

# Health information systems in the elderly home care

## – a summative evaluation of TES-mobile

### Abstract

Home care is playing a significant role in elderly healthcare, since the number of hospitals and nursing homes will not be sufficient in near future. Mobile information technology is an important part of home care, and evaluation of such systems is crucial. However, evaluation studies run the risk of being incomplete and only address one group of stakeholders.

The aim of this study is to address this gap and perform a summative evaluation of mobile system developed for the home care sector, the TES-Mobile, based on a framework for evaluation by Chatterjee et al. (2009). To achieve this, a triangulation of both qualitative and quantitative methods was used: a survey distributed to the care providers, interviews with unit managers and observation of the care providers when using the system.

The study reached out to 456 care providers which of 251 responded, given a response rate of 54%. 80% of the care providers were assistant nurses, 9% were nurses, 4% occupational therapists and 6% operational managers. Additional interviews were held with 3 care unit managers, out of 18 in total sample.

The results show that there is a difference in user satisfaction from the different stakeholders and that nurses and occupational therapists are less satisfied with the system than the assistant nurses. It is clear that the system was developed with assistant nurses and care assistants in mind, but to achieve overall user satisfaction, the system must be further developed, with all stakeholders in mind.

**Key words:** Elderly home care, system evaluation, mobile health, health information system, TES-mobile, TES Care App, user satisfaction.

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# 1 Introduction

## 1.1 Background

The existing number of hospitals and nursing homes will not be sufficient to meet the intended needs for the elderly as population projections estimate a worldwide significant increase in numbers of elderly in the near future (Nieboer et al., 2014; Lindberg et al., 2013). Home care is therefore playing a significant role in the reorganization of health systems as it offers help for the elderly to maintain an optimal level of independence in their own home, given them an alternative to classical hospitalization and nursing homes (Palm, 2014; Bossen et al, 2013). Today's technology has a huge influence on how the home care is provided and the use of ICT applications in home care is an expanding research area, with a variety of ICT applications used to increase access to home care and as a tool for communication between care providers and patients or family members (Lindberg et al., 2013). Mobile application to support integrated healthcare services in elderly home care is becoming a self-evident part as they provides benefits as portability (anywhere), immediacy (any time) and convenience (easy access) attributes, all which suits the dynamics and mobility of home care providers (Mosa et al., 2012; Nielsen & Meniste 2013; Norris et al., 2009; Vimarlund et al., 2008). However, technology by itself is not a sufficient condition for changes to take place and are realized only when it meets the needs of all user groups of elderly homecare and adapted to the characteristics of the homecare setting (Bossen et al., 2013; De Rouck et al., 2008). Healthcare is a complex institutional field which requires a careful reflection during the development and the adoption of HIS because of the involvement of different stakeholders which all have developed their own particular habits, interests, power, roles, needs and expectations (Nielsen & Meniste 2013; De Rouck et al., 2008; Nieboer et al., 2014). Otherwise, there are high risks it ends up with system failure, why the adoption of mobile IT in health care remains somewhat limited and have a high fail rate (Nieboer et al., 2014; Norris et al., 2009). The healthcare industry is rather recognized as having lagged behind other industries in the use and adoption of new information systems (Akter et al., 2013; Nielsen & Meniste 2013).

As HIS are intended to improve the functioning of health professionals and organizations in managing health and delivering healthcare, it is morally imperative to ensure that the intended beneficial effect on patients and professionals, together with that optimum results are achieved and that any unanticipated outcomes are identified (Keizer et al, 2011; Brown et al, 2013). Evaluation is therefore an essential part of design and adoption of HIS. A lack of attention to evaluation may result in dissatisfied users, decreased effectiveness, and increases in error costs (Brown et al., 2013). Further should the focus of the evaluation be if the HIS is usable and useful for the intended audience (Ben-Zeev et al., 2015), but there is a lack of properly done evaluations why previous literature calls for more extensive studies (Lindberg et al., 2013; Brown et al., 2013; Keizer et al. (2011); Vimarlund et al. 2008). Evaluation studies also run the risk of being of limited value for certain stakeholders, or of presenting a distorted picture of reality if the focus only lies on one specific stakeholder, which in this case may be on one of the care provider groups. Home care work is, as mentioned, highly cooperative in nature it is therefore of importance that the new technology augments the network of care around elderly by allowing all actors to follow, influence and be a part of the cooperative care of the elderly (Bossen et al., 2013). It is therefore important to include all types of end user groups in the evaluation of a system (Brown et al., 2013; Nielsen & Meniste 2013; Nieboer et al., 2014). Rigorous evaluations of HIS in the sector of home care are therefore recommended and of great importance (Lindberg et al., 2013; Brown et al., 2013; Keizer et al. (2011); Vimarlund et al. (2008).

The purpose of this study is to address this gap in previous research by doing a summative evaluation of a mobile system in the public sector of elderly home care, using the evaluation framework of Chatterjee et al. (2009). A case study was conducted evaluating a mobile HIS system in the field of elderly home care and the contribution of this study can be divided into two parts: (1) one scientific contribution, which focus to **examine the importance to include various stakeholders and end users**

**in the evaluation**, and (2) one targeted contribution to the participated municipality, as the results of the evaluation can be of importance to support the system's continuous improvement.

## 1.2 The TES-mobile case

This paper describes experiences from a Swedish local government project (TES-mobile) in the elderly home care of Örebro municipality. The main purpose of the two year project was to switch from an error prone analog solution with poor usability to a digital mobile solution that facilitates the daily work of the care providers. The TES-mobile system consists of two parts: (1) Radio Frequency Identification (RFID) tag mounted by the door in the elderly's home, and (2) TES Care App within a smart phone. It is also connected to a desk-top application and a web based interface. Since the beginning of 2015, the system has been introduced in all home care units within the municipality. The TES-mobile is mainly used by four types of care providers: assistant nurses, nurses, occupational therapists, and operational managers. Approximately 1300 care providers now use TES Care App in Örebro, providing care for about 4300 elderly citizens.

## 2 Theoretical framework

Information systems are defined as overall information processing in an organization, including both the information technology and the involved human users. The success of an implemented ICT is heavily dependent on how it matches with the users' workflow, the quality of information it is offered, how it is introduced in the organization including further training and support, and on the motivation of the end users and their use of the system (Nielsen & Meniste 2013; Nieboer et al., 2014). It is therefore of importance that evaluation criteria and relevant variables are strictly defined before the start of quantitative studies. However, currently there are few evaluation frameworks for HIS making rigorous evaluation a challenge (Brown et al., 2013). Keizer et al. (2011) provides with a good practice guideline to plan and perform a scientifically robust evaluation studies in health informatics, but does not focus on mobile HIS. Both Chatterjee et al. (2009) and Yen (2010) focus specifically on evaluation for mobile health technology and were assessed and compared after our requirements to our specific case. The outcome resulted in the use of the framework by Chatterjee et al. (2013), but the framework provided by Yen (2010), Health-ITUEM, have been further assessed by Brown et al. (2013) resulting in good qualification. Chatterjee et al. (2009) clarifies the success factors associated with mobile healthcare work through previous research. Factors affecting the use and satisfaction of the collaborators with the mobile technology are system quality, information/content quality, and service quality. Further, they suggest that use and user satisfaction affects the net benefits. The variables from Chatterjee et al. (2009) are described more in detailed in table 1.

**Table 1** – Definition of key variables from the theoretical model by Chatterjee et al. (2009)

<b>System Quality</b>	
Extent of data processing	The extent to which the information system is able to effectively integrate data from different places and has the necessary tools to support decision making, i.e. the amount of data processing capability.
Extent of information access	The extent to which the information system is able to provide users with access to data stored in centralized databases, i.e. the amount of information that can be accessed by the mobile device.
Communicability	The number of communication channels provided by the mobile device and its subsequent use.
Portability	The extent to which the mobile device supports the flexibility of care provider’s work by easily be carried from one location to another.
<b>Information/Content quality</b>	
Structure of the task	The extent to which the task being performed by the care providers is routine, predictable with well-defined solutions or unbounded and unpredictable with no clearly defined procedures.
Urgency of information	The extent of time pressure under which the care providers perform a task and to which the task requires immediate response from involved stakeholders.
Mobility of the care providers	There are three different type of mobility:  Spatial mobility - The extent of “geographical movement” of the care providers from one location to another, involving wandering, traveling, and visiting.  Temporal mobility – The order, sequence, duration, and recurrence of the activities being performed by the care providers.  Contextual mobility – The extent to which the care providers need to “continuously reframe their interactions” while performing their daily activities.
Information complexity	The extent to which the information being dealt with by the care providers (and being handled by the mobile device) consists of audio, video, and image components, in addition to textual data.
<b>Service quality</b>	
System reliability	The extent to which the system can be depended upon to complete a task without problems and breakdowns.
System support	The extent to which there is commercial software and hardware support available for the mobile device.
<b>Outcome variables</b>	
Use	The extent to which the mobile device is actually used by the healthcare workers in their day-to-day task performance.
User satisfaction	The extent to which the care providers are satisfied with the use of the mobile device (i.e. with their experience of mobile technology-mediated work).
Net benefits	The extent to which there is a reduction in the delay of healthcare service provided to patients, increase in the accuracy and efficiency of healthcare service, reduction in errors in medical records, improved security of medical records, increase in the ability to continuously monitor critical patients, etc.

## 3 Methods

A combination of quantitative and qualitative methods was used in order to gather evaluative data of the TES mobile system. This was done as evaluators should not be too deeply embedded in either the qualitative or quantitative paradigm as it may neglect the possible contributions of the complementary approach (Lindberg et al., 2013). The three sources of data were the following:

- A questionnaire to the care providers who use TES mobile system in their everyday work including assistant nurses, nurses, occupational therapists and operational managers.
- Interviews with unit managers.
- Observations of assistant nurses as they use TES mobile in their daily work.

Method triangulation gives the researcher the possibility to look at a phenomenon from different perspectives, and generates more data which is likely to improve the quality of the research. It also gives the researchers possibilities to compare results from the different methods and to show consistency in the results, since data from one source can corroborate another and show that the result is not dependent on the method of choice. To combine quantitative and qualitative methods is a common triangulation that is often used within information systems research (Oates, 2006).

### 3.1 Site selection

There are 37 home care units in the municipality of Örebro with a total of approximately 1300 care providers and 25 unit managers. The participating care units were selected through a systematic sampling by selecting every second care unit in a list, sorted by alphabetic order, starting with the first unit on the list. One of the home care units participated in an earlier pilot study of the system and was therefore intentionally selected to contribute to the sample, giving a total of 21 units. Three of the selected units could not participate due to high work load. In total, this study reached out to a sample size of 456 care providers and 16 unit managers in 18 home care units.

### 3.2 Questionnaire

We distributed the questionnaire to 456 care providers and 261 responded, which gave an external loss of 204 and a response rate of 56%. Out of the remaining sample there was an additional internal loss of 10 responses due to incomplete answers. The remaining 251 responses gave a total response rate of 54%. The design of the questionnaire was based on the framework of Chatterjee et al. (2009) to measure each key variable, using advice and guidance from Oates (2006) and Ejlertsson (2005). Due to the high number of potential respondents the questionnaire was designed, custom made together with reuse from previous research, with a handful of closed questions but the majority of statements were designed so that the respondent could choose alternatives on a 5-point Likert scale ranging from "Does not agree at all" to "Strongly agree". Before participation, the care providers were informed that the participation was voluntary, anonymous and that the answers only were going to be used for this research. This to ensure ethical fundamentals was met. For the complete questionnaire, see appendix C.

For the quantitative data, several statements were predetermined based on each variable in the framework by Chatterjee et al. (2009). Stata was used as an analysis tool when looking at the values for each variable. As the questionnaire was designed obtaining ordinal data, medians and frequency distribution was a suitable mean to present data. For the three main variables system quality, service quality and content quality, we summarized each individual's statements of the sub variables measuring the variables. Later the mean values were presented for each stakeholder group. By using

this method a so called index value is created which can be done when using Likert scale and has several questions/statements measuring the same thing (Ejlertsson, 2005). In this case statements measuring system quality, service quality and content quality.

### 3.3 Interviews

Three semi-structured interviews were carried out with three unit managers to gather qualitative data about the TES-mobile system. Their participation was voluntarily and was the result of an interview request sent out to the 18 care unit managers within the sample size. They were informed that their participation was anonymous to others, apart from us, but that the interview were going to be recorded in order for later transcribing. The interviews took place during a physical meeting at the offices of the participated care unit managers in order to make sure the interviewee felt confident. The questions per se were in advanced prepared and designed based on the variables from the framework used in this study, developed by Chatterjee et al. (2009). See appendix D.

With the framework as an outline for the content, the result from the interviews where three transcripts. A theme analysis of the transcripts was done according to Oates (2006), where the content was divided into three themes:

- Irrelevant data for this particular study
- Segments that are more of a descriptive type
- Data that is relevant for the aim of this study

The descriptive data helps to explain the use and context of the application, i.e. that the care providers have a minute-by-minute planning of the day in TES Care App. The data that was relevant for this study were opinions about the system, and the unit managers' experience of TES mobile, i.e. that unnecessary economic costs have been used for repairing as the mobile phones are fragile. The descriptive data was used to describe the background of the different variables, and the data relevant for the aim of the study was used in combination with the result of the observation and questionnaire to give a general picture of the results according to the framework.

### 3.4 Observation

Two participant observations were done as a means of understanding the integration and adoption of TES-mobile system in practice, i.e. care providers' daily work. This was done by following two different assistant nurses separately during a regular morning work session, for approximately four hours each. We contacted one of the care unit managers asking for permission for an observation and to neither be in control or involved in the choosing of study objects, we asked the head of the unit to select two care providers. Before doing the observation, we signed a confidentiality agreement, to assure that we followed the rules of professional secrecy. For each appointment, we or the care provider that was observed, asked the elderly customer for permission to take part in the visit.

We assured the observed personnel that we not in any way where judging their work, and that we only where there to observe the use of TES Care App, and also explained the purpose of the observation to the elderly customers. Our role in the observation was to be overt participant-observers, following the care providers in their work without participating in their work (Oates, 2006). We asked the care providers lots of question regarding TES Mobile and wrote field notes during the observation. When suitable, we also asked the elderly customers if they had any comments about the new system. The data gathered in this phase resulted in field notes, where we

wrote down the number of times the application was used, how it was used and the number of customer visits. We also took notes on their comments of the user experience of the mobile, and the answers to asked questions. Examples of questions asked are: “Are you satisfied with the TES mobile?” and “Is there something in the application that you feel is missing?”.

The field notes were then transcribed and analyzed by doing a simple thematic analysis (Oates, 2006), meaning that we simply highlighted the content relevant for the investigation, and sorted it within the framework. For example, the notes about when the personnel used the application (mainly in the beginning and end of each visit) was sorted under the “use” variable in the framework, and notes about number of visits and travelling time between them was sorted under the “mobility” variable.

## 4 Results

Out of the 251 respondents, 86 % (n=217) were full time workers and the remaining 14% (n=34) were substitutes. The division of gender were 87 % (n=218) women and 11 % (n=27) men, with additional 2 % (n=6) not filling in gender. 80 % (n=200) were assistant nurses, 9 % (n=24) nurses, 4 % (n=10) occupational therapists, and 6 % (n=15) were operational managers in charge of the planning in TES mobile. Two respondents (1%) chose to be in the group “other care workers”, but are too few for further investigation, but are still of importance in the combined values.

### 4.1 System quality

Out of 243 responses from the questionnaires’ statements, measuring system quality, the combined mean index value was 39.67 out of potentially 55. However, there were some differences between the care provider groups which are of interest. Assistant nurses had a mean index value of 41.65 (n=192), nurses of 27.12 (n=24), occupational therapists of 29.50 (n=10), and operational managers of 40.53 (n=15), see appendix B.

#### 4.1.1 Extent of data processing

Home care providers often work in an environment of high activity, uncertainty and interruptions. In that kind of environment, a system with high quality of data processing will increase the use and user satisfaction with a mobile device. Data processing consists of two parts: to effectively integrate data from different places and to have the necessary tools to support decision making (Chatterjee et al. 2009). TES-mobile uses a smart phone to scan a RFID-tag when entering and leaving an elderly customer’s home. This information is sent to the server via the mobile network and in scenarios without internet connection, the information is saved in the smart phone until it can synchronize to the server, minimizing the risk for data loss. TES Care App builds upon TES planning system for desktop which receives data about the customers from a system of medical records called Treserva. The data that should be transferred is the planned activities for each customer’s visit, but today the care providers have to work parallel in the systems. As one of the interviewed puts it; “the idea is that the integration should work, but today it does not”.

The registration is basis for the elderly customers’ invoice and the care providers’ daily planning. Care unit managers do not use the application directly, but can see the registration of visits made by each employee. All of our interviewees felt that the TES Care App indirectly helps them in their decision making and planning as they can see how many care providers are needed to complete all visits of the particular day and by comparing the actual time spent on visits to what was initially planned. The



managers can then trace where there are leaks in the resources. There is also a possibility to closely monitor care providers' movements during the day and to see exactly where they have been, minute by minute, after registered visits. Note that the care unit managers were clear that they did not use the system for work history verification since they trusted their workers. However, the care providers were somewhat neutral to the statements of which the system helps them in their daily work situation, see table 2. Both nurses and occupational therapists had a low median value, indicating that TES-mobile system do not support their daily work. The assistant nurses felt more supported by the system during work and the operational managers were quite neutral to the statements. The frequency table in appendix A shows that the majority of users scored a 4 on the Likert scale on all three questions even if there were mixed responses ranging from 1 to 5.

**Table 2** - Extent of data processing, median values.

Statement	Overall	Assistant nurses	Nurses	Occupational therapists	Operational managers
The system helps me make decisions in my day-to-day work	3 (n=243)	3 (n=192)	1 (n=24)	1 (n=10)	3 (n=15)
The system facilitates my work tasks	4 (n=250)	4 (n=199)	2.5 (n=24)	3 (n=10)	3 (n=15)
The system helps me prevent mistakes in my work	4 (n=243)	4 (n=192)	1 (n=24)	2 (n=10)	3 (n=15)

\* Statements with answer range of 1-5. 1="Strongly disagree", 5="Strongly agree".

There were some reported problems when updating TES mobile. For example, if one care provider gets sick and has to leave at lunch, the visits for the afternoon has to be rescheduled for other care providers. Updates should go through automatically, but care providers must most of the time update the system manually in order to see the changes. Even if the changes are updated automatically, there is no notification of a changing schedule and the care providers must therefore constantly check the schedule. "It would be really helpful if I just could push a button which automatically sends out messages to all care providers to update their phone", said one of the interviewees. TES Care App is also connected to a web interface, where one can mark an elderly customer as inactive, among other features. A common reason for putting a customer as inactive is a longer visit to the hospital, so that visits for a certain period do not get planned. The integration between the web interface and the smartphone application does not work properly, which can lead to unnecessary visits and concerned care givers when the customer is not at home, or visits that are missed when the customer is home.

#### 4.1.2 Extent of information access

Incorrect information, or time loss due to inadequate information, is one of the biggest problems that could be solved with adequate ICT tools (Brown et al., 2013). The level of relevant information in the system is therefore an important factor for the use and user satisfaction of a mobile system (Chatterjee et al., 2009). The quality of information is also in direct relation to the quality of service (Akter et al., 2013). Within the TES Care App, one can access all necessary information in order to perform the planned visits, from phone numbers to relatives to detailed instructions of personal care.

The amount of information that can be interacted with from the mobile application is very limited. Care providers can register new, unexpected visits but there is not possible to change any information from the application. To change information, one has to use TES desktop. All of the

interviewees also had requests for more functions in the system and one of the interviewed managers actually thought that the care providers had access to too little information. Examples of missing features were access to FASS<sup>1</sup> integration with Mawell<sup>2</sup>, notebook function to write down important work notes, a feature naming previously care providers visiting an elderly patient, better design of the schedule as the care providers only see the names of the elderly to visit at the overview, not the time, unless they click on the name of the elderly patient. Access to a combined daily work schedule of all care providers working that particular day, not just one's own schedule, was also a request that all of our interviewees brought up. Visits of one care provider can only be seen at a daily basis and twelve hours forward and there were additional requests to see visits from a more extended time frame. The TES-mobile system have no access to the customers' medical information or documentation of health which is an important feature for increased use and user satisfaction according to Chatterjee et al. (2009). By looking at table 3, one can see that nurses and occupational therapists has the lowest median value regarding the information accessed and used by the system, while the assistant nurses and operational managers have higher median values. By looking at the frequency table in appendix A, the majority of users scored a 4 or 5 on the Likert scale on all four questions.

**Table 3** - Extent of information access, median values.

Statement	Overall	Assistant nurses	Nurses	Occupational therapists	Operational managers
The system contains all information I need for my daily work	4 (n=243)	4 (n=192)	2 (n=24)	2 (n=10)	4 (n=15)
It is easy to get the information I need from the system	4 (n=243)	4 (n=192)	3 (n=24)	2.5 (n=10)	4 (n=15)
I always have updated information about care recipients and my workday in the smartphone	4 (n=243)	4 (n=192)	1 (n=24)	1.5 (n=10)	5 (n=15)
I trust that the information in the system is correct and that nothing disappears from it	4 (n=251)	4 (n=200)	3 (n=24)	3.5 (n=10)	4 (n=15)

\* Statements with answer range of 1-5. 1="Strongly disagree", 5="Strongly agree".

The TES-mobiles are further locked to prevent use of other applications such as the Internet due to safety reasons. During the observations one of the care providers mentioned a request to have access to Internet, just for the possibility to check work related information if a given situation demanded this. Otherwise the care providers were not disturbed of having the mobile locked. The information is protected by two steps. First there is a pin code on the mobile phone and then a TES login, but the TES-login is not locked to one specific phone meaning a care provider can access the information through any TES-mobile. The care providers understood the necessity for the procedure, but mentioned it was a little bit frustrating to log in twice and as the system logs out the user automatically after a short time of inactivity, they frequently must do so. One positive outcome from TES-mobile is that it makes the information more secure, since all the information was previously

<sup>1</sup> Farmaceutiska Specialiteter i Sverige, in eng. "The Medicines Compendium for healthcare professionals", a compilation of all medicines prescribed by different healthcare instances.

<sup>2</sup> Human resources system where substitutes can be booked.

printed on paper. An additional safety procedure is that it is possible to completely make the phone useless from a distance, if it should be stolen or lost.

#### 4.1.3 Communicability

The lack of adequate communication tools impedes the care providers in their work (Brown et al., 2013). According to Chatterjee et al. (2009) are the preferred integration between healthcare workers through voice, either face-to-face or by telephone calls, or through text services such as email or short message services (sms). It would therefore be obvious that the system supports these needs, but the stakeholders did not have a complete picture of which communication channels were provided with the TES-mobile system. The system supports communication through calls and sms, even if one of the interviewees said that the communication using sms only worked in one direction, given only the care unit manager the possibility to send sms. The contacted care providers were then forced to call back in order for a complete communication between the stakeholders. Access to working emails were not supported by the system, something that was desirable based on our observation. The majority of users rated the statement that the care providers could use the system to all communication needed for their work were four or five on the Likert scale (n=251), meaning that most of the respondent were happy with the communication channels that are provided with the system.

#### 4.1.4 Portability

The portability is a necessity when using mobile systems within the health care, since mobile care providers need mobile tools. It is important that the device is of right size and reliable for user satisfaction (Chatterjee et al., 2009). However, problems were pointed out with the battery time as it discharges very fast, also having a long charge time; "It takes about a whole day to charge the phone if it is completely discharged". Care providers are therefore often forced to charge the battery during lunchtime or other breaks in order for continuous use. There is no possibility for the care providers to choose whether to turn off the GPS-function, for saving battery time, making the overall portability somewhat limited. The phones are not portable pleasing either as they often slip out from the care providers' pocket or its shell, which is used for fall protection. According to one of the interviewees, unnecessary economic costs have been used for repairing as the mobile phones are fragile. When looking at the care providers median values of the statement, "The mobile phones' design and performance (e.g. size, screen size, battery life) do not prevent me from using the system when needed", the median values were 4 for assistant nurses and 3 for nurses, occupational therapists and operational managers with a combined median value of 4 (n=251) including all care providers.

### 4.2 Content quality – the nature of work

A total of 237 respondents answered to all statements measuring content quality with an index mean score of 13.92 out of 20. Once again the nurses and occupational therapists had a lower mean score, 10.43 (n=23) respectively 10.33 (n=9) and a higher index mean value by the assistant nurses (14.48, n=189) and occupational therapists (14.35, n=14).

#### 4.2.1 Task structure and urgency of information

According to Chatterjee et al. (2009) the used system must be incorporated into the care providers' day-to-day work practices, as the extent to which the mobile technology will be adopted by the care providers will depend on how well the technology can support their day-to-day work routines. The working duties are generally planned after a repeating pattern to ensure comfort and stability for the

elderly, but there are many factors affecting the daily routine. An unplanned accident in one of the customer's home may prevent delay to the next customer in line for care and in worst case scenario start a chain reaction of delays to the remaining customers that particular day. It can also be the other way around that a care provider is called for personal emergency of duty which prevents the care provider to continue to work that particular day. Then someone else need to replace this persons work hours. The healthcare sector is therefore known to be an environment with high stress factor, and where tasks need to be performed with urgency (Chatterjee et al., 2009).

There is also a possibility that the urgency increases if the burden of care is increased, but not enough to take in one more staff member during the day. Then there is a risk that the schedule gets more compressed than it should and that the planned travelling time between visits is unrealistically short. All of our respondents have noted that there is also a big difference in how the care personnel experience the stress – some are more stressed than others.

Two of the interviewees said that TES-mobile, when working properly used by care providers knowing how to handle it, can reduce the stress level. A positive aspect that has been pointed out is that when working in the field, the care providers has the phone numbers to all elderly customers in the application and can now easily give them a call if they see that they are running late. The GPS-function in the application can also help in reducing the stress for new employees, since they easily can see where they are going. It seems to be a difference in how care providers experience the application which affects the stress level. One of the interviewee said that TES-mobile reduces stress when seen as a tool that can aid them in their work, but another stated that the system not has helped to reduce the stress at all, since the staff feels more monitored, even though this is not the purpose of TES.

Not all care providers think that the TES-mobile system is well suited to their working situation, see table 4 at median values of nurses (1) and occupational therapists (2) even if the assistant nurses and operational managers thinks the opposite with a mean of 4. However, the system does not seem to be too well suited for easy rescheduling in unforeseen situations as the statement have a median value of 3 between all care groups (n=237). The care providers also need access to information fast (4), but as pointed earlier were there some disappointments with the automatically logout function in the system as it slows down care providers to get access to information fast during urgencies.

**Table 4** - Task structure and urgency of information, median values.

Statement	Overall	Assistant nurses	Nurses	Occupational therapists	Operational managers
The system is well adapted to my work situation	4 (n=237)	4 (n=189)	1 (n=23)	2 (n=9)	4 (n=14)
If something out of the ordinary happens, it is easy to use the system to reschedule	3 (n=237)	3 (n=189)	3 (n=23)	3 (n=9)	3 (n=14)
I often work under great time pressure	4 (n=237)	4 (n=189)	4 (n=23)	3 (n=9)	4 (n=14)
During a workday, I often need quick access to information from the system	4 (n=237)	4 (n=189)	3 (n=23)	4 (n=9)	4 (n=14)

\* Statements with answer range of 1-5. 1="Strongly disagree", 5="Strongly agree".

#### 4.2.2 Mobility of healthcare workers

The spatial mobility, i.e. the geographical movement, is high within the home care sector since the care providers visit elderly customers in their own homes. According to one of the interviewees, visits and traveling between geographical areas have increased due to downsizing. The temporal mobility refers to the time aspect of mobility and this can vary from day to day. The care providers have a minute-by-minute planning of the day in TES Care App and if everything goes according to plan, the temporal mobility is low. However, as stated previously, sometimes things happen that causes the care assistants visit to be longer than planned, and this has a domino effect on the rest of the shift. The contextual mobility, meaning the different contexts the care providers work in, is also high. As one unit manager expressed it: “the care assistant is a master at being a chameleon – one moment you comfort someone who is sad because their loved ones has passed away and the next you visit someone who is happy for their great grandchild”.

During the four hour observations, the care providers had respectively seven and eight visits. The visits ranged from 10-50 minutes and the travelling time between these where about 2-10 minutes with bike. To aid the care providers in their movement, TES Care App has GPS and the addresses to all of the elderly customers, but two of the interviewees said it is rarely used since the care providers know the working area so well, even though it can be very useful for substitutes.

#### 4.2.3 Information complexity

The information from TES Care App is textual, besides from the GPS-function, and thus has a very low complexity, compared to systems with e.g. image and video use. According to the interviewees, the care providers can see information about the elderly customers, what is to be done during the planned visit, telephone numbers to the customer and its relatives and entry codes.

### 4.3 Service quality

The opinions about the service quality were more in agreement as the assistant nurses (n=200), occupational therapists (n=10) and operational managers (n=15) had an index mean value of 24.83, 22.6 and 25. The nurses (n=23) had once again a lower index mean score of 19.34. Combined (n=250), the care providers had an index mean score of 24.27 out of 35 possible.

#### 4.3.1 System reliability

One of the most important aspects of the use and user satisfaction is the reliability of the system, i.e. that the system is available anytime, anywhere (Akter et al., 2013). The users have to have confidence in that the system completes its tasks without problems or system breakdowns (Chatterjee et al., 2009). According to the interviews and observations, the application crashes quite often, the system log out users, the telephone/application freezes, the system does not always register visits, and sometimes the application is completely gone from the phone. All of these problems make it more difficult to work, since every visit must be registered manually. One of the interviewees told us that once the TES Care App stopped working, and even though all data should be stored locally on the phone until the server was available again, only a few of the registered visits where synced.

As a backup plan, most care providers had their own schedule in printed form and in some case the whole groups plan for the day, but more and more workers only use the phone to view the planning. This can create a problem under a breakdown of the system if the care providers only rely on the digital information, something concerning both the observed care providers and interviewed unit

managers. The interviewees also said that many of the phones had stopped working resulting in interfering with the working process as many of the care providers now stand without TES-mobile phones, forcing them to register their work manually. The total median value of the statement, "I rarely experience technical problems with the TES-mobile" were neutral (3, n=251). The separate values were 3 (nurse assistants), 2 (nurses), 2.5 (occupational therapists), and 2 (operational managers) indicating that they might face some technical problems during their work.

#### 4.3.2 System support

If the system should fail in some way, the availability of consistent support is an important part of the service quality, and the lack of support has negative consequences on use and user satisfaction (Chatterjee et al., 2009). The care units has a telephone number that goes directly to the TES-mobile support, but as one interviewee said, it is more common that the care providers turns to the unit manager for help instead. One of the interviewed managers had contacted the support a couple of times when the system brought up wrong elderly person's information when information of a current customer was needed. This specific problem has now been solved as it has not happened again. However, not all issues go through the TES-mobile support which may have given a false picture of the system reliability. "The TES-mobile support says that they have gotten very few fault reports", said one of the unit managers. One unit used an employee to fix these problems, and another one said that they cannot call every time something happens if they know how to fix the problem themselves, but just because they can fix the problems on their own does not mean that the system is completely reliable. In the beginning, the care providers had experienced that they were "shoved around" and redirected to different instances when called the support, but they also said it had improved today. The care providers seemed to know where to turn if issues occurred as the median were 4 (n= 251) on that particular statement.

### 4.4 Outcome variables

#### 4.4.1 Use

The use of the system is high as the average nurse assistant has about 10-15 visits a day according to the interviews. The TES-mobile is used in the beginning and the end of each visit to register when the visit started and when it ended, by holding the phone close to the RFID-tag mounted by the front door in the customer's home. During the observation one of the observed care providers forgot to register a start of a visit and could therefore not log out from the visit. The care provider told us it happens every now and then and that one can manually register the visit at a later point from a computer. There is also a possibility to start and end the visit by pressing a button in the application instead of using the RFID-tag, and this was done four times during the observation. Once, one of the subjects started the visit right outside the door when waiting for the customer to open, and three times it was used to end the visit after we left the customers apartment to throw away garbage.

#### 4.4.2 User satisfaction

The implementation of TES Care App seems to have been of various successes. One of the care unit managers did not work during the implementation phase, another felt that the adoption went well just with some minor problems, and the third manager said it was quit chaotic during the first weeks of the adoption phase and were blaming the technology because of system breakdowns, rather than the care providers. During the implementation, films and information about the system could be accessed through the internal network which was of help to some of the care providers and managers. According to one interviewee the care staff seems overall satisfied with TES-mobile, and

pointed out that another positive aspect is that everyone got their own smartphone: “The staff feels that we are investing in the technology, which makes them more satisfied with using it.”

By comparing with the old system, TES-mobile is more flexible when register visits, reduces the time to register, and have reduced the use of physical papers during the working hours making the information more secure as one now need a login to access information. Among the respondents (n=243), 56% (n=136) preferred the new system, and 14.5% (n=35) preferred the old system. 24.5% (n=59) responded that it did not matter which system they used or that they could not choose between them and 5% (n=13) had never used the old system.

The TES-mobile is also easy to use according to the data collection which may cause higher user satisfaction. The care providers are in general pleased with the system according to the questionnaire data, showing a total median value of 4 (n=243) of the statement “Overall, I am pleased with the system”. The majority (33%, n=82) of the users did actually rate a 5 on the statement, indicating they strongly agreed with the statement, see frequency table in appendix A. Once again, there were some differences between the different care provider groups but the lowest median value was only 3 (n=24) by the nurses and occupational therapists (n=10). The assistant nurses (n=192), and the operational managers (n=15) both had the median value of 4.

4.4.3 Net benefits

According to the interviews the visit time of each elderly patient have been reduced. Most likely this is because the TES-mobile entails more exact registrations than the previously process which was done manually. However, there are some dilemmas about this punctuality and veracity visit times. First of all, each care unit strives to the political goals of having 73% of the working time in the customers’ homes. This goal controls how resources are mediated and if a care unit does not reach the goal, the unit is in need of staff cutbacks, something the care unit managers were concerned about.

The problem does not seem to be overpopulated care units as the working situation often requires care providers to expand their geographical working area to support the workload of other care groups. And, as one of the interviewees pointed out, even the most perfect planning will fail when something unplanned happens, which it often does, since they are working with people in their homes and daily lives. With the new system in place, the political goals need to be updated. As one of the unit manager said, “The goal is now too high and we cannot reach it anymore”. The care unit managers were somewhat concerned about the future of the home care, but did not blame the current situation on the new system. The TES-mobile system also reduces time spending on administration for the assistant nurses, but could not be supported by the other care provider groups, see table 5. The total median values were also reflecting a neutral standpoint to the statements of the system increasing the quality of care, or increasing the efficiency of work.

**Table 5 – Net benefits, median values.**

<b>Statement</b>	<b>Overall</b>	<b>Assistant nurses</b>	<b>Nurses</b>	<b>Occupational therapists</b>	<b>Operational managers</b>
The system makes it possible for me to spend less time on administrative tasks at the	3 (n=237)	4 (n=189)	1 (n=23)	1 (n=9)	2.5 (n=14)

computer					
The system increases the quality of the care me and my colleagues can give the elderly	3 (n=237)	3 (n=189)	2 (n=23)	2 (n=9)	2.5 (n=14)
The system helps me get more effective in my work	3 (n=237)	4 (n=189)	2 (n=23)	2 (n=9)	4 (n=14)

\* Statements with answer range of 1-5. 1="Strongly disagree", 5="Strongly agree".

## 5 Conclusions

This study has found evidence supporting the importance of including all end users and various stakeholders in order for a proper evaluation of HIS, as the result may vary depending on the selection of evaluation object. The system per se is better than its replacement, but is missing many requested features before it may actually facilitate the work of the care providers. TES-mobile is mainly designed for the assistant nurses which are reflected through the collected data, but one cannot ignore the evidence of the system lacking the ability to please all different care providers. This evaluation has showed that the system needs to be further developed in order for a complete acceptance between all the different care provider groups.

### 5.1 Limitations

It is known that users and workflow need a lot of time to get used to new systems and it is important to point out that this evaluation was done after approximately 5 month of use. Evaluation results can change significant during a short period of use, why it is of importance to further evaluating this system in the future.



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# Appendix A

**Appendix Table 1 – Frequency**

Statements with answer range between 1 = “Strongly disagree” to 5 = “Strongly agree”.	1	2	3	4	5	Total
<b>System Quality</b>						
The system helps me make decisions in my day-to-day work	17.28% (n=42)	10.70% (n= 26)	28.81% (n=70)	30.86% (n=75)	12.35% (n=30)	(n=243)
The system facilitates my work tasks	14.00% (n=35)	10.80% (n=27)	22.80% (n=57)	28.40% (n=71)	24.00% (n=60)	(n=250)
The system helps me prevent mistakes in my work (e.g. forget to hand out medicine, miss a visit)	17.70% (n=43)	9.05% (n=22)	21.81% (n=53)	29.63% (n=72)	21.81% (n=53)	(n=243)
The system contains all information I need for my daily work	9.47% (n=23)	8.23% (n=20)	11.93% (n=29)	37.45% (n=91)	32.92% (n=80)	(n=243)
It is easy to access the information I need from the system	5.35% (n=13)	11.11% (n=27)	15.23% (n=37)	39.09% (n=95)	29.22% (n=71)	(n=243)
I always have up to date information about the care recipients and my workday in the smartphone	11.52% (n=28)	3.70% (n=9)	16.87% (n=41)	27.98% (n=68)	39.92% (n=97)	(n=243)
I trust that the information in the system is correct and that nothing disappears from it	11.55% (n=29)	11.55% (n=29)	19.52% (n=49)	35.86% (n=90)	21.51% (n=54)	(n=251)
I can use the smartphone for all communication I need in my work	7.97% (n=20)	6.37% (n=16)	8.37% (n=21)	33.47% (n=84)	43.82% (n=110)	(n=251)
The system does not limit the access to other useful functions in the smartphone	13.15% (n=33)	9.56% (n=24)	34.66% (n=87)	23.11% (n=58)	19.52% (n=181)	(n=250)
I rarely forget to bring the mobile when I shall perform my duties	8.40% (n=21)	2.00% (n=5)	5.60% (n=14)	11.60% (n=29)	72.40% (n=49)	(n=251)
The mobile’s design and performance (e.g. screen size, battery) does not stop me from using the system when I need it	9.56% (n=24)	13.55% (n=34)	21.12% (n=53)	30.68% (n=77)	25.10% (n=63)	(n=251)
<b>Content Quality</b>						
The system is well adapted to my work situation	12.24% (n=29)	7.17% (n=17)	16.88% (n=40)	40.51% (n=96)	23.21% (n=55)	(n=237)
If something out of the ordinary happens, it is easy to use the system to reschedule. (Unexpected things could be that a care recipients have to go to the hospital or that a colleague gets sick and has to cancel the work day.)	26.58% (n=63)	14.77% (n=35)	28.69% (n=68)	19.41% (n=46)	10.55% (n=25)	(n=237)
I often work under high time pressure	2.95% (n=7)	11.39% (n=27)	16.03% (n=38)	49.37% (n=117)	20.25% (n=48)	(n=237)
During a workday I often need quick access to information from the system	5.06% (n=12)	4.64% (n=11)	15.19% (n=36)	43.46% (n=103)	31.65% (n=75)	(n=237)
<b>Service Quality</b>						
I can get access to the system any time I need it	5.58% (n=14)	13.55% (n=34)	15.54% (n=39)	35.46% (n=89)	29.88% (n=75)	(n=251)

To log on to the system is a rapid process	16.73% (n=42)	21.91% (n=55)	15.54% (n=39)	35.06% (n=88)	10.76% (n=27)	(n=251)
To get information from the system is a rapid process	6.77% (n=17)	15.54% (n=39)	16.73% (n=42)	39.04% (n=98)	21.91% (n=55)	(n=251)
To change and save information in the system is a rapid process	13.20% (n=33)	12.80% (n=32)	36.00% (n=90)	29.20% (n=72)	8.80% (n=22)	(n=250)
I rarely experience technical difficulties with the TES-mobile	17.13% (n=43)	22.71% (n=57)	15.54% (n=39)	36.25% (n=91)	8.37% (n=21)	(n=251)
The system protects the personal information about the care recipients	3.59% (n=9)	5.18 (n=13)	21.91% (n=55)	27.89% (n=70)	41.43% (n=104)	(n=251)
If I experience problems with the system I know where I can turn to get help	5.58% (n=14)	7.97% (n=20)	15.14% (n=38)	26.69% (n=67)	44.62% (n=112)	(n=251)
<b>Outcome Variables</b>						
I am overall satisfied with the system	8.23% (n=20)	8.23% (n=20)	20.99% (n=51)	28.81% (n=70)	33.74% (n=82)	(n=243)
The system is easy to use	8.23% (n=20)	6.58% (n=16)	17.28% (n=42)	30.86% (n=75)	37.04% (n=90)	(n=243)
I can use the system without outside help	2.81% (n=7)	4.42% (n=11)	12.45% (n=31)	33.73% (n=84)	46.59% (n=116)	(n=249)
I am overall pleased with the smartphone's performance and design	7.17% (n=17)	15.19% (n=36)	15.61% (n=37)	30.80% (n=73)	31.22% (n=74)	(n=237)
The system makes it possible for me to spend less time on administrative tasks at the computer	22.36% (n=53)	14.77% (n=35)	14.35% (n=34)	31.65% (n=75)	16.88% (n=40)	(n=237)
The system increases the quality of the care me and my colleagues can give the elderly	19.83% (n=47)	15.19% (n=36)	25.74% (n=61)	26.58% (n=63)	12.66% (n=30)	(n=237)
The system helps me get more effective in my work	17.30% (n=41)	13.50% (n=32)	21.52% (n=51)	29.96% (n=71)	17.72% (n=42)	(n=237)

## Appendix B

**Appendix Table 2** – Median and overall evaluation rating

Statements with answer range between 1 = “Strongly disagree” to 5 = “Strongly agree”.	Overall	Assistant nurses	Nurses	Occupationa l therapists	Operationa l managers	Other care personnel (n=2)
<b>System Quality</b>						
The system helps me make decisions in my day-to-day work	3 (n=243)	3 (n=192)	1 (n=24)	1 (n=10)	3 (n=15)	4
The system facilitates my work tasks	4 (n=250)	4 (n=199)	2.5 (n=24)	3 (n=10)	3 (n=15)	4
The system helps me prevent mistakes in my work (e.g. forget to hand out medicine, miss a visit)	4 (n=243)	4 (n=192)	1 (n=24)	2 (n=10)	3 (n=15)	3.5
The system contains all information I need for my daily work	4 (n=243)	4 (n=192)	2 (n=24)	2 (n=10)	4 (n=15)	4.5
It is easy to access the information I need from the system	4 (n=243)	4 (n=192)	3 (n=24)	2.5 (n=10)	4 (n=15)	4.5
I always have up to date information about the care recipients and my workday in the smartphone	4 (n=243)	4 (n=192)	1 (n=24)	1.5 (n=10)	5 (n=15)	4
I trust that the information in the system is correct and that nothing disappears from it	4 (n=251)	4 (n=200)	3 (n=24)	3.5 (n=10)	4 (n=15)	4
I can use the smartphone for all communication I need in my work	4 (n=251)	4 (n=200)	3 (n=24)	2 (n=10)	4 (n=15)	5
The system does not limit the access to other useful functions in the smartphone	3 (n=251)	3 (n=200)	2.5 (n=24)	3 (n=10)	3 (n=15)	4
I rarely forget to bring the mobile when I shall perform my duties	5 (n=250)	5 (n=199)	5 (n=24)	5 (n=10)	5 (n=15)	2.5
The mobile’s design and performance (e.g. screen size, battery) does not stop me from using the system when I need it	4 (n=251)	4 (n=200)	3 (n=24)	3 (n=10)	3 (n=15)	5
<b>Total System Quality</b> Min = 11, Max = 55 * Calculated by summarizing the answers to the statements measuring system quality. Presented as a mean value.	<b>39.67</b> (n=243)	<b>41.65</b> (n=192)	<b>27.12</b> (n=24)	<b>29.50</b> (n=10)	<b>40.53</b> (n=15)	<b>44.50</b> (n=2)
<b>Content Quality</b>						
The system is well adapted to my work situation	4 (n=237)	4 (n=189)	1 (n=23)	2 (n=9)	4 (n=14)	4.5
If something out of the ordinary happens, it is easy to use the system to reschedule. (Unexpected things could be that a care recipients have to go to the hospital or that a colleague gets sick and has to cancel the work day.)	3 (n=237)	3 (n=189)	3 (n=23)	3 (n=9)	3 (n=14)	3
I often work under high time pressure	4 (n=237)	4 (n=189)	4 (n=23)	3 (n=9)	4 (n=14)	3.5

During a workday I often need quick access to information from the system	4 (n=237)	4 (n=189)	3 (n=23)	4 (n=9)	4 (n=14)	3.5
<b>Total Content Quality</b> Min = 4, Max = 20 * Calculated by summarizing the answers to the statements measuring content quality. Presented as a mean value.	<b>13.92</b> (n=237)	<b>14.48</b> (n=189)	<b>10.43</b> (n=23)	<b>10.33</b> (n=9)	<b>14.35</b> (n=14)	<b>14.5</b>
<b>Service Quality</b>						
I can get access to the system any time I need it	4 (n=251)	4 (n=200)	3 (n=24)	4 (n=10)	4 (n=15)	4.5
To log on to the system is a rapid process	3 (n=251)	3 (n=200)	3 (n=24)	2.5 (n=10)	4 (n=15)	4
To get information from the system is a rapid process	4 (n=251)	4 (n=200)	3 (n=24)	3 (n=10)	4 (n=15)	4
To change and save information in the system is a rapid process	3 (n=250)	3 (n=200)	3 (n=23)	3 (n=10)	3 (n=15)	3
I rarely experience technical difficulties with the TES-mobile	3 (n=251)	3 (n=200)	2 (n=24)	2.5 (n=10)	2 (n=15)	3
The system protects the personal information about the care recipients	4 (n=251)	4 (n=200)	3 (n=24)	3.5 (n=10)	5 (n=15)	5
If I experience problems with the system I know where I can turn to get help	4 (n=251)	4 (n=200)	3.5 (n=24)	4.5 (n=10)	5 (n=15)	5
<b>Total Service Quality</b> Min = 7, Max = 35 * Calculated by summarizing the answers to the statements measuring service quality. Presented as a mean value.	<b>24.27</b> (n=250)	<b>24.83</b> (n=200)	<b>19.34</b> (n=23)	<b>22.6</b> (n=10)	<b>25</b> (n=15)	<b>28.5</b>
<b>Outcome Variables</b>						
I am overall satisfied with the system	4 (n=243)	4 (n=192)	3 (n=24)	3 (n=10)	4 (n=15)	4.5
The system is easy to use	4 (n=243)	4 (n=192)	3 (n=24)	3 (n=10)	5 (n=15)	4.5
I can use the system without outside help	4 (n=249)	4 (n=198)	3 (n=24)	4.5 (n=10)	5 (n=15)	4.5
I am overall pleased with the smartphone's performance and design	4 (n=237)	4 (n=189)	2 (n=23)	3 (n=9)	4 (n=14)	4.5
The system makes it possible for me to spend less time on administrative tasks at the computer	3 (n=237)	4 (n=189)	1 (n=23)	1 (n=9)	2.5 (n=14)	5
The system increases the quality of the care me and my colleagues can give the elderly	3 (n=237)	3 (n=189)	2 (n=23)	2 (n=9)	2.5 (n=14)	4
The system helps me get more effective in my work	3 (n=237)	4 (n=189)	2 (n=23)	2 (n=9)	4 (n=14)	3.5

# Appendix C

## Evaluation of TES-mobile

We are two Örebro University students from the master program of Informatics who know do an evaluation of the TES-mobile project. We will be pleased if you could answer the questions below and the participation is of course anonymous and the result will only be part of this study.

**1. Home care unit:** \_\_\_\_\_

**2. Gender:**

- Woman
- Man
- Other/Choose not to answer

**3. Professional group**

- Assistant nurse
- Nurse
- Occupational therapists
- Operational manager
- Other care professional

**Did you participate in the pilot program of TES-mobile?**

- Yes
- No

**4. Type of employment:**

- Full time employment
- Timed employment month
- Substitute

**5. How familiar are you with the use of a smartphone?**

- Very large, I have an own smartphone I use at a daily basis surfing, using applications, games and more.
- Quite large, I have an own smartphone mostly for the use of phone calls and text messages.
- Okay, I had used smart phones several times before.
- Quite small, I had used a smart phone at few occasions before.
- None, I had not used a smartphone before the use of TES-mobile.

**6. Do you think that the education in TES-mobile were sufficient?**

- Yes, fully sufficient.
- Okay, could have been more, but it worked.
- Should have been more, not quite enough.
- Absolutely not, I would have wanted more training and education before the use of the system.

**7. Was the information about the purpose with TES-mobile clear before the adoption?**

- Yes, fully sufficient, I understood the purpose with the adoption.
- Quite okay, I had some understanding of the purpose with the adoption.
- Should have been more, not quite enough-
- No, I did not understand why we would use a new system.
- I did not work during the adoption of the new system.

## 9. System Quality

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
<b>Extent of data processing</b>					
The system helps me make decisions in my day-to-day work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system facilitates my work tasks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system helps me prevent mistakes in my work (e.g. forget to hand out medicine, miss a visit).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Extent of information access</b>					
The system contains all information I need for my daily work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is easy to access the information I need from the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I always have up to date information about the care recipients and my workday in the smartphone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I trust that the information in the system is correct and that nothing disappears from it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Communicability</b>					
I can use the smartphone for all communication I need in my work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system does not limit the access to other useful functions in the smartphone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Portability</b>					
I rarely forget to bring the mobile when I shall perform my duties.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The mobile's design and performance (e.g. screen size, battery) does not stop me from using the system when I need it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 10. Content quality

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
<b>Structure of the task</b>					
The system is well adapted to my work situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If something out of the ordinary happens, it is easy to use the system to reschedule. (Unexpected things could be that a care	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



recipients has to go to the hospital, or that a colleague gets sick and has to cancel the work day

**Urgency of information**

I often work under high time pressure

During a workday I often need quick access to information from the system

**11. Service quality**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
<b>System reliability</b>					
I can get access to the system any time I need it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To log on to the system is a rapid process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To get information from the system is a rapid process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To change and save information in the system is a rapid process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I rarely experience technical difficulties with the TES-mobile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system protects the personal information about the care recipients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>System support</b>					
If I experience problems with the system I know where I can turn to get help	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Outcome variables**

**12. How many times a day do you use TES mobile?**

- More than 10 time a day.
- 7-9 times.
- 4-6 times.
- 1-3 times.
- Less than one time a day.

**13. In comparison to the old system that was used due to last December 2014.**

- I prefer the current system.
- I prefer the old system.
- I cannot choose/does not matter.
- I did not use the old system.

#### 14. Outcome Variables

User satisfaction						
I am overall satisfied with the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system is easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can use the system without outside help	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am overall pleased with the smartphone's performance and design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Net benefits						
The system makes it possible for me to spend less time on administrative tasks at the computer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system increases the quality of the care me and my colleagues can give the elderly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The system helps me get more effective in my work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### 15. Do you have your own TES-mobile?

- Yes.
- No, I use a group mobile.

**Thank you for your participation!**

Regards Josefine and Rickard

# Appendix D

## General questions

- How long have you worked as unit manager? How long have you been manager in for this group?
- How does the planning work today with TES?
- What is the role of the operational managers within the TES mobile system?

## The adoption

- How did you get information about the replacement of the old system to this new system, i.e. TES mobile?
- Did you have a strategy when you informed the care staff about the change?

## Task structure

- How do you look at the care staffs work duties? Are they well defined and routine based or are they unstructured and different day to day?

## Urgency

- Do you believe that the care providers work under high time pressure?
- Have you experienced that TES-mobile system have helped to handle or to reduce this possible time pressure?

## Extent of mobility

- How mobile does the care providers have to be in their work? Are they working on the same location for a long time period each day or are they mobile between different locations?

## Data processing

- Have TES mobile helped you in any decision making?
- How does the integration between Treserva, TES and TES-mobile work?

## Portability

- Have you experienced any problem with the use of the telephones?

## Extent of information access

- How much information can the care provider get access to from TES mobile? Have you noticed if something is missing which are needed by the care providers?
- Who can access the information and who can modify, add and delete information about the customers?

## Communicability

- Do the care providers use any other functions in the mobile phones, except TES-mobile?
- Which communication channels are used with the help of the mobile phone?

## Information complexity

- What type of information can the care providers access through TES mobile?
- Is all information text based or do you use pictures, video, or audio components as well?

**System reliability**

- Have you experienced breakdowns or that the application has crashed?
- Have the mobile phones been reported fractional? What happens in a situation like this and do you have clear guidelines of what to do if the mobile phones do not work?

**System support**

- Have the care providers clear guidelines when it comes to the support of TES-mobile?
- Do you know if they have been in contact with the support? How did that go?

**Other**

- Have you gotten questions or reactions from customers or relatives about the new system?
- What do they feel about this new system?
- What positive effects can be noted after the use of TES-mobile?
- What negative effects can be noted after the use of TES-mobile?
- Are you pleased with the use and adoption of the TES-mobile?