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Systematic-interdisciplinary approach to eHealth equipment design

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ABSTRACT

eHealth has improved the performance of multiple health systems worldwide by integrating Information and Communication Technologies (ICTs) into national (structured and coordinated) strategies in the health sector. However, once the foundation is laid for the development and implementation of eHealth solutions, researchers, engineers, doctors and other stakeholders have no single way to develop eHealth solutions. Therefore, a systematic interdisciplinary method is proposed to design electronic health equipment to meet the requirements and needs of all people involved in the use of the equipment, and comply with the laws and regulations of different countries.

On the basis of systematic and interdisciplinary methods, a method is proposed, that is, the collaborative use of different systematic methods allows stakeholders to continue to cooperate and share the experience. Consequently, the method will allow the design of eHealth devices that, regardless of their use, meet the needs of the user, the requirements of the personnel who will use them, the standards and regulations of the country where they are developed, and provide total satisfaction with the device. Finally, the eHealth solution is designed through systematic thinking, through the analysis of needs and needs, and through exploring different perspectives, observation backgrounds, participant participation, discussion and stakeholder consistency, so as to provide a sustainable product that meets all participants.

Keywords: eHealth solutions; methodology; system approach; human factors; interdisciplinary

1. Introduction

There are many methods to design medical equipment[1,2], but they cannot be fully applied to the development of eHealth solutions, because most solutions have a prominent aspect: human factors. However, this does not mean that they cannot serve

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as a basis for developing these solutions. However, to some extent, we must fill the gap between the different needs of medical device methods and eHealth solutions.

To this end, it proposes a systematic way of thinking to supplement these missing spaces and create a method that covers all aspects of equipment design[3]. In addition, the systematic approach allows problems to be analyzed from different perspectives and global perspectives, not just unilateral or even individual.

On the other hand, eHealth gives priority to user-centered layout, but it has been proved that one of the main defects in eHealth solution design is not active and the affinity between users is very low. Therefore, using the system method to design electronic equipment is a feasible choice, because it tends to consider all components of the system and their interactions. In this case, human factors will be the main variable of analysis. Although the research of soft systems was initially carried out on the basis of general system theory, in the past few decades, the research of soft systems has become a very useful tool for analyzing complex problem situations with high human impact[4,5], such as eHealth solution.

The reason for creating a systematic and interdisciplinary approach enables eHealth solutions to meet the needs, requirements, regulations, standards, etc. Of everyone involved in using it. This is achieved through the establishment of a working group in which all participants who have any impact on the use, design and development of equipment will participate in order to explore each variable involved through their experience and understanding of each participant.

2. Background

Ehealth seems to have broken the paradigm of health care and provision of health services, and integrated ICT into the health sector[6,7]. However, due to various circumstances (background, resources, investment, culture, etc.), the impact of this trend is different all over the world. Therefore, each country has developed a strategy to integrate eHealth into its health system to meet its needs and potential[8,10].

However, once the eHealth foundation is established in the health system, the next step is to develop solutions matching these foundations to generate an integrated system of medical monitoring, treatment and care, as well as an information system that can better manage the information in the health system. However, the development of these solutions does not have a clear path like the development of medical devices. Due to different situations and aspects, the same method cannot be used, because one method focuses on the use of medical personnel (medical device method), and the other method must focus on any stakeholders in the health sector, especially patients (eHealth solutions). However, through the systematic method and its difference and comprehensive idea, the method of medical devices has become the initial basis of this medical device solution method, that is, to distinguish the methods of medical devices with the characteristics of medical devices, and finally the systematic method. This difference integral is shown in **Figure 1**.

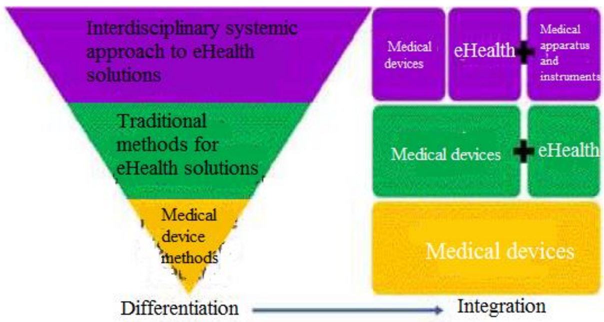

Figure 1. Differentiation-integration process of the interdisciplinary systemic approach to eHealth solutions.

However, some suggestions have been put forward to develop eHealth solutions, among which User-Centered Design (UCD) and technical methods are the most helpful. However, only a few people mentioned the participatory approach in design, the multidisciplinary nature of research, the background of developing solutions, business models, etc., although ultimately all of these should be part of the solution design process.

Therefore, it is suggested to combine all these factors with other factors to form an interdisciplinary systematic method, which can meet both the needs of users and all the research aspects involved in the development of this device.

3. Methods and tools

As systems are becoming increasingly complex, the systemic approach appears on the scene as a tool for interpreting and working with them. The systemic approach proposes a global vision of systems, not as individual entities, but as a whole, given that the sum of their components and the interactions between them generates a result that is superior to that of the individual components. Among the contributions proposed by the systemic approach are the following[5,11,15]:

- Interdisciplinary and multidisciplinary.
- Participate in the process.
- See every element as important.
- Open systems analysis (relationship between system and context).
- Vision of differentiation and integration.
- It focuses on relationships, not objects.
- It allows a large amount of information to be obtained from a small amount of data that synthesizes these data.

There is no doubt that the system method has a comprehensive and multidisciplinary view, but this method cannot be the only tool used in the system, which is why the system method is used. It includes hard, soft, liberated, postmodern methodology and so on.

On the other hand, interdisciplinary is a term. Since the psychologist Jean Piaget put forward it in the 1970s, it tries to take different methods to solve problems and the relationship between subject and object, which not only involves multiple disciplines, but also goes beyond them. In other words, it breaks the boundary of disciplinary knowledge. Because if there is no fixed limitation in reality, why should we analyze it with limited disciplines[16,17].

Interdisciplinary is the pursuit of knowledge beyond disciplines. By integrating disciplines and supplementing with the scientific, experience and practical knowledge of each relevant person, can enrich the solution of any problem[18,19].

The collaborative combination of interdisciplinary and systematic methods enables people to comprehensively explore problems from different angles, with the integral participation of those involved and without thought restrictions. Therefore, for the proposed method, in addition to supporting systematic and non-systematic methods, the advantages of these two concepts will be utilized. For this purpose, a combination of two stages, steps and method models, including technical, human, organizational, commercial and other methods, will be used to produce a postmodern method that allows the creation of e-health devices by meeting technical, human and normative requirements[20].

The procedure for obtaining an interdisciplinary systematic approach is as follows:

- Find the latest ways to create electronic devices.
- Define the method of developing equipment.
- Identify the shortcomings and opportunities of each research method, which will be achieved through an interdisciplinary process, in which participants have different research fields, but have experience in the field of eHealth.
- Define the most important variables for the design of electronic equipment.
- Through the analysis of defects, opportunities and important variables, the best method of treatment equipment design is determined.
- Define the steps and steps of the equipment design method.

A systematic interdisciplinary design method is proposed.

4. Analysis of electronic equipment development methods

Then, we review recent articles published on search engines, such as Scopus, ScienceDirect, Springer link, Google Scholar and IEEE Xplore, and describe the methods used to identify the main development methods used and the main opportunity windows for improvement. **Table 1** shows the analysis of the methods of some electronic devices currently developed.

Table 1. Electronic equipment and its development method

Author/year	Solution suggestions	Main methodological methods
(Tariq. Tanwani and Farooq, 2009)[21]]	Remote patient geti6n	Human approach
(Van Wilson. Wentzel and Van Gemert-Pijnen, 2013)[22]	Intervention measures	Participatory and multidisciplinary method
(Celik et al., 2017)[23]	Mobile ECG	Technological approach
(Verhees, Van Kuijk and Simonse, 2018)[24]	Point-of-care testing through eHealth	Business model
(Almeida. Almeida and Figueiredo-Braga, 2018)[25]	Mobile solutions for depression	Multidisciplinary approach
(Sousa et al., 2018)[26]	Platform to support the care and assistance of older adults	Participatory approach
(Monteiro et al., 2019)[27]	Cloud-based electronic health system	Technological approach
(Shanin et al., 2018)[28]	Using the Internet of things to monitor patients	Technological approach
(Shivakumar, Arora and Mani, 2018)[1]	Universal electrochemical reader	System method
(Monton et al., 2018)[29]	Integrated wearable sensor	Technological approach
(Shokrekhodaei et al., 2018)[30]	Heart rate monitor	Technological approach
(García et al., 2018)[31]	Stroke detection application	Technological approach
(Celesti et al., 2019)[32]	Cloud computing system	Technological approach
(Bedson et al., 2019)[2]	Pain monitoring application	Human approach
(Vossebeld et al., 2019)[33]	Electronic medical record for nurses	Technology acceptance
(Pierleoniet al., 2019)[34]	Atrial fibrillation monitoring	Technological approach
(Vitabile et al., 2019)[3]	Remote processing and analysis of clinical data for health care purposes	Technological approach
(Rihana, 2019)[4]	Vital signs monitoring	Technology and human methods
(Domingues et al., 2019)[35]	Remote gait analyzer	Technological approach
(Kildea et al., 2019)[5]	Person-centered patient portal	Participatory approach

From the research done, it is possible to observe the trend of technology and human methods, but not combined, but go one way or another. In fact, in this review, only one device is developed under the system method, just like under the main development framework.

It is worth mentioning that most revised publications with a major human focus have adopted a participatory approach in their design to give priority to the availability of solutions. Unlike technical method solutions, the technology or materials used are dominant.

However, this does not mean that there is no combination of methodological methods. The most popular one is the combination of technical methods and human methods. Although this is great progress, it at least integrates the background, the current and future interrelationship of equipment, interdisciplinary and systematic global vision.

The information obtained from this analysis shows that some of the methods used in implementing these e-health solutions have opportunities and shortcomings. Therefore, a method can be developed, including the most commonly used methods and the promoted system vision.

5. Development method

Before creating a method, you need to determine which variables will affect the creation of eHealth devices. The following variables are considered when developing methods[10,36,38].

- Human factor
- Technical factor
- Economic factor
- Cultural factor
- Normative
- Context
- Use

Once the variables that make up the eHealth solution and the methods of other authors to develop eHealth solutions[39,44] are determined, it is possible to propose an interdisciplinary system approach that allows the development of these solutions. By comparing the different steps, they can be divided into six stages:

- Problem description
- Diagnosis
- Design
- File
- Implementation
- Operation and maintenance

From these steps, it can be seen that these activities will help to develop eHealth solutions in a systematic and interdisciplinary way in order to benefit from them. **Table 2** lists the steps and activities for each phase.

The proposed method involves all variables of the eHealth solution, as well as systematic and interdisciplinary technologies and some method steps, in order to find a sustainable solution that meets all the requirements of stakeholders.

6. Conclusions

The proposed approach allows the development of eHealth solutions, taking into account all those involved in the use and development of eHealth solutions. Similarly, when establishing the maintenance and permanence phases, it stipulates that the solutions will be continuously monitored, evaluated and innovated. In addition, through the analysis of various existing solutions, the necessary processes or activities for developing these solutions can be determined, and each specific method of comparing solutions can be supplemented. Finally, using tools such as systematic and interdisciplinary approaches, a more comprehensive view of the solution can be obtained by integrating the different views of all parties concerned, but the method still has room for improvement and then evolved into a method, with the aim that each country can develop its own customized method according to its specific needs.

Table 2. Develop eHealth solutions with a systematic interdisciplinary approach

Problem description	Diagnosis	Design	Documentation	Implementation	Maintenance and permanence
Define the problem	Determine the status quo	Idealized model	Record the process of solving the problem	Manufacturing final products	Monitoring and evaluation index
Determine user needs	Determine context	Brainstorming (from practical and theoretical experts)	Document the policies followed and possible changes, if necessary	Implement the final product	Maintain
	Identify resources	Model elaboration	Record the development process of prototype and final product	Define solution evaluation metrics	Implementation feedback (iterative process)
	Determine the specifications and strategies to be followed by the equipment	Choose the best choice			Final product innovation (iterative process)
	Define participation	Prototype development			

Conflict of interest

The authors declare no conflict of interest.

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