LET_ME: An Electronic Device to Help Elderly People with Their Home Medications

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Abstract. Recent literature reports on high adverse events rate, especially among elderly people, due to bad self-administration of their drug therapy. They make errors taking wrong drugs, or taking drugs with incorrect dosage and frequency. These "*therapy errors*", in the USA, cause about 3,000,000 hospital admissions each year. Within the medical informatics community, different research groups are developing computer-based support systems addressing this problem. This paper presents a novel approach in this area, and describes a device to make home drug therapy as safe as possible. The system designed took into account the whole process, starting from drug prescription by the general practitioner, to the drug acquisition to the chemist and, finally, to drug assumption at home.

Key words: Therapy errors, medication errors, administration errors, non-compliance, home therapy, elderly people

1 Introduction

Since the '60s the number of publications about errors due to wrong use of drugs is constantly increasing. Many of these papers talk about the high mortality rate, and especially among elderly people, due to bad self-administration of their drug therapy. Recently, a number of new devices have been developed to help elderly people take their medicines, but the novelty of this project regards the whole context related to the home drug treatment: it considers the roles of general practitioners, specialists, pharmacists, and of course the patients themselves.

A *therapy error* is any predictable event that can cause the incorrect use of a drug or a damage to a patient when the drug is under control of caregivers or the patient himself[1].

These errors can happen in every moment of the drug management process and can be classified as[1]: *prescription errors*, *transcription errors*,*therapy preparation errors*, *administration errors*, *dispensing errors*. Another potential issue of the home treatment is caused by drugs that do not require prescription. Self-medication can improve the attention for one's own health, but it can also increase the probability that self-prescribed drugs are used incorrectly, modifying the effects and safety, increasing the probability of ADEs (Adverse Drug Events) due to drugs misuse.

Often elderly people self-manage their drugs, and errors are caused by memory problems, unavailable prescriptions, and/or lack of understanding of the treatment regimen. Increasing the number of contemporary drugs or the assumption frequency of drugs, increase the errors that they can make[3, 2].

The organisation of the paper is: in the following section we illustrate the project and some applications; and then we present the conclusions and future works.

2 LET_ME

The name of our device is *LET_ME* (from the Italian words LETtore di prescrizioni MEdiche; in English: reader of medical prescriptions). The final user of this device will be the elderly or, in general, people with memory problems that must follow a home therapy, their caregivers, and people with drug allergies. LET_ME is a PDA (Personal Digital Assistant), equipped with 2 reader: a bar code reader used to identify the drugs by means of a special kind of bar code, called *farmacode*; and an RFID reader to identify the patient, that is supposed to wear a simple wristband. This functionality is necessary when more than one patient use the device in the same home (e.g., husband and wife). The proposed system needs information about drugs marketed in Italy, and so the database used in this project has been supplied by "Farmadati Italia S.r.l.".

LET_ME has two modalities: *programming modality* and *user modality*.

2.1 Programming Modality

The programming can be made by the prescribing doctor or by the pharmacist.

1. Programming by *the prescribing doctor*. The patient goes to the doctor bringing the LET_ME with him. The doctor repeats for all medicines:
   - using his PC, writes and prints the prescription;
   - then, he prints the bar codes of the prescribed drugs with the same computer procedure. Referring to the pharmaceutical label, he must print the bar code on the new adhesive label representing the A.I.C. code and the drug name. In addition, the text "LET_ME PROJECT" will be printed to explain the presence of the new label, in case patient drug boxes are checked for legal reasons. Next steps are:
     - the doctor reads the A.I.C. code using the bar code reader;
     - LET_ME recognises the code, by searching into its drug DB, and displays it with the corresponding drug name;
     - the doctor assesses dosage and time, or frequency. To make this programming phase as much smooth, speedy and safe as possible, the device can: show standard dosages and timing reported in the DB for all the pathologies/symptoms curable with this drug; allow to modify dosages and/or timing displayed at the previous point, by pressing few buttons; verify possible presence of components that

can cause allergy or intolerance to the patient, possible interactions with drugs already stored for the patient in the patient's active list, to show possible drug-food and drug-drink interactions.
- when the prescription is completed it is stored into the patient's active list, which is integral part of DB;

Also, the doctor can update previous prescriptions.

2. Programming by *pharmacist*. The programming will be done by the pharmacist when the patient goes to the doctor forgetting the LET_ME, following doctor's instructions about drugs, dosages and frequencies. If, among the prescribed drugs, there are some refundable medicines, the pharmacist removes the original farmacode labels, and replaces them with the ones printed by the doctor. If the patient buys drugs on his initiative, for example O.T.C. (Over-The-Counter) or S.O.P. drugs (Senza Obbligo di Prescrizione; in English: without prescription obligation), the pharmacist will not do anything.

Checks. LET_ME carries out four checks. With the first one, it checks whether the drug is already stored. The second check controls the drug components to which the patient is allergic or intolerant (e.g. penicillin) The third check controls that the active principle is not in "conflict" with the other active principles already present in the current patient's treatment. In this case, LET_ME displays a message which says that the drug can not be administrated combined with the other one and if the programmer is the doctor, he decides how to proceed. If the programmer is the pharmacist, he will stop programming and contact the doctor. The last check regards drug-food interaction and drug-drink interaction, in order to avoid alteration of the expected drug effects. The device verifies if the drug must be taken "on a full stomach" or "distant from mealtimes" and if some particular food and/or drinks can modify the therapeutic drug effects.

An example of a drug-drug interaction check: we suppose that among drugs present into patient's active list there is the "SIVASTIN 28 CPR 20 MG RIV", the allergy list is empty, and the doctor prescribes to the patient the "LIPOZID 30 CPR 600 MG". LET_ME checks if this drug is already stored in the patient's active list, and it is not, then it checks drug-drug interactions, and it finds that an interaction exists between SIVASTIN active principle (simvastatin) and LIPOZID one (gemfibrozil) and so the device shows on the screen a message such as: "The drug contains gemfibrozil that interacts with simvastatin, and so this drug can not be prescribed since the patient is taking SIVASTIN 28 CPR 20 MG RIV".

2.2 User Modality

When the patient is at home and he needs drug information, he turns on the device and moves the package near the reader. Then, LET_ME shows the prescription stored, with the following information: name of medicine; dosage; time or frequency; note about food and drink Pressing the AUDIO button, the displayed information can be listened through a synthesized voice. This is useful for patient with eye problems, that are known to be an error source too[4].

If the patient uses LET_ME with a O.T.C. or S.O.P. drug, we have two cases:

1. this kind of medicines were prescribed by the doctor and so LET_ME has a stored regimen about them;
2. they were bought from patient on his initiative and so LET_ME does not have regimen, or they were bought in shop different from a pharmacy.

Let us focus on the second case. Patient holds the "TACHIPIRINA 20 CPR 500 MG". Patient turns on LET_ME, which reads the farmacode; LET_ME seeks the drug into the patient's active list and does not find it. So the device makes a search into its DB to see if the drug is an O.T.C. or a S.O.P. Then, LET_ME extracts the active principle of TACHIPIRINA, i.e. paracetamol, and checks for drug-drug interaction with the medicines stored into the active list. We suppose that into the active list there is "TEGRETOL CR 200 30 CPR 200MG"; its active principle is the carbamazepine which interacts with paracetamol, so LET_ME shows: "This drug contains paracetamol that interacts with carbamazepine, so this drug can not be taken because TEGRETOL CR 200 30 CPR 200MG is in your therapy".

3 Conclusions and Future Works

The aims of this new device called LET_ME are: improving medication adherence and safety in the administration of medications; reducing hospitalizations, and consequently healthcare costs. Compared to the existing tools, LET_ME: allows patient's doctor to keep under control all the prescribed drugs, avoiding dangerous drug-drug interactions; it can be used by more than one patient, thanks to an identification wristband; it gives information about food and drinks that could interact with the patient's drugs.

Now, we plan to evaluate the system in two phases. First, with some subjects volunteers, to test the reliability of the device, its usability, discovering bugs. The second phase will be a trial with more subjects. These subjects will be subdivided in two groups: the first will use this device and the second one (the control group) will not use it, to prove the efficiency.

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