

Role of ICTs in the Health Sector in Developing Countries: A Critical Review of Literature

Md Jahid Hossain PANIR

Senior Assistant Secretary, Ministry of Public Administration, Government of the People's Republic of Bangladesh

Abstract. This paper explores the domain of literature on information systems or electronic health (e-health) in the rural healthcare in developing countries. The main aim of this paper is to contribute to the development informatics community literature by bridging a knowledge gap. Based on secondary data, the study analyses the key policy debates and presents previous research finding. It shows that ICTs play a marginal role in access to health information due to the health vulnerabilities and limited information resources of the poor. This paper concludes that no ICTs will work in a resource-poor setting unless livelihood-based approach is intervened.

Keywords. Electronic health, Data-information-knowledge, Access to information, Millennium development goals, Information-centered ICTs, Developing countries.

1. Introduction

In this digital age, information and communication technologies (ICTs) are considered to be the 'catalysts to development'.⁷³ Many studies demonstrate that information systems (IS) can make significant contribution to the health sector particularly in the primary health care (PHC) in developing countries.¹⁶ However, such studies are insufficient due to the pilot syndrome of HICT projects.⁶⁹ ³⁰ argues that the poor and the health professionals are the major targets of health-related millennium development goals (MDGs). But most of the world's poor (about 75 per cent) and significant numbers of health workers live in the rural areas⁸⁴ and often remain in the wrong side of the digital divide.^{21,63} Therefore, researchers advocate that traditional approach of ICT intervention is not a solution because they do not address the livelihoods of the poor and cannot bring them to the access to ICTs. Thus, the result is the information gap in the health communication.⁴⁴

A number of studies on electronic health (e-health) show that digital ICTs in the health sector face tremendous constraints and do not produce desired outcome.⁷¹ Development informatics researchers claim that one of the main reasons of such a setback is the lack of understanding of 'information first' approach in electronic development (e-development) initiatives.⁵¹ They opine that the understanding of the ability of the poor to access, to assess, and to apply information and to act upon it, is important before mediating any ICT initiative. This is because the poor are entangled with numerous vulnerabilities in their livelihoods.³⁶

Submitted: November 3, 2010

Accepted: February 15, 2011

Under this backdrop, this paper critically reviews relevant literature on the potential role of ICTs in the rural healthcare to understand the insights into the realities of e-health implementation in a resource-poor setting. The main aim of the study is to contribute to the development informatics community literature by bridging a knowledge gap in ICT applications in the health sector domain.

As a research method of this study, a systematically structured search of the literature has been applied to generate peer-reviewed academic articles. For this purpose, several databases such as ProQuest, Informa Healthcare, Palgrave, SpringerLink, and Sage journals online have been utilized by using the combination of keywords such as 'health', 'information communication technology', 'developing countries', 'resource poor settings', and 'millennium development goals'. Furthermore, the review is also supplemented by other e-journal search engines including 'Medline' and 'Google Scholar'. After examining the article abstracts, only relevant literature has been reviewed and synthesised. This paper selected literature that touched upon the areas of ICTs in the healthcare in developing countries and was sufficiently critical in order to understand the conventional thinking as well as the critique of it.

The remaining part of this paper is structured as follows: Section 2 conceptualizes the insights into data-information-knowledge continuum; Section 3 highlights the issues and policy debates across ICTs in achieving health MDGs; Section 4 analyzes main research findings on electronic health (e-health) initiatives; and Section 5 concludes the study with key suggestions.

2. Information, Communication, Knowledge and ICTs

The recent insights of information society theories reveal that there has been a gradual shift of emphasis 'from a preoccupation with *technology* as a strategic resource to a growing interest in *information* and its exploitation'.¹³ This 'information-centered' or 'information-intensive' concepts have been clarified by⁵¹ with the explanation that the intrinsic role of ICTs is two folds: *First*, when, as a process, ICTs perform 'handling of data electronically or digitally', they either change data into information or move data from sources to recipients. *Second*, when ICTs facilitate as 'sources of outcome', they turn information into knowledge that helps either in learning or decision-making or taking action. Therefore, ICTs are 'processors' or 'communicators' to enhance communication processes for transmitting information and exchange of knowledge.

One of the most influential conceptual approaches in the 'data-information-knowledge continuum' is the work of³¹. They term 'information' as a 'message to inform people' which is sent from a sender to a receiver in the form of documents or audible or visible communications 'to change the way the recipient perceives something' or 'to have an impact on his judgment and behaviour'. The messages (information) including traditional mail, e-mail, Internet transmissions are delivered through hard (e.g. wires, delivery vans, satellite dishes, and post offices) and soft (e.g. handing over a piece of paper) networks.

In ICT, 'information' is central - originating from data and moving towards knowledge. Although 'data' provides no judgment or interpretation, it is essential raw material for the creation of information³¹ which is important for effective data management in any electronic development (e-development) initiatives particularly in the health sector.⁶⁷ Knowledge management (KM) utilizes how these data can be transformed into another resource.^{5,80} Thus, knowledge constructs a shared

Submitted: November 3, 2010

Accepted: February 15, 2011

understanding of how information can be applied to solving problems and getting things done by utilizing intuition, judgment, and wisdom.¹³

Drawing on the work of ^{80,89,90} explicated two basic taxonomies of knowledge in organizations: tacit and explicit. Tacit dimension of knowledge is an individual's mental maps, intuition, beliefs, judgment, and viewpoints (cognitive elements) & know-how, skills and personal experience (technical elements). Explicit knowledge is formal, systematic knowledge that can be codified, written down, and passed on to others in documents.^{15,29} The implications for this knowledge management approach in ICT applications are important as suggested by ⁴⁷. He argued that explicit knowledge is a people-to-documents approach, so developing an electronic document system that codifies, stores, disseminates, and allows reuse of knowledge as opposed to person-to-person approach under tacit knowledge. These issues are crucial in knowledge-sharing. ICTs, for example, such as videoconferencing or the telephone, are proved effective at enabling people to transfer tacit knowledge.

The impacts of the role of ICTs in this data-information-knowledge continuum are of great value in development informatics since ICT embodies the 'message' (information), the 'cement' (communication) and the 'vehicle' (technology). The discourse on issues of technological rationality indicates that the medium is not the message (information) but it strongly affects it.²⁰ Message is more important than the delivery vehicle. This implies the notion that more and new digital ICTs will not necessarily improve the access to information.¹⁴

In practice, as argued by ³⁴, there is not enough literature on 'demand-driven information' or 'people-oriented information' ²⁷ in the review or assessment of ICT applications in development projects. This bottom-up approach is vital for the real success of these projects which are targeted for the rural poor who often lack in access or assess information for their vulnerabilities. Their real need of information and the socio-political realities are often ignored while initiating ICT interventions in resource-poor settings with the overemphasis on technology determinism. As a result, there remains a design-reality gap and consequently many health-related ICT projects start to fail.⁵²

3. ICTs, Health and MDGs in Developing Countries

ICT in the health sector is rooted in health informatics. Based on the theories of various disciplines, informatics makes right information available to the right people, within and without an organization, at the right time and place and for the right price.²

So, the true focus of health informatics is on 'handling health information' - ICTs are just tools to facilitate information management.¹ This involves two fundamental aspects: technology and information management. Technology aspect emphasizes on the best technology for achieving the desired outcome while information management places importance on key components of non-technical issues, e.g. information - for whom, where and when.⁹⁹ Consumer health informatics, a subset of health informatics under socio-technical context⁷, focuses on identifying consumer information needs and developing systems and strategies to enable consumers to access that information.⁵⁶

As identified by researchers, information & communication is one of the basic pillars in any health system that can benefit from the use of ICTs⁶¹. ⁵⁹ identified three broad categories where ICTs can be harnessed for improving health service:

Submitted: November 3, 2010

Accepted: February 15, 2011

functioning of health care systems e.g. patient records and hospital management, health care delivery through direct use of ICTs and communication around health. However, the reality is that ICT initiatives in electronic patient record have often proved to be unsuccessful in many cases even in developed countries.^{12,35,41} In case of developing countries, these ambitious applications have not been widely diffused because they are not used by the majority of the world’s poor who represent a significant portion in development.³⁹ As a result, most ICT projects cannot sustain due to the failure to achieve their intended goals and ultimately become unsustainable.^{32,58}

Health is considered to be the ‘heart’ of MDGs because it is central to the global agenda of poverty reduction and crucial measure of human development.^{40,101} Out of eight MDGs, three are directly related to health: Reducing child mortality (goal 4), improving maternal health (goal 5) and Combating HIV and AIDS, malaria, and other diseases (goal 6). Each goal to be achieved by 2015 has specific targets and indicators to measure the progress which are summarised in Table 1 below:

Table 1: Health-related MDGs & their Targets to be Achieved by 2015.

MDGs	Targets	Strategies/Indicators/Focuses
4. Reduce child mortality	5. Reduce by two-thirds, by 2015, the under-5 mortality rate	<ul style="list-style-type: none"> • Immunisation
5. Improve maternal health	6. Reduce by three-quarters, by 2015, the maternal mortality ratio	<ul style="list-style-type: none"> • Delivery assistance by skilled health personnel
6. Combat HIV/AIDS, malaria and other diseases	7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	<ul style="list-style-type: none"> • Reduction in HIV prevalence among pregnant women • Increase of contraceptive use rate • Spread of comprehensive knowledge about HIV/AIDS • Reduction in prevalence and death rates associated with malaria & tuberculosis.

Source: Adapted from UN ICT Task Force (2005);¹⁰.

Development theories hold that development is a synchronised process and encompasses all areas to affect. Thus, policy efforts and discussions on all other MDGs show some connections with broader health determinants that ultimately affect people’s lives.^{57,102} Similarly, the fourth and fifth MDGs with the targets of reducing child mortality and improving maternal health respectively can be viewed together through the prism of ICTs that benefit increased health delivery for both mothers and children⁵⁹.⁴³ exemplified it by adding that: “every day that is not spent being ill or taking care of a child sick with a recurring disease such as malaria can be used productively”.

So, the achievements of health-related targets of other MDGs in the area of poverty, education, empowerment of women, sanitation and international partnerships can also contribute to improvements in the health status of millions of people around the globe.^{94,103} Many development organisations such as OECD, DfID, and SIDA have

Submitted: November 3, 2010

Accepted: February 15, 2011

explored that ICTs, when incorporated effectively into development programmes in synergy with any other policy initiatives or strategies, can be useful tools in achieving MDGs.^{30,74}

However, some IS researchers challenge e-development initiatives and suggest a broader look in which ICTs can contribute to socio-economic development.⁵⁴ They point out that MDG-inspired prioritization of ICT applications for development sectors are not always effective because ICT consumption projects in developing countries, where technologies are applied with 'e' mania, (e.g. e-health and e-government) have experienced at least one-third total failures and one-half partial failures.⁵³

When viewed from technological rationality apart from 'demand-driven and information first' (micro-level & bottom-up) approach, new ICTs, with their attractions, persuade many researchers, professionals, donors, and policy makers to exploit these technologies in potential of e-health projects implementation. It embarks on how ICTs can be utilised to achieve these health-related goals resulting in piloting with donor support with a 'grand opening ceremony'³⁷, then short-term win for political gain⁶⁹. However, this supply-driven technological rationality approach often takes a broader area of ICT applications that represent 'the low ranging fruit from pilots'^{14,91}.¹⁰ posits several areas including training for health workers, information-sharing on diseases, reproductive health & AIDS prevention both with rural care-givers and local people through locally appropriate content in local languages.

Other researchers identified new interventions that include knowledge-sharing between various stakeholders, information systems development for the management of patient record, and education and awareness-creation of the public towards causes, knowledge transfer, and prevention of different illness.^{6,26,45,49,95} However, these issues are open to debate surrounding the ICT field with a variety of terminology differences.⁵⁹ For example, a recent literature review⁸² identified 51 distinct definitions of e-health with no possible resolution⁶⁹.

These broad focus areas of ICT applications in achieving health MDGs are mostly suggested from the perspective of developed countries where both demand-side and supply-side of information are of prime importance. However, 'information and knowledge society' being a key consideration in development settings⁹⁸ implies that *access to information* should be the base and best represented by demand-driven ICT use. *Knowledge*, as the core of development agenda that fundamentally contributes to interconnect all information-related digital divides³, can be another 'strategic resource' to be exploited in a resource-poor setting.

4. Previous Findings on e-Health

Focusing on information-centered ICT applications in developing countries is relatively a new area in the field of health informatics. Strong evidence-based literature drawn on impact assessments or outcome measurements is even lacking in overall ICT applications in the health sector. Published evidence currently available in this field tends to be at pilot or the proof-of-concept stage.⁹ In many instances, the claims are not independent analyses, rather based on pooled experience, consensus statements, and policies.⁶⁹ However, most of the studies adopted the 'technology rationality' focus which was not the aim of this research.

Submitted: November 3, 2010

Accepted: February 15, 2011

Therefore, this study focused on the findings on IS applications in the health sector in developing countries and attempted to identify the knowledge gap. It first looked at the overall role of ICTs in development and then moved towards the healthcare domain.

4.1. IS in Developing Countries

The importance of the concepts of ‘information’, ‘information first’ to be at the starting point of development ICTs has been propelled by many IS researchers^{51, 36} and ⁵⁵ contribution towards the ‘information-centered ICT’ concept is a key example. The theory of ICT4D propounded by ³⁶ is one of the most relevant prior works. The main findings reveal that ICT applications may only bring marginal direct benefits for poverty reduction and the potential for ICT applications depends on both financial capital plus access to cultural, political and educational resources. Finally, the study suggested with evidence that access to social assets and building trust and confidence through locally contextualized social networks built through community-based initiatives is more important than seeking access to new information from digital ICTs.

With regard to ‘access to information’ in a resource-poor community, ‘information flows via prevailing networks of communication’ is a predominating theme in the recent IS literature. This ‘information-intensive infrastructure’ (e.g. radio network) is a pre-requisite for information diffusion ^{42,46} due to the scarcity of network infrastructure in most developing countries.⁴⁹ It is evidenced by many researchers that information handling technologies with their very function of ‘handling information’, have the advantage to supplement pre-existing technologies by improving information-communication a priori to new ICT innovations (e.g. the Internet).^{36,55,81,88}

It is also justified that combining both old (e.g. user-friendly radio) and new technologies depending on contextual reality has demonstrable benefits.⁶² Multiple ICT routes (e.g. Internet, radio, SMS, PDAs and print materials) are beneficiary for e-learning to link to the latest research and information.⁶⁰ According to technology acceptance theories, in many developing communities the cell phone, not the PC is a pre-occupied medium of information and knowledge-sharing.^{38,48} However, as pointed out by ⁵¹, mismatch of ‘e-development’ versus ‘i-development’ approach without considering the contextual realities of ICTs in development cause failure.

4.2. ICTs in Healthcare in Developing Countries

Although there is a scarce of literature on ‘access to information’, a broader view of ICTs in the health sector in developing countries, finds sufficient studies.⁵⁹ conducted a comprehensive study by focusing on current status, challenges of e-health.⁶⁹ and ²⁴ emphasized on the potential role of ICTs in the management of health communication. Another study by ⁸⁵ embarked on the role of ICTs in health information access and dissemination in Uganda and analysed how information is obtainable through libraries.⁷⁸ outlined the overall ICT activities in Botswana to improve the provision and management of information in the rural healthcare.

The health information systems programme (HISP), a broader network of action research initiatives being undertaken in various public healthcare organizations in developing countries for improving primary health care (PHC) delivery through the use of district health information systems (DHIS) software also enumerates a number of health ICT (HICT) studies.¹⁷

However, most of the HICT studies emphasized on health policy-making e.g. planning, resource allocation, implementation & monitoring of patient health status.¹⁰⁰ For example, ²³ contribution on the development of telehealth in Zambia; ⁷⁰ study on implementing health information systems in Zanzibar focusing on political commitment; ⁶⁵ work on human resource capacity building in the health information system in Tanzania; ⁸³ investigation on implementing challenges on health informatics in developing countries; ⁶⁶ analysis on the challenges of sustainability of health information systems in developing countries, ⁷⁷ emphasis on the contribution to the use of library for dissemination of health information in Sierra Leone; ⁹¹ and ⁹² analysis on the challenges of sustainability of health information systems in developing countries; and the research by ⁷⁵ on telemedicine in rural community are key studies on this area. Table 2 presents a summary of more research focuses/findings on HICTs in developing countries:

Table 2: Research Focuses/Findings on HICTs in Developing Countries.

Authors	Focuses/Findings
⁷¹	Decentralisation and democratic accountability of health IS in developing countries;
²⁷	Demand-driven community tele-centres;
¹⁸	Sustainable HIS across developing countries.

An interesting and common finding is that the management of information mostly through developing information systems (e.g. automation of patient records) in low-income countries is quite dismal for several reasons including data complexity⁸, static nature of database⁶⁸, lack of supports and motivation from participants⁷², lack of technical staff or ‘people-ware’¹¹.

⁵⁵ identified three types of gaps existing in health care information systems (HCIS) domain. These are: (a) mismatch between design rationality and behavioural realities; (b) situational incompatibility, e.g. private sector application copied for public sector; and (c) contextual inconsistency, e.g. application in one country but developed in a different country. Ahmed (2002) argued that these initiatives are at least the building blocks of computer-based information systems by replacing a manual record-keeping system.

5. Conclusion

Throughout the literature review, the generic role of ICTs for data processing and for access to information & knowledge-sharing has been analysed to gather the elaboration of their critical success factors. The anatomy of information-handling technology reveals that in search of the root of any ICT interventions in development, the focus on the contextual realities with a bottom-up approach is essential because these projects are targeted for the poor who are often crippled with vulnerabilities.^{33,64,93} The livelihood approach to grasp the role of ICTs ⁷⁶ may offer a way of thinking towards the poor entangled with vulnerabilities.^{19,87} Before harnessing the potential of ICTs, social structures and processes of their surrounding environment where they live and interacts need to be considered as they affect the lives of the poor.^{22,28,86}

Submitted: November 3, 2010

Accepted: February 15, 2011

The critical analysis suggests that the access to information is meaningless and there cannot be any contribution of information for development until ‘information chain’ is fully exploited. Its four resources i.e. *data resource* (availability of relevant data); *economic resource* (money, skills, and the knowledge) to access data; *social resource* (motivation & confidence) to access, assess and apply data; and *action resource* (money, skills and technology) to take action and decision are crucial for the real access to health information.⁵² Previous studies also suggest that the content-based informal information is of great importance for strategizing ICT applications in the rural healthcare because ‘the poor hold informal information as indigenous knowledge’³⁶ and such a knowledge is “a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information”.³¹

As argued by⁹⁷ ‘new concepts will take time to root’. So, for implementing e-health as a digital strategy to non-digital people, an integrated, pragmatic and visionary approach is more important than plucking any low-ranging fruits. Ultimately, no approach will work until there is any spontaneity among the ultimate beneficiaries.

References

- [1] Abbott, P. (2002) Introducing nursing informatics, *Nursing*, **32**(1), 14.
- [2] Abdelhak, M., Grostick, S., Hanken, M.A. & Jacobs, E. (1996) *Health Information: Management of a Strategic Resource*, W.B. Saunders Company, Pennsylvania, USA.
- [3] Abidi, S.S.R. (2001) Knowledge Management in Healthcare: Towards ‘Knowledge-driven’ Decision-support Services, *International Journal of Medical Informatics*, **63**, 5-18.
- [4] Ahmed, M. (2002) Electronic Birth Registration in Rajshahi, Bangladesh, eGovernment for Development, *Success/Failure Case Study No.16*.
[Online] <http://www.egov4dev.org/success/case/rajshahi.shtml> Accessed 25/10/2010
- [5] Alavi, M. & Leidner D.E. (2001) Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues, *MIS Quarterly*, **25**(1), 107-136.
- [6] Al-Shorbaji, N. (2005) ‘Use of ICT in achieving MDGs in the Eastern Mediterranean Region’, in *WHO Regional Office for the Eastern Mediterranean: Report of an inter-country meeting*, Cairo, Egypt, 17-19 October.
- [7] Altman, K. (2003) Informatics in the care of patients: ten notable challenges, *Western Journal of Medicine*, **166**(2), 182-22.
- [8] Atkinson, C., Tillal, E., Paul, R., & Pouloudi, A. (2001) ‘Investigating integrated socio-technical approaches to health informatics’, *34th Hawaii International Conference on System Sciences*, 3-6 January.
- [9] Batchelor, S. & Norrish, P. (2005) *Framework for the assessment of ICT pilot projects: beyond monitoring and evaluation to applied research*, Information for Development Program (InfoDev), Washington DC.
- [10] Bajpai, N., Sachs, J.D. & Volavka, N. (2005) India’s challenge to meet the millennium development goals, *CGSD Working Paper No. 24*, Center on Globalization and Sustainable Development, The Earth Institute at Columbia University, USA.
- [11] Ball, M.J., Weaver, C.A. & Kiel, J.M. (eds) (2004) *Health Information Management Systems: Cases, Strategies and Solutions*, 3rd edn. Springer, New York.
- [12] Ballantine, J. & Cunningham, N. (1999) ‘Strategic information systems planning: applying private sector frameworks in UK public healthcare’, in *Reinventing Government in the Information Age*, R. Heeks (ed), Routledge, London, 293-311.
- [13] Bellamy, C. (2003) ‘Moving to e-Government: The role of ICTs in the public sector’, in *Public Management and Governance*, T. Bovaird & E. Löffler (eds), London, Routledge, 113-25.
- [14] Bhatnagar, S. (2004) *E-Government: From vision to Implementation*, Sage, New Delhi.
- [15] Blackler, F. (1995) Knowledge, knowledge work and organizations: an overview and interpretation, *Organization Studies*, **16**(6), 1021-1046.
- [16] Braa, J. & Brobel, B. (2003) Strategies for Developing Health Information Systems in Developing Countries, in *WITFOR 2003 WhiteBook*, D. Khakar (ed.), IFIP Press, Luxemburg, 175-219.
- [17] Braa, J. & Hedberg, C. (2002) The Struggle for District-Based Health Information Systems in South Africa, *Information Society*, **18**(2), 113-127.

Submitted: November 3, 2010

Accepted: February 15, 2011

- [18] Braa, J., Monteiro, E. & Sahay, S. (2004) Networks of Action: Sustainable Health Information Systems across Developing Countries, *MIS Quarterly*, **28**(3), 337-362.
- [19] Carney, D. (1999) *Sustainable Livelihood Approaches Compared*, Department for International Development, London.
- [20] Castells, M. (1989) *The informational city: information technology, economic restructuring and the urban-regional process*, Blackwell, Oxford.
- [21] Castells, M. (2001) *The Internet galaxy*, Oxford University Press, Oxford.
- [22] Chambers, R. & Conway, G.R. (1992) Sustainable Rural Livelihoods: Practical Concepts for the 21st Century, *Discussion Paper 296*, Institute for Development Studies, University of Sussex, UK.
- [23] Chanda, K.L. & Shaw, J.G. (2010) The development of telehealth as a strategy to improve health care services in Zambia, *Health Information and Libraries Journal*, **27**, 133-139.
- [24] Chandrasekhar, C.P. & Ghosh, J. (2001) Information and Communication Technologies and Health in Low Income Countries: The Potential and the Constraints, *Bulletin of the World Health Organisation*, **79**(9), 850-855.
- [26] Chen, H. (2001) *Knowledge Management Systems: A Text Mining Perspective*, The University of Arizona, Tucson, AZ.
- [27] Colle, R.D. & Roman, R. (2005) 'Towards Demand-driven Community Telecentres', in *Information Systems in Developing Countries: Theory and Practice*, R.M. Davidson, R.W. Harris, S. Qureshi & D.R. Vogel (eds), City University of Hong Kong Press, Hong Kong, 113-129.
- [28] CPRC (2008) *Escaping Poverty Traps: The Chronic Poverty Report 2008-09*, Chronic Poverty Research Centre, Manchester, UK.
- [29] Daft, R.L. (2004) *Organization Theory and Design*, 8th edn. Thomson, Ohio.
- [30] Danida (2005) *Lessons learned in the health sector*, Ministry of Foreign Affairs, Denmark
 [Online] http://www.ivs.life.ku.dk/English/Nyheder/2010/~media/Ivp/docs/pdf/Full_note_Danida_8_case_stories.ashx Accessed 23/09/2010
- [31] Davenport, T. H. & Prusak, L. (1998) *Working Knowledge: how organizations manage what they know*, Harvard Business School Press, Boston, MA.
- [32] Davis, H.T.O. & Nutley, S.M. (1997) The rise and rise of evidence in health care, *Public Money and Management*, **19**(1), 9-16.
- [33] DfID (1999) *Sustainable Livelihood Guidance Sheets*, Department for International Development, London.
- [34] di Villosa, F.N. (1998) *Information, Management and Participation: A New Approach from Public Health in Brazil*, Frank Cass Publishers, London.
- [35] Dodd, W. & Fortune, J. (1995) 'An electronic patient record project in the United Kingdom: can it succeed?', in *Medinfo 1995*, R.A. Greenes, H.E. Peterson & D.J. Protti (eds), Healthcare Computing and Communications Canada, Edmonton, 301-204.
- [36] Duncombe, R. (2007) Using the Livelihoods Framework to Analyze ICT Applications for Poverty Reduction through Microenterprise, *The Massachusetts Institute of Technology Information Technologies and International Development*, **3**(3), 81-100.
- [37] Duncombe, R. (2009a) *Health and ICTs*, ICTs and Socio-Economic Development course unit handout (Lessons/Feedback for Health and ICT Case Studies), IDPM, University of Manchester, UK, 26 November.
- [38] Duncombe, R. (2009b) Assessing the Potential for Mobile Payments in Africa: Approaches and Evidence from Uganda, *Development Informatics Working Paper No. 41*, Centre for Development Informatics, University of Manchester, UK.
 [Online] http://www.sed.manchester.ac.uk/idpm/research/publications/wp/di/documents/di_wp37.pdf Access 24/10/2010
- [39] Duncombe, R. & Heeks, R.B. (2002) Enterprise across the Digital Divide: Information Systems and Rural Micro-enterprise in Botswana, *Journal of International Development* **14**(1), 61-74.
- [40] Dzenowagis, J. (2005) *Connecting for health: global vision, local insight*; Report for the World Summit for the Information Society, World Health Organization, Geneva.
- [41] European Commission (2006) *ICT for Health and i2010: Transferring the European Healthcare Landscape - Towards a Strategy for ICT for Health*, European Commission for Society and Media, Belgium.
- [42] Flamm, K. (1987) *Targeting the computer: Government support and international competition*, Brookings Institution, Washington, DC.
- [43] Greenberg, A. (2005) *ICTs for Poverty Alleviation: Basic tool and enabling sector*, SIDA, Stockholm.
- [44] Godlee, F., Pakenham-Walsh, N., Ncayiyana, D., Cohen, B. & Packe, A. (2004) *Can we achieve health information for all by 2015?* *Lancet*
 [Online] <http://image.thelancet.com/extras/04art6112web.pdf> Accessed 22/10/2010

Submitted: November 3, 2010

Accepted: February 15, 2011

- [45] Gustafson, D.H., Hawkins, R., Boberg, E.W., Pingree, S., Serlin, F. & Graziano, F., (1999) Impact of patient centered computer-based health information and support systems, *American Journal of Preventive Medicine*, **16**, 1-9.
- [46] Hanna, N. (1994) Exploiting information technology for development: A case study of India, *World Bank Discussion Paper No. 264*, The World Bank, Washington, DC.
- [47] Hansen, M.T., Nohria, N. & Tierney, T. (1999) What's Your Strategy for Managing Knowledge?, *Harvard Business Review*, March-April, 106-116.
- [48] Harvey, J. & Sturges, P. (2010) The cell phone as appropriate information technology, *Information Development*, **26**(2), 148-159.
- [49] Hearthfield, H. & Louw, G. (1999) New Challenge for Clinical Informatics: Knowledge Management Tools, *Health Informatics Journal*, **5**(2), 67-73.
- [50] Heeks, R. (1999) Information and Communication Technologies, Poverty and Development, *Development Informatics Working Paper No. 5*, Institute for Development Policy and Management, University of Manchester. [Online] www.sed.manchester.ac.uk/idpm/publications/wp/di/index.htm Accessed 22/10/2010
- [51] Heeks, R.B. (2002) i-Development not e-Development: Special Issue on ICTs and Development, *Journal of International Development*, **14**(2), 1-11.
- [52] Heeks, R.B. (2005a) Foundations of ICTs in Development: The Information Chain, *eDevelopment Briefing No. 3*, Centre for Development Informatics, University of Manchester, UK. <http://www.sed.manchester.ac.uk/idpm/research/publications/wp/di/short/DIGBriefing3Chain.pdf> Accessed 23/07/2010
- [53] Heeks, R.B. (2005b) 'ICTs and the MDGs: On the Wrong Track?' Briefing Paper, Centre for Development Informatics, University of Manchester, UK. [Online] http://www.sed.manchester.ac.uk/idpm/research/publications/wp/di/short/di_sp07.pdf Accessed 23/08/2010
- [54] Heeks, R.B. (2010) Do Information and Communication Technologies (ICTs) Contribute to Development?, *Journal of International Development*, **22**, 625-640.
- [55] Heeks, R. B. & Duncombe, R. (1999) Information, ICTs and Small Enterprise: Findings from Botswana, *Development Informatics Working Paper No. 7*, Centre for Development Informatics, University of Manchester. [Online] www.sed.manchester.ac.uk/idpm/publications/wp/di/index.htm Accessed 24/10/2010
- [56] HISA (2004) *Providing Leadership in eHealth*, Health Informatics Society of Australia (HISA). [Online] <http://www.hisa.org.au/> Accessed 14/10/2010
- [57] Hornik, R.C. (1988) *Development communication: information, agriculture, and nutrition in the Third World*, Longman, New York.
- [58] Hovenga, E., Kidd, M. & Cesnik, B. (eds) (1996) *Health Informatics: an overview*, Churchill Livingstone, South Melbourne, Australia.
- [59] InfoDev (2006) Improving Health, Connecting People: The Role of ICTs in the Health Sector of Developing Countries, *Working Paper No. 7*, Information for Development Program (InfoDev), Washington, DC. [Online] <http://www.infodev.org/en/Publication.84.html> Accessed 27/10/2010
- [60] ITU (2005) *Making better access to healthcare services*, National Institute of Information and Communications Technology, Tokyo.
- [61] Jamison, D. T., Breman J.G., Measham, A. R., Alleyne, G., Claeson, M., Evans, D. B., Jha, P., Mills, A. & Musgrove, P. (eds) (2006) *Priorities in Health*, The World Bank, Washington, DC. [Online] <http://catalogue.nla.gov.au/Record/3700540?lookfor=subject:%22Public%20health%20-%20Developing%20countries.%22&offset=20&max=78> Accessed 11/10/2010
- [62] Kenny, C. (2002) Information and Communication Technologies for Direct Poverty Alleviation: Costs and Benefits, *Development Policy Review*, **20**(2), 141-57.
- [63] Kenny, C. (2006) *Overselling the Web? Development and the Internet*, Lynne Rienner Publishers Inc., Colorado.
- [64] Khaleda, N. (2001) *Governance of the Health Care Sector in Bangladesh*, University Press Ltd, Dhaka.
- [65] Kimaro, H.C. (2006) Strategies for Developing Human Resource Capacity to Support Sustainability of ICT based Health Information Systems: A Case Study from Tanzania, *The Electronic Journal of Information Systems in Developing Countries*, **26**(2), 1-23.
- [66] Kimaro, H.G. & Nhampossa, J.L. (2007) The challenges of sustainability of health information systems in developing countries: comparative case studies of Mozambique and Tanzania, *Journal of Health Informatics in Developing Countries*, **1**(1), 1-10.
- [67] Kuhn, K.A. (2004) 'Global Outlook for Health Information and Communication Technologies', in *Health Information Management Systems: Cases, Strategies and Solutions*, 3rd edn, M.J. Ball, C.A. Weaver, & J.M. Kiel (eds), Springer, New York, 553-567.

Submitted: November 3, 2010

Accepted: February 15, 2011

- [68] Lorenzi, M.L. & Riley, R.T. (2003) *Managing Technological Change: Organizational Aspects of Health Informatics*, 2nd edn. Springer, New York.
- [69] Lucas, H. (2008) Information and Communications Technology for Future Health Systems in Developing Countries, *Social Science & Medicine*, **66**, 2122-2132.
- [70] Lungo, J.H. & Iqbal, F. (2008) Development of Health Information System in Zanzibar: Practical Implications, *Journal of Health Informatics in Developing Countries*, **2**(1), 24-32.
- [71] Madon, S., Krishna, S.K. & Michael E. (2010) Health Information Systems: Decentralisation and Democratic Accountability, *Public Administration and Development*, John Wiley & Sons. [Online] <http://onlinelibrary.wiley.com/doi/10.1002/pad.571/pdf> Accessed 23/10/2010
- [72] Madon, S., Sahay, S. & Sudan, R. (2007) E-government Policy and Health Information Systems Implementation in Andhra Pradesh, India: Need for Articulation of Linkages between the Macro and the Micro, *The Information Society*, **23**(5), 327-344.
- [73] Mansell, R. & When, U. (1998) *Knowledge Societies: Information Technology for Sustainable Development*, OUP, Oxford.
- [74] Marker, P., McNamara, K. & Wallace, L. (2002) *The significance of information and communication technologies for reducing poverty*, DFID, London. [Online] http://www.oecd.org/dac/ictcd/docs/matrixdocs/GBR_paper1.pdf Accessed 30/09/2010
- [75] Martinez, V., Villarroel, J., Seoane, J. & del Pozo, F. (2005) Analysis of Information and Communication Needs in Rural Primary Health Care in Developing Countries, *IEEE Transactions on Information Technology in Biomedicine*, **9**(1).
- [76] McNamara, K. S. (2003) *Information and Communication Technologies, Poverty and Development: Learning from Experience, Framework for Thinking about ICTs, Poverty, and Development*, Information for Development Program (InfoDev), The World Bank, Washington, DC.
- [77] M'Jamtu-Sie, N. (2003) Disseminating Health Information in Sierra Leone: The challenge, *Information Development*, **19**, 250-254.
- [78] Moahi, K.H. (2009) 'ICT and Health Information in Botswana: towards the Millennium Development Goals', *Information Development*, **25**, 198-206.
- [79] Moyi, E. D. (2003) Networks, Information and Small Enterprises: New Technologies and the Ambiguity of Empowerment, *Information Technology for Development* **10**, 221-32.
- [80] Nonaka, I. (1994) A Dynamic Theory of Organizational Knowledge Creation, *Organization Science*, **5**(1), 14-37.
- [81] Narasimhan, R. (1983) The socioeconomic significance of information technology to developing countries, *The Information Society* **2**(1), 65-79.
- [82] Oh, H., Rizo, C., Enkin, M. & Jadad, A. (2005) What is eHealth (3): a systematic review of published definitions, *Journal of Medical Internet Research*, **7**(1). [Online] <http://www.jmir.org/2005/1/e1/> Accessed 20/09/2010
- [83] Oak, M.R. (2007) A review on barriers to implementing health informatics in developing countries, *Journal of Health Informatics in Developing Countries*, **1**(1), 19-22.
- [84] Ojo, T. (2006) Communication networking: ICTs and health information in Africa, *Information Development*, **22**(2), 94-101.
- [85] Omona, W. & Ikoja-Odongo, R. (2006) Application of information and communication technology (ICT) in health information access and dissemination in Uganda, *Journal of Librarianship and Information Science*, London, **38**(1), 45-55.
- [86] Osman, F.A. (1999) The Dynamics of the Public Policy Making Process: A Case Study of the Health Policy of Bangladesh, *PhD Thesis*, Department of Government, University of Manchester, UK.
- [87] Phillips, D.R. (1990) *Health and Health Care in the Third World*, Longman, Harlow, UK.
- [88] Pigato, M. (2001) Information and Communication Technology, Poverty and Development in Sub-Saharan Africa and South Asia, *Africa Region Working Paper Series No. 20*, The World Bank, Washington, DC.
- [89] Polanyi, M. (1962) *Personal Knowledge: Towards a Post-Critical Philosophy*, Harper Torchbooks, New York.
- [90] Polanyi, M. (1967) *The Tacit Dimension*, Routledge and Keon Paul, London.
- [91] Raghupathi, W. (1997) Health care information systems, *Communications of the ACM*, **40**(8), 81-82.
- [92] Sahay, S. & Walsham, G. (2006) Scaling of Health Information Systems in India: Challenges and Approaches, *Information Technology for Development*, **12**(3)165-200.
- [93] Seabrook, J. (2001) *Freedom Unfinished: Fundamentalism and Popular Resistance in Bangladesh Today*, Zed Books, London.
- [94] Sein, M.K. & Harindranath, G. (2004) Conceptualizing the ICT Artifact: Toward Understanding the Role of ICT in National Development, *The Information Society*, **20**, 15-24.

Submitted: November 3, 2010

Accepted: February 15, 2011

- [95] Suggs, L. S. (2006) A 10-year retrospective of research in new technologies for health communication, *Journal of Health Communication*, **11**(1), 61-74.
- [96] UN ICT Task Force (2005) Tools for Development: Using Information and Communications Technology to Achieve the Millennium Development Goals, *Working Paper*.
[Online] <http://www.unicttaskforce.org/perl/documents.pl?id=1275> Accessed 17/10/2010
- [97] Walsham, G. (1993) *Interpreting Information Systems in Organizations*, Wiley, Chichester.
- [98] Webster, F. (1995) *Theories of the information society*, Routledge, London.
- [99] Whetton, S. (2005) *Health Informatics: A Socio-Technical Perspective*, Oxford University Press, Victoria, Australia.
- [100] WHO (1994) Information Support for New Public Health Action at the District Level – Report of a WHO expert committee, World Health Organization, *Technical Report Series No. 845*, Geneva:1-31.
[Online] <http://apps.who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan=1&codcol=10&codcch=845> Accessed 20/10/2010
- [101] WHO (2005a) *Health and the Millennium Development Goals*, World Health Organization, Geneva.
[Online] http://www.who.int/mdg/publications/mdg_report/en/index.html Accessed 19/10/2010
- [102] WHO (2005b) *eHealth tools and services: Needs of Member States*. World Health Organization, Geneva
[Online] http://www.who.int/kms/initiatives/tools_and_services_final.pdf Accessed 13/10/2010
- [103] World Bank (2009) *Information and Communications for Development: Extending Reach and Increasing Impact*, The World Bank, Washington, DC.
[Online] <http://allafrica.com/sustainable/resources/view/00011823.pdf> Accessed 12/10/2010