ORGANISATIE

Heartbead

Assuring do-not-resuscitate statements for frail elderly

Resuscitation after a cardiac arrest is not always desired. A Do-Not-Resuscitate decision can be written down in a DNR statement or a DNR medal. Difficulties are found in the current process of assuring DNR decisions, difficulties that result in unjustified resuscitation. The Heartbead system was developed to assure DNR statements in a way that fits daily life of frail elderly and the workflow of healthcare professionals.

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The chance of survival with a good quality of life after a cardiac arrest is very low for elderly with the age of 70+ outside the hospital (Van Delden et al., 2013). Each person has the right to decide whether to receive treatment, including the choice to be resuscitated or not. Besides the patient's choice not to be resuscitated, the physician can also decide that it is medical futile to resuscitate (Van Delden et al., 2013). The patient's decision not to be resuscitated is called a Do-Not-Resuscitate, DNR decision, and is written down in a DNR statement. Next to a written DNR statement, in the Netherlands a DNR medal is a legally accepted way to communicate the written DNR decision to bystanders or healthcare professionals in case of a resuscitation situation when the patient is unconscious. Despite these DNR communication tools, people still are resuscitated (Brims, Kilminster & Thomas, 2009). Reasons for this are missing conversations with patients, improper validation of DNR statements, or statements that are not at hand at the very moment or not judged as being legally valid (Micallef, Skrifvars & Parr, 2011). Transferring DNR decisions between institutions is often lacking too.

Bringing someone back to life resulting in a possible bad quality of life, is a heavy emotional burden for family, the patient and healthcare professionals, with high costs for the hospital (Datta et al., 2013). For these reasons, a new concept was designed to assure the DNR statements of frail elderly. The Heartbead system was created for resuscitation situations outside the hospital and was based on literature studies, observations, interviews with the main stakeholders (i.e. physicians (general practitioner), ambulance personnel, frail elderly) and participatory research at the specific healthcare departments (for more information see Westgeest, 2014). The Heartbead assures a DNR statement and contains personal information, including information about a life-or-death decision. Firstly, it is important that all stakeholders have confidence in the product, so they are willing to use the Heartbead. Secondly, the product must provide the DNR statement rapidly because of the nature of a resuscitation situation. Thirdly, it is preferably that healthcare professionals, instead of bystanders, take the responsibility to resuscitate or not, based on the DNR statement. Additionally, the design should fit the (work) flow of all users and require minimal effort.

The Heartbead system

The Heartbead system is able to assure DNR statements of frail elderly. Figure 1 shows the system, which contains the Heartbead, the physician's monitor and reader, the ambulance personnel's monitor, and the checkpoint and reader.

Heartbead

The Heartbead, which has the shape of a bead, can be attached to the emergency response necklace, bracelet or watch of frail elderly, giving them the possibility to wear it close to their body without bothering their daily life. Inside the Heartbead, a RFID tag is integrated, enabling the digital recording of all legally required DNR information and personal information. To make the Heartbead as less stigmatizing as possible and to maintain privacy, the information is not shown at the outside of the Heartbead.

Physician's monitor & reader and checkpoint & reader

To fit the Heartbead system to the physicians' workflow and to encourage confidence in the Heartbead system, the reading and updating procedure of the Heartbead

is done with the use of the software the physician is already using. The physician receives feedback from the Heartbead system after each step to validate what information is recorded and that the updating procedure is successfully completed. The addition of a checkpoint at the physician's office gives frail elderly the possibility to check the information that is recorded at the Heartbead.

Ambulance personnel's monitor

Ambulance personnel use a device during the resuscitation process to monitor the patient's heart rhythm and, if necessary, to apply electrical shocks. This device, with an additional integrated RFID reader, enables ambulance personnel to read the DNR statement from the Heartbead. When the monitor is placed near the patient, and the Heartbead's RFID is within the reading range of the reader, a sound is given, and the message is shown at the display of the monitor that a Heartbead is found followed by personal and DNR information. To make sure the found Heartbead belongs to the patient, multiple checks are integrated, like a picture of the owner of the Heartbead and a unique personal code.

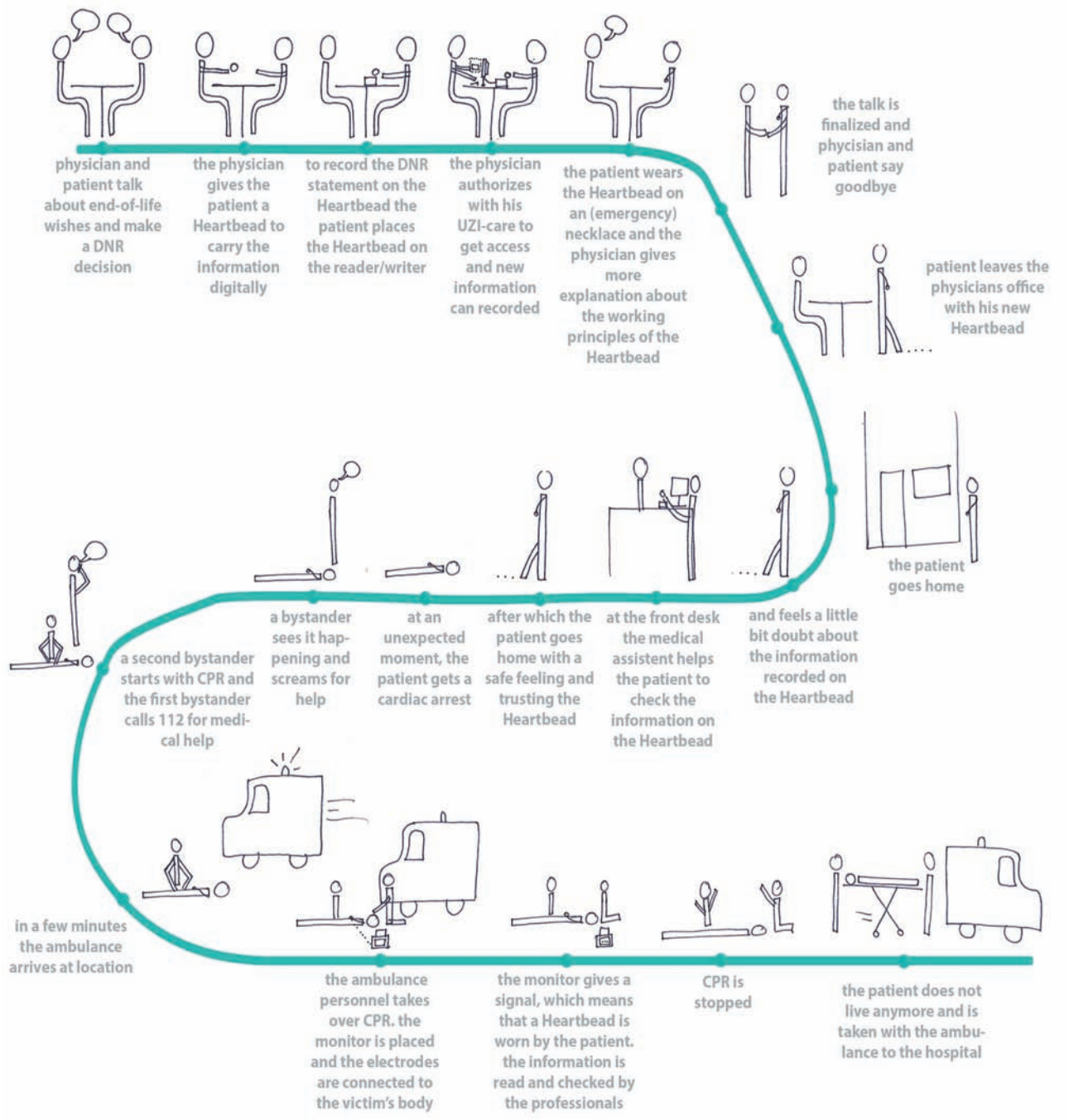

Figure 1. Overview of the Heartbead system and Heartbead.

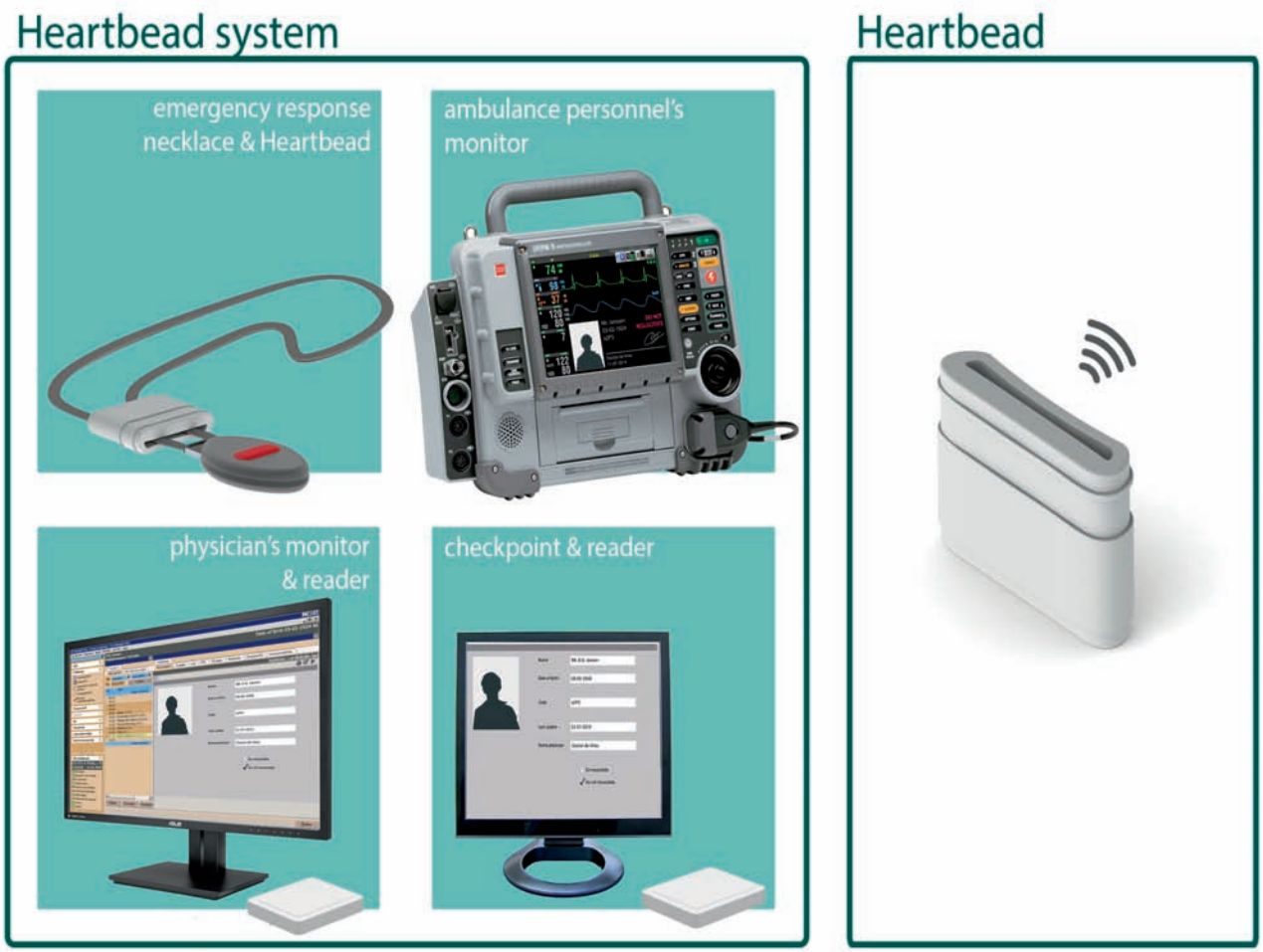

Figure 2. Storyboard showing the intended use of the Heartbead system

Use of the Heartbead system

The Heartbead system (see figure 2) can be used in two situations:

1. the updating and reading situation at the physician's office, and
2. reading the Heartbead in a resuscitation situation.

In situation 1, the physician is able to read and update the information of the Heartbead with the use of his computer and a RFID reader that is connected to it. The elderly are asked to put the Heartbead on the reader and information automatically appears at the physician's monitor. This screen is shared with the elderly to increase their confidence in the Heartbead. The elderly (and accompanying family member) have the possibility to see what is happening and what information is recorded. Elderly wear the Heartbead attached to their emergency necklace.

In situation 2, during a heart attack, the patient is unconscious. Ambulance personnel who arrive at the location are able to automatically read the RFID signal from the Heartbead on the heart monitor, which shows the recorded information.

Evaluation

Methods

The Heartbead system was evaluated to gain feedback from the stakeholders, to study if the concept would fit their (work) flow and to look for possible improvements. The different parts of the Heartbead system were tested with the three main user groups; frail elderly, ambulance personnel and physicians. Observations, simulations and interviews were conducted to get insight into the thoughts of the users. The evaluation focused on the interactions that occur during the use of the Heartbead system and focused on the questions: Is the user able to trust the product? Does the product fit the (work) flow of healthcare professionals and daily life of elderly?

Prototypes

To support the understanding and use of the Heartbead, a prototype was 3D printed and attached to an emergency button necklace. As this was a prototype, there was no RFID tag inside, and it was not possible to record information. Although the prototype had the right shape and the right dimensions, it was made of a non-bendable plastic instead of a combination of polypropylene (PP) and polyethylene (PE).

Figure 3. Left: example of a simulation screen of the physician's system, shown during the updating procedure. Right: example of a simulation screen of the ambulance personnel's system, shown during the resuscitation situation (*fictional data).

Besides the Heartbead prototype, a PowerPoint simulation slideshow (see figure 3, left) on a laptop was used to simulate the updating and reading procedure at the general practitioner's office. The PowerPoint simulation visualized the different steps the physician should follow and provided the possibility to see how the physician would interact with the Heartbead system. Furthermore, the simulation gave the elderly the possibility to experience the complexity and the understandability of the Heartbead system.
To evaluate the Heartbead system with ambulance personnel, another PowerPoint simulation was used during a simulated resuscitation situation (see figure 3, right). This simulation visualized the DNR messages including the sound provided by the monitor.

Results

Evaluation with frail elderly

Two frail elderly (living in a care home) were interviewed about the Heartbead system (see figure 4, left). These elderly were chosen based on their knowledge about DNR statements and their wish not to be resuscitated. Both elderly had a positive attitude towards the Heartbead system, but talked mostly about the Heartbead and less about the complete Heartbead system. They had difficulties to see what was shown to them on the laptop, it required effort to see what was happening. The elderly felt no distrust towards the physician; so checking what the physician was doing was not needed to trust the Heartbead. Wearing the Heartbead in combination with the emergency response necklace was a solution the elderly liked, because they were not required to think about taking the Heartbead with them. However, it also created a bit of confusion since the emergency necklace is normally only worn inside the home and the Heartbead has to be worn outside as well. They were a bit confused about what to do when going outside.

Evaluation with physicians

Four physicians were interviewed (see figure 4, middle) about the Heartbead system: one general practitioner specialized in elderly care, one specialist geriatric medicine working in a nurse home, and two clinical geriatrists. All four physicians found that the procedure fitted their workflow, and that it did not require a lot of effort to understand the Heartbead system and to

Figure 4. Left: evaluation with a frail older person. Middle: evaluation with a physician. Right: resuscitation simulation with ambulance personnel.

conduct the updating procedure. Sharing the information on the screen with the patient is something that will increase confidence, according to the physicians. Some additions were mentioned, like the possibility to physically print the information that is recorded on the Heartbead, and recording the patient's general practitioner's name.

Evaluation with ambulance personnel

The Heartbead system was evaluated with two ambulance nurses and with the head of the ambulance department. A resuscitation situation was simulated with ambulance nurses and an ambulance chauffeur (see figure 4, right). In the simulation, the ambulance nurses were asked to perform resuscitation, as they would do in a real situation. The laptop was placed next to the monitor. It gave a sound to attract the attention of the nurses during the procedure. The ambulance personnel mentioned that their confidence in the Heartbead system is mainly determined by the assessment of the Heartbead system by the sector and employer. The system attracted their attention at the right time in the process, so it fitted their workflow.

Conclusion

All user groups experienced the Heartbead system as useful and were enthusiastic. The physicians liked the fact that the Heartbead updating software was integrated in their Electronic Patient Record, and the ambulance personnel liked the monitor-integrated reader. Both design decisions fitted the healthcare professional's workflow and contributed to their confidence in the Heartbead system. The elderly did not clearly understand how the system worked, but their evaluation of the Heartbead itself was positive. Further research is recommended about the technology and about the willingness of all stakeholders to change the existing way of recording DNR's. The authors are continuing this project.

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