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Development of a web-based pharmaceutical care plan to facilitate collaboration between healthcare providers and patients

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ABSTRACT

Background   In medication therapy management there is a need for a tool to document medication reviews and pharmaceutical care plans (PCPs) as well as facilitate collaboration and sharing of patient data between different healthcare providers. Currently, pharmacists and general practitioners (GPs) have their own computer systems and patient files. To facilitate collaboration between different healthcare providers and to exchange patient data we developed a paper-based tool. As a result the structured collection of all relevant information for a clinical medication review was more protocol driven. The tool also enabled to plan interventions and follow-up activities: the PCP. The PCP was piloted among three GPs and six community pharmacists. Interviews with all healthcare providers concluded the PCP was found a very useful tool to collect and share patient data. A disadvantage was the time spent to collect all information. We therefore developed our PCP into a web-based tool: the web-based PCP (W-PCP).

Objectives   Development of a W-PCP to (1) provide healthcare providers with information from pharmacist- and GP computer systems and (2) facilitate collaboration between healthcare providers and patients.

Development and Application   W-PCP facilitates uploading and sharing of patient data among health care professionals and collaboration between professionals and patients on performing treatment plans. The W-PCP is a stand-alone application developed by cocreation using a generic software platform that provides developmental speed and flexibility.

Method   The W-PCP was used in three research lines, two in primary care and one in a hospital setting. Outcomes measures were defined as satisfaction about efficiency and effectiveness during data sharing and documentation in providing care and conducting medication reviews using the W-PCP.

First experiences concerning the use of W-PCP in a primary care setting were collected by a questionnaire and interviews with pharmacists and GPs using the W-PCP.

Results   A questionnaire about first experiences with the W-PCP was sent to 38 healthcare providers. 17 healthcare providers returned the questionnaire (response 44.7%). The use of W-PCP resulted in positive experiences from participating healthcare providers. One of the needs expressed is to have the W-PCP application integrated in the current pharmacy and GP computer systems. All experiences, needs, and ideas for improvement of the current application were collected. On the basis of experiences and requirements collected, the application will be further developed.

Conclusions   The W-PCP application can potentially support successful collaboration between different healthcare providers and patients, which is important for medication therapy management. With this application, a successful collaboration between different healthcare providers and patients could be achieved.

INTRODUCTION

According to the hospital admissions related to medication (HARM) study, in the Netherlands, 19,000 medication-related hospital admissions per year are avoidable, i.e. 2.4% of all hospital admissions and 5.6% of all emergency admissions.[1] Of these admissions 46% were defined as potentially avoidable. A report following the HARM study recommended having a yearly medication review.[2] According to the literature several types of medication reviews have been defined, of which the type that addresses all issues relating to the patient's self-reported experiences after and about use of medicines in the context of their clinical conditions is defined as a clinical medication review.[3]

When just a general practitioner (GP) performs a review of medications, only information about diagnoses and prescriptions are available. GPs do not know if medicines are actually collected from the pharmacy and if patients actually take the medicines. When just a pharmacist performs a review of medications, only information about dispensed medicines is available. Pharmacists do not know diagnoses. When both GP and pharmacist are involved, information from both professions can be combined, however, this does not provide insights about patients taking the medicines. When besides the GP and pharmacist also the patient is involved, more information is available about medicine taking behaviour, including non-adherence due to side effects and the use of non-prescription medicines. Therefore, to perform a clinical medication review, it is important to have information from different healthcare providers as well as from patients.[3] Samal et al.[4] concluded that primary care providers need better tools to improve longitudinal disease management including improvement of efficiency and quality of care. Longitudinal data management is important to improve chronic disease care. Not only current diagnoses and clinical values are important, but also context about responses to previous medication changes.

Currently, all healthcare providers have their own computer system and patient files. To facilitate collaboration between different healthcare providers and to exchange patient data we developed a paper-based tool. This tool was originally developed by the University of Groningen (RuG), where it is used during internships in the pharmacy education program. The structured collection of all relevant information for a clinical medication review is a learning objective. The tool also enabled to plan interventions and follow-up activities: the pharmaceutical care plan (PCP). This PCP contains different sections that contain all relevant patient information and a part to develop the care plan where treatment goals, actions, and evaluations can be documented. In 2008, we performed a pilot study with the main aim to gain experience with a paper-based PCP in the Dutch primary care setting. The study was conducted with three GPs and six community pharmacists over six months. Patients (n = 23) were included from January 2008 to July 2008 during the GP consultation using to the following inclusion criteria:

- patients who raised a question or issues concerning their complex medication regimen to their GP; or
- GP who identified several problems with a patient's medication.

Patients received an information leaflet explaining the study and, following written consent, an appointment was made with one of six participating pharmacists for a consultation. Before the consultation, the pharmacist reviewed information from the GP and pharmacy computer systems. Information was collected in the PCP in paper form. After the patient consultation, the pharmacist developed a care plan based on the collected information and discussed the plan with the GP. Finally, the GP discussed the care plan with the patient and medication changes were made in collaboration with and agreed by the patient.

From interviews with all participating pharmacists and GPs, we concluded they found the PCP a very useful tool to collect all relevant information. Information from both pharmacist and GP computer systems were available together with input from the patient, presented in a structured manner. A disadvantage was the time spent to collect all information. Most information was available in the existing computer systems and pharmacists were copying this information into the PCP.

It would have saved a lot of time if this information could have been automatically uploaded from their respective computer systems. Collaboration between pharmacist and GP will be easier when they both have access to the same patient file. If an electronic patient file can be shared between different healthcare providers, both pharmacist and GP will have an up-to-date file making the care plan easier to manage. The opportunity to upload patient data from both pharmacy- and GP-computer systems and to share this information among different healthcare providers is rather unique and, has not been described extensively in the literature. A systematic review about health information technology (HIT) in GP practices concluded that HIT has the potential to benefit GP practice organisations.[5] However, there are significant barriers like financial barriers (costs for development and implementation), technological barriers (concerns about privacy and confidentiality of patient data), and educational barriers (sufficient training is needed before implementation in daily practice). We expect the same potential problems when we develop HIT serving both GP practices and pharmacies.

On the basis of our experiences with the paper-based PCP, we developed a next step. A web-based PCP (W-PCP) was developed serving two goals: first, to have information from pharmacist and GP computer systems available by an automated upload provided to both healthcare providers and second, to facilitate collaboration between healthcare providers and patients. In this paper, we describe the development of the W-PCP, first experiences in primary care setting, and future research plans.

DEVELOPMENT

A collaboration between the Department of Pharmacotherapy and Pharmaceutical Care (University of Groningen), PharmaPartners (PP) (the largest software company and market leader as provider of IT-systems for Dutch pharmacies and GPs practices[6]), Kring-apotheek (a Dutch pharmacy chain), and Catharina hospital (a hospital in Eindhoven, the Netherlands) was established to develop the W-PCP based on its paper version. This collaboration served two purposes: (1) to build commitment from different stakeholders who would support multidisciplinary medication review developments and (2) to deliver input for the requirements analyses in designing the web-based tool.

The design of the W-PCP was developed as a result of conducting a requirements analysis. Stakeholders opinions about health care professionals' development of multidisciplinary care in a changing market, where fee for prescription was to be replaced by fee for service, and previous research by the RuG, using a paper-based PCP, were used as an input to start the development of the W-PCP. In several meetings with stakeholders four important requirements were agreed upon:

- first, the tool has to be web-based;
- second, it has to be multidisciplinary so that multiple healthcare providers can cooperate within the application;

- third, it has to operate separately from a pharmacy- and/or GP-computer system, so that users of different software can be connected; and
- fourth, patients' privacy needs to be secured.

The waterfall method was chosen to develop the W-PCP. This method fully supports the design principles of sequential development and is still a widely used way of thinking in software development companies.[7–9] The first publication about managing the development of new software based on this method was written by W. Royce in 1970.[10] PPs development process was established on waterfall principles because it is seen as common practice in software development. Owing to the fact that W-PCP is a stand-alone application, it is very suitable for development by a third party. For that reason, PP decided to cocreate. Cocreation means trying to find ways of creating value by cooperating between customers, consumers or third parties. By partnering in the value creation process, companies can better balance the objectives of value creation: managing the bottom line (net revenues) and the top line (revenues). Furthermore, cocreation is becoming a competitive imperative.[11] VitalHealth Software (VHS) is a global software organization that has developed a generic software platform that is flexible enough to give appearance to disease management and seamless care for healthcare providers.[12] For the reasons mentioned above, cocreation with VHS was initiated. Development using this platform provides speed and flexibility in development and also creates the possibility for future product development.[13]

W-PCPs architecture had to facilitate in a multidisciplinary setting and as a web-based application. As development was outsourced to VHS, the platform architecture had to be developed. To succeed, close collaboration between healthcare providers was required. Sharing of information and communication between healthcare systems was needed. Therefore, the Open Zorg Informatie Systemen (OZIS—in English 'Open Health Care Information Standard'), a communication standard that was introduced in 2003 in the Dutch primary care setting, was chosen. It was initiated by the OZIS-foundation, which is founded by several major software suppliers. The main goal of this standard is to increase the potential to exchange electronic patient data between healthcare providers by identifying or developing open standards.[14]

APPLICATION

The waterfall method distinguishes different development phases: system development from a sequential perspective where each phase has to be finished before the next can start. Each phase, individually or combined, is applied during the development process.[8,10,15]

The content of the W-PCP is identical to the paper-based PCP, for which the content is based on the literature and experience in practice settings.[16] Information from both pharmacist and GP computer systems needs to be documented in the W-PCP. In addition to general patient

data, other patient data to be uploaded and documented consists of:

- information on diagnoses/episodes (from GP computer system);
- information on medicines prescribed (from pharmacist computer system);
- information on clinical values/laboratory results (from GP computer system); and
- information on life style (from GP computer system).

We chose to develop the W-PCP as a stand-alone web-based application. All healthcare providers in the Netherlands, independent of software used, would be able to use the W-PCP next to their own software application. This would allow for a broader implementation and faster access to the practice settings, compared to waiting for prioritizing individual systems' developments. To protect patients' privacy, several measures have been considered:

1. W-PCP is accessible through a secured web site;
2. each healthcare provider needs to login to the application with a unique password; and
3. each healthcare provider only has access to his/her own patient files.

A complete specification of requirements, use cases, functional design, and architecture of the system was composed. VHS then developed and configured W-PCP, structured on their VH-platform. Applying an application development platform, costs for development were reduced.[13]

The W-PCP is used adjacent to pharmacists and GPs own computer system. Patient data from these two computer systems can be uploaded into the W-PCP application, which provides patient data to both healthcare providers (Figure 1). Each patient record within the W-PCP consists of three parts (Figure 1). The first part consists of general patient information, such as name, address, date of birth, and name of pharmacy and GP. The second part consists

of medical and pharmaceutical data uploaded from pharmacy- and GP-computer systems (Table 1). When information from the pharmacy computer system (AIS—in Dutch 'Apotheek Informatie Systeem') and the GP computer system (HIS—in Dutch 'Huisarts Informatie Systeem') is uploaded, this information is stored in the W-PCP and date and time stamped. This enables the time sequence of events to be noted. Information can be added after consulting the patient about his or her medicines use, including medicines which are obtained from general drug stores and/or from another pharmacy. The final part contains of the care plan where pharmacist and GP can define goals, actions, and how they will be evaluated. A patient-friendly printing option is available to print the care plan for the patient to keep at home.

Every patient must have their pharmacy and GP be registered within the W-PCP. A healthcare provider can only see the files of their own patients. This ensures patients' privacy. Patients in the Netherlands only visit one GP and one pharmacy, based on the existing health care insurance structures.

The testing phase involved two activities. The RuG performed functional tests and additionally the application was tested from the user perspective using process flow and usability tests. VHS and PP executed technical tests, where connections between applications and data extractions were tested. Identified errors were communicated and solved. During the pilot phase, pharmacists and GPs could only request support from PP when there were errors in performance. New requirements were collected for future development but no updates were released during the pilot.

METHOD

The developed W-PCP application has been used in three different settings: in an academic setting by RuG, involving 12 pharmacists and 38 GPs; in a hospital setting by the
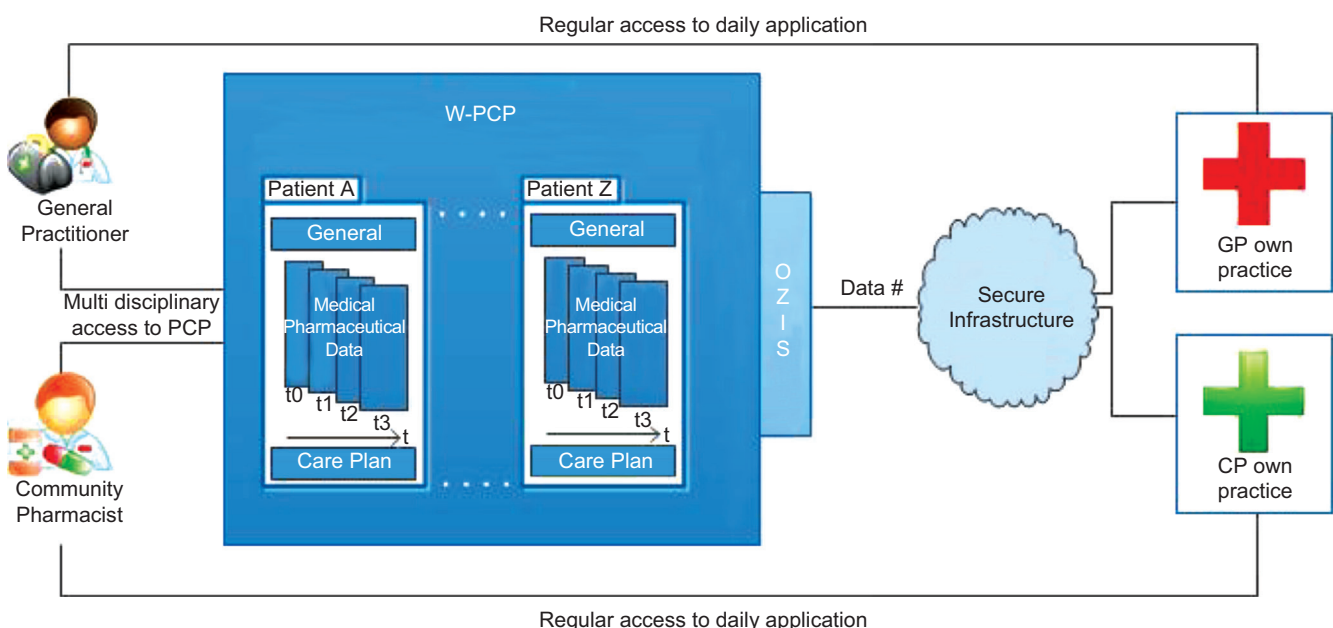

Figure 1 Structure of W-PCP. (#Data uploaded is further specified in Table 1)

Table 1 Data uploaded from pharmacy and GP computer systes

		Data uploaded
Data from GP computer system	Diagnoses (if ICPC[a] coded)	ICPC code, date (e.g. asthma, diabetes)
	Lifestyle (if ICPC[a] coded)	ICPC code, date (e.g. smoking, diet)
	Clinical values	Date, value, unit (e.g. blood pressure, cholesterol)
Data from pharmacy computer system	Medication (if ATC[b] coded)	Name medicine, dosage, prescribed usage (e.g. two tablets once a day), number tablets dispensed, starting date, end date, and (initial) prescriber

[a]ICPC: International classification of primary care.[17]
[b]ATC: Anatomical therapeutic chemical classification.[18]

Catharina hospital; and in a proof-of-concept (PoC) by PP among their customers, involving ten pharmacists and 10 GPs. In this paper, we focus on the use of W-PCP in a primary care setting (e.g. cases 1 and 3) by RuG and PP.

The University of Groningen used the application in a study where patients were selected according to pre-defined inclusion criteria:

- age 60 years or older;
- use of five or more medicines for chronic use; and
- of which at least one medicine was for a cardiovascular disorder.

After informed consent, patients were randomised in an intervention or control group. Patients from the intervention group were invited for a consultation with their pharmacist. The pharmacist developed a PCP in cooperation with GP and patient. The W-PCP was used to collect all data.

The PoC by PP did not have any inclusion criteria for patients. Pharmacists and GPs were asked to use the W-PCP during one year for patients who they thought would benefit. Ten settings used the W-PCP during the study period of one year, four settings gave consent to analyse data collected in the W-PCP.

During the study period, pharmacists and GPs were asked regularly for their first impressions and ideas for further improvement of the web-application were collected. Outcomes measures were defined as satisfaction about efficiency and effectiveness during data sharing and documentation in providing care and conducting medication reviews using the W-PCP. After the study period, a questionnaire was sent to all pharmacists and GPs who used the W-PCP that asked about their experiences with efficient and effective data sharing. The questionnaire consisted of 15 questions divided into four topics:

- W-PCP and provision of health care;
- W-PCP and interprofessional collaboration;
- W-PCP and reimbursement fees; and
- W-PCP and future developments.

In addition, unstructured interviews were conducted involving all pharmacists and GPs to collect information on experiences with the application and needs for further improvement of the application.

RESULTS

Patient characteristics and outcomes will be described elsewhere, rather this paper will focus only on the experiences of healthcare providers after using the W-PCP application.

The questionnaire about first experiences with the W-PCP was sent to 38 healthcare providers (pharmacists and GPs) who used the W-PCP (19 from both research lines). In total, 17 healthcare providers filled in the questionnaire (response 44.7%). What was clear from the questionnaire, and supported by feedback from the W-PCP users during both studies, was that healthcare providers are in need of an application like W-PCP to register and document performed care activities. One of the questions, 'In your opinion, can you provide better patient care using the W-PCP?', a majority of healthcare providers answered 'yes' (70.6%). A question concerning collaboration, 'Does the W-PCP provide added value concerning collaboration between you and other healthcare providers?', was answered with 'yes' by 64.7%. Almost all healthcare providers (94.1%) agreed with the proposition that a fee is needed to provide healthcare by pharmacist and GP together. We asked healthcare providers what an acceptable fee for the care delivered would be (medication review, development PCP, propose interventions, and follow-up) and different answers were provided. Depending on the time spent, the answer ranged from € 25–70 per patient (GP) and € 100–200 per patient (pharmacist). Almost half (47.1%) of the healthcare providers would recommend the W-PCP to colleagues. Healthcare providers who answered 'no' to this question indicated that they would recommend a tool but not necessarily the W-PCP tool or that they would not recommend the tool in its current format.

One of the needs of healthcare providers is to have the W-PCP application integrated in the current pharmacy and GP computer systems. In its current version, information from the pharmacy and GP computer systems is uploaded into the W-PCP but information added in the W-PCP (e.g. interventions from the PCP) cannot be transferred back to the original systems. This means pharmacists and GPs would now have two patient files, one in their original software system and one shared by the pharmacist and GP.

During these study periods all experiences and ideas for improvement of the current application were collected. This information will be used for further development of the application.

DISCUSSION AND FUTURE PERSPECTIVES

Healthcare providers showed that there is a need for a tool to document medication reviews and PCPs and to cooperate with and to share patient data amongst multiple healthcare providers. First experiences showed the W-PCP could be a solution. PP decided to further develop the application based on ideas for further improvement from healthcare providers involved in one of the research lines. Our main concern is the integration with existing pharmacist and GP software systems.

Our aim is to continue the development process to be able to have the application available for all health care providers as soon as possible. Different phases will be described in the second development process. The first focus will be to solve small existing errors and inconveniences within the application. After this first phase, the improved tool will be ready to use by health care providers. The following phases will focus on the integration of the application into pharmacist and GP software systems and the transfer of information from the W-PCP back to the original source. Finally, the W-PCP application could be linked to a patient portal from PP ('MijnGezondheid. net') where patients could have access to their own care plans.[19] This could help facilitate the successful collaboration between different healthcare providers and patients concerning medication therapy management including adherence improvement, if needed. As described in a European report[20] national eHealth infrastructures become more important for the benefit of citizens and health systems. Grant *et al*. described the implementation of a web-based tool for patient medication self-management for blood pressure control.[21] When the patient has an active role in the healthcare team this could have clinical benefits, however, technology should be further developed and tested. When more information concerning medicine taking is available, patients might be able to make better use of their medicines. The W-PCP application could facilitate this information and have this information available for multiple healthcare providers, and eventually also for patients.

Limitations

The questionnaire we have sent to healthcare providers to ask their first experiences and opinion about the W-PCP application was not validated. The researchers visited the study locations regularly and during those visits healthcare providers expressed their opinion, remarks, and suggestions to improve the application during unstructured interviews. This feedback was discussed regularly. Some technical difficulties in connecting source systems to the W-PCP were experienced during the start of this paper, which could have negative bias on healthcare providers' opinion.

CONCLUSION

A W-PCP has demonstrated the possibility for pharmacists and GPs to efficiently and effectively share patient data. First experiences of the W-PCP in different settings were positive. Based on collected experiences and additional requirements, the application will be further developed. This application can potentially support successful collaboration between different healthcare providers and patients, which is important for medication therapy management.

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