Driving forces for information and communication technology innovations in smart health in St. Petersburg

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Abstract. The article analyses institutional environment of the process of introduction of information and communication technologies while developing the smart health concept. The best practices of innovations in healthcare, based on information-communication technologies, are analyzed. To define the driving forces for information and communication technology innovations the expert opinion analysis is held — the article uses results of the survey of the opinion of the heads of public and private medical organizations in St. Petersburg. Recommendations for regulatory authorities and medical organizations concerning enhancement of the process of introduction of innovations are formulated.

Based on analysis of current situation in Russian healthcare and experts’ opinions, we conclude that main drivers for information and communication technologies introduction in public medical organizations are being represented by State healthcare digitalization strategy and competition with private medical organizations in market paid services sector. Main drivers for private medical organizations are increase in demand for paid medical services and increase in competition in this sector.

The smart health concept is not just assuming introduction of innovations inside medical organizations, but also needs effective collaboration between clinics, patients and city management.

It is necessary to take into account flexible environment of medical organizations. Digitalization in healthcare system should be based on integration of needs and enhancement of collaboration among groups of interests.

1. Introduction

Innovations in public sector aim to improve productive efficiency, quality and availability of services. Innovations in healthcare system can be defined as ‘adoption of those best-demonstrated practices that have been proven to be successful and implementation of those practices while ensuring the safety and best outcomes for patients and whose adoption might also affect the performance of the organization. In other words, innovation in healthcare is defined as those changes that help healthcare practitioners focus...
on the patient by helping healthcare professionals work smarter, faster, better and more cost effectively [1].

Innovations in healthcare affect products (services), processes and administrative structure of medical organizations [2]. Innovative products are new services which are purchased by the client (for example, new clinical procedures). Innovative processes are new ways of service provision (for example, on-line medical records). Organizational innovations are connected to external and internal environment of medical organizations and provide possibility to create new business-model. Digital innovations, which improve client-oriented behavior, are connected with process as well as marketing innovations [3].

Difficulties in definition of innovations in healthcare system can be explained by existence of different approaches to modelling and analysis of medical organizations. While analyzing medical organization in terms of production function, innovations are treated as different novelties in the field of medical technologies and medical products [4]. While analyzing medical organizations in terms of knowledge and information flows, innovations are treated as novelties in the field of management these information and knowledge flows, including introduction of information and communication technologies in medical organizations [5–7].

Traditionally, the state government becomes the source of innovations in healthcare system. For example, the Netherlands Ministry of health initiated introduction of electronic medical records for the patients of medical organizations [8]. Introduction of such process innovation, having the same set of structural elements for medical information, as it is used to be in traditional, paper, records, was done in order to improve organizational efficiency of medical organizations — ‘specialists should spend more time for analysis of medical information, rather than for information processing’ [8]. Modern research has proved that successful development of healthcare system is mostly defined by effectiveness and efficiency in information and communication technologies implementation while providing medical services [8]. It can be explained by the need of detailed description of the process of medical services provision, for example — recording information about patient’s complaints or any interactions within medical insurance system. Bullinger shows that, despite the state’s leading role in medical organization innovations, success of any novelty depends on top management and employees of medical organizations preparedness for adopting these novelties [9]. One of the obstacles to innovations in public sector, as well as in healthcare is impossibility to meet needs of all stakeholders. One of the best practices in this area is described in [9] — introduction of open information platform called ‘GemeinsamSelten’ — the resource, which provides all stakeholders (patients, doctors, researchers, medical equipment suppliers, managers, etc.) with possibility to leave their feedback concerning their problems regarding healthcare and interactions with medical organizations. The users of the platform have possibility not only to complain to the problem, but also to provide their offers on how to overcome these problems. In 2011, the platform helped medical organizations to find more than 50 innovative solutions to the problems revealed. Among them, 17 (32%) were in the field of information and communication technologies, 16 (30%) — new products and processes, 11 (21%) — improvement of existing products and services, 9 (17%) — knowledge and information flows management [9].

Healthcare IT systems can also be used ‘to inform workers and managers about changes to workplace vulnerabilities and new means that may be available to meet challenges, such as widely varying demand’ [10].

Digitalization in healthcare aims to increase possibilities of patients to get access to medical services, medical services efficiency improvement, improvement of communications between different groups of member of healthcare system, and, finally, to increase quality of citizens’ lives. The main facilitators of innovative activity in healthcare system are governmental bodies (including healthcare regulators), consumers (patients) and clinics.
Development of information and communication technologies (ICT) gave birth to electronic health (e-health) concept. According to the definition of the World Health Organization, ‘e-health is the use of information and communication technology (ICT) for health. Examples include treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health’ [11]. Implementation of this concept makes it possible to decrease medical aid costs and improve quality of medical services.

Emergence and sophistication of different types of mobile devices (including mobile phones, patient monitoring devices, personal digital assistant) and other wireless gadgets became a reason for the beginning of the mobile health (m-health) era — ‘emerging mobile communications and network technologies for healthcare systems’ [12]. Later, implementation of health technologies as a part of infrastructure for smart cities, together with electronic health (e-health) and mobile health (m-health) technologies caused appearance of ‘smart health’ concept. Thereby, it is possible to define smart health in the following way: ‘smart health (s-health) is the provision of health services by using the context-aware network and sensing infrastructure of smart cities’ [13].

The smart health environment includes four groups of elements which are joined in a single system, i.e. they are toughly linked to each other and should be developed simultaneously. These are smart technologies, smart regulators, smart medical organizations, and smart patients.

The goal of the research is to define innovation drivers for the smart health. To achieve the goal, following objectives were formulated — to analyze positions of groups of interest involved in ICT introduction, to analyze best practices, and to find main problems in interaction among main stakeholders.

2. Research methodology

On the basis of analysis of contemporary characteristics of healthcare systems and expert opinions collected by interviewing heads of public and private clinics the article provides conclusions concerning main problems in interaction among main stakeholders.

In the first turn, we have to analyze positions of main groups of interest — regulators and medical organizations.

The aim of The Federal Strategy for Healthcare Development for 2015–2030 lies in creating conditions conducive to ensuring accessibility and higher quality of healthcare services provided to citizens, as well as respect for the rights of citizens in the field of healthcare [14]. To achieve this aim, the state is proposing, above other means, to develop ICT in healthcare. This measure, according to the Strategy, assumes development of Federal digital network so as to provide healthcare stakeholders with possibility of effective communication by means of ICT.

One more Federal project, the state priority project called ‘Improvement of processes of organization of medical aid on the basis of ICT development (The e-health)’ started in November, 2016. The goal of the project is improvement of efficiency of management of the provision of medical care to patients by means of ICT: development of the possibility to schedule a doctor appointment; shift to electronic documentation system; provision of minimum 10 e-services available for patients via medical service ‘My health’ on the State services portal.

Urban policies in St. Petersburg, including those in field of digital technologies and innovation, follow the Federal Strategy. Therefore, the city government (represented by St. Petersburg Public Health Agency) initiated unification of disparate and dissimilar medical information systems into a single e-health environment. In February 2017, the ‘Electronic Healthcare’ project was included in the list of priorities for St. Petersburg development. Now 84 (about 30%) public medical organizations are covered by this project. By 2020, the e-health system should also aggregate private medical organizations. By now, all patients of involved clinics have a possibility to get information about their clinical tests on-line, and later it will be possible to get online access to doctor’s notes. This project aims to create unified electronic
medical records for all patients, which can be used in any medical organization. Finally the project should create not less than 45 e-services for patients, doctors and public health authorities.

Even brief description of key strategic directions of state programs for healthcare development shows that innovations in RF healthcare sector are required by the government, so modern innovative trends are to be taken into consideration both by state and by medical institutions.

To sum up the state propositions in the field of ICT innovations in Russian healthcare system, the following are to be mentioned: (a) accelerated innovative development of healthcare on the basis of new diagnostic technologies, digital medicine and telemedicine technologies; (b) establishment of telemedicine consultations with leading specialists from practical medical centers, available for patients, doctors and medical organizations; (c) establishment of integrated state information system in the field of health care with involvement of comprehensive analytical program for big data processing; (d) establishment of information systems to support adoption of medical decisions assistance, including the use of artificial intelligence (machine learning).

Private medical organizations started to use modern technologies much earlier. Thus, in 2000, medical business started to digitize. By now, according to Alexander Solonin, Head of Saint Petersburg Private Clinics Association, vast majority of private medical institutions installed either software solutions developed personally for them, or acquired them from IT companies.

Today, almost all aspects of clinics management and their services are concentrated in medical information systems: maintenance of medical records, storage of clinical tests’ results, management of material supplies, handling of medicines and supplies between storage and use sites, procurement, storage and transfusion of blood components, medical economics, reporting and analysis efficiency of medical departments, etc.

Establishment of electronic medical records, as well as development of templates for patient interviews and electronic reporting, exempted doctors from most of routine work. First and most important achievement on the way to further digitalization is the possibility to abandon paper medical records. Medical information systems enable the doctor to see the entire history of the patient's applications and his research, to filter and find the information he needs. Thus, the doctor can devote more time to the patient, instead of flipping previous notes in search of the latest clinical studies.

So, digitalization in healthcare industry makes it possible to solve yet another common problem - to ensure the storage and accessibility of medical data.

Digitalization helps medical business to solve even more complex tasks corresponding to the profile of a particular institution.

Though, it is technically feasible to integrate private and public medicine into a single digital space, there still remains a number of unsolved issues. First of all, the architecture of the future St. Petersburg e-health system is implicitly drawn. There is no single decision on the place for the storage of the patient information - a single database or clinic’s servers. Also it is necessary to develop criteria for transmitted information, which would be sufficient, but not superfluous.

The second problem is incompatibility of the formats in which medical information is currently stored — it is very important to make a single database to be compatible with other medical information systems. It is necessary to move to a single standard for information exchange, the use of a single, widely understandable ‘language’ in which this information will be presented. HL7 FHIR standard is used worldwide. It includes many resources that can cover the entire perimeter for medical data transmission. However, adaptation of medical information systems already installed in institutions to the new standard requires considerable costs, which are not affordable for all private clinics.

Finally, there still remains a number of legal issues, which are required to regulate storage, management and access to the patient's personal data.
These three groups of issues become a question which has to be addressed to municipal or even Federal Government as a part of healthcare development strategy. Absence of integrated approach to digital strategy in healthcare may be identified as one of the factors, which slow down development of smart health concept in RF healthcare system.

3. Findings
To define factors, influencing development of smart health in city, we analyzed expert opinions of heads of public and private medical institutions in St. Petersburg (19 respondents in total). Questions were connected with factors of external and internal environment and main constraints on the path of application of healthcare innovations in medical organizations — development of smart medical organizations.

Results of surveys and interviews show that private and public clinics are interested in technological projects and development of smart doctors, but are currently paying very little attention to ICT projects, which could attract extra patients and to improve quality of services. Nevertheless, the respondents noted, that growth of total quantity of patients in St. Petersburg is affecting the quality of medical institution activities, alongside with that, current Federal strategy of healthcare development is playing a very important role for public medical institutions in defining steps for innovative products application.

The main problem concerning establishment of new ICT technologies in RF medical institutions is that existing positions and, accordingly, the interests of key decision-makers on establishment of new technologies (health authorities, health facility managers, doctors) do not and cannot ensure steady orientation of the innovation process on their clinical and economic efficiency improvement.

In order to increase the scope of ICT projects establishment among public and private clinics and their patients it is required to develop self-regulation and to ensure wider participation of private clinics in state medical insurance program. It will lead to enhancement of competition in healthcare system, which will create incentives for different types of innovations in healthcare.

The smart health concept, which includes not only technological but also managerial support from the government, may become the most powerful tool to benefit from developed competition via a single e-health space.

Today, medical insurance companies are not interested in medical organizations innovation. Medical insurers have to participate in provision of information about available digital services as well as assist patients and medical organizations to use these services. Insurers, being intermediary agents between medical organizations and patients, have to become the fifth element of smart health concept.

4. Conclusion
Based on the analysis of current situation in Russian healthcare and experts’ opinions, we conclude that main drivers for information and communication technologies establishment in public medical organizations are being represented by State healthcare digitalization strategy and competition with private medical organizations in market paid services sector. Main drivers for private medical organizations are: (I) increase in demand for paid medical services and (II) increase of competition in this sector.

The smart health concept is not just assuming establishment of innovations inside medical organizations, but also requires efficient collaboration among clinics, patients and city management.

It is necessary to take into account flexible environment of medical organizations. Digitalization in healthcare system should be based on integration of needs and enhancement of collaboration among groups of interests.

5. Further research implications
Findings displayed by the current research, can be implemented in following areas:

- assessment of impact exerted by healthcare digitalization on patients satisfaction;
- comparison of digitalization impacts exerted on private and public clinics involved in mandatory medical insurance system.

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