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A Decision Support Software Package for medical treatment of I.C.U. patients

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Abstract. Critically ill patients admitted in I.C.U. often have multiple complicated problems which necessitate the use of a large number of drugs. The multiple potential interactions between substances and underlying pathologies as well as between substances themselves, obviate the need for a decision support system. We therefore developed a software package for medical treatment support in I.C.U. environment which is based on Microsoft Visual Basic 3.0 and it is organised around the commercially available RDBMS Access 2.0. The database consist of: a) all available substances, b) all generic names of medications available in Greece for each substance, c) incompatibilities (2,300 cases), d) interactions (50,000 cases) and e) cost information for each drug. This system assures the safety of the administered treatment, helps to adjust the dose according to the situation of each patient (anthropometric data, laboratory results, prognostic/severity score e.t.c.) and screens for possible interactions and incompatibilities between the administered drugs. It could also be used for education, treatment algorithms application and it will serve cost-reduction policy. It is a useful and powerful tool for ICU staff which does not impose additional work to the daily practice routine and it is currently under evaluation in clinical settings.

1. Introduction

The practising physician in most of the medical specialities is aware of and feels comfortable to administer only a limited number of remedies without previous book or note consultation. A survey has shown that each physician knows around thirty remedies regarding the dose, interactions and incompatibilities with other drugs, side effects, cost and toxicity. On the other hand, the intensivists cover a broad field of medical specialties and each patient receives a large number of drugs. Most of the intravenously administered drugs, create incompatibilities and drug interaction problems. Enough time for a review of the current literature before administers a drug rarely exist. Therefore, the need for a bed side updated information is obvious. That is even more important, in units where there is no clinical pharmacist available. Several decision support systems have been developed to diagnostic decision [1, 2], to evaluate test results [3] or to optimise treatment in specific diseases [4, 5, 6]. Computerised medical order writing in ICU have been shown to be of importance and may be used even without previous computer experience [7,8].

We thus aimed to develop a computerised medical order writing system associated with a decision support system for treatment in ICU.

2. Description of the System

The system presented is a Window-based program application intended to provide the intensive care physicians with : a) a computerised drug prescription order b) on-line electronic information for medications and c) a complete on-line electronic patient treatment chart.

The first is modelled on the traditional drug catalogues and the second is modelled on the traditional paper chart, but goes way beyond. We separated the database of the system into two categories: the "reasoning database" and the "retrieval database".

The retrieval database contains data related to patients as anthropometric data, selected biochemical laboratory result regarding hepatic and renal function and all treatment prescribed through the system. The reasoning database contains data that are structured in nature and each data record had to be accessible by a unique key.

The core of the reasoning database is the information concerning the medications available in Greece. In details it concerns : a) all available substances (almost 2,000), b) all generic names of medications available in our country for each substance (almost 12,000), c) incompatibilities (2,300 cases), d) interactions (50,000 cases), e) side effects for all substances on system, and f) cost information for each drug.

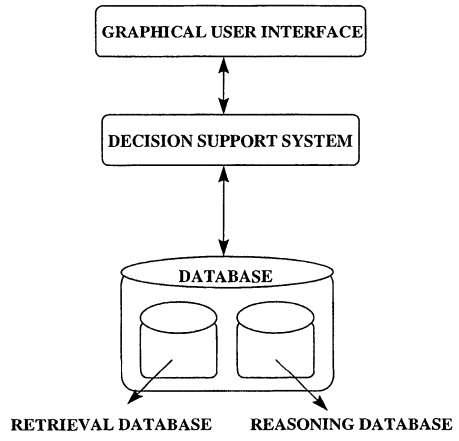

Fig. 1: System's design

Each record identifies a particular substance and contains information as compounds' generic names, usual dosage, and incompatibilities. Of particular note, this database is organised hierarchically by category and sub-category of each compound. We choose to develop the system using Microsoft Visual Basic 3.0 and the commercially available RDBMS Access 2.0 (Microsoft, Redmond, WA, USA). The overall system's design is illustrated in Fig. 1.

The database entity relation diagram is outlined in Fig. 2. The interaction of the system with the physician is initiated by the insertion of the patient's anthropometric data. Then, the physician may issue a computerised drug prescription order. The contents of the order, except from those referring to the patient, can be entered either by selecting a generic name or a product name. In the first case, when the physician selects a generic name, all the drugs containing it, appear in the screen so that she/he can select the appropriate one.

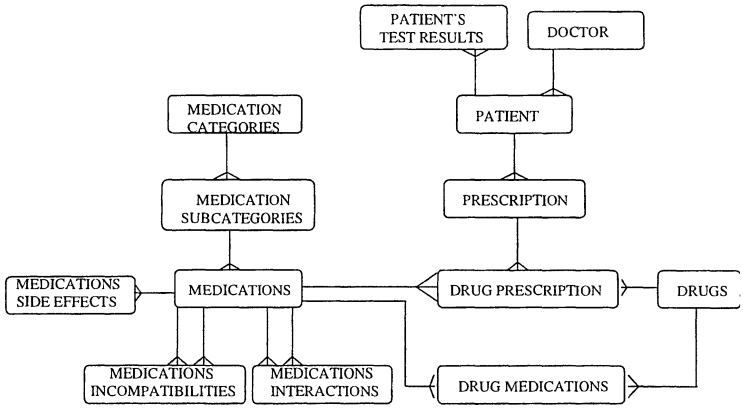

Fig. 2: Entity-Relationship Diagram

In the second case, when the physician selects a product name, it is automatically inserted into the order, along with the generic names of substances included in the selected drug. In both cases, cost and dosage information about the drugs and/or the medications are given to the physician that can be proven helpful when she/or issues the drug prescription. The system checks for probable incompatibilities and interactions between the medications and provides warning messages if there is any problem, together with probable interactions with food. In addition, the intravenous infusion rate is calculated for the medications given to the patients by this way.

The physician may also record the changes in the patient's medical situation by entering into the system the results of the patient's biochemical laboratory tests (each time the patient undergoes such tests). This information is stored in the retrieval database and a continuous updated electronic chart is produced. Finally, the Apache score is calculated from the data stored in the chart for each patient.

In order to optimise the use of the system in the ICU environment, we aim to transfer this system to a local area network with pen-based hand-held computer systems. In addition to hand-held terminals, our system will include wireless communications infrastructure that will be based around a system of transmitters that receive infrared signals. The hand-held terminals will work with an easy to use environment that will permit to the physicians a fast communication with the central system by the patient beds.

3. Discussion

The system we developed, is a useful and powerful tool which provides the I.C.U. physician with : a) a computerised drug prescription order b) on-line electronic information for medications and c) a complete on-line electronic patient treatment chart. Furthermore, the system can be used as an educational tool for the junior physicians who are unfamiliar to the environment of ICU. The facility of integrated computerised prescription, enables the application of : a) algorithms for treatment of specific situations, b) algorithms for cost reduction c) drug expenditure summary. The acceptance and the familiarity of the system

to computer unexpirient physician, as well as the clinical significance of its use are currently under evaluation in clinical settings.

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