



omnia

 **FLIR** ASSESSMENT
SYSTEM

*NEW PRODUCT SOLUTIONS FOR FUTURE
FIRSTRESPONDER COLLABORATION*

Anna Hing
MFA Advanced Product Design
Term Project/ Fall Semester 2019/20 (shortened report)



UMEÅ INSTITUTE OF DESIGN
UMEÅ UNIVERSITY

INTRODUCTION

*NEW SOLUTIONS FOR FUTURE
FIRSTRESPONDER COLLABORATION*

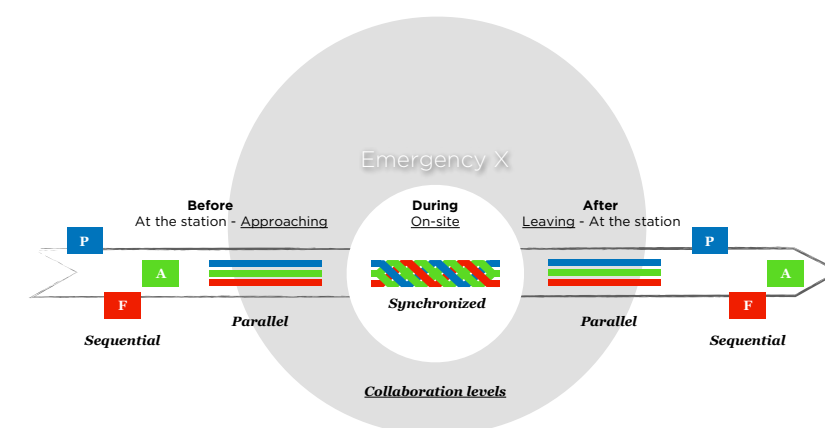
FIRST-RESPONDERS

First-responders are a crucial part of our society, typically including paramedics, police officers and firefighters. As the first ones to arrive and provide assistance at a scene of emergency, like an accident, natural disaster or a crime, their actions can decide over life and death of the affected.

In some situations, especially incidents with larger victim counts, the collaboration between the different first responder groups can determine if the final outcome of an incident is more or less successful.

Although these incidents are rare, the extent can be severe. This is why efforts are put into practicing the ability to collaborate across disciplines, both during their respective educations and through live drills exercises as professionals.

Due to Umeå Institute of Design's long established connection to local first-responder groups, we had the great opportunity to closely collaborate with them in this project.



COOPERATION WITH FLIR

FLIR is the world's largest commercial company specializing in the design and production of thermal imaging cameras, components and imaging sensors. They were founded in 1978, with the headquarter based in Wilsonville, Oregon, USA. With more than 2,700 employees they have manufacturing and R&D facilities all over the world, including our project partner's office in Täby, Stockholm.

OBJECTIVE

The objective with this project is to identify relevant design opportunities and explore the design space for new product solutions for synchronized collaboration between first responders while being at an emergency site, keeping in mind both the 'before' and 'after' scenario.



OBSERVING

RESEARCH TRIP TO SANDÖ

On the 26th of September we got the chance to visit the MSB first responder training facility, a college and campus, on the island Sandö 183 km south of Umeå.

On this day police, ambulance and firefighter students from different Swedish towns came together for a joined two day practice. The campus provides this with a large area staged with houses, vehicles and more, replicating real life scenarios.

The first half of the day the students of each group go introduced to the tools and methods of the other two groups. In the afternoon and evening I took part in two exercises. In my case a bus crash and a house fire scenario. Immersing into these scenarios was a great way to get a feeling for their work and the challenges they face.





OBSERVING

UMEÅ – ANNUAL MASS CASUALTY PRACTICE

On the 17th of October we got to take part in the annual mass casualty practice for professional first responders, which took place at a large sport arena in Umeå.

The Theme:
A rock concert, at which a few of the risers collapsed, multiple injured people.

The Main Focus:
Health situations that change over the course of the incident.

Our Participation:
Part of our group took part as victims, the other as observers, which was especially valuable later on, to understand the situation and the pain points from both perspectives.

UNDERSTANDING

INTERVIEWS



LARS ÅKE- LÖFQVIST

Trained nurse and paramedic with over 20 years of experience. He is specially trained for mass casualty incidents and teaches other paramedics.

“The triage has to be done really fast, it would be great if I could just scan the patients”.

We met Lars two times: first at the Umeå exercise and later at the ambulance station. He is specially trained for mass casualty incidents and could point out the challenges the paramedics faced in the training we had observed. He also gave us an overview of their leading structures, which are way less hierarchical than the ones at the fire department. About his job he says that he doesn't take his work home and explains how important it is to socialize with colleagues and talk about experiences.



MAGNUS ESSNER

Firefighter commander, age 48, 21 years in office

“It's very important that everyone has the same picture of what is going on”.

As a commander Magnus helped us understand the firefighter operations from a more strategic, managerial perspective. He explained how he likes his job, however points out the challenges of having “too many voices in your ear”. He emphasized the importance of communicating frequently with the other first-responder groups during an incident and making sure that everyone has the same picture of what is going on.



JAMES COOPER

Firefighter, age 37, 10 years in office

“We are trained to do the triage, but rather wait for the paramedics to arrive.”

“You can't rely on the IR cameras to see”
(e.g. holes in the ground)

James was the one to show us around the station. Talking to him helped us understand the mindset of a fire fighter. He explained how most of them have a sport background, a strong sense of team spirit and stay loyal to the job until retirement. He explained how they are often the first group of first-responders to arrive at an accident and have to take over some of the other's tasks like directing traffic or first aid (stabilizing the patient's neck or cpr). He says they are trained to do a triage (assessment of the patient), but in real life never do it because they rather wait for the ambulance to arrive.

ANALIZING

KEY PAIN POINTS | OPPORTUNITY AREAS



ANTICIPATION

WINDSHIELD REPORT

The so called "Windshield Report" is conducted "from the windshield", when first-responders arrive at the accident site. It is a quick verbal description of what can be seen from an outside perspective.

The reports by the ones first at the accident are vital for the other first-responder groups. It helps them prepare while they are on their way.

Paramedics said they would wish for even more information, like video or camera footage to understand the situation.

ASSESSMENT

TRIAGE

Triage is the process of determining the priority of patients' treatments based on the severity of their condition.

Currently paper cards are attached to the victims to indicate their condition, which is very inconvenient and time consuming. Paramedics said that they only use it in exercise scenarios.

green: priority 4
(patients can e.g. walk and take care of themselves)
yellow: priority 3
orange: priority 2
red: priority 1
(very severe conditions)

OVERVIEW

STATUS & LOCATION CHANGE

In the Umeå exercise the priority one and four victims were split up into an area outside of the arena and one inside. This made it hard to keep track of changing conditions, which one of our classmates experienced first hand (playing a victim).

FOCUS

REPORTING

Paramedics spend a lot of time documenting and reporting their decisions.

When patients are sent to the hospital the paramedic has to explain their health condition, which is hard to communicate and often miss-understood. They would wish for pictures or videos to show to the hospital.

In mass casualty incidents they use folders with checklists to follow, which helps them focus in stressful situations.

FOCUSED ANALYSIS



TARGET GROUP
Focus on the work of paramedics, in collaboration with with the other first-responder groups.



SCENARIO
Mass casualty incidents, or incidents with several patients involved.

AREA OF INTEREST

DESIGN OPPORTUNITY & VALUE PROPOSITION

In mass casualties time is the most valuable resource when it comes to saving the lives of the affected. Hence, the time it takes until a paramedics can treat a patient can decide over life and death. Even though it is clear that in such situation all three blue light groups are very important, it seemed, like improving the work of the paramedic, e.g. saving time through smarter solutions, would have the most impact on the outcome of such an incident.

Therefore the aim of this project was to find new tools, strategies or solutions to help paramedics, in collaboration with the other first responders –especially the group that arrives first on site –, find the most critical patients as fast as possible, keep track of their condition, communicate more efficiently and thereby bringing the focus back to the most important – the treatment of the affected people.



UNDERSTANDING

Q & Q WITH A PARAMEDIC

After deciding to focus on the work of paramedics in mass casualty incidents lots of new questions arose.

UNDERSTANDING THE EXERCISE IN UMEÅ

Back at the ambulance station we were able to talk to Erik, a paramedic who had also taken part in the Umeå exercise. By walking us through all the procedures and steps taken in larger incidents, we got a more detailed understanding of their work and challenges.

VALIDATING PAIN POINTS

We could validate some previously analyzed pain points and identify less important ones. For example the topic of "overview" (problem of losing the patient out of sight) turned out to be less about location, and rather linked to a lack of clear responsibilities and organization.

They would appreciate more information before arriving at a site, as well as, receive actual health data rather than "their opinion" (Erik), meaning the windshield report by Firefighters or Police. This would save time and give them the possibility to "ask other things" (Erik) when they arrive.

However, he stressed that the numbers, patient health data, and observations, made by the paramedic, are of similar importance. One should not only relying on numbers, since instruments can be wrong or the patient under heavy medication.

*"I LIKE BEING A PARAMEDIC BECAUSE I CAN FOCUS ON THE INDIVIDUAL PATIENT."***

*"IF I ALREADY HAD THE NUMBERS, I CAN ASK OTHER THINGS WHEN I ARRIVE."***

*"TALKING TO THE PATIENT IS IMPORTANT, SO THEY KNOW WHAT IS GOING ON."***

*"ONE CAN'T JUST RELY ON THE NUMBERS."***



* EMILIE LIND, PARAMEDIC **FREDERIK OSTERLUND, PARAMEDIC

CURRENT METHODS

CURRENT TRIAGE DECISION SYSTEM

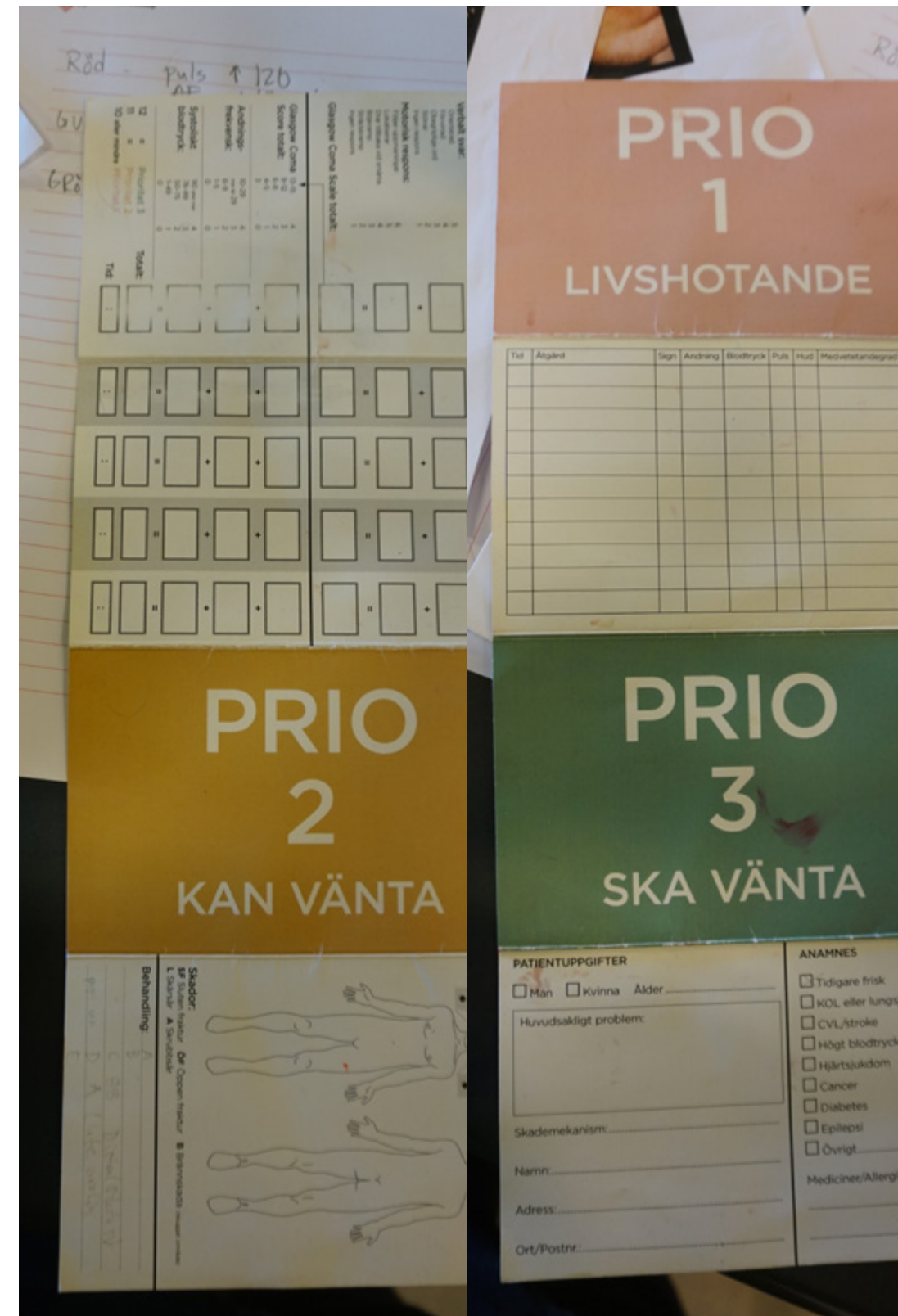
Currently the patients are prioritised by a process called triaging, whereby patients are given numbers and colours to identify their health status and priority for treatment. This is mainly defined by they're vital signs and the severity of their injury.

START – SIMPLE TRIAGE AND RAPID TREATMENT

START is a widely used triage tool. In this system a stack of cards in a protective coat is attached to the patients hand with a rubber band.

Patients are assigned to one of the following four categories:

- Deceased/expectant (black)
- Immediate (red)
- Delayed (yellow)
- Walking wounded/minor (green)



CURRENT METHODS

WHAT HAS TO BE MEASURED?

VITAL SIGNS

Vital Signs are important for understanding the state of a person's health.



Heart Rate



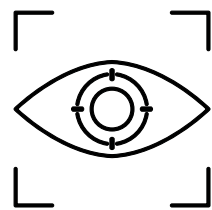
Blood Pressure & Oxygen



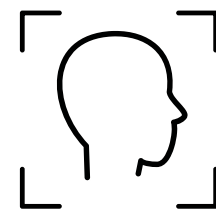
Respiration



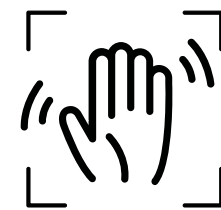
Temperature



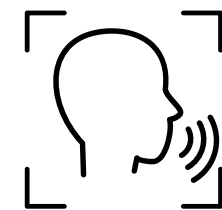
Eye Movement



Skin Color, Dryness & Sweating



Motory Functions, Lift Arms and Legs



Speech/ Cognition

PROCEDURE

ABCDE METHOD

In larger casualties vital signs have to be measured extremely fast and therefore are measured manually by looking at the patient (skin colour), talking to the patient (reactions), as well as, seeing and feeling the vitals.

Airway



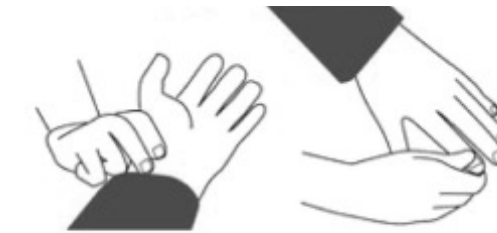
Head tilt and chin lift

Breathing



Look, listen and feel

Circulation



Heart rate Capillary refill time

Disability



Alert
Voice responsive
Pain responsive
Unresponsive

Exposure



Remove clothing

HEARING

FEELING

SEEING

CURRENT METHODS

REPORTING & DOCUMENTING SYSTEMS

IN CAR TABLET

Documenting is an important part of the paramedic job. Every detail is captured to reason the decisions taken by the paramedic. Currently Swedish Paramedics use a tablet mounted in the car to document their cases, which can be taken out of its docking station and used on the go e.g. inside a patients house.

The advantage is that the documentation process starts as soon as the paramedics is with the patient and the information is sent immediately to the hospital. Paramedics usually finish the report at the hospital or at the ambulance station.

“RIGHT NOW THE SYSTEM CAN’T SHOW ME WHAT IS IMPORTANT IN MASS CASUALTY SITUATIONS”*



IMPORTANT INFORMATION

General Information about the incident:

- How many patients are involved in the incident? Important for Paramedics and the hospital to prepare.
- What is their condition?

Patient Data

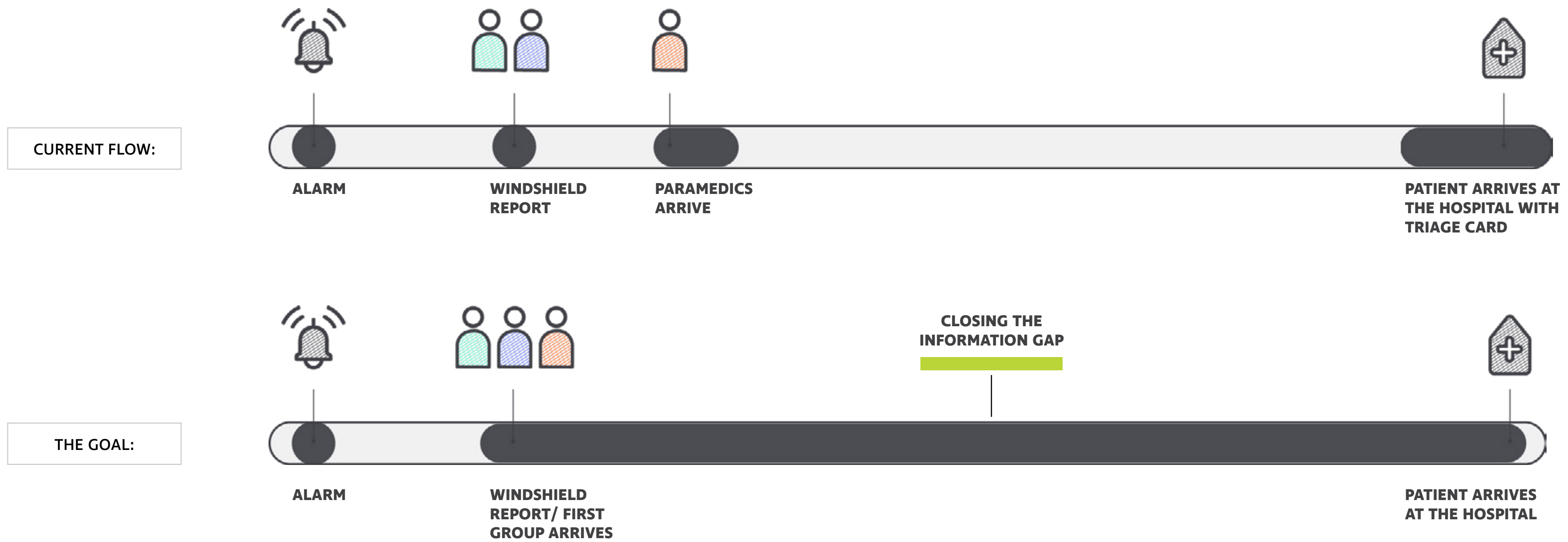
- Name, Gender, Address, ID Number Important for the police.
- Medical history (e.g. diabetic) Helpful before the treatment.
- Injuries
- Interventions/ Treatment History Important for doctors on site and the hospital.
- Care Provider ID (Paramedic/ Physician)
- Time of action
- Overall Triage Category (Priority) Important for all on site!

* FREDERIK OSTERLUND, PARAMEDIC

CONCLUDING

COMMUNICATION TIMELINE

As this simplified communication timeline shows, the major pain point in the current system is clearly a gap in the communication between the first blue light group arriving on scene and the paramedics, as well as, between the happenings on scene and the hospital. The patient health data is currently only transmitted via the card.



CONCLUDING

PROS & CONS OF THE CURRENT ASSESSMENT METHOD



PROBLEMS

DATA CAPTURE

To capture the patient data the card has to be taken out of the plastic sleeve and all the data is written manually onto the paper.

DELAYED ASSESSMENT

The first people on scene are not paramedics, but FF or police which often don't feel qualified to do an assessment. This means that it takes longer until patients are correctly assessed.

ASSESSMENT UPDATE

A patient's status can change any time. Updating the priority on the card is time consuming.

INFORMATION SHARING

The main problem is that the information is only captured on the tag and not shared with other first-responders and most importantly not with the hospital.



ADVANTAGES

ANALOG

pen & paper is easy to understand

VISIBLE

priority can be seen by anyone

ACCESSIBLE

it is an affordable and easily accessible product.



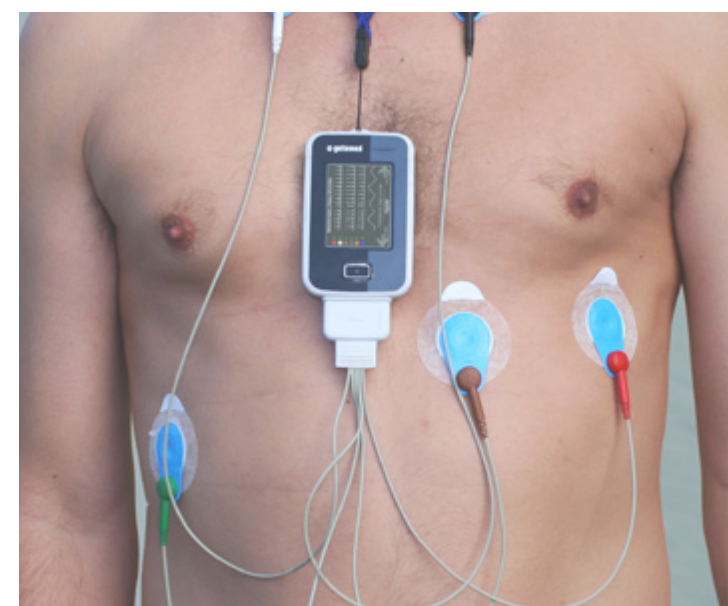
ADDITIONAL RESEARCH

TECHNOLOGY FOR VITAL SIGN MEASUREMENT

ON THE BODY



Optical – Photoplethysmography measures blood volume changes optically. (portable)



Electronic – Electrocardiography measures through Electrodes. (semi portable)

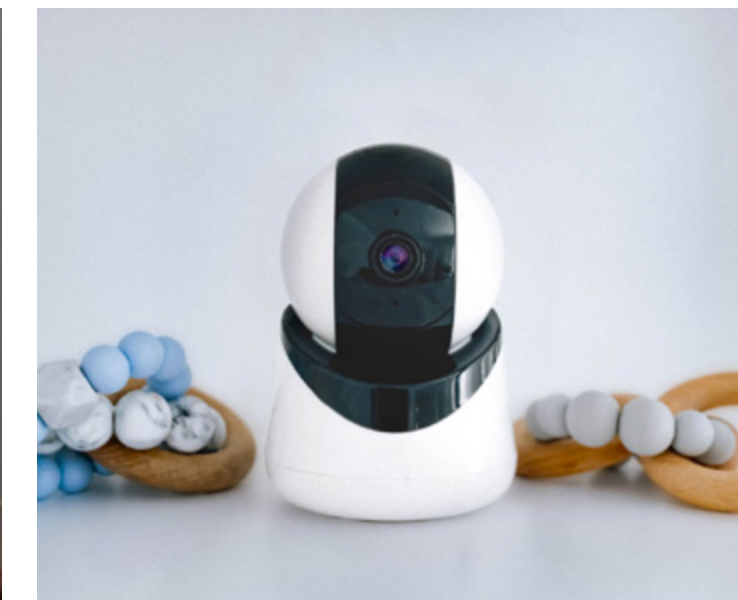
NON-CONTACT



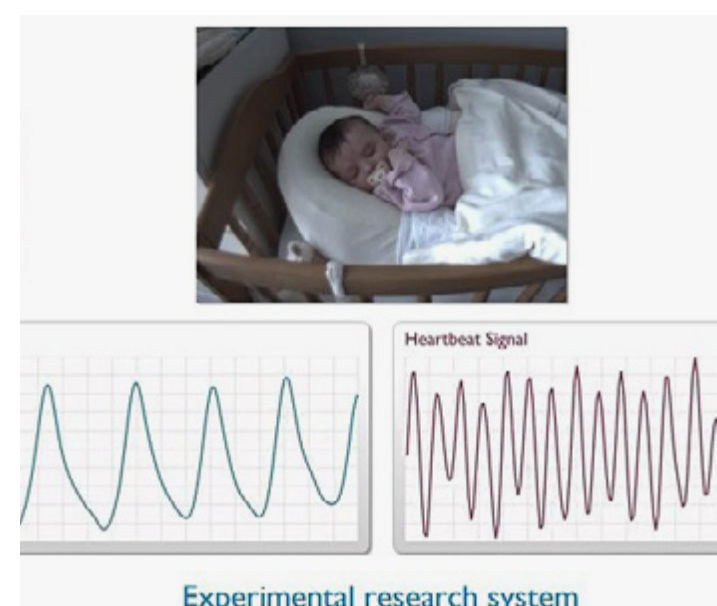
Vitals signs via RFID radio waves are emitted into the body and reflected back by organs.



Smart Beat Researchers from Utah State University can estimate breathing and pulse with visible light video camera.



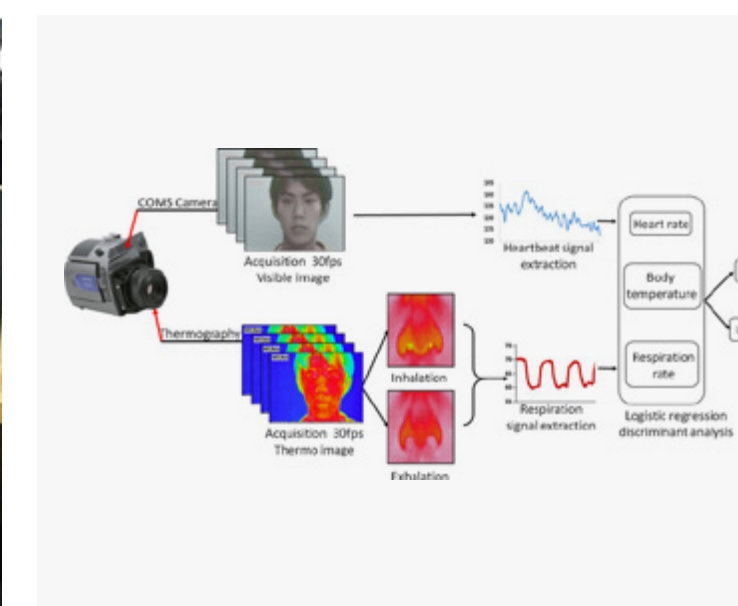
Smart Beat Baby Monitor visible light camera measures breathing through video footage.



Philipps Baby Monitor – Measures absolute arterial blood oxygenation levels without touching the patient.



Infrared Thermometer Identifying people with diseases at airports



IR & Visible Light Camera two cameras complementing each other.

TECHNOLOGY

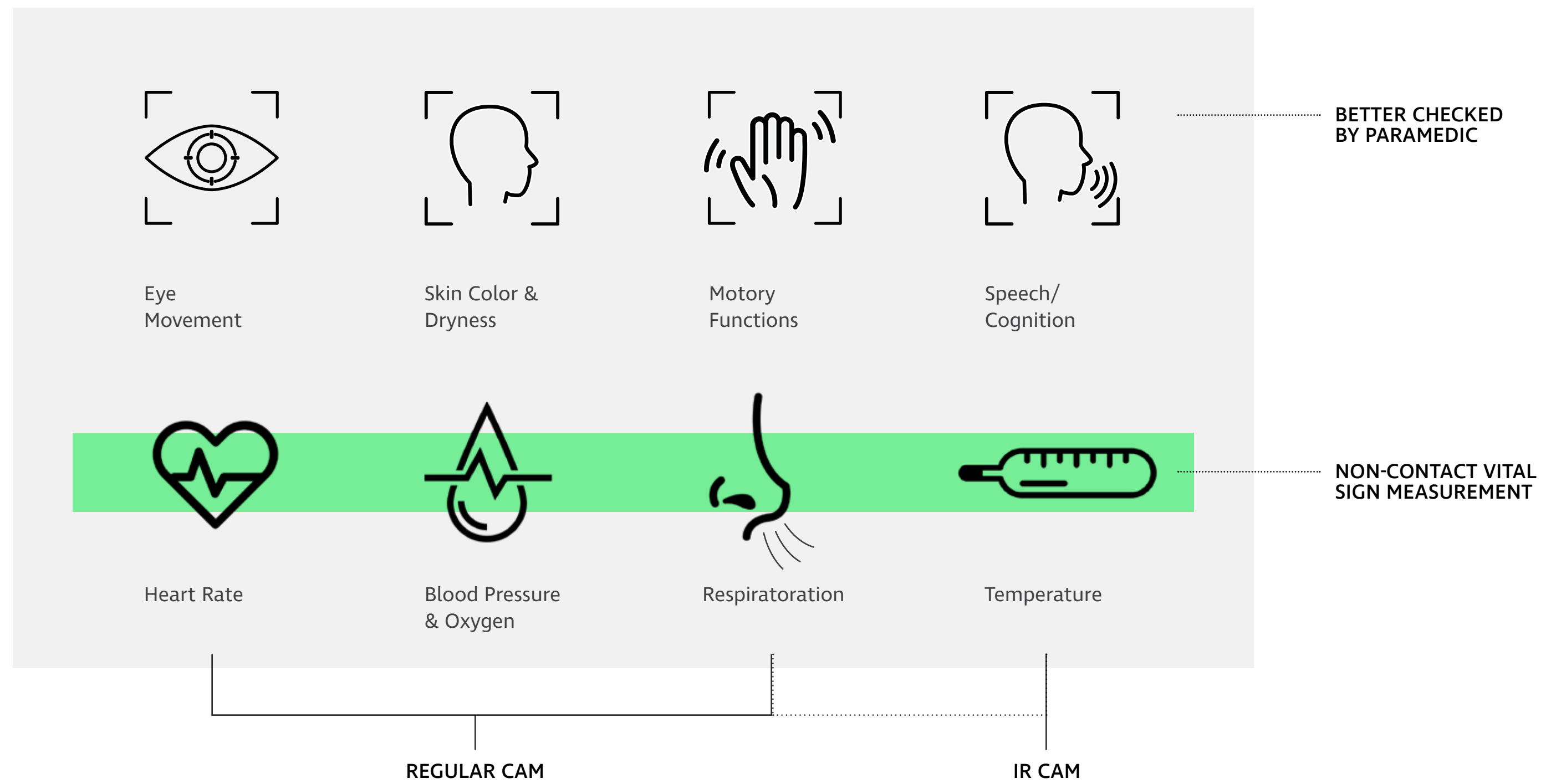
WHAT COULD BE SENSED

CAMERAS MEASURING VITAL SIGNS

While searching for ways to make vital sign measuring faster and more accessible I came across non-contact measuring technologies, which utilise visible light cameras as well as infrared cameras (as illustrated on the previous page). The number of research articles on this topic show the relevance of this technology. Common use cases are e.g. baby monitoring, or vital sign measurement of patients with infectious diseases that can't be touched.

SPLITTING THE TASKS

Camera technology is capable of measuring many things, yet, more interactive things like assessing speech and cognition are easier and faster for a human to observe. Therefore, I made a division between what could be sensed and what observed by the paramedic.



IDEATION

REQUIREMENTS

CAMERA

- always ready for mass casualties
- unobtrusive in size and attachment
- convenient placement on the body
- easy and fast "scanning" process
- measures vital signs, at least roughly
- scans & receives patient status
- recognizes which patient is supposed to be assessed
- easy to read display
- visual overview of patients and their status
- information adapted to the user
- possibility to override the camera's assessment
- protects patient privacy

TAG

- measure vital signs
- easy & fast attachment to patient
- highly visible status indication
- status update
- availability in large quantities
- second life/ reusable
- versatile attachment
- weather resistant

VALIDATION

VALIDATING

CONCEPT VALIDATION WITH THE PARAMEDICS

UTILIZING PAPER MOCKUPS

The goal of this visit was to get some feedback on the first concept ideas, specifically the chosen camera concept. Simple paper mockups of the camera and the tag helped to illustrate the concept and worked surprisingly well as objects to talk about, interact and demonstrate procedures with.

REDUCING THE TAG

The paramedics were quite fond of the idea of reducing the tag to its essence, using it only as an identification and keeping it as simple and analog as possible.

RESOLVING REPORTING ISSUES

They saw the potential in the the camera-device to help resolve reporting issues, by functioning as a transition piece to the real report, as well as, for the leader to get more overview. Furthermore, they made me aware of the importance of overriding the camera by the paramedic.

*“NOT EVERY PATIENT NEEDS AN EXPENSIVE TAG.”**

*“IT SHOULD BE SIMPLE AND COST EFFECTIVE.”**

*“THIS COULD BE THE TRANSITION PIECE TO THE “REAL” REPORT”**

*“OVERRIDING THE CAMERA IS IMPORTANT”**



* JOHANN ANDERBOM - TRAINED NURSE & PARAMEDIC

IDEATION

CAD DEVELOPMENT

While designing the challenge was to find a mix between a more rugged, technical and medical, friendly appearance.



VISUALIZATION

THE OMNIA SYSTEM

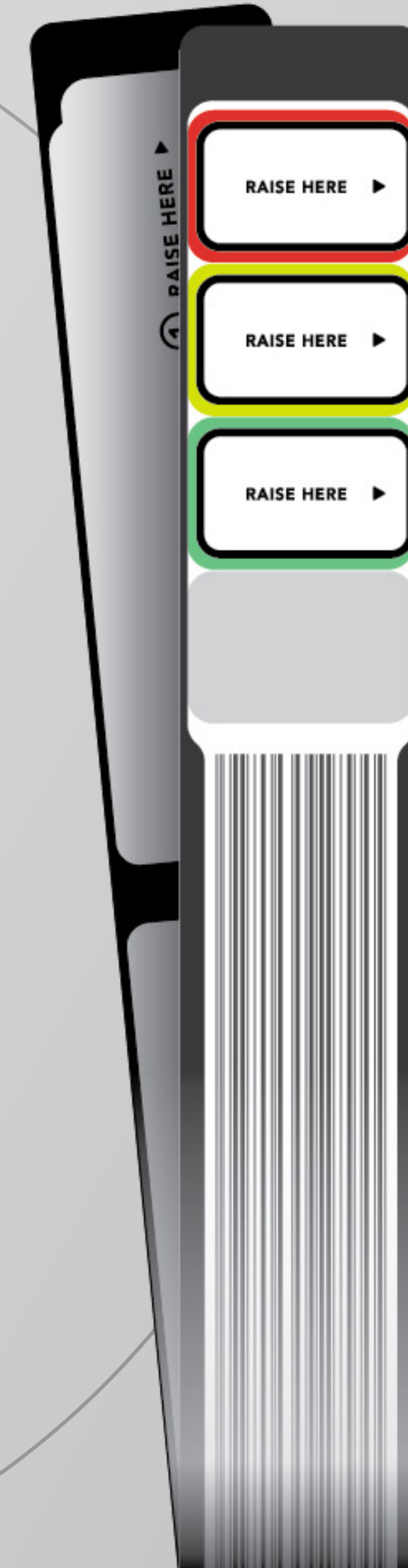
SENSORY & ANALOG

The Omnia System consists of two parts – the companion and the tag. The companion is a device worn by the first-responder to measure vital signs, prioritise patients and document the process. It is accompanied by a reduced assessment tag that identifies the patient and links the collected data to the patient.

The sensing technology is thereby shifted completely onto the companion device, allowing for a simple, analog ID tag.



omnia
FLIR ASSESSMENT SYSTEM



VISUALIZATION

SHAPE DEVELOPMENT

SHAPE

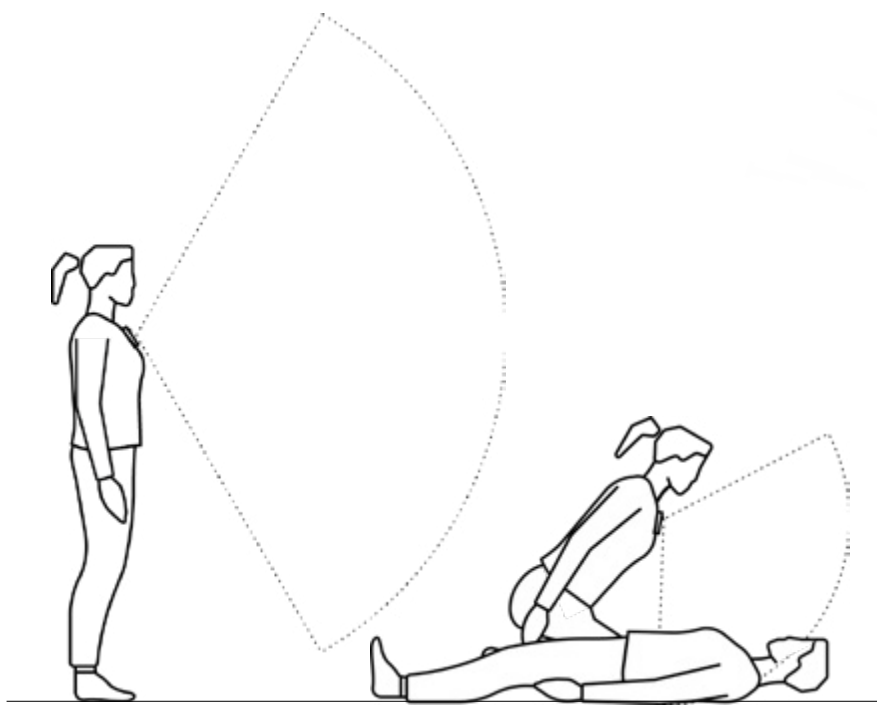
In the final design the camera module is integrated into a soft, rounded body, which gives the object a friendly, modern appearance and makes it feel less intimidating to the patient.

The soft surfaces are encased by a protective frame, while the rubber grip ensures a safe usage.

The CMF conveys a clean, professional appearance, known from other medical products.

PLACEMENT

The companion is worn on the upper chest area, since this area indicates the direction in which a person is facing the most, while limbs and head are turned more frequently.



VISUALIZATION

THE COMPANION

FEATURES

The companion is held on the chest by a magnetic Fidlock connector, which allows for an easy snap-on attachment and quick release by pulling it to the side.

In the back is a touch-screen and on the sides three buttons controlling the voice-record function, as well as, the camera shutter button.

Back,- and front-facing lights at the lower end of the object show the priority indication.



VOICE RECORD

CAMERA SHUTTER

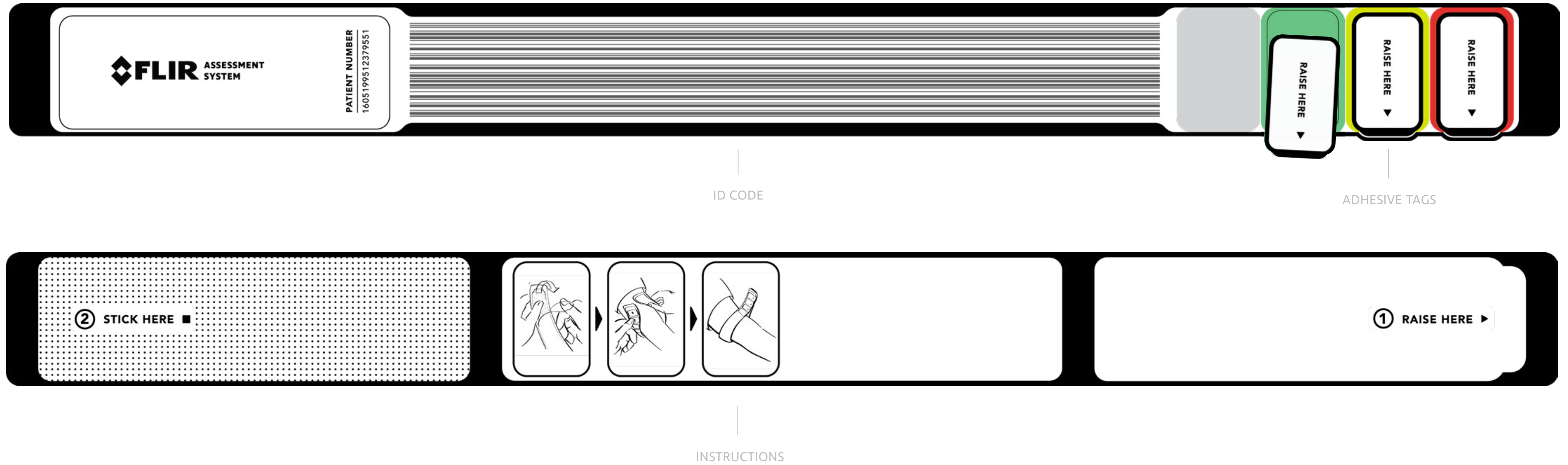
INDICATION LIGHTS



VISUALIZATION

THE TAG

The tag is a simple strip of paper similar to a flight tag, with adhesive areas to attach it to the patients body. It has smaller adhesive tags for the priority colours. By taking off a tag the assessment colour is revealed and can be changed easily any time. On the middle part is a barcode, holding the patient number. Clear instructions in the inside and numbering make it univesally usable.



VISUALIZATION

SCENARIO – FIRST ASSESSMENT



1. First group of first-responders, e.g. firefighters, arrive on site.



2. Firefighter checks a patient. Takes a tag, which is stored in a box at his waist.



3. Takes of the sticker from the tag.



4. Easily attaches it to the patients arm.
The camera gives him an indication light for the priority



5. The firefighters can now confidently set the priority colour.



6. While the first-responders on site continue the assessment, the patient data has already been sent to the hospital, as well as, to the arriving paramedics.

VISUALIZATION

PARAMEDIC ASSESSMENT



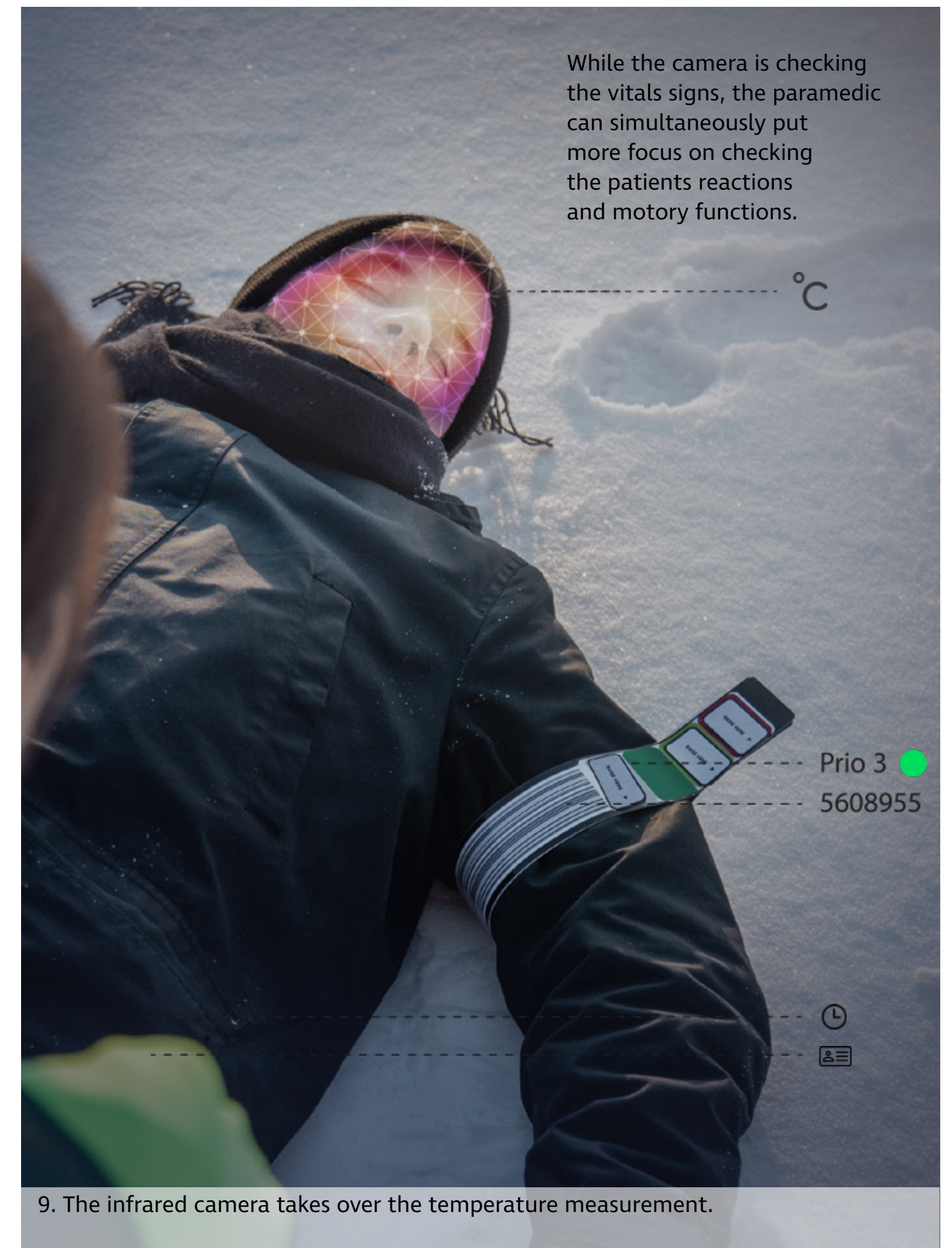
7. When the paramedics arrive on site, they are prepared for the situation. They do another detailed assessment with the camera.



10. In the next step the paramedic can decide to change the priority on the tag.



8. Besides the vital signs the camera scans the patient number on the tag, reads the priority colour and adds a time stamp and the paramedic's ID to the data.



While the camera is checking the vitals signs, the paramedic can simultaneously put more focus on checking the patients reactions and motory functions.

9. The infrared camera takes over the temperature measurement.

VISUALIZATION

CAPTURE INJURIES

An advantage of carrying a camera is that the first-responder can quickly document injuries, in context with the scene, which helps the hospital understand the situation.



VISUALIZATION

CHECK VITAL SIGNS

The paramedic can always go back to a patient and check the latest vital signs. Alternatively, he or she can quickly do another scan.

INTERFACE

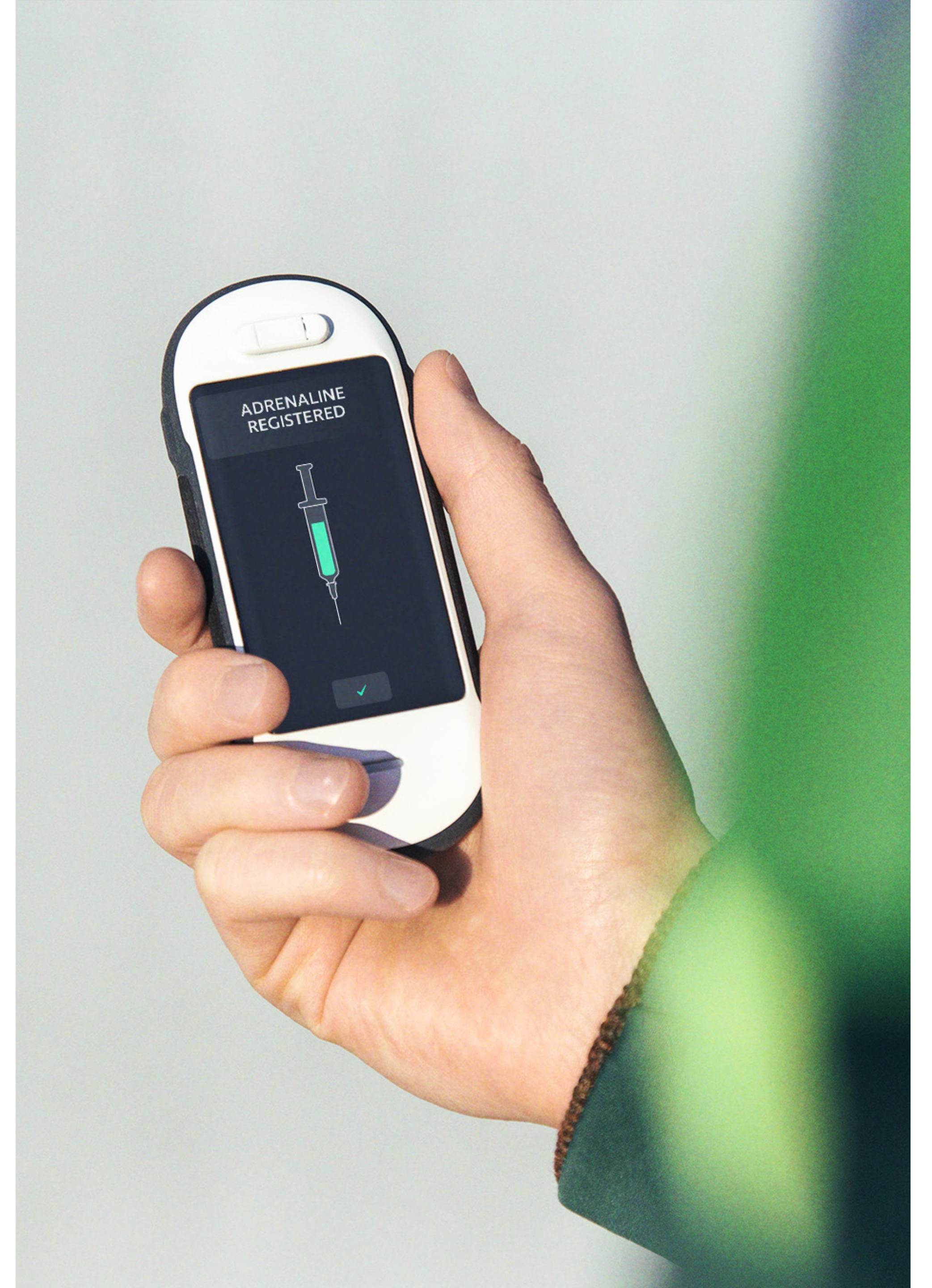
The interface can be read at a glance. It communicates through clear and easily readable numbers and icons and reduces the amount of visual information to the minimum.



VISUALIZATION

RECORD TREATMENT

Treatments and medicine information can be added to the report. When the two record buttons on the left and right of the companion are pressed, the device starts a voice to text recording. Medicine could be recognized automatically and be approved by the paramedic. Medicine is often labeled with QR-codes and similar, which makes it easy to either scan or sense it. Thereby, the device takes over as much of the data input as possible, simply asking for confirmation by the paramedic.



APPENDICES

LIST OF REFERENCES

IF A PICTURE IS NOT LISTED IT WAS EITHER TAKEN OR PRODUCED BY STUDY COLLEAGUE OF MINE OR MYSELF.

PICTURES

PAGE 5: MAP OF UMEÅ & SWEDEN, [HTTPS://MAPSTYLE.WITHGOOGLE.COM](https://mapstyle.withgoogle.com), 24.11.2019

PAGE 14 : PHOTO BY JOSEPH MORRIS ON UNSPLASH, [HTTPS://UNSPLASH.COM/PHOTOS/6INHt0ICFDW](https://unsplash.com/photos/6INHt0ICFDW), 25.11.2019

PAGE 22: PHOTO OF CURRENT TRIAGE DECISION SYSTEM, [HTTPS://EN.WIKIPEDIA.ORG/WIKI/TRIAGE_TAG](https://en.wikipedia.org/wiki/Triage_Tag)

PAGE 23: VITAL SIGN MEASUREMENT, [HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC3273374/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3273374/)

PAGE 22: HOLTER, [HTTPS://CS.WIKIPEDIA.ORG/WIKI/HOLTER](https://cs.wikipedia.org/wiki/Holter)

PAGE 22: CAMERA, [HTTPS://WWW.TECHHIVE.COM/ARTICLE/3436619/SMART-BEAT-REVIEW.HTML](https://www.techhive.com/article/3436619/smart-beat-review.html)

PAGE 22: THERMOMETER, [HTTP://WWW.IDEASTREAM.ORG/NEWS/NPR/353230343](http://www.ideastream.org/news/npr/353230343)

PAGE 22: IR & VISIBLE LIGHT CAMERA, [HTTPS://SUN-MELAB.COM/ARCHIVE](https://sun-melab.com/archive)

PAGE 22: RADIO TAGS, [HTTPS://NEWATLAS.COM/RADIO-TAGS-VITAL-SIGNS/52664/](https://newatlas.com/radio-tags-vital-signs/52664/)
[HTTPS://WWW.NATURE.COM/ARTICLES/S41928-017-0001-0](https://www.nature.com/articles/S41928-017-0001-0)

PAGE 22: PHILIPPS CAMERA, [HTTPS://WWW.PHILIPS.COM/A-W/ABOUT/NEWS/ARCHIVE/STANDARD/NEWS/PRESS/2016/20160606-PHILIPS-PROPRIETARY-CAMERA-BASED-MONITORING-TECHNOLOGY-IS-FIRST-IN-THE-WORLD-TO-MEASURE-ABSOLUTE-ARTERIAL-BLOOD-OXYGENATION-LEVELS-WITHOUT-EVER-TOUCHING-THE-PATIENT.HTML](https://www.philips.com/a-w/about/news/archive/standard/news/press/2016/20160606-philips-proprietary-camera-based-monitoring-technology-is-first-in-the-world-to-measure-absolute-arterial-blood-oxygenation-levels-without-ever-touching-the-patient.html)

PAGE 22: REMOTE SENSING, [HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S1201971217300103](https://www.sciencedirect.com/science/article/pii/S1201971217300103)

PAGE 22: SMART BEAT, [HTTPS://WWW.FORBES.COM/SITES/ROBERTGLATTER/2018/01/30/NOVEL-VIDEO-CAMERA-CAN-MONITOR-YOUR-HEART-RATE-USING-ONLY-YOUR-FACE/](https://www.forbes.com/sites/robertglatter/2018/01/30/novel-video-camera-can-monitor-your-heart-rate-using-only-your-face/)

PAGE 22: APPLE WATCH, [HTTPS://NEWS.GOOGLE.COM/TOPICS/CAAQJQGKIh9DQKftrVfVTEWYMHZNREV4YzIXAU5ESVNBb-VZ1S0FBUAe?hl=en-ca&gl=ca&ceid=ca:en](https://news.google.com/topics/CAAQJQGKIh9DQKftrVfVTEWYMHZNREV4YzIXAU5ESVNBb-VZ1S0FBUAe?hl=en-ca&gl=ca&ceid=ca:en)

PAGE 36: MOODS, [HTTPS://WWW.PINTEREST.DE/](https://www.pinterest.de/)

GRAPHICS

PAGE 5: BUS GRAPHIC BY TINJO THOMAS, [HTTPS://THENOUNPROJECT.COM/SEARCH/?Q=BUS](https://thenounproject.com/search?q=bus), 20

PAGE 5: MAGNIFYING GLASS GRAPHIC BY VALERIY, [HTTPS://THE-NOUNPROJECT.COM/SEARCH/?Q=LUPE&I=2340777](https://thenounproject.com/search?q=lupe&i=2340777), 2019

PAGE 5: BIKE GRAPHIC BY FAUZAN AKBAR, [HTTPS://THENOUNPROJECT.COM/SEARCH/?Q=BIKE](https://thenounproject.com/search?q=bike), 2019

PAGE 23: VITAL SIGN ICONS, [HTTPS://THENOUNPROJECT.COM/](https://thenounproject.com/)

PAGE 30: VITAL SIGN ICONS, [HTTPS://THENOUNPROJECT.COM/](https://thenounproject.com/)

CITATIONS

PAGE 3: ABOUT FLIR, [HTTPS://EN.WIKIPEDIA.ORG/WIKI/FLIR_SYSTEMS](https://en.wikipedia.org/wiki/FLIR_Systems), 24.11.2019

