

Future Care: Rethinking technology enhanced aged care environments

Jennifer Loy, University of Technology Sydney & Natalie Haskell, Griffith University

Keywords: *Spatial, Social, Health, User-centred, Assistive, Design, Telemedicine*

Abstract

Purpose: Cutting-edge hospital and residential care architecture and interior design aim to address the emotional and practical needs of patients, staff and visitors. Yet, whilst improving on past practice, current approaches to design still rarely recognise or respond to individuals. This paper provides a review of design-led research into digital technology across disciplines for the personalisation of health care environments and is informed by the authors' ongoing hospital-based research.

Approach: This review is based on a design anthropology framework providing insight into designing for changing the experience for older patients in current healthcare contexts and future focused strategies, integrating digital technologies and human-centred design across scale and disciplines. It is informed by ongoing hospital studies based on design-led research methodology, drawing on design anthropology and ethnographical methods.

Findings: Technology enhanced, human-centred, assistive devices and environments implemented into health care across scale are developing but integration is needed for meaningful experiences.

Research limitations: This review is a positioning paper for design-led research into digital technology across scale and medium.

Practical implications: This paper provides the basis for practical research including the ongoing hospital-based research of the authors.

Social implications: This approach potentially enhances emotional experiences of connected health care.

Value: Future care scenarios are proposed, with technology and human experience as key drivers. Individualised and personalised solutions better cater for diversity. Within this context, it is strategic to question and test new ways of crafting the aged care experience. This paper brings new direction to this discussion.

Paper type: Review paper.

Introduction

Healthcare scenarios rely on understanding complex systems of interaction in relation to a wide range of users and accommodating differing requirements within functionally diverse workplace environments. This challenge is growing as health care architecture in the twenty-first century becomes increasingly human-centred, as demonstrated in exemplar healthcare building projects such as the 330,000-square metre Karolinska University Hospital Solna, which won the Future Healthcare Design Prize and European Healthcare Design Award 2017. In this project, White Tengbom drew on evidence-based research to emphasise the importance of natural light, access to external views and a rethinking of the organisation of treatments based on a 'patient first' strategy. The common spaces are a feature of this facility and furnished with natural materials,

as well as site specific large and small-scale art works. In addition to providing an environment that is visually interesting, the art pieces – one of the largest Swedish public art investments – work in conjunction with thematically designed signage and lighting, to assist wayfinding and a sense of connection within the building. The architects describe their intention as to create a facility that strengthens the “idea of a hospital as a civic building that people can take pride in” (White Arkitekter, 2017). Whilst this facility represents a shift in thinking in terms of patient care, it is still limited in its approach, with no apparent differentiation between patient-experiences for individuals. With over 700 rooms for patients, the design focusses on improving engagement between healthcare providers and patients across the board, rather than on the basis of individual need. The individual’s experience is still dependent on the availability of staff and their cursory knowledge of the person’s history and personality. Vulnerable individuals, such as those with no immediate family, can be overlooked or isolated. This may be exacerbated by practical problems, such as an inability to navigate within the hospital independently, even with the help of established wayfinding strategies.

Many future focused research projects, such as the IBI Groups Salutogenic Home of Tomorrow, investigate scenarios where care occurs in the home. They suggest the home could include spaces for “diagnosis, treatment and healing and general wellbeing” (Mazuch, 2017, p. 43). Based on theories such as salutogenesis (*focussing on supporting human health over the factors that determine a disease*) and biophilia (*suggesting that humans need to be closely associated with nature*), the design of these spaces consider how environments can encourage wellbeing and health, rather than purely focusing on the treatment of disease. Even so, the likelihood of time spent within a hospital or residential care environment is still considerable. Extending the approach into these environments aligns with projects such as Maggie’s Centres (UK), which seek to create “comforting and uplifting environments,” as “refuges for care” for cancer patients (Jencks, 2017, p. 67; Wildevuur, 2017, p. 60). These projects demonstrate a more holistic approach to providing practical, and emotional support, including opportunities for social contact and wellness activities.

Evolving technology enabled healthcare

Over the last two decades, digital technologies have created opportunities for new layers of meaning, monitoring and communication. Technological disruptions in other fields inform the development of innovative solutions into the healthcare environment, from the introduction of continuous, real-time temperature monitoring (e.g. FeverSmart) to telemedicine for remote regions, slowed by the complexities involved in the healthcare context (Grol *et al.*, 2013). Innovations in thinking create new connections between people, objects and their built environment. Tom Dixon, Creative Director at the Finnish furniture company Artek, demonstrated this by embedding stories into the company’s iconic stools, accessed through a smart phone. Technology-enhanced hospital environments can now incorporate data collection points via, for example, smart wristbands or door monitors, to provide real-time patient data (Majumder, Mondal and Deen, 2017), and integrated technologies to enhance aesthetics and patient communication, such as demonstrated in the digital wall displays in the Peter MacCallum Cancer Centre. This design of the visual environment within healthcare, based on factors such as lighting, colour, artwork and views of nature (Salonen *et al.*, 2013, p.3, Andrade *et al.* 2016, p.

301) demonstrates that digitally facilitated, responsive placemaking can be employed as a counter to static design solutions, for example through parametric design based on optical design systems controlling moving images, colour and light frequencies etc., (Ziegler, 2015, p. 55) to create personalised spatial cues (Morag et al. 2016, p. 247). Building on this, it should be increasingly possible to create bespoke engagements between people, products and place not driven by utility only, but rather by an individual's character and emotional needs. The practical research informing this paper is founded on a design anthropology framework, considering how people, "perceive, create, and transform their environments through their everyday activities" (Gunn et al., 2013, p. xiii). This perspective includes embracing design ethnography in the design process, to consider the role design has in defining the human experience both through designed artefacts, the design process and in this case, the patient experience.

The value of this approach has been highlighted by researchers, such as Pullin (2009), as the next step in healthcare design. This builds on the work of architects such as White Tengbom, taking the 'patient first' approach to the next level with technology in order to be 'people-first':

A recent conference on assistive technology described its vision as "utility, usability and accessibility." If these necessities are the extent of our vision, then traditional clinical testing could probably suffice. But more subjective and sensitive aspirations seem overdue: the engagement, experience, and emotion that a design elicits should be just as important. (Pullin, 2009, p. 138)

Advanced digital technologies now provide multiple opportunities for monitoring and interaction in real time via multimodal sensor data allowing the design of personalised responsive environments. The MIT DoppelLab demonstrates real-time motion detection, audio levels, temperature and humidity monitoring. Whilst the application of this data for building management and maintenance is clear, the MIT Tidmarsh Living Observatory study suggests directions for a next level approach that could be integrated into new design thinking for healthcare environments. This is where sensors pick up data that enhances the experience of the environment. Sensor networks "document ecological processes and allow people to experience the data at different spatial and temporal scales. Small, distributed, low-power sensor devices capture climate, soil, water, and other environmental data, while others stream audio from high in the trees and underwater" (MIT, 2017). This aligns with Carlo Ratti's Internet of Things (IoT) based Office 3.0 personalised office experience, coined the Internet of Spaces (IoS). Although in different contexts, these projects demonstrate the technological facilitation of a personalised experience, relevant to healthcare environments.

Rather than as a passive recipient of ubiquitous computing outcomes, wearable technologies are starting to provide individuals with greater control over their environment. Designer Monisha Chippada designed a battery powered hood that blocked out electronic signals and shielded the user from view as a "safe space in this chaotic kind of world" (Yu, 2017). Taking control further, hearing aids now connect to smart phones, and provide users with the ability to change how they experience sound, as demonstrated by the LiNX 3Ds (Alter, 2017). Enhanced healthcare environments combining personal and spatially responsive technologies that contribute to the "holistic treatment of patients" (Huisman, 2012) will need to be crafted across scales to be truly human-centred. Digital technologies evolve at a rapid pace, across multiple platforms and

through disparate disciplines making it difficult to maximise the opportunities an integration across mediums and scale could bring. Research is needed that targets different contexts (driven by user identification and analysis) to understand their potential across applications. Strategies are needed that respond not only to the functional needs of patients but also their emotional needs, based on digitally enabled experience tailoring and management. Such enhanced tailoring has the potential to address the 'people-first' challenge for healthcare environments. The Australian National Digital Health Strategy highlights the changing consumer expectations for empowerment in the healthcare experience along with expectations that "digital technologies will facilitate improved access to healthcare services, delivering services in ways that are convenient for them" with 65% of respondents suggesting the healthcare system is difficult to navigate (Australian Government, 2016).

Older patient experience

A key demographic in this context is the older patient because of the potential benefits for the emotional wellbeing of this group and also the impact of an ageing population on healthcare costs and priorities. The developed world is entering the 'Third Era of Health' with longer lifespans and an increasing focus on patient wellbeing (Mazuch, 2016, p. 43), resulting in a shift to embrace the human aspect of healthcare environments: "the complex and personal, not only within academic and clinical medicine, but also within health and social care" (Miles, 2017, p. 3). The growing emphasis for a 'people-first' approach aims to recognise and respond to the uniqueness of an individuals' lived experience. As discussed by Miles, patients are complex - not only defined by disease or organs requiring medical intervention, but as human beings "with narratives, values, preferences, psychology and emotionality, cultural situation, spiritual concerns...worries, anxieties, fears, hopes and ambitions – and more" (2017, p. 4). Within current healthcare environments, including aged care facilities, it is difficult to respond to the narratives of individuals, yet with the potential of digital technology to facilitate responsive, engaged environments, this could change.

Older patients frequently present with deteriorating cognitive or sensory abilities (sight, hearing, touch sensitivity), reduced motor function, the possible onset of early stage dementia and a heightened response to the impact of medical treatments. It is not possible to generalise capabilities – and would be the opposite of the intent driving this research – unfamiliar environments are likely to be confusing and difficult to navigate when experiencing any number of these impairments. As suggested by Burton, Mitchell and Stride, the "consideration of the built environment is particularly pertinent for older people; as they age...declining health and functional status can make them more susceptible to barriers" (2011). In addition, the dual-task performance required to navigate a space; memory, cognitive navigational skills and sensorimotor skills (Zijlstra *et al.*, 2016, p. 62), is more difficult with ageing. Multi-sensory environmental cues matter, for example through changes in sound and lighting, first to orientate and map pathways, then provide journey progression indicators to counter issues such as memory loss and confusion. Morag, Heylighen and Pintelon state that "people need to be provided with a consistent set of indications ... good wayfinding design promotes healing because it provides people with a sense of control and empowerment, key factors in reducing stress, anxiety and fear" (2016, p. 243), irrespective of – and in direct response to - the impairments

they may be experiencing. More, the facilitators for a sense of control need to be tailored to the individual. This results in a complex set of requirements based on considerations of engagement and time, including extended periods in communal areas. As highlighted by Daily, “much of the patients’ time investments remain invisible to clinicians” (2017). Montgomery highlights these “places in between key areas of the hospital,” such as the hallways and waiting areas:

These are the spaces we find ourselves as we search for entries and exits, walk from department to department, and wait, vulnerably with our loved ones ... It is the quality, character and configuration of these spaces that can make or break our healthcare experience. (2017, p. 114)

Counters to the ‘toxicity of time’ should include personalised interventions enabled by digital interactions. Spatial and technology strategies are needed to redefine the older patient healthcare scenario.

Adams suggests a re-coding of modern hospitals is needed. He argues that people’s expectations of hospital environments have changed, to seeking designs beyond impersonal clinical institutions to ones that inspire wellness. Emotionally, Andrade discusses the “spatial and physical conditions of hospital settings on patients’ subjective well-being” (2016, p. 301) and the impact of a lack of connection. The hospital environment can be designed with the intent to create an appealing image, but Andrade *et al.* suggest that “correlational studies cannot disentangle the unique effect of the physical and social forces” and the complexity of the hospital care relationship – involving “trust, intimacy, and empathy” (2016, p. 300). The social aspect is supported by Annear *et al.*, who found “access to networks of support and social participation” was a positive influence on older people’s health (2014, p. 602). This expands with concepts such as ‘sense of coherence (SOC)’, taking an individual’s responses to external factors into account, for example in determining the impact of stress. Antonovsky (1996, p. 15) discussed the relationship between the built environment the sense of coherence (Boscherini, 2017, p. 108) with the intent of making experiences more meaningful, comprehensible and manageable for individuals accessing services. Technology enables a layer of customisation to individual needs, particularly for an individual’s sense of coherence, to encompass “cognitive, behavioural and motivational” drivers that are unique - difficult to support in a one-size-fits-all solution.

Ongoing design-led research explores the confluence of environment and technology across scale and disciplines to provide an integrated approach to spatial and physical interaction in public hospitals and aged care facilities. As part of ethnographic research, site surveys including systems and usage patterns enable a broad understanding of the hospital environment. Building on this, ethnographic methods are also being used within the current investigations to uncover individual perspectives, through interviews, surveys and focus groups (to include design methods integrated into workshops to engage participants and participatory processes). In gaining data and insights from field study, ethnography has had a growing inclusion in design process since the early 1990’s, largely driven by HCI and firms such as Xerox PARC (Plowman, 2003, p. 35), to organisations such as IDEO today. As suggested by Gunn, Otto and Smith there is a “genuine affinity between design and ethnography as processes of inquiry and discovery that includes the iterative way process and product are interconnected and the reflexive involvement by researchers and designers” (2013, p. 6) relevant for study involving patients in

an empathic and reflective experience intended to uncover lived experiences, individual needs and behaviours. As technology, and in turn real-time data, is increasingly part of the patient experience, wider considerations of phenomenon such as the “Quantified Self” and “Qualified Self” and the subjective qualitative experiences of patients becomes possible.

‘Healthy Aging’ as defined by the World Health Organisation, is facilitated by age-friendly environments (both physical and social) and older-person-centred approaches that create ‘healthy environments’ enabling quality of life and wellbeing, involve designing “supportive environments enabling people to do what is important to them, despite losses in capacity” (WHO, 2015). Digital developments create opportunities to consider how trust and empathy can be facilitated to increase patient agency and positively augment the patient experience, how patient time can be reduced in the hospital environment (with aspects of care extended into the home through improved communication and telemedicine) and how time spent within the hospital environment can be supported. Salonen cites Ulrich and Horsburgh in suggesting healthcare environments are “often considered starkly institutional, unacceptably stressful, and unsuited to the emotional needs of patients, their families and healthcare personnel,” that there is “a need to create a healing ... environment that supports wellbeing and helps patients cope with the stress that accompanies illness” (2013, p. 3-4).

Adding value

Older individuals have challenges and concerns additional to those of other demographics, but there is little more than basic universal design evident in health care facilities. There is a need to understand the lived experience of older people when designing assistive devices and experiences: “design innovation and anthropology...should adhere to clear principles of respectful engagement with people’s values, the translation of them through processes of inclusive co-design, and the evaluation of their effects on people’s experiences from the perspective of the vulnerable” (Gunn, Otto and Smith 2013, p. 245). As supported by Kolko: “the first part of the design strategy is the emotional value proposition” (2014, p. 117).

When designing for this demographic, a people-first approach calls for that emotional, social and cultural context to be explored. Hoffman highlights the “societal embedding of products and needs,” (2012, p. 28) and the importance of latent and future needs in innovative product development (Hoffman, 2012, p. 10). Future needs are relevant to the changing use of technology, digital literacy, digital equity and future uptake implications, as well as sociocultural sustainability. Customisation, facilitated by technological innovation, allows culturally, socially and contextually relevant solutions that respect diversity and create interactions that are familiar, that people want to engage with, form attachments too and make part of their lives. Rowland *et al* suggest “four different ways to look at context: operational, behavioural, ecological, and sociocultural” (2015, p. 162), and Greenfield (2006) emphasises the humanisation of digital integration:

Some of the most beautiful everywhere I’ve seen was designed by former PARC researcher Ranjit Makkuni, whose New Delhi-based Sacred World Foundations works to bridge the gap between technological and traditional cultures. This is information processing interwoven with the familiar daily forms not of the developed world, but if the global

South, cycle rickshaws, clay pots, and amulets among them. It's a lovely reminder that the world contains a great many different "everydays", beyond the ones we happen to be used to.

Whether clay pot or beer mat, though, these projects all capitalize on the idea that the distinctly local application of intelligence, and not the generic, one-size-fits-all vision embodied in computers, will turn out to be amongst the most important and useful legacies of our technological moment. (Greenfield, 2006, p. 22)

Kuniavsky advocates emotional design in digital innovation, with greater relationships between experiences and devices because the "use of devices is rarely the most important activity in someone's life, but the devices form part of a larger flow of needs, desires, and activities ... having an experience may be impossible without the use of a specific device, but the device does not form the whole experience" (2011, p. 15). Norman states, "any object is part of its environment," that there is a need to consider context more, the environments things are used in and usage patterns (2011, p. 123). These perspectives highlight the opportunities designers have to look across scale and discipline, to consider solutions and objects that are familiar when incorporating digitally assisted devices and system wide solutions.

Norman argues, in *The Invisible Computer* and elsewhere, that the difficulty and frustration we experience in using the computer are primarily artefacts of its general-purpose nature. He proposes that a truly human-centred design would explode the computers many functions into a "quiet, invisible, unobtrusive" array of networked objects scattered throughout the home: simple, single-purpose "information appliances" in the form of shoes, bookshelves, even teddy bears. (Greenfield, 2006, p.22)

The key driver in designing for an older person demographic is the respect for, and understanding of, diversity and character. Research is needed in this area when looking at value-adding in the healthcare context. The ideology of global design consultancy, IDEO, encapsulates this approach, arguing that the users themselves "are the ones who hold the key to their answer". To create "innovative new solutions rooted in people's actual needs" (IDEO, 2015, p. 9), according to Rowland *et al* (2015, p.176) "the first step is to move beyond the comfort of your own workplace into the places where potential users work, play, eat and sleep", hear their stories and gain knowledge of lived experiences. In the context of this paper, to design with empathy should result in interactions patients trust. The intent is that this will lead to their use in vulnerable moments to access care that has the potential to value add to their lives and experience (rather than detract).

Challenging design

If design has done less to engage with some disabilities than others – less with sensory impairment than mobility impairment, for example – then an area it has made little contribution to all is cognitive impairment. Perhaps one reason cognitive impairment is difficult for any design team is that it is so difficult to imagine what it must be like. (Pullin, 2009, p. 285)

The loss of cognitive functions, such as impaired memory and attention span is a key issue to consider. In current healthcare environments, digital interfaces support navigation facilities and service provision (such as automated patient check-in kiosks). Recent advances in individualized digital wayfinding, including the Mayo Clinic's Patient app and the MediaNav application, guide patients from home and navigating the hospital. These provide a consistent system of cues that can be adjusted for the individual patient. The strategy reduces missed appointments, automates reminders and the preparation needed for hospital visits. These systems also enable data analytics on the patient's movements that can further help a healthcare provider understand the patient journey as a starting point. Conceptual approaches look at providing more personalised and customised solutions, such as the FeelSpace, which provides tactile cues in an unobtrusive wearable to guide users to destinations.

There are growing numbers of assistive devices, wearables and systems providing digitally assisted care. Solutions providing a holistic, integrated approach are based on the whole patient journey, key interactions and care relationships (Mould, Bowers and Ghattas, 2010, p. 2). The supplemental e-Health approach is being incorporated in test groups utilising consumer wearable health-tracking products, e.g. Fitbits, to track health data (Nelson, Verhagen and Noordzij 2015; Wired, 2017) through telecare, such as Bristol Careline, to more speculative robotic companions for older people, e.g. ElliQ. These interventions can potentially reduce time in hospital, streamline consultations and therefore reduce waiting time. However, these systems require a level of digital literacy that needs to be considered alongside the acceptance and use of digital aids by this demographic. As suggested by Mostaghel and Oghazi, a number of factors will impact on uptake, including "gerontechnology self-efficacy, gerontechnology anxiety, cognitive abilities, self-reported health conditions and physical function" (2017, p. 1970). The impact of digital devices on the older patient's experience can vary, it can be a support (such as an aid in memory cues for navigation), or, for example, increase anxiety, with the perceived added complication of the device to comprehend. Technology integrated solutions can aid or detract from an older patient's sense of independence and control. Perceived usefulness (how it will improve the experience and quality of life) and ease of use (correlating to usefulness and the level of effortlessness to use) are key uptake drivers, linked strongly to the individual's level of confidence in using technology (Mostaghel and Oghazi, 2017, p. 1973). As digital tools are implemented in older patients' healthcare solutions, the patient experience and importantly the patient uptake and engagement with these assistive technologies will impact the future care experience.

Nordgren (2014) emphasises preference differences, with some preferring only human contact and face to face socialising, whilst others embrace the independence of digital tools, or it may be context or situation dependant. It is therefore strategic in research to customise and offer digital tools as a choice when testing disruptive innovations for this sector. This is supported by Kolko, "...you must perceive technology as a means toward a larger end, and that larger end is to help people achieve their goals and realise their hopes and dreams" (2014, p. 21).

Immersive technology

Stories are my contextual framework for thinking. And story-telling is my way to connect buildings with people. (Morris-Nunn, 2006)

Architect Robert Morris-Nunn (2006) describes story-telling as an architectural form, with the aim of engaging with the 'culture and traditions of people and place.' His three-dimensional settings are staged with the aim of adding to the richness of people's lives, including for aged care facilities. In the Tasmanian Corumbene Aged Care facility:

Corridors outside people's private rooms were transformed to become 'theatrical' streetscapes, rich with meaning for the residents themselves, many of whom suffer from dementia and live in a world of memories from long ago. (Morris-Nunn, 2006)

Digital technology allows designers to build on responding to the shared history of patients and to embracing personal histories as an overt part of constructed experiences via technology-enabled wearables, responsive environments and - going forward - mixed reality. Technology is only now making this a realistic possibility. The different environments experienced concurrently by different characters through tailored digital immersion portrayed in the market scenes in the 2017 science fiction film, *Valerian*, are still some way off, but the ability to utilise integrated digital technology to create a richer, more personal, informed experience is not.

In the area of interactive media, the distinction between a product, the content it delivers, and a service that it may be just a small part of is blurring. The role of design is broadening, and even a user-centred approach to design is no longer focused on issues of usability alone, but on the overall experience being created. (Pullin, 2009, p. 137)

Redesigned healthcare spaces, such as the exemplars discussed, incorporate strategies to create supportive environments. The use of integrated devices can add another layer, to craft the experience with the patient, rather than with the care facility, to enhance their subjective experience. Wearables can mediate the care experience no matter where the patient is. This has the potential to provide a sense of empowerment and control for the patient, with the ability to track and record health issues as they occur, access personal medical data and receive targeted prompts for medication, care information or healthy living activities. Added to that, the ability to place sensors on the body to record variances and provide real-time feedback to individuals, healthcare personal, carers or family members, allows a level of self and community monitoring that could see a rise in telemedicine and home-based care. The implications of this digital shift, and the perception of care transitioning from largely institution focused to personalised and constant in a person's life, can change how and where older people live, and the nature of home and residential care. As governments support the uptake of digital health services, such as in Australia with the National Digital Health Strategy (2016), the impact of these digital interventions and innovative solutions need to be considered.

Conceptual designs are exploring the personalised assistive care market for the older person, while also redefining what that market is. The Design Museum recently explored future ageing and the "potential for design and designers to enhance the experience of our later lives" (2017). The Aura Powered Suit, for example, supplements muscular ability rather than accommodating a lack of mobility (Fuseproject, 2016). It presents a shift in thinking towards augmenting in promoting healthy ageing and engagement with the world physically, socially and emotionally, despite losses in capacity.

'Ubiquitous' meant not merely 'in every place,' but also 'in everything.' Ordinary objects, from coffee cups to raincoats to the paint on the walls, would be reconsidered as sites for

the sensing and processing of information, and would wind up endowed with surprising new properties. Best of all, people would interact with these systems fluently and naturally, barely noticing the powerful informatics they were engaging. The innumerable hassles presented by personal computing would fade into history. (Greenfield, 2006, p.11)

In spite of Greenfield's argument, responding to the opportunities provided by ubiquitous computing does not mean merely creating invisibility, but rather engaging with the technology to enhance the experience of the individual in ways that may be seamless but not neutral. For the first time, it is now possible to tailor individual experience to a person, to recognise who they are and respond to their character and behaviours. For example, smart orthotics can monitor the gait of the wearer, giving real time information on stability, pace and direction. This information can provide clinical evidence, but also be translated into wayfinding to rest spots for example, or the way back to the individual's room. Beyond that, it can provide information in a way that is tailored to the physical needs and emotional preferences of the individual through subtle or direct cues. In future healthcare, it should be possible to tune the environmental response to the individual much as avatars in online games are adjusted to favour different characteristics.

Conclusion

Design is about humanizing technology or finding ways for technology to integrate into the fabric of our culture. (Kolko, 2014, p. 21)

At the core of the design process are the people accessing care. On a recent site visit during this research, an older person had spent two hours finding the hospital building and was unable to find the waiting area for his appointment. He was tired and in the midst of treatment. The space had been designed for aesthetics and included automated enhancements, but it was not comprehensible for him. It is impossible to summarise a particular patient demographics experiences without stereotyping, but talking to staff and patients, a person-centred approach is a common theme.

As designers, more time is needed to understand the particular challenges older people face physically and emotionally, and their individual needs and experiences, to design truly supportive environments and experiences that respect and empower to best meet their care needs. The future care scenario is being redefined with technology and human experience as key drivers. It is time to question and test new ways of crafting care experiences through a range of innovative design and health solutions as the research and technical possibilities evolve. The older demographic presents with a diverse set of needs, and, beyond that, the myriad of history, character and behaviours that individuals bring to a group. This paper aims to highlight the need for cross-disciplinary research to investigate not only the specific practical requirements of this group, but highlight the value in learning from, and responding to their experiences, attitudes and preferences in tailoring design facilitated by ubiquitous digital technology solutions integrated across scale and medium.

The ongoing hospital-based study informing this paper is based on a design-led research methodology. The research questions the constraints of disciplinary thinking on the application of digital technologies a holistic approach to design for health and wellbeing. This research engages with:

1. Advances in digital technologies allowing for new interactions in healthcare scenarios.
2. Sensitive handling of digital technologies for older patients.
3. A change in thinking utilising digital technologies working across scale and time for integrated, immersive experiences.
4. The ability to recognise and respond to individuals beyond the functional to add meaning, connection, respect and tailored interaction styles to the scenario.
5. Design-led research to explore the potential change in thinking and development of specific tools.

The architects and designers of twenty-first century healthcare facilities have the opportunity to create new experiences through the recent advances made in digital technologies. Designing for older patients provides a good starting point to developing a universal design approach that challenges the idea that one-size fits all, and instead works to acknowledge, support and celebrate the individual.

References

- Adams, A. (2017), "Decoding modern hospitals: An architectural history", *Architectural Design*, Vol. 87, No. 2, pp. 16-23.
- Alter, L. (2017), "New hearables connect you to the world in ways you can't imagine", available at: <https://www.mnn.com/health/fitness-well-being/blogs/hearables-will-connect-you-world-ways-you-cant-imagine> (accessed 14 December 2017).
- Andrade, C.C., Lima, M.L., Devlin, A.S. & Hernández, B. (2016), "Is it the place or the people? Disentangling the effects of hospitals' physical and social environments on well-being", *Environment and Behavior*, Vol. 48, No. 2, pp. 299-323.
- Annear, M., Keeling, S., Wilkinson, T., Cushman, G., Gidlow, B. & Hopkins, H. (2014), "Environmental influences on healthy and active ageing: a systematic review", *Ageing & Society*, Vol. 34, No. 4, pp. 590-622.
- Antonovsky, A. (1996), "The salutogenic model as a theory to guide health promotion", *Health Promotion International*, Vol. 11, No. 1, pp. 11-18.
- Australian Government. (2016), "National Digital Health Strategy", available at: <https://www.digitalhealth.gov.au/about-the-agency/publications/australias-national-digital-health-strategy> (accessed 2 December 2017).
- Boscherini, G. (2017), "A sense of coherence: Supporting the healing process", *Architectural Design*, Vol. 87, No. 2, pp. 108-113.
- Burton, E.J., Mitchell, L. & Stride, C.B. (2011), "Good places for ageing in place: Development of objective built environment measures for investigating links with older people's wellbeing", *BMC Public Health*, Vol. 11, No. 1, pp. 839-839.
- Daily, K. (2017), "The toxicity of time", *Journal of Clinical Oncology*, Vol. 0, JCO.2017.74.7907.
- Design Museum. (2017), "New Old", available at: <https://designmuseum.org/whats-on/pop-up-exhibitions/new-old> (accessed 4 December 2017).
- Fuseproject. (2016), "Superflex aura powered suit", available at: <https://fuseproject.com/work/superflex/aura-powered-suit/?focus=overview> (accessed 8 December 2017).

- Greenfield, A. (2006), *Everyware: The Dawning Age of Ubiquitous Computing*, AIGA Press, New Riders, USA.
- Grol, R., Wensing, M., Eccles, M. and Davis, D. (Eds.) (2013), *Improving Patient Care: The Implementation of Change in Health Care*, John Wiley & Sons, UK.
- Hoffman, E. (2012) "The relevance of users in product development," in *User Integration in Sustainable Product Development*, Greenleaf Publishing, UK, pp. 9-33.
- Huisman, E.E., Morales, E., Hoof, v., J Joost & Kort, H.H. (2012), "Healing environment: a review of the impact of the physical environmental factors on users", *Building and Environment*, Vol. 58, pp. 70-80.
- IDEO. (2015), *The Field Guide to Human Centred Design*. IDEO, San Francisco.
- Jenks, C. (2017), "Maggie's architecture: The deep affinities between architecture and health", *Architectural Design*, Vol. 87, No. 2, pp. 66-75.
- Kolko, J. (2014), *Well Designed: How to Use Empathy to Create Products People Love*, Harvard Business Review Press, Boston Massachusetts.
- Kuniavsky, M. (2010), *Smart Things: Ubiquitous Computing User Experience Design*, Morgan Kaufmann Publisher, Amsterdam.
- Nelson, E., Verhagen, T. & Noordzij, M. (2015), "Health empowerment through activity trackers: An empirical smart wristband study", *Computers in Human Behavior*, Vol. 62, pp. 364-374.
- Nordgren, A. (2014), "Remote monitoring or close encounters? Ethical considerations in priority setting regarding telecare", *Health Care Analysis*, Vol. 22, No. 4, pp. 325-339.
- Norman, D. *Living with Complexity*, The MIT Press, London.
- Majumder, S., Mondal, T. & Deen, M. (2017), "Wearable sensors for remote health monitoring", *Sensors*, Vol. 17, No. 1, pp. 130.
- Mazuch, R. (2017), "Salutogenic and biophilic design as therapeutic approaches to sustainable architecture", *Architectural Design*, Vol. 87, No. 2, pp. 42-47.
- Miles, A. (2017), "From evidence-based to evidence-informed, from patient-focussed to person-centered. The ongoing "energetics" of health and social care discourse as we approach the Third Era of Medicine", *Journal of Evaluation in Clinical Practice*, Vol. 23, No. 1, pp. 3-4.
- Massachusetts Institute of Technology. (2017), "DoppleLab: Tools for exploring multimodal sensor data", available at: <http://doppellab.media.mit.edu/> (accessed 14 December 2017).
- Massachusetts Institute of Technology. (2017), "Tidmarsh living observatory", available at: <https://tidmarsh.media.mit.edu/> (accessed 5 December 2017).
- Montgomery, T. (2017), "Cultivating the 'in-between': Humanising the modern healthcare experience", *Architectural Design*, Vol. 87, No. 2, pp. 114-121.
- Morag, I., Heylighen, A. and Pintelon, L. (2016), "Evaluating the inclusivity of hospital wayfinding systems for people with diverse needs and abilities", *Journal of Health Services Research & Policy*, Vol. 21, No. 4, pp. 243-248.
- Morris-Nunn, R. (2006), "Blurring Reality", available at: <https://core.ac.uk/download/pdf/15618109.pdf> (accessed 12 December 2017).
- Mostaghel, R. & Oghazi, P. (2017), "Elderly and technology tools: a fuzzysset qualitative comparative analysis", *Quality and Quantity*, Vol. 51, No. 5, pp. 1969.

- Mould, G., Bowers, J. and Ghattas, M. (2010), "The evolution of the pathway and its role in improving patient care," *Quality and Safety in Health Care*, Vol. 19, No. 5, pp. 2.
- Plowman, Tim. (2003) "Ethnography and critical design practice" in Laurel, B. (Ed.), *Design Research: Methods and Perspectives*, The MIT Press, London, pp. 30-38.
- Pullen, G. (2009), *Design Meets Disability*, The MIT Press, Boston.
- Rowland, C., Goodman, E., Charlier, M., Light, A., and Lui, A. (2015), *Designing Connected Products: UX for the Consumer Internet of Things*, O'Reilly Media Inc., Boston.
- Salonen, H., Lahtinen, M., Lappalainen, S., Nevala, N., Knibbs, L.D., Morawska, L. & Reijula, K. (2013), "Physical characteristics of the indoor environment that affect health and wellbeing in healthcare facilities: a review", *Intelligent Buildings International*, Vol. 5, No. 1, pp. 3-25.
- Tunstall, E. (2013), "Decolonizing Design Innovation: Design anthropology, critical anthropology, and indigenous knowledge", *Design Anthropology: Theory and Practice*, Eds. Wendy Gunn, Ton Otto and Rachel Charlotte Smith, Bloomsbury Academic, London, pp 232-250.
- Wildevuur, S. (2017), "Could health learn from design?", *Design for Health*, Vol. 1, pp. 59-64.
- White Arkitekter. (2017), "Karolinska University Hospital Solna", available at: <http://whitearkitekter.com/project/karolinska-university-hospital-solna> (accessed 10 December 2017).
- World Health Organization. (2017), "Ageing and Health", available at: <http://www.who.int/mediacentre/factsheets/fs404/en/> (accessed 5 December 2017).
- Wired. (2017), "When your fitbit goes from activity tracker to personal medical device", available at: <https://www.wired.com/story/when-your-activity-tracker-becomes-a-personal-medical-device/> (accessed 27 December 2017).
- Yu, K. (2017), "The anti-smog scarf: Australians create wearable tech of the future", available at: <https://www.sbs.com.au/news/the-anti-smog-scarf-creating-the-wearable-tech-of-the-future> (accessed 10 December 2017).
- Ziegler, U. (2015), "Multi-sensory design as a health resource: Customizable, individualized, and stress-regulating spaces", *DesignIssues*, Vol. 31, pp. 53-62.
- Zijlstra, E., Hagedoorn, M., Krijnen, W.P., van der Schans, Cees P & Mobach, M.P. (2016), "Route complexity and simulated physical ageing negatively influence wayfinding", *Applied Ergonomics*, Vol. 56, pp. 62-67.