

IT-supported Double Medication Check for Home care

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Abstract—This paper presents the work in progress for the Double Medication Check project. The aim of this project is to provide an IT-supported solution for the Double Medication Check (DMC). The need for DMC is pressing. Failures are being made during the dispense of medicines, which costs lives and increases the costs of health care. The practice of DMC puts strain on home care organizations, where increased costs and high workload are practical constraints. With the use of the eHix method, we hope to develop a sustainable IT support for DMC so safe and effective DMC will occur in the home care.

Keywords: double medication check; IT support; home care; effective medicine dispense.

I. INTRODUCTION

Many elderly people in long-term care programs (extra mural as well as intramural) use combinations of different medications, which increases the risk of failure during the dispensing of medications by healthcare professionals. Different studies show that faults are being made due to dispense errors of medicine. Each year 1735 patients die in Dutch hospitals because of unintended injury caused mostly during the dispense of medication [1]. The HARM (Hospital Admissions Related to Medication) study of 2006 concluded that 2.4% of all hospitalizations in the Netherlands are due to medication-related issues. This results in about 41.000 hospitalizations each year from which 19.000 are avoidable [2]. Again, this report concludes that most of these hospitalizations are caused by faults during the dispense of medications.

Medication errors cause much suffering for the patients as extra treatments thereby mean higher healthcare costs. The effects of medicine errors are even higher for elderly people [3]. At this moment, 16% of the Dutch population is older than 65 years (2,7 million). This number will increase. The Dutch Central Statistical Office estimates that by 2060 about 26% of the Dutch population will be 65 years or older. About 30 to 45% of this population uses five or more different medicines on a daily basis [4]. The most common problems concerning this population's medications are the use of unnecessary medication, the incompatibility of different medicines, and avoidable side effects [4].

A. Double Medication Check

In 2009 and 2010, the Dutch Healthcare Inspection (IGZ) exercised thematic supervision of medication in

nursing homes, homes for the elderly and disabled and home care. The study concluded that the medication safety for vulnerable groups in long-term care and home care is inadequate [5]. The study also suggested that the use of technology could improve medication safety [5].

Based on this conclusion, a taskforce consisting of leading actors in the Dutch health sector developed a national directive called "Safe Principles in the Medication Chain". In this directive, the double medication check (DMC) is defined as an important practice/safeguard for reducing medication errors during the dispensing of medications [6]. This directive also describes the medication process (see Figure 1).

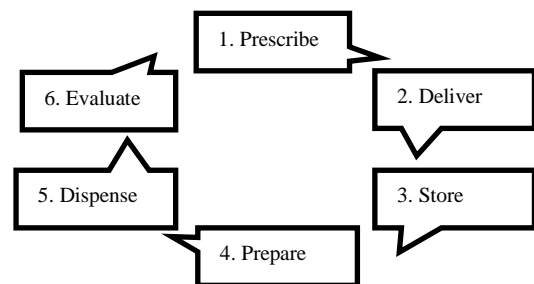


Figure 1. Medication process

DMC is conducted in the 'dispense' phase of the medication process. The medication is dispensed by a licensed healthcare professional and has to be checked by either another licensed healthcare professional, an informal carer or the patient him/herself. In practice, it is difficult to apply DMCs. It is rather expensive and time-consuming and therefore, in many cases, these DMCs are not always performed. On top of this, many care organizations have to deal with declining budgets, which puts pressure on labor-intensive practices such as DMCs.

B. IT-Supported Double Medication Check

As suggested in many studies, the use of IT technology could improve medication. This might also be the case for the DMC. To our knowledge, the use of IT-supported DMC has not been validated considerably worldwide. There are some studies that have been done on the use of videoconferencing for DMC. Results have not been positively overwhelming [7]. In this paper we pose the research question: In what way can IT support contribute to

a safer way of dealing with medication in home carehome care that needs to be double checked?

The research group IT Innovation in Health Care at Windesheim University of Applied Sciences (Zwolle, The Netherlands) is involved in a research center called Tech for Future. Within this center, the research group is developing an IT-supported solution for DMC at home care. The aim of this research is to develop a working beta-version of an IT-supported DMC and to understand and measure whether IT-supported DMC is able to lower the costs and improve the process and user satisfaction of DMC in home care. The project will be conducted with one Dutch care organization, which provides intramural and extramural care to the elderly and chronically ill. For the project, we focus on the DMC in the dispense of medicines in extramural care.

II. APPROACH

In order to develop a feasible IT solution in a structured manner, the eHealth Innovation framework will be used. In former projects, the research group IT Innovations in Health Care at Windesheim University of Applied Sciences developed a business model approach as an instrument to bridge the gap between innovative eHealth ideas and successful IT-based care services. This approach is well suited to the characteristics of an IT service innovation like the IT-supported DMC [8].

The starting point of the eHix-method is the STOF model [9]. The STOF model describes the business model based on four perspectives or domains: the *Service* perspective—a description of the service, the value proposition (the value of the service for users), and the intended audience. The *Technology* perspective—a description of the required technical functionality and architecture to deliver the service. The *Organization* perspective—a description of the resources, activities, roles, and structure in which the value network partners provide the service. And the *Finance* perspective—a description of how the service generates revenue (earnings) and the distribution of costs and benefits among the parties involved in the value network.

The eHix combines the STOF model with a phasing that provides support for the lifecycle of the innovation process. See Figure 2. The five phases proposed by Hettinga [10] form the basis for the phasing: inventory phase, design & development phase, experimental phase, pilot phase and development phase, experimental phase, pilot phase and

implementation phase. In the *inventory* phase, the ideas of a new service are created, and the needs and requirements of the users are analyzed. In the next phase, the technology is designed and developed, and thoughts about the business model of the service are initiated. In the *experimental* phase, users try out the new application in a laboratory setting, while in the pilot phase, more users are involved testing the application of the service in their daily practice and giving input for a successful deployment in the *implementation* phase.

The eHix thus combines the five stages in the innovation process (concept phase, design phase, test phase, pilot phase, implementation phase) with the four aspects of the business model (service, technology, organization, finance), resulting in a matrix containing 20 (4 by 5) cells. Each cell contains the essential steps and choices to be made in the innovation process for a specific domain within the business model in a particular phase. The eHix matrix structure is shown in Figure 2 with the main keyword in the cell displayed.

A. Inventory Phase

To lay a good fundament for this project, we first take a broad view by mapping and analyzing all the stakeholders involved. A good stakeholder analysis is crucial to enhance the project's chances of success; it makes sure all parties are being taken into account, all interests are being mapped, and the evidence needed to prove the IT solution's value is clear [11]. At the same time, we familiarize ourselves with the care organization and its needs. We specify which clients are involved, which scenarios of DMC are currently used at the care organization, and the most pressing needs according to the stakeholders. To retrieve this information, we first interview the most important stakeholders. The initial interviews at the care organization are with the home carehome care manager, a number of professional carers, and the IT manager. Based on the results of these interviews we observe five carers while they do their rounds and perform the DMC at their clients' homes. From here on, we are able to sketch the different scenarios of DMC currently practiced. We will complete these scenarios with process analysis, which will be the focus in a following brown paper session with the care manager, five carers, and the IT manager. This brown paper session allows us to verify the detailed scenarios with the stakeholders and to take stock of the most pressing needs according to these stakeholders. Involving the most important stakeholders in this way creates ownership and involvement. It makes the stakeholders take responsibility for the whole process of identifying needs and forming solutions. This will add to the acceptance of changes to come.

Even though user-requirement analysis is usually done in the phase following the Inventory phase, we will also use the brown paper session in this phase to already draw up the user requirements. There is a pressing need to work as efficient as possible with the stakeholders' availability, since the care organization's manager and carers are strapped for time.

To put the challenge of DMC in a broader context, interviews are held with carers of selected home carehome care organizations in the region. In addition, national and

	Inventory	Design & Development	Experimental	Pilot	Implementation
Service	Value Proposition	User Requirements	Value Evaluation	Perceived Value	Service Offer
Technology	Technology Scan	Design	Prototype	Reliability	Scalability
Organization	Project Structure	Impact Analysis	Resources	Support	Implementation Plan
Finance	Finance	Business Case	Business Case Checks	Evaluation Model	Costs and Benefits

Figure 2. eHix matrix structure combining business model domains with innovation phases

international eHealth entrepreneurs are consulted on the DMC. At the same time desk research is done on the IT solutions currently on the market.. Scientific studies on DMC and eHealth in publications in online and eHealth magazines are accessed to make sure the DMC issue is approached from all angles.

The costs of this current project are financed by a subsidy provided by the Tech For Future research center. In this Inventory stage, however, we do initiate the revenue and cost model with the care organization's manager. Developing the possible financial scenarios of sustainable financial resources at this first stage of the project increases the chances of embedding the project in the standing organization.

B. Design and Development Phase

We have already drawn up the user requirements and contextual conditions iteratively with our most important stakeholders. In this next phase, we follow up translating this inventory of user requirements and specific organizational context into technical specifications and user specifications. We also construct mock-ups together with the care organization's home carehome care manager and IT manager. Keeping these stakeholders involved is crucial at this point in the project. Active involvement of stakeholders at this stage enhances the chance of structural embedment of the envisaged IT supported solution in the organization.

At the same time, we draw up the specifications of the envisaged solution with the stakeholders. We also analyze the technical and user specifications of the most fitting IT solutions currently on the market. Once the specifications of the envisaged solution are clear, we make a fit-gap analysis between the envisaged solution and the most fitting existing IT solution. This analysis will give an indication of whether or not it is feasible to even experiment with this most fitting IT solution in our Telecare Skillslab (for further explanation see Experimental Phase).

Being in constant dialogue with the care organization, we can then sketch the impact of the envisaged IT solution on the organization. By drafting a scenario that embeds the envisaged solution into the work processes and technical infrastructure, we are able to analyze the impact of the solution on the standing organization. Being clear on the requirements and impact the device will have on the organization, we then follow up with a first outline of the business case, including the costs/benefits and operationalization of the less tangible elements that are prominent in the care organization's strategy.

The outcome of the impact analysis and first outline of the business case can be decisive factors in the continuation of the project to the next phase, the Experimental Phase. Depending on the outcomes, the care organization or other stakeholders might decide it is not (yet) worthwhile in terms of effectiveness, efficiency, or other interest that they carry to continue with the realization of a beta version of the envisioned IT solution. However, since this project's goal is to test the feasibility of an existing device and no costs are being made to realize a new beta version, this phase in the project is not decisive.

C. Experimental Phase

With an existing IT device available, experiments with potential users (carers) will be done in our Telecare Skillslab to assess the value proposition of the IT solution. The research group IT Innovations in Health Care established the Telecare Skillslab to contribute to education in eHealth and facilitate telecare research. The Skillslab consists of two locations situated at the Windesheim campus. One location has been furnished as a living accommodation, which makes it possible to experiment with domestic applications of sensors in a realistic manner. The other location aims at facilitating formal or informal carers, providing care at a distance. Cameras installed in the ceiling provide the researchers with possibilities for non-obtrusive observation.

During the experiments with the existing IT-supported DMC found on the market, the focus is not only on the technology, but also on important issues such as privacy and embedding the technology in daily routines. For the resources needed in this phase—the Telecare Skillslab, the existing IT-supported DMC, and the necessary people—our project planning is most important. It is not until the experiments are completed that we can do the business case check and adjust our initial cost/benefit analysis, an important indicator of structural embedding of the IT solution in routine care. Not only should overall costs be evened out with overall benefits, but a proper balance between costs and benefits of individual stakeholders within the care chain should also be pursued. The adjustment of the business case after the experiments can give a good indication as to whether or not the IT device should be brought into the next phase.

D. Pilot Phase

In the pilot phase, we will test the IT-supported DMC on site, with the carers performing the various DMC scenarios at selected clients' homes. The aim of the pilot is a final test for functionality, reliability, and usability. The pilot will be of small scale with the focus on technical functionality as well as user friendliness. During the pilot, we will also explore whether end-users intend to keep using the technology and to what price. Once the results of the pilot study are finalized, the business case will be adjusted again to the findings of the pilot. The final business check is to ensure whether the use of the technology leads to the intended effects: a more effective DMC for home care leading to the same or higher quality of care against lower costs.

Since the project's scope excludes implementation, we have made the decision for now not include the last phase, the Implementation Phase.

III. PRELIMINARY RESULTS

Initial research regarding the DMC at the care organization started in February 2014. The project will conclude at the end of January 2015. Hence, at the time of writing, only six months of the project can be considered. This section highlights some preliminary results and lessons learnt from these months.

While the process of DMC seemed to be quite straightforward initially, during the inventory phase, we came across the practice of various scenarios of DMC at the care organization. Many of these scenarios were not included in the care organization's official guidelines but were adjustments of the DMC process by the carers on site. Even though these adjustments are not officially recognized scenarios, these practice adjustments done by the carers have to be taken into account while mapping out all the scenarios of DMC. By not taking into account the 'hidden' adjustments done in the work field by carers could we could miss vital information on the work field, thereby excluding practical user requirements.

After extensive desk research and field research, we could only find one existing IT solution for DMC currently on the market. This made the selection of IT solutions in the technology scan of the Inventory Phase redundant. This existing IT solution is used in a few care organizations for DMC in home care and will be considered in this project.

During the interviews with other care organizations, a small number of respondents mentioned the use of Social Media, such as WhatsApp and SMS, as alternatives to dedicated IT-supported solutions for DMC. These IT solutions were not endorsed by the care organizations but 'inventions' used by the professionals themselves. The care professionals using these 'solutions' were not aware of the issues of privacy and legislation around the distribution of personal data like medicine use.

IV. CONCLUSION AND FUTURE WORK

In this paper, we described the DMCs project's ambition to deliver eventually: impetus for the realization of an IT support for DMC in home care. It is our hope that with this IT support, including administration and registration of risky medication, will contribute to a safer dealing with medication. We also presented the first months of progress of the DMC project.

The main conclusion to be drawn from the current progress is that, in general, there is a consensus that IT support has the potential to improve the DMC as it is currently practiced in the field. The technology scan in the Inventory phase resulted in only one 'official' IT supported solution and several 'informal' IT supported solutions. This interests shows that our research does fill the need for more evidenced based IT solutions regarding DMC.

Future work on the project concerns the plans to improve the existing IT solution based on the results of our experiments and pilot study. When the existing IT solution

does not fulfil the expected requirements at all, we will develop a complete new IT solution for DMC at distance together with our IT students and our Health Care students.

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