

Results of a Tailored Communication Framework Through E-Health

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Abstract. This paper proposes a new framework to enhance the interaction of individuals with e-health and encourage the adoption of healthy lifestyles. Achieving a lifestyle change by the use of e-health is a complex issue that can be broadly addressed by analysing, in parallel the individuals' attitude towards their health condition and their approach and readiness to monitor and change their attitude by the use of new technologies. Our work has been to conceive, develop and evaluate a novel framework that explains how to promote the acceptance of e-health in terms of the perception of healthcare and of the use of technology to perform a desired or recommended lifestyle change. In order to place the user at each dimension a set of questionnaires was designed and implemented. These questionnaires assisted us in understanding what personalised information needs to be provided according to the stage the user is at as well as to other variables (such as age, cultural background, etc). Moreover, we created a communication strategy to provide tailored information regarding promotion and prevention of healthcare by means of e-health and promote the use of technology solutions to improve individuals' habits by enhancing their interaction with technological means. The framework was finally evaluated by users and healthcare professionals.

Keywords: E-health acceptance, healthcare promotion, e-health communication strategies.

1 Introduction

Preventing or delaying illness and death from chronic disease is possible [1]. Many of these diseases can be prevented or ameliorated through behaviour changes [2]. At least 80% of all cardiovascular diseases and "type 2" diabetes and over 40% of cancer could be avoided through healthy diet, regular physical activity and avoidance of tobacco use, which are behaviours that can be influenced and modified through education.

ICT and its applications are increasingly looked upon as a potential answer to the requirements of a modern society, with demands for better healthcare, improvements in medical outcomes, and maintenance of a relatively high quality of life, especially

with the onset of chronic health conditions coming to the fore as a key issue. Furthermore, implying a view of utilising the technology as a tool for (re) addressing the prevailing state of affairs, ICT tools and applications are also seen as having a potential to support an enhanced access to health information in general and indeed, to the health system itself in particular [3]. Characteristics such as the tailoring of messages, instantaneous feedback, appeal or engagement are potential advantages that new ICT can provide (adapted from [4]) and that may be of enormous benefit to attain behaviour change.

ICT innovations have the capacity to support empowerment of individuals in managing their health concerns and acquiring the necessary resources to achieve their goals. Moreover, it can ensure ubiquitous availability of the tools and communication channels necessary to support empowerment [5]. However, although there is much emphasis on the adoption of ICT implementation in the field of healthcare (e-health) [6], [7] there is still a lack of understanding the in-depth rationale to how these applications assist individuals to effectively change lifestyle behaviours.

On the one hand, there is a scarce on studies that relate the use of ICT to change attitude towards healthcare and on the other, the studies often focus on the technical aspects of ICT failure, neglecting what has been learned from the behavioural sciences about humans and their interaction with ICT; this may be the answer to understand the added value that ICT bring over traditional channels of healthcare provision. The success of ICT implementation in order to cause a change in individual's behaviour is often grounded in behavioural science, using theories and models to identify conditions and determinants of successful use [8]. Therefore, working out why an individual would use an e-health application to change his/her lifestyle means paying attention both at the behavioural aspects both in attitude towards healthcare and in technology readiness. This paper proposes a new framework that provides a tailored communication strategy by means of e-health promotion applications to understand the reasons of individuals to use new ICT to perform changes in their lifestyle. This is a multifold issue that can be tackled broadly by analysing their willingness to change health behaviours and to do so by using an e-health application.

Besides, this paper presents a practical implementation of the framework used for encouraging healthy eating, implemented using "portlets", a novel Web component based on Java technology that returns dynamic content to user requests [9], allowing the highest possible degree of personalization. The use of new web design technologies increases also the system's dynamism and interactivity.

2 Methods

Our intention is to build a framework that provides personalised information according to a set of variables relevant to the user. Tailoring both the channel and the content of the message has proven essential for persuading individuals to change their health behaviour [10]. In order to personalise information, a 5-step approach was defined based on the modification of a strategy for the creation of a personalised healthcare communication strategy [11]:

- Step 1: Analysing the problem to be addressed and understanding its determinants and defining a new model

- Step 2: Developing an assessment tool to measure a person's status on these determinants
- Step 3: Creating tailored messages that address individual validation of determinants of the problem
- Step 4: Developing algorithms to link responses from the assessment into specific tailored messages to create the final health communication.
- Step 5: Final evaluation.

A description of these steps and how they have been applied to the creation and implementation of the framework follows:

- *Step 1*

Theoretical models are useful in predicting which patients will use e-health and in understanding what factors influence their decisions. Models also can aid in designing and evaluating the ability of specific e-health applications [12]. Currently there is no integrated framework that includes a sufficiently broad set of influencing factors to understand the multidimensionality of the reasons why people use ICT to embrace a healthcare change [8]. There have been previous attempts in understanding whether a single factor may have an effect on their e-health adoption, by partially applying some of the psychological models that explain behaviour change. However, it was noticed that applying only one of the theories (i.e. the "Stages of Change") [13] was somehow limited as there are a wider variety of factors that influence a user's decision to adopt a change in his/her life in order to perform a healthcare change.

Moreover, without addressing the full range of factors, strategies to change usage behaviour run the risk of being ineffective because they fail to recognise interdependencies between individual and organizational factors [8]. Our research focuses on how to promote effective change in health behaviour by means of modern ICT. Therefore, a detailed study focusing on both healthcare and ICT dimensions was carried out to understand the stage the user is at.

In the first case research developed in psychology and public health that attempts to understand the promotion of health among the populations is complex and there are a number of significant theories and models that underpin the practice of health promotion and individual's attitudes towards the change, these being mainly: the Health Belief Model [14], Theory of Reasoned Action [15] and the Theory of Planned Behaviour [16], the Trans-theoretical (stages of change) Model [17] or the Precaution Adoption process Model [18]. These theories explain health behaviour change by focusing on the individual with the principal intention of providing information either to improve knowledge or change behaviour.

On the other hand, our task is to understand why users would make use of an ICT platform (denominated from now on "e-health" platform) in order to perform a change in their attitude towards health (i.e. use the Internet or a mobile phone to help them quit smoking, to encourage them to follow a diet, etc). However, we only found adoption theories that explained why a user would make use of an ICT platform to carry out a specific ICT-work related task (i.e. adoption of spreadsheets, use of email, word processor, etc) in different environments (companies, hospitals, government agencies, etc) and situations, although not health related attitudes. Studies elaborated show the interest of individuals in using an ICT application but there is no holistic framework to explain the link between these last two (i.e. the use of ICT to perform

changes in health behaviour). Our work has been to conceive and develop an integrative framework that explains the different stages the user is at both in terms of the perception of healthcare and the use of technology to perform any change.

- *Step 2*

In order to understand what the individual's status is regarding the variables previously explained, we designed and implemented a set of questionnaires to place the user at a stage in each of the paths so that we understand what personalised information needs to be provided according to the stage the user is at. Other factors (personality, age, etc) need to be taken into account but in this work we will focus on the stage at the healthcare and the ICT level.

- *Step 3*

Working together with the health professionals we modelled the structure of a medical intervention in the field for an individual placed at each of the stages in the different pathologies studied (6 month healthy-eating plan and 10000-step programme for diabetic patients), arriving to the construct of personalised messages for each case.

- *Step 4*

After having modelled the intervention we modelled the tool for the healthy-eating plan that provides the personalised messages according to the user needs. This tool is a Web-based tool in which messages are provided through different channels according to different variables. This solution has an additional advantage, since it makes such information available to the user through the Internet. For this purpose, different innovative technologies relative to dynamic Web development have been analysed, such as Java Portlet [9], JSP, Oracle databases, HTML or Macromedia Flash. The selection of these technologies is based on the following requirements: interactivity, personalisation, portability and usability, as well as a potential seamless integration in any kind of system. The whole process described in step 4 consists itself of five different stages. In each stage, different technologies have been selected to achieve the required functionalities of the full system. These stages are: Login, Questionnaires, Personalisation, Storage and Presentation.

At the Login stage the user's individual information is recalled from the database records, which have been previously stored in the general profiling process. The Questionnaires about health behaviour has been developed. Their functionality is to define the users' main concern and to discover their motivation status regarding their health [19] and their attitude towards new ICT. The previous steps have been already used to provide required methodologies to classify the user into each stage, and to suggest appropriate motivational techniques for them.

The Personalisation stage adapts the information to be delivered to the user. The user's profile is modified after the questionnaires are filled in. Thus, the system is personalised according to the user's preferences and completed with the most suitable information.

The Storage stage responds to the need of storing the users' profiles, with all the corresponding security and coherence requirements, to be later used all along the session. Finally, at the Presentation stage the personalised information and recommendations according to the results of the previous stages are presented to the user. The information shown has been selected in collaboration with health professionals.

To model the information provided, the structure of a standard medical intervention for a user suffering any of the different pathologies studied has been modelled with the guidance of healthcare professional.

The final communication strategy was designed and tested with the doctors.

• Step 5

An evaluation of the framework is already being carried out. Results show promising and the feedback obtained from the different stakeholders is currently being used to perform a second iteration of the whole communication methodology.

3 Results

3.1 The Model Proposed

A model that takes into account in parallel both the healthcare stage of the individual as well as his/her technical readiness to perform a change using technologies was conceived and designed. The added value of this model is that it allows placing the user at a stage in both dimensions (see Figure 1).

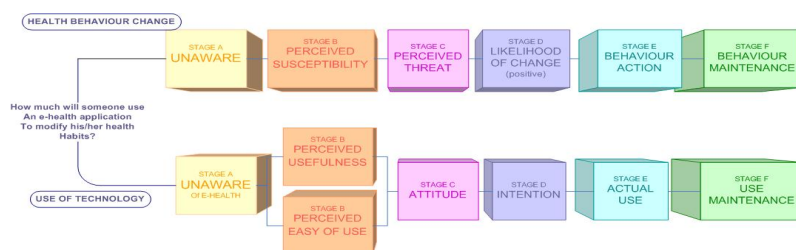


Fig. 1. The model proposed

As there are many similarities across the different theories, the upper path of the model (health behaviour change) is an adaptation from an integrative model proposed by Fishbein [20]. The model proposed considers the key variables of the models previously cited [4]. This path is appealing as it reflects the importance of intra-individual, environmental factors and self-efficacy. The main stages of the model are:

- Unawareness: an individual never heard about the issue and therefore may have no opinion about it.
- Perceived susceptibility: One's opinion of chances of getting a condition
- Perceived threat: the belief that one is susceptible to a specific problem
- Self efficacy: the belief that one has the ability to change one's behaviour
- Attitude to change: making a plan to change behaviour
- Action: implementing the plan to change behaviour
- Maintenance: continuation of behaviour change

This model supposes that individual's usually pass through the different stages, although the pace may be different for different individuals or different behaviours.

Movement backward toward an earlier stage is also possible (although not to stage 1 obviously). The lower path of the model is an adaptation of the Technology Acceptance Model (TAM) model proposed by Davis [21], [22] that models how users come to accept and use technology. Its stages are similar to the health behaviour model, although adapted to technology. The difference of the stages lies in these two stages [22]:

- Perceived usefulness: degree to which someone believes that a system would enhance the job performance.
- Perceived ease-of-use: degree to which a person believes that using a system would be free from effort.

3.2 The Questionnaires Designed

In order to be able to place the user in a stage a questionnaire/survey instrument was developed based on the model presented. It took into account the substantive factors influencing the adoption and readiness of individuals to perform a health behaviour change and in parallel to do it by means of an e-health application. Based on the stages identified in the model, two different sets of questions were developed, one for each branch. The questions try to find out the attitude of the user towards the two specific variables: one related to the interest in health (how the user relates to the healthcare stage) and the other related to their motivation and skills to use ICT to promote their well-being (whether the user would be ready to use an e-health application).

Although both stages are linked, two different questionnaires are presented to the user. Questionnaires are implemented in JSP, to allow conducting the user “intelligently” to the most appropriate question depending on previous answers. There are several ways to arrive to the same stage but with different characteristics depending on the answers to key questions and these are also taken into account when tailoring the information. The e-health questionnaire identifies whether users have knowledge, motivation or access, to use ICT to make a health change.

The health questionnaire (see Figure 2) assesses whether users have the awareness and the right guidelines to control their health, if they feel susceptible to suffer from that pathology and if users are following any healthcare plan. With these objectives in mind, three specific strategies to encourage self-care can be followed: offering correct and personalised information, helping users use this information and promoting ICT as a means to support healthcare by easing access to quality information and specific services, helping health problems follow-up and making the relation between patients/users and health professionals closer.

3.3 The Intervention Selected According to Stage

Once users complete both questionnaires they are allocated to a stage in their attitude towards the healthcare and the use of e-health to achieve a positive change. The process that models the intervention followed by the professional is selected.

3.4 The Algorithm Developed

The Web platform described has been implemented with the following features:

- To offer personalised information in form, tone and content.
- To be visual, dynamic and interactive.
- To be able to be integrated in an e-learning system.

In this sense, a training activity consists of a multimedia session through the Internet and presented by means of a visual and friendly interface. In particular, the implemented tool is a portlet using many of the characteristics of the specification JSR 168 [9], providing the user a two modes portlet: VIEW and HELP. The VIEW mode allows the user to get authenticated. After that, users are asked about their main concern and the questionnaire is displayed to classify users.

Once the user has been classified the information is stored in the database and personalised information is presented in terms of form, tone and content. The tailoring process is performed by using techniques that, using the adopted methodology [19], are the most appropriate to instruct, to convince and to motivate users. Users' awareness to take control and be co-responsible of their healthcare, is raised by presenting only relevant information through a personalised interface.



Fig. 2. Personalized information presented to the user

The database structure offers different types of information: profile, lifestyle characteristics and behaviour towards health and e-health status. The latter is the most important since it can be dynamically changed every time a user accesses the system and modifies any aspect related to his health behaviour. In this way, if the user has not changed the information introduced in previous sessions, the results displayed by the system reflect the user's needs and motivation. Information in the database must observe confidentiality and security requirements. All these requirements of structure, integrity and coherence suggested the use of a well known and established relational database such as Oracle.

3.5 Personalised Information

According to these stages, the information offered to the user is selected in line with the main features identified, and presented in the most suitable way so that a change

to improve his/her health with the use of ICT can be achieved. Figure 6 shows the information for a user in Action stage (this is related to obesity as a pathology).

3.6 Evaluation of the Framework

The survey developed for the evaluation of the framework concept among the general population and non-specialists healthcare professionals was responded by 20 people. Healthcare professionals believe personalised e-health can help patients and the overall population towards improving the effectiveness of people and perform tasks in a more effective way. The system is believed to be useful in easing people's routine (i.e. reminders, suggestions, feedback, etc), and to allow do tasks more effectively, such as taking a routine to take care of one's healthcare. On the other hand the less valued aspect is the perceived capabilities of the system to persuade and encourage self-care. In this regard and in order to improve this factor, this research worked intensively on the enhancement of this functionality by introducing motivating factors that encourage people to use e-health systems to improve the care of their healthcare.

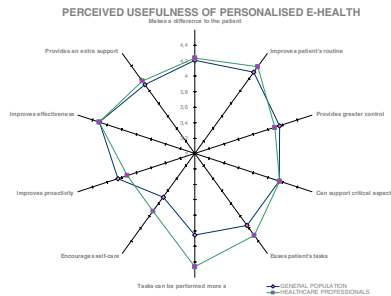


Fig. 3. Results of expert evaluation of the concept of the framework

4 Discussion and Conclusions

Information is critical to health-related decisions and the way this information is selected and processed plays a pivotal role in the decision making of individuals. This model allows the classification of users according to their attitude towards healthcare, and their readiness to adopt the change by the use of new technologies. It provides a framework for the provision of personalised information according to these and other key variables. Besides, the application of this framework promotes the empowerment of the individuals, as well as guidance, monitoring, through ICT and it will certainly make an impact on health-related behaviour.

This framework is novel as it proposes a framework that may be applied to the conception, design and evaluation of any e-health application. Besides, it aims at providing a communication structure for different application targets (medical informatics, public health informatics, etc) and to different stakeholders (healthy individuals, patients, professionals, etc). The framework promotes empowerment of the individuals by providing tailored information, as well as the acceptance of technology and it will certainly make an impact on health-related behaviour. Overall, this framework is likely to

provide deeper insights into the process of improving e-health acceptance so it can meet ongoing individuals' needs and become an increasingly integrated part of the preventive healthcare services value chain.

This framework allows enhancing the user modelling process by taking into account both health behaviour aspects as well as technological, not having been considered up to this moment and could be part of the explanation of e-health common underuse. It may assist both healthcare professionals and individuals to have a deeper understanding about both, the provision of healthcare and the delivery channel. However, the inclusion of other dimensions is also necessary in order to be able to effectively reach the individuals.

These tools are not meant to substitute the role of the professional, but help patients in raising awareness of their conditions and encouraging them to assume healthier lifestyles. This tool serves as a guide through the different stages of motivation described in the e-health framework until the desired healthy behaviour is adopted. Personalisation and usability are characteristics that allow this tool to create a user-centred healthcare model. Their needs and preferences are considered to allocate healthy habits promotion.

Other advantage of this tool is its portability, due to the use of Portlets, implemented as Web files (.war) that can be deployed by a portlet container being, at the same time, their content independent from it; the tool developed can be used in any other platform without the need of introducing any modification.

Overall, this framework is likely to provide deeper insights into the process of improving the acceptance of e-health, so it can meet ongoing individuals' needs and become an increasingly valued part of health care services.

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