Design and Implementation of a Web-based Application for Patient Management and Decision Support Using Mobile Phones and Geographic Information System

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Background and Purpose: HIV affects a significant proportion of the population in many developing countries. One major problem with HIV treatment is to make patients pursue their treatment, including medication and medical check-ups until completion. While there may be many reasons for the lack of endurance, there may be ways to improve completion of treatment programs by maintaining better contact between doctors and patients. Mobile phone text messaging is well suited for supporting self-management and improving patients' self-efficacy skills through, for instance, medication reminders and supportive messages. But there is also a need for interactive program management by reacting promptly and effectively to deviations from program plans. This may include operational decisions for short term management of patient retention at individual care centres, tactical decisions such as re-configuring the messaging based on performance, and strategic decisions e.g. if and when trends are discovered which can be attributed to some factor(s), like geographical, social, economic, or other conditions, call for large-scale systematic action. Despite the growing body of literature reporting positive outcomes of e.g. SMS based communication with patients, there is yet very little research about the integration of communication technologies and spatial decision support systems. This paper seeks to address this gap in the literature by investigating the design issues that need to be addressed regarding both content and form, addressing patient end-users as well as decision makers at different levels, as well as system requirements, protocol decisions in relation to the development of an integrated wed-based tool designed to support patients' self-management of disease and health workers' decision-making based on a system designed and implemented in Mozambique.

Method: A case study involving three healthcare sites in Mozambique as a basis for discussing general design issues for this kind of system. A messaging system implemented in all sites feeds data into a central data repository which can be used for analysis of operations and decision support. Interviews with healthcare workers and decision-makers were undertaken to define user requirements and to inform content development as well as system design. Prototyping was used for usability tests and questionnaires for user acceptance.

Results: The developed system automatically, based on the treatment schedule, sends SMS appointment reminders, medication reminders, and supportive messages to patients enrolled in antiretroviral treatment. The system also maps patients' movements within their residential area so as to understand their mobility patterns. We found six crucial design considerations that need to be addressed for success: (i) availability of data; (ii) text message content; (iii) remote care; (iv) systems features; (v) cost, and (vi) connectivity. By integrating statistical functions the project ensured that data analysts and decision-makers can analyse and monitor patients' treatment outcomes. While prototyping allowed to perform several improvements mainly for issues (ii), (iii) and (iv), questionnaires indicated a general positive acceptance of the web-based platform used as a decision support system.

Conclusions: The integrated system provides support for increasing patients' knowledge, skill, and confidence in managing their health problems. Moreover, it provides a representation of patients'

treatment regarding both outputs – e.g. medication and visit patterns – and outcomes – result of treatment - which can inform decision-making during the treatment process as well as after. The project showed that there are several design considerations which must be taken into account, and which may require different solutions in different contexts so as to achieve the intended benefits.

Keywords: web-based system, reminder system, GIS, decision support, patient management