Personas: The Linking Pin in Holistic Design for eHealth

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Abstract— **Personas, lively descriptions of distinctive user groups for a technology, have the potential to be a useful tool for designing useful and usable eHealth services. In this paper we discuss the role of personas in a holistic design approach for eHealth: the CeHRes roadmap. We show, using the case of a mobile tick and Lyme tool, how one can develop personas and how one can use these personas in future design efforts. We argue that they can be useful for creating requirements and eHealth design, can be the basis for the development of scenarios that guide problem analysis with stakeholders, and finally, can inform both formative and summative evaluations.**

Keywords-Personas; Holistic Design; Human-Centered Design; Business Modeling

I. INTRODUCTION

Since their introduction, personas have rapidly gained popularity as an important tool for inspiring technology design. Originally, personas have been defined as "*hypothetical archetypes* of actual users" [1]. They are a set of fictitious persons, each one typical for a group of people, who will, potentially, use a new technology. Traditionally, personas are presented by means of a short biography with a photo and the goals they hope to achieve by means of the technology. Such descriptions can be quite detailed, including, for example, hobbies and the breed and name of the dog that the persona has for a pet. They are used by a technology development team to get a good grasp of the different user groups (in a way they are a short summarization of a user group's distinctive characteristics), as inspiration for design and, finally, to engage the design team members [2].

Within the context of electronic health (eHealth) design, personas have been used in several projects, including the development of electronic patient records [3], a public website with cancer-related information [4], a digital assistant for nurses [5], and a handheld device to monitor chronic heart failure [6]. These publications, however, do not provide detailed, hands-on guidance for developing and utilizing personas for eHealth. An important step forward in systematic use of personas in eHealth was made by LeRouge and colleagues [7]. Illustrated by the design process of a mobile self-management tool for diabetes patients, they document the development, use and usefulness of personas

for eHealth in detail. However, all the aforementioned studies focus only on the use of personas in a human-centered approach towards design, thereby ignoring the business model that needs to be created if one wants an eHealth technology to be sustainable as well. In this paper, we discuss the development, use and usefulness of personas in a holistic design approach towards eHealth, which incorporates both human-centered design and business modeling. We illustrate this discussion using the development of a mobile tool for preventing and treating tick bites, in order to prevent Lyme disease.

The rest of this paper is organized as follows. In Section 2, we discuss the CeHRes (center for eHealth research) roadmap, a holistic design approach for eHealth, which will form the basis of the mobile 'tick tool' development, and in which we embed the use of personas. In Section 3 we introduce the design case used to illustrate our use of personas, followed by the procedure we applied to determine and understand the most prominent user groups, and to create personas. To conclude this section, we outline how we have used these personas and will use them in future design activities. We complete this paper with a reflection on the use of personas in the development process and an outline of future work.

II. HOLISTIC DESIGN FOR EHEALTH

A. CeHRes Roadmap

The development of technology (be it in the context of health, government, or somewhere else) can be guided by means of several design approaches. Human-centered design, which advocates the systematic, continuous consultation of potential users, from as early in the design process on [8], is one such approach. It has been found to have positive effects on the final system; for example, it prevents the inclusion of superfluous features and increases user acceptance [9]. Another approach, business modeling, focuses on generating a good fit between the technology in development on the one side, and organizational resources and capabilities on the other side, in order to create a viable technology [10].

The CeHRes roadmap is a framework that guides the design of eHealth applications [11]. It incorporates both a human-centered design, and a business modeling approach.

Figure 1 displays the roadmap and shows the five main phases in the development process:

1. **Contextual inquiry**. In the first phase, the design team must get an understanding of prospective users and their context, and analyze the strong and weak points of the current provision of care.

2. **Value specification**. Next, it is determined which values the different stakeholders deem important. These values and prospective users' needs and wishes need to be translated into functional, organizational and technical requirements

3. **Design**. Based on the requirements, (a prototypical version of) the technology is developed. The framework advocates the application of cooperative design in which the design team creates the technology with prospective users and stakeholders together.

4. **Operationalization**. At this moment the technology is launched, marketing plans are set into motion, and organizational working procedures are put into practice.

5. **Summative evaluation**. Finally, the eHealth technology is evaluated: How is it being used and what is its effect on patients and healthcare?

The CeHRes roadmap should not be seen as a waterfall process, but is iterative in nature: formative evaluations should be conducted continuously. Each phase comes with a set of design and evaluation tools that can be deployed, but their suitability depends on the situation at hand. A complete overview of these tools and their uses can be found at [12].

B.   Personas as Linking Pin in the CeHRes roadmap

Within the holistic approach to eHealth design that the
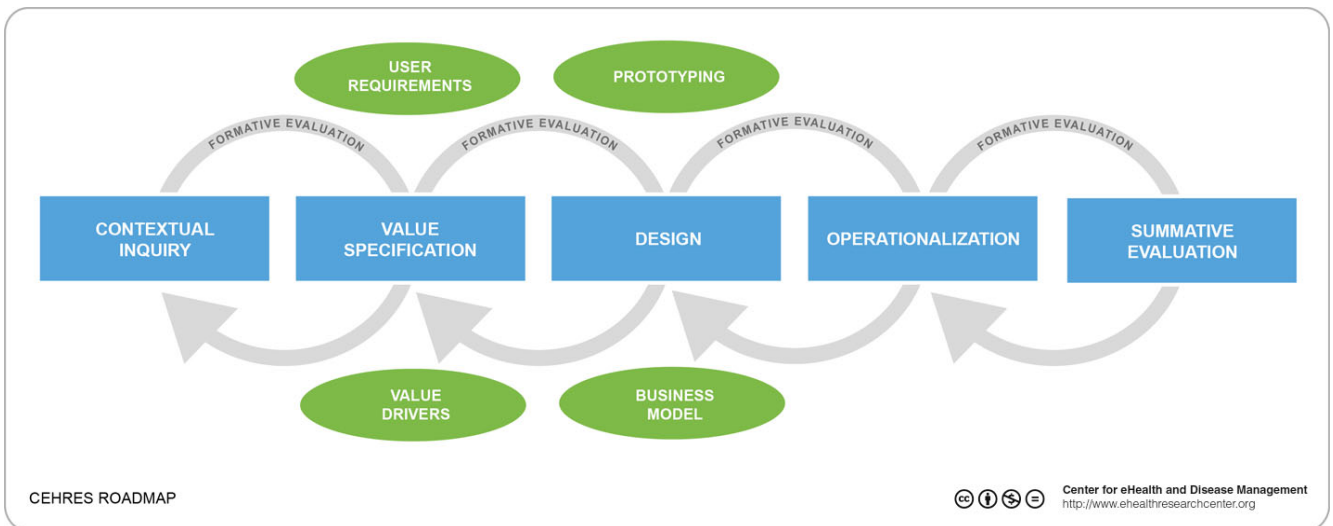

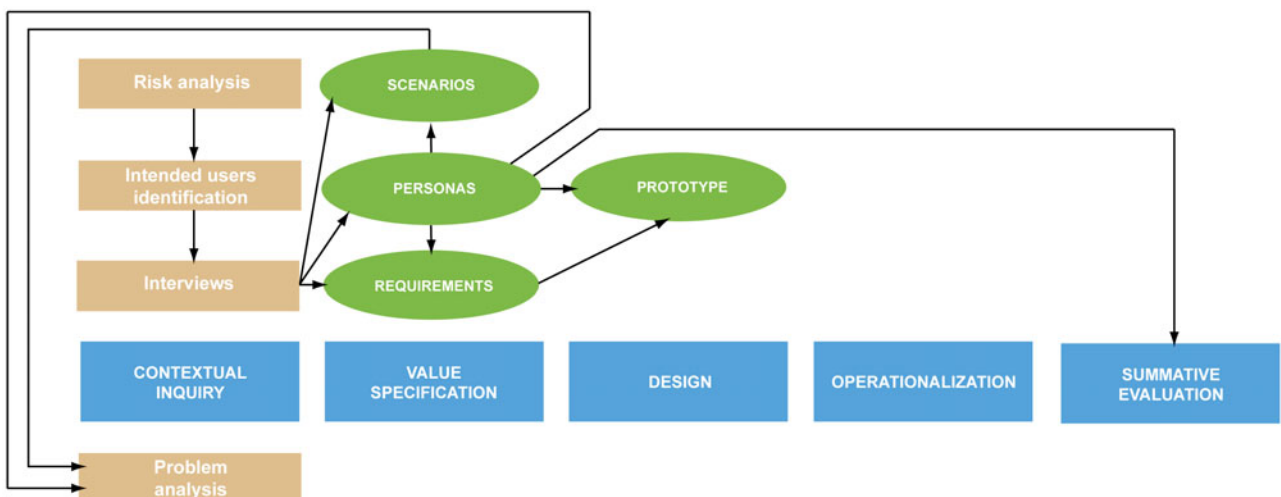Figure 2.   CeHRes roadmap

Figure 1.   Personas in the CeHRes roadmap

TABLE I.   EXCERPTS OF TABLE DESCRIBING INTERVIEW RESULTS AND TRANSLATION TO PERSONA: THE ONE THAT DOESN'T CARE

Interview segment	The one that doesn't care	Sample quote	Translation to persona
Knowledge of ticks and Lyme disease	Widespread: some people know nothing, some people know a lot. For persona 'medium knowledge' is used.	Woman: "yes, a bug that sucks blood out of you. It will get stuck to your skin and then it will suck your blood I believe." Daughter: "And then it squirts something back and then you become ill from that. Then you get Crohn's disease? [interviewee thinks] No, Lyme disease." Woman: "It will probably have something like clawlike teeth. And I think something's in there. […] It's about the head, that should come out. Because there's something in it. And when you've done that, you have to see whether you get this little circle. You have to keep an eye on it. And when this little circle turns up you have to go your GP immediately."	But he does know some things about the bug. He knows that it's an insect that bites and sucks your blood. He also knows it can give you Lyme disease. Finally, he thinks that ticks fall down on you from trees
Dealing with tick bites	Have different strategies for dealing with tick bites: • Removing themselves with (tick)pliers • Visiting a doctor	Man: "Well, we have these tick pliers, so I think I'd give it a shot. To get it out." Interviewer: "Do you have these?" [shows tick pliers] Man: "Yes. Although I'd need the description to find out what is the best way to do that." Man: "yes, I've understood that you need to visit your GP then." Interviewer: "So you'd call your GP?" Man: "Yes. Not at first of course. When you're bitten you're not sure. It could of course also be a mosquito bite."	and that if you're bitten you should visit your GP to get the tick removed.

CeHRes roadmap is, personas can play an important role. They can serve as inspiration for functional design and interface & interaction design, but they can also be used to reflect on the existing organizational structures behind care (e.g., by letting stakeholders discuss a persona's journey through healthcare for a given situation, thereby identifying weak and strong points). As such, the use of personas and the CeHRes roadmap to develop eHealth technology serve as a catalyst for change in health care: New care through new technology.

Figure 2 shows how we have embedded personas within the CeHRes roadmap. We would like to stress that this is not the only possible strategy for using personas, nor is it necessarily the best way for doing so. Whether and how one should use or develop personas depends on the design context and the means available to the design team. That being said, we think that the role we have assigned to personas, both in the roadmap and the case study, ensures that the resulting personas are valid and that their usefulness is maximized.

The development of the personas is based upon a risk analysis to determine the most important user groups for the new eHealth technology, and interviews with members from these user groups. These personas, combined with scenarios (fictitious anecdotes of a persona experiencing an illness and the associated healthcare) will then be used as input during a stakeholder session that has the goal to reflect on the existing care delivery process and to eventually alter this practice. They also serve as input for the requirements engineering and actual design of the new eHealth technology and the evaluation thereof.

III. FROM THEORY TO PRACTICE: THE CASE OF DESIGNING A MOBILE TICK TOOL

Lyme Borreliosis is an infectious disease caused by Borrelia spp. and transmitted to humans by a bite from an infected tick. In 2006-2007, 1.1 million citizens (out of a population of 16 million) in the Netherlands were bitten at least once by a tick [13]. This number is in line with a trend that shows that the number of tick bites and infections with tick-borne diseases is increasing in the last decades.

In order to end this trend and to prevent the contraction of Lyme disease, a novel approach to alerting citizens to the dangers of tick bites, and how to deal with these insects was needed. It was decided to create a new intervention by following the CeHRes roadmap. The use of mobile technology was introduced as a technology push. As people are mostly confronted with ticks on locations away from home (e.g., forests or dunes), it was posited that people would benefit from information and instructions provided on site.

The design team consisted of two experts on eHealth development and two experts in the field of infectious disease control. Furthermore, four local health authorities (in Dutch: GGD) were committed to the project and invested time and effort in the recruitment of participants and contributed their thoughts during the development process.

TABLE II.   EXCERPTS OF TABLE DESCRIBING INTERVIEW RESULTS AND TRANSLATION TO PERSONA: THE ONE THAT CHECKS

Interview segment	The one that checks	Sample quote	Translation to persona
Knowledge of ticks and Lyme disease	Medium to high knowledge of ticks and Lyme disease	Woman: "They are these little bugs. You don't see them very well. You have a chance of being bitten by one when you go walking in the forest. I don't know whether there are any other places […] but for sure where there are trees. So you can be bitten by one. Not only humans, animals as well. And if it stays stuck for too long, then there's a chance you become ill. Then you get Lyme disease and that's a big drama. So you have make sure you get it out on time."	By now, Anouk also knows some things about ticks. She knows that you can get a tick bite when walking in the forest and that it can make you very ill. So she thinks it's very important to find a tick bite as soon as possible.
Dealing with tick bites	Will remove the tick themselves with (tick)pliers	Woman: "Remove them myself" Interviewer: "And how would you do that?" Man: "You have these special devices you can put on them." Interviewer: "Do you have one of those at home?" Man: "My parents used to have one. But since I live together we don't have those. Maybe a good idea to get one of those sometime."	Should she find a tick that has bitten, then she would remove it herself using tick pliers.

At the moment of writing, the development process for the mobile tick tool has not been completed. We have completed the development of the personas and are preparing the stakeholder meeting which will use the personas as input for rethinking the prevention and care activities for Lyme disease. We will discuss this in more detail in Section III D.

A. Determining user groups

The first step in the development of our personas was to determine the primary user groups for the mobile tick tool. Therefore, the four Local Health Authorities conducted a risk analysis: they identified the groups of people that were most at risk of contracting Lyme disease as a result of a tick bite and that would be most susceptible towards persuasive efforts. The risk analysis was based upon a systematic procedure for risk determination for infection prevention [14]. This procedure, on its turn, was developed using a literature review, Dutch national infection prevention guidelines, practical experience, and previously published procedures for risk determination.

The risk analysis identified three primary user groups: Recreationists, children, and green professionals (e.g., gardeners and foresters). We decided to create one mobile application for recreationists and children, as these groups partly overlap (people that spend a lot of time outdoors may do this with their children). For green professionals we will develop a separate specific mobile tick application in collaboration with occupational health experts. In this paper, we will now focus on the development of the personas for the primary user group 'recreationists' only.

B. Interviewing the primary user group

In order to understand our primary user group 'recreationists,' and the designated context of use, we conducted 15 semi-structured interviews. The interview protocol was based upon the overview of persona attributes by [7]. It consisted of three main parts. The first part, **demographics** focused on interviewee characteristics, such as age, family situation, etc. The second part, **healthcare specifics**, zoomed in on the interviewee's knowledge of ticks and Lyme disease, how they deal with ticks and tick bites (including checking for tick bites), their attitudes towards possible information sources for tick- and Lyme related information, their stance towards preventive measures, and finally, the frequency with which they visit risk areas. The last issue was questioned by asking interviewees to state how often they visited risk areas, identified in [15, 16]. In the last part of the interview, **technical specifics** were discussed. Interviewees were asked about their skills, possession of mobile technology, wishes and expectations regarding a mobile tick tool and a web-based variant, and finally, in which situation they would use these technologies. As the interviews were semi-structured, the interviewer was allowed to discuss interesting issues that came up during the interview.

The interview participants were recruited by two Local Health Authorities (one in a high endemic, and one in a low endemic area) and consisted of persons receiving vaccinations for international travel. This group of people can be assumed to be frequent recreationists. All interviews took place at the Local Health Authority office; right before or after the interviewees received their vaccinations. Some interviews were conducted with individuals, some with pairs of people (e.g., husband and wife). Each interviewee received a gift voucher for their participation. Prior to the interview, the interviewer explained the goal of the interview, explained that the interviewee would remain anonymous, and obtained permission for making an audio recording. Each interviewee then signed an informed consent form. An average interview lasted 30 minutes.

There is no set procedure for translating interview data into personas. We transcribed the interviews and then analyzed using Atlas.ti 6.2 by classifying each comment under the applicable category in the persona attributes overview, as suggested by [7]. Then, we created an overview, displaying each interviewee's response to the most important attributes.

C. Personas for a public mobile Lyme tool

From the overview with interviewees' responses it became clear that there were two distinctive groups of people and that we should create two personas. The first persona we called **the one that doesn't care**. This persona corresponded with the answers of 12 interviewees, making it our primary persona. In short, this persona is not really concerned about ticks or Lyme disease, does not visit risk areas often, does not check for ticks, and intends to use technology only when being confronted with a tick bite. Our second persona, **the one that checks**, was represented by 3 interviewees, making it our secondary persona. This person has experience with being bitten by a tick, often visits risk areas, (almost) always checks for ticks, and will use technology to read about ticks out of curiosity.

In order to create the persona biographies, we created two tables (one for each persona) in which we listed relevant interview segments, how the group of interviewees representing a persona responded, typical quotes, and finally, the section of the persona biography that represents this interview result. In Table 1 and 2 we provide excerpts from these tables for the two different personas.

Figure 3 shows our persona for the one that doesn't care. We have given this persona a name, Mark, and added a picture to the biography to make it livelier. Each sentence in the persona description corresponds to a finding from the interviews.

Mark is 54 years old and planning engineer for a construction company. He lives together with his wife. Together, they have two children (21 and 19 years old) that live on their own by now. They don't live completely alone though, together they take care for their dog: Tommy

Fortunately, Mark has never been bitten by tick. But he does know some things about the bug. He knows that it's an insect that bites and sucks your blood. He also knows it can give you Lyme disease. Finally, he thinks that ticks fall down on you from trees, and that if you're bitten you should visit your GP to get the tick removed. Mark has seen ticks before, Tommy takes them home now and again. Then, Mark or his wife remove them with tick pliers.

Mark does not visit nature very often. In the summer he likes to sit in his backyard, and when they go on vacation he and his wife like to make long walks through the forests or the mountains. He does not take preventive measures to prevent a tick bite then. He also doesn't check for tick bites afterwards. It simply does not cross his mind.

His digital skills are perfectly fine, Mark thinks. After all, he thinks it's fun to try out new technology and he has numerous apps on his iPhone 4g. He takes his phone everywhere and never turns it off. Mark will only start to search for information about ticks on the Internet or on his iPhone when he notices he's been bitten by a tick. In that case, he will Google first, but will also check out the website of his Local Health Authority.

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Figure 3. Persona Mark

D. Using personas in the development process

Writing the biographies of our personas marked the end of persona development. At the moment of writing, we now enter the stage of utilizing personas in our holistic design process. There are, in our view, a variety of ways for benefiting from these user representations which we will use in the design of our mobile tick tool.

First, personas will be used to inspire the creation of requirements, as well as functional and interface & interaction design of prototypical versions of the mobile tick tool. The design team must question the usefulness and appearance of the design with the different personas in mind. Is this function one Mark or Anouk (the secondary persona) would use? Will Mark and Anouk understand the explanations about Lyme disease that are published on this website? Furthermore, the personas, and especially their disposition towards preventing tick bites and checking for tick bites, will be used as a basis for persuasive design. It is towards these attitudes that

persuasive strategies, as implemented in the mobile tick tool need to be geared [17].

Second, personas will serve as the basis for the creation of scenarios describing a typical case of getting a tick bite and consequently, contracting an Erythema Migrans (a frequent first, innocent sign of Lyme disease). These scenarios will also be inspired by interviews we held with people that contracted Lyme disease, and their stories. These scenarios will be presented to stakeholders (identified on the basis of the prevention and care protocol for Lyme disease in the Netherlands) such as GPs, Local Health Authorities and tourist services in high endemic areas. By means of these scenarios we wish to stimulate a discussion about the strong and weak points of the current prevention and care path for tick bites and an Erythema Migrans (problem analysis in Figure 2). The identified problems can then be tackled through the design of the mobile tick tool and the business model that accompanies it. As a result, personas will also serve a role in the business modeling track of the design process.

Third and finally, personas will influence the design of the evaluations that will be conducted throughout the design process. During formative evaluations (conducted in order to receive redesign input), personas will be used when recruiting evaluation participants, as suggested by [2]. It is also possible to use personas for cognitive walkthroughs. In this case, experts can be asked to look at a prototype and to determine whether they can find redesign issues, asking themselves questions like: Would Mark understand what he is looking at? Could Anouk use this function successfully and satisfactorily? With regard to the summative evaluation of the mobile Lyme tool, the personas will be used to select the proper evaluation criteria, especially when it comes to the persuasive effect of the mobile tick tool. Persuasive goals and strategies need to be set according to each persona and need to be evaluated accordingly.

IV. CONCLUSION AND FUTURE WORK

In this paper we have discussed how one can develop and utilize personas for eHealth within the context of an holistic design approach. Personas can be the linking pin in the development process of eHealth. They serve as lively summarizations of user groups, can inform design, and finally, inspire problem analysis activities with stakeholders. Therefore, we can only encourage eHealth developers to look seriously into the possibilities for utilizing personas in their development processes. In the future, we will complete the design of the mobile Lyme tool, following the CeHRes roadmap and utilizing the personas where applicable.

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