UX Approach to Designing a Clinical Decision Support System for Pain

Completed Research Paper

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ABSTRACT

The User Experience-driven Innovation (UXDI) framework emphasizes the importance of understanding user needs in product design, particularly in developing effective healthcare solutions. This research applies the UXDI framework to design a Smart Clinical Decision Support System (CDSS) aimed at assisting healthcare professionals in managing chronic pain, a condition that significantly impacts patients' quality of life and poses considerable challenges for healthcare providers. This CDSS design focuses on the inspiration phase of the UXDI framework to identify the characteristics and needs of target users, i.e., healthcare professionals, and to understand their tasks. We start the inspiration phase by interviewing three physicians from oncology, pain management, and dental surgery—fields where pain management is crucial. These interviews gathered detailed information about physicians' workflows and interactions with patients related to treating and managing chronic pain. The resulting information verified the need for an intuitive and easy to use smart pain CDSS in clinical practice and informed the development of a high-level task experience map as well as two personas representing target users of a smart CDSS. Analysis of the interviews also highlighted the need for a dashboard to provide clinicians with the information that they need for patient care in an intuitive and concise way.

Keywords (Required)

Clinical Decision Support Systems (CDSS), UXDI framework, User-centered Design, Biomarker of Pain

INTRODUCTION

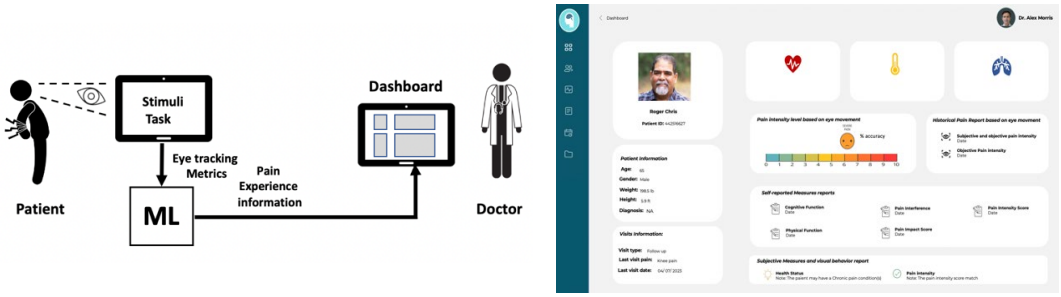
The User Experience-Driven Innovation (UXDI) framework highlights that successful product design relies on UX research being fully integrated throughout the product lifecycle. In addition to verifying the need for the product and gaining a deep understanding of the target users' needs, effective development of organizational systems begins with a detailed mapping of the workflow into which the system will be embedded (Sankar et al. 2023, and 2024; Djamasbi & Strong, 2019). The framework contains three essential phases: *inspiration phase*, *ideation phase* and *implementation phase*. The *inspiration phase* focuses on gathering information about user needs and challenges to identify opportunities for innovation through UX design. The *ideation phase* employs a systematic, iterative approach where UX research is used to test and improve solutions for the identified opportunities. The *implementation phase* centers on measuring the impact and monitoring the success of the solution after it is launched in the market space. The UXDI framework draws from four influential disciplines: 1) **Design Thinking**, to examine problems and solutions from the user's perspective, 2) **Innovation**, to align product design with business strategies and resource planning, ensuring market competitiveness, 3) **Design Science**, to apply existing theories to reduce uncertainties in product development and use design artifacts to develop new theories; and 4) **Neuro Information Systems (NeuroIS)**, to utilize sensor-based technologies for capturing users' experiences at a deeper cognitive level.

Hence, as part of a larger project that is developing a smart CDSS that assists physicians during their decision-making process for managing chronic pain, we used the UXDI framework to guide our development process. Chronic pain is an increasing burden that significantly impacts patients' quality of life and poses considerable challenges for healthcare (Rikard et al., 2023). In the chronic pain context, the relevant focus for CDSS design is physicians and their needs for support in providing effective pain care. Literature emphasizes the potential benefits of smart CDSS in supporting healthcare professionals in the decision-making process for managing chronic pain (Granviken et al., 2023). There is also a pressing need for reliable biomarkers to objectively assess and manage pain in both research and practical healthcare settings (Borsook et al., 2011). Hence, the smart CDSS uses physiological biomarkers of chronic pain to provide clinicians with an objective assessment of their patients' chronic pain experience (Alrefaei et al., 2023b).

This paper seeks to address the following questions: 1) Market Need: Can we validate the market need for a CDSS for chronic pain management? 2) Task Experience Map: What is the current workflow, and how can the CDSS be integrated into it? and 3) Personas: What are the characteristics and needs of the target users that can guide the initial prototype design of the CDSS?

METHOD

We conducted 30 to 45 minute unstructured and semi-structured interviews with three physicians from different northeastern clinics—oncology, pain management, and dentistry. To engage these physicians in a dialog that would provide the needed information, we provided an overview of the smart CDSS, consisting of two major components: 1) a subsystem for collecting objective pain experience measures through patients' physiological biomarker, and 2) a dashboard that summarizes the needed information to assist them in treating and managing chronic pain (Alrefaei et al., 2023a) (Figure 1).



1.a. Overall Concept 2.a. Dashboard

Figure 1. The sketches used in interviews to engage participating physicians in a dialog about their needs

RESULTS

Our results include the need for the CDSS and associated dashboard, the task experience map that captures design insights, including the need to include nurses as a user group, and the personas developed.

Market Need

The overall system concept served to capture unsolicited feedback about the need for a smart CDSS in clinical practice. All three physicians emphasized the critical need for a smart CDSS that can objectively and accurately measure pain. All noted that because pain is a subjective experience, it is predominantly assessed via self-reported measures. This subjective assessment results in variability in patients' pain perception, posing a challenge when developing treatment options for patients. In all three departments (oncology, pain management, and dental surgery), the physicians stressed the value of objective measures of pain

experience to guide their treatment decisions. All participating physicians provided unsolicited feedback about the value of a smart CDSS in monitoring patient pain intensity levels during visits and tracking changes in pain levels over time for helping them design better pain management strategies for their patients. The need is perhaps best captured by one physician who said that such a system "will help in improving pain diagnosis, enabling more targeted treatment plans, and ultimately enhancing the quality of life for patients." One new idea was to also offer suggestions for medication prescriptions.

The dashboard sketch (Figure 1b), designed to initiate dialog about workflow, validated the need for a simple, intuitive display of the information physicians need about their patient's treatment plan in one place. Physicians liked that the dashboard design in the sketch was "nice and simple," compared to the complex and cluttered interfaces they currently use. They underscored the significance of providing the most relevant information to healthcare providers based on their needs. For example, one physician said, "Current medical records are often overloaded with unnecessary documentation, so having the necessary and relevant data in one place is valuable". The need for and value of a dashboard such as the one presented in our initial sketch was best captured by the statement from one physician which explained that the dashboard in the sketch provided "a quick and efficient tool, allowing doctors to gather important information without excessive effort". While the initial dashboard sketch received positive reviews, physicians offered suggestions to enhance both the design and functionality of the dashboard sketch. Recommendations included incorporating additional patient details such as underlying conditions, historical pain prediction charts based on objective measures and self-reported measures, and all previous diagnosis information for the patient. Furthermore, all physicians recommended integrating the dashboard with existing hospital systems to streamline workflow for healthcare professionals.

Task Experience Map

Insights from these interviews were used to develop an initial task experience map, outlining patient visit workflow by capturing key steps from pre-consultation tasks performed by nurses to physician consultations and treatment planning (Figure 2). This map provides a high-level view of the patient care process during an office visit, identifying the critical interactions and information flow between different visit stages. It reveals a significant overlap in responsibilities between nurses and physicians, indicating that nurses are also target users of a smart CDSS. Thus, the CDSS must be designed to accommodate the needs of both user groups (physicians and nurses) to enhance their collaborative efforts. The task map also reveals the crucial role of nurses in collecting self-reported measures from patients during office visits, presenting an opportunity to collect patients' pain biomarkers simultaneously with nurses collecting self-reported pain measures (Alrefaei et al., 2023b).

The task experience map in Figure 2 provides the steps involved in patient care before and during the physician visit. Initially, nurses perform a basic examination, e.g., check vital signs, update patient records, and collect self-reported pain measures. This process ensures that the physician has all the necessary information when they see the patient. The physician then reviews their current health status and medical history, conducts a physical examination, and discusses the diagnosis, treatment plan, and any necessary follow-ups with the patient.

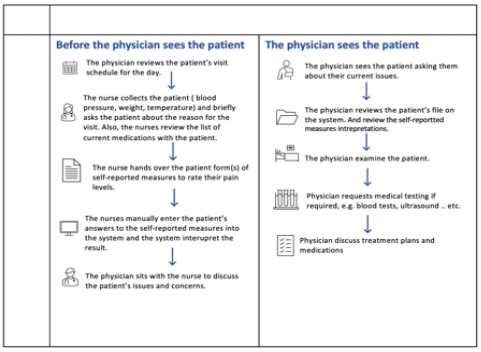


Figure 2. The task experience map

Personas

Persona development is critical for developing successful user-centered information systems because it enables a deeper understanding of target users' needs, preferences, and behaviors relevant to product design. It facilitates the development of solutions more likely to resonate with users, enhancing the overall success of product adoption and continued use (Sankar et al., 2023; Jain et al, 2019). Personas are developed using two methods. Research personas are crafted through direct engagement with users, e.g., interviews. They capture various aspects of life and work that are relevant to the design of the "to be" system. Proto personas are a more speculative creation, based on knowledgeable assumptions rather than direct interactions with the target users (Jain et al., 2019).

Our interviews were designed to enable the development of a physician research persona (Figure 3). Because physicians emphasized the key role of nurses in the pre-consultation process of patient visits, we developed an initial proto persona for nurses (Figure 4), based on the descriptions and insights provided by doctors about nurses' roles and responsibilities during patient visits. Because this proto persona was not created based on interviews with nurses, it represents an early approximation of nurses' needs, which we will further refine through interviews with nurses in near future (Jain et al., 2019, Larkin et al., 2023, Varzgani et al., 2023).

Our two personas share several key needs to support daily practices. Specifically, both (1) require comprehensive patient information for providing effective care, (2) need efficient and collaborative tools to assess and handle their daily tasks and provide seamless communication among healthcare teams, (3) share a need for simple design interfaces to quickly access patients' data, ensuring that they can use this information with minimal cognitive effort and (4) need access to tools that assist in the diagnosis processes as well as enhancing the quality of treatments. The two personas differ in why they need such collaborative tools. Nurses need the tools to streamline the care process in an easy and efficient manner during the visit. Physicians need the tools to access information for making care decisions.

To make and prioritize design decisions, certain aspects of personas are represented on a spectrum (Jain et al. 2019, Larkin et al. 2023, Sankar et al. 2023). We identified three aspects that would be important in initial design decisions: 1) Level of technology usage in practice, which can be used as an approximation of the persona's comfort in using technology at work 2) Level of trust in technology, which can be used as an approximation for the persona's trust in advanced technology to assist the diagnosis process, and 3) Level of shared decision making with patients, which represents an approximation for the persona's preference to engage patients in shared decision making about their health as part of the care process. The information in the first two spectrums helps to make design decisions about features that are needed to create positive user experiences for those who are not tech savvy and/or have little trust in technology, to those who find it easy and helpful to use smart technologies in the workplace. The information in the third spectrum helps to identify design aspects that enable presenting information to patients during the visits. The first two spectrums are relevant to both personas, the third is relevant to physicians only. In addition to assisting design decisions, personas can also help to identify need for targeted training programs that can minimize negative perceptions about the system.

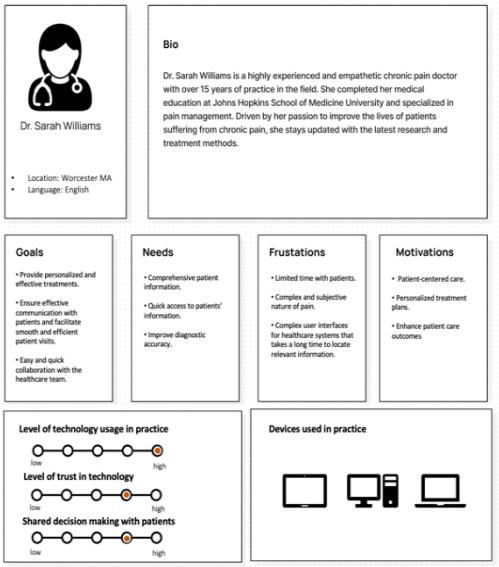


Figure 3. Physician research persona

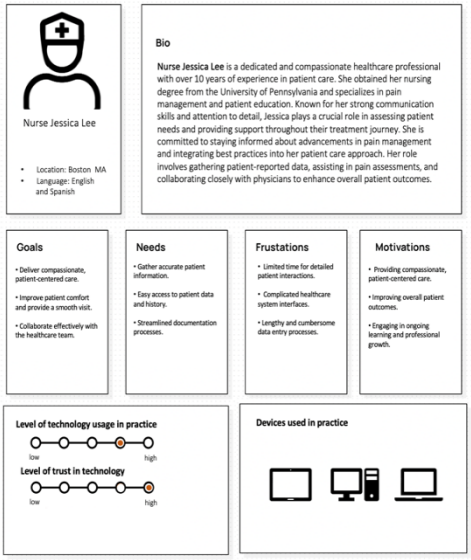


Figure 4. Nurse proto persona

CONCLUSION AND LIMITATIONS

This research employed the inspiration phase of the UXDI framework during a project that is developing a smart CDSS for chronic pain (Alrefaei et al., 2023b). The results verified the need for a smart CDSS in clinical practice and supported the need for a dashboard as a "control" panel for physicians to plan pain experience treatment and management for their patients. Outcomes of the inspiration phase included a task experience map and 2 personas representing physicians and nurses who will be using the smart CDSS.

One limitation is interviewing only 3 physicians (n=3). Using information from a small set of target users, however, is a common industry practice for designing user-centered products and services (Alrefaei et al., 2023a; Larkin et al., 2023). Because participating physicians treated chronic pain in different clinical settings (e.g., oncology, pain management, and dental surgery), the consistency in findings regarding the system needs and the generalizability of task experience map indicates a sufficient initial sample. Our future studies will include interviews with nurses (to develop nurse research personas) and a larger pool of physicians to build and refine our personas and ensure the completeness of the information needed for CDSS design decisions. We will also focus on collecting data from more diverse healthcare professionals to better understand the complexities of decision-making in pain management. We will refine the task experience map with the additional information to ensure it meets the diverse needs of potential system users, thereby enhancing its ability to guide the design of a smart CDSS.

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