HealthPass: Bridging Communication Gaps Within the Healthcare System

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Abstract
HealthPass is a digital application that allows for patients to take control of their own healthcare data, learn about their health status and seamlessly transfer their medical information to any healthcare facility around the world. We developed this application in response to data gathered during interviews with international students who expressed their frustration in dealing with the healthcare system in the United States. These patients told us about not being able to seamlessly transfer their basic medical information such as immunization and allergy records and not fully understanding what practitioners were communicating to them. To develop the application, we employed the use of a user-centered design process that included gathering insight from our target user population through feedback sessions. This allowed us to improve on our prototypes and through several iterations, we were able to design an application that most effectively responded to the needs of our target users.

Introduction
Electronic Health Records (EHR), which includes information related to immunizations, prescription medication, and allergies are largely non-transferable between healthcare systems. This limitation has contributed to a discontinuity of care between medical facilities with patients having to regurgitate basic medical information at every medical facility they visit. Moreover, for patients with serious medical circumstances, remembering their medical history may be cumbersome and at times impossible-especially if the patient is not fully able to advocate for themselves (i.e. children or those with cognitive deficits). In the

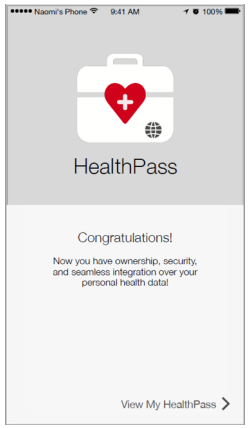
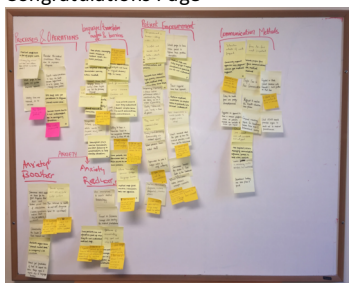


Figure 1: HealthPass Sign Up Congratulations Page



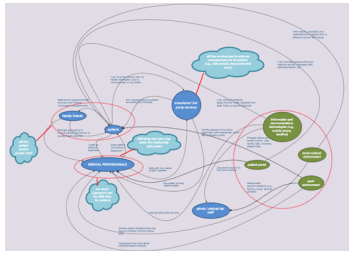


Figure 2: Synthesizing ideas (upper)
Figure 3: Social model (lower)

case of non-native English speaking patients, the issue is compounded by communication barriers that prevent these patients from effectively communicating their needs and medical history to their provider. In addition, international travelers who receive health care services from multiple health systems throughout the world have reported experiencing inconsistencies in the type of treatment they are prescribed for a particular health concern, which further diminishes their trust in systems of care as well as their overall satisfaction with navigating the healthcare system. Lastly, communication of important medical information to the patient by a practitioner may not be clearly understood, especially in the case of non-native English speakers. This lack of effective communication may leave patients with feelings of anxiety and ambiguity about their health status.

With these problems regarding communication within the healthcare system in mind, it is imperative to develop a solution that alleviates patient frustration with the healthcare system. With the advent of smartphone technology and the digitization of health care information it is possible to create solutions to this problem that; a) gives patients ownership and control over their personal health data, b) leverages technology so that there can be seamless transfer of information between health practitioners and systems of care, and c) empowers patients to become more informed advocates for themselves through education about their own medical histories and health status.

By empowering patients with access to their own health data, allowing for transfer of this data between health systems and educating the user about their own health status, we hope to relieve some of the anxieties, confusion and frustration many feel when interacting with various health care facilities and practitioners. It is in this way that we hope to level the playing field by ensuring that patients from all backgrounds can have access to the same efficient, effective and appropriate healthcare experience that local community members receive, wherever they choose to travel.

Design Process

With this design goal in mind, we followed a structured process to develop a design that brings along a solution to many of the mentioned problems. The overall process can be split into building interview guidelines, identifying stakeholders & users, deriving user needs and insights from these interviews, building an initial design concept, running brief evaluation sessions on the concept with real users, derive the insights from this interaction and build a high-fidelity prototype, run in-depth evaluation sessions with real users and then finally, with these new insights, develop a final prototype that solves previously identified UX problems. This overall process can be detailed and described in the actual steps that were taken by the team:

1. We started with individual brainstorming to find ideas that we believe require our attention from a healthcare communication perspective.
2. We then proceeded to synthesize our ideas together in group sessions using the white board, identifying larger themes and grouping ideas in them. Looking at all the large themes with sub-ideas, we identified the main overarching idea. (Figure 2)
3. The next step was to identify and discuss the people potentially affected by our idea. We concluded that our users are mainly international students, but also local students with little understanding of their healthcare systems. Being at a large university in the US, we could identify many directly affected people in our surrounding. We decided to split up in groups to conduct interviews with people who fit into this framework of international students. Through talking with multiple of them, we could identify certain user needs: confidence in responding to medical situations, respect received and shown by medical professionals during interaction, wish for more involvement in the treatment decision-making process, clear communication with medical professionals and effective and

Figure 4: Paper Prototype

Figure 5: Low Definition Prototype

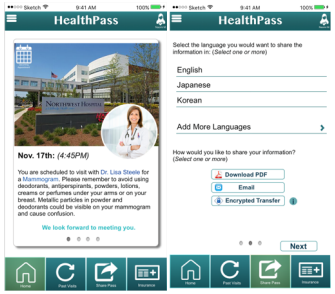


Figure 6: First Version of High Definition Prototype

efficient transfer of personal information throughout different healthcare systems. Lastly, we developed a social model to describe the problem and user space better. (Figure 3)

4. Based on the insights from interviews with real users in our surrounding, we then developed an initial proposed design concept and an initial prototype of a solution that could potentially help the affected group of people. Everyone developed individually 20 ideas on how to tackle the affected group's goals and problems. In a group session, synthesized this information, discussed all ideas and identified a new idea, build from parts of individual ideas. This initial prototype was done as a paper prototype and Balsamiq prototype.
5. In the next step, we tested this initial concept again with real users from our surrounding, that fit the main group of international students in the US with little support or understanding of the local healthcare systems and interactions. With the insights from these brief mock-evaluations, we build a new high-fidelity prototype using InVision. Additionally, we developed an evaluation plan for in-depth evaluation sessions of the new prototype, outlining our task-based evaluation session and detailing the tasks we wanted users to accomplish in the session.
6. Afterwards, we proceeded to conduct separate 30-minute evaluation sessions with five real users, having note takers, facilitators and observers in the session. From this information, we were then able to derive real UX problems with the prototype.
7. In the last step, we developed a final prototype. With the input from the evaluation sessions, we sat together as a group again, discussing the UX problem instances and UX problems with the prototype. We developed and discussed multiple different approaches to solve these problems in our design and concluded with solutions to the top UX problems. These were then built into the prototype which was now turned into an improved final prototype.

Design Requirements for Our Solution

Based on the interviews with potential users, we identified five main goals that they want to achieve through our service: 1) confidently respond to medical emergencies in both familiar and unfamiliar situations; 2) Be respected by medical professionals; 3) More involvement in the treatment decision-making process; 4) Clear communication with medical professionals despite language barriers; 5) Effective and efficient information transfer across the healthcare system.

Based on these five goals and the interviews, we carefully chose five main design requirements for our solution.

A. Our design must facilitate communications through digital means through a mobile device;
B. Our solution should take into consideration different understanding of technology by people of different cultural and socioeconomic background in our society;
C. We should provide patients with adequate, easy-to-understand information regarding diagnosis and medication;
D. Visual materials should be included as appropriate to increase comprehension of medical information by non-medical professionals;
E. The product should provide inter-system support, streamlining patients' medical information as well as physician and medical staffs' paperwork.

Prototyping and Implementation

1. ***Concept Validation:*** We designed a low-fidelity paper prototype of the HealthPass mobile application (Figure 4). This method enabled us to rapidly prototype our concept to present to our user group, and assess their beliefs about our proposed product, and patterns of interaction. Consistent with the User Goals, these features were included and emphasized:

Figure 7: User Evaluation Setup

- *Rapid Emergency Response*: Enables the user to quickly and effectively respond to unexpected health events that require medical attention.
- *Educational Resource:* Provides the user with tools to become educated on health-related topics, and improve their understanding of commonly used medical terminology
- *Transferable Health Record:* Enables the user to seamlessly transfer their personal health information between health systems.

The feedback from our user group indicated that several elements of the user interface (UI) were confusing. Specifically, users expressed that the iconography we employed is unconventional and difficult to interpret, and also that the home screen contained an overwhelming amount of information. Users also considered the application overly robust.

2. ***Expert Heuristic Evaluation:*** User feedback was incorporated into the second iteration of the HealthPass mobile application, which we translated into a low-fidelity prototype designed in Balsamiq (Figure 5). The ability to store, access, and share personal health information was reaffirmed as the defining feature of the application. Five expert evaluators reviewed the prototype, and identified usability violations based on Nielsen's Heuristics. Consensus among the evaluators indicated that the prototype failed to comply with the efficiency of use principle, with several features requiring numerous steps to complete seemingly simple tasks (e.g., accessing information related to prescriptions, sharing health data). In addition, several sections of the prototype contained superfluous elements that detracted from the primary focus of the application, and the evaluators agreed that revisions will need to be made to the layout to reduce informational clutter.

3. ***Design Validation:*** Guided by the heuristic evaluation, we designed a high-fidelity digital prototype of the application, which we presented to our user group (Figure 6). This iteration enabled us to observe the user experience, and gauge our user groups' response to a functional prototype. As more resources were dedicated to the visual elements of the UI, this also enabled us to assess the value that our user group assigns to the aesthetics of the application. As revealed by the expert evaluation, we eliminated and/ or re-organized informational content to enhance the look of the application, and we streamlined processes associated with frequently performed interactions to reinforce the seamless quality that we had hoped to achieve with this iteration.

   Usability testing sessions for this prototype focused on identifying UX problem instances, and translating them into UX problems that could be effectively addressed. Following a synthesis of the data from all user interviews, the three primary UX problems identified were as follows:

   - Relevant and routinely accessed information was not highly visible
   - Transferring health data is unnecessarily convoluted
   - Health-related data is presented in a format that is difficult to comprehend

User Evaluation and Final Prototype

1. ***Evaluation Session:*** After designing the high fidelity prototype of the application, we recruited five users from Cornell University (from varied backgrounds) to test our prototype. The primary objective of the user evaluation session was to identify areas to improve the broader design of the HealthPass application as well as to improve the four main features. This would happen by letting the users conduct a task-based walk-through of those features (Homepage, Share Pass, Insurance, Past Visits) in order to identify major issues with the design and the HealthPass

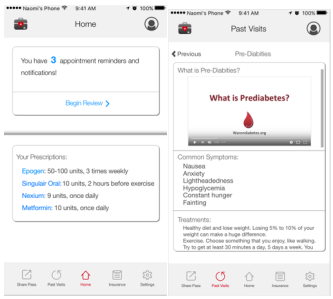


Figure 8: Change 1

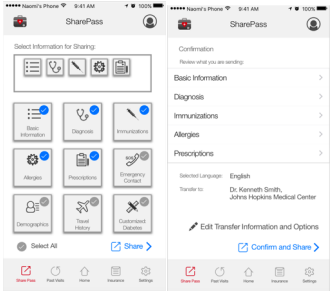


Figure 9: Change 2

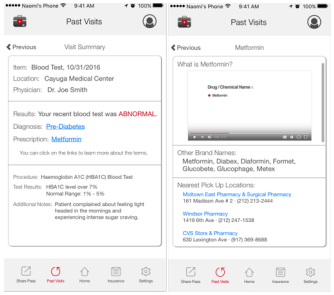


Figure 10: Change 3

usability. This primary objective was broken down into five tasks.

We wanted to understand if the user could use the different functionalities at ease without asking for help or getting stuck at any screen. Figure 7 shows the setup of the evaluation session organized for the participants. A session protocol was created that captured the tasks and activities in detail for every role. Each participant was accompanied with a facilitator, notes taker and an observer during the evaluation session. Tasks associated were to identify the appointment details on the index cards, sharing the pass details to the medical practitioner, accessing details of the past visits, insurance, advanced information on diagnoses and prescriptions. We encouraged the users to interact as much as possible while using the application during performing the specific tasks. This usability testing made sure that we had more detailed findings for each task designed for the application.

After the designated tasks were completed, the participants were asked a list of open questions to further gauge their experience with the application. The inputs from those questions provided us further insights for the improvement of the design.

2. ***Evaluation Session Results and Analysis:*** From each participant's evaluation session, we collaborated the note taker's and observer's notes to understand the accessibility of the application for various tasks. Results from the evaluation session revealed several UX design problems that diminished the overall experience of the interaction with the HealthPass application. One of the limitation of our evaluation was that some minor features were not thoroughly fleshed and therefore unresponsive, which kind of confused the user and detracted from a seamless user experience. The top ten UX design problems were put together based on the common UX instances recorded in each session. By assigning the severity for each of the design problems, we finalized three UX problems which required improvisation in the final prototype.

Based on the analysis of the evaluation session and notes captured, the below three changes were selected to be incorporated in the final prototype:

1) Increase the visibility of information related to diagnoses and prescription medication, and provide additional details related to these areas.
2) Process simplification of health information transfer (i.e., Sharing Pass).
3) Present health data (e.g., medical testing results) in a format that is easily consumable and comprehensible even by users with low health literacy.

3. ***Final Prototype:*** The above changes were incorporated in the design in Sketch and then implemented in Invision to have the interaction flow.

Change 1 - The first change Figure 8 was incorporated in the new design by modifying two aspects – getting the prescriptions details easily available and by representing more valuable information about the diagnosis and prescription under the past visits screen.

Change 2 – The second change Figure 9 as incorporated into the design by modifying the screens related to share pass functionality to provide a seamless experience for the users to quickly transfer their pass to the medical practitioners.

Change 3 – The third change Figure 10 was incorporated in the new design by modifying the Visit Summary screen to have more precise data that can be easily understood by a common person also.

Conclusion

The HealthPass mobile application was conceived of to address the unique needs of an international student population, who

receive health services from various providers on multiple continents. However, as we interacted with a range of potential users, we quickly realized that such a product has mass appeal in domestic markets, and conceptually appears to effectively respond to the persistent problem of the non-transferable nature of medical health records between healthcare facilities. Through our exploration, we encountered several logistical feats that we will be required to overcome before such a product as HealthPass can be fully integrated in systems of care. Specifically, ensuring that personal health information remains private and protected from cyber threats is a salient issue that has perplexed many in the healthcare industry, and as cyber threats become increasingly sophisticated, it is becoming more difficult for facilities to protect their patient data. Lastly, encouraging health systems throughout the world, who embrace their unique culture and regulations, to adopt HealthPass may be an insurmountable feat, and without cooperation and support from health facilities, implementation may be infeasible. However, we maintain a sense of optimism because more healthcare experts have raised this particular issue, and have foreshadowed a seamless patient experience through processes of care, which may be supported by transferable medical records.

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