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IMPROVING PREVENTIVE BEHAVIOR IN RELATION TO TICK BITES AND LYME DISEASE FOR PROFESSIONALS IN THE GREEN SECTOR

"If we knew what it was we were doing, it would not be called research, would it?" (Albert Einstein, 1879-1955)

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Furthermore I hope that with this research I have provided a step into the right direction by providing ways to increase the preventive behavior and attitude of professionals working in the green sector who have to struggle with problems of ticks (and Lyme) in their professional working place. Beside the fact that this research is only '*a drop in the ocean*' I sincerely hope that I have reached my goal to improve the safety of professionals in the green sector

As this paper is the last step for completing my education, it reveals the road to my career as a health scientist which I am looking forward to.

Thank you all and enjoy the reading.

2. ABSTRACT

Objective: New means for informing people are created due to the uprising communication technologies. These new technologies can be used to improve preventive health behavior. Professionals in the green sector in the Netherlands (and abroad) are facing with the uprising problem of ticks and Lyme infection. The RIVM (Dutch National Institute for Public Health and Environment) would like to improve preventive behavior among those people. The intention is to create an user centered e-Health application that changes behavior and attitude of those people in such a way that it would result in fewer tick bites and Lyme infections. The objective for this research is to provide guidelines for such a system based on needs and requirements from the stakeholders and molded into a persuasive technology.

Methods: The CeHRes roadmap is used as guideline for the holistic design process. Through this roadmap different techniques were used for gathering and processing the data. Two large reports conducted in the Netherlands with cooperation of Stigas (Prevention service for the agricultural and green sector) were used , in the sector 'forest and nature'(n=1019) (Bosschap & Stigas, 2009) and in the greening- and gardeners sector (n=798) (Stigas, 2010) Other methods were: stakeholder analysis, user observation, interviews (n=15), online focus group (n=5), personas, brainstorming and prototyping. Thematic analysis is used for processing the data. Beside the empirical data the system is supported by persuasive features based on the PSD (Persuasive System Design) and BCSS (Behavior Change Support System).

Results: Derived from the empirical data it seems that professionals in the green sector feel that the problem with ticks and Lyme is not recognized enough by health care professionals and their own employers. Prevention for tick bites and Lyme infection should focus on providing information about ticks and Lyme and preventive measures. Combining off- and online media seems best suited for the job, whereas face-to-face contact is most preferable. The provided information should be based on a guideline that is national accepted by all those working in the green sector. Information should be clear and simple and should include both low-level and high-level information.

Conclusion: Using technologies alone such as an e-Health app for a mobile phone would be one step too far, however combining this with other media seems to be suited for the job. Using the holistic CeHRes roadmap based on human centered design can increase the adherence with the persuasive system, incorporating needs and requirements from different stakeholders. This e-Health application can be seen as a product that does improve preventive behavior. However only relying on such an application would be insufficient; more research is needed as improvement within the health care and organizations.

3. INTRODUCTION

During the last couple of years the amount of people visiting the physician with Lyme related symptoms are increasing(A. Hofhuis, 2011). However the authors of a recent study (Vanthomme, Bossuyt, Boffin, & Van Casteren, 2012) have proposed that this could be caused by: better knowledge of the disease, better diagnostic methods, increased awareness of the general practitioners (GPs), changed recreational habits, urban growth to rural surroundings, greater tick densities, and climate changes. The fact remains that in the last couple of years the incidence of tick bites is increasing in the Netherlands and that it is becoming a national health problem (Hofhuis et al., 2010). The people with the highest risk of getting tick bites are people working in the natural habitat of tick. Those are people working in the green sector such as foresters, gardeners or people from the parks department. For these people, Lyme disease is officially stated as a work-related disease. In order to create more safety and restrain these numbers of incidence, the RIVM (National Institute of Public Health and Environment) wants to take preventive measures which consist of creating a more preventive behavior and way of thinking in relation with Lyme disease.

The RIVM would like the solution to be an e-Health application as a result of a holistic design process. The holistic framework that will be used is the CeHRes roadmap (Van Gemert et al., 2011), this roadmap serves as a guideline for planning, coordinating and execute the participatory development process of an e-Health technology. This framework consists of several aspects with the use of qualitative research. The process starts with the contextual inquiry which can be done by empirical research, then defining relevant stakeholders and their influences, needs and requirements. In the design phase testing and fine tuning will be done throughout user testing and or prototyping. After this step the implementation plan will be created, eliminating barriers and creating facilitators for promoting successful implementation. The end product will not be the final e-Health application but will provide a prototype that includes a theoretical underpinning of the prototype design, this is based on persuasive technology theory such as the PSD (Persuasive System Design) and BCSS (Behavior Change Support System) which provide guidelines for creating a successful persuasive technology. The CeHRes roadmap provides the user centered design, the PSD principles will enhance the persuasiveness of the system and by using the BCSS the system supports behavior change. These three theories complement each other in the process of designing a persuasive user centered design that will improve preventive health behavior.

Despite the fact that there is no consensus in several aspects of tick bites and Lyme disease, this application will be based upon a guideline from the CBO (Central Guidance Organ), the CBO is an

organization that focuses on the development, implementation and assessment of professional quality policy in the Dutch health care. This guideline has recently been revised and is based on international literature and systematic reviews.(CBO, 2011)

This thesis will take place with combined efforts of the RIVM (Dutch National Institute for Public Health), Stigas (advisory board for a safe environment in the green sector) and the University of Twente. The problem at hand is the increase of tick bites and infections with Lyme Borreliosis in the Netherlands (BRON) and especially for those at high risk, this group of people consists mainly of green workers, for them this is already a work-related disease. By using modern technology the goal will be to reduce this problem.

4. PROBLEM STATEMENT

Every year new work-related diseases arise. According to the Dutch Center for Occupational Diseases (NCvB) the definition for an occupational disease is as follows: '*A disease or disorder as a result of a strain which predominantly occurred during labor or in the labor environment*'. They also define a labor accident as: '*A labor accident is an accident to an employee in work-related activities which can be seen as a accidental, sudden event, that has led to a direct damage of this persons health'.*(NCvB, 2008) In 2009 a Dutch field police officer strained a lawsuit after being infected with Lyme borreliosis due to his work activities who were mainly outside in forest. The Dutch Judge ruled in favor of the police officer, thereby stating that the Lyme borreliosis as a result of a tick bite was an occupational disease.(Bestuursrechter, 2009)

Piacentino and Schwartz (Piacentino & Schwartz, 2002) published an article in which they wanted to clarify the occupational risk of Lyme disease among outdoor workers. They compared 91 articles and found that outdoor workers had and increased risk of seropositivity for antibodies to *Borrelia Burgdorferi.* However these studies compared the outdoor workers with people that had lower risk of Lyme borreliosis from residential and recreational exposure to ticks, for instance control groups that live in endemic areas and control groups in areas whereas Lyme disease is low are absent.

De Groot (2011) emphasizes the importance to provide health education and preventive measures for those at high risk (Groot de, 2011). De Groot (2011) also underpins that all those involved such as; health care professionals, pharmaceutical companies, researchers, the government and the green sector need to progress the area of diagnostics, treatment and education.

According to Corapi et al (2007) (Corapi et al., 2007) there are sufficient primary and secondary prevention strategies for reducing tick bites and Lyme borreliosis. These strategies apply different aspects such as: reduction of hosts, tick habitat modification, chemical control, biological control, pharmacologic control, personal protection(Corapi et al., 2007). They also mention that beside these different preventive measures which differ in effectiveness and costs, the appliance of such measures is universally low, and they suggest that new prevention strategies should aim at raising the confidence of the ability of people to use certain strategies or measures for preventing tick bites and Lyme borreliosis, a change in behavior. They also mention the importance of persuasive cues for changing this behavior, one important aspect that will be included in this research. "*Well-designed public-health campaigns should include persuasive cues to action that address attitudes and beliefs about Lyme disease, and should provide resources to increase self confidence in taking appropriate action."(Corapi et al., 2007)*

Based on a Polish report it seems that there is still uncertainty and lack of knowledge among professionals in the green sector (Kurnatowski, Warpechowska, & Kurnatowska, 2011). Other evidence is sparse as there are few studies about this population in relation to ticks and Lyme, therefore not all evidence can be generalized to countries such as the Netherlands. During this research the aim is to find out what knowledge is missing and in what way this information can be provided to the potential users and finally how this information can be implemented in such a way it improves preventive behavior. Therefore based on public health the RIVM wants to create an e-Health application for the professionals working in the green sector to promote/improve preventive behavior towards tick bites and Lyme disease. Modern communication technology can be used to support this goal. The RIVM underlines the importance of these technologies as it can offer customized/ tailored prevention towards specific groups, which seems more suitable for the task at hand than mass media communication interventions(Brug, de Vries, & de Vries, 2005).

5. MAIN RESEARCH QUESTION

The main purpose of this research is an answer to the following research question below. By answering this question and create a scientific foundation for a product that can improve health related matters among professionals working in the green sector. With growing numbers of internet and mobile phone usage the RIVM wants to anticipate to this 'new' media and therefore develop an e-Health application. There are two main research questions focusing on the design process and the 'final' product:

- *How can e-health technology support the improvement of preventive behavior towards reducing tick bites and infection with Lyme borreliosis among professionals working in the green sector?*
- *In what way could a holistic design process provide the basis of the e-health technology?*

The main research question is answered through the design, recommendations and conclusion. The sub questions are answered by the chapters they refer to, the contextual inquiry, value specification and design.

6. THEORETICAL BACKGROUND LYME BORRELIOSIS

The lifecycle of the tick involves 4 different stadia; egg→larva→nymph→adult. In each stadium after being hatched, a blood meal is needed to evolve into the next stadia. The hard ticks seek hosts by climbing into grasses and undergrowth, they wait until a host comes along and than just

grab on by it. In every stadium the tick seeks out a new host. The *B. burgdorferi* multiplies itself during each blood meal, which than transfers itself during a tick bite. After the infection the spirochete can spread itself through the tissues or blood, after this the spirochete can survive for many years in the hosts' skin, joints or even the central nerve-system. The clinical manifestations can either occur because of inflammation reactions due to the spirochetes or because of the auto immune response of the human body (RIVM, 2005).

6.1. EPIDEMIOLOGY

Hubalek (2009) has researched via different reports the epidemiology in Europe. Lyme borreliosis occurs between 30 and 55°N in North America and between 35 and 60°N in Europe. It is estimated that the number of incidence for LB is: 65.000 in Europe, 16.500 in America, 3.500 in Asia and even 10 cases in North Africa. Some of these number are estimations because of the fact that in some countries Lyme borreliosis was not disease that had to be mandatorily registered and noted (A. Hofhuis, 2011; Hubalek, 2009). In a Dutch research whereby the ticks were removed within 24 hours(84%), only 3% got Lyme disease(J.J.W.M.Jacobs, 2008). The RIVM is conducting research every 4-5 years and since 1994 there is an increase in general practitioner consults for EM from 39 per 100.000 inhabitants in 1994 to 134 per 100.000 inhabitants in 2009. This is an increase of more than 300%, comparable with the number of general practitioner consults for tick bites that increased from 191 per 100.000 inhabitants in 1994 to 564 per 100.000 inhabitants in 2009(A. Hofhuis, 2011). The number of ticks infected with Borrelia varies from 0.8%-33%. From a research conducted in 2006-2007 revealed that in the Netherlands 1.1 million people suffered from one or more tick bites, concluding from the previous numbers one could state that every one out of fifteen people consults the general practitioner(A. Hofhuis, 2011).

6.2. DIAGNOSIS

Until now there is really no golden standard for the diagnosis of Lyme borreliosis. According to Steere (Steere, 2006) serology for confirmation of Lyme Borreliosis is the most practical. He also states that in Europe "*no single set of criteria has resulted in high levels of sensitivity and specificity" (Steere, 2006).* This is in accordance with other authors that stress this important fact as well.(Engstrom, Shoop, & Johnson, 1995). The diagnosis is therefore based on a careful assessment of exposure to ticks, complaints and observed physical abnormalities, serology and any other laboratory research that has been done, and finally exclusion of other potential medical diagnosis(CBO, 2011). The ECDC (European Center Disease Control) states that in the case of erythema migrans no laboratory tests are required, clinical evaluation and an assessment of tick exposure is advised. They postulate that laboratory tests are necessary to confirm a diagnosis for later stage infection, but on the other hand also state that false-positive tests in

patients with other infections or auto-immune diseases can lead to an inappropriate treat and misdiagnosis.(ECDC, 2010) The LDA (Lyme Disease Action) state on their website (LDA, 2012) that because of the lack of quality in European clinical trials there is disagreement on the diagnosis and the treatment as well among guidelines provided by different organizations.

6.3. SYMPTOMS

Lyme borreliosis has many symptoms; people who are affected can have no symptoms at all, or could have many of the symptoms. It is extremely rare to get all of the main symptoms; from a tick bite to skin lesion, to nervous and heart system involvement, to arthritis and after this; late involvement of the eyes, nervous system, skin tissue and joints could also occur(Strle & Stanek, 2009). The manifestation of Lyme borreliosis is different for every human; however some of the symptoms are more common than others. Lyme borreliosis is divided into three stadia. **Early localized Lyme borreliosis**, red expanding rash (Erythema Migrans or EM) or in other words 'bull's eye' rash. (ALDF, 2010; CBO, 2011; RIVM, 2005). The second stage is the **early disseminated Lyme borreliosis** in this stage the spirochetes have spread themselves throughout the body, through tissues and blood. Lyme-carditis and Lyme-arthritis, myalgia, arthralgia and radiculopathy could also occur (CBO, 2011; Steere, Coburn, & Glickstein, 2004). The last stage is **late disseminated stage or chronic Lyme borreliosis**. Chronic arthritis and acrodematitis chronic atrophicans (ACA) could occur. In this stage late or chronic neuroborreliosis can present itself, this can consist of several disabling neurological disorders, however none of these neurological disorders are typical symptoms for chronic neuroborreliosis, therefore the consistency between these different disorders should be postulated as chronic neuroborreliosis(CBO, 2011; Strle & Stanek, 2009).

6.4. TREATMENT

There is still discussion about what would be the best way to treat Lyme borreliosis; there is not yet universal consensus about the treatment. However it is widely agreed that treatment with antibiotics can cure and help preventing later stages of Lyme borreliosis. In the guideline by the RIVM(RIVM, 2005) they stated that the diagnosis Lyme borreliosis can be diagnosed when somebody has: erythema migrans, or at least one manifestation of disseminated infection, and serological confirmation in serum and / or CSF (Cerebrospinal fluid). The diagnosis of Lyme Borreliosis remains a challenge as diagnostic test have a lack in sensitivity or specificity. (Makhani et al., 2011)

6.5. PREVENTION

"An ounce of prevention is worth a pound of cure" (Benjamin Franklin 1736). The goal of this research is to endeavor preventive behavior and attitude. What is meant with prevention in this research?

According to Sassen (Sassen, 2004) the goal of prevention (in health care) is to optimize conditions for good health en minimize the factors that have a negative effect on health and trying to prevent health problems. Prevention can be seen as the total of measures that is needed to guard and improve the health condition with preventing sickness and health issues. In order to make prevention work, a change in behavior and or attitude is needed, how this change can be accomplished is explained further on.

There are three main types of prevention: primary, secondary and tertiary prevention. The two most important types of prevention for this research are primary and secondary prevention, explained in the following paragraphs. Tertiary prevention mainly focuses on optimizing the health condition when someone already suffers from a disease or disorder. In this stage the health issue has become manifest and this is beyond the scope of this research.

Current prevention is based on protective clothing, and a preventive behavior and attitude. Preventive measures for occupational hazard as presented in the concept guideline by the CBO:

Use clothing that is impregnated with permethrin.
The employer should do a comprehensive risk assessment for every situation in which employers are exposed to ticks.
The employer should inform each employee that can be exposed to ticks about potential risks and preventive measures.
The employer must make sure that proper instruction is given about protective clothing, tick repellent agents and the way how to safely remove a tick.
The employer must ensure himself that all measures are actually correct implemented.

Table 1 Preventive measures for occupational hazard (CBO, 2011)

The above measures are assertions from the CBO guideline; these recommendations are only a part of all the recommendations from the concept guideline. The CDC (Centers for Disease Control and Prevention) NIOSH (The National Institute for Occupational Safety and Health) have collaborated and have set recommendations for both the employer and employees. One can see that the recommendations from both organizations overlap each other. As stated in 6.2 it seems that while both diagnosing and the treatment of Lyme Borreliosis remain a point of discussion,

while in the field of prevention there is more agreement and it can vary from brief to extensive recommendations.

Provide training for workers that includes information about the following:
• **How Lyme disease is spread**
• **The risks of exposure and infection**
• **How workers can protect themselves from ticks**
• **The importance of the timely reporting of workplace illnesses and injuries**

Table 2 Recommendations for employers by CDC and NIOSH (NIOSH, 2011)

6.5.1. PRIMARY PREVENTION

The goal of primary prevention is to prevent diseases and disorders and thus decreasing the incidence and prevalence. In order to reach this goal it is necessary to know what causes the disease, what the risk factors(McKenna, Faustini, Nowakowski, & Wormser, 2004) are and what personal factors have a connection with the disease or disorder. In order to tackle these issues it can be necessary to change the behavior or make a safer environment. When applying this to the research, primary prevention includes all the preventive measures that have to be taken before someone is bitten by a tick, thus decreasing tick bites. This can be done by changing the attitude and therefore creating a more preventive behavior, or it can be done by applying preventive measures such as protective clothing.

There are several measures that can help in preventing getting bit by a tick and getting Lyme borreliosis. The following measures are from the recently updated guideline from the CBO (Central Guidance Organ)(CBO, 2011). Most of these measures apply as well on citizens as on people working the green sector, however some of these recommendations are especially for this last group.

Vaccines

Vaccinating against Lyme borreliosis is also a form of primary prevention. Despite the fact that vaccinating people with a high risk of getting tick bites seems to be cost effective. (Meltzer, Dennis, & Orloski, 1999; Shadick, Liang, Phillips, Fossel, & Kuntz, 2001) There is not yet a vaccine that meets the regulatory and medical requirements. (Shen, Mead, & Beard, 2011) As mentioned by Sigal (Sigal, 2002) a vaccine should not be looked upon as the golden solution, as no vaccine is 100% effective. Shadick (Shadick et al., 2001) researched the cost-effectiveness of such a vaccine. They came up with a cost-effective ratio of $53.700/QALY and in case of an extra booster shot $72.700/QALY gained. Therefore one could state that for people with a 'normal' risk profile it wouldn't be cost effective. However they also mention that it appears to be cost-effective for people whereby the seasonal probability of infection with *Borrelia burgdorferi*

infection larger is than 1%(Shadick et al., 2001). However because of safety issues with those vaccines there is so far is no commercial vaccine available that meets the specific vaccine standards, as previous vaccines were removed from the market.(Shen et al., 2011)

6.5.2. SECONDARY PREVENTION

The goal of secondary prevention is to detect and prematurely treat diseases and disorders. In this case the main goal is to favor the prognosis of the health problem. Whereas primary prevention focuses on trying to find causal relation such as risky behavior, secondary prevention tries to detect this behavior. Secondary prevention in relation to Lyme borreliosis is shaped as creating risk decreasing behavior, such as doing a body check to detect ticks. But this could also be symptom recognition and contacting professional health care workers in order to receive the correct treatment in time and preventing a more deteriorated stage of Lyme borreliosis.

7. PERSUASIVE E-HEALTH TECHNOLOGY

7.1. E-HEALTH

The phrase e-Health will be mentioned a lot in my research, what is meant with e-Health in the literature and thus what do I mean with e-Health? There are many different definitions for e-Health, one of the broadest and used definitions is the definition of Eysenbach. "*E-Health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology"*(Eysenbach, 2001). E-Health can express itself in many ways, from 'simple' websites to advanced applications.

7.2. CEHRES ROADMAP

The CeHRes Roadmap is holistic approach for the development of e-Health technologies. This model tries to create a best-fit between user needs/requirements and the technology. In summary this model consists of several important steps in which formative evaluation have an important role in the entire process. As this research aims at behavior change, different persuasive features are imbedded in the system which 'persuades' users to behave in a different way. Another important aspect is the business model, which focuses on the implementation of the technology, something which has not received that much attention in the development of ehealth technologies.(van Limburg et al., 2011) The project will be multidisciplinary with health care professionals, designers, technicians, end users and other important stakeholders with

influence on the design process. The first step is **contextual inquiry**, in this step it is important to define the different problems that stakeholders have and how technology could resolve this. For this step I will make use of several observational techniques. It is important to know in what context the end product will be used and who these end users will be. In order to do this it is necessary to do stakeholder identification, consisting of all relevant stakeholders. After that a stakeholder analysis is done, to include all those who have impact or are impacted by the technology. All of these observations will be the foundation of this research. The next step is **value specification**, specification of the values from the previous step. Hereby are the different stakeholder needs and requirements ranked and can be looked at the possibilities for the design. There will always be limitations to the technology and resources, therefore the key stakeholders have to define their needs and demands. For the value specification different considerations for different stakeholders apply, by specifying the values, these will merge into a list that consists of requirements. **The design**, in which the different key values will be imbedded in a design, in this step it is also important to test and evaluate several designs and ideas. Most important are the potential users, nevertheless all stakeholders should be involved in this step. Via prototypes and/or testing the concept design can be evaluated and adapted. The following step is the **operationalization**, in other words, how can this new technology be implemented in the current work environment. This involves introduction, adaption and implementation of the technology in practice. In this step it is important to make use of some sort of business model. The last step is the **summative evaluation**, which consists of testing the 'final' application and satisfaction with all relevant stakeholders and end-users. This summative evaluation also comprehends the possibility to keep improving, there has to be room for feedback from the users in order to keep stakeholders needs and demands satisfied and reach compliance. (van Gemert-Pijnen et al., 2011)

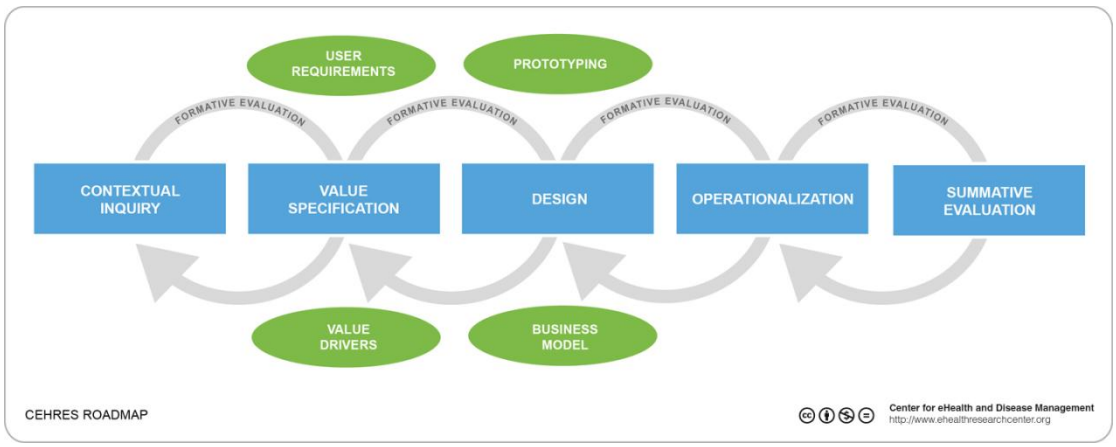


Figure 1 CeHRes roadmap. Center for e-Health and Disease Management, University of Twente

7.4 PERSUASIVE TECHNOLOGY

B.J. Fogg (Fogg., 2003) describes it in this way: *A persuasive technology tool is an interactive product designed to change attitudes or behaviors or both by making desired outcomes easier to achieve.* It is always difficult to try and make people do certain things, whether this is consciously or unconsciously. Although people have different motivations, abilities and triggers, the key is to try and facilitate these intrinsic factors. By conducting research one can uncover these intrinsic factors. What precisely triggers and motivates people is not clear; every individual will behave differently, although some common habits are shared, in order to make the technology successful, the focus should be on these common behavior patterns for making something persuasive. Oinas-Kukkonen and Harjumaa (Harri Oinas-Kukkonen & Harjumaa, 2008) have a different definition; "*Persuasive systems may be defined as "computerized software of information systems designed to reinforce change or shape attitudes or behaviors or both without using coercion or deception".* This definition has three different outcomes, the goal is to reinforce, change or shape attitudes and behavior. Based on these principles they have set up a theoretical framework for using persuasive technologies. For this they have created the Persuasion Design Model (PSD)(H. Oinas-Kukkonen & Harjumaa, 2009) which makes use of Fogg's work (Fogg, 2003) for the design principles, and extended this. While B.J. Fogg has done extensive research on the topic of persuasive technology, for this research a more 'complete' model is needed. While Fogg described different design features that can be applied, it does not make the transformation from these principles to software requirements (H. Oinas-Kukkonen & Harjumaa, 2009). As the PSD model is the foundation, the next step is the Behavior Change Support System (BCSS) (Harri Oinas-Kukkonen, 2010) .

7.3. THE PERSUASIVE SYSTEMS DESIGN MODEL (PSD)

The PSD is based on different theories, empirical research, conceptual analysis and other research. The phases in the PSD are as follows: first, the key issues behind the persuasive systems, the second step is analyzing the persuasion context and the last step is the design of system qualities(H. Oinas-Kukkonen & Harjumaa, 2009). There are seven key issues behind the persuasive systems. The first two assumptions are about the users in general, the second two assumptions are about the persuasion strategies and the last three assumptions relate to the system features. At first, the information technology is "always on" this means that when creating a persuasive system, the intention is always to steer people towards the desired action. The second postulate is about the commitment and consistency. This means for instance in this research that when foresters do a self-check after a day of work, they do this because they know it reduces the chance of getting infected with Lyme due to a tick bite. Or by letting them know whenever they register tick bites, the information is used to set up an incidence map. The third

assumption divides people into two different routes, the direct and indirect route. This is similar to the ELM, the central and peripheral route. The fourth assumption is in line with B.J. Fogg's work, as he speaks about tiny steps, persuasion is incremental. In other words, the path to the target behavior and/or attitude goal should be divided into little steps, each step taking someone further towards the desired behavior/attitude. The fifth assumption states that persuasion through persuasive systems be always open, the intended user should be aware of the intention the designer has with the system, since persuasion should be based upon voluntariness. The sixth assumption relates to unobtrusiveness, when creating a persuasive system it should avoid disturbing the users' process when performing a task. This assumption takes into account the Kairos factor, the system should make use of the opportune moment. For instance when using a sms-alert about the risk of getting sun burned, it has little or no use sending the text at the end of the day as it would be an inopportune moment. The last assumption aims at persuasive systems being both easy to use and useful. As with most of the information technology systems, they should take usability heuristics into account, creating systems that are in line with the intended user, making the process of changing behavior and/or attitude as comfortable as possible.

7.4. PERSUASION CONTEXT

The second phase is the analysis of the persuasion context; this phase consists of three steps, the intent, the event and the strategy.

7.4.1. THE INTENT

As we look at the research question, the goal is to (voluntary) change behavior and attitude. As discussed earlier Oinas-Kukkonen provides a table with different outcomes, this is called de 'Outcome/Change Design Matrix'(H. Oinas-Kukkonen, 2010). Because of the heterogeneous group it is hard to pin the change down to a single change. For some professionals the behavior and/or attitude change can be new, for others could it mean that it should be altered or reinforcing behavior and attitude. Whereas a onetime behavior change would be easier to accomplish than introducing a new behavior that is permanent, the design focuses on the 'hardest' change. In the behavior grid by B.J. Fogg (Fogg & Hreha, 2010) behavior change is more elaborated, varying from doing a one-time behavior to a permanent change and doing new, familiar and increasing behavior, or decrease/stop a certain behavior.

7.4.2. THE EVENT

Like in the 'contextual inquiry' in the CeHRes Roadmap Figure 1(van Gemert-Pijnen et al., 2011) it is important to define the context of use and the users context and the technology context. At first the use context, how will the user make use of this system, what kind of behavior and/or attitude do we want to change, in other words, in what context is the system used. Next step is

the user context, the best persuasive systems would be a system specific designed for a person. It is important to define the facilitators and barriers for changing behavior and/or attitude, this means analyzing the target group on different levels. The design should promote preventive behavior and attitude, this application should be used on regular basis in order to reinforce to new behavior and attitude. As we would like to be unobtrusive, change is based on voluntariness. One of the advantages is the fundamental shared and common goal, to promote safety.

7.4.3. THE STRATEGY

Since the primary users are heterogeneous the strategy will be to choose the indirect and the direct route. As some of the users will have previous experiences and built up knowledge, it would be best to chose a direct route, via this route the changed behavior and attitude or more likely to remain (Petty, Cacioppo, Strathman, & Priester, 2005) Despite the fact that this route would be the best way to reach our goal, there will be users that do not share these experiences and knowledge. In order to involve both groups the combination of direct and indirect persuasion would be most suitable.

7.5. THE CEHRES ROADMAP AND THE PSD.

7.5.1. COMBINED EFFORT

As these two methods are discussed it is important to stress in what way they relate to each other and how these methods are combined. They all have similarities and overlap with each other, but in order to give insights into the design process of this research it is necessary to clarify the differences and overlap. The CeHRes roadmap provides this research its backbone, the research strategy is derived from the CeHRes roadmap. As mentioned earlier, this research focuses on the 'Contextual Inquiry', the 'Value Specification' and the 'Design', whereas for this research the design will result in a prototype and not the final design. The two remaining elements of the CeHRes, 'Operationalization' and 'Summative Evaluation' will remain subjects for further research provided by the RIVM. The PSD's persuasion context is somewhat similar from the contextual inquiry in the CeHRes roadmap, as they both aim at revealing the context of use. The PSD design principles are used to increase the persuasiveness of the system. As the different aspects from the CeHRes roadmap and PSD are merged, they will be fit into the framework which results in the ehealth technology that should increase the preventive behavior among professionals in the green sector.

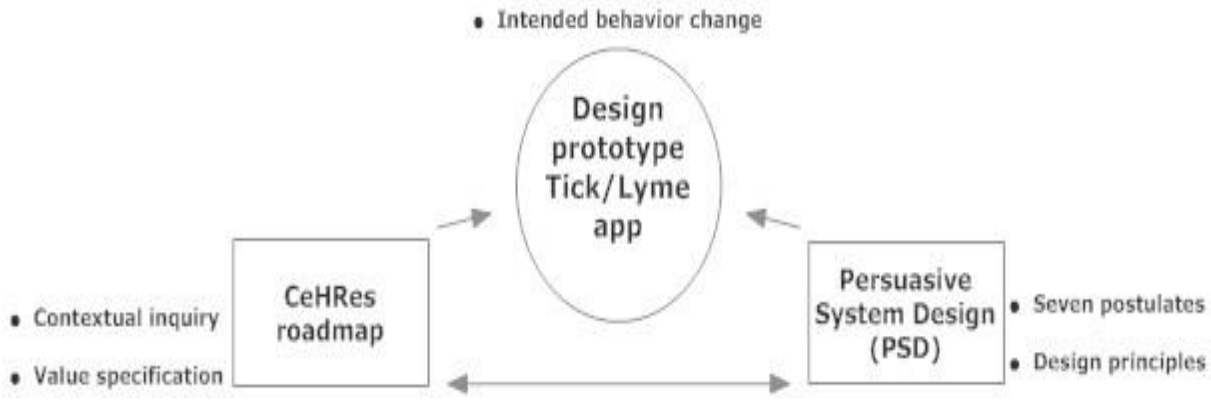


Figure 2 Combined methods

BOOKMARK

The following chapters 8, 9 and 10 are structured in chronological order according to the CeHRes roadmap. Each of these chapters contains answers to the sub questions, covers the different tools used for answering the questions and will lead to an answer for the main research question which can be found in the conclusion, chapter 11.

8. CONTEXTUAL INQUIRY

a) Who are the intended users, who are the primary end users?
b) What problem(s) specific problems encounter professionals in the green sector in relation with ticks and Lyme borreliosis?
c) What is the context of use in which the technology is going to be implemented?
d) What are the user needs and requirements?

8.1. STAKEHOLDER IDENTIFICATION

The following chapters in contextual inquiry will describe the methods and elaboration on gathering the information from the primary users.

8.1.1. METHOD & ANALYSIS

The first step of the stakeholder analysis is identifying who the stakeholders are. But first, what are stakeholders, while there are many different definitions, for now the 'definition' of Bryson (2004) is used: "*The term refers to persons, groups or organizations that must somehow be taken into account by leaders, managers and front-line staff"(Bryson, 2004).* Put in an easier way one could state that stakeholders are those who have an influence or are influenced by a specific

project. The first step was by describing all relevant tasks and goals. After this first step I started by the identification of the relevant stakeholders. During conversations with different organizations with employees working in the green sector and consult from Stigas, primary users and stakeholders were defined. The next step is to define the users into two different groups. Whereas the primary users will be the professionals in the green sector, that use the application. The last step was connecting different stakeholders with the relevant tasks and goals. Other stakeholders have different varying tasks as displayed in Table 3 Stakeholder identification.

Stakeholder identification	Lyme application
Stakeholders	Main tasks/goals
Professional in the green sector	• To be aware of ticks • To know what to do when bitten • To know what Lyme disease is • Increase risk decreasing behavior • Decrease risk increasing behavior • To prevent getting bitten
Employer(s) in green sector	• Providing additional information • Setting requirements • Provide access to application • Stimulating the use of the application
RIVM	• Updating application • Providing adequate information • Conducting research • Measuring effectivity • Provide folders • Provides training • Evaluation
Technical support	• Testing and creating system
Stigas	• Marketing

Table 3 Stakeholder identification

8.1.2. RESULTS

Who are the primary users, who are the relevant stakeholders?

Primary users and stakeholders

It seems that according to the literature the incidence of tick bites and EM is increasing in the Netherlands (Hofhuis et al., 2010). Despite this fact there are several people consistently at high risk. Those are people working in the habitat of ticks; foresters, gardeners, landscapers etc. Those people are the main focus of this research, creating a select group of people. At forehand the primary user group should consist of people that performed tasks in their working routine that resulted in high-risk situations (chance of getting bit by a tick and risk of Lyme infection). In

order to find out what professions and what tasks were at high risk two reports are used that were conducted among green professionals (Bosschap & Stigas, 2009; Stigas, 2010)

According to these reports there are several risk factors, these seem to apply more or less on all those who are working in the green sector. The next step is to simply select those professions with the highest risks. Based on this data a concept selection for six professions was made; Arborists, Landscapers, Gardeners, Nature supervisors, Estate administrators and Hunters. One problem with different profession names is that they do not always reflect the actual activities one performs, meaning that somebody who is called a forester has many different task and not all of these task are typical forester tasks. Hence it seemed logical to approach it in a different way. The problem was tackled by contacting different employers and employee's which resulted in a list that differed from the original primary users. So instead of selecting the primary users by occupation, the selection is based upon risk. As various factors affect the risk, it does not seem fit and rather impossible to create percentage limit. Therefore the basic criteria applies that the primary users are people that due to their tasks have an occupational hazard of getting bitten by a tick and thus increasing a infection with Lyme Borreliosis. Summarized, professions with the highest risk of getting tick bites are professions that have activities in heaths and forests, whereas activities like maintenance of parks and plantations or getting in contact with animals have high risks. The selected people/professions seem to be representative as they are those working in the green sector and have greater risk for tick bites and Lyme infections.

8.1.3. CONCLUSION

The first step in this stakeholder identification was the setting forth of relevant tasks and goals, this was followed by connecting stakeholders to these tasks and goals. This resulted in Table 3, beside the fact that this table is not very specific it however makes clear whom the relevant stakeholders are. As for the technical support, this is yet unclear who will be the provider of the technical aspect. With regard to the 'employer(s)', because of the potential wide spread of this ehealth technology and also the unrestrained access, it would not be relevant to put all those organizations in this table, thus I chose to define them as 'employer'. The same applies for the 'professionals in the green sector'. That does not mean (as can be seen under *Primary users and stakeholders)* that there are no specific professionals and organizations for this research. The following chapters will focus on the persuasion context, and will elaborate on the use context, user context and technology context as described in the PSD (H. Oinas-Kukkonen & Harjumaa, 2009).

8.2. USER OBSERVATION

8.2.1. METHOD & ANALYSIS

In order to find out how the daily routines of for professionals in the green sector look like. This way it can show how the technology can be fitted in into the daily habits, what problems during labor they may encounter. When doing this user observation the observer will remain in the background and only ask questions that are relevant for this research. Since the environmental context has a big influence in this study, field observation is wise to use(Maguire, 2001). However the observations in this research consisted of showing the researcher the environment in which the working activities take place. Furthermore the outfit in which they worked was shown. All of these observations provided some context insights for the results of the interviews.

8.2.2. RESULTS

What is the context of use in which the technology is going to be implemented?

The observations of professionals (who were also participants for the interviews) in the green sector was not as intended, and did not consist of observing the professionals during their working activities. The observations did however consist of observing the working areas and observing the professionals in their 'office' before or during the interviews. This provided not only information about the potential risks in the scenery; it also showed the professional environment in which these professionals fulfill their tasks. The most important observations:

- The outdoor scenery differed from low grassy vegetation to forests.
- The work clothing was worn throughout the day.
    - Wearing long sleeves varied based on personal risk assessment of the environment and temperature
    - On average the professionals wore high shoes, long trousers and long sleeves (sometimes shirred)
    - The discarding of work clothes usually did not took place after someone was home, but before showering and sleeping.
- Avoiding the tick habitats was often not possible, but whenever possible did happen.
- They always seemed to be aware of the risk of tick bites, performing daily body control.

8.2.3. CONCLUSION

After these observations it has become clear what use of context is. Professionals in the green sector often have varying task from office work to spending their days in nature. While having negligible risks of getting by a tick while working at the office, working in the nature results in more risk. Not every environment is suited for the habitat of ticks (see Epidemiology p10). However most of the professionals considered working outdoors as risky. Furthermore the

observations showed that the behavior in relation with tick bites did not end at the end of the day, as ticks sometimes transport themselves on clothes, which could lead to being bitten while at home. This leads to the assumption that the ehealth technology should be available at all the times. To derive behavioral insights and more information about the persuasion context and information about the needs and requirements interviews with those professionals were required.

8.3. INTERVIEWS

8.3.1. METHOD & ANALYSIS

I will be using semi-structured interviews in order that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation. These interviews will be held with my primary users, whereas the goal is to research the attitude and behavior of the interviewees about tick bites and Lyme disease. For this case the in-depth interviews are useful for detailed information about a person's thoughts and behavior or attitude, or asking opinions about certain topics. These interviews are used to provide context to other data, getting a clearer picture of the reasoning behind behavior. These interviews are also important for people that don't want to participate in a focus group or persons not eager to speak out their personal opinion in a large group. (Boyce, 2006) The focus group will be more pointed towards solutions and held with experts or people from management, these semi structured interviews are for revealing personal values that might not show in a group discussion.

8.3.1.1. Interview Schedule

The interview schedule (page 63) is based on different personal characteristics that are required for a user centered design as described by (Lerouge, Ma, Sneha, & Tolle, 2011). They also sum up different characteristics that are important for this research. Demographic characteristics that can be used are: prior knowledge and experience, physical characteristics, cognitive characteristics, social and physical environment and job tasks and requirements. Especially important for this study can be the: technology skills (computer, mobile phone), the educational level/intellectual abilities/skills of the users, attitude towards technology and learning style. (Lerouge et al., 2011)

The above characteristics are in accordance with the main research question derived from this table and subdivided into 5 main categories:

- Demographic information.
- Knowledge ticks/Lyme

- Tacit knowledge
- (Preventive) behavior
- (Communication/information) technology

Tacit knowledge can be seen as personal knowledge that is practical and context specific, or in other words the know-how.(Ambrosini & Bowman, 2001) Polanyi the creator of this concept also describes human knowledge as *"We know more than we can tell",* (Polanyi, 1966) for example; someone knows how to walk, but cannot explain precisely to someone else how they do it. Translated into this research, by referring to tacit knowledge the goal is to find the meaning behind certain behavior. The opposite of tacit knowledge is explicit knowledge, this can be verbally explained. Ambrosini and Bowman (2001) displayed the different degrees of tacitness in a figure, which makes it somewhat easier to comprehend the concept of tacit knowledge, or as they prefer, tacit skills. The relevance of tacit knowledge for this research is that it is necessary to know what triggers people to act, or why they don't. Tacit knowledge can provide insights about important aspects of the persuasion context and is therefore important for the contextual inquiry. As professionals in the green sector have to take certain occupational risks, for instance that they cannot avoid of walking through the tick habitat. This can for instance result in small risk-assessments, by letting them tell via storytelling about their daily work routine, articulating their mindset and thus providing tacit knowledge. As shown in Table 4, some examples of tacit knowledge were shown. It is however rather difficult as tacit skills often involve non verbal communication, something which took place during the interview but can't be put down into words.

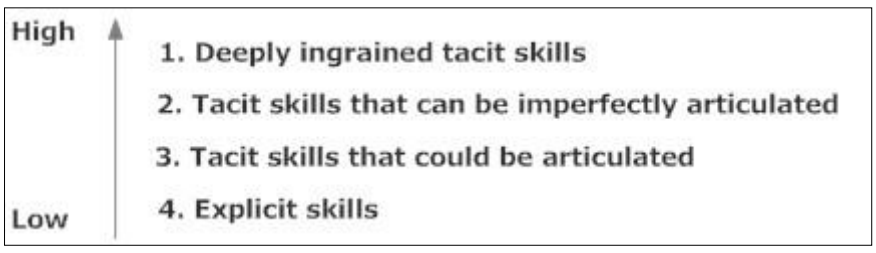


Figure 3 Degrees of tacit knowledge (skills) based on (Ambrosini & Bowman, 2001)

Citation from interview	Tacit 'knowledge'
You don't wear your trousers in your socks? "*No, but I can explain why, I check myself every evening".* So basically you simply take the risk en because of this self check you'll notice the tick bites within 24h? "*Yes, and you know what, wearing your trousers in your socks and long*	Creating 'false' safety. It's one or another.

sleeves, afterwards you come home, feel tired and got some things to do, then you would think it's not necessary to check yourself because of these preventive measures.."	
"*..Never, these trousers are down made slim down below, so that they have a hard time crawling in, of course I'm a bit taller en walking with my trousers in my socks it sort of…well…of course it important to check yourself, whenever I leave the field, I momentary take a look at my trouser and arms."*	I can protect myself, but my appearance is important as well, I try to compensate.
"I'm not waiting in the grass for them to come…"	Aware of the risk
"I'm not excited about putting the clothes in the hamper. So basically you should just leave them at the backdoor, you've had a long day of work and at home they need you as well, so there is not much space to think, well let's take off all clothes."	I know what to do, but it costs me too much effort or it is inconvenient.
"Make sure you put your pants in your boots." Do you wear them like that? *"Also, yes, I think it makes little sense, there creatures are so small and they just jump on another piece of clothing."*	Why would you, when it offers only little protection.
"In my opinion I feel that whenever someone is performing this line of work and you're not thinking about this potential risk, then you're not doing well for yourself"	It is your own responsibility, to takes care of yourself

Table 4 Tacit knowledge examples

8.3.1.2. The interview design

Each interview started with a short intro, in which the participants were informed about the purpose the duration, the way the privacy was ensured. Furthermore permission was asked to record the interview with a voice recorder. Participants were asked to answer as honestly as possible and the data was used after an approval of the transcript. During this interview the participants were asked to describe a typical working day, this in accordance with the literature that states that storytelling can be a useful method for gathering tacit knowledge(Ambrosini & Bowman, 2001). As addition each participant was interviewed in his or hers work place, which with exception of two participants. Before and after the interviews the working environment was observed as well as the working clothes and office.

8.3.1.3. Target group

Semi structured interviews were conducted for this research, thematic analysis (Braun & Clarke, 2006) was used for analyzing data. Fifteen interviews were held with different professionals from the green sector, they are the same group of people by whom the observations took place, they all are professionals with work activities that result in an increased risk for tick bites and Lyme infections and could therefore be called representative as these people will be the primary

users. The demographic characteristics are displayed in Table 5. Most of the participants are male and have an average age of 46. The level of education was mainly MBO or freely translated 'community college' and although have different names were related to the current profession, beside these general educations several training courses were followed throughout the years. A few also moved on to 'college' or HBO and the two ecologists studied at a university. The preferred learning style was mainly a combined method of theory and practice, besides asking their preference, the way of gathering information was also asked, which supports the majority with combined learning styles. As previously mentioned, the occupational tasks are strong related to the risk of tick bites and Lyme infection. These tasks varied from walking down the footpaths to crawling through bushes and getting in contact with (sometimes deceased) wildlife. The duration of being exposed was on average eight hours or more per week, however this number is not quite accurate as tasks are not always scheduled and may differ from day to day.

Gender	Male n=13	Female n=2		
Age	Min: 33	Max: 61	Average: 46	
Education	Vocational education (n=10)): mainly forest/gardening education. (Dutch) (MBO: Bosbouwschool(7), hoveniersopleiding(, Middelbare tuinbouwschool, Lagere tuinbouwschool, Detailhandel, Landbouwschool, Middelbare bosbouwcultuurtechniek)	Higher vocational education (n=3): landscaping/forestry education. (Dutch) (HBO: Natuur en landschapstechniek Lerarenopleiding, Landschapskunde(2) Bosbouw en natuur, Cultuurlandschapsbeheer)	University (n=2): Biology (2)	
Learning style	Theory(2)	Practice(2)	Combination: (9)	No preference: (2)
Occupational tasks	Daily and cyclic maintenance, vegetation recordings, adviser management of nature, wildlife recordings, forest en nature management, various foresters tasks; inspection and maintenance, managing contractors, supervision cattle, supervisor, technician field technique, pruning, mowing, surveillance.			

Table 5 Demographic characteristics

8.3.1.4. Thematic analysis

Thematic analysis is a method for identifying, analyzing and reporting patterns within the data.(Braun & Clarke, 2006) While there are different methods for analyzing qualitative data, this method seems well suited for a novice researcher. According to Braun & Clarke (2006) this has to do with the fact that in order to use thematic analysis it is not necessary to have detailed knowledge of theoretical and technological approaches such as the grounded theory(Glaser & Strauss, 1967) and discourse analysis(Gee, 2011). This method consists of five phases(Braun & Clarke, 2006).

1. The first phase is that of getting familiarized with the data, transcription of the data and writing down ideas for coding. Since the interviewer was the one who also did the analysis, getting familiarized with the data already started during the interviews
2. Phase two consist of generating codes from the data that will be used in the next phase. The coding in the second phase involved coding all the data which resulted in over 1000 codes, with much overlap in between the codes, this was due to the fact that different words or a different sequence of writing it down was used.

Citation from interview	Code
"Impregnated clothing, during sunny weather I roll up my sleeves in the car, but let's say I went back into the forest then down go the sleeves."	Prevention based on risk assessment
"I'd rather use, which I also use for my pets, those are little crowbars, you have them in small and large, you slide it in between and you turn without using force and off he goes."	How to remove ticks
"My experience during the time I suffer from Lyme now, is that there is lots of ignorance, and your employer does not know how to handle it."	Obscurity and ignorance
"If really would use that Lyme app, than in fact you are already infected. You would probably go look for information once something is wrong."	Information gathering
"It should be hyped; everyone should be aware of the risk. It could be that this problem is as	Raising awareness

severe as it was fifteen years ago, but that the level of knowledge about the disease itself has increased."

Table 6 Coding example

3. Creating themes happens in the third phase, since there were too many codes to create direct themes, themes based upon the transcription and interview schedule were created, after this most of the codes were linked to a specific theme. These themes were used for creating the personas. Table 6 shows step three as the codes were already narrowed down to more usable codes based on the interview schedule, so that for example text related to prevention all fell under the same topic.
4. In the fourth phase themes are reviewed, creating subthemes, combining them or even dismiss themes that are not supported enough. Themes were separated into topics from the interview schedule, were narrowed down some more, and combined in major themes.
5. During the fifth phase the definitive themes are named. The outcomes can be drawn into a thematic map or more common know, mind map. The themes were displayed in a mind map, however in order to make it more clear it is put into a table, this can be seen in Table 7.Table 7 Data from interviews structured in themes

5.1.1. RESULTS

What is the context of use in which the technology is going to be implemented?

What are the user needs and requirements?

While most of the participants seem to be aware of different ways to prevent getting bit by a tick, they were not always consistent with their behavior. The participants seem to depend their degree of preventive behavior on their own risk assessment, despite the fact that there all of the participants agreed that they were at high risk for getting bit by a tick. There was consensus about the fact that there was really no way to guarantee that prevention offered 100% safety. The prevention has to be practical, which means it has to be workable and not hinder during labor. The knowledge about Lyme and ticks varied, while the largest majority knew more than the basics about the ticks, the knowledge about Lyme disease was limited with uncertainties about the infection, diagnosis and treatment. The participants were in agreement about the growing magnitude of the tick and Lyme problems. There was a need for unambiguous information for ticks and especially Lyme Borreliosis, as information provided by websites or health care professionals differed and were not always in accordance with each other. The experiences from participants with the 1st line care were not positive. They felt misunderstood by their physician and specialist in the secondary care. The reliability of the diagnosis was according to the participants low and the effect of the treatment was insufficient. Because of this

some of the participants mentioned that they lacked confidence in the health care. However they did state that the knowledge among physicians and specialist was slightly improving compared to the past, several years back. The opinions about the employer varied from getting sufficient support from the employer by means of protective clothing and providing adequate information. While others felt that their employer could improve their effort to protect their employee's. According to some of the participants the problem was not taken seriously and lacked the company guidelines or protocols, in their opinion there was an absence of responsibility taken by the company. Information was gathered through different ways. The knowledge and experience of other co workers was often used and most of the provided folders by different organizations were seen as valuable. The search for information was not a dynamic process but only occurred when someone felt the urge to search for information.

Subject	Outcome requirements	Citation from interviews
Prevention	1. Prevention does not provide 100% safety. 2. The preventive behavior depends on own risk assessment of the situation. 3. Prevention has to be practical	*1. The (impregnated) clothes are fine, but it is not sacred, you are not 100% protected* *2. This year I am somewhat careless, there are fewer ticks. So less ticks result in you being more careless? Yes, that is true but I didn't suffer from any tick bites this year.* *2-3. So in areas with ticks you pay more attention to prevention than in area's with less ticks? Yes, you can fully wrap yourself in clothes, but the result is that you get very hot. Our day consists of about 15-20km walk, so you have to lose your heat if possible [….}…During the summer you can chose between sunstroke or potential tick bites.* *3. Pleasure is important, when dressing up like an astronaut it decreases the joy you have in your job.*
Information (gathering)	4. Colleagues- and expert opinions are important and often used. 5. Literature, the internet and information by the employer is also often used. 6. Needs to be specified for professionals 7. Information provided should be based on scientific research	*4. Education, searching for information? We make use of intranet and information is provided there about ticks and Lyme disease, there is this tick radar and you discuss it with colleagues, some of them are allowed to visit workshops or meetings, afterwards they tell you things they have learned of write a report about it. Most of my information is gathered within the company.* *5. Information? I have had information about ticks in my education I sometimes go on the internet to look for information and I use my experience I accumulated over the years, I also read brochures available in the office.* *6. Tick radar? It is nice that you can see what areas are infected and in which places there is more risk of getting bit by a tick or where the most infected ticks are.* *7. Preventive measures should be accompanied by scientific proof.*
Ticks and Lyme	8. There is a need for unambiguous information 9. The problem is getting bigger 10. Beside the fact that Lyme disease can be quite severe, the ins and outs are vague. 11. Always at risk	*8. How do you determine whether information is correct? That's the tricky matter wherever you look the information differs from each other and is ambiguous. And information from the government? That information is also not correct in my opinion it seems incomplete. It is getting better however compared to the past.* *9. I think the number of ticks really increases as well as the ticks that are infected, so in that way I would say the problem is getting worse.* *10. But the symptoms can be ridiculously vague, fatigue, poor concentration, problems with your bladder, poor vision, allergic to many things. It really is a long list of complaints. But when you mention those symptoms to a random person, he will probably 'suffer' from some of those symptoms, so it is very difficult.* *11.The risk is much higher for us compared to an average citizen, we are of course much more in the field, [...] the amount of ticks differ in every area, usually I know up front whether or not ticks are present in the area .*

Health care	12. Professionals in the green sector feel that the general practitioner and specialist have a lack in knowledge, which results in a lack of trust among green professionals. 13. The diagnosis is not reliable 14. Uncertainty about the effect of the treatment 15. There is no national or international consensus about the treatment and diagnosis.	*12. I'm not happy about the fact that the level of knowledge is not that high in my organizations, they are of course no scientists. But if you're at your GP and he sends you off with nothing, then I'm like what's this? We are people that work in tick infected areas, why aren't we taken seriously... that is frustrating sometimes.* *13. So tests in the Netherlands are less reliable?? Yes, I once knew a boy that was tested positive for Lyme in the Netherlands but when he got tested in Germany he tested negative for Lyme.* *14. It's a little weird, you get a cure and then you just hope it's gone.* *15. So I went to the doctor and thus he tells me it has to be a red circle, but when I went to see the weekend doctor he was willing to treat me.*
Employer	16. Has to support employees with preventive measures, provide working guidelines	*16. It is sometimes said that you are at risk, but they do not control whether you check yourself for bites or anything. A protocol is now being development, which is about time.* *There is no protocol or fixed rules, so you have to take the initiative yourself. It is also true that you are responsible. Your boss may ask you to check yourself and you can always say yes. But a protocol would be useful, as it would provide you a guideline you can follow.*
Technology	17. Should increase knowledge about ticks and Lyme 18. Should incorporate and registration system for tick bites 19. Should offer communication option for contacting colleagues	*17. Such an app should provide all the information you could possibly store on it, that is plain and simple and convenient for people that are not in contact with ticks every day.* *18. Do you report your tick bites and do you inform your employer about this? I've done it for a while, but it's almost impossible to write it down every time. Because you so often get bitten? Yes.* *19. Tick radar? It can be convenient to inform people of the potential risky areas. But I would probably not use it myself as I would rather ask a co worker to update me about the place I need to visit for the job.*

Table 7 Data from interviews structured in themes

5.1.2. CONCLUSION

The data from the interviews provides different sorts of information. It now has become clear what problems occur during their daily work routines, the attitude towards ticks and Lyme but also towards health care. It provides also insights about what they think and how they behave themselves. What can be derived from the interviews is that most of these participants are above 'average' informed about the risks they encounter, but also know a thing or two about prevention. New technology should not interfere with their daily routines, this in accordance with the BSCC which should be unobtrusive. They want the medical specialist and general practitioner to be better informed, and their employer to provide the necessary preventive measures. The interviews provided the context in which the ehealth technology should be implemented but it also provided several needs and requirements for the primary users, these needs and requirements will act as basis for the following chapter in which the different values that are important to the primary users as well as other stakeholders are transferred into the requirements for the design. The interview results also provide the data required for the personas which later will be used in the design phase.

5.2. PERSONAS

5.2.1. METHOD & ANALYSIS

For getting a fictional representation of the user characteristics, a persona can be made. The persona can display the key goals for the user and in combination with the designing this persona makes sure that the user needs are fit into the system (Lerouge et al., 2011) Creating a persona involves describing the workflow, how does this day look like, what skills does the persona have and what goals will this persona try to reach, what attitude has the persona and how does the environment look like (Goodwin, 2001). These personas should resemble the users of this product and therefore should be given a name and entire personality(Maguire, 2001). One of the important aspects of creating these personas is the personality. The personas for this research are based on the interviews with 'real' people, characteristics from these people will than blend into the persona.

In addition to the personas, scenarios can be made in order to test the system. These scenarios represent real life problems or tasks. After the prototype design phase the primary users can discuss problems and needs while personas in combination with scenarios are being used. This way the designer can embed the user needs and requirements into the design. The goal of this method is to try and understand the user requirements and make them more comprehensive for the designer. By creating scenarios the context of use is already taken into consideration. (Maguire, 2001)

5.2.2. RESULT

Persona 1. Rob van Dijk (Don't worry)

Rob is a 53 year old man, married, and has two children, in the age of 17 and 19. The live outside of town in a green environment... His children are students live near the university in a dorm rooms and only visit home in the weekends. Rob is a quiet man, that rather avoids being in stressful situations, he reflects this attitude towards others.

Technology doesn't interest him. He has heard about social media, but phones are used for calling, his pc is mainly used for work, looking for information and sending emails. He reads the journals that are available in the canteen, because he is not that familiar with the internet. His

cell phone is always near in order to be attainable for home- and work phone calls. In his opinion smart phones are a waste of money and he doesn't need one. According to Rob people only look at their screen and lose eye of each other.

Rob works as supervisor in a wooded area of around 125 acres, together with two co workers. His duties vary from emptying trash bins, to cutting trees and rasterizing. This year Rob has reached his 25 years of service and his job brings him joy.

In his point of view tick bites and the consequences are not that big of a problem. Ticks have always been around and you just know what to do and what not. He has been bitten a few times, but never suffered from Lyme. He tells people that they shouldn't worry too much, because avoiding ticks is impossible. Rob does not have an active preventive attitude, he wears clothes provided by his employer, long trousers, high shoes and a shirt with long sleeves. When the temperature rises he walks around with short sleeves. According to Rob you can do all kinds of crazy tricks to protect yourself, but in his opinion the joy in work is priority and you shouldn't worry too much. He heard many stories about ticks, their bites and consequences; sometimes he wonders what is true and what isn't, according to him there are no real specialists in this field. He knows you should remove ticks as soon as possible and you usually can feel it when ticks are walking over your body. He really has no idea of the potential consequences of Lyme, according to him it is a long list of symptoms. He knows that one of his co workers is treated with antibiotics and was cured from Lyme.

Coming home after a long day outdoors, he first has supper with his wife. After this he puts his clothes on the chair in the bedroom and puts on casual clothes. During his shower he checks his body for strange bugs and goes to bed.

Interview section	Persona type: 'Don't worry'	Quote from interview	Translation to persona
Knowledge ticks	Level of knowledge is high. Well aware of own risk, and habitat of the tick.	(Male) "*If you spent a lot of time working beside the walking paths, than it increases the chance you stumble across ticks."* (Interviewer) Then where are they? (Male) "*In the bushes, usually in the lower vegetation, at the level of your stomach or below."* (Interviewer) How do you get in contact with the ticks? (Male) "*He has this cycle when he leaves the egg he goes straight towards a meal, in his case blood, he then chooses larger and larger hosts to feed on. They then drop, and get on to you from below and not from above."*	Rob knows his profession results in risk for getting bitten by a tick, he knows in which places they live and how they gain access to your body.
Knowledge Lyme	Level of knowledge is average to high, knows about contamination, a little bit about the diagnosis and how people are treated.	(Interviewer) Do ticks have other diseases besides Lyme? (female) *"Yes, different types of co infections, babesia, rickettsia and so forth, but I don't recall them at this moment."* (Interviewer) And how about the symptoms? (Male) *"If you suffer from a red circle, then you are one of the lucky ones, then you are certain."* (Man) *"But the*	Rob is aware of the fact that the tick carries along different types of bacteria. He is aware of the typical red circle, which people seem to call erythema migrans and he also knows that the symptoms can vary

		complaints can be ridiculously vague, fatigue, poor concentrating, problems with your bladder, poor vision and allergic to many things. It really is a long list of complaints. But when you mention those symptoms to a random person, he will probably 'suffer' from some of those symptoms, so it is very difficult." (Interviewer) How about the treatment? (male) *"Yes, I have had two weeks of antibiotics, they request you to stay out of the sun, and then that is the weird thing about it, nobody asks you whether the antibiotics were effective and tells you are cured."*	from headache to whatever you can think of. He knows that people are treated with antibiotics, but doubts the efficacy.
Behavior and attitude	Recognizes the importance of several preventive measures but it shouldn't be n the expense of joy in work.	(Interviewer) Which preventive measures do you know? (Male) *"I'm not going to panic and act like I have to tuck in my trousers, it is al useless because the tick could have entered your body via your head and travels down your neck to the rest of your body. I don't mind walking through the forest with short trousers, because sooner or later they will find a way to end up on your body."* (Same question other interviewee)(Male) *"When wearing a suit like the asbestos removers you will gain safety. But this is not feasible in practice. It has to be a pleasure working outdoors, you shouldn't have to be afraid of everything."*	Rob is aware of several preventive measures and applies it on some level, because in the end, nothing really provides guaranteed safety.
Technology	Has some skills in relation to modern technology, is not really interested in the potential by using it during his job.	(Interviewer) What do you consider as potential possibilities for an app for the smartphone in relation to ticks and Lyme? (Male) *"Such a tick radar that could inform you of potential risky areas, I don't believe in it. You only need one tick to get bitten and infected."* (Some question, other interviewee) (Male) *"Or something that bleeps when entering an infected area. (Interviewer)A sms alert? (Male) Yes, something like it, there is an EHBO app available which holds all relevant info. For example that you know how to remove a tick, we do know, but recreationists don't."*	In relation to the technologies Rob sees potential opportunities, but according to him this isn't the solution. Professionals in the green sector are well aware of all the risks.
Needs	Need for expert knowledge and organizations with national guidelines.	(Interviewer) How do you rate the reliability of information? (Male) *"You got lots of different websites and they all tell you something else. There should be 1 reliable website for everyone. It would also be nice to be able to put your own experiences on that website."* (Interviewer) What kind of information is not yet provided? (Male) *"..It is all so vague of course, the entire matter surrounding the tick, especially the Lyme thing. You suddenly are infected with Lyme and only get treated when your body shuts down. They should provide yearly checkups and when you are tested positive you should be treated immediately en find out what more they can do to help."*	Needs for people or institutes with knowledge and experience. Need for unambiguous information and guidelines. This is all just confusing

Persona 2, Jos Mutselaar. (Responsible)

Jos is a 46 year old male, married and has a daughter who just reached the age of 4. Jos lives in the middle of a city in a terraced house. Jos is an active guy; he likes to go for a ride on his mountain bike and loves to walk. He is the captain of a soccer team. His wife

sometimes has the feeling that Jos is pushing it too much and she tries to slow him down. During outdoor activities Jos is always aware of the risk of ticks and he checks his family and himself for bites. His 4-year old daughter was once bitten at the age of 3 and she suffered from a hazy red spot, the general practitioner told him it was just s skin condition. After much insistence, the general practitioner decided to prescribe antibiotics, from which she recovered.

Jos is in possession of a laptop, pc and also has a smartphone. He is actively involved in social media and often roams the internet for information. He uses his smartphone to send messages, but also for posting work-related posts on twitter. He asks various organizations for information about ticks and Lyme. In his opinion the dynamic flow of information from the internet is positive, but it is also a disadvantage as you have to look hard in order to find the correct information.

Jos works as a technical advisor and mainly steers the contractors in the right direction for carrying out their jobs. Jos does not have to leave the footpaths, and does not spend his entire days outdoors. While working he wears impregnated clothes (provided by his employer), high shoes and long sleeves. He doesn't care whether its winter or summer, you always have to protect yourself.

Ticks are a major issue for him, several of his colleagues got bitten, and he also got bitten a couple of times. One of his colleagues is still very ill. According to Jos, the problem of ticks is wasn't always around, you knew they were there, but rarely saw them. Unlike nowadays and Jos has gotten percipient. He always informs the contractors of about the protection that is necessary, sometimes colleagues joke about him because of his concerns. Even the physician asked Jos for advice. Despite the fact he doesn't mind to share his knowledge. He is disturbed about the ignorance of some people. According to Jos there is still a long way to go, but improvements and necessary. He hopes for recognition of the problem. Protocols are being developed at his work, but in his opinion they should have done it earlier.

Interview section	Persona type: Responsible	Quote interview	Translation to persona
Knowledge ticks	High level of knowledge. Is well aware of the lifecycle, the habitat, risks and size of the problem.	(Interviewer) How do you remove ticks? (Male) *"You have to pull them out in a straight line, turning has no added value because of the barbed hooks on the bottom and top of the hypostom." (*Interviewer) What can you tell me about the pathogens it's carrying? (Male) *"Lyme is the most famous one, babesia, baconella, recesting, but also one-celled organisms such as the tapeworm."* (Interviewer) Where do you stumble upon tick? (Male) *"I usually see them in areas with grassy/low vegetation, usually I notice them crawling among the wild cattle. I've noticed them on higher vegetation somewhere around*	Jos is well aware of the presence of ticks, he also knows what type of vegetation they prefer and how they can come in contact with your body. If it isn't necessary he does not depart from walking paths, but unfortunately this isn't always possible in his line of work. In his opinion cattle has an important role in the spread of ticks.

		the level of your knees as well. The combination of cattle and vegetation of knee height seems to me the most dangerous."	
Knowledge Lyme	Average-high level of knowledge, because of own experiences with Lyme.	(Man*) "That red circle tells you something about the Lyme, my general practitioner insists of contacting him when I notice one. But that red circle only applies in some of the Lyme cases"*	Jos has gathered quite some knowledge about the Lyme, this is due to the fact he has gotten infected with Lyme himself. Despite his above average knowledge there are several uncertainties which can sometimes be frustrating.
Attitude and behavior	Is aware of the risks and informs others as well.	(interviewer) How do you gather your info? (Male) *"I happened to have had a learning-in-the-field day, I shared the knowledge gathered from this day with my colleagues. But it is most important to be assertive and don't hold back when it comes to looking for information." […] Due to our profession we are always remembered about the ticks, you read about in journals or see something on your television, this triggers to look for information yourself."* (Interviewer) Are you aware of the risks? (Male) *"Yes, but in such a way that I do not always think about it, it happens subconsciously. You cannot avoid every tick, sometimes I mention to the men of the contractor that they always should check themselves at the end of the day."*	Safety for your family and colleagues is important for Jos. He always tries to support en encourage people to promote the safety. He is well aware of the potential hazards and has routine in protecting himself.
Technology	Prefers face-to-face contact above communication technologies.	(Interviewer) Tick radar? *(Male) "It is nice to see which areas are most infected with ticks or ticks that are infected. But you should be aware that some people may avoid those areas. Which isn't a problem for recreationists, but I can't avoid all those areas while on the job."* (Interviewer) Do you prefer your information digital or on a paper? (Female) *"It is not problem to send it to me via email, for this type of information it is important that I can be updated quite easily, because the preventive measures of today may be outdated tomorrow."* (interviewer) So an app would be convenient because you can easily update it? (Female) *"Yes, but I wonder what the added value of such an app would be, most of us are have sufficient knowledge, if you're looking for new information you will probably do this while at home, because during outdoor activities you really don't have time to go surfing on you smartphone.."*	Jos has his doubts when it comes to all those new technologies, the advantages do not per see outweigh the disadvantages, it can provide you witch quick and up to date information. But on the other hand, has his doubts about the added value of such technologies when every area you work in has ticks..
Needs		(Male speaks about colleague) *"…She went to see the physician en didn't receive any antibiotics, according to her physician all those 'Lyme gossip' was nonsense, however she did persist on getting antibiotics and she got antibiotics. The physician still didn't believe her, they all think is something mental, that's how it's done."* *(Interviewer) Are there any regulations in relation to reporting tick bites? (Male) "There is no standard form on which you can write down our tick bite, I could create one but I wonder whether this is my responsibility of that of my boss. I don't know if there are any special guidelines, but if they are there, they should provide us with that information."*	Need for recognition and unambiguous protocols and guidelines

Persona 3, Guus de Mulder (Powerless and helpless)

Guus is a 63 year old male, divorced recently and has two children living independently. Guus has had several jobs previously and works now almost 6 years as supervisor. This job suits him well, less pressure than his old jobs. He has two dogs which he daily takes out for a walk. His house is located in a small village and he has a large garden. Guus likes to read en enjoys his peaceful surroundings. He believes that the problem with ticks and Lyme could get a lot worse than they are now.

His employer provided him with a smartphone, which he can use to call in problems or use the GPS function to mark certain areas. He also uses this smartphone to read his emails. Although at first sight he wasn't too fond of this smartphone, he now is starting to see the benefits. Nevertheless, he makes little use of his smartphone. According to Guus, the medical field should provide solutions to the tick problem, and for now they seem not up for the task. In his opinion the modern technology is particularly helpful for information

It is now three years since Guus has been bitten by a tick during his work, which resulted afterwards in an infection with Lyme. Before Guus started with his new job he never heard of ticks and Lyme disease. Although Guus removed the tick himself and he didn't saw a red circle, he began to feel feverish and he awkward and not like the old Guus. He decided to see his general practitioner, but his gp said that because of the lack of this red circle it couldn't be Lyme, the general practitioner requested he should take some rest. After a moth of rest Guus still felt like he was sick and he decided to go and see his gp again. This time his gp decided to some serological test and if the test result was positive, Guus would have gotten a prescription for antibiotics. However his blood result was negative and Guus went back home.

At work one of his colleagues mentioned the fact that the blood tests weren't that reliable and he still could have Lyme despite the negative outcome. Guus felt really bad, but again went to see his gp, whom gave him antibiotics, just to be sure, after two weeks Guus felt like he was reborn. Despite his quick recovery it didn't took long before he started to feel ill again. He didn't feel like going to see the gp again, because of the blood test earlier that came out negative. Guus talked about his problem to his boss, and although he understood guus' problem, he couldn't help him either.

Guus had lost fun in work and happiness in life. After several years of struggling he spoke with someone that informed him of alternative therapy, despite his doubts he went to see this man that provided this therapy. And as if a miracle had happened Guus started to feel alive again.

Although Guus is feeling better now, he has lost trust in medicine and he had even more fear of ticks than ever.

Interview section	Persona type: Powerless and helpless.	Quote interview	Translation to persona
Knowledge ticks	Average to above average, familiar with habitat and looks of the tick	(Interviewer) Can you tell me about the life cycle of the tick? (Male) *"As nymph he lives of small animals such as mice, from which he can get infected with the bacteria Borrelia. He then looks for larger hosts and that when you could get in contact with the tick, you could get infected, but you are safe if you remove the tick within 24 hours."* (Interviewer) How do they enter your body? (Male) *"They hide themselves in grassy and low vegetation; they don't come falling from trees, from your feet until the height of your knees is where they are." […] "Until about 0.5 meters that is as high as they go."*	Guus knows a thing or two about the habitat of ticks, He knows where to find them and it is always in the back of his mind.
Knowledge Lyme	Average-high level of knowledge. Is aware of the symptoms, how you can get infected and the treatment.	(Interviewer) what can you tell me about the consequences of Lyme? (Male) *"You could end up in a Wheel chair because your joints lose their function, your heart, or nerve system, you could also die. Children could be obstructed in their growth. […} I still suffer from cold feet and sometimes I feel like my throat is being pinched, a pity that is."*	Guus is familiar with the consequences of Lyme, he suffers from it himself, but also has heard 'horror' stories about other people that suffer from Lyme. That is not to be sneezed at for him.
Attitude and behavior	Because of the consequences of Lyme sometimes anxious en precautious.	(Male) *"I don't see them that often, although it always goes in circles in my mind. Sometimes I worry so much that I feel somewhat depressed. I sometimes wondered if I should look for another job because of these ticks, mainly because of the danger and my colleague whom suffers from a tick bites and will probably end up in a wheel chair, as a result of such a little tick."* *(Interviewer)And when you're having your lunch break? (Male) "I will never sit on places that increase the chance of getting bit by a tick. You could see it as an obsession. I notice about myself that sometimes I avoid going to places just to be safe from ticks. It's not only yourself you should be worried about, but also your family, if you take them somewhere….I've also got a dog so I'm really careful."*	The fact that Guus is well aware of the Lyme disease makes him particularly alert of the potential risks. In a preventive way he is much more active than most of his colleagues, sometimes at the expense of joy in his work.
Technology	Does not see added value in smartphone app. Knowledge and insights are most important.	(Interviewer) Is there still a need for information in your profession? (Male) *"Yes, no, you could never get saturated from information. People should become more aware and the awareness takes little steps, usually something has to go completely wrong before action is taken."* (Interviewer) What could be the added value of technology, for instance a smartphone? (Male) *"It would be convenient for me to create an application that supports me with the registration of tick bites, but I'd rather use paper and pencil. I would draw a body and then upload it to my device."* (Interviewer) Would information add something to the value of this app? (Male) "*I have plenty of knowledge myself, but it could be useful for new employees. Everyone should know how to behave, how you can protect yourself, what do you need to know, self checks etc. I don't like when I am approached without asking for, however I am interested if this information is useful for me. "*	Guus see the ticks and Lyme disease as a major social problem which is not simply solved. 'Green' professionals have sufficient knowledge, but perhaps for new employees it would be useful to provide additional information

Needs	Lacks trust in medicine en lacks trust in own employer.	*(Female) "Tuesday I suffered from a tick bite and the following Thursday I felt sick. I also noticed a red spot, but it wasn't a circle. I could however convince the general practitioner of the fact that I wanted antibiotics, because I normally don't like getting antibiotics, so the general practitioner was like: "Okay". ."* (Interviewer) So you had to persuade your general practitioner? (Female) *"Yes, those people are really not that into ticks and Lyme as well as some specialist, although there are some exceptions."* (Interviewer) Education throughout your employer? (Female) *"The physician from work really doesn't know anything about ticks. I don't think they really notice it as a problem. […] My employer only takes action when we ask for it, they are also developing a protocol, but it takes forever."* (Male) *"Make sure that there is a specialist available somewhere in a Dutch hospital, so that someone can specialize himself in the field of ticks and Lyme, so that in case of an emergency there is always someone at hand to ask for help. Create an expert or create en institute which is specialized in this field, nowadays everyone knows a small part of the story, but information is never complete. I myself don't know where to go for good advice."*	Guus hears many different stories, nowadays the policy differs quite much from the past. Because of experiences of himself and his colleagues, he lacks confidence in medicine, according to him, they know too little and provide insufficient care. If necessary, he goes looking for information or uses alternative treatments.

5.2.3. CONCLUSION

What are the stakeholder needs and requirements, what priority problems are there, how can these values be translated into the design?

The personas created in this research can be used for further improvement of the design, when functionalities are being tested, these personas in combination with scenarios can be used to check whether or not the system meets the requirements. As these personas are based on the participants from the interviews, the personas are middle aged. Being middle aged could have an impact on the usage of modern communication technology. This specific group has specific needs and could have different skills than the younger population who are more familiar with information technology. As described in Lerouge et al. (Lerouge et al., 2011) the adoption and usability of these new information technology systems are points for improvement. The following chapter will discuss the online focus group (OFG), during this method the first prototype (by means of the empirical data and the personas) is presented to different professional that are either experience experts, have a management job in the green sector, or are tick/Lyme experts.

6. VALUE SPECIFICATION

During the value specification the different needs and requirements from stakeholders are gathered and these will hold as the foundation for the design.

(Value specification) Which key economical, social and behavioral values for stakeholders can be defined based on the contextual inquiry?

a. Who are the relevant stakeholders and what influence do they have?

b. What are the stakeholder needs and requirements, what priority problems are there?

c. Which barriers and facilitators in the work environment for preventing tick bites are present?

d. How can these values be translated into design functionalities and important factors for implementation?

6.1. STAKEHOLDER ANALYSIS

6.1.1. METHOD & ANALYSIS

The goal of the stakeholder analysis is to find out their main roles, responsibilities and task goals in relation to the system(Maguire, 2001). A stakeholder analysis can be described as: *"Stakeholder analysis is a process of systematically gathering and analyzing qualitative information to determine whose interests should be taken into account when developing and/or implementing a policy or program." (Schmeer, 1999)* Not only provides a stakeholder analysis an overview of every important or less important stakeholder, it also provides the researcher information about to what extent the needs and requirements of different stakeholders should be taken into account. Especially for this research whereas the underlying holistic approach plays a role, it is important, in order to reach consensus about the to-be-develop approach that the requirements and needs of the primary users are taken into account. Another important aspect of the stakeholder analysis is to make sure the development is implemented properly, evaluated and there is sufficient (financial and non-materialistic) support. Many different methods and ways to perform a stakeholder analysis are described in the literature (Bryson, 2004). The stakeholder analysis for this research was created with the '*Power vs. Interest Grid*' *(Eden & Ackermann, 1998)* and the holistic approach.

6.1.2. *RESULTS*

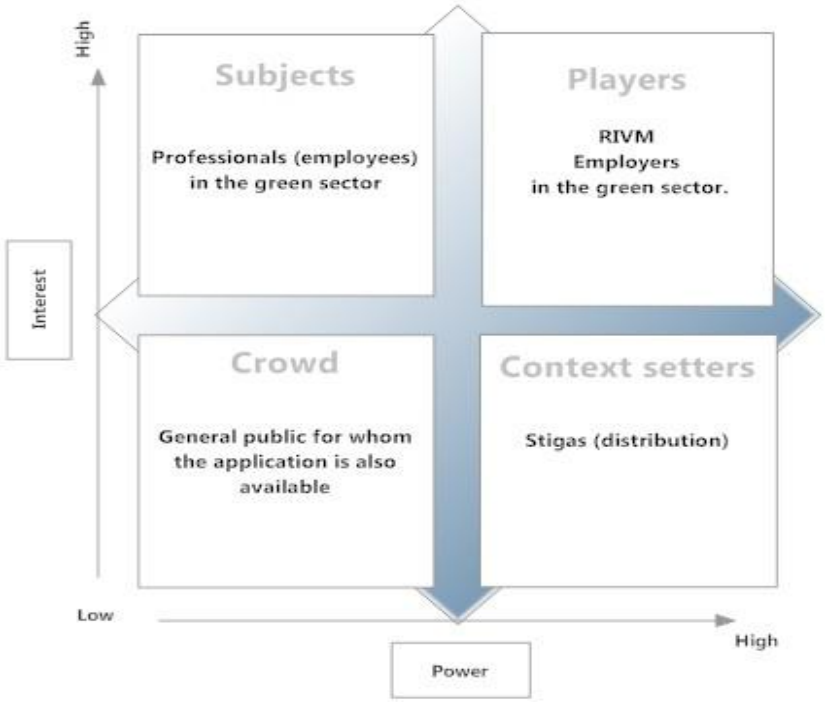


Figure 4 Stakeholder Analysis

6.1.3. *CONCLUSION*

Who are the relevant stakeholders and what influence do they have?

As can be seen in Figure 4 the analysis is done based on the different stakeholders. Not all relevant stakeholders are placed in the analysis as this would involve writing down every organization that has people in service who fulfill the 'requirements' of primary users, or even have an interest or role in this research. Hereby the RIVM is the appointing authority, removing most of the financial barriers, thus providing no financial strains on other stakeholders. The RIVM can be seen as the most powerful stakeholders for they provide research, the development of the design and support in a material way. They are guided by organizations that will provide their employees with access and support to the application, together with the employee's they create requirements which leads to power over the design. The employers are unspecified, due to implementation all over the Netherlands. The subjects are the primary users who will make use of this application and share a high interest as it would improve their safety. Stigas as an organization with a wide reach many connections and influence serve as context setters by creating awareness and distributing this application guided with relevant information. The crowd involves all those who are interested in the application but didn't contribute to the development.

6.2. ONLINE FOCUS GROUP

6.2.1. METHOD & ANALYSIS

A focus group is a way to collect data from a group of people that discuss topics chosen by the researcher(Morgan, 1997). Focus groups are suitable for examining how knowledge, and more importantly, ideas, develop and operate within a given cultural context.(Kitzinger, 1995). Specified on this research, the purpose is to: gather information about current policies with regards to ticks and Lyme and to discuss the outcomes from the interviews (early prototype) as well as setting requirements for the ehealth technology. During the focus group different topics/problems and potential solutions will be discussed. These focus groups will be held with relevant stakeholders, the participants were selected mainly based on two items:

- Profession, should be able to influence company policy and is familiar with the policy
- Interests should play an active role in the tick/Lyme issues and has specific knowledge about this topic.

Some of these are the same people who were contacted for recruiting people which could be interviewed. Several people were invited, however not all of them wanted to participate and of those willing to participate only four did indeed participate, this rather low participation was due to personal or unknown reasons.

Profession	Company	Relation with ticks/Lyme
Senior advisor Microbiology & Infectious Diseases (did participate)	Ministry of Defense	Experienced at bridging the gap between policy and research by translating (military medical) needs into research projects and by incorporating scientific advances into policy.
Head of Dept. Guidelindevelopment & PhD Researcher Health Education	RIVM	Is involved in guideline development and use of new media in education
Biologist/researcher (did participate)	RIVM, University of Wageningen.	Expert in the ecology of Lyme borreliosis. Active in education. Member of national green working group Lyme.
Prevention advisor	Stigas	Chairwoman of national green working group Lyme. Takes part in various tick&Lyme projects, o.a. weekvandeteek.nl.
Organizational policy advisor	Staatsbosbeheer	Member of national green working

		group Lyme.
Environment-, health& safety- and environmental coordinator	Natuurmonumenten	Member of national green working group Lyme.
Forester (did participate)	Natuurmonumenten	Experience expert. Active involved in education and association for Lyme patients. Member of national green working group Lyme.
Wildlife biologist (did participate)	KNJV (Royal Dutch Hunting Association)	Member of national green working group Lyme. Contribution as sound board member for large Dutch Lyme report.
Physician	ArboVitale/Stigas	Member of national green working group Lyme.

Table 8 OFG participants' characteristics

The participants for this focus group consist of different people, some of their activities are described in the above table, this is only a small selection of their actual involvement in tick and Lyme issues. These people were chosen in order to try and reach consensus about the features that needed to be imbedded in the system. The participants for the interviews consisted of primary users who had work related needs and requirements. While the participants for the online focus group also share knowledge about the feasibility of the application, creating a more top-down view for the design.

Participants have the opportunity to express their views on a range of topics, they can actively think about the existing supply of care or how the new technology should look like. This type of research is not only meant to find out what problems there are, but it also stimulates to think and have suggestions for improvement. This method is only meant for people willing and able to put thoughts into words (CBO, 2004). There are several reasons (p45 Pros and cons) why the online focus 5group was preferred over an 'offline' focus group. However the basics of a focus group remain the same.

6.2.2. DESIGN OFG

The setup for this focus group is as follows. An internet forum is an area that can be used by people to discuss about certain topics on a website. This forum can be modified by the researcher in a way that suits best for the research. Since the information can sometimes be sensitive or personal, it is possible to make it 'invisible' for people who don't have access to the forum. There are much more functionalities that provides the researcher with the possibility to create a 'protected' area for the focus group. For this specific research several features were used. The online focus group can be held synchronous and asynchronous (Tates, 2010). In a

synchronous online focus group all the participants respond at the same time, during an asynchronous online focus group participants can choose a convenient time for them to respond, thus increasing 'comfort' but it can decrease the interaction; this focus group was held asynchronous.

In order to let the researcher hold the reins it is possible to restrict almost everything. The main goal is to create a discussion, so that's what the researcher needs to keep in mind.

Before starting the online focus group some preparations are made. In this research was tried to keep as much control as possible. The researcher created users accounts for every participant. Why not letting them create their own account? At first, in order to persuade people to do something, making it easier to do stimulates participation. Secondly, for your own administration it is more clear when creating login data in a for example numerical sequence. The second step is to create the topics for discussion, based on the research the subject can be divided into different days. Whereas in a traditional focus group one would plan to change the subject, in the online focus group you can do this by creating a time span to respond. After a certain time the participants have no longer access to this subject and can only post reactions in the allowed sub forum. By stimulating the participants to post a response for every subject an agreement can be made that those who respond to every subject will get a small financial compensation. The 'amount' of discussion and thus amount of data depends on the responses of the participants; therefore it has to be made clear to the participants that their efforts are crucial for the success of the focus group. Another important factor is the creations of a focus-group-friendly environment, setting rules, giving permissions, create boundaries and making clear what your goal is. During this focus group five days were selected in which every day a new topic was addressed. Those were:

1. Current policy within companies and government
2. Information and education
3. Offline media, folders.
4. Application for smartphone
5. Creating a website for information/communication

These five topics were the main subjects open for discussion, screenshots can be seen below. What was done during this OFG. The contextual inquiry was used to create personas and together with parts from the value specification several requirements were translated into the design or asked in the topics of the OFG. The participants then were able to respond and express their thoughts and feelings about the topics and/or prototype design as well as comment on

each other. The 'Discussieleider' posted questions, and the participants could answer and respond at any given time, during the OFG period of one week.

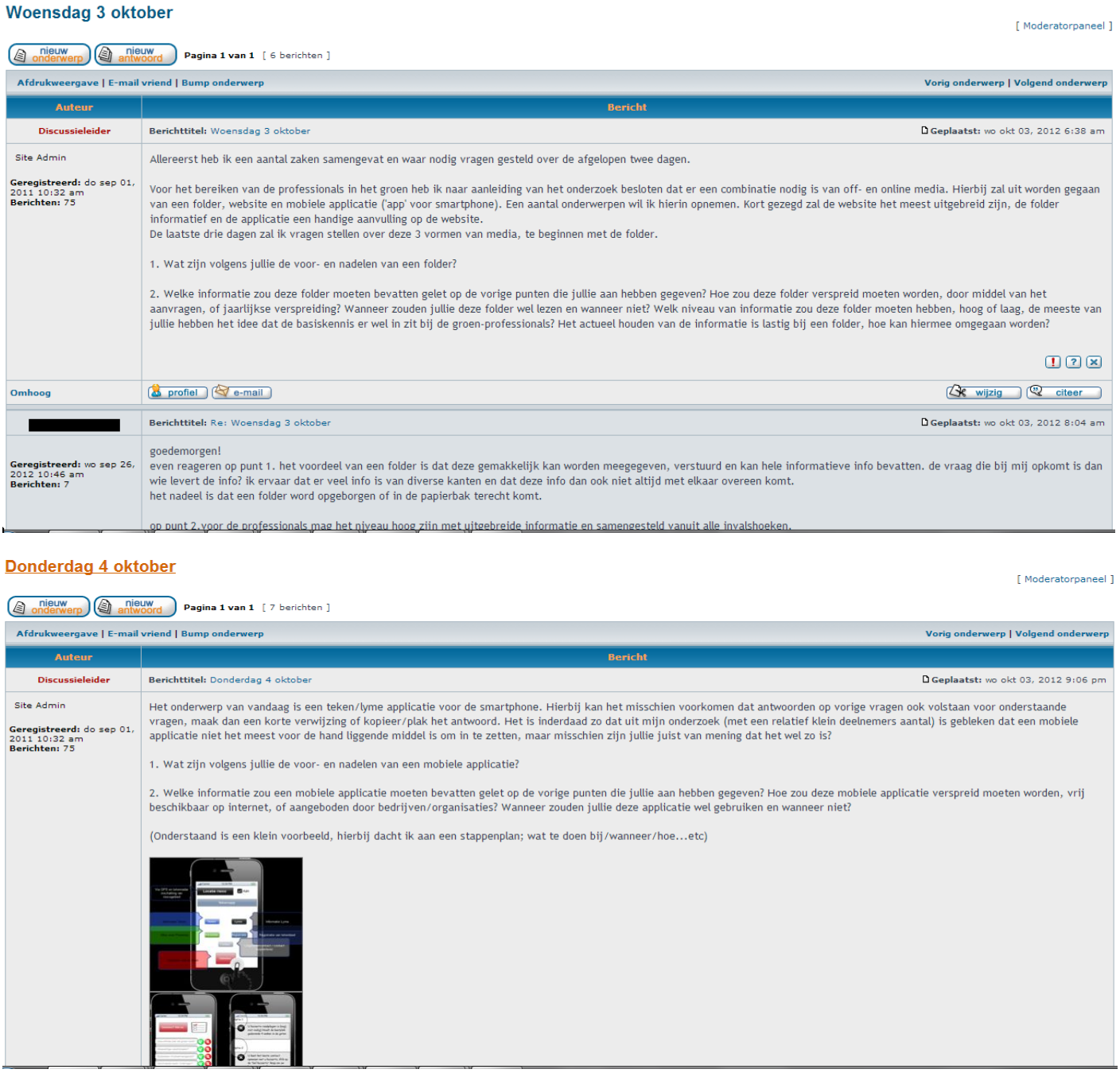


Figure 5 Screenshots OFG

Pros and cons

While using an online focus group there are different pros and cons as already mentioned before. The following enumeration is combined from experiences in this research and scientific literature. (Rezabek, 2000; Tates, 2010)

- Analyzing data takes less time

- No need for recording material, everything is in digital format.
- People that have either little time or not able to travel can participate from any pc with an internet connection
- People can be even more honest because they are 'safe' behind their own screen.
- People can think their answers through; they have more time to formulate.

- There is less interaction between participants, non-verbal information.
- Information can be harder to interpreter without hearing or seeing emotions.
- Stimulating participants to respond can be harder.
- A pc with internet connection is needed.
- It can be hard for the researcher to act as a discussion leader, with asynchronous OFG, people don't respond immediately to the questions.

5.1.1. RESULTS

Which barriers and facilitators in the work environment for preventing tick bites are present? How can these values be translated into design functionalities and important factors for implementation?

The following information is based on Table 9. The current policy should also aim at people already gotten ill from Lyme, tertiary prevention and rehabilitating former employees. Registration is important as it can provide data about the magnitude of the problem. The information that is available is not specific for professionals in the green sector, the information should include more information about personal protection and preventive measures. Employers should act more proactive by doing risk assessments and providing protective clothing of useful information. Information should be presented both off- and online, the information should incorporate a sort of action guide, what-to-do-when. Other information requirements are: tailoring information, keep it short and simple low and high level information, the information should be unambiguous; the presented information should provide specific guidelines that are accepted nationwide. A question box would be convenient, for asking all sorts of questions. Another important aspect is the face-to-face contact, this seemed favorable, things to share the knowledge such as educate the educator were mentioned. Providing folders could be digital and it should include references to other information media. This other media can involve websites or applications for mobile phone. One of the advantages of digitally stored information is that it is easy to adapt and keep update. Both should be easy to access and simple to navigate to the wanted information. The website could also incorporate a personal file, which can be useful after infection. News could be displayed. With regard to the mobile application, the

main disadvantage is that one would require a smartphone with internet connection. SMS- alerts were mentioned to keep people alert several weeks after being bitten or at the beginning of the season and connect data with 'Tekenradar'.

One of the outcomes from the OFG was a system that was called train-the-trainer, in which the knowledge and skills are shared and transferred to others. More of these outcomes are described below. The analysis of the data was done via the same way as the interviews, thematic analysis, p27.

Subject	Characteristics/Requirements	Citation from OFG
Folder **Website** **Mobile application**	1. Digital distribution 2. Refer to other media 3. Create personal Tick/Lyme dossier 4. Objective information 5. SMS alert 6. Requires smart phone and data usage 7. Online media is easier to keep it up to date 8. Either primary or secondary prevention 9. Roadmap design	1. *"Set up an digital distribution list, keep it up to date en distribute the folder via digital ways"* 2. *"This brochure should not be too long, for more info refer to a website", wildlife biologist)* 3. *"Maybe it's possible to add a personal dossier on a website which for example consists of sms reminder."* 4. *"Perhaps the most frequently asked questions could be embedded in an app." "In addition, website where you can easily find all info, which is also up to date with the latest insights. Wherever you can go with all your questions. Now the information is disseminated." (wildlife biologist)* 5. *"When you have filled in the date of a tick bite, maybe after 'x' days you should receive a reminder which makes you check for potential EM. "* 6. *"When I look at my colleagues, most of them have no smartphone" (nature 'manager'/experience expert).* 7. *An online app can be easily updated."* 8. *"You could also create a connection to link the registration of a tick bite to tickradar.nl." (biologist/tick expert).* 9. *"When someone is bitten you have to be able to guide that person step-by-step."*
Communication means	10. Combine off- and online media 11. Personal education, sharing knowledge 12. Train the trainer 13. Information level from low to high 14. Uniform approach and consensus among organizations 15. Add 'question box'	10. *.."Both options are possible off- and online".* 11. *"Regardless of all the if's and buts, I think that personal information (offline) is best" (biologist/tick expert).* 12. *…"or in larger organizations with help of a train-the-trainer construct."* 13. *"Translating the information specified on knowledge and needs is necessary".* 14. *"Of which all should be in agreement with professionals for providing up to date information which provides uniform guidelines and approach".* 15. *"..Still it seems better to have some people within companies that serve as question 'box'" (forester/experience expert).*
Policy	16. Focus too much on primary and secondary prevention 17. Add some sort of registration system 18. Offer risk assessments 19. Responsibilities employer 20. Lack of focus on diversity of green professionals	16. *"Information provision is aimed at preventing and rightly so, but for the people who already have Lyme's there is no safety net" (forester/experience expert).* 17. *"To properly understand how big the problem really is, a good registration is required, both by doctors and by occupational health and safety department (ARBO), a uniform way of record, and that the health and safety registration systems are up for the task" (Senior Advisor Microbiology & Infectious Diseases)* 18. *"Authorities should therefore as responsible employer make risk assessments for their own employees to see whether their occupational tasks, including the duration and frequency of these tasks brings along any hazards or risks which could to an increase of average risk compared to 'regular' citizens."* 19. *"This could be the employers or sectors' responsibility to create these folders en keeping them updated.* 20. *"Information to smaller groups of "green" workers is not sufficiently known; such as people who provide community services or volunteers that work outdoor" (biologist/tick expert).*

Table 9 Results focus group

5.1.2. CONCLUSION

The data from the OFG provides more insight in the demands and wishes for the ehealth application, and provides more background in the reasoning behind these requirements. In line with the interviews, face-to-face contact is preferred over online and digital information. However a combination with off- and online media seems most useful, as it offers the most complete approach. Some of the outcomes were translated into technology requirements while others such as the fact that folders should be digitally distributed are left aside, not because the degree of importance, but whether or not it was applicable for the smartphone application in this research. Most of these requirements are together with the interviews and persuasive system design (PSD) principles embed in the design.

6. DESIGN

The design phase is the last part of this thesis and will combine empirical data and theory into a prototype that can be classified as a persuasive ehealth technology constructed by means of a holistic design process.

Which requirements are critical and have to be put into the design?
What persuasive elements can be fit into the design?

6.1. DESIGN AND SYSTEM FEATURES

6.1.1. PROTOTYPE

The entire research was done in order to create an holistic e-Health design that improved preventive behavior and attitude among professionals in the green sector. This design and guidelines are based on literature, interviews, focus group and personas. Combining these different types of data results in specific needs and requirements in order to improve the preventive behavior and attitude. These recommendations can be used for different types of media, but for now the focus is on creating an application for a mobile smartphone.

As we follow the PSD there are several factors to take into account, which can be used to create the design and evaluate the design. The PSD is the foundation and this design will be based upon the design principles of the PSD.

The following table includes all features that have been imbedded in the system which can be found under. Not all of the following features are withdrawn from both empirical data and theory, hence the fact that theory can improve the application in ways that the empirical data did not show. Not all empirical data can be embedded in this system, this way it could seem like

the system is missing data. The boxes that remain empty under ‘requirements’ are derived from theory.

In order to make the following design more clear, every requirement translated into the prototype is provided a number. *For example the first picture consists of requirements 1, 5 and 7.*

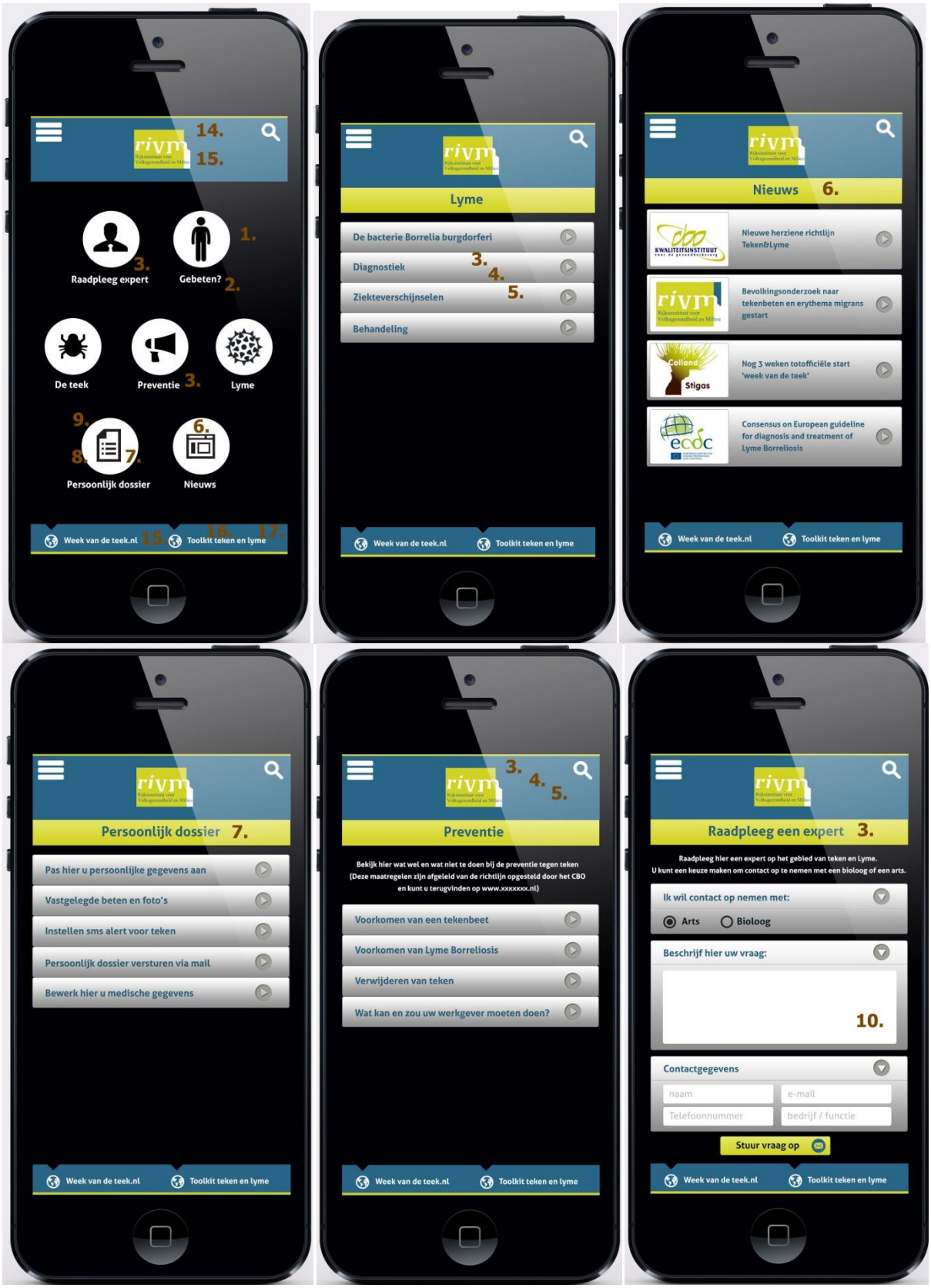
Primary Task Support			
Requirements (Selected from theory= T, selected from interview= I, selected from focus group= OFG	**Persuasive theory**	**Prototype implementation**	**Extra info**
1. Use of application must be simple and quick. (T, I 2. Need for registration system. (I, OFG)	Reduction, reducing complex behavior into simple task, reducing the effort.	The systems reduces the effort for the registration of tick bites, the system itself , information can be easily found under the tabs The 'body' symbol can be used for gaining access to the registration of tick bites, tick bites can be registered and are in connection with tekenradar.nl.	The system is created in such a way that it is easy to use, users can easily find what they are looking for, in which the Icons and the simple layout play an important role.
3. Specified information (T,I,OFG) 4. Information level from high to low. (I, OFG) 5. Short and simple (T,I,OFG) 6. News topic (I,OFG)	Tailoring, the information provided will be specific to the needs and interests of the green professional	The information in this app will be specified on needs, information about specific areas is provided due to the connection with *tekenradar.nl* (this connection cannot be displayed. Information about certain areas, protective clothing or for example the treatment of Lyme disease. Information is divided in different subtopics, the user can gain access by a 'drop-down' window. Information is concise and by providing links to other information sources, there is the possibility to look for more	As derived from the data users wanted the level of information from low to high, therefore the most basic information is available on the app, and more content is provided with linking to other websites. Specific news for the green professional is selected and shown in the 'news' feature, this could include news about potential new treatment or improved protection methods.

		comprehensive information. The news topic displays relevant information, specified on the green professional.	
7. Adding a personal dossier, with registered tick bites and posted information. Ability to change settings (I)	Personalization, creating personal settings to increase persuasiveness.	The user has the possibility to add different kinds of data into his personal dossier; information can be send towards an email account. The personal data consists of: - Tick bites registration - Possibility to store GPS data, where has one been. - Pictures of bites. - Medical data such as blood values. - System options, sms-alert on/off. GPS on/off.	This personal dossier is conceptual, as users wish to add different kinds of information in their personal dossier, it can be added later on. This personal dossier should consist of a simple summary of the users' personal data about ticks and Lyme.
Dialogue support			
Requirements	**Persuasive theory**	**Prototype**	**Extra info**
8. Reminder when to check for ticks. (T,I,OFG) 9. Get an SMS alert when the 'tick season' has begun. (I)	Reminders, by reminding the target behavior increasing the likeliness of reaching the behavior goal.	There are several reminders built into the system that reminds them either to check themselves after work, get an SMS-alert when ticks will become more active and reminders when someone is bitten to watch the bite mark. These options can be switched on/off in the settings	This feature is not yet shown in the mockups, however it will be imbedded in the system, by adding this feature, the system helps to trigger people to be alert.
10. Molded into what-to-do-when design. (T,I)	Suggestion, by providing suggestion at the right moment increasing the	After the registration of a tick bite takes place the system will suggest what the user	By showing the users what to do when they are bitten, adding reminders, and

	persuasiveness	should do (keep an eye on bite mark) and provide info with what if the bite mark changes. The systems ask the user which information he wants and information will be displayed when going over a specific symbol. The user takes consecutive steps in the system. The system shows different options, contact an expert of look for information.	providing relevant information, users will be able to easily proceed through the system. This feature could also be extended by creating a function for prediction. ("*Did you mean 'ticks' instead of 'tiks'?", or "Taking a picture of your tick bite helps you to determine whether it has changed")*
11. Liking (T)	Liking, increasing the visual appearance of the application makes it more attractive	The system will be design by specialist to make the application visual attractive.	The system is created in such a way that it should be attractive for green professionals to use, in this case the colors from the RIVM logo are being used, but this can be changed in whatever preference organizations have. The user is able to change this in the options menu. (Not visible in mockup therefore the numbers are not visible in the mockup)
	System credibility		
Requirements	**Persuasive theory**	**Prototype**	**Extra info**
12. Reliable information (T,I,OFG) 13. Information in accordance with general scientific literature and supported by all participating organizations. (I,OFG)	Trustworthiness, as users see the system as reliable the persuasive powers will increase.	The system will make use of information provided by the government and other highly rated organizations which offer all the same information. Logos are shown in the app. One aspect that really came forward during the interviews was the lack of confidence and reliability in health care,	As it is important for users to have access to trustworthy information, the information on this application is provided by the RIVM, by showing the users that different organizations are involved it should increase the trustworthiness. Adding sources to the information will be

		health professionals and their own employers. By increasing the system credibility this barrier can be brought down and bringing back the trust.	done as well. (Not visible in mockup therefore the numbers are not visible in the mockup)
14. Opportunity to consult an expert. (T,I,OFG)	Expertise, If users feel that the system is guided or supported by expert knowledge the persuasiveness increases.	The system is supported through the possibility to contact an expert, this could be a biologist, or someone that is familiar with company policies. This is done via email, so the expert has time to respond	As there are many uncertainties about various topics on ticks and Lyme, the possibility of asking an expert should get rid of this.
15. Real world feel (T)	Real-world feel, by showing the organizations behind the application, the system has more credibility.	The system is clear about the goals, its intent and the organizations behind this application. It provides information about the organization.	The system will make clear to the user which goal it has, promoting health behavior.
16. Information provided by trustworthy organizations (T,I,OFG)	Third-party endorsement, adding well known and respected organizations into the app will increase credibility.	By incorporating different stakeholders such as the RIVM, Stigas, Staatsbosbeheer, Natuurmonumenten, Defensie. Adding logos.	Potential users were asked what in their opinion were reliable sources of information, by adding organizations that were seen as reliable information it should increase the credibility.
17. Information must be available on paper and digital (I,OFG) 18. Referring to other media (OFG)	Verifiability, if the information of the content can be checked with other websites it can increase credibility.	Information provided on this application should be in line with information provided via folders or other means of distribution. By adding links to websites (RIVM www.tekenradar.nl, Stigas) or persons to contact about the app.	Different ways of educating and creating awareness are being used. This application should not be seen as a standalone but as part of. (17. Not visible in mockup therefore the numbers are not visible in the mockup)
	Social support		

Requirements	Persuasive theory	Prototype	Extra info
19. Epidemiological information (I, OFG)	Social comparison, the application can increase motivation if users can compare themselves to other users.	By showing data extracted from the registration and making statements about certain organizations of parts of the Netherlands, one can compare to others to see if their measures have the effect,	By collaborating with the data from tekenradar.nl users should be able to see which places are more hazardous than others. However it would be more usable of this information is more specific and precise. (Not visible in mockup therefore the numbers are not visible in the mockup)
20. Exchange experiences with co workers. (I) 21. Sharing knowledge. (I,OFG)	Recognition, by offering recognition for individual or group, users are more likely to adopt target behavior.	By adding a possibility for a forum in which users can exchange experiences and thoughts. This way the user can read about the possible hazards and the consequences.	This feature has not yet been embedded in the system. However the data showed that exchanging experiences and knowledge was seen as valuable. Since this is only a prototype application, the forum feature could be added later on. (Not visible in mockup therefore the numbers are not visible in the mockup)


rivm
14.
15.
Raadpleeg expert
3.
Gebeten?
1.
2.
De teek
Preventie
3.
Lyme
9.
8.
7.
Persoonlijk dossier
6.
Nieuws
Week van de teek.nl
15.
Toolkit teken en lyme
16.
17.
Lyme
De bacterie Borrelia burgdorferi
Diagnostiek
3.
4.
Ziekteverschijnselen
5.
Behandeling
Week van de teek.nl
Toolkit teken en lyme
Nieuws
6.
Nieuwe herziene richtlijn Teken&Lyme
Bevolkingsonderzoek naar tekenbeten en erythema migrans gestart
Nog 3 weken totofficiële start 'week van de teek'
Consensus on European guideline for diagnosis and treatment of Lyme Borreliosis
Week van de teek.nl
Toolkit teken en lyme
Persoonlijk dossier
7.
Pas hier u persoonlijke gegevens aan
Vastgelegde beten en foto's
Instellen sms alert voor teken
Persoonlijk dossier versturen via mail
Bewerk hier u medische gegevens
Week van de teek.nl
Toolkit teken en lyme
3.
4.
5.
Preventie
Bekijk hier wat wel en wat niet te doen bij de preventie tegen teken
(Deze maatregelen zijn afgeleid van de richtlijn opgesteld door het CBO
en kunt u terugvinden op www.xxxxxxx.nl)
Voorkomen van een tekenbeet
Voorkomen van Lyme Borreliosis
Verwijderen van teken
Wat kan en zou uw werkgever moeten doen?
Week van de teek.nl
Toolkit teken en lyme
Raadpleeg een expert
3.
Raadpleeg hier een expert op het gebied van teken en Lyme.
U kunt een keuze maken om contact op te nemen met een bioloog of een arts.
Ik wil contact op nemen met:
Arts
Bioloog
Beschrijf hier uw vraag:
10.
Contactgegevens
naam
e-mail
Telefoonnummer
bedrijf / functie
Stuur vraag op
Week van de teek.nl
Toolkit teken en lyme


rivm
Teken
Wat zijn teken?
Hoe zien teken eruit?
3.
4.
Hoe loop je een teek op?
5.
Waar komen teken het meest voor?
Week van de teek.nl
Toolkit teken en lyme
rivm
Gebeten?
10.
Selecteer de plek waar u gebeten bent
Leg uw beet vast op foto
Week van de teek.nl
Toolkit teken en lyme

7. CONCLUSION

This study aims to examine in what way ehealth could increase the safety of professionals in the green sector, the main research questions:

- *How can e-health technology support the improvement of preventive behavior towards reducing tick bites and infection with Lyme borreliosis among professionals working in the green sector?*
- *In what way could a holistic design process provide the basis of the e-health technology?*

These research questions were then divided into sub questions based on the CeHRes roadmap, *contextual inquiry, value specification* and *design.*

Contextual inquiry consists of gathering *information intended users and the environment in which the technology will be implemented.* We have examined extrinsic en intrinsic factors in order to get a good understanding of the prospective users and their context, what problems do occur and how we can try to solve these problems or at least improve safety. During this research the CeHRes roadmap was used main research method, as the first step of the roadmap consists of 'contextual inquiry' we did stakeholder identification, observed and interviewed professionals in the field. Beside this step of the roadmap, we also used the PSD which also covers the 'persuasion context' which can be compared to the 'contextual inquiry' as they both strive to gather the same information. This first step of the research gave plenty of information about the context in which the professionals work, what problems related to ticks and Lyme they have and it provided us with insights about their behavior and attitude. The data shows that overall professionals in the green sector were quite familiar with ticks and Lyme, they knew how to protect themselves, where and when ticks are mainly active and were known with different symptoms of Lyme. Most of them also knew people that did have Lyme. They often felt like regular medicine failed to perform their duty. Beside this they mentioned the problem with guidelines or protocols, as there still is no national guideline available, everyone uses their own experiences and knowledge to act in the way they think is best.

Value specification, the recognition and quantification of different values for key stakeholders and users. The next step was the value specification in which all the requirements and needs that were seen as important for the relevant users and stakeholders were translated into functional, technical and organizational requirements. By analyzing the stakeholders and defining their interest and power values were selected for imbedding into the system. Personas were created by translating the data of the interviews into fictional characters, these personas were used for creating the first prototype of the design. This prototype and other information was discussed in

an online focus group, which lead to translating their requirements into a new design, but because of the lack of participation, full potential of the online focus group was not reached. There were different requirements that were important to both the users and stakeholders, but could not be imbedded in the mobile application, topics like diagnostics and treatment. Persuasive theories such as the PSD offer several of features of which not all are suitable for smartphone applications. Providing better health care (as in treatment or diagnostics) or creating a guideline is despite their importance not possible to resolve with this application. It seemed that however providing correct information was important, as the current information seemed sometimes contradicts itself, is not correct or differs within different providers.

Design, building the prototype that embeds the users' wishes and requirements and also making the application persuasive. However certain aspects could be integrated in the system, for this last step, the designing phase. The PSD was used for its design principles and it provides different assumptions behind successful persuasive technologies aimed at behavior change. Creating a system that meets all the requirements of the users and stakeholders and also is persuasive 'enough' is not an easy task it requires knowledge of information technology systems but also required knowledge about psychological theories. By adding several design principles the systems becomes more persuasive, however endlessly adding persuasive features into the system could clutter the system and results in the opposite of persuasiveness, balance is needed which can be gained by usability testing. The result is an application for the smartphone that should support professionals in the green sector with their problems they encounter with ticks. It however does and probably will never fulfill all needs. As testing and further development for this app is required its completion could take a while.

How can e-health technology support the improvement of preventive behavior towards reducing tick bites and infection with Lyme borreliosis among professionals working in the green sector?

In what way could a holistic design process provide the basis of the e-health technology?

The results showed that a mobile application was not the best way for changing the preventive behavior and attitude of professionals in the green sector. Based on the empirical data it showed that people preferred face-to-face contact. One could wonder whether this is due to the fact that they just don't like carrying and using a smartphone or using a pc for gathering information, or is it because they simply prefer interaction. Maybe the true potential of communication and information technology has yet to be discovered by the professionals in the green sector. Despite these facts the RIVM wanted to create an e-Health application. This application is not the best

solution for the problem; however it could be a helpful addition. By creating (or using already develop systems) and combining different communication channels it would create a network with a wider reach. While some only read digital papers and others depend on paper folders, both can be reached.

About the outcomes, an important aspect was that this research showed that in contrast to the earlier mindset that professionals in the green sector have a lack of knowledge about ticks and Lyme, it seemed that this was not the main issue, but they lacked confidence in health care and employers. Thus the focus should be more widened to increase this lack of confidence, and by increasing this confidence generating more compliance with current preventive measures. This research has mainly focused on creating an E-health application, which could help professionals in the green sector to improve their preventive behavior in relation to tick bites and Lyme Borreliosis. However this is only a part of the pie that could decrease the risk for the people with occupational risks for tick bites and Lyme. By increasing several other factors such as improving knowledge, researching better diagnostics, providing better treatments, increasing the confidence in health professionals and creating consensus about an uniform guideline to tackle this problem are all needed to make forward steps into protecting these employees. Not all of the above can be solved by creating a smartphone application. This application could however increase the knowledge on various topics such as ticks, Lyme and prevention. This could lead to better understanding of potential risks and how to protect one against those risks. The personal file with the registration of tick bites and the possibility to store medical information could help physicians with diagnosing or mapping the epidemiological data. As the application is provided by several organizations it should increase credibility and confidence in those organizations. Optimizing health care and ehealth applications is a dynamic process due to the fact that knowledge and behavior is subject to changes of which not all can be foreseen.

8. REFLECTION

The following quote summarizes this research in a few words:

"Designing BCSS's (Behavior Change Support System) is a complicated task. Not only it covers user interface issues, it requires detailed understanding of human computer interaction, computer-mediated communication and incorporation of socio-psychological theories".(H. Oinas-Kukkonen & Sitwat Langrial, 2012). BCSS are based on the PSD, therefore it can be compared to the ehealth technology in this research. Various knowledge aspects make the creation of an ehealth application by means of holistic design a complex process.

Few researches have been done about the behavior and attitude of professionals in the green sector in relation to ticks and Lyme. Therefore prior knowledge about the attitude was sparse and therefore the outcomes of this interview cannot be easily compared to other research. However there was information available gathered through surveys that consisted of information about protective clothing, the incidence and the presence of protocols or guidelines.

During this research several methods for gathering data and analyzing the data have been used. Most of the times there is some deviation from the methods as described within the literature. Does this have an effect on the validity of this study, it could be. But since much of the data is subjective and performed by a novice researcher it seems not more than realistic to have this deviation. The main objective was and is however to create an application that improves preventive behavior and this research is one step in the right direction.

One of the rather 'new' instruments was the online focus group is rather new, as a result of the modern technology. The intention remains the same, creating a discussion with a group of people. However the implementation differs, while the regular focus group is conducted in a space where people can talk to each other face-to-face with the researcher as discussion leader. When using an online focus group setup the participants do not see each other. Both methods have their pros and cons. Despite the fact that what is in my opinion the biggest advantage, that fact that it saves a lot of time and it is easier for people to participate, the downside is the participation. For this focus group less than half of the invited people that were willing to participate did indeed participate, which has a negative effect on the discussion in such a way, that there is less discussion.

Validity, are the outcomes of this research a reflection of the behavior/attitude/knowledge of professionals in the green and are the results and conclusions applicable for all professionals in the green sector. First of all, this research is not finished yet. The important steps of implementation (business plan) and evaluation still have to be done, for these two steps further

research/action is required. What I tried to provide with this research is an e-Health application which can be used by professionals in the green sector in the Netherlands, which has the goal to improve preventive behavior in relation to tick bites and Lyme Borreliosis. This thesis only provides directions and can be seen as a guideline, since the prototyping is not yet done, the efficacy cannot be measured. Whether findings will result in improved preventive behavior is unsure. The use of empirical data and theory should however provide solid underground.

There is a possibility of a reliability bias, for instance the interviews and the analysis of the interviews. As this research is performed by a novice researcher, and not an experienced researcher, it could influence the results. The interviews were conducted, transcribed and analyzed by the same researcher. Idealistic one would analyze and discuss the data with another researcher so that there are fewer inconsistencies in the analysis. Despite the absence of a second researcher, insights are given about the findings and the findings were checked by a more experienced researcher. This was not done as thoroughly as how the main researcher did it, but still, supervision took place.

Often heard about qualitative research is the fact that is does not produce a statistical value, no p-value. Some values cannot be measured in a metrical way. However this does not mean that qualitative research cannot increase the objectiveness. By using multiple researchers and giving readers insight to the data, or explaining why certain conclusion are derived it can increase the objectiveness.

At last the personal reflection. As a novice researcher there were still many facets of scientific research that had to be learned. This involved all phases of the thesis, from planning to the development of the 'final' product. Familiarizing myself with different methods took time and in the end there are various things that when I look back could have done better. The use of an online focus group saved time, but since this method is not that often used it was unsure whether or not this would work. One of the main problems that occurred was arranging people to participate in the research; it took a lot of time and patience to persuade people to play an active role. However since all the participants were asked on a voluntary base and with little or no compensation it isn't that strange.

9. RECOMMENDATIONS

There are important aspects that should not be forgotten, the operationalization and summative evaluation. Beside those two it is important to create a business plan, this research did not focus on the financial aspect, but is nevertheless of importance. Building the design, testing the system, keeping t up-to-date, running costs and so forth, all of these factors should be taken into account when creating an e-Health application like this. This should be developed before releasing it to employers and their employees.

As the Arbo (working conditions) requires certain responsibilities from employers it would be wise to look into this legal obligation. They are required to; examine accidents at work and record and report these, provide information and instruction about a safe working environment, secure safe working methods, fights hazards at the source, take the necessary management measures, takes care of appropriate personal protective equipment supplies.(MinisterieSZW, 2012) One could state that by only using these regulative measures, employers are responsible in such a way that they should do their utter best to keep their employees safe. By pointing the employers at their responsibilities could result in them acting in a more responsible way, this definitely needs more attention and provides employees with persuading powers to their employer.

Despite the fact that the operationalization is beyond the scope of this research it is nevertheless important to create a successful implementation strategy in order to increase the usage of the application. Guidelines a described by Grol could be useful, five different phases in the implementation strategy are described. (R. Grol, 2005). These steps are: orientation, insight, acceptance, change and maintenance. It is important to involve the users in all these steps. Increasing the number of participants for both the interviews and the focus group should increase the generalizability but also create a better understanding of wishes and demands for new technology. Idealistic would be a working group like the already existing 'Landelijke Groene Lyme Werkgroep' which consist of various professionals; researchers, policy makers, executors. Combining different organizations and expertise would create a more 'whole' point of view. Following a holistic design process demands the input of various stakeholders and the end users, without their input and knowledge the practical element of the technology could get lost. Adding personas and scenarios into the design incorporates user wishes and demands into the design and requires the designers to take the users' point of view into the design.

The last step is evaluation. The framework makes use of formative evaluation one could argue that such a product would always be 'in progress'. This study covers only the steps to provide guidelines for the design; therefore evaluation is also beyond the reach of this research.

Monitoring things like effectiveness, usage and efficiency fall outside the scope of this research. Nevertheless this step is of big importance as the method for holistic design is an evolving process in which continuous evaluation is needed. In order to keep up with the requirements different stakeholders have, the system should provide room for feedback and suggestion.

Not all is 'gloom en doom'. Professionals in the green sector seem to be well aware of the problems at hand and are willing to try and put it to a hold. They may lack trust and confidence in health care, but on the other hand also state that the level of knowledge among physicians and specialists is increasing. In my opinion the professionals in the green sector seem (based on this research) like a group that is willing to take active measures, care for colleagues and citizens. Therefore they are willing and motivated to help developing new policies and guidelines.

10. APPENDIX

10.1. INTERVIEW SCHEDULE

Demografic information

1. **Sex**
2. **Age**
3. **Highest completed education**
4. **Family situation (children that are educated in ticks/Lyme)**

Physical disabilities

Learning

What way of learning do you prefer? By watching, listening or doing?

Knowledge about ticks

1. **What can you tell me about ticks?**
   Bites
   Way of removing
   Diseases
   Habitat
   Stages of development
   Risks
2. ***How does a tick look like?***
3. ***Have you ever come into contact with ticks? Do you consider yourself at risk of getting bitten by a tick, why so?***
4. ***Do you consider this risk to be low, medium or high?***
5. ***Do you know in what season ticks are most active?***
6. ***In your opinion in what environment you have more chance of getting bit by a tick?***
7. ***Have you ever been bitten by a tick?***
8. ***How do you remove a tick?***
9. ***How have you been informed about ticks, or did you look for information yourself?***

Do you believe that the current interest for ticks and Lyme is just a hype or is it rightly so?

Knowledge on Lyme

1. **Do you know what Lyme disease is? Please explain.**
   Contamination
   Consequences
   Symptoms
   Treatment
2. **How did you gain this information about Lyme?**
3. **When do you go looking for information? Prevention, after being bitten, in case of 'symptoms'.**
4. **How do you look for information about Lyme?**
5. **Where would you search for information about preventive measures?**
6. **Where do you look for information after being bitten?**

Tacit knowledge

1. **Could you explain to me how an average day working outdoors looks like? This can be done by telling me in a way of telling me a story. Please tell me about the beginning until the end of your day, everything could be important. During your story I will ask if necessary questions for clarification. (Hereby taking the time for every aspect by questioning; why or why not, how and when.)**

Topics of discussion in chronological order (examples):

1. ***Getting dressed, how does the working outfit look like, what protection offer these***

clothes, does one wear the same clothing throughout entire year, washing clothes, colleagues and heir working clothes, who pays for these clothes, what if they are damaged, etc.

2. ***Working activities, during work are you aware of the risk of ticks that could be present, what do you do with this 'knowledge', are you colleagues acting the same way? Why do you act this way? What are your main tasks, how, when, duration?***
3. ***Lunch break, where do you have your lunch break, are you keeping in mind the risk of ticks?***

End of the day, when do you take off your working clothes, where do you put them, when are they being washed, do you (or partner) check yourself for tick bites, how often do you check yourself?

Behavior ticks/Lyme

1. **What preventive measures do you use for preventing yourself from being bitten?**
2. **Could you sum up more of these preventive measures?**
3. **How do you feel about these measures? What measures should your employer take according to you?**

Examples

Preventive measures for Lyme:

- ***Removing the tick within 24h***
- ***Education about Lyme***

Extra preventive measures for occupational hazard:

- ***Impregnated clothing***
- ***Wear clothing with long sleeves, long trousers and high Shoes.***
- ***Trousers in socks***
- ***Insect repellent agent such as DEET.***
- ***Risk assessments by the employer for working activities.***
- ***Education offered by the employer about high risk working activities.***
- ***Information about preventive measures offered by the.***
- ***Information about removing ticks and checking for tick bites.***

4. **How do you think your colleagues feel about these measures?**
5. **Do you know colleagues that have suffered from tick bites? How do they handle with tick bites?**
6. **Do you register your tick bites?**
7. **Do you see the importance of the registration of tick bites?**

How does this registration take place and is your employer involved?

Technology

1. **How do you rate your technology skills from 1-10 whereas 10 is the highest, when you think about working with a pc (word processor, the internet), mobile (smart)phone.**
2. **Which technologies do you use? Smartphone, laptop, pc, tablet.**
3. **If you have a smartphone of tablet, do you use any 'apps'?**
4. **In your opinion what are the main advantages of a smartphone?**
5. **Would you prefer to receive information about ticks and Lyme digital (pc, smartphone) or via offline media such as flyers? Why?**
6. **Would you rather read from a screen or a folder?**
7. **What do you think is important for embedding in an app in relation with his research? Tick radar, etc.?**
8. **For how many years do you use the above technologies?**
9. **For what purpose do you use these Technologies, work, social activities, for**

information or for fun (games)?

Remainder

1. **Are there any important issues we may have missed or you want to point out?**

10.2. LITERATURE

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