A Mobile Alerting System for the Support of Patients with Chronic Conditions

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Abstract: *In today's healthcare environment, information systems are mostly used to support clinical staff. However, in current information systems, for patients assistance in the management of their chronic conditions is neglected. Yet, it is vital that patients with chronic conditions are actively involved in their disease management. This promotes personal responsibility, encourages understanding of their condition, gives them more control over their treatment and fosters their compliance.*
In this paper we propose the concept of a mobile system for supporting the management of the conditions of patients with chronic diseases. This system will allow for monitoring the patient's health and the notification of doctors if emergency action is required. Also patients themselves may specify personal alerts for condition-related issues. Further, we show a comparison of existing systems against use cases we have developed in respect to their applicability to our approach. Finally, deduced from our use case analysis, we present a conceptual and architectural design of this system.

Keywords: Event notification, alerting, monitoring, healthcare, chronic condition.

1. Introduction

In today's healthcare environment, information systems are mostly used to support clinical staff, whereas patients are neglected in the support of the management of their conditions.

Push-based systems have proven valuable in the medical area (Kuperman et al., 1999; Purves & Robinson, 2004; Wagner et al., 1998). One example of systems employing this push-based approach is clinical alerting systems (AS). They are used to provide alerts in previously specified situations. Healthcare staff may define their interests with the help of so-called profiles. The system filters incoming information according to these profiles and alerts healthcare staff when their profiles are fulfilled. The use of such systems results in an improvement of patients' outcomes due to faster reaction of physicians to laboratory results and events involving medication-related issues (Kuperman et al., 1999). Also in clinical workflow systems the push-based approach has been applied effectively. This is due to the fact that in clinical workflow there is little time to interrupt an activity to query for information using traditional pull-based information systems (Purves & Robinson, 2004): Information has to be delivered without medical staff requesting it as their work is too demanding to constantly think of all potentially required emergency actions. Any patient can show unexpected reactions so it is not feasible to use a pull-based approach to request information.

However, if we shift our point of view from the support of clinical staff to the support of chronic patients, we can observe that such patients also have to manage tasks similar in complexity to those performed by clinicians. They have to keep track of their regime of medications and doctor appointments and have to check parameters such as blood sugar or blood pressure. Furthermore, depending on their condition they might have to scrutinize their dietary intake and in the event of any abnormalities take the appropriate ac-

tions. Despite these time and concentration consuming obligations patients with chronic conditions have a life and thus managing their condition has to be accommodated into it.

Consequently, it seems to be self-evident to design a system that would support both patients and their healthcare providers in the process of treatment. Nevertheless, few systems for the support of patients have been developed to date. In this paper, we propose the design of a mobile alerting system (MAS) for the support of patients with chronic conditions. This system incorporates a lightweight AS and a lightweight database. The database stores condition-relevant data and the AS is responsible for filtering this data. Thus, in contrast to recent proposals our approach is patient-centred without neglecting the needs of medical staff. Moreover, we strongly promote the cooperation between patients and medical staff.

Patients are reminded of condition-related issues such as taking the appropriate medicine at the correct time, doctor appointments or adverse effects of medications to the medication they are already taking. Important parameters gained in the self-dependent handling of the patient's disease (such as measurements of blood sugar or blood pressure) are stored in the system and automatically transferred to the doctor's Electronic Health Record (EHR). This data will be filtered according to the doctor's guidelines. Thereby critical conditions requiring emergency treatment or general changes in the treatment plan will be recognized earlier and in doing so can be treated earlier. Moreover, patient compliance shall be improved and thus the clinical outcome of the treatment. Patients will be given more relevant information about their conditions and personalised tips about a better adjustment of their lifestyles to their conditions. This information will take into account the knowledge level of the respective patient and it is possible to adjust the level of information from beginner to expert.

From this argumentation it becomes evident that our patient-based approach is helpful in a clinical setting as well as in more general medical-related areas. There have already been studies in several areas of healthcare where patient compliance has improved because of supporting mobile systems. This indicates the need for systems supporting patients as shown in (Palermo et al., 2004). This trial examined the impact on children's compliance when using electronic systems to document their pain.

Our patient-based approach requires vital research in several areas. These cover the fields of ASs, data modelling, information systems, security, mobility and HCI. This paper presents our initial work leading to an architectural and conceptual design of the system. In detail the contributions of this paper are:

1. The concept of a supportive mobile alerting system (MAS) for patients with chronic conditions
2. A use case analysis for our proposed MAS
3. An analysis of existing systems in respect to their suitability for this kind of support system
4. The architectural design for such a patient-based support system
5. The conceptual design for this new kind of medical system

The remainder of this paper is organized as follows: In Section 2 we present possible applications of the support system and outline several use cases. Section 3 describes related work and investigates its applicability to our approach. Our proposal for the architectural design of the system is discussed in Section 4. Afterwards, in Section 5 we present our considerations towards the conceptual design of the system including functional and constraint requirements. These requirements relate to different research areas and are outlined in several subsections. Finally, the paper is rounded off in Section 6 by a conclusion and directions for future research.

2. Applications of the Support System

After a general introduction to our proposed support system, we now refine the possibilities for the employment of this system and show a representative selection of use cases.

2.1. Employment

There are several clinical and general healthcare-related application areas that can profit from our system. Exemplarily, we now present three of them (the first is a summary of the one introduced in Section 1).

1. Our support system can be employed to help patients with chronic conditions such as diabetes, glaucoma, chronic heart failure or cardiovascular diseases and support them in the management of their conditions. Thus, it promotes patients' personal responsibility and encourages their understanding of their conditions. Furthermore, it provides patients with more control over their own disease management and reminds them about important condition-related issues.
2. Additionally, we propose the employment of our support system in disease management programmes. In the USA these kinds of programmes have existed since the mid-nineties, whereas in several other countries such as New Zealand (Hobson et al., 2003) or Germany (Erler, 2002) they have only recently been introduced. We suggest our MAS to be used in such a setting in order to relieve doctors of bureaucratic organizational work and to help guaranteeing proper documentation. Most certainly, the active involvement of patients in their own treatment would also improve their compliance in the treatment suggested by clinical staff.
3. Next to the described clinical settings, our system can generally be used for the surveillance of the conditions of persons under stress or pressure, e.g. when performing extreme sports. There it supports athletes themselves but also the organisers of events. Another inherent application is the support of travellers. In (Vilella et al., 2004) it has already been shown that text messages on mobile phones seem to be an effective tool for increasing compliance of travellers with vaccination schedules. Therefore it appears to be very likely that an employment of a MAS for travellers would be accepted for maintaining a good health under unusual conditions, e.g. if people have to take malaria prevention medicine regularly.

2.2. Use cases

In the following we will describe three use cases for a better understanding of the functionalities of the system proposed. We have a use case for patients, doctors and nurses, respectively. These use cases we have deduced out of initial interviews we have led.

2.2.1. Use case patient

Mr Smith suffers from diabetes and from glaucoma. He has to take two different kinds of eye drops. One kind in the morning and in the evening and the other kind three times a day. His diabetes he is managing with two shots of insulin a day. His MAS reminds him whenever any of his medications is due to be taken. For this it displays which medication has to be taken in what amount. When Mr Smith has taken the respective medication he informs his system about this fact. Furthermore, the system tells him when to test his blood sugar. Mr Smith stores the result of his measurement in the system. If it is too high, the system alerts him to take an additional shot of insulin. If it is too low, the system tells him that he should eat and recommends a meal. When Mr Smith has to get himself other medication at the pharmacy, e.g. because he has a headache or a cold, he can check with his MAS about possible interactions with other medications. Additionally, the MAS informs Mr Smith when he has to go to appointments with doctors and when he has to get new prescriptions. With the help of his system he can also check how much carbohydrate units a certain kind of food has.

2.2.2. Use case doctor

Dr Jones is Mr Smith's GP and is monitoring Mr Smith's diabetes and general health. When Mr Smith's blood sugar values are extremely high, Dr Jones is informed about that by Mr Smith's MAS. Additionally, when his blood sugar values are slightly high over a longer period of time and his retinal screenings have worsened within that time period or the blood flow in his feet is getting poor, Dr Jones is alerted of that by his clinical information system (CIS). Dr Jones can check Mr Smith's blood sugar values in his EHR, which

is synchronized with Mr Smith's MAS. Thus, the EHR contains all measurements made by the patient. With the help of the EHR updated in this way, he can also check whether the bad blood sugar values might be due to Mr Smith not complying to take his medicine (this of course assumes that the input the patient is giving to the system is truthful). When there are any new research findings concerning Mr Smith's condition, Dr Jones is informed about them by the CIS.

2.2.3. Use case nurse

Mr Murray is occupied as a nurse at the ophthalmologic department of Dr Jones' clinic. He performs tasks such as taking photographs of patients' retinas, putting in dilating eye drops, handing out medications to stationary patients and organising examinations and rooms with the appropriate technical devices for those examinations. When Mr Smith comes in for his retina screening the CIS alerts Mr Murray to use counter dilating drops after having dilated his patient's pupils for the eye examination. Otherwise, due to Mr Smith's glaucoma his intraocular pressure might increase very high, which would be dangerous for him. Furthermore, the CIS informs Mr Murray which patients are going to have what examinations and alerts him when required technical devices are available. Between his other tasks Mr Murray also has to make his round and hand out medications to stationary patients. The CIS helps him with that by alerting him whenever a patient needs to take his medication.
As we can see from these example use cases our support system provides advanced support mechanisms. Thus, it suits the complex requirements of differing healthcare providers and patients.

3. Related Work

As we have already mentioned in Section 1, there is a great number of CISs that have been developed either for the support of physicians or for the support of other medical staff. Several of them have been examined by us for their applicability to our approach: A real-time clinical alerting system for intensive care units (Chen et al., 2002), the Columbia-Presbyterian Medical Center clinical event monitor (Hripcsak et al., 2003), a laboratory results alerting system for ambulatory and hospitalized patients (Iordache et al., 2001), a wireless clinical alerting system for the use at surgical intensive care units (Major et al., 2002), a real-time notification service of laboratory data (Poon et al., 2002), a wireless clinical alerting service for physiologic, laboratory and medication data (Shabot et al., 2000) and CLEM, a clinical event monitor (Wagner et al., 1997). None of these systems have been designed according to the needs of patients, but solely for the use of clinicians. Hence, their applicability for our patient-centred approach is not given.

Besides this large number of ASs for clinical staff, a number of workflow systems, following the push-based approach, have emerged in recent years. We have analysed the following systems for their suitability to our patient-based approach: EVE, a distributed event-based workflow system (Geppert & Tombros, 1998), Soprano, a clinical workflow system (Hobson et al., 2003), a careflow management system for chronic patients (Panzarasa et al., 2004), PLAN, a framework and specification language with an event-condition-action mechanism for clinical test request protocols (Wu & Dube, 2001) and a clinical reminder system for ambulatory care (Zheng et al., 2004). However, most of these systems only target the workflow of clinicians, i.e. they are intended to support healthcare providers. Thus, they neither sufficiently support patients nor do they offer solutions targeting the complex requirements of patients.

A step in the direction of our proposal is (Panzarasa et al., 2004), which allows patients to obtain readings of their parameters themselves and sends them to care centres. Nevertheless, the evaluation of these readings is exclusively performed at care centres. Hence, in contrast to our approach patients only transmit data but are excluded from their own treatment.

Orion's commercial system Soprano Clinical Workflow (Hobson et al., 2003) is used for disease management and offers automated care alerts and reminders for health professionals. It also coordinates care tasks

between healthcare providers. However, it does not meet the requirements necessary in our area of application, since it is merely centred on medical staff, e.g. it lacks a mobile component for patient support.
In (Wagner et al., 1998) it has been shown that clinicians like information being pushed to them. Nevertheless, user profiles are required, as there is a high inter-user variability in how people prefer information to be pushed to them. Neither (Panzarasa et al., 2004) nor (Hobson et al., 2003) offer the possibility to define user profiles and thus, they are not applicable for our purposes.

The TIP system (Hinze & Voisard, 2003) is under ongoing development in our group. It is an AS which allows general user profiles and is now extended to support mobile devices. However, it lacks sufficient security mechanisms and works with a data model and a language to define profiles which is only suitable for the domain of tourism. Its applicability to our requirements which are described in detail in Section 5 is an open question and remains to be examined.

As we can see from this discussion current systems neither meet the various requirements of a patient-based approach nor offer an architecture that suits the demands of that kind of support system. In the following section we present the general architectural design fulfilling the requirements of our support system.

4. Architectural Design

In this section we give an overview of the architectural design of our mobile support system and the general clinical infrastructure it is embedded in. This architecture meets the specific requirements which have been outlined in the use cases in Section 2 but also all general requirements that are described in Section 5 as conceptual design considerations. An example of these considerations is an AS (realised by the event filter and lightweight database/Electronic Health Record, respectively) interacting with both patients and doctors. Evidently, parts of our system have to be integrated into an existing CIS, e.g. to promote data interchangeability and reusability. Our architecture allows for this integration. Figure 1 gives an overview of our proposal for the architecture of our support system, which consists of three components.

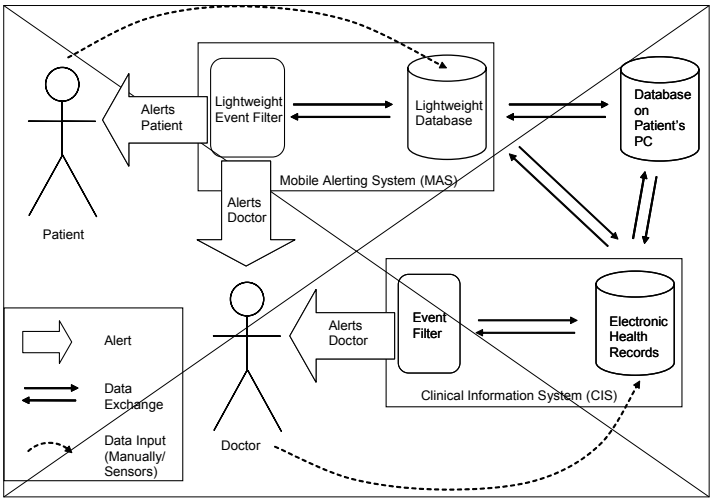

Figure 1: Architecture of the Support System for Patients with Chronic Conditions

In the upper part of the picture there are two components, the MAS and the patient's PC. Below, the third component, the existing CIS with an integrated event filter is shown. This event filter is our extension of the existing CIS. These three main components of our support system interact by bidirectional data exchange.
Conceptually, the MAS consists of a lightweight database and a lightweight event filter. The database holds condition-related patient data, which includes profiles, parameters measured by patients, educational material about a patient's condition and medical information provided by doctors or nurses. This data is supplied

to the system manually or by sensors. Since both medical staff and patients are able to define profiles for patients, our system suits both medical requirements and personal situations and preferences. Next to the profiles defined for patients, medical staff can also define profiles to be alerted themselves. The event filter is responsible for filtering incoming data. If this data matches a profile of a patient, he is alerted. Since medical staff are able to define own profiles they are alerted when their profiles are fulfilled.

Patients' master data can be transferred to the MAS from the hospital database or from the GP's information system and does not have to be stored by patients themselves. To avoid data loss we back up data from the MAS to the patient's PC. This task can be obtained automatically according to preferences of patients. Furthermore, due to restricted resources of a mobile device we utilise the patient's PC to store the full history of patient data.

The event filter incorporated in the CIS works similarly to its mobile counterpart with the difference that doctors may register different profiles than for the MAS. Furthermore, the event filter in the CIS matches profiles against the complete history of data, which cannot be held on the lightweight database of the mobile system. This set of data also includes information that has entered the clinical database via other sources than a patient's MAS (e.g. by an ECG). Hence, the clinical event filter allows both the combination and utilisation of the complete data stored in the CIS and data provided by patients.
For this reason, the CIS can discover and control sleight long term changes in the conditions of patients, whereas the MAS fulfils its aim in monitoring for sudden abnormalities.

5. Conceptual Design Considerations

Next to the use cases we have presented in Section 2.2., we have developed a first cut requirements analysis with the help of selected interviews. This analysis and the use cases yield several functional and constraint requirements, which cover the areas of alerting systems, data modelling, information systems, security, mobility and Human Computer Interaction. Currently, we are verifying and extending our requirements analysis with a survey and plan a content analysis of online communities. In the following sections we will give a brief overview of functional and constraint requirements. Thereby we also point out what research issues are relevant for the design of our system. Note that the requirements systematised in the following research areas depend on each other.

5.1. Alerting systems

In all three use cases (Section 2.2.1. – 2.2.3.) various alerting functions were required. Consequently, we suggest the utilisation of an AS for these adaptable alerting functions. To give you an impression of the conception of ASs we begin with a brief introduction to their operating mode: ASs are systems that inform their subscribers about certain facts they are interested in. Information about these facts is provided by publishers, which send messages about these facts to an AS. These messages are referred to as events. They describe changes in the state of an object (in our context, e.g. in the blood pressure of a patient). The interests of subscribers are defined by so-called profiles, which describe filter operations on events. These profiles are registered with an AS. Whenever the AS receives an event which matches one or several profiles, the respective subscribers are alerted by a notification. The previous description shows that ASs offer a high amount of flexibility, e.g. subscribers can subscribe and adapt profiles depending on their personal circumstances. Furthermore, the paradigm of ASs (subscribe once, filter regularly) matches the needs of chronic patients, e.g. keeping disease patterns and medical parameters relatively stable: The observation of patients' health has to be performed regularly (filtering) and is constant to a certain extent (subscribe profiles, once). Nevertheless, if changes in the condition of a patient occur, his or her treatment can be changed (adapt profiles). Hence, ASs are the perfect solution to our problem, since they offer a very adaptable concept and allow continuous observations with little effort.

For ASs our first cut requirements analysis has discovered differing demands depending on the role of users, since they have to perform differing tasks in the management of diseases (cf. all three use cases in Section 2.2.). Currently, we have specified requirements for patients, doctors and nurses. The patient-based functions a support system has to offer include the tasks shown in Table 1.

Alert patients to take the correct amount of medicine
Alert patients to take medicine at the correct time
Alert patients to take the correct type of medicine
Alert patients to get a new prescription
Alert patients of possible interactions between the medication they are currently taking and another medication they want to take
Alert patients of possible adverse effects of the medications they are taking
Alert patients to make appointments with their doctor
Alert patients of having an appointment with their doctor
Alert patients to measure parameters and store them in the system
Alert patients about critical values of their readings, e.g. too high blood sugar values
Alert patients about critical values of their parameters involving a combination of several parameters such as usually only a doctor could judge (e.g. visual fields, cup/disc ratio and eye pressure)
Alert patients of new educational material concerning their conditions

Table 1: Patient-based Alerting Functions

Doctor-based alerting functions differ from patient-based ones (cf. use cases doctor and patient). They are generally more refined than the requirements of patients (although they also vary between patients). Doctor-based alerting functions include those functions which are given in Table 2.

Alert doctors if patients' readings are critical, e.g. too high blood sugar values
Alert doctors about critical values of their patients' parameters involving a combination of several parameters (e.g. visual fields, cup/disc ratio and eye pressure)
Alert doctors if patients' readings are slightly abnormal over a longer period of time
Alert doctors if patients are not complying with taking measurements of their parameters
Alert doctors if patients are not complying with taking their medicine regularly
Alert doctors of possible interactions between the medications their patients are currently taking and other medications they are going to be prescribed
Alert doctors of possible adverse effects of the medications their patients are taking
Alert doctors about new educational material concerning their patients' conditions

Table 2: Doctor-based Alerting Functions

Functions the AS should offer for nurses differ only slightly from doctor-based ones (cf. use case nurse and use case doctor) and include the tasks given in Table 3.

Alert nurses to give the correct amount of medicine
Alert nurses to give medicine at the correct time
Alert nurses to give the correct type of medicine
Alert nurses to send patients to doctor consultations
Alert nurses when technical devices for examinations are available
Alert nurses of critical values of their patients' readings, e.g. too high blood sugar values
Alert nurses of critical values of patients' parameters involving a combination of parameters
Alert nurses about new educational material concerning their patients' conditions
Alert nurses of possible interactions between the medications their patients are currently taking and other medications they are going to be prescribed
Alert nurses of possible adverse effects of the medications their patients are taking

Table 3: Nurse-based Alerting Functions

Before being able to express these alerting functions, we have to specify a suitable data model. This model has to allow for the representation of the characteristics of the medical domain. Then, we need to develop a

Profile Definition Language that is suitable for this domain. This language has to be built on the data model we will develop. Thus, we are able to define profiles for all the alerting functions described above.

5.2. Data model

In order to enable the MAS to successfully offer its functionalities we have to be able to represent facts about patients, their conditions, medications, organisational structures, etc. Hence, we have to develop a data model that allows for all details of the medical domain (e.g. in the use case patient we have two different kinds of diseases with treatments that might interact). Especially, it has to take into account the inter-user variance of patients and medical staff as denoted in our use cases and should be adaptable to all major chronic diseases. For this adaptability personalised parameters are to be stored such as presented in Table 4.

Master data of the patient (e.g. name, address, date of birth)
Data about medications taken by the patient (e.g. name, dosage, time to take it)
Allergies of the patient
Parameters measured in respect to the patient's disease (e.g. blood pressure and blood sugar)
Other data relevant for patient (e.g. maximal pulse for running)

Table 4: Personalised Parameters

Moreover, it would be relevant to be able to represent general medical data in our data model such as given in Table 5.

Information about adverse effects of medications
Information about interactions between medications
Educational material about conditions

Table 5: General Parameters

To ensure the integration into an existing medical infrastructure we will develop a data model suitable for both the description of the medical domain and the identified functional and constraint requirements.

5.3. Information systems

Doctors need to make use of their CISs to refer to patient data (cf. to Dr Jones in the use case doctor). So it is indispensable that our system should integrate with existing information systems that also contain EHRs. This is necessary for both the utilisation of already existing clinical data by our MAS and the integration of data from our MAS into the CIS. A further advantage is the possibility to easily synchronise the data held by the MAS of a patient, the data held by the PC of a patient and the data held by the CIS.

We will therefore design the AS to be adaptable to formats usually used by CISs. Hence, the possibility for data exchanges between our system, EHRs and the overall clinical infrastructure is given. This means in order to facilitate information sharing we will examine existing EHR architectures such as the G-CPR Framework (Forslund et al., 2000), the HL7 RIM (Vizenor, 2004), the CEN ENV 13606 (Blobel, 2002) and the Australian GEHR project (Blobel, 2002) for their applicability to our project.

5.4. Security

Clearly, a combination of personal and medical data is sensitive and confidential. Consequently, due to the delicate nature of medical data (Anderson, 1996) security issues have to be addressed: Firstly, confidentiality is of relevance. Therefore the transmission of data from the MAS to the backup medium on the PC and to the information system in the clinic has to be secure. Otherwise patient data could be accessed by unauthorized people such as possible employers (e.g. Mr Smith's employer does not necessarily have to know about his glaucoma, c.f. use case patient). Backup of data has to be realised automatically, since patients do not want to be concerned with it. Secondly, a secure authentication mechanism to access the MAS, the PC and the CIS is essential to avoid unauthorised persons to access patient data. Otherwise it would be problematic if patients left the support system anywhere unattended. Finally, data integrity must be guaranteed

and also non-repudiation must be given. It must not be possible to forge medical data as this may be hazardous to the life of the patient. There are standard solutions to the described problems which might be utilised in our context. Hence, at the moment we will not focus on these security aspects. Though, it remains to be analysed if these standard solutions really suit our application scenario.

5.5. Mobility

Since we are dealing with a system on a mobile device, there are certain limiting factors which have to be taken into account. One area to deal with are the problems involved with the transmission to and from the mobile device. We only have a limited bandwidth to work with and therefore our data model and implementation have to be developed in a way that allows for the transmission of the required content using a small bandwidth. Also transmission itself has to be guaranteed and a minimal latency is necessary to ensure that medical staff are able to react fast enough when emergency actions are required. Furthermore, to avoid unnecessary costs, it is essential that the system only establishes a connection when actual data transmission is required (e.g. we only require transmission when Mr Smith has inserted new blood sugar values, cf. use case patient). The MAS will be used in hospitals too; hence it has to be made sure that there is as little electromagnetic interference with other medical devices as possible. Similar to the problem of limited bandwidth of transmissions, due to costs the mobile device will only have a limited amount of main memory and hard disk. Thus, the MAS has to be a lightweight version, whereas the AS that is directly integrated into the CIS should contain the full functionality. Accordingly, the database running on the mobile device has to be a lightweight version of the database in the CIS.

5.6. Human Computer Interaction

There are some HCI issues which are significant for the development of the data model underlying the MAS, e.g. patients should be able to adjust the AS to the level of surveillance they can accommodate in a certain situation. This should be possible since the level of surveillance is dependent on the time of day and the situation and mood the patients are in, e.g. if Mr Smith is taking a nap in the middle of the day he would like to disable alerts about minor issues (cf. use case patient). For each chronic condition we have to design basic default settings, which can be chosen if desired. Additionally, we have to offer advanced functions which are programmable by users. Hence, our MAS requires an easy-to-use interface adaptable to people with different conditions. It should be possible to switch to a voice interface, e.g. if Mr Smith's vision worsens in a way that he cannot manage the display anymore (cf. use case patient). For the acceptance of the AS it is vital that a variety of alerting media are offered so users can choose what best suits them. Also, the AS should enable clinicians to practice their own protocols and best practice guidelines and not press them into using schemas they cannot work with.

6. Conclusion and Future Work

In this paper we have proposed a novel kind of support system for patients with chronic conditions. Our approach exploits a mobile alerting system to actively involve patients in their own treatment. This system aims to improve patient compliance in the treatment of their conditions, to relieve doctors from organizational bureaucratic work and thus to improve the overall treatment results.

We started by identifying exemplary use cases for our new kind of support system. On the basis of these use cases we analysed and investigated several existing systems in respect to their suitability as patient-based mobile alerting systems. None of these examined systems has proven to be able to support the entire range of features identified in our use cases. >From our use case analysis, we deduced functional and constraint requirements for this novel kind of patient-based mobile alerting systems. On this basis we proposed the general conceptual and architectural design of our support system. Our architecture includes an autonomous component for patients as well as an extension of current clinical information systems. Thus, our envisioned patient-based support system enhances currently deployed medical infrastructures by providing the possibility to actively involve patients leading to a more effective management of their diseases.

In the future we want to refine the requirements identified so far and develop a suitable data model and Profile Definition Language. We will also practically realise our mobile alerting system, e.g. by utilising core features of the TIP system (Hinze & Voisard, 2003) depending on their applicability.

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