

The challenges of delivering validated personas for medical equipment design



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ABSTRACT

Representations of archetypal users (personas) have been advocated as a way to avoid designing in isolation. They allow communication of user needs and orient teams towards user experience. One of the challenges for developers of interactive medical devices is that most devices are used by a wide variety of people, and that developers have limited access to those people; personas have the potential to make developers more aware of who they are designing for. But this raises the question of whether it is possible to deliver useful, valid personas of interactive medical device users. The aim of this research was to develop and test a rigorous, empirically grounded process of constructing personas, with the objective of reflecting on that process. Many challenges were encountered: we found that directly linking the personas to a user population was not possible and although personas were a useful tool for supporting communication and elicitation across disciplines, it was hard to make them representative when picking details that were relevant and checking accuracy. Checking the content resulted in disparate, possibly incommensurable, views. Despite this, the personas proved useful in supporting the transfer of knowledge across professional perspectives.

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1. Introduction

1.1. Overview

From the perspective of healthcare providers, safe, usable, well-designed, medical equipment underpins quality of care. The problem is, it is not always clear what constitutes ‘well designed’. There may be a lack of clarity regarding who the user is, what they need or how needs differ (Money et al., 2011). It can be hard for designers to step into the shoes of the patient or clinician when hospitals are extreme, protected, often closed, environments. The design of medical devices provides a challenge, in terms of representing the user and incorporating this into the product (Martin et al., 2008; Vincent et al., 2014). A variety of guidance is available (e.g. (AAMI, 2009; FDA, 2011; IEC, 2007; NPSA, 2010a, b; Sawyer, 2009)), but traditional forms of user representation may be challenged, given a broadening of application and generalisation of technology (e.g. generic products used by different types of individual such as anaesthetists and agency nurses).

Taking infusion devices as an example, the variability between users can be great. Those controlling the pump may have minimal training (on how to use the pump), may be patients themselves, or may have extensive training and have undergone occupational selection. Similarly, there may be varying levels of procedure, process, monitoring or control associated with use. There are multiple and diverse interests that need representing during design. This paper is about the feasibility of defining the characteristics of a typical user (as a step in a “user centred design” process) in this context.

1.2. The origins of the persona technique

Our aim was to understand how the use of one HCI/HF/Ergonomics technique (personas), adapts to support the development of a common class of medical equipment (infusion pumps). We assume a broad variation in the skills and background of users and devices that cater for multiple contexts (as described in Obradovich and Woods (1996)). Cooper outlines the use of personas in the context of software design as follows:

“A persona is a single, specific but representative, hypothetical user archetype based on a study of the user community. We distil the distinctive characteristics of that user community to just a few personas... We use them as tools to describe and articulate the

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views of the user, that becomes the standards for writing software” (Cooper, 2000)

Personas include definitions of user goals; they describe what users want to accomplish and why. Typically, they are created during the design of consumer products and websites, and are described in papers and textbooks such as those of Cooper (2004; 2007), Pruitt and Adlin (2006) and Pruitt and Grudin (2003).

1.3. The benefits of using personas

Personas can be employed to represent the user during design, without requiring that development teams gain first hand experience of the environment of use. They support reasoning about the mental state of another (e.g. theory of mind (Pruitt and Grudin, 2003)). For example, User Interface (UI) designers need to provide a representation of the system, which communicates function and status to users, without necessarily communicating the internal workings. Norman (1998) argues the need to support the match between the *design model* (e.g. conceptualisation that the designer has in mind), *system image* (e.g. UI), and a *user's model* (e.g. conceptual understanding developed to explain the operation of the system). Personas support this match and provide a way to help designers infer the user's point of view (e.g. their goals, skills and needs).

For UI design, personas have been shown to play a role in supporting organisation wide design input and communication amongst mixed teams (for a review of the benefits see (Miaskiewicz and Kozar, 2011)). In theory, personas allow multidisciplinary teams to incorporate the needs of users together, at an early stage in the design (Nieters et al., 2007). Personas help designers focus on user goals (Pruitt and Grudin, 2003), and encourage extrospection and confrontation of unfamiliar design constraints (Noessel, 2012). They reduce the need to include users in design teams, and allow development personnel to work at a distance (Salmi et al., 2012). Personas can be used to support communication; create empathy amongst the design team; broaden focus; allow clarification of the position taken by a team-member and provide a linguistic approximation to the end user (Matthews et al., 2012). Personas help the articulation and resolution of design decisions in a context where design reasoning may be tacit. They provide a vehicle to make explicit the “why are we building it like this?” Many of these benefits can apply to safety critical contexts, for example as a way to fill gaps across multiple independent risk analysis activities (Björndal et al., 2011).

For Human Factors and Ergonomics practice, uses are diverse and varied, with personas being applied to support: the development of simulation and training systems in the automotive industry (Setia and Glyn, 2013); user requirements for car design/inclusive design (Marshall et al., 2014); the design of Personal Fall Arrest Systems (PFAS) (Liu et al., 2009); and the design of audit management systems for aircraft maintenance (Dharwada et al., 2007). This variation in application can be positive as it shows flexibility in adapting to various needs. For example, within healthcare personas have been useful for: making data anonymous (Jay et al., 2012); supporting inclusive design (Busch et al., 2013); and allowing for consideration of wider socio-technical or system-wide factors (HealthFoundation, 2012).

The use of personas in an applied context has been well explored; however, there has been comparatively little research seeking to understand the inherent constraints and limitations of the technique, and challenges associated with constructing content. This topic needs addressing in order to provide an understanding of how researchers and practitioners can get the most out of the technique, and make sense of a mixed literature regarding the overall utility.

1.4. The drawbacks of personas

In domains outside medical equipment manufacture, research has identified several issues concerning the use of personas. For example, during industrial software design, personas are invoked less often than expected (Matthews et al., 2012). Researchers have questioned whether they substitute for the involvement of real users (Bodker et al., 2012). Designers may bypass personas, instead using an appeals based process based on their own opinions or stories relating to hypothetical interactions with a product (Friess, 2010). Benefits are limited if the information contained within a persona conflicts with other statements of user need or provides false constraints on the design problem (Matthews et al., 2012). Even if content is correct and in agreement with other sources, there may be issues of trust. For example, student designers were shown to lack trust in a persona if they did not participate in the original user research themselves (Long, 2009). There is also the possibility that use becomes politicised or result in infighting. For example, once a product is under development, there may be a resistance to defining who the user is. Marketing and sales professionals may avoid adopting a user archetype when clients have already stated their priorities (Ronkko et al., 2004).

Added to these concerns, the process for creating a persona may vary. The technique has been adapted, depending on what people want to accomplish and why. This occurs despite textbook descriptions (e.g. those that provide advice on the planning, creation, deployment, use and reuse of personas) being very clear. For example, textbooks such as (Adlin and Pruitt, 2010) support practice by: breaking down the technique down into a staged process; illustrating typical content; and giving examples from practice (Cooper et al., 2007; Nielsen, 2013; Pruitt and Adlin, 2006). At one extreme, personas may be produced in seconds, as part of a caricature exercise during a design focus group. At another extreme, Pruitt and Grudin (2003) describe a persona exercise that lasted for 10 months and involved 22 people, to support the development of a Microsoft product. The differing types of output falling under the persona banner are so different that they cannot be fulfilling the same aim.

1.5. The use of personas to support medical device design

Research is required, because: for medical devices, the application of personas is in its infancy (e.g. not referenced by standard practice such as (IEC, 2007)); in other domains there is scepticism about their value (Chapman and Milham, 2006); and their use to support the design of healthcare technology has received little attention (Lerouge et al., 2011). Although there is potential for personas to provide a broad representation of user requirements, there is a tension between the need to “design for just one person” (Cooper, 2004), and standardised medical device practice (e.g. (Keay and Callander, 2004)), where equipment such as infusion pumps needs to adapt to suit the needs of many. During the design of medical technology, personas might be applied to prevent misunderstanding and/or encapsulate a broad range of user needs, but there is still much to be learnt about how this technique can be applied.

We wanted to understand the practicalities of generating persona content for infusion devices, when the aim was to communicate multiple and varied needs that would not easily lend themselves to formal requirements (e.g. social factors). The aim was to test whether it was feasible to create personas to represent user needs. We were not aiming to design our own device or evaluate the use of personas in a development context, but to work through the process of generating representative persona content. No previous studies have examined how personas can be constructed for

healthcare technology design, in order to reflect on the challenges of doing so. Our intent was to deliver the content to medical device developers, but our focus was on the process of creating personas and consulting with a variety of stakeholders (patient representatives, healthcare professionals and HCI/HF/Ergonomics investigators), to learn about the feasibility of developing content. When creating the content, we did not work directly with industrialists, due to concerns that we might inappropriately interact by (for example): creating conflicts of interest, compromising intellectual property, intervening in a way that conflicted with wider policy (e.g. “harmonised” European design practice), or compromising a reputation for providing independent advice. We also wanted to avoid bias in our creation of content by (for example) endorsing a single product or using device specific terminology. We outline our experiences during the creation and checking of the personas in an academic/healthcare setting and reflect on the challenges.

2. Methods

The study was conducted with a team of patient representatives, healthcare professionals and HCI/HF/Ergonomics investigators, with limited input from industrial stakeholders (see Section 3.5). Instead, we worked with a multidisciplinary team assembled for a UK research project investigating methods to support the design of safe, usable, interactive medical devices (CHI + MED: www.chi-med.ac.uk). Our method was to take the results of situated/observational studies and reflect on the challenges of presenting material in a way that would make it possible to check the extent to which the representation was true to life, well grounded and justifiable. We also created material describing sequences of equipment interaction (scenarios). In reporting the process of constructing the personas, it has been necessary to occasionally refer to the accompanying scenarios, but they are not the focus of this paper.

2.1. How the methods related to other studies

The personas were created using a modified approach, based upon a combination of the techniques defined by Pruitt and Grudin (2003) and Cooper (2004). A detailed description is provided in Table 1, which illustrates how our approach compares with the persona technique outlined by Cooper (“C”), Pruitt and Grudin (“PG”), subsequent variations (“PG Ext”), as well as other approaches (e.g. Marketing [“M” Personas]).

Both “Pruitt–Grudin” and “Cooperian” personas provide a tool for design, but vary in terms of permanency attached to content. Pruitt and Grudin’s original description (2003), (PG in Table 1), suggested that content was retained indefinitely, whereas for Cooper (2004), personas may be discarded once the design is complete. There are other differences. For example, Cooper’s original personas (C in Table 1) were based on ethnography and interviews, whereas Pruitt–Grudin personas provide an interface to a wider range of data gathering techniques, although the process in recent textbooks by Cooper e.g. (2007), has become more data driven (C-Ext). Given these differences, we modified the basic process for generating a “Pruitt–Grudin” persona (Pruitt and Grudin, 2003) (pp 2–8), to place an emphasis on observational/ethnographic investigation, and allow for inclusion of fictitious data. The PG process is paraphrased as follows:

1) Start by reviewing and linking to market segmentation and demographic studies.

Table 1

Comparison of the method used to create the personas with other textbook descriptions. See note for explanation of column headings.

Persona construction stage	Use of method/variation in technique ^a	M	C	C (Ext) ^b	PG	PG (Ext)	This study
Review and link to user research ^c	Ethnography		X	X	X	X	X
	Other personas		X	X	X	X	
	Qualitative data		X	X	X	X	X
	Quantitative data	X	X	X	X	X	X
	User surveys	X	X	X	X	X	
	Market research	X	X	X	X	X	
	Market segmentation	X	X	X	X	X	
	Demographics	X	X	X	X	X	
	Designer intuition		X		X	X	
	Personal experience		X				X
Group related findings/identify characteristics	Affinity diagramming					X	X
	Persona skeletons					X	X
	Constrain content?		X	X			X
	Plot on behavioural dimensions?			X		X	
Assemble and link to a repository	Allow fictional content?		X				X
	Foundation documents				X	X	
	Computer aided qualitative data analysis						X
Check the persona representations	Evaluation of evidence						X
	Check accuracy	X			X	X	X
	Check clarity						X
	Check currency						X
	Check referencing						X
	Check scoping						X
	Check typicality	X					X
Check potential for bias						X	

^a M = Marketing Persona as defined in (Floyd et al., 2008); C = Cooper Persona (Cooper, 2004); C Ext = Updated Cooper Persona (Cooper et al., 2007); PG = Pruitt–Grudin Persona (Pruitt and Grudin, 2003); PG Ext = Updated Pruitt–Grudin Persona (Pruitt and Adlin, 2006).

^b Cooper et al. (2007) outline a concept of provisional personas, where the need for grounding in data is relaxed (similar to ad-hoc personas). These are not reviewed in this table.

^c Structure for this section taken from (Floyd et al., 2008).

- 2) Review and link to user research, including field studies, focus groups, and interviews. Include the output of market research activities.
- 3) Group related findings (e.g. affinity diagramming).
- 4) Group users and constrain the number of persona representations based upon product type and levels of available resource.
- 5) Assemble a repository of information underpinning the persona/profile, which could include information relating to the work activities, household and leisure activities, goals, fears, aspirations, market size, influence, demographic attributes, technology attributes, communication abilities and international considerations. The repository would also contain interview data that could be used as a basis for quotations and references from literature review.
- 6) Check the persona representations. One way of doing this would be by going back to the user group in question, to confirm the extent to which the material is true to life or valid.
- 7) Disseminate the personas. For example, place them on an intranet or consider other techniques such as the use of posters, flyers, mugs, mouse mats, beer glasses etc.
- 8) Use the personas to support design decisions. Cross-reference the personas with product features to allow prioritisation of resource, or inclusion/omission of feature type depending on whether it helps or hinders a given persona.

We omitted stage 1, because it was hard to link this type of data with the ethnographic/observational data used during stage 2 (Section 2.2). We took a bottom up, data driven approach for stages 3 and 4. We extended and adapted stage 5 so that claims from the

observational studies could be linked to the persona content. We also extended stage 6, using a semi-structured script to collect a range of feedback regarding the truthfulness of the material. Stages 7 and 8 do not form the focus of this paper.

2.2. Assembling the evidence and generating the content

Persona content was based upon several observational studies (Table 2). In most cases, the observations had been structured using an underlying framework which applies Distributed Cognition to the design of Team-working systems (DiCoT) (Blandford and Furniss, 2006). The framework treats the healthcare context as a system and provides a number of theoretical lenses to structure data. It describes how information is transformed and propagated, (e.g. how the technology, tools, artefacts, room layout and people coordinate). For example, the information flow model (one of five models), gives an account of what the system does, including main inputs and outputs, as well as details concerning inherent process (e.g. what would happen to patients before, during or after treatment).

In addition to the observational studies, we also reviewed procedure manuals, special issue journals/conference proceedings, training materials, competency lists and Internet resources. All sources were loaded into NVivo 10 (QSR International, Victoria, Australia). We linked statements or claims made in the persona with evidence, through a process of in-vivo coding (Fig. 1). Where possible we maintained traceability between the persona and underpinning evidence. Although we did not rule out the use of fictitious content, anecdotes, intuition or inspiration, we used a data driven process where possible. Persona-scenario pairs are outlined in Table 3 (the scenarios are described elsewhere). In total, seven personas were created. An example is shown in Fig. 2.

2.3. Checking the material

We went through a staged checking process with patient representatives, healthcare professionals and HCI/HF/Ergonomics investigators (Table 4). The goals were to reflect on the plausibility of generating and checking the persona content, as well as to obtain

Table 2
Project sources for persona content.

Hospital context	Title	Reference
Accident and Emergency	<i>Workarounds in Accident and Emergency & Intensive Therapy departments: resilience, creation and consequences</i>	(O'Connor, 2010)
Haematology/Oncology	<i>Medical device design and use in the Haematology/Oncology day unit</i> <i>Unremarkable errors: low-level disturbances in infusion pump use</i> <i>Behind closed doors - a distributed cognition study of infusion pump use in round-the-clock haematology treatment</i>	(Furniss, 2010; Furniss et al., 2011; Gant, 2011),
The Intensive Care Unit	<i>Extending distributed cognition analysis for complex work settings: a case study of infusion pumps in the intensive care unit</i> <i>Understanding infusion administration in the ICU through Distributed Cognition</i>	(Rajkomar, 2010; Rajkomar and Blandford, 2012)
The Medical Equipment Library (central stores)	<i>Mutually towards best practice: exploring medical equipment libraries to inform dicot and vice versa</i>	(Werth, 2010)
Surgery	<i>Learning and using contextual inquiry and DiCoT: A comparative case study in a healthcare context</i>	(Berndt and Furniss, personal communication)

feedback to refine our understanding of context. Individuals were asked to confirm their suitability as a reviewer and answer the topics in Table 5. The questions used to seek feedback were created to: establish the extent to which others could justify the claims made in the persona content; learn whether the material was representative; and reflect on the process of creating the content. Some of the interviews were conducted on-line or over the phone. Where possible, interviews were audio recorded and data were transcribed verbatim.

3. Results and discussion

As with many studies describing the challenges associated with the persona technique (Chapman and Milham, 2006; Dotan et al., 2009; Friess, 2012; Long, 2009; Matthews et al., 2012; Nieters et al., 2007), we came across several difficulties in creating and checking content. They are listed in Table 6 and described in the following Sections 3.1–3.3.

3.1. Reconciling unclear, incomplete or contradictory evidence

We found limitations in our ability to reconcile multiple accounts relating to infusion pump users. For example, a lot of the persona content was dependent upon the context in which the individual worked and it was hard to know to what extent it generalised.

"P1: The problem you're going to have with any of this, is every case is different."

HS-03-01

Professionals based in different hospitals had different ways of doing things (e.g. clinical practice would be different). We needed to act on conflicting or uncertain evidence, which was often indeterminate. For example, two of our participants disagreed with each other regarding a statement contained within a persona, concerning the potential for a nurse manager to arrive prior to a shift commencing. From one perspective:

"P1: Apart from tangential, this thing about getting an hour before... that's not standard."

I: Okay, it's not typical?

P1: Trust me, that's not standard."

HS-02-01

And from another:

[Talking about the same example]

I: Would anyone do that?

P2: I do. I mean, I was [there] before everybody and stay there after as well."

HS-03-01

At times it was questionable whether a persona could ever be evaluated as being right or wrong, in line with the findings from other studies outside healthcare (Dotan et al., 2009). A potential mitigation would be to consider the nature of the sources used to construct the content, as is typical with safety case methodology. For example, by considering the nature of evidence, we could have judged the assurance, certainty or freedom from doubt that it provided (e.g. relevance, coverage, trust, independence – (Kelly,

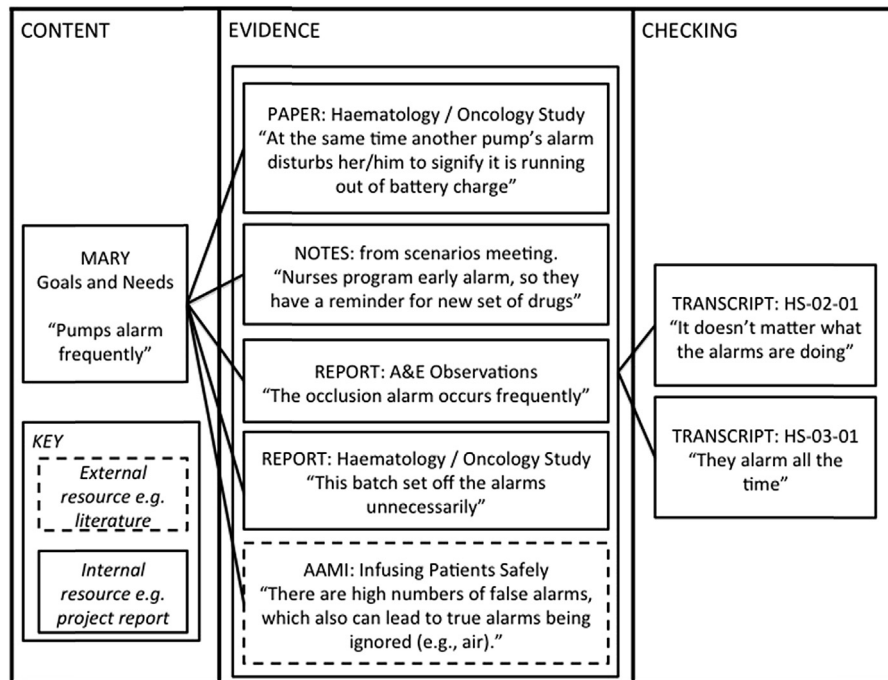


Fig. 1. Illustration of the linking and checking of content for one part of the "Mary" persona.

1998)). We could have also considered the confidence and reliability that it provided (e.g. independent scrutiny, rigour, diversity, replication of evidence and reinforcement of multiple lines of evidence (Menon et al., 2009)).

3.2. Structuring and scoping the persona writing exercise

There were numerous personas that could have been produced, but resources were finite. Approaches to deciding which personas to write included:

- 1) Representing as many possibilities as we could using pre-existing structures and then selecting a subset for expansion (using techniques described by Pruitt and Adlin (2006));
- 2) Extracting stories from the observational work.

Table 3
Persona types.

Ref.	Name	Age, profession, background	Persona–scenario combinations
1	MARY	24, Staff Nurse, Oncology Services	SCENARIO 1: Mary is administering a sequence of treatments
2	YASIN	40, Nurse Manager, Oncology Services	SCENARIO 2: Yasin is setting up treatments in an isolation room
3	FRANK	40, Clinical Engineer Device Trainer	SCENARIO 5: The equipment library has run out of volumetric pumps SCENARIO 8: Frank is installing an infusion pump on an air ambulance
4	JIM	67, Patient, Haematology/Oncology	SCENARIO 3: Jim can't sleep
5	SURESH	38, Hospital Pharmacist (Clinical), Oncology Services	SCENARIO 7: Suresh is helping to implement a hospital wide policy relating to infusion device use
6	FRED	55, Consultant Anaesthetist, Surgery	SCENARIO 4: Fred is setting up an epidural pump
7	MIRIAM	30, Agency Nurse, Various	SCENARIO 10: Miriam is practicing some tricky calculations

Note: The term "equipment library" may be UK specific and akin to a central store of hospital equipment.

The first approach involved considering the extent to which pre-defined, generalisable structures could be used to create and/or select a series of personas. For example, hospitals structure their staff by specialism.

"we have a department called Infection Control which will have... it's usually nurses who are employed in that role. We have about seven or eight nurses employed in that role, so very... they're quite high band nurses, so... Band 7s..." HS-01-01

Employees are standard functional units, with defined responsibilities, duties, and reporting lines. An "infection control persona" would be defined along the lines of a "Clinical Nurse Specialist: Infection Prevention and Control, Band 7" and include skills, goals and responsibilities, as defined by hospital policy and structure. We explored the possibility of using such a list to guide our selection and construction of personas (e.g. national job profiles), but there were practical issues. For example, structures varied between different hospitals, and were prone to constant change.

The other approach was to take the observational results outlined in Section 2.2, extract stories, and base our personas on them, akin to Cooper's original work. For example, the following content informed the Frank persona:

"I have heard stories of infusion pumps having cigarette burns on them, where it looks like a cigarette has been stubbed out." (Furniss, 2010)

In this case, content was inspired by observational/ethnographic work, similar to Cooper's original suggestion e.g. "every time a flight attendant would tell us a new story, we would invent another persona." (Cooper, 2004 p. 142). Although content is based on data, there is flexibility in allowing for interpretation of the data. In the context we were working in, taking an interpretivist stance was the practical option. We aimed to understand and communicate the meaning of social phenomenon, with an emphasis on the world of

PERSONA0T.docx Last updated 01/02/2014

MARY Age: 24, Staff Nurse, Oncology Services

Personal Background and Profile

Mary has been working for the health service for two years. Mary normally works alongside 4 nurses and one nurse manager. Mary takes blood samples, delivers anticancer therapies, in addition to providing supportive therapy. As well as setting up and delivering infusions, Mary is responsible for caring for patients, educating them about their treatment, reviewing, checking and updating records and liaising with other healthcare professionals. Mary works as part of a multidisciplinary team, which is often short staffed. Mary normally gets her colleagues to double check any calculations prior to acting on them, however when the unit is short of staff this isn't always easy.

“Even coming to the hospital can be stressful, emotional and a worry to patients”

Likes / Dislikes

Mary likes R&B music and goes out with her colleagues, to local clubs on a Friday night. In her spare time she is a member of a local running club and periodically runs charity 10k races. Despite being in the job for a while, Mary finds it difficult when treatment is not successful. In some cases, Mary will get to know the patient and family quite well, although her colleagues tell her she needs to keep detached. Mary tends to focus on the positive and works hard to make sure that patients receive the best possible experience given the potential negative emotions associated with terminal illness.

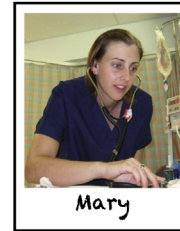
Attitude to Equipment

When equipment fails or doesn't work as intended, Mary gets cross and frustrated as she worries that patient care is being compromised. She tends not to show her emotions. Mary doesn't care about device functionality other than that used to program the infusion. If pumps are alarming frequently or configured inappropriately then Mary lets the nurse manager know. Mary is familiar with IT packages such as Word and Outlook and has a degree in nursing. Before using the infusion pumps, Mary completed a 40-minute training session with a Trust trainer, covering the process of identifying the giving set, loading the pump and programming the infusion. Mary hasn't read the device manual, but has been on a day long training course relating to the clinical aspects of IV therapy.

Goals and Needs

When using infusion pumps, Mary aims to quickly and reliably program the pump, whilst making sure that the patient is comfortable. Pumps alarm frequently and Mary is sometimes distracted when attending to a device. During a given day, Mary will need to program several infusions, sometimes using multiple devices simultaneously. Mary may program the device when wearing clinical gloves and look away or leave the

device unattended during the programming sequence.



Picture from: <http://tinyurl.com/7eopuca>

The content is not based upon the pictured individual. Page 3 of 19

Fig. 2. Example persona content. See also <http://tinyurl.com/n2stptx>.

experience “as it is lived, felt, undergone by social actors” (Schwandt, 1994). We needed observational studies and stories from the field to do this, but in selecting content and deciding which personas to write, we accepted that empirical and analytical parts of the source content were inseparable, and that there was an element of uncontrolled subjectivity (Dourish, 2006).

3.3. Knowing if and when to include fictitious content

A controversial aspect of the persona technique has been whether or not to include fictitious content, and/or amalgamate multiple sources, to support an engaging description. In part, our content was fictitious and resulted in participants (listed in Table 4) buying into the underlying descriptions. In many cases, the personas struck a chord, which was helpful in understanding wider organisational and social factors. For example:

[Providing Suresh as an example of how to alienate colleagues]. “You'd get slapped, and he would be very unpopular and he'd be excluded. And I'm actually not joking, that is exactly how to not get people to work with you in a hospital setting, and I've seen it

happen many times.” HS-03-01 [The Suresh persona described a fictitious hospital pharmacist being particular about how drugs were stored]

Although the textbooks warn of including fictitious and/or evocative content in the persona description, we found that it was difficult to avoid it. Adlin and Pruitt (2010) suggest that casting against expectations and/or providing emotive content detracts from more salient information about product use. We found emotive content was a helpful way of understanding the healthcare professional.

The downside of fictitious content is summarised by Chapman and Milham (2006), who describe “a problematic relationship between personas and user populations,” the concern being that fictitious content gives rise to representations that are not falsifiable. There came a trade-off between creating a detailed persona, where separate parts were grounded but the overall composition was an amalgamation (e.g. not instantiated), or creating more general content that could be linked to a population and where ambiguity could act in the favour of exploration and extrapolation (Gaver et al., 2003). In addressing the balance, we wanted to make the content engaging, but not expose the descriptions to ridicule.

Table 4
List of participants.

Line Ref	Profile	Recording method
1	RES-00-01 HCI/ERGONOMICS RESEARCHER	Notes (meeting)
2	RES-03-01 HCI/ERGONOMICS RESEARCHER	Notes (meeting)
3	RES-05-01 HCI/ERGONOMICS RESEARCHER	Notes (meeting)
4	RES-04-01 HCI/ERGONOMICS RESEARCHER	Notes (meeting)
5	RES-02-01 HCI/ERGONOMICS RESEARCHER	Notes (email)
6	RES-01-01 HCI/ERGONOMICS RESEARCHER	Notes (meeting/email)
7	RES-03-02 HCI/ERGONOMICS RESEARCHER	Transcript (audio recording)
8	RES-05-02 HCI/ERGONOMICS RESEARCHER	Notes (email)
9	HS-02-01 DEVICE TRAINER	Transcript (audio recording)
10	HS-03-01 SENIOR NURSE	Transcript (audio recording)
11	REP-01-01 PATIENT REP	Notes – phone call
12	HS-01-01 MEDICAL PHYSICS	Transcript (audio recording)
13	HS-04-01 HEALTHSERVICE MANAGER	Transcript (audio recording)
14	RES-06-01 HCI/ERGONOMICS RESEARCHER	Notes – phone call

Note: 9 and 10 conducted together (focus group)

Table 5
Interview topics pertaining to personas.

Topic	Question
Accuracy: How accurate is the material?	Can you give examples of factual inaccuracies?
Clarity: How clear is the material?	Can you give examples of the parts that are not clear? Can you give examples of similar material that is easier to understand? Was appropriate terminology used?
Typicality: How typical is the content of the material?	Would those described usually be involved in the activity? Who are the others that are involved in the activity?
Plausibility: How plausible is the material?	Can you give examples of parts that are implausible?

Table 6
The challenges of constructing and checking personas.

Challenge	Impacts	Mitigation
Reconciling unclear, incomplete or contradictory evidence.	It was hard to resolve conflicting sources of evidence and represent differences in healthcare practice.	Questioning the nature of evidence.
Structuring and scoping the persona writing exercise.	It was hard to scope the exercise and prioritise areas for investigation. There was no way of knowing how much coverage we had achieved.	Relaxing assumptions regarding the extent to which we assumed that the content generalised.
Knowing if and when to include fictitious content.	In amalgamating multiple sources of evidence and/or including fictitious content, the personas were unlikely to exist in reality.	Using the personas for sensitisation, and knowledge elicitation rather than a detailed design specification.

Feedback indicated that we had yet to meet these objectives. For example, one participant suggested that there was comparatively less value in the personal background and profile section (about a third of the single side of content):

“I would say one thing about the personas in general. I think that some of the biographical details seem a little frivolous in relation to how they would affect people’s behaviour at work” RES-02-01

Overall, the problem was that, even if claims are linked to evidence, every time an attribute or claim about a person is added, it becomes increasingly unlikely that the persona will exist within a population (Chapman and Milham, 2006). It is therefore necessary to express caution about the plausibility of checking the content. Although in principle it was possible to link the content to evidence, in practice it was hard to know how representative the content was.

3.4. How can personas inform medical device design?

In line with studies that have focused on the use of personas within development organisations (Bodker et al., 2012; Dayton, 2003; Matthews et al., 2012), we would recommend that personas are used as a way to support communication, with the following caveats. In practice, it was difficult to build confidence in evidence, link the content to evidence, reconcile contradictory evidence, know what evidence to include as well as discriminate between evidential and fictitious content. We therefore recommend that personas are used to support knowledge elicitation and communication, where compromises in grounding are made up for by the benefits relating to the widening of participation, broadening of feedback, flexibility in discussion and provision of a two way dialogue.

For example, those involved in the design and use of medical technology may be uneasy with the concept of medical equipment causing harm. When confronted with ideas, beliefs or values that conflict with their own, mental unease would force them to address these conflicts. Stakeholders (e.g. those with an interest in the project), may convince themselves that equipment is safe and/or act in denial in terms of the potential for medical error (Lester and Tritter, 2001; Mizrahi, 1984). Actively discussing the personas forces exposure and confrontation of mismatches, making personas ideal for education, communication, sensitisation and group reflection. Within the context of medical device design, this would be a novel application.

3.5. Limitations of the study

The lack of industrial involvement is a limitation of the study. There was a concern that by working closely with product design teams, we would have compromised our objectivity (e.g. been unable to separate analysis from wider factors such as political, financial, relational or definitional conflicts e.g. (Gulliksen et al., 2003)). We may have influenced product development teams in a way that was not appropriate (e.g. cause unnecessary conflicts between sales and development teams as in Ronkko et al. (2004)). Although personas are well placed to allow for mediation and overcome political differences, acting as boundary objects (Hall-Andersen and Broberg, 2014; Massanari, 2010; Star and Griesemer, 1989), not all accounts of their deployment in industry are positive (Blomquist and Arvola, 2002). We were primarily interested in methodological limitations, during the construction phases. We therefore restricted our analysis to this stage. The use of a limited range of participants to generate and check the content also limits the scope of the findings, although we would expect the reported challenges to be exacerbated by widening participation.

Where we did receive feedback from infusion device manufacturers, we did so via project engagement activities (workshops) and email correspondence. Discussions centred on differences between actual and intended uses of infusion pumps, and similarities between the personas and their own “in house” content. They suggested that material should state wider interdependences in the work context (e.g. interdependencies between personas). They also suggested the need to link persona content with a specific product in development. Although we did not discuss ways to promote uptake within an organisation, other studies have provided recommendations including the use of cards, posters, and cardboard cut-outs (Mulder and Yaar, 2007). Given the challenges we observed, best practice for deployment (e.g. communicating the origins and constraints of the content) provides a stimulus for future work.

3.6. Conclusions

Establishing a ground truth and providing a global representation of healthcare professionals is difficult. We therefore need to find ways for teams to build and manage their own understanding. Our findings show that the persona technique can be used to support, and complement a number of Knowledge Elicitation (KE) techniques such as documentation analysis, think aloud, unstructured interviews, structured interviews, group interviews, probes and event recalls (Hoffman et al., 1995), as well as standard usability practice (e.g. (IEC, 2007)). The personas are working as a “first pass knowledge base”, (Young and Gammack, 1987), which allows mismatches between the understanding of those involved to be identified and opinions expressed and negotiated. Although there is a well-established, frequently applied literature regarding how to understand context with regard to user and usage (Holtzblatt, 2009), there is less developed literature regarding how different disciplines can communicate, combine and reconcile understanding. Although untested, we would expect the persona technique to offer a broad range of advantages to industry: for example, getting new recruits to consider important aspects of the customer; disseminating information about users across an organisation; making the process of discussing user needs fun; making it easy for employees to represent the user, or switch hats when it comes to discussing user requirements; and giving employees look ahead regarding future customers.

Competing interests

None.

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