EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

Towards social robotics in healthcare

Roessingh Research and Development

UNIVERSITY OF TWENTE.

MST Medisch Spectrum Twente een santeon ziekenhuis

BLUE COMPANION E-HEALTH PROJECTS

Vera Hengeveld

Gianluca Zia

Stephanie Jansen - Kosterink

This workshop focuses on **how to define use-cases for social robotics** in healthcare by means of co-creation sessions with the target population, on **the technical implementation of the clinical needs**, and it focuses on preparing such a robot for care market introduction.

- Short introduction
- **How to define use-cases for social robotics in healthcare** by Stephanie Jansen

Two projects:

- **Maatje: a robot to stimulate physical activity in children with cancer** by Vera Hengeveld
- **The first introduction of social robotics in rehabilitation care** by Stephanie Jansen

- Discussion → *Pros and cons of co-creation in developing social robotics in healthcare*

- Technical implementation of defined use-cases for social robotics by Gianluca Zia

- Discussion / Q&A

How to define use-cases for social robotics in healthcare

STEPHANIE JANSEN-KOSTERINK

ROESSINGH RESEARCH & DEVELOPMENT

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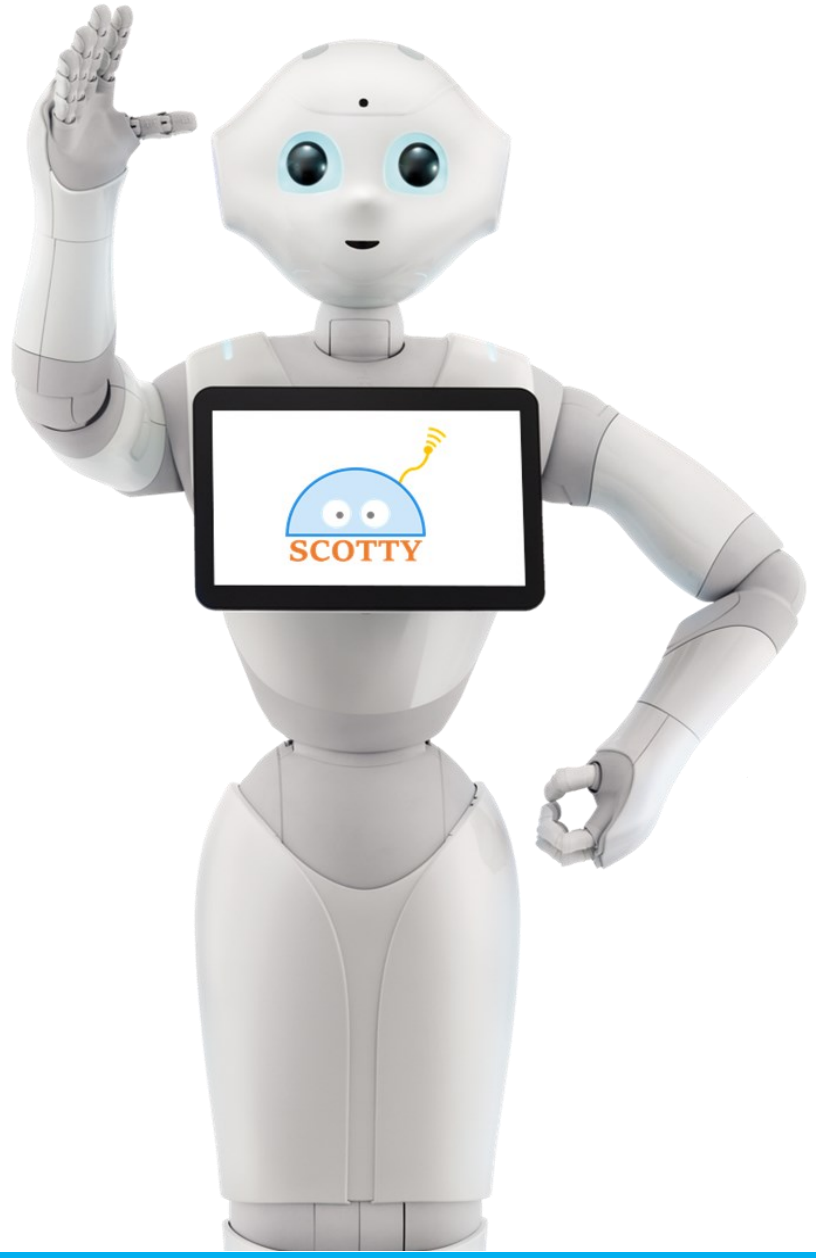


Let's meet Scotty!

SCOTTY – project

- DIH-HERO Technology Transfer Experiment
- Partners – Roessingh Research and Development & BLUECOMPANION
- Implementation side – Roessingh Center for Rehabilitation
- Aim: The implementation of a social robot in rehabilitation care.

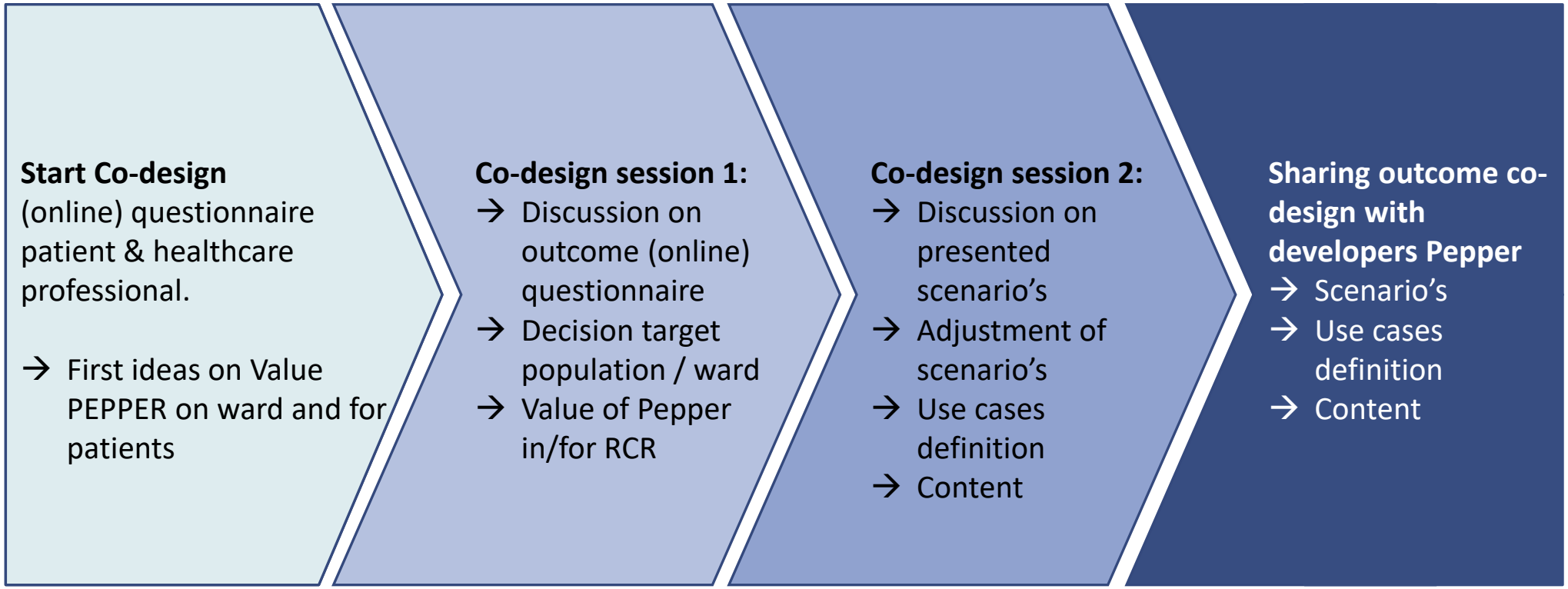
Scotty

- Humanoid robot (Pepper, SoftBank Robotics)

Roessingh Research and Development

Use case development by co-creation with foreseen end-users

Method


Start Co-design
(online) questionnaire patient & healthcare professional.
→ First ideas on Value PEPPER on ward and for patients
Co-design session 1:
→ Discussion on outcome (online) questionnaire
→ Decision target population / ward
→ Value of Pepper in/for RCR
Co-design session 2:
→ Discussion on presented scenario's
→ Adjustment of scenario's
→ Use cases definition
→ Content
Sharing outcome co-design with developers Pepper
→ Scenario's
→ Use cases definition
→ Content

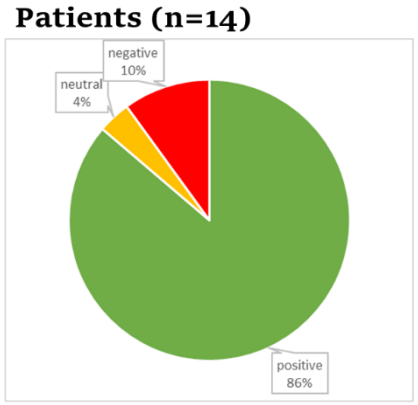
Start Co-design

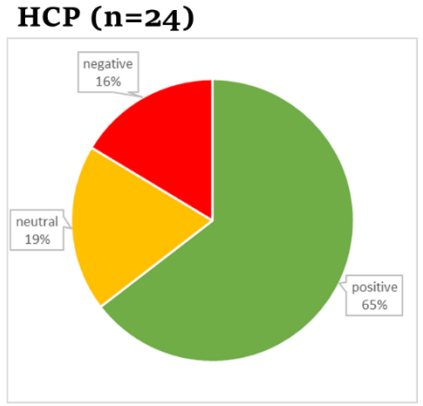
Online questionnaire for Pt and HCP
- Attitude towards robots
- Intention to use
- Task Pepper

14 patients
- Gender: 57% female & 43% male
- Age: 61 years (SD 17 year)
- Ward: 100% ward 1 / spinal cord injury

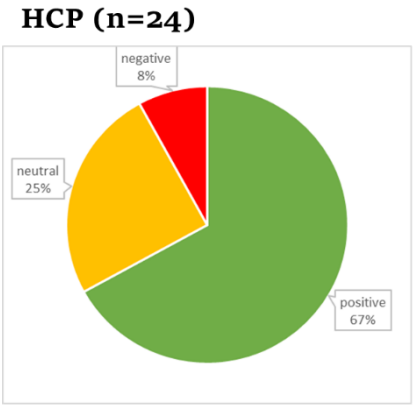
24 health care professionals
- Gender: 92% female & 8% male
- Age: 40 years (SD 14 year)
- Ward: 100% ward 1 / spinal cord injury

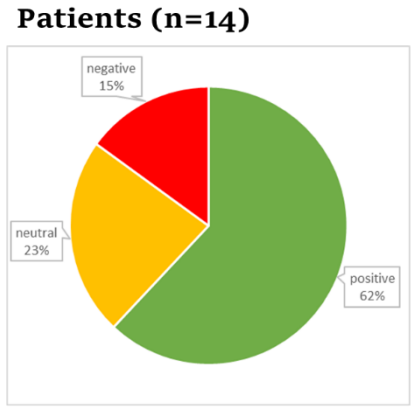
Attitude:





Intention to use:





Co-design session 1 & 2

- Session 1: March 23, 2021 (90 minutes)
  - Outcome online questionnaire
  - Decision on target population / tasks Pepper
- Session 2: April 6, 2021 (90 minutes)
  - Discussion first draft scenario's
  - Content

Innovation manager

Nurse

Nurse in training

Rehabilitation physician

The host

To provide general information of RCR and care process

To provide directions within RCR

To ask out simple evaluation

To ask menu preferences (breakfast / lunch / diner)

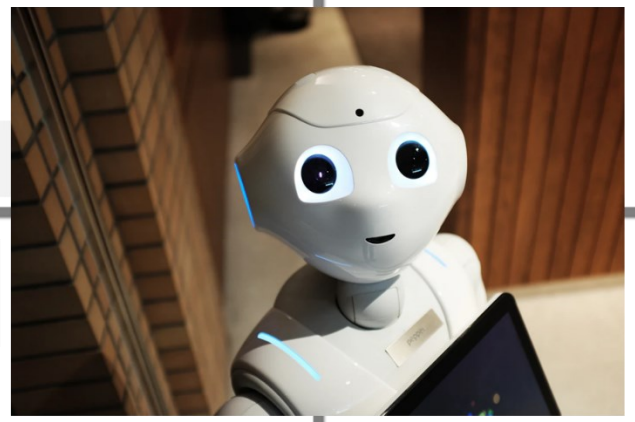
The nurse aid

To note and store daily control (health) data

To interpret for non-Dutch patients

To ask out questionnaires

To store outcomes of self-administrated questionnaires



The PT assistant

To record routine exercises with patient and PT

To provide information on transfers

To remind patients to perform their routine exercises by showing the recorded videos

The companion

To solve a puzzle with the patient

To play a quiz with (the) patient(s)

To play a game with the patient

To read a book with the patient

Scenario 1: Pepper as host

A new patient (Job, 52 years old) is admitted at Peppers ward. During the first day Pepper brings Job a visit to introduce himself. In a short monologue Pepper tells how he started working at RCR and gives Job an overview of his RCR knowledge on the different departments, treatments and wards. Peppers also tells Job that he loves to help him when he is in need of any general information or directions. Pepper ends the conversation with a "turn" and wishes Job a good day!

Job indicated that he is okay that Pepper helps him to notify the kitchen with his eating preferences for breakfast, lunch and dinner. So, the next day Pe
the daily food suggestion list. Together with
weekday with completing those lists. One day
weather will be. His older sister will visits him
nearby. He asks Pepper and Pepper gives Job pr

After two weeks Job has his first therapy sessi
aware of the locating of the department he as
position and shows Job on the same map the
satisfied with Pepper's help. Pepper ends the co

Time to go home! Job is ready to leave the
home. One final visit with Pepper as Job has t
help and due to the requested responses on
patient care) Job is glad he could complete the

Scenario 1 – use cases

- 1.1 Introduction of Pepper
- 1.2 Ask out eating preferences for breakfast, lunch and diner
- 1.3 Ask about weather forecast
- 1.4 Ask about direction within RCR
- 1.5 Complete release evaluation form
- …

SCOTTY

The host

To provide general information of RCR and care process

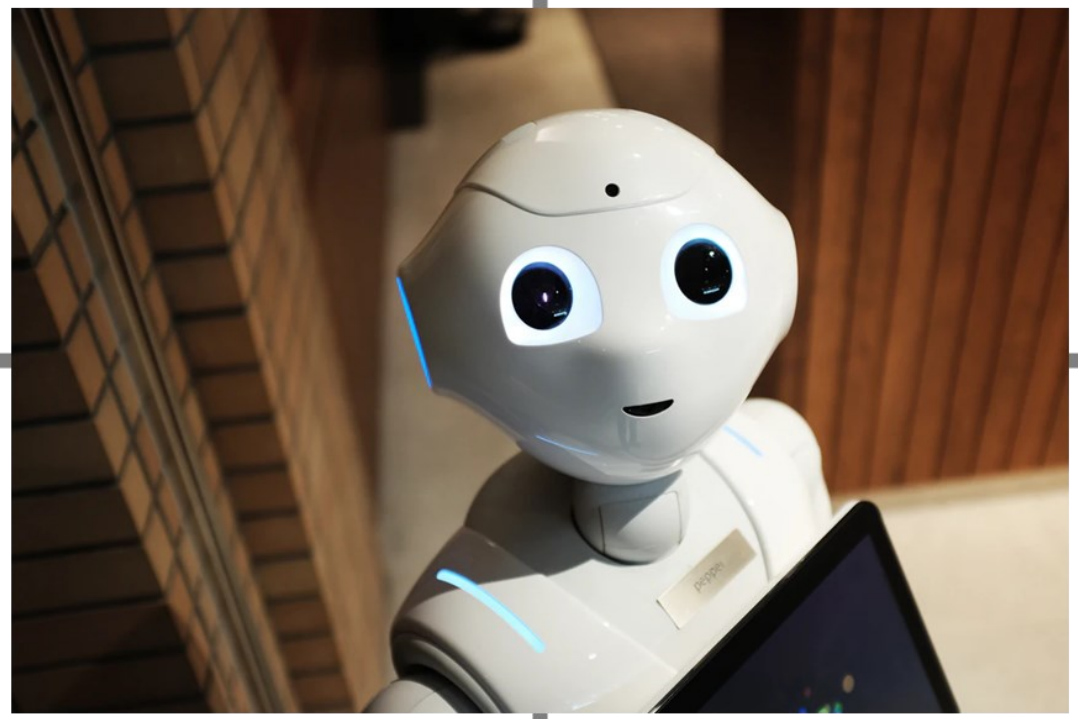
To provide information about weather forecast

To ask out simple evaluation questions

The nurse aid

To note and store daily control (health) data

To ask out questionnaires and store outcomes



The PT assistant

To remind patients to perform their routine exercises

To show patients their training videos

The companion

To read a book with the patient

To play a game with the patient

Experiences?

Maatje

The use of a robot from a clinical perspective

-Project background
-End-user involvement

V. Hengeveld
R. Russcher

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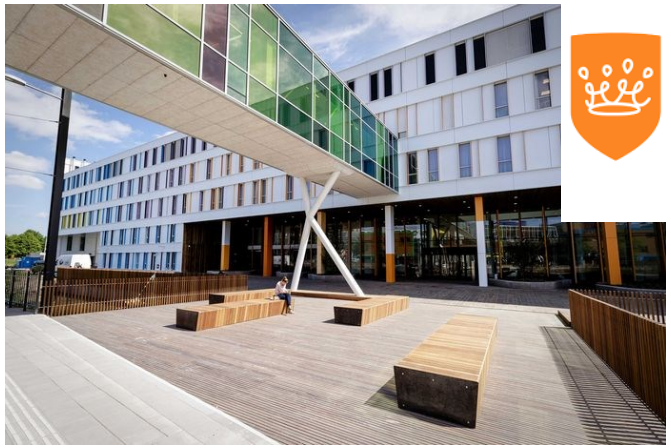

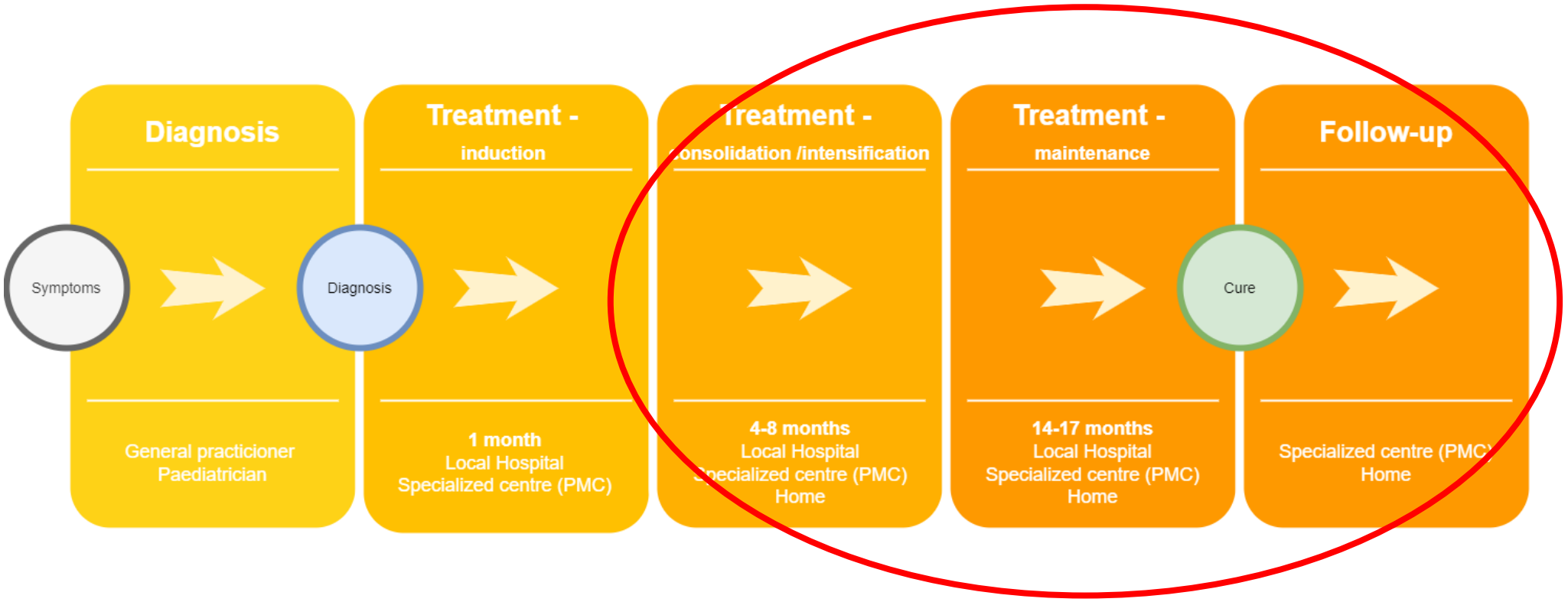
Diagnosis
Treatment - induction
Treatment - consolidation /intensification
Treatment - maintenance
Follow-up
Symptoms
Diagnosis
Cure
General practicioner
Paediatrician
1 month
Local Hospital
Specialized centre (PMC)
4-8 months
Local Hospital
Specialized centre (PMC)
Home
14-17 months
Local Hospital
Specialized centre (PMC)
Home
Specialized centre (PMC)
Home

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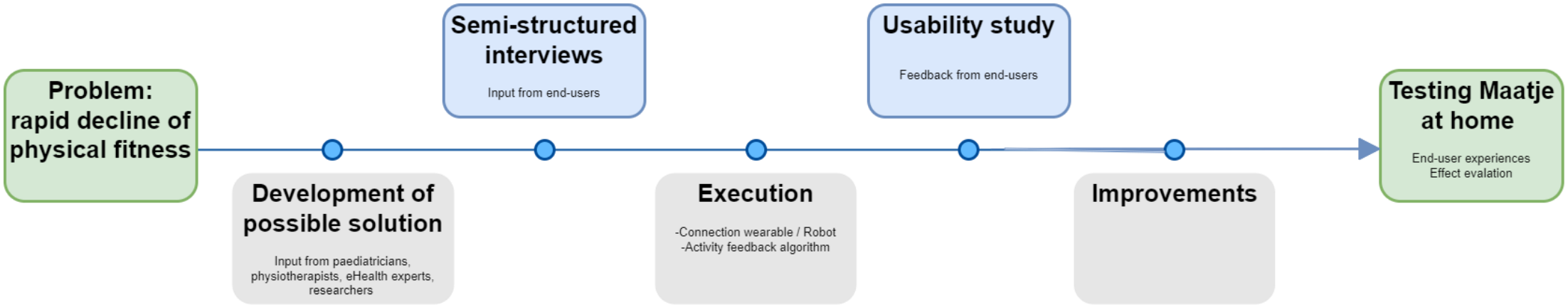
End-user involvement



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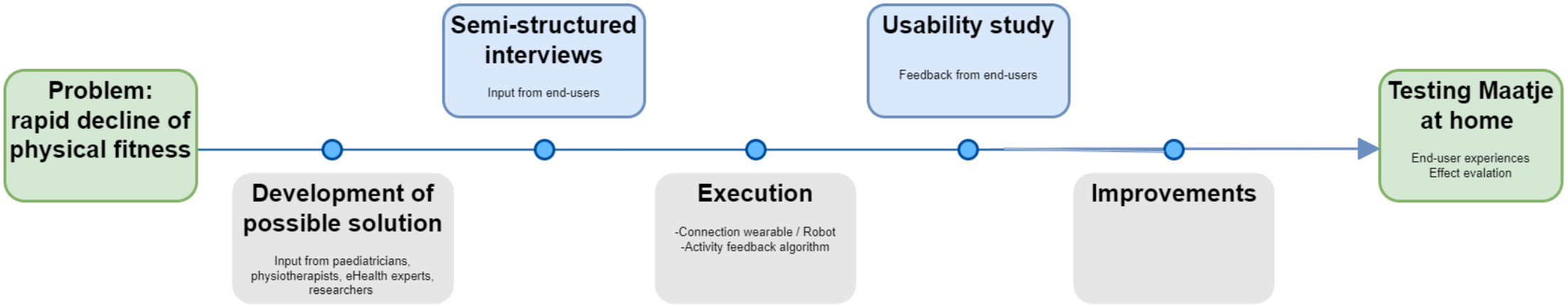
End-user involvement

'' Nouja. Ook een beetje van moet je haar dat dan nog aandoen... ''
'' Well, also like should you have to put her through that as well..."



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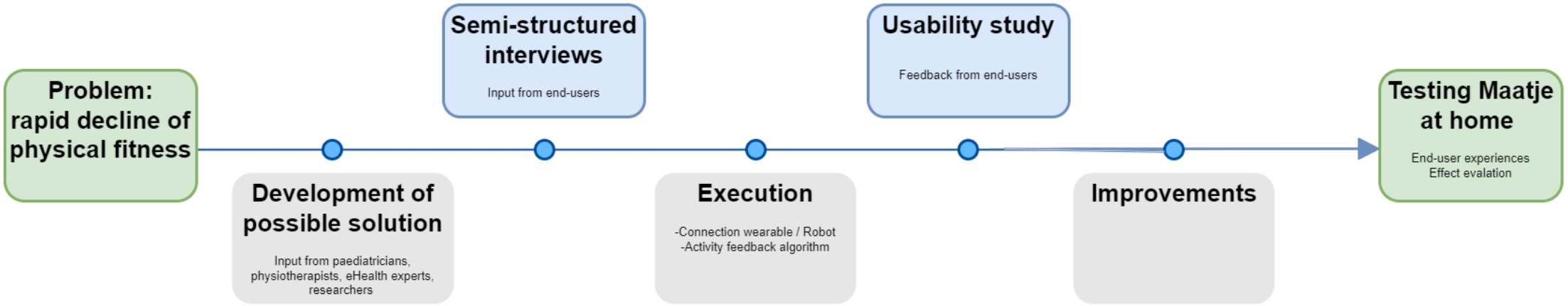
End-user involvement

'Maar hij voelt zich nu natuurlijk in het onderhoud ook gewoon wat beter. Alleen die dexa die komt elke drie weken terug. Ja dat hakt er echt wel in"
'' But he feels better in the maintenance phase. Just that dexa every three weeks. That takes its toll"



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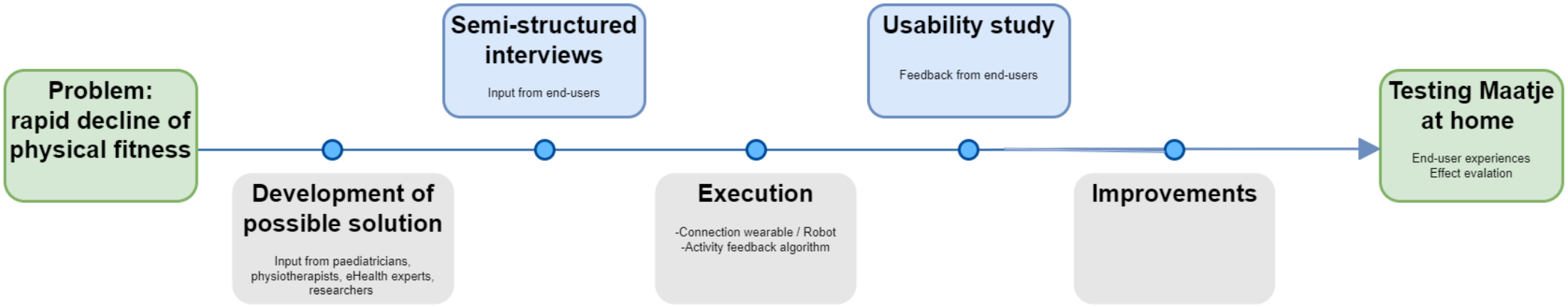
End-user involvement



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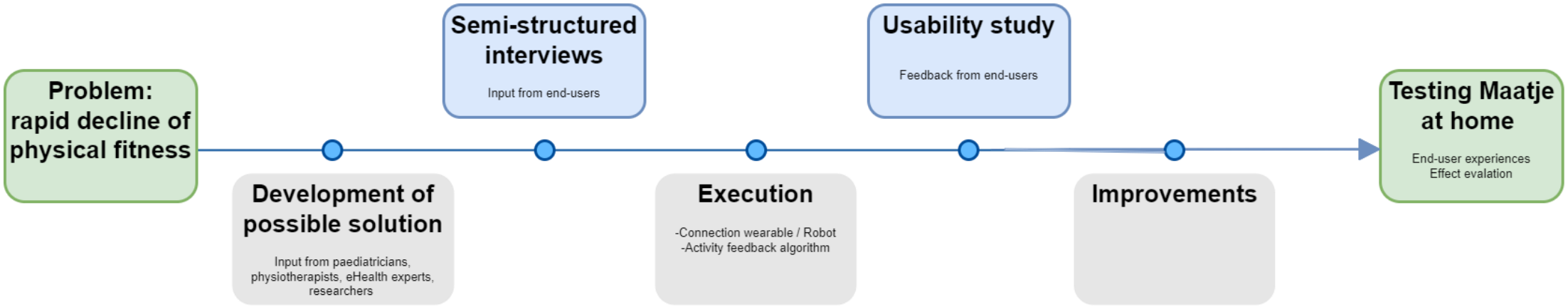
End-user involvement

6-9 children with oncological disorder (4-10 years) + parent
Pre-defined tasks

Think-aloud
Performance metrics
- *-task completion (%)*
- *-task completion time (sec)*
- *-task satisfaction (after scenario questionnaire)*



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Link naar filmpje

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The first introduction of social robotics in rehabilitation care

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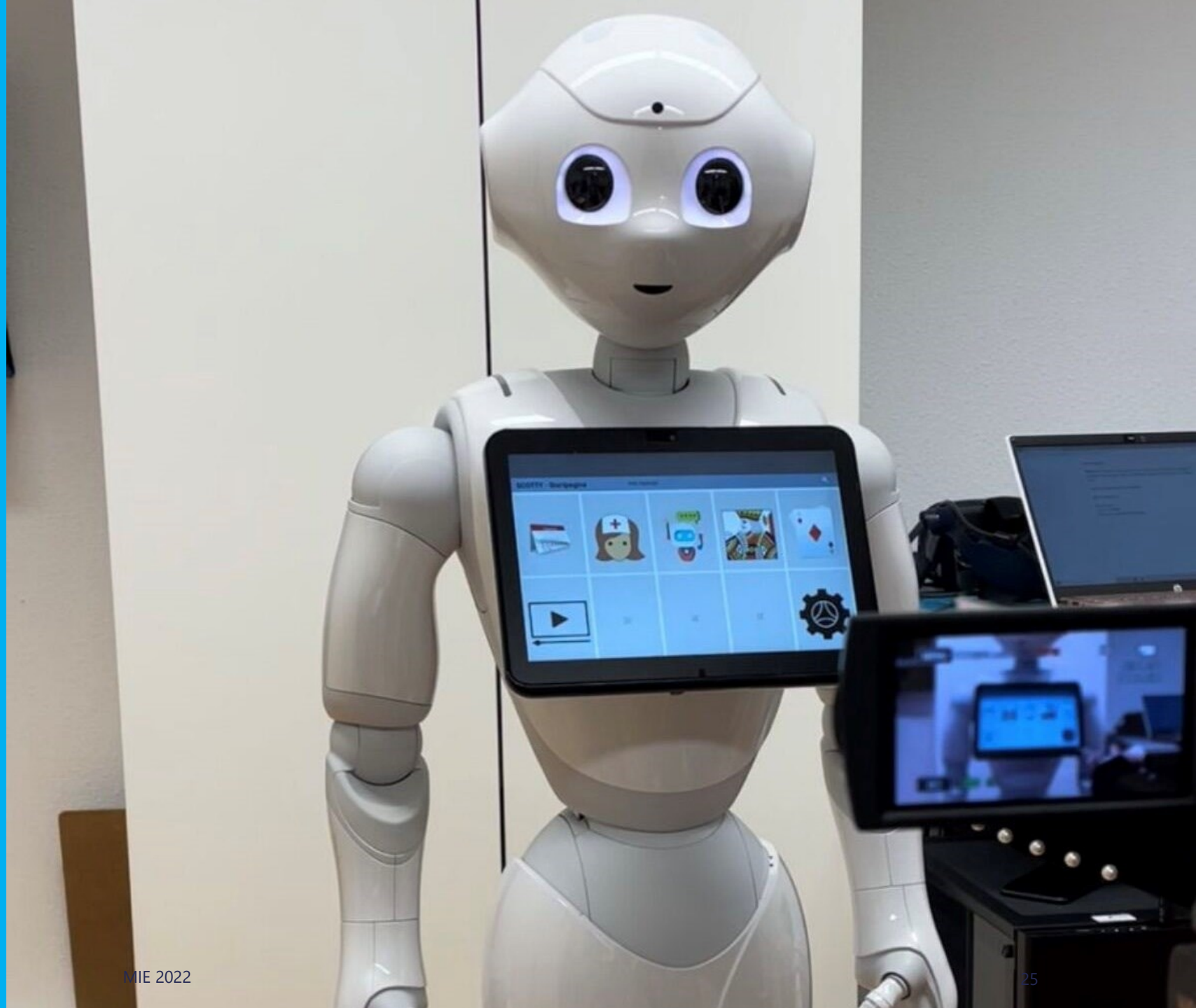
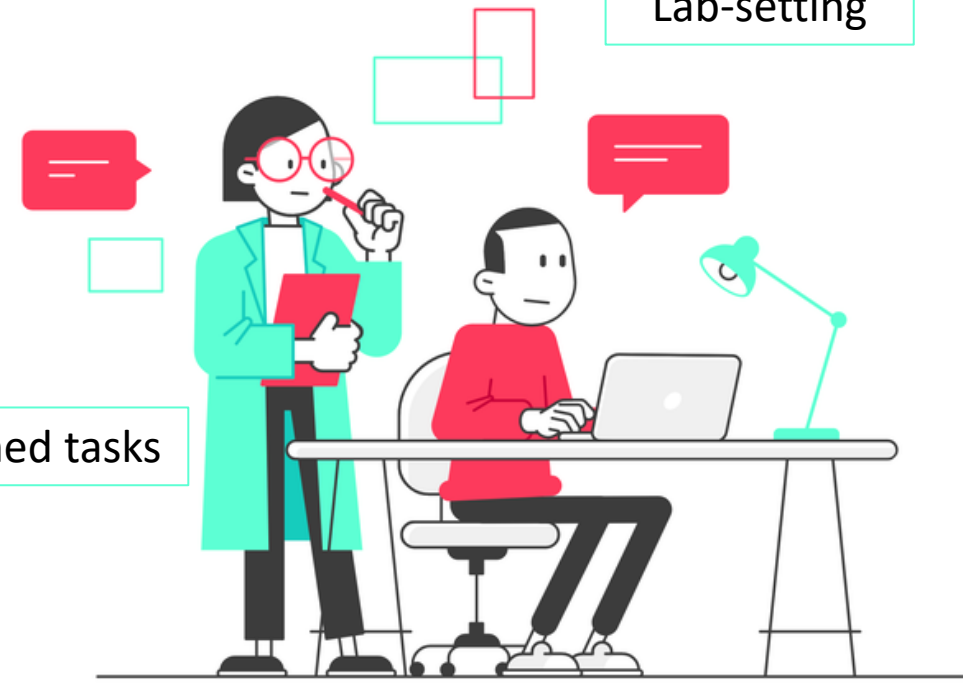
Testing with End-users



Methods

USABILITY TEST

Lab-setting



Pre-defined tasks

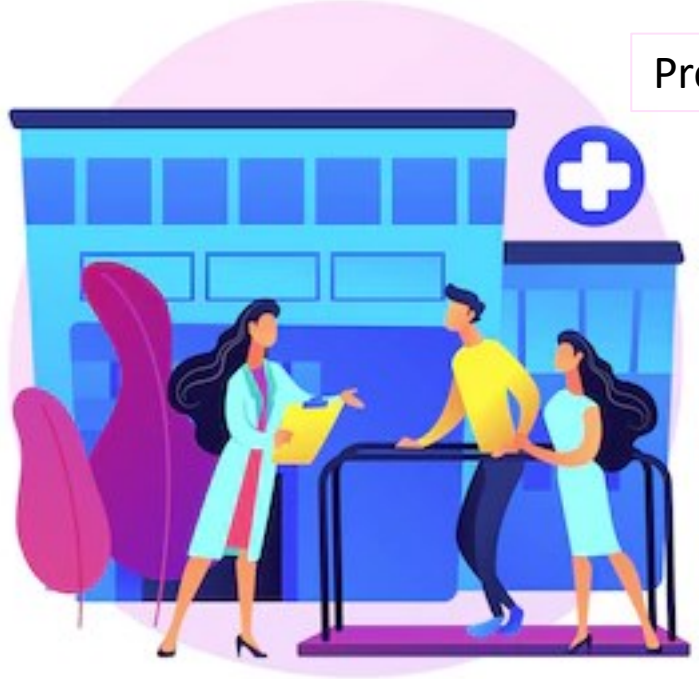
TAM questionnaire

ACCEPTANCE TEST

Rehabilitation centre

Rating acceptance at first sight

Pre-defined tasks



Rating acceptance after each task

Almere Model questionnaire

Results - Participants

Total: 12 participants

5 patients
60% male
Age range 19 – 77

3 nurses
100% female
Age range 19 – 50

4 technical experts
75% female
Age range 20 – 27

Results – Usability issues

When signing in: trouble finding the right button

When opening a questionnaire: unclear which QR code needs to be used

When answering questions: unclear that user has to wait with giving answers until the blue lights are on

When completing questionnaires: unclear what kind of answer the robot is looking for

When opening a questionnaire: unclear that they had to use a QR code

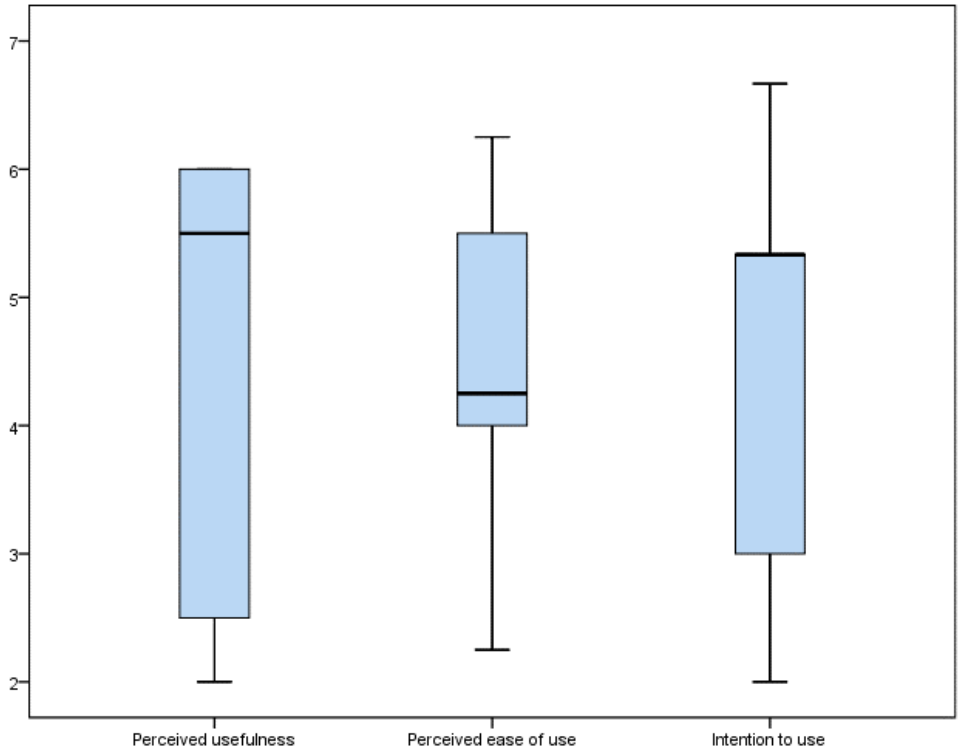
When opening a questionnaire: unclear how to use the QR code

When answering questions: unclear how to response (by speech or by writing)

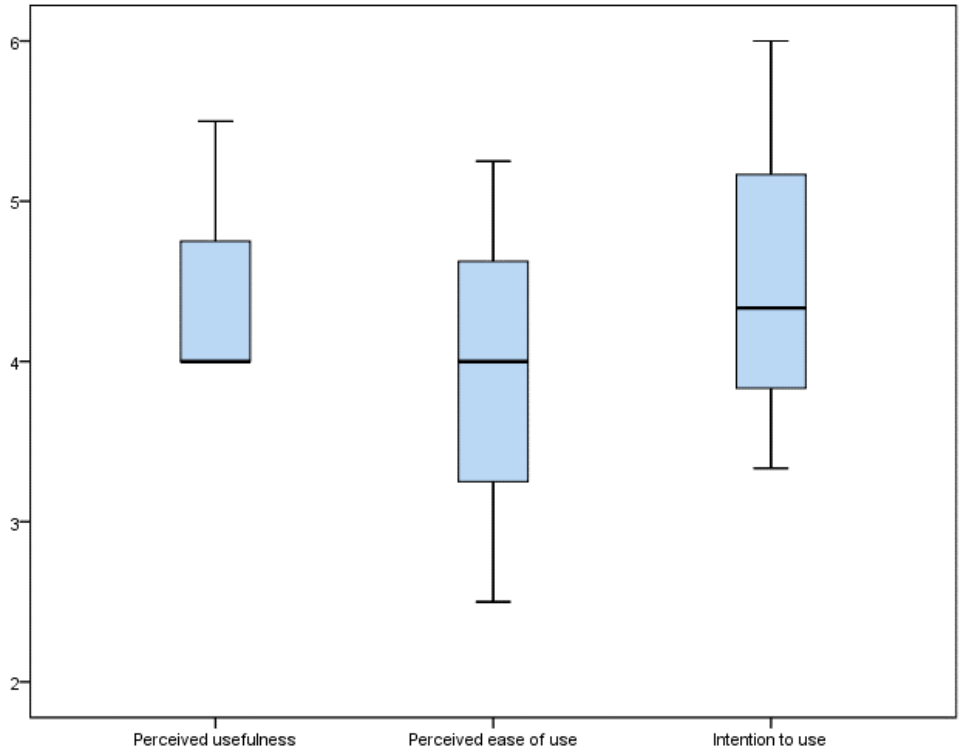
Usability issues severity	N issues among technical experts	N issues among nurses	N issues among patients	N issues among all roles
Minor	6	3	6	15
Serious	4	10	5	19
Critical	4	4	4	12
Total	14	17	15	53

Results – Technology Acceptance Model

Patients



- **Nurses**



Results – Acceptance test 2

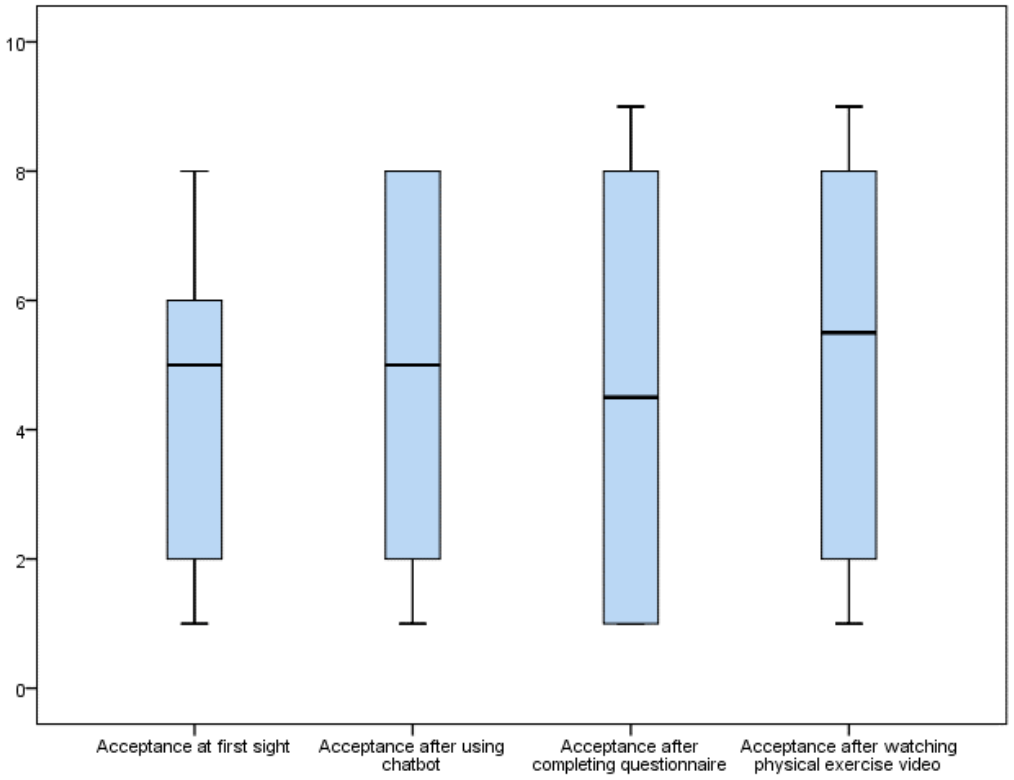
- **Total: 16 participants**

6 patients
66.7% male
Age range 39 – 72

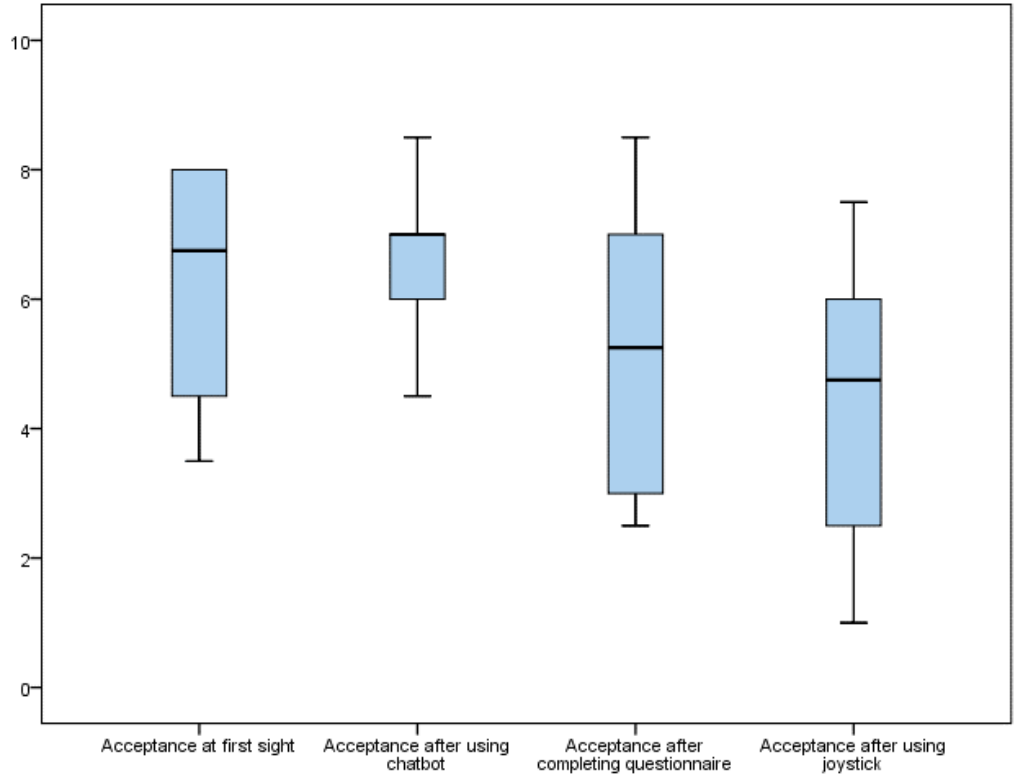
10 nurses
90% female
Age range 24 – 63

Results – Acceptance rate

Patients

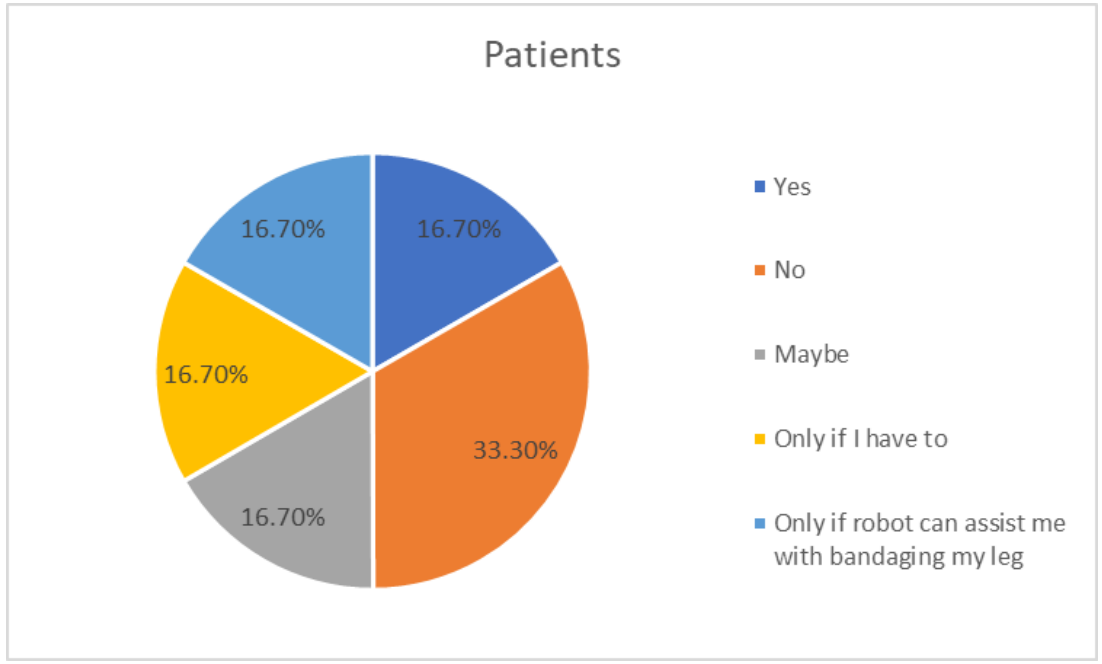


- **Nurses**



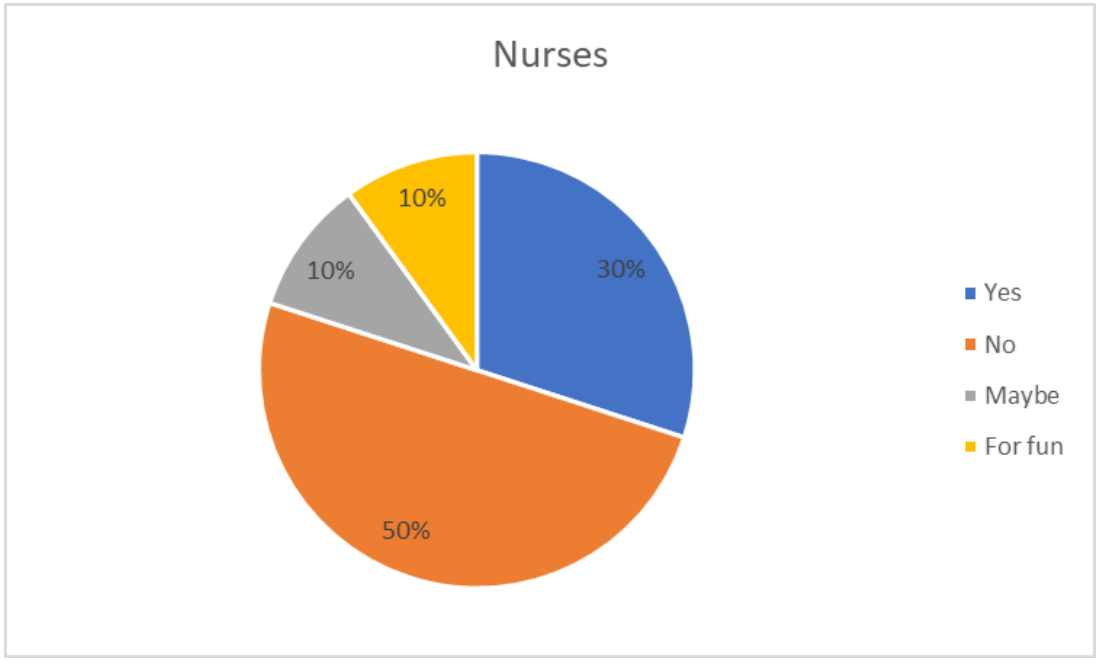
Results – Intention to use

"Honestly, I'm a bit hesitant about that. It's all a little bit strange."



"No, because I don't think using it will have added value for me."

"I would purely use it because it's possible, maybe for a bit of relief, but more for the fun. Not for care purposes. Nurses need to perform those tasks."



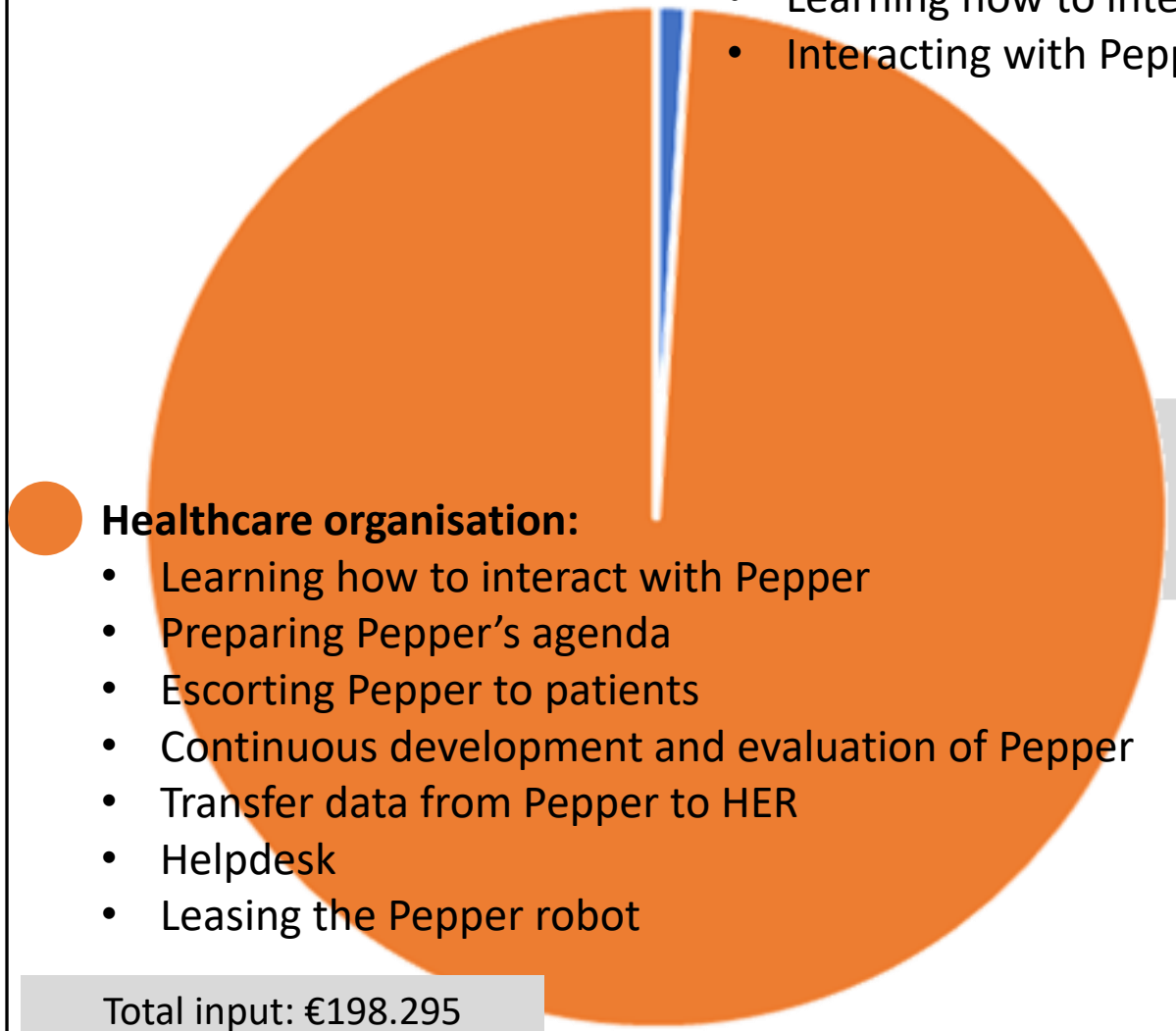
"Yes, I want to give it a try."

"Looking at the current version of the robot, no I won't."

Accessed the societal impact by means of the Social Return on Investment methode (SROI)

INPUT

Users:
- Learning how to interact with Pepper
- Interacting with Pepper



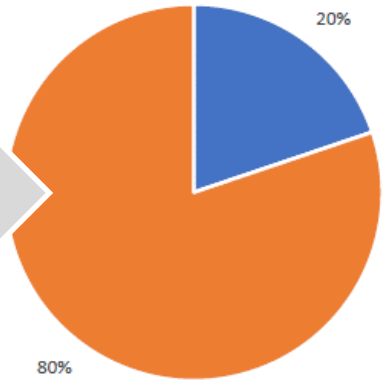
Healthcare organisation:
- Learning how to interact with Pepper
- Preparing Pepper's agenda
- Escorting Pepper to patients
- Continuous development and evaluation of Pepper
- Transfer data from Pepper to HER
- Helpdesk
- Leasing the Pepper robot

Total input: €198.295

SROI RATIO 0.06

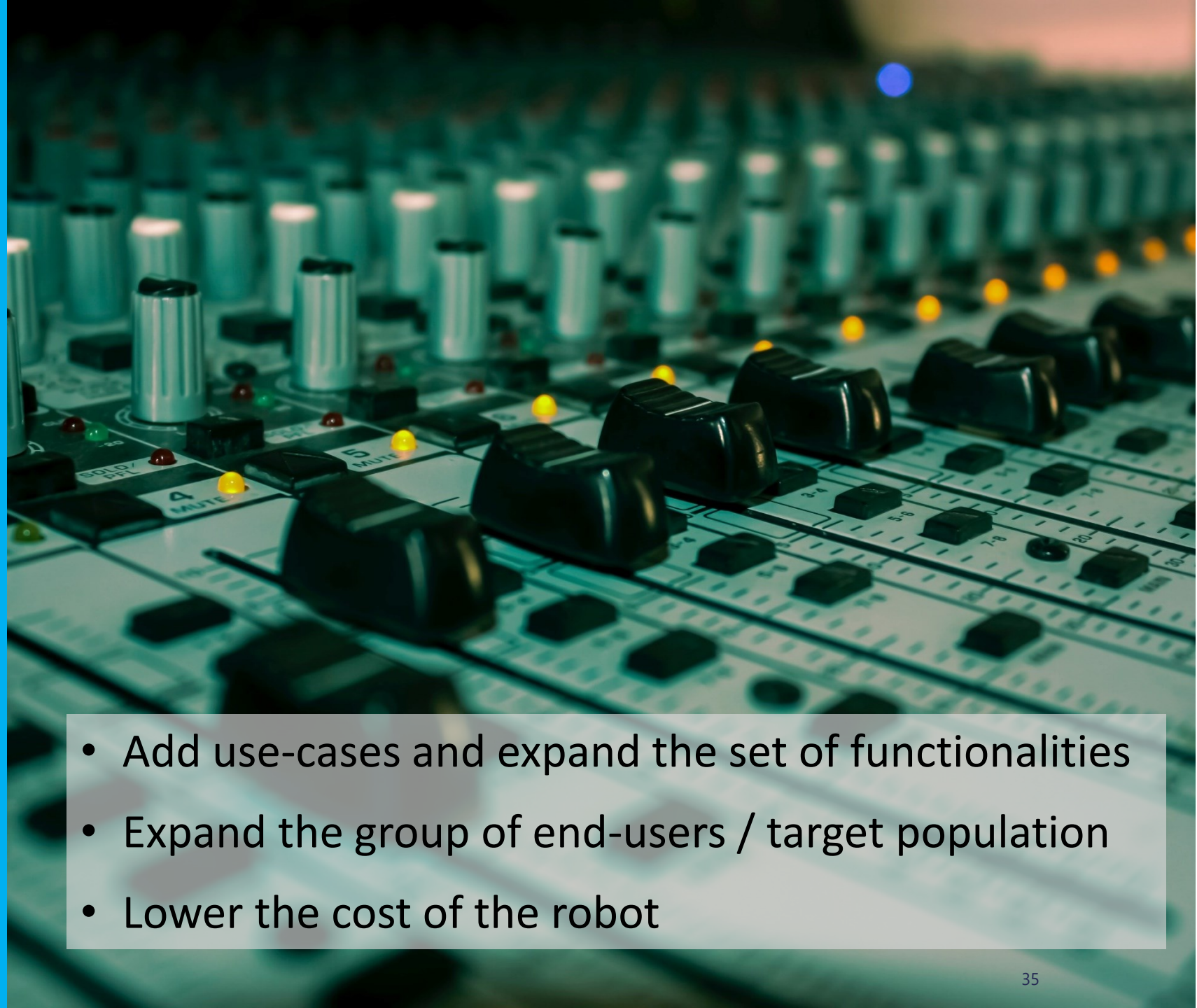
VALUE

Users:
- Increased quality of life



Healthcare organisation:
- Increased work satisfaction
- Decreased workload
- Increased work process efficiency
- Image innovative character

Total value: €11.854



- Add use-cases and expand the set of functionalities
- Expand the group of end-users / target population
- Lower the cost of the robot

Lessons Learned

- To expectation toward social robotics in rehabilitation care are (unreal) high, educate potential end-users to make the expectation realistic
- To increase acceptance involve end-user, especially during the development stage and not only as study participant
- For a positive business case important to have impact, especially given the high price.
- Make sure the social robot is a solution, a means of solving a problem. Never a aim!

Thank you for you attention!

CONTACT

Stephanie Jansen-Kosterink

s.Jansen@rrd.nl

www.rrd.nl

Discussion:
Pros and cons of co-creation in developing social robotics in healthcare

STEPHANIE JANSEN-KOSTERINK

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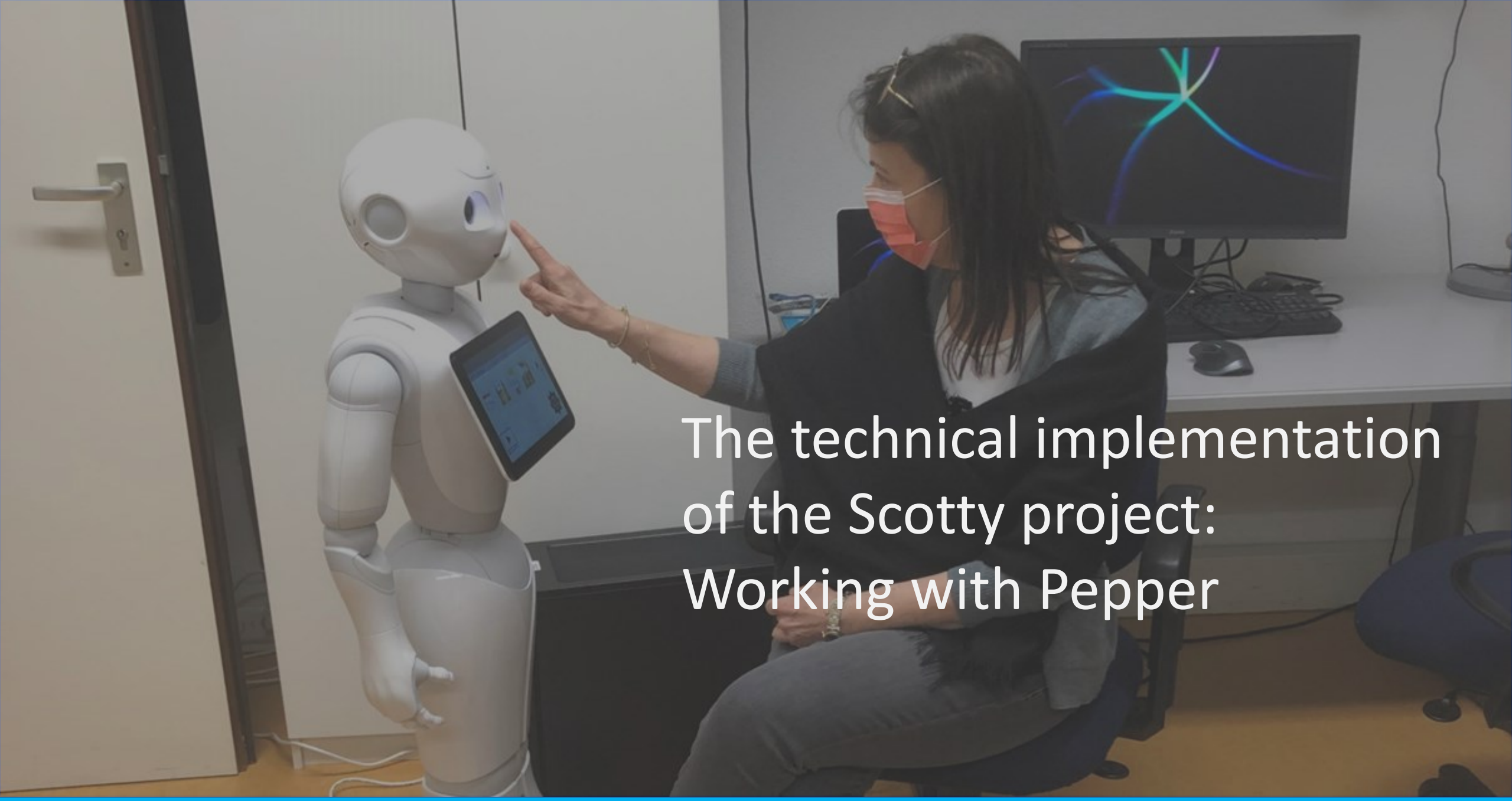
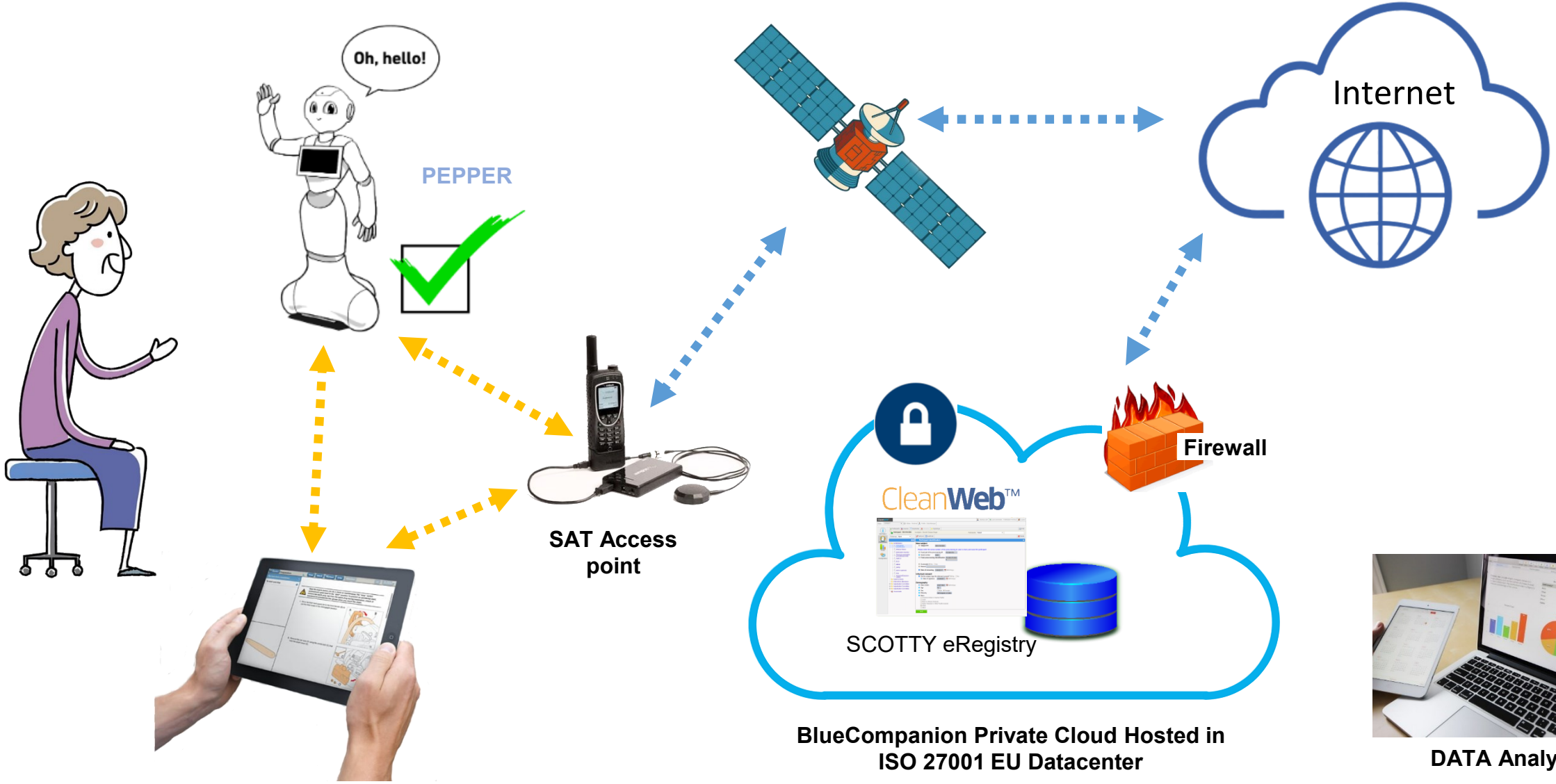
BLAW
BLAW
BLA



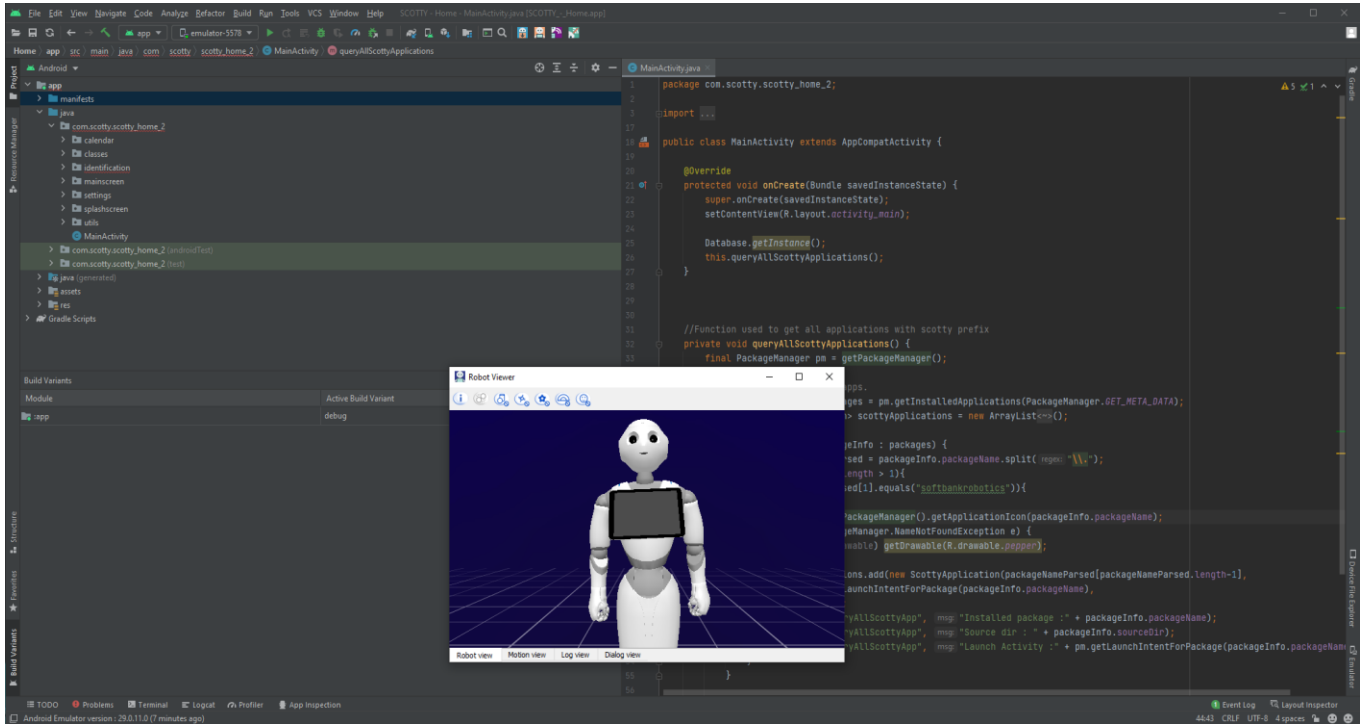
The technical implementation of the Scotty project: Working with Pepper

Information and Communication Technology Architecture for SCOTTY



Development phase

- ✓ Environment set up (team spread across 3 different countries: France, Italy and UK)
- ✓ Communication channels setup: Servers, VPN, security Team Setup.
- ✓ Component development: Scotty greetings chatbot, Scotty WEB site, scotty calendar, Clinical eCRF
- ✓ Integration of different component



Strengths:

- Pepper speaks many languages
- it was possible to develop the project with a remote team
- Very sophisticated development environment and library

Weaknesses

- Android studio is very dispersive, a language like Python would be preferable (used in previous versions)
- Difficulty testing and using applications if you are not native speaker
- Pepper hardware not up to date and not upgradeable (e.g. the tablet)

Scotty's Enabling Features today

- **The Interaction Platform:**
  - ✓ **A web-based platforms** is accessible and operational at Scotty.Bluecompanion.eu
  - ✓ **Scotty's Agenda: enables daily planning for Patient's appointments**
  - ✓ **eCRF: ready for collecting Patients' data**
- **Accessing the data:**
  - ✓ **Scotty sending data to the remote server**
  - ✓ **Look at/retrieve the results**

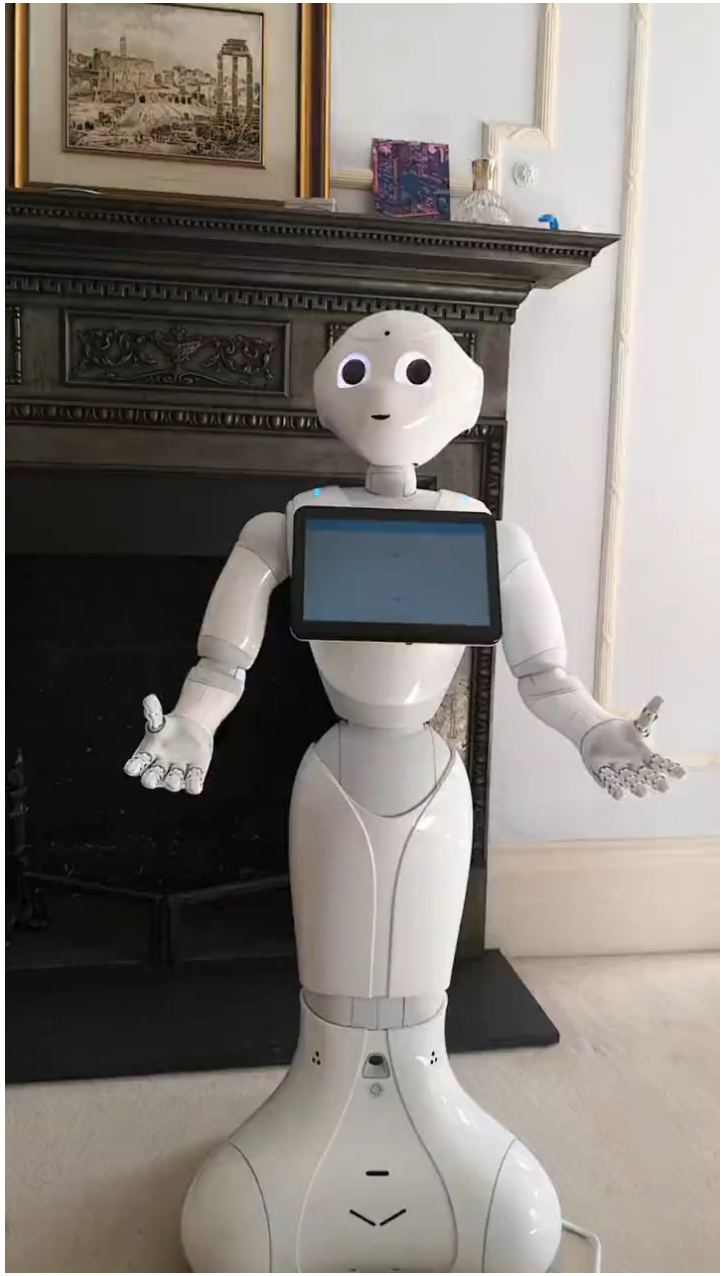
- ✓ **A dedicated web platform allows to access the program functionalities:**
  https://scotty.bluecompanion.eu/

Future innovations

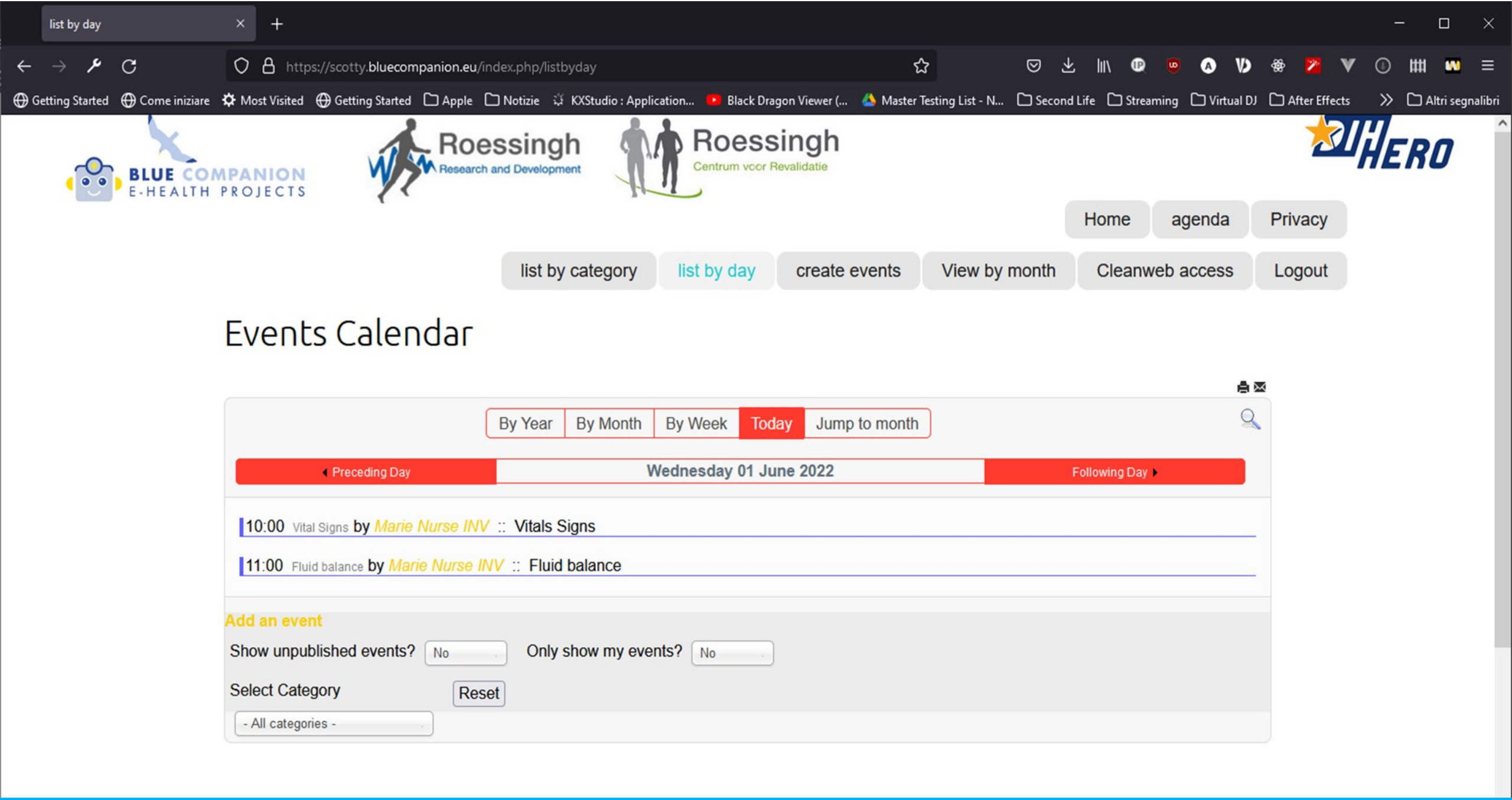
SCOTTY IN A GLIMPSE

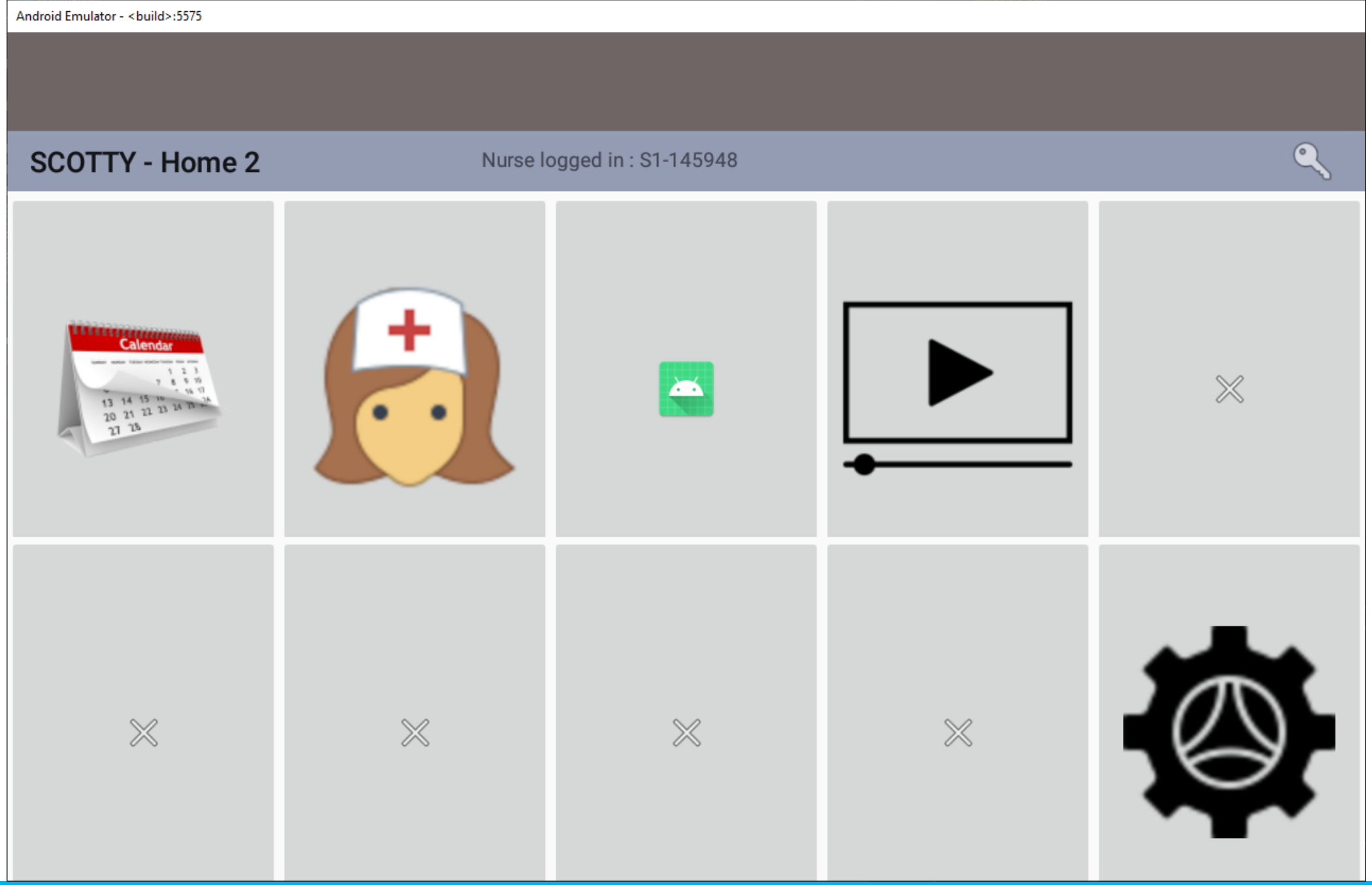
The future is fast approaching, and a new era of digital innovation and disruption is here.

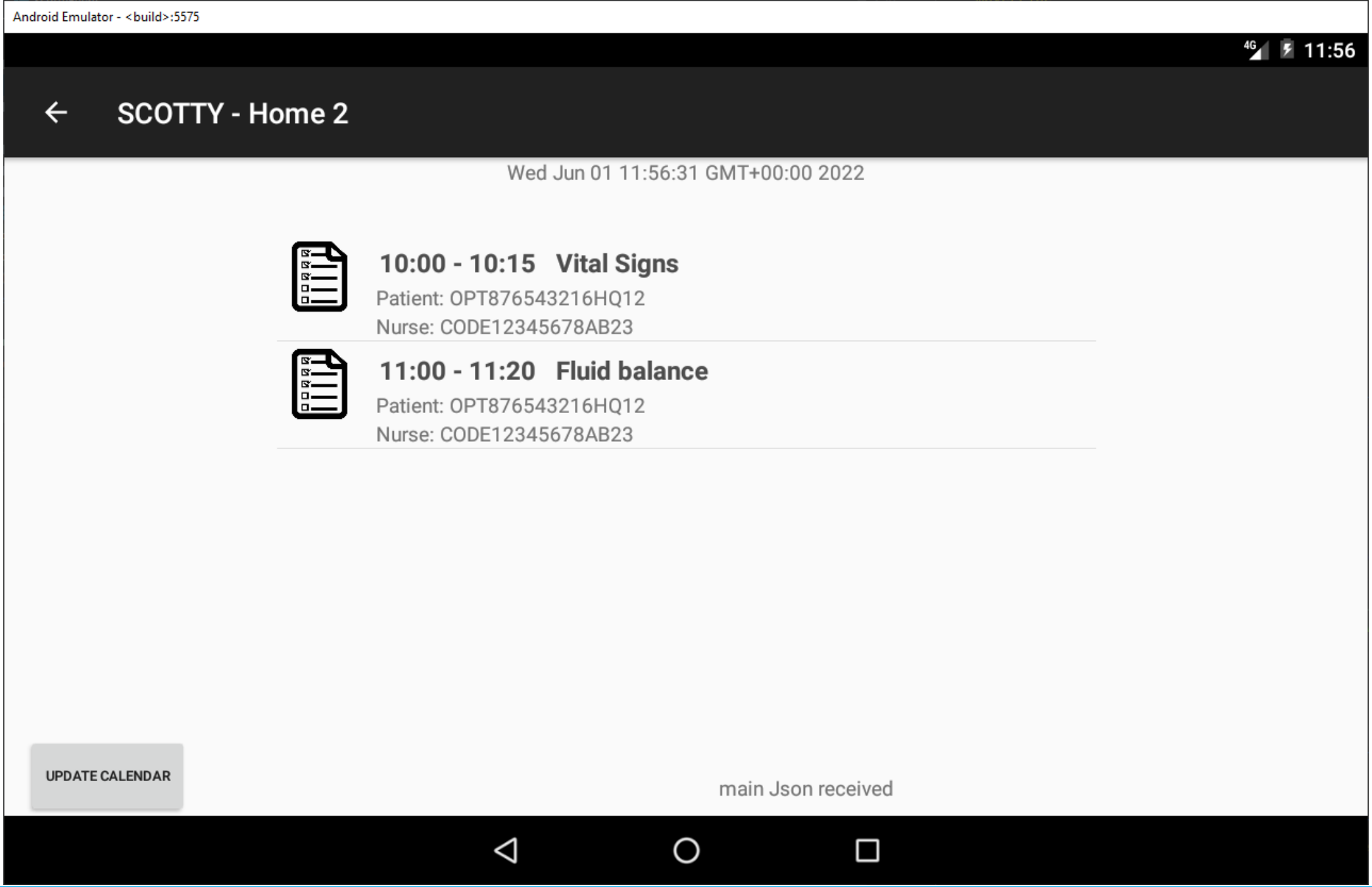
LEARN MORE



Welcome greetings chatbot example…

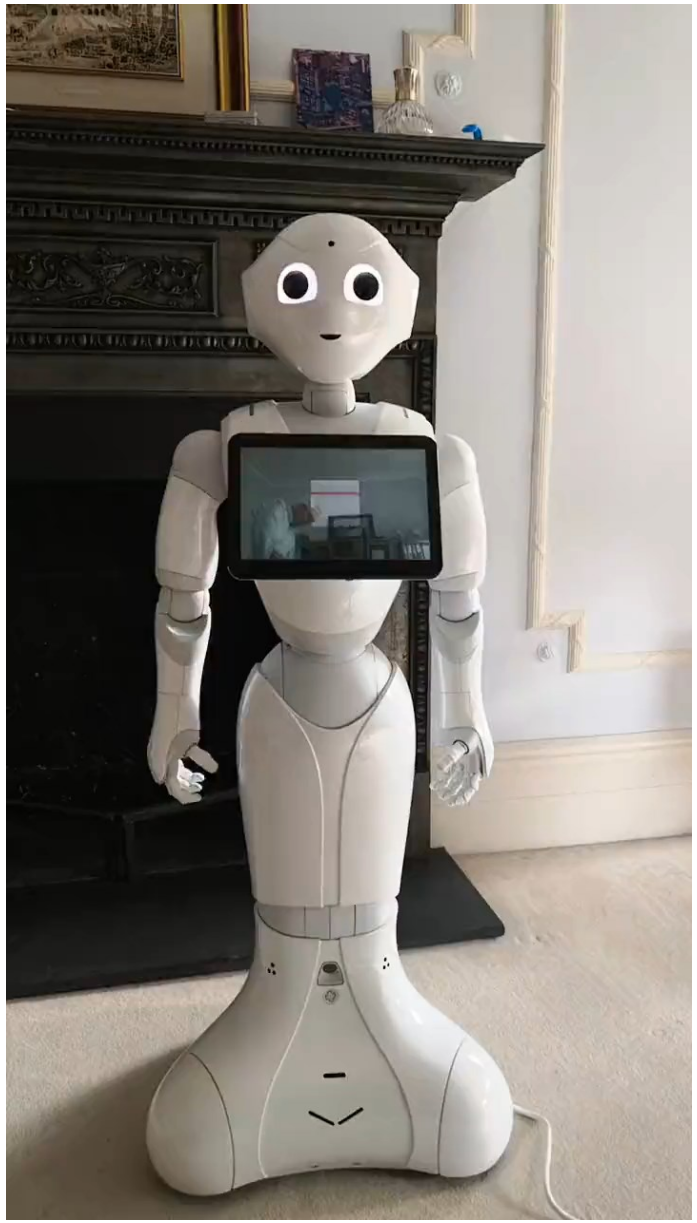

list by day
https://scotty.bluecompanion.eu/index.php/listbyday
Getting Started
Come iniziare
Most Visited
Getting Started
Apple
Notizie
KXStudio : Application...
Black Dragon Viewer (...
Master Testing List - N...
Second Life
Streaming
Virtual DJ
After Effects
Altri segnalibri
BLUE COMPANION
E-HEALTH PROJECTS
Roessingh
Research and Development
Roessingh
Centrum voor Revalidatie
DIHERO
Home
agenda
Privacy
list by category
list by day
create events
View by month
Cleanweb access
Logout
Events Calendar
By Year
By Month
By Week
Today
Jump to month
Preceding Day
Wednesday 01 June 2022
Following Day
10:00 Vital Signs by Marie Nurse INV :: Vitals Signs
11:00 Fluid balance by Marie Nurse INV :: Fluid balance
Add an event
Show unpublished events?
No
Only show my events?
No
Select Category
Reset
- All categories -


Android Emulator - <build>:5575
SCOTTY - Home 2
Nurse logged in : S1-145948
Calendar


Android Emulator - <build>:5575
11:56
SCOTTY - Home 2
Wed Jun 01 11:56:31 GMT+00:00 2022
10:00 - 10:15 Vital Signs
Patient: OPT876543216HQ12
Nurse: CODE12345678AB23
11:00 - 11:20 Fluid balance
Patient: OPT876543216HQ12
Nurse: CODE12345678AB23
UPDATE CALENDAR
main Json received

Scotty administers the vital signs questionnaire:

- reads information from the web platform (calendar)
- asks questions
- listens and checks the answers
- sends replies to the eCRF server ...



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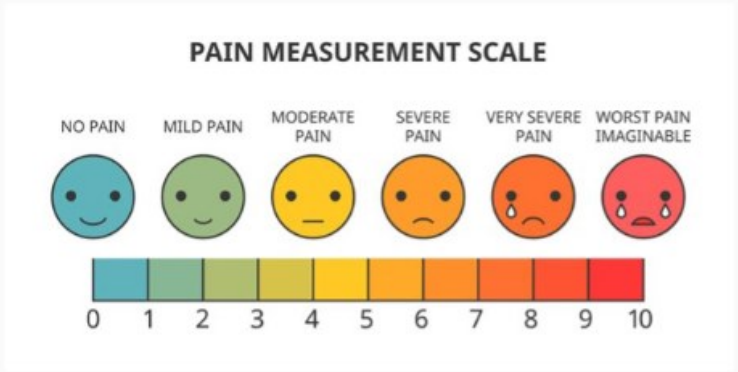
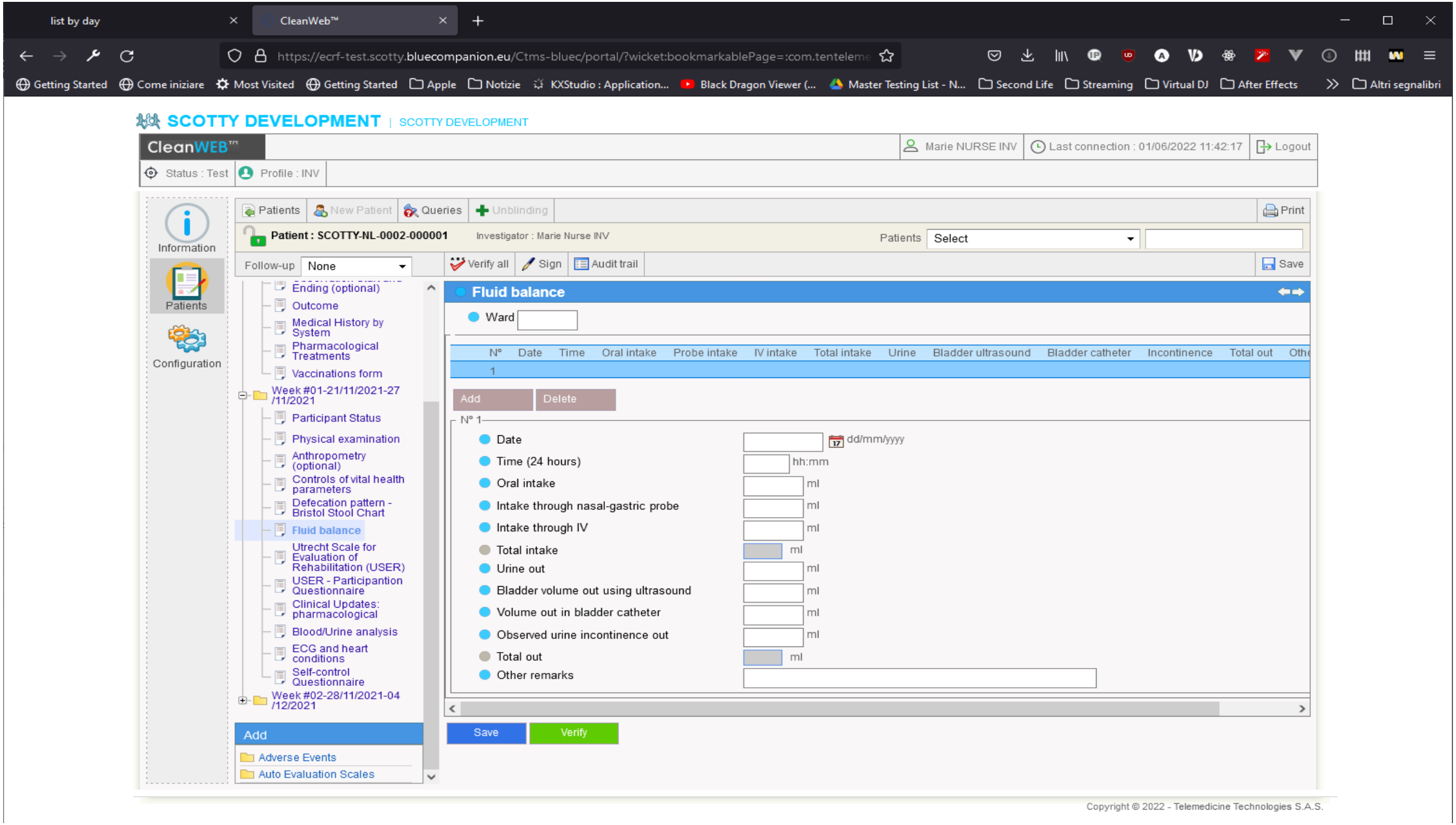


From zero to ten, what is the Pain Score?

ZERO | ONE | TWO | THREE | FOUR | FIVE | SIX | SEVEN | EIGHT | NINE | TEN

OPT876543216HQ12


list by day
CleanWeb™
https://ecrf-test.scotty.bluecompanion.eu/Ctms-bluec/portal/?wicket:bookmarkablePage=:com.tenteleme
Getting Started
Come iniziare
Most Visited
Getting Started
Apple
Notizie
KXStudio : Application...
Black Dragon Viewer (...
Master Testing List - N...
Second Life
Streaming
Virtual DJ
After Effects
Altri segnalibri
SCOTTY DEVELOPMENT
SCOTTY DEVELOPMENT
CleanWEB™
Marie NURSE INV
Last connection : 01/06/2022 11:42:17
Logout
Status : Test
Profile : INV
Information
Patients
Configuration
Patients
New Patient
Queries
Unblinding
Print
Patient : SCOTTY-NL-0002-000001
Investigator : Marie Nurse INV
Patients
Select
Follow-up
None
Verify all
Sign
Audit trail
Save
Ending (optional)
Outcome
Medical History by System
Pharmacological Treatments
Vaccinations form
Week #01-21/11/2021-27/11/2021
Participant Status
Physical examination
Anthropometry (optional)
Controls of vital health parameters
Defecation pattern - Bristol Stool Chart
Fluid balance
Utrecht Scale for Evaluation of Rehabilitation (USER)
USER - Participantion Questionnaire
Clinical Updates: pharmacological
Blood/Urine analysis
ECG and heart conditions
Self-control Questionnaire
Week #02-28/11/2021-04/12/2021
Add
Adverse Events
Auto Evaluation Scales
Fluid balance
Ward
N° Date Time Oral intake Probe intake IV intake Total intake Urine Bladder ultrasound Bladder catheter Incontinence Total out
1
Add
Delete
N° 1
Date
dd/mm/yyyy
Time (24 hours)
hh:mm
Oral intake
ml
Intake through nasal-gastric probe
ml
Intake through IV
ml
Total intake
ml
Urine out
ml
Bladder volume out using ultrasound
ml
Volume out in bladder catheter
ml
Observed urine incontinence out
ml
Total out
ml
Other remarks
Save
Verify
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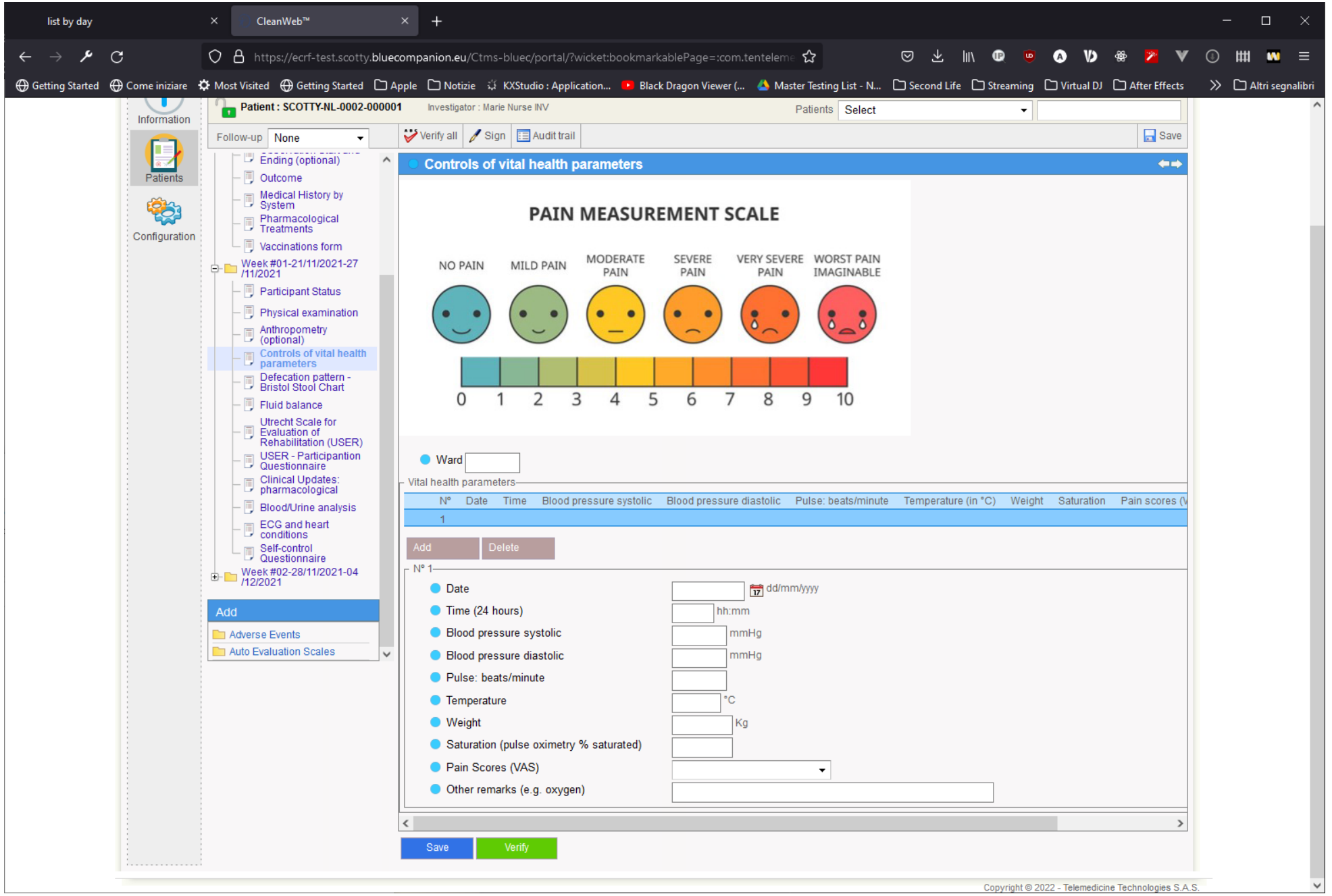
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CleanWeb™
https://ecrf-test.scotty.bluecompanion.eu/Ctms-bluec/portal/?wicket:bookmarkablePage=:com.tenteleme
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Participant Status
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Fluid balance
Utrecht Scale for Evaluation of Rehabilitation (USER)
USER - Participantion Questionnaire
Clinical Updates: pharmacological
Blood/Urine analysis
ECG and heart conditions
Self-control Questionnaire
Week #02-28/11/2021-04/12/2021
Add
Adverse Events
Auto Evaluation Scales
Controls of vital health parameters
PAIN MEASUREMENT SCALE
NO PAIN
MILD PAIN
MODERATE PAIN
SEVERE PAIN
VERY SEVERE PAIN
WORST PAIN IMAGINABLE
0 1 2 3 4 5 6 7 8 9 10
Ward
Vital health parameters
N° Date Time Blood pressure systolic Blood pressure diastolic Pulse: beats/minute Temperature (in °C) Weight Saturation Pain scores (V
1
Add
Delete
N° 1
Date
dd/mm/yyyy
Time (24 hours)
hh:mm
Blood pressure systolic
mmHg
Blood pressure diastolic
mmHg
Pulse: beats/minute
Temperature
°C
Weight
Kg
Saturation (pulse oximetry % saturated)
Pain Scores (VAS)
Other remarks (e.g. oxygen)
Save
Verify
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Scotty's Retained Business Capacity

- **Scotty is a well organised and connected robotic persona :**
  - ✓ Scotty's Agenda: enables daily planning for Patient's appointments
  - ✓ She automatically interacts with the web-based platform
  - ✓ Scotty's eCRF keeps Patients' data in a GCP/GDPR compliant digital environment
- Those features can be easily adapted to a new context

Scotty's Retained Business Capacity

- **Scotty is a social robot – dialogue is the favourite interaction:**
  - ✓ **Recognises people**
  - ✓ **Introduces herself**
  - ✓ **Chats**
  - ✓ **Administers Questionnaires (with visual feedback) to the Patient**
  - ✓ **Reviews the exercises with the Patient**

- **We consider the "consultation room" as the most promising context**

Scotty's Retained Business Capacity

- **Scotty's platform allows to conduct Clinical Trials:**
  - ✓ **All patients answers (chat or questionnaires) are interpreted and stored in the eCRF**
  - ✓ **This specialised task save time for HCP (direct data flow)**
  - ✓ **Scotty's environment is *per se* highly standardised**
  - ✓ **A number of upstream and downstream (e.g. analytics) operations are executed**

Results (1)

- ✓Scotty as a Nurse-Aid follows “her” own daily agenda, compiled in advance by the HCPs.
- ✓The robot **collects standard medical data via a conversation** with the patient, e.g., sleep, defecation (Bristol standardised questionnaire), fluid balance, etc. and get additional parameters via her integrated tablet.
- ✓**Time consuming self-evaluation questionnaires are completed by the patient with Scotty’s help**. All clinical data are automatically recorded in the e-CRF.
- ✓Scotty as a Physiotherapist-Aid is capable **to show preselected physical exercises as short tutorial videos, and to remind the patient about prescribed physical programs.**
- ✓Beside core productive activities, the implementation of chatbot-led “casual” conversations may establish an initial, clear interaction model between the HCPs, the patients and the robotic “persona”.

Results (2)

- ✓By implementing Scotty as written in original plan we met the project requirements
- ✓The robot correctly interacted in Dutch with HCP and Patients
- ✓Data were correctly stored in the eCRF after the interview
- ➢However, according usability studies:
  - ❖HCP see little added value (for routine activities): Scotty cannot substitute for current HCP tasks
  - ❖Scotty cannot move autonomously within the rehabilitation ward
- ➢Gap versus (human) expectations

Conclusions

1. The sought-after advantages were to lighten the HCP daily workload and mitigating patients' "loneliness" in the busy ward.
2. Usability tests demonstrated a gap with respect to expectations, i.e. the robot cannot replace a nurse.
3. The robot can however perform very specific tasks:
    1. **to capture (and record) medical data in a standardised way**
    2. **to present/explain to patients their exercises by a customised video**
    3. **to engage in a chat.**
4. Overall, the introduction of a social robot as "HCP-Aid" within a rehabilitation ward constitutes an innovative approach. **This can be replicated, adapted, and further developed in other healthcare infrastructures like at the Nursing Home.**
5. **The benefits of Scotty's paradigm are based on her capacity of establish a "personal" relationship with the user, communicating, recording - and tailored for Clinical Trials.**

Mum, what's next?

Thank You!

CREDITS:
Susanna Del Signore (1), Behrouz Fard (2), Ina Flierman (2), Gianluca Zia (1), Stefania Del Signore (1), Alessandro Loria (1), Stephanie Jansen (3), Marian Hurmuz (3) and Lex van Velsen (3)

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E-HEALTH PROJECTS

Roessingh
Centrum voor Revalidatie

Roessingh
Research and Development

Q&A