Point of Care Drug Administration through Handheld Mobile Device

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Abstract— *This paper introduces a numerical assessment methodology to integrate EMR to the handheld device to reduce medication errors in the hospital setting. Softwareis designed to support positive patient identification using bar code technology which is deployed using handheld devices with integrated bar code scanners. Hand held Point of care device automates the documentation of medication administration and documentation of tasks related to specific physician and nursing orders at the point of care (POC). Hand held Point of care device also enables you to document simple nursing tasks from the handheld device which would prevent errors which are 39% in ordering, 12 % in Transcribing, 19% in dispensing and 38% in ordering and to overcome hazardous effects.*

Index Terms—*Electronic Medical Record (EMR), electronic medication administration record (eMAR) and prescription order entry systems (POES)*

I. INTRODUCTION

Hand held Point of care device provides a safe medication process by scanning a patient's wristband identifier and then scanning a medication bar code identifier. Within these scanning events, Hand held Point of care device automatically checks for the five (5) patient medication rights (right patient, right drug, right dose, right route, and right time). Hand held Point of care device also enables you to document simple nursing tasks from the handheld device. For example, you can complete vital sign documentation or intake and output documentation at a patient's bedside, and the results will be stored in the database immediately.

With POC serving as the platform for the Hand held Point of care device solution, the infrastructure for the incorporation of additional mobile applications is established when deployed via handheld devices the different functionalities can be used in such solutions. Recent literature on health care quality contains numerous alarming statistics on occurrences and consequences of preventable medication errors.[1] Medication errors can occur at any stage of the use process, from ordering, transcription and dispensing to administration. Administration errors that lead to serious non-compliance to medication directions contribute a significant percentage (25 – 40%) of all errors. They are the cause of 25 % of admissions to nursing homes and have led to billions of dollars in hospital cost and deaths in thousands each year. [2]

Medication administration has been labor intensive for health-care professionals and, hence, can be error-prone. A naive user may be on multiple medications and have many prescriptions each year, in addition to over the counter (OTC) drugs and health supplements. Staying compliant over years and decades is challenging, even for well-educated and disciplined users. These facts have motivated the use of device and information technologies for prevention of medication errors and improvement in compliance. [1]Numerous administration and compliance aids are now available. For health-care professionals, pharmaceutical distributors and hospital equipment industry offer all sorts of medication carts, cabinets and robots for administering medications in a controlled manner and tracking the use and inventory of medications managed by them[2].Devices and tools for personal and small clinic use range from pill boxes, Alarms, and programmable medicine dispensers to on-line scheduling and time table formatting tools and services. Existing administration and compliance-aid devices and tools fall short in many aspects; automation and integration are the most important. Take existing dispensers for

personal use as an example. Some of the frequently cited reasons for non-compliance are inability to understand directions and inconvenience of rigid schedules. Existing dispensers are of little or no help in this respect: One must manually load the medications into the dispenser and program the device according to directions. Modern drug libraries provide comprehensive information on firm and hard dose size and timing constraints and compliance criteria for common medications. Because such information is not captured to guide their operations, existing dispensers and scheduling tools cannot take advantage of the information to make medication schedules more flexible and user friendly while remaining rigorous in compliance.

This paper focuses on the point-of-care and end-user level of an open environment of information systems, tools and devices for integration and automation of medication process [4]. It is encouraging to see increasingly wide spread deployments of electronic health record, electronic medication administration record (eMAR) and prescription order entry systems (POES).

By and large, they are not fully integrated with administration tools, however. Most of the smart medication carts, cabinets and robots used in hospitals and home-care and assisted living facilities are custom built and have proprietary interfaces. Like medication dispensers for personal use, the tool environment does not support their integration and automation to the degree required for error-free medication administration. Even the integration of devices with interface capabilities conforming to HL7 standards requires extensive custom development [3]. This provides further motivation for an integrated chain of medication process support tools that extend all the way down to administration devices and compliance aids.

II. MEDICATION ERROR

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring and use. Medication Errors are analyzed by the types of breakdowns within the medication system. The categories of errors may not be mutually exclusive because of the multidisciplinary and multi factorial nature of medication errors. Medication errors are categorized along each functional step of the medication cycle: ordering, transcription, preparation and dispensing, administration, monitoring, equipment /environment and contributing factors.

Order Error – Types of ordering errors include: inappropriate medication selected, inappropriate
dose, illegible order, duplicate order, order not dated/timed, wrong patient/chart selected, contraindications, verbal order misunderstood, verbal order not written in the chart, wrongfrequency, route, therapy duration, alert information bypassed or use of nonstandard nomenclature
Or abbreviations.

Transcription error –Transcription involves both the orders that are manually transcribed onto manual record (e.g., medication administration record (MAR)) and electronically transcribed into computer systems (eMAR) [5]. Types of transcription errors include: wrong medication, time, dose,
frequency, duration, rate patient/chart, verbal order misunderstanding, verbal orders not entered into SCM system, orders entered into SCM that are discrepant from the medication history, order not manually transcribed onto MAR, wrong scheduling of doses in the eMAR.

Preparation/Dispensing Error – Types of preparation and dispensing errors include: Inaccurate labeling, wrong quantity, medication, dose, diluent, formulation, expired medication, Pyxis refill error, and delay in medication delivery.

Administration Error – Types of administration errors include: Wrong patient, dose, time, medication, route, rate, omission, extravasation (may be an ADR) and unauthorized dose given Equipment Environmental Factors – Types of equipment environmental problems included: lookalike/sound-alike problems, pump problems, Pyxis

problems, computer problem, equipment availability, and packaging/design problem. Contributing Factors – Types of contributing factors include: fatigue, calculation error, knowledgedeficit, performance deficit, workload, computer software issue, computer downtime, hybrid system(manual/computer processes), lack of communication between practitioners, missing critical info,alert bypassed, MAR reconciliation process, order entry into pharmacy systems, accessed viaoverride, charting related error, medication reconciliation at transitions.

Other - Any system breakdown that is not captured with one of the above predefined breakdownpoint should be classified as "other" and described.

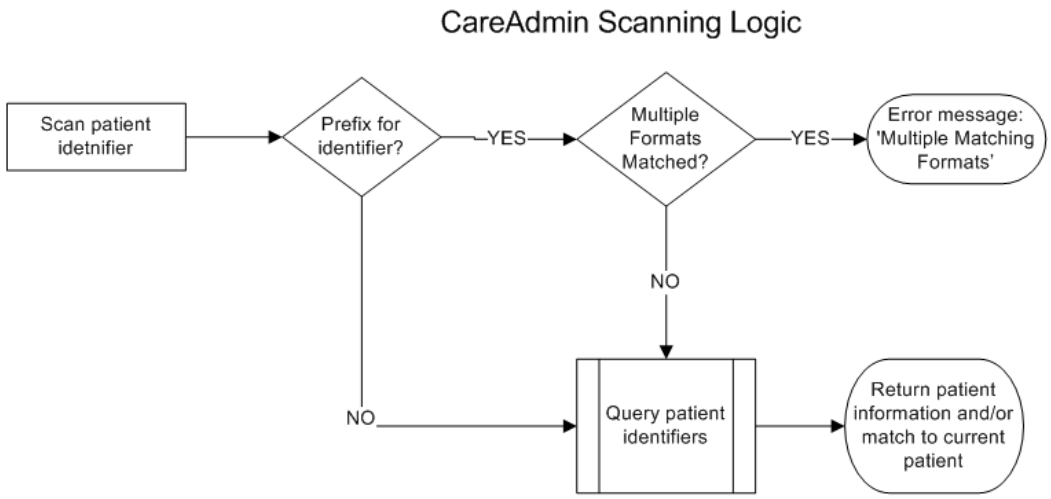

Fig1: care device work flow

III. RELATED WORK

From the mid-1990s onwards, when Internet access andusage became widespread and turned into the primary networkfor telecommunications, e-Health emerged as a promising field for better and more efficient health care delivery using web enabled services. The subsequent eHealth revolution gave rise to a substantial growth in the number of available tools to monitor the patient's condition, usually in the home environment, and in facilitating earlier diagnosis and more effective treatment [4]. Examples of commercial systems employed in practice include Bosch Health Buddy [5], [6] and Intel Health Guide [7], which are devices that support the attachment of sensors and the transmission of data to a central server where they can be inspected by responsible caregivers. Although existing eHealth systems support monitoring of the patient's condition, they provide very limited feedback to the user [7]. Typically, a few, often just one, clinical parameters are measured, and stored within a database system to be interpreted by a health care professional. Thus, these systems just collect data and lack the clinical interpretation capabilities of a medical doctor, who takes the patient's history into account, including that of the underlying disease, and has the clinical expertise to interpret patient data. The availability of modern mobile computing and communication technologies opens new avenues for computing, allowing a part of the medical decision-making tasks, such as diagnosis, selection of appropriate treatment, and prognosis, to be relocated from the doctor side to the patient, at any place and at any time [8]. This technology has given rise to the field of mobile health or mHealth [9]. Currently, the most commonly used mHealth technologies include smartphones, personal digital assistants (PDA), wireless tablet computers, wearable wireless bio-sensors and disease monitoring devices. The rapid penetration of this kind of devices into our daily lives is expected to provide greater access to health care, to larger segments of the population. Another great advantage of mHealth lies in its capability to support patient empowerment by helping improving the awareness on his/her own health condition and on the estimated outcomes, guided by the mentioned smart devices. Always with the explicit intention of the user/patient.

IV. EVALUATION

The usability and reliability of mobile health systems are key factors in their acceptance and adoption for long-term use, by the users, in disease self-management. To guarantee these properties, a thorough evaluation of each system's components (hardware and software) is required, which involves multiple testing phases. This process usually starts by testing the individual components (for example, use of sensors, mobile device operation, manual data entry), then moves on to integrated testing to check whether or not the different components work together as intended (for example, data transmission, networking), and finally by performing field tests with the users in the environment for which the system was actually designed. During the first two phases, formal methods, such as model checking and program verification, may be applied, for example to prove the absence of deadlocks. During field testing, evaluation is done by a randomized clinical trial, where each patient is using the same system, but for half of the randomly selected patients the system will have no effect on the management of the disease, in such a way that the system does not provide any effective feedback to those patients, while for the other half of the patients the system will indeed give such appropriate feedback [6]. As for many mobile health systems guarantees can be given that they will never be harmful to the patient, evaluation amounts to determine whether the originated intervention is effective, i.e. that it contributes to improve health care by comparing standard care results, such as the number of patients that are admitted to a 2013 IEEE 15th International Conference on e-Health Networking, Applications and Services (Healthcom 2013) 191hospital each year. If the number of admissions has dropped for patients who used the mobile health system, then there would be clear evidence that the system would have been effective. Before an actual field test can be started, insights are needed regarding the usability, reliability, and user-friendliness of the system, because, if the system fails to meet reasonable requirements regarding these aspects, carrying out a proper field test will be a clear waste of time. Therefore, before any field testing is carried out, in the MoSHCA project, usability tests will be performed with future users, subsequently obtaining feedback through questionnaire. The feedback will not only report on issues with the technical operation of the system, but it will also relate to usefulness and added value in terms of self-management, confidence, and willingness for a continuous usage of the system. A usability test may also help pinpoint

V. ISSUES THAT NEED TO BE WORKED ON TO IMPROVE THE SYSTEM.

A. Hardware Limitations

Although current mobile devices such as smartphones have sufficient processing power for off-line data interpretation and signal processing, continuous and real-time interpretation of user data will inevitably put high demands on available battery power [6]. There is a need for more insight in the trade-off between available battery power and apps algorithms execution, in association with energy consumption.

B. Communication

The concept of a smart health care assistant implies the need for deploying different sensors depending on the diseases which are dealt with. However, we are not yet in the position that one can easily integrate a new/unforeseen sensor in the smart health care assistant's architecture. Often, the data exchange protocol of a commercially available sensor is not publicly available and/or a generic interface device that allows integrating different sensors does not yet exist [6].

C. Model Building

Building disease models for the interpretation of user data from scratch is difficult and time consuming. However, after the introduction of a smart health care assistant it may become feasible to exploit machine-learning methods to learn and tune models from large sets of user data, giving rise to a gradual quality improvement of the device. However, until the widespread availability of these devices, manual building of models will be primarily practice [6].

D. Contextual Awareness

Patient characteristics, such as age, gender, personal and family history of diseases, lifestyle choices with respect to eating, alcohol consumption, smoking and sports, are often the factors that affect the risk of developing a disease. When a disease is already present, these factors and related options may, positively or negatively, affect the course of the disease. Such patient-specific information can be easily collected by answering questions or filling-out questionnaires on a mobile device. Part of this information is also available in health records. It will be a key challenge to integrate all this contextual information in order to provide robust and relevant feedback to the user [6].

E. Ethical Considerations and Safety

Current concerns for establishing the public's trust in mobile health systems relate to the security of collecting and transmitting patient data. However, these concerns are expected to be outweighed in the future by further developments in digital security using, for example, electronic signatures, authentication and multi-application smart-card solutions, and by proven health benefits to the individual by using mHealth systems.
Furthermore, a mobile health system can in principle function without access to remote data, so future developments may allow the patient to control whether or not its sensitive data is transmitted, and when. Also, appropriate training programs can further enhance the willingness of health care professionals to adapt their clinical practices by using mobile decision support technologies. Finally, mHealth systems are meant to stimulate sharing the responsibility between all stakeholders in the health care system, which in turn can stimulate further requirements [6].

VI. CONCLUSION

The development of smart mobile health care assistants involves various research challenges, many of them technical, while others concentrate on the stakeholders, such as the end user and society as a whole. In the paper these challenges are addressed by well-chosen use cases that cover a wide range of current and future applications of smart mobile technology. This paper covers the main issues that must be tackled for the successful development and deployment of such systems.

VII. REFERENCES

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