

Software Tool for Planning and Monitoring of Provided Medical Services

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Abstract – Business planning and monitoring is a very complex process for any company or organization. The problem is especially pronounced in the health systems which are exclusively focused on patients and their health state. In addition to planning a sustainable business health institution, it is necessary to consider a plan for providing services and features in the prevention and treatment of diseases, as well as legislation and regulations governing the health care system of the Republic of Serbia. This paper describes the process of creating a plan for the provision of medical services using the implemented application Medis.NET.PlanRada. The problems that may arise in the planning process are also described. The application can be useful when planning medical services for a certain period of time, usually on an annual basis, as well as for monitoring the implementation of the execution plan in primary health care institutions.

Keywords – Planning, Plan execution, Primary health care, Plan realization, Plan monitoring.

I. INTRODUCTION

Planning is a process of forming a suitable model with a desired future and designing appropriate ways to achieve that future. The result of this process is a plan, which is the projection of the desired state, providing steps that help a company reach the previously set goals. This process is especially complicated for large companies and systems such as a country's health care system.

The health system is one of the most complex systems in a country. Each state has an obligation to take care of, and improve the health status of its population, although the models of functioning are more or less different. According to the World Health Organization, a healthcare system includes a healthcare infrastructure that provides a set of programs and services and provides health care to individuals, families and community [1].

A health system has to ensure health care which is physically, geographically and economically accessible, as well as affordable, integrated and of high-quality. It also needs to ensure the development of healthcare workers, sustainability of funding, decentralization of management and financing, as well as placing patients in the center of the system. Its purpose is to preserve and improve human health by providing efficient modern and traditional health services. At the same time, these should be accessible and acceptable to people [2]. Given the system's importance and impact on

people's health and economy, states implement a series of measures for the planning and management of health systems. The aim is to ensure stable financing and a rational and high-quality health care delivery system in order to provide basic health care within available resources.

Due to the complexity of health system, the process of planning its proper functioning is extremely complex. National plans and strategies for the development and improvement of the entire system are adopted at the state level, while each institution plans its operations in accordance with the national strategy. Particular attention has been paid to the quality and efficiency of health care services in order to preserve health, and improve preventive and current diagnostic activities and therapy. For healthcare facilities, the process of planning is more important than its outcome.

The planning process is motivated by the tendency to lower the degree of uncertainty that the future holds and avoid undesirable future situations. Planning would be unnecessary if one could be certain that there would be no unpleasant surprises in the future and that the desired objectives could be accomplished on their own. Having in mind that the degree of abstraction and uncertainty in planning increase with the length of the period in question, planning includes developing both short- and long-term plans. For every plan, a choice is made among several options, together with decisions on how to optimally utilize the limited resources which are at the institution's disposal.

This paper describes the planning in primary healthcare institutions (health centers, student clinics, and occupational medicine), the objectives and problems that occur during the planning process, as well as the application that helps creating the plan, especially in monitoring its execution. The application itself can be integrated with pre-existing medical information systems. This paper will describe the integration with the existing medical information system MEDIS.NET [2].

II. PLANNING IN PRIMARY HEALTHCARE INSTITUTIONS

Primary health care is the foundation of the entire healthcare system. This implies that the majority of patients' health problems and needs are solved at this level with active support of individuals, families and communities. This is done through standard interventions, such as preventive and curative examinations, promotion of health and prevention, early diagnosis, timely treatment and rehabilitation. Primary health care should have a central place and role in the development strategies of health systems and solve at least 80% of all health problems.

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Legislation and required standards play a major role in the planning process for healthcare institutions. For example, it is necessary to consider the following facts when developing the plan:

1. Health Care Act stipulates that every health center in the Republic of Serbia is obliged to plan, monitor, analyze, evaluate and report on the health status of the population in the area it covers [3].
2. Rules of Procedure for the elected physician make it possible for a patient to choose and change the elected physician [4].
3. The Law on Protection of Population against Infectious Diseases obliges public institutions in the Republic of Serbia to make their own plans to organize their activities in emergency situations [5].
4. The Law on Personal Data Protection obliges all health institutions to draw up a plan for data security which determines technical and other organizational measures for the security of personal data [6].
5. The Strategy for Improving the Quality of Health Care provides processes for reaching a higher level of efficiency and effectiveness at work, as well as greater customer satisfaction and health care providers [7].

Given the above, health institutions make monthly, annual and multi-annual plans for their work and improving operations and the quality of services. These plans relate to different aspects, starting from the plans for dealing with cases of infectious diseases, through plans on medical waste management, maintenance of the institution, purchase of equipment, and staff training, to planning the provision of services and introduction of new ones, as well as planning resources (both human resources and medical appliances and accessories). The focus of this article will be on the planning of services that should be provided, their spatial distribution, together with adequate doctors' workload and medical equipment necessary to carry out the plans.

III. IMPLEMENTING SOFTWARE TOOLS

MedisNET.PlanRada is an upgrade of the Medis.NET health information system [8], developed by the Faculty of Electronic Engineering in Nis. It has been successfully implemented and is currently used in more than 20 health centers in Serbia. It is a desktop application, realized in C# under .NET framework. Database integration is done with PostgreSQL. The application is integrated with the medical system to allow downloading the data regarding the services provided to patients, physicians who provide these services, and the devices used in the provision of certain services, the spatial and temporal dimension of the services, as well as a minimum data set about the patients who use these services (age, sex, elected physician, health center or medical clinic belong to according to their address). These data are necessary to create a plan for providing health services and evaluating the success of the plan.

The application consists of several parts:

1. Module of services mapping – enables the division of a service prescribed by the RFZO (republic fond of health insurance) in multiple primary services for a

more detailed description of the service, its planning and monitoring.

2. Modules for the acquisition of data regarding the provided services – enables the integration with any medical information system by creating appropriate mapping information on the provided services. The purpose of this module is to download a minimal set of existing data about the provided services from the information system.
3. Module for plan creation – provides service planning according to the department, organization unit, location and unit; resources (doctors, medical technicians, tools); grouping of services in sub-tables and tables and planning by created tables/sub-tables.
4. Module for execution overview - provides an overview of the plan and execution of the provided services, with the percentage of plan realization for the desired period and relevant department, location, unit, chosen physician or device.
5. Reports module – enables the generation of various reports on the plan and its execution which health institutions should provide to the institutions monitoring their work.

The application can be integrated with any health information system, regardless of whether it is a primary, secondary or tertiary health care system.

IV. MEDISNET.PLANRADA DESCRIPTION

Before creating a plan for providing a service, it is necessary to define which of the existing services, regulated by RFZO, are provided for the given department and at the given location. Because of the number of services provided in larger health institutions, the amount of resources they have and the number of patients they treat, it is convenient to plan at the level of departments and the services within a department rather than at the level of services throughout the facility. In order to plan related services together, it is also convenient to classify the services according to the area they belong to (passive health care, active health care, work plan at interventions, preventive examinations, check-ups,...) (Fig. 1).

Šifra primarne usluge	Šifra i podšifra usluge	Naziv primarne usluge
1001	1200039.01	PRVI PREGLED ODRASLIH
1002	1200047.01	PONOVNI PREGLED ODRASLIH
1003	1000017.01	KRATKA POSETA LEKARU
1004	1000025.01	SPROVOĐENJE IMUNIZACIJE
1005	1200054.01	SLOŽEN KURATIVNI PREGLED
1007	1000223.01	CILJANI NA RANO OTKRIVANJE KARCINOMA DEBELOG CREVA
1008	1200013.01	PREVENTIVNI PREGLED
1009	1000215.01	INDIVIDUALNI ZDRAVSTVENO VASPITNI RAD
1010	1000207.01	GRUPNI ZDRAVSTVENO VASPITNI RAD
1011	1200088.01	Skrining/ rano otkrivanje depresije
1012	1200062.11	Skrining/ rano otkrivanje dijabetesa tipa 2
1013	1200070.01	Skrining/ rano otkrivanje kardiovaskularnog rizika - muškarci
1014	1200070.02	Skrining/ rano otkrivanje kardiovaskularnog rizika - žene

Fig. 1. Classifying primary services

When entering the plan for service execution, it is necessary to select the year for which the plan is created, department, location and the unit. After that, the system will display a list of all services that belong to the selected items, together with

the information about the plan and its realization for the previous year. The number of services planned for the previous year is displayed for the selected department, location and the unit, together with the number of realized services, percentage of execution, number of physicians and nurses who provided the services, as well as the average time physicians and nurses took to provide a specific service. In addition to these data, there is also the number of insured persons who gravitate to the selected health station. This number represents the total number of insured persons services are planned for. The number of services which should be provided in the following year is predicted based on the last year's plan and its realization, the number of physicians and nurses available for the current year, and the change in the number of insured persons who gravitate toward a health clinic. The system analyzes the provided information and proposes the number of services that need to be planned, while the staff from the planning department has the possibility of adjusting the proposed plan for the number of services (Fig. 2).

Redni broj	Sifra	Naziv	Izvršeno	Ukupno planirano	Planirano za izvod	Planirano za raspisati	Br. lekara	Br. sestara	Vreme lekara (min)	Vreme sestara (min)	Br. posetilaca	Obuhvat
1	1200039.01	PRVI PREGLED ODRASLIH	78621	54530	54530	0	26,0	26,0	30	15	250500	0,00
2	1200047.01	PONOVI PREGLED ODRASLIH	140469	112490	112490	0	26,0	26,0	15	10	250500	0,00
3	100017.01	KRATKA POSETA LEKARU	11081	7846	7846	0	26,0	26,0	10	10	250500	0,00
4	100025.01	SPROVOĐENJE IMUNIZACIJE	4899	3980	3980	0	26,0	26,0	10	5	250500	0,00
5	1200094.01	SLOŽEN KURATIVNI PREGLED	2122	1373	1373	0	26,0	26,0	20	10	250500	0,00
6	1000223.01	CILJANI NA RANO OTKRIVANJE KARCINOMA DEBELOG CREVA	1129	2550	2550	0	26,0	26,0	15	15	100000	0,00
7	1200013.01	PREVENTIVNI PREGLED	2157	3825	3825	0	26,0	26,0	30	10	250500	0,00
8	1000215.01	INDIVIDUALNI ZDRAVSTVENO VASPITNI RAD	4022	4567	4567	0	26,0	26,0	25	25	68000	0,00
9	1000207.01	GRUPNI ZDRAVSTVENO VASPITNI RAD	224	332	332	0	26,0	26,0	90	90	79000	0,00
10	1200088.01	Skining/ rano otkrivanje depresije	1197	2346	2346	0	26,0	26,0	15	15	152000	0,00
11	1200086.01	Skining/ rano otkrivanje dijabetesa tipa 2	702	2550	2550	0	26,0	26,0	15	15	250500	0,00

Fig. 2. Form for entering the service data plan

The planning process has to be finished in all departments, at all locations and in all units, and the plans are then verified. During the process of verification, it is necessary to pay attention to the workload of physicians, technicians and devices. Planning for devices is usually done explicitly by defining the number of services possible to provide on specific medical equipment. Planning for human resources is conducted for all employees in the department together. Since the plans do not explicitly state the names of physicians and technicians, in the process of verification, services for a department are divided according to the physicians and technicians who perform them, analyzing the total time required for the realization of services and whether the time fits into the total number of working hours annually, considering the possible deviations (a physician's seek leave, attending seminars and conferences).

When creating a plan of service provision, it is necessary to consider the same location where the ambulance services will be provided, as well as patients who gravitate towards that location. If the healthcare institution is in a rural area with the majority of older population, services are planned predominantly for general practitioners (curative and preventive examinations and interventions) and patronage visits to the elderly, while the number of the planned services for the pediatric department is much smaller. On the other hand, if the ambulance is located within the school, all planned services relate exclusively to school children.

After creating and verifying plans, their execution can be monitored. If the application is integrated with Medis.NET information system, it is not necessary to download the data about service provision because the application itself is integrated with that system. It can be used as a standalone application, too. In this case it is necessary to provide the data about plan execution for a defined period by the unit and location. To monitor the realization of the plan using any other medical information system, it is necessary to synchronize the data firstly (downloading data regarding service provision). It is possible to view the plan realization in the chosen time period at several levels, per department, department and locations, department, locations and units, according to physicians and technicians. Depending on the selected option, a higher or lower level of plan realization is displayed. If the organizational unit is selected, plan realization will include the total number of planned services (from all locations and units), and all the services that can be provided by the department, together with the total number of executed services. The percentage here represents compliance with the plan. This considers the period in which services are provided, and if the period does not include the full year, scaling of the annual plan is performed for the selected period (Fig. 3).

Redni broj	Sifra	Naziv	Planirano (ukupno)	Izvršeno (ukupno)	Procenat (ukupno)	Vreme lekara (ukupno)	Vreme sestara (ukupno)	Br. lekara	Br. sestara
1	1200039.01	PRVI PREGLED ODRASLIH	54530	24545	180,05	490900	308175	26,0	26,0
2	1200047.01	PONOVI PREGLED ODRASLIH	112490	31279	111,22	469185	312790	26,0	26,0
3	100017.01	KRATKA POSETA LEKARU	7846	2568	130,41	25580	25580	26,0	26,0
4	100025.01	SPROVOĐENJE IMUNIZACIJE	3980	686	89,67	6860	3430	26,0	26,0
5	1200054.01	SLOŽEN KURATIVNI PREGLED	1373	512	140,16	10240	5120	26,0	26,0
6	1000223.01	CILJANI NA RANO OTKRIVANJE KARCINOMA DEBELOG CREVA	2550	397	62,27	9565	9565	26,0	26,0
7	1200013.01	PREVENTIVNI PREGLED	3825	552	57,73	11040	5520	26,0	26,0
8	1000215.01	INDIVIDUALNI ZDRAVSTVENO VASPITNI RAD	4567	983	86,11	24375	24375	26,0	26,0
9	1000207.01	GRUPNI ZDRAVSTVENO VASPITNI RAD	332	76	91,57	6840	6840	26,0	26,0
10	1200088.01	Skining/ rano otkrivanje depresije	2346	865	150,9	13275	13275	26,0	26,0
11	1200082.11	Skining/ rano otkrivanje dijabetesa tipa 2	2550	694	108,86	10410	10410	26,0	26,0
12	1200070.01	Skining/ rano otkrivanje kardiovaskularnog rizika - muškarci	893	153	68,53	2295	2295	26,0	26,0
13	1200070.02	Skining/ rano otkrivanje kardiovaskularnog rizika - žene	1020	251	98,43	3765	3765	26,0	26,0
Ukupno za celinu			197382	63571	128,83	1080200	787730		

Fig. 3. An overview of plan realization for the chosen period of time

When analyzing the execution for part of the period for which planning has been undertaken, it is necessary to be careful because the data can lead to the wrong conclusion. For example, if you look at the previous figure (Fig. 3), it can be concluded that the number of the first examinations is planned badly because there were almost twice more services than planned in the first three months of the current year. However, the analysis should also consider the time of the year for which the plan execution is reviewed (the first three months of the year) and the health situation in the country at that time. The fact is that influenza epidemic was recorded in this period, causing the number of first examinations to increase significantly. It is also important to note that during the summer months, there are fewer examinations, but also the resources (physicians and technicians) to provide the services during that period. For a more precise analysis of the execution plan, it is best to look at the allocation of concrete services provided in the previous year, as well as the distribution of services during the current year and compare all that with the planned number of services (Fig. 4).

Fig. 4. confirms that the number of first examinations at the beginning of the year is noticeably higher than in the rest of

the year, and that a similar situation is repeated from year to year. Therefore, this fact is very important for monitoring the realization of the plan. For each of the planned services, there is a correlation with the time of year. For example, a regular check-up of first grade children is carried out from May to the end of August, vaccination is usually done in the spring and fall, an injuries due to falls usually occur during the winter months.

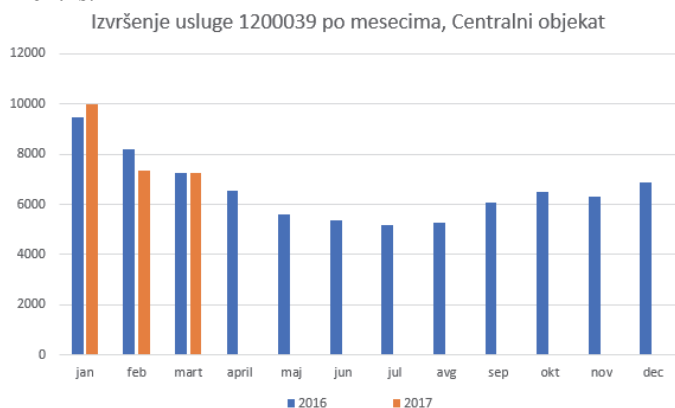


Fig. 4. Service execution

Given all the above, it can be concluded that service monitoring should be done for short periods of time but with great awareness of the connection between the location where the services are provided and the time range for single services. The job is further complicated by the sheer number of services. The described system therefore includes an automatic check of plan realization which singles out only those services whose execution deviates more than a specified percentage (considering the total number of planned services in the current and previous year (or previous years, according to the history data that an institution possess), the distribution of their execution by months, and the degree of deviation that the user defines). The deviation percentage can be defined by the users themselves. Greater deviations require further analysis and possibly the revision of the planned service provision. For example, if the number of first examinations and interventions due to a flu epidemic significantly increases, it is necessary to increase the number of physicians and technicians, reallocate resources from other sites or departments if possible, or make a reorganization plan to reduce the number of other services whose execution is not so critical. If service is not realized according to the plan, this does not necessarily mean that there is an error in the planning process, but may indicate a change of health condition of the population gravitating to that institution.

Another important aspect to the service planning and monitoring their realization is monitoring the workload of physicians and technicians, or devices that provide these services. Due to the constant development and advancement of treatment and prevention, the plan needs to include periods when the staff attend professional training seminars, and are therefore not able to provide the planned services. The number of insured persons who gravitate toward an institution, their age structure are considered when planning physicians and technicians who will be at the site to provide services. Further improvement in the planning can be achieved by analyzing the medical histories of patients in a

certain area in order to select the most qualified physician for the most common diseases in a given area.

V. CONCLUSION

This article describes some of the problems the health institutions face when creating a plan for providing services and monitoring its realization. It describes developed application that supports the entire process of planning and monitoring the execution of the plan with warnings about significant deviations from the plan and appropriate reports. The application enables planning and execution monitoring, as well as the workload of physicians, technicians and devices. The goal is to increase the efficiency and quality of services, and improve the health state of the population. Deviations from the plan are easy to detect. They can represent a change of the population's health state in a certain area.

The described solution represents the first phase of the application's implementation for planning services in primary health care. The second phase requires the existence of a database with information of the provided services from a longer period of time (several years) which the system will use to "learn" how services are planned and realized for defined parameters. The system would then be able to precisely generate an execution plan of services for the future, following the migration of the population (based on the change in address), aging, gravitation to institutions, available devices and human resources and their knowledge, as well as new methods and trends in treatment. This gives room for further work on the application's development and simplification of the medical service planning in primary health care.

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