

Health Information Systems for Community Based Health Workers: A Case for Mobile and Wireless Technologies

Adesina ILUYEMI, Christina FITCH, David PARRY and Jim BRIGGS
Centre for Healthcare Modelling and Informatics, University of Portsmouth, School of
Computing, Lion Terrace, Portsmouth, PO1 3HE, United Kingdom
Tel: +44 23 92846784, Fax: + 44 23 92846364, Email: Adesina.Iluyemi@port.ac.uk

Abstract: This paper supports the case for the use of mobile/wireless technologies to support community based health workers (CBHWs) in Africa. Many international efforts are focussed on improving healthcare in Africa in a cost-effective way, and the potential benefit for Africa in both the relief of suffering and economic saving is huge. The wide availability of wireless/ mobile technologies on the continent makes it possible for the development of mobile health information systems to support CBHWs. These workers can provide essential primary health services within the community. If any technology is to be of use it should be able to be suitably integrated into the workflow and social environment of the users. The use of mobile technology by CBHWs may be particularly effective in the context of providing information and knowledge support to CBHWs for patient care especially in the face of HIV/AIDS epidemics in Africa.

Keywords: community based health workers, mobile devices, wireless networks, GSM, district health information system, primary/community healthcare, organisational and human factors.

1. Introduction

This paper supports the case for the use of mobile/wireless technologies to support community based health workers in Africa. Africa is burdened with health problems that can be effectively managed at the community level. The wide availability of wireless/mobile technologies on the continent could assist the development of mobile health information systems to support the people providing essential primary health services within the community.

Although there are marked differences between Africa and England in the mode of health service provision, epidemiology, demography and the diffusion of ICTs within the health system, we believe there are enough similarities and congruence to make comparisons worthwhile. Included in this are the respective role played by community healthcare within the overall health system, and the need for healthcare professionals to be mobile to be best serve their patients.

Both systems adopt a public service-driven approach and rely on public funding to run their operations. Patients move from the lower level of the health system to the higher level depending on the complexity of their problem. The burden of disease in England is the high prevalence of chronic disease, which contrasts with the double burden of both infectious and chronic disease in Africa.

A recent report from the World Health Organisation (WHO) titled "Health and development in Africa" emphasized the importance of economic growth and development on the continent to support tried and tested investment in health services [1]. It reiterated the double burden Africa has of both *infectious* diseases (such as HIV/AIDS, tuberculosis (TB) and malaria) and emerging *chronic* diseases (such as stroke, cancer, diabetes and heart disease)

[1]. Aside from these, maternal and childhood diseases are of major burden to the health systems in African countries [1].

The report further highlighted community-based initiatives and community involvement in health service provision as a model of health provision on the continent. The success of community-based health management schemes involving CBHWs, especially in HIV/AIDS management, was cited as good practice worthy of emulation [1]. Furthermore, the poor state of the national health systems was regarded as a major public health burden. The building of efficient health information systems for the gathering of vital health datasets and indicators for evidence-based policy formulation, health provision and for disease surveillance was seen as highly important in the report.

The objectives of this paper are to:

1. present a case study exploring the feasibility and use of mobile technologies in community healthcare in England
2. provide insights from the case study on the issues of support structures, service management and organisation of mobile technologies in community healthcare
3. present issues, challenges and policy implications of the development and implementation of community health information system to support health workers
4. relate the findings of the case study to Africa's health environment

2. Community healthcare in England and Africa

Community healthcare forms an important part of national healthcare delivery in both England and Africa in both urban and rural settings. Primary healthcare forms an important entity of national health care delivery in developing countries whose most of the population abode in isolated, rural regions using the public health care system [2]. This is informed by *“essential healthcare based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self reliance and self-determination”* [3]. It is normally the first level of contact of individuals, families and communities with the national health system, bringing healthcare as close as possible to where people live and work and it is focussed on health promotion and disease prevention. Hence, any technology or method applied within this context, should meet these criteria. However, health service provision in England is more of a curative model rather than a preventive model as is the case in Africa, but a new policy shift in the UK indicates moves towards a community based and preventive driven model [4]. This provides an opportunity for England to learn from Africa.

In England, community healthcare is delivered through Primary Care Trusts (PCT). These organisations are responsible for providing or procuring services to meet the health needs of the population they serve.

In Africa, many countries deliver community healthcare through district health systems (DHS).

In both cases, the human interface at this first level of the health system are what we generically refer to as community based health workers (CBHWs), though the precise job titles used varies widely from place to place.

3. Mobile telephony in community healthcare in England

3.1 Organisational context

Community healthcare covers both health and social care systems. This involves the provision of primary healthcare and acting as an interface between the patients/client and the health and social care systems. Community healthcare provides home, domiciliary and community care services to people such as the disabled, the chronically ill, the elderly and newly born babies, thereby providing a continuum of care that stretches beyond hospital buildings [5].

The district nurses and health visitors are the personnel that provide healthcare services and are the focus of our discussion. Both are regarded as primary care or community nurses and are normally employed directly or indirectly by the PCT [6]. The community healthcare model may be a viable and sustainable option of providing healthcare services to the population in many developing countries where modern healthcare infrastructures are not readily available.

District nurses (DNs) work together with long-term ill and disabled patients and their carers in the community, assessing healthcare needs and developing appropriate packages of care. A Health Visitor's (HV) role involves encouraging and helping citizens to achieve their potential for health and well-being. They are health promoters in schools and homes in the community [7]. HVs undertake the developmental screening of children, and help develop and provide health education programmes for individuals and communities, whilst some HVs specialize in working with older people. Both these types of CBHW attend to patients in their own homes, usually after initial contact with a general practitioner or after discharge from hospital. This type of outreach working demands a means of maintaining communication and coordination with their bases while working within the community [8]. While working within a clinic or hospital, DNs and HVs typically use fixed computers to read and enter data into electronic patient records, to access medical guidelines and use e-mails as a means of communication [6]. However, working in the community demands high mobility and the need to communicate and coordinate with their base. This is what warrants the use of mobile technologies [5].

3.2 Healthcare work and mobile telephones

We conducted a case study of mobile technology use in community healthcare in England, based on interviews with key CBHWs and their managers.

Mobile telephones were provided to the CBHWs by their PCT to support their daily healthcare work and to ensure organisational efficiency and output. However, this was not without some problems. A shortage of mobile phones (especially during the busy weekdays) was a management issue.

The PCT noted two benefits arising from the health workers' use of mobile phones.

1. There was an improvement in meeting response targets set down for dealing with urgent calls. This could be seen as contributing directly to efficiency targets of the organisation. However, from the health workers' perspective, the mobile phone may not be seen as "essential" to their primary task of healthcare provision.
2. There was a reduction in travel time due better communication between the CBHWs and their bases. They no longer had to return to their bases to pick up referrals so frequently.

Other mobile technologies used by the CBHWs were digital cameras and data pens. The digital cameras were mainly used to document wound care. This was observed to improve patients' outcome because attaching pictures to their medical notes provided a means of

monitoring their progress and response to treatment. Data pens were used to capture patients' records and daily activity logs – this was then downloaded to the enterprise information system on return to the clinic. Although the *capture* of data in the community was made possible by the data pens, *retrieval* and *access* to it was not. To regulate the CBHWs' use of the mobile devices, guidelines or protocols were provided on what data can be stored on the mobile devices, what to do in case of theft (and to reduce this risk), when to recharge batteries practices, and how to hand over the phones and other equipment ready for the next set of users.

3.3 Issues identified by the case study

Analysis of the interviews brought out nine interesting issues.

1. A major factor in the successful delivery of community healthcare is recognition of how teams of people work together. Any technology or equipment provided to healthcare professionals needs to support such team interaction.
2. Availability of equipment. There is a need to ensure adequate supply of mobile devices for the team.
3. Technical support. Whatever equipment is provided, technical and maintenance support needs to be in place for the effective use of the equipment.
4. Working practices and protocols need to be developed. Where mobile devices are deployed, it may be that practices and protocols need to be amended. In other cases, new protocols and practices need to be agreed and accepted by all professional groups.
5. Standards are an important issue, both for the integration of patient records and the incorporation and integration of (new) technologies. However, achieving standards has technical, organisational and political challenges because of enshrined interests and power structures.
6. There is a pressure point between the policy makers at the centre and the care providers in the community about the perception of what is important.
7. Mobile technology design. Health organisations need to collaborate with device designers and manufacturers in order to customise mobile devices to fit the requirements of their tasks. This is to ensure that the technology does not impact negatively on the job function of CBHWs, and it does not compromise security and confidentiality.
8. Focus on job function. The deployment of technology should not lead to CBHWs becoming deskilled, nor should it compromise the patient care they provide. Also, features to support security and confidentiality must not have a negative impact on patient interaction or job satisfaction.
9. Range of equipment. Although mobile telephones are clearly beneficial to community healthcare, other equipment is required as well, such as digital cameras.

In conclusion, these CBHWs, as qualified and highly motivated professionals, are likely to be positive to changes in working practices that contribute to increased quality of patient care [5].

4. The technological context

So how can these findings support the use of mobile and wireless applications in community care in Africa?

The New Partnership for Africa Development (NEPAD), the development initiative of the Africa Union, has recognised the potential of ICT in the achievement of rapid economic development and social integration of the continent [9]. The International Telecommunication Union (ITU), in proposing low-cost wireless connectivity for rural areas in developing countries, rationalised that wireless or mobile technologies have faster roll-out time (re-

duced implementation duration), lower maintenance costs, and higher network adaptability than fixed networks [10].

The use of wireless and mobile technologies for developmental purposes like health (telehealth and telemedicine), education (tele-education), communication (e-mail) and business and community development (e-commerce) are highly regarded by ITU [10]. ITU in a report in 2002, proposed the commission of pilot projects to validate the potential application of packet-based wireless access infrastructure such as the GSM-IMT-2000 family for multimedia service provision and applications in developing countries [10].

There were 177 million mobile users in Africa as of November 2006 [11]. A report on mobile telephony diffusion in Africa highlighted the potential of using high speed and broadband GSM-based wireless technologies such as GPRS, EDGE or 3GSM/HSDPA for Community Information Centres in a pilot study from South Africa [12]. This initiative is based on the “Shared Access To Data” concept, a system of providing internet access to multiple users from a single point. The “Shared Access to Voice” scheme is another initiative by GSM Association in Africa [12]. This involves the development and deployment of a portable GSM-wireless box-phone complete with solar charging accessories to imitate a commercial public phone booth. The innovation permits the sharing of a single phone by multiple users. The “Emerging Market Handset (EMH)” programme, an initiative to make mobile phones financially accessible to the masses is also taking off [12]. The use of low cost mobile devices such as Personal Digital Assistants (PDAs), Smartphones and Cellular phones has been demonstrated to be feasible in some countries in urban and rural Africa [13-15]. This approach and presents a case for the use of GSM networks to support CBHWs in Africa.

5. District health systems in Africa

5.1 Organisational context

In the context of Africa's health systems, CBHWs provide a vital role working within the communities in which they live, located in rural, urban, semi urban settings [16]. CBHWs may be either paid or volunteers, and are trained within the DHS they are expected to work for. Aside from delivering essential primary care services, CBHWs are also agents of health promotion and healthcare development. They also act as community change agents or advocates for socio-economic development and community empowerment. In recent times, there has been a call to use this group of HWs for the provision of health services in Africa based on the background of the systematic brain drain within the health system [17, 18].

In developing countries, there is often a shortage of health workers. The World Health Report 2006 [19] addressed this with special emphasis on Africa's health systems. The report listed three challenges facing the health systems in developing countries namely:

1. achieving the UN Millennium Development Goals (MDGs);
2. combating chronic disease; and
3. managing health crises

The Report recommended the use of mobile telecommunication technologies as a means of supporting CBHWs' activities. The role of a CBHW as a health advocate in the community was shown to be enhanced through the use of a community health information system, i.e. improving the dialogue between the CBHWs and community members for participatory decision making and facilitating two-way communication between the community and the DHS [20].

Godlee et al identified lack of access to the Internet as one of the three barriers to the achievement of health-related MDGs, and proposed that the improvement in access to contextual information and enhanced access to Internet for health workers as a way of bridging

this knowledge gap [21]. The potential of e-mail was identified as a means of accessing health information, enabling inter-professional communication and reducing the sense of isolation that many healthcare professionals working in the community feel. This proposition fits the bill for the application of wireless and mobile technologies to meet these needs [22].

5.2 *What can Africa learn from England?*

The case study in section 3.3 above presented some issues to be considered in the development and implementation of mobile technologies to support the tasks and activities of CBHWs in England. In this section, we revisit the 10 issues identified in that case study and consider how they apply in an African context.

1. Teams of CBHWs in Africa undoubtedly interact with each other and with their managers in different ways. What they share in common with their counterparts in England is the necessity to analyse these interactions and ensure that the technology supports them rather than hinders.
2. Availability of equipment is likely an even bigger issue in Africa than in England. The English experience highlights the need to have in place a sharing and prioritisation policy, and to ensure that those workers with the greatest needs have the most access. The development of new "cheap" devices, leveraging the ever-expanding networks that are rolling out across the continent, is well underway.
3. The need to provide adequate technical support to the CBHWs cannot be overemphasized. The health system needs to put in place a culture of maintenance and equipment reliability which should be made easily available to workers at their normal base.
4. The use of mobile technologies will provide a catalyst to change the way of communicating and coordinating healthcare activities, implying the need to develop new working practices and protocols. For example, as digital cameras have become a standard in most mobile phones, a CBHW in an isolated rural community could employ it for teleconsultation. Photographing an uncommon skin lesion, and then sending the image over the wireless network to a remote specialist in a district health hospital for diagnosis, could provide a means of detecting new cases of HIV/AIDS which could be life-saving for the individual concerned [23-25].
5. The lack of adequate medical data sharing standards was another issue raised in the case study. The often haphazard provision of health services by heterogeneous networks of public, private and non-governmental organisations in Africa [26], makes this an issue not to be taken lightly. However, the absence of legacy record systems in these contexts may mean that developments are more easily introduced. The possibility of institutional challenges to the implementation and development of standards has already been documented in district health development programmes in Africa with potential solutions provided [27].
6. The need to bridge the gap between local and central policy making process within the health system was raised in the case study. The hierarchical and distributed nature of district health systems, as being the common practice in most African countries, can make the working relationship between the periphery and the centre problematic at times [28].
7. The issue of mobile technology design and development is a difficult one for Africa. Health organisations collaborating with device manufacturers might not be feasible in Africa because of lack of bargaining power and low industrial base. However, the approach taken by the "Emerging Market Handsets" initiative [12] could provide a model for how this barrier can be overcome, by entering into contracts with manufacturers in developed countries. Notably, the Cell-Life model of developing localised and cultur-

ally sensitive cellular phone-based software for the management of HIV/AIDS patients is worthy of emulation [29].

8. There is of course a need to maintain the integrity of the primary task of the CBHW. Mobile computer usage has a potential deskilling effect on CBHWs' intellectual input into their tasks. For example, to rely too much on say a PDA-based HIV/AIDS clinical guideline could result in a CBHW failing to upgrade his or her thorough reading of textbooks. However, the use of mobile technologies to provide access to continuing medical education materials, especially to isolated CBHWs, could also be a way of avoiding the "deskilling effect" as experience in Uganda shows [22]. While ICT in healthcare can increase efficiency, it can often result in unpredicted consequences that could adversely affect job satisfaction and performance [30]. This is directly relevant to mobile support for the CBHWs, since there is a shift in focus from patient-oriented activities to mobile device-oriented activities [5]. For example, a CBHW's need to enter or read information from a mobile device will have a potential impact on maintaining eye-contact with the patient. This could lead to failure to pick up some diagnostic signs and symptoms. Moreover, a CBHW working in Africa tends to interact more with friends and family members of the patient, and this provides an avenue of interference to clinical workflow.
9. The provision of appropriate mobile devices is also essential. For example PDAs could be proper for a clinical task that requires data entry and reading off the screen, i.e. clinical guidelines, but the use of mobile phones is more appropriate for voice related interactions.

6. Conclusion

The findings from the case study in England have been applied to the use of mobile technologies to support CBHWs in Africa. Supporting CBHWs in Africa with mobile technologies has been proposed by WHO as a way of empowering them to provide essential primary healthcare services [19]. This is supported by the recent commendation of a programme involving the use of PDA-based Electronic Health Record for the effective management of HIV/AIDS patients in rural communities by CBHWs in Kenya [31].

This paper has presented the health and mobile/wireless technology landscape in Africa with various policy and developmental drivers for their improvement and adoption. A case was made for the use of mobile technologies by community based health workers for health services provision within the community in Africa. The lessons learnt can, with a degree of interpretation, be applicable to the use of mobile technologies to support CBHWs in Africa. There are opportunities for research, such as through the BEANISH programme [32], to facilitate the transfer of those lessons. However, it must be noted that the successful implementation of mobile technologies into community healthcare demands organisational and work process readjustment, political will at national, regional and local levels rather than pure technological development [5].

References

- [1] World Health Organisation (WHO), "The Health of the People," WHO-Regional Office for Africa Addis Ababa 2006.
- [2] E. Byrne and S. Sahay, "Health information systems for primary health care: Thinking about participation," *Proceedings of the International Federation of Information Processing, IFIP*, vol. 9, pp. 237-249, 2003.
- [3] World Health Organisation (WHO), "Primary Health Care Approach: Alma Ata Declaration," The World Health Organisation, Geneva 1978.
- [4] DoH, "'Our Health, Our Care, Our Say'" Department of Health, London 2006.
- [5] C. J. Fitch and C. Adams, "Managing mobile provision for community healthcare support: issues and challenges," *Business Process Management Journal*, vol. 12, pp. 299-310, 2006.

- [6] T. Chan, S. Brew, and S. de Lusignan, "Community nursing needs more silver surfers: a questionnaire survey of primary care nurses' use of information technology," *BMC Nurs*, vol. 3, pp. 4, 2004.
- [7] A. L. McDonald, I. H. Langford, and N. Boldero, "The future of community nursing in the United Kingdom: district nursing, health visiting and school nursing," *Journal of Advanced Nursing*, vol. 26, pp. 257-265, 1997.
- [8] B. Skattør, P. Hasvold, L. Berntzen, and T. Engvig, "Mobile Work–Mobile ICT Supporting Secondary Work Final Report ", Oslo 13 May 2004.
- [9] NEPAD, "e-Africa Commission," Addis Ababa 2001.
- [10] International Telecommunications Union (ITU), "'Bridging the digital divide, providing digital opportunities for all'," International Union for Telecommunications, Geneva 2002.
- [11] L. Goering, "Africa Embraces a Wireless Way of Life," 2006.
- [12] GSMA, "Development Fund Annual Review," GSM Association 2005.
- [13] B. Dwolatzky, E. Trengove, H. Struthers, J. A. McIntyre, and N. A. Martinson, "Linking the global positioning system(GPS) to a personal digital assistant(PDA) to support tuberculosis control in South Africa: a pilot study," *International Journal of Health Geographics*, vol. 5, pp. 34, 2006.
- [14] M. Grabowsky, T. Nobiya, M. Ahun, R. Donna, M. Lengor, D. Zimmerman, H. Ladd, E. Hoekstra, A. Bello, and A. Baffoe-Wilmot, "Distributing insecticide-treated bednets during measles vaccination: a low-cost means of achieving high and equitable coverage," *Bulletin of the World Health Organization*, vol. 83, pp. 195-201, 2005.
- [15] R. T. Lester, L. Gelmon, and F. A. Plummer, "Cell phones: tightening the communication gap in resource-limited antiretroviral programmes?," *AIDS*, vol. 20, pp. 2242-2244, 2006.
- [16] I. Friedman, "Community Based Health Workers in the South African Health Review 2002," *Health Systems Trust. Durban*, 2003.
- [17] D. Dovlo, "Using mid-level cadres as substitutes for internationally mobile health professionals in Africa. A desk review," *Human Resources for Health*, vol. 2, 2004.
- [18] C. Hongoro and B. McPake, "How to bridge the gap in human resources for health," *The Lancet*, vol. 364, pp. 1451-1456, 2004.
- [19] World Health Organisation (WHO), "Working together for health," The World Health Organisation, Geneva 2006.
- [20] E. Byrne, "Using action research in information systems design to address change: a South African health information systems case study," *Proceedings of the 2005 annual research conference of the South African institute of computer scientists and information technologists on IT research in developing countries*, pp. 131-141, 2005.
- [21] F. Godlee, N. Pakenham-Walsh, D. Ncayiyana, B. Cohen, and A. Packer, "Can we achieve health information for all by 2015?," *The Lancet*, vol. 364, pp. 295-300, 2004.
- [22] IDRC, "The future of Africa is mobile," International Development Research Centre 2004.
- [23] C. Massone, G. P. Lozzi, E. Wurm, R. Hofmann-Wellenhof, R. Schoellnast, I. Zalaudek, G. Gabler, A. Di Stefani, H. Kerl, and H. P. Soyer, "Cellular Phones in Clinical Tele dermatology," *Archives of Dermatology*, vol. 141, pp. 1319-1320, 2005.
- [24] C. Ebner, G. Gabler, C. Massone, R. Hofmann-Wellenhof, G. P. Lozzi, E. Wurm, and H. P. Soyer, "Mobile teledermatology coming of age," *e & i Elektrotechnik und Informationstechnik*, vol. 123, pp. 148-151, 2006.
- [25] C. Massone, G. P. Lozzi, E. Wurm, R. Hofmann-Wellenhof, R. Schoellnast, I. Zalaudek, G. Gabler, A. Di Stefani, H. Kerl, and H. P. Soyer, "Personal digital assistants in teledermatology," *British Journal of Dermatology*, vol. 154, pp. 801-802, 2006.
- [26] E. Mosse and P. Nielsen, "Communication Practices as Functions, Rituals and Symbols: Challenges for Computerization of Paper-based Information Systems," *EJISDC*, vol. 18, pp. 1-17, 2004.
- [27] J. L. Nhampossa, "Strategies to deal with Legacy Information Systems: A Case Study from the Mozambican Health Sector," *Proceedings from IRMA: Innovations through information technology, Idea Group Inc., New Orleans, Louisiana, USA*, 2004.
- [28] T. Bossert, "Analyzing the decentralization of health systems in developing countries: decision space, innovation, and performance," *Social Science and Medicine*, vol. 47, pp. 1513-1527, 1998.
- [29] Cell Life, "Cell Life," Civil Engineering Department of University of Cape Town, Cape Town 2006.
- [30] M. A. Hebert, "Impact of IT on health care professionals: changes in work and the productivity paradox." vol. 11, 1998.
- [31] World Health Organisation (WHO), "Kenya: Electronic record-keeping saves lives " in *World Health Report*, vol. 2007. Geneva: The World Health Organisation, 2007.
- [32] BEANISH, "Sixth Framework Programme Priority 2 Information Society Technologies," European Commission, Brussels, Specific Support Action Annex 1- "Description of Work" September 2006.