Using Health Information Systems to Solve the Shortage of Medical Experts in Rural Communities

Vikash Ramharuk

Abstract

Technology has advanced beyond expectations. For instance, people use unlimited computing power at unlimited speeds with unlimited storage. The Internet also provides universal connectivity. Information technology (IT) is increasingly applied in the health sector. Applications of information and communication technologies (ICT) to the health sector include Electronic Patient Records, Health Information Systems (HIS), the setup of Intranets and secure Extranets via the Internet, and for sharing information among institution and individual participants in the health sector, the use of public networks such as the Internet to distribute information, Health Decision Support Systems, the provision of remote diagnostics via Telemedicine, and Community Health Information System for local, regional and national health planning. The overall goal of the research was to investigate alternative applications of Telecentres and HIS to help assess healthcare information. In doing so, it enhances the knowledge of the development of healthcare information resources. It identified some key areas that planners of HIS should include in their strategic planning.

Keywords

Healthcare, Health Informatics, Internet, Telecentres.

1. Introduction

The rapid growth and the increasing scope of services and widening of network connections are making the application of technology such as the use of Palm Digital Assistants (PDAs), Electronic Patient Records (EPR) and Decision Support Systems (DSS) in the healthcare sector inevitable. One of the many applications that were inevitable was universal access to healthcare information and services made possible by the growth of the Internet (Godlee, 2004). However, what is not taken into consideration is access to primary health care, especially for those in rural communities (The African Development Forum, 2000). People from disadvantaged communities have no access to the Internet let alone own a telephone or a personal computer in his or her house (Godlee, 2004). The next section will review relevant literature to ensure a proper prior knowledge base.

2. Literature Review

2.1 Information and Communication Technologies for the Health Sector in Africa

The gap between the developed and the developing world that exists in information and communication services is also present in the health sector (The African Development Forum, 1999). Researchers such as Haux (2002), Hammond (2003) and Kusakabe (2005) are under the impression that the health sector is fifteen years behind other sectors in application of ICT. At the same time, it appears as though the gap between Africa and the developed world in the health sector is widening. Investment in ICT in the health sector in Africa could complement health services provision. By replacing traditional paper-based operations with flexible electronic means, new technologies could bring cost reduction and effectiveness in terms of timely delivery of services in Africa.

2.2 Improving Information Access for Healthcare Providers

Most healthcare providers in developing countries continue to lack access to the information they need to deliver the best possible healthcare with

available resources (The African Development Forum, 2000). However, progress has been made in many areas: increasing availability of ICT; increasing number and range of health information support programmes; increased availability of free resources on the Internet; evolution of an international community committed to improving health information access; and increasing political interest in access to healthcare information as a key development issue (Lallement *et al.*, 2004). Healthcare providers are a diverse group with widely varying social, educational, cultural, economic, and behavioural attributes. They have a variety of information needs: the needs of a community health worker in rural Kenya are different from those for instance in Kathmandu (Godlee, 2004).

2.3 Medical Informatics

Medical informatics helps gather and record facts, and to interpret them in order to participate to the process of care or to build new medical knowledge. But at the same time they are conceived and built, computerized medical applications that change the health-care system itself and its efficiency by modifying the relationships between the actors of the system and by creating new opportunities or problems (Degoulet & Fieschi, 1997).

According to Rothschild *et al.* (2004) a system is a set of interrelated elements, with each element connected to every other element directly or indirectly. A hospital is a type of system, yet healthcare IT has largely failed to view it as such (Rothschild *et al.*, 2004). HIS are primarily there to support hospital activities on operational, tactical and strategic levels. However, they form another level of important building blocks in the national health system to allow appropriate management information allowing appropriate levels of control (Economic Commission for Africa, 1999). In South Africa, for example, there is a system in place to request a standard monthly hospital report form from public and private sector hospitals, which is complementary to the information systems at individual hospitals (The African Development Forum, 1999). It appears as though computerized HIS are being implemented in an increasing number of hospitals in Africa.

2.4 Research Questions

Much of the literature addressed the problems faced in the health sector, especially in Africa but the following still remains a problem:

- What measures should be undertaken to ensure an efficient, advanced, and yet affordable future Health Information System?
- What purpose should Electronic Patient Records serve?
- Define the issues involved in improving access to healthcare information?

2.5 Conclusion

Technology has advanced far beyond expectations. IT can help improve the medical care in Africa. It is increasingly used to improve HIS. The problem is, however, that many communities cannot use this because there is no facility around to do it.

3. Research Methodology

The participants of the study were patients from the local community clinic and learners from the Tongaat Secondary School. The sample size was 118, which constitutes a census of all the grade 11 and grade 12 learners at the school, together with patients from the local community clinic. The sample is representative of the number of patients a doctor at the local community clinical attends to on a daily basis. The questionnaire consisted of 28 questions of which 7 were open ended questions. A total of 118 questionnaires were collected from respondents from both rural and urban areas.

4. Presentation of Results

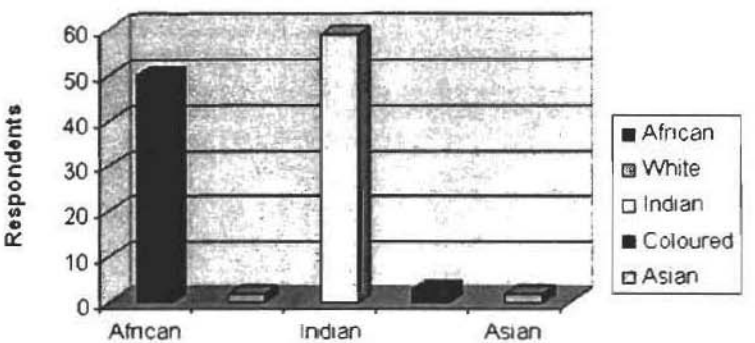
In this section the results of the survey are presented and interpreted.

4.1 Ethnic Composition of the Sample

As compared to the samples taken by the Economic Commission of Africa (2000) and the African Development Forum (2000), which specifically targeted rural areas in Africa where clean water and electricity appears to be

a luxury, this sample is a combination of both respondents. In addition this sample highlights the inequalities all exist in access to healthcare information within a community as small as Tongaat.

Figure 1: Respondents by Race



4.2 Level of Computer Literacy of the Sample

The computer literacy amongst rate the respondents show that not only is there a digital divide in Africa but it is also present in a small community such as Tongaat. The majority of the African respondents do not own a computer or have an alternate place to access computers. One of the factors that contribute to the level of computer illiteracy among the African race is that many of the respondents were at a school where they were exposed to computers. Had it not been for this, then of the African respondents above the ages of 20 only 10% (5) are computer literate.

The count implies that four different races were used. The ANOVA shows the results of the completely randomized analysis of variance. In this set of data, since the calculated F=0.85 is less than the tabled F, Fcrit=4.26, the null hypothesis is accepted that the level of computer literacy, alternative access to computers and possession of a computer at one's home is all dependent on the race of the individual.

4.3 Willingness to Pay for Healthcare

Although great strides have been made over the last century in preventing diseases and extending life in the developed world, the situation in the African region remains bleak (Kusakabe, 2005). The reason for this is most likely due to insufficient funds. Many of the respondents are unable to pay for healthcare and visit the local community clinical as treatment is free. The researcher *cites* one of the respondents: "I will never be got dead at the local community clinic". When asked the reason for not wanting to visit the local community clinic, one of the respondents answered: "I just don't trust the treatment and service available even though it's free".

The majority of the respondents feel that they should be paying for primary healthcare. However, 29% (34) of the respondents feel that they should not be paying for healthcare. Among the respondents that feel that they should not be paying for healthcare, a majority of them argue that they were promised free healthcare by the government.

Table 1: Willingness of Respondents to pay for Healthcare

Age Group	Employed	Willing to Pay for Healthcare
0 – 19	0.075% (1)	80% (54)
20 – 29	62% (13)	77% (16)
30 – 39	100% (12)	58% (7)
40 – 49	88% (7)	43% (3)
50 and over	25% (2)	0% (0)

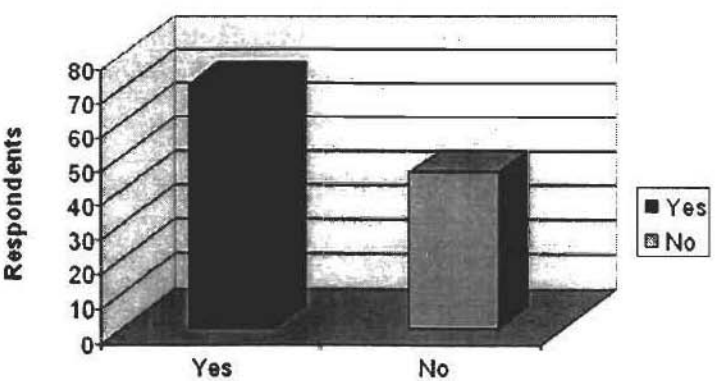
Table 1 illustrates that as the percentage of employed respondents increases so does the percentage of the respondents willing to pay for healthcare. However, as the percentage of unemployed respondents increases, the percentage of respondents willing to pay for healthcare decreases. Therefore, by developing Telecentres and improving HIS in these rural areas will not only improve access to proper healthcare but also create job opportunities for many of these community members. This will in turn put many of the community members in a better position to be willing to pay for healthcare.

The ANOVA shows that the total sum of squares within groups is 2.26, while the total sum of squares about the mean ignoring the groups is 2.29. The grouping accounts for a sum of squares of 0.02. The F statistic is 0.06 and this has a p-value of 0.98. In this set of data, since the calculated F=0.07 is less than the tabled F, Fcrit=3.24, the hypothesis is accepted that the respondents that are employed are more willing to pay for healthcare as compared to those respondents that are unemployed.

4.4 Using HIS for Medical Diagnosis

It's a fact that there is a shortage of medical professionals in Africa (The African Development Forum, 2000). People staying in rural areas have to travel several kilometres in order to receive medical treatment and in most cases wait on average between one to two hours in doing so. Figure 2 illustrates the number of respondents that are willing to undergo treatment using HIS.

Figure 2: Willingness to undergo treatment using Health Information Systems



The development, strived by many individuals, to replace the patient record by a life long health record has not yet been established (Haux, 1997). Data relevant to patient care are still primarily held separately by the various institutions involved in the care process. However, the importance of

internationally available data that is accessible via the Internet and chip cards will increase (Haux, 1998). The researcher share the view of Haux that exchange of patient data should to a large degree done electronically.

4.5 Knowledge of Health Information Systems

Many of the respondents coming from rural areas and impoverished backgrounds had no idea what so ever what a Health Information System is or what is its function. As compared to the respondents from urban areas only a few did not know what a Health Information System is and what is its function. This could be attributed to the digital divide between the rich and poor not only between the small community of Tongaat but also throughout the world. According to the Economic Commission of Africa (2000) the health sector is about 15 years behind other sectors in application of information and communication technologies and at the same time the gap between Africa and the developed world in the health sector is widening.

Table 2: Knowledge of Health Information Systems

Background	Know what Health Information Systems are	Do Not Know what Health Information Systems are
Rural Area	28% (14)	72% (36)
Urban Area	57% (39)	43% (29)
Total	42.5% (53)	47.5.% (65)

Table 2 indicates that the majority of respondents coming from rural areas have no idea what a HIS is nor do they know what the function of HIS is. This is probably due to the fact that many of the respondents from the rural areas have not been to school and only 10% (5) of African respondents above the age of 20 are computer literate. The researcher is of the opinion that even though many of the respondents from the rural areas have no idea

what the function of a HIS is they should at least have an alternate place to access computers.

Table 3: Using Health Information Systems for Medical diagnosis and Treatment

	Will use Health Information Systems for medical diagnosis	Will not use Health Information Systems for medical diagnosis	Will undergo treatment using Health Information Systems	Will not undergo treatment using Health Information Systems
Knowledge of Health Information Systems	86% (46)	14% (7)	78% (41)	22% (12)
No Knowledge of Health Information Systems	52% (34)	48% (32)	48% (32)	52% (34)

In Table 3 it can be concluded that as the percentage of respondents having some knowledge of HIS increases, so too does the percentage of respondents willing to use HIS for medical diagnosis and undergo treatment using HIS. This could be attributed to the fact that of the respondents that are not willing to use HIS for medical diagnosis many of them are not exposed to the latest technology available and therefore are unaware of the potential benefits that lie with these technologies.

Table 4: Covariance – Knowledge of Health Information Systems

Covariance

	Rural Area	*Urban Area*
Rural Area	0.0484	
Urban Area	-0.0154	0.0049

Both the entries of the covariance output table are less than 0.05 (Alpha) which means that the hypothesis is accepted that respondents living in urban areas have a greater knowledge of HIS as compared to respondents living in rural areas. This could be attributed to the fact that respondents living in urban areas are more exposed to technology as compared to respondents living in rural areas who have little or no exposure to technology.

4.6 Internet Usage for Healthcare

It appears as though important progress has been made in many areas of the health sector. The growth in access to the Internet and e-Mail have increased the possibility for interaction at local, regional, and international level, in addition more content is available to a growing number of people, especially those in tertiary institutions, hospitals, research institutions and urban settings (Godlee, 2004).

Figure 3: Respondents that have phoned or used the Internet for medical advice

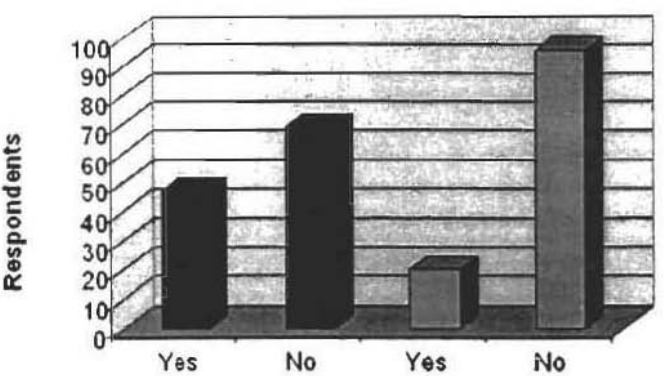


Figure 3 shows that 40% (47) of the respondents have previously phoned for medical advice, However, only 17% (20) of the respondents have ever used the Internet for medical advice.

Table 5: Internet usage for medical advice

	Will use the Internet for medical advice	Will use the Telephone for medical advice
Male	48% (30)	42% (26)
Female	76% (42)	41% (23)
Total	62% (72)	41,5% (49)

As mentioned previously only 17% (20) of the respondents reported having used the Internet for medical advice before. Of the present sample, , 62% (72) of the respondents agreed that they would use the Internet for medical advice if given the opportunity. Table 5 also reveals a greater willingness among females to use the Internet for medical advice than among males. Just over 75% (42) of the female respondents agreed that if given the opportunity, they will use the Internet for medical advice, while only 48% (32) of the male respondents agreed that if given the opportunity, they will use the Internet for medical advice.

Table 6: t-Test - Internet Usage for Healthcare

t-Test: Paired Two Sample for Means

	Will use the Internet for medical advice	*Will use the Telephone for medical advice*
Mean	0.62	0.415
Variance	0.0392	5E-05
Observations	2	2
Pearson Correlation	-1	
Hypothesized Mean Difference	0	
df	1	
t Stat	1.413793103	
P(T<=t) one-tail	0.195957897	
t Critical one-tail	6.313751514	
P(T<=t) two-tail	0.391915794	
t Critical two-tail	12.70620473	

The p-value of the observed statistic is 0.40. Since this value is greater than 0.05 it can be concluded that both the Internet and Telephone could be used extensively for medical advice.

4.7 Telecentres

It appears as though many of the rural communities suffer from lack of primary care physicians or specialized healthcare professionals. This inadvertently leads to rural community members travelling a great distance in order to receive proper healthcare services which in turn lead to over population of patients and local clinics, to such an extent that the ratio of patients to a single doctor exceeds three hundred to one. The respondents were asked to indicate the number of hours the wait in order to receive healthcare and the distance they travel in doing so.

Table 7: Time spent and distance travelled to receive healthcare

Background	Time spent waiting in order to receive healthcare	Distance travelled in order receive healthcare
Rural Area	48.88 minutes	10 kilometres
Urban Area	27.24 minutes	6 kilometres
Total	38.06 minutes	8 kilometres

4.8 t-Test to Analyze Distance Travelled and Time Spent to Receive Healthcare

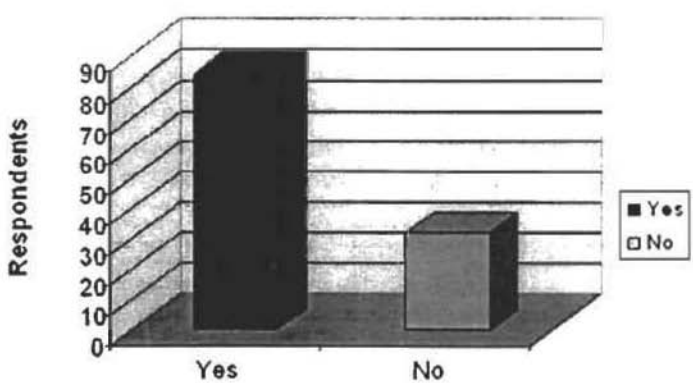
Table 8: t-Test - distance travelled and time spent to receive healthcare

t-Test: Paired Two Sample for Means

	Time spent waiting in order to receive healthcare	*Distance travelled in order receive healthcare*
Mean	38.06	8
Variance	234.1448	8
Observations	2	2
Pearson Correlation	1	
Hypothesized Mean	0	
df	1	
t Stat	3.406163265	
P(T<=t) one-tail	0.090846575	
t Critical one-tail	6.313751514	
P(T<=t) two-tail	0.18169315	
t Critical two-tail	12.70620473	

The t-statistic is 3.41. A two tailed test was used since the researcher is comparing both the distance travelled and time spent in order to receive healthcare from respondents living in both rural and urban areas for negative as well as positive skewing, where negative skewing relates to occurrences lower than the predicted average and positive skewing to occurrences higher than the predicted average. The p-value of the observed statistic is 0.18. Since this value is greater than 0.05, it indicates that on average, respondents from rural areas travel a greater distance and spend more time waiting for healthcare as compared to respondents living in urban areas. The t Critical value indicates how big the t-statistic would have to be in order to be significant. To be significant at the 5% level, the t statistics has to be 1.75 for a one-sided test and 2.13 for a two-sided test. If the sample sizes are larger then these values will be slightly smaller.

Figure 4: Respondents that intend using the Telecentre for Health Informatics



More than 60% (69) of all respondents do not know what a Telecentre is and more importantly 76% (38) of the respondents living in rural areas have no idea what the purpose or the function of a Telecentre is. This shows that Telecentres are required. However, on a more positive note 77% (92) of the respondents agreed that building a Telecentre will help improve the standard of medical information access.

4.9 Using Correlation to Analyze whether Telecentres could Improve Access to Medical Information

Table 9: Correlation - Telecentres will improve access to medical information

Correlation

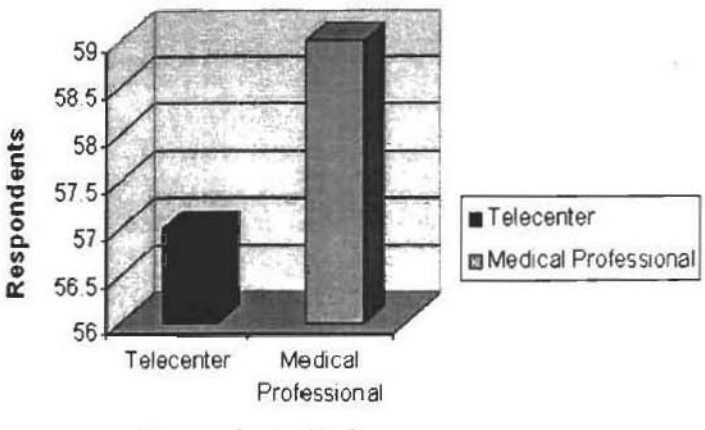
	Knowledge of Telecenters	No Knowledge of Telecenters	Telecenters will improve medical information access	Telecenters will not improve medical information access
Knowledge of Telecenters	1			
No Knowledge of Telecenters	-1	1		
Telecenters will improve medical information access	1	-1	1	
Telecenters will not improve medical information access	-1	1	-1	1

The entries on the diagonal of the correlation output table are all greater then 0.05 (Alpha). The hypothesis is therefore rejected indicating that the respondents who have some knowledge of Telecentres agree that a Telecentre will improve medical information access. On the other hand many of the respondents from rural areas have no idea what a Telecentre is and are unaware of the potential benefits that lie in developing Telecentres in rural areas.

4.10 Telecentre Access Versus Consulting a Medical Professional

Figure 5 indicates that 48% (57) of the respondents agreed that they will use the Telecentre for minor illnesses and 52% (61) of the respondents preferred visiting a medical professional then using a Telecentre for minor illnesses.

Figure 5: Telecentre versus consulting a Medical Professional



The researcher is of the opinion that the reason stated by many of the respondents not to use the Telecentre for minor illnesses is due to the fact that 76% (38) of the respondents from the rural communities have no idea what a Telecentre is or its function and this is depicted by Table 10.

Table 10: Telecentre versus Medical Professional

Age Group	Telecentre	Medical Professional
0-19	85% (57)	15% (10)
20-29	76% (16)	24% (5)
30-39	46% (6)	54% (6)
40-49	40% (3)	60% (5)
50 and over	12% (1)	88% (9)
Total	52 % (83)	48% (35)

The table illustrates that if it is faster and cheaper to receive healthcare using Telecentres 52% (83) of the respondents agreed on using the Telecentre while 48% (35) of the respondents would rather visit a medical professional. This is an increase of 4% as compared to Figure 2 (Section 4.3.). In a recent survey carried out by the researcher, after visiting

five of the local general practitioners in Tongaat it was calculated that a visit to the local general practitioner will set a patient back in the range of one hundred and twenty to one hundred and fifty Rand.

4.11 Using ANOVA to Analyze Medical Professionals Versus Telecentres

The F ratio of 0.04 is much less then the Fcrit ratio of 5.32. This indicates that if given the opportunity, respondents are more then willing to use a Telecentre for minor illnesses than compared to a medical professional. This could be attributed to the fact that the Telecentre will be considerably cheaper as compared to visiting a medical professional for minor illnesses and also the respondents will not have to travel many a mile in order to receive healthcare as the Telecentre should be developed in these rural areas and made easily accessible to the community members.

4.12 Conclusion

The gap between the developed and developing countries continues to widen, and this is most evident in the African countries especially within the health sector (The African development Forum, 2000). However, they state that ICT applications present a considerable opportunity to narrow the expertise gap especially in rural areas. The benefits of offering rural and impoverished communities reliable and accurate access to the Internet and communication services are endless. The statistics calculated and given above all demonstrate this.

Lallement *et al.* (2004) note that there are inherent conflicts between the sustainability objective and the desire to assist those most in need - the poor, disadvantaged and un-electrified rural communities. In other words he states that the establishment and operation of Telecentres, Internet connectivity and communication services in marginal areas have to be treated as social investment projects with subsidies justified on equity grounds.

5 Answers to Posed Research Questions

The following are the questions posed. The researcher will answer these questions based on the analysis and findings and the reviewed literature.

5.1 What measures should be undertaken to ensure an efficient, advanced and yet affordable future Health Information System?

On the brink of the 21st century, numerous institutions and people have concerned themselves with the future development of ICT and healthcare provision (Haux *et al.*, 2002). The three decisive factors to ensuring an efficient advanced and yet affordable Health Information System are the development of the population, advances in medicine and advances in health informatics.

5.2 What purpose should Electronic Patient Records serve?

The use of medical data such as the Electronic Patient Record is empirical in order to achieve patient-centred recordings for cooperative care. Haux *et al.*, (2002) state that patient-centred refers to healthcare across healthcare institutions and to the fact that information processing are not concentrated around just one hospital. It also means that all healthcare professionals, especially physicians and nurses, have access to relevant patients' data, according to their respective authorizations.

5.3 What are some of the issues involved in improving access to healthcare information?

Although only aggregated data may be made available via HIS the quality of input data should not be compromised. The training of Health Information System staff should be considered very important in terms of sustainability. Establishing HIS should be logically linked with the concepts of Telecentres in areas under serviced in terms of ICT infrastructure.

6 Recommendations

The main goal of the research project was to ensure that everyone has access to relevant, reliable, and up to date healthcare information that they can understand and act upon. In order to reach this goal, the researcher makes the following recommendations for action on the part of the Government of South Africa and its partners.

The researcher suggests the launching of a special initiative to improve access to healthcare information in the developing world. As first steps towards achieving universal access, the researcher shares the view of Godlee (2004), in recommending that, establishing working groups to draft strategy, objectives, and programmes of work in seven key areas:

- Researching information needs and barriers to use of healthcare information.
- Providing access to existing materials for healthcare providers in developing countries
- Providing access to the results of research
- Improving relevance and usability of materials for healthcare providers in developing countries
- Improving reliability and currency of materials for healthcare providers in developing countries
- Improving Internet and e-Mail connectivity.
- Skills development and Training

7 Conclusion

The results of this study have indicated that there are inequalities to the access of healthcare information. The results indicate that 10% of African respondents over the age of 19 are computer illiterate and have no alternate access to healthcare information. However, if given the opportunity to use the Internet or a Telecentre for medical information, 62% of the respondents agreed that they would take up this opportunity. The results have indicated

that by improving HIS and building Telecentres in these rural and impoverished areas, access to medical information will certainly also increase.

The development towards a more information and information technology-intensive, but also information technology-dependent, healthcare community is definitely a challenge with respect to security and privacy (Smith & Eloff, 1999). They also note that HIS are having a positive beneficial effect on healthcare organizations and delivery of healthcare. The development of the qualification for end-users of HIS should provide both a safety reassurance for patients whose medical records are involved and a confidence amongst healthcare professionals. This will promote the use of HIS by reducing two sources of opposition: anxious patients and reluctant medical professionals.

The real work of filling the Health Information System with medical knowledge has to be done by medical experts, who normally have other priorities. The challenge is convincing the experts that building such a system is their professional responsibility. Gell (1997) further states that constructing such systems which is of enormous help to the poor and less privileged is itself a scientific and professional achievement comparable or superior to writing a textbook and should carry the same recognition. Much appears to have been done in the development of technical standards, integration, and communication of HIS (Haux *et al.*, 2002). However, much more remains to be done.

References

Degoulet, P & M Fieschi 1997. Critical Dimensions in Medical Informatics. [online]. Accessed on 03/05/05 at: www.bioinfomed.isciii.es/Bioinforsalud2002/Draft_WP.pdf.

Economic Commission for Africa 2000. ICT for Health Sector. [online]. Accessed on 12/05/05 at: http://www.un.org/dept.

Godlee, F 2004. Improving Access to Health Information in the Developing World. [online]. Accessed on 15/05/05 at: http://www.unitedations.org.

Hammond, W 2003. Making the Boundaries Clearer: Revisiting Information Systems with Fading Boundaries. [online]. Accessed on 22/04/05 at: www.snre.umich.edu/ecomgt/collaboration/Sustaining_Success.pdf.

Haux, R 1997. Aims and Tasks of Medical Informatics. [online]. Accessed on 02/05/05 at: www.dwarf.umi.cs.tu-bs.de/cms/staff/haux/Publications. pdf.

Kusakabe, M 2005. How to Scale Up Sustainable Telecentres? [online]. Accessed on 17/05/05 at: www.Telecentre.rdec./27_R_7_ Telecentre_Training_Camps_Kusakabe.pdf.

Lallement, D, E Terrado & Y Zhang 2004. Empowering Information and Communication Technologies in Isolated Areas: Learning from the Solar-net Villages Program in Honduras. [online]. Accessed on 25/04/05 at: www.esmap.org/.../30e871526524f10e85256fc300 1149a3/$FILE/Renewable%20Energy_Article.pdf.

Rothschild, A, L Dietrich, M Ball, H Wurtz, H Farish-Hunt & N Comerer 2005. Leveraging Systems Thinking to Design Patient-centered Clinical Documentation Systems. [online]. Accessed on 26/04/05 at: www.bmjpg.com/Wed13/M1.pdf.

Smith, E & J Eloff 1999. Security in Health-care Information Systems—Current Trends." [online]. Accessed on 29/04/05 at: www.show. scot.nhs.uk/elearning/ availabletopublic/module1.pdf.

The African Development Forum 2000. Improved Information and Communication Technologies for the Health Sector in Africa - Implications and Challenges. [online]. Accessed on 14/05/05 at: http://www.uneca.org.

Vikash Ramharuk
School of Information Systems & Technology
University of KwaZulu-Natal
Durban, South Africa