ACIPS: A Framework for Evaluating Patient Perception in the Introduction of AI-enabled Healthcare

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Abstract
UPDATED—August 21, 2020. In this paper, we present ACIPS, a framework for evaluating patient response to the introduction of AI-enabled digital technologies in healthcare settings. We justify the need for ACIPS with a general introduction of the challenges with and perceived relevance of AI in human-welfare centered fields, with an emphasis on the provision of healthcare. The framework is composed of six principles that measure the perceptions of acceptability, comfortability, informed consent, privacy, and security patients hold when learning how AI is used in their healthcare. We propose that the tenets composing this framework can be translated into guidelines outlining proper use of AI in healthcare while broadening the limited understanding of this topic.

Author Keywords
artificial intelligence; healthcare; framework design; economics and behavior; human-AI interaction; digital empathy; usability; acceptability; privacy; security.

CCS Concepts
•Applied computing → Health care information systems; •Human-centered computing → User models; •Computing methodologies → Artificial intelligence;

Introduction

In the provision of healthcare services, artificial intelligence (AI) is ubiquitous. With applications in clinical diagnosis, personalized medicine, drug discovery, epidemiology, and operational efficiency [20], AI is undeniably changing the healthcare landscape for the better. However, a technological approach to healthcare comes with its own set of challenges. In particular, we focus on the complex social structure that emerges from the Doctor-AI-patient interaction. Studies that look at users' response to the introduction of AI-enabled tools in human-welfare centered fields, indicate the outcome of the interaction is contingent on the level of complexity and type of the task, the expertise of the user, and the mental models users have formed about the fairness of the tool [10] [14] [24] [5]. Begetting mental models that ignite a cooperative interaction between healthcare providers and patients will require a regulatory and behavioural approach that can provide a guiding base for all users involved [7] [28].

In the medical field, concerns arise about service providers' ability to engage in positive cooperation between doctors, AI, and patients [25] [27] [20] [2]. Terry and Cane put forth the idea that the increasing use of digital means of healthcare provision is eroding doctor-patient empathy and the associated positive health outcomes that come from this interaction. In the same vein, Morley et al., warn that an over-reliance or mismanagement of AI can lead to the impersonalization of healthcare provision, and consequently a decrease in trust and doctor-patient empathy [17] [9]. Emanuel and Watcher argue that the promise of AI in healthcare is deliverable only if we are able to establish a positive behavioural approach. For example, by developing strategies that encourage empathy and trust in the digital realm [27], such as identifying and designing a set of fundamental ethical guiding principles [25] [28], and utilizing AI in a strategic way such that not only doctor-AI-patient interactions become more efficient, but doctor-patient interactions improve as well [22] [2].

Canalizing trust in AI-enabled healthcare has great potential for doctors and patients alike. In terms of operational efficiency, it can decrease wait time for patients [11] and decrease health-related information asymmetries [23] [29] [8]. The latter is a step in the right direction towards increasing patient adherence to prescribed treatment, in combination with a healthy relationship with the prescribing physician [29] [7]. Moreover, the use of AI in clinical support systems has clear advantages in diagnosis, treatment selection and monitoring [18]; however, there is a positive consequence of the usage of support systems that is not often talked about. This form of AI offers relative anonymity to users and, along with other means of digital communication, decreases the need for face-to-face interaction between patients and carers. Anonymity has been proven to increase users' self-disclosure on otherwise sensitive topics, including emotions and concerns [4]. This secondary feature is especially relevant for settings where health-related topics might be taboo and therefore difficult to discuss with carers for fear or shame. For instance, in India and Bangladesh (among other developing nations), sexual and reproductive health is very much a taboo, and shame and stigma around it contribute to young girls' negative health outcomes [26]. Preliminary studies on the usage of health digital applications (e.g. mHealth) show that these tools are widely accepted by users in Bangladesh and India; however, digital literacy is still low and in person consultation still plays a crucial role in the development of better health service provision that is in accordance with local norms and patients' ethics and values [1] [16].

ACIPS Framework

LaRosa and Danks acknowledge the need for the establishment of standards that assist in maintaining trust between patients and healthcare providers [13]. In this paper, we propose a framework to set guidelines for how AI-enabled technologies should be formally introduced to patients in healthcare settings. The core principles of this framework are broken down into 6 parts: *Acceptability, Comfortability, Consent, Understanding, Privacy*, and *Security*. For brevity, the framework will be referred to as ACIPS.

Acceptability

Sekhon et al. develop a comprehensive theoretical framework for acceptability that encompasses the subjective evaluations made by patients who experience and healthcare practitioners who deliver a respective intervention [21]. Dyer and Robinson synthesize the term acceptability into a definition that embraces the aspects of experiential healthcare treatment and social validity [6]. We craft the principle of *Acceptability* to elucidate how AI-enabled technologies conform to a patient's ethical values and expectations. If patients are given the right to explicitly accept that a healthcare intervention enabled with AI will be used in their care, this will lead to greater trust of these respective systems and possibly enhanced quality of care.

Comfortability

While comfortability is often overlooked in the informed consent process, it is a key part of the patient experience [30]. Pelvic examinations are particularly known to be challenging experiences for both physicians and female patients and can be eased by using a plastic speculum (an instrument used to widen an orifice for inspection) over a metal one [12]. Unfortunately, when receiving gynecological exams, selection of a speculum is often left to the preference of the provider with little regard to patient choice [3]. We believe that if patients are given the opportunity to express their level of comfort in how AI-enabled technologies are used in their treatment, this will lead to improved patient healthcare outcomes and a stronger understanding of perceptions of AI in these domains.

Informed Consent

Advancements using multimedia interventions have been introduced to improve the informed consent process, however, this process still remains convoluted by the lack of transparency provided when attempting to understand how or why certain equipment is being used in patient care [19]. While considerable effort is taken upon physicians and other medical personnel to apprise patients of the possible benefits and/or detriments of a respective procedure, there is little transparency about the tools used in these procedures. In the principle of *Informed Consent*, patients are comprehensively informed about the presence and utility of AI integrated within software or equipment being used for their care and can exercise their right to consent to these technologies.

Privacy and Security

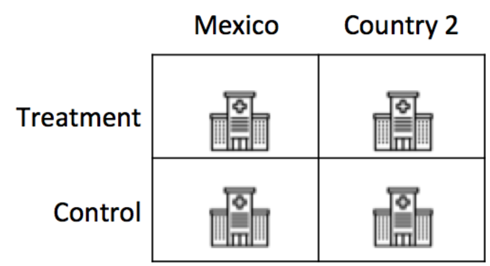
Over the past few years, data breaches such as hacking, malware attacks, and phishing have affected healthcare systems around the world almost incessantly [15]. As the need for machine learning systems to be trained on extraordinarily large amounts of data increases and the opportunities for contributing personal health data grow, it is imperative that patients are aware of the implications associated with engaging in AI-enabled technologies. When designing the principles of *Privacy* and *Security* in the ACIPS framework, it was important to establish that patients would know what and how personal data is collected from AI-enabled technologies, how this data is securely and privately kept, and the autonomy that can be exercised in the management of their personal data.

Experimental Design

We propose a pilot evaluation of the effectiveness of ACIPS with an experimental approach in Mexico, by randomizing hospitals into two groups: treatment and control. The selection pool of hospitals will be determined by the readiness to include an AI-enabled tool in their healthcare provision, irrespective of the task. Treatment hospitals will be encouraged to adopt AI in their healthcare provision, and offered a training workshop guided by the tenets that compose ACIPS; control hospitals will not be offered the workshop but will be encouraged to adopt AI-based healthcare. The sample size will be determined by a 0.8 power analysis, including a 0.05 alpha, and a hypothetical delta increase of 0.5. The outcome variables to analyse include average scores of patients' ratings of acceptability, comfortability, informed consent, privacy and security. ACIPS variables are measured on a likert scale that ranges from 1 to 10, with 1 being the worst score and 10 the best score. We measure the difference in means between the treatment and control hospitals of the four ACIPS principles, as well as that of an ACIPS composite score. We balance the two groups with pre-treatment characteristics such as location of the hospital, average income of regular patients, medical specialization, and previous experience with AI.

Finally, we intend to scale up the evaluation in a second country and include a multilevel set-up. The scale up would allow us to increase cross-cultural validity of ACIPS by pooling hospitals within and across countries, and further evaluate patient well-being – a hypothesized consequence of the usage of the ACIPS framework. Figure 1 exemplifies the proposed design.

Figure 1: Scaled-up experimental design



Conclusion and Future Work

The field of humans and technology interaction, especially in the domain of artificial intelligence for healthcare, is still in its infancy. In particular, exploring the need for technology to be used in a complementary manner, more than as a replacement for human care in medicine could be beneficial for the successful introduction of mobile or computer applications. Moreover, in developing countries, using a complementary approach for app usage and introduction could ignite economies of scale by creating trust for typically taboo topics and bringing more people to seek medical advice where before they would not dare.

Our proposed framework provides a strong foundation to expand literature regarding the study of public concerns with AI-based technologies and human-centered design of these systems. To continue our work, we plan on developing an empirical study to test our proposed framework and evaluate its effectiveness in real-life settings. The insights of physicians, nurses, and other medical workers will be invaluable as we progress in this research and we plan on forging collaborative partnerships in this domain.

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