

Design Recommendations for Presenting Clinical Guidelines on Mobile Devices

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Abstract

Some areas of clinical practice are still required to access and utilise clinical information that is inefficient or restrictive. Therefore, mobile device information delivery is becoming a key factor. However, recommendations on presenting clinical information on mobile devices are limited or not optimised for modern mobile design. Results from user-centred design studies inform the creation of a set of recommendations to assist in creating and delivering clinical guidelines on mobile devices.

Keywords:

Practice Guidelines, Software Design, Smartphone

Introduction

Local point of care clinical guidelines are often available as basic web pages, PDFs or documents (word, epub). Despite widespread availability and use, access to clinical guidelines can be highly inefficient and restrictive [1]. Previous studies have investigated the delivery of clinical guidelines on mobile devices [2,3], but rarely implement recommendations for design [4] and often fail to involve users in each aspect of the design and development process, leading to poor usability. Common issues include focussing on navigational design (likely due to the complexity of the information) while continuing to present the guidelines to users in the original format – not optimised for mobile. This work presents the results from various user-centred design studies that inform a set of 15 recommendations to assist in enabling the rapid development of clinical applications for mobile devices. The application provides access to various clinical guidelines, as well as inline programmatic decision algorithm and calculation tools, for use as an ‘aide-mémoire’ for clinicians during clinical practice. An example of how the guidelines are presented is provided in figure 1. Ethical approval was granted by Keele University Research Governance in the Faculty of Natural Sciences (ERP2370) and UHNH.

Methods

Observations were conducted with clinicians at the Royal Stoke University Hospital over three months between May and July 2019, in five wards. They were conducted following the methods described by O'Reilly [5], with the ‘jotting note’ method [6] adopted for recording. The observations were used to identify if (and how) clinical guidelines were being used. They also aimed to establish any current technology utilisation, and the clinician’s interactions with technology. Following these observations, a **survey** was then conducted to understand

current smartphone and application usage amongst clinicians and medical students. The full details of this study can be found in [7].



Figure 1: Example presentation of clinical information

To obtain functionality and design feedback for the mobile app, **focus groups** with clinicians were conducted utilising both open discussion [8] and idea writing [9]. Sessions were time-sensitive (scheduling constraints inherent in clinical roles) and individual sessions, though preferred, were not possible. Open discussion sessions were audio-recorded and transcribed. The transcripts and outputs of the idea writing were then analysed using thematic analysis. **Think-aloud** sessions were conducted as a method of evaluation [10] and further feedback where participants were asked to retrieve information within the mobile app by following clinical scenarios. These sessions were audio-recorded and transcribed. The transcripts and outputs of the think-aloud sessions were then analysed using thematic analysis [11]. The Brookes System Usability Scale (SUS) [12] was used to gather feedback in the form of a usability score during all stages of testing and evaluation.

Results

The following sections give a brief overview of the results from each method and how they have informed the design of the mobile app and the final 15 recommendations presented in the conclusion. Observations showed that inconsistent delivery of health information leads to a multi-modal use of technology and the importance of providing clinicians with the necessary tools for efficiency (e.g. clinicians were observed using multiple systems to access patient information and another system to enquire about clinical workflow and drug dosage - which then required manual calculation). It is therefore important that any

clinical application minimises manual tasks e.g. manual calculations and where possible minimise the requirement to use other systems (if possible), e.g. if a drug dosage calculation is required, this should be available to the clinician without the need to use another app or system. A key result from the survey (see [7] for full results) was the importance of cross-platform device support. Therefore, any clinical application must support multiple devices i.e. iOS and Android. The survey also identified a range of different apps that clinicians currently use (e.g. BNF, MDCalc, Clinicalc). A review of these was undertaken to identify common design patterns with the majority of apps containing: a list view layout using categories or A to Z contents; basic filter functionality for access to information; a menu system that supports navigation using a tabbed view. The key theme identified from the focus groups is that clinicians appreciate the clean, clear layouts that do not impede workflow. Clinicians provided positive feedback regarding the Q&A style format of the flowchart design within the app, but also suggested retaining the original flowchart design to give a gestalt view. Clinician's feedback also suggested the use of acronyms (e.g. PE for Pulmonary Embolism) when searching or filtering guidelines. Another consistent point was that warnings require a hierarchy based on their severity with the use of more noticeable colours, and that a reduction in text may be beneficial.

Conclusions

The feedback elicited during the UCD processes described in this study has culminated in the creation of 15 recommendations for developing clinical information delivery applications for mobile devices. The recommendations suggest that any mobile application that presents clinical guidelines should:

1. Be cross-platform (iOS, Android and Web)
2. Provide multiple methods of accessing the content in list views (i.e., A to Z and Categories)
3. Minimise unnecessary wording in titles (i.e., 'Acute heart failure' should be presented as 'heart failure')
4. Have a menu that can be easily accessed, preferably using a tabbed menu design
5. Utilise icons/images as well as headers
6. Provide a basic filter function to filter content in both menu and information sections
7. Minimise manual tasks (i.e., Drug dose calculations)
8. Provide as many tools and resources as possible to minimise the requirement to use other systems
9. Provide clear decision algorithms and calculation tools in line with content, and ready to use (i.e., does not require activation)
10. Provide original content for any tools or decision algorithms (i.e. An original flow chart)
11. Utilise acronyms, but also provide a method of understanding acronyms where possible
12. Minimise the number of warnings/alerts to avoid 'alert fatigue'
13. Display warnings/alerts in line with content, ensuring they are salient in design and succinct and explicit in content
14. Repeat warning content within the main information

15. Reduce the use of long sentences and provide information as succinctly as possible

Aside from the recommendations elicited from feedback and evaluation, it is clear that further investigation into personalised delivery is required.

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References

- [1] Z. Burton, and H. Edwards, A little less conversation, a little more high impact action, *Futur Healthc J.* **6** (2019) 201–201. doi:10.7861/futurehosp.6-1-s201.
- [2] A. Kwa, M. Carter, D. Page, T. Wilson, M. Brown, and B. Baxendale, NOTTINGHAM UNIVERSITY HOSPITAL GUIDELINES APP—IMPROVING ACCESSIBILITY TO 650 HOSPITAL CLINICAL GUIDELINES, (2015) 220.
- [3] K.F. Payne, L. Weeks, and P. Dunning, A mixed methods pilot study to investigate the impact of a hospital-specific iPhone application (iTreat) within a British junior doctor cohort., *Health Inform J.* **20** (2014). doi:10.1177/1460458213478812.
- [4] J. Nielsen, Enhancing the explanatory power of usability heuristics, (1994) 152–158. doi:10.1145/191666.191729.
- [5] K. O'Reilly, *Ethnographic Methods*, (2004) 157–174. doi:10.4324/978020320068_chapter_7.
- [6] R.M. Emerson, R.I. Fretz, and L.L. Shaw, *Writing Ethnographic Fieldnotes*, (1995). doi:10.7208/chicago/9780226206851.001.0001.
- [7] J. Mitchell, E. de Quincey, C. Pantin, and N. Mustfa, The Development of a Point of Care Clinical Guidelines Mobile Application Following a User-Centred Design Approach, (2020) 294–313. doi:10.1007/978-3-030-49757-6_21.
- [8] J. Kitzinger, Qualitative Research: Introducing focus groups, *Bmj.* **311** (1995) 299–302. doi:10.1136/bmj.311.7000.299.
- [9] A.B. VanGundy, BRAIN WRITING FOR NEW PRODUCT IDEAS: AN ALTERNATIVE TO BRAINSTORMING, *J Consum Mark.* **1** (1984) 67–74. doi:10.1108/eb008097.
- [10] Nielsen, Evaluating the thinking aloud technique for use by computer scientists, *Advances in Human-Computer Interaction Vol. 3.* (1992) 69–82.
- [11] J. Fereday, and E. Muir-Cochrane, Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development, *Int J Qual Meth.* **5** (2006) 80–92. doi:10.1177/160940690600500107.
- [12] J. Brookes, SUS: a "quick and dirty" usability Scale, 1996. doi:10.1201/9781498710411-35.

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