Evaluating Connectivity for a Heart Failure Database

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Abstract

In this study it has been evaluated whether connecting a heart failure database with other information sources is technically and financially feasible. This database is used to collect research data for the outpatient clinic for heart failure patients and has been implemented in Microsoft Access. Four connections are required for a maximum link-up of the database. However, only one of these connections is technically feasible. Therefore it was concluded that connecting a medium scale research application like this heart failure database to other information systems is not (yet) a realistic option.

1. Introduction

The Interuniversity Cardiology Institute of the Netherlands (ICIN) is currently conducting a large ICT project (EPD-CAR, Electronic Patient Record for Cardiology) that has as its main objective the development of an electronic patient record that integrates alpha-numerical data, images and signals. An important sub study of this EPD-CAR project is the development of a database for the collection of research data and for supporting the care process at the outpatient clinic for heart failure patients at the Academic Medical Center (AMC) in Amsterdam, The Netherlands.

The objective of the work described in this article was to evaluate whether connecting the heart failure database with other information systems in the hospital is technically and financially feasible.

2. Methods

A thorough analysis of the care process at the heart failure clinic was done in order to define the requirements and information needs for the heart failure database. The results of this analysis were visualized with a class diagram. A class diagram describes the types of objects in a system and the various kinds of static relationships that exist among them [1]. This class diagram was used as the data model for the heart failure database.

The heart failure database itself has been implemented in Microsoft Access.

For each group of data items it was evaluated whether these data items were available in an information system other than the heart failure database. When this was the case, the technical and financial feasibility of connecting with this information system was assessed.

3. Problem

The heart failure database is currently used by the three heart failure nurses at the AMC. At the moment they only use the database for research focused on finding prognostic indicators for heart failure and not as a tool to support the primary care process as was originally intended. Main reason for this is that the database does not fulfil one of the most important requirements, i.e. that the system has links with other systems containing valuable patient data so as to avoid the need to switch between various kinds of systems [2]. Besides that, the heart failure nurses do not have time to collect and record the patient data in the database prior to a patient's visit to the heart failure clinic. Because of these problems the evaluation described in this article was done.

4. Results

4.1. The data model

The data model that resulted from the analysis of the care process at the heart failure clinic counts 27 objects containing 442 different data items in total. A simplified version of this data model is shown in figure 1. The development of this model has been described elsewhere [2]. In the following paragraph the model will be explained.

In figure 1 Test, Quality of life, Intervention and Serious adverse event are categories of objects. Table 1 shows the objects that are contained by the four categories.

It becomes clear from figure 1 that a Test, Quality of life measurement, Intervention or Serious adverse event applies to only one patient, but that a patient can have zero or more Tests, Quality of life measurements, Interventions and Serious adverse events. In contrast, a

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patient can have only one general practitioner and pharmacy, but a general practitioner and pharmacy can have zero or more patients. The same goes for country of birth: a patient can be born in only one country, zero or more patients can be born in a country. Patients have appointments at the heart failure clinic: consultations. All consultations are done by one of the cardiologists or nurses at the heart failure clinic. Finally, patients get medication. The object medication describes which medication the patient receives, the daily dose, the start and end date of use of the medicine and the reason for stopping prescription of the medicine.

4.2. The database

The extensive version of the model shown in figure 1 formed the basis for the design of the heart failure database. Based on this model the tables and data fields for the database were defined in Microsoft Access. The final database consists of 27 tables containing 480 data fields in total.

Table 1. Categories of objects in the data model. (MLHFQ = Minnesota Living with Heart Failure Questionnaire)

category	objects
Test	chest X-ray, blood test, echocardiogram rest ECG holter ECG nuclear scan
Quality of life	MLHFQ Euroqol-5D
Intervention	operation (e.g. CABG) catheterization (e.g. PTCA) implantation of ICD/pacemaker
Serious adverse event	hospital admission presentation at the emergency department myocardial infarction

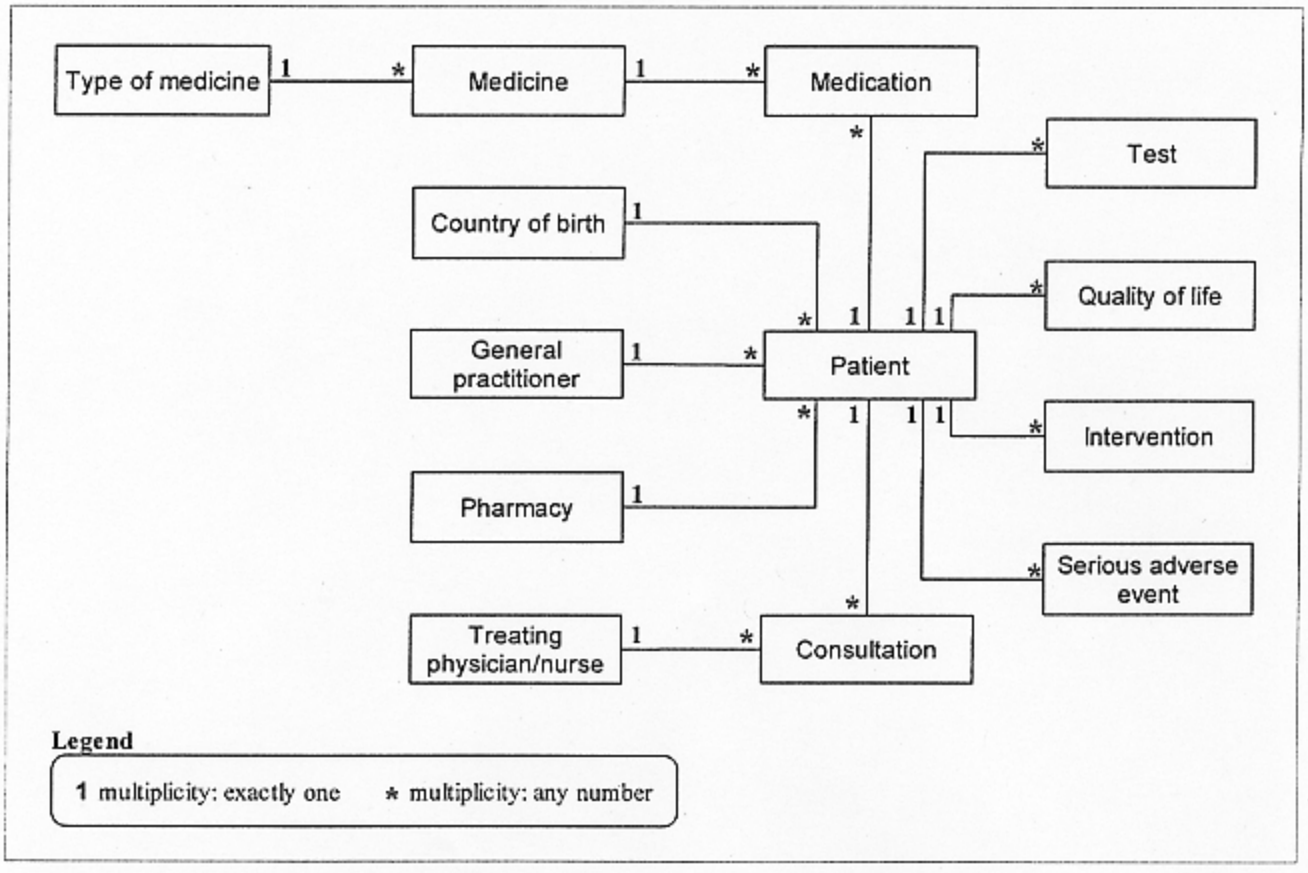

Figure 1. Simplified version of the data model.

The seemingly discrepancy in the number of data items between the data model (442 data items) and the database (480 items) is caused by the addition of primary and secondary key attributes to the tables in the database.

4.3. Connectivity evaluation

Four other information systems in the hospital contain data items that are also used in the heart failure database. So in total four connections are required for an optimal link-up of the heart failure database. This integrated solution would decrease manual input by the heart failure cardiologists and nurses by 35% (see table 2).

As can be seen from table 2 the main connection would be the link with the Hospital Information System (HIS) of the AMC. However, part of these data items (40%) is stored as free text and can therefore only be distilled from the text manually. Furthermore connecting the database with this HIS is technically rather complicated because of the proprietary protocol that has to be used for data exchange.

About 9% of the data items is primarily stored in the Apollo system. The Apollo system is a cardiology information system that currently is being implemented at the department of Cardiology at the AMC. Technically Apollo is a Microsoft Access application with an underlying SQL server database [3]. As the heart failure database is also a Microsoft Access application connecting with Apollo is technically feasible. However, the costs of this connection probably outweigh the productivity gain (9%). This is because a translation has to be made from the structure of the heart failure database to the structure of the Apollo database.

Table 2. Number and percentage of data items available in each information system.
(HIS = Hospital Information System).

information system	number	percentage
HIS	110	25%
Apollo system	38	9%
ECG system	5	1%
Holter ECG system	2	0%
Total	155	35%

Connecting the heart failure database with the ECG system of the AMC is difficult because of the legacy system underlying the formats and protocols used for data exchange.

Connecting with the ECG or Holter ECG system is not an option because the productivity or quality gain of the connection does not compensate for the costs.

5. Discussion

The heart failure database as it is implemented now has proven to be a valuable research tool. However, to be used as an instrument supporting the care process at an outpatient clinic for heart failure patients it is necessary that it is connected with other information systems of the hospital.

The biggest hurdle to system integration at the AMC is the difficulty in connecting with legacy systems like the HIS and the ECG systems.

In addition, even a medium-scale application like the heart failure database contains such an amount of primary data that when a connection is technically feasible the implementation costs still tend to outweigh the productivity or quality gain.

It can be concluded that connecting the heart failure database to other information systems at the AMC is currently no realistic option. However, when in time legacy systems like the HIS or the ECG system are being replaced and/or their connectivity is enhanced, system integration should be reconsidered.

References

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