A Design Perspective on Future Healthcare Services for the Home Environment

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Abstract

A recent paradigm shift in healthcare merges the traditional domains of cure and care in healthcare services with prevention and provides all of us with more participation as well as more responsibility in our own healthcare. This shift creates not only a need for personalization of services but also a design challenge with respect to inclusion and acceptance. Healthcare moves into people's homes and merges medical devices with services hereby enlarging the current contrast between medical device cleanliness and the often cozier and textile-rich home environment. These developments bring important design challenges that will be addressed in this chapter, thereby raising important questions for the implementation of a new design perspective on healthcare.

1 Introduction

The recent paradigm shift in the organization of healthcare that places (ICT supported) care technology in the homes and lives of people calls for a deeper analysis of the impact of this development. Important questions arise as to how this development will affect the (perceived) quality of care and people's feeling of independence. Further, questions have to be asked about how care technology (often combination of medical devices and services) has to be developed in such a way that people will not feel

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M. A. Pfannstiel, C. Rasche (eds.), *Service Design and Service Thinking in Healthcare and Hospital Management*,
https://doi.org/10.1007/978-3-030-00749-2_10

threatened by allowing the technology into their home but, rather, are confident to welcome it into their lives. In many cases, treating people at home is less expensive and at the same time offers the benefit of empowering the individual patient to be in control of their own care process. However, the design of healthcare devices and services for at-home use needs attention. Whereas traditional development of healthcare services has focused on designing medical equipment and service interfaces to be useful and usable for professional and experienced staff of hospitals and clinics, healthcare services now also have to be useful, useable, and even desirable to use by people at home. In a future of healthcare where people take care of their health throughout their lives, they will be supported by a system of objects, services, and people in their homes. This brings the design of medical devices and services to the domains of interaction design and design for experience. A desirable healthcare service (a service that patients will want to use) might in some cases conflict with efficiency of the service.

Designers of the healthcare services of the future need to design both for the healthcare professional side and for the patient home side (see Bitterman, 2011; Wildevuur, 2017). Moreover, these two should understand each other and match. In designing for the patient home side, there is much to gain: a better design that acknowledges people's experience of their bodies and the context in which they will use the design (their home) will lead to better use and acceptance of the design. Simply providing information may not be sufficient to evoke action in people. The home context, the situation where people receive information, and the state of mind they are in will be important for the design of these future healthcare services. In this chapter, we will discuss two perspectives on designing for the patient home side: (1) a focus on the physical aspects of the human being and (2) a focus on the home experience. In the first, a body-centered design approach is essential. In such an approach, a designer needs to consider how a healthcare service might adapt to people's capabilities and how it might conflict with or stimulate sensory pleasures. In the second, the designer needs to consider the aesthetics and practicalities of the home environment as well as how the home context might influence the use of the healthcare service and vice versa.

These starting points will contribute to establishing a design space for designing health(care) products and services for the home environment. An inclusive and effective design project would address both of these points at some point in the design process, but the starting point might be different. In this way, we aim to contribute to an inspiration catalogue for healthcare services design of the future. Before we further elaborate on how to design from these two starting points, we will first further discuss healthcare at home today and in the near future. We will end the chapter with a discussion on important issues and debates around the domestication of healthcare.

2 Current Design for Healthcare at Home and the Way Forward

The recent paradigm shift in the organization of healthcare has led to a growing number of people who monitor their health, manage a disease, or follow some kind of treatment at home. These activities can take several forms; people can either completely monitor and self-manage their health, they can collect data about health parameters that are then send to a health professional, or they can use a form of telehealth or telecare where they communicate with a health professional at a distance. Monitoring health parameters at home or following treatment at home potentially empowers patients and is often less demanding and less expensive. However, it may also mean that patients can't rely on a caregiver to support them and often problems with adherence exist. This section will briefly outline current practices of healthcare at home and the expected changes in the near future.

2.1 Healthcare at Home

Technology plays a determining role in how we have shaped healthcare services and how we will shape the healthcare services and, indeed, the healthcare systems of the future. Since their inception in the 1940s, technology-supported healthcare services have undergone rapid changes, accelerating in the last few decades. Specifically, since the introduction of smart devices, the use of telehealth and telecare services has rapidly grown. This development also denoted the start of making connections between medical devices and consumer electronics. In 2010, Bayer Diabetes Care in the UK introduced the Didget, a blood glucose meter that connected to a Nintendo game computer (Diabetes.co.uk, 2010). This connection allowed children to manage their diabetes by rewarding them for consistent testing habits with points to unlock new game levels and options. Since then, connected products have never left the health domain because they have proven to be an essential part in solving some of the challenges that are currently dominating the health(care) landscape. An aging population and an increased attention for patient-centered care (see, e.g., Anderson & Funnel, 2005) have led to a paradigm shift in healthcare where the emphasis is placed on self-management in both health and disease. ICT-supported care can support self-management, online therapy, and connections to health professionals, and within this field, smart connected devices will play an increasingly important role.

So far, implementation of smart networked technology in self-management of health(care) has been targeted either at prevention of disease (e.g., leading a healthier lifestyle supported by an object that tracks your steps), at (self-) cure of a disease supported by a health professional (e.g., following an online or blended therapy), or at care at home (e.g., solutions that support people with dementia to live at home and that, for example, track their behavior). A future where these three areas will connect and in which we will collaborate with objects in distributed systems to monitor,

manage, and maintain our health as well as to (self-) cure and to care for us is very well imaginable.

Indeed, several future visions on healthcare echo aspects of this idea. In their HC2020 Signals & Forecasts Map, the Institute for the Future (2009), for example, identifies how self-tracking could lead to integration of data that is gathered by people in a prevention phase to application of insights in research and development and in treatment practices. Moreover, one of the global players in healthcare industry, Philips, envisions a future where healthy living, prevention of disease, and treatment are looped and supported by connected systems that work "across a patient journey".

A future scenario might foresee someone managing their health using a device that monitors their blood pressure or heart rate and that alerts a health professional when measurements are off the normal range. At some point in her life, this person might be confronted with adversity, which results in experiencing high levels of stress for a considerable time period; this may lead her to start a therapy that is (for some time) monitored by a health professional. Later in her life, she might develop a chronic condition and need continuous care, but she might be able to continue living at home, supported by several sensing objects that connect to her health system (which in its turn connects to the health professional system). Throughout her life, this person has lived with an evolving healthcare system in which both people and objects play a role as care entities.

Much of the research and development in the domain of designing medical devices for use in a home environment has so far focused mainly on ergonomics and preventing mal-use. The above scenario shows that bringing in the human perspective, in the sense of designing for engagement in use and pleasure of using and owning products, is essential. After all, we can only benefit from a future where we will interact with healthcare services and systems throughout our lives if these services are seamlessly integrated into our daily lives and activities.

2.2 Technology, Engagement, and Personalization

At-home healthcare services have been portrayed as a simple necessity, solving the issues with rising costs and demands in healthcare. In line of this necessity, they have also been portrayed as the Holy Grail, enabling patient-centric care at the point of need and "aging in place." On the other hand, it has been argued that the technology that is needed to support such healthcare services will take away the warmth of human care (Pols & Moser, 2009 further discuss this perceived discrepancy between cold technologies and warm care). As so often in such debates, the truth probably lies somewhere in between. However, how we design such technology-supported care systems will have a large influence on the final impact on the lives of people who use them, be it patients, family members, or other informal caregivers as well as professional carers.

We know from implementation of e-health and personal health systems that adherence can be an issue. However, there is a role for design in this development, a role that (interaction) design has played before when new technologies were

introduced: that of connecting people and technology. In a discussion on the role of design in behavior change support systems, Ludden, van Rompay, Kelders, and van Gemert-Pijnen (2015) have argued how engagement with a health support system can lead to health improvements following two routes. Not only can design play a role in keeping people engaged with a health system or intervention, leading to sustained use and hence to a better general outcome (improving effectiveness of the intervention), design can also engage people in the direct interaction with the health system or intervention. In its turn, this will lead to sustained and repeated use which will eventually have a positive effect on the effectiveness of the intervention.

Internet of Things (IoT) technology allows us to move beyond therapies and e-health solutions that are hidden inside computers or mobile phones allowing the technology to become a more integral part of people's daily activities instead of (web-based) support tools that exist alongside these activities. In this way, such systems could offer a more meaningful way of interacting, predicting, and adapting. We need new or adapted design tools that help designers consider the dynamic nature of distributed connected healthcare systems. In a situation in which people and objects have to collaborate to manage health or cure a disease, it makes sense to start thinking of objects as social actors in a social environment such as the home.

Moreover, for healthcare support systems, it is essential to understand how to design for engagement at different levels of interaction. One area that we might learn from is in virtual and gaming research studies. In this domain, presence and immersion are seen as important contributors to engagement (Crutzen, van 't Riet, & Short, 2016). Immersion in this context refers to a state of high motivation to play the game, while retaining some awareness of one's surroundings. Presence refers to the experience of being personally and physically inside a virtual environment. In an IoT environment, it seems relevant to study the presence of a system in someone's life and environment to study engagement at the system level. Crutzen et al. (2016) goes on to argue that a clearer and more useful conceptualization of engagement would see engagement as a motivational construct that goes beyond the specific time that is spent playing (e.g., actual use as an outcome). In other words, people can be engaged in using a healthcare support system both during the direct experience of the system (with important determinants being enjoyment, aesthetics) and when they are not directly experiencing the system (but, e.g., may be thinking about the system). An important determinant for the latter level is involvement (see, e.g., Kelders, 2015). While this sheds some light on the concepts that contribute to engagement, we still know little about how to design for this engagement at these different moments in time and levels of interaction.

Healthcare design traditionally focuses on providing products and services that compensate the degrading effects of declining health. For instance, walkers are provided to compensate reduced walking capabilities. Future healthcare services will increasingly also include a focus on improving overall well-being and a focus on enabling the preservation of those values, and activities in life that are most important to people will be just as important. Where a loss in capabilities can generally be determined objectively, values and activities that are most important to people to preserve in life are rather subjective and of a personal nature. Healthcare design that aims at improving overall well-being therefore increasingly requires a

personalized approach. Personalization becomes even more important now that healthcare services are moving into the home, an ultimately personalized space. Every home will provide a unique context of use where the care product or service should seamlessly fit into. Designing products that provide personalized, dedicated, and effective care for people in their home environment therefore requires a holistic approach. The design process should holistically explore and address the care that needs to be provided based on (a) the needs and values of the person, (b) the capabilities and (physical) characteristics of the person, (c) the home context for care, and (d) the state of the art in possibilities to provide this care. Fortunately, both new materials and technologies and production techniques become available that make it feasible to personalize designs with less effort.

In the next sections, we will elaborate on two perspectives that we see as valuable and inspiring starting points for designing the at-home healthcare systems of the future: designing from the *body* and designing from the *home* context. The two perspectives may be relevant for different types of healthcare at-home design challenges. In any case, a healthcare at-home service involves a body or multiple bodies and a home context, but the one may be a more relevant starting point than the other depending on the specific aim of the service. Additionally, rapid developments in smart home (e.g., IoT) technology and wearable technology bring many opportunities for designing from and with these two starting points.

2.3 Designing for and from the Body

Healthcare technologies are inevitably concerned with the body. One could argue that all technology we interact with is somehow for the body since our body is involved not only in the perception of the world as well as in the specific interaction. When it comes to healthcare technologies, both aspects are equally important. The body we design for might be disabled or in other ways encumbered (temporary or permanent) which will have an impact of how we perceive the world and our ability to interact with it. Anecdotally, a recent LASIK surgery for the second author not only enabled her to see without glasses (−7 and stigmatism) but it also changed her entire perception of what was now feasible (e.g., swimming and playing soccer), even if the same things had easily been possible before too (e.g., with contact lenses or sport glasses). Even so, she had not perceived herself as disabled, but the newly acquired 20/20 vision made her realize that she had unknowingly limited her activities because of a flawed eyesight. Thus, to design for an ill body is not only to design for functional abilities but just as important to design for perceived abilities—or possibly to deliberately challenge those.

First, it seems relevant to consider what role the healthcare technology is supposed to play in relation to our body. Here, Verbeek (2008), in an elaboration of Ihde's work, proposes five different relationships we can have with our technologies. Healthcare technologies may take on any of these relationships, but it is important that the designer considers what the most likely relationship a certain technology will have

because the relationship is more or less invasive to the user's current relationship with the world.

When looking through a pair of glasses, the glasses are not noticed explicitly but are "incorporated"; they become extensions of the human body. Secondly, technologies can be the terminus of our experience. In this "alterity relation," human beings interact with a device, as is the case when taking pills from an automatic pill dispenser (depicted in Fig. 1, left image). A third human–technology relation is the "hermeneutic relation." In this relation, technologies provide representations of reality, which need interpretation in order to constitute a "perception"—like a thermometer—which does not produce an actual experience of heat or cold, but delivers a value which needs to be "read" in order to tell something about temperature. The fourth human–technology relation Ihde distinguishes is the background relation, where technologies are not experienced directly, but rather create a context for our perceptions, like the light coming from the device used for bright light therapy does. In the cyborg relation, "a new entity comes about. Instead of organizing an interplay between a human and a nonhuman entity, this association physically alters the human" (Verbeek, 2008, p. 391). A Cochrane implant that enables the user to hear through the technology can thus be said to be a cyborg relationship where the intentionality of the technology melts with the intentionality of the user (human).

The challenge for a designer is, as Svanæs (2013) writes, that "[t]he lived body is our experienced body, the body through which we live our lives, which is different from seeing the body as an object in the world. As a resource for body-centric design, this makes us aware of the difference between using our own bodies and bodily experience as a resource in the design activities (1st person perspective) versus taking a more analytical perspective on the body (3rd person perspective)" (Svanæs, 2013, p. 2). Researchers at the Design Academy Eindhoven have explored a way to enable designers to explore and question older people's mobility issues rather than just sympathize with their situation by making use of rich storytelling and developing a kit of artifacts that the designer can wear for a period of time as a means to try life with a similar level of physical constrains (Daam, 2014). For example, a designer would wear a pair of glasses that blurs his or her vision and gloves that mimic the feeling of arthritis in the hands. As such, these artifacts enable designers to get a 1st person

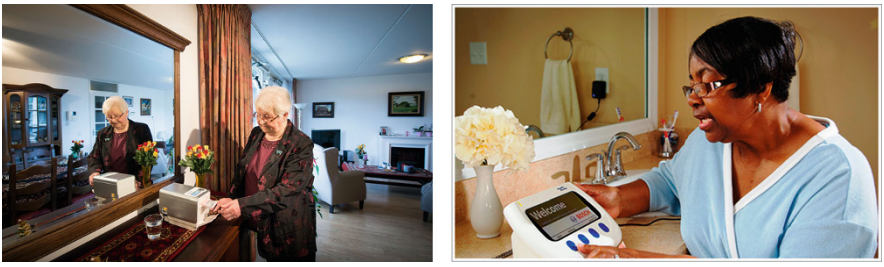

Fig. 1 Tablet-dispensing device and Health Buddy in home environments. Source: Philips Group Communications (2014), 3HC (2018)

perspective on what would otherwise remain a 3rd person perspective. Whether, or to what extent, such artificial disabilities will trigger an appropriate level of perceived constraints is a question however.

Another line of methods is concerned with ideation based on the body—thus rather than starting with a function that needs to be supported these methods encourage the expansion of the design space before even thinking about a solution. For example, Wilde, Vallgårda, and Tomico (2017) have collected and analyzed eight different ideation methods for embodied design. Of these, perhaps the most interesting to look at is Wilde's own OWL method. By incorporating props on different parts of the body, Wilde explores what we imagine such props could be if they had a function (Wilde & Andersen, 2010). She uses these props as a method for potential users to dream and for designers to become more open for alternative physical shapes and placement on the body as well as alternative functions. Similar approaches could be used in participatory design workshops, for instance, for people with a specific healthcare need where the props can spark a reflection or discussion among participants on how, when, and where to use a healthcare technology if it were designed like one of the props.

Finally, it makes sense to look at recent research and development considering wearable technology as a source of inspiration. Developments in mHealth (often in the form of health monitoring applications on smartwatches) are rapid. Next to this, recent innovation in fibers and textiles has significantly transformed both their material structures as well as their sphere of use and applications in various industries from fashion to sports, health, and industrial products (see, e.g., McQuaid, 2005; Pailes-Friedman, 2016). Specifically, smart textiles and fibers are increasingly engineered with the integration of electronic circuits and sensors, which combine hybrid materials such as metals, plastics, as well as chemical and biological coatings and substrates that substantially complexify the material composition of fibers and textiles. Such materials offer many opportunities for the design of healthcare services that can be worn on the body. Recent examples include efforts in design of a smart vest to correct posture (Van Rees, Mader, Smits, Ludden, & Lamontagne, 2018) and to integrate the art of jewelry making with designing wearable devices that monitor health parameters. Hiremath, Yang, and Mankodiya (2014) give a more elaborate account of the promises that the "Wearable Internet of Things" brings and how it might be combined with the second starting point for designing healthcare at home that we will discuss: the (smart) home.

2.4 Designing for and from the Home

Home is where the heart is. This expression denotes how important our homes are to us. They are the spaces where we feel safe, often among our family members and/or loved ones. People spent much time and effort making and decorating their homes, making it reflect who they are and what they like. Julienne Moore further explores the centrality of the concept of home within Western society (Moore, 2000), clarifying the significant role of the home at a social, cultural, and symbolic level.

Throughout history, our homes have changed, following (maybe even reflecting) changes in technological developments. In this time and age,

technological developments are transforming our homes into smart homes, thereby influencing people's practices and experiences in the home environment. Already, early adopters of smart home technology are using smart lighting and heating systems or, for example, manage their weight using a (Wi-Fi-enabled) smart scale that connects to a mobile application. It will not be long before we can monitor whether our children have brushed their teeth long enough and we will be able to measure many more health parameters through other "things" we are used to encounter and use in our homes. To give an example, Philips has been working on developing a smart mirror through which we can monitor vital signs by analyzing our skin color. Next to new and better ways to monitor our health, devices and services that can be used to manage a disease or follow a therapy are increasingly used in the home and expected to be further integrated into the future smart home (see, e.g., Chan, Campo, Estève, & Fourniols, 2009; Demiris & Hensel, 2008).

For the design of at-home healthcare devices and services, it is important to realize that the practical and typical situation in a particular home environment (e.g., the mere presence of dust and/or clutter) may influence use or functionality of the device/service. Besides these more functional aspects, the place where a healthcare device is used also has implications for the meaning and experiences of the devices and the care services as a whole (Oudshoorn, 2011). Designing for the wide variety in and within home environments is therefore more complex than designing for a (more controlled and standardized) healthcare environment such as a hospital. Moreover, designers of at-home healthcare services should realize that the design in its turn might influence the home environment and the particular experience and identity that its inhabitant might want to portray. The industry has spent a lot of time building platforms, apps, and services. Much of these, if not most, have hidden the healthcare services and therapies in laptops, tablets, and mobile phones. An important drawback here is that hiding the healthcare service often contributes to issues with reach and adherence (see Ludden et al., 2015). Developments in healthcare services for the home environment have also introduced dedicated devices (boxes) that are usually operated through screens and buttons.

Two examples can be seen in Fig. 1: the image on the left is taken from a promotion campaign for an automatic pill-dispensing device (Philips Medido), and the image on the right shows a woman using the Health Buddy system (Health Buddy). In both images, the quality of the materials and shapes used in the home environment differs from those used in the healthcare device. The healthcare devices do not seem to be designed in a (home) context- and material-centered way. As such, merely because of their physical appearance, the healthcare devices will influence the experience of the home.

While treatment at home empowers the patient, and empowered patients are more active in following their treatment as they should, there is a world to win in making the appearance of at-home healthcare devices and services better fit and even integrated in a home environment. Joshi and Bråthen (2016) discuss how material features of assistive technology play an important role on whether and how they will be used, arguing how

materials and devices that do not look like something that belongs in a hospital can add to positive self-image and empowered users.

Similarly, in a designerly critique on the domestification of healthcare exploring the impact of healthcare devices and services on our physical and emotional relationship with our home space, Chamberlain and Craig (2016, 2017) make visible what alternative design for healthcare at home might look like. They present a collection of critical artifacts carrying the knowledge from several workshops with potential users of healthcare services. The designed artifacts integrate medical services with objects that are familiar to most people and that would be associated with a home context.

Similar to what the developments in smart textiles are bringing to the wearable technology domain, integrating smart (technology-rich) textiles in the home could be another way to make healthcare at home more desirable. The comfort in touch of these materials and the similarity and familiarity with how we "decorate" our homes in combination with the technological capabilities that are required make them very well suited for use in future developments.

3 Discussion

We have discussed two perspectives on designing the patient at home side of future healthcare services with the aim to contribute to a new discourse and source of inspiration for future healthcare designers. In light of the shift in care that increasingly makes use of technology and emphasizes self-management in care using technology, it is important to consider the ongoing discussion of the impact of this development on people's experiences of care. It has been argued that "cold" technologies will be implemented at the cost of warm human care (Bauer, 2004). However, this perspective on using technology in care does not consider how people develop affective relationships with and through technology (see Pols & Moser, 2009, for analyses and examples) and how in fact the design of healthcare technology might facilitate building or sustaining these relationships.

Using the body and the home as starting points for the design of at-home healthcare services is not just about the aesthetics of the physical part of the product service system, but there is a challenge in designing for the interaction with these systems as well. For example, the temporality of interaction (see Vallgårda, Winther, Mørch, & Vizer, 2015) might have to be different in a medical environment than in a home.

There are a couple of other things that are important for the further development of this field that we will briefly discuss here. In this contribution, we have mostly looked at the patient side of the changing health landscape. We have done so to be able to observe and discuss the experience of having objects with the intent to support well-being. However, observing the challenges and opportunities that these developments in healthcare services bring to the other side, that of the health professionals is equally necessary. Considering the future of self-management where systems of objects that support healthcare will be dynamic and require not only objects to be able to move in and out of them but that will also require health professionals to be able to move in and

out of them, this side of such systems will require considerable attention in the near future too.

Another thing that we would like to address here is that implementations of e-health systems may not always reach the groups who need them most. They have not done so in the past, and designers of the healthcare systems of the future need to be aware that especially when designing with the aim to empower patients or users of healthcare systems for the home environment, reaching the uninterested remains a challenge. A particular challenge also lies in the need for systems to evolve (in order to remain interesting and relevant) over time. People may be very different in their behavior when they first engage with a system when compared to when they have been working with them for a considerable amount of time.

4 Conclusion

As some of the examples in this chapter have shown, designers can take on a role as provocateur in envisioning the healthcare of the future and in developing services/systems that enable people to shape their personal health(care). At the same time, the fast and ongoing developments in how we change our healthcare systems will benefit from including the people who will use them in the design process. Or, as Bitterman (2011) also argues, involvement of all end users (patients and caregivers) and experts (medical personnel, sociologists, psychologists, product developers) involved in the complex system of introducing healthcare services at home is needed. Traditional participatory design processes may be too abstract to connect to people's desires. New and creative ways to involve people in design and evaluation processes will be needed to engage them.

Finally, a crucial element of the design of future at-home healthcare services is and will be trust (see Van Velsen et al., 2016). In order for healthcare services to be adopted by large groups of people (varying in their level of education and in their experience with and knowledge of technology, income, educational level), it is important that people are at ease with and understand the technology they use. Different people might want or need to deal differently with making decisions and taking responsibility in healthcare, and the healthcare services that we develop should acknowledge their needs.

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