

Medical Sciences

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PROTOTYPING A HEAT MAP OF HEALTHCARE DEPARTMENS

***Summary.** This article reveals the concepts of "patient migration", "heat map" and combines these definitions. Lists the main problems that can be solved with this system. Represents code marks and their further scaling, and also provides the list of problems which will resist integration of this system.*

***Key words:** heat map, migration, ID.*

Introduction. In connection with the decentralization of medical institutions, as well as new technological solutions in the field of information technology, cloud computing, and analytical developments in the fields of machine learning with finance, it is possible to build a system of patient migration between health facilities . In addition, which can be scaled within: district, city, region, country, union of countries. Before beginning this article, it should be noted that the author does not know about the possible decisions of

the state in which he lives, which are included in the list of developments classified as "state secret".

Define “migration”, and “heatmap” meaning

It is necessary to begin with definition of term of migration. Migration is the mechanical movement of living organisms from one area to another[1]. This may be due to seasonality or necessity. However, it should be noted that in our case, we need to understand the migration of the population. Population migration is a complex social process that affects various aspects of socio-economic life of mankind. People who migrate are called migrants. Persons who have moved abroad are immigrants who have moved to the country - immigrants. The difference between the number of immigrants and emigrants - the migration balance (net migration) - directly affects the population of the country. Statistics of migration processes are widely used in various social sciences and applied disciplines. For example, in criminology, when analyzing the state of crime in a particular area, determining the complexity of the operational situation, identifying the causes of offenses and more. However, we may use this data to track patients, sick people, or people with complications, or in rehabilitation. General research has shown that migratory units or individuals gather in the same area for a set of specific characteristics, namely that the area may carry additional information necessary to understand the quality of migrating units.

Now it is necessary to outline the understanding of the term heat map. A heatmap is a graphical representation of data, where individual values in a table are displayed using colour. The term "heatmap" was originally coined and officially trademarked by software developer Cormac Kinney in 1991. He used the term to describe a 2D display depicting real-time financial market information [2]. Similar hierarchical colour coding systems are used in fractal images and other data presentation systems. The term "heat map" is also sometimes referred to as mapping. The basis of a heat map - the idea of

colouring a table with data - is more than a century old. An example can be found in Toussaint Lois' statistical atlas of the population of Paris, published in 1873, which shows the frequency of occurrence of characteristics (nationality, occupation, age, etc.) in 20 districts of Paris [3].

In order to make the structure of the data more explicit, the researchers rearranged the columns and rows of the coloured matrices in different ways. Sneeth in 1957 demonstrated the results of cluster analysis by placing columns with similar values next to each other. Jacques Bertin used a similar representation to display data that corresponded to the Guttman scale. The idea of connecting hierarchical clustering in the form of trees with table rows and columns came from Robert Ling in 1973. Ling, using overprints of printer symbols, depicted different shades of grey, one symbol one pixel wide. Leland Wilkinson in 1994 developed the first program (SYSTAT) for depicting cluster heat maps with high-resolution colour graphics [3]. The search for the best way to rearrange the contents of the matrices continues even now, e.g. SVD decomposition gives very good results [3].

There are many different colour schemes with their own disadvantages and advantages that are used in heat maps. Often heat maps with a large number of colours (rainbow colours) are used because people are able to distinguish more different shades of colour than distinguish grey of different intensities. This allows more details of the image to be parsed out and noticed. However, a great variety of colours is not recommended for the following reasons [4; 5; 6; 7]:

- Widespread colour schemes (e.g. jet, which is the default in many data visualisation programs) are too bright to display correctly in the black and white spectrum or print. Also, in such colour schemes, the yellow and blue areas are more visible, distracting the observer from the main point.
- The small difference between the colours makes us see gradients that are not really there, which makes the real gradients less noticeable. In this way,

rainbow colour schemes hide details rather than making them more apparent.


Regardless of the choice of colour scheme, a colour legend explaining the meaning of the colours should be attached or described in an accompanying text. Various colour schemes are used, sequential and divergent [8].

A main idea and a code system

As disclosed in Section 2, heat maps can be used to indicate some overlap of features and to highlight them in colour, in order to simplify the visual perception of the data. The notion of migration refers to moving one group of units linked by a common feature to another that has the most appropriate set of features to meet the requirements of the group of units. What if the object of migration is a patient who possesses a set of attributes of some disease, and the destination, i.e. migration for him is the health care facility that best addresses his problems? Better in terms of speed of service provision, quality or proximity to the facility. Further, by combining this group of patients who share a common attribute, which is assigned the same coding, colour, it is possible to graphically represent the migration of these patients on a map of the selected area of the region. The region can be a city district, city, region of Ukraine, part of Ukraine or Ukraine itself.

This map will take shape more like a meteorological map of temperature or wind masses movement, which will provide for certain points or clusters where the data will be processed and registered. Also, it should not be imagined that this will be an ordinary two-dimensional map. This type of map will not cope with the visibility of all the data that can be collected and presented. A three-dimensional map should be used, the vertical slice of which will be a bottom-up spectral analysis that will add information to the report and to the visual experience. In order to begin to implement this system, it is necessary to understand how to identify users and correctly correlate their values. For this purpose, the author presents a unique coding system from which to start

designing the basic necessary parts of the system, as well as its further implementation. Figure 1 shows an example of a patient encryption code.



380.38.CiID.21584762.CID.RID.CiID.OID.MKX-10

Fig. 1. Encryption code

In this code, there is a part highlighted in bold to indicate the obligatory part, which implies where the patient starts to move from, and in the future the prefixes can change, thereby showing the patient's movements, as well as the history of his illness. This encoding represents:

- code of the country;
- area code;
- area code (CiID);
- single taxpayer code.

This completes the main part, further there are branches that will reveal the patient's condition:

- code of the country where he applied for the service (CID);
- the code of the area where he applied for the service (RID);
- code of the city where he applied for the service (CiID);
- the code of the medical institution to which the patient applied;
- disease code according to table MKX-10.

At this stage, the information will be dynamically updated with each new user request with a new code, based on this, the assignment of this code can be implemented when registering an identity.

Pros and cons

This section will describe the pros, as well as the obvious and possible disadvantages of implementing this development. It should be noted that not all

the pros and not all the disadvantages of the authors can be predicted and accommodated in this article.

Benefits:

1. We can track the course of patients and filter them by illness in order to understand and respond promptly to the outbreaks of pandemics or emergencies.
2. The emergence of a unified number that will help to store the patient, as well as to fully view his medical history and movement, which will improve the work of healthcare facilities from paperwork.

Now let's list the disadvantages, which, unfortunately, are more:

1. Additional accountability of ordinary people and strengthening of registry restrictions that may seem inhumane
2. Difficulty in perception and readability of data on the heatmap and working with it
3. There is no one common storage location for the use of computing technology
4. The problem of data warehouse security and scaling
5. The complexity of calculations and data processing. Figure 2 shows a map of existing medical institutions in Ukraine [9]. If we add up all active institutions, we get 6243, then imagine that there are about 42 million people in Ukraine, then by multiplying the first and second numbers we get the value of 262 billion and 206 million values, this is only a registration, without taking into account visits to a health protection place. All this shows that there is no computing power for the fast processing of such a large amount of data.

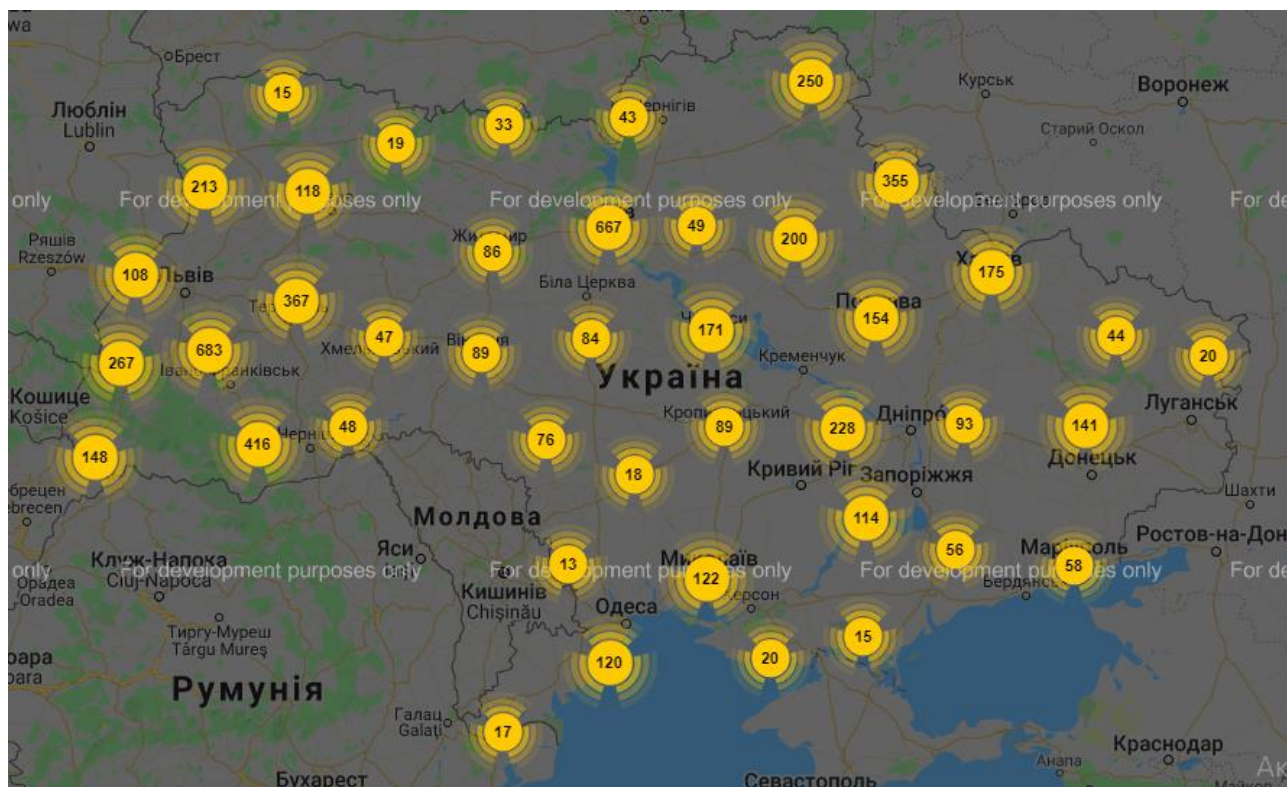


Fig. 2. The map of healthcare organizations in Ukraine

Conclusion. This article explored the idea of creating a new patient ID key in order to attempt to design a heatmap of patient migration within a single country. The concept of the work itself was considered, as well as the pros and cons of the idea of architecture were outlined. For the most part, the system has collected more negative responses than positive ones, since it can be considered an inhuman surveillance process, which will reiterate the Constitution of our country.

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