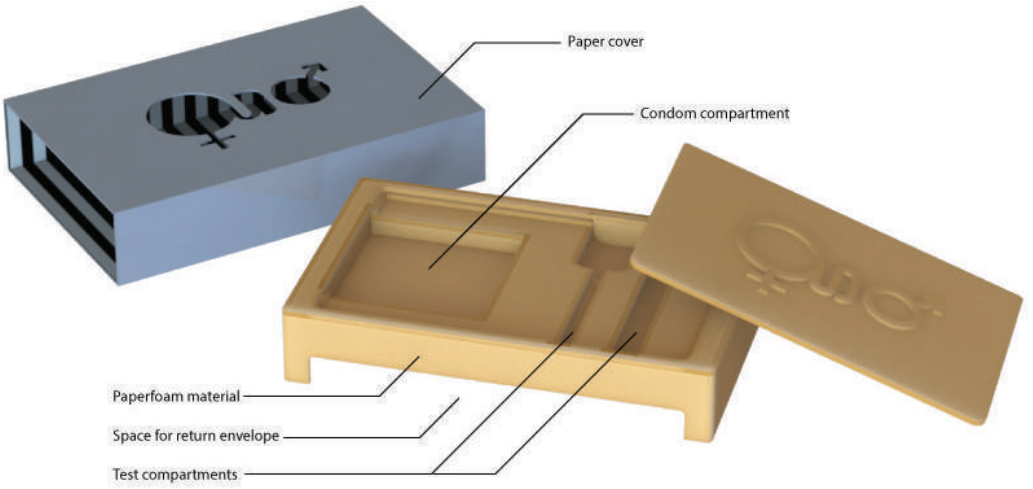
QUDO: CHANGING THE WAY PEOPLE GET TESTED

Graduate: P.A.J. Vegt (2015)
Supervisory team: M.H. Sonneveld, H.M.J.J. Snelders
Partner: Delft University of Technology (internal research project)

Chlamydia is the most prevalent sexually transmitted infection (STI) in the Netherlands. Approximately 300,000 chlamydia tests are conducted annually at GP practices, with a great impact on healthcare costs. To keep testing accessible for everybody, a testing tool was developed that focuses on the user experience as well as costs. As 300,000 people are tested for chlamydia annually, and there is a much larger group eligible for testing, this is an interesting business case.

'Qudo' is about making STI tests acceptable, something that is part of our daily lives. A user-friendly testing environment is developed that provides testing and personal advice. By changing the way people think about STI testing and reducing testing costs, the Qudo concept aims to reduce chlamydia prevalence.





DESIGN FOR YOUNG PATIENTS

KONNEKT: ENCOURAGING SOCIAL INTERACTION OF ISOLATED PAEDIATRIC PATIENTS

Graduate: J.J. Jansweijer (2013)
Supervisory team: E. Giaccardi, M.C. Rozendaal
Partner: Princess Máxima Centre for Paediatric Oncology

In children's cancer hospitals, children sometimes have to be isolated for health reasons. This means they are not allowed to leave their room, and that there are restrictions to who can visit them in their room. In some cases, isolation can be for up to 4 months. During this period, children are deprived of direct social contact with their peers and are usually very bored. This long-term isolation can negatively affect their social development. The goal of this project was to support the social development of isolated children in children's cancer hospitals by bringing them into contact with other children in the hospital.

In interviews with children, we found three play types: adventurers, gamers and tinkerers. To support each of these play types, we developed KonneKt: an ambiguous game which should be played on the window between patient room and hallway. The game consists of shapes which can be attached to the window. Different meanings can be attributed to the shapes. For example, games like chess can be played,, but a tinkerer can build fantasy worlds, and the adventurers could build an obstacle route. KonneKt enables isolated children to stay connected to the other children in the hospital, and even to play with them.

HABITY: FAMILY COMPANIONS

Graduate: L. Pofferi (2014)
Supervisory team: M.C. Rozendaal, M. Melles, T. Bogl
Partner: Princess Máxima Centre for Paediatric Oncology

Childhood cancer greatly affects the social and physical life of children and their family, including things like education, school, profession, marital relationships and family dynamics. Recurrent hospitalization is often necessary to provide effective medical treatment. The goal of this project is to provide a solution for families coping with such a disrupted family situation. The focus is to enhance the sense of connectedness and presence within the household.

Habity is a group of six objects that can recreate the home experience outside domestic boundaries. Habity aims to increase the sense of presence among members of the same family between two remote locations: the home and the hospital. Communicating through sensory interactions, such as light and (household) sounds, Habity aims to translate the home dynamics and activities into rich output that can be experienced in the separate context of the hospital.

ROOMI: INTERACTIVE HOSPITAL ENVIRONMENT FOR CHILDREN WITH CANCER

Graduate: N. Isik (2013)
Supervisory team: H. de Ridder, M.C. Rozendaal
Partner: Princess Máxima Centre for Paediatric Oncology

Each year, about 530 children aged 0 to 18 are diagnosed with cancer in the Netherlands. Following the diagnosis, both the child and the family have to deal with many stress factors. During hospitalization and the treatment process, each child will feel, behave, and cope in different ways. The physical environment can play an important role in the way a person experiences the atmosphere in that environment. Therefore, we designed 'ROOMI' to support the coping process of patients and their families.

ROOMI is an interactive installation developed for children with cancer and their family, with the aim of helping them cope better with their emotions during their stay at the Princess Máxima Centre for Paediatric Oncology. ROOMI helps children with constructive emotional processing by making it possible for them to express, externalize and find a response to their emotions. Manipulating the pillow-like object creates light effects in real time, creating different ambiances in the room. ROOMI is installed in patient rooms and consists of a pillow-like object and a LED lighting system. The pillow and the LEDs are wirelessly connected. The ROOMI pillow consists of five smaller pillows, each representing an emotion. Each has its own way of manipulating and creating a light effect; 'ROOMI' has a different goal and function for each emotion.

BUDDY: A NEW WAY OF MOVING FOR CHILDREN WHO ARE RECEIVING CHEMOTHERAPY

Graduate: M.M. de Reus (2014)
Supervisory team: H. de Ridder, J.J.M. Zijlstra, M. van Dullemen
Partners: npk design, Princess Máxima Centre for Paediatric Oncology

The Buddy is an IV pole especially designed for children aged 4 to 10 who are undergoing cancer treatment. This group of children like to run around, so the Buddy helps them to have a better time while their chemotherapy is being administered.

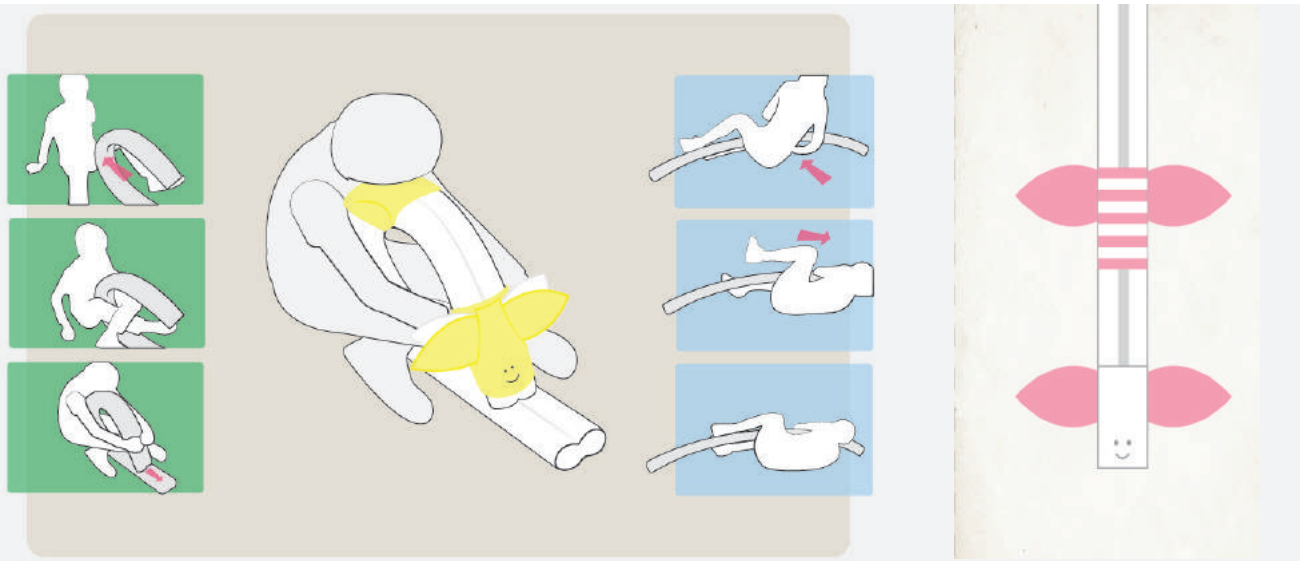
The IV pole's handles make it easier for children to walk around with the product on their own. To make the product interactive, and to make it feel less like a walker, the handles of the Buddy are flexible; they can move up and down. This results in a playful feeling. Another fun factor is the scooter on the back of the Buddy. The children can use the scooter to ride around within the hospital. The Buddy also helps with daily activities. For example, because the Buddy is easy to steer, children can go to the toilet alone without needing extra help. With the help of a colour system, medical staff have a better overview of the chemotherapy equipment. They can see directly which IV bag belongs to which pump.

IMPROVING THE EXPERIENCE OF LUMBAR PUNCTURE FOR CHILDREN

Graduate: P. Nannen (2014)
Supervisory team: J.F.M. Molenbroek, N.J.H. Vegt, J. Pérez Payarols
Partner: Hospital Sant Joan de Déu Barcelona

Children who have meningitis are diagnosed by undergoing a lumbar puncture. During this procedure, the physician takes a sample of cerebrospinal fluid collected between two vertebrae in the lower back. Because this intervertebral space is very small, the child has to sit quietly with a flexed back for several minutes. It is very important that the child does not move; if the puncture fails, the process starts again, and the child may experience more secondary effects after the Lumbar Puncture. The aim of this project was to improve the lumbar puncture experience for children aged 8-11.

It became clear that children are anxious because of poor communication and distraction. In the redesign of the patient journey, the child receives a simple overview of a fantasy journey towards the secret waters. The process is divided into four visual steps on the way to the top of a mountain. The children fly with their fantasy animal towards the top, and collect four colours on the way. To reduce anxiety caused by the nurses holding them, the children are asked to hug their fantasy animals while on their journey. Children can create their own creatures and give them a special name. This personal protective friend will support the child, and facilitates interaction between child and parents. The new experience is designed to feel like sitting on the back of your protective friend, while playfully transmitting a feeling of trust, control, and comfort.



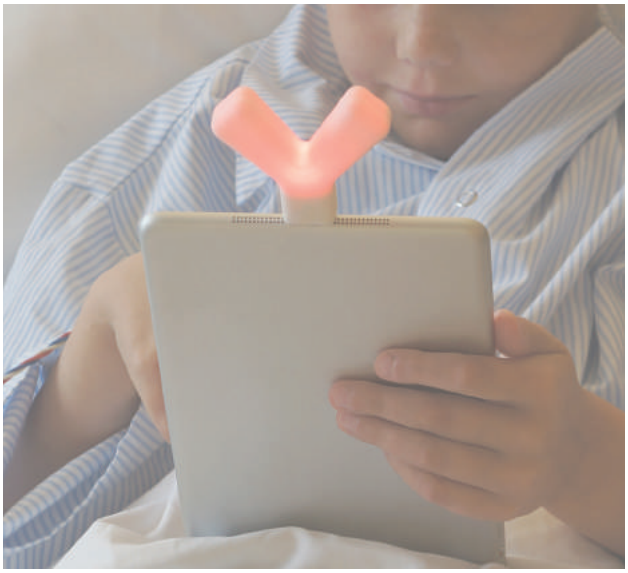
LUKO: RAISING THE VISIBILITY OF CELL RESEARCH IN PAEDIATRIC ONCOLOGY

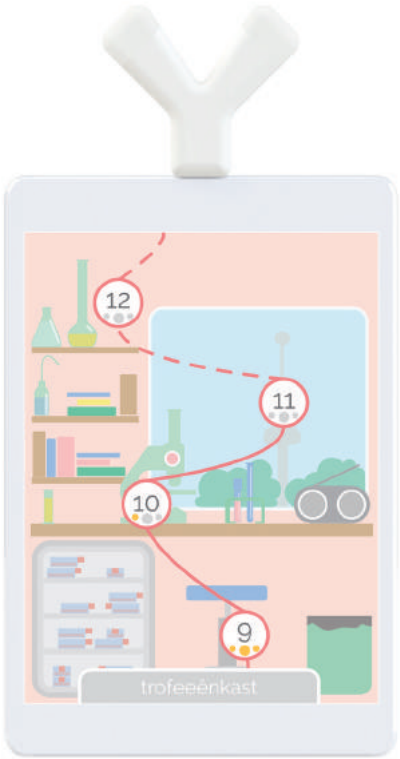
Graduate: C.M. Schreuder (2014)
Supervisory team: M. Melles, A.J. van der Helm, M. den Boer
Partner: Princess Máxima Centre for Paediatric Oncology

This graduation project was conducted for cell researchers at the Princess Máxima Centre for Child Oncology. They want to make their work more visible and raise the visibility of what can be achieved with research. The target group was children aged 6-12, diagnosed with cancer.

Luko is a combination of a game application on a tablet and a physical product attached to the tablet, a receptor. In the application, games can be played that incorporate aspects and components of cell research. At every level, the task is to heal a Luko cartoon via a number of games. These games show the story of research and the steps that need to be taken in order to fix a cell in the end.

Luko takes children into the world of research. It triggers their curiosity and provides them with a wider range of knowledge about their disease. Luko forms a trigger for social contact between patients in the day care ward and provides the opportunity to exchange experiences and knowledge. Luko makes coming back for the next chemo slightly easier, and encourages the children a bit more. But most of all, Luko is fun to play and teaches children new things while waiting for the chemo day to finish.





SUPPORTING PREMATURE BABY-PARENT BONDING

Graduate: R.I. Schopman (2013)
Supervisory team: E. Tempelman, M.H. Sonneveld, W. Flendrie
Partner: Jeroen Bosch Hospital

In this graduation project, the student set out to design a toy for premature babies with additional functionality that will positively influence their development. The resulting concept is a cuddly toy blanket, shaped like a butterfly. There are two types: one has a separable scent cloth, and the other has this separable scent cloth and an additional sound module. The cuddly toy has four different types of strings based on what is considered best for premature babies of different ages. This was determined after discussing several types of shapes, thicknesses and materials with neonatology department nurses.

The upper wings of the butterfly can be used as a scent cloth. The wings can be taken off by pulling them through the butterfly's body and worn by mothers and fathers. After the cloth has absorbed their scent, it can be pulled through the butterfly's body again so that the toy bears the familiar scent of the child's mother or father, which helps to calm the baby. The butterfly's firm head, body and separate wings provide several ways to cover, protect and support the baby. In this way, nurses can use the toy to make the baby feel more comfortable. The second type contains an additional sound module with which parents can record themselves, a song, or other sounds which the nurses can play to calm the baby when the parents are not there.

This project explores new ways for parents to bond with their premature baby. Bonding has a positive effect and helps the baby to develop. In addition, it also expected to make parents feel better as they can now participate in caring for their baby instead of passively observing; it makes them feel a little less powerless.

KANGAROO TRANSPORT FOR PREMATURE BABIES

Graduate: J.M. de Groot (2014)
Supervisory team: R.H.M. Goossens, E.J. Jepma, H. Willemsen
Partner: BabyBloom Healthcare

Moving premature babies to other hospitals is often performed at least once during their hospital period. Two major concerns regarding incubator transport are traffic safety - the baby is often transported without being restrained, and stress - the baby is often stressed due to high level of vibrations, light, sound, and transfers. Kangaroo care is a well-known technique within neonatology, in which a baby is placed skin-to-skin on the bare chest of the parent. The benefits for both baby and parent have been studied and confirmed.

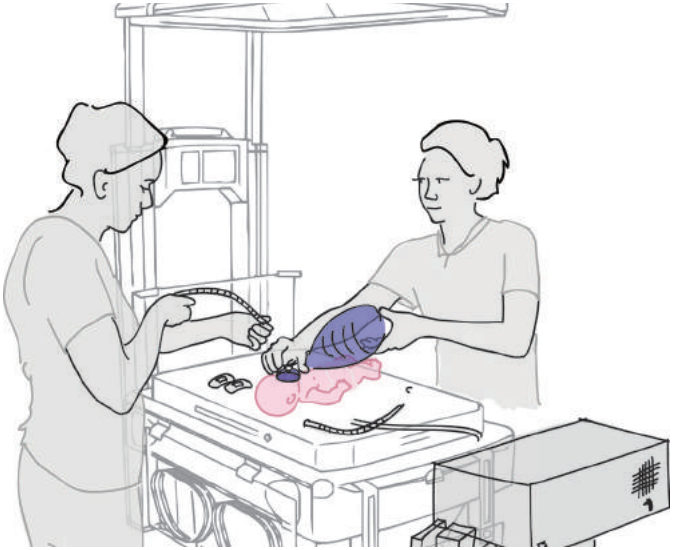
The BabyBloom Womb and the Kangaroo Transport Stretcher are the results of research that enable kangaroo transport of premature babies. The BabyBloom Womb consists of a harness and a pouch to keep the premature baby next to their parent's chest. All the tubes and wires are guided and connected to the devices on the Kangaroo Transport Stretcher, and the window enables medical personnel to observe the baby during transport. The parent can touch their baby's skin by opening two zippers on the front. The baby experiences less stress as it is close to its parent, and the Womb ensures the baby's safety during transport. The Kangaroo Transport Stretcher contains all the devices required for neonatal intensive care transport.

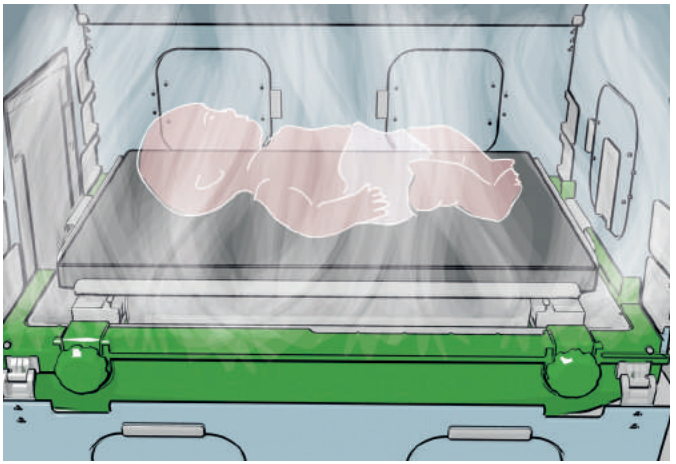
AIRENA: A NEW INCUBATOR TECHNIQUE

Graduate: D.S. Ceulemans (2013)
Supervisory team: R.H.M. Goossens, S.G. van de Geer, H. Willemsen
Partner: Babybloom Healthcare

This graduation project resulted in a design proposal for a new incubator technique, which protects extremely premature infants from cold stress during a medical procedure, while allowing optimal access to the infant.

The proposed design, Airena, provides optimal access to the infant after removing the incubator's side panels and the canopy, while protecting the infant against cold stress during a medical procedure. The Airena makes use of a novel incubator technique and, based on flow simulations, seems promising and an improvement in comparison with current incubators due to its increased warm and humid environment in combination with optimal accessibility to the infant.





A HIGH-END WHEELCHAIR FOR CHILDREN

Graduate: D.S. Oosterhuis (2012)
Supervisory team: J.F.M. Molenbroek, E.W. Thomassen
Partner: Van Beyma

The subject of this graduation project is a manually propelled wheelchair for children, intended for daily use over a number of years. Products like this are, in general, reimbursed by local governments, which has resulted in a complex and static market situation involving numerous stakeholders. The student designed a complete and unconventional paediatric wheelchair that integrally solves the major problems faced by stakeholders in the current market situation (end-users, manufacturers, distributors, therapists and local governments).

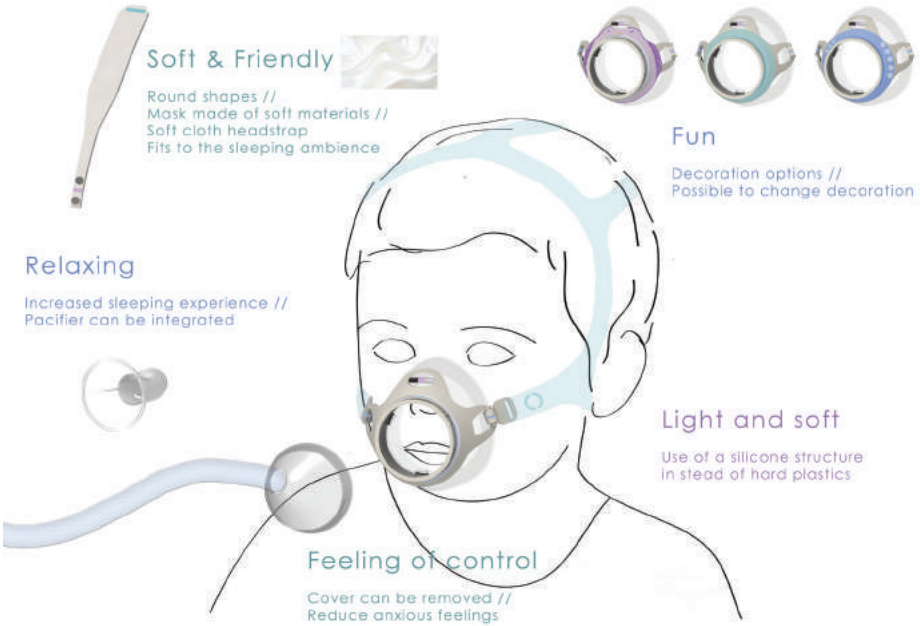
The design's key element is an intelligent adjustment principle based on detailed research of anthropometric data regarding the growth and correlation of the user's body dimensions combined with a critical market analysis. Research outcomes were translated into a product design suitable for industrialized series and mass production.

USER-FRIENDLY RESPIRATORY MASK FOR NON-INVASIVE VENTILATION IN CHILDREN

Graduate: V.M. Migchelbrink (2013)
Supervisory team: J.F.M. Molenbroek, R.H.M. Goossens, T. Taat, M. Zondag
Partner: Sophia Children's Hospital

When a child's spontaneous breathing is interrupted, support can be given via mechanical ventilation. This can be applied either invasively (with a tracheostomy) or non-invasively (using a mask). The use of invasive ventilation in children is risky and challenging and can result in damage to the (often still vulnerable) throat, an increased risk of airway infections, the need for surgery, and an extensive patient care. These challenges are significantly reduced when applying non-invasive ventilation (NIV). However, the centre for home ventilation in Rotterdam, specialized in the treatment of paediatric children that require mechanical ventilation at home, has indicated that it is difficult to find a suitable full-face mask (covering both nose and mouth) for their young paediatric patients.

The goal of this graduation project was to collect and understand user and context information, aiming to reveal NIV user needs and possible challenges. The final result is a design for a user-friendly respiratory mask for children aged between one - six, which improves comfort during use. The final product proposal is a modular mask set in which many different user scenarios are possible. The mask has been designed to be as user-friendly as possible and to increase both physical and mental experience during use.



DESIGN FOR AGEING

HEARTBEAD: ASSURING DO-NOT-RESUSCITATE STATEMENTS FOR FRAIL ELDERLY

Graduate: V.J.E. Westgeest (2014)
Supervisory team: M.H. Sonneveld, L.S.G.L. Wauben, M.A.M. van Wijk
Partner: Reinier de Graaf Hospital

After a cardiac arrest, resuscitation is not always desirable: the chance of survival with a good quality of life is very low for the elderly aged >70 outside a medical institution. Every person has the right to decide whether to be resuscitated or not, and to record their decision in a Do-Not-Resuscitate (DNR) statement. The elderly can communicate their DNR statement either by a written statement or by wearing a DNR medallion. Despite these tools, people are unjustifiably resuscitated, resulting in emotional and financial burden. The goal of this project was to design a product that carries and transfers DNR statements between the physician, the patient, ambulance personnel and bystanders. The product matches the flow of the processes between these different stakeholders, and engenders a feeling of trust between healthcare professionals and the frail elderly.

The Heartbead system is designed to guarantee awareness of DNR statements of the frail elderly. The Heartbead, the main component, contains an RFID tag to record the DNR statement. The Heartbead can be attached to the emergency response necklace of the frail elderly, giving them a product that fits their daily lives. The monitor contains a reader and portrays the message that a Heartbead has been found, displaying the legally required information about the patient. Physicians are able to read the information from the Heartbead and record their decisions. At the checkpoint at the physician's office, the frail elderly can check the information recorded on the Heartbead.

Heartbead

Heartbead system

REDESIGNING THE AGE SIMULATION SUIT

Graduate: R. den Rooijen (2015)
Supervisory team: J.F.M. Molenbroek, L. Goto, B.J. Naagen
Partner: Delft University of Technology (internal research project)

Many people live with a disability. Most of the time, with a little effort, this group can be accounted for when designing and arranging user environments. However, many able people often find it difficult to empathize with those with a disability. The age simulation suit is a tool to help people overcome this; it gives the wearer the opportunity to empathize with people with a disability. The assignment for this project was to improve the design of previously developed age simulation suits, focusing on improving the ease of use, adjustability of simulations, and improving the simulated disabilities.

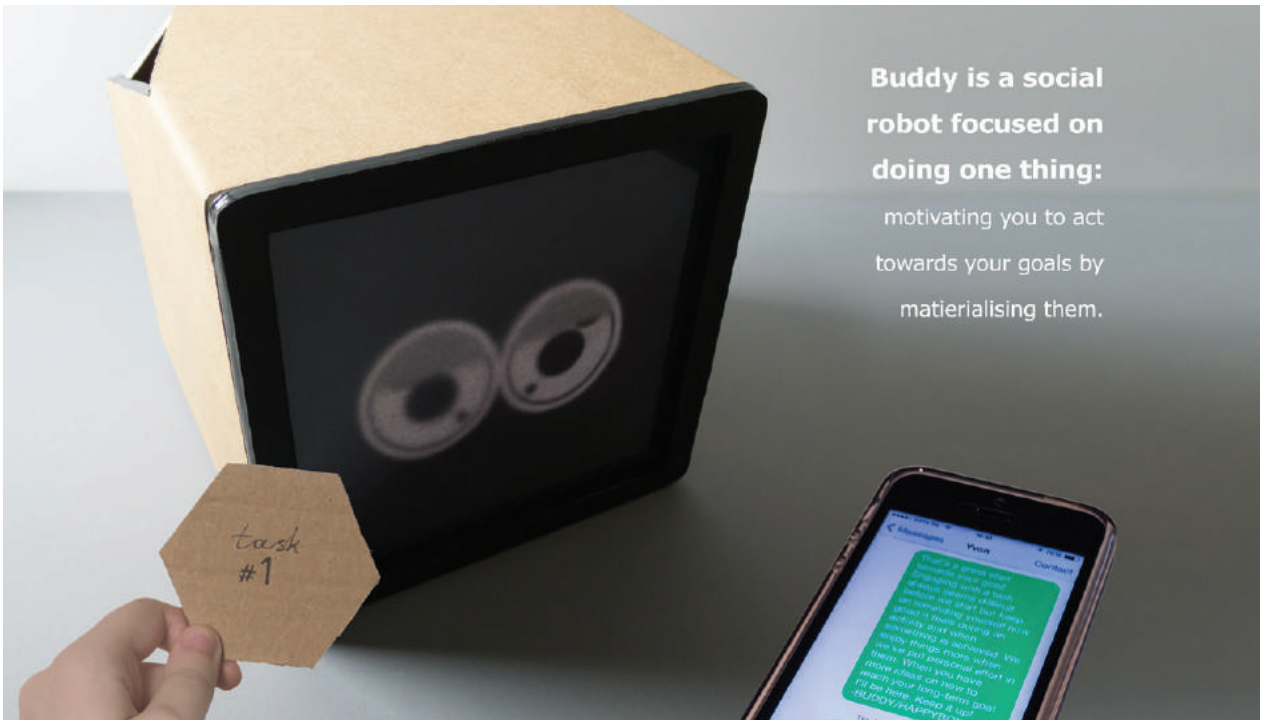
The new suit design can simulate different, age-related disabilities, including loss of strength, balance disorder, loss of sense or touch, hearing disorders, vision disorders or movement restrictions. The suit open source and thus able to be produced by anyone who is interested. The use of 3D printing and other easily available production methods makes this possible.

BUDDY: ARTIFICIAL COMPANIONSHIP TO PREVENT LONELINESS IN THE FUTURE BABY-BOOMER ELDERLY

Graduate: A.E. Papadopoulou (2014)
Supervisory team: S.U. Boess, R. Paauwe, H. Tangelder
Partner: VicarVision

Buddy is the result of an explorative research-through-design approach in the field of artificial companions. The main goal of the project was to create a prevention tool for alleviating feelings of loneliness. The selected target group were the baby-boomers: people that are not old yet, but are currently in transition. The most appropriate moment to intervene is at retirement, as it has been found to be one of the crucial moments in a person's life, and one that may lead to becoming a lonely senior.

Since not many robots that deal with this specific issue are currently available, several explorative prototypes were developed using user insights and feedback. The proposed design is an embodied companion that provides the elderly with a structured way to segment their long-term goals into short-term ones, by motivating them along the way, as a buddy would do, via SMS communication. Evaluation of the concept revealed that the presence of another being, even an artificial one, has an effect in the companionship people feel when executing their tasks, increasing their motivation.

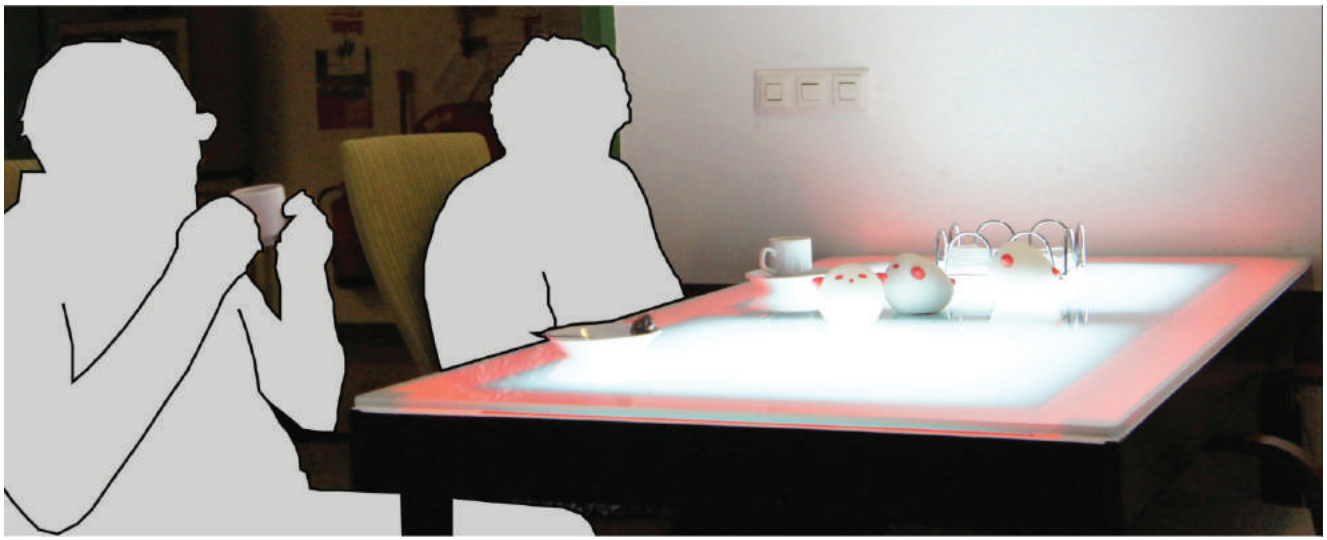


IMPROVING ACTIVITY BEHAVIOUR OF DEMENTED ELDERLY BY LIGHT DESIGN

Graduate: L.W.P. Canton (2012)
Supervisory team: R.A. Birkhoff, H. Anderiesen, G. Wagenaar
Partner: Philips

Many demented elderly suffer from disturbances to their circadian rhythm. It is well-known that sufficient lighting can positively influence the circadian rhythm of this group, however lighting conditions in nursing homes are often insufficient. The goal of this project was to design a lighting solution targeted to help the demented elderly in a nursing home, increasing their daytime physical activity levels.

A light table was developed which brings dynamic bright light more efficiently into the eyes of residents than the conventional ceiling mounted solutions. The bright light follows a dynamic pattern with varying intensity and colour levels during the day. The light table includes objects that alter the table edge's ambient lighting when residents interact with the objects. This engages residents at the table, hence they are exposed to beneficial bright light for longer periods. The ambient lighting also makes the atmosphere in the room more pleasant, because bright light with a high, 'cold' colour usually creates an unpleasant atmosphere in a room.



FIETS'R: MOVEMENT STIMULATION FOR PEOPLE WITH DEMENTIA

Graduate: Y. van 't Hof (2013)
Supervisory team: S.G. van de Geer, F.A.P. van Doorn, K. Post
Partner: Ontmoetingscentrum Vermeertoren - Pieter van Foreest

Dementia is a collective term for diseases characterized by memory problems, intellectual problems and changes in behaviour. The process can never be reversed, but reactivation of the affected brain cells can possibly delay its process. This means that it is important to stimulate people with dementia to 'move'. The aim of this graduation project is to identify the needs and wishes of people with dementia, in order to design something that stimulates them to move, either individually or together with their informal care givers.

User research showed that many of the things the patient and carer loved to do together in the past are no longer possible, for example cycling. The Fiets`R (contraction of the Dutch words `fiets`-bicycle - and `reminiscreen`) makes it possible for patients to `cycle again`. Patients can sit on a chair while they make the familiar cycling movement. A tablet pc is used to show photos of subjects that appeal to the patient or play music they like. As long as the patient is cycling, the photos are shown on the tablet or the music continues. Together with the carer, the patient can talk about the photos or the music to recall memories from the past (reminiscence). If the patient stops cycling, the slideshow/music pauses: this is the motivation the patient needs to continue cycling. A selection of SD cards is available, making it possible to show general photos and music, but personal photos and music choice can also be included

Make a choice between *watching photos* and *listening to music*

After choosing *watching photos*: make a choice between two different themes

Start cycling in order to see the photos

During cycling there is a slideshow of the photos

DESIGN FOR AGEING

ELICITATION OF PRIDE IN HUMAN-PRODUCT INTERACTION FOR PEOPLE WITH DEMENTIA

Graduate: I.A. Owusu (2012)
Supervisory team: P.M.A. Desmet, H. Anderiesen, M. Moshagen, L. Sorokin
Partner: University of Mannheim

One in three people aged over 65 will develop dementia, a set of symptoms that includes loss of memory, mood changes, and problems with communication and reasoning. Alleviating these symptoms is crucial, not only for the patients, but also for all their formal and informal caregivers. However, instead of taking a problem focused attitude of reducing the patients' negative emotions, an approach that has been shown to have meaningful consequences for wellbeing is to enable patients' experience of positive emotions in everyday life. In this study, we broach the issue of pride, a distinct complex emotion related to achievements with the aim of exceeding the general spectrum of positive versus negative emotions. When applied to people with dementia, pride may not only have positive effects in a momentary human product interaction, but it can also improve their wellbeing and even their mental state in the long term.

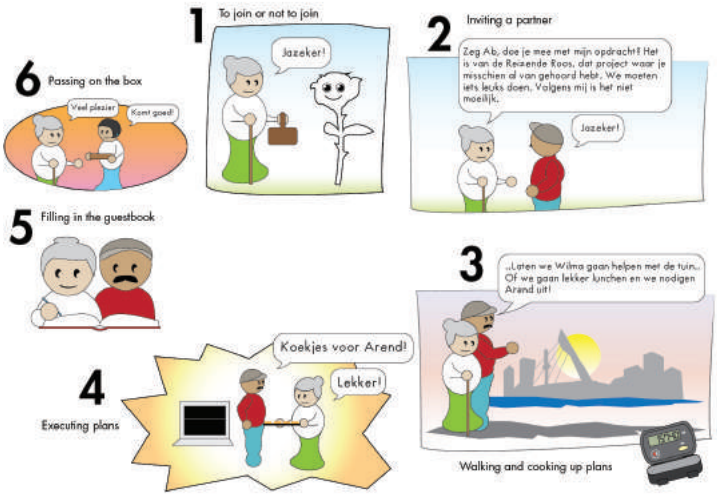
Pride opportunities, such as sharing achievements and getting positive feedback, were practically applied in a design process focussing on the elicitation of pride for people with dementia. Inspired by a quote by Eduardo Hughes Galeano (1992), the designer called the design "Recordis". This Latin term comprises many aspects which reflect the characteristics of the design in addition to eliciting pride; it is made for people with dementia for whom memory has a different meaning, it is about practicing memory by remembering the right locations of the rings on a record. The analogy of a record player holds true, as there is a close relationship with reminiscence; users "let their memories pass back through their hearts", triggered by the music they are listening to.

DE REIZENDE ROOS: USING PERSUASIVE GAME ELEMENTS TO INCREASE PHYSICAL ACTIVITY

Graduate: J.W. Bos (2013)
Supervisory team: V.T. Visch, I.J. Mulder, R.G. Prins
Partner: Erasmus Medical Centre

Public health benefits from promoting a healthy lifestyle including sufficient physical activity (PA). Walking is deemed to be one of the most effective forms of PA. Erasmus Medical Centre conducted a study to see if and how new social and physical interventions in certain neighbourhoods in Rotterdam can induce an increase in the weekly walking time of people aged 55+. A persuasive design is required, tailored to the context of the neighbourhoods and the motivation of the target group.

'De Reizende Roos' (the travelling rose) can best be typified as an effort to brand walking as a cognitive and social tool which ultimately helps people retain independence. The objective of the branding campaign is that people can choose to deploy this tool according to their needs. One quality of walking is highlighted: how walking benefits a good conversation. Branding, or raising awareness, happens by means of a learning experience: participants are immersed in an experience and subsequently they turn the experience into knowledge by reflection and abstraction. De Reizende Roos is a narrative which gives meaning to the learning experience. The narrative is about building up the neighbourhood by establishing personal relations and acting positively. The concept consists of boxes which contain, among other attributes, an assignment to perform a 'spontaneous act' together with a partner. Essentially this assignment is a social challenge and the suggested approach is to take a walk together in order to work out the details. After performing the act, participants are asked to reflect on the event by filling out a guestbook. The goal of the reflection is that the participants put the experience into words and thus transform it into knowledge. The guestbook also helps participants to compare themselves with and learn from other participants.



TIPI: SUPPORTING ELDERLY REHABILITATING FROM TOTAL HIP REPLACEMENT USING INTERPERSONAL INFORMATICS

Graduate: D.J. Kroon (2013)
Supervisory team: D.V. Keyson, J.C. Jimenez Garcia
Partner: Delft University of Technology (internal research project)

In this graduation project, the goal was to design a smartphone application for the elderly rehabilitating from total hip replacement. A combination of interviews and sensitizing materials was used to investigate the product context and the ADL (activities of daily living) of the elderly rehabilitating at home. This was followed by iterative design cycles and concept development, leading to a final design.

The core aim of this project was to increase the motivation and self-awareness of elderly people rehabilitating after total hip replacement surgery, by enabling them to monitor their own physical activity and share practical rehabilitation tips with fellow total hip replacement patients. The combination of personal informatics with interpersonal informatics, supported by persuasive technology and social sciences, was the key to achieving this goal.

The TiPi application enables patients to:

1 - Receive a 'tip of the day' in the morning

2 - Rate the quality of the tips

3 - Use their personal 'messenger bird' to send a tip in the afternoon

4 - View their physical activity information in the notebook

5 - Use the mood indication to match their 'messenger bird' to their feelings

BLOEI: EMPOWERING ELDERLY PATIENTS AND THEIR CARE NETWORK

Graduate: J.W. Alberts (2015)
Supervisory team: A. Albayrak, S.U. Boess, M.H. Vastenburg
Partner: ConnectedCare

Research has shown how important it is for elderly people to feel independent and empowered. During the ageing process, the elderly experience several events that can have a great impact on both their physical wellbeing, as well as on their mental and subjective wellbeing, which might result in feeling insecure and sometimes leading to depression. Elderly are often not involved in their own care process and are perceived as patients. In order to increase their empowerment, the attitude of the care network plays a crucial role. Within this project we therefor considered all stakeholders in the care network: the elderly, the formal caregiver and the informal caregiver.

Bloei is an application which supports elderly in their ageing process, by reflection and awareness of their well-being and their possibilities, this way increasing their feeling of being empowered. Through positive reflection on important moments in their daily lives, while assessing their abilities through health assessment, the elderly are supported in the development of their self-efficacy. With tailored advice and inspirational activities, they become aware of their abilities. The informal caregivers are involved by reflecting on positive moments and defining the abilities of elderly and the formal caregivers play a role in the health assessment part. This way, the role of the caregiver changes from carer to support, and is more aimed at confidence-building.

FALL PREVENTION IN THE BATHROOM

Graduate: A.C. Huisman (2013)
Supervisory team: R.H.M. Goossens, E.W. Thomassen, M.L.H. Larsen
Partner: Handicare

Falling is a common problem among people aged 55 years and over. In the Netherlands, 95,000 elderly people are treated in the emergency room as a result of a fall each year. On a yearly basis, 3,000 elderly are treated for a fall in the bathroom or shower. Current bathroom aids are mainly designed to provide comfort and to prevent the elderly from falling, however they often look outdated and do not match the design of the bathroom. In addition, most elderly people do not want to buy (bathroom) aids prior to injury because they do not want to 'admit' to ageing. The focus of this project was to develop a concept design for a product or product line for the elderly which offers comfort when taking a shower, and prevents them from falling: the concept has to be safe, ergonomic and attractive.

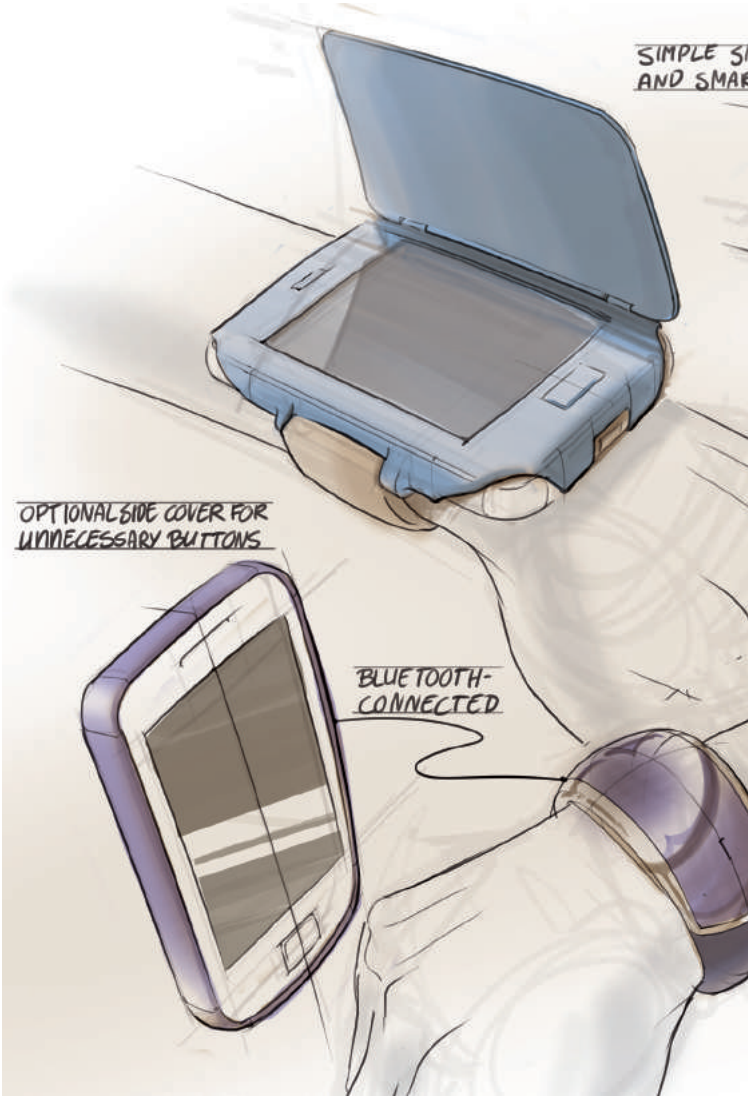
The final concept is constructed from an aluminium extruded profile of which the exterior is based on ergonomic guidelines, and the interior on functionality and ease of installation. The rail allows the user to connect different products in the product series for additional safety. In addition to the profile, a construction element was designed that connects the profile with the wall of the bathroom. Important features of the design were to ensure that the product is easy to install, as well as that it matches the aesthetics of a modern bathroom suitable to the target group.

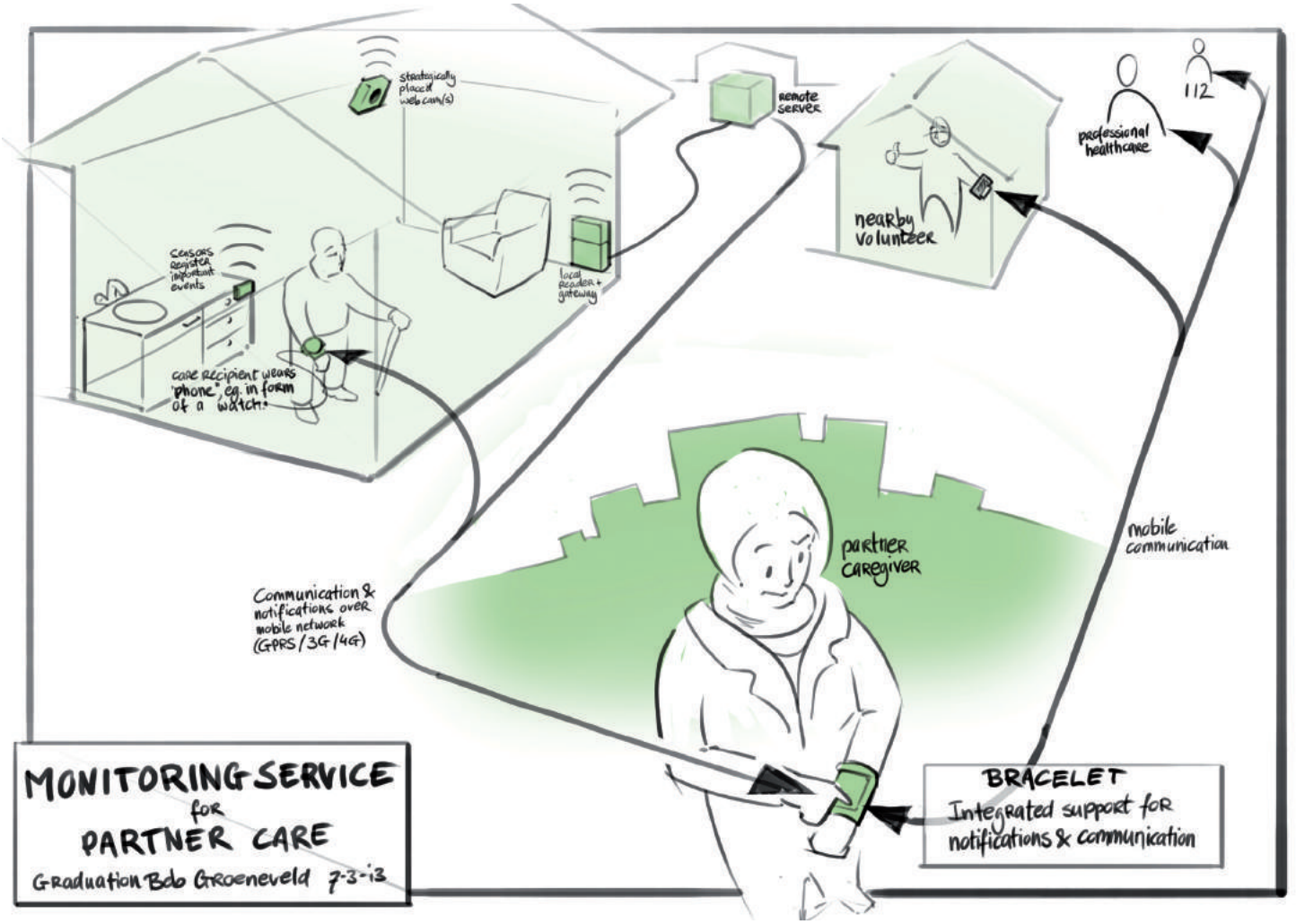
DESIGN FOR INFORMAL CAREGIVERS

COMMUNITY-BASED CO-DESIGN FOR INFORMAL CARE: BRIDGING THE GAP BETWEEN TECHNOLOGY AND REAL LIFE

Graduate: B.S. Groeneveld (2013)
Supervisory team: A. Freudenthal, S.U. Boess
Partner: Epposi

Innovative Product Service Systems (PSSs) are needed in order to keep the healthcare system affordable, while safeguarding or enhancing care quality. In this study, the student examined the application of a community-based co-design approach to assistive technology development for informal care. A sequence of methods was applied, involving end-users and communities in the earliest design stages. A design target was found together with informal caregivers, and a solution was iteratively developed together with various stakeholders. This PSS solution enables the informal caregiver both to monitor the care recipient even when not physically present, and to efficiently manage emergency situations if these occur. The PSS arranges existing technology in a contextually appropriate way, making the solution much more likely to be accepted by end-users and their neighbourhood communities. Community-based co-design was essential in achieving this result.



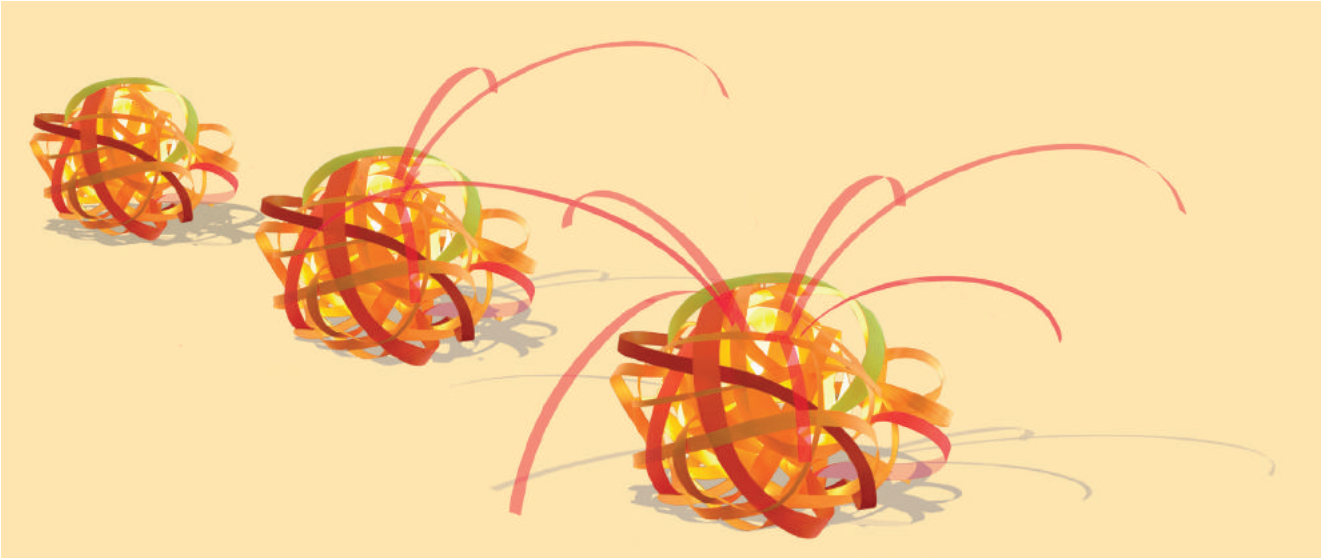

strategically placed web cam(s)
remote server
112
professional healthcare
nearby volunteer
sensors register important events
local receiver + gateway
care recipient wears 'phone' eg. in form of a watch
partner caregiver
mobile communication
Communication & notifications over mobile network (GPRS/3G/4G)
MONITORING SERVICE
for
PARTNER CARE
Graduation Bdo Groeneveld 7-3-13
BRACELET
Integrated support for notifications & communication

AMARANT: ENCOURAGING THE APPLICATION OF HUMOUR BETWEEN INFORMAL CAREGIVERS AND PEOPLE WITH DEMENTIA

Graduate: J.H.E. Blom (2014)
Supervisory team: V.T. Visch, M.H. Sonneveld, C. Aarts
Partner: Dementie ondersteunings en trainingscentrum (DOT) - De Wever, Tilburg

Approximately 70% of people with dementia live at home and are cared for by informal caregivers, who, on average, spend 20 hours a week on caregiving, for a period of five years. Providing informal care can be demanding, both emotionally as well as physically and many informal caregivers are overburdened. In order to relieve the burden of providing informal care, several methods of coping can be applied, of which a very powerful one is humour. In addition to the positive effects humour can have on physical health, such as reducing the release of stress hormones as well as massaging internal organs, it also has beneficial psychological effects. It can lighten the emotional burden of the situation and positively influence social relationships.

By taking the personal humour experience of the informal caregiver and the dementia sufferer as a starting point, Amarant aims to emphasize the positive experience triggered by humour. By doing so, it stimulates awareness of the power of humour and the value of sharing a laugh. Amarant is an object which stimulates the informal caregiver to build a collection of tokens. Each of the tokens is a physical representation of an experience or memory of humour. The collection element motivates the user to keep on searching to collect more tokens. By doing so, the informal caregiver becomes more aware of small, otherwise unnoticeable experiences of humour.



POOL: BUILDING UNDERSTANDING WITHIN FAMILIES OF TEENAGERS WITH CANCER

Graduate: A. Dsouza (2015)
Supervisory team: M.C. Rozendaal, P. D'Olivo
Partner: Princess Máxima Centre for Paediatric Oncology

Teenage cancer is an extremely stressful event for families. Besides having to deal with the disruptions caused by the cancer, the family also has to deal with the challenges of teenage development. Each member of the family has different perceptions and ways of coping with the situation. This often leads to misunderstandings which manifest themselves in marital distress, sibling neglect, over-protective parenting etc.

Pool is an activity kit that helps family members to connect with each other and build on family strengths, by making them more aware and appreciative of each other, improving their ability to handle this challenging situation. Family members share their opinions through a game-like activity, in which the interactive tiles light up to indicate whose turn it is. The resulting family strength leads to a greater sense of self efficacy and the family feels more capable of handling their challenging situation.

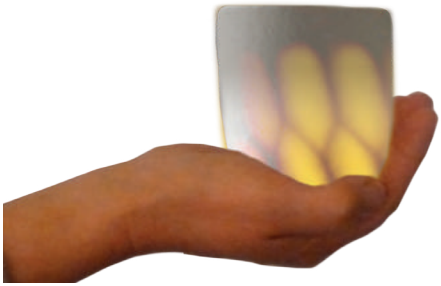
MOKKOP: A PERSONAL MOMENT FOR PARENTS OF HOSPITALISED CHILDREN WITH CANCER

Graduate: J. van Beusekom (2013)
Supervisory team: E. Giaccardi, M.C. Rozendaal, A.P.O.S. Vermeeren
Partner: Princess Máxima Centre for Paediatric Oncology

When a child is diagnosed with cancer, parents tend to forget about their own well-being and focus totally on their child. In many cases, parents break down during the lengthy treatment period and get emotional problems.

Mokkop is coffee mug that reminds parents that they need to take a moment for themselves. It lights up five times a day to trigger parents to consider that moment as being suitable to leave for a 5 to 10-minute break, and have a cup of coffee or go for a walk. Often parents experience a form of social isolation, so the signal is reinforced by being sent to a neighbour.

MOKKOP is a simple product that integrates well with the current habit of taking a coffee break, providing parents with care and support from the hospital. It reminds parents to think about themselves for a moment, without forcing them. By involving other parents, these moments can be lengthened and parents are able to regain energy.



Mokkop

A personal moment for parents of hospitalized children with cancer

DESIGN FOR THE PHYSICALLY CHALLENGED

MEETING UP: INCLUSIVE DESIGN FOR POST-LINGUAL HEARING IMPAIRED PEOPLE

Graduate: C. Ramirez Nates (2015)
Supervisory team: J.F.M. Molenbroek, A.J.C. van der Helm
Partners: Oorzaak, Leiden University

A lack of awareness of hearing people can complicate communication between Post-lingual hearing impaired people (POD) and Hearing people (H). This is because, despite being aware of rules of communication such as speaking slower and one at a time, the H group simply forgets them in the middle of a meeting. In addition, as POD people cannot hear, it is difficult for them to find the speaker and even more so when two or more people are speaking at the same time. Furthermore, due to the fact that meetings are not usually well structured, the communication can become confusing, even for the H group. Surprisingly, H people have similar problems. Thus, there is a need for more structured and better organized meetings.

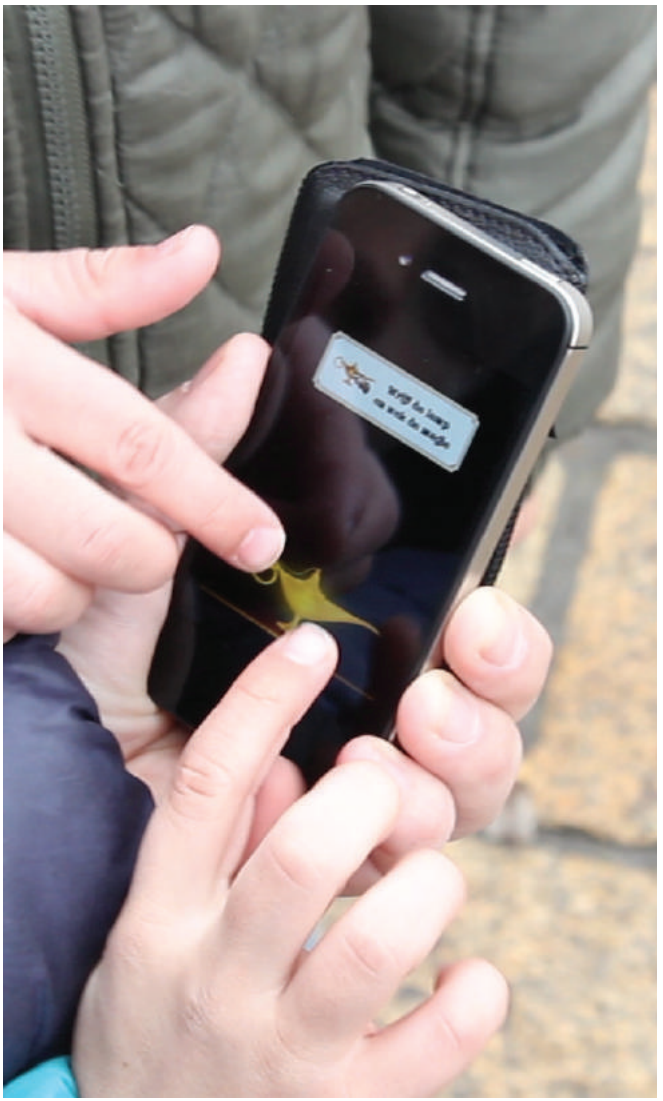
The final design concept is called MEETING UP: a product that includes a Meeting Point (a physical device) and a Meeting App (an application) which improve communication between POD and H people in meetings by creating structure, order and awareness. Meeting Point is placed on the centre of the table and provides order during meetings. In addition, the Meeting App provides more structure to the meetings.

TWINKEL: ENHANCING THE EFTELING EXPERIENCE FOR DEAF AND HARD OF HEARING PEOPLE

Graduate: N.H. Lau (2013)
Supervisory team: H. de Ridder, F. van Mourik, K. Willemen, C. Bertens
Partner: De Efteling

The Efteling has been welcoming and entertaining its visitors ever since the opening of the Sprookjesbos in 1952. It is proud of the fact that it is accessible for (almost) every guest: It offers for example special facilities for wheelchair-dependent people, however those with hearing loss are not supported by any facilities. People with hearing loss have difficulties hearing and understanding the auditory information of an attraction. This problem needs to be tackled quickly as the number of people affected continues to rise due to ear damage through excessive noise levels, and the ageing of our society. The Efteling will therefore have to deal with more people who have difficulty understanding auditory information. The focus of this project is on the design of a facility that enhances the Efteling experience for those with hearing problems.

The product, Twinkel, is a smartphone application designed as a continuation of the attraction. The app matches the Efteling's vision and the technological trend among both the young and the elderly. Twinkel gives those with hearing deficits the feeling that they are equal to those with good hearing, because the use of smartphones is so common that they will not be recognized as such. In the presence of Twinkel, people with hearing loss can enjoy the Efteling independently. As a result, it unburdens their hearing family members. In conclusion. Twinkel has been designed to ensure that the Efteling remains an enchanting experience for all the family.

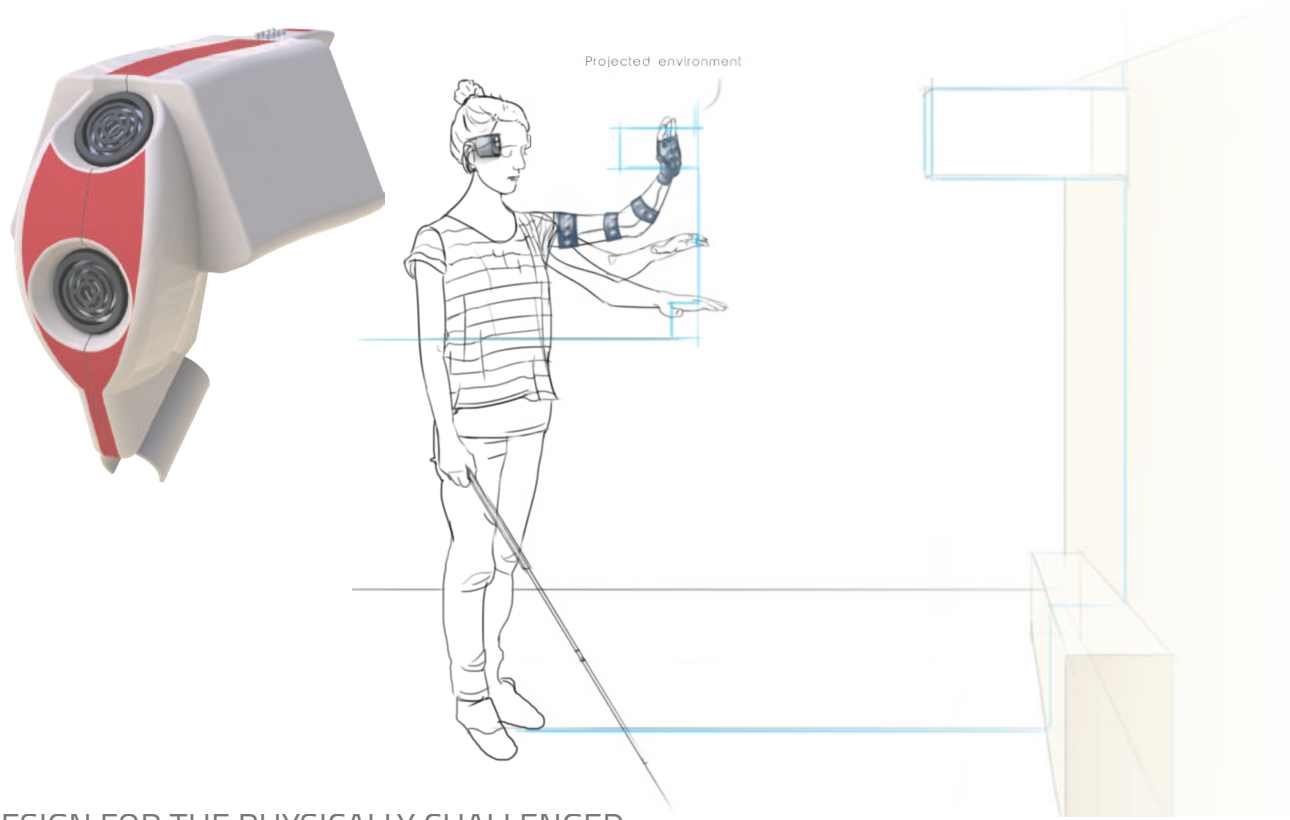


POINT: OBSTACLE DETECTION DEVICE FOR THE VISUALLY IMPAIRED

Graduate: R. Blokdijk (2012)
Supervisory team: C.C.M. Moes, A. Albayrak, M. Belderbos
Partner: Optelec

Not being able to rely on your eyes is a condition that greatly reduces visually impaired people's (VIP) quality of life, as we live in a visually oriented world. The aim of this graduation project was to design a new product that improves a VIP's quality of life. A greater awareness of the environment results in an improved feeling of safety and certainty, two of this target group's most important values. This awareness can be extended by detecting obstacles so that the VIP can better anticipate situations.

Different concept directions were evaluated by prototyping and testing with users. Both VIP and blindfolded sighted participants preferred 'Point'. "Point" is a cane add-on that gives the blind user additional information about obstacles. Point the device at a point in the environment, and the device will communicate the distance using braille points.



FLEXTENSION: PREVENTING FLEXION CONTRACTURES IN THE KNEE AFTER TRANSTIBIAL AMPUTATIONS

Graduate: C. Knoope (2011)
Supervisory team: A. Albayrak, A.H. Jellema, A. Huber, P. van Diggele
Partner: Livit Orthopaedics

The aim of this project was to design the next generation of a flexible brace to prevent flexion contractures in the knee after transtibial amputations. The brace has to prevent flexion contractures in the knee by applying an extension moment on the knee joint, strong enough to fixate the leg when in extension. This extension moment has to be applied by the three-point principle, covered by an existing LIVIT patent. The brace should allow the user to bend the knee in order to relieve the stretched muscles, but when the user bends the knee, the brace must ensure that the joint corrects the position of the leg to full extension (180°).

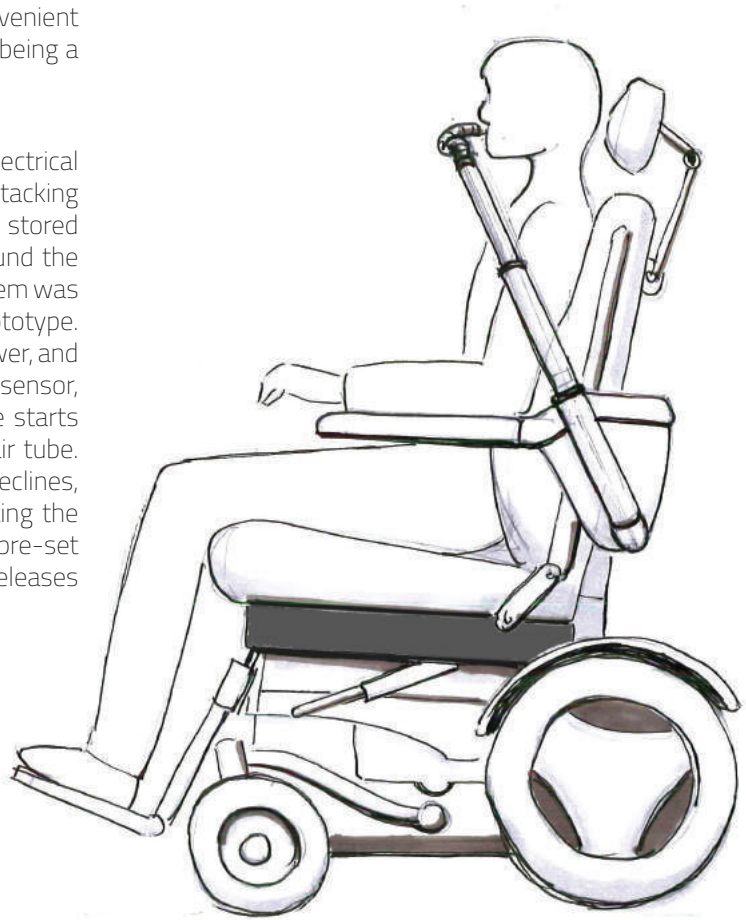
Flextension connects two glass fibre poles on the sides of the leg by using two straps on the dorsal side and one strap on the ventral side of the leg. The glass fibre poles apply a continuous extension moment which, during a flexion moment, fixates the brace on the leg by the applied forces; therefore circular closed straps around the leg are not needed. The load is adjustable by tightening the flexible straps.

AUTOMATIC AIRSTACKING DEVICE

Graduate: W.A. Verheij (2010)
Supervisory team: C.C.M. Moes, S.G. van der Geer, K. Lindenhovius
Partner: University Medical Centre Utrecht

Airstacking is a relatively new treatment for people suffering from a neuromuscular (or related) disorder. These disorders affect the respiratory muscles, so to keep the respiratory system in condition and prevent pneumonia, the lungs are inflated on a regular basis by means of a resuscitator balloon. The patient always needs assistance from a partner or caregiver. This is not only inconvenient for patients and carers, but it is also perceived as being a highly discomfiting experience.

The airstack buddy is an integrated device on an electrical wheelchair which is always available for airstacking assistance. An automated telescopic system stored behind the user's elbow propels the air tube around the upper arm towards the mouth. The telescopic system was detailed and evaluated by building and testing a prototype. The required airflow is generated by a compact blower, and electronically regulated by a passing valve, a flow sensor, and a pressure sensor. The airstacking procedure starts when the user starts to breathe in through the air tube. The system detects when the user's inhalation declines, and supports the inhalation by gradually generating the required airflow. The procedure stops when the pre-set maximum pressure is reached or when the user releases the air tube.



DESIGN FOR THE PHYSICALLY CHALLENGED

DESIGN FOR REHABILITATION

THERAPEUTIC DEVICE FOR LOW BACK PAIN

Graduate: T.T. Vu (2013)
Supervisory team: R.H.M. Goossens, M. Hajian, G. Vallinga
Partner: Enraf-Nonius

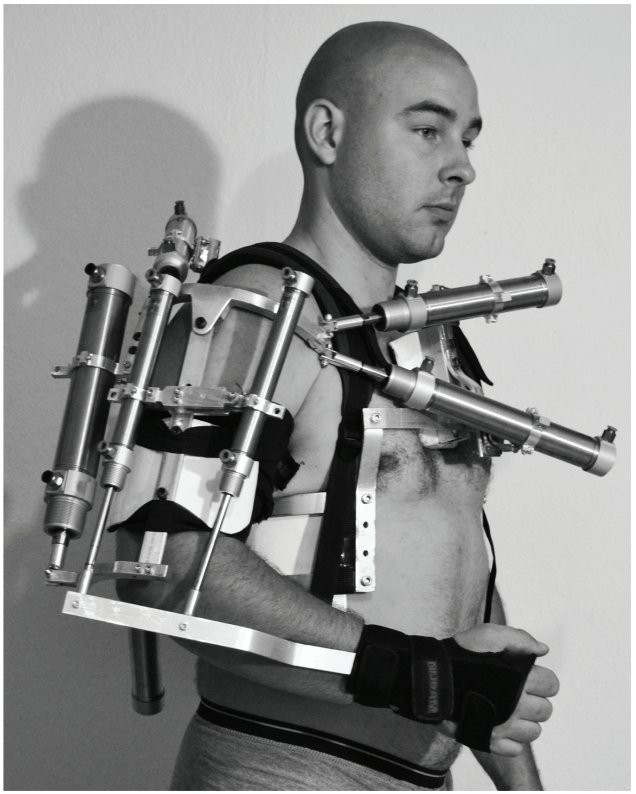
This graduation project marked the first exploration step of Enraf-Nonius, a producer of physiotherapy and rehabilitation devices, to the new market of automotive therapeutic devices for Low Back Pain (LBP). LBP is a common musculoskeletal disorder that affects the spine's flexibility, stability, and strength, causing pain, discomfort, and stiffness. The most common treatment of LBP includes passive mobilization of the back region, which in many cases requires use of great force, thus tiring the therapists. The new device aims to assist the therapist by providing greater control of their therapeutic movements.

The device can generate two effective movements, including the rotation of the back, as well as the alternative movement of flexion/extension with straight legs. Driven by two linear and three rotary actuators, the device can generate in-between motions, allowing seamless transformation from one position to another. The highlight of the device resides in its ability to generate a large range of movement (up to 120 degrees for flexion/extension and 100 degrees for back rotation). It can be used in healthcare facilities such as rehabilitation centres and hospitals.

LOW COST ROBOTIC EXOSKELETON SYSTEM FOR UPPER LIMB POST-STROKE REHABILITATION

Graduate: J. Luijten (2013)
Supervisory team: Z. Rusák, A. Kooijman
Partner: Delft University of Technology (internal research project)

Stroke is a leading cause of disability. In Europe, there are approximately 1.1 million new cases of stroke annually, and an estimated 6 million people live with moderate to severe disabilities as a result of stroke. 85% of post-stroke patients suffer from disabilities to the upper extremities. The annual economic burden of stroke is calculated at €27 billion in Europe alone, and is expected to double by 2030 due to demographic changes. Of this total sum, 16% is attributed to labour costs for therapists. In addition, projections show a shortage of therapists able to provide adequate rehabilitation services in the future.



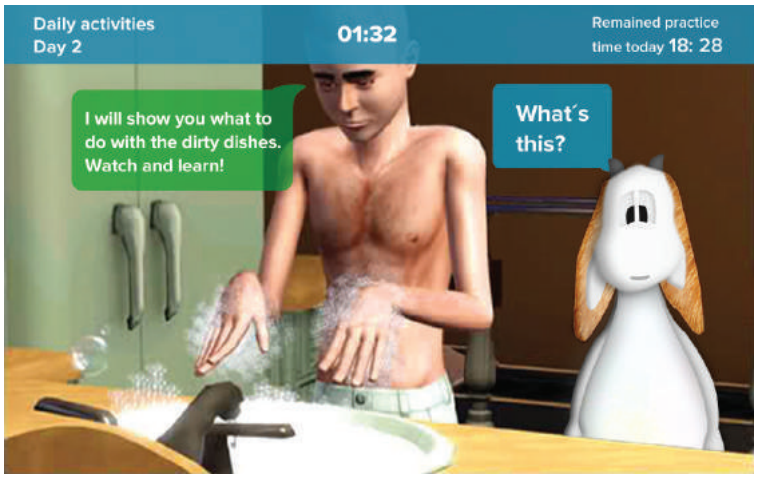
Robotics can be implemented in post-stroke rehabilitation due to their potential advantages over conventional methods with regard to the recovery of functions, costs and recovery time. In this graduation project, a low cost robotic exoskeleton device is developed enabling upper limb stroke rehabilitation, to provide rehabilitation therapists and patients with the means for cost effective post-stroke therapy. The solution supports the natural kinematic model of the human upper extremities. The workspace of the proposed robotic device optimizes the effect of the therapy by supporting everyday motion. Software can be programmed to implement and control daily exercises. Upper limb exercises can be programmed by the rehabilitation therapist by moving the patient's arm in the desired path. The patient can then practice the pre-programmed exercise without additional help from the therapist. This solution is expected to both ease and complement the work of rehabilitation physicians, therapists and nursing staff.

PATIENT MOTIVATION IN REHABILITATION THERAPY

Graduate: M. Szaniawski (2014)
Supervisory team: R.M.H. Goossens, S.U. Boess, G. Kraan
Partner: Reinier de Graaf Hospital

Motor rehabilitation therapy requires patients to be highly motivated to exercise regularly. However, rehabilitation practices are not designed to be motivating and are often repetitive which results in patients not exercising as planned and therefore failing to complete their therapy. As a result of that, they do not regain their manual abilities in the time expected, and need to prolong their treatment. Serious games can be used to counteract this effect. However, in the context of healthcare they must always fulfil a medical purpose, and therefore become more of an obligation in the patient's eyes. Thus, what is now available cannot be considered a game, since game-playing is intrinsically motivated and cannot be compelled. Therefore changing the patient's mindset by increasing intrinsic motivation towards effective rehabilitation tasks (i.e. games) is a prerequisite to encourage practice and improve adherence to therapy. This can be achieved by introducing meaningful interactions, altering the nature of rehabilitation exercises from repetitive physical effort to become a playful and motivating challenge.

By introducing the concept of possible 'selves' to rehabilitation therapy, the patients' mindset can be altered and practice behaviour supported at an intrinsic level by giving them an outlook on the possible future benefits and consequences of their behaviour. By bringing the patients' mindset in the right state, any subsequent behaviour or application will be performed from an intrinsic interest in recovery. A persona-based stimulus has been designed that depicts a possible future-self in relation to therapy in order to help patients adopt a possible 'self'. Individuals who attained this 'self' had significantly higher intrinsic motivation and perceived practice competence.



REHABILITATE YOURSELF!
REHABILITATION INTERTWINED IN DAILY LIFE

Graduate: A.C.C. Möhlmann (2014)
Supervisory team: A. Albayrak, M. Melles, H. Bodewes, S.B.W. Vehmeijer
Partners: Zimmer Biomet, Reinier de Graaf Hospital

This project focuses on the recovery phase at home after a total hip replacement without the need for the involvement of a physiotherapist. The aim was to design a solution that helps patients attain a healthy gait during the recovery phase and to provide them with a feeling of medical certainty, while giving information and feedback.

BioStep provides the patient with a new way of rehabilitation by making their daily life activities a part of the programme. BioStep is a smart insole with an app which creates a healthy gait by tracking the gait of the patient. The smart insole measures the pressure and the roll of the foot using pressure sensors. When an abnormality in the gait is measured, the patient feels a vibration. A message pops-up on their smartphone explaining the measures and suggestions to improve their gait. The app also provides other functionalities such as setting goals and sharing information with peers.

3D PRODUCT TO REPLACE THE TRADITIONAL PLASTER WRIST ORTHOSIS

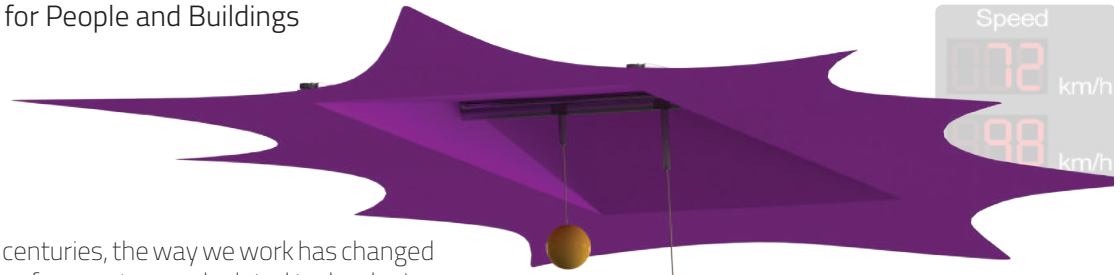
Graduate: P. Leon Loreto (2014)
Supervisory team: J.F.M. Molenbroek, H.J.J. Deen
Partner: Vectory3

Current plaster wrist orthosis can be improved in hygiene and wearing comfort for the patient. The removal process (by an orthopaedic technician) is expensive and time consuming. With 3D printing technologies, it is possible to achieve a customized product that supports user comfort while reducing the number of process steps.

The goal of this project was to develop a 3D-printed wrist orthosis to replace the traditional plaster type and increase wearing comfort for the patients. The healing of a distal fracture depends on the re-positioning of the radius related to the carpal bones. The stability of the carpal and metacarpal bones is important for hand movement meaning carpal and metacarpal bones have to be aligned. Therefore, the immobilization is crucial, but only between the first carpal row and distal radius. The final design is easy to fit and remove, light and solid, and flexible to fit different people based on a scan. The designs are ready to print in 3D printing formats and fit the patient easily, greatly shortening the process.

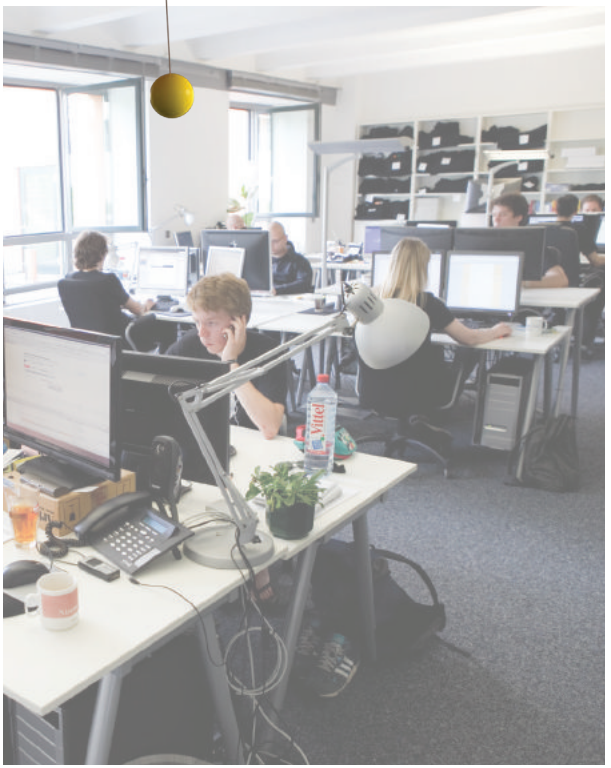
PETSEKLETSER: IMPROVING PHYSICAL VITALITY AT THE OFFICE

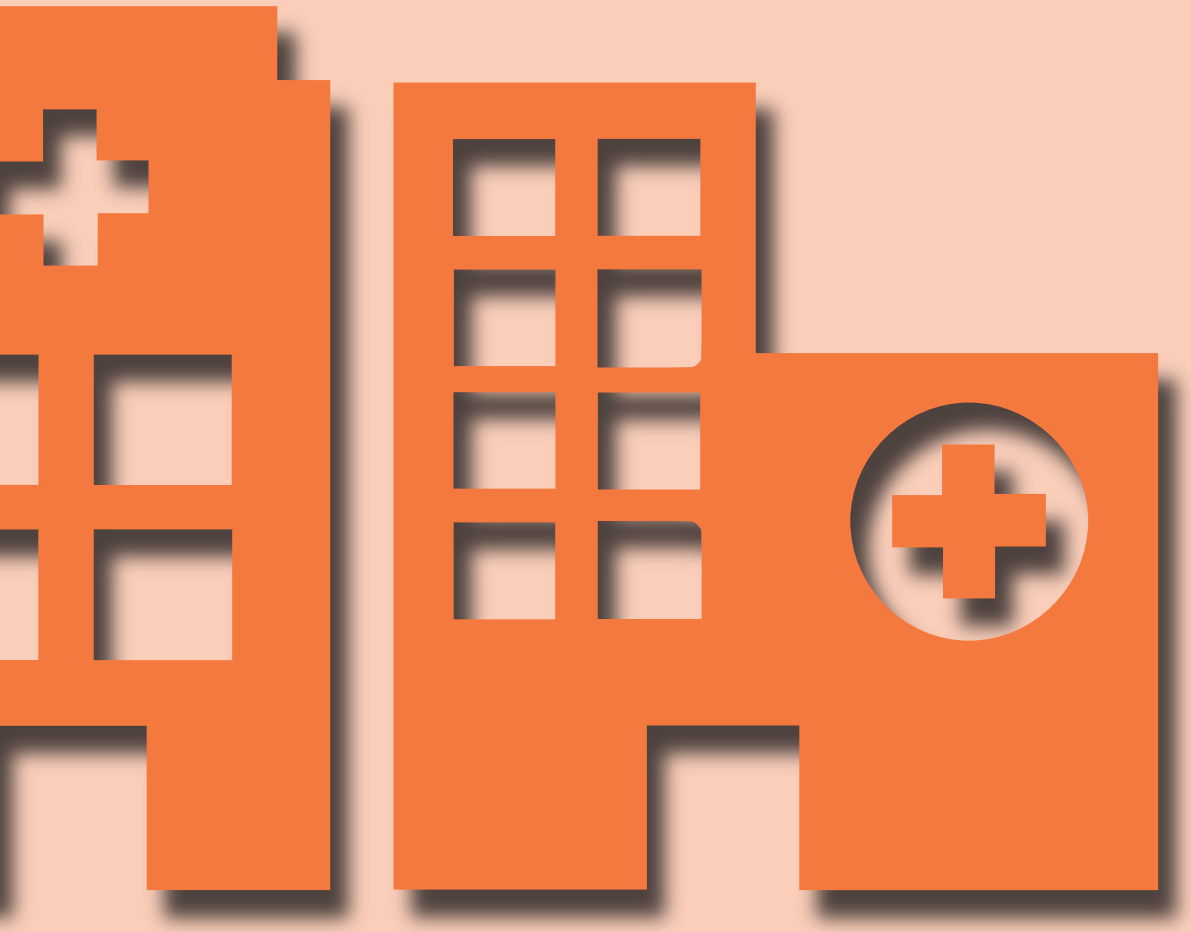
Graduate: A.A. Heijnen (2014)
Supervisory team: J.F.M. Molenbroek, N.J.H. Vegt, F. Thoolen
Partner: Centre for People and Buildings



Over the past few centuries, the way we work has changed drastically. Our use of computers and related technologies are important drivers of these changes. Nowadays, many people work in an office using a computer, resulting in their being seated for a large part of the day. Sitting is comfortable for many people. However, being seated for too long or in the wrong position can lead to physical and cognitive complaints.

The Petsekletser has been developed with the user and environment as its main focus. It stimulates movement of the upper body while walking from A to B in the office, preventing stiffness in the upper back and shoulders. Office workers are triggered to hit a ball hanging from the ceiling on various walking routes through the office. Hitting the ball at the right height can help loosen the vertebrae in the upper spine, a place where many complaints occur when working with computers. The ball includes a sensor located next to the product that measures and displays the rotation speed. It gives feedback to the user and, in this way, increases the use rate. The Petsekletser not only makes physical activity fun, it may also help prevent upper back pain and stiffness.





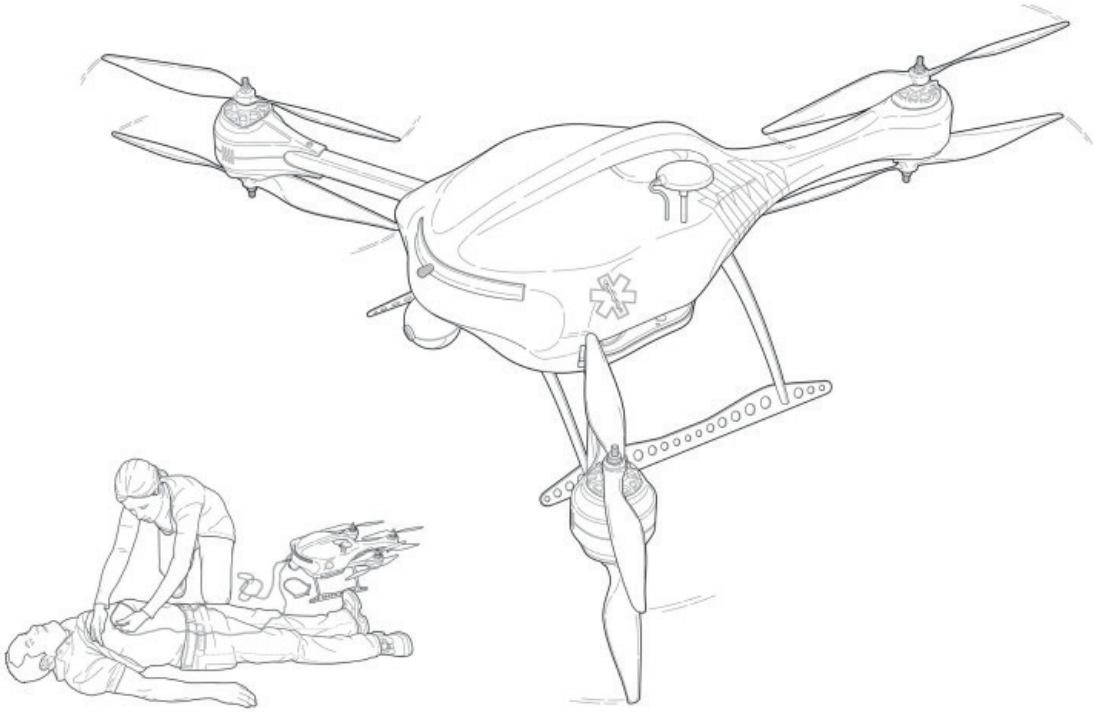
DESIGN FOR HEALTHCARE FACILITIES


TUDelft

AMBULANCE DRONE

Graduate: A. Momont (2014)
Supervisory team: R.H.M. Goossens, C.L. Nauta, P. de Jonghe, J. de Jaeger
Partners: Living Tomorrow, University Hospital Gent

Every year, nearly one million people in Europe suffer from a cardiac arrest. A mere 8% survive due to the slow response times of emergency services. The project's aim was to improve existing emergency infrastructure using a network of drones capable of saving lives. At over 100km/h, a drone can be at the required location within 1 minute, which improves chances of survival from cardiac arrest from 8% to 80%. This could provide immediate help to a total of 700,000 people each year, reducing costs to the EU healthcare system by €200 billion This new type of drone folds up and can be used as a 'toolbox' for emergency supplies. Future implementations will also serve other use cases such as drowning, diabetes, respiratory issues, and traumas.



BIKE FOR LIFE

Graduate: S.J. Beeks (2014)
Supervisory team: I.A. Ruiter, J.F.M. Molenbroek
Partner: St. Elisabeth Hospital

The St. Elisabeth Hospital in Tilburg is one of the few hospitals in the Netherlands with a bicycle ambulance. This bicycle is designed to be a stand-alone support vehicle to facilitate the Quick Response Team (QRT-team) and is an integral part of the safety management system of the hospital. The bike is intended for use on the entire hospital site (indoors/outdoors) and should be able to reach any destination within 5 minutes with all the necessary equipment. The current bicycle ambulance was developed 8 years ago and throughout the years, more and more equipment has been added. This has resulted in a product that no longer supports the workflow of its users. Equipment is stored inefficiently which sometimes result in ergonomically undesirable actions by its users and the bike is no longer designed for the amount of equipment it has to carry, resulting in problems in its handling. The goal of this assignment was to create a new vehicle to facilitate the QRT-team when transporting the necessary equipment to a distress-call.

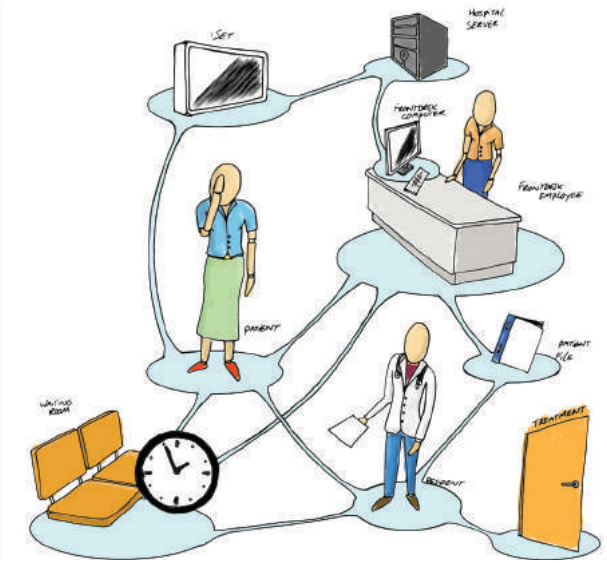
The unique selling point of the new design is its flexibility in storing medical equipment. A platform was created for the QRT-team to store/arrange the equipment to support its own needs. Three different partitions are mounted on the "Bike for Life" and can be pulled outwards (on both sides) by means of a rail system to which they are attached. This allows the members of the QRT-team to find and take out the necessary equipment in an ergonomically correct position. The pattern of the partitions makes it possible to rearrange the equipment so that pieces can be changed or added to the packing list. This makes the bike a future-proof solution, and gives the Bike for Life the flexibility needed so that it can be adopted by other hospitals.

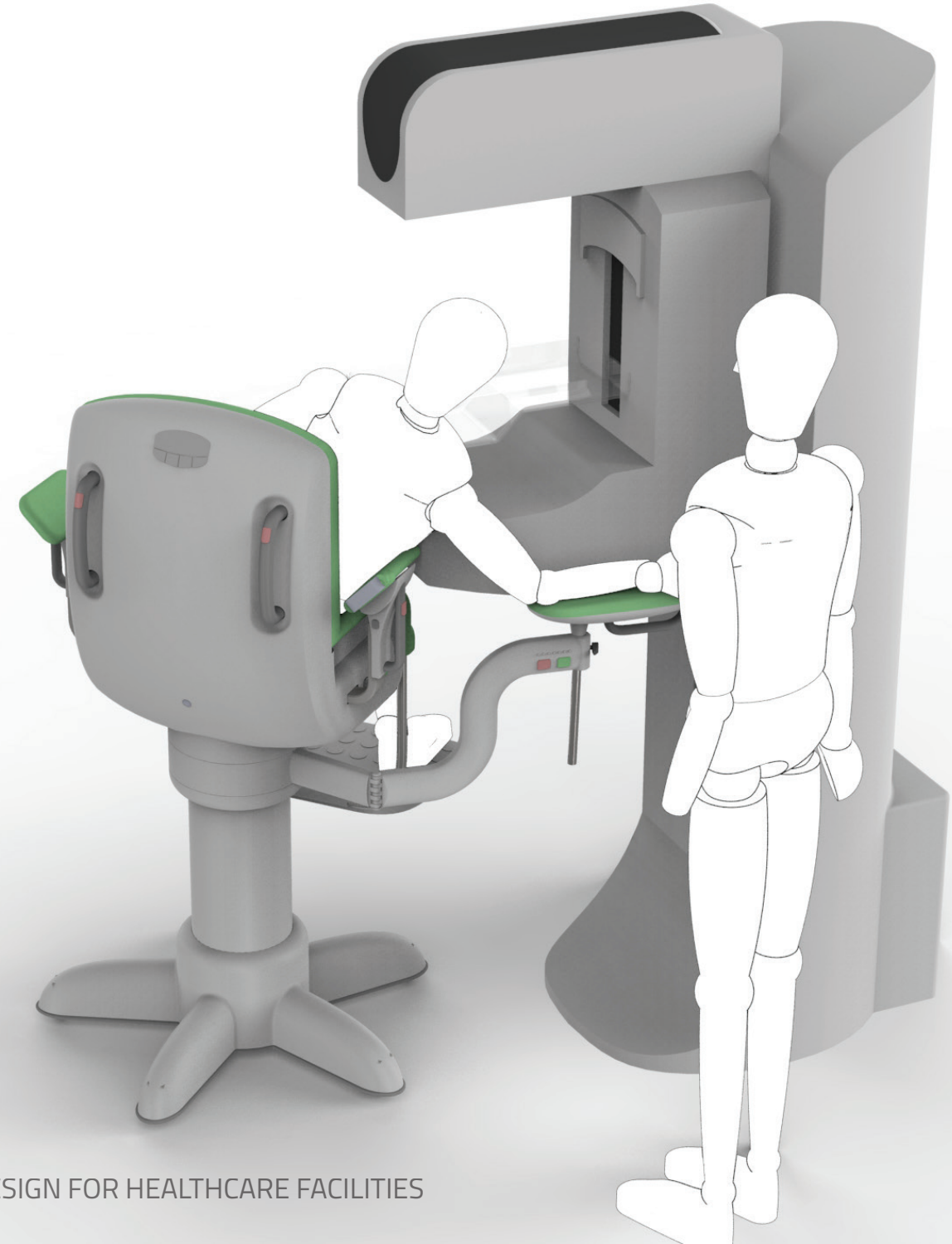
SELF-TRIAGE SYSTEM

Graduate: R. van Deventer (2014)
Supervisory team: L.W.L. Simonse, R.H.M. Goossens, E. van Eijk
Partner: Rotterdam Eye Hospital

The Rotterdam Ophthalmic Institute is developing a self-triage instrument, the ISET, for the Rotterdam Eye Hospital (OZR). This system is to be used by patients who need triage when visiting the Accident & Emergency (A&E) department. The ISET system consists of a series of questions that need to be answered by the patient – or a companion - through the use of a touch screen interface. The system assigns a colour code to the patient indicating the patient's urgency, with the goal of prioritizing patients. This colour code is conveyed to the medical personnel by means of a coupon. During development, it became clear that although the software was functional, more attention needed to be paid to the device's usability and appearance.

This project's aim was to improve usability for both patients and staff, to style the appearance to suit the OZR brand, and to prepare the concept for implementation. The new design features a service user interface that is made to specifically support the Rotterdam Eye Hospital's branding. The service user interface is displayed on a durable screen with high image quality and it offers users' help in the form of a figure called Okki. This figure was designed to attract the attention of the service users and reduce their anxiety by making them feel welcome and well treated.





SUPPORT FOR MAMMOGRAPHY

Graduate: L.V. Neve (2015)
Supervisory team: I.A. Ruiter, J.F.M. Molenbroek, C.A. Grimbergen, G.J. den Heeten
Partner: Academic Medical Centre Amsterdam

Breast cancer has a high incidence and death rate and can be treated more effectively and with less invasive treatments if detected at an earlier stage. Breast cancer screening is designed to improve early detection and is considered valuable by many experts. Mammography, the current method of screening, has however many issues resulting in discomfort and pain for the patient, ergonomically incorrect postures for the radiographer, and poor test results.

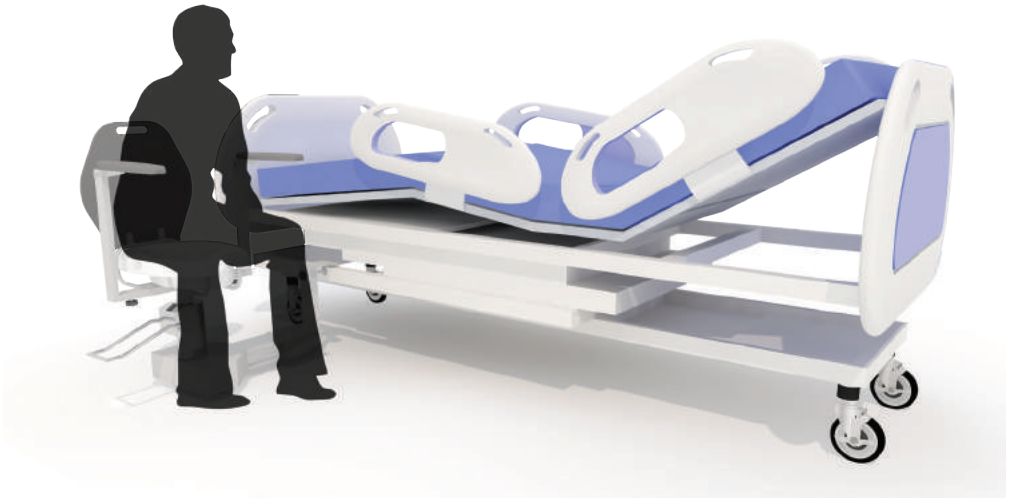
The MammoComfort is a chair, specially designed to improve the mammography experience by incorporating a number of functions, providing the client with more comfort, and the radiographers with a healthier work environment. These functions include an automatic correct height setting through a balanced spring system, a stable breast positioning by making the client tilt 45 degrees instead of the instrument and ergonomically correct positioning through convenient handles and spherical wheels. This results in making the procedure less error prone, ultimately leading to a better screening. The MammoComfort is fully compatible with most existing mammography instruments in mammography.

OLLA-DELUXE: A PATIENT SPECIFIC COMMODE

Graduate: P.L. Dinh (2015)
Supervisory team: I.A. Ruiter, E.W. Thomassen
Partner: Pharmafilter

The commode is an item that is most prone to being a potential cause of cross contamination, even more so as commodes are often shared between patients in the same ward. In addition, the nurses often have to 'hunt' for the commode because they are not always stored in the designated spots or are in use by others. This combination of factors can result in an uncomfortable long wait for the patient and an increased chance of infection.

The Olla-Deluxe is a patient-specific commode, achieved by connecting the commode to the hospital bed. This reduces the chances of cross-contamination between patients. The one-person-use saves nurses up to 30 minutes of cleaning time per use. The concept has features that support nurses in their work, and also allows the patient to have a correct toilet posture.



EXOSKELETON ARM SUPPORT FOR HELPING CAREGIVERS LIFT DISABLED CLIENTS

Graduate: V. Stiglic (2014)
Supervisory team: M. Hajian, I.A. Ruiter, J.F. Schorsch
Partner: Delft University of Technology (internal research project)

The aim of this project was to design an arm support for a powered exoskeleton to help caregivers lift disabled clients. This project is part of a PhD project at the Faculty of 3me in TU Delft, which aims to develop 'Chiron', an exoskeleton for caregivers. The idea is to reduce the physical and psychological stress caregivers experience when lifting and manipulating with their clients, while speeding up the process itself. The goal of this graduation project was to develop a design proposal for the Chiron arm support.

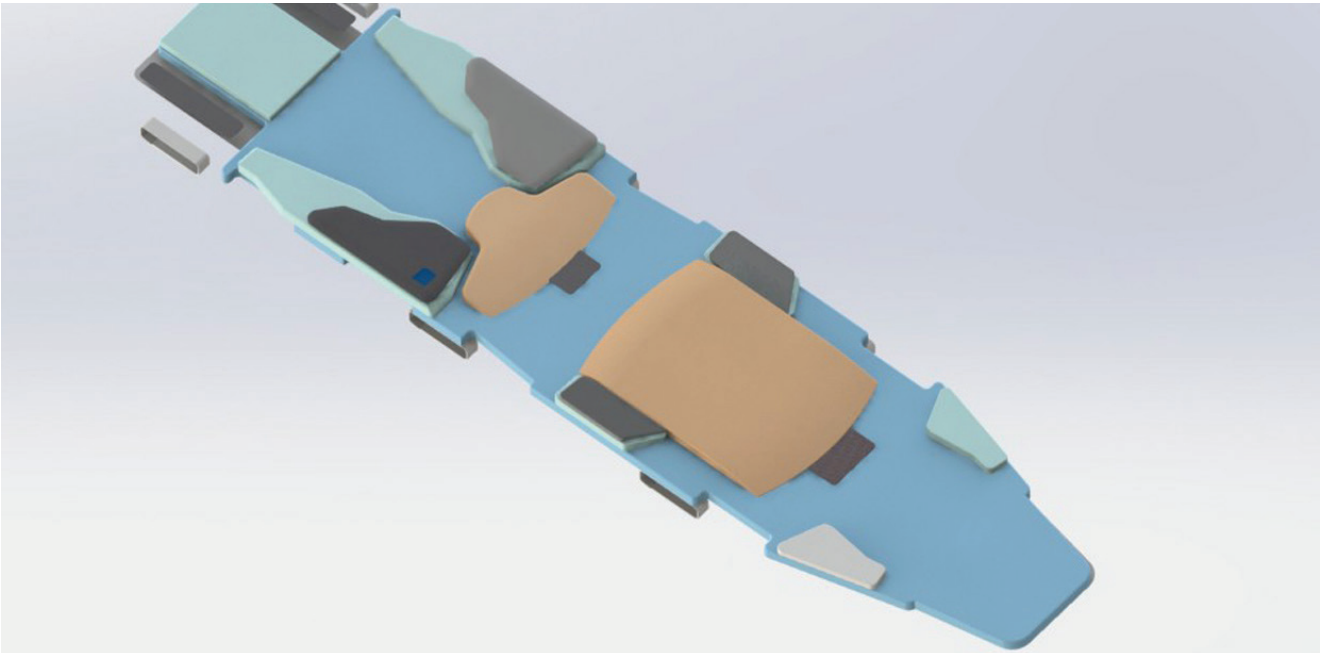
The newly designed arm support enables a fast, simple and safe way of putting the device on and off the arm (donning and doffing). In addition, the arm support fits a wide variety of arm sizes. The design has proved itself in user tests to be an effective ergonomic interface between the caregiver and Chiron. The aesthetic factor was well received since the elegant curved product simplifies the complex underlying structure of the exoskeleton, thereby supporting its use in a caregiving environment.

PRESSURE ULCER AND HYPOTHERMIA PREVENTIVE SURFACE

Graduate: A.B. Nedkov (2012)
Supervisory team: R.H.M. Goossens, M. Hajian, M. de Bont
Partner: Erasmus Medical Centre Rotterdam

Spinal boards are designed to fixate and immobilize patients. However, they are often the cause of pressure ulcers and hypothermia. Pressure ulcers are caused by prolonged pressure on the patients lying on the spinal board. Hypothermia is often caused by the prolonged exposure to a cold environment.

The new design is a pressure relieving surface which can be applied to existing spinal boards. The pressure-relieving surface includes chemical heating pads which warm the patient while fixated. It consists of multiple layers of foam which are placed over each other to redistribute the pressure. The material reflects the curvature of the patient and thereby reduces the pressure; it is able to withstand pressures of up to 190 mmHg on the main surface, which means that the pressure can be reduced by half.

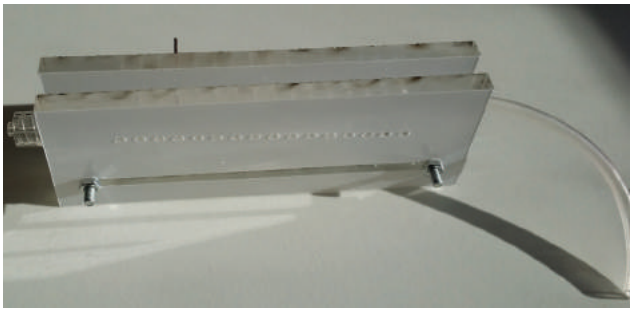


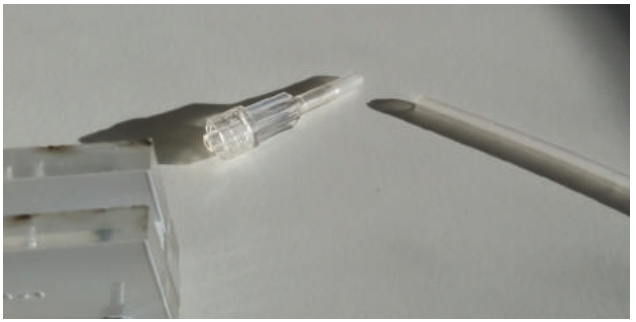
RELEASE: PREVENTION OF ACCIDENTAL REMOVAL OF PERIPHERAL INTRAVENOUS CATHETERS

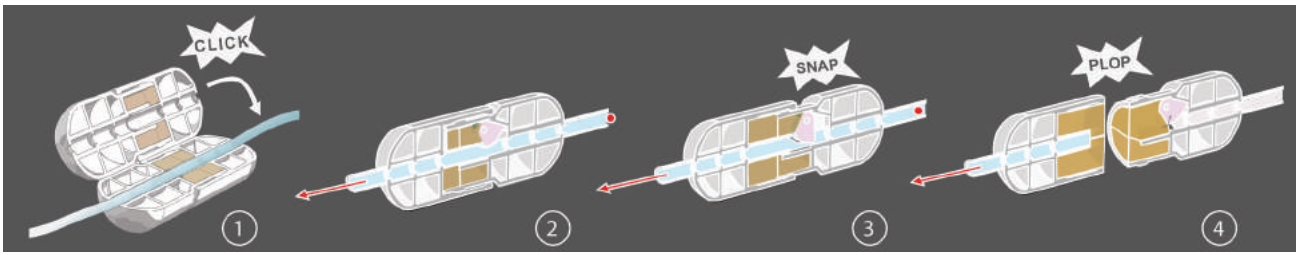
Graduate: F.G. Baas (2015)
Supervisory team: J.F.M. Molenbroek, A.H. Jellema, W. Swagerman
Partner: Swagerman

Accidental removal of a catheter results in blood or chemicals dripping onto the patient's bed and clothes. In addition, the removal can lead an increased chance of infection, difficulties finding a new spot for replacing the catheter, and general hygienic issues. This is both labour-intensive and potentially dangerous and might result in a longer hospital stay and higher dissatisfaction of both the caregiver and the patient.

Release© improves the freedom of movement of the patient while ensuring comfort and safety of the caregivers. The product prevents accidental removal as result of an excessive pull force through automatic disconnection at a point just prior to release of the peripheral intravenous catheter. The product can be placed directly on the intravenous infusion line anywhere in the system, and it only interferes with the infusion when needed. It can be easily reconnected after (accidental) disconnection, and importantly, without compromising safety or comfort.





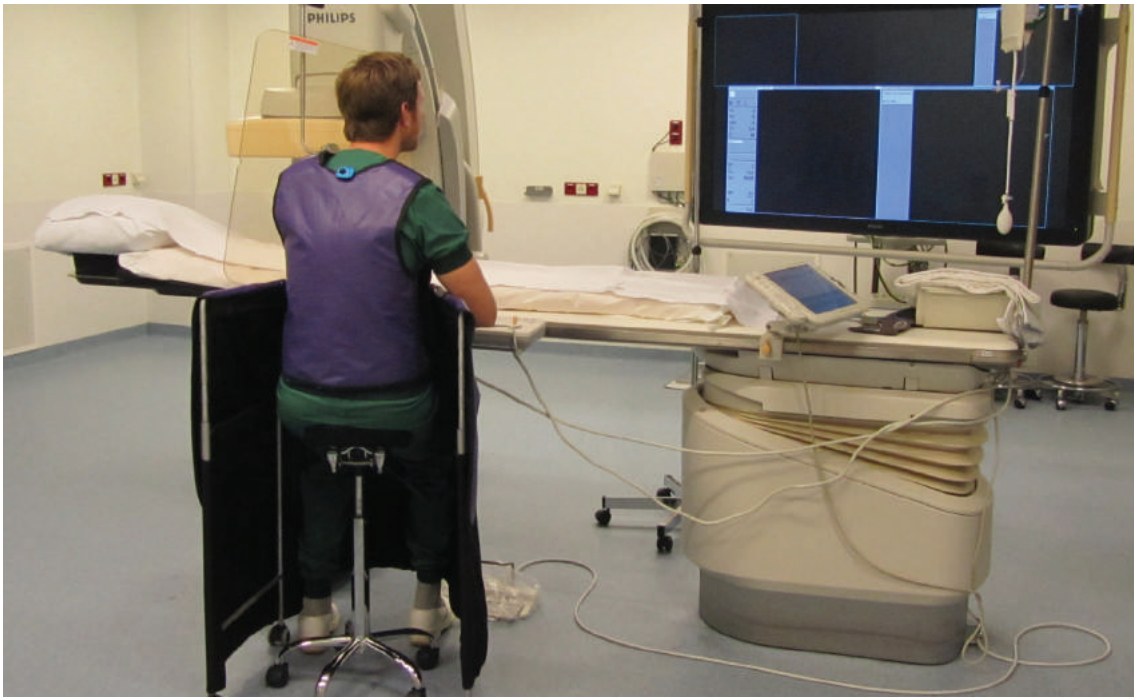


X-ERGO: IMPROVING THE PHYSICAL COMFORT OF INTERVENTIONAL SPECIALISTS

Graduate: G. de Bruijn (2014)
Supervisory team: A. Albayrak, I.A. Ruiter, M. van Alfen
Partner: Philips

Interventional specialists are exposed to a great deal of radiation during long-lasting procedures, hence they have to wear a heavy lead apron for protection. Both wearing the heavy lead apron and these long-lasting interventions can result in muscle fatigue in the legs and feet, as well as lead to ergonomic problems such as neck, back and knee complaints.

This graduation project shows the development of X-eRgo: a solution for the physical problems interventional specialists face during image-guided interventions. The design consists of a high stool and a mobile lead protection with lead protection drapes. Both components are adjustable in height. X-eRgo improves the current working situation for the interventionalists. Physical complaints and muscle fatigue in the lower extremities are reduced as less weight is carried, and physicians are able to better focus on their patients as they can work in a more comfortable position.

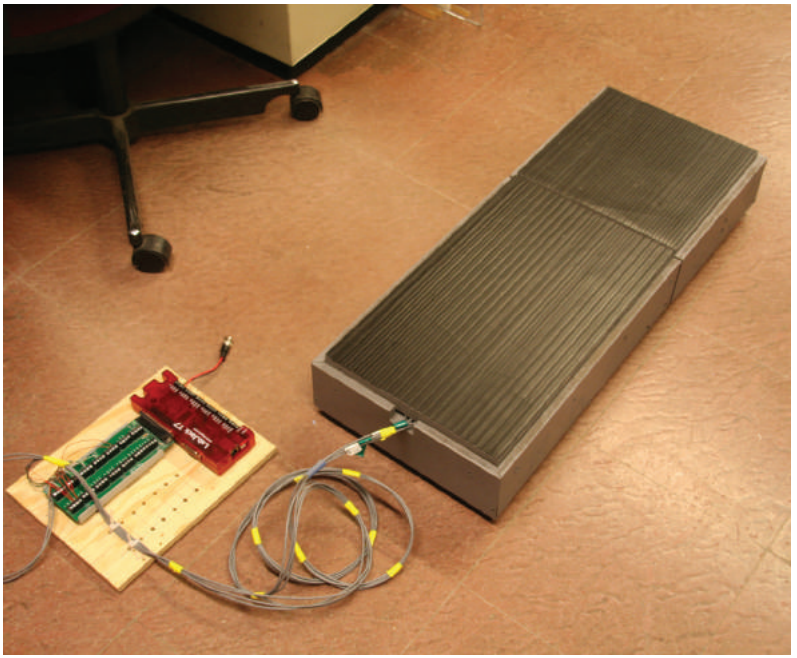


ERGONOMIC BODY SUPPORT FOR LAPAROSCOPIC SURGERY

Graduate: A.A Waumans (2014)
Supervisory team: R.H.M. Goossens, A.L.M. Minnoye, J.L. Herder, N.C. Hanumara
Partner: MIT Precision Engineering Research Group

While in the operating room (OR) the focus is mainly on the patient, recent research has shown that ergonomics in surgery are a structural problem. Almost unanimously, surgeons stated that they experience discomfort during or after operating. Discomfort, however, is a vague term, and it is difficult to come to a consensus on its exact causes, or how to solve it. For this reason, discomfort is split into three external parameters: load, exposure time, and posture. The main target of this project was exposure time reduction.

The resulting design consists of two modules: an upper body support and a standing platform. The upper module is a combination of a flexible abdominal platform and fixed arm rests for a shorter structural loop, resulting in more precision. The platform consists of a stiff surface on springs, inducing posture variation. Together, the two modules result in a combination of postural variation and load variation, but provide sufficient support of the upper body, while still allowing the surgeon to retain control and move autonomously.



BREASTFEEDING SUPPORT FOR NURSING STAFF

Graduate: B. Steenbeek (2013)
Supervisory team: M.C. Dekker, A. Albayrak
Partner: Waterland Hospital Purmerend

Breastfeeding might be seen as something natural and 'easy', however often directly after birth, babies do not 'latch-on' properly to the mother's nipple and nurses need to assist. During this activity, they support the baby's head and body and the mothers' breast in order to guide the baby correctly to the breast. This can take up to 12 minutes, during which the nurses stand in static postures bending forwards with their upper body and often twisting their backs, which ultimately can lead to low back pain or even hernias.

The aim of this project was to design a support for hospital nursing staff to make the breastfeeding process a more comfortable action for them to perform. The design should reduce the prevalence of low back pain (LBP) amongst nursing staff working in Obstetrics & Gynaecology wards (O&G), and thereby reduce absenteeism resulting from these symptoms. The new support is designed to be used during difficult breastfeeding situations. In these cases, the nurse positions the product at the bed side, and after correctly setting the height, leans on the support.

HEALTH CADDY: A MOBILE OFFICE FOR CAREGIVERS IN NURSING HOMES

Graduate: F.M.C. Tel (2013)
Supervisory team: I.A. Ruiter, J.F. Prins, A. Veendijk
Partner: Pezy Product Innovation

Due to the ageing population, the number of people entering institutions is increasing. Currently, professional caregivers already have a huge workload; in the future this only will increase. Dutch healthcare institute Siza wanted to improve the efficiency and the quality of their morning care (the most hectic part of the day) for both their caregivers and their clients.

The Health Caddy, a mobile office for caregivers, includes a workspace, an information system and the required materials. Users can freely decide what kind of materials they want to bring along. Changing the configuration is easy due to the modular character. The Health Caddy has facilities to preserve and dispense medication, and it has a mobile information system. The concept strongly emphasises patient registration using a tablet computer. Caregivers have access to client registers, medication diagnostics, and registration data. Personal calendars and other schemes can also be retrieved.

With the use of the Health Caddy, caregivers are able to do their morning routine without interruptions. The content can be precisely decided in advance, making them aware they have the right materials. This mobile workstation creates a fluent and much more relaxing process for themselves and for their clients.

THE GUARDIAN: OPTIMISING PATIENT AIR TRANSPORT

Graduate: J. van de Ruit (2015)
Supervisory team: P. Vink, A. Albayrak, J. van den Bosch
Partner: Electronic House Rotterdam

Every year, hundreds of patients are returned by air transport to the Netherlands from all over the world. In 2013, a team of Industrial Design master students was asked to design a modular Intensive Care Unit for patient repatriation; the Guardian. The Guardian is used by a medical team to safely transport a patient, while family members, regular passengers and the cabin crew surround the unit. An important thing they all have in common is that they are likely to be witnessing this form of patient transport for the first time. The goal of this follow-up graduation project was to study these stakeholders and to optimise patient transport by airplane for them. A holistic approach was taken by considering the relationship between four separate designs and the Guardian concept as a whole. The designs function on their own for each stakeholder, but a combination will optimise Guardian repatriation in its entirety.

- Design part A | Information for family and passengers

By providing family members and passengers with two brochures, they are fully informed of what the Guardian entails and what they can expect.

- Design part B | The cabin walls

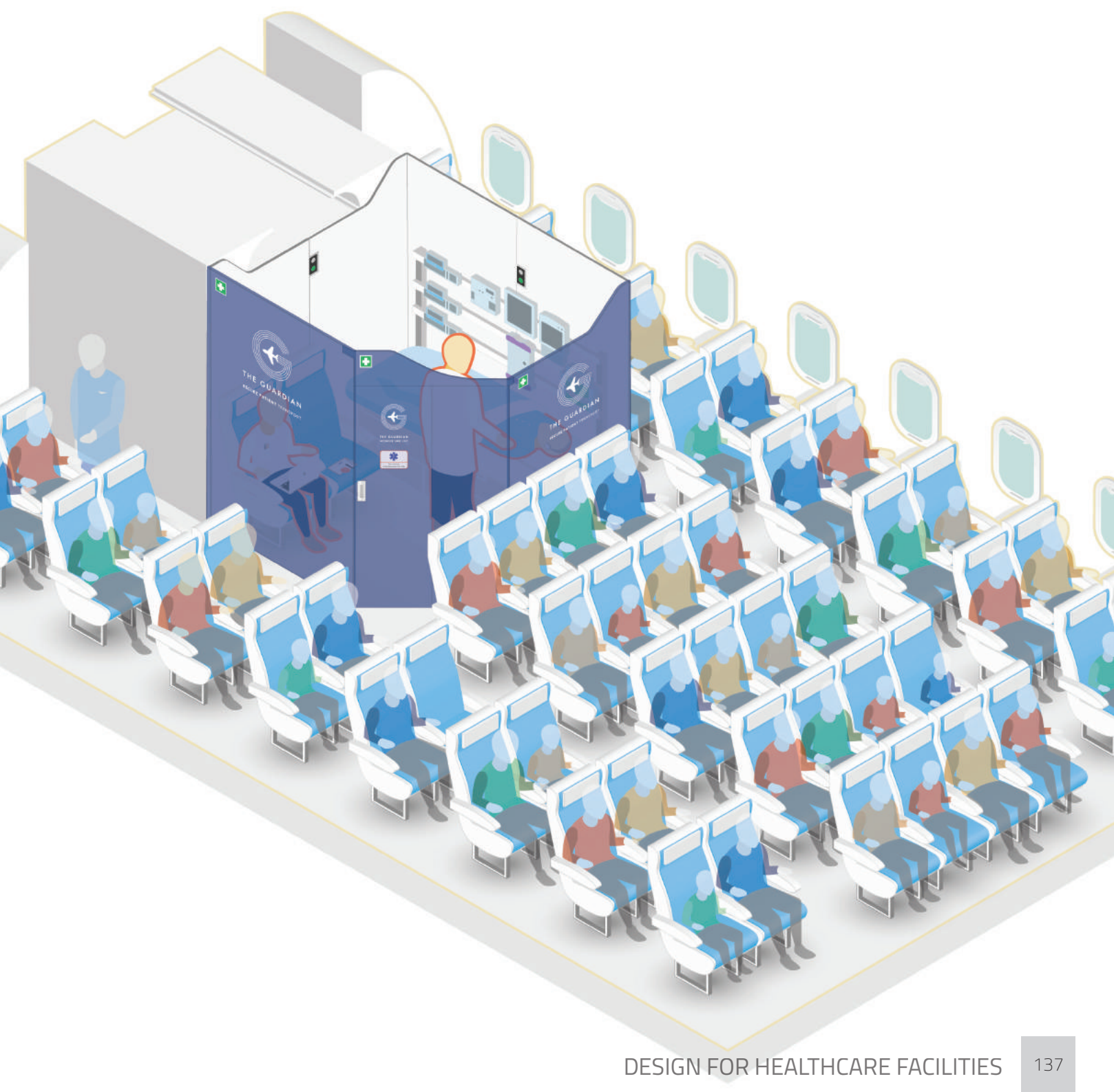
The walls enable passengers to immediately get some notion of the purpose of the cabin. The Guardian logo is featured on each side, along with the words: Secure Patient Transport. This communicates the true essence of the cabin, since further information can be found in the brochure 'Information for Passengers'.

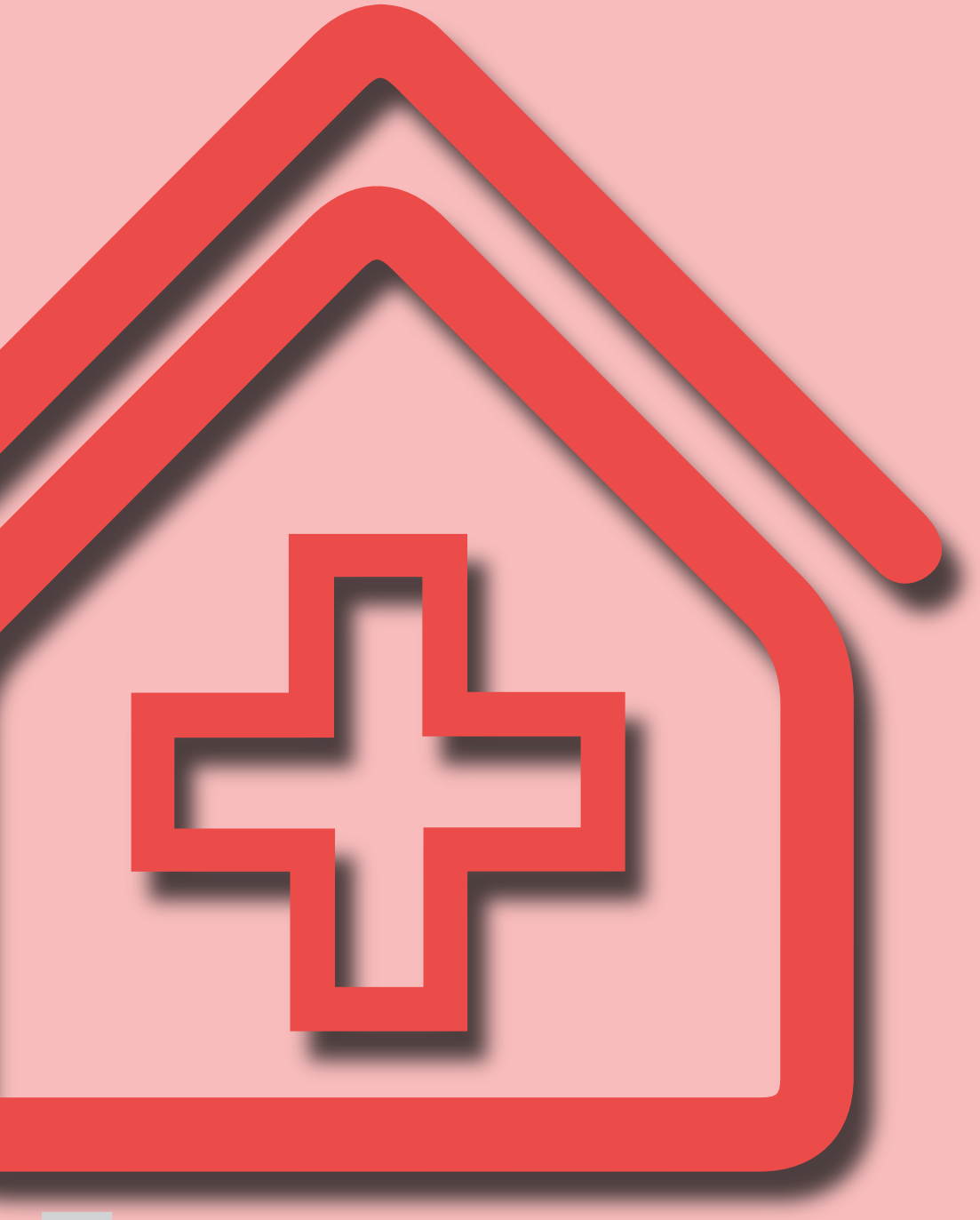
- Design part C | The Guardian Guide

The guide supports the medical team at three stages: before, during and after the flight. By providing an overview of all the on-board equipment and medication, the team can prepare the repatriation in advance. It also informs them how they can brief the cabin crew, and how to keep the family informed during the flight. Lastly, the guide, in a pre-specified document, describes how the patient transfer should be prepared and safely executed.

- Design part D | The Guardian Wearable

During an emergency, situations may occur where the medical team requires assistance from a cabin assistant. The Guardian Wearable helps them to instantly contact someone without having to leave the cabin. A small wireless device worn by a cabin assistant enables this contact.


THE GUARDIAN
THE GUARDIAN



DESIGN FOR HOMECARE FACILITIES

TAILORED TELEHEALTH DEVICE FOR PATIENTS WITH A CHRONIC CONDITION

Graduate: A.T.V. Pestalozza (2014)
Supervisory team: M. Melles, P.M.A. Desmet, J. Lacroix, J. Tatousek
Partner: Philips

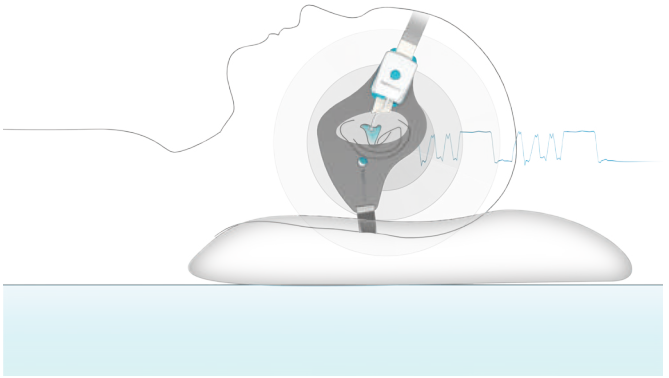
Telehealth systems allow patients to measure their vital signs at home and send them to a monitoring health agency. Remote monitoring increases patient independence, but also their responsibility as they provide the first input to the monitoring system: patients get an active role in managing their own care. As a consequence, the design and development of engaging and user friendly devices that stimulate consistent and sustainable use of the system, becomes crucial. A more patient-centred and tailored approach is expected to increase patients' motivation to use the system and to provide more reliable data. This project focuses on defining a set of guidelines for the design of tailored interactions with telehealth devices based on the psychological profiles of chronic patients.

A blood pressure meter was used as a design case. Two patient profiles were selected as a target group for the design explorations: the optimist and the sensitive. Different solutions to motivate patients to measure their blood pressure were designed, each based on the patient' motivational styles profile and their emotional state while measuring. Design ideas were not only related to the action of measuring the blood pressure, but also to managing the condition in general. The design ideas were translated into experiential prototypes that were tested with chronic patients in subsequent design iterations and refined according to their feedback.

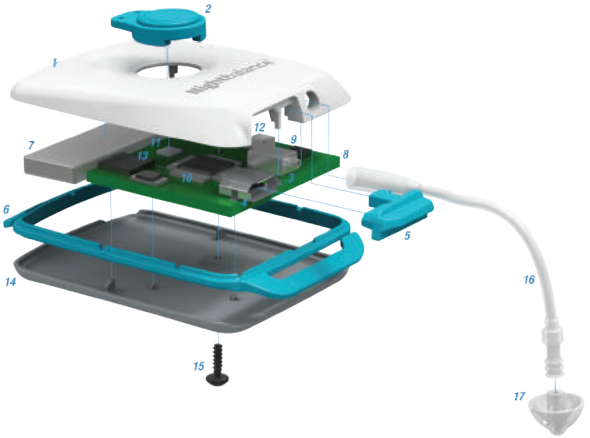
SLEEP POSITION TRAINER

Graduate: J. Zhao (2012)
Supervisory team: R.H.M. Goossens, M. Hajian, T. van Oorschot
Partner: NightBalance

Obstructive Sleep Apnoea Syndrome (OSAS) is characterized by periods of reduction and cessation of the nasal airflow during sleep. Almost 24% of the western population suffer from OSAS: their sleep quality is enormously impacted and OSAS is associated with significant morbidity of other diseases. Due to its physical cause, patients show a steady 56% correlation between the total number of apnoea and the supine position (sleeping on the back). The Sleep Position Trainer (SPT) developed by NightBalance has proved effective in these position-dependent patients.



An SPT positioned around the upper head is required when the head position is found to be more important than the trunk position. The newly designed SPT is a small and light device which patients can comfortably wear around the upper head, held in place by an ergonomic band. It gently trains the patient not to sleep in a supine head position by triggering a controllable auditory stimulation. Initial prototype tests have shown a greater than 50% time-reduction spent in a supine position.

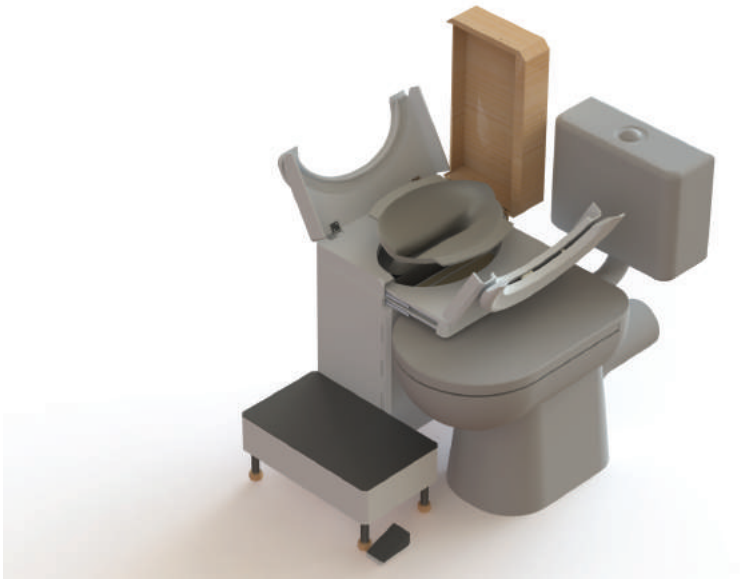


OLLA-ON-THE-MOVE: TOILET FOR CHEMOTHERAPY BODILY WASTE CONTAINMENT

Graduate: S.F.S. Chang (2013)
Supervisory team: R.P. Koster, I.A. Ruiter, P. Kelly, E. van den Berg
Partner: Pharmafilter

Olla-on-the-Move is a toilet designed for cancer patients undergoing chemotherapy. Working together with Pharmafilter, the starting point was to design a product or product-service system to provide a hygienic and dignified programme of care for removing hazardous chemotherapy bodily fluid waste (urine and faeces) from the home, to be treated by the Pharmafilter purification process. Nurses, doctors, patients and family members were interviewed in order to gain an in-depth understanding of the design context. This led to the design of a mobile toilet tailored to the changing needs of patients, providing dignified care in usage and service, and one that allows the collection of chemotherapy waste into packages for collection and transport.

Olla-on-the-Move is a toilet that allows the patient and family members to share the same lavatory. This allows the patient to follow their normal routine in the lavatory, providing a feeling of "dignified care". The product has been designed to be converted to a stand-alone unit, allowing for use outside of the lavatory should the situation require this.

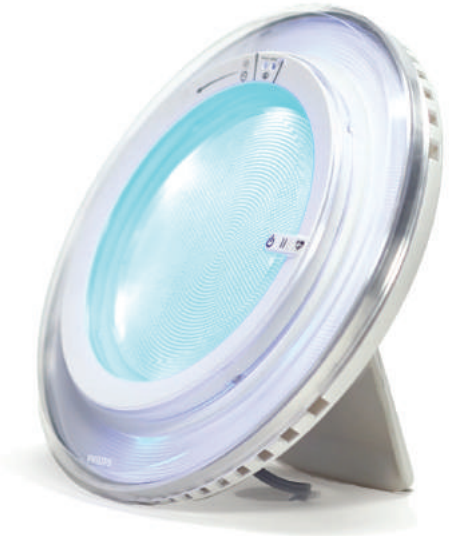


ENERGYLIGHT FOR PEOPLE SUFFERING FROM SEASONAL AFFECTIVE DISORDER

Graduate: R.J. Rosenbrand (2012)
Supervisory team: C.J.P.M. de Bont, J.I. van Kuijk, I. van de Wouw
Partner: Philips

Philips currently sells three light therapy products that claim to make you 'feel more energetic throughout the day, in a natural way'. The products are mainly targeted at people suffering from Seasonal Affective Disorder (winter depression) and sub-syndromal Seasonal Affective Disorder (winter blues). Market research showed that there is a significant growth potential for light therapy products, although currently both product awareness and the transition to purchase intent are limited. People think the products are expensive and they are not convinced that the light treatment is effective. The goal of the project was to identify opportunities for a new generation of light therapy products for people suffering from seasonal affective disorder.

The SunSphere is a showcase for demonstrating how the findings from consumer, market and scientific research can be translated into a single product. The results suggest that users appreciate the product in terms of design, how it is used, and light output. Together with the integration of two light settings and distance sensing, the participants indicated that the product has clear added-value that is likely to validate the indicated sales price. From a business perspective, the product has the potential to replace the current generation of EnergyLight products, and differentiate them from competitors by means of aesthetics, light output, and additional functions.



THE SQUAT ASSISTANT: DESIGN FOR OBESITY

Graduate: C.C. Wu (2013)
Supervisory team: J.F.M. Molenbroek, C.C.M. Moes, T. van Sheppingen
Partner: Tilcentrum

Obesity is defined as having a Body Mass Index greater than 30. Globally in 2008, 35% of adults were overweight, and 12% were obese. Obesity is a chronic disease and it has a great impact on personal health, the economy and society. This graduation project set out to discover the essential needs for obese people. The vision defined for this project was: "By combing home activities and training exercise to improve physical condition, the end-users are motivated to be more active and improve the quality of their lives".

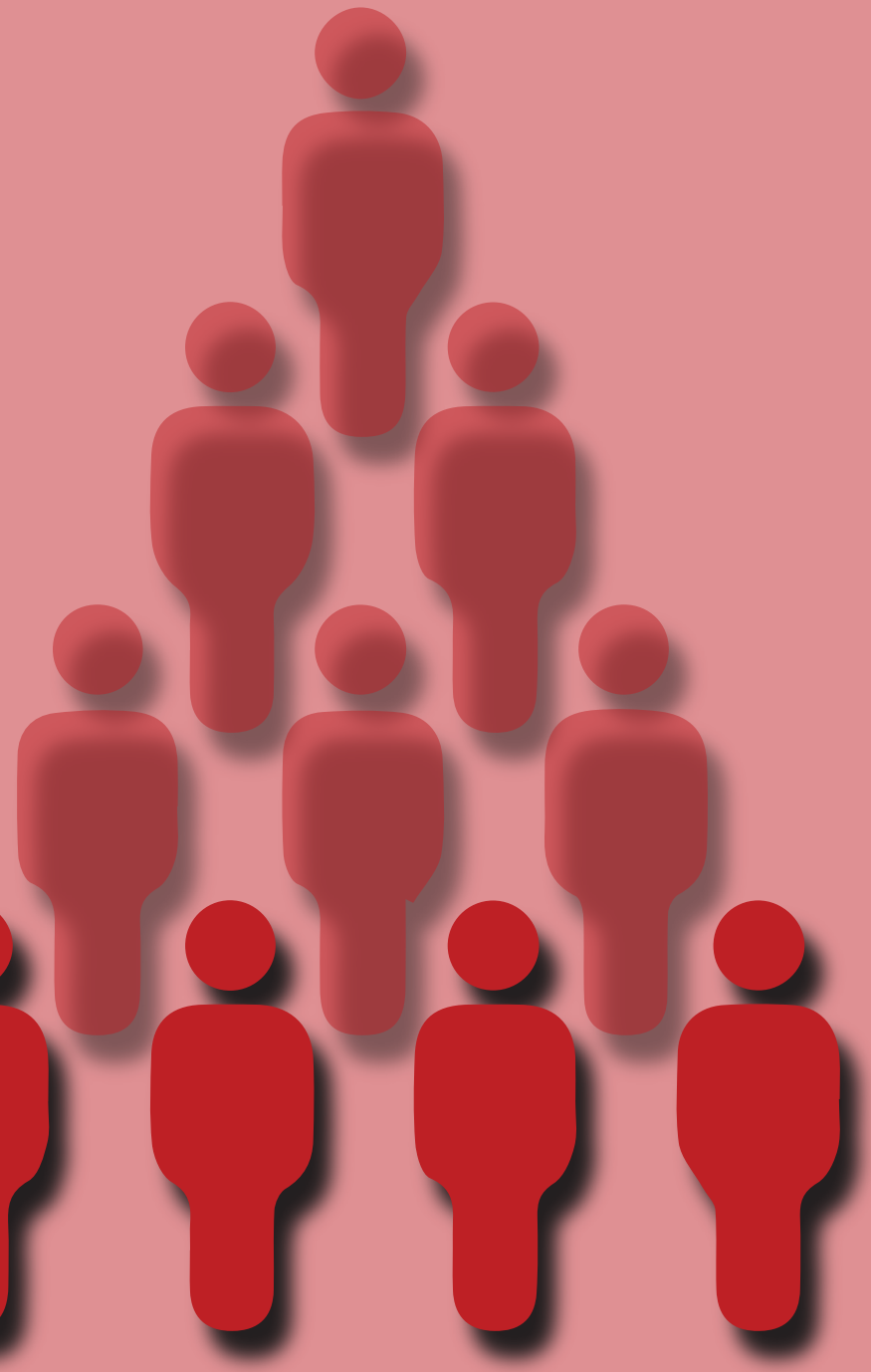
Obese people with Lower Back Pain (LBP) are not able to stand for a long time. The Squat Assistant provides a resting device which encourages the user to sit in a position to improve natural lumbar lordosis. Meanwhile the user can do a body stability exercise (for example a body weight squat) which helps reduce LBP.

WEE: ERGONOMIC BATH CART FOR INSTITUTIONAL OR HOME USAGE

Graduate: M.J.J. Eichenbrenner (2011)
Supervisory team: J.F.M. Molenbroek, L.H. Langeveld, R. den Breejen
Partner: Medsorg GmbH

One of the most frequently used products for the care of the disabled and/or the geriatric elderly is the – often forgotten - bath cart. It is used for transporting immobile patients to the bathroom and supporting carers when performing basic hygiene routines. Medsorg GmbH sells these types of medical devices, and has gradually gained a reputation for being a one-stop supplier for care institutions. The company is now looking at developing a product line for the Asian market. The goal of this graduation project is to design an ergonomic bath cart which offers improved comfort, reduced physical strain, and efficient economy of time for the manual transfer procedure. In the analysis phase, research was conducted on nursing profession workload, the market, and we looked at a product benchmark, legislation, and user-requirements. In a number of qualitative interviews with nursing staff and residential-care inhabitants, the context of use and user-product interaction were investigated.

The research led to the design of Wee, a flexible ergonomic transfer chair designed to support the hygiene routine of people with limited mobility. Based on the credo: don't lift but slide, it allows the carer to slide the immobile resident comfortably from bed-to-chair in a lateral posture. Additionally, the chair's ingenious folding mechanism supports the movement of the immobile person from a reclined to a sitting position, and vice versa. As no lifting is necessary, the daily routine for carers and residents is easier and more comfortable. The added value of the concept lies in the reduction in time and the number of steps taken, less physical strain, and in an improved working posture, resulting in a significant reduction in time and costs.



DESIGN FOR THE BASE OF THE HEALTHCARE PYRAMID

TACHYPNEA DIAGNOSIS FOR LOW RESOURCE SETTINGS

Graduate: L.C. Medema (2013)
Supervisory team: R.H.M. Goossens, M.C. Dekker, P. Dadlani
Partner: Philips

Globally, pneumonia is responsible for 18% of the deaths of children aged under five. The vast majority of these deaths are in the poorest regions; in 2010 a total of 1.4 million deaths of children in developing countries.

The right diagnosis is key in the treatment of pneumonia. In rural settings where health facilities are largely unavailable, the World Health Organization has developed guidelines to classify pneumonia at a community level. A rapid respiratory rate (tachypnea) in combination with cough indicates pneumonia and a need for antibiotic treatment. In order to judge whether the respiratory rate is rapid, a health worker counts the number of breaths for 60 seconds and compares them with the cut-off rates for pneumonia. Current practice shows that counting respiration per minute is difficult, resulting in miscounts. Mistakes are made or health workers are not trusted, which in turn results in children receiving overdoses of antibiotics or no treatment at all. Therefore this graduation project focused on the development of an automated respiration counter for children up to the age of five, using a tri-axial accelerometer.

The designed product will make a great difference to the diagnosis process. The process will become easier, quicker, and much more accurate, and will strengthen peoples' trust in the diagnosis. This will result in a reduction in antibiotic use and more accurate patient referral to higher healthcare facilities, when necessary.

MEU CORAÇAO FELIZ: BLUEPRINT FOR HYPERTENSION PRIMARY HEALTHCARE IN BRAZIL

Graduate: L.N. Nino (2014)
Supervisory team: G.C. Calabretta, O.E. Eris, G. Geleijnse
Partner: Philips

Hypertension is a common condition in Brazil, often leading to more severe cardiac diseases that put a strain on the Brazilian society and healthcare system. Hypertension can be well managed with the right support in primary care, but resources are scarce in the Brazilian public healthcare system. This project describes the development of a human-centric designed (HCD) blueprint, using the design of a product service system for hypertension for the primary healthcare sector in Brazil as a case study.

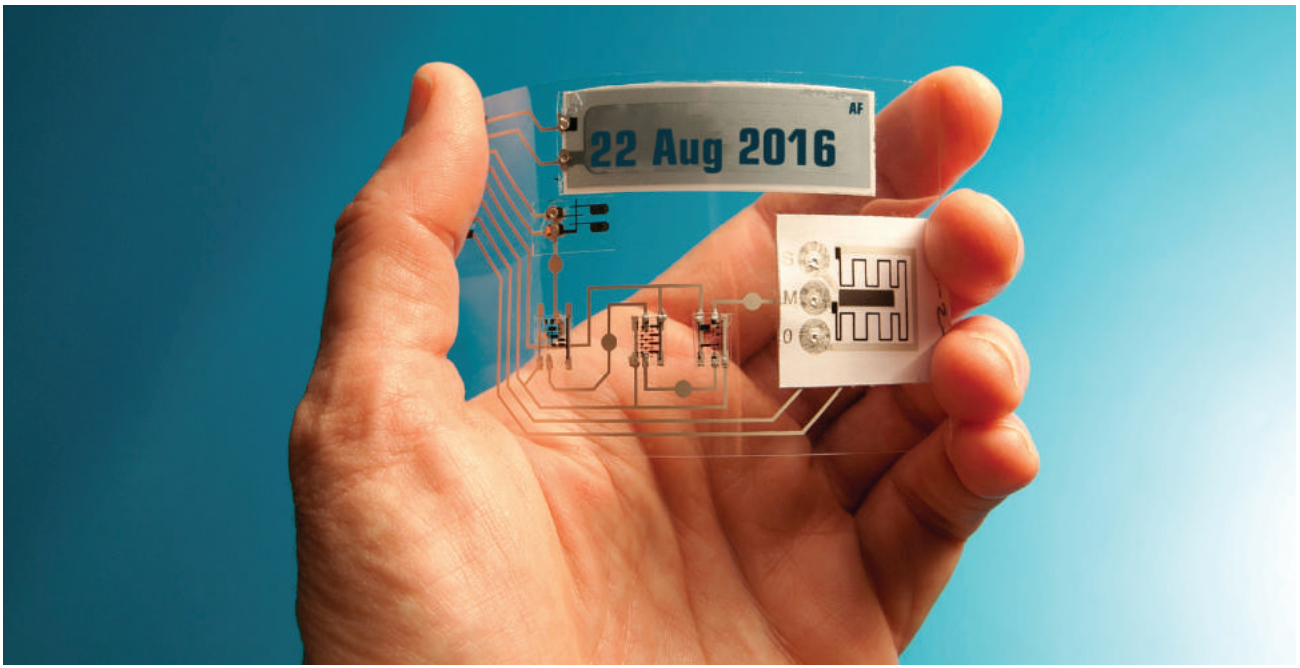
My Happy Heart Program (Meu Coração Feliz) is a product service system for the early detection and effective management of hypertension, developed for Brazil's primary healthcare. The product service system is communicated via an HCD blueprint, with the goal of benefitting both the human condition and business. Ultimately, the HCD blueprint and My Happy Heart Program present a business partnership between a healthcare company and the Brazilian public healthcare sector. This partnership results in higher access to care and more effective hypertension detection and management, resulting ultimately in happier and healthier patients.

USE BEFORE DATE: MONITORING COLD CHAIN ITEMS IN THE HUMANITARIAN AID CONTEXT

Graduate: M. Bariain (2014)
Supervisory team: M. Melles, D. Rhein, A.L. Santos, M. Tanaka
Partner: Médecins Sans Frontières

Many medicines, tests and vaccines are sensitive to heat and/or cold. Therefore, they need to be transported and stored at a constant temperature, between 20C and 80C, to retain their medicinal properties. These items constitute the Cold Chain, the preservation of temperature from manufacture to administration. This is a considerable obstacle in developing countries, particularly in areas that are hot, isolated, and lack a reliable electricity supply.

Use Before Date (UBD) is a digital expiration date that uses printed electronics technology. UBD is a sticker that calculates and displays the expiry date of the Cold Chain item. It contains sensors, rewritable memory, a display, a wireless communication system, and a battery to run the system. UBD provides information to the end user about the quality of the Cold Chain items and makes them aware of the consequences of their behaviour (exposing the items to heat or cold). By giving them this knowledge, they also have to take responsibility. Also, UBD prevents items from being unnecessarily thrown away. UBD intuitively informs and alerts users.

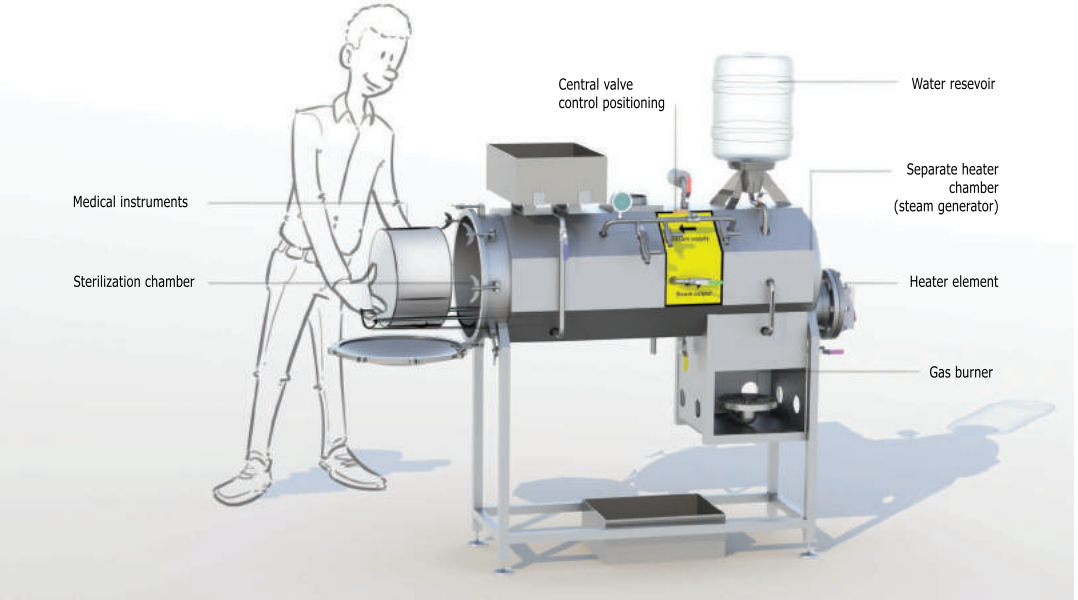


WATER-SPARING STERILIZATION FOR HUMANITARIAN AID

Graduate: F. Stokman (2014)
Supervisory team: J.C. Diehl, J.J. van den Dobbelsteen, A.L. Santos, O. Huldt, M. Tanaka
Partner: Médecins Sans Frontières

Sterilization is the process that kills and removes microorganisms from medical devices, and is one of the most important contamination prevention steps in a hospital. The goal of this project was to find a solution for the problems that occur during the sterilization processes conducted by Médecins Sans Frontières (MSF). Currently, MSF uses the Robustex 90L autoclave to sterilize their instruments, however MSF was interested in a an improved version of the Robustex. Different stakeholders have different requirements regarding sterilization and face different problems with their sterilizers making it difficult to design an autoclave that suits all their needs under every specific condition.

The main focus for the redesign of the Robustex is a more water, energy and time efficient sterilization process. The redesign of the water heater part of the autoclave improved the product's technical specifications. In addition to the technical design aspect of the autoclave, the redesign also focused on the usability and manufacturability of the product. In conclusion, this project resulted in a robust autoclave by separating the heating space from the sterilization chamber. The redesigned version consumes 75% less water, 23-38% less time, and 30-50% less energy during a sterilization cycle.

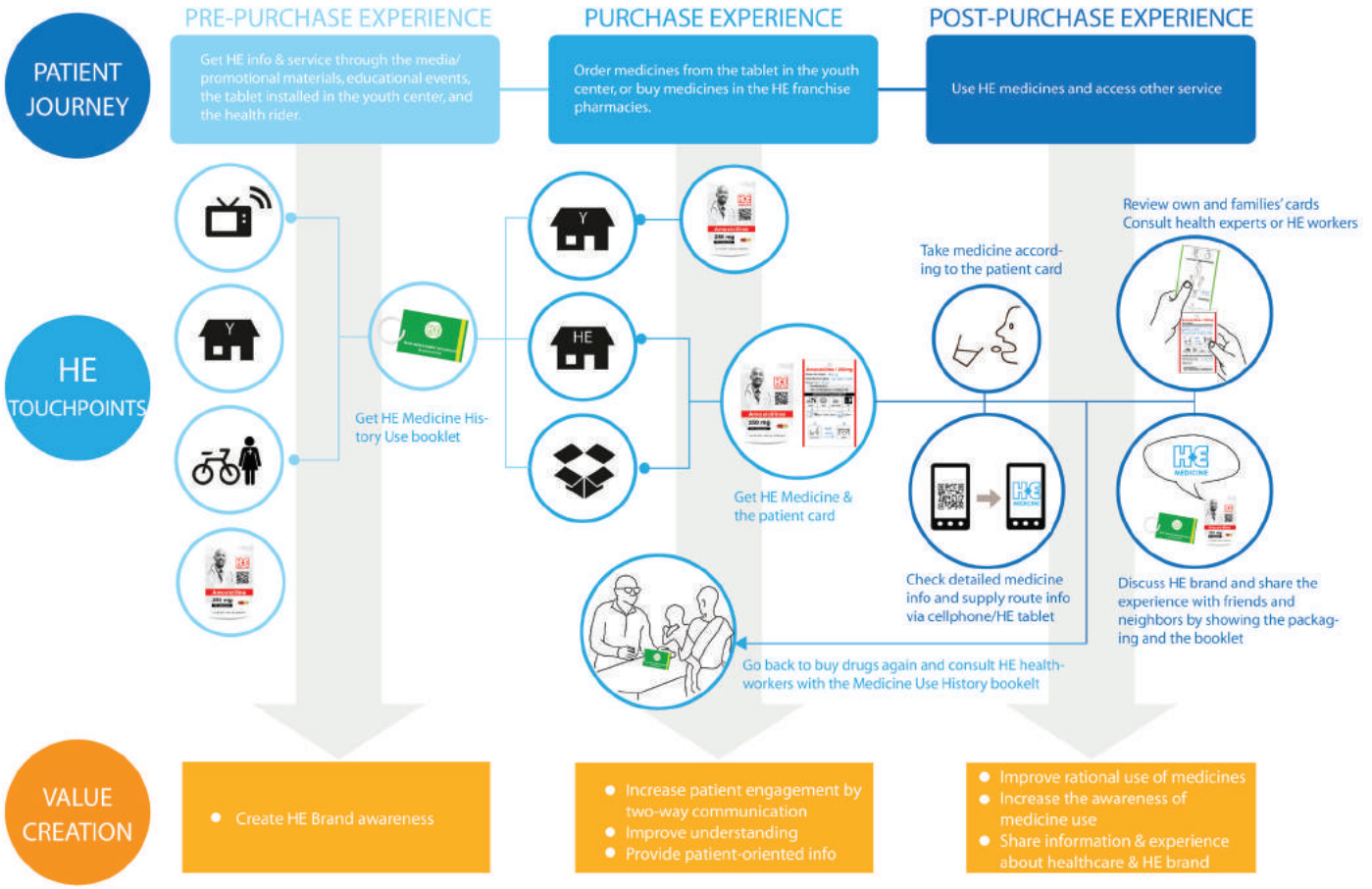


PACKAGING STRATEGY FOR INCREASING TRUST IN GENERIC MEDICINE

Graduate: H. Wang (2013)
Supervisory team: H. Kuijpers, A.H. Jellema
Partner: Healthy Entrepreneurs

Essential medicines are vital to maintain healthcare, and they should be available with assured quality and affordable price that every individual can access. This is a fundamental human right. Nevertheless, in Sub-Saharan Africa, an estimated 50% of the population lacks access to essential medicines. To increase the availability and reliability of essential medicines, Healthy Entrepreneurs developed a stable supply chain to provide affordable and qualitative generic medicines to the Base of the Pyramid population. Generic medicines are drugs that can be produced legally when there is no patent protection for the production of the original medicines. The prices of generic products are usually significantly lower than their branded equivalents. However, due to a lack of inspection and control in these countries, the majority of generic medicines are counterfeits or the quality is substandard, which result in poor reputation and people's distrust in generic medicines. The aim of this project was to increase trust in generic medicines by developing qualitative packaging and an effective communication strategy.

The final packaging is a flexible zipper lock bag which offers advanced protection compared to the currently used repacked bag, and which is much cheaper than blister and strip packaging. In addition, a patient card was developed as well as a medicine use history booklet to store the patient cards. Both cards and booklet function as communication tools to assist the pharmacist's explanation and improve the patient's understanding of the drug use. Another purpose of this design was to involve patients in their own treatment, by collecting the cards and discussing them with health professionals, thereby increasing the patient's awareness of healthcare and rational use of medicine. All in all, the new packaging, the patient card, and the booklet increased patients' feelings of trust in the Healthy Entrepreneurs brand, and function as touchpoints representing the brand identity and raising brand awareness in the target market.

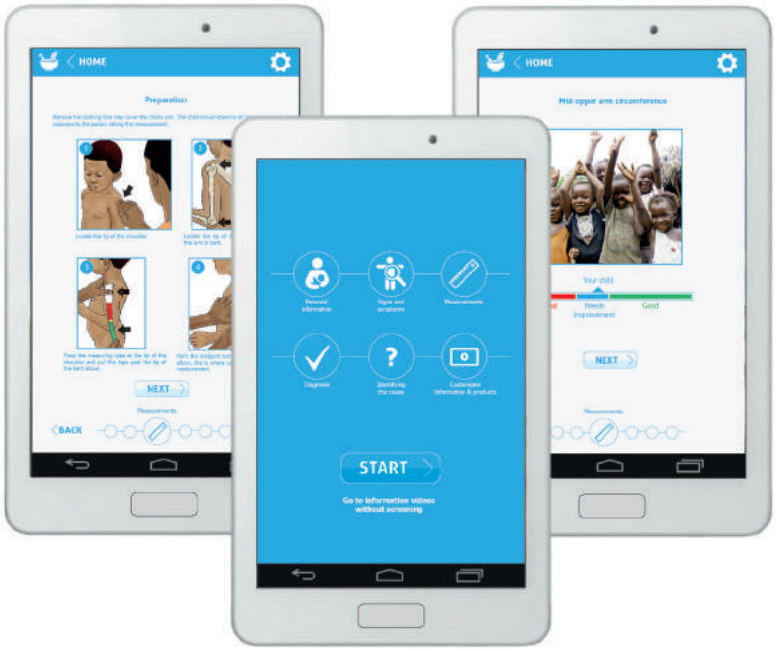

PATIENT JOURNEY
PRE-PURCHASE EXPERIENCE
Get HE info & service through the media/ promotional materials, educational events, the tablet installed in the youth center, and the health rider.
PURCHASE EXPERIENCE
Order medicines from the tablet in the youth center, or buy medicines in the HE franchise pharmacies.
POST-PURCHASE EXPERIENCE
Use HE medicines and access other service
HE TOUCHPOINTS
Get HE Medicine History Use booklet
Get HE Medicine & the patient card
Take medicine according to the patient card
Review own and families' cards
Consult health experts or HE workers
Check detailed medicine info and supply route info via cellphone/HE tablet
Discuss HE brand and share the experience with friends and neighbors by showing the packaging and the booklet
Go back to buy drugs again and consult HE healthworkers with the Medicine Use History bookelt
VALUE CREATION
Create HE Brand awareness
Increase patient engagement by two-way communication
Improve understanding
Provide patient-oriented info
Improve rational use of medicines
Increase the awareness of medicine use
Share information & experience about healthcare & HE brand

SCREENING OF MALNUTRITION IN CHILDREN IN THE RURAL AREAS OF THE GREAT LAKES REGION (AFRICA)

Graduate: B. van Geel (2015)
Supervisory team: R.J.H.G. van Heur, A. Albayrak, T. Beentjes
Partner: Healthy Entrepreneurs

In developing countries, malnutrition is still one of the major problems and underlying cause of the majority of illnesses that cause death in young children. One of the problems is that malnutrition is not recognized by the parents, and/or that they do not have the knowledge and the means to improve their child's situation. By creating awareness about the problem and providing them with a screening service that can establish a diagnosis and provide them with the information and products that they need, the child's health can be improved.

The screening service uses the assessment of different signs and symptoms and several measurements. The result of these assessments enables carers/family to distinguish between children who are healthy, children who are mildly malnourished, and those who are dangerously malnourished and immediately need a referral to a health centre. By identifying the cause of the malnutrition, a customized set of informational videos, products, brochures and additional information sessions can be selected. Using this information set, the parents are able to treat the condition of their child and prevent the child from future malnutrition.

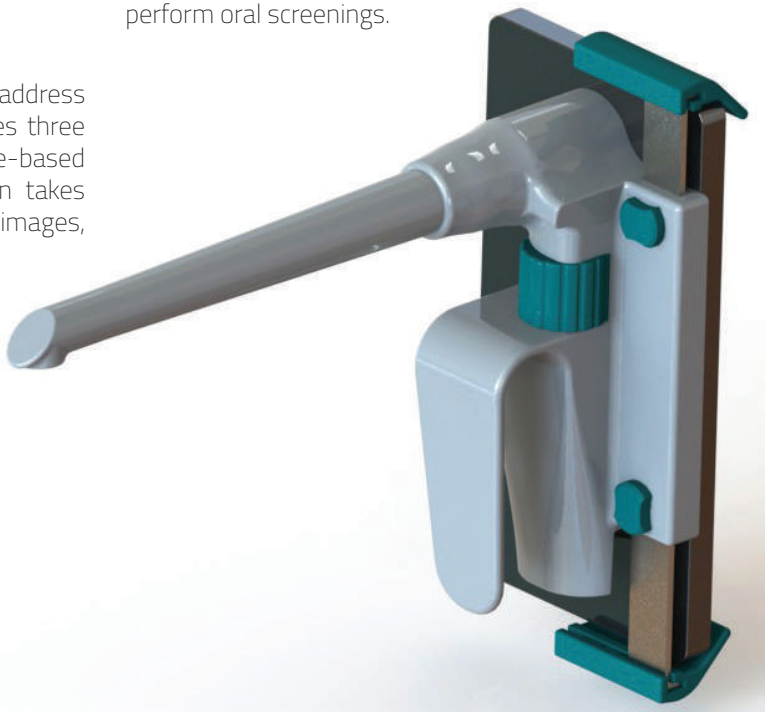


ORAL SCREENING DEVICE FOR RURAL AREAS IN INDIA

Graduate: P. Noguera Idiondo (2014)
Supervisory team: V. Parmar, A. Mink, A. Ramkumar
Partner: Forus Health

Oral cancer, almost unknown in Europe, has a high incidence in India. This is mainly due to the habits, poor nutrition, and poor dental hygiene of the population, especially in rural areas where awareness is low. Approximately 68% of the Indian population live in these rural areas, and there is a chronic lack of wealth, means, facilities and specialists, thus the population have poor and difficult access to healthcare. Moreover, specialists are most commonly found in the major cities. Travelling to urban areas to be diagnosed and treated is time-consuming and expensive for the rural population. A large number are pushed into poverty each year as they can ill-afford their healthcare payments.

The 3danta oral screening device was designed to address the oral cancer problem in India. The device uses three different light-based techniques and software-based analysis for image-based diagnosis. The design takes advantage of the smartphone's ability to gather images, as well as to store, analyse and send information through the internet. The 3danta-smartphone system is part of an e-consultation service developed by Forus Health Pvt. Ltd., partner in this project. The aim of this product-service system is to put dentists and technicians in rural areas in contact with specialized care in urban areas The 3danta device empowers health workers to better screen people's oral cavities in rural areas; it is simple, portable, energy self-sufficient and costs less than other oral cancer detection devices currently on the market. Moreover, its software-based pre-diagnosis of the the oral cavity allows people with no specialized medical background to perform oral screenings.



BLINK: NON-INVASIVE PAEDIATRIC VISION SCREENER FOR URBAN AND RURAL INDIA

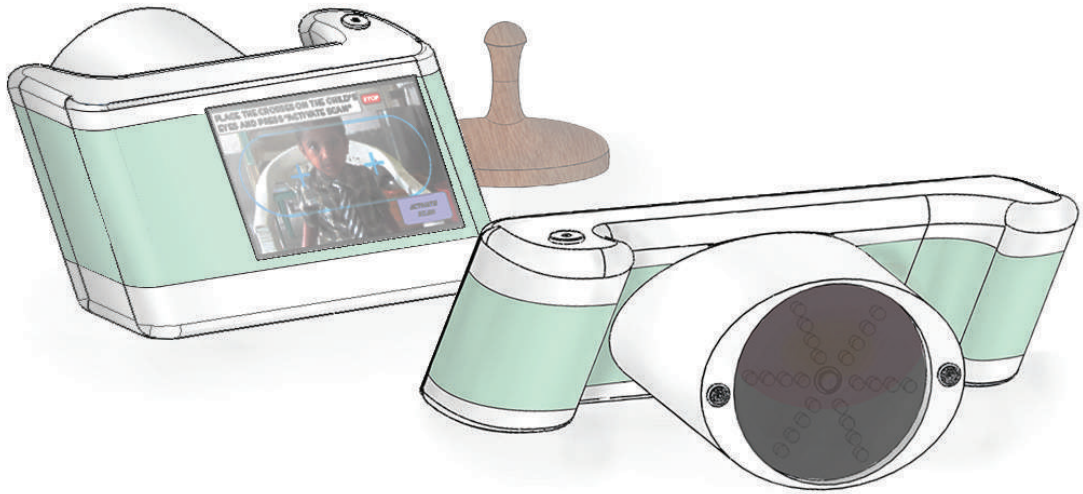
Graduate: H. Hoogewerf (2014)
Supervisory team: R.H.M. Goossens, L. Goto, P. A. van de Bovenkamp, U. Dutta
Partner: Forus Health

In India, approximately 36 million children suffer from low vision, mainly caused by the refractive errors amblyopia and trabismus. It is especially important to detect amblyopia in young children, as this ailment causes irreversible damage to the child's sight if not treated before the child's 8th year. This can lead to one-eye-blindness, increasing the child's chances of developing full blindness. Thereby, low vision can lead to a loss of productivity at school, thereby reducing the child's future life-prospects. Unfortunately, India lacks an adequate healthcare provision, especially to the poorer groups in society, leaving many cases of low vision in children undetected and untreated.

By introducing a non-invasive paediatric vision screener that enables people without medical backgrounds to perform paediatric eye-screening, teachers and health-workers can screen children in urban and rural settings. The design of the Blink was based on the information gained from the target group, the children and on environmental factors in both rural and urban settings.

The design includes:

- An interface specially designed for use by people with little experience of operating electrical devices. The interface guides the inexperienced user step by step through the process.
- An ergonomic housing design of the paediatric vision screener, housing the working principle designed at Forus Health, whilst facilitating a firm and stable grip for the user.
- An implemented trigger which serves to attract children who are not familiar with medical examinations, and who find large devices intimidating.

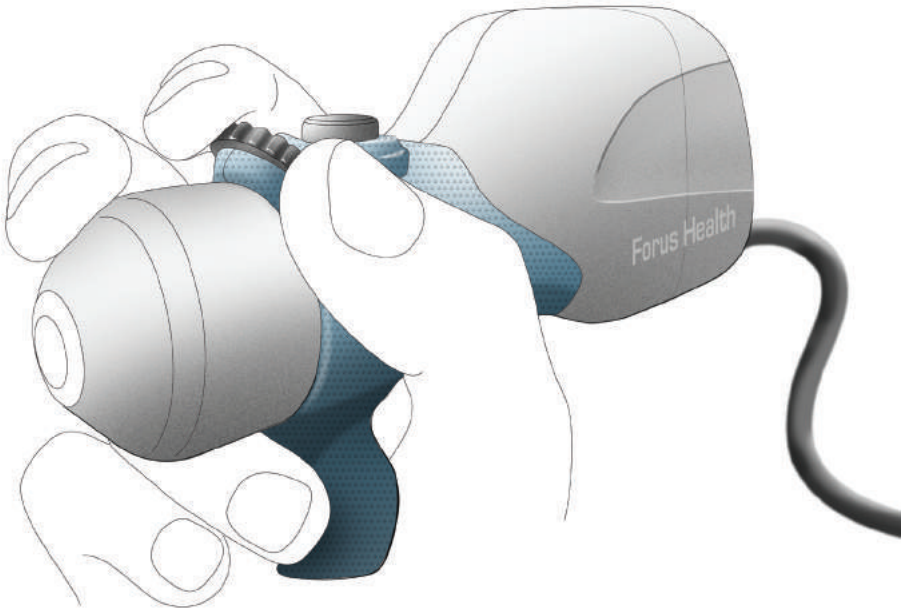


EYE SCREENING DEVICE TO DETECT RETINOPATHY OF PREMATURITY IN INDIA

Graduate: W.B. Horstink (2013)
Supervisory team: R.H.M. Goossens, A. Mink
Partner: Forus Health

Retinopathy of Prematurity (RoP) is an eye ailment that can cause blindness in premature infants. Since the disease is only detectable after an eye examination, most premature infants need to be screened by taking images of their retina. In India, there is only one doctor per 80,000 infants, so a telemedicine system would be valuable for finding these patients. Currently, the RETCAM (Clarity Medical Systems) is used in a number of telemedicine programs to find patients that need treatment, however its use is limited due to the investment required. The company Forus Health in Bangalore (India) is addressing this issue and has the ambition to develop a more affordable device that is suited for the Indian context.

First, research was done into the Indian healthcare context, user preferences, available technology, user ergonomics, and infant safety. The conclusion of this investigation was that there is a need for a handheld precision camera that is able to contact the eye and that can be operated with integrated controls. The ergonomic support on the device ensures a stable operation, even while operating the integrated controls. An ergonomic product casing design allows for an ergonomic precision grip due to its small diameter. User research had a significant impact on the design process and the use of prototypes as the main tool for generating ideas was evaluated as being extremely useful when solving non-standard ergonomic problems.



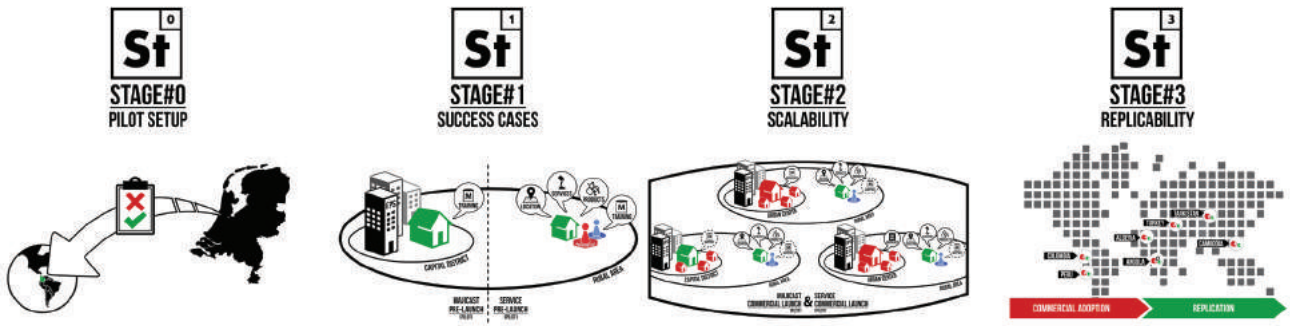
DESIGN FOR THE BASE OF THE HEALTHCARE PYRAMID

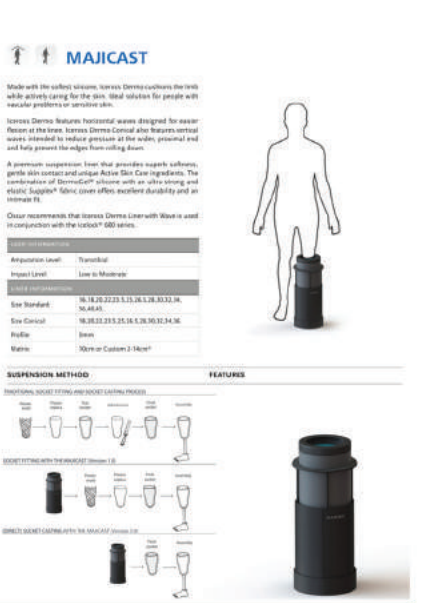
LEGBANK: A STRATEGIC VIEW ON ORTHOPAEDIC CARE IN COLOMBIA

Graduate: S.C. Herrera Manzano (2015)
Supervisory team: M. Tassoul, F. de Jonge
Partner: ProPortion Foundation

This graduation project was grounded in the conceptualisation and future implementation of a social-based initiative called LegBank; a project initiated by the ProPortion Foundation, with the main purpose of increasing access to low-cost and high quality prostheses at the Base-of-the-Pyramid (BoP) in Colombia.

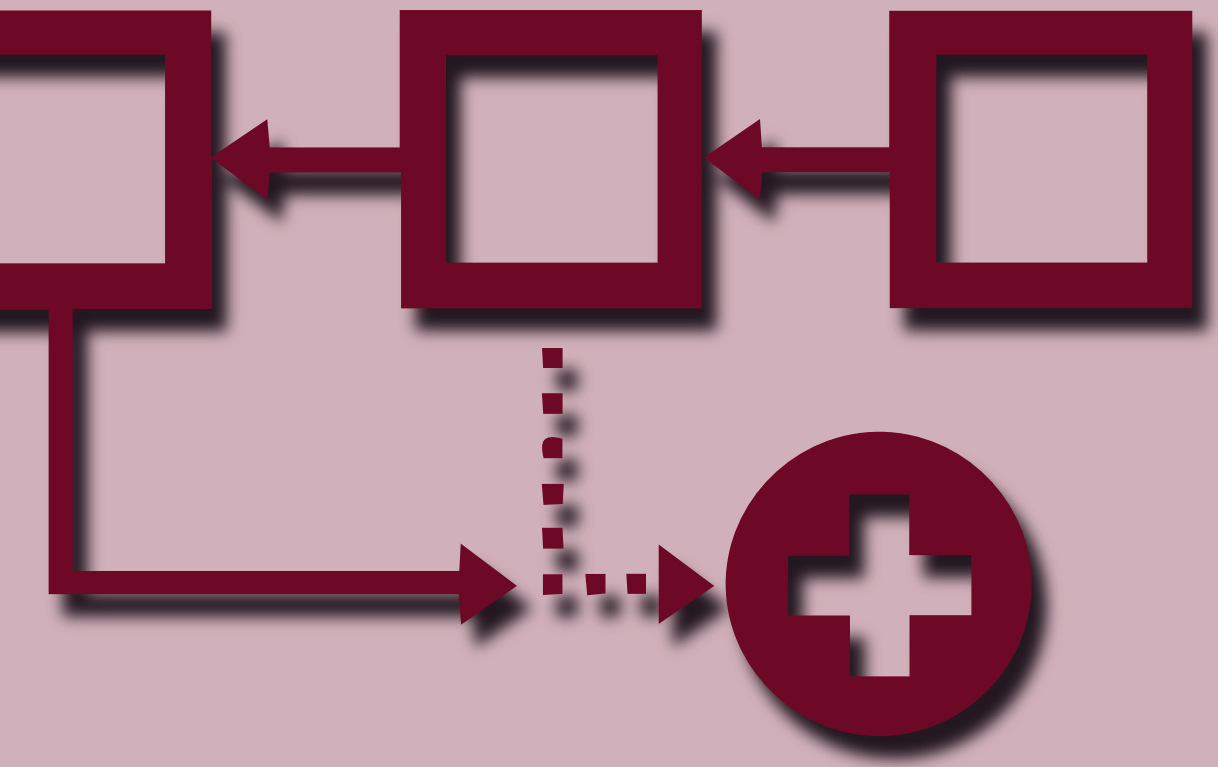
This project started as a Joint Master Project at the Faculty of Industrial Design Engineering. It resulted in a product concept 'Majicast' and two business model concepts for the product's introduction on the Colombian market. Taking these main deliverables as starting point, in this subsequent graduation project the focus is on the delivery of a strategic view for a future social enterprise. The aim was to provide the ProPortion Foundation with a broad understanding of a feasible, desirable, viable and impactful business strategy with the potential to bring an innovative and context-fitted value proposition (Majicast) closer to the lives of many people with mobility disabling conditions in distant rural areas.





COMMERCIAL ADOPTION

REPLICATION



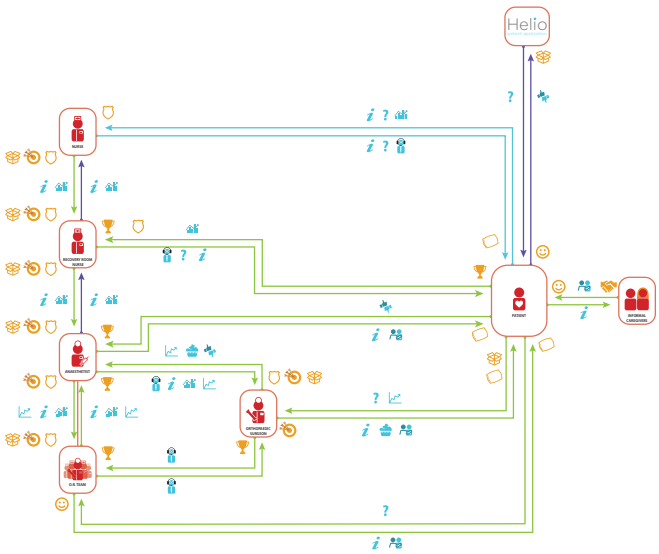
DESIGN FOR NEW HEALTHCARE BUSINESS MODELS

BUSINESS MODEL INNOVATION OF THE 1-DAY RAPID RECOVERY HIP PATHWAY

Graduate: R.I. Oosterholt (2015)
Supervisory team: L.W.L. Simonse, S.U. Boess
Partners: Zimmer Biomet, Reinier de Graaf Hospital

Patients who require a total hip replacement (THA) may spend more than 4 days in a hospital to recover. 1-day Rapid Recovery enables THA patients to leave on the day of surgery, greatly improving the post-operative recovery. The Reinier de Graaf hospital in Delft, however, is still the only hospital in the Netherlands who routinely treats patients in 1-day. This graduation project focused on the design of a business model for the 1-day THA care pathway in order to increase the acceptance and guide the implementation of 1-day THA care pathways in Dutch hospitals.

The new 1-day THA care pathway model design visualises the network of actors and how they are connected by care activities along the care pathway. The model defines the roles of the actors and describes the content of the care activities. An integral part of the business model is the Helio concept. Helio enables the patient to provide feedback on every touchpoint of the clinical pathway with the use of a mobile application. The Helio caregiver platform enables the caregivers to digitally identify problems within the pathway based on the patient's feedback and initiate projects to resolve the problems by collaboration with fellow caregivers in a digital environment.

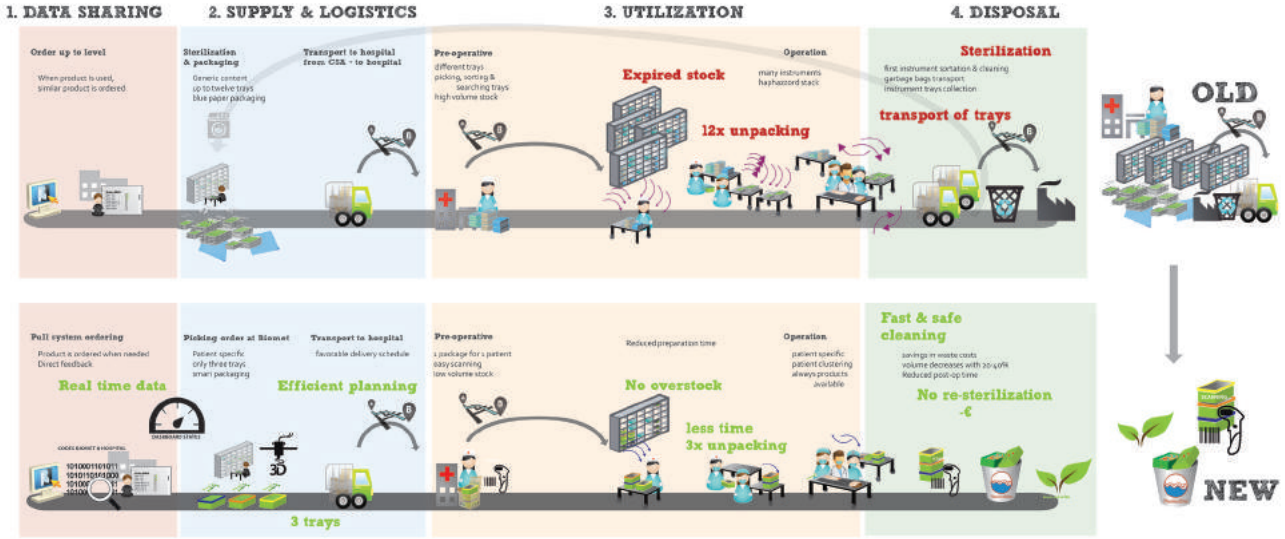


VISUAL BUSINESS MODEL DESIGN: IMPLEMENTING DISPOSABLE, PATIENT SPECIFIC INSTRUMENTS IN ORTHOPAEDIC SURGERY

Graduate: K. Stolk (2014)
Supervisory team: L.W.L. Simonse, F. de Jonge
Partners: Zimmer Biomet, Reinier de Graaf Hospital

In this project, a modular strategy tool was generated for the (future) implementation of disposable instruments within the domain of orthopaedic surgery.

The tool involved three main actors; the hospital, the manufacturer and the waste handler. An elaborate four-step framework was developed that creates a basic strategic pathway to implement disposable instrumentation for total joint replacements. The product journey within this framework started with a workflow with digital, physical and system touch points. The workflow was improved by context experts in the field of device manufacturing and orthopaedic surgery. Sustainable healthcare was explored and translated into opportunities for servitisation (creating value by adding services) into the workflow design. The study concluded with the presentation of a visual modular business model derived from the elaborate workflow. Tangible and intangible value transactions between the actors are included as well as logistic based, knowledge based, cost based and efficiency transactions. A business case is introduced outlining a contract type and how to create market share, and how a win-win-win situation could be achieved for all stakeholders.

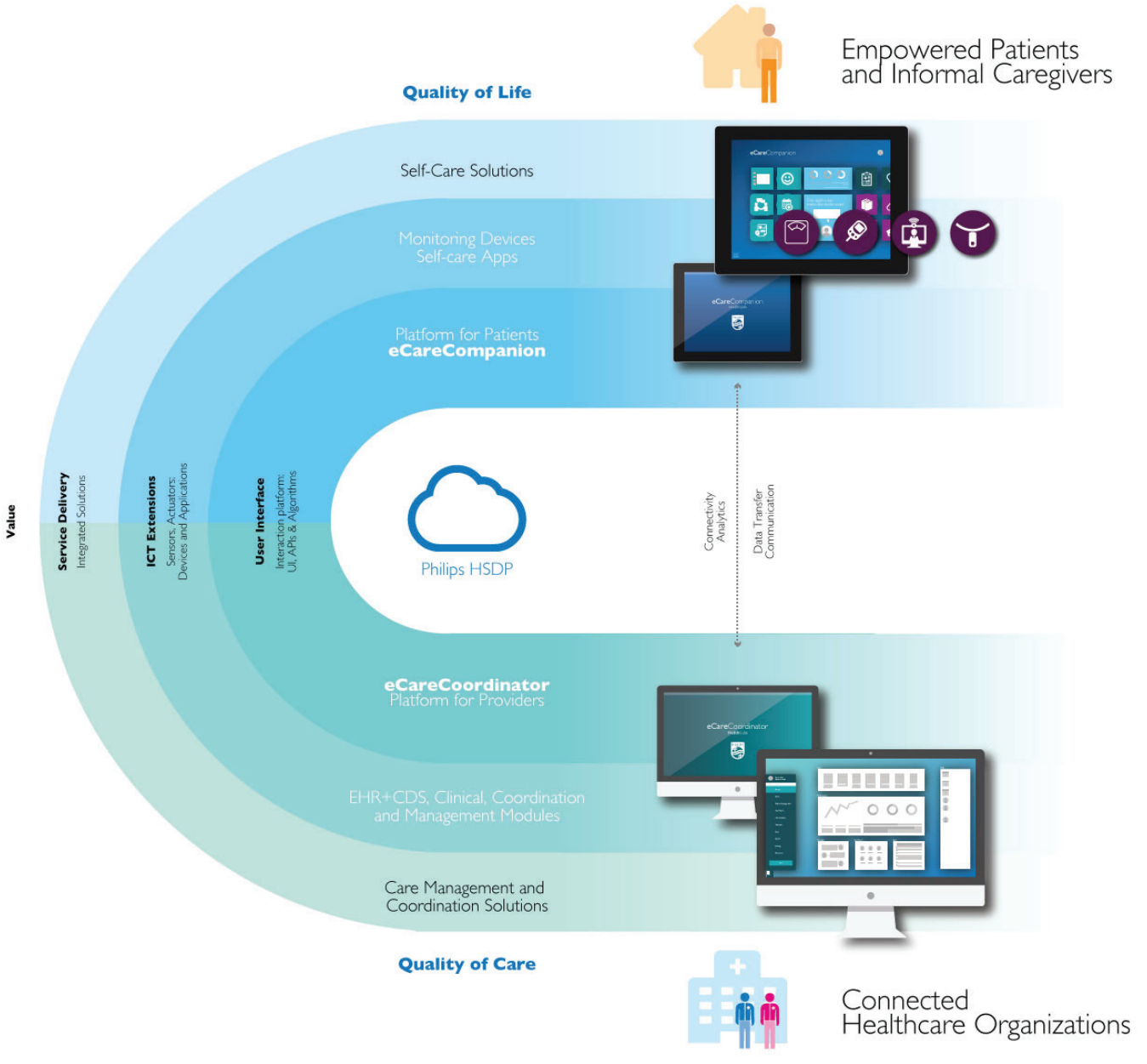


CREATING SHARED VALUE THROUGH INTEGRATED CHRONIC CARE DATA SOLUTIONS

Graduate: R. Canales Durón (2015)
Supervisory team: M.S. Kleinsmann, L.W.L. Simonse, E. van de Garde, B. López
Partner: Philips

The goal of this project was to explore the value of data in chronic care and identify innovation opportunities for the Philips telehealth program Hospital to Home. The research in this project focused on understanding the changing context of care coordination in the Netherlands for chronic care as a result of new technologies and changing roles in care. The main problems addressed were the difficulty in communicating and sharing information for care coordination, the conflicting views on value in healthcare, and healthcare workers' resistance to change. The goal was to create empowered patients and informal care givers, and connected healthcare organizations.

The project resulted in an integration strategy for Hospital to Home and an organizational-business model addressing challenges in chronic care. The integration strategy proposes a future vision for innovation that focuses on building a platform for digital care, based on current solutions in use within Hospital to Home. The organizational-business model features components that facilitate value creation for chronic care in the Netherlands using value-based legal entities known as 'care groups' to overcome organizational barriers. In this strategy, Philips plays a key role in providing digital services for chronic care, thereby driving the transformation of healthcare organizations towards integrated care with the help of their solutions.


Empowered Patients
and Informal Caregivers
Quality of Life
Self-Care Solutions
Monitoring Devices
Self-care Apps
Platform for Patients
eCareCompanion
Philips HSDP
Connectivity
Analytics
Data Transfer
Communication
eCareCoordinator
Platform for Providers
EHR+CDS, Clinical, Coordination
and Management Modules
Care Management and
Coordination Solutions
Quality of Care
Connected
Healthcare Organizations
Value
Service Delivery
Integrated Solutions
ICT Extensions
Sensors, Actuators:
Devices and Applications
User Interface
Interaction platform:
UI, APIs & Algorithms

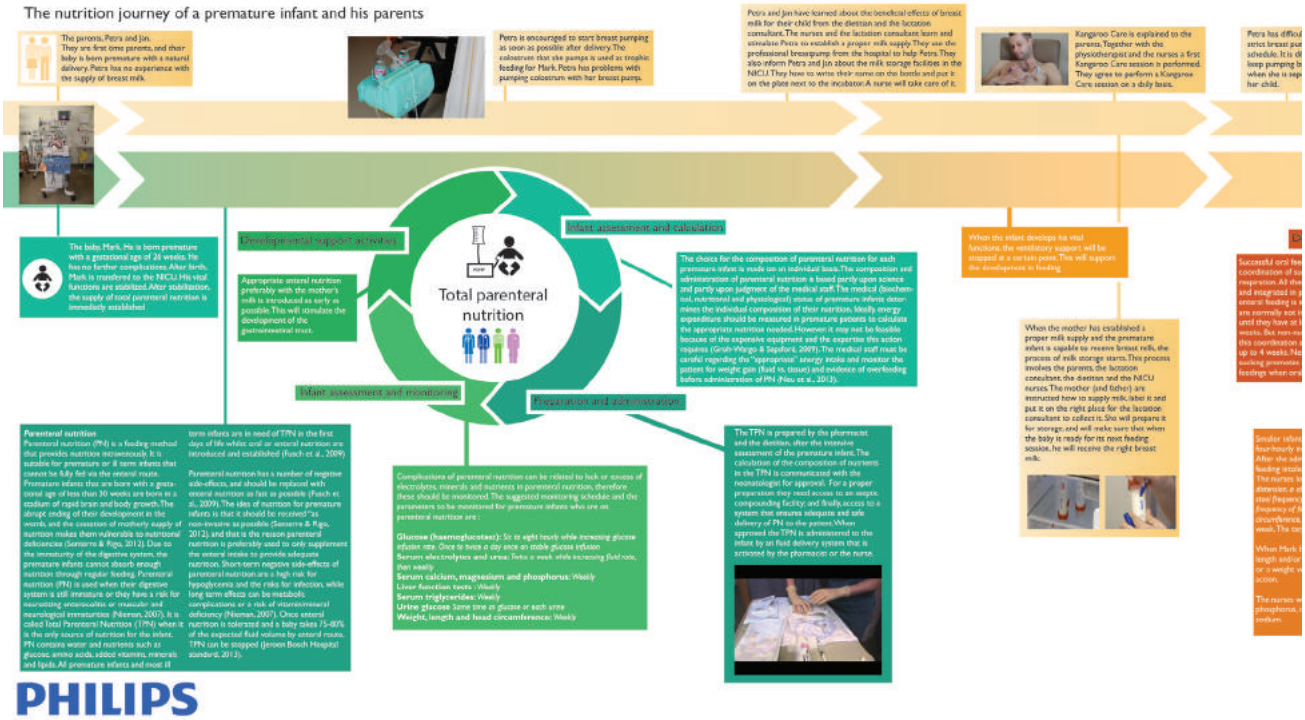
PHILIPS AVENT: OPPORTUNITIES FOR A GO-TO HOSPITAL STRATEGY

Graduate: T.J. van Schijndel (2013)
Supervisory team: M.S. Kleinsmann, S.R. Dehli, G. Christiaansen
Partner: Philips

Philips offers a range of mother and child care products under the name of Philips AVENT. The goal of this project was to identify opportunities and solutions for Philips AVENT to enter the hospital market, specifically focussing on parental involvement and optimizing nutrition in the Neonatal Intensive Care Unit (NICU).

In this graduation project, the student identified potential innovation opportunities in the areas of parental involvement and the optimization of nutrition in the NICU. A strategy and design directions were developed and linked to the Philips AVENT brand, in order to fully utilize these opportunities and to strengthen business in the mid/long term. Three design directions were developed:

* Education & training
* Parental support & motivation
* Developmental support of the baby

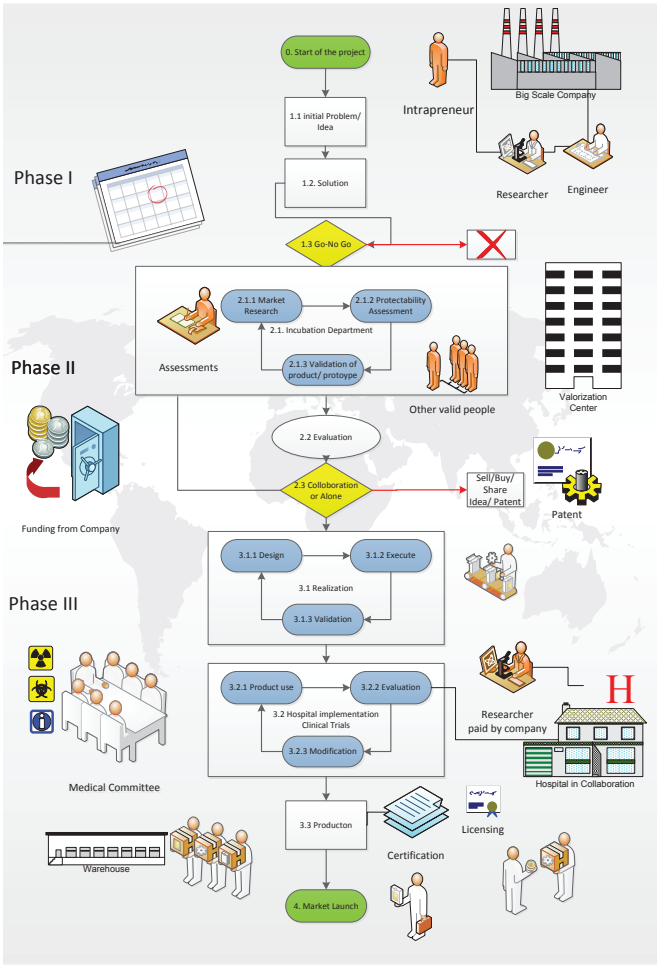


RELIEVING BOTTLENECKS IN HEALTHCARE INNOVATION

Graduate: A. Boru (2012)
Supervisory team: F.E.H.M. Smulders, R.H.M. Goossens
Partner: Delft University of Technology (internal research project)

Healthcare is a highly complex system which has many stakeholders: patients, relatives, doctors, nurses, medical specialists, hospitals, health insurance providers, pharmaceutical companies, medical technology manufacturers, public health representatives, and government departments. Although providing optimal care to improve the health of patients is the common aim, each stakeholder has a different viewpoint on how to achieve this. This incongruity in the system is one of the greatest barriers to innovation in the field of healthcare. Innovative efforts initiated by any of the stakeholders are often unlikely to succeed thanks to the complex tangle of stakeholders in the different areas of the healthcare structure. Thus, it is difficult for innovation to be accepted and adapted by the entire healthcare system, resulting in a lengthy innovation process.

The main goal of this project was to provide a conceptual framework to support and improve the current product/service innovation process in the field of health care. The research focused on understanding the dynamics of health care innovation, looking at the bottlenecks in the implementation of innovative new products/services from a stakeholder perspective, and the redesign of product/service innovations on a conceptual level in the setting of the Dutch health care system.



INDEX OF GRADUATES

INDEX OF SUPERVISORS

INDEX OF PARTNERS

Design is the perfect facilitator
for sustainable change in healthcare.

This booklet showcases 116 healthcare graduation projects completed by Industrial Design Engineering Master's students in the period 2013-2015. The projects are divided into twelve categories, reflecting on-going developments in society, healthcare and the research portfolio at Delft University of Technology's faculty of Industrial Design Engineering.

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