# A BUSINESS MODEL OF RUSSIAN E-HEALTH BASED ON PROCESS INTEGRATION OF INDUSTRY 4.0: THE DEVELOPMENT OF INDICATORS FOR INFORMATION COMMUNICATION

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## ABSTRACT

*This paper attempts to develop generalizable indicators of the information-based communication to (1) theoretically assess and define E-Health and (2) devise a generalizable e-health business model built on the indicators of information-based communication. Hereby, the status quo in German E-Health Industry 4.0. and European healthcare standards of the World Health Organization are reviewed and the corresponding information systems in the Russian healthcare are evaluated in a comparative perspective.*

*We then determine promising directions for the development of E-Health in Russia, following the logic of the process integration of information systems. The final part of the paper discusses results of the preceding theoretical analysis: identification of the main participants in the Russian E-Health business model; development of ten universal components that form indicators of information-based communication for E-Health in Russia; the authors' suggestions targeting at the implementation of a unified state information system in the Russian healthcare in 2021-2025.*

**Keywords:** E-Health Business Model, Process Integration, Information-Based, Communication, Russian Healthcare.

## INTRODUCTION & LITERATURE REVIEW

Implementation of a dynamic E-Health business model represents a major challenge for both political scientists and economists, as it lies on the intercept of financial and social concerns, bringing up a critical societal issue – the health of the entire population – which has become especially salient in light of the worsening environmental conditions worldwide (Remoundou & Koundouri, 2009). From the economic perspective reviewed by (Spil & Kijl, 2009), this policy area is unique due to its emphasis on the (telemedicine) technology, as opposed to the classical business model concept with a focus on the product value creation process. For this reason, Research & Development phase, i.e., the preparatory planning stage, is of key importance for the development of an efficient E-Health business model, which determines the relevance of this study. The suggested technology should be then adjusted for the political and socio-economic constellation faced by the target country (Scherer & Siddiq, 2019). Consequently, despite the extensive foreign literature on the E-Health problématique, existing E-

Health models proposed by European and American economists are highly dependent on the regional context and industrial specifics (Shaw et al., 2017). We contribute to the E-Health studies by critically assessing the previous E-Health experience in Germany and extending the research field for natural resource-based economies, e.g., Russian economy (Bradshaw & Connolly, 2016).

Further, an insufficient operationalization of the E-Health fundamental concepts prevents scholars from standardizing and classifying e-business models in accordance with their profitability (Shaw et al., 2017). We attempt to narrow this gap and will propose effective and sustainable E-Health solutions at the federal states' level for Russian Federation. Hence, the key objectives of the study are (1) identification of the pivotal participants in the Russian E-Health business model; (2) development of generalizable components that form indicators of information-based communication for E-Health in Russia; (3) determination of directions for the implementation of a unified state information system in the Russian healthcare in 2021-2025.

## E-Health in the Contemporary Literature

Technological advances in medicine have led to a diversification of forms of operation in the healthcare sector, as well as to changes in patient data management schemes. On the German example, Häcker et al. (2008) analyze various ways of enhancing this policy area from the technological perspective. More specifically, they discuss possibilities of the country's economy for the gradual transition to telemedicine services for patients (Häcker et al., 2008). The authors also emphasize the importance of enterprises that provide telemedicine services for the treatment of cardiovascular and diabetic diseases.

Hereby, it should be noted that telemedicine technologies are already widely used in the integrated remote measurement of stress level, physical activity and other important indicators of the patient's health status under the conditions of the Ambient Assisted Living (AAL) scenario. Gersch (2012) examine several types of economic activity required for a successful AAL within the E-Health business model, referring to existing Internet platforms that execute remote monitoring of patients. Di Rienzo et al. (2020) offer a universal technological solution for AAL-a multi-sensor platform that is capable to receive multivariate bio signals from a patient, which helps improve the mechanisms for E-Health process integration into the existing healthcare system.

The work of Mathar (2010) constitutes another strand of the telemedicine studies, suggesting a social perspective on E-Health with the focus on a digital patient. Digital patients are thus viewed as service receivers of the scientific and technical healthcare system. Information & Communication Technologies (ICT) are presented by the author as a social structure that unites telemedicine centers. Thus, communication between E-Health participants forms social and technical networks in which different elements, human and technology ontologically interact (Mathar, 2010). Subsequently, Mathar defines various types of activities of telemedicine nurses in socio-technical networks as the "*healthcare science and technology micro-policy*", as well as the resulting relationships between the participants of the process (Mathar, 2010). The implementation of such a socio-technical network has been studied in detail by Wesley et al. (2019) using the example of Patient-Reported Outcomes (PROs), i.e., the outcomes of self-monitoring of health status performed by a digital patient with the support of ICT.

Finally, bringing two aforementioned views together, Lux identifies three groups of participants in the E-Health interaction based on Industry 4.0: healthcare service receivers (Patients (P), who denote medical service receivers in real and virtual spaces), healthcare service

providers (Doctors (D)), and healthcare service insurance (Insurance (I)). In line with Lux, nine different relationships can exist within the E-Health business model: Patient-to-Doctor (P2D) and Doctor-to-Patient (D2P); Patient-to-Insurance (P2I) and Insurance-to-Patient (I2P); Insurance-to-Doctor (I2D) and Doctor-to-Insurance (D2I) (Lux, 2017). Relationships can also emerge within individual groups of participants (P2P, D2D, I2I) and will be considered in our E-Health scenario in the next section.

## A Generalizable E-Health Business Model: Definitions and Concepts

According to Linder (2000), a business model should create a simplified abstract counterpart of a company, preserving its basic elements and describing the relationships between its central participants with an emphasis on the individual production logic of the firm. Following Lux (2017) and Linder (2000), we define a Russian E-Health business model as an interaction system with three participants along nine possible channels (P2D, D2P, P2I, I2P, I2D, D2I, P2P, D2D, I2I) based on a set of medical information systems and existing socio-technical networks. The fundamental goal of our E-Health business model is therefore the provision of high-quality medical services both in face-to-face and electronic formats to Russian residents.

Furthermore, while planning a gradual introduction of an E-Health business model to Russian markets, we stress the value of existing universal E-Health standards and consider them a minimal requirement to be satisfied in our business model. For this reason, we suggest taking the World Health Organization's (WTO) prescriptions as a baseline framework for implementing a comparable pilot project in Russia. Specifically, in 2018, the WTO developed the following legal guidelines for the development of E-Health in ten different areas:

1. Developing regulatory mechanisms to formalize medical jurisdiction, rights and obligations of E-Health participants in the field of payment for telemedicine services, as well as refunds.
2. Ensuring the safety and high quality of patient services based on the principles of data transparency and transmissibility.
3. Protection of personal (identifiable) data of E-Health clients regardless of the selected service format. i.e., face-to-face/electronic.
4. Protection of health status data of E-Health clients regardless of the selected service format.
5. Protection of the web space for the exchange of personal data of E-Health clients between medical service insurance and doctors within one country.
6. Protection of the web space for the exchange of personal data of E-Health clients between medical service insurance and doctors in the international medical community.
7. Protection of the web space for the exchange of personal data of E-Health clients for research purposes.
8. Managing client access to client health status data within the E-Health register.
9. Exercising the E-Health client's right to correct or replace health status data within the E-Health register.
10. Exercising the E-Health client's right to delete health status data within the E-Health register.

The aforementioned principles are pivotal for achieving a high-class client-oriented communication and therefore, must be reflected in the indicators for assessing the interaction between the participants of the E-Health business model in Russia, which we present in Table 1. Please note that many scholars acknowledge a growing demand for a generalizable canvas when developing a business model, so we decide to stick to this approach in Table 1. A canvas should divide each business model into four component parts (groups of participants): client, offer, resources, and finance (Osterwalder & Pigneur, 2011). Consequently, we have developed

comparable indicators for assessing nine interaction channels emerging between three participants within the E-Health business model.

The indicators, which we present in Table 1, are classified, according to the functional principle, i.e., each component serves its purpose in the specified model and is therefore, functionally independent from others. We further acknowledge the importance of distinct stages for weighting indicators, dependent on their relative contribution to the success of a business project. Thus, the main predictors of successful interaction at the experimental prototype stage are considered to be technological advances, such as improving the quality, availability and level of support for E-Health technology. By contrast, participant funding and management are of increased importance in assessing the quality of information-based communication between business model participants at the pilot project stage.

**Table 1**
**INTERACTION BETWEEN PARTICIPANTS OF THE E-HEALTH BUSINESS MODEL**

| Interaction channels | Indicators | Statistics required to assess interaction of participants | |
|---|---|---|---|
| | | **Components that form indicators** | **Authors' Comments** |
| Intergroup Interaction<br>P2D<br>D2P<br>P2I<br>I2P<br>I2D<br>D2I<br>Intra-group Interaction<br>P2P<br>D2D<br>I2I | Client | 1. Classification of E-Health clients – digital patients<br>2. Distribution channels for the provision of telemedicine services<br>3. Strength of relationship between the healthcare service insurance provider and the healthcare service receiver | For clients' categorization, quantitative data is needed to assess the willingness-to-pay of various social strata and their budget constraints relative to each other. Regional discrepancies and moving wage averages should be also accounted for.<br>The following channels of service provision are considered:<br>- personal consultation with a doctor/employee of the insurance company<br>- medical -examination/consultation through an intermediary (e.g. nurse, laboratory assistant)<br>- mixed format<br>A division into three possible formats is offered: online, partly online and face-to-face (the most active interaction). |
| | Offer | Value Offer | Relative cost of an individual telemedicine service is considered in comparison with its face-to-face counterpart. |
| | Resources | 1. Key activities required to provide telemedicine services<br>2. Key Resources<br>3. Key Partnerships | Data on the number of persons involved in the process of providing the service<br>Resource support of the industry, in particular, the availability and level of state support for the technology<br>The need for external partnerships for the provision of telemedicine services within E-Health (e.g., availability of collaborations with scientific laboratories or hospitals) |
| | Finance | The cost-to-benefit-ratio related to the provision of services | Profitability data for individual telemedicine services and the E-Health model in general |
| | *Technology | Technological novelty of the service (availability of prototypes and counterparts) | Statistics on the use of similar telemedicine services within the E-Health business models in the Russian Federation and abroad. |

| | | | |
|---|---|---|---|
| | *Preventive Value | Relevance of telemedicine services for the prevention and treatment of chronic diseases among the aging population | Level of correspondence of telemedicine technologies existing within the business model to the problem of chronic diseases among the aging population (agism) |

Note: * Propositions of authors

## DISCUSSION

### Promising Directions of E-Health Development in Russia

After devising a generalizable e-health business model based on the indicators of information-based communication, we apply previously defined concepts to existing legal and social regulations of Russian markets. We refer to the Federal Law (2020) *"On Fundamental Healthcare Principles in the Russian Federation"* and the Federal Project (2020) *"Creation of a unified digital circuit in healthcare"*, when discussing possible directions of E-Health development in Russia. According to these judicial acts, following five main information systems in the healthcare sector should be considered responsible for the provision of telemedical services in Russian E-Health:

1. federal state health information systems (in particular, the Uniform State Health Information System (USHIS), which manages medical data storage, healthcare professionals, organizations, services, purchases, medicines, prescriptions registers);
2. health information systems of the Federal Compulsory Medical Insurance Fund and Territorial Compulsory Medical Insurance Funds (FCMIF);
3. state health information systems of the constituent entities of the Russian Federation (or regional MISs);
4. medical information systems of medical organizations (MISs) and information systems of pharmaceutical organizations;
5. other health information systems.

*"Other health information systems"* constitute individual health information systems of federal states, health information systems of the FCMIF and territorial compulsory medical insurance funds, state health information systems of constituent entities of the Russian Federation, medical information systems of medical organizations and information systems of pharmaceutical organizations, according to the Decree #447. The functional capabilities of state health information systems (SISs) of the constituent entities of the Russian Federation must be implemented in accordance with the *"Requirements for state health information systems of the constituent entities of the Russian Federation, medical information systems of medical organizations and information systems of pharmaceutical organizations"* (Telemedicine law in Russia, 2020). The baseline implementation can be extended in twenty areas:

1. Maintaining regulatory and reference information of the constituent;
2. Fixing an appointment with a doctor (e-register office);
3. Organizing emergency and primary medical care (including air ambulance);
4. Ensuring the provision of medical care using telemedicine technologies;
5. Accounting for the medical and demographic indicators of the constituent entity of the Russian federation and the resources of the health care system;
6. Maintaining specialized patient registers under individual icd codes and categories of citizens;
7. Providing the constituent entity of the Russian federation with medicines and medical products, including preferential drug provision;
8. Ensuring the maintenance of an integrated electronic medical record in the constituent entity of the Russian federation;

9. Supporting management decisions at all levels of the healthcare organization of the constituent entity of the Russian federation;
10. Maintaining treatment standards (approved by a federal system of maintaining treatment standards with regional additions;
11. Functional segment of the *"blood transfusion service"* (functional counterpart);
12. Providing sanitary and epidemiological monitoring;
13. Recording preventive examinations of the population;
14. Functional segment of immunization, (15) regional laboratory information system;
15. Regional system of medical image storage (central archive of medical images);
16. Ensuring automation of medical care processes under individual icd codes and categories of citizens;
17. Ensuring monitoring of obstetrics;
18. Maintaining strict reporting and accounting documents (temporary disability leave, preferential prescription form, etc.) Of the constituent entity;
19. Enterprise service bus (The decree #268, 2020).

Further, state information systems (SISs) of the constituent entities of the Russian Federation may consist of other subsystems and components that are not provided by the basic and extended sets of functional capabilities, e.g., supportive systems, regional e-health online-portals, patient accounts, e-education online-portals (e-libraries), databases for scientific research and educational purposes, professional community portals. In order to improve the status quo, the newly created Center of Competence for Health Digital Transformation might be employed to deliver methodological support and coordination of federal project activities in the constituent and release unified requirements for the subsystems of state health information systems (Source: Federal Project (2020) *"Creation of a unified digital circuit in health care based on the unified state information system in the health sector (EGISZ)"*).

Putting it in the nutshell, numbers to be changed in 2021-2025 are the following: the number of citizens that uses the services of the personal account *"My Health"*, the share of medical organizations of the state, municipal health systems that uses the Unified State Health Information System, the share of medical organizations of the state, municipal health systems that ensure the continuity of the provision of health care to citizens, the share of medical organizations of the state and municipal health systems that provide citizens with access to electronic medical documents in the Patient Account *"My Health"* in the Unified State Health Information System.

Finally, we present our four-stage planning strategy for expanding the Federal Project *"Uniform State Health Information System"* for 2021-2025 in further detail in Appendix, as it frames a direction for future research rather than an issue for discussion in this paper.

## CONCLUSION

This study identified three main participants of the E-Health business model – patients, doctors, and insurance – and explored diverse interactions between them based on generalizable indicators of information-based communication. The main purpose of the E-Health business model was then defined as prolongation of the life expectancy of citizens and improvement of their life quality. Both goals can be achieved by increasing the efficiency of healthcare (and E-Health) in Russia resulting from the optimization of medical information systems.

Authors further developed ten components that form indicators of information-based communication for the development of E-Health: classification of E-Health clients, distribution channels for the provision of telemedicine services, strength of relationships between the insurance provider and the service receiver, value proposition, key economic activities required

to provide telemedicine services, key resources, key partnerships, the cost-to-benefit ratio related to the provision of services, technological novelty of a service and the relevance of the telemedicine service for the prevention and treatment of chronic diseases among the aging population.

Lastly, authors discussed promising directions for the development of the Russian E-Health industry following the previously specified business model. Albeit, sufficient progress is already observable in this area, it should be emphasized that the existing information portal "E-Health" remains far from optimal. Specifically, it requires comparative diagnostics of available information resources based on the Unified State Health Information System, which is beyond the scope of this study.

Another limitation of this research is that the study did not critically assess the efficiency of the existing Russian health business model for the period of its transformation. The effectiveness of the e-business model within German Industry 4.0 was examined very briefly as well. Consequently, this study should be considered only as an introductory theoretical manuscript, which aggregates the propositions from Industry 4.0, legal and social regulations of the World Health Organization, and organizational and managerial aspects of Russian markets to an E-Health business model for Russia.

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## APPENDIX

**Table A1**
**PROPOSED SOLUTIONS FOR THE DEVELOPMENT OF THE UNIFORM STATE HEALTH INFORMATION SYSTEM**

| Measure | Contents | Period | Sources of Funding |
|---|---|---|---|
| Stage I | | | |
| The number of citizens who used the services in the Patient Account *"My Health*" on the Unified Portal for Public Services and Functions in the reporting year, mln people. | Accounting for three participants in the e-business model in 9 areas of relationships, including private medical institutions, public, private medical insurance providers. | 2021-2022 | Medical Insurance Companies: public, private |
| Stage II | | | |
| The share of medical organizations of state and municipal health systems that use medical information systems for organizing and providing healthcare to citizens providing information interaction with the Unified State Health Information System, % | Accounting for services based on the process integration of the e-business model: a) E-Health, b) data processing and telecommunication devices for use in the healthcare system, c) information technology services in the healthcare system, d) data processing services in the healthcare system | 2021-2022 | Federal, regional budgets |
| 1. The share of medical organizations of the state and | Policy implementation in nine areas based on the process vertical and | | Federal, regional |

| | | | |
|---|---|---|---|
| municipal healthcare systems that ensure the continuity of the provision of healthcare to citizens through organizing information interaction with centralized subsystems<br>2. State health information systems of the constituent entities, % | horizontal integration of the information system of quantitative, cost indicators, their accounting in the E-Health business model | | budgets |
| Stage III | | | |
| The share of medical organizations of the state and municipal health systems that provide citizens with access to medical e-documents in the Patient Account *"My Health"* on the Unified Portal for Public Services and Functions, % | Development of the information portal *"E-Health"* considering three participants in the E-Health business model, the possibility of entering and monitoring data by its three participants. | 2023-2024 | Medical insurance providers: public, private |
| Stage IV | | | |
| 1. Classification of basic indicators in four subgroups according to the functional principle:<br>2. Client, number of Russian E-Health clients;<br>3. Offer, i.e., a certain percentage that is obtained by dividing the number of telemedicine services into general services, %;<br>4. Resource provision of the telemedicine industry, number of employed persons;<br>5. Finance, i.e., the cost-to-benefit ratio related to the provision of telemedicine services, absolute value. | Calibration of the indicators of the Russian E-Health business model in accordance with the (best) foreign counterparts. | 2021-2025 (performed in parallel with Stages I-III) | Federal, regional budgets |

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