eHealth - market potential: the RO-SmartAgeing system

Maria GHEORGHE-MOISII, Alexandru SIPICĂ, Simona-Nicoleta VOICU-ZAMFIROIU

National Institute for Research and Development in Informatics – ICI Bucharest

maria.moisii@ici.ro, alexandru.sipica@ici.ro, simona.voicu@ici.ro

Abstract: Home health monitoring of the elderly has grown in recent years and the context of pandemic has facilitated its evolution, offering the opportunity for medical service providers to expand and improve the quality of eHealth systems and products. A major market potential is represented by the field of eHealth - in this case the home health monitoring of the elderly, the context of the pandemic being a decisive factor in the exploration of this potential. The need to design viable solutions geared towards a target market becomes an inevitable challenge to improve profitability and therefore stakeholder value. The paper presents in detail a SWOT analysis highlighting the key points of eHealth monitoring systems, identifying the optimal potential of these solutions. The case study presents a viable eHealth solution highlighting a competitive advantage in personalised home monitoring for the elderly as well as a financial projection.

Keywords: eHealth monitoring, elderly, RO-SmartAgeing system, eHealth market potential.

eHealth – potențial de piață: sistemul RO-SmartAgeing

Rezumat: Monitorizarea sănătății la domiciliu a vârstnicilor a luat amploare în ultimii ani, iar contextul pandemiei a facilitat evoluția acesteia oferind posibilitatea furnizorilor de servicii medicale să se extindă și să îmbunătățească calitatea sistemelor și produselor în domeniul eHealth. Un potențial de piață major este reprezentat de domeniul eHealth - în acest caz, de monitorizarea sănătății la domiciliu a persoanelor vârstnice, contextul pandemiei fiind un factor decisiv în explorarea acestui potențial. Conceperea unor soluții viabile orientate spre o piață țintită devine o provocare inevitabilă pentru a îmbunătăți profitabilitatea și prin urmare, valoarea părților interesate. Lucrarea prezintă în detaliu o analiză SWOT prin intermediul căreia sunt reliefate punctele cheie ale sistemelor de monitorizare eHealth, identificându-se potențialul optim adus de aceste soluții. Studiul de caz prezintă o soluție viabilă eHealth ce pune în evidență un avantaj competitiv în monitorizarea personalizată la domiciliu pentru persoanele vârstnice, precum și o proiecție financiară.

Cuvinte cheie: monitorizare eHealth, vârstnici, sistem RO-SmartAgeing, potențial piață eHealth.

1. Introduction

Developing scalable, cost-effective and efficient technology solutions to improve the overall health and well-being of individuals has become vital in today's digital economy (da Fonseca et al., 2021). High-profile organization interventions focus on leveraging and enhancing individuals' strengths to increase employee wellbeing and organization outcomes in healthcare (Senbekov et al., 2020). Designing these types of solutions requires designers to ensure that new technologies (such as health apps and web-based platforms) are not only efficient and usable, but also have the potential to actively immerse consumers and users in the niche market.

In eHealth, the use of technology to support patient health and wellbeing is sometimes an issue due to lack of adherence to target audiences. Often, the people using an eHealth solution (providers, patients, healthcare professionals, etc.) do not use the technology offered in the way the developers intended, thus calling into question what niche researchers call non-adherence.

The expansion of the eHealth sector and remote patient monitoring through the use of digital healthcare solutions in both ambulatory and home care facilities has created lucrative opportunities for healthcare providers in the market.

Long-term care falls within the broader scope of social and health services (European Commission, 2019). In addition, responsibilities are shared between different institutional actors at different levels. The older population is much more concentrated in rural or remote areas and benefits less from adequate health services.

The demand for long-term residential care services is largely unmet due to the low volume of outpatient services provided and the insufficient number of care workers (OECD, 2019). Older people

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need a combination of social and health-care services for effective health monitoring and IT&C solutions could provide an innovative and integrated response.

2. eHealth market analysis, prospects and potential

Market developments in eHealth are influenced by the high demand for wearable devices, the analysis of large volumes of data and new innovations in the Internet of Things (IoT) for healthcare and the increase in government initiatives that support the use of eHealth solutions and services.

The increasing need to manage the prevalence of chronic diseases such as cancer and diabetes is further influencing the healthcare market. Rising disposable incomes, formation of accountable care organizations, advancements in healthcare infrastructure, rapid digitization and availability of dynamic nature of health benefit plans are positively affecting the eHealth market. According to the research report, Data Bridge, on eHealth, the market is projected to grow at a rate of 23.00% during the forecast period from 2022 to 2029.

As early as 2020 healthcare companies were already on the path of digital transformation, but, with the onset of the pandemic, this direction has gained momentum and the real potential of telemedicine has been highlighted. Importantly, the older population is increasingly using technology to monitor their health and improve their awareness of a healthy lifestyle.

The global telehealth market size was valued at USD 6.1 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 17.0% from 2021 to 2028 (Grand View Research, 2021).

Comparing several regions in terms of growth potential in the telemedicine market, it is noted that North America dominates the specialty market with a share of 59.2% in 2021, while Asia-Pacific has registered a growth rate of 33.7% in 2021, mainly due to the large number of patients with chronic diseases and low healthcare facilities. The use of telemedicine solutions in combating infectious diseases and epidemics, along with the implementation of blockchain, artificial intelligence and data analytics are also expected to be the areas of opportunity for the Asia-Pacific market. Due to its huge potential, this market offers a great opportunity to meet the specific needs of each of these stakeholders by introducing a single product (Mathews et al., 2019).

High costs associated with the implementation and maintenance of eHealth solutions and security concerns related to privacy, licensing and data breaches are expected to hamper the market growth.

The global telemedicine market is expected to grow at a CAGR (annual growth rate) of 26.6% during the forecast period, to reach USD 285.7 billion by 2027, from approximately USD 87.8 billion in 2022 (ReportLinker, 2022).

The context of the global COVID-19 pandemic has challenged healthcare organizations to accelerate the adoption of digital solutions and technologies needed to streamline healthcare delivery. Recently, eHealth solutions offered through technology, such as telehealth and patient monitoring outside traditional clinics, have been increasingly accessed.

According to Deloitte's study, in the first six months of 2020, globally, 1.25 billion health and exercise apps were downloaded, up 34% over the same period in 2019. In addition, the outlook for remote medical services has improved. While, prior to the pandemic, this area was estimated to grow by 15% annually until 2025, it is now expected to grow by 20% annually. Virtual diagnostics, too, is expected to grow by more than 15% annually by 2030 (Deloitte, 2020).

These developments have also highlighted the importance of improving digital literacy, both for patients and healthcare professionals, so that the services offered in the virtual environment are as effective as possible.

The major interest shown in the provision of healthcare services at home shows that the potential market for eHealth in the elderly segment is growing. Therefore, home monitoring systems based on digital technologies will be key elements in the healthcare market, fostering new economic activities.

The RO-SmartAgeing solution presented in this case study is an alternative method for safe

health monitoring for the elderly to improve their quality of life at home. User data is protected with an SSL (Secure Sockets Layer) certificate which creates an encrypted communication channel between the web server running the platform and the browser from which it is accessed. (Ianculescu et al., 2020; Tudora et al., 2021).

3. SWOT analysis

The need to monitor many patients, coupled with the lack of medical resources, makes the adoption of these SMART monitoring solutions crucial for future healthcare services.

To provide an overview of eHealth monitoring systems, the SWOT analysis is presented (Table 1).

Table 1. SWOT analysis of health monitoring systems

STRENGTHS	***WEAKNESSES***
• *Raising the quality of health-care services by diversifying the capabilities of health-care staff;* • *Strong advantage in pandemic periods;* • *Safe health-care;* • *Providing personalized, high-performing and less intrusive healthcare;* • *Facilitating access to other information and clinical research through cloud-computing based services;* • *Means to improve the efficiency and effectiveness of systems and their control and reduce costs;* • *Continuously lowering the price of ICT technologies.*	• *Missing of information and confidence in specific eHealth solutions;* • *Missing of legal clarity for health and wellness specific mobile applications;* • *Missing of transparency regarding the use of data collected by such apps;* • *Frequent changes in the management structure of the Ministry of Health;* • *Missing of binding legislation on standardization framework;* • *Missing of cooperation between relevant institutions;* • *Insufficient use of international standards.*
OPPORTUNITIES	***THREATS***
• *eHealth monitoring systems make it easy to stay in a familiar environment for a long time;* • *Socio-economic inclusion, quality of life and patient empowerment through greater transparency;* • *Access to services and information as well as the use of social media in health;* • *Possibility to use the experience of other EU Member States and WHO.*	• *High upfront costs of setting up eHealth systems;* • *Regional differences in access to ICT services, with disadvantaged regions having limited access;* • *Inadequate or fragmented legal frameworks, especially in the area of eHealth services, where reimbursement systems are not in place.*

Effective patient management through the use of remote monitoring systems ensures personalized and prompt care thus simplifying the overall healthcare system. One of the current challenges in healthcare is patient empowerment. A rapid analysis of key strategic points, as well as the identification of strategic alternatives, helps communities in the field of correct decision-making, as well as in strategic planning.

The growing number of elderly people urgently requires the implementation of the telemedicine paradigm in healthcare facilities. The need to monitor large numbers of patients, coupled with the lack of healthcare resources, makes the adoption of these SMART monitoring solutions crucial for future healthcare services.

4. Case study: RO-SmartAgeing

The eHealth monitoring system for the elderly allows the data associated with a patient, obtained with the help of medical devices and emerging technologies, to be collected, centralized, analysed and processed, giving medical staff, personal caregivers, the elderly and their families the ability to follow their real health status correlated with the specificities of the environment, the evolution of present vital parameters, the ability to be able to define a personalized profile of the patient and medical services adapted to their needs and particularities for personalized care.

4.1. Strong system characteristics

The smart environment is the core of the remote monitoring system for elderly people and can be customised according to the needs of the beneficiary.

- **Innovation**

The use of innovative healthcare models can be beneficial in balancing quality and cost containment. The system is an innovative product based on emerging digital technologies, with application in the field of patient-centered health monitoring, ensuring personalized intelligent services. The IT solution provides value to the organization, society and ultimately the beneficiaries. The operational dimension includes improving clinical outcomes, efficiency, effectiveness, patient satisfaction and safety, profitability, quality improvement and cost containment. The environmental dimension involves physician acceptance, organizational culture, regulatory acceptance partnerships and collaborations (Gheorghe-Moisii et al., 2021; Omachonu & Einspruch, 2010).

- **Performance**

The system offers a practical alternative to medical and social services by supporting a personalized and complex management of information and data associated with a beneficiary (elderly person) that are collected in a non-clinical intelligent environment (at the patient's home) as well as by creating expanded medical decision support and assistance capabilities. The system also provides services aimed at supporting medical acts centered on the needs of the elderly patient, such as supporting a correct preventive and real-time diagnosis, as well as the identification and establishment of a personalized therapeutic protocol adapted to possible changes in the evolution of a chronic condition.

- **Personalization**

The system has associated the concept of customization as a basic criterion of operation, being designed to have the following characteristics derived from the architecture based on IoT and microservices: modular hierarchical structure, well-defined organization around functionalities, high scalability and flexibility, fault tolerance, autonomous development of some services, speed of implementation and increased availability, decentralized data management, increased possibility to choose other technologies/programming languages for new components to be added to the already developed application.

- **Design**

The system interface is simple and easy to use both by specialists and elderly patients, but also by unauthorized users in the system. The components of the system are easily accessible, the system ensures maximum flexibility and scalability so that it can be customized both according to the particularities of the monitored person, but also to the short-term and long-term evolution of the state of health, offering a varied range of personalized integrated services and patient centered.

- **Convenience in use**

Using the Internet facilitates the creation of multi-faceted platforms with the possibility of interaction between different customer segments. A multi-faceted platform increases its value as it attracts more users (different customer segments), a phenomenon known as the network effect. The user interface elements of the system are easy to access, understand and use. Thus, users are able to interact,

collect, store, process and visualise information related to the proposed monitoring within the RO-SmartAgeing system.

- **Adaptation and integration**

A feature that describes the adaptability of the RO-SmartAgeing system is its scalability, which is a key factor in ensuring the efficiency of a number of components, which may vary depending on the end user/beneficiary, but also due to the possibility - facilitated by the system's microservices-based architecture - to upgrade components.

- **Quality**

The viability of the system has a qualitative and a quantitative aspect. The qualitative part is concerned with understanding the risks and opportunities, while the quantitative part focuses on validating its financial viability.

4.2. Competitive advantage of the RO-SmartAgeing system

Competitive advantages are based on innovative and relevant smart IoT solution. In addition to existing technologies the RO-SmartAgeing system includes:

- Modular hierarchical structure, well-defined organization around functionalities, high scalability and flexibility, fault tolerance, ability to develop services autonomously, increased deployment speed and availability, decentralized data management, increased possibility to choose other technologies/programming languages for new components to be added to the already developed application;
- Possibility to integrate new services, thanks to the scalable architecture of the system continuity is ensured leaving room for innovation and creativity;
- The intelligent environment is the core of the remote monitoring system and it is the way in which the elderly person can continue their activity safely in their own home, being monitored continuously in a discreet manner and as non-invasively as possible;
- IoT components including sensors: biomedical (measuring pulse, body temperature, blood oxygen levels, blood pressure); motion (such as gyroscope, accelerometer, depth camera); wearable (such as smartwatch, GPS patches). Data collection is continuous;
- The system offers a practical alternative to medical and social services by supporting a personalized and comprehensive management of information and data associated with a beneficiary (elderly person) that is collected in a non-clinical smart environment (at the patient's home) as well as by creating extensive medical decision support and assistance capabilities.

The system services provide personalized monitoring for elderly patients and their careers, either formal or informal. Among the most important functionalities that elderly patients can benefit from in the smart environment are:

- Non-invasive monitoring of current health status to define a true profile of the elderly person showing the current status of some medical parameters (physiological and cognitive);
- Monitoring current activities and lifestyle;
- Monitoring personal safety;
- Defining a model for tracking locomotor decline and preventing falls;
- Personalized environmental adaptation allowing controlled use of environmental devices or alarm triggers in the event of an abnormal health parameter or an unexpected and dangerous event;
- Supporting remote assessment by the personal physician of the elderly person's current health status and early diagnosis;
- Creating facilities to support the older person's social interactions;

- Facilitate the empowerment and involvement of the elderly in the optimal management of their own health;
- Identifying the most representative ways of caring for the elderly.

5. Financial projections

Regardless of the shape, size or how interesting and innovative a business is, the interest of most investors leads to the financial aspects of the business. As it is shown (Bușe et al., 2008) costs established with sufficient accuracy, together with budgets, are vital tools of control. They serve as benchmarks for comparing accomplishments to plans throughout project life cycles. Assembly of project components and project status reports depend on reliable cost estimates and budgets.

The key elements of any business plan are: anticipated sales volume, analysis of customer needs, product features, market dynamics and competitor strategies. Another very important element is the estimation of the number of potential buyers, the possibility of establishing long-term ties with them, the frequency and size of orders as well as the market share that will be held.

In developing the financial projections, a short and medium-term financial scenario of a maximum of 5 years was considered. In this sense, according to Table 2, the financial offer for the services of the RO-SmartAgeing system is based on subscription. As a strategic element, it was decided that the value of the subscription should not increase, a decision that aims to strengthen the increase in the number of customers by a minimum of 80% in 5 years. At the same time, the estimated flow will increase from almost 15% in 2023 (the first year of operation) to almost 27% of the total estimated flow in the 5th year of financial operation.

To determine the market potential, we considered two financial performance indicators, namely: the IRR indicator (internal rate of return) and NPV (net present value).

The IRR indicator is ideal for analysing capital budgeting projects to understand and compare potential annual rates of return over time. A minimum of subscription requests is estimated from 100 subscriptions to 180 for year 5. Using the calculation model available in the excel application and presented in Table 2, we obtained a first calculation of the IRR, which was estimated at (19%), a value indicating that the solution is feasible.

Table 2. IRR calculation model for the RO-SmartAgeing system

Nr. Crt.	Years	Estimated price per service	Estimated subscriptions	Estimated flow
0	2019			**-2,400,000**
1	2023	500	100	600,000
2	2024	500	120	720,000
3	2025	500	130	780,000
4	2026	500	150	900,000
5	2027	500	180	1,080,000
Total				**4,080,000**
IRR				19%

NPV of the initial investment - for the calculation of this indicator, a cash flow realized as a result of the payment of equipment in advance is considered. A calculation scenario is projected in Table 3 in which account is taken of:

- *Identifying the number of periods (t):* In this case, the equipment is expected to generate a monthly cash flow over a period of five years, which means that 60 cash flows and 60 periods will be included in the calculation;

- *Identify the discount rate (i):* the alternative investment is expected to pay 6% per year. Due to the fact that the equipment generates a monthly stream of cash flows, the annual discount rate should be converted into a periodic or monthly rate. Using the following formula, we find that the periodic rate is 0.75%.

A general calculation formula for Discount Rate/Periodic Rate, often used in project evaluation is:

$$PR = \left(\frac{FV}{PV}\right)^{\frac{1}{n}}$$

where: P

R – Periodic Rate;

FV – Future value of cash flow;

PV – Present value;

n – Number of years until the FV.

Then in our case

$$PR = \left(\frac{1}{0,06}\right)^{\frac{1}{5}} = 0,75\%$$

In this case it is assumed that monthly cash flows are earned at the end of the month (as per the monitoring service subscription payment), with the first payment arriving exactly one month after the chip was purchased. This is a future payment, so needs to be adjusted for the time value of money. For this calculation, five advance payments are assumed, as shown in Table 3. For the NPV calculation, we consider a minimum increase in Cash Flow of 0.2% for each year.

A general calculation formula for NPV, often used in project evaluation is:

$$NPV = \frac{Cash\ flow}{(1+i)^t}$$

Table 3. NPV calculation simulation

Period (months)	Cash Flow	Indexed Cash Flow 20%	Monthly cash flow (euro)	Calculation NPV	NPV
Month 1	25000	1.00	25000	$NPV = \frac{25.000€}{(1+0,75)^1}$	14241,98
Month 2	25000	1.20	30000	$NPV = \frac{26.000€}{(1+0,75)^2}$	9736,03
Month 3	25000	1.44	36000	$NPV = \frac{26.500€}{(1+0,75)^3}$	6655,69
Month 4	25000	1.73	43200	$NPV = \frac{27.000€}{(1+0,75)^4}$	4549,93
Month 5	25000	2.07	51840	$NPV = \frac{27500€}{(1+0,75)^5}$	3110,40
Month 60	25000	2.49	62208	$NPV = \frac{30.000€}{(1+0,75)^{60}}$	0.00

In interpreting this value, three cases are analysed, namely:

- NPV < 0 - This type of investment opportunity is not profitable;
- NPV = 0 - This is the case where both cash inflows and outflows have equivalent present values;

- NPV > 0 - The value of its cash inflows is greater than its outflows.

Thus, the value acquired from the estimated calculation is profitable if it gives a positive value. According to the calculations, the NPV is 18645.29 euro, which indicates that the investment is an opportunity.

6. Conclusion

In the current context of market demand, telemedicine is an attractive, efficient and affordable option. In addition, this technology is of major importance in keeping healthcare providers safe. Telemedicine services have become an essential asset with important implications across the healthcare continuum.

eHealth represents a market that can provide value for many diverse stakeholders, including hospitals, patients, research organizations, pharmaceutical companies and health insurers. Innovations in digital health-care continue to gain ground and importance not only in numbers, but also in expertise and competence.

Telemedicine offers several advantages, especially in non-urgent/routine care and in situations where services do not require direct provider-patient interaction. This reduces resource use, improves access to care and minimizes the risk of person-to-person transmission of any type of infectious agent. In addition, the associated reduction in resource consumption due to less need for personal protective equipment can equate to substantial financial savings when considered on a national, continental or global scale.

The RO-SmartAgeing system is a viable health monitoring solution with opportunities for safe independent living at home for the elderly by providing adequate remote monitoring of health parameters, thus becoming an important support for both patients and their careers. As the solution is minimally invasive and easy to replicate the system can be successfully implemented at the end beneficiaries' home.

The surest way to create a market advantage in the healthcare area is to use online media and content marketing. It is about traffic initiation and retention but also about content (creating, publishing, distributing to a target audience, online) with the help of which the basics are set correctly and the sales department teams are supported to possess thorough sales knowledge and better opportunities (Mitan, 2019). Telemedicine solution providers can remotely identify patients who may require additional care using personalized approaches. Thus, telemedicine can be a powerful monitoring and coordination mechanism to ensure appropriate use of provider facilities.

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Maria GHEORGHE-MOISII is a Scientific Researcher in the Department - Systems and Applications for Society within the National Institute for Research and Development in Informatics - ICI Bucharest. She obtained the Master's degree in Organizational Management and Human Resources at Spiru Haret University in Bucharest in 2009. The main areas of interest for the research activity

include: e-Government, eHealth, evaluation of web usability and accessibility, software testing and evaluation, business models.

Maria GHEORGHE-MOISII este Cercetător Științific la Departamentul Sisteme și Aplicații pentru Societate din cadrul Institutului Național de Cercetare-Dezvoltare în Informatică – ICI București. A obținut diploma de Master în Management Organizațional și Resurse Umane în cadrul Universității Spiru Haret din București, în anul 2009. Principalele sale domenii de interes pentru activitatea de cercetare includ: e-Guvernare, eHealth, evaluarea utilizabilității și accesibilității web, testare și evaluare software, modele de business.

Alexandru SIPICĂ graduated from the Faculty of Management in 2005. He obtained the Ph.D. degree at USAMV Bucharest. He currently works as a Scientific Researcher III at ICI Bucharest. His main areas of interest are Business Models and Project Management. He is involved in research projects specific to the information society. His research has been published in journal articles and specialized conferences.

Alexandru SIPICĂ a absolvit Facultatea de Management în anul 2005. Deține o diplomă de doctor la USAMV București. În prezent lucrează ca Cercetător Științific Gradul III în cadrul Institutului Național de Cercetare-Dezvoltare în Informatică - ICI București. Principalele sale domenii de interes pentru activitatea de cercetare sunt: Business Models și Project Management. Este implicat în proiecte de cercetare specifice societății informaționale. Cercetarea sa a fost publicată în articole de jurnal și în conferințe specializate TIC.

Simona-Nicoleta VOICU-ZAMFIROIU has graduated from „Alexandru Ioan Cuza" University, Iași, Faculty of Philosophy and Social - Political Sciences, Specialization Communication and Public Relations, with a master's degree in Public Relations and Advertising. She has over 10 years of experience in Communication and Social Media, being involved in various projects in the central administration, but also in the private sector. Since 2017 she carries out the activity within the National Institute for Research - Development in Informatics - ICI Bucharest. The main areas of interest for the research activity include: eHealth, business models, strategic communication and digital diplomacy.

Simona-Nicoleta VOICU-ZAMFIROIU a absolvit Facultatea de Filosofie și Științe Social-Politice, Specializarea Comunicare și Relații Publice, cu diploma de master în Relații Publice și Publicitate, în cadrul Universității „Alexandru Ioan Cuza" din Iași. Are o experiență de peste 10 ani în Comunicare și Social Media, fiind implicată în diverse proiecte în Administrația Centrală, dar și în sectorul privat. Din anul 2017 își desfășoară activitatea în cadrul Institutului Național de Cercetare-Dezvoltare în Informatică - ICI București. Principalele sale domenii de interes pentru activitatea de cercetare includ: eHealth, modele de business, comunicare strategică și diplomație digitală.