From the lab to the field: the challenges of the take-off process for a bedside mobility app

Blondon Katherine[a], Cavin David[b], Lovis Christian[c], Ehrler Frederic[c]

[a] Medical Directorate, University Hospitals of Geneva, Switzerland
[b] IT Department, University Hospitals of Geneva, Switzerland
[c] Division of Medical Information Science, University Hospitals of Geneva, Switzerland

BACKGROUND: The implementation of mobile phone apps for patient care in hospital settings requires careful consideration of many challenges. We developed and pilot-tested a mobile app to support nursing workflow at the bedside in our institution, and are currently deploying our solution on a large scale.

AIM: In this paper, we present our considerations and approach to the large-scale deployment of our mobile app.

METHOD: We reviewed our experience in designing and developing this mobile app from its creation to its deployment. We identified prior and new challenges when preparing for large scale deployment, and discuss our approaches to overcome these challenges.

RESULTS: We identified the specific challenges encountered during large-scale deployment and addressed a large range of problems including maintenance, security, logistics and acceptance aspects of such a deployment.

DISCUSSION: Issues encountered at early stages of the development process must be reconsidered during large-scale deployment. The rapidly evolving context, such as the technology and the stakeholders' opinions, can influence the acceptability and more generally the overall feasibility of the envisioned solutions. Adopting an incremental approach can allow for adjustments during the take-off process.

Keywords: innovation, mobile health, hospital information systems

Introduction

The implementation and use of mobile phone applications for patient care in hospital settings involves challenges at many levels [1]. In this paper, we report our experience with the implementation and deployment of a smartphone app to support bedside workflow for nurses [2]. This app was based on end-users' requirements, and was designed and iteratively tested with close involvement of the users. We recently conducted a pilot study in two wards of our institution to assess the feasibility, acceptability, satisfaction and efficiency of our solution for clinical documentation at the bedside. We are currently proceeding to a large-scale deployment in the institution.

Some challenges were encountered during the creation process of the app, others during the pilot study, and yet another set when we were considering deployment the app at an institutional level [3]. After describing and reporting the challenges encountered throughout the development process and pilot test phase, we will focus on the decisions and issues we faced during the take-off process of the app in our institution. Table 1 presents a summary of the different challenges faced at the various stages of the project. The issues with the complexity of the healthcare setting, such as the authentication process, have been discussed in detail elsewhere [4], as have the design, development and usability assessments of the app for a pilot test [5].

Correspondence:
Katherine Blondon, University Hospitals of Geneva, 4 rue Gabrielle Perret Gentil, CH-1205 Geneva, Switzerland, Katherine.Blondon[at]hcuge.ch

Table 1: Summary of the challenges faced at the various stages of the project.

Challenge	Creation	Pilot test	Take-off
App maturity	Choice of features	Validation	Extension vs restriction
Devices	Choice of device	Validation	Scaling up
Security	Defining a new strategy	Validation	Adapting the solution at an institutional level
Maintenance	Maintenance on demand	Quick reaction	Industrialisation of support by IS/IT teams
Deployment	Deployment for testing	Handmade	Need for an institutional setup
Acceptability	End user involvement	Collecting feedback	Finding champions
Disinfection	–	Procedure and impact on logistics (e.g. type of iPhone case)	Revision of the procedures
Training	Super user	Tailored training	Scaling up

The app

Bedside Mobility is a smartphone app that supports the nurses' workflow, in particular the tasks and documentation conducted at the bedside. The app was born as an attempt to overcome the limitations of the current paper-based support, which carries the risk of missing updated information and potential transcription errors, such as for clinical parameters if these data are entered at a later time [6]. It was also intended to improve nurses' operational efficiency by helping them maintain more timely and effective documentation during their shift [7, 8]. Nursing staff identified several key functionalities that support patient care workflow at the bedside during interviews and focus groups: patient identification, need for a patient-specific to-do list, and ability to document clinical data (validation of planned tasks, or collection of data on clinical parameters, for example). The resulting Bedside Mobility app, designed to be effortlessly self-handled and easy to use [5], addressed many of the users' needs. Some of them were not addressed with the first version of the app because of limited resources, however. For example, we did not develop a camera function to upload images directly to the patient's chart (without saving a copy on the device) during the pilot test phase. Likewise, the ins and outs calculation in the app did not include intravenous therapies, which is still a work in progress in the electronic health record (EHR) system.

The pilot test

The pilot test was sequentially conducted in two wards (of 16–18 beds each), limiting the need to five iPhones in total for the nurses and nursing assistants. The app was updated whenever needed, and the devices were stored by the head nurses of each unit. The app was only used during daytime schedules on weekdays, to ensure the availability of technical support during its use. Devices were charged during the night in preparation for the next day, in a locked room. The wards were visited daily during the test to collect information about issues encountered and ideas for improvement.

The results of the pilot test were positive overall, in terms of satisfaction, use and feasibility. More detailed results have been reported by Ehrler et al. [9]. Interestingly, despite high satisfaction and adoption by the nurses, the nursing assistants did not seem to give such positive ratings. The latter considered that they did not have the same needs at the bedside in terms of task lists; furthermore, delayed entry of the type of documentation required on their behalf had little impact on patient care. For the nurses, a quantitative assessment of their clinical documentation time and interactions with patients demonstrated some improvements with the mobile app. Overall, the range of functionalities available in the app addressed the nurses' main needs at the bedside. We encountered no major technical issue during the test period, and were even able to provide small improvements based on users' feedback during this phase.

In the qualitative feedback from the study, comments from the users concerned the size of the iPhone screen, which was perceived as rather small, in particular when trying to read the graphical display of the vital signs. Another less expected feedback concerned the disinfection process after the use of the devices: despite choosing waterproof and disinfectant-resistant iPhone cases, the disinfection specialists expressed concerns about pathogen contamination from users' pockets where the devices were stored between successive uses.

Planning the take-off

Following the positive results of the pilot test, the hospital top management decided to deploy the app at a large scale. This decision raised a new set of questions. First of all, it became necessary to decide on the level of maturity of the app. Should we first improve the app with additional functionalities, such as the camera function, or proceed immediately with the large scale deployment? In other words, with constrained resources, there is a trade-off between adding new functionalities and deploying a simpler solution on a larger scale. The problems to be addressed are not the same in these two scenarios. Several points needed to be considered at this stage, beside the financial and human resources assigned to the problem.

Ensuring IT support

One of the points to consider was the technical support of the app. The EHR system is needed at all times for patient management and therefore requires 24/7 support by the IT department. Since the Bedside Mobility app is fully integrated with our home-grown EHR system, IT support was initially expected in full time. However, the hospital IT team only support software programmed according to good practices of the IT department (programming language and structure). Although this was not the case in our situation, the fact that the Bedside Mobility app does not aim to replace the EHR but is simply an alternative tool for nurses, it seemed acceptable to provide partial IT support for the app. Indeed, data entry and retrieval can always be conducted through the "usual" approach (EHR access from the desktop or laptop computers in the wards). Overall, a consensus for technical support was reached between the hospital IT and the project teams, which took all these elements into consideration: the IT support will be available 24/7 but only to document the problems and to relay them to the Bedside team developer. Since any app dysfunctions will not obstruct use of the patient charts in any way, this solution was considered acceptable for the institution. When the app is adapted for newer technology at a later date, it will then be re-written in a language that the hospital IT can support. Besides the support aspects of the application, the IT teams are also involved in the acquisition and the maintenance of the mobile hardware. This includes the enrolment of the devices into an institutional Mobile Device Management (MDM) system in particular and the ability to support all potential infrastructure issues, such as access to Wi-Fi or the backend systems.

IT security issues

For the pilot test, we adopted a tailored authentication mechanism to comply with the security constraints of the hospital IT while maintaining the best user experience [4]. One of the difficulties we faced was the sharing of devices between several nurses, which prevented the use of bio-

metric identification. Up to twenty nursing staff in a ward needed to be able to use the devices interchangeably, whereas biometric identification is intended for a single user (for instance the Touch ID is limited to 10 figures). Initial tests highlighted the necessity to maximise the duration before time-out. It was important for the users to remain connected, even if occupied with a short intervention, to avoid the lengthy full login process. However, we also needed to ensure that a stolen device would not remain logged in. Therefore, we used the iPhone's sleep mode to limit access the app, which allowed the legitimate users to rapidly regain access to the app.

The strategy tested during the pilot phase leveraged the use of beacons to restrict access to the app within a predefined area. Although interesting, this solution cannot be scaled up, as installing beacons in the many different sites of the hospital would have been too costly. By reviewing the requirements with the security officer, we have been able to relax some of the security requirements, which eventually allowed us to give up the beacons. Even more interestingly, the security officer was open to consider the possibility of a Bring Your Own Device (BYOD) solution in the near future.

Choice of devices

Since the completion of the pilot test, we have been considering adapting the app to a device with a larger screen, such as an iPhone+, based on the nurses' feedback. Such considerations at this point are important at logistical and financial levels. Obviously, the costs will be higher with phablets, but the impact may be minimised to some extent by accommodating only the nursing staff (rather than the nursing assistants) with iPhone+ devices. Additionally, the number of larger devices could be partially further reduced if we allow the users to bring their own device. This BYOD concept has gained popularity in recent years since most care professionals own a private smartphone and security strategy in the hospitals have progressively resolved the associated challenges. However, it is important to consider the cost of having to adapt the app to the different devices, and to be able to provide updates and support in a more individualised manner. Furthermore, it is as yet unclear whether nurses are willing to use their own devices for professional work in our institution.

Another logistical aspect for smartphones in the wards is the disinfection process. Mobile devices are kept in the pocket, and can convey pathogens from one patient to another. During the study, the iPhones were encased in a waterproof and dustproof case, which was tested for resistance to disinfectant. Our hospital infection specialists initially raised concerns during the pilot test about putting the device in the pocket of a white shirt, due to the presence of micro-organisms. They however agreed to this practice for the larger deployment, as long as users maintain the usual hand disinfection process recommended in our hospital.

Finally, the charging station and, in particular, avoidance of theft had to be addressed globally. Although the pilot test was run only during working hours, charging stations represent an important factor with full-time use of the devices.

Choosing champions

The theory of diffusion of innovation underlines the importance of early adopters (champions) of new approaches and technologies, who can then influence their peers [10]. This was emphasised in the results of the technology acceptance assessment of the pilot study showing that social influence was an important trigger to use of the app [11].

Choosing champions for the large-scale deployment of the smartphone app required the consideration of several factors: interest and support from the nursing heads and their teams for the solution, the potential for financial support from the department (mainly to contribute to the initial investment into acquiring the devices), and anticipated early adopters in the nursing teams. In our case, the chief nurse stakeholder played an instrumental role in identifying wards with champions for an incremental deployment and fast adoption. This incremental approach by ward or division is particularly interesting as we explore and adapt our solution for large-scale deployment.

Last but not least – training the users

In addition to a user experience and usability focused approach in designing our solution, as well as constant support from the IT teams throughout the project, we have also planned resources to train the users as they adapt their work processes to the new tool. The nursing staff has a wide variability in terms of use of mobile devices, and this training helps ensure that all users can benefit from the app functionalities. Head nurses in the ward can play an important role in providing support to new users, and in the pilot study, peers were equally supportive for app use.

Conclusion

We draw several conclusions from this experience with large-scale deployment. First, we integrated all identified prior challenges from the creation process and pilot test to adapt previous solutions to a large scale. Second, we kept in mind that things can change over time. This is particularly important for mHealth projects owing to the rapidly changing landscape at all levels. For example, security requirements were less restrictive a year after the pilot test. Third, we addressed the challenges with an incremental approach, to be able to tackle newly encountered obstacles successively.

References
1 Ehrler F, Wipfli R, Teodoro D, Sarrey E, Walesa M, Lovis C. Challenges in the Implementation of a Mobile Application in Clinical Practice: Case Study in the Context of an Application that Manages the Daily Interventions of Nurses. JMIR Mhealth Uhealth. 2013;1(1):e7. doi: http://dx.doi.org/10.2196/mhealth.2344. PubMed.
2 Ehrler F, Lovis C, Blondon K. Addressing the Complexity of Mobile App Design in Hospital Setting with a Tailored Software Development Life Cycle Model. Stud Health Technol Inform. 2016;228:200–4. PubMed.
3 Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful implementation and adoption of large-scale health information technology. J Am Med Inform Assoc. 2013;20(e1):e9–13. doi: http://dx.doi.org/10.1136/amiajnl-2013-001684. PubMed.
4 Ehrler F, Blondon K, Baillon-Bigotte D, Lovis C. Smartphones to Access to Patient Data in Hospital Settings: Authentication Solutions for Shared Devices. Stud Health Technol Inform. 2017;237:73–8. PubMed.
5 Ehrler F, Weinhold T, Joe J, Lovis C, Blondon K. A Mobile App (BEDSide Mobility) to Support Nurses' Tasks at the Patient's Bedside: Usability Study. JMIR Mhealth Uhealth. 2018;6(3):e57. doi: http://dx.doi.org/10.2196/mhealth.9079. PubMed.

6   Fahimi F, Abbasi Nazari M, Abrishami R, Sistanizad M, Mazidi T, Faghihi T, et al. Transcription errors observed in a teaching hospital. Arch Iran Med. 2009;12(2):173–5. PubMed.

7   Poissant L, Pereira J, Tamblyn R, Kawasumi Y. The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. J Am Med Inform Assoc. 2005;12(5):505–16. PubMed.

8   Ammenwerth E, Spötl HP. The time needed for clinical documentation versus direct patient care. A work-sampling analysis of physicians' activities. Methods Inf Med. 2009;48(1):84–91. PubMed.

9   Ehrler F, Ducloux P, Wu DTY, Lovis C, Blondon K. Acceptance of a mobile application supporting nurses workflow at patient bedside: Results from a pilot study. Stud Health Technol Inform. 2018;247:506–10. PubMed.

10   Ward R. The application of technology acceptance and diffusion of innovation models in healthcare informatics. Health Policy Technol. 2013;2(4):222–8. doi: http://dx.doi.org/10.1016/j.hlpt.2013.07.002.

11   Holden RJ, Karsh BT. The technology acceptance model: its past and its future in health care. J Biomed Inform. 2010;43(1):159–72. doi: http://dx.doi.org/10.1016/j.jbi.2009.07.002. PubMed.