Supporting quality indicators in the UK national health service.

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Abstract. *Quality indicators for performance management of the UK National Health Service have been introduced for general practitioners (GPs) in order to monitor if they are meeting their performance targets. Such requirements impose significant load to GPs' everyday operations and any type of software solution that stores relevant information and addresses performance indicators can help GPs to justify their fundholding. In this paper we report on a way of incorporating the semantics of a set of quality indicators in a database schema that can fit any GPs' practice. We concentrate on indicators that posed problems when creating the database and we provide a discussion that justifies our design decisions.*

Keywords. Database, NHS quality indicators, GPs' performance management.

1. Introduction

"Quality" has become an important issue as part of new regulatory initiatives in the UK National Health Service (NHS) in the last 8 years. The aim of the UK government is to change the efficiency of the NHS and its internal relations, while at the same time having less direct control and management responsibility for running the NHS. The proposal by the Department of Health is to establish a framework for assessing NHS performance, by measuring aspects of health improvement, fair access, effective delivery of appropriate care, efficiency, the patient experience, health outcomes, and similar [9]. Performance indicators are used by the Primary Care Trusts within the NHS to address the performance management, which have direct impact on all NHS services, including our local general practices.

In this paper we address the problem of achieving performance targets for GPs' practices through the involvement of information technology and the design of a specific database, which can store all the relevant information that supports performance management and its quality indicators. We believe that such a comprehensive GPs' practice database will enable more efficient performance management, particularly if it is accessible within and across each Primary Care Trust. There is a substantial list of quality indicators and a selection of these (from organisational, practice management and patient experience quality indicators) have been represented in this paper.

Section 2 gives a related background of the problem domain and an overview of our related works. In section 3 we introduce quality indicators and outline design issues when addressing a selection of indicators. We chose to discuss database design issues, which posed problems and provoked discussions within the research group. For example, indicators that deal with repeated prescriptions, recorded patient deaths, and the ability of GPs' practices to deliver information on the latest NHS initiatives on addressing high blood pressure and smoking, were in the core of our interest. We conclude in section 4.

2. Related Background and Aims of the Paper

Health Minister Aneurin Bevan established the National Health Service (NHS) in the UK in 1948. The NHS represented an international landmark in the provision of healthcare, the principles on which it was founded remain true today: the NHS provides comprehensive care to everyone in the UK who has the right to use it, on the basis of people's clinical need – not on their ability to pay [7]. The UK government Department of Health, which is responsible for health and social care policy in the UK, sets standards and drives modernisation across all areas of the NHS. It set up 28 Strategic Health Authorities in 2002. Their role has been to manage the local NHS on behalf of the Secretary

of State, to be a key link between the Department of Health and the NHS, and to ensure that the quality and capacity of the health service is adeqate and in line with national health priorities.

The NHS comprises organisations like Strategic Health Authorities, Primary Care Trusts, Care Trusts, Mental Health Trusts and Hospital Trusts. Primary Care is provided by the people we normally see when we first have a health problem. It might be a visit to a local GP, dentist, optician, or just a trip to a pharmacist. NHS Walk-in Centres, and the phone line service provided by NHS Direct are also part of primary care. All of these services are managed by local Primary Care Trusts (PCT), which are now at the centre of the NHS and are given 75% of the NHS budget.

GPs' Practice, like many other NHS services, are managed through financial incentives. Fundholding was probably the most significant change in financial arrangements for the NHS, aiming to contain costs, stimulate competition and bring resource allocation decisions closer to the patient [3,6,8]. Under "standard" contracts, UK GPs have been rewarded for increasing patient list sizes and for providing specific services to achieve target payments (with no incentive to over-service, but an incentive to limit the availability of appointments, and pressure to keep appointment times to a minimum). The new GPs' contract (from April 2004), brought more funding and fundamental structural change, but greater regulation and performance monitoring. There are concerns that many of the quality targets (such as the incentive to diagnose, investigate and treat hypertension) have not been adequately financed [5]. Furthermore, this new environment has a strong emphasis on performance management, quality payments, and greater engagement with the private sector, thus holding GPs to account.

In this paper we address the latest NHS requirements imposed on GPs' practices as part of the new financial arrangements. We analysed the document sent to all GPs' practices in 2004, where certain performance targets have been set. We aim to address the issue of satisfying such targets though the employment of Information Technology (IT) and automation, whenever possible. We believe that a comprehensive data repository or even a database, held at every GPs' practice (and accessible by PCTs) would help to reach such targets and address the GPs' performance ratings.

In our previous work we designed a database, which could help any GPs' practice to create reports and to keep information on (i) a legacy system that GPs' practices might have had to keep electronic copies of patient records, and (ii) any current and future NHS requirements in terms of addressing performance management [10]. Such a database could contribute towards the interoperability in NHS healthcare information systems, which connect healthcare trusts and GPs' practices [4].

In this paper we show how certain NHS targets, imposed on GPs, have been automated and how relevant information could be kept within a local GPs' practice's database, in order to support their performance management. We believe that any GPs' practice could use our ideas in order to (a) make amendments to an existing database schema, if they have already have one, (b) design a new database from scratch, or (c) use our database schema as a guide when selecting Commercial-off-the-Shelf (COTS) components that address performance management. However, the problems of customising and amending existing IT solutions, which GPs' practices might have acquired from the (COTS) marketplace, with views of supporting GPs' performance management, is outside the scope of this paper and is being address in our future works [2].

3. Quality Indicators for GP Performance Management

We use the document, issued by Lambeth PCT in London, which specifies all of the quality indicators (QI) for GP performance management [9]. They are divided into: practice management, patient experience and organisational QI. Each QI carries certain points, which are grouped into 'maximum points available', 'PCT agreed points' and 'practice aspiration points'. PCT agreed and practice aspiration points are worth £53.50 to £83.50. In this paper we concentrate on a few indicators and show how their semantics are incorporated into a GPs Practice's database schema. The indicators are:

1. Deaths of all patients must be recorded, including deaths at practice premises and deaths where terminal care takes place at home.
2. Repeated prescriptions are clearly marked.
3. Smoking status is recorded and blood pressure taken and recorded for each patient.

4. Each patient may receive a range of information, including leaflets on child safety and the dangers of smoking (if needed).

Each of these QIs must be available for the PCT control. This means that each practice must prove that they are following the guidance for their performance management (where 1-4 above are just a few of them).

We also looked at one of the GP practices, located in Clapham, South West London, who was willing to consider our ideas of adapting the database schema of their legacy application in terms of addressing their performance management. Consequently, we were limited to using MS Access as the only means of implementing our database design and adapting the application built upon it. We have guaranteed the anonymity of the GP practice. The reasons were numerous and range from the sensitivity of the topic to the fact that they have already been using a COTS component that addresses their everyday operational needs and electronic patient records.

In the next subsections 3.1.1, 3.1.2 and 3.1.3 we discuss how we incorporated the semantics of QIS 1-4 above, into a database schema.

3.1. Specific Design Issues

When designing our database schema, we adopted the following approaches:

(1) We used a combination of top-down and bottom-up approaches and exercised iterative development throughout the database design activities.

(2) We primarily worked through Lambeth PCT's quality indicators document and identified potential attributes and entities.

(3) We used our intuition as the main factor that influenced our first selection of attributes and entities. In all subsequent iterations a more logical structure emerged.

Identifying and storing semantics was partially met by the identification of entities and attributes [1]. Establishing relationships along with their multiplicity and cardinality completed this effort. The final entities are all in Third Normal Form. The complete data model that represents a generic model that can suit any GPs' practice in the UK is available in [10].

3.1.1. Patient Death Details

We had to decide how and where to store details of patient deaths. Details that need to be recorded include time, date, place and complication_details. The high level of detail meant that one set of death details would only apply to one patient. Obviously, one patient can only have one set of death details. Therefore, if Patients and DeathDetails were created as two separate tables they would have a 1:1 relationship. When normalising a relational database design, a 1:1 relationship might pose problems [1]. Although the death details will eventually be filled in for all patients, for most patients they will be empty for many, many years. Therefore, we had two options:

1. combine the Patient and DeathDetails tables and have the death related fields empty for most patients, or
2. have two separate tables with a 1:1 relationship.

We finally decided that it was more important to follow the relational database design protocols and so chose option (1) (see the Patient table in Fig. 1). The other benefit of this option was that queries on patient deaths would not require any joins, thus reducing the processing time and costs.

3.1.2 Consultation Details

GPs need to be able to maintain a record of information gathered during consultations with patients. Some examples of this information are:

(a) a patient's smoking habits,

(b) a patient's blood pressure, and

(c) which leaflets have been given to patients.

The smoking habits of a patient (a) were recorded using a Smoking_Status field in the Patient table. We then realised that it was important to keep a history of a patient's smoking habits over time. Therefore, we moved this field to the Consultation&Appointment table and added a field called No_of_Cigarettes. Data can only be entered into No_of_Cigarettes if the Smoking_Status field is set to true. This design will enable statistics about the number of smokers in the UK (or in different regions) to be easily gained by only searching records where the Smoking_Status is set to true, and then finding out their pattern of smoking if necessary.

The Government requires patients' blood pressure to be taken during consultations (b). This has been implemented using two fields in

the Consultation table: BP_Systolic and BP_Diastolic. This will again enable a history of a patient's blood pressure to be retained, and will allow for statistics to be easily calculated.

The Information_Type table records all information leaflets (or other forms of information) that are available to hand out to patients, as required for (c). It is possible for more than one leaflet to be handed out in a consultation and for one leaflet to be given to more than one patient. Therefore, there is a M:N relationship between the Consultation and Information_Type tables. The resulting link table has been called Information_Given and contains the primary key of the Consultation and Information_Type tables and a date (see Fig. 1).

We also created a relationship between the Information_Given and Consultation tables. This facilitates the recording and subsequent identification of records in Information_Given that result from a consultation. We left the relationship optional at its 'many end' so that the information given is not only restricted to a consultation but may also be given at other times and through other means – e.g. email – in the future. Using this new design enables a history to be retained of the information given to patients.

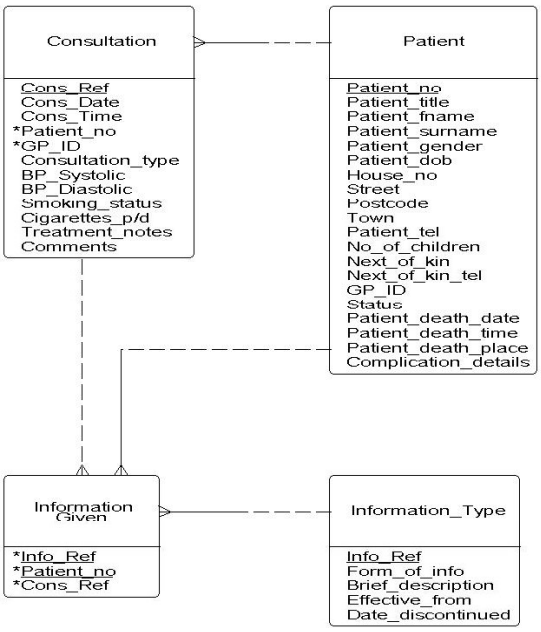

Figure 1. Patient and information details

3.1.3 Prescriptions & Repeat Prescriptions

Another requirement from the government, which the database design needed to address, was to store all prescriptions. This requirement also makes it explicit that the GPs' practices need to distinguish between standard prescriptions and repeat prescriptions, and keep track of them all. At this stage, we had already identified the table Consultation with a primary key which is made up of Date, Time and an attribute called GP_ID that references the Employee_Number of the practitioner with whom the consultation is booked. To store the details outlined in the requirement given above, we identified a set of tables:

(i) Drug,
(ii) Prescription,
(iii) Repeat_Prescription

The main difference between a prescription and the repeat prescription (both of which can be made up of one or more drugs) is that the former is always created and given to the patient as a result of a consultation, while a repeat prescription requires no consultation but can only contain medicines that have previously been included in a standard prescription.

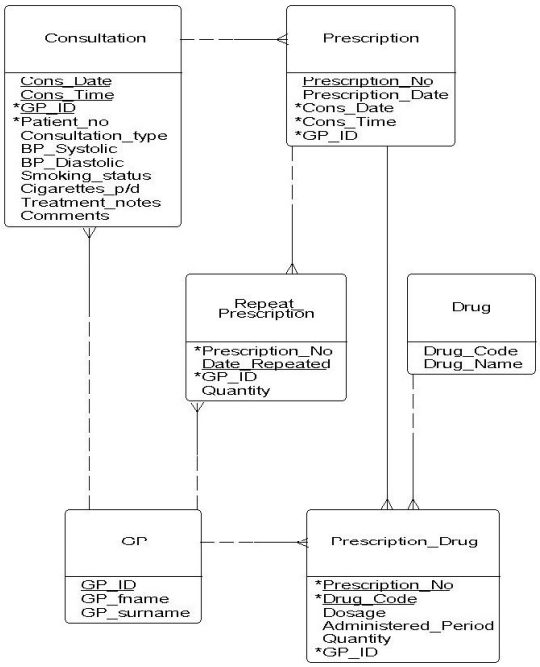

Figure 2. Prescriptions and repeat prescriptions - version 1

From this, we established a 1:M relationship between Consultation and Prescription, enforcing the business rule "each prescription must result from a consultation session and more than one prescription can be produced from 1 consultation". To enforce that a repeat prescription request is always associated with a previously issued standard prescription, we also

established a 1:M relationship between the Prescription and the Repeat_Prescription.

Finally, an additional table to (i)-(iii) above, which we named Prescription_Drug, emerged as a "link table" resolving the M:N relationship between Drug and Prescription, and records all the drugs that are contained in the prescription. Repeat_Prescription aims to address the issue of distinguishing between the prescriptions that resulted from the consultation and the prescriptions that are repeat requests "because the patients are required to take them for a period of time". This table became the child of the Prescription table and included a date attribute which recorded the date the drug is prescribed again, and the GP_ID that references the Employee_Number of the practitioner who authorises the prescription.

This pattern can be seen widely in other domains, such as Supplier-Part-Project [1]. We give this design in Fig. 2.

However, we soon realised that there were a few problems with this design which we itemise here:

1. Except the attributes that appear as foreign keys as a result of the 1:M relationship with the Consultation table, the Prescription table only contains Prescription_No (the primary key) and Prescription_Date (which stores the date that the prescription is issued). The Prescription_Date attribute is the same as the Cons_Date and is therefore redundant. This left us with a table that only contains the primary key attribute which is a surrogate.
2. The design only allows the repeat of an entire prescription, i.e. all drugs in that prescription and not repeats of individual drugs.

With a further revision, the following changes were made to the initial design shown in Fig. 2.

1. We didn't need a Prescription table and the table Prescription_Drug would suffice to store the drugs that are prescribed as a result of a consultation. Therefore, we deleted the Prescription table and moved its primary key (Prescription_No) to the Consultation table.
2. The deletion of the Prescription table in (1) above resulted the original relationship between Prescription and Repeat_Prescription being re-established between Prescription_Drug and Repeat_Prescription which allowed individual drugs to be selected for a repeat prescription.
3. The deletion of the Prescription table in (1) above also resulted the original relationship between Consultation and Prescription being re-established between Consultation and Prescription_Drug. We then renamed the Prescription_Drug table as Prescription.
4. We decided to choose a surrogate primary key (Cons_Ref) for the Consultation table because the current choice of primary key (a combination of Cons_Date, Cons_Time and GP_ID) caused all these attributes to be repeated in the relevant child tables as foreign keys.

The choice of a surrogate key as opposed to a combined key in (4) above raised the question of whether this surrogate key (Cons_Ref) could be used as the Prescription_No when issuing prescriptions. This seemed an effective and efficient solution and hence we decided to omit the Prescription_No from the Consultation table.

These changes can be seen in Fig. 3 below.

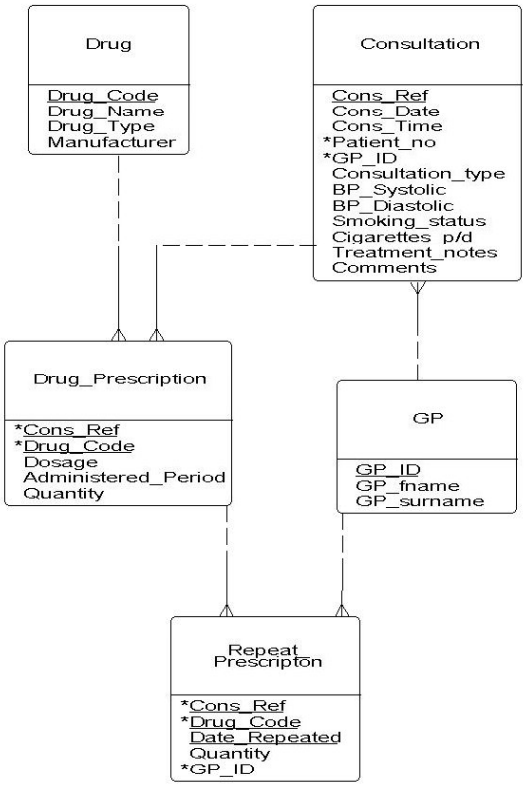

Figure 3. Prescriptions and repeat prescriptions - version 2

4. Conclusions

In this paper we address the latest NHS requirements imposed on GPs' practices as part of their new financial arrangements with the UK Government. We analysed the document from Lambeth PCT where GP's performance targets have been set in terms of organisational, practice

management and patient experience QI. The semantics of GPs' everyday operations and their QIs were transmitted into a specific database, which will enable more efficient performance management, particularly if it is accessible within and across each PCT. We concentrate on the QIs that posed problems when creating the database and we provide a discussion that justifies our design decisions.

We are not aware of any software solution recommended by the UK Government, which addresses QIs and performance management within GPs' practices. Our solution might trigger amendments to an existing database schema, if GPs' practices already have one, or provide the basis for the design of a new database. The most intriguing approach would be to use the discussion and design decisions given in this paper to address (c) from section 2, i.e. to use it as a guide when selecting COTS components that address QIs and performance management. Currently, the majority of GPs' practices do depend on COTS software solutions, which are unlikely to exhibit flexibility for incorporating QIs within their existing database schema [2].

5. Acknowledgment

We wish to thank the GPs' practice from Clapham, South West London, for constructive collaboration.

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