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Browser Based Platform in Maintaining Clinical Activities – Use of The iPads in Head and Neck Clinics

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Abstract:
Purpose: Incompatibility between documentation and clinical workflow causes physician resistance in organized data collection, which in turn complicates the use of data in patient care improvement. To resolve the gap, we developed an iPad compatible in situ browser-based platform that integrates clinical activity with data collection and analysis presentation. The ability to perform in-clinic activities and monitor decision making using the iPad was evaluated.

Methods: A browser-based platform that can exchange and present analysed data from the MOSAIQ database was developed in situ, the iPads were distributed in head and neck clinics to present the browser for clinical activities, data collection and assessment monitoring. Performance of the iPads for in-clinic activities was observed.

Results: All in-clinic documentation activities can be performed without workstation computers. Accessing patient record and previous assessments was significantly faster without having to open the MOSAIQ application. Patient assessments can be completed with the physician facing the patient. Graphical presentation of toxicity progression and patient radiation plans to the patient can be performed in single interface without patient leaving the seating area. Updates in patient treatment status and medical history were presented in real time without having to move paper charts around.

Conclusions: The iPad can be used in clinical activities independent of computer workstations. Improvements in clinical workflow can be critical in reducing physician resistance in data maintenance. Using the iPad in providing real-time quality monitoring is intuitive to both providers and patients.
1. Introduction
Clinical workflow, which consists of numerous focus-demanding tasks, has been known to be associated with various inevitable interruptions and distractions which slow down workflow and induce medical errors. While researchers identified clinical documentation to be one of the most vulnerable activities for workflow interruptions [1], efforts to improve the process have been mostly, if not exclusively, devoted to Electronic Health Record (EHR) development. The downside to this EHR reliant approach is that the design of the product is focused on extended generalization instead of customization capability, which resulted in ignorance of institution specific clinical ergonomic factors that affect physicians’ ease-of-use (such as documenting while facing patients, fast mobile application start-up solutions, structured data collection, or intuitive data presentation). The compromised fluency of workflow generated physician resistance to adoption [2-4]. In our department of radiation oncology head and neck clinics, the problems were duplicative, and even worse given our excessive amount of patients. To overcome the difficulties, a browser-based platform (“Onco-Browser”) as part of our integrative clinical informatics project --“Oncospace” was developed and customized to fit in hand held terminal devices which were proven to be feasible in integrating into clinical workflow [5]. The iPads were deployed in clinics to host the browser for clinical activities management. Performance and clinician acceptance of the solution was observed and evaluated.

2. Methods
A browser-based platform that can exchange and present analyzed data from the MOSAIQ database was developed in situ (“Onco-Browser”), data collection forms that were created in the MOSAIQ system were customized to fit hand-held devices, the browser access was protected using institution specific login portal. The iPads were distributed in radiation oncology head and neck clinics to physicians, nurses and patients. The system was deployed for clinical activities management including medical record documentation, research data collection, patient reported quality-of-life (QOL) assessment collection for patients, radiation machine schedule planning, clinical assessment monitoring and graphical presentation. Data collection by patient alone was maneuvered under “Guided Access” mode in iPads to prevent browsing over to other patients, and all data collection forms are submitted with the provision of clinician username and password. Data presentation was developed under physician requirements to accomplish complex task of patient evaluation and education. Presented data was pulled and analyzed in real time from the MOSAIQ database in the form of graphics and charts for toxicity interpretation and intuitive patient education.

3. Results

3.1. Clinical Activity Performance
All in-clinic activities were able to be performed without workstation computers. Patient demographic data and treatment progress can be viewed on a single page as seen in Figure 1. Clinical data collection can be performed on the iPads without the access to mobile workstations, time to access collection form has improved compared to opening the clinical system application on a mobile workstation as the only time lag is the browser opening period. Data collection forms were touch screen friendly with size customizable radio buttons and drop down lists as shown in Figure 2, enabling physicians to complete the patient assessment process without facing away from the patient. Patient QOL data collection is achieved via “Guided Access”, which prevents the patient from free browsing (Figure 3). Medical record documentation is automatically generated by integrating a robust documentation template with data points from in-clinic data collection and/or inter-departmental data (such as phlebotomy etc.). Language processed by the voice recognition tool (Siri) is acceptable by head and neck physicians and has been using the function since deployment. Medical documentation are also occasionally performed by voice input.
Figure 1. Patient summary page with test patient, this page was used by physicians for quick overview of patient before entering clinic room.

Figure 2. Clinical data collection page, automatically generated from pre-existing forms in Onco-Browser application.

Figure 3. “Guided Access” mode in the iPad for self-entering QOL data, which was designed to reduce stress for patients and provide more privacy.

Figure 4. Toxicity progression comparison in bar plot, four graphs represented different time periods and can be easily customized.
3.2. Data Presentation.
Toxicity progression is presented in numerous graphical means i.e. bar graph, star chart, line plot etc. (see Figure 4), enabling patient participation on interpretation of toxicity trends. Patient education was significantly improved when real time in-clinic analyzed data was presented via the iPads in intuitive graphical form. Frequent dose prescription bar plot (see Figure 5) enabled physician to double check when their prescribed dose to a single diagnosis was deviating from regular prescriptions. Dose-Toxicity plot enabled dosimetrists and physicians to avoid predicted toxicities when planning organ at risk (OAR) dose-volume histogram (DVH) as shown in Figure 6.

![Figure 4](image1)

![Figure 5](image2)

Figure 5. Aggregated dose prescriptions for a single diagnosis, y axis represent prescription frequency and x axis represents type of prescription

![Figure 6](image3)

Figure 6. Dose-Toxicity Plot for a single OAR, different colour represents a toxicity grade.

4. Discussion
Although the idea of a mobile solution to solve clinical difficulties is not new and has been a topic of research for feasibility in numerous studies [5-8]. General resistance grows over time which results in ‘Technology Disadoption’ [4] due to the clinical nature of narrow tolerance in workflow breaks. We believe mobile solutions will only be adopted by physicians in clinics if they (and in the order of our assumed priority): 1. Do not exhibit or have minimal buggy behaviours; 2. Maintain intuitive user interfaces; 3. Adopt research capabilities, including fast data collection, clinical/research database data exchange, easy data querying, and data analysing/aggregating tools; 4. Improve workflow of conventional clinical activities; 5. Provide additional functionalities to enhance user experience, i.e. Fast access to dosimetric databases for in-clinic dose plan overview, aggregated toxicity progression by diagnosis for patient education and predictive narcotic dose adjustment etc. In addition to above, building relationship with clinical champions who are willing to promote and demonstrate the advantages in adopting mobile solutions is critical to the success of implementation.
This research is the first of its kind to demonstrate performance of an implemented iPad solution, and results show that the iPads can be used for clinical activities to provide augmented functionalities and enhanced clinical user (physicians, patients, nurses) experiences. Theoretically, this platform can be implemented on any terminal device that supports internet browsing, but the iPad was specifically chosen because of its guided access feature provided enhanced security when the patients are operating on the device. Further study is needed to evaluate the efficiency in enhancing clinical workflow of this deployment.

5. Conclusion
The iPad can be used in clinical activities independent of computer workstations. Improvements in clinical workflow can be critical in reducing physician resistance in data maintenance. Using the iPad in providing real-time medication quality monitoring is intuitive to both providers and patients.

6. Acknowledgement
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7. References