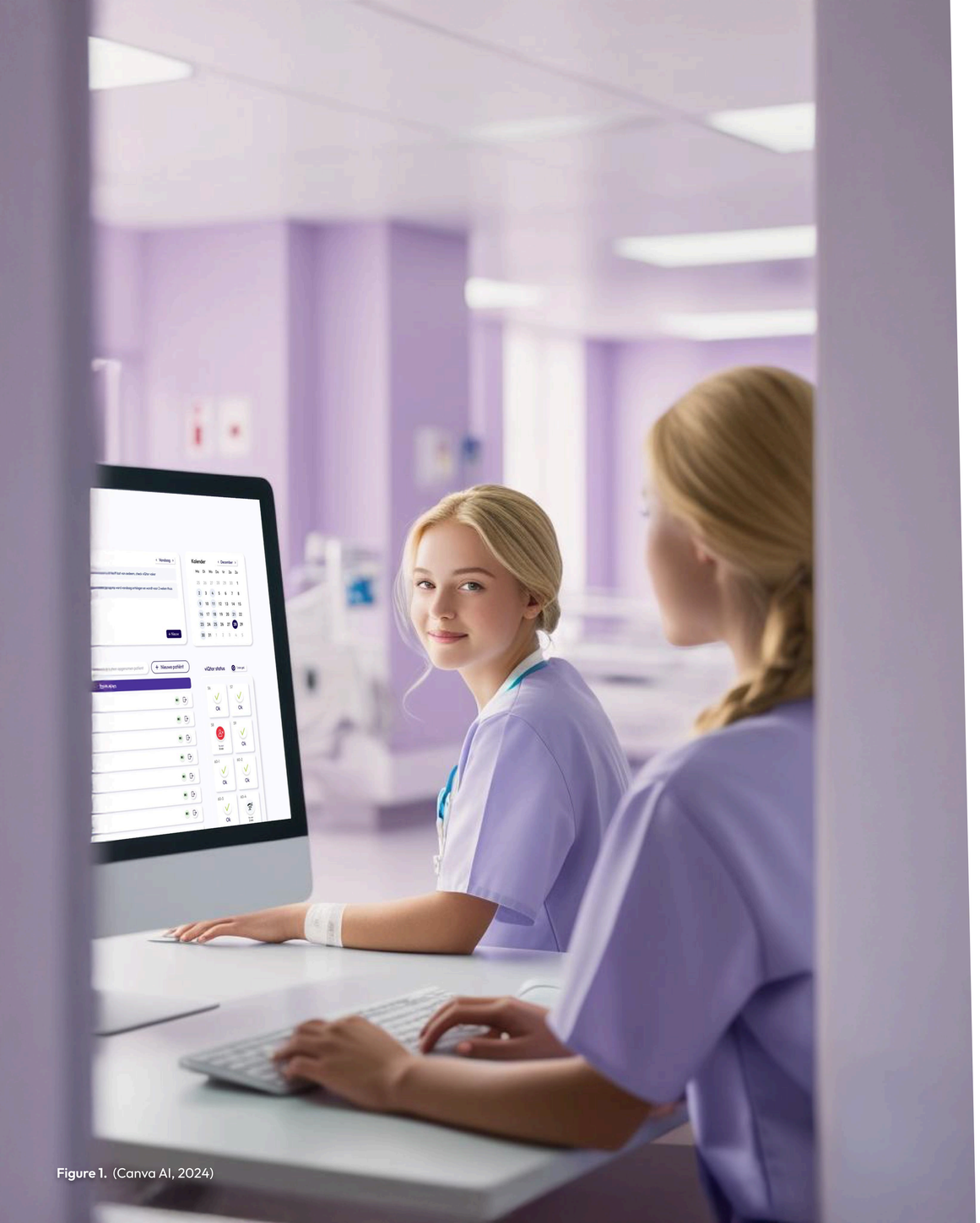


Figure 1. (Canva AI, 2024)

REIMAGINING UI FOR MONITORING VITALS IN THE GENERAL WARD

Susan Draaijer | Master ID, Sem A 2024/2025

M2.1 Project at smartQare

Coached by Daniel Tetteroo

smartQare Lotte Giele, Frank Boon, Michael Heesemans

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Research conducted at:
Catharina Ziekenhuis Eindhoven
Laurentius Ziekenhuis Roermond

Continuous monitoring

Introducing problem-statement

Critical issue in detecting early patient deterioration

- **40% of unexpected deaths** are documented to occur within general wards (*in the Netherlands*)

Philips Healthcare. (2024).

- **10.9%** of patients **discharged from the intensive care unit (ICU)** ultimately succumb to death in general wards (*in the Netherlands*)

Braber, A., & van Zanten, A. (2010).

Figure 2. viQtor. *smartQare* (2025)

smartQare

Introducing project scope

Design challenge

"How might smartQare's UI platform enhance usability and streamline workflow for nurses in the general ward, while maintaining the accuracy and accessibility of patient data?"

In response →

- User-centered design approach
  - ↳ *Cognitive information processing*
  - ↳ *Human attention ⇔ interaction*
  - ↳ *Natural user interface (NUI)*

Figure 2. viQtor. *smartQare* (2025)

Literature

Cognitive information processing

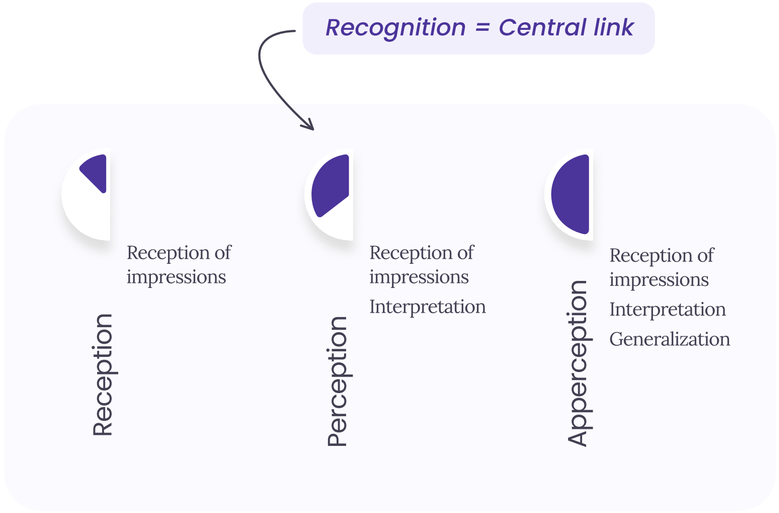


Figure 3. The cognitive chain of external information analysis model (Wnuk, 2019)

Steve Krug *Book; "Don't make me think"*

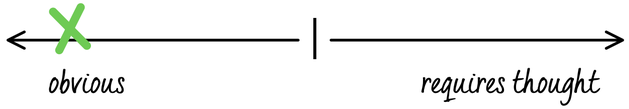


Figure 4. Obvious - Requires thought. (The Interaction Design Foundation, 2024)

Krug (2000)

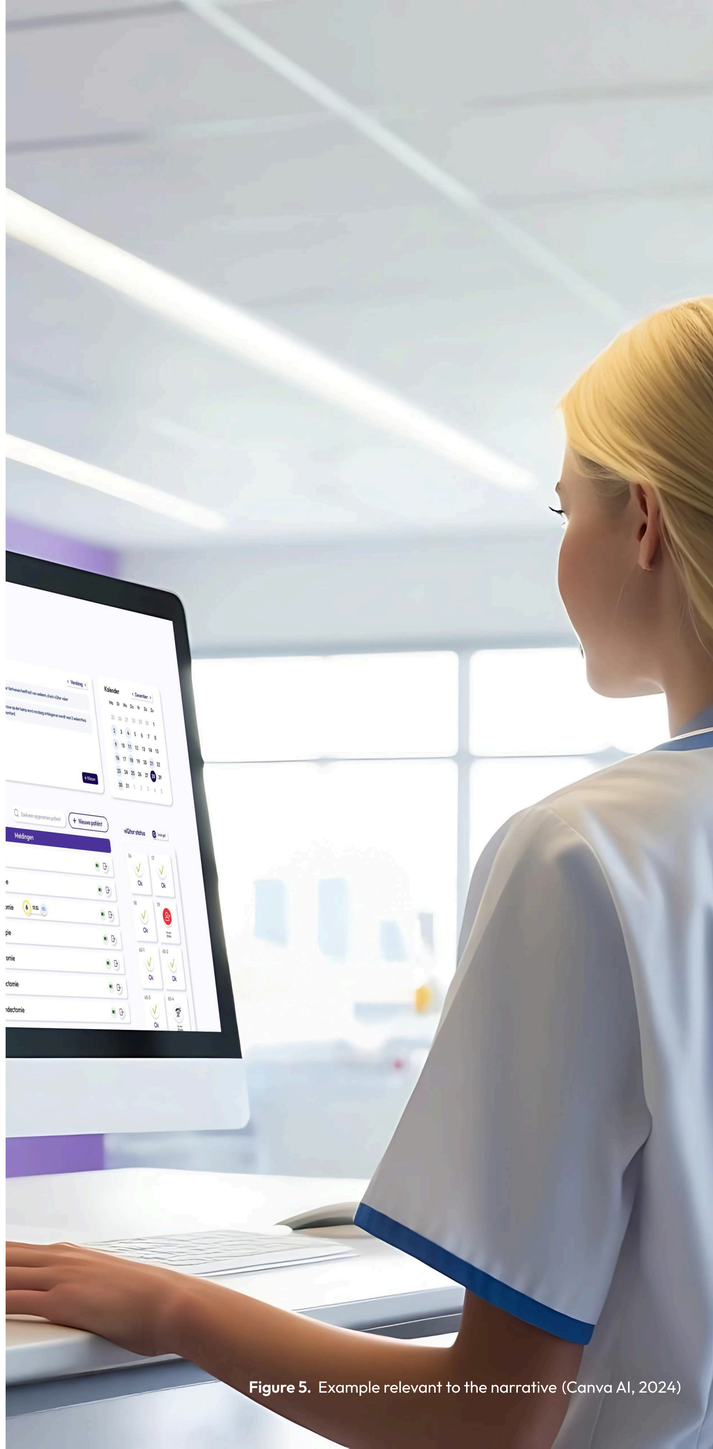


Figure 5. Example relevant to the narrative (Canva AI, 2024)

Literature

Human attention ⇿ Interaction

Weiser, M. (1991)

*"Weiser's discussion of **ubiquity** in the computer for the 21st century broached **the need for computing devices to seamlessly blend into everyday life by** operating in the **periphery of attention**"*

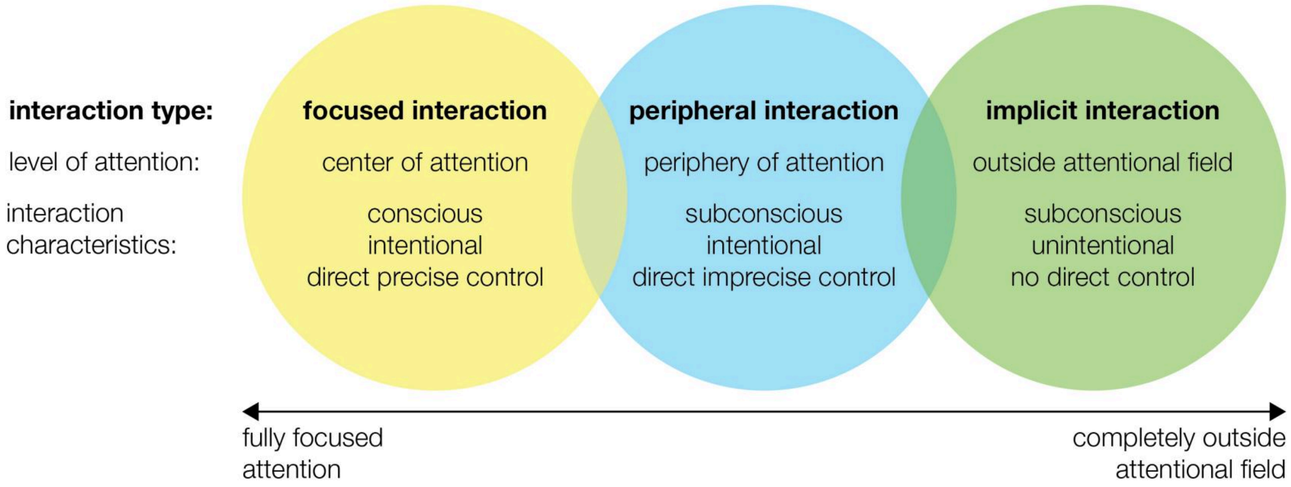


Figure 6. The interaction-attention continuum, (Bakker & Niemantsverdriet, 2016)

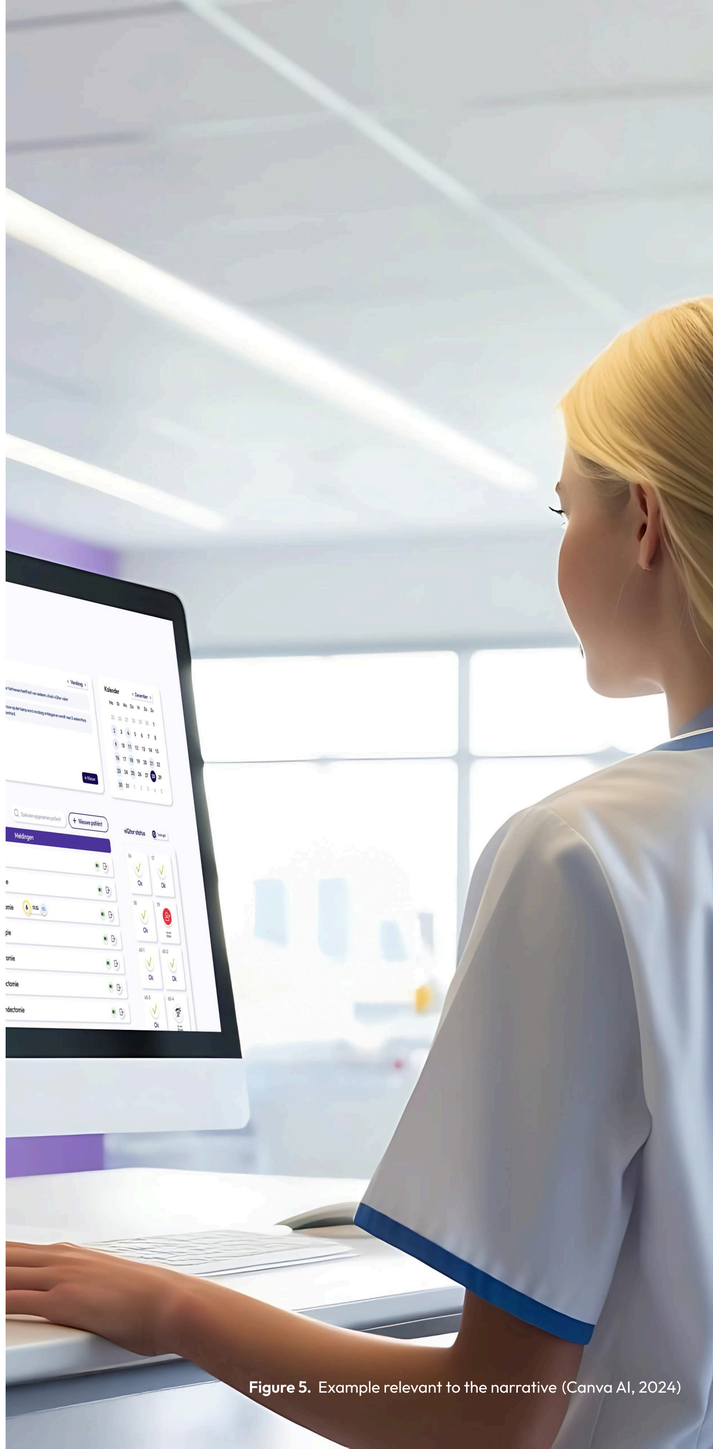


Figure 5. Example relevant to the narrative (Canva AI, 2024)

Literature

Human attention ⇿ Interaction

As a result, the user interface would be designed to →

- *Convey a hierarchy of importance*
- *Enhance situational awareness*
- *Minimize disruptions (enhance workflow)*
- *Prevent cognitive load & alarm fatigue*

Bakker & Niemantsverdriet. (2016)

*Level of **attention*** ⇿ *Severity of the **problem*** + *Priority of **action***

Weiser, M. (1991)

Overall, advocating for →

*A **Future** where **technology enhances human capabilities** and **fits seamlessly into the fabric of daily life**, allowing for a **balance between interaction and attention** management.*

Figure 7. Example relevant to the narrative (Canva AI, 2024)

Literature

Natural User Interface (NUI)

Mortensen, D.H. (2020)

NUIs strive to ***minimize the mental effort*** required from users by designing interactions that are '***direct***' and aligned with their '***natural behavior***'.

Guideline for designing NUIs

- *A NUI should take advantage of the users' existing skills and knowledge.*
- *A NUI should have a clear learning path and allow both novice and expert users to interact in a natural way.*
- *Interaction with an NUI should be direct and fit the user's context.*
- *Whenever possible, you should prioritize taking advantage of the user's basic skills.*

Mortensen, D.H. (2020)

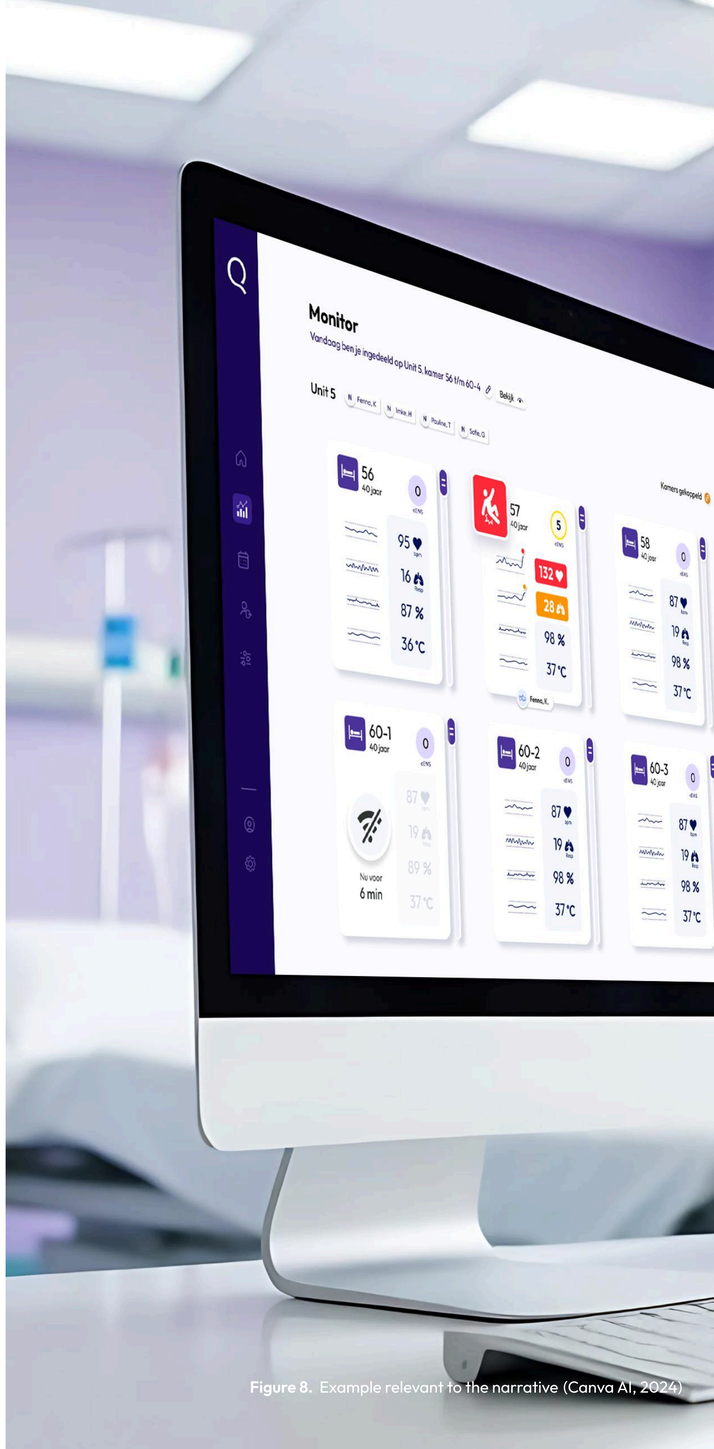


Figure 8. Example relevant to the narrative (Canva AI, 2024)

UI changes

Current smartQare platform

- **Preliminary understanding** smartQare's UI capabilities
- *Evaluate user experience & potential shortcomings*
  - → *Unstructered interview target user*
  - → *Teams meeting project/quality manager*

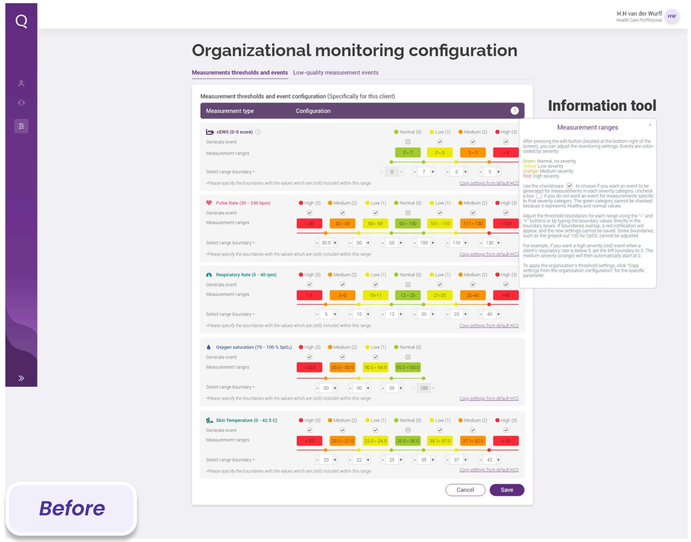


Figure 9. Current smartQare platform

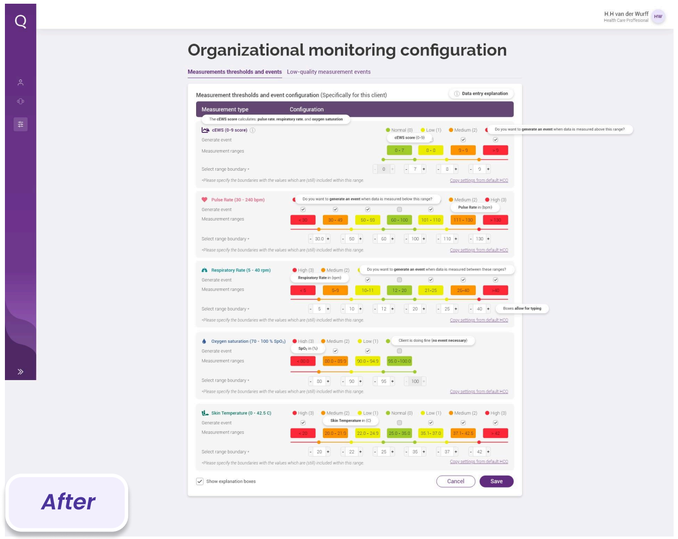


Figure 10. Example UI Change

Laurentius bezoek 11/10/2024

Geboortedatum + **kamernummer** + **patiëntnummer** moeten op een manier zichtbaar zijn in cliëntenlijst

- **Laurentius wil ordenen op kamernummer**, dit is de eerste aandacht-focus in de cliëntenlijst (daarna pas apparaat status)

Een individuele HCP moet een overzicht kunnen selecteren zodat **alleen zijn/haar patiënten te zien zijn** in het cliëntenoverzicht

Momenteel teveel gegevens om in te voeren wanneer je een nieuwe cliënt aanmaakt

Cliëntenoverzicht moet op een manier een onderscheid laten zien tussen twee patiënten met **dezelfde achternaam**

- Er zijn metingen die een **melding** aangeven, terwijl dit **niet nodig is in het geval van de ziekte/diagnose van de patiënt** (voorbeeld hoge hartslag tijdens slapen)

  → (idee voor mogelijke oplossing) Eigenlijk moet je de **diagnose van een patiënt ergens kunnen selecteren** zodat dit meeweegt in het genereren van event. Voorkom hiermee dat de event-waardes handmatig ingevoerd moeten worden voor alle cliënten

- **Bewakingslijst** is duidelijk in het algemene overzicht, maar **de meldingen voor een specifieke patiënt** zijn moeilijk te vinden

Nieuwe icoontjes zijn goed, vallen meer op dan de huidige icoontjes. Goed idee dat alleen de icoontjes van toepassing zichtbaar zijn, en de rest op dat moment wegvalt

- Nieuwe toevoeging van **Pulse Rate, SpO2, Respiratory Rate** in **cliënt overzicht** is top
  - → Door de toevoeging van deze waardes is er echter nu een grotere overeenkomst tussen cliënt overzicht en bewakingslijst lay-out gezien waardoor het **verwarrend is in welk scherm je zit**

Mental model

User-centered design approach

The Interaction Design foundation (2024)

*"What a user **expects to happen** when interacting with a product **based on experience**; they help us **construct expected interactions with reality**"*

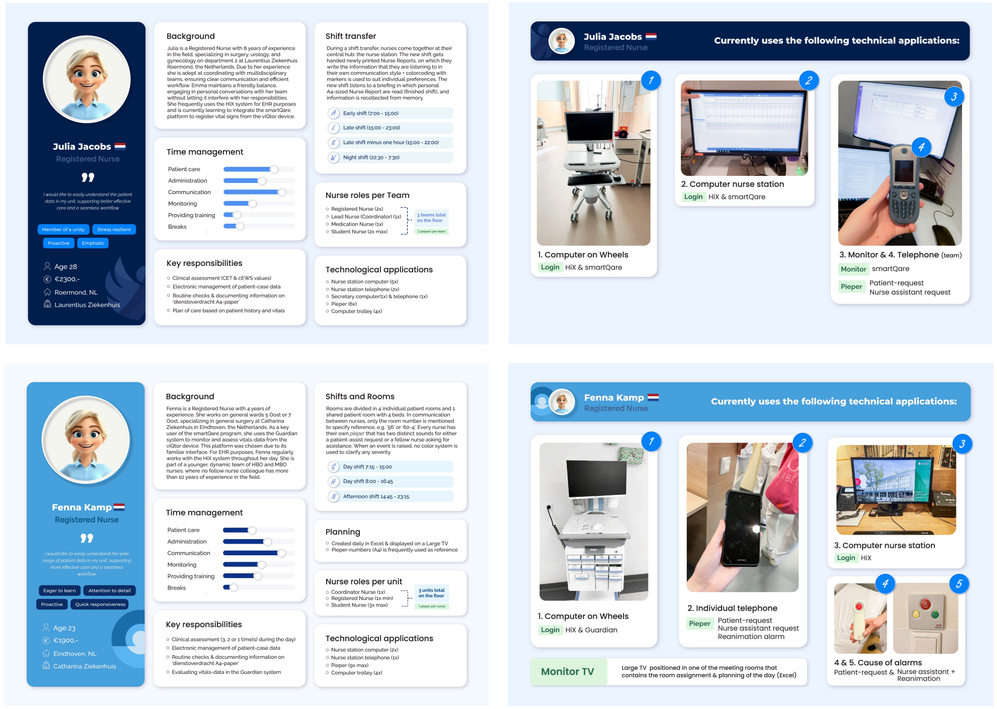
→ *Natural User Interface (NUI)*

Contextual inquiry

- Communication
- Verbal & written terminology
- Ingrained rituals
- Interpreting vitals data
- Use of technical applications
- Utilization of smartQare platform
- General observations

Analyse findings

- Persona's
- Technical applications resume
- Natural environment model



Adobe Stock (2024)

Figure 11. Persona's & Technical applications resume

Natural environment

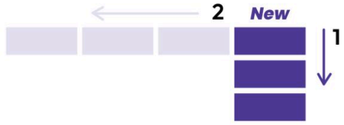
Laurentius & Catharina *Highlights*

Verbal Terminology

Terms	Meaning
Melding	Notificatie bij grenswaarde overschrijding
B2	Term om afdeling aan te geven
Team	Groep verpleegkundigen met bep. rollen
Kamer 10 (L)	Ruimte waar een patient ligt
Nummer 59 / 59 (C)	Ruimte waar een patient ligt
Meneer [Achternaam]	Refereren naar patient
Mevrouw [Achternaam]	Refereren naar patient
Meneer	Wordt gebruikt inplaats van achternaam
Mevrouw	Wordt gebruikt inplaats van achternaam
Pieper	Telefoon op zak van verpleegkundige
Pieper van Team 1 (L)	Telefoons verdeeld o.b.v. teams
Lab	laboratoriumtest (uitslag)
Casus	Compleet beeld van patiëntgeval
Bijzonderheden	Niet-specifieke informatie over patiënt
Trendlijn	Grafiek lijn van vitale waardes
Patiënt	Persoon opgenomen in het ziekenhuis
Ontslagen	Persoon dat ziekenhuis gaat/heeft verlaten
Uitgetrokken	Meetapparatuur losgehaald van lichaam
Unit	Gedeelte kamers op een afdeling
Boventallig	Lerende/student verpleegkundige
Spoedje	Patient casus met spoedopname
Vakgeleerde	Gediplomeerde verpleegkundige
Omloop	Verpleegkundige over de hele afdeling
DACO	Overziet opgenomen/ontslagen patiënten
Dagstartbord	Naam van planningsbord voor de dag
Vandaag	De huidige dag
Morgen	De dag na de huidige dag

Interpreting vitals data

- The nurse reviews the new vital data **vertically**, from top to bottom, in a table-like format where the position and value alone convey the significance of each vital (1). Afterwards, they examine the **historical data for each vital** to determine whether the new measurement deviates from that **specific patient's previous measurements** (2).
- For the **trendline** data in the smartQare portal, the nurse only examines the graphs for **abnormalities**. HiX & Guardian give the option to see the numeric data in graphs, yet this option is currently **never used** by nurses.



Auditory cues

Footwear (Canva, 2024)

Auditorty cues

- Nurses are trained to respond to auditory cues from pagers and the ward's standard telephone.

Footwear

- Nurse clogs are a recognizable clothing item of nurses' attire in the hospital.

ROOMS AS CENTRAL REFERENCE POINTS

- Hospital **rooms** serve as the **reference point** for communication, notifications, and planning, Moreover, in most cases solely the room number is communicated to explain a certain situation
- At both Laurentius and Catharina hospitals, rooms are grouped into fixed clusters called "**units**" (at Catharina). Each unit is managed by a **team of nurses with different roles**. While the grouping of rooms within a unit always stays the same, **nurses are assigned to different units for each shift**, working with a new set of colleagues each time.

Hospital structure

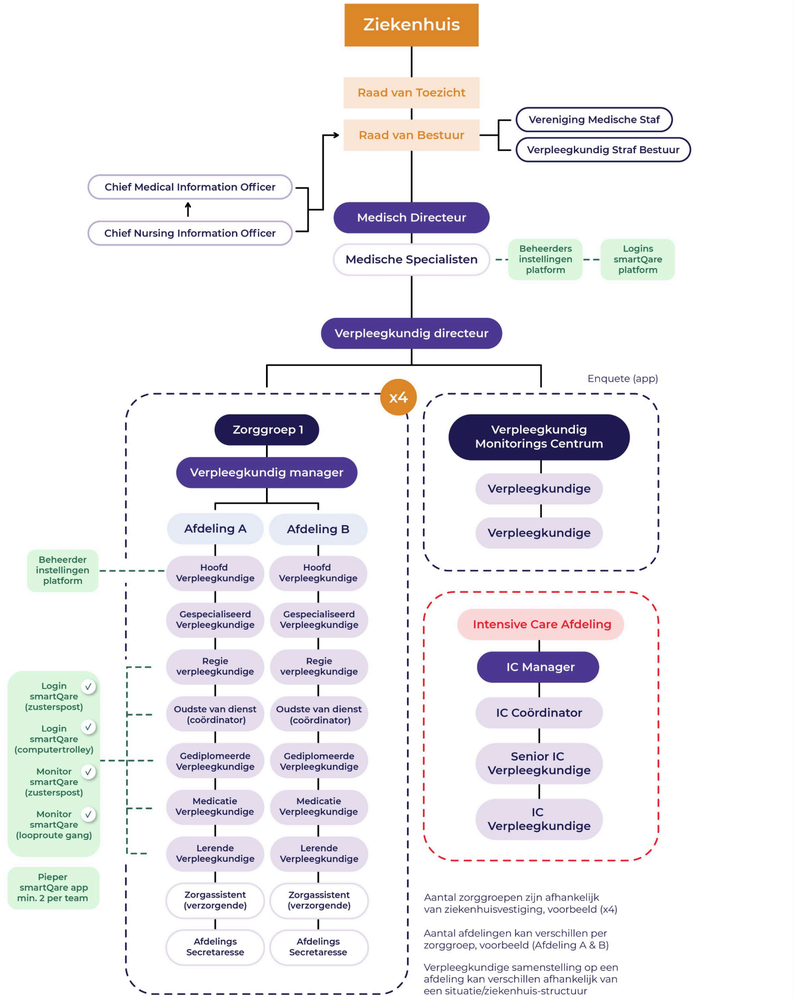
Different structures (example) & terminology

Laurentius		*Catharina*	
Afdeling B2		5 Oost	
Team		Unit	
Oudste van dienst (coördinator)	Pieper	Regie verpleegkundige	Pieper
Gediplomeerde verpleegkundige	Pieper	Vakgeleerde verpleegkundige	Pieper
Gediplomeerde verpleegkundige		Boventallige verpleegkundige	Pieper
Medicatie verpleegkundige		Boventallige verpleegkundige	Pieper
Lerende verpleegkundige			
Lerende verpleegkundige			

** Both teams can differentiate based on scenario and room allocation*

Organisatie structuur ziekenhuis (compact)
nadruk: verpleegkunde afdeling

Ziekenhuis, NL



User scenarios

	Vaste computer	Computer op wielen (CoW)	TV scherm (niet interactief)	Tv scherm (niet interactief)	Mobiele telefoon
Digitale applicatie					
Ziekenhuis locatie	Zusterspost	Gang of Patientenkamer	Muur van de zusterspost	Muur in de gang	Op-persoon
Scenario illustratie					
smartQare applicatie	Individuele Login	Individuele Login	Monitor afdeling	Monitor per unit	App
Essentiële functies	1. Na het zien van een live melding op een van de monitoren, VPK navigeert naar een specifieke patient zodat het totale beeld van ○ meldingen ○ algmene vitale waardes ○ trendlijn grafieken ○ patient informatie ○ patient geschiedenis kan worden geëvalueerd 2. Evalueer uitgebreider monitor scherm voor laatste metingen 3. (Algemeen) een klinisch inzicht opbouwen van patiënten 4. Ontslaan van een patiënt 5. Planning checken van de dag	1. Navigeren naar een specifieke patient zodat het totale beeld van ○ meldingen ○ algemene vitale waardes ○ trendlijn grafieken ○ patient informatie ○ patient geschiedenis naar voren kan worden gehaald, tijdens communicatie met de patient & meekijken van een arts 2. Wijs een patient toe aan een nieuw kamernummer 3. Familie contactgegevens voorhalen	1. Evalueer live numerieke vitale waarden in combinatie met de bijpassende trendlijn over de afgelopen aantal uur (hele afdeling) 2. Check voor gemiste meldingen, login om deze meldingen vervolgens te evalueren 3. Reageren op geluid voor meldingen van overschreiden vitale waardes gedurende e.g. 15 min + Valdetectie 4. Check viQtor status & batterij 5. Controleer welke collega ingedeeld staat op welke kamer	1. Evalueer live numerieke vitale waarden in combinatie met de bijpassende trendlijn over de afgelopen aantal uur (per unit) 2. Check voor gemiste meldingen, login om deze meldingen vervolgens te evalueren 3. Reageren op geluid voor meldingen van overschreiden vitale waardes gedurende e.g. 15 min + Valdetectie 4. Check viQtor status & batterij	1. Val detectie alarm 2. Grenswaarde overschreden alarm

Canva AI. (2024)

Wireframing

Blueprint: define lay-out & informational hierarchy

Why this ideation method?

- Numerous interface options can be evaluated
- Prevent deploying significant resources (effort & time)
- Issues come forward early

Foundation of the ideation process →

- Mental model
- Natural User Interface (NUI) Guide
- Gestalt principles of human perception

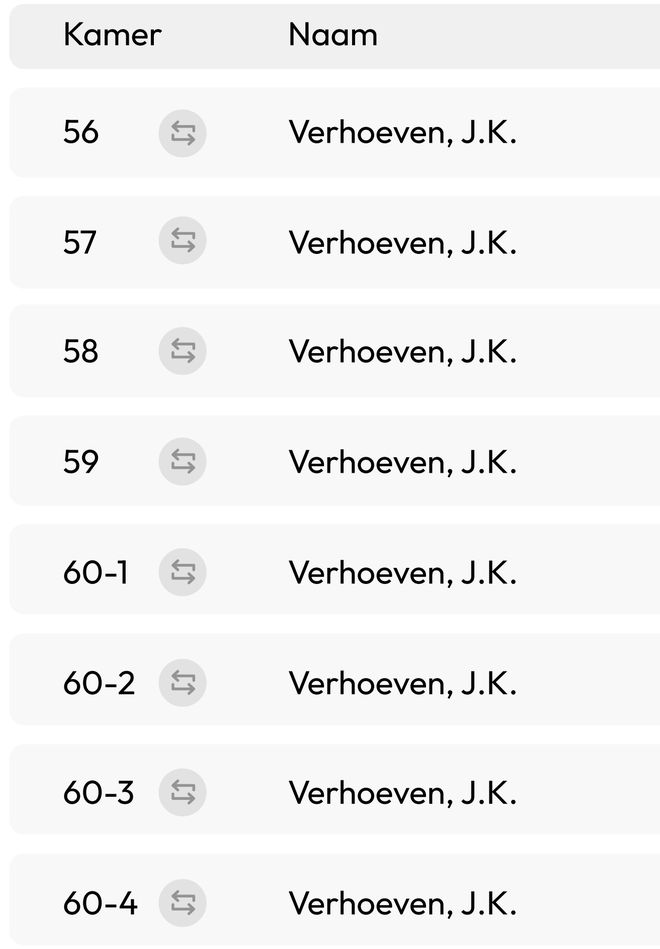
Wireframes validation →

Preference user test

↳ *Experts general ward: Physician-investigator & Regieverpleegkundige*

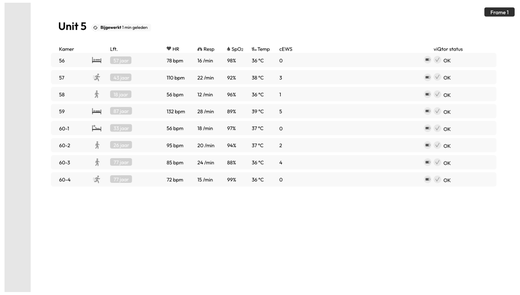
Context insights (structured interview)

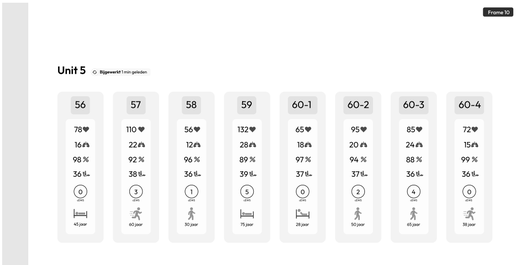
↳ *1 Regieverpleegkundige, 2 Boventallige verpleegkundige*

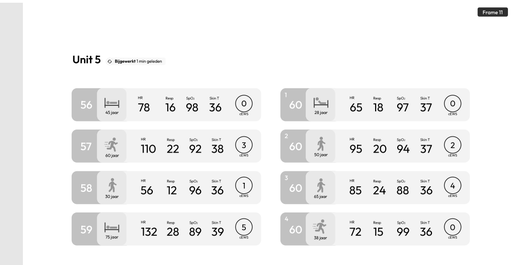


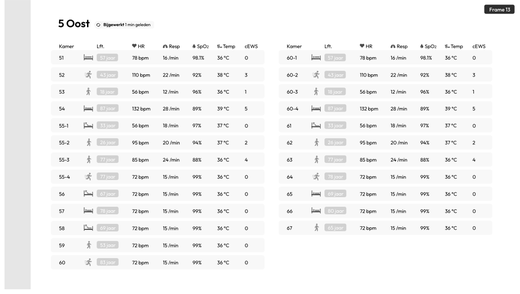
Wireframing

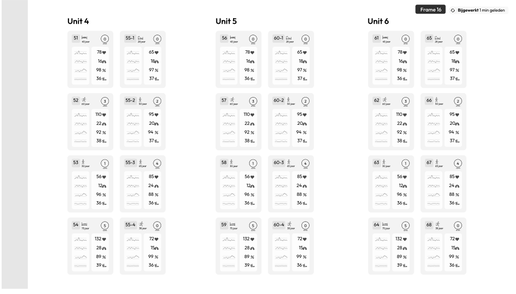
Blueprint: define lay-out & informational hierarchy

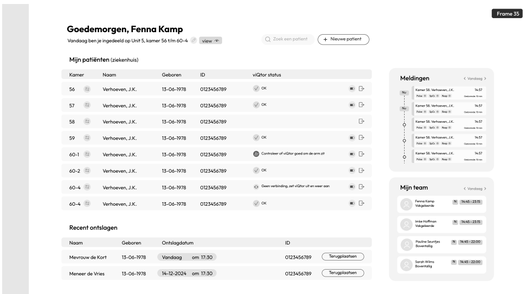


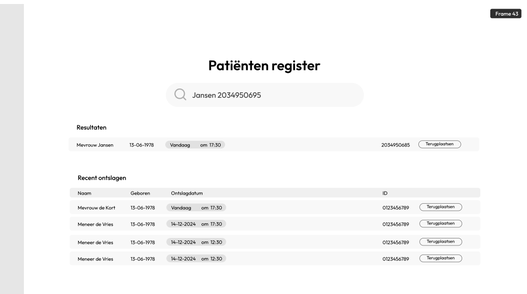


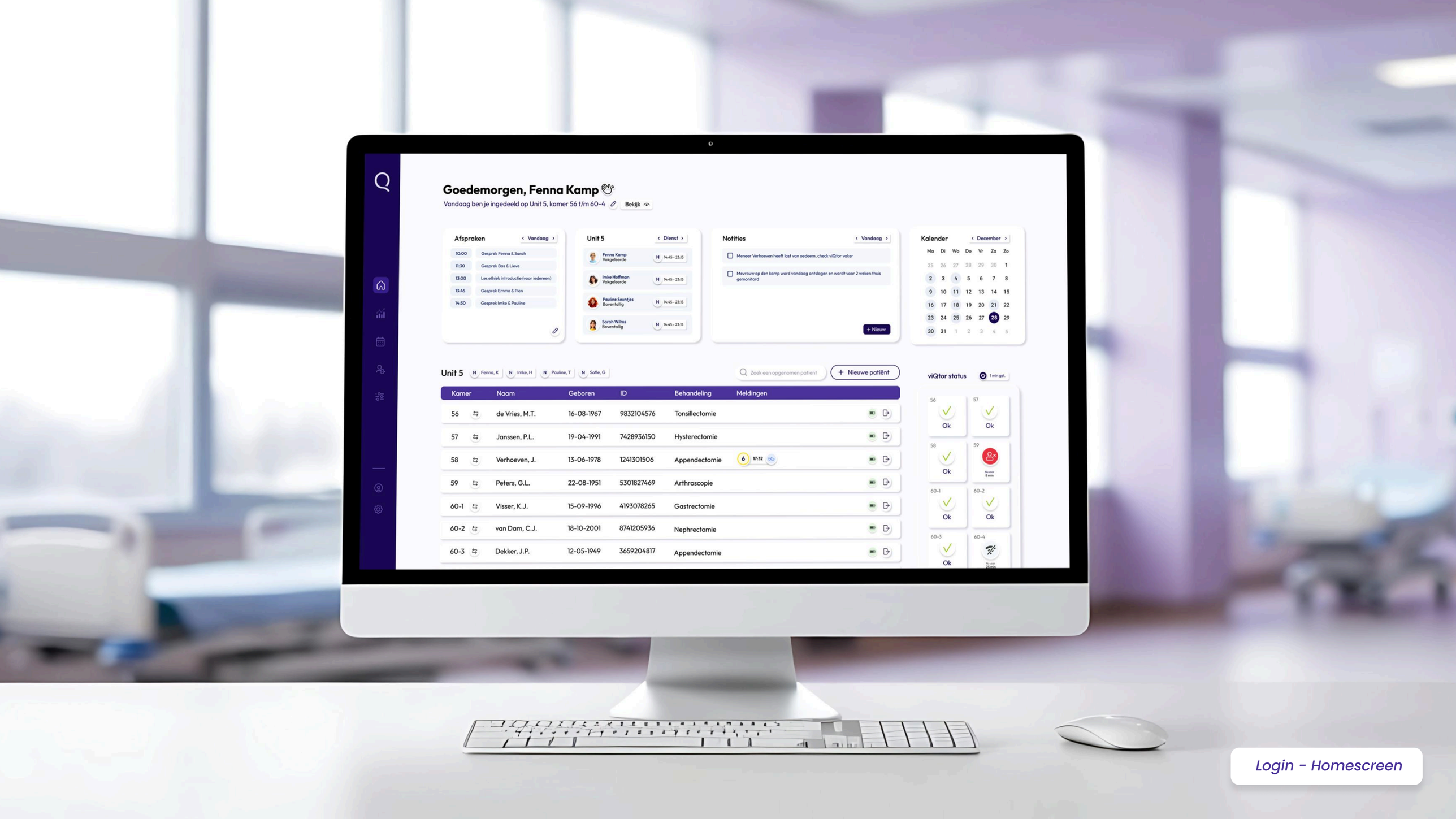




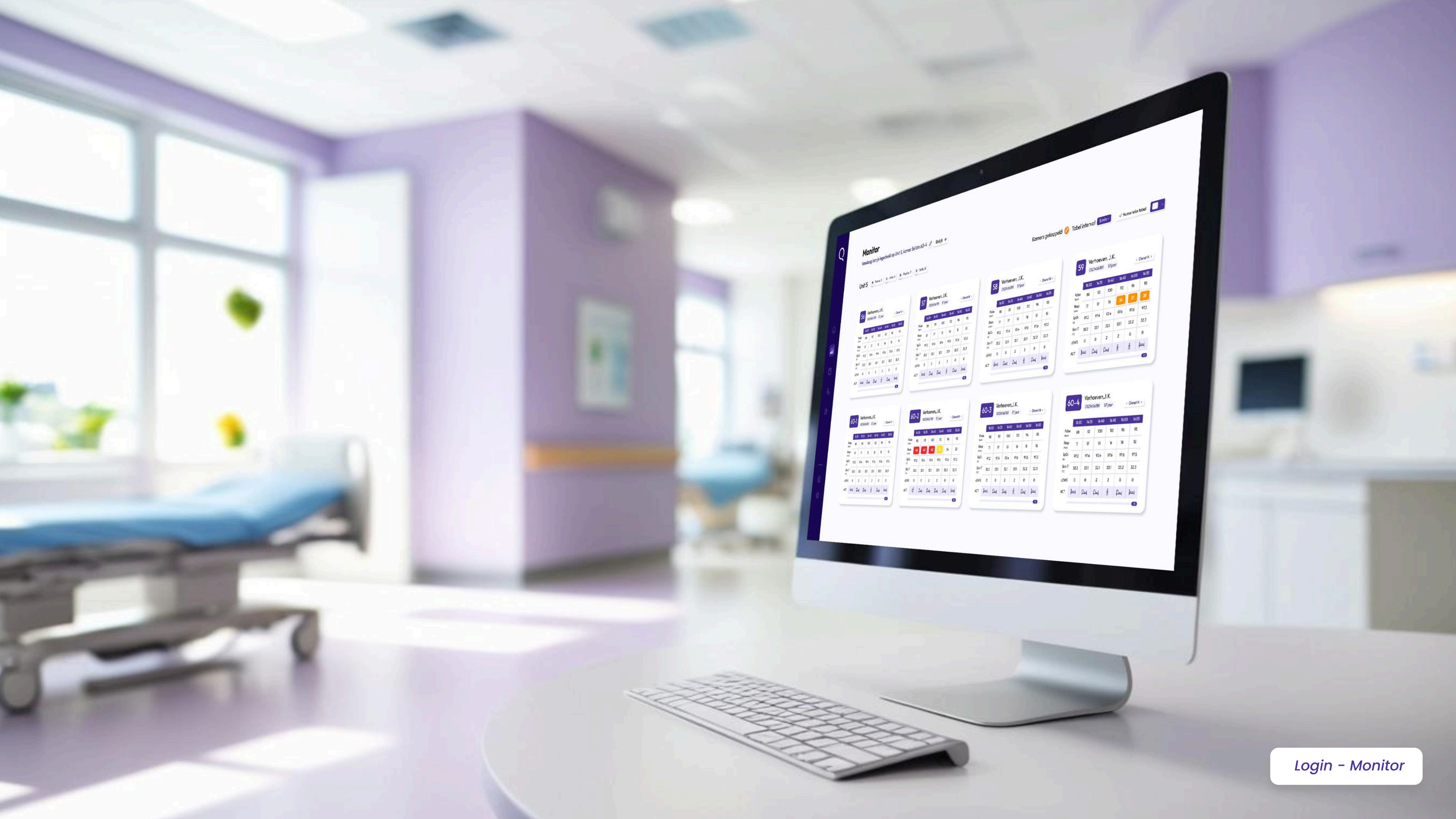


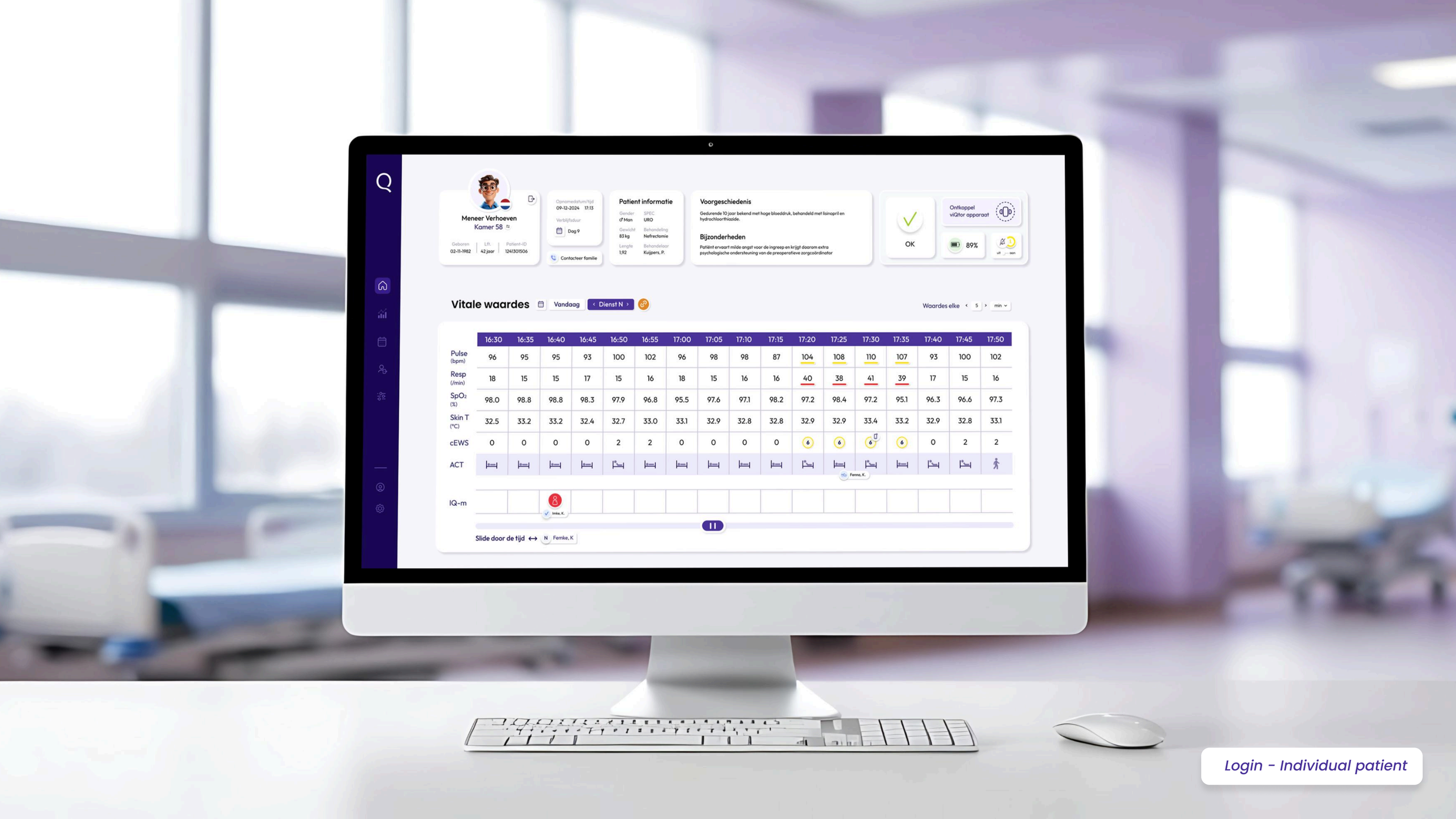






Login - Homescreen


Monitor
Unit 5
Login - Monitor



Login - Individual patient

Monitor nursing station

Technical realization

SVG example & effective implementation

- SVG can be scrutinized and altered
- Actual smartQare data incorporated within the SVG
  - ↳ *Illustrates that actual data (live) can be integrated within the designed UI*

Future vision →

UX/UI Designer ⇔ Highly skilled programmer

Terminology settings evironment →

- ↳ *First use of smartQare platform*
- ↳ *Enhance usability for each specific hospital culture*
- ↳ *Netherlands & worldwide*

Technical realization

Target user

DNS

https://portal.smartQare...
IP-adress

Internet

APIs

Wifi

Web application

RFID Login + short password

- Chrome
- Internet explorer
- Firefox

Patient

Data

Internet

Provider

Data

NB IoT

Max 10 km

Storage & Processing

Internet

Data

Webserver

Data

Cloud

Validation

Final user-test Catharina ziekenhuis

Participant criteria

- *Minimum educational level - Vakgeleerde verpleegkundige*
- *Exclusion - Participants who had previously participated in the research*
- *Dutch nationality*

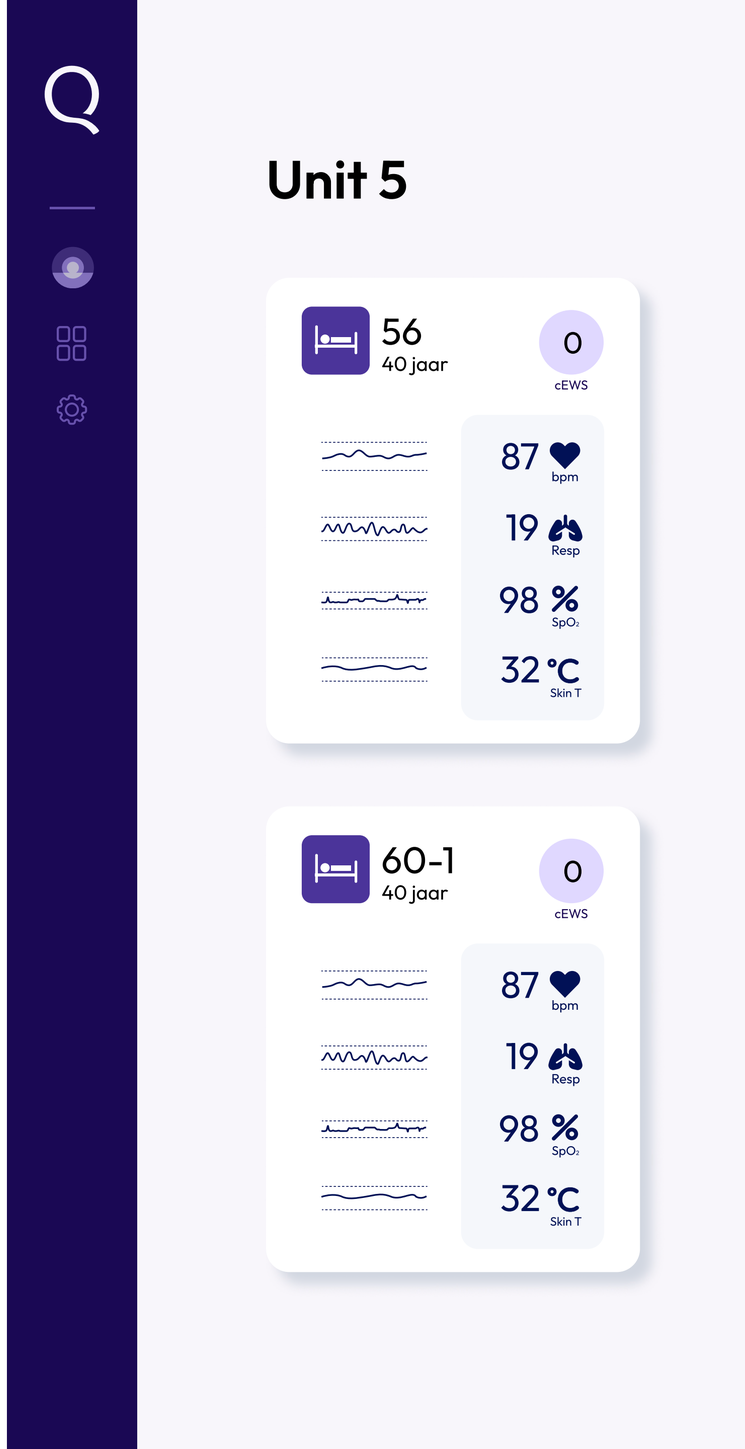
Sample size

- *Recruited 3 Participants*
- *Recommended 5 Participants*

Nielson, J. (2024)

Method

- *Part 1 - Monitor per unit & Monitor nursing station*
  - ↳ *Qualitative insights if NUI is accomplished*
- *Part 2 - Login application*
  - ↳ *Usability test*



Future works

Vision for smartQare

Limitations

- *viQtor - central position*
- *Validation user test includes only part of the final design*
- *Laurentius Ziekenhuis & Catharina Ziekenhuis*

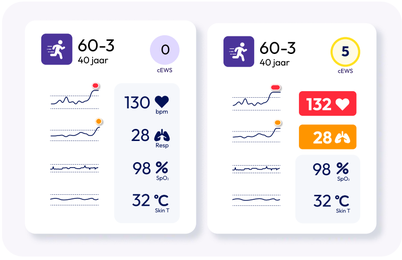
Future steps

Unified platform

- *Vital signs data*
- *EPR data*
- *Medication log*

AI enhanced

- *'Pieper' numbers*
- *Agenda & Planning*



Unit 5 N Fenna, K | N Imke, H | N Pauline, T | N Sofie, G

Kamer	Naam	Geboren	ID
56	de Vries, M.T.	16-08-1967	9832104576
57	Janssen, P.L.	19-04-1991	7428936150
58	Verhoeven, J.	13-06-1978	1241301506
59	Peters, G.L.	22-08-1951	5301827469
60-1	Visser, K.J.	15-09-1996	4193078265
60-2	van Dam, C.J.	18-10-2001	8741205936
60-3	Dekker, J.P.	12-05-1949	3659204817
60-4	Schouten, D.	19-06-1966	2084739165

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Figure 2. viQtor. *smartQare* (2025)

Figure 1. (Canva AI, 2024)

FMP PROPOSAL

Susan Draaijer | Master ID, Sem B, 2025

Coach: Daniel Tetteroo

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Identity & Vision

Learning points

Observer | *Visual learner* | *Ambitious* | *Curious* | *Introvert* | *Forward thinking* | *Psychology-informed*

- ***Responsibility*** *- Comprehending our human* ***psychological foundation***
- ***Subconscious*** *&* ***Conscious*** *mind*
- *Establishing the user's* ***Mental model***
- ***Health*** *is the foundation upon which all aspects of human life are built*

> *"I believe that through full understanding and contemplating detail to subconscious mental operations, a closer step towards improving the user experience can be attained"*

smartQare

Learning points

Figure 2. Final design smartQare - Monitor nursing station (Canva AI, 2024)

1. ***Notification emerges**, noticed by **periphery of attention***
2. ***Interaction-attention continuum** determines how much attention is drawn to **deliberate places on the screen** (sizing, contrast, color)*
3. *Notification can be **evaluated within the context provided** at that moment for that specific patient (Age, activity level, trendline history & duration)*
4. ***Nurse visits patient** and **takes necessary actions***

***Between notifications**, there is **no subconscious contextual awareness** about the status of the patient*

Technology in Healthcare

Technology-first approach

smartQare

smartQare (2025)

Competitors

Biobeat (2024)

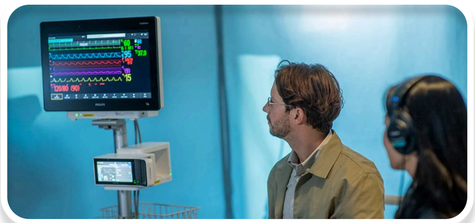
Dozee (2024)

Results in technology-first solutions

Physiological parameter	3	2	1	0	1	2	3
Respiratory rate (BPM)	0%		2%	86%	10%	2%	0%
Oxygen saturation (%)	19%	12%	17%	52%			
Temperature (C°)				92%	8%		
Systolic blood pressure (mmHg)	7%		6%	53%	31%	3%	
Diastolic blood pressure (mmHg)	2%	30%		63%		%4	
Heart rate (BPM)			3%	74%	17%	6%	
Stroke volume (mL)	4%		15%	76%	3%		1%
Cardiac output (L/min)	1%		9%	85%	5%		
Systemic vascular resistance (dynes·sec·cm^{-5})		3%		35%	53%	5%	3%

EWS

Eisenkraft et al. (2023)



Redesign Sound

Eisenkraft et al. (2023)

Alarm fatigue

A recognized challenge for decades, in ICU environments particularly

*First identified by ECRI in **1974** as a critical issue in healthcare*

Bethune (2019)

*"Achieved more notoriety since The Joint Commission made improving the effectiveness of clinical alarm systems one of their National Patient Safety Goals in **2003**"*

PubMed Research

Albanowski et al. (2023)

"Ten Years Later, Alarm Fatigue Is Still a Safety Concern"

Cognitive overload | *Interruption of clinical workflows* | *Desensitization among clinicians* | *Death*

Fundamental misalignment between technological capabilities and user needs

- *83% of healthcare professionals report to feel overwhelmed by alarms*

Ruppel et al (2018)

Worldwide Developers Conference

From Technology-first to User-Centered: Bridging the gap

Steve Jobs Worldwide Developers Conference

Youtube (1997)

"You've got to start with the customer experience and work backward to the technology"

"you can't start with the technology and try to figure out where you're going to try to sell it"

Nearly three decades later, this vision is still overlooked in the healthcare sector specifically

Calm technology

Intensive Care landscape - CCU

Calm technology (n.d.)

> *"**Calm technology** encourages the creation of systems that interact with users in a manner that **minimizes disruptions, aligns with physiological attention**, and **seamlessly integrates into workflows**"*

Gap in current research & approaches

The intersection of **Alarm fatigue** mitigation and **Calm technology** in the context of Intensive Care departments has not yet been thoroughly explored

- ***Fresh perspective** on **technology design** in the Healthcare context*

Bakker & Niemantsverdriet (2016)

Steve Jobs

Clinical environment is respected | ***User-centered design at the center stage*** → ***Working backward to technology***

FMP Proposal

Two perspectives: preventing & mitigating Alarm fatigue

Professional identity

*"I believe it is through **understanding** that we allow ourselves to create changes in the most **effective**, **moral**, and **radical** way"*

Nurses in the General ward

- ***Preventing***
  Alarm fatigue

smartQare®

Perspective 1

Nurses in the CCU (IC)

- ***Mitigating***
  Alarm fatigue

máxima medisch centrum

Perspective 2

smartQare (2025) *Máxima MC (2025)* *Canva AI (2024)*

Approach

Four-phase design process

Research conducted during M2.1 project = Groundwork for understanding the complex dynamics of the healthcare system

↳ ***Introducation** to **clinical environment***

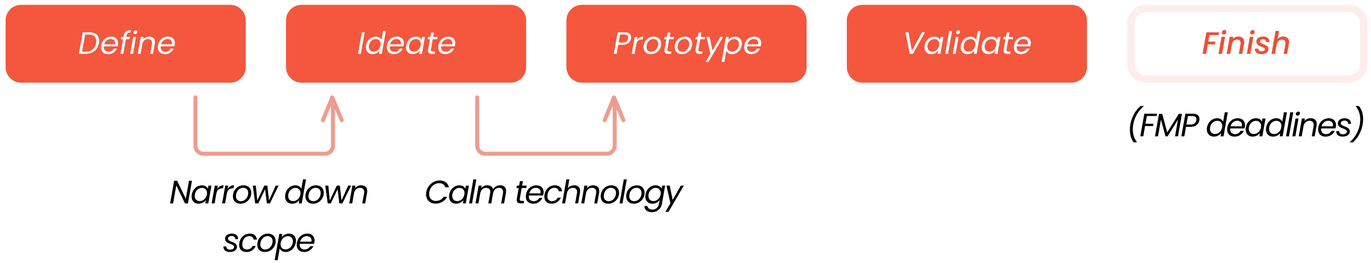
↳ *Identifying **which variables are prioritized** in specific scenarios*

↳ ***Collaboration** among nurses*

↳ *Interpreting **vital signs data***

↳ *Specialized **terminology** essential to clinical practice*

Milestones approach



Outcomes & success criteria

Intended outcomes

- *User-Centered Design solution*
- *Established mental model for the CCU*
- *Offer new perspectives to spark future design possibilities*
- *Final design founded on the principles of calm technology*

Success criteria

- The design aims to mitigate a focused aspect of alarm fatigue and contribute to improved patient care, with the understanding that any shortcomings identified through user testing will be addressed as part of the project
- The design enables users to establish patient context, within the narrowed scope, to guide actions
- The design is perceived as a support rather than a burden in terms of cognitive load
- The design aligns with nurses' mental models and workflows in the CCU

THANK YOU FOR LISTENING!

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Figure 7. (Canva AI, 2024)