Building Clinical Decision Support Systems for Clinical Practice in Poor Settings: Critical System Features

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ABSTRACT  
This study is a follow up on a previous one, it seeks to fill a critical knowledge gap, by providing information on the opinions of experts in a poor setting on the features of a computerized clinical decision support system they consider would aid their practice. Uninvariant analysis uncovered five systems features, albeit variants of one feature: the requirement to provide unique patient care recommendations.

Keywords  
Clinical decision support systems, Ghana

1. INTRODUCTION  
Clinical decision making is the art of arriving at an informed judgment regarding the optimal treatment needed by a patient [1]. Making this judgment call is the essence of everyday clinical practice, a key task is to balance personal experience with existing scientific knowledge [2]. Usually a physician would have to apply clinical and biomedical knowledge, invoke problem-solving skills, weigh the probabilities of various outcomes, and balance risk-benefits [2]. Notwithstanding arbitrary clinical decision making in disregard of available clinical evidence are rampant in both the developed, and developing world [3]. A nationwide audit using 439 quality indicators conducted in the US revealed that adults receive only half of recommended medical care [4], similarly the US Institute of Medicine estimated that up to 98000 residents were dying as a result of preventable medical errors [5]. In poor settings in Africa with high health stakes characterized by a high disease burden and a small work force with minimal training, the need for good clinical decision making is even more compelling [6]. Improvements in clinical decision making may be accomplished through training [7, 8], and the adoption of computerized clinical decision support systems [9]. Adoption of computerized clinical decision support systems may also lead to improvements in prescribing practices [10], reduce medication errors [11], enhance the delivery of preventive care services [12], and improve adherence towards recommended care standards [13]. Successful implementation of computerized clinical decision support systems (CCDSS) is a complex process [14], thus failures are bound [15]. Efforts to determine CCDSS features implicated in clinical practice improvements have relied on the opinions of experts in the developed world [15], little is known about the opinions of experts in resource-limited settings, even though it is well documented that successful implementation of CCDSS also depends on the clinical practice settings [16]. This paper seeks to fill this knowledge gap.

2. METHODS AND MATERIALS  
This study is the result of a survey among practicing physician doctors at a Ghanaian Teaching Hospital affiliated to a Medical School using a questionnaire designed to investigate skills in ICT, and physician attitudes towards incorporating ICT into their practice and the medical school curriculum. Physicians who returned their completed questionnaires were regarded as having given their consent to participate in this study.

2.1 Setting and Participants  
A cohort of 98 physicians of the Tamale Teaching Hospital was served questionnaires. The participating physicians were informed of the Purpose of the study, the requirement to complete a questionnaire, and the general content of the questionnaire. They were also told that their participation in the study was voluntary and that no personal identifiable information was going to be taken. The teaching hospital is located in Tamale the metropolitan capital of the northern region of Ghana. It is one of the third generations of teaching hospitals to be established in the country. The hospital is affiliated to the medical school of the University for Development Studies. At the moment, the hospital has no public access to computers for medical students, it however provides broadband internet access for staff and students, and computers are not available in the library for students to use, currently the hospital is the only clinical training site for medical education in northern Ghana.

2.2 Survey Instrument  
The physicians were asked the following questions pertaining to: instructional methods, educational tools, ICT skill types: Basic (able to do basic word processing and use the internet), Intermediate (Have mastered the basics and have developed additional skills, including the use of different software programs), Advanced (Knowledgeable about hardware and software), ability to perform certain task with computers, frequency of computer use, they were also given a list of desired EMR system capabilities and then asked to judge if those capabilities were: Relevant (I would be much more likely to use a system with this capability, I would however not use a system that lack it). Non-Relevant (my decision to use a system would be unaffected by the presence of this capability), I don’t know (the meaning or implication of this capability is not clear to me.). A drafted version of the questionnaire was administered to students (n=100) in June, 2011. Internal reliability (Cronbach’s alpha) obtained from combining items with ordinal responses was 0.82 (95% CI) for intra class correlation coefficient; 0.79 to 0.88. The
questionnaires were administered to the physicians who consented to participate in the study.

2.3 Data Analysis
Statistical analysis was performed using STATA (version 11.0, StataCorp. 2009). In order to identify responding physicians’ computer use habits, an analysis of frequencies of items derived from responses to questions related to frequent computer use was undertaken. Categorical variables relating to EMR system capabilities were analyzed using chi-square, resulting in a response rate of 70.0%. The mean age for responding physicians was 29 years with a distribution of 29 ± 1.4 (mean ± standard deviation). The physicians were mostly men, majority used a computer daily, while a small number said they don’t use computers (Table 1).

3. RESULTS
Overall 140 physicians received survey questionnaires, out of which 120 of them returned their questionnaires, 22 questionnaires were discounted due to incomplete data, resulting in a response rate of 70.0%. The mean age for responding physicians was 29 years with a distribution of 29 ± 1.4 (mean ± standard deviation). The physicians were mostly men, majority used a computer daily, while a small number said they don’t use computers (Table 1).

Table 1. Participant (n=98) Demographics’

<table>
<thead>
<tr>
<th></th>
<th>n(%)</th>
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<tbody>
<tr>
<td>Age</td>
<td>29.0 ± 1.4</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>41(42.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>57(58.0%)</td>
</tr>
</tbody>
</table>

Responding physicians desired a clinical decision support system with the ability to provide advice on the care of specific patients (Table 2). They also preferred that the system be able to provide several other recommendations, while also been able to explain the rationale behind each recommendation it gives on the care of specific patients (Table 2).

Table 2 A contingency table describing proportions of physicians who judged CDSS patient care features as either Relevant or not

<table>
<thead>
<tr>
<th>system Capabilities related to patient care &amp; management</th>
<th>Total (n=98)</th>
<th>Relevant (n=59)</th>
<th>Non Relevant (n=39)</th>
<th>P -Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>when the system provides medical advice on the care of specific patients it always provides multiple alternative recommendations</td>
<td>65(66.3%)</td>
<td>48(81.4%)</td>
<td>17(43.6%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>the system can clearly explain the rationale for advice it gives on the care of patients</td>
<td>64(65.3%)</td>
<td>46(78.0%)</td>
<td>18(46.2%)</td>
<td>0.0012</td>
</tr>
<tr>
<td>Users can browse the information in a system as well as asking it to provide advice about care of specific patients</td>
<td>64(65.3%)</td>
<td>48(81.4%)</td>
<td>16(41.0%)</td>
<td>&lt; 0.0001</td>
</tr>
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Regarding the integrity and security of a clinical decision support system, two system features were identified to be significant (Table 3). One feature relates to the integrity and validity of recommendations provided by a clinical decision support system, while the other relates to the ability of a clinical decision support system to guarantee the confidentiality of patient information.
Table 3. CDSS security features considered to be either relevant or non-relevant by responding physicians

<table>
<thead>
<tr>
<th>System integrity &amp; Security Capabilities</th>
<th>Total (n=98)</th>
<th>Relevant (n=59)</th>
<th>Non Relevant (n=39)</th>
<th>P -Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>the system has been demonstrated in research studies to provide treatment recommendations at least as accurate as human consultants</td>
<td>67(68.4%)</td>
<td>47(79.1%)</td>
<td>20(51.3%)</td>
<td>0.0031</td>
</tr>
<tr>
<td>level of confidentiality and security must be better than the paper record</td>
<td>70(71.4%)</td>
<td>54(91.5%)</td>
<td>16(41.0%)</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

4. DISCUSSION
Clinical decisions made by physicians vary from one practice to the other, depending on the size of the practice, its geographical location, the capabilities of physicians, treatment policies and protocols, and organization of the practice [16]. Arriving at the most optimal clinical decision therefore is a complex process requiring finesse and wisdom, usually a physician would have to integrate scientific evidence, peculiar patient characteristics and wishes, together with other non-clinical factors in process the Art of Medicine. Physicians often adopt this process from different perspectives, influenced by varying levels of wisdom, experience, understanding and sensitivity; culminating in inconsistent patient outcomes. In poor settings where logistical and resource constraints have conspired to reduce this traditional art of medicine to the level of a physician’s experience informed through repeated trial and error.

In view of this clinical decision support systems are being seen as avenues for reducing, if not eliminating the over reliance on personal experience in the clinical decision making process, particularly in poor settings with the recent emphasis on evidence based medicine, the need for clinical decision support systems has become critically important. However what system features are needed in a CDSS to make it effective is a matter of great debate. Through this study five system feature have been identified, that can be considered as critically for successful implementation of CDSS in environs that are constrained by logistics and resources. The identified system features emerge out of a singularly thematic concept: that of providing patient cantered clinical advice. Despite this, individually the identified system features address specific challenges in making clinical decisions in poor settings.

In a systematic review of published literature to determine system features that make effective CDSSs, Kawamoto, and colleagues [9] reported four unique features. The results of this study are consistent with their findings. In fact they re-enforce one particular system feature: the need to provide unique patient recommendations, instead of just assessments of their conditions. The results of the current study reveal further its other variants: therefore, not only must a CDSS be able to provide automated recommendations of the care of specific patients, it must in addition be able to provide other such recommendations, and also be able to provide a rationale for each recommendation it provides to physicians.

The essence of having a CDSS provide recommendations is, to help mitigate the confounding factors that turn to sway clinical decisions away from optimal paths as may be dictated by clinical evidence. Among such confounding factors are; the wishes and preferences of patients, a physician’s personal characteristics, and external influences of a physician’s professional colleagues. The wishes and preferences of patients can be persuasive arguments against prevailing clinical evidence. Escher and colleagues [17]) report in their study that 71% of physicians attributed their decision to admit their patients to the intensive care unit to the wishes and preferences of their patients. The moral argument in favour of the wishes and preferences of patients is that, if patients get what the want, they are more likely to adhere to treatment regimens. Several studies [18, 19] report the influence that a physician’s idiosyncrasies have on his or her clinical decision making. The network of professional interactions that a physician engages in also influences their clinical decision making. Physicians who are exposed to new medical trends through conferences, seminars, and workshops are more likely to be clinically well informed than their peers who do [20]. In poor settings opportunities for such refresher training are either rare or non-existent. The availability of CDSS may therefore serve as a check against the tendency to compromise clinical evidence in favour of the wishes and caprices of patients and physicians.

The identified CDSS features reported in this study, as well as those reported by other studies would not guarantee the effectiveness of a CDSS, particularly in poor settings. The effectiveness of a CDSS involves interactions between technologies and organizations, deciding on the best path that guarantees success or prevent failures is a complex process [14]. A CDSS is only as good as its knowledge base [21]. A CDSS with the ability to evolve its knowledge base may prove effective in poor settings where knowledge resources are either not available or difficult to come by.

5. CONCLUSION
This study has uncovered five individual system features that are critical for effective implementation of computerized clinical decision support systems in poor settings.

6. ACKNOWLEDGMENTS
The students who willing participated in this study are greatly indebted,

7. REFERENCES


