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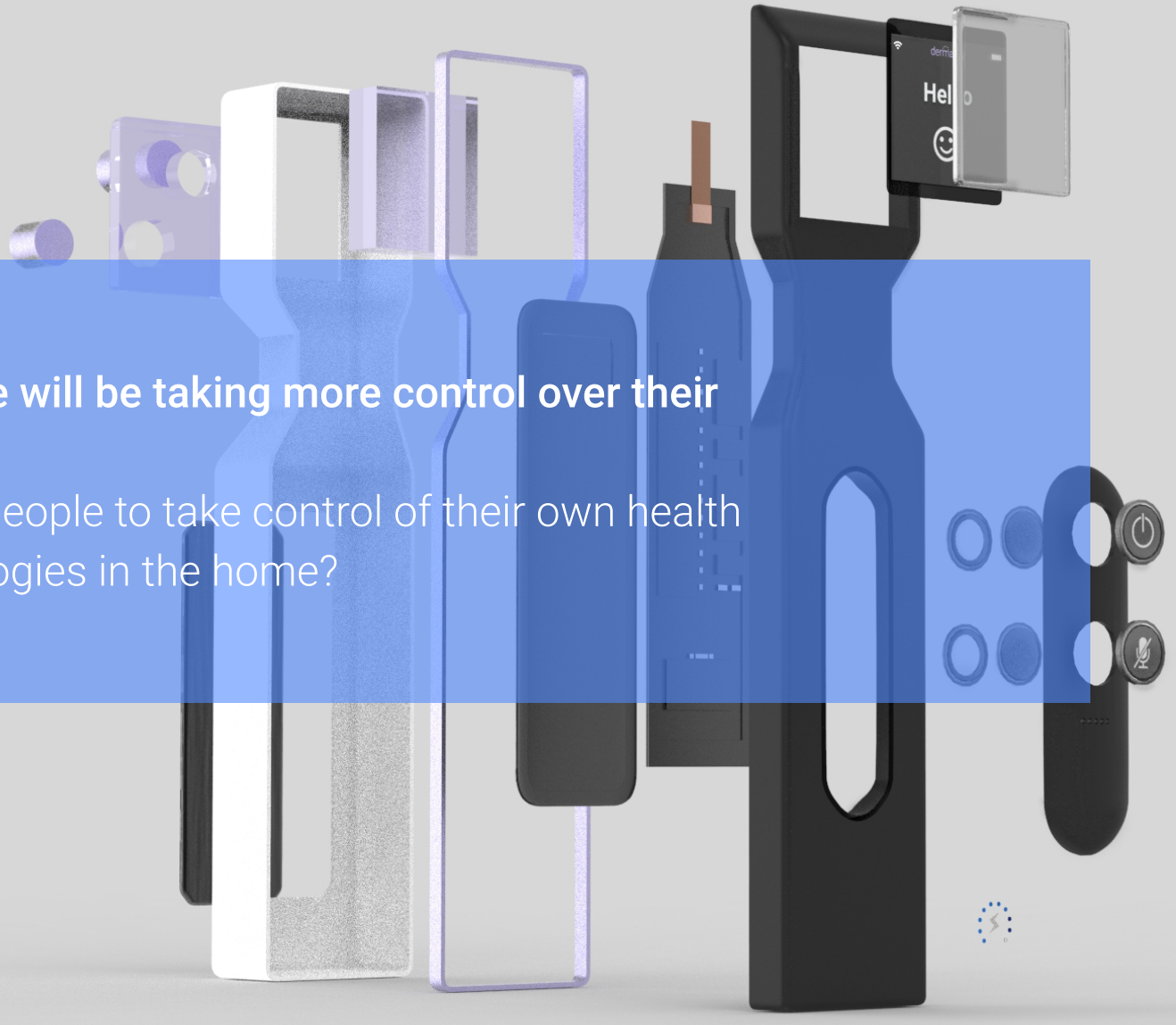
How can we better equip and empower people to take control of their own health and wellbeing through emerging technologies in the home?



MA Product Design Innovation

Charlotte Bennett / id10695663

Module Leader: Clive Hilton

Predictions suggest that by 2030 people will be taking more control over their own health and wellbeing from home.
How can we better equip and empower people to take control of their own health and wellbeing through emerging technologies in the home?

Date of submission: 10th August 2021

Words: 3,760

Abstract

This project aims create an outcome which can help people to self-diagnose dermatologic conditions from home. The aim is to incorporate emerging technologies to create a cost-effective solution, which will ease pressures on the NHS. Primary and secondary research results will feed into the design process to conclude the most suitable outcome.

Contents

Section 1: Research

1.0 Introduction

The UK has an ageing population, with 1 in 4 people expected to be over the age of 65 by 2050 (Living longer: how our population is changing and why it matters, 2018). These demographics will exert pressure on healthcare services such as the NHS. Healthcare professionals (HCPs) have predicted that patients will be taking a more active role in their health by 2030, most of which will be conducted from home (Healthcare in 2030, 2021). It is important to question the role design will play in this shift, and how emerging technologies will contribute to such developments.

In addition to the strains felt by an ageing population, a recent survey conducted by the British Medical Association found that 1 in 4 doctors were likely to take a career break and 21% were considering leaving the NHS for an alternative career (Why is there a shortage of doctors in the UK?, 2020).There are several flaws regarding the UK's health system, such as the UK not having enough doctors to meet demand, with WHO suggesting that there are currently two million doctors short of the global target (Why is there a shortage of doctors in the UK?, 2020).

Another problem facing the UK when it comes to doctor shortages is Brexit. In the UK, 9.7% of the medical workforce is made up of doctors from the EU (Why is there a shortage of doctors in the UK?, 2020). After the EU referendum, statistics showed that 45% of EU doctors were considering leaving due to the voting outcome (Why is there a shortage of doctors in the UK?, 2020).

There is an unprecedented number of graduates searching for work outside of the UK, taking time out and not taking up training posts, with an additional number of senior doctors taking up an early retirement (Why is there a shortage of doctors in the UK?, 2020). Seeing that there are numerous strains on the UK healthcare system, it is exciting to imagine how technology can play its part in creating a better, more efficient, cheaper future of healthcare, to support HCPs, not replace them.

1.1 Investigative objectives

• **Online interview** – Compose an online interview with a blind employee from the RNIB team, which allows for new perspectives and an insight into accessibility. (Sent via email).
• **User testing/prototyping –** Complete appropriate prototypes of design developments and user testing to test appropriateness and gain feedback.
• **Desk based research** – Complete qualitative and quantitative research to understand existing products in the marketplace, emerging technologies and current challenges faced with a focus on health and medical care in the UK. This study also looked at inclusive design principles.
• **Existing Case Studies** – Understand different health and medical care challenges, including the future of health in 2030, how much people are spending on over the counter medicines and social determinants which affect health.
• **Limitations** - One of the aims of this study would have been to conduct ethnographic research and in-person interviews. However, due to COVID, research was conducted online.

1.2 Ethics Application

For this study, an ethics application was conducted and approved, including a risk assessment.

2.0 Health in 2030

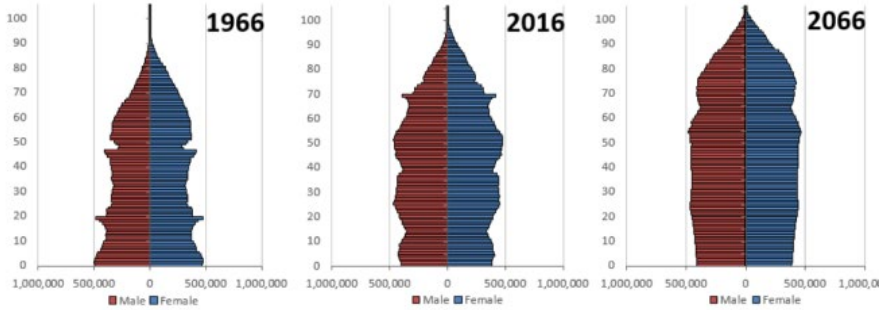
"Looking to the longer term, the pandemic has exposed fundamental weaknesses in both social care and public health (Ham, 2020)".

Statistics show that 62.1% of UK doctors believe that patients will take more responsibility for monitoring their health by 2030. There will be a constant push to reduce costs which will lead patients to becoming central to their own healthcare, in many cases being expected to treat and monitor themselves from home. The future will be partly focused on the aim to keep people well rather than react when they are already ill (What do patients want?, n.d.).

2.1 UK Demographics

The growth in population in the UK has been on the rise, since 2011 we can see a steady increase, especially between the ages of 50-75, highlighting the ageing population in the UK.

Figure 1 Population growth over time



Note. UK population growth between 1966 and 2066. (Overview of the UK population: January 2021, 2021)

Figure 1.1 Overview of the UK population: January 2021

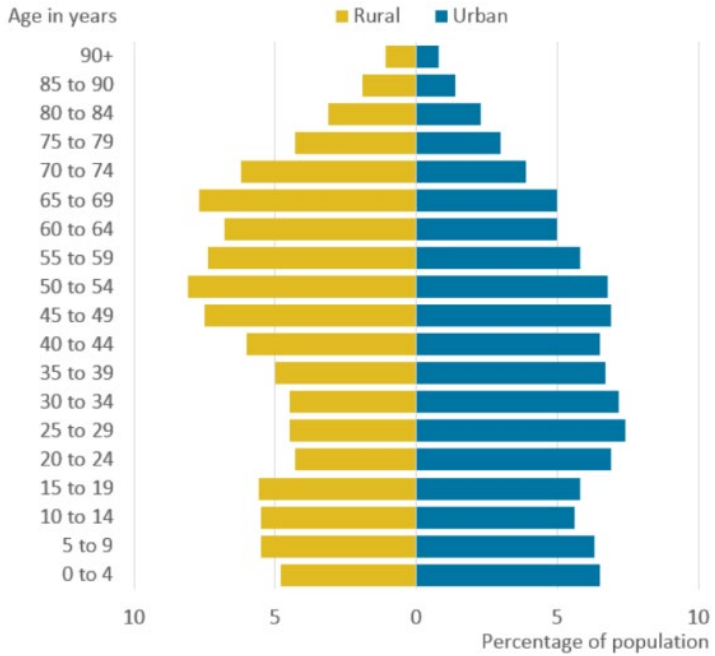
Note. UK population statistics. (Overview of the UK population: January 2021, 2021), *(Bennett, C, 2021)*

Age is an interesting factor to consider for this project since it is important to question how many people in society are digitally literate, especially those who are older. Technology will not be slowing down, in fact will be enhancing in the next few decades and it is therefore vital to narrow down the gap of exclusion.

Another point to consider though will be that the current younger generations are being brought up in a technological world and therefore as time progresses, they will also get

older and take their tech savvy knowledge with them. Furthermore “Patients are embracing new technology across most aspects of their lives and increasingly expect their healthcare to be supported by it" (Preparing the healthcare workforce to deliver the digital future, 2019).

Figure 1.2 UK population in rural and urban areas



Note. UK population in rural and urban areas (Overview of the UK population: January 2021, 2021)

2.2 Health technologies of the future

Figure 1.3 Emerging health technologies

Note. AI, Genomics and Sensors are said to be some of the exciting technologies of the future of healthcare. (Economist T. , Is this the future of health? | The Economist, 2019), (Bennett, C, 2021)

2.3 Artificial intelligence

AI could play an interesting role in the future of the healthcare industry due to its lack of consciousness. Unlike humans, AI does not have a conscience and would not face burn out, like many HCPs do. AI powered machines can work 24 hours a day (Economist T. , Is this the future of health? | The Economist, 2019).

However, there are several ethical implications of AI. One is ownership and taking responsibility. For example, if a doctor misdiagnoses a patient, they can be held accountable.

However, if AI were to incorrectly diagnose a patient, who is to blame? The technology? The product? The company? The manufacturer? Further ethical considerations are patient safety and data governance (Preparing the healthcare workforce to deliver the digital future, 2019).

Health challenges of the 21st century that have triggered the use of AI include, but are not limited to, life expectancy, dementia and Alzheimer's, diabetes, and mental health conditions (Preparing the healthcare workforce to deliver the digital future, 2019). AI has the potential to create more efficient, effective, and sustainable healthcare systems (Spatharou, Hieronimus, & Jenkins, 2020), but currently holds many challenges, including the significant issue of data and digitisation of electronic health records (Economist T. , Is this the future of health? | The Economist, 2019).

AI has its strengths and can be used to an advantage in healthcare through the automation of tasks and accelerating mundane tasks (Manyika & Sneader, 2018). AI can improve accuracy, which supports clinicians, and it can predict outcomes, enabling resources to be allocated more efficiently. AI can also empower patients by enabling them to monitor their own conditions (Economist T. , Is this the future of health? | The Economist, 2019).

2.4 Nano-array plasmonic sensors

Advancements in sensors adopting ultra-sensitive bio nanotechnologies could enable early diagnosis and therefore transform the speed at which patients can access the right treatment and potentially prevent disease. These advancements will not only support health workers on the front-line, but where appropriate, enable people from home to check up on themselves. (Preparing the healthcare workforce to deliver the digital future, 2019).

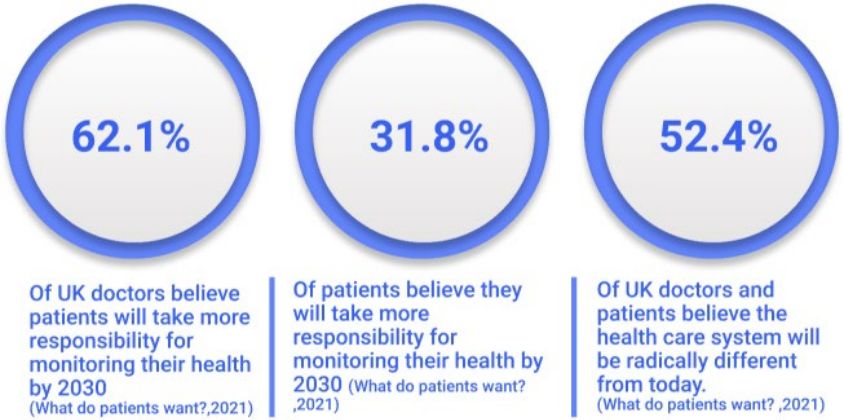
Data connectivity will be important if patients are testing from home. “A new generation of smartphone connected diagnostic tests are under development, with the ability to utilise in-built sensors and connectivity to link results to online care pathways". (Preparing the healthcare workforce to deliver the digital future, 2019).

Figure 1.4 Top 10 digital healthcare technologies and their projected impact on the NHS workforce from 2020 to 2040

Note. Technological advances impacting healthcare and the magnitude of disruption. (What do patients want?, n.d.)

2.5 Self-diagnosis in the home

Figure 1.5 Patients monitoring their health from home in 2030



Note. UK doctor and patient statistics based on who believes that patients will be taking more responsibility for their own health in 2030. (What do patients want?, n.d.), (Bennett, C, 2021)

For much of the past year and a half, people were not allowed to leave home unless for work, food, or medication in the UK and were advised where possible to work from home. This could align well with the concept of people taking care of themselves from home. With people more used to spending significant amounts of time at home, it could make sense to incorporate more healthcare processes here. There is already

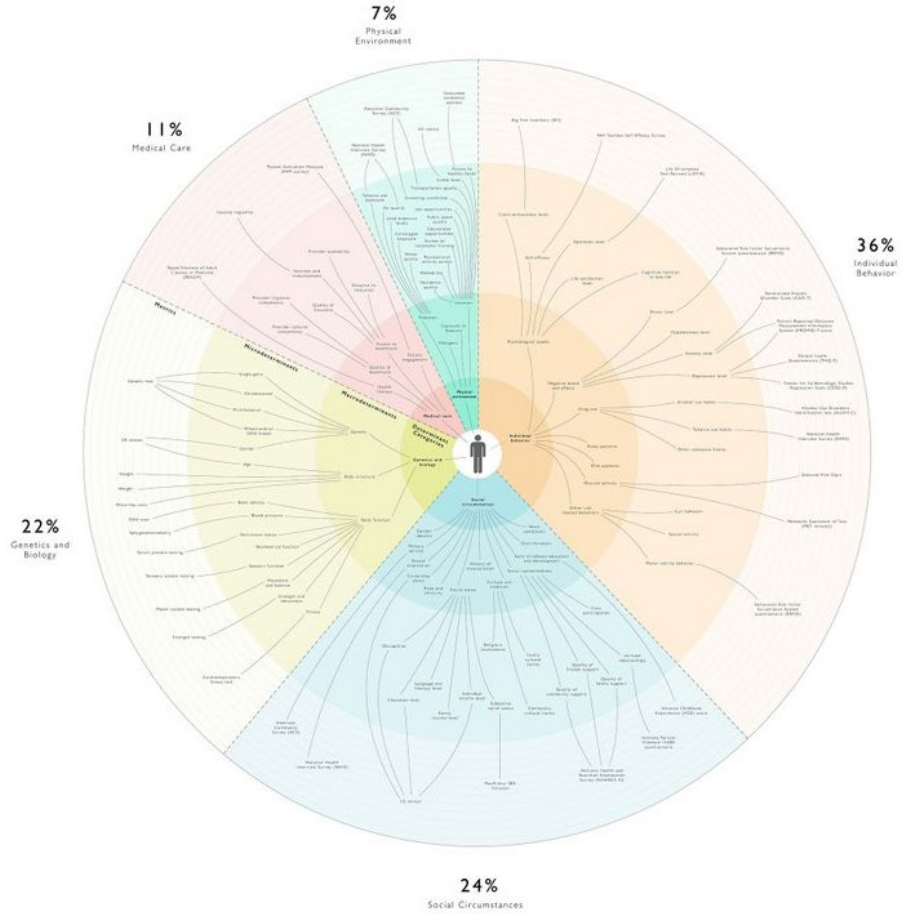
an element of healthcare in the home, including the likes of making doctors' appointments via an app and ordering prescriptions for delivery. It is interesting to consider what is next.

Questioning how technology will align with an ageing UK population is important as "within 20 years, 90% of all jobs in the NHS will require some element of digital skills" (Preparing the healthcare workforce to deliver the digital future, 2019), showing that technology will be at the forefront of healthcare in years to come. Despite an increasing level of digital literacy among the population, social determinants will always be an important consideration.

2.6 Social determinants

Much of the UK's ageing population live in rural areas, making it challenging to reach appointments, especially as elderly people are less likely have a car. In these circumstances, having digital appointments and equipment from home to better take care of their health and wellbeing would increase convenience and accessibility. "A range of social determinants affect health outcomes, and digital health technologies should redress not reinforce inequalities, with particular attention given to vulnerable and marginalised groups". (Preparing the healthcare workforce to deliver the digital future, 2019)

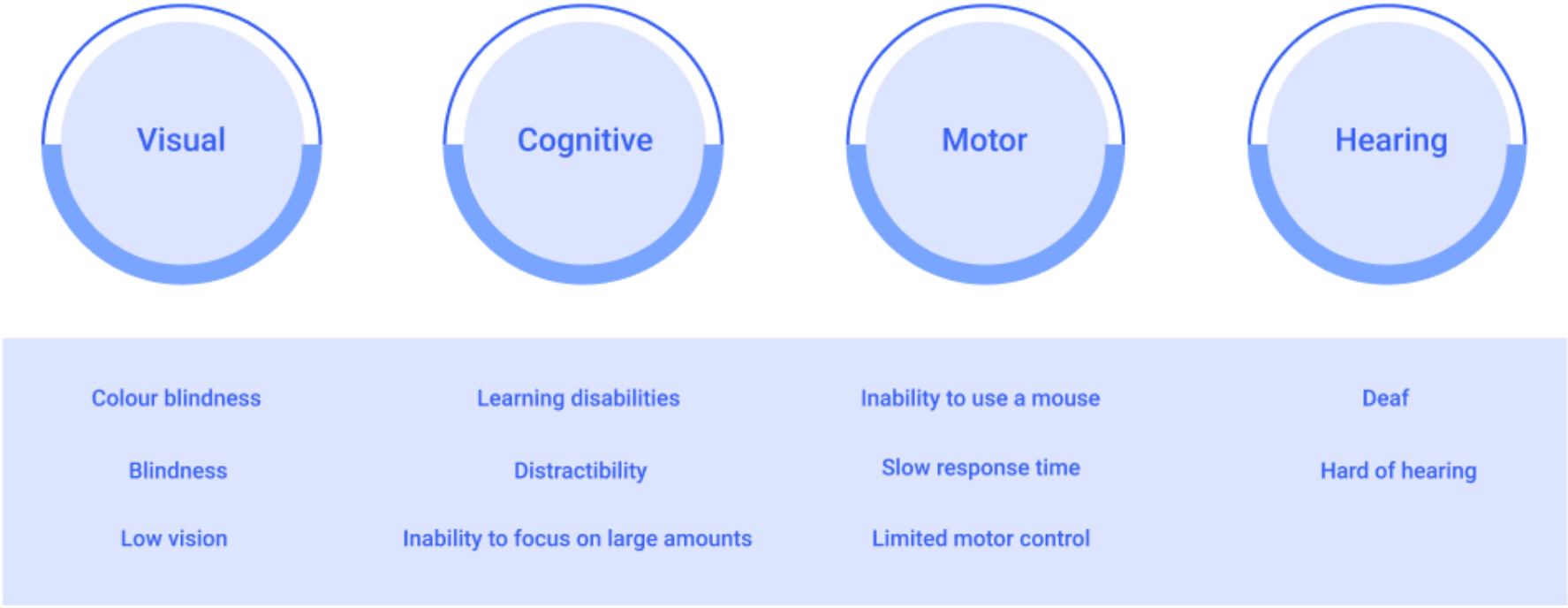
Figure 1.6 Social determinants of health



Note. The social determinants of health diagram. (Determinants of Health, n.d.)

3.0 Inclusive design

Figure 1.7 Types of disabilities



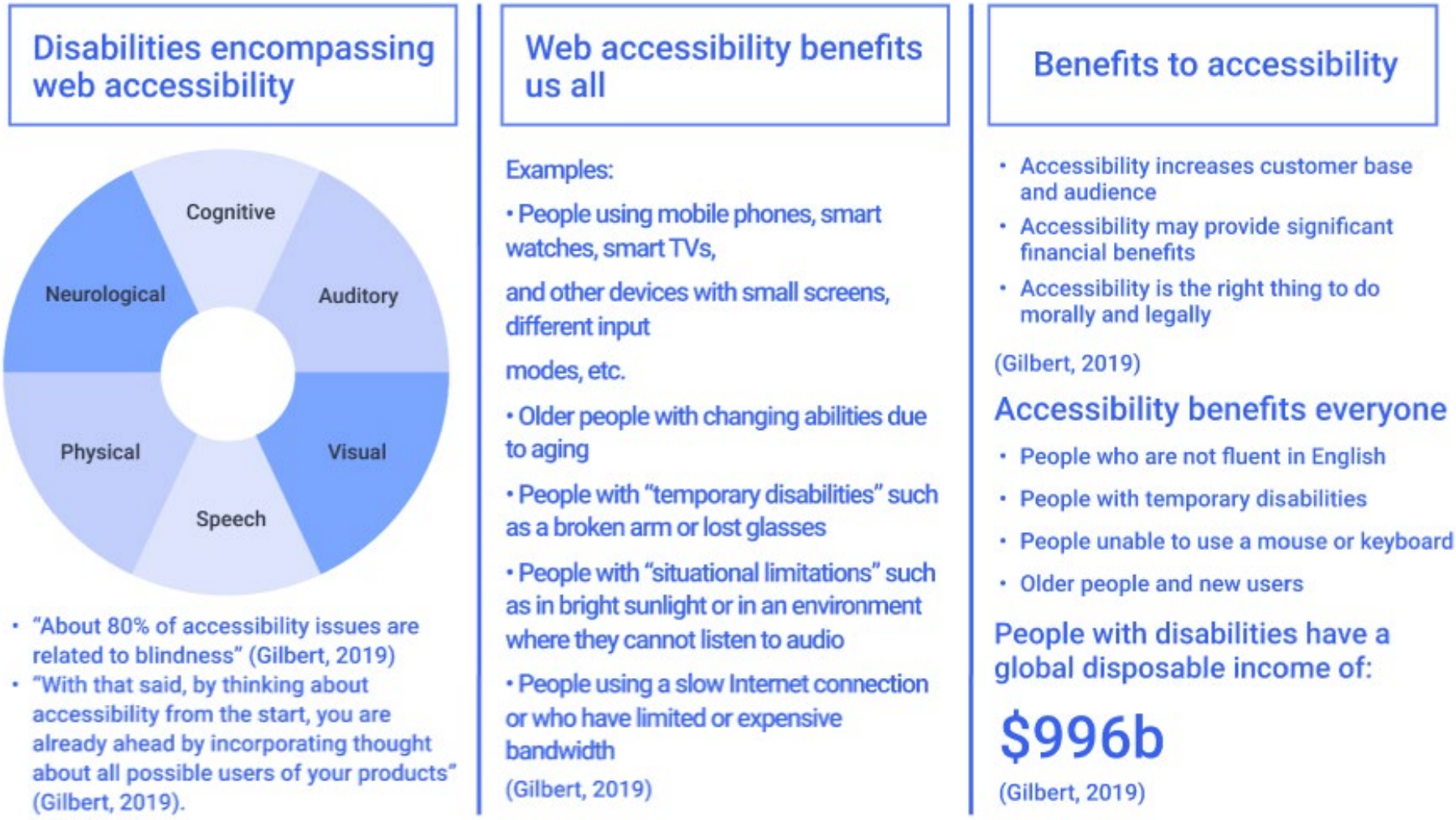
Note. Types of disabilities and what encompasses them. (Gilbert, 2019), (Bennett, 2021)

3.1 User-friendly theory

Accessibility should be put at the start of a project and not an afterthought.

"User friendliness is simply the fit between the objects around us and the way we behave" (Kuang & Fabricant, 2019).

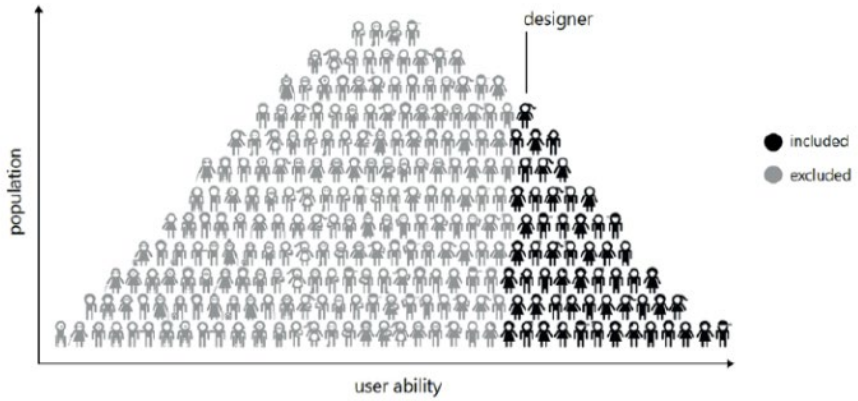
Figure 1.8 Accessibility and its importance



Note. Benefits to accessibility. (Gilbert, 2019), (Bennett, 2021)

3.2 Inclusive design for the user

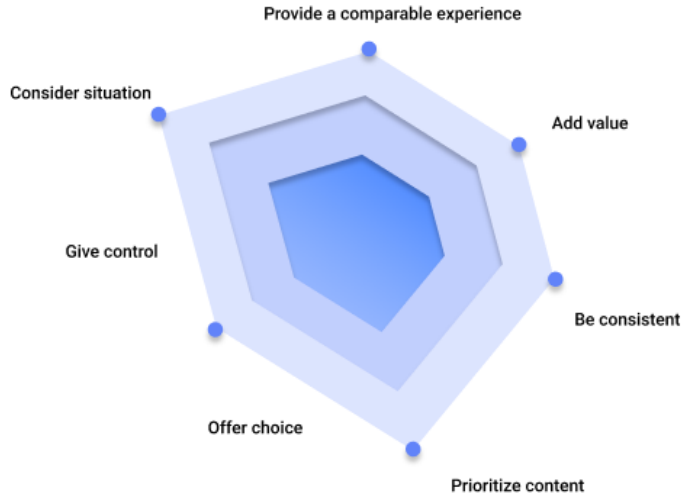
Figure 1.9 Inclusivity in the design process



Note. Design still excludes many. (Microsoft)

“Accessibility, or lack of, is constantly at the forefront of disabled peoples' minds. It is a constant worry and, although The Equality Act (2010) states access or reasonable accommodations must be in place, it is an ongoing issue that does not seem to be improving" (Langdon, Lazar, Heylighen, & Dong, 2020). The inclusive design methodology closely relates to accessibility and universal design; however, inclusive design is a process for creating design that can be used by a diverse group of people (Chapman, n.d.). People often lack awareness of the importance of inclusion, meaning that often, disabled people are not included in the design process (Gilbert, 2019). For example, only in recent years was the world's first pregnancy test prototype for blind and visually impaired women developed, allowing them to independently use the product without having to disclose the results to others before knowing themselves, which would invade their privacy (Dean, 2020).

Figure 2 Inclusive design principles



Note. Inclusive Design Principles. (Swan, Pouncey, Pickering, & Watson, Inclusive Design Principles, n.d.), (Bennett, 2021)

3.3 Inclusive design for business

Applying inclusive design principles to the design process and product or service can prove valuable for business. People with disabilities and their friends and families have a global collective disposable income of 8 trillion dollars. (Google Developers, 2018). Businesses must take action to incorporate an inclusive approach to their business strategy to reach wider markets. Inclusive design principles will be used for the purpose of this project.

4.0 An interview with a member of the RNIB team

Primary user research was conducted as part of this study. The research included an online interview with a blind member of the Royal National Institute of Blind People. The purpose of this research was to gain insights from the start of the design process to enable accessibility to be incorporated.

The feedback proved to be incredibly insightful, with it becoming a pivotal part of the design process. A variety of design-related questions were asked, including the types of daily challenges faced, the current products they use, which products are suitable for their needs, how their impairment impacts tasks they complete and which technologies they use, as well as their opinions on them.

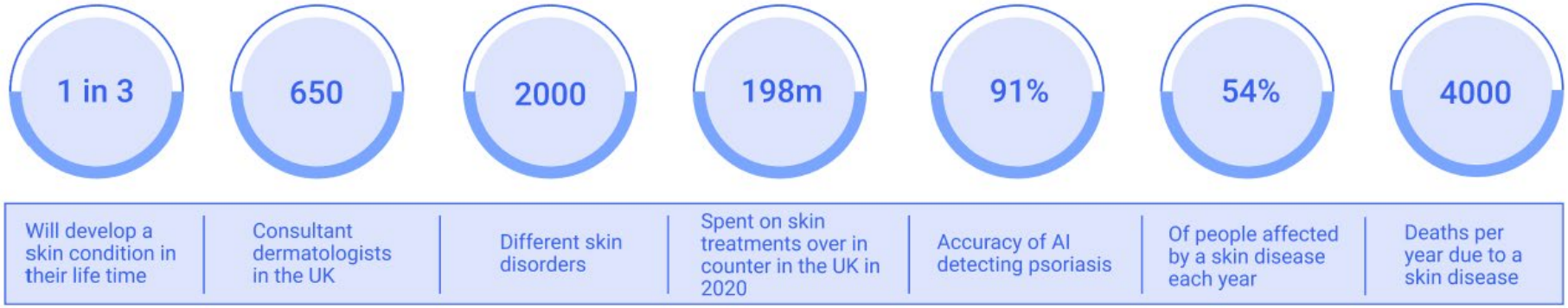
The participant mentioned that the future is moving towards a high-tech, touchscreen world, but such devices are becoming less accessible, with blind and visually impaired people often relying on low-tech devices, despite this being something she would prefer to avoid (Bluhm, 2021).

The participant mentioned that touchscreen devices could be made more accessible for visually impaired and blind people by making the buttons further apart so they can be marked up with transparent bumps on, and the interface could be made so that the touchscreen uses text to speech when operated. Finally, the connection to the app should be seamless with no worry about software updates.

Due to the research question being linked to health and medical care, the participant was asked how they manage their healthcare routines and wellbeing from home, with pointers including teeth, pregnancy, and skin. The participant reflected on not being able to find out about her pregnancy

first and had to rely on friends and family telling her the results, making her feel incredibly upset as her privacy was disrupted. She also mentioned that if she were to have a skin condition, and was unaware of it, she would need to go to the GP first to detect it and then get advice, but given the current situation with Covid-19, it is difficult to get an appointment with a GP and feels “at a loss". Furthermore, despite video consultation, she would prefer to be able to self-diagnose. This was an important discovery in the research, as it prompted the question: if someone has a skin condition that they are unable to detect, how are they able to treat it and look after it? How do people in general look after their skin conditions and what if the person is blind or visually impaired? If the skin condition is not itchy or painful, perhaps it is even harder to detect and in special cases where people live completely alone, perhaps they are unable to detect it at all. This discovery led to further research into the field of dermatology.

Figure 2.1 Dermatology statistics



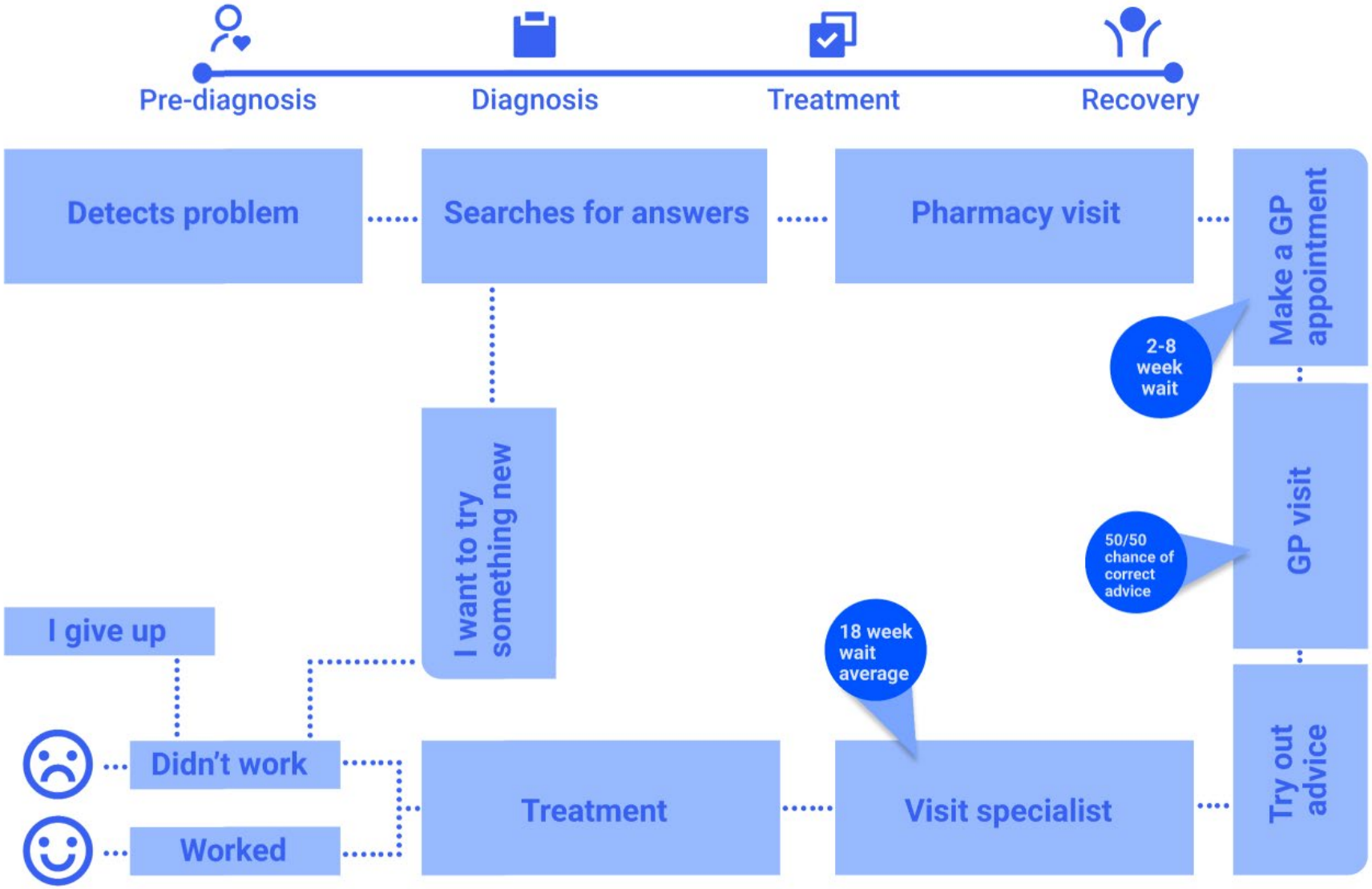
Note. Dermatology statistics. (Levell, Jones, & Bunker, 2013), (Bennett, 2021)

5.0 Dermatology

Primary research suggests that people would like to detect their own conditions before having to visit a doctor. Recent statistics show that there are approximately 650 dermatologists to consult over 66 million people in the UK, (Levell, Jones, & Bunker, 2013). This could explain why the waiting time for a GP appointment is between 2-8 weeks and a specialist appointment is up to 18 weeks (Levell, Jones, & Bunker, 2013). There are about 2000 different types of skin disorders, and around 1 in 3 people will develop a skin condition in their lifetime (Levell, Jones, & Bunker, 2013). Furthermore, skin conditions are the cause of an estimated 4000 deaths in the UK per year. If people were able to self-diagnose skin conditions, it could eliminate the wait for a GP appointment, allowing for more rapid diagnosis and treatment – possibly saving lives. AI has already been shown to detect psoriasis with an accuracy of up to 91% (Imagine, 2021). This project will further investigate how dermatology and technologies such as AI can be combined.

"Technology is most certainly driving dermatological advancements; if wearable devices prove to be as invaluable to people as companies predict, much of long-term skin conditions will be self-managed with little clinician input" (Tynan, 2020).

Figure 2.2 Patient journey



Note. Patient journey mapped out. (Bourlioux & Christensen, 2018), (Bennett, 2021)

5.1 Patient Journey: Dermatology

The pandemic has exposed fundamental weaknesses in social care and public health (Ham, 2020). There were already several growing concerns prior to the pandemic regarding the stability of the NHS, and it will be vital to consider what the future of the healthcare system envisions. There is a constant and necessary push to reduce costs for the NHS which will therefore see patients becoming central to their own healthcare, many will be expected to treat and monitor themselves from home by 2030. (Healthcare in 2030, 2021). Having examined a current patient journey, numerous faults have been detected.

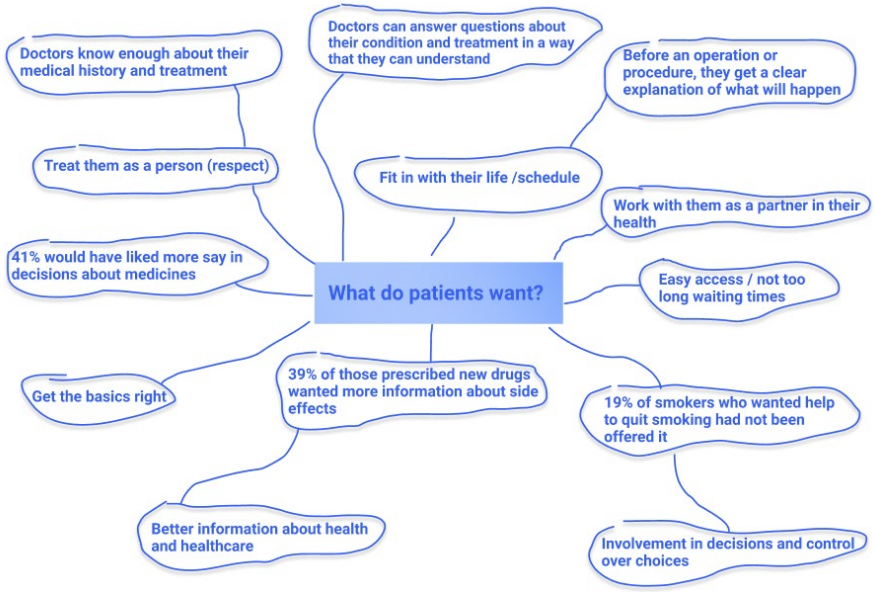
A typical patient journey will commonly include the patient detecting the problem, prompting them to search for answers. If one has not found a solution at this point, they may visit a pharmacy, or they may consider booking a GP appointment which has a lengthy wait. However, a GP only has a 50 percent chance of giving the correct diagnosis (Bourlioux & Christensen, 2018). If the prescribed treatment is unsuccessful, there is another potential 18 week wait for a specialist. If this additional treatment does not work, they may wish to try something else, bringing them back to the beginning of their journey. This paradigm is a lengthy process, which can increase stress and affect a patient's health. The long waiting times for treatment could therefore lead to further deterioration in condition.

Figure 2.3 Patient feelings and questions

Note. Self-reflection on dermatology experience. (Bennett, 2021)

5.2 What patients want

Figure 2.4 What do patients want?

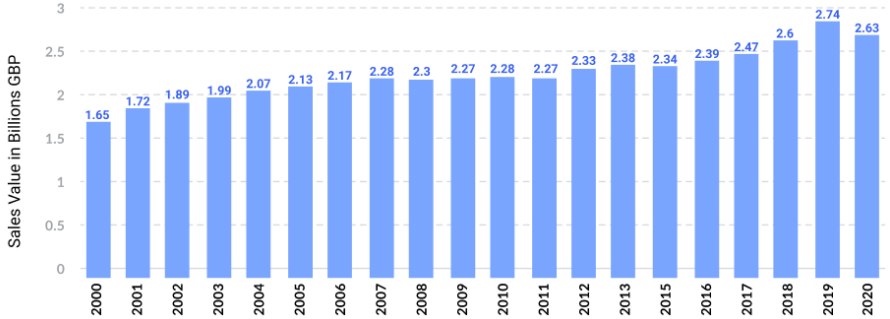


Note. Brainstorming patients wants and needs. (Robert, et al., 2011), (Bennett, 2021)

5.3 Patient over-the-counter treatment costs

As annual sales of over-the-counter medicines has been mostly rising each year for the last 20 years (Mikulic, 2021), it is important to question how effective treatments have been. It is also important to question how many of the prescribed treatments people pay for work effectively. With the subject of dermatology, if there is only on average a 50 percent chance of correct diagnosis by a GP, one must wonder how much money is wasted on unsuccessful treatments. This could lead people to giving up on finding a solution, since they know, they will have to pay for the next treatment, knowing it may not be effective for their condition.

Figure 2.5 Annual sales value of over the counter (OTC) medicines in Great Britain from 2000 to 2020



Note. Over the counter sales of medicines in Great Britain between 2000 to 2020 in billions GBP. (Mikulic, 2021), (Bennett, 2021)

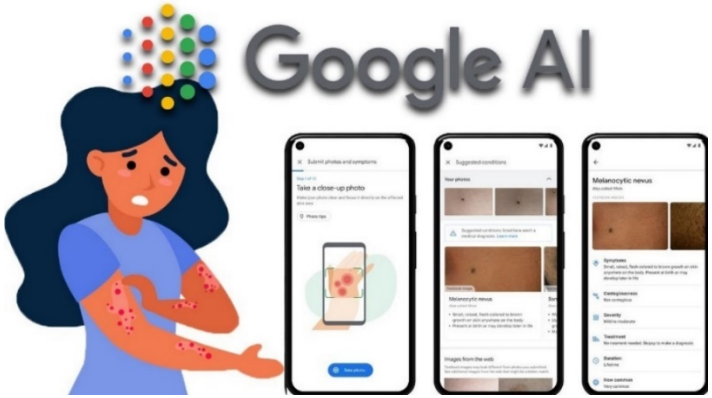
6.0 Google App Case Study

Google are in the process of launching a new app for dermatology with the use of AI to diagnose common skin conditions. For the process to work, one must take three

photos of their condition and answer questions about it (Glatter, 2021). The app can detect up to 288 skin conditions but does not offer a final diagnosis. The tool is not aimed to be used as a replacement of medical advice, nor is it for medical testing.

While this app could be a good start into understanding more about skin conditions and early diagnosis, the concept has several downfalls. Firstly, and most obviously if one does not own a smartphone, they would not be able to access data about their conditions, excluding many - with 35% of people over 65 still not owning a smartphone (Do you personally use a smartphone?* - by age, 2021). If one must take photos of their condition, they are reliant on a good camera and lighting, which could be a challenge for some older mobile phones. Furthermore, whilst the app currently can detect up to 288 of the most common conditions, there are over 2000 different types of skin conditions, which could disadvantage those with rare conditions. Additionally, with regards to inclusion, the algorithm was built on a training dataset of which only 3.5% of people represented brown, dark brown or black skin (Glatter, 2021). One argument was that 'biased sampling' was taking place and could lead to over or under-diagnosis of non-white people (Glatter, 2021). The app also appears to be limited to 2D technologies and since the app is its own entity, one could question if people would prefer to have all their health data in one space and not have to download multiple different apps. Perhaps the app could align with a physical product or a digital space which could be accessed not just by mobile.

Figure 2.6 Google AI



Note. Googles AI app which can detect 288 different skin conditions (Glatter, 2021)

7.0 Design Research Conclusion Specification

Predictions suggest that by 2030, people will be taking more control over their own health and wellbeing from home. Considering that UK healthcare professionals are on the brink of a burnout, it is important to realise how emerging technologies could enable patients to better take care of themselves and effectively relieve pressures on the NHS. After researching several areas within healthcare, the focus on dermatology was selected. Since there are currently only 650 consultant dermatologists in the UK to serve a population of over 66 million inhabitants, these shortages in healthcare professionals leads to longer waiting times for patients. The project will aim to design a solution that can be used at home in the field of dermatology, enabling users to self-diagnose where possible and aiming to offer different ways of achieving the user goal to enhance an inclusive approach. The solution should also not be solely reliant on a mobile phone.

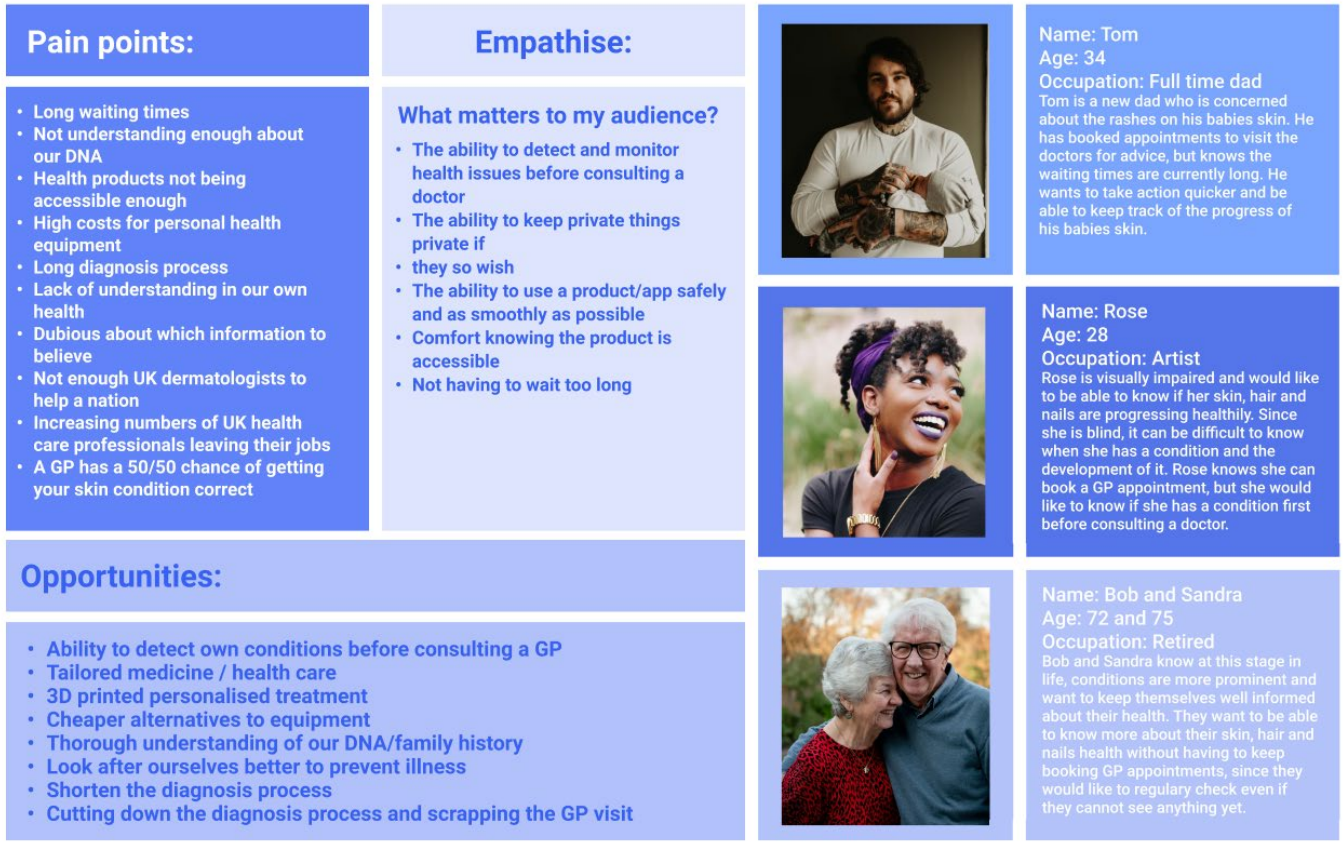
7.1 Final Design Brief

Design a cost-effective solution in the field of dermatology, which incorporates emerging technologies that can be used in the home environment for people to better understand, monitor and take care of their skin, hair, and nails from home, encouraging better control over their health.

8.0 Design outcome

9.0 User and narrative

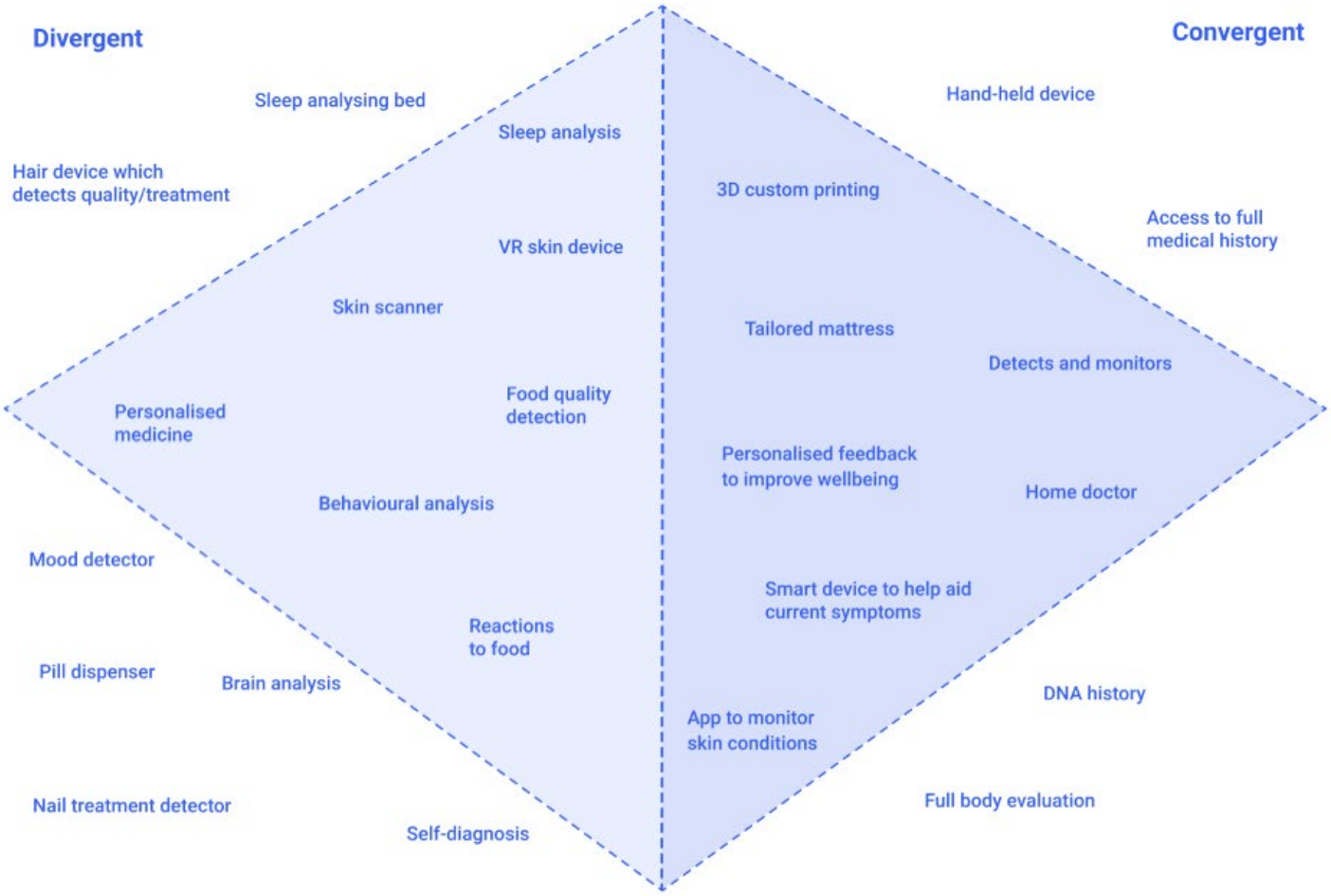
Figure 3 User and narrative



Note. User pain points, needs, opportunities and personas. (Bennett, 2021)

10.0 Divergent and convergent brainstorming

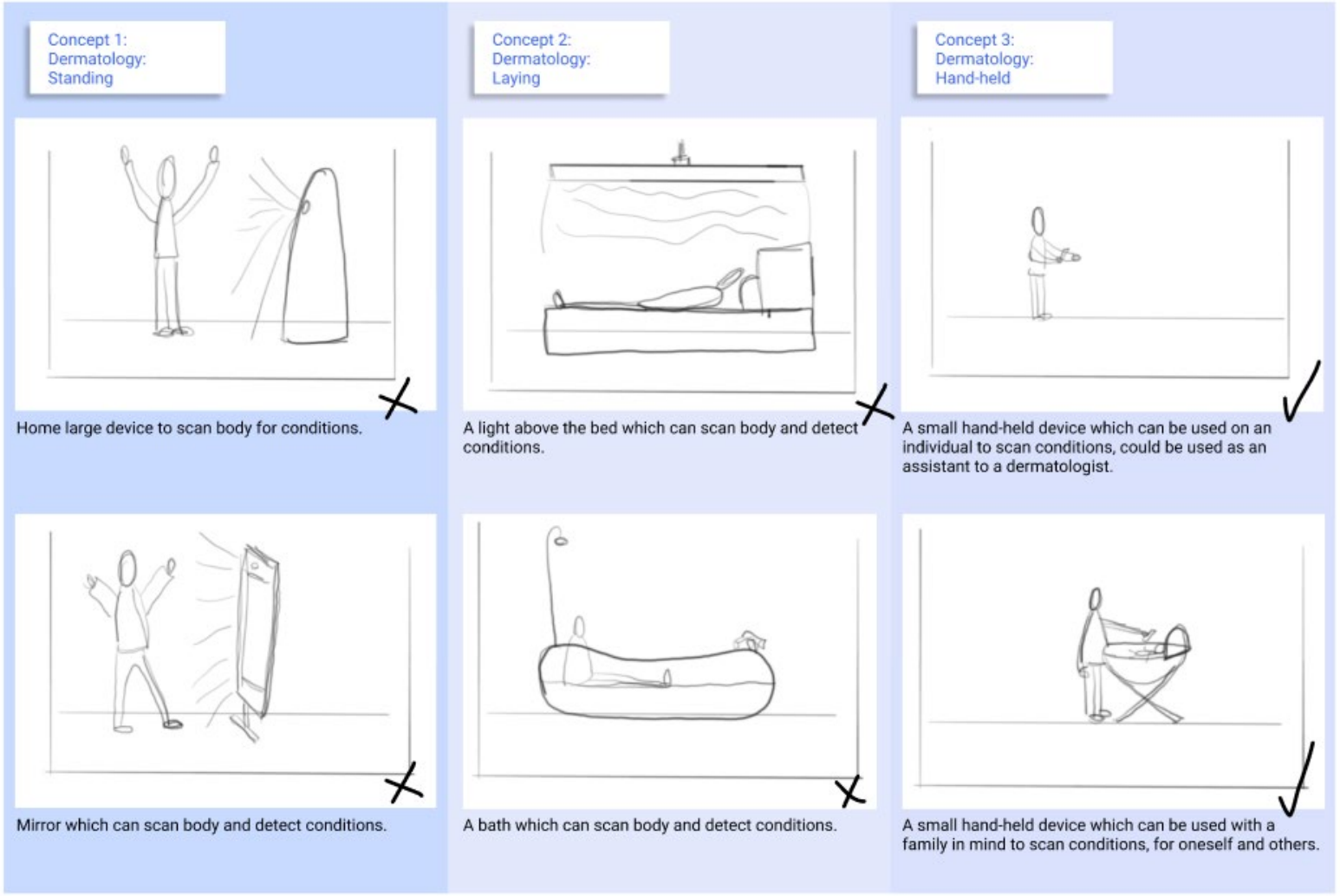
Figure 3.1 User and narrative *divergent and convergent brainstorming*



Note. Brainstorming (Bennett, 2021)

11 Concept ideation

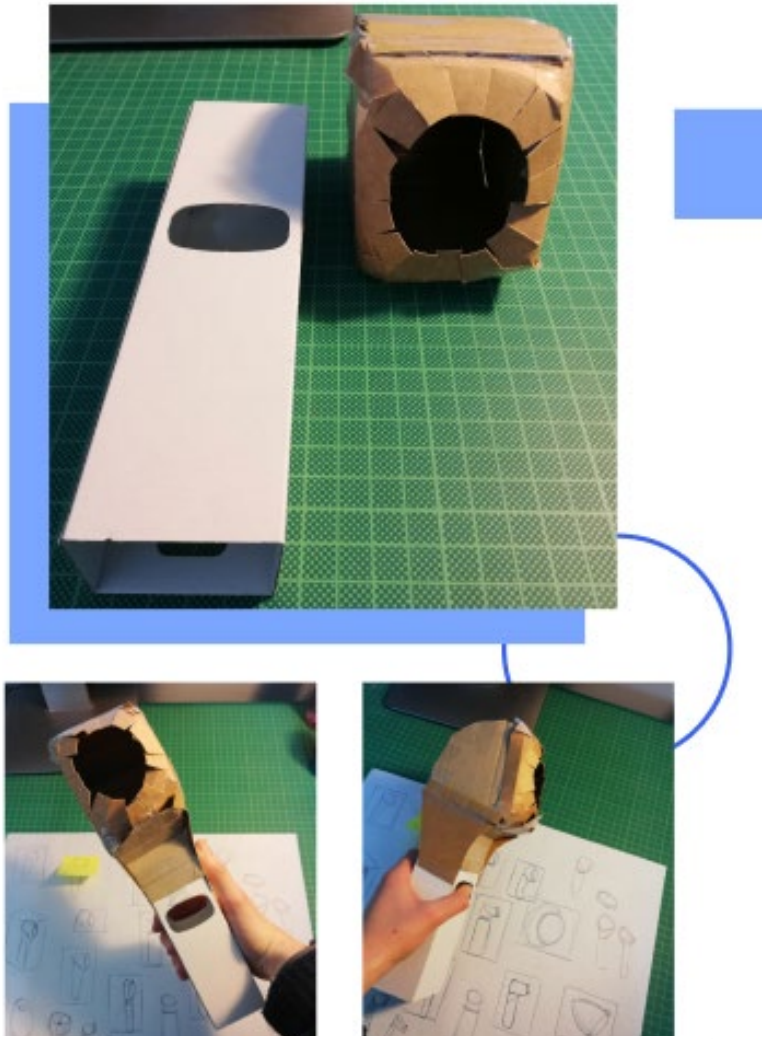
Figure 3.2 Initial concept ideation



Note. Initial concept ideation, different scenarios. (Bennett, 2021)

11.1 Paper prototyping and initial development of concepts

Figure 3.3 Sketching and paper prototype development

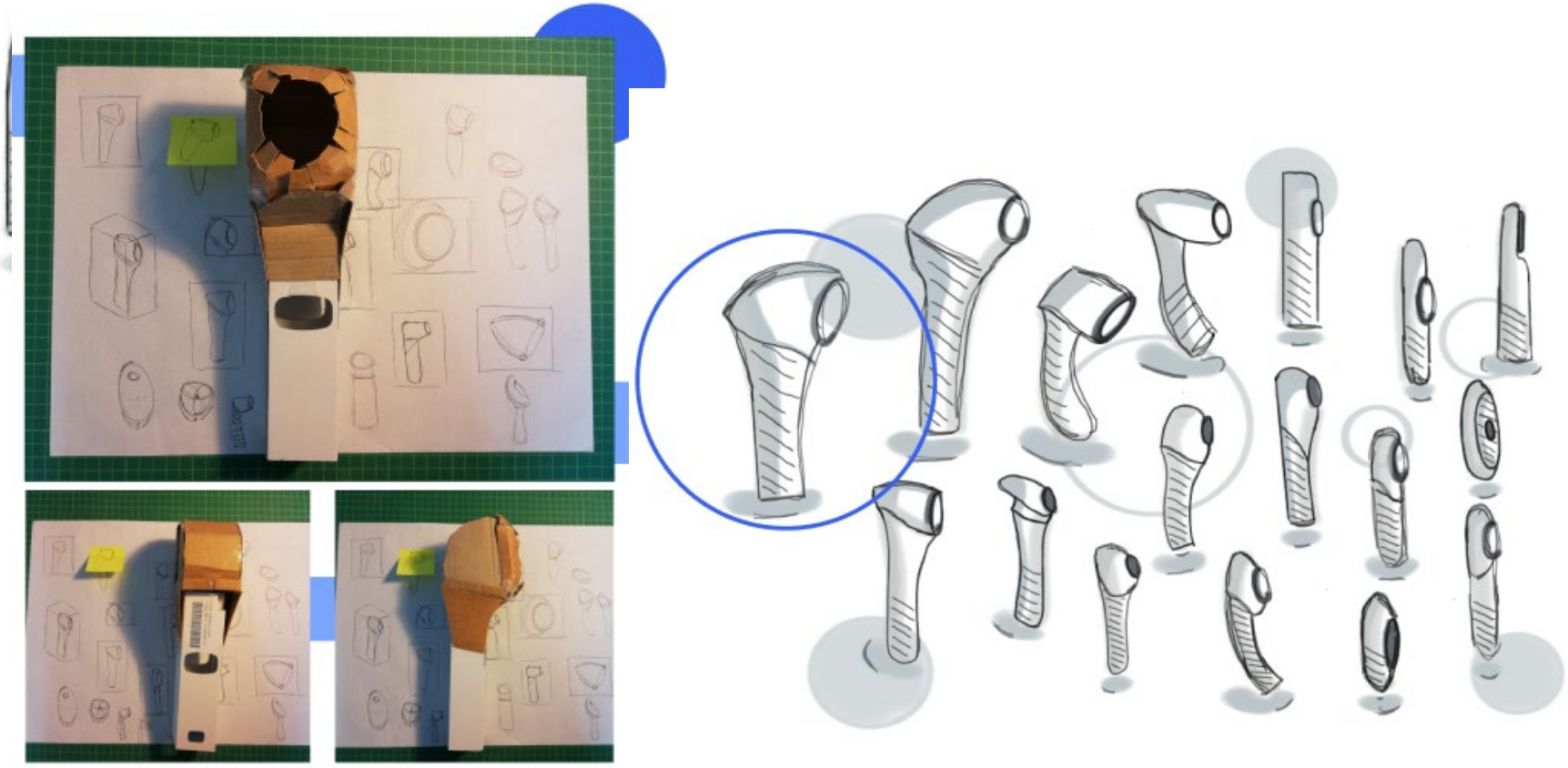


Note. Many sketches and iterations, combined with paper prototypes. (Bennett, 2021)

After selecting a few concepts, it was time to develop ideas further. Paper prototyping enabled a quick and easy way to develop ideas and give a sense of size and potential appearance.

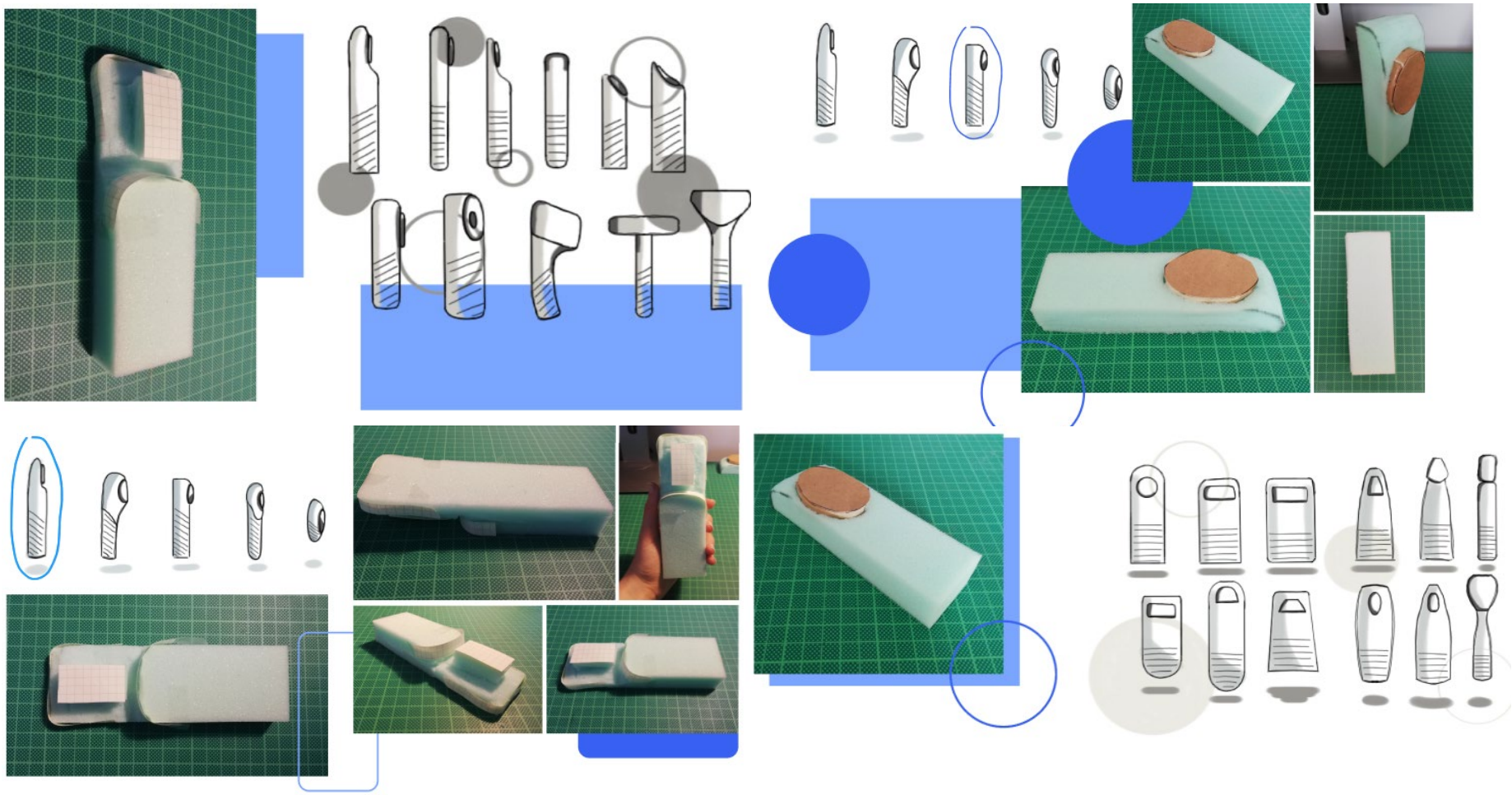
Focusing on dermatology meant looking for a solution that could benefit people by allowing them to better understand and look after their hair, nails, and skin. Considering the future of healthcare appears to look like it will be placed very much at home, it was important to note that the design outcome would need to be suitable for use inside the user's home. Initial concepts included looking at potential products and devices which could allow users to scan and monitor their skin, hair, and nails. These included the ideas of a mirror that scans, a large fitted light system hung over the bed, and hand-held devices. Whilst the concepts of lights and mirrors, could have been taken forward, it was questionable as to whether they would work effectively on smaller conditions and close-up. It was therefore more feasible to move forward with the concept of a hand-held scanning device.

Figure 3.4 Sketching and paper prototype development



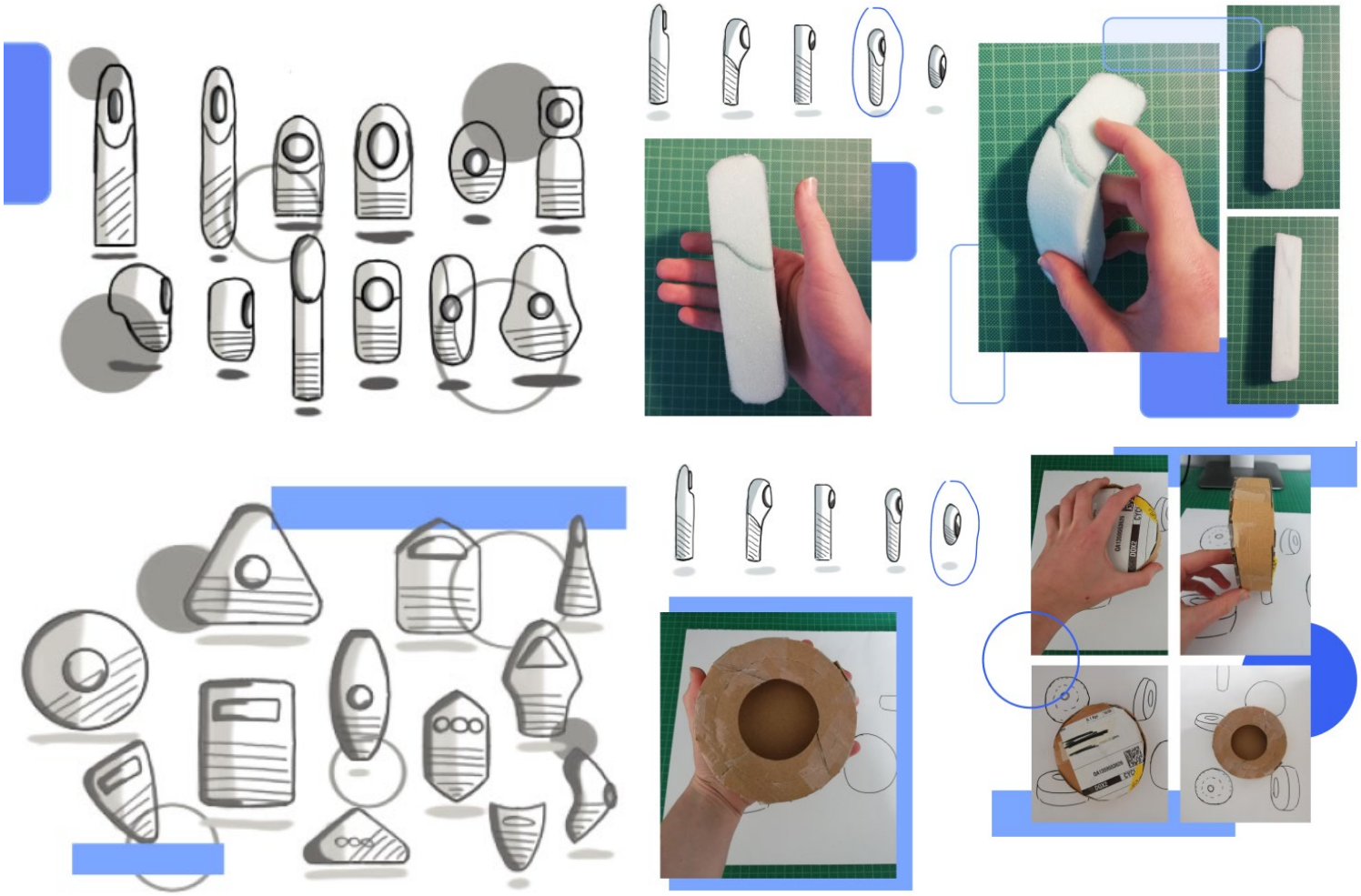
Note. Further development sketches and iterations. (Bennett, 2021)

Figure 3.5 Further sketching and foam prototype development



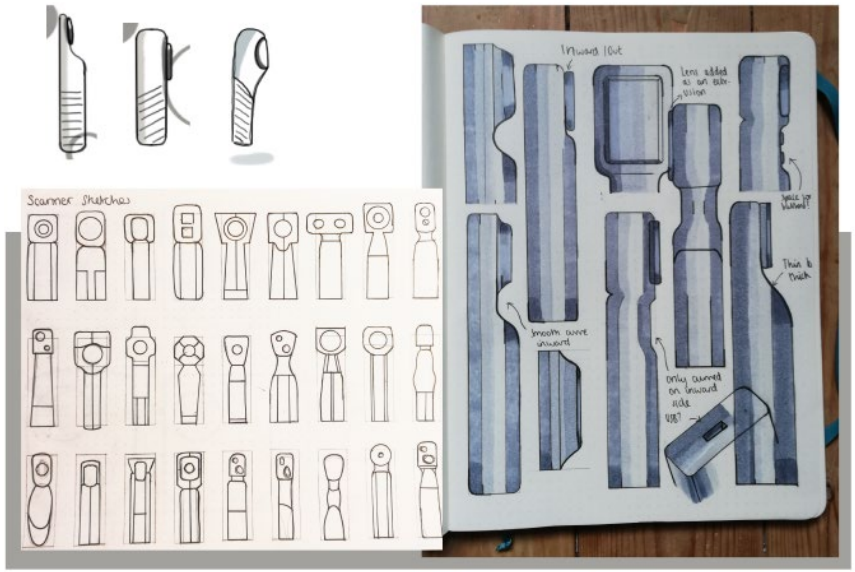
Note. Further development sketches and iterations, and foam prototypes. (Bennett, 2021)

Figure 3.6 Further sketching and foam prototype development 2



Note. Further development sketches and iterations, and foam prototypes. (Bennett, 2021)

Figure 3.7 Concept selection

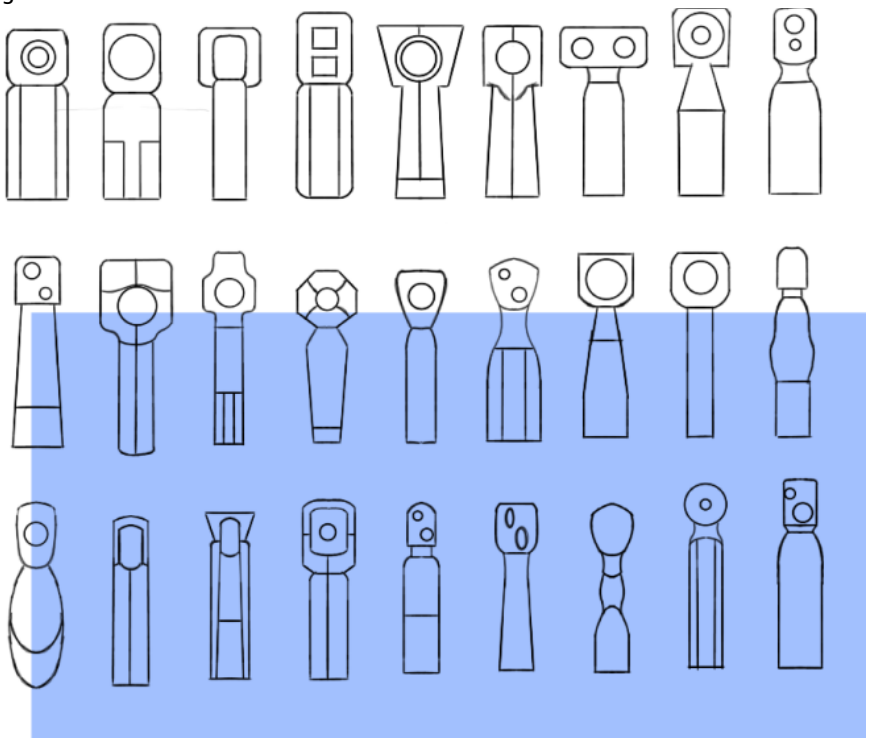


Note. Concept selection. (Bennett, 2021)

After initial ideas had been developed, it was time to move onto thumbnail sketches before moving onto development. It was important to explore different shapes before deciding on the final look. The thumbnail sketches helped to create more realistic ideas but also offer a variety of potential outcomes.

11.2 Thumbnail sketches

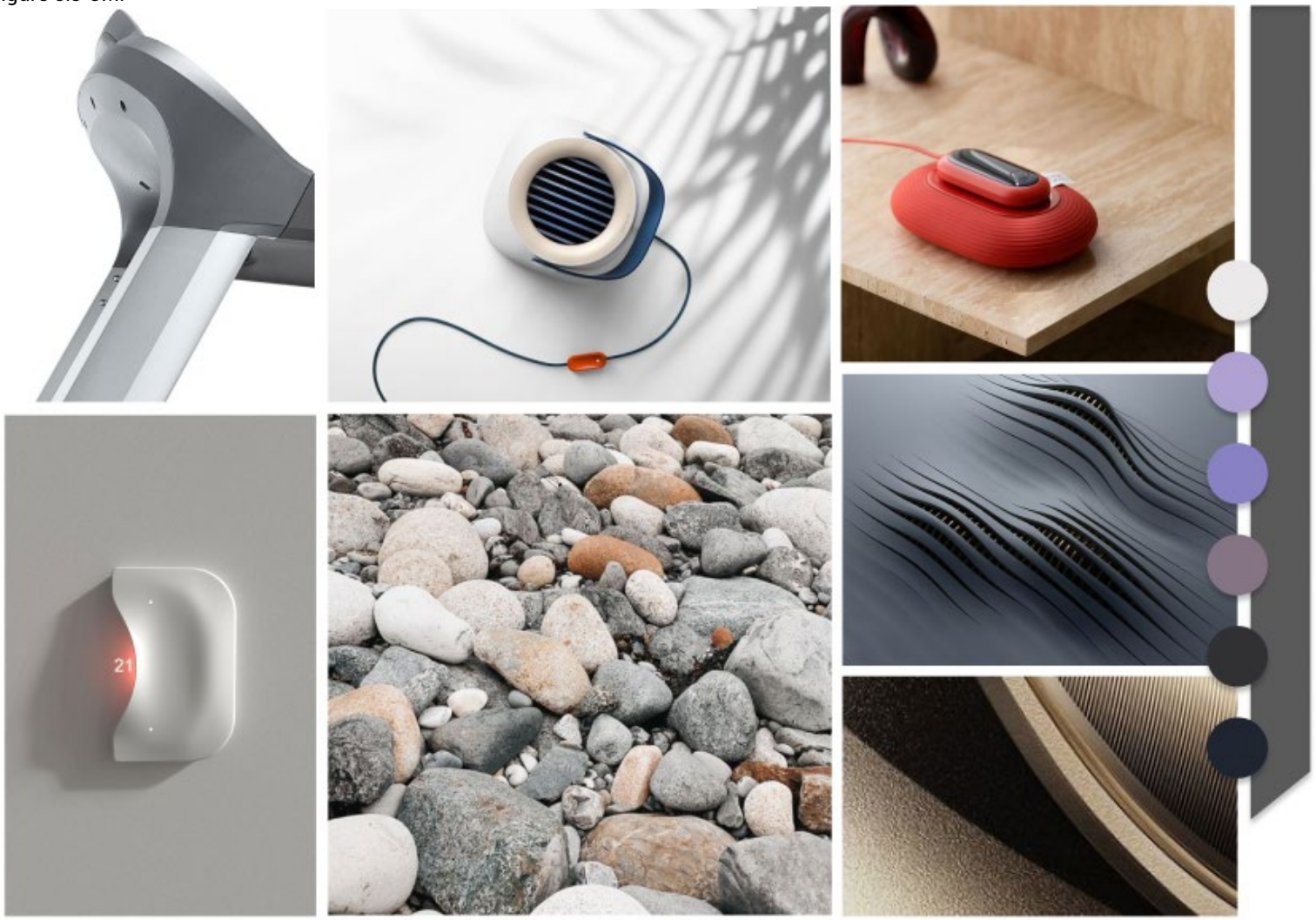
Figure 3.8 Thumbnail sketches



Note. Thumbnail sketches extraction from journal. (Bennett, 2021)

11.3 CMF

Figure 3.9 CMF



Note. CMF design board (Bennett, 2021)

11.4 Sketch modelling and 3D CAD printing

Figure 4 Sketch modelling

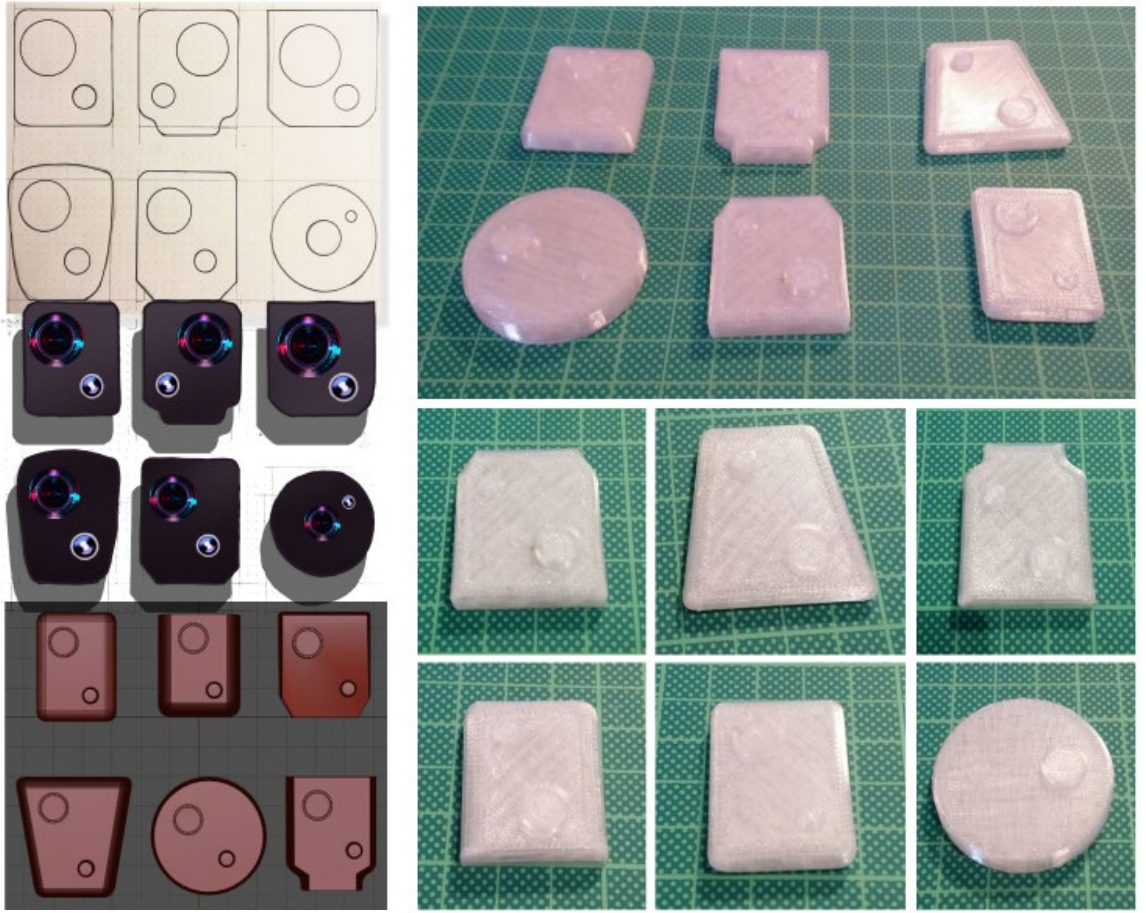
Note. Sketch modelling development work (Bennett, 2021)

Figure 4.1 Sketch modelling 2

Note. Sketch modelling development work (Bennett, 2021)

3D CAD modelling and printing were created as part of this project. Initial sketching was formed in parallel to modelling, this gave a quick and efficient way of getting ideas down. The most suitable shape(s) were selected for design development, since the face would need to fit two a camera and a sensor on, with an adequate to allow for A, B, C measurement.

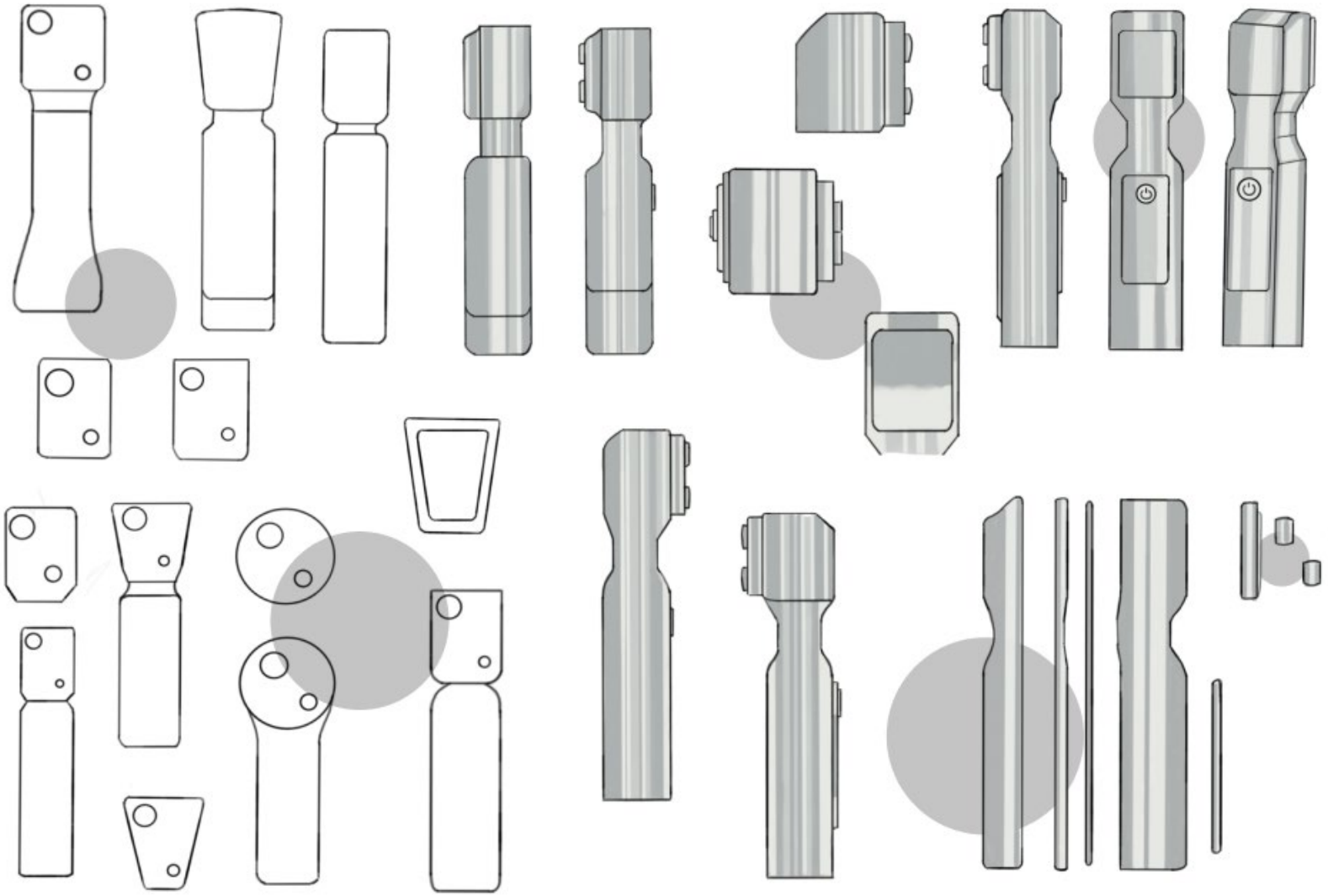
Figure 4.2 CAD and 3D printing



Note. CAD and 3D printing sensor shapes

11.5 Design development sketches

Figure 4.3 Development sketches



Note. Design development sketches from journal. (Bennett, 2021)

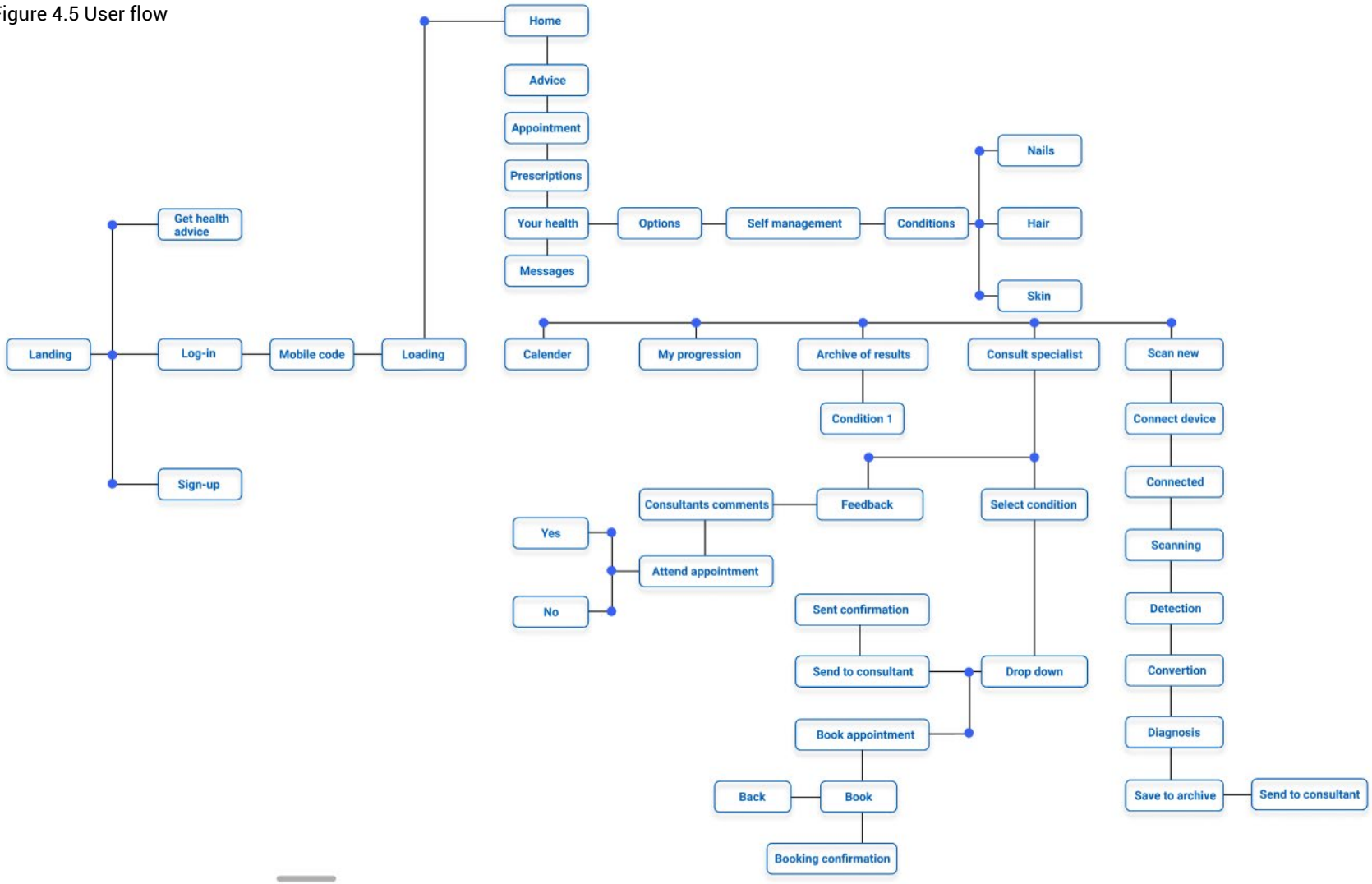
11.6 Branding

Figure 4.4 Branding

Note. dermate branding ideation. (Bennett, 2021)

12.0 App / Web development: user flow

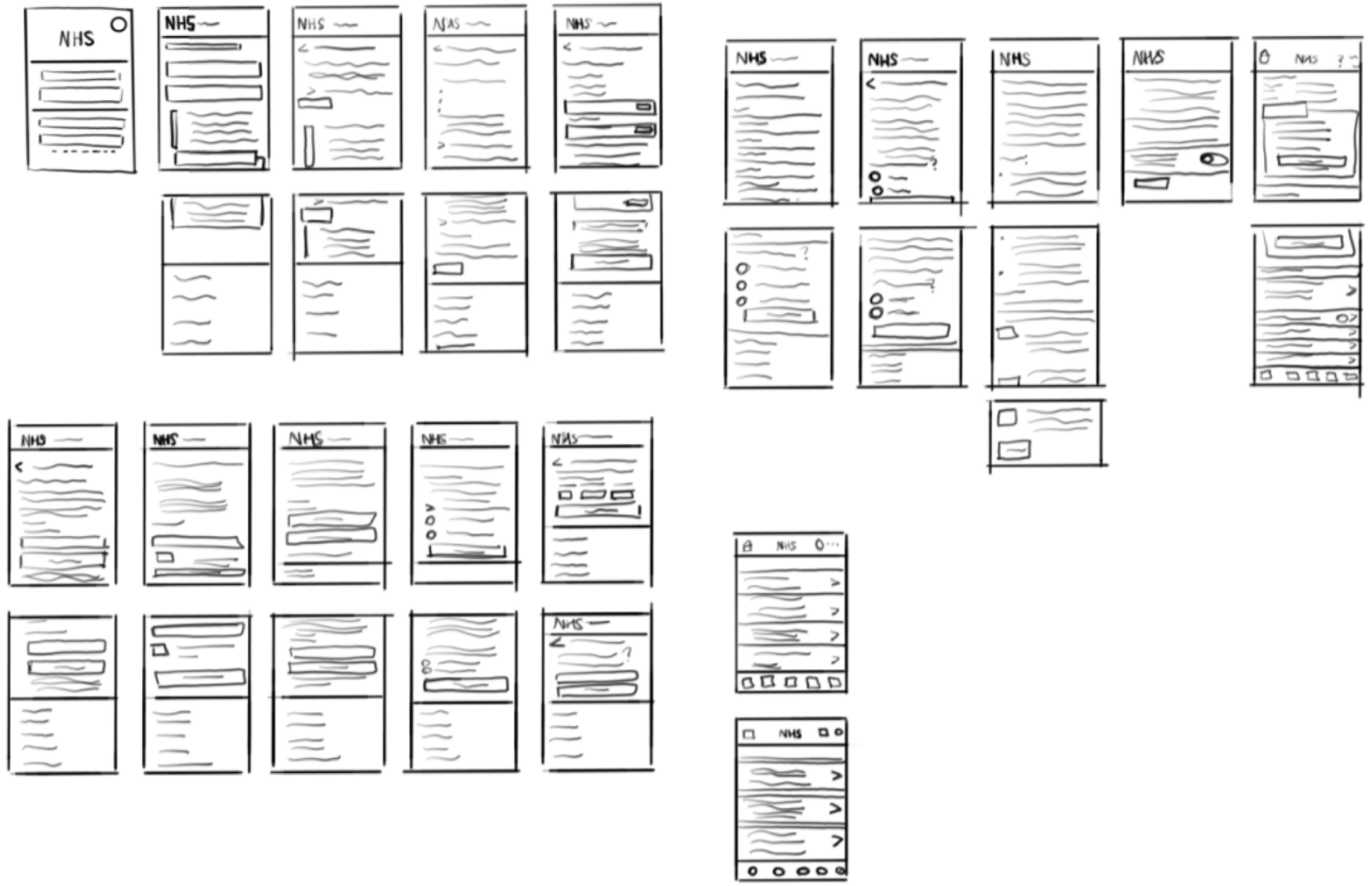
Figure 4.5 User flow



Note. Web and app user flow (Bennett, 2021)

12.1 NHS onboarding flow

Figure 4.6 NHS onboarding flow



Note. Hand sketches / Current NHS onboarding flow (Bennett, 2021)

12.2 App final screens

Figure 4.7 Final screens

Note. Final screens app and web. (Bennett, 2021)

12.3 App user testing

Figure 4.8 User testing

Test goals:

- User navigation (A to B)
- Understanding the purpose
- Any pain points / improvements
- Overall feedback

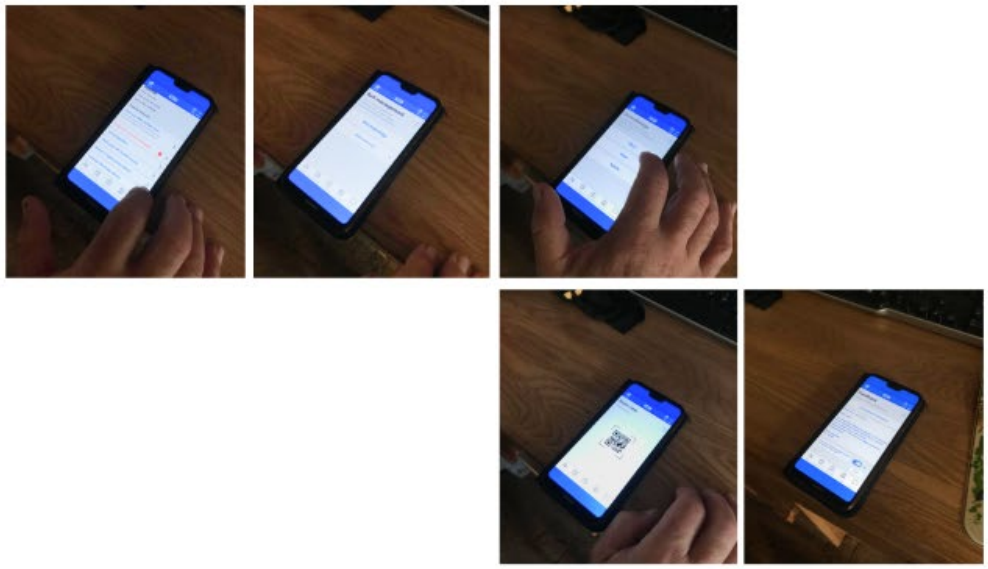
Pain points / improvements

- Allow booking options (user 1)
- Buttons at the start should be clickable (not just arrow) (user 1)
- Sometimes would intuitively scroll (user 2)
- Some headings look like buttons (user 2)

Overall feedback

- Loves the concept (user 1)
- Would use it (user 1)
- Likes that data can be stored privately (user 1)
- Understands navigation (user 1)
- Easy to use (user 2)

Test: User 1



Test: User 2

Note. Testing the app through Figma mirror on two users for feedback. (Bennett, 2021)

13.0 Final solution

The final solution is called Dermate. Dermate can analyse and diagnose hundreds of different skin conditions through its nano-array plasmonic sensors and AI technology. The nano-array sensors aim to detect a condition, which is sent live to the app and then will use AI to convert the data into a diagnosis. Although the project started with accessibility in mind, it can be used by many types of users.

Dermate offers an inclusive experience as users can either lease the handheld device from the pharmacy at a small fee and use it in their home environment, or for those without mobiles or spots that are difficult to reach, can book an appointment at their local pharmacy. People can lend it for several months if they wish to monitor their condition(s) for longer periods, which provides a cost-effective solution. They can also order dermate online for the period of time they need, and have it delievred to their house. This is especially beneficial for those who live in more rural areas.

The device connects with a dermatology integration as part of the NHS health app.

The device is made mostly of recycled aluminium, one of the green materials. Offering a lightweight experience but also sturdy and long-lasting.

The hardware combined with an NHS intergrated app allows users to self-diagnose conditions, and also sends results to a consultant for further checking, in more serious cases. This allows for time to be saved in the early stages of diagnosis and also reduces people booking appointments when their condition is less serious, easing pressures on the NHS.

13.1 Product heroshot

Figure 4.9 Heroshot

Note. Heroshot: dermate. (Bennett, 2021)

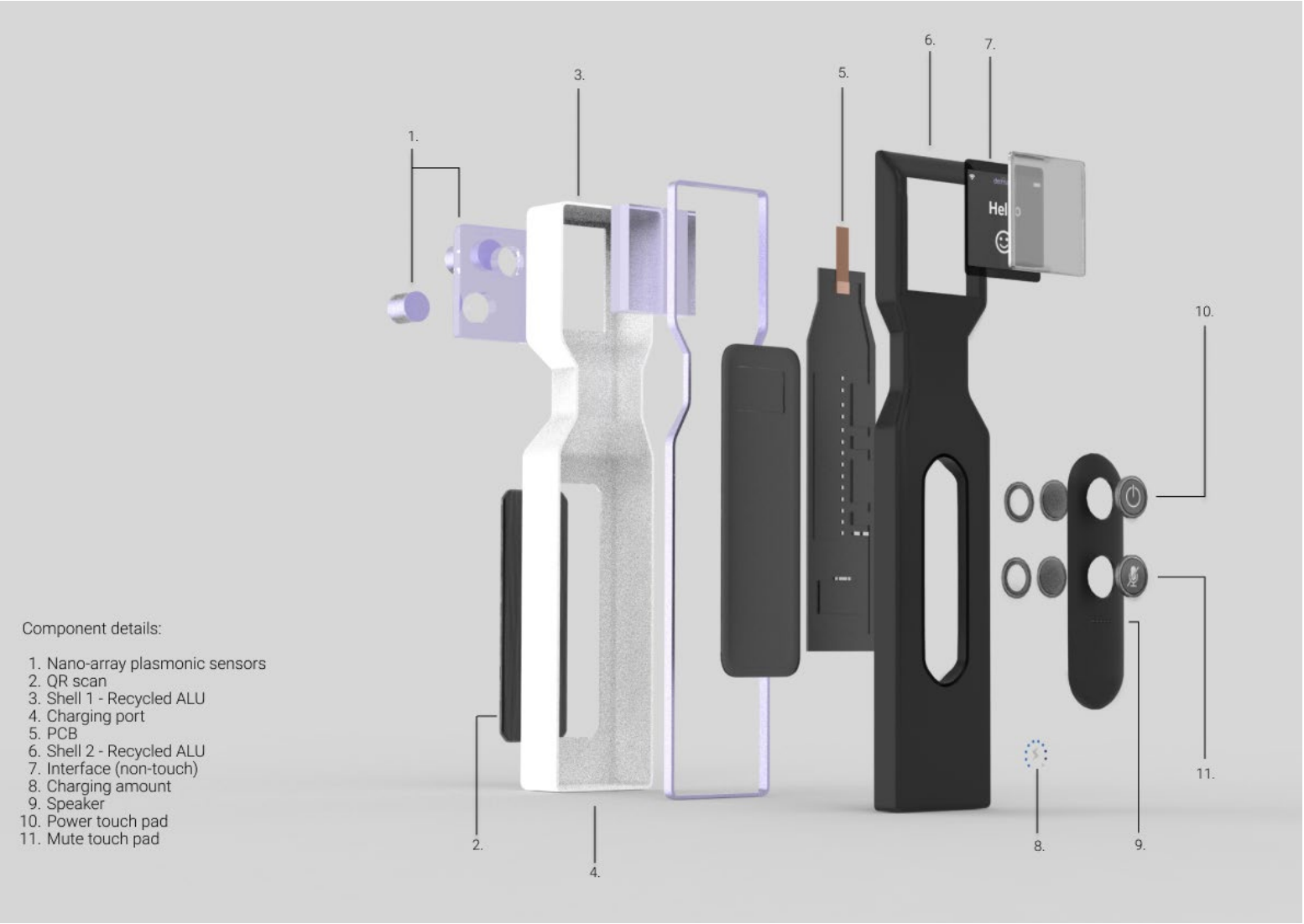
13.2 Product action shot

Figure 5.0 In action shot

Note. Patient using dermate to self-diagnose (Bennett, 2021)

13.3 Product exploded view

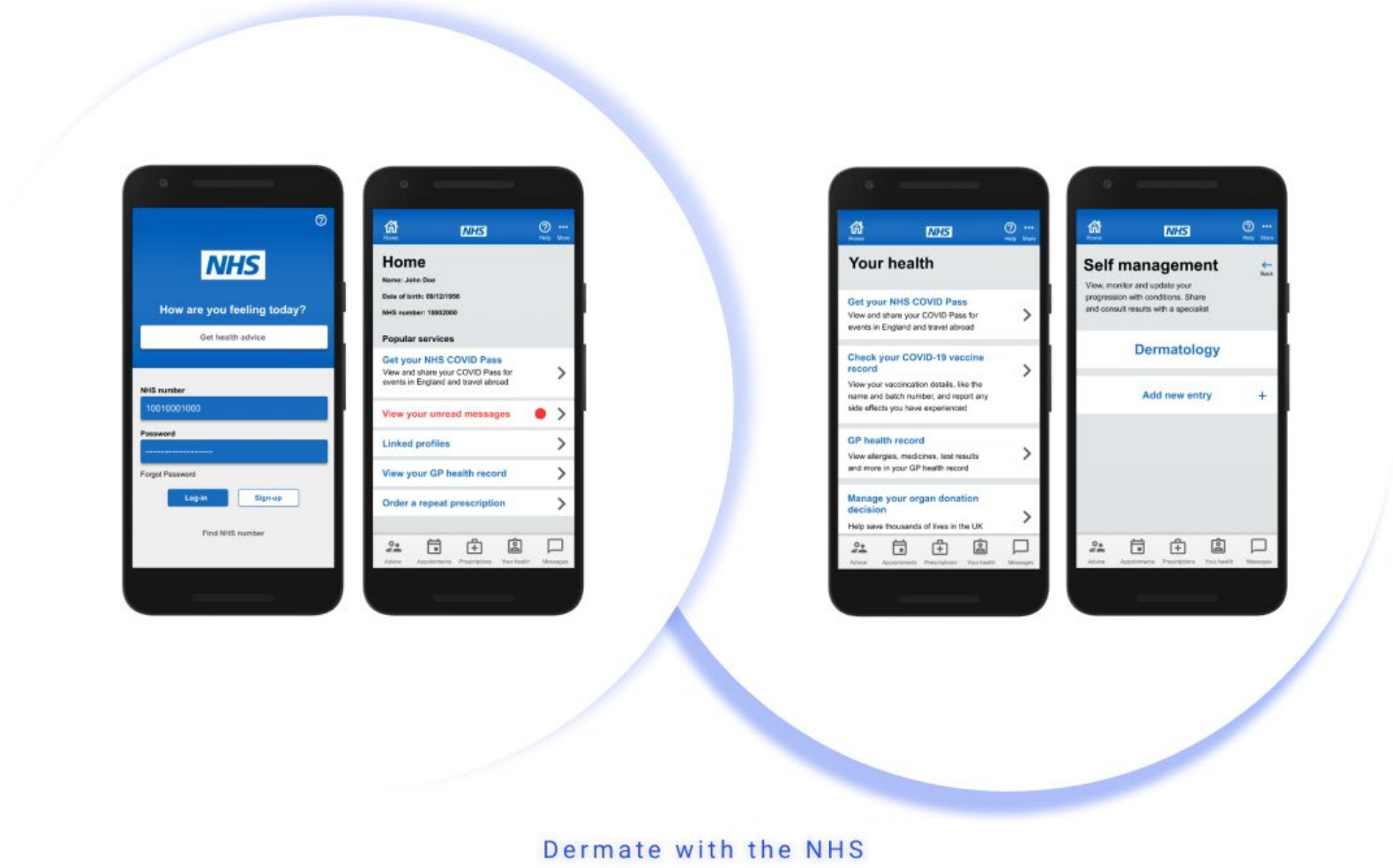
Figure 5.1 Exploded view



Note. dermate exploded view (Bennett, 2021)

13.4 App heroshot

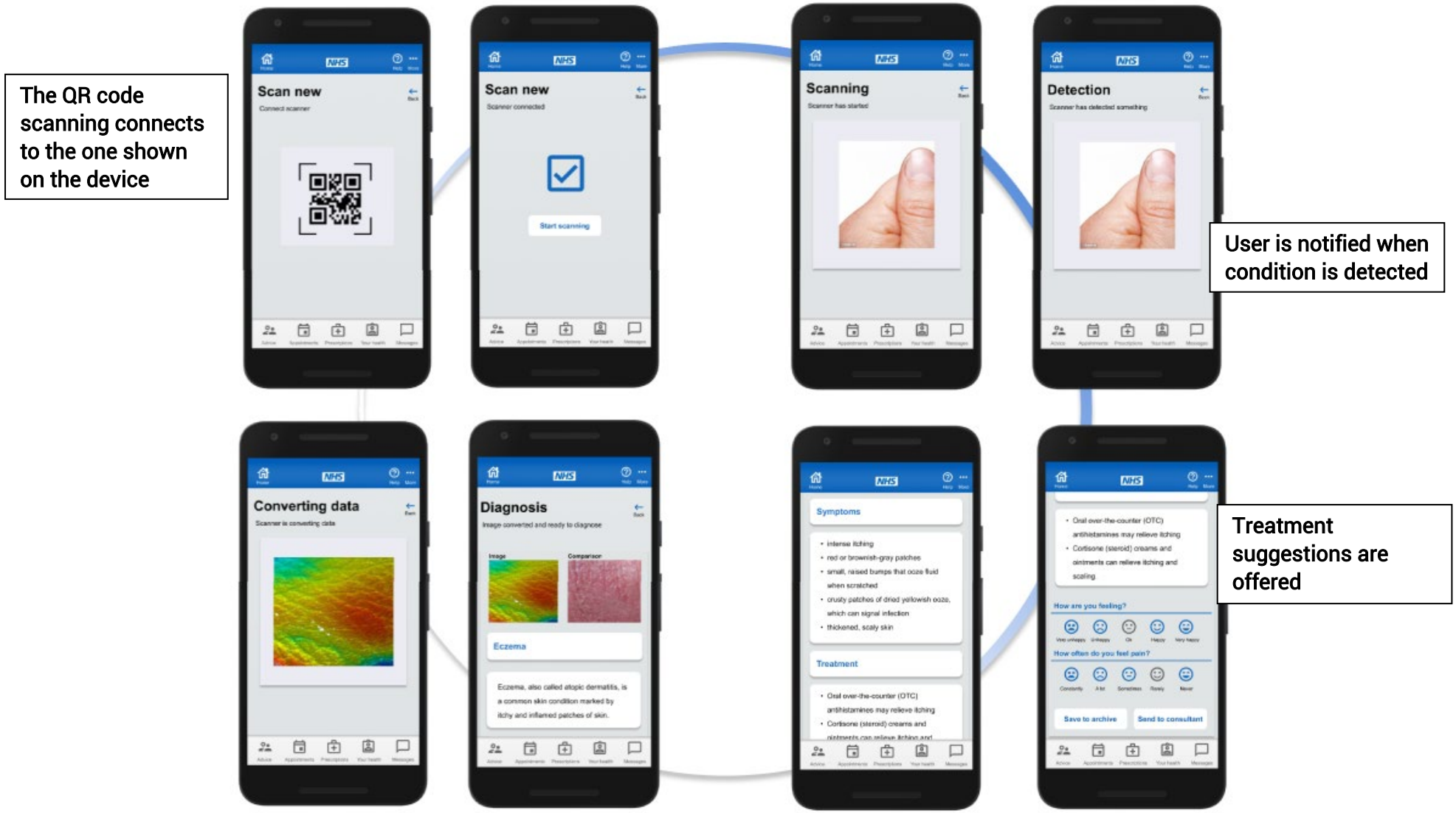
Figure 5.2 NHS / dermate app heroshot



Note. NHS/ dermate heroshot intergration (Bennett, 2021)

13.5 Final screens

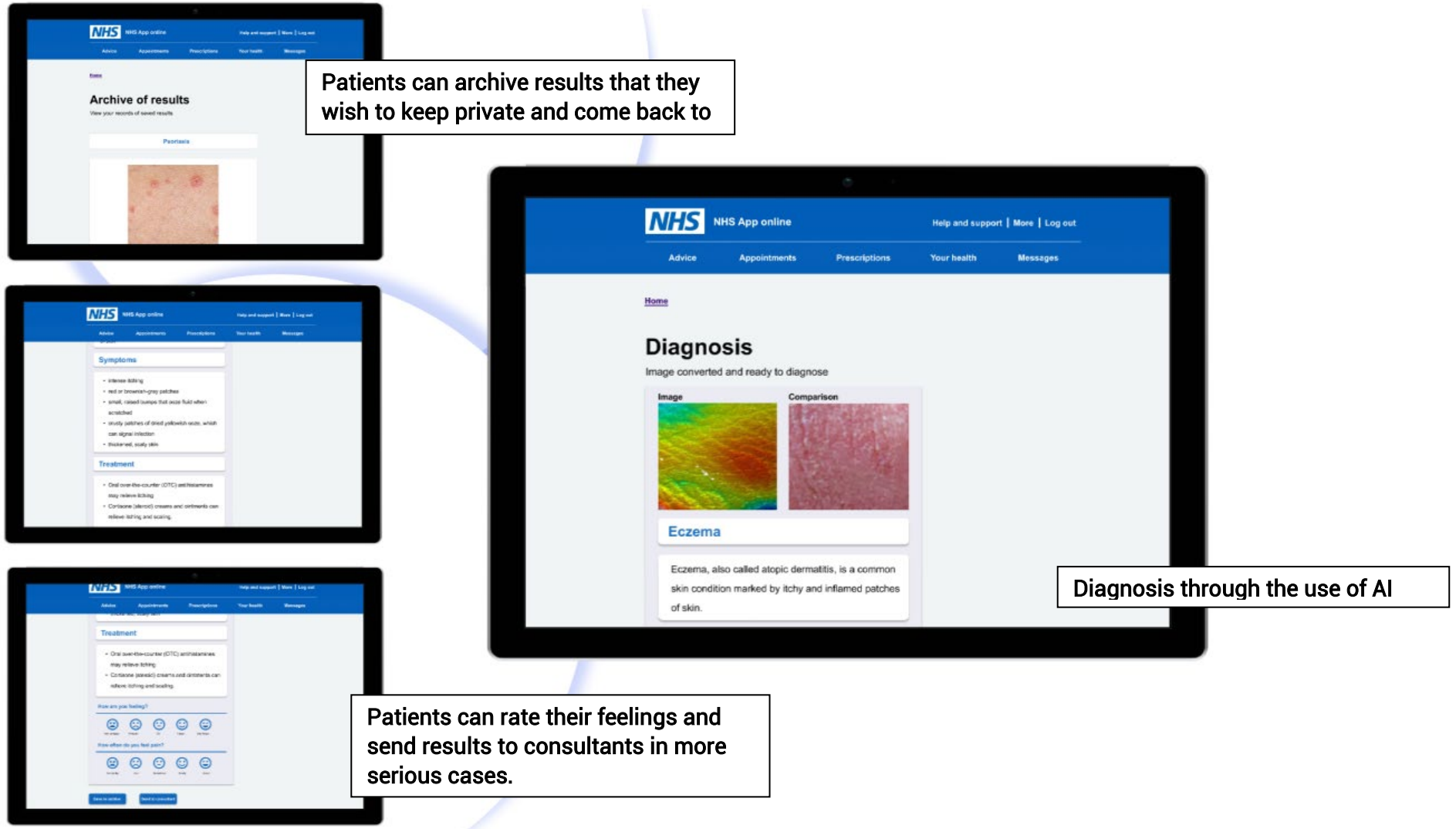
Figure 5.3 NHS / dermate app heroshot 2



Note. NHS/dermate final screens of the scanning process (Bennett, 2021)

13.6 App and tablet mode

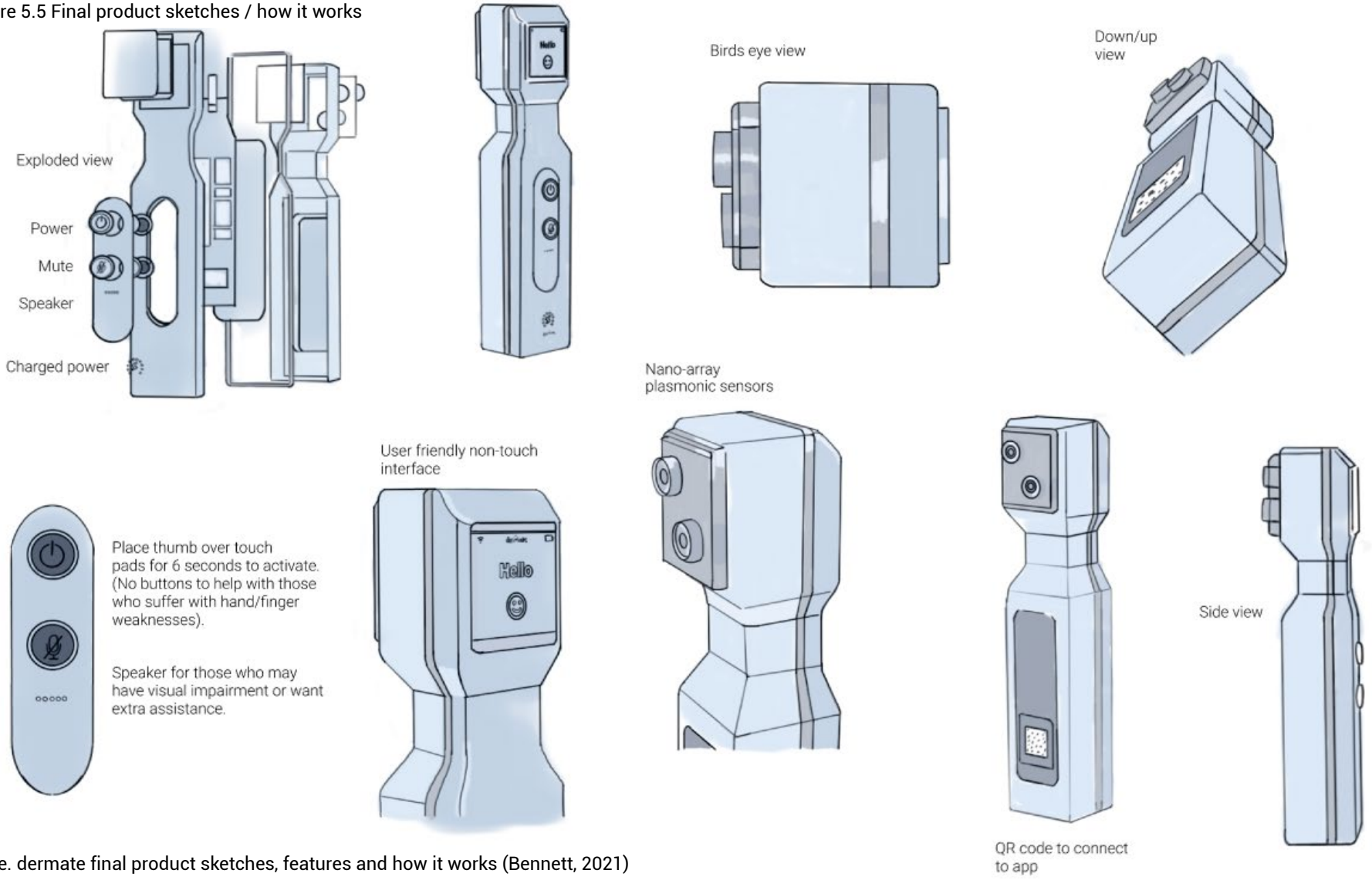
Figure 5.4 NHS / dermate tablet mode



Note. NHS/dermate tablet version of the scanning process (Bennett, 2021)

13.7 Final product sketches / how it works

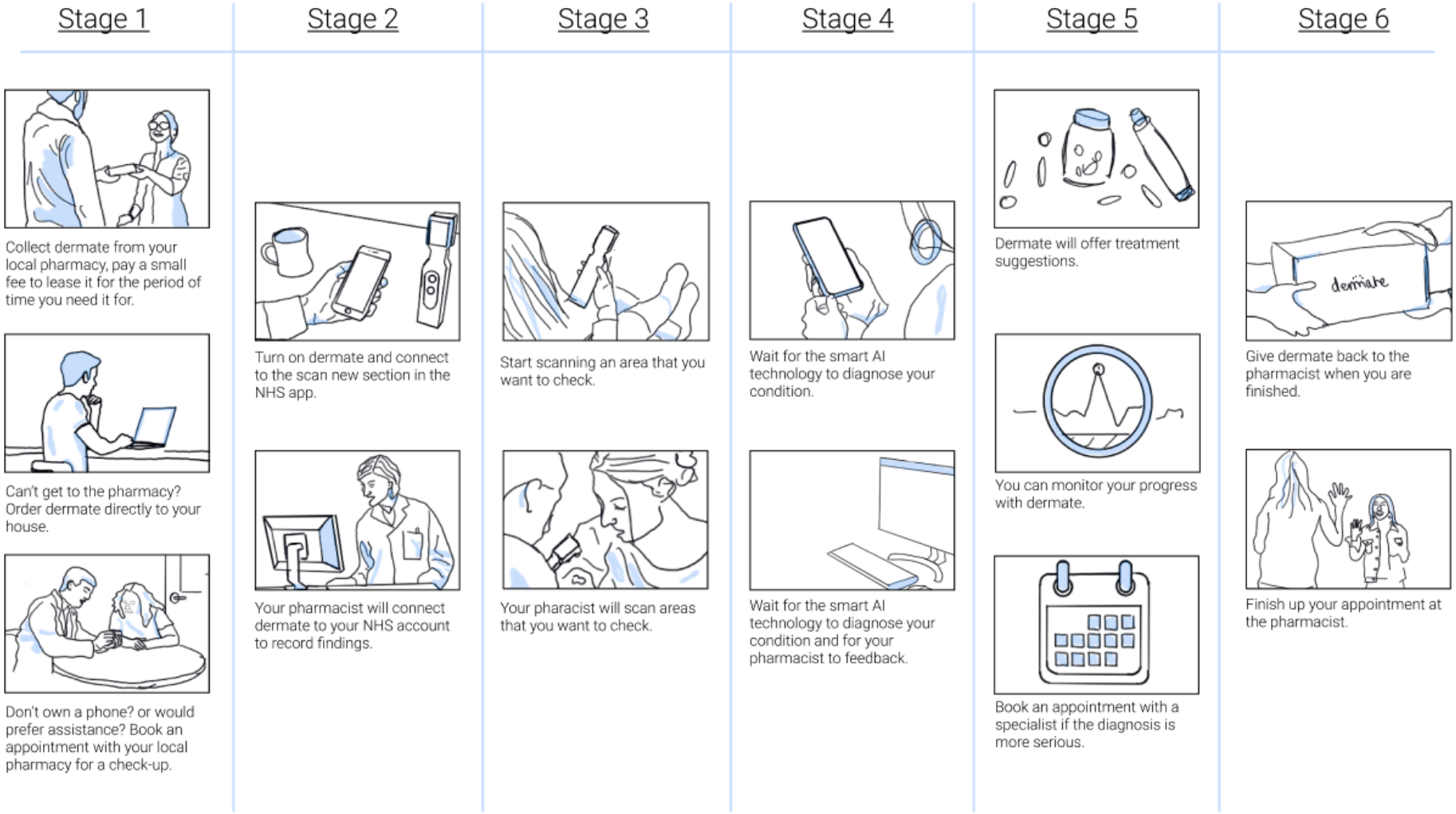
Figure 5.5 Final product sketches / how it works



Note. dermate final product sketches, features and how it works (Bennett, 2021)

13.8 Inclusive user story

Figure 5.6 Inclusive user story



Note. User process of using the product (Bennett, 2021)

14.0 Design Reflections

This project started with questioning how a blind person would be able to detect and monitor their skin, hair, and nail conditions, if they were not able to see or feel them and did not want to consult a doctor first. This was a pivotal finding in the primary research since it tied in with the secondary discoveries at looking to the future of health in the home environment. This project shows the importance of research in the design process and how it feeds into the final design outcome. The project at hand was a challenging but exciting one and highlights how design and technology can be used to our advantage to solve global issues. Investigating further into accessibility and inclusive design has been incredibly insightful for this project and shows why designers should incorporate accessibility into their processes, to not just benefit business but most importantly the users, and to avoid unnecessary exclusion from their products.

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Acknowledgements

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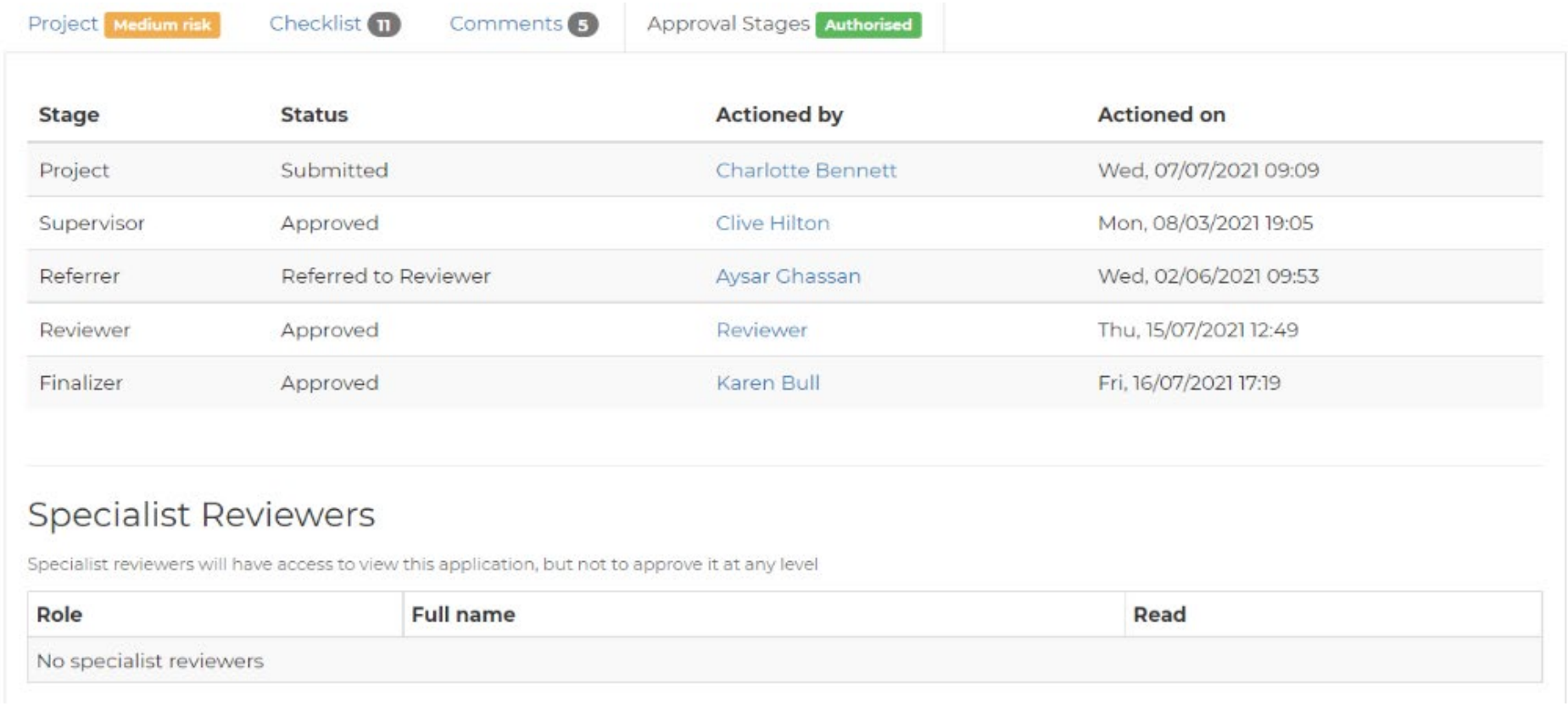
Appendix 1. Ethics application



Project Medium risk | Checklist 11 | Comments 5 | Approval Stages Authorised

Stage	Status	Actioned by	Actioned on
Project	Submitted	Charlotte Bennett	Wed, 07/07/2021 09:09
Supervisor	Approved	Clive Hilton	Mon, 08/03/2021 19:05
Referrer	Referred to Reviewer	Aysar Ghassan	Wed, 02/06/2021 09:53
Reviewer	Approved	Reviewer	Thu, 15/07/2021 12:49
Finalizer	Approved	Karen Bull	Fri, 16/07/2021 17:19

Specialist Reviewers

Specialist reviewers will have access to view this application, but not to approve it at any level

Role	Full name	Read
No specialist reviewers		

Appendix 2. Glossary

AI – Artificial Intelligence

"Refers to a broad field of science encompassing not only computer science but also psychology, philosophy, linguistics and other areas. AI is concerned with getting computers to do tasks that would normally require human intelligence." (Stefan van Duin and Naser Bakshi, 2017)

Brexit

An exit (= act of leaving) by the United Kingdom from the European Union (short for "British exit"), (Cambridge Dictionary, 2021).

British Medical Association

The British Medical Association *(*BMA*) is the trade union and professional body for doctors and medical students in the UK,* (BMA, 2021).

Dermatology

The scientific study of the skin and its diseases (Cambridge Dictionary, 2021).

Determinants

Something that controls or affects what happens in a particular situation (Cambridge Dictionary, 2021).

Ethics

The study of what is morally right and wrong, or a set of beliefs about what is morally right and wrong (Cambridge Dictionary, 2021).

EU – European Union

The European Union is a unique economic and political union between 27 EU countries that together cover much of the continent (European Union, 2021).

NHS – National Health Service

It refers to the Government-funded medical and health care services that everyone living in the UK can use without being asked to pay the full cost of the service (Fullfact, 2017).

RNIB – The Royal National Institute of Blind People

The UK's Leading Charity Supporting Blind and Partially Sighted People (RNIB, 2021).

WHO – The World Health Organisation

WHO's primary role is to direct international health *within the United Nations' system and to lead partners in* global health *responses* (World Health Organisation, 2021).

Appendix 3. Interviewee participation form

PARTICIPANT INFORMATION STATEMENT

The aim of this study is to investigate how visually impaired and blind people interact with current domestic products and existing technologies to better understand challenges, opinions, and areas of improvement. The study is being conducted by Charlotte Bennett at Coventry University. You have been selected to take part in this questionnaire survey because you will be able to give invaluable insights into your interactions with current domestic products and technologies. Your participation in the survey is entirely voluntary, and you can opt out at any stage, by informing the gatekeeper. If you are happy to take part, please answer the following questions relating to creating a more inclusive user experience in the field of domestic consumption.

1. What are some of the challenges you face in day-to-day life?

I am a totally blind person, and the society is getting to the state of mainly using hi tec Touch screen but less accessible devices. For example, I bought a new kitchen recently and I looked into induction cookers, they are mainly touch screen or would link to an app, these apps, however, are often changing in accessibility. To find the right one, is rather difficult. I also bought a new microwave, it is not a touch screen Microwave, I was told, however it has a touch screen as well as dials and the power button and start and stop is only a touch screen button.

I have ways to mark up those with little bump on *please see www.rnib.org.uk/shop

For more details you can get them in different colours, sizes, or see through, but I'm not very keen to mark up my kitchen that I paid loads of money for, with bump on if I could achieve this in any other way.

Looking for devices/appliances we can use means, we often have to go for low level devices without a touch screen and this isn't, really, what I'd like to do!

2. How does your impairment impact or not impact the way you complete daily tasks?

I am a very positive person, and I strive to achieve what I set out to achieve, however if a website I need to use is not accessible then I would struggle for a bit, if an app is not laid out the way it would help, i.e., certain buttons aren't labelled this is, what just prolongs the task and creates difficulties!

I am trying to find a solution even it means that I need to find a round about solution – for the time being, or I need to get assistance every now and then with a task, in order to learn how to do it myself, if it is not accessible, but it is true to say, we live in a sighted world, I must say however, that I'm amazed at people's attitude to take to accessibility, and to strive to make online platforms like MS teams or zooms or such accessible. I think we have done a lot in this field and it is easier to live in a world with a lot of technology to enable us to live without any barriers.

3. Which products do you benefit most from using?

I use a smart phone with various apps to aid me in a lot of tasks at home to name a few:

- Scanning letters and communications
- Identifying bank notes
- Communicating with friends
- Producing online orders /shopping etc
- Online banking
- Keeping in touch with friends
- Researching online

I use a smart speaker *amazon Echo*

I have a few other products that are products made for blind people:

A digital talking kitchen and bathroom scale
Measuring spoons and cups *for baking*
Bump ons for identifying touch screen elements etc.
Braille typewriter or note taker.

4. How are these products tailored or not tailored to your needs?

A few products just work out of the box *see smart phone, smart speaker*
They have an accessibility menu where I can alter settings i.e., switch on a screen reader or magnification and a lot of more accessibility settings.

Then there are products like the kitchen scales etc. that are especially produced for blind people and they consist of larger buttons *because a lot of elderly people are blind as well* and speech /text to speech menu's*

5. Are there any products that you find challenging to use or are simply unable to use?

Yes, self-service systems/machines/terminals in hotels or airports etc.

6. How do you work around these impacts to get what you need?

I need to ask for sighted assistance or try to do this online with a screen reader on smart phone or computer.

7. What technologies if any, do you currently use and why?

I use a screen reader on any technology that I use as I am totally blind, I don't need magnification.

8. What do you like and dislike about these technologies?

I dislike that a screen reader I prefer *jaws* is rather expensive I know I can get a free one but obviously I prefer this one, I dislike that some aspects like graphics or carousels or spin boxes of some sorts are still rather inaccessible, but it has gotten a lot better over the years and I'm glad that we have this opportunity.

Your answers will help us to identify key challenges you face with existing products and your opinions. The questionnaire should take approximately 10-20 minutes to complete depending on the length of your answers. Your answers will be treated confidentially and the information you provide will be kept anonymous in any research outputs/publications. Your data will be held securely on the researchers Coventry University OneDrive account with password protection. All data will be deleted by the 16th of August 2021. The project has been reviewed and approved through the formal Research Ethics procedure at Coventry University. For further information, or if you have any queries, please contact the lead researcher Charlotte Bennett bennettc2@uni.coventry.ac.uk. If you have any concerns that cannot be resolved through the lead researcher, please contact Clive Hilton at ab2359@coventry.ac.uk. Thank you for taking the time to participate in this survey. Your help is very much appreciated.

I have read and understood the above information.

☐

I understand that, because my answers will be fully anonymised, it will not be possible to withdraw them from the study once I have completed the survey.

☐

I agree to take part in this questionnaire survey. I confirm that I am aged 18 or over.

☐

I agree to the above

Date: 05/05/2021
Madleen Bluhm

From: Madleen Bluhm <[redacted]>
Sent: Tuesday, May 18, 2021 12:32:02 PM
To: Charlotte Bennett <charlottebennettdesign@hotmail.com>
Subject: RE: [EXTERNAL] Research project

Hi Charlotte

You can add my name to the report and
If I can help any time during now and the final touches do not hesitate to come to me!

Best regards,

Madleen Bluhm
Technology for Life Coordinator – South East of England / Cydlynydd Technoleg am Oes – De Ddwyrain Lloegr
RNIB Technology for Life Team / Tîm Technoleg am Oes RNIB
Desk: [redacted]
Mobile: [redacted]
Email: [redacted]

I am an English Speaker

Website: www.rnib.org.uk
Facebook: www.facebook.com/rnibuk
Twitter: www.twitter.com/RNIB

From: Charlotte Bennett <charlottebennettdesign@hotmail.com>
Sent: 18 May 2021 10:23
To: Madleen Bluhm [redacted]
Subject: RE: [EXTERNAL] Research project

CAUTION: External. Do not click links or open attachments unless you know the content is safe.

Dear Madleen,

Thank you very much for your responses, they have been very insightful. As I continue with my research I would like to keep your updated with my ideas. When I finalise the report, would you mind if I add your name with a thanks or would you prefer to remain anonymous? Thank you.

Best regards,
Charlotte

(Participant was happy to be mentioned in the report).

Appendix 4. List of figures