REAL MATERIAL ETHEREAL

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Technology and the Emergency Department: A Speculative Design Approach

Abstract

Today, radical developments are occurring in the Emergency Department due to advances in technology that is redefining our relationship with our health and healthcare providers. This relationship is becoming digitised, more personalised, integrated into our lives, and responding in real time to our choices, actions and our overall wellbeing. These developments are driven by design. Focussing on the Emergency Department waiting room, this paper draws attention to the role design can play in imagining the Emergency Department of the future. This report presents a suite of speculative design outputs - informed by collaborative work undertaken with an Emergency Department in Melbourne, Australia - that aim to provoke questions about the role of technology in the Emergency Department of the future. These speculative proposals are not framed as implementable products or solutions, rather as tools to help us question and examine the implications of emerging technology before committing to specific further research and development. The proposals presented in this report invite, through dialogue, a reflection on the relationship between people and technology in the intense context of the Emergency Department. These proposals aim to make technology perceptible in new ways, and create spaces for discussion about what the future could and should be. Important findings in this project lie not just in the hypothetical design outcomes, but also in how design can be used as a tool to examine, interrogate and explore the implications and impact of emerging technologies upon individuals and care experiences in healthcare.

1. Background and Introduction

The Emergency Department (ED) plays an important role in how people access urgent medical care. For patients who visit an ED, an urgent visit to the hospital can be one of the most disruptive and stressful episodes of healthcare that one can experience. Patients usually have little time to physical or emotionally prepare, as they enter a fast-paced environment that is typified by high volume, high acuity, emotional patients with visible injuries. This report focuses on the front of house in the ED – from arrival at the hospital to the waiting room – and describes part of an ongoing PhD study that uses a speculative design approach to explore how technology might manifest in the ED, and open up debate upon the implications of that technology.

Today, patients who arrive at the ED are 'triaged', and priority is given to patients with the most severe and urgent injuries while other patients wait. In Australia, patients are categorised on a one to five scale, where category one is the most serious and severe. Under this system, a category five patient can wait up to two hours in the waiting room before receiving treatment[1]. The reality is, however, that some patients are already waiting significantly longer than what this target would suggest[2], and with a growing and ageing population, it's likely that in the future more people will have to wait longer to receive treatment.

Today, radical developments are occurring in the ED due to advances in technology that is redefining our relationship with our health and healthcare providers. This relationship is becoming digitised, more personalised, integrated into our lives, and responding in real time to our choices, actions and our overall wellbeing. These developments are driven by design.

This report aims to draw attention to the role design can play in imagining the ED of the future. In doing so, this paper does not aim to provide implementable products or solutions, rather present design proposals that aim to open up critical debate on the future of the ED and make the role of technology perceptible in new ways. This is achieved through informed extrapolations upon existing product lineages, which act as tools to help us question and examine the implications of emerging technology before committing to specific research and development. These proposals – typified by ambient technology, artificial intelligence and machine learning – act as stimuli to provoke debate and discussion upon their implications [3,4].The contribution of this report is not just the design proposals, but also in how studio-based design research can contribute to a better understanding of technology, and how it might impact future care experiences in the ED.

2. Materialising our imaginations: Early learnings from Design Practice

Previous work in the PhD project included a review of relevant literature and primary research – observations, workshops and interviews – with ED patients, staff, carers and visitors. This report weaves together this data, which formed the inspiration for the initial creative exploration and design experimentation into the ED waiting room. Using a combination of designerly techniques and data collected through primary research; the initial creative investigation focussed on the waiting room furnishings and how the form of furniture could be manipulated and organised to support people awaiting care. Attention was made to

investigate how furniture could be designed and arranged in an ED to afford individual and group privacy, but also give patients the feeling that the furniture was gently 'hugging' them, with surfaces that fold around the occupant (*see figure 1*). These early experiments also considered configuration in the ED, including ingress and egress from the waiting room (*see figure 2*). As the investigation deepened, the exploration began to more explicitly explore the role of technology, and how this might be embedded in the ED front of house of hospital registration, triage and the waiting room.

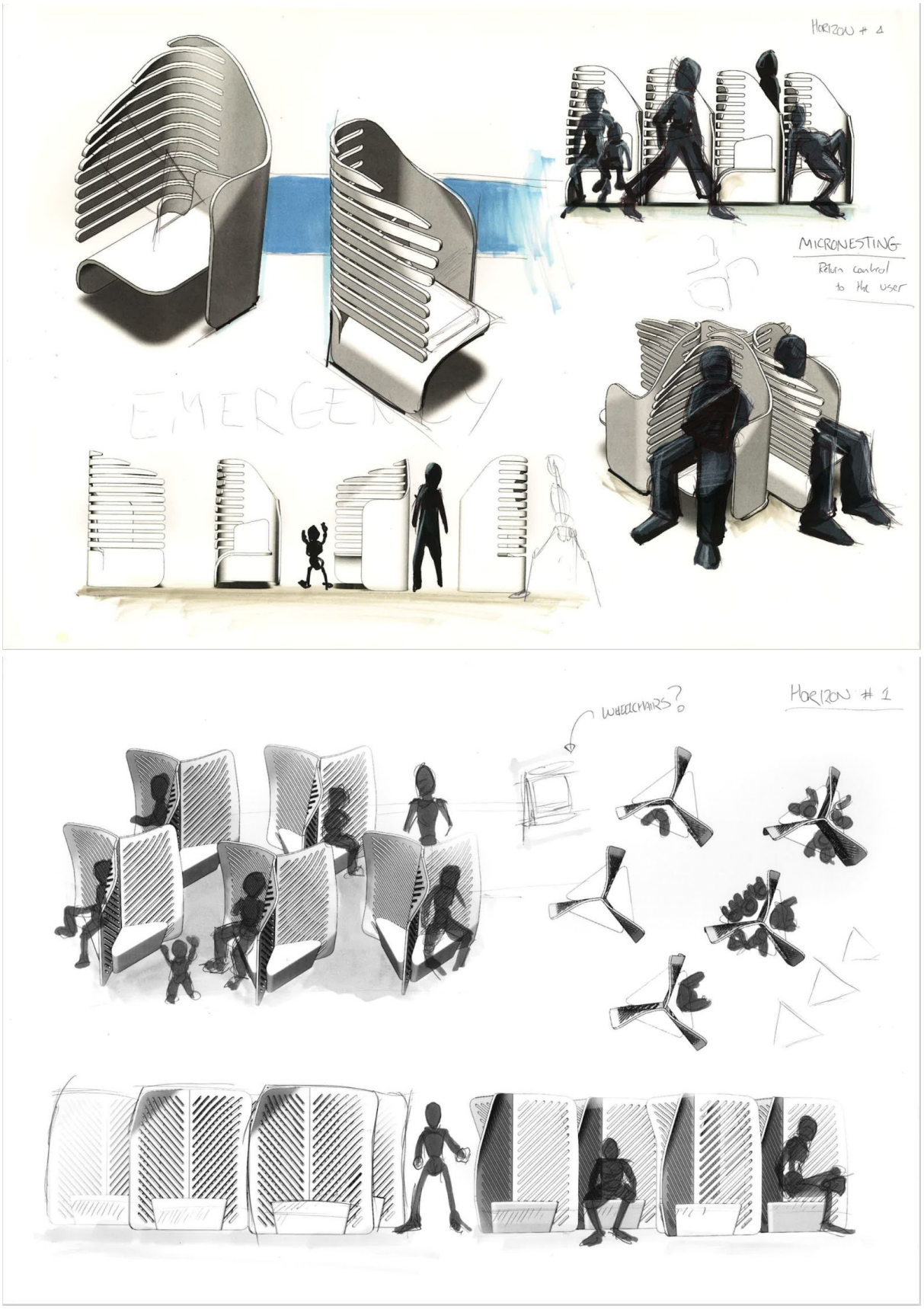

Figure 1: Conceptual sketches of waiting room furniture that was intended to give the feeling of a 'hug' to occupants. 'Fingers' in the furniture could be moved and manipulated by the occupant.

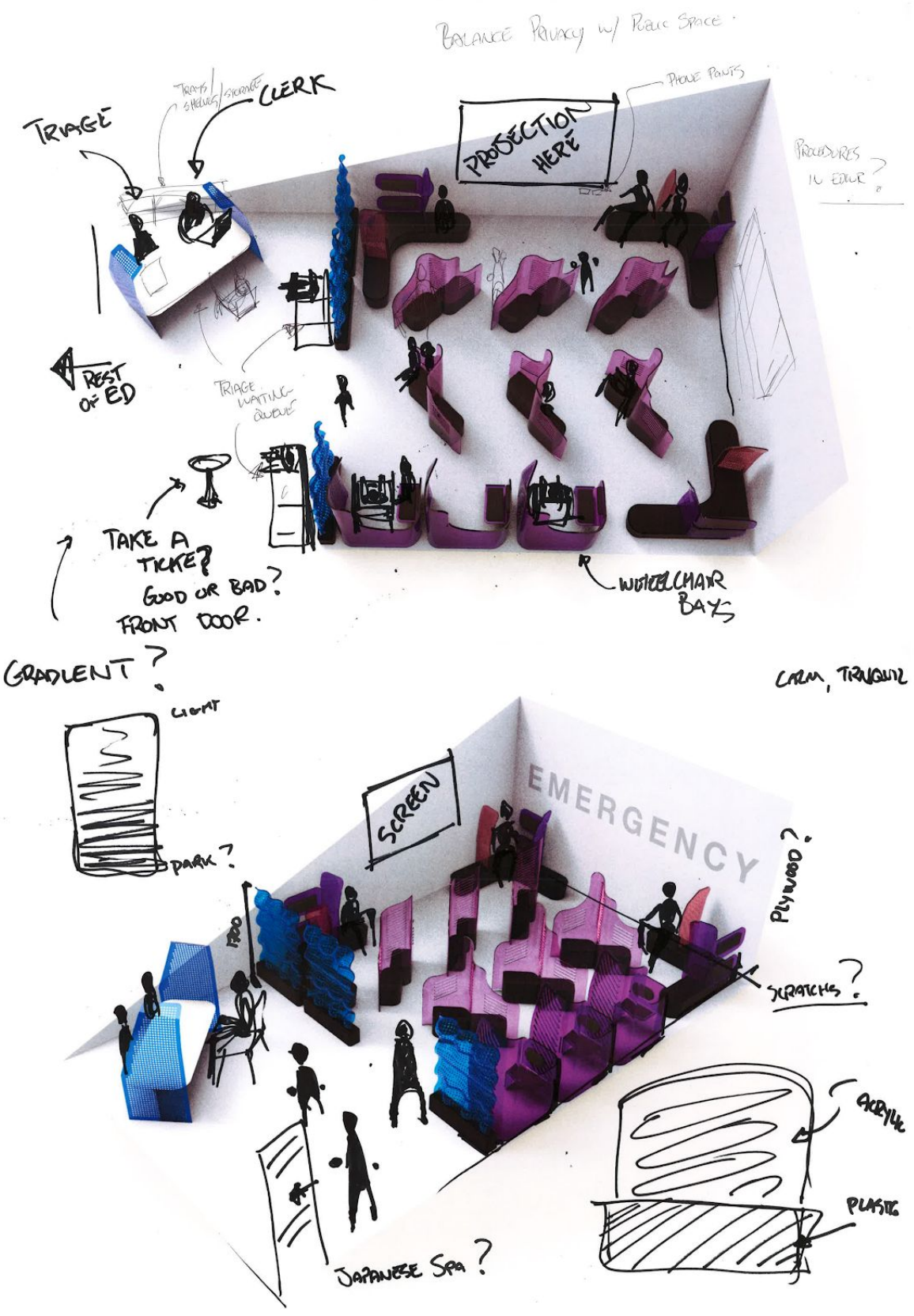

Figure 2: An early conceptual design of an Emergency Department waiting room, building upon the 'hug' furniture dividers.

3. Meet ASKLEPIOS: The Digital Companion for the Emergency Department

In workshops and interviews, ED staff expressed a desire for automated systems that manage and prioritise their work; and patients expressed the want for a 'companion' who could provide feedback to them on their journey. This inspired the design of a speculative artificial intelligence system; that synthesised medical data about patients and automated processes of hospital registration and triage, while monitoring patients and providing real-time feedback. This following section describes the design of an 'avatar' for this digital AI system named ASKLEPIOS after *Asclepios*, the Greek god of medicine and healing. Figure 3 presents a map of the features of the ASKLEPIOS AI system, which was developed in response to published literature that also advocated for automation and technological integration into the ED[5]. Mapping the features of the ASKLEPIOS AI system enabled the next phase of the investigation; the form factor that ASKLEPIOS might assume in the ED.

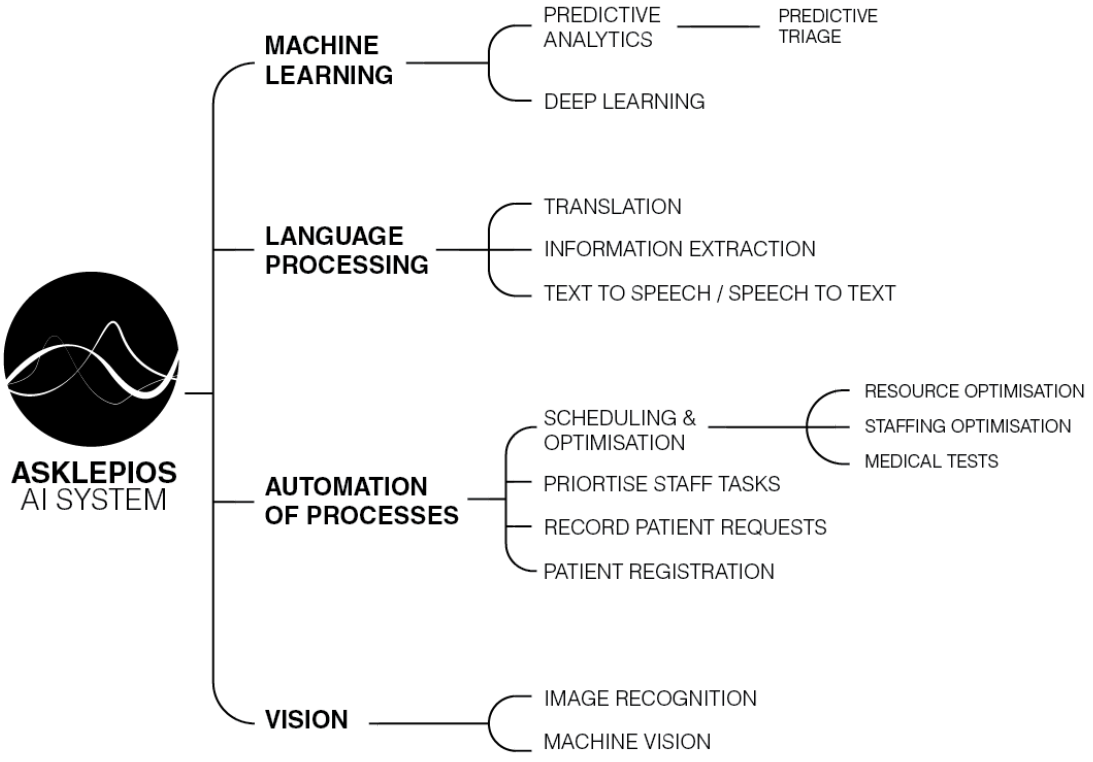

Figure 3: Mapping the features of the hypothetical ASKLEPIOS Artificial Intelligence system.

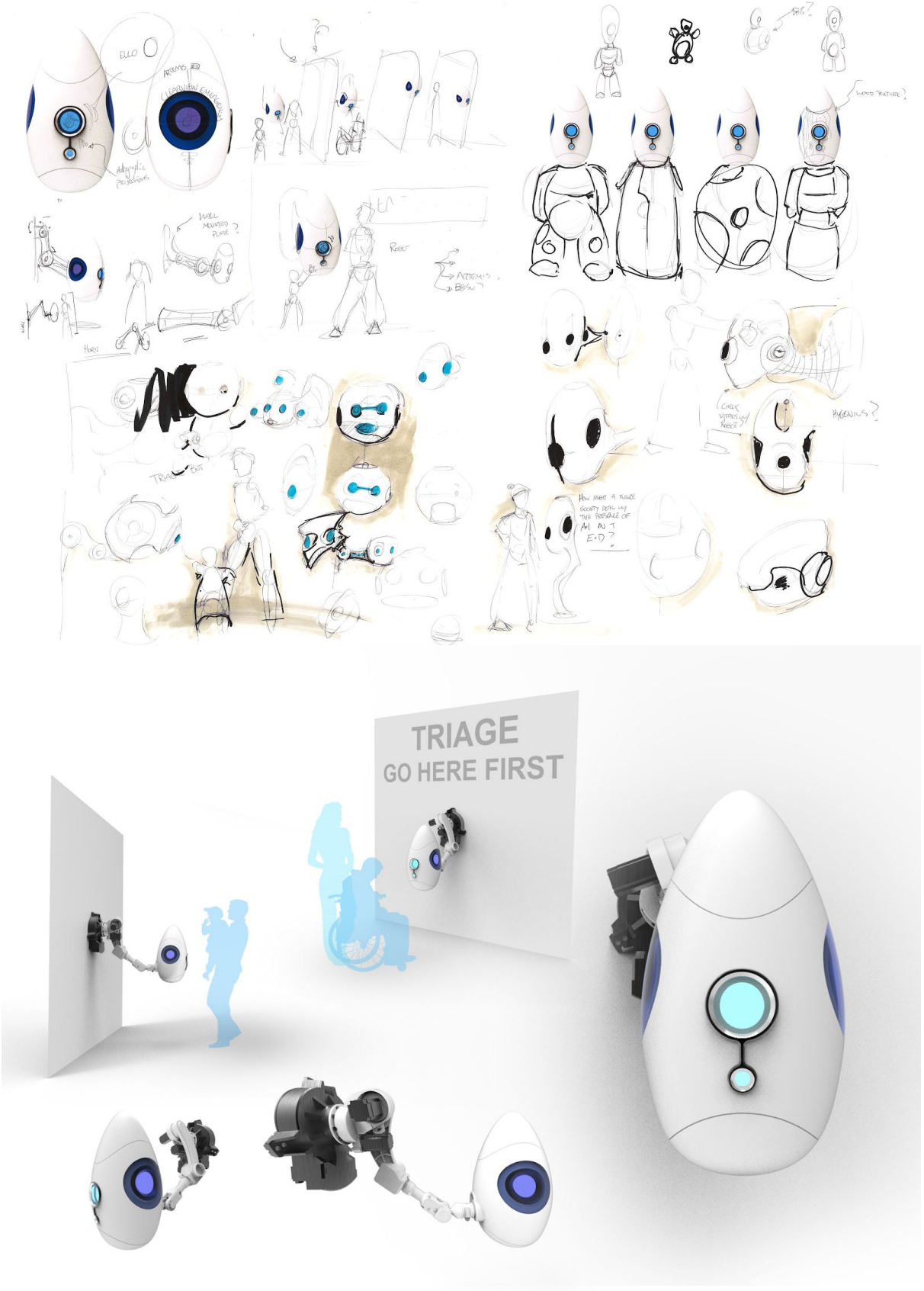

Figure 4: Early sketches and low-fidelity 3D models of how ASKLEPIOS might appear in the Emergency Department as a piece of product design.

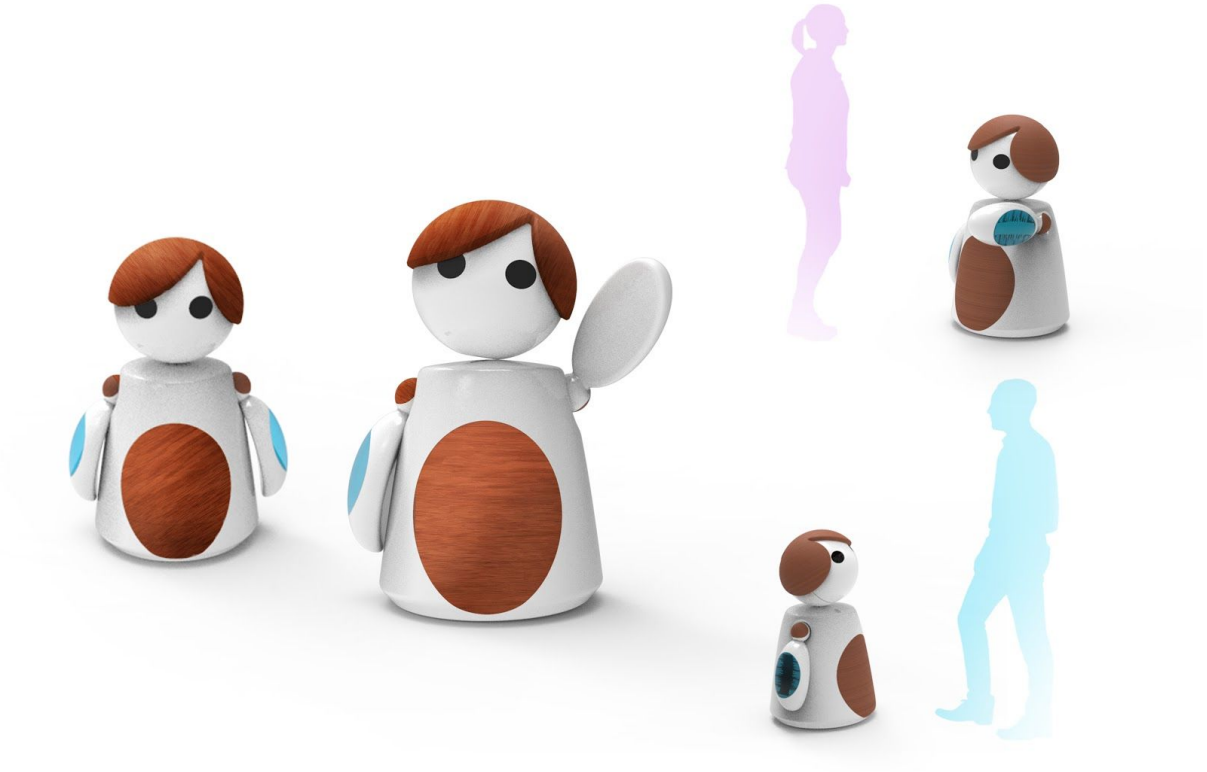

Figure 4a: Further exploration as to how ASKLEPIOS might manifest in the Emergency Department.

The creative exploration interrogated what was the 'appropriate' form for an artificial intelligence system to take in the unique and intense context of healthcare. Drawing inspiration from science-fiction and popular culture such as *2001: A Space Odyssey* (1968) and *Interstellar* (2014), design experiments explored how technology could be personified into a character with anthropometric and other abstracted human features. These experiments explored how shapes could be arranged to give the impression of a 'human' face, to create character and 'aliveness'.

Figure 5: ASKLEPIOS AI as screen based interface. Interaction between user–AI in this experiment involved both text-to-speech and speech-to-text

Further experimentation with the ASKLEPIOS AI system endeavoured to make the feeling of technology ambient, and embedded within the atmosphere and infrastructure within the ED rather than as a separate, distinct device. Figure 5 illustrates Asklepios as a neutral icon for a screen based interface, figure 6 presents an iteration of ASKLEPIOS that exists as ambient within waiting room chairs, colour-coded to correspond with a respective triage category and figure 7 presents a version of ASKLEPIOS without a screen, where the AI interaces with the patient through voice and an augmented reality interface.

In figures 6 and 7, ASKLEPIOS exists within waiting room furniture and responds to respective triage categories. ASKLEPIOS measures the patient's vital signs and behaviour through embedded sensors and cameras, and alerts staff in case of a deteriorating patient. Figure 8, and figure 8a present these creative experiments. Unlike the magazines that are often found in waiting rooms, patients can engage with media entertainment via the screen within the ASKLEPIOS device. Figure 8c takes this idea further, and presents the media experience as an augmented reality ‘screen’.

Figure 6: Exploring how ASKLEPIOS might be embedded within furniture, how 'smart furniture' could move patients around the waiting room autonomously, and how that furniture might be arranged in an Emergency Department.

Figure 6a: A visualisation of how a number of the ASKLEPIOS chairs might be configured in an Emergency Department waiting room

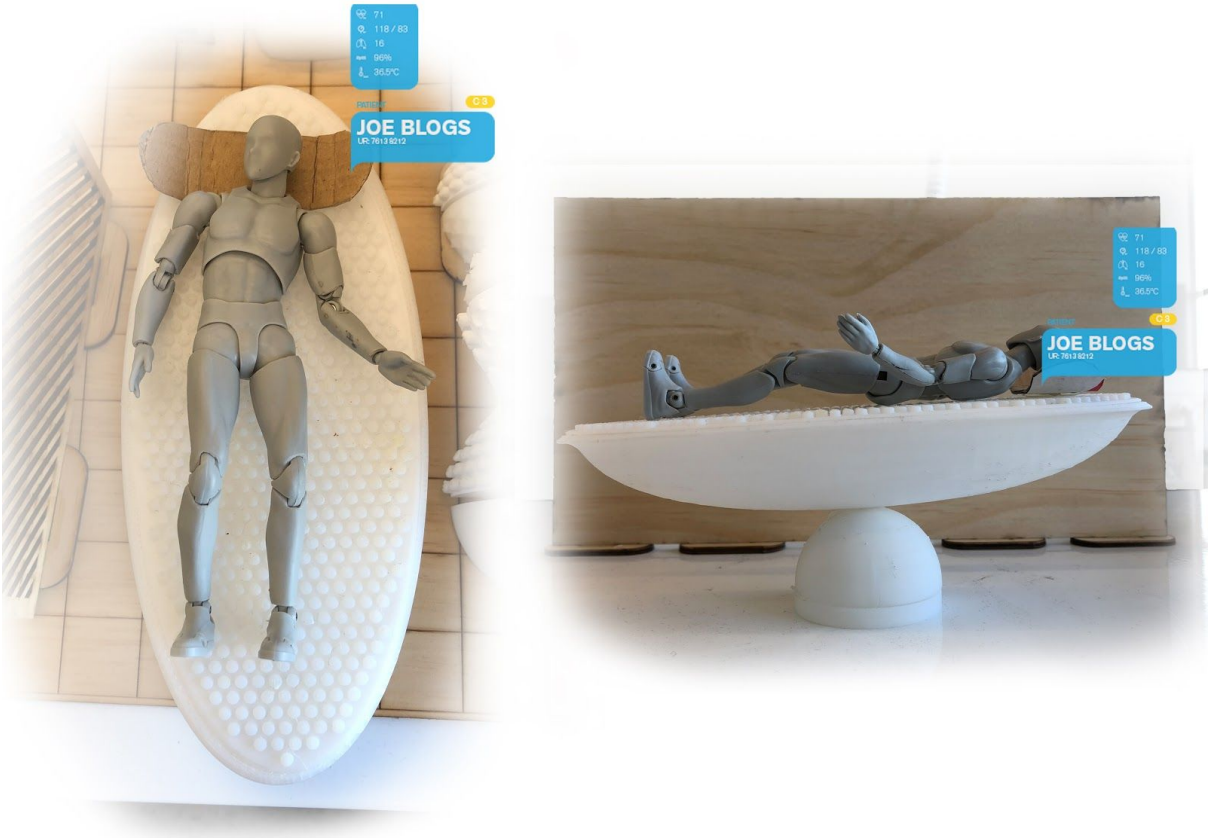

Figure 7: Photograph of a 1:12 scale plastic model of a waiting room 'pod', where critical patients could await treatment. ASKLEPIOS engages with patients and staff using an augmented mixed reality interface attached to the device.

4. Social implications of the technological future

There is an opportunity for ASKLEPIOS, and other AI platforms to impact the ED of the future. From automating hospital processes, managing patients awaiting a doctor, to reassuring family members – the technology described in this report is not just administrative, it has a 'caring' role. But to what extent can ASKLEPIOS or any technology 'care' for patients and their waiting experience in the ED? The creative exploration has revealed that the role of 'caring' for the patient does not just belong to medical staff, but can be embodied in the very furniture and infrastructure that occupies the ED.

The designer Peter Jones observes that caring – as a verb – means different things to different people and many subscribe to a different definition of care[6]. Providers (health practitioners) often view caring as the delivery of medical procedures, while recipients (patients) might view caring as reassurance – '*you're not alone', 'it's all going to be okay*' – while facilitators (hospital administrators and perhaps designers) view caring as the design of environments, systems and services. Settling these different views is not simple; the problem becomes ontological, a question upon the reality of caring[7]. How might these ontological questions be further complicated by the involvement of technology, artificial intelligence and machines? Would you feel cared for, if you're primary interaction with the emergency department at the front door was with a machine?

The proliferation of technology in the ED will impact experiences for patients and staff alike, and the particulars of this impact – on both clinical workflow and patient experience – have not yet been thoroughly interrogated. The proposals in this report aim to open up critical debate on the future of the ED, and explore the ethical, cultural, social and political implications that ASKLEPIOS might present for the ED of the future.

The use of ASKLEPIOS also presents other concerns and challenges – such as the loss of social contact; dangerous misperceptions about ASKLEPIOS's capabilities; trust of ASKLEPIOS (a lack of, or too much) and a diffusion of blame when things go wrong. It seems likely that current debates about health data security might also apply in the future, as ASKLEPIOS might pose a potential or real risk to a compromise of patient and staff privacy. If a mistake is made, who is to blame? Is it ASKLEPIOS, or the 'humans'? What is the acceptable probability for a medical error for ASKLEPIOS? Is that different to a human? Could ASKLEPIOS act as a "moral buffer" between actions and their consequences? How

would you feel if you were the victim of an error in a department where ASKLEPIOS was installed?

The technological future in the ED is in need of critique. To do this, future work in this project will involve the refinement of the ASKLEPIOS concept and presenting the concept as a series of design fictions; hypothetical user scenarios set in the distant future. These fictions will explore how ASKLPEIOS might impact daily activity in the ED; how this technology might impact the wait and care experience of the ED. These fictions aim to make perceptible the abstracts of technology, and discuss the experiences of users in tangible yet fictionalised ways. Figure 7, 7a and 7b presents some of the design fictions as works in progress.

Figure 8: A hypothetical map of a patient experience who is engaging with ASKLEPIOS. ASKLEPIOS helps the patient navigate from the place of injury to his local Emergency Department, while triaging and registering the patient into the hospital system before arrival.

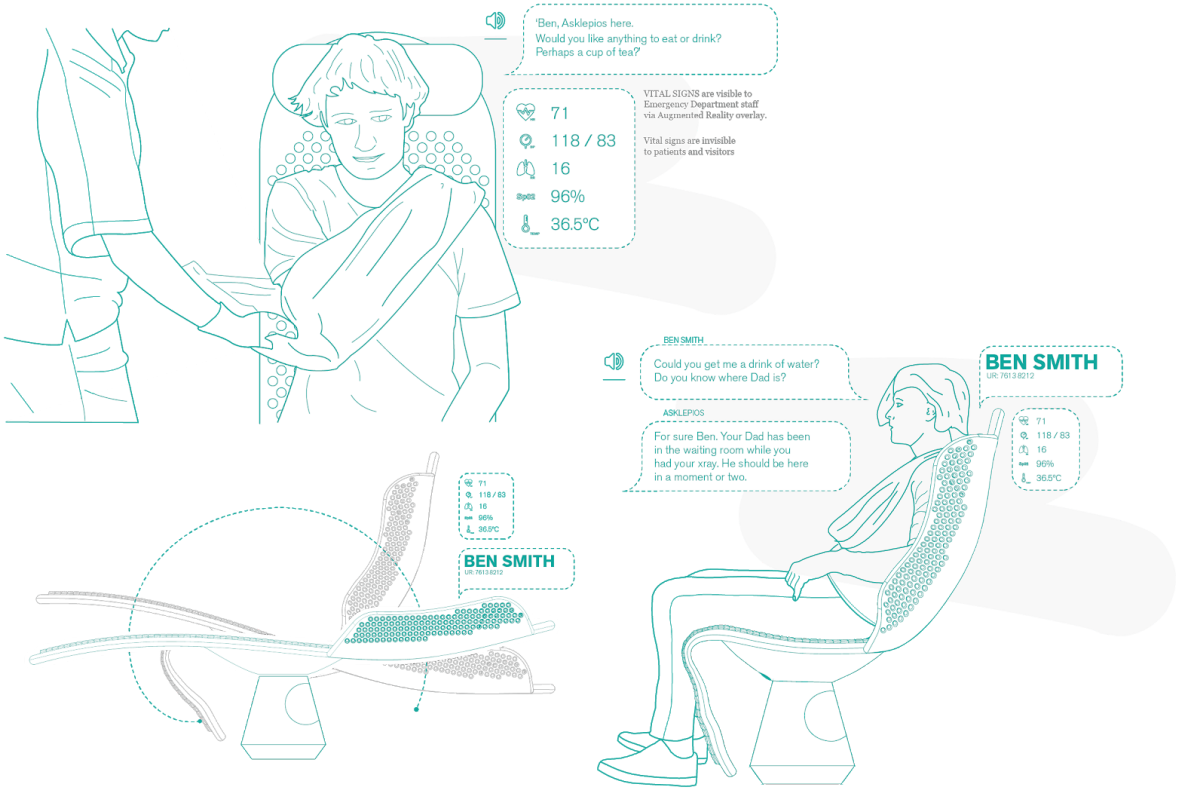

Figure 8a: Illustrations of how a patient might interact with ASKLEPIOS while sitting in the Emergency Department waiting room

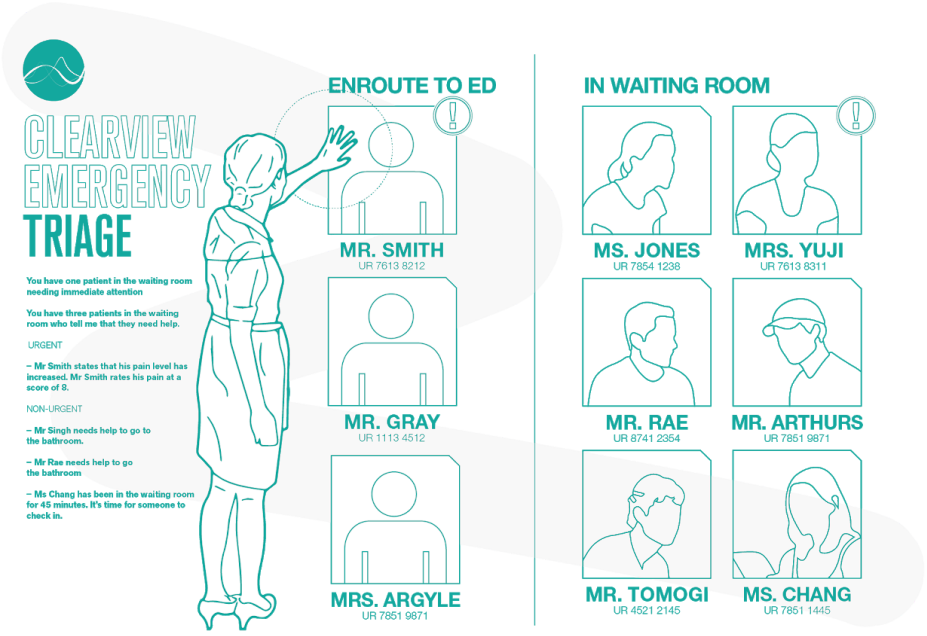

Figure 8b: Illustrations of a triage nurse interacting with a large Emergency Department whiteboard. ASKLEPIOS records, documents and priortises patient requests and presents this information to the triage nurse who can then deliver clinical care.

Figure 8c: Illustrations of a patient using ASKLEPIOS and an Augmented Reality interface to watch a football match in the Emergency Department waiting room.

5. Conclusion and Future Work

The kind of design that has been described in this report does not aim to advocate for a particular kind of future for the ED front of house. Instead, it invites a reflection on the relationship between possible and preferable futures and examine not only new applications for technology in the waiting room of the future, but also its potential implications. The hypothetical proposals in this report aim to make technology perceptible in new ways, and create spaces for discussion about what the future *could* and *should* be.

Important findings in this project lie not just in the design outcomes, but also in how design can be used as a tool to examine the impact of emerging technologies upon care experiences in healthcare. Important opportunities for the Emergency Department – and perhaps also elsewhere in healthcare – lie in the ethical use of technology to help people in crisis. As this report briefly discussed however, this future is fraught with technoethical and social questions. The proposals described in this report introduce us to such a future, and aim to provoke questions that may have only ever been otherwise asked at the end of the technological journey. These articulations aim to encourage academic and institutional discourse towards a much more considered technological destination, than the one we might otherwise stumble towards.

6. Endnotes

1. Council of Australian Governments (COAG) 2011, 'The National Health Reform Agreement-National Partnership Agreement on Improving Public Hospital Services', COAG, Canberra.

2. Carter, Eileen J., Stephanie M. Pouch, and Elaine L. Larson. "The relationship between emergency department crowding and patient outcomes: a systematic review." *Journal of Nursing Scholarship* 46, no. 2 (2014): 106-115.

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6. Jones, Peter. Design for care: Innovating healthcare experience. (Rosenfeld Media, 2013.)

7. Jones, *Design for care: Innovating healthcare experience*.