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# Healthcare support for underserved communities using a mobile social media platform

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ABSTRACT

Emerging digital technologies for healthcare information support have already contributed to reducing the digital divide among rural communities. Although mobile health (m-health) applications facilitate provision of support for treatment consultation in real-time, their substantial potential has not yet been operationalised for decision support to meet citizen demand in developing nations. Modern healthcare information access, especially in rural areas of developing countries, is critical to effective healthcare, since both information and expert opinions are limited. Mobile phone and social media penetration, however, is often extensive. In this paper, we design and evaluate an innovative mobile decision support system (MDSS) solution for rural citizens healthcare decision support and information dissemination.

Developed using a design science approach, the instantiated artifact connects underserved rural patients in Bangladesh to general practitioners (GPs) – allowing GPs, based on queries and information support provided, to evaluate patient conditions virtually and provide answers for further diagnosis or treatment. A cloud platform using social media embodies health record information and is used with a rating technique that matches queries to profiled remote experts, participating asynchronously. A comprehensive evaluation of the MDSS artifact ensures its utility, efficacy, and reliability.



## 1. Introduction

Advanced information and communication technologies are transforming society by addressing the digital divide, the most recognised "social issue" for empowering rural citizens [41]. Rural citizens in developing countries have been suffering from "digital divide" in healthcare support due to limited access to experts and electronic health (e-health) information. As part of e-health, Mobile-health (m-health) provides many benefits such as enhancing self-management [28] and reducing travelling and medical expenditure [10]. Over the past two decades much academic and commercial research has been conducted on improving m-health technologies, mainly focused on identifying specific relevant issues, exploration of potential benefits, and new technology development. Varshney [53] however, noted that m-health in developing countries suffers from a range of barriers such as lack of infrastructure, cultural and social resistance, lack of education, and the role of medicine. Our case example of Bangladesh illustrates a developing country with a good digital infrastructure, but research attention in m-health is generally lacking in the developing countries context. IS research should promote "the productive application of information technology to human organisations and their management" (ISR (2002) cited in Hevner et al. [24, p. 76] and motivates creative solutions for healthcare information support for rural, remote and other underserved communities. Using design science, we therefore aim to develop and evaluate an innovative solution artifact for Bangladesh's rural communities to reduce the digital divide in m-health provision.

Various innovative m-health applications have been introduced in recent years. As well as extending healthcare coverage [29], other design directions include supervising support services [27], improving hospital management [11], motivating support service [51], improving training support [37], providing suitable healthcare in emergencies [19], and improving decision making [7]. Alongside these providing effective decisions support is one of the vital issues for rural communities, specifically when it is related to general medical practices in terms of public healthcare.

The majority of the population in many developing countries live in rural areas having limited access to modern general facili-

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ties and to specialized hospitals [4,22]. For Bangladesh, with a total population of approximately 160 million, there are only approximately 96,000 registered General Practitioners (GP/doctors) available. Although 70% of total population live in rural areas, 75% of total qualified GPs are practicing in urban areas [22]. Although mobile decision support systems (MDSS) technologies have successfully addressed many healthcare issues related to clinical decision support such as for field health workers' information assistance [5], for cardiovascular disease [48], incorporating patient data streams [15], and offering epidemiological support for managing infectious disease [34], few MDSS approaches have focused on decision support for rural communities, or for general practice support, where GPs manage types of illness that present in an undifferentiated way at an early stage of development, or which may require non-urgent intervention and care [1].

To address this gap, we aim to develop and evaluate a MDSS solution approach (called Bhalo-Achi – (it means: *I am Fine*) for providing general healthcare decision support and medical information dissemination. Using design science research (DSR) guidelines [24] we design the solution artifact to address user demand for general practice services. Cognizant of the increasing pervasiveness of mobile phones and social media usage, the solution targets the demand of Bangladeshi rural citizens, who do not have adequate access to healthcare support in general practice.

The proposed approach connects citizens to doctors based on the queries and information provided by the patients. Available doctors evaluate a patient's condition and provide answers for diagnosis or treatment. In the solution, we use a doctor-rating technique [39] which "incentivises" doctors and healthcare professionals to provide expert support and disseminate medical knowledge. We prototyped the solution ensuring direct stakeholder involvement then evaluated the design using the comprehensive evaluation process of Venable et al. [54] in which we employed both descriptive and experimental methods of Hevner et al. [24]. Our findings show the practical usefulness of the decision support: in seeking free medical consultation, finding alternative medicine brands for cost saving, reducing frequency of direct consultation, enhancement of self-management, and reducing doctors' workflow burden. In addition, the user-based rating system, familiar to social media users, encourages the doctors to asynchronously participate in providing free information, ultimately increasing profile awareness.

Utilizing a cloud computing platform (at the service provider's end) for e-health introduces many opportunities for healthcare service delivery, and especially for developing nations. Cloud computing adopts a service oriented architecture (SOA) and supports the functionalities of an integrated e-Health system as a number of inter-operable software services [25]. This fits the client side environment and supports scalability. As well as technical requirements, the social context in which it is embedded must be closely considered in design: in this case remote or rural areas, with relatively poor or less educated citizens, but with good mobile device access and social media literacy. This paper therefore describes an "ensemble approach" [44] to designing the m-health solution in which cloud-computing ensures service integrity at the back end and the mobile application interface ensures effective accessibility at the front end for users with continuing satisfaction and enrichment anticipated with the application in dynamic use.

The paper is organised as follows. The next section describes the problem context and literature background of the study. The following section presents the methodological details followed by the description of the proposed MDSS solution. The section after that provides the system evaluation process. The discussion section provides overall discussion on the contribution of the study while the final section summarises the study presenting its delimitations and further directions for research.

## 2. Background context and literature

### 2.1. Problem context

Proper diagnosis and preventative measures are crucial healthcare strategies, yet people in rural and remote areas may receive poor or inadequate treatment due to the lack of effective medical diagnostic facilities and expertise. They may not even get appropriate consultation, precaution, awareness and education on food, nutrition and lifestyle that could assist them to prevent and manage health complications. Effective decision support and expert advice through professional guidelines would make a huge difference towards tackling their regular non-emergency health condition. Effective consultation establishes a relationship over time, and through effective communication between GPs and patients, can inform specific decision-making processes determined by the prevalence and incidence of illness in the community [1].

According to WHO however, approximately 44% of member states (countries) have less than 1 physician for every 1000 of population. In Bangladesh, there is only one GP for every 1700 patients, against a Millennium Development Goal of at least 2.5 physicians, nurses, and midwives per 1000 people needed to provide adequate coverage with primary care interventions [55]. For general practice, most of the concerns are related to primary care and service at the first point of medical contact. This service is mainly for providing medical information support for dealing with health issues regardless of the age, sex, and any other characteristics of the individual concerned.

### 2.2. Existing MDSS

Mobile phones using GPRS and Internet technologies provide a useful application platform for data processing, transferring and disseminating for patients and clinicians on an "anywhere, anytime" basis [13,53]. A clinical decision support systems (CDSS) is a type of specialised DSS application that directly aids in "clinical decision making in which characteristics of individuals are matched to a computerized knowledge base for the purpose of generating patient-specific recommendations [26]. Combining these, mobile Decision Support Systems (MDSS) applications can be classified into three groups: 1) mobile based CDSS for physicians and healthcare professionals (e.g. [3,28,38]); 2) MDSS for outreach health workers (e.g. [31,48]); 3) and MDSS for public use (e.g. [15,49]).

For example, Krause et al. [30] designed a mobile application for providing physicians with decision-relevant information on potential organ receivers, aiding assessment of forthcoming organ transplants and maintaining security of documentation. Michalowski et al. [40] developed a mobile CDSS for emergency support of different acute pain presentations, while other studies in mobile based CDSS for medical emergency management have identified solution design requirements for emergency triage decision support [47]. Such system solutions primarily support healthcare professionals or clinicians in their own practices rather than enhancing patients' self-management or monitoring of their medical conditions.

For outreach health professionals, mobile DSS (MDSS) solutions have also been designed, e.g. to enable consistent and quality primary healthcare delivery to rural populations [5]. A tablet-based CDSS for cardiovascular disease management was also designed by Praveen et al. [48] for use by non-physician health care workers (NPHWs) and physicians in a rural Indian context. This involved a four-step process: patient registration, past medical history and medications, risk factor measurements, and treatment advice, all maintained by users, using the open Medical Record System (OpenMRS) to upload locally collected data to a server.

We found however, only a few MDSS focused towards public use or citizen empowerment, providing information guiding diagnosis and self-management. These are summarised in Table 1.