

Mobile Patient Questionnaires – Implementation and Evaluation

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Abstract

Patient questionnaires regarding patient reported outcomes are valuable information for the treating physician as well as for clinical researchers. To reuse this data, often documented on paper, it needs to be transferred into the respective databases by the medical staff. As this method is time-consuming and error-prone it is rarely done in routine medical care. Therefore, we developed a web-application to capture patient questionnaires on mobile devices. The resulting data is automatically transferred into the electronic health record and available to be used for different clinical purposes. We then evaluated the system with respect to usability and cost effectiveness compared to the paper-based workflow. We used iPads which paid off after 7 months taking into account material and personnel costs of a scientific assistant. The mobile application achieved a system usability score of 80.34 out of 100 points, thus proving a good acceptance by the users. Patients and medical staff reported in semi-structured interviews that they were highly satisfied with the system and they even preferred it compared to the paper-based workflow. Physicians now use quality of life information during treatment. This study shows that the mobile documentation of patient questionnaires is technically feasible and provides valuable data for treatment and research alike.

1. Introduction

Patient reported outcomes (PRO) like the quality of life (QoL) are a valuable source of information for the medical treatment as well as for clinical research. Unlike physicians patients often report different perceptions of their health status [1, 2] and they feel much better cared for when being asked about their QoL [3]. In clinical studies PROs are regular parameters and especially longitudinal research makes use of this kind of patient data. However, in clinical routine care PROs are rarely documented. Snyder and Aaronson state that “logistical challenges in collecting, storing, analysing, and reporting PROs in real-time have been a barrier to their use in practice” [4]. Currently QoL data is documented on paper forms, mainly used for research purposes and thus often not integrated in the electronic health record (EHR) from where it could be used for medical treatment. In a single source approach medical data should only be captured once and then be available for secondary use, e.g. for medical treatment, clinical research and quality management alike [5, 6].

Therefore, our objective was to develop an efficient method to document patient questionnaires, make this information available in the electronic health record (EHR) as well as in an aggregated and anonymized form for clinical research and quality management purposes. The system was then to be evaluated regarding usability and cost effectiveness.

2. Clinical Problem / Requirements

In our pilot department, the Competence Centre for the Diagnosis and Therapy of Chronic Pruritus (KCP) within the Department of Dermatology at the University Hospital in Münster, Germany [7] the workflow regarding PRO documentation was as follows:

A patient receives paper-based questionnaires upon arrival while waiting for the appointment with a physician. The completed questionnaires are available in the paper-based patient record. If the physician wants to use the outcome the respective scores have to be calculated before the treatment. For research questions the data has to be manually inserted

into dedicated research databases. Not only is this workflow error-prone (manual calculation of scores and transfer into electronic sources) but for the clinical user it is also time consuming and impractical during medical care and therefore rarely done. That is why we were looking for an easy solution which follows the single source approach.

3. Implementation / Design

3.1. Mobile workflow of Patient Questionnaires

The implementation process was twofold. First we included the respective patient questionnaires in the local hospital information system (HIS) using the integrated form design tool [8]. In that way it was already possible for the medical staff to manually transfer QoL data into the respective form within the EHR and use the available data for different purposes [9]. In a second step we developed a web-based application for the patient questionnaires [10, 11]. It was implemented according to usability standards [12, 13] and optimized for Apple's iPad [14]; however, it can also be used with other (mobile) devices as it works with any browser. We chose to use a touchscreen device with a capacitive pen as it best represents the former pen and paper workflow. In addition hygiene requirements are easier to meet than with keyboards. A kiosk was found to be not practical as waiting areas sometimes change and more than one patient at a time complete the questionnaires. Other tablets comparable to the iPad were analysed but found to be similar in pricing and functionality.

Figure 1 shows a screenshot of the questions as they are presented to the patient. As can be seen we chose to present only one question per screen, used big buttons and did not implement any additional functionality which might distract the user.

While the patient completes the chosen questionnaires the system checks whether the minimum required number of questions is answered and if necessary directs the patient to those missing answers or discards the questionnaire. After the successful completion of the questionnaire an XML file is generated and automatically imported into the respective EHR form. In there the scores are calculated and the QoL data is immediately available for the medical treatment.

3.2. Single Source

Using the mobile application for data capture and the EHR forms as storage, PRO data is now documented according to the single source approach. It is only captured once but available for different purposes. Within the EHR PRO data can be displayed in a longitudinal overview for each patient. This data can be transferred into the doctor's letters for communication and it can furthermore be exported together with other relevant data in an anonymized form to research or quality management databases.

The new workflow using the mobile application is as shown in figure 2.

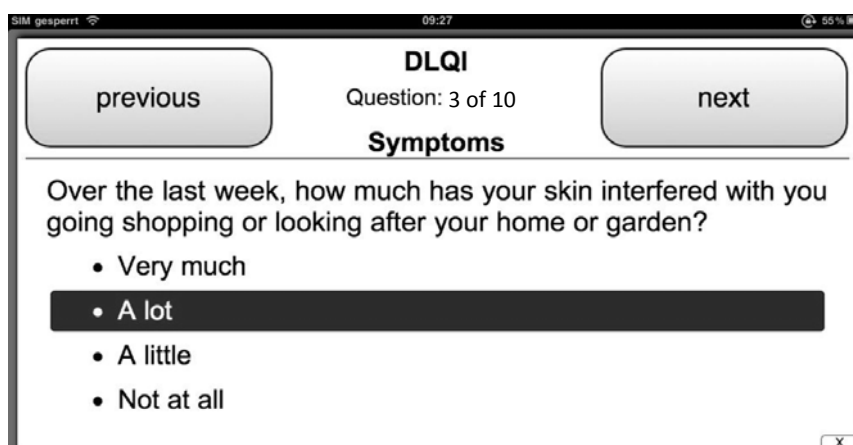


Figure 1 – Screenshot of a question in the mobile application: One question per screen with big font and button size and number of questions to be completed.

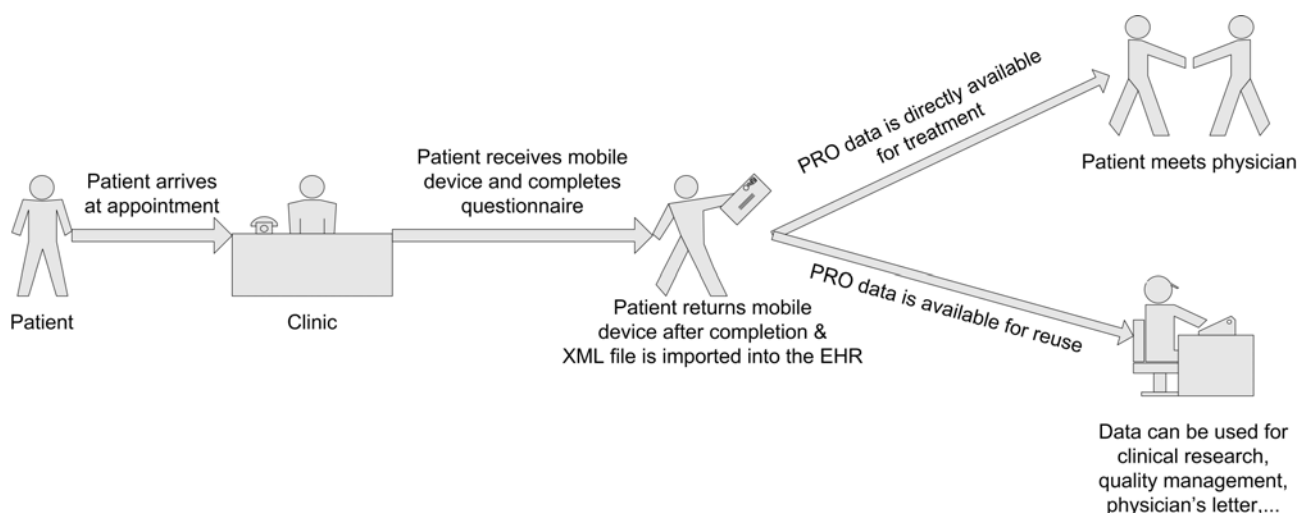


Figure 2 – New Workflow of PRO documentation according to a single source approach QoL data is documented electronically, automatically transferred into the EHR and available for reuse.

4. Evaluation

In our pilot department we implemented three different questionnaires with respect to QoL, anxiety/depression and patient benefits [15-17]. During our evaluation period an average of 105 patients per month completed all three questionnaires (50.5% male and 49.5% female patients, average age 56.5 years). We evaluated time and cost measurements as well as user acceptance of patients and medical staff. The evaluation was done within 3 months using quantitative (time and cost measures) and qualitative (user questionnaires and interviews) methods.

4.1. Time and Costs

Through observations and logfiles we found out that the post-processing time of paper-based questionnaires (manual transfer of data into the EHR and filing the forms into paper-based records) is 55 seconds on average per questionnaire. For three different staff profiles (student assistant, scientific assistant, medical documentation assistant) we calculated the respective personnel costs. Regarding the costs for material we included paper, staples, printing and energy costs. This adds up to an average of 0.02 Euro per paper sheet. Filing of the paper forms was necessary for archiving purposes; however, if data is only available electronically within the EHR, an additional paper record might not be necessary anymore. Thus the filing time we needed to take account in our current setting might become redundant in the future.

The personnel and material costs per questionnaire sheet are shown in table 1.

In comparison we calculated the cost for one iPad including a disinfectable skin and cover (tested and approved by the Institute of Hygiene, University Münster), capacitive pens for easier data entry and energy costs. The total costs sum up to 690.35 € per mobile device.

With these numbers a break-even analysis was done, which showed that 3801 sheets post-processed by a student assistant, 2406 by a scientific assistant and 1737 by a medical documentation specialist come up to the same costs as one mobile device. In the use-case of our pilot department, where three questionnaires were used for an average of 7 patients per day (4 workdays a week), one iPad paid off after 7 months based on the personnel costs of a scientific assistant and a depreciation period of the mobile devices of three years.

Table 1 - Total costs per paper questionnaire sheet in Euro composed of personnel and material costs.

	Student assistant	Scientific assistant	Medical documentation assistant
Personnel costs	0.16	0.27	0.38
Material costs	0.02	0.02	0.02
Total	0.18	0.29	0.40

4.2. Usability

To evaluate user acceptance and usability the system usability score (SUS) questionnaire [18], to which we added seven questions of our own, was attached to the PRO questionnaires on the iPad. In addition we performed semi-structured interviews with randomly selected patients and the medical staff.

From 111 questionnaires (return rate 94.1 %) the overall SUS score was 80.34 (from 0 to 100 where higher is better) with a standard error of 1.37, standard deviation of 14.39 and a range from minimum 45 to maximum 100. According to Bangor et.al this equals to a score for good usability [19]. The evaluation of our additional questions showed that, even though the patients are not very familiar with computers, they were open-minded and willing to support the new mobile patient questionnaires. They also found the questions easier to read and understand although only layout and not content was changed. This became even more evident during the patient and staff interviews from which the following citations are taken:

Patients:

“I just see advantages, even though I am not a fan of computers. It is much better to read and clearly arranged and it was not difficult at all!”

“The big letters help to clearly understand the questions, especially those with negations. I am not a native German speaker and for me it was easier this way.”

“[...] Paper is “inconvenient” and somehow more to answer. The answers on the computer seem to be more precise.”

“It really was fun.” and “The system shows the technical innovation of the hospital!”

Medical and administrative staff:

“In the beginning I was sceptical especially with respect to the older patients. But they have no problems at all. I really like the system and would recommend it to other departments.”

“The questionnaires are self-explanatory and the menu navigation is very good. Everything is well readable and also conveniently to handle.”

“[...] so that enthusiastic patients asked: ‘May I use the iPad again today?’ Or a man wanted to get one for his wife as a birthday gift”

“[...] on paper I only see the answers to the questionnaires and not the calculated score. Now the score is already available during treatment which is much better, thus I would always choose this system again.”

“[...] it has a significant influence on the treatment. For example when I see that a patient has a high depression score I choose a different medication, this is not possible when I use the paper based version.”

Physicians evaluated the data they were getting and what patients reported about handling the device. Administrative staff also evaluated battery life which was found to be sufficient and WiFi issues. As already stated during the interviews with the medical staff, two physicians view the immediate availability of QoL scores in the HIS as one of the important advantages. Critical scores are visually marked in the EHR forms and a link for a psychosomatic consultation is provided to the treating physician. Furthermore, the doctors choose the medication differently, if it is known that the patient has critical depression or anxiety scores. With the paper-based questionnaires such information was often only available after the treatment. Thus physicians expect that the patient outcome profits from the immediate data availability. In addition, the accumulated data can now directly be used for scientific questions. The correlation of pruritus intensity with QoL and anxiety/depression has already been proven by an analysis of the electronically collected data [20].

5. Comparison with other approaches

In this evaluation study we compared the mobile patient questionnaires with the formerly performed paper-based workflow. Alternative scenarios were evaluated by studies using personal digital assistants (PDA) [21] or an electronic pen and paper [22] where similar positive results were achieved. However, PDAs usually have a small screen which is difficult for patients (especially those of older age) to handle. In comparison the size of the iPad screen was seen as a big advantage in our evaluation. In addition our patients reported that they literally had fun using this mobile device and they thought that the clinic was very innovative using such advanced methods.

Using a kiosk system like eCHAT [23] was found to be not suitable in our clinic setting where many patients simultaneously have to use the system in different waiting areas. However, Warren et al. support our approach to

integrate quality of life data into the EHR and to provide a system, which increases the use of such information in routine treatment. We took it to the next level and also provide the collected data for secondary use.

In a recent study of electronic PRO collection Fromme et al. assessed the usability of tablet PCs for older patients and they had a good overall rating, although they experienced a difference to younger patients [24]. However, neither were the involved costs evaluated nor was the data transfer to the EHR considered as we did in our study.

6. Lessons Learned

Based on our objectives to develop an efficient method to collect PRO data by using the single source approach, we learned that this is technically feasible and well accepted by patients and medical staff alike. Furthermore it proved to be cost-effective and we can recommend the system for other clinics. However, during the evaluation we also came across a few points to be considered. One bottleneck in the workflow was the administrative office. The waiting for case IDs, needed for patient identification in the HIS, sometimes led to a time delay by using the mobile patient questionnaires. Another critical factor is the stable WiFi connection which we had to enhance during the implementation phase as it caused long loading periods and sometimes even system crashes. To protect the iPads against damages and meet hygiene requirements we tested different cover skins, against theft and loss we installed a device tracking system.

In a future setting, patients might have the possibility to complete questionnaires at home, like diaries. At the moment this is not possible, as the patient's case ID for identification in the EHR is needed.

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