Modelling Situational Room for Healthcare

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Abstract: This article is devoted to the healthcare situational room modelling, which could be used for large data analysis and optimize data mining processes. Each healthcare organization like ambulance service, hospital or clinic has every day huge data sets coming from patient’s data analysis. There are huge information amount gathered in patient medical card, which should be used in diagnosis establishment and patient treatment, treatment history stores on paper version 25 years after that it disposes. This article describes formal methods applicability for the healthcare situational room modelling.

Key words: Situational room %Healthcare %Formal methods %Large data sets

INTRODUCTION

Millennium Development Goals (8 MDGs and 21 tasks) which were signed on UNN Declaration in 2000 has 3 primary goals assigned to Healthcare worldwide [1][2]. There were 300,000 hospitals in operation worldwide at the middle of 2012, there are some third world countries which do not have operating hospitals and if they do, they are in poor working condition. The country who has the most operating hospitals is China, with a total of 69,105 and India has the second most with 15,067 in operation. The US is ranked number ten in the world in regard to how many hospitals it runs and totals to 6,097 in operation as at 2012, the Russian Federation has 11,200 hospitals, other countries hospitals count listed in Table 1 [3].

The Kazakhstan Republic has 1054 hospitals and 3720 clinical medical organizations. Hospital organizations improvement and expansion had happened in 7 republic regions (2013), according forecast hospital beds count will be 120 000 beds. As a whole on the republic render medical services provided by 59 thousand doctors and 126 thousand average medical personnel. Total emergency medical service stations - 274, total ambulance institutions-3 462.

Kazakhstan’s 80% medical institutions are in state ownership. For this reason the state plays an important role in medicine questions. In connection with the Kazakhstan entry into WTO, the Republic legislation in medicine questions brought into accord with the international standards. The Kazakhstan Republic legislation institute developed the Kazakhstan Republic Code "About people health and health system". The present Code came into force since January 1, 2009. Since January 1, 2010 the Uniform National health system was introduced.[4]

The general expenses for implementation of the Program will make 427 525,9 million tenge from the state budget [4].

The Kazakhstan pharmaceutical market volume in 2008 exceeded $1 billion and the growth tendency is at the 15-20% level. In Kazakhstan more than 10 thousand medicines are registered, representations from 100 countries. The medicines domestic production makes about 12% Kazakhstan common pharmaceutical market of.

<table>
<thead>
<tr>
<th>Country name</th>
<th>Hospitals count</th>
</tr>
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<tbody>
<tr>
<td>China</td>
<td>69,105</td>
</tr>
<tr>
<td>India</td>
<td>15,067</td>
</tr>
<tr>
<td>Vietnam</td>
<td>12,500</td>
</tr>
<tr>
<td>Nigeria</td>
<td>11,588</td>
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<tr>
<td>Russia</td>
<td>11,200</td>
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<tr>
<td>Japan</td>
<td>9,413</td>
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<tr>
<td>Egypt</td>
<td>7,411</td>
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<tr>
<td>South Korea</td>
<td>6,446</td>
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<tr>
<td>Brazil</td>
<td>6,410</td>
</tr>
<tr>
<td>USA</td>
<td>6,097</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>1054</td>
</tr>
</tbody>
</table>

Sources: MapsofWorld 2013 [3]
In 2009 the project about medicines distribution uniform system introduction was announced, it allowed reduce the medicines prices entered and carry out purchase directly to producers. By 2012 it is planned to create effective infrastructure, having paid special attention to transport and logistic component development.

The Kazakhstan medical equipment market volume is estimated by experts approximately in 200 million US dollars a year. Nevertheless, the market still strongly depends on medical equipment import, which share makes 90% from total market amount.

The Kazakhstan Republic State program in healthcare development “Salamatty Kazakhstan” for 2011-2015 has a budget near 427 525,9 mln.tenge. Government epidemiological organizations took part and also state register products and substance formation informatization. According to the Kazakhstan Deputy Prime Minister, hospitals informatization in Kazakhstan will be introduced step by step, at first-in each regional hospitals. For today more than 750 thousand population electronic health passports were created [4]. Below is listed Kazakhstan Union Information Healthcare system main components [5].

Kazakhstan Union Information Healthcare system has next main components:

- SMES (sanitarian-medical epidemiology system) which solve next tasks:
  - Expeditious adoption of effective administrative decisions on stabilization in Kazakhstan Republic at all levels of sanitary and epidemiologic situation;
  - Sanitary and epidemiologic service uniform information database formation at republican level;
  - Reduction of the labor costs necessary for monitoring sanitary and epidemiologic situation.

There are three main scopes are allocated for SMSES today [6].

Epidemiological Surveillance: This area includes collecting and information processing on infectious and parasitic diseases. On the provided information basis there is a emergency notices formation, epidemiological inspection center cards, reports. Also there is an information processing on professional incidence and intra hospital infections, on coverage by preventive inoculations of the population and movement of vaccines, passes also calculation of requirement for a vaccine. SMSES work terminal point is incidence annual indicator forecast formation for the forthcoming epidemic season.

Sanitary and Hygienic Control: The second work area is connected with collection information concerning habitat factors (such as the soil, drinking water) and sanitary and epidemiologic supervision objects (educational institutions, objects of a social life, the markets). Following the processing results and the information degree analysis in all listed factors compliance to the Republic of Kazakhstan sanitary and epidemiologic norms miscalculates.

Epidemiological Service Activity Management: In the third area collecting, processing and the information analysis on activity indicators bodies quality the Government epidemiological organizations took part and also state register products and substance formation automation is carried out.

- Medical-statistical information system is efficiency increase in medical organizations activity at all levels and healthcare governing bodies. MCC carries out patients addresses personified accounting automation to the medical organizations. MCC automates by medical organizations activities for the following main types of medical care:
  - Ambulance;
  - Out-patient and polyclinic help;
  - Stationary help.
- Medicines provision control system, which basic purpose is management processes automation by medicines provision, monitoring the medicines usage, the organization information collecting and processing from all regions and providing saved-up information to health system participants.

Situational model and methods in healthcare. Situational model in healthcare should allow carry out the following functions:

- Modeling regional health system situations;
- Optimum indicators selection from resources;
- Business processes support on adjustment and data quality improvement (for example, patients duplication identification, classification for entered addresses, diagnoses classification, etc.);
- Situations monitoring in health system in an evident and clear look for the manager;
- Indicators configuration which automatically inform users (including by e-mail) at an exit on legal limits key values out;
Usage Formal Methods in Healthcare Situational Room Modelling: Formal methods are very useful for healthcare situational analysis to create formation for evaluation situations in future.

In this article author describes situational room in traumatology.

In the Kazakhstan President’s message “Strategy Kazakhstan-2050” it is noted in the item 4 “Nation Health - a Basis of Our Successful Future”. According to the National plan of measures on actions Decade realization on traffic and injury prevention safety for 2011-2020, the Kazakhstan Republic healthcare development State program "Salamatty Kazakhstan" for 2011-2015 it is necessary to develop measures for injuries decrease.

In the Republic of Kazakhstan traumatism in all its manifestations takes the second place in incidence structure (6,88 percent), as the reason of an exit to disability - the third place.

Injuries as the important indicator social living conditions influence on a population health state, happens different: production (industrial and agricultural), non-productive (transport, street, household, sports), children’s. For quite some time now there was such concept, as office injuries.

Formal model creation for injuries forecasting it is necessary to describe each injuries equations like (as the trauma reason): the injuries represents equations system is ordinary differential equations N order and consists from the following equations:

\[
\text{FIR} = \frac{\text{ND} \times \text{ER}}{100,000}
\]

Where FIR-the accidents frequency; ND-the victims number owing to an occupational accident; ER-the number of people being exposed to risk [7].

The non-productive injuries system is described by the following equations:

\[
1/(1 + e^{-\text{LQC}(0.757) - 0.647 \times \text{DGM}^2})
\]

where LQC is Q-corner for left bottom extremity concedes and DGM², a square difference between thickness of both hips (mathematical algorithm "Fernandez's injuries").

Collecting Primary Data: Collecting primary data will be carried out by historically developed IS and, if necessary, additional aggregated input program modules or primary information. At the level IS-primary data sources structure reduction, reference books to uniform qualifiers and definition for each qualifier thus is required, within which IS it changes.

The Integration Tire: The specialized integration tire allows to separate transformation data logic from one essence in another, from communication technical modules with data formats concrete types (the file with dividers, Fox Pro, Oracle, etc.). This approach will allow adapt quickly system for change in programs primary sources and, if necessary, it is rather easy to connect new programs and systems.

Adjustment Layer and Data Quality Improvement:
This level issues are duplicates patient entries identification and elimination, residential address classification, etc. As adjustment data various mechanisms which will often operator demand intervention will be applied, it is expedient to use a business processes control system for these purposes. This approach will allow programming minimize costs at creation new or change already used adjustment processes and data updating.

Analysis, Analytics and Information Submission to Users: This level is realized by means this class leaders among software products - Pentaho BI. Information collected within the previous levels illustrates a concrete situations set in region health system. It also should be performed in usability form for doctors and patients to analyze it correctly (different analysis types, diagnosis, etc.)
The transport injuries equation is described by the following formula [9]:

\[ TR = (PP + PK) \times ND/ER \times 100,000 + Li \]

- **TR** - Road accidents frequency;
- **PP** - crosswalks in the city number;
- **PK** - city intersections number in the;
- **ND** - the victims number owing to an occupational accident;
- **ER** - the people number being exposed to risk;
- **Li** - lethal outcomes quantity.

The children's and teenage injury equation is described on a trend line basis, statistical data, Fischer's criterion and a smallest squares method. It is most difficult to formalize the household injury equation since there is a set of parameters [10].

**CONCLUSIONS**

As a conclusion this article analyses some injury equations, shows the empirical study of the healthcare situational modelling. In conclusions author plans to develop injuries forecasting model on the formal methods basis and injury statistical data in hospitals and implement it in future.

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