Approach to Extract Billing Data from Medical Documentation in Russia - Lessons Learned

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Abstract. Lack of a proper infrastructure of health care providers leads to the breaks in the health care process informatization. This results in the manifestation of different data entry points. The different data sets that are entered in these different points tend to serve the same task. However, due to the different qualification of staff a consistency of data cannot be preserved. The paper presents an approach where data is split to the different levels.

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Introduction

Due to the lack of infrastructure and resources a complex informatization still remains a problem for Russian healthcare institutions [1-3]. This causes a situation when a hospital information system (HIS) does not support the entire business process automation. The main process of a health care institution is “appointment - doctor’s examination – billing to the regional insurance fund” [4; 5].

When a HIS has multiple data entry points it has to consider that the information entered by doctors and operators is different. One of the possibilities to solve this problem and provide consistency of the medical data and correct billing could be to introduce such architecture of a HIS where medical and billing data would be separated into different logical levels. The necessity to send billing data to different payers (compulsory insurance, private insurance, regional budget, paid services) also This paper presents an approach to a HIS architecture where data is logically separated into different levels. Each level solves specific data processing tasks. The cooperation between different data layers is based on the data transformation algorithms and data editing control.

1. Methods

The first step of the study was modelling of business processes of healthcare providers to define data entry point and data set to be entered. We also calculated the rate of incorrect billing records for the year 2013 based on the data obtained from the regional insurance fund to be able to compare the results of the project with the current

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state. This was done by interviewing doctors in public health care providers in Saint-Petersburg, Russia. The second step was to study the regional norms for billing records generation. The third step was a definition of a data model that separates billing and medical data into different levels.

We evaluated the efficiency of the approach by a comparison of the % of billing records generated by the developed system that were accepted by the regional insurance fund and the average acceptance rate.

2. Results

When the process is fully automated one can observe a chain of data transformation from primary medical records to billing data (figure 1). Whereas, interruptions in the process automation causes different data entry points. The typical examples of business process automation are presented in the figure 2. The most wide spread type is when the application of HIS is limited to the appointment planning and manual entry of the medical data after the doctor’s examination is finished. Doctors write all the data on paper and afterwards these papers are given to operators who enter the data in HIS (figure 2a). In some cases even the appointment part is skipped and the application of a HIS is limited only to the data entry from paper documents (figure 2b). Some healthcare providers use a mixed model, where some doctors work with a HIS (figure. 1), and the others work with paper documents (figure 2). In case of the partial automation of the process (figure 1) operators enter a reduced data set into HIS, which is sufficient only for billing purposes and not enough for a comprehensive electronic medical record (EMR).

![Figure 1. Main data transformation process](image)

![Figure 2. Process with a paper based entry of data (a). (b) – the case where only billing data is entered.](image)

The proposed approach logically divides data into 4 levels (figure 3):

1. **Medical data level**
   This level consolidates the EMR data of a patient without any connection to the billing method. A HIS queries data in this level to show EMR data to a user or to build a medical statistical report.

2. **Billing specific medical data level**
This level sorts medical data according to the billing method. Specific information required by different insurance companies or budget funds is added to the medical data to prepare it for billing.

3. **Billing data level**

Data from the level 2 that is transformed by billing algorithms is stored on this level. This level consolidate all the income of a health care provider independently of a payer. A HIS queries this level for financial reports.

4. **Data export level**

This level contains data in a way that it can be exported to the billing information systems. Data transformation algorithms build data packages from the level 3 data according to the requirements of external billing systems. For example the regional insurance fund of Saint-Petersburg requires dbf files with a certain structure, While in Leningrad region this will be XML files.

Data processing logic

For an efficient data processing a HIS provides entry points for two data levels: medical and billing. When a HIS covers the processes (figure 1 and figure 2a) a user can enter data on the medical data level. Within the process (figure 2b) a user enters data on the billing data level.

The following example demonstrates data transformation for the case of full process automation and compulsory health insurance billing. Compulsory insurance billing scheme in Saint-Petersburg implies that an insurance company pays for a completed treatment case irrespective of how many appointments a patient had during the treatment and how many services (in Russia some manipulations during an appointment are considered as extra services, for example Ultrasound examination. In case of private insurance they can be paid separately) were rendered. So if we have a treatment case (figure 4) that consists of 3 appointments and 2 services an insurance company will pay the same money if it was a case with 1 appointment and 3 services. Data transformation logic must consider this when generating billing data out of medical data.
Figure 4. Treatment case decomposition

The following algorithm defines the procedure of data transformation from the entry of medical data to the export of billing data.

Step 1. Medical data entry
A doctor enters medical data collected during the patient’s examination. A system adds to these complementary parameters such as the method the system will produce a billing data for this appointment.

Step 2. Generation of billing specific medical data
A HIS separates medical data according to the billing method that was automatically added to the medical data on the previous step.

Step 3. Generation of billing data
1. A system selects all the cases that are “completed” and “awaiting billing”.
2. For each case from the step 1 a system selects all the services and appointments with a status “awaiting billing”;
3. If a case consists of more than 1 appointment or service a system queries the closing appointment for the complementary parameters of the treatment;
4. From the closing appointment a system selects the following complementary parameters of the treatment:
   • conditions of care (ambulatory, stationary),
   • type of care (primary, special),
   • doctor’s profile (i.e. immunology, neurology),
   • doctor’s specialty (i.e. internist).
   • form of care (i.e. emergency),
5. A system selects a tariff that corresponds to the parameters from the point 4;
6. All the appointments and services of the case change status to “billing processed”;
7. Billing data is copied to the general billing object. The following data processing is being performed according to the billing rules of the payer (regional insurance fund in our case).

Step 4. Generation of billing export data
An export record (file) is formed from the billing object according to the requirements of the billing system (i.e. dbf for Saint-Petersburg)

Step 5. Billing data export
Billing record is exported to the billing system.

Data transformation for the case of reduced process automation and compulsory health insurance billing.

This scenario differs from the full automation scenario. The data entry starts on the step 3 where an operators enters data sufficient for billing.

Step 1. Billing data entry
1. Treatment case data is entered:
   • conditions of care (ambulatory, stationary),
   • type of care (primary, special),
   • doctor’s profile (i.e. immunology, neurology),
   • doctor’s specialty (i.e. internist).
   • department,
   • diagnosis

2. Data is transferred to the medical data level with only a doctor id, patient id, diagnosis and appointment date.

3. A system selects a tariff that corresponds to the parameters from the point 1;

4. All the appointments and services of the case get a status “billing processed”;

The following steps are the same as for the full process.

In this case the very limited data is entered on the billing data level and this is not sufficient for an EMR. However, the transfer from billing to medical data level allows having a history of appointments and diagnosis that can be a good basis to start an EMR later. The approach was implemented in the Electron HIS in Saint-Petersburg. The evaluation of the approach showed that the correctness of billing has reached 98%, which is a very good result in comparison with an average regional success rate 74% reported by the regional insurance fund.

3. Discussion

Separating data into medical and billing levels showed a high efficiency for the HIS that has to deal with fragmented process automation. Despite causing data base redundancy and extra data processing procedures that need to be performed after the data has been entered, data separation allows to increase the efficiency of data processing tasks like medical or financial reports building.

4. Conclusion

The paper presents an approach to the development of a HIS where medical and billing data levels are clearly separated from each other. This is especially required in the situation when a health care provider does not have enough resources for full business-process automation or the process of HIS implementation has just started.

References