Integrating Translational Design Ideology for Consumer-Targeted, Informative eHealth

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Abstract—**Understanding translational design challenges in educational and informative eHealth area is useful because production of applications for this field is constantly growing. The goal in translational health design is to produce applications which add real value for customers. This study considers several frame areas which support design. Target setting, quality policies, strategy management, tasks of care intensity, and overall evaluation of the projects have been selected as frame areas. In each frame area, key issues relevant to translational design targets are highlighted. Practical evaluation can improve the likelihood of meeting the goals of translational science in educational eHealth design.**

Index Terms—**Informative eHealth, patient education, translational design.**

I. INTRODUCTION

In recent years, translational science and medicine have gained much attention in health care policy. "Translational research refers to translating research into practice" and the purpose is that new innovations and knowledge could reach their target groups and are implemented correctly [1]. The main ideas of translational science stress real, practical values for patients and are therefore also useful in the area of informative, educational, consumer-targeted eHealth innovation design. In patient information and tutoring, the question relates to health-related learning environments. *Patient information* covers activities which offer services such as information and support for health consumers in general and specialized areas of health management, including preventive, curative, and follow-up needs. Informative activities may include the delivery of pure information, patient activation, and instruction and communication regarding health management, often done in cooperation with health providers. Such applications can be standalone applications, web-based modules, or part of a system's infrastructure (such as applications connected to medical records). In educational eHealth, the challenge is to translate technological advances into functional solutions and learning environments which serve individuals more efficiently. In addition to simply giving patients information, such applications can increase patient activity levels by offering practical knowledge and a deeper understanding of personal health problems. This improves communication between customers and health providers [2] and helps increase positive outcomes [3]. If this ideal could be even partially realized, it could mean remarkable reductions in healthcare costs along with improvements in quality, meaning that the question is not a minor one.

As an evaluative tool, translational design can help develop and improve future learning and knowledge environments [4]. Educationally-focused, tutorial eHealth systems in particular need close evaluation because this area is growing quickly. Therefore, in translational design aspirations, in order to be competitive, applications should be considered in relation to their real value for patients.

Views and understanding of translational science may to a certain degree inspire designers to integrate these concepts in their designs. However, practical evaluation of designs can help design practice to incorporate the design targets of translational science. This means that a focus on design supporters, theoretical frames of design is necessary. Understanding the role of these frame areas can deepen understanding and can assist eHealth designers in this challenge.

Design-science research in Information System development often means consideration of so-called "wicked problems" [5], and information delivery in eHealth is no exception. In consumer-targeted eHealth, policy changes happen quickly, and sometimes the lack, as well as, the abundance of models, strategies, and good practices may cause confusion. Therefore, the selected design frame areas need to be evaluated in terms of their appropriate functions in translational design projects.

II. TRANSLATIONAL SCIENCE AND MEDICINE; UNDERSTANDING CHALLENGES

As pointed out by Wehling, "translational efforts are as old as medicine" [6]. The purpose of translational medicine is to enhance patient care by making research discoveries for the betterment of human health or treatment of disease [7]. Translational science means operations which can bridge the gap between basic science research and clinical practice [1]. This means that "translational research brings discovery directly from the bench to practical applications in patients" [8]. Hence, availability issues and meaning of adoption policies are emphasized in this context. The target is that "traditional boundaries among basic research, clinical research and patient-oriented research are yielding to a single, continuous, bidirectional spectrum commonly termed translational research or translational medicine" [9].

Clinical and translational medicine is defined by Spada as "the art to use scientific concepts and procedures to create interactions and synergies between different scientific medical disciplines and clinical practices…" [10]. It has been noticed that translational science has its reengineering needs

when trying to enhance the patient care with better clinical applications [11]. In eHealth, there are many challenges. Marriott *et al.* [12] point out that "… interactive technology is not the same as truly engaging community members; interacting with the community, with or without health information technologies, means ongoing bidirectional communication between community members and their health care providers...". Health information policies which evaluate production only in view of usefulness and user-center design are not enough; in clinical practice, attention must also be paid to data integration and interoperability [13].

On the other hand, it is true that "opportunities to advance the discipline of translational science have never been better" [11]. The field of educationally-focused, tutorial design is constantly growing, producing informative, instructional, and communicative applications and systems for prevention, curative processes, and follow-up. Current areas of particular interest in translational medicine include health systems research, optimization of management structures, disease control and prevention, health knowledge dissemination, and personnel trainings on translational medical research, as well as certain topics in biomedical research [14].

In addition to biological research, economic, social, psychological, and legislative factors have a place in translational research processes [15], [16]. Synergistic thinking and positive interactions are widely emphasized as determinants of success in this area [17]. Translational research underlines the value of utility and focuses heavily on the quality of customer service. In practice, this requires synergy among many areas of design development. It is underlined "the importance to understand the definition and concept of clinical and translational medicine but also the importance of allowing the variations of the understanding" [10]. This also means that both the translational process and its definition and implementation can continuously evolve [18].

III. Problem Setting and Methodology

This study addresses the questions and issues which designers face when trying to produce patient-targeted informative and instructional eHealth applications in the spirit of translational science. It also considers the challenges of translational design and those areas which help designers to evaluate their translational design goals. This study deals with the traditional support areas of design, which consists of *target setting, assessment policy, strategic thinking,* and *quality management*. Nowadays, issues of *care intensity* form a meaningful part of an economic evaluation of health policy, so this area is also discussed here in terms of its power to evaluate translational design. However, the relationship of cost intensity to intensity of care requires more consideration and therefore special attention is given to synergistic thinking with these two areas. The areas of so called design supporters, theoretical frames and their role in translational design aspirations is discussed by emphasizing certain key areas in each frame. It is useful to define each of these management areas as an important part of basic knowledge but also to evaluate *the appropriateness of these design support areas* in each design context.

An Information System model presented by Hevner *et al.* [5] considers key areas of development and design, specifically, Environment, IS research, and Knowledge Base. Knowledge Base refers to foundations and methodologies as elements affecting the rigor of a design. The foundation of a design consists of its connected theories, frameworks, models, methods, and instantiations [5]. This study considers and evaluates the knowledge base and theoretical frameworks which can assist designers in understanding and applying ideas of translational medicine to their design philosophy. This study examines literature on translational medicine and research, eHealth design, design science, health technology, general and health-related quality theory, and health policy.

This study focuses on the following issues:
1) Why should ideas of translational science receive attention in the area of eHealth design, which focuses primarily on patient information and tutoring in key areas of information sharing, prevention, curative processes, and follow-up?
2) Which issues need special consideration in selected frame areas when aspiring towards translational design in informative, patient-targeted eHealth?

IV. Translational Design Needs in Informative eHealth Design

The need to understand translational design processes in eHealth innovation area is understandable. The purpose of tutorial healthcare is "to provide patient-specific data to patients in a manner that is accurate, timely, and understandable" [19]. When patients have a deeper level of knowledge and understanding of their health concerns, they can play a more dynamic role in their own care. Patients who actively and effectively manage their own health have more positive clinical outcomes [3], and eHealth has a key role in increasing patient involvement in decision making [2].

In this area, eHealth applications try to improve the quality of patient care through connective processes. New technologies have increased design intensity, but the question is how to develop applications and systems that combine remarkable utility for customers with innovations that could incorporate wanted health outcomes; "betterment of human health".

It is stressed that without real tools, methods, or systematic approaches, translational science can easily mean only "wishful ideas instead of real improvements" and therefore "methods and tools to facilitate the translational process need urgently to be developed" [6].

In contextual design policy, the following requirements are realized:
1) Need to understand translational design challenges in digital patient information.
2) Need for methods and models which increase the incorporation of translational ideas in eHealth design.
3) Need for integration of practical evaluative methods for design practices.
4) Need for functional strategies for coordination and

system interaction.

Deeper control of these four issues can minimize so-called "wicked problems" in this area. Different roadmaps, codes for good design, and health-related adoption models contain guidelines and strategies which try to also conform to the requirements of translational science. However, established quality frames and related criteria sets often require elaborate, project-based action in order to efficiently serve translational design processes. In many sub-special areas of health related information there is need for enough contextual knowledge bases and frames to serve design, which then may increase the value to patients with more successful toolkit-service combinations.

V. Focus Areas and Their Evaluation in the Challenge of Translational Design

A. Key Frame Areas for Design

Evaluation policy has two levels. At the *macro level* in the area of eHealth, it is useful to constantly evaluate several design-related categories, referred to as design support areas. *Target setting, strategy policies, quality management,* issues of *cost* and *care intensity,* and the *general evaluation policy of the project* should all be considered in eHealth-related translational design. As resource-intensive management areas, these support areas should increase efficiency instead of loading the design with bureaucracy. Therefore, the manageability of these macro-level frames needs attention. This study also highlights some key issues in each frame to illustrate the role of these frames. Furthermore, these management areas overlap to a certain degree. When targets are formulated, mission quality and therefore quality management must also be taken into consideration. However, it is easier to interpret these key areas and use them to evaluate projects if these areas are approached with the given specification. In design projects, these areas assist in evaluation and decision making, but in each individual project, it is also important to realize that evaluation should focus on the manageability and appropriateness of these guiding key areas as well.

B. Setting and Assessing Translational Design Targets

How can educational eHealth projects define their mission and design targets aligned with translational design ideas? In this context, the purpose of translational design is, above all, to foster policies and products that are useful, user-friendly, and ethically acceptable. This goal guarantees that *utility to the customer* is a high priority. Translational design requires a two-way flow of information (from research to practice and from practice to research) [4]. Evidence-Based Medicine (EBM) also underlines listening to customers as an important aspect of project evaluation. Listening to customers requires a profound understanding of the needs and requirements of different target groups. In spite of the existence of these goals, a deep understanding of the patient experience is not often achieved in eHealth interventions [3]. Evaluating utility to customers is a task that requires input from the entire infrastructure and service system of a project. This means that a wider perspective for design is necessary. When utility to

customers is stressed, this does not mean that profitable products are then devalued. On the contrary, in most cases, truly profitable products are necessary from the customer's perspective as well as the producers': "the profit is unlikely to be sufficient alone to advance translational research" but "has been the driving force behind many important discoveries in healthcare" [20].

For learning to be successful, "students need to learn what they are supposed to learn" [21], and this idea applies to health-related applications as well as any other sector. If the target and mission of the product is clear to the customer, users are more motivated than when confronted with a product whose target is hard to realize.

Target setting in this field requires situational evaluation, and in a translational design approach, it is naturally reasonable to try to find the most urgent and critical information challenges. This works if there are obvious and visible information gaps. Unfortunately, this is often not the case. In such situations cross-disciplinary approaches and abilities are valuable in realizing new insights [22]. It is essential, when solving problems, to concentrate not only on solving them after they occur but also on preventing them in the first place with more or better information and health promotion. As known, in the area of prevention, digital patient information has a great deal of potential to provide a good return on investment.

C. Streamlining Strategic Thinking

Strategic thinking may sound uninspiring in the context of design, when novel design plans are invented. However, since design involves targeting complex organizations and heterogeneous groups and also has some specialty requirements, the meaning of strategic thinking is valuable to realize in the view of design. In the area of eHealth, absent, poor, or vague strategic thinking creates a barrier to a successful eHealth policy [23]. Strategy policy, however, should reflect a clarity which allows it to manage complexities with practical guiding principles; "eHealth strategies should not be so detailed and unwieldy that these cannot be used as a functional and guiding document" [23]. Individual design projects also need a strategic outline, which must be manageable.

Barello *et al.* [3] noticed *low patients* engagement in the development and design of the care process in the implementation of eHealth programs. This is a task which also requires attention in the strategic planning of design projects.

In translational health promotion services must be *cohesive, coordinated, and synergistic* for products to be properly implemented and to function properly. This means that eHealth technologies should not be considered separate entities but rather as key components of the system [24]. In dealing with patient information, the challenge is not to create usable products but rather usable service, and applications, directly or indirectly, form one piece of the service system. When trying to guarantee a *functional service concept,* strategic thinking is necessary, and it cannot be limited to application design. There are both radical and traditional perspectives and approaches to healthcare and health promotion [25]. In the area of educational eHealth, promotional activities often combine the old and the new:

traditional needs and fixed systems are completed using new kinds of actions and applications. Strategic thinking is needed when new models are applied to current health protocols and systems as well as when changing or replacing old models and protocols in this area. In thorough strategic thinking, the concept of service gets enough attention, and application design is not seen as an independent and isolated task. Hence, the connection between strategic outlines and design must not be too loose.

D. Integrating and Managing Quality Policy

Quality requirements like comprehensibility, ease of use, controllability, accessibility, safety, and ethical acceptability are often the first features which come to mind when patient-targeted, informative educational products are in question. *Theoretical Aspects of Quality* in healthcare include points which are specific to health-related fields but also some which come from general quality theory.

A health-related quality scheme developed by Donabedian [26] presents areas of process, outcome, and structure and their subcategories as evaluation targets. Connected subcategories include efficacy, effectiveness, efficiency, optimization, acceptability, legitimacy, and equity [26]. eHealth applications are often one part of the service process, and are also part of the system's infrastructure and have an impact on service outcome. When connected quality issues are considered, eHealth embodied in all these areas has connected evaluative needs.

Several ethical codes, some general and some with a focus on eHealth, also offer guidelines for more sophisticated eHealth design as well different acceptance models in the IT sector or in health-related IT. At the macro level, specific requirement lists can be categorized into larger quality areas. Ethical aspects, mission thinking, and meaningful innovation policy require constant attention in eHealth quality policy.

In general quality terminology, service quality and its subcategories and overall general quality frames are defined. General quality frames of macro level emphasize e.g., factors like mission, customer, product, process, and production, as well a comparison of cost to value, all of which are relevant to quality in eHealth development as well. There are several facets to both product and customer quality. "IT artifacts can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes" [5]. Furthermore, understanding of patient experience should guide the design and development of eHealth interventions and patient engagement more intensively [3].

In the area of eHealth, high–quality products do not necessarily guarantee high-quality care; the product-process combination must function properly and seamlessly. New kinds of IT infrastructures create changes in health service protocols, and this requires continuous quality inspections. Quality aspects require consideration even at the first stages of design but quality issues need naturally continuous evaluation during the design and maturation. Transition means that service processes will change, disappear, and receive technological innovations, but do changes in fact enhance the quality of services and processes? What kinds of new ethical questions should be considered through these changes? Translational design should mean that new innovations are truly evaluated by and valued for their usefulness instead of their novelty. In addition to increasing patients' health-related activities, the purpose is often to increase care intensity in related processes with product design. Therefore, follow-up and evaluation are needed to identify the quality effect of increased intensity level. Versatile quality frame with wide understanding of quality issues is useful in this design area [27].

E. Economic Consequences and Issues Related to Care Intensity in Translational Design

In healthcare policy, issues of *care intensity* and *return on investment* (ROI) form a theme which nowadays is useful to include in discussions on cost allocation. This topic is vital to health technology policy, so care intensity is one factor to address when evaluating translational medicine in eHealth in this context area. The intention is that higher levels of patient interaction and activation could increase care intensity levels and possibly increase return on investment. It is well known that preventive actions and applications are very cost-effective at preventing disease in the long run. In health care higher intensity care can improve patient outcomes [28]. On the other hand, many resources and high care intensity may not necessarily increase quality of care or customer satisfaction. Greater care intensity can be linked to worse outcomes as well [29], [30], and higher service intensity does not always mean higher quality [31].

Optimality means that "there is a best or optimum relationship between costs and benefits of health care…" [26]. Intense design activity in certain area may produce overlapping toolkits, which could provide more options but may also lead to too intense self-health management, leading or self-monitoring. Moreover, there is evidence that very time-consuming applications which are intended for daily use may initially interest users but cause boredom over time due to the amount of time required. Excessive time requirements may then hinder genuine use and daily practice [32]. It is reasonable to evaluate the meaningful requirement level of self-health management of applications intended for regular use (e.g., users with intensive follow-up needs). In context related translational design aspirations a useful but also a challenging goal is optimal care intensity with high level of quality. Evaluation of intensity issues should focus on the following aspects:

1) Defining, identifying, and prioritizing areas where the care intensity level needs improvement,
2) Producing applications to improve care intensity, and
3) Recognizing the danger of too-intense activity. An application which requires too much of patients' time and resources or which requires guidance from health professionals without well planned support desk may not be utilized leading to lost resources.

F. Controlling Overall Evaluation Policies

At the *macro level,* evaluation of a project must look at the manageability of supporting frame areas: target setting, strategic thinking, quality management, and issues of intensity. In projects, the roles of these frame areas can be defined by identifying the key issues and areas connected to each one.

At the *micro level,* evaluation confirms that designed products are *fit for their purpose*. Hevner [5] defines design evaluation methods as observational, analytical, experimental, testing, and descriptive. In analytical static evaluation, the purpose is to examine the structure of the artifact, e.g., its complexity [5]. This type of evaluation is particularly important in the area of consumer-targeted health applications. This field requires creative design that must solve complex problems. To be translational – that is, useful and usable – educational health products must be intuitive for users; self-directed, and suitable for continuous use however without too intense complexity level. Evidence in a useful form is one challenge in long-term evaluation [33]. Even though "large amounts of data currently sit in silos within health and social care systems" sometimes there is difficulties in obtaining informative evidence [34]. Greenhalg *et al.* [33] remark that despite the benefits of evidence based medicine, as unintended consequences, sometimes "the volume of evidence, especially clinical guidelines, has become unmanageable and the evidence-based quality mark has been misappropriated by vested interests". Obtaining usable evidence of the appropriate level and quantity, as well as the development of related assessment technology, needs constant attention in this area of eHealth.

TABLE I: KEY ISSUES OF MACRO-LEVEL EVALUATION

Design target	Is change needed and why?
	Is change useful, usable, and ethically acceptable?
	What kind of product will produce the desired change?
	Has a user-driven approach been considered?
	Has the product-process connection been considered?
	Has product complexity been considered?
	Has preventive medicine received enough attention?
Assessment policy	What kind of evaluation verifies the transition?
	Is the evidence usable and reasonable in quantity?
	Is the assessment policy manageable?
Strategy management	Is synergy & service entity emphasized?
	Has patient engagement been considered in design?
	Is the strategy policy manageable?
Quality management	Is the perspective on quality versatile enough?
	Does the product-process connection enhance service quality?
	Is the quality policy manageable?
Care-intensity & cost-efficiency	Does optimal care intensity connect high quality level?

VI. CONCLUSION

The purpose of translational design in patient-targeted information sharing is to enable changes which are valuable, desirable, and ethically acceptable. Table I shows some key questions for selected evaluative frame areas. In innovative development areas the requirements of translational approach, design, procedures, and actions need all attention. Even if designers in educational eHealth are aware of the ideas in translational research, it is useful to consider how designers could better apply these ideas to their designs. Identification of the framing areas and their contextual elaboration can help designers accomplish this challenge. It is beneficial to recognize and define the support areas for design but also to evaluate their usability, appropriate role, and manageability in the design scheme.

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