

Most appropriate information communication technology for health education in HIV management in rural communities: A systematic review

TL Malinga
23870974
BCur

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Supervisor: Prof Dr P Bester
Co-supervisor: Mrs K Smit

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DECLARATION

I, Thobile Lorraine Malinga, student no 23870974, declare that the dissertation titled: “*Most appropriate information communication technology for health education in HIV management in rural communities: A systematic review*” and the critical analysis of the research methods are my own work and has not been previously done by someone else.

This research was approved by the Scientific Committee of INSINQ (Quality in Nursing and Midwifery) of the School of Nursing Science and the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences of the North-West University (NWU), Potchefstroom Campus.

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ABSTRACT

The World Health Organization (WHO) coined the concept of eHealth in 1999. Ever since, information communication technology (ICT) has been explored as a possible means to assist health systems, to improve health education and to increase research. Now, almost two decades later, various types of ICTs have been explored as possible means to increase the health outcomes of overburdened health systems, especially in resource-limited contexts. One such context is the delivery of comprehensive healthcare amidst the Human Immunodeficiency virus (HIV) epidemic in South Africa. As all South Africans can now receive antiretroviral therapy (ART) irrespective of their viral load, the traditional primary healthcare context has to adapt to incorporate additional complex health interventions. Yet, HIV management – implying prevention, diagnosis, disclosure and ART – goes hand-in-hand with health education. The argument is that an informed patient is an actively participating patient. It is therefore essential to increase patients' active buy-in into their own care. Due to the overburdened health system in South Africa and the limited time that health professionals have with patients, ICT's can be seen as additional mechanisms to extend health education beyond the borders of the clinic.

The aim of this research was to identify the most appropriate ICT for health education as part of HIV management in rural communities. Appropriateness was measured by looking at the concepts of ease-of-use and usefulness from the technology acceptance model (TAM) and the 5C's, namely the context, content, capacity, connectivity and community of the eHealth model for developing countries. A rigorous, eight steps, systematic review was conducted by the researcher, following a search strategy based on PICOT. From inclusion and exclusion criteria and the screening of articles' quality and bias a final data set of seven (n=7) articles were isolated for analysis. Rigour was strengthened by having a co-reviewer for inter-rated reliability and a third reviewer was consulted in the event of an arbitrary decision. Two (n=2) articles were excluded as these articles were not available in English. Only primary sources were used.

The results indicated that ease-of-use and usefulness were equally noteworthy in the selection of ICTs. Context is the most substantial component to consider as part of the appropriateness of ICT in rural communities. First, understand the context, then the community, capacity and connectivity – only thereafter is the focus on content. mHealth (mobile devices, text messaging, SMS) presents the most appropriate types of ICT for HIV management in rural communities. Yet, mHealth as a vector for health education needs further exploration. Appropriateness of ICT goes hand-in-hand with a realist adaptation to the rural context and to

remain resilient to typical rural challenges. Recommendations were formulated based on the results and a policy brief was compiled by the researcher aimed for governmental and non-governmental stakeholders.

Key concepts: appropriate, HIV, healthcare personnel, ICT, health education, rural community, evidence-based practice.

(Abstract word count: 454)

LIST OF ABBREVIATIONS

AIDS	Acquired immuno-deficiency syndrome
ART	Antiretroviral treatment
AUTHeR	Africa Unit for Transdisciplinary Health Research
CASP	Critical appraisal skills programme
CDC	Centres for Disease Control and Prevention
CHW	Community health workers
DoH	Department of Health
EBP	Evidence-based practice
ETU	Education and training unit
FHS	Faculty of Health Sciences
HACO	Health Action Charity Organisation
HAART	Highly active antiretroviral therapy
HIV	Human Immuno-deficiency virus
HREC	Health Research Ethics Committee
HRSC	Human Sciences Research Council
ICN	International Council of Nurses
ICT	Information communication technology
JB	Joanna Briggs Institute
MAStARI	Meta-analysis of statistics assessment and review instrument
NIMART	Nurse-initiated and managed ART
NOTARI	Narrative, opinion and text assessment and review instrument
NWU	North-West University
PEPFAR	President's Emergency Plan for AIDS Relief
PHC	Primary healthcare
PLC	Positive living centre
PLW	People living with HIV

PRISMA	Preferred reporting items for systematic reviews and meta-analysis
PICOT	Population, intervention(s), context, outcome and time
PMTCT	Prevention of mother-to-child-transmission
RCT	Randomised control trials
SAMJ	South African medical journal
SIDA	Swedish International Development Agency
SMS	Short message service
SPIDER	Swedish Programme for ICT in Developing Regions
TAC	Treatment action campaign
TAM	Technology acceptance model
TB	Tuberculosis
TRA	Theory of reasoned action
TRAC	Treatment and Research AIDS Centre
UNAIDS	United Nations
UNECA	United Nations Economic Commission for Africa
UNICEF	United Nations' Children Fund
WHO	World Health Organisation

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CHAPTER 1: INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION

This research argues that within an information age and despite the high level of adoption of mobile technology in South Africa, research evidence is needed to isolate the most appropriate type of information community technology (ICT) (of which mobile phones is only one type of device) for health education in HIV management in rural communities. Sub-Saharan Africa is still mostly rural, with some 64% of the population living outside cities. These areas will remain predominantly rural for at least another generation (United Nations Economic Commission for Africa [UNECA], s.a). The rural population is expected to grow until 2045, as the pace of urbanisation is slower here compared to other regions. The majority of rural residents live in extreme poverty. South Africa has a digital divide, yet lacks ICT and legal infrastructure (United Nations' Children Fund [UNICEF], 2012:3). To ensure sustainable value propositions for future health education initiatives, it is necessary to apply the right ICT to the context of the healthcare provider. Only when considering the most appropriate type(s) of ICT for health education about HIV management in rural communities, can the development path be understood and can recommendations be formulated. Chapter 1 introduces the research problem and the methodology followed to obtain the research outcomes.

1.2 BACKGROUND AND PROBLEM STATEMENT

The impact of HIV is pervasive and far-reaching, affecting individuals and communities physically and psychologically, but also economically and socially as families lose their most productive members to this disease (Asokan, 2012:80). According to UNAIDS, in 2014, 36.9 million people were living with HIV/AIDS (PLWH) globally, of which 17.1 million did not know they had the virus and needed to be reached with HIV testing services, while approximately 22 million did not have access to HIV treatment, including 1.8 million children (UNAIDS, 2015:5).

1.2.1 Present realities of HIV prevalence

HIV prevalence refers to the number of persons living with HIV at a given time, regardless of the time of infection, irrespective of receiving the diagnosis (aware of infection), or the stage of disease (Centres for Disease Control and Prevention [CDC], 2014:2). Prevalence is influenced by the incidence and the length of time that people live with HIV (Treatment Action Campaign [TAC], 2010) and is key to evaluating the effectiveness of interventions such as health education and the provision of treatment (TAC, 2010). According to the Joint United Nations Programme on HIV (UNAIDS, 2012:4), 34.0 million people around the world were living with HIV at the end of 2011. The burden of the pandemic varies considerably between countries and regions.

Sub-Saharan Africa remains the most severely affected by the HIV pandemic, with nearly one in every 20 adults living with HIV and accounting for 69% of the people living with HIV worldwide (UNAIDS, 2012:4). Although the regional prevalence of HIV is nearly 25 times higher in Sub-Saharan Africa than in Asia, almost five million people are living with HIV in South, South-East and East Asia combined. After Sub-Saharan Africa, the Caribbean, Eastern Europe and Central Asia are most heavily affected, where 1.0% of adults were living with HIV in 2011 (UNAIDS, 2012:8-10).

In South Africa, HIV remains a prominent health concern (Makombe, 2014:1) with more HIV-positive citizens than any country in the world (Beaubien, 2013) and a reported 6.4 million people living with HIV in 2012 (Shisana *et al.*, 2014). In some provinces, more than 40% of the population is infected and the majority has never been tested for HIV (PopTech, 2013). Although adult prevalence has stabilised at about 17%, the absolute number of people living with HIV (PLW) is increasing, with approximately 100 000 additional PLW per annum (UNAIDS, 2012:51). In addition, the Human Sciences Research Council (HSRC) reports that in 2012 the HIV incidence in South Africa was 469 000 new HIV infections in the population aged two years and older (Shisana *et al.*, 2014:XXIV). Of those who are HIV positive, 90% of the population is infectious, untreated and at risk for premature death (PopTech, 2013).

The impact of HIV is multidimensional as HIV affects both the individual and society at large (UNAIDS, 2012:33). HIV carries a social stigma, preventing many from getting tested or pursuing treatment, and wide-spread misinformation about how the disease is contracted remains (PopTech, 2013). The majority of PLW in South Africa seek care only after developing HIV-related symptoms (Kizito & Suhonen, 2011:269). Further complicating matters is South Africa's overburdened healthcare system, rendering care and health education through the spectrum of the disease, including patients with end-stage HIV or full blown AIDS (PopTech, 2013). It is within this reality of HIV where the dissemination of information via ICT is noteworthy (UNAIDS, 2012:4).

1.2.2 Realities of HIV management in rural South African communities and the role of health education

The sheer scale of the HIV epidemic in sub-Saharan Africa finally led to an expanded global response. South Africa, a nation in which more than five million people are estimated to be infected with HIV, has established large-scale prevention and treatment programmes. However, the uptake and effectiveness of many of these programmes remain suboptimal and have marginal impact on the trajectory of the epidemic (Norman *et al.*, 2007:1775). The logical first step in HIV-management is captured by the WHO's (2015) five key components (referred to as the "5 Cs") that must be respected and adhered to by all HIV testing and counselling services.

These components are consent, confidentiality, counselling, correct test results, connection (linkage) to prevention, care and treatment. It presents a comprehensive and complex process of HIV management, activated by disclosure. Disclosure of one's HIV status is the essential first step to behaviour modification and to accessing treatment for HIV management. Yet, this very first step is already complex. In the Western Cape, participants from two communities with a similar ethnic mix but with very different rates of disclosure of HIV status were interviewed. The researchers concluded that many of the experiences surrounding the disclosure of HIV infection in these two communities were not entirely dissimilar. Individuals in Mbekweni and Umzimkhulu found it difficult to disclose their HIV status, went through periods of negotiation and management, and did not encounter dissimilar rates of stigma or rejection from loved ones (Norman *et al.*, 2007:1780). Disclosure is therefore universally abstract and multidimensional.

Furthermore, HIV management in South Africa developed over the past decade from mostly external funding. In 2003, the United States of America's (USA) government dedicated 15 billion dollars over five years to fight HIV in the 15 countries with the greatest local burden of disease, referred to as the President's Emergency Plan for AIDS Relief (PEPFAR). At that time, 34 million people worldwide lived with HIV, with 20 million in Sub-Saharan Africa without access to highly active ART (HAART) (Katz *et al.*, 2013:1385). The realisation of PEPFAR became a beacon in HIV management. The re-authorisation of PEPFAR in 2008 strengthened productive relationships between the USA and South African governments toward improved programme sustainability (PEPFAR, 2016). Today, the South African government leads an unprecedented scale-up of HIV prevention, care and treatment services throughout the country. In 2010, the South Africa public health policy transferred doctor-based and hospital-centric ART services to decentralised provision of nurse-initiated and managed ART referred to as NIMART (NDOH, 2010) to enable a faster HIV management programme expansion. By 2013, Nyasulu *et al.* (2013:232) reported that the decentralised ART initiation by professional nurses within the Department of Health in Gauteng (the study was conducted in collaboration with the City of Johannesburg), led to increased ART uptake, reduced workload at referral clinics and opportunity for nurses to focus more on complicated cases. What is being realised in South Africa was already promoted by the WHO in 2007, referred to as task shifting (the delegation of tasks to less specialised healthcare personnel), an essential component of the WHO's public health approach to ART programme scale-up (WHO, 2007). Task shifting of NIMART, among other services, had some positive effects in Rwanda, Malawi, Mozambique, Lesotho and in smaller projects in South Africa. The gains included earlier and faster patient enrolment; improved patient outcomes; greater acceptability and accessibility (particularly for rural populations); reduced patient transport costs and improved patient retention (Sanne *et al.*, 2010:1-7).

Exceptional and contextual solutions to upscale HIV management are necessary in South Africa. South Africa has a significant rural population with some of the highest HIV burdens. In addition, the South African rural context presents a unique and vulnerable population often characterised by poor socio-economic conditions, limited access to healthcare services, limited available clinical support and poor healthcare resources. All of these characteristics impact negatively on healthcare provision, resulting in poor health outcomes compared to urban South Africa (Omelo *et al.*, 2016:1). Considering that primary healthcare (PHC) is the dominant healthcare service in rural communities, the realisation of ward-based community health workers (CHW) outreach teams as part of a series of strategies to re-engineer PHC by 2011, became a welcoming initiative. The national policy outlines that communities (referred to as wards) should have at least one PHC outreach team comprising a professional nurse, an environmental health officer, health promoters and six to 10 CHWs for improved access and health outcomes and to take health services to the community. The nurse team leader should be employed at a PHC clinic (DoH, 2011). Outreach teams can strengthen health promotion, empowering citizens with self-care beyond expectations of curative care.

On 2 September 2016, Dr Aaron Motsoaledi, the current South African minister of health, verbalised in a television interview aired by the South African Broadcast Corporation that ART would be activated for all PLWH irrespective of their CD4 cell count to decrease HIV transmission and improve life expectancy to all South Africans. This decision stemmed from the recent WHO guidelines (WHO, 2015:24-26). Yet, the stigma surrounding HIV affects PLWH and their families. Community support, awareness campaigns and public events to mobilise the community to support HIV projects are some initiatives essential to improve each citizen's knowledge about HIV and to decrease stigma (Education & Training Unit [ETU], 2016). When considering the complexities of HIV management, health education on HIV remains paramount. For example, in 2013, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2013:2) reported that 91% of literate women in sub-Saharan Africa knew that HIV is not transmitted by sharing food, compared to 72% of illiterate women. Hussein *et al.* (2013:849) concluded in Pakistan that health education in HIV treatments centres is necessary to bridge the communication gaps between the patient and health professional.

Health education is not limited to the dissemination of health-related information. It implies a combination of the promotion of the motivation, skills and self-efficacy (confidence) needed for a person to take action to improve his or her health. It also includes the communication of information regarding underlying social, economic and environmental determinants influencing health, individual risk factors and behaviours and the use of the healthcare system (WHO, 2015:13).

Health education moves beyond increased knowledge about personal health behaviour towards demonstrating the organisational and political possibilities of addressing the social, economic and environmental determinants of health (WHO, 2015:13). ICT is a proven mechanism to obtain economy of scale to distribute health education information. ICT both revolutionise and disrupt human life (Shiferaw *et al.*, 2012:1-2) and its application in health is described broadly as eHealth. eHealth is the use of information and communication technologies (ICT) for health. Examples include treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health (WHO, 2016). Furthermore, eHealth has the potential to facilitate healthcare delivery towards better health and universal health coverage.

mHealth (mobile technologies for health) is a growing set of tools being applied in diverse health settings (Kahn *et al.*, 2010). mHealth interventions for improving HIV/AIDS care in low and middle-income countries is a promising strategy, but its evidence-base is still limited (Curioso *et al.*, 2007). The application of technology for improving healthcare has not always resulted in success (Black *et al.*, 2011), suggesting a need for thoughtful implementation guided by formative evaluations. mHealth is also a rapidly expanding area of research (Free *et al.*, 2010) with programmes and interventions using mobile electronic devices (MEDs), such as personal digital assistants (PDAs) and mobile phones, for a range of functions from clinical decision support systems and data collection tools for healthcare professionals (Blaya *et al.*, 2010); to supporting health behaviour change and chronic disease management by patients in the community (Cole-Lewis *et al.*, 2010). For the last decade, mHealth has constantly expanded as a part of eHealth. Mobile applications for health have the potential to target heterogeneous audiences and address specific needs in different situations, with diverse outcomes, and to complement highly developed healthcare technologies (Fiordelli *et al.*, 2013). More strategic approaches are needed to plan, development and evaluate the impact of mHealth (Kay, 2011).

The AIDS Education and Training Centre (AETC, 2014), a USA-based national coordinating resource centre, confirmed that the complexity of HIV management and the rapid development of HIV information requires continuous health education and skills development as an essential aspect in HIV management. Health education can be presented on different levels, to different target audiences and in various formats. Table 1-1 provides an outline of the various possibilities for HIV education on various levels.

Table 1-1: Health education in HIV management presented on different levels and in various formats

Level of health education in HIV management	Aim of health education in HIV management	Examples of the various opportunities to and formats of health education
Individual , referring to health education targeting persons at increased risk of becoming infected with HIV or already infected.	- To inform and empower a person towards behavioural change (Averting HIV and AIDS [AVERT], 2016). - To promote health status, prevent infections and improve wellbeing. - To provide direct support.	Provide information through direct conversation and personal interaction with health professionals and caregivers, lectures, support programmes, counselling and psychosocial support, stigma and discrimination reduction programmes (AVERT, 2016), pamphlets, posters, infographics.
Family , household, groups as the burden of HIV fall directly on the family, partner, household or close groups such as men having sex with men.	- To improve, promote and maintain health. - To prevent infection by those living nearest. - To improve people's coping ability and resilience.	Counselling and therapy alone or with a partner or together as a family, informal training, fun days and recreational activities, support groups, drama workshops, family therapy, door-to-door visits, pamphlets, radio, newspaper, workshops, plays, songs, industrial theatre, posters, infographics and graffiti, funerals, prayer meetings (ETU, 2016), support by caregivers.
Community , referring to the context in which individuals and families affected by HIV and AIDS live and may experience stigma and isolation.	- To enable community involvement in the prevention, treatment and care of HIV. - To educate people towards more tolerance, less discrimination. - To facilitate community outreach programmes.	Health education in communities requires involving influential people such as ward councillors, churches, community and traditional leaders, teachers, nurses, shop stewards and reporters. Health education is best provided through established structures such as schools, welfare organisations, religious groups and churches, women's groups, support groups, community care projects.
Society , such as public health education and public health awareness campaigns.	- To educate as many people as possible about HIV prevention, support to PLWH and non-discrimination. - To change public attitude, to get publicity and reach vast numbers of people directly and to make issues about HIV visible (AIDS Education and Training Center [AETC], 2016; ETU, 2016).	Door-to-door visits, pamphlets, radio, newspaper, workshops, plays, songs, industrial theatre, speeches and community meetings, posters, infographics and graffiti, marches, cultural events, funerals, prayer meetings, loudhailers, billboards, information tables set up at busy centres (ETU, 2016).

Established information resources on HIV health education such as ETU and AETC, aimed at providing HIV health education content and processes, make insignificant reference to ICT. Yet, AVERT (2016) acknowledges that the efficiency of health education can improve with the use of new HIV prevention tools, such as mobile phones to be used for interaction and information sharing.

1.2.3 ICT as a medium for health education in HIV management

ICT enables access to information through telecommunications and is seen as a functional instrument in the global response to HIV. ICT availability grew exponentially over the last 20 years and has been adopted widely (Farach *et al.*, 2015:1). The potential of ICT in healthcare is based on feasibility, being relatively affordable, granting access to appropriate knowledge and information for all affected by HIV, including preventive actions (Scheibe *et al.*, 2012:79; Driscoll, 2001:4). Innovative tools such as the Internet, personal digital assistants, tablet computers, mobile phones and other technologies are a growing arsenal in the effort to manage HIV and other sexually transmitted infections (Curioso *et al.*, 2007:262; Adams *et al.*, 2014:153; Chib *et al.*, 2012).

As the price of ICT decreases, ICT devices are more readily available, even in resource-constrained settings (Curioso *et al.*, 2007:1). There has been exponential growth in access to communication technology in South Africa over the last decade (Allison *et al.*, 2014:1). By the end of 2014, there were almost three billion Internet users globally, with two-thirds from low to middle income countries and almost 77 million mobile-cellular subscriptions (one user can have multiple subscriptions) in South Africa by 2013 (International Telecommunication Union [ITU], 2014).

Especially mobile devices (such as cellular phones, smart phones and tablets) provide a high-impact, low-cost platform in the management of HIV and tuberculosis (TB) (PopTech, 2013). Most South Africans have access to a mobile device. Mobile phones, including smart phones, are widely accessible in South Africa and more than 75% of those in low income groups who are 15 years or older own a mobile phone (Peyper, 2013). A mobile device, which is only one example of ICT, is one of the most accessible ways to access the Internet in a country with unreliable broadband connectivity and economic inequality. Statistics South Africa (StatsSA, 2014:14) reported that more than a third of South African households (41%) had at least one member who used the Internet either at home, at work, a place of study or Internet café's.

As ICT accessibility increased, research exploring ICT in HIV management has echoed nationally and internationally. Swendeman and Rotheram-Borus (2010:139) acknowledge that both mobile phones and the Internet are essential in HIV treatment and the prevention of sexually transmitted diseases.

The Health Action Charity Organisation (HACO, 2012), Swedish International Development Agency (SIDA) and the Swedish Programme for ICT in Developing Regions (SPIDER), explored the use and needs for ICT in HIV management in Botswana, Mozambique and Zambia through participatory action research. ICT facilitated HIV management and the need to explore best practices in ICT was voiced. Yet, ICT was subjected to internal (cost and affordability for example) and external barriers (broadband coverage and illiteracy, for example). Kizito and Suhonen (2011:263) explored ICT for HIV and AIDS prevention education in developing countries and concluded that more research is necessary to link the potential of ICT strategies in health education amongst adolescents. The United Nations Children's Fund (UNICEF, 2011:3) assessed ICT efficiency for preventing mother-to-child-transmission (PMTCT) in eleven South Asian countries and concluded that ICT, although complex, is essential in the comprehensive management of HIV and AIDS.

1.2.4 The quest for the right ICTs for health education

In light of South Africa's HIV burden, health education is integral to HIV management as one mechanism to enhance patient compliance and prevent new infections. Various cases of successful development of ICTs in developing countries have been reported. Already in 2008, Sørensen, Rivett and Fortuin (2008:39) concluded that there has been isolated ICT adoption in HIV management in South Africa, but no single consolidated system yet. The Cellphone4HIV programme by de Tolly and Alexander (2008:8-9) concluded that language, technical skill and costs should be determined prior to the implementation of ICT projects. In South Africa, mobile phones have the potential to facilitate the social behavioural and political changes required for HIV prevention interventions to impact on the HIV pandemic (Scheibe *et al.*, 2012:79). Osunyomi and Grobbelaar (2015:1) agree that South Africa's eHealth environment is emerging, but they identify insufficient ICT adoption in target audiences. As the battle to combat HIV continues in South Africa, so does infrastructure towards increased ICT access develop, making ICT a viable option in HIV management. Research focuses especially on ICT in HIV prevention and treatment adherence (Luneburg, 2009; Dewing *et al.*, 2014:63-71; Psaros *et al.*, 2015). ICT infrastructure and accessibility are increasing, and ICT will continue to be used in HIV management in South Africa in the future (as capsulated within the eHealth Strategy of South Africa, 2011). More examples of ICTs related to HIV information and health education are presented in table 1-2.

Table 1-2 Examples of HIV information and education projects/studies/initiatives

Project, study or initiative	Description
Mobile phones for monitoring AIDS patients (South Africa)	Explored the use of mobile phones to communicate HIV-related information and investigated the sustainability and scalability challenges of mobile phone-based applications for HIV care. It concluded that adoption and sustainability from the caregivers' and patients' perspective were not merely dependent on the capability of the technology to enhance service delivery, but on the participants' willingness and ability to adopt technology despite continuous costs (Kizito <i>et al.</i> , 2011: 266-69).
Mobile phone quiz for HIV education and SMS for HIV awareness campaign and testing information (Uganda)	Explored the effectiveness of SMS-based HIV education system that uses a quiz format to assess people's knowledge of the disease, including causes and prevention. Participants with the highest accuracy and participation rates were entered into a free "airtime" (pre-paid mobile phone units) drawing and other prizes. The researchers concluded that structured SMS messages can be used effectively for HIV/AIDS education in an application where errors are tolerable (Kizito <i>et al.</i> , 2011:266-69).
Mobile-based e-learning program for HIV prevention intervention among the youth (Nigeria)	A mobile-based eLearning platform was created to provide Nigerian teenagers with the relevant skills to protect themselves against HIV and gender-based violence. The platform used video, SMS and news threats to enable communication among youth on HIV prevention and to foster behavioural change. Mobile phones enable communication among the youth. Over 10 000 questions and answers were delivered during the first operating month (Kizito <i>et al.</i> , 2011:269).
Indian Mobile Games to fight HIV/AIDS in Africa	Games were designed for a variety of devices from basic Java phones to smart phones. Examples are Penalty Shoot Out and AIDS Fighter Pilot. In Penalty Shoot Out, the player gets messages related to the HIV to save a penalty or score a goal. When saving a penalty, the player got a message related to HIV awareness and prevention, while scoring a goal means that the player received information about transmission, myths and misconceptions about HIV (Kizito <i>et al.</i> , 2011:269).
Phone-based reporting capabilities through TRACnet (Rwanda)	The Treatment and Research AIDS Centre (TRAC) provided real-time access to information on HIV and ARTs nationwide through ICTs. A web-based system (TRACnet) provided monthly ART indicators, weekly reporting on drug shortages and stock-outs and case-based reports on CD4 cell count tests (Kizito <i>et al.</i> , 2011:269).
Email services for information dissemination (Zimbabwe)	The project disseminated basic HIV information and preventive issues via e-mail services provided by SatelLife's health network. This network provides low-cost e-mail and health information services to the health community (Kizito <i>et al.</i> , 2011:270).
Telemedicine project (Ethiopia)	This project tested a telemedicine application among trained medical doctors at ten different sites. It concluded that telemedicine implementation depended on technological factors rather on eGovernment readiness, enabling policies, multi-sectoral involvement and capacity building

	processes. The use of combined interoperable applications in the local context was highly recommended (Sherifaw, 2012:1).
AIDSWEB (Africa)	AIDSWEB involves schools in Africa using ICT solutions to promote HIV/AIDS education and prevention activities. The early results from the project suggest that technology could play a complementary and useful role in helping combat HIV/AIDS (Kizito <i>et al.</i> , 2011:266-269).
loveLife (South Africa)	Established in 1999, loveLife is recognized today as one of the most effective awareness campaigns on HIV globally. The target audience is adolescents and young adults and HIV health education is presented through radio, television and the printed media, amongst other initiatives. One positive outcome of loveLife was the improved communication between adolescents and their family members about healthy lifestyle and HIV (World Bank, 2003:103).
SoulBuddyz (South Africa)	SoulBuddyz is a mass media edutainment initiative directed at children aged eight to 12 and based on the Soul City compendium for adults. Through television, radio, magazine and printed skills books, children received essential health education on HIV, gender and youth sexuality (World Bank, 2003:13).
Straight Talk (Uganda)	This project entails the provision of information on HIV through the Straight Talk Foundation delivered via newspaper and radio shows and directed at adolescence. This programme had a reportedly impact on adolescents' HIV-information needs and increased general HIV awareness (World Bank, 2003:17).
U-report (Zambia)	U-report is a focused mHealth application providing real-time mobile counselling and polls on HIV among adolescents and young people with a national reach of over 98 000 subscribers. From a SMS-based intervention it provides confidential, free-of-charge and real-time counselling services on HIV and reproductive health to adolescents and youths (Haas, 2016:70).
Blued (China)	Blued is a dating application connecting gay men and other men having sex with men while providing HIV information in an entertaining format and linking users to HIV testing services (UNAIDS, 2015:32).
Young Africa Live (YAL)	Young Africa Live is an African- and entertainment-based interactive mobile platform that enables young people towards a discourse on events affecting their daily lives such, as HIV and gender issues (UNAIDS, 2015:32).
Shuga (Africa)	A television and radio soap opera with an interactive internet platform that includes Youtube explores HIV testing, counselling, positive prevention etc. (UNAIDS, 2015:32).

Table 1-2 clearly reveals that various types of ICTs are used globally to empower people at various levels and in different age groups in the management of HIV.

1.2.5 Problem statement: the need for a sustainable value proposition

The background literature presents the realities of HIV globally and in South Africa. Despite major investment in HIV and AIDS, the prevalence of HIV and the incidence of new HIV infections remain a concern. The latest statistics from Global Health revealed that there were approximately 36.7 million people worldwide living with HIV/AIDS at the end of 2015, a global HIV prevalence of 0.8%, and an estimated 2 million new HIV infections, 220 000 of which were among children (Avert, Global Health, 2016). HIV prevalence confirms the complexities associated with HIV and the inevitable combination of bio-psychosocial factors, making HIV everybody's responsibility.

There has been a shift in HIV management in South Africa. As indicated by the 2009 HIV awareness campaign in South Africa, HIV has been integrated into the larger health systems and is now presented as a chronic disease and clustered within the country's quadruple burden of disease. HIV management now goes beyond prevention to include the comprehensive process of HIV awareness, prevention and treatment. HIV management remains a complex and sophisticated service and South Africa stands proud considering the successful implementation of ARV treatment at PHC level. Despite initiatives such as NIMART and the introduction of HAART for all South African citizens who are HIV-positive, irrespective of their viral load, the influx of ART users' burdens clinics despite PHC re-engineering. As HIV management becomes more sophisticated, so does the need to educate society on all the aspects of HIV when considering the responsible role that society plays by being informed health system users. For instance, the challenge of disclosure entails a major HIV prevention obstacle – the majority of people who are infected with HIV do not know they have the virus. This is where health education is pivotal.

Health education remains a powerful mechanism to empower health system users toward active participation in HIV management. The pressing need for health education in HIV management requires alternative education methods such as the use of ICTs. As globalisation and digitisation infiltrate rural South African communities, connectivity and mobile device adoption improves. Printed media by means of posters and information brochures can now be fortified or replaced by digital versions. The past decade's research presents an increased application of various types of ICT within different aspects of health and aligns with the eHealth strategy, globally and in South Africa. Despite the promises of practical solutions of telemedicine, there is still insufficient evidence on its positive impact in sub-Saharan Africa (Shiferaw & Zolfo, 2012). Lacking infrastructure and expensive connectivity are two factors that influence the adoption of ICT in developing countries. In some developing countries, such as Uganda, radio programmes have been employed successfully, but this medium should be upgraded (Litho, 2010). Litho (2010) concludes that more benefits can be expounded from the benefits of ICT in health, especially in relation to HIV.

The AIDSTAR-Two project (2011:26-32), a publication funded by PEPFAR following an exploration into ICT use in various health programmes, identified hindering factors for ICT adoption towards health system strengthening, namely costs, fragmented infrastructure, variations in ICT literacy, inefficient interoperability, hindering policies, the need to truly understand the context and related content, lack of sound monitoring and evaluation of ICT initiatives and limited utilisation of local languages. Genz *et al.* (2015:70) warn that ICT adoption from mobile devices by drug users in the USA indicated lower adoption by people in lower socio-economic groups (typical to South African rural communities). ICTs therefore present with both benefits and limitations. The quest for the right type of ICT to address health education in HIV management in rural South Africa communities has not yet delivered answers. To enhance a more sustainable value proposition of health education initiatives using ICT, it is necessary to inform health systems of the most appropriate ICT for a specific business case. There may be sufficient research on ICT in health education in general, but there is insufficient evidence on the application of the right type of ICT for health education in rural communities for HIV management. When health professionals can link the right technology to health education for HIV management in rural communities, it can improve the sustainable value proposition thereof. This research aims to fill this gap in research.

1.3 RESEARCH QUESTION

The research problem culminates in the following question “*What research evidence is available regarding the most appropriate ICTs for health education in HIV management in rural communities?*”

1.4 OBJECTIVE

The objective was to identify and describe the most appropriate ICTs for health education in HIV management in rural communities by means of a systematic review.

1.5 RESEARCHER’S ASSUMPTIONS

The researcher’s assumptions divide into meta-theoretical, theoretical and methodological assumptions, as set out in the subsequent discussion.

1.5.1 Meta-theoretical assumptions

Meta-theoretical assumptions refer to the researcher’s beliefs about the person as a human being, society, the discipline, and the purpose of the discipline, as well as the general orientation about the world and the view research that a researcher holds about the nature of research (Botma *et al.*, 2010:187). The researcher’s meta-theoretical assumptions stem from a Christian worldview. Man, as a God-created being, can also present as rural community members receiving health education for HIV management through different types of ICT.

Societies are those rural communities containing multiple people affected by HIV and in need of health education in HIV management. Health is viewed as "... *a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" (WHO, 1946:100) and refers to health education about HIV management through the most appropriate ICT. Nursing encompasses autonomous and collaborative care of individuals of all ages as well as families, groups and communities, either sick or well and in all settings (International Council of Nurses [ICN], 2009). In this research, nursing refers to HIV management and related health education and the most appropriate ICTs to conduct this health education.

1.5.2 Theoretical assumptions

The technology acceptance model (TAM) by Davis (1993) and Drury's (2005:19-26) eHealth model for developing countries formed the basis of the theoretical assumptions for this research.

1.5.2.1 Technology acceptance model (TAM)

The TAM serves as the first theoretical framework that directed this systematic review. TAM is based on the principles adopted from Fishbein and Azjen's (1975) theory of reasoned action (TRA) (Davis, 1993:476). Davis' version of TAM presents a valid and reliable prediction of the acceptance or adoption of new technologies by end-users (Davis, 1989; Davis, Bagozzi & Warshaw, 1989). It is a model that is commonly to measure technology acceptance (King & He, 2006) in general. The TAM specifies the causal relationships between system design features, perceived usefulness, perceived ease of use, attitudes towards and actual usage behaviour (Davis, 1993:475). The goal of most organisation-based information systems is to improve the performance on the job. Unfortunately, performance impacts are lost whenever users reject systems. User acceptance is often the pivotal factor that determines the success or failure of an information system project. Overall, the TAM provides an informative representation of the mechanisms through which design choices influence user acceptance and should therefore be helpful in applied contexts for forecasting and evaluating user acceptance of IT. In this research, the concepts *ease of use* and *usefulness* of ICT in health education in HIV management were applied during the data extraction of the systematic review.

1.5.2.2 eHealth model for developing countries

The eHealth model by Drury (2005:19-26) lists five components to consider in eHealth technologies and implementations in developing countries. These components, referred to as the 5Cs, are context, content, connectivity, capacity and community. The components are tabled and described below. These five components did not direct the systematic review to find evidence of the most appropriate ICT for health education in HIV management in rural communities, but served as a framework to analyse the research results during data extraction and synthesis.

Table 1-3: Components in eHealth in developing countries (Drury, 2005)

Component	Description
Context	Consider especially structural poverty, sustainable developmental goals and the role that ICT can play to support health workers in rendering healthcare.
Content	The health information content available and used by health workers and the migration of paper-based material to digital format.
Connectivity	The networks (available/absent) that enable and support the transmission of information.
Capacity	Utilising ICT to build the capacity of the health workers.
Community	ICT that extends beyond health systems to the empowerment of the community.

1.5.2.3 Definitions

The following definitions were central to this systematic review:

Appropriateness is the extent to which an intervention or activity fits with or is apt in a situation. Clinical appropriateness is about how an activity or intervention relates to the context in which care is given (Pearson *et al.*, 2005:207-216).

Information communication technology (ICT) is a collective term including any communication device or application, including radio, television, phones (telephone, cellular phone, smart phone), computer and network hardware and software, satellite systems, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICT is best described in a particular context, such as ICT in education or healthcare. ICT has more recently been used to describe the convergence of several technologies and the use of common transmission lines carrying diverse data and communication types and formats (Janssen, 2015).

Health education refers to any combination of learning experiences designed to help individuals and communities improve their health by increasing knowledge or influencing attitudes about health (WHO, 2015).

HIV management is a collective term referring to the full circle of HIV care aligned with positive health behaviours such as nutritional maintenance, disclosure and antiretroviral (ARV) adherence (Maertens, 2011:7) and sexual health (Turnbull, 2011:67). Partnerships between marginalised communities and support agencies from the public sector, private sector and civil society are the pillars of HIV management (Nair & Campbell, 2008:45).

Rural communities are, according to the Rural Development Framework, sparsely populated areas where people farm or depend on natural resources. It includes villages and small towns that are dispersed throughout these areas and areas that include large settlements in the former homelands that depend on migratory labour, remittances and government social grants for their survival. They typically have traditional land tenure systems (Rural Development programme, 2011:192).

Systematic review is a critical assessment and evaluation of all research studies that address a particular clinical issue (Agency for Healthcare Research and Quality [AHRQ], 2015). It implies a structured, comprehensive synthesis of research literature to determine the best research evidence available (Burns & Grove, 2013:28) and involve a detailed and comprehensive plan and search strategy, aimed at reducing bias by identifying, appraising, and synthesizing all relevant research on a particular topic (Uman, 2011:57-59).

1.5.2.4 Central theoretical argument

Health education is an essential aspect within the comprehensive process of HIV management. Various types of ICTs are used in health education and have potential in health education in general and in HIV management in rural communities specifically. The question raised was what type of ICT is the most appropriate for health education in HIV management in rural communities. The best research evidence can be collected and analysed by means of a systematic review. In this way one can determine the most appropriate ICT for health education in HIV management in rural communities. When the researchers have determined the most appropriate ICTs for health education in HIV management, the right ICT can be applied to health education to enhance the sustainable value proposition thereof.

1.5.3 Methodological assumptions

The methodological assumptions are based on the systematic review process (see figure 1-2) as stipulated in Botma *et al.* (2014:241) and deduced from evidence-based practice (EBP). EBP is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient (Sackett, 1996:71-72). It entails integrating individual clinical expertise with the best available external clinical evidence from systematic research. Carnwell (2001:57-63) defines EBP as the systematic search for and appraisal of best evidence to make clinical decisions that may require changes in current practice, while taking into account the individual needs of the patient. Yip *et al.* (2013) define EBP as the “...*decision-making on the care delivery to patients, which is based on current, identified, and validated research evidence, consumer’s preferences, expert opinions and societal expectations.*” EBP is associated with increased patient safety, improved clinical outcomes, reduced healthcare costs and decreased variation in patient outcomes (Black *et al.*, 2015:14).

EBP requires specific skills such as efficient literature searching and the application of formal rules of evidence in evaluating clinical literature. EBP is presented in Figure 1-1 (below), described thereafter and applied to this research.

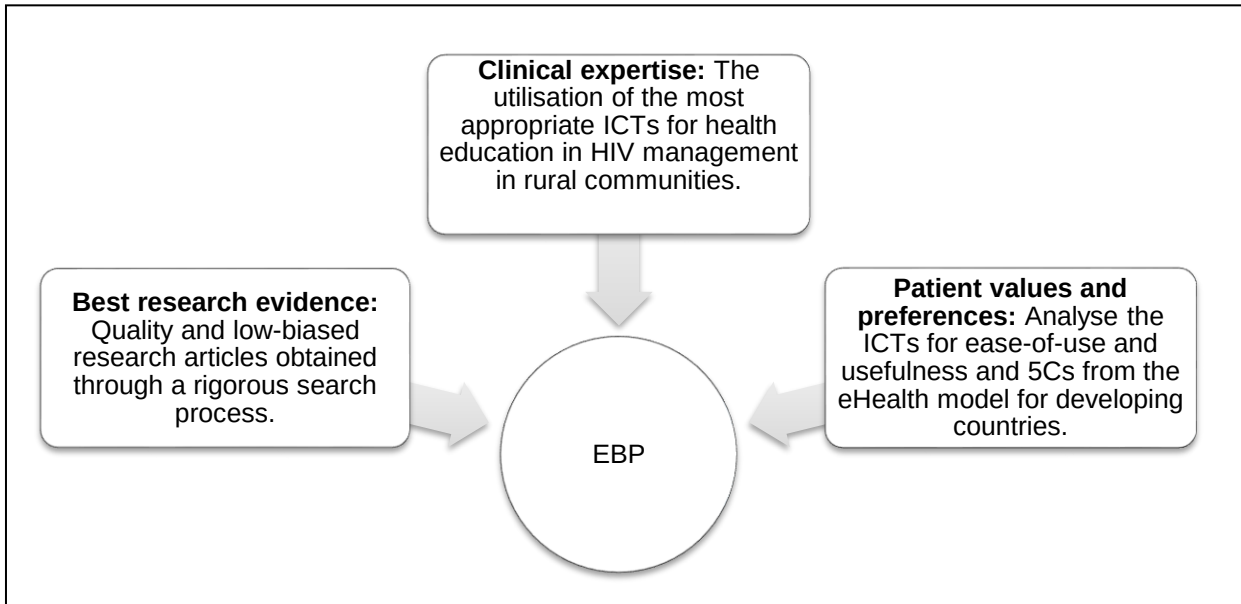


Figure 1-1: Evidence-based practice overview applied to this research (adopted from Sackett, 1996:71)

Clinical expertise refers to how healthcare professionals use their clinical skills and experience to identify patients' unique health problems and needs, values and expectations and the benefits of potential interventions (Brink, van der Walt & van Rensburg, 2012:15). In this systematic review, clinical expertise refers to utilising the most appropriate ICT for health education in HIV management.

Patients' values and preferences imply the predilections, concerns and expectations of each patient (Brink *et al.*, 2012:15). In this systematic review, patient preference is defined as the choices made by participants regarding ease-of-use and usefulness of ICTs.

Best research evidence states that although evidence originates from various sources (personal experience, reported experience of others or systematic research); best research evidence can be achieved by following a rigorous process of searching for and analysing literature. This systematic review pursued a rigorous process to search and analyse literature on the most appropriate ICT for health education in HIV management in rural communities and reported and declared according to a specific method.

1.6 RESEARCH METHODOLOGY

The research methodology entailed the rigorous process of a systematic review.

1.6.1 Systematic review

A systematic review is a literature review designed to locate, appraise and synthesise the best available evidence relating to a specific research question to provide informative and evidence-based answers. This information can be combined with professional judgement to make decisions about how to deliver interventions or to make changes to policy. A systematic review was selected as the appropriate method to find the best evidence of the most appropriate ICT used in health education in HIV management in rural communities, since it enables the researcher to gain insight into the strengths and limitations of literature, to develop critical appraisal skills of literature and to understand the different methodologies (Dickson *et al.*, 2013:7) used in ICT-related studies for health education in HIV management. The systematic review implies also that the researcher relies on quality literature with the risk of limited publications. It is a time consuming process. This systematic review was realised according to the steps proposed by Botma *et al.* (2014:241-247) as graphically depicted in Figure 1-2 (below) and described thereafter.

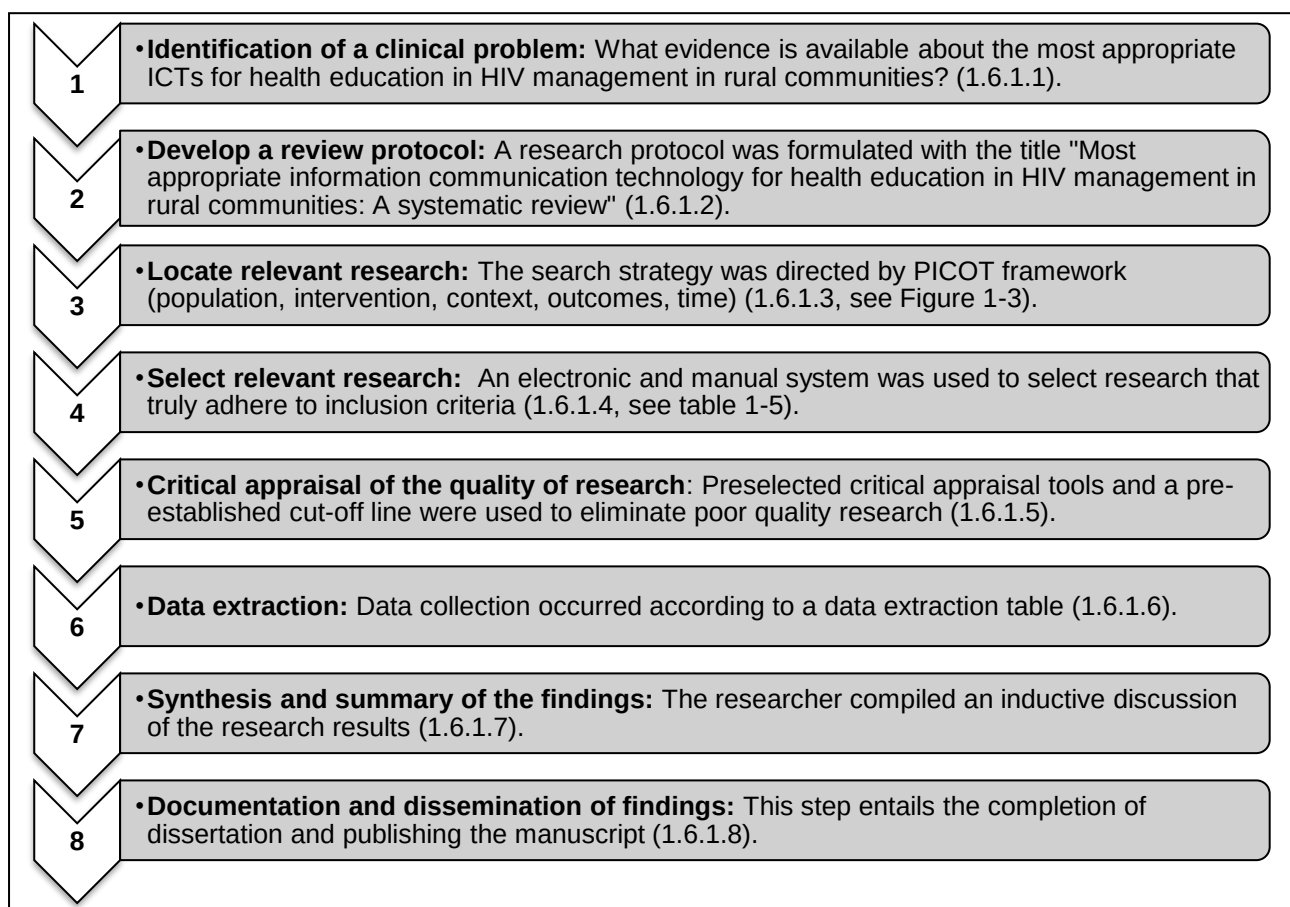


Figure 1-2: Systematic review steps applied in this systematic review (adapted from Botma *et al.*, 2014:241-247)

1.6.1.1 Step 1: Identifying the problem

Already in 1997, Cook *et al.* (1997:376-380) stated that “A good systematic review is based on a well-formulated and answerable question”. In this systematic review, the proposed focus question was “What evidence is available for the most appropriate ICT for health education in HIV management in rural communities?” During the formulation of the research problem, the Database of Abstracts of Reviews of Effects (DARE), the Campbell Collaboration and the Cochrane Library were accessed to ensure that this research was not a duplication of previous research.

1.6.1.2 Step 2: Developing the research protocol

Systematic reviews should set clear questions (CRD, 2008:6) that should be presented in a research protocol. As suggested by Dickson *et al.* (2013:3), a comprehensive protocol was developed for this systematic review. This protocol was approved by INSINQ (Quality in Nursing and Midwifery), a research focus area, and the Health Research Ethics Committee, both part of the Faculty of Health Sciences of the North-West University (Potchefstroom Campus). The protocol formulation included preliminary searches on various search engines.

1.6.1.3 Step 3: Located relevant research

The PICOT framework was used as a roadmap to obtain relevant research (Guyatt *et al.*, 2008). PICOT (Riva *et al.*, 2012:168) was applied to direct the search process regarding the **p**opulation, **i**ntervention(s), **c**ontext, **o**utcome and **t**ime (see figure 1-3). A search strategy was developed by providing a comprehensive list of key terms related to each component of the PICOT (Uman, 2011:57-59). The PICOT guided the researcher and co-reviewer during the actual data collection process.

(P) Population	• People that are HIV positive and those living with them.
(I) Intervention	• Health education on any aspect of HIV management (prevention, treatment, rehabilitation, health promotion).
(C) Context	• Rural communities in developing countries.
(O) Outcomes	• The appropriateness of the selected ICT used in the research. Addressing "ease of use" and "usefulness" and the five C's of the eHealth model.
(T) Time	• Research expanding between 2000-2016.

Figure 1-3: PICOT framework applied to this research

1.6.1.4 Step 4: Selected relevant research

The selection of relevant literature was done in two stages. Stage one involved an initial screening of titles and abstracts against the inclusion and exclusion criteria (Table 1-4) to identify potentially relevant studies.

Table 1-4: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criterium
• To be eligible for this review, research had to either present appropriate ICTs for health education in HIV management with at least one condition explicitly related to rural communities. • Articles available for review, even in the event of reasonable cost or subscription that the researcher obtained with the assistance of the information specialist for the Faculty of Health Sciences at the Ferdinand Postma Library of the North-West University (Potchefstroom Campus). • Research since 2000 because eHealth and mHealth are two concepts absorbed into healthcare by the WHO by 1999.	• Research that addressed only ICT or health education or HIV management or rural realities and where the relationships between these concepts were not inherent in the research.

The second stage was the screening of full text articles identified as possibly relevant during the initial screening (CRD, 2008:13). The researcher worked through the list of search engines and databases available from the Ferdinand Postma Library and the following were used: EBSCOhost (Academic Search Premier, Business Source Premier, Cinahl with full text, Health Source Nursing Edition, MasterFile Premier, Medline, PsychInfo), Emerald, Google Scholar, JSTOR and ScienceDirect. These search engines and databases were proposed after preliminary search results yielded some articles that are significant to the primary research. To increase the efficiency of this study, MeSH (medical subject heading) terms and keywords were used. Table 1-5 presents the preliminary search strategy derived from the PICOT elements with added keywords and MeSH terms and as it was used within Boolean search strings.

Table 1-5: Search strategy

PICO(T)	Preliminary search strategy
Population: People who are HIV-positive and people living with them	("people who are HIV positive" [MeSH term] OR HIV-positive" OR "people living with HIV" [MeSH term] OR "people living with HIV/AIDS" [MeSH term] OR "PLWH" OR "PLWH and PLC" OR HIV-seropositivity [MeSH term] OR "HIV infection" [MeSH term] OR "RNA virus infection" [MeSH term] OR "acquired immunodeficiency syndrome" OR AIDS OR HIV/AIDS OR "AIDS virus" OR "HIV transmission" [MeSH term] or "people living with HIV" [MeSH term] OR "people living close to people with HIV/AIDS" [MeSH term]).
Intervention: Health education in HIV management	("health education" OR "health-education" [MeSH term] OR "community health education" [MeSH term] OR "nursing education" [MeSH term] OR "AIDS education and training" [MeSH term]) AND ("HIV management" OR "HIV prevention, diagnosis, treatment and care" [MeSH term] OR "comprehensive HIV care" [MeSH term] OR "management of HIV/AIDS" [MeSH term] OR "antiretroviral agents" [MeSH term] OR "antiretroviral therapy" [MeSH term] OR "highly active antiretroviral therapy" [MeSH term] OR HAART OR "anti-HIV agents" [MeSH term] or "management of opportunistic infections" [MeSH term] OR "treatment and prevention" [MeSH term] OR "initiation of antiretroviral therapy" [MeSH term] OR "HIV testing and counselling" [MeSH term] OR "pre-and post-test" [MeSH term]).
Outcomes: Appropriate communication technology	(appropriate OR fitness OR suitability [MeSH term] OR usefulness OR "ease of use" OR acceptability OR adequacy OR applicability OR feasibility OR proper) AND/OR ("information communication technology" OR ICT OR "information technology" [MeSH term] OR "telecommunications" [MeSH term] OR computing [MeSH term] OR eHealth OR mHealth OR infocommunications [MeSH term] OR "information access" [MeSH term] OR "telecommunications" [MeSH term] OR "mobile health" OR Internet OR "World Wide Web" [MeSH term] OR "electronic mail" [MeSH term] OR email OR www).
Context: Rural communities in developing countries	("rural communities in developing countries" OR "rural hospital" [MeSH term] OR "rural health" OR "rural health services" [MeSH term] OR "developing countries" OR "emerging countries" [MeSH term] OR "economically developing countries" [MeSH term] OR "less developed countries" [MeSH term]).

Final search strategy	("HIV-positive" OR "people living with HIV" OR HIV/AIDS OR AIDS") AND ("health education") AND ("HIV management" OR "HIV prevention, diagnosis, treatment and care" OR "comprehensive HIV care" OR "management of HIV" AND ("information communication technology" OR ICT OR "information technology" OR "telecommunications" OR computing OR eHealth OR mHealth) AND ("rural communities" OR "rural health services").
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During step four, rigorous record keeping (Cook *et al.*, 1997:376-380; Dickson *et al.*, 2013:3) was ensured.

1.6.1.5 Step 5: Critical appraisal

Step five involved critical appraisals of the methodology and ethics of the selected literature (Botma *et al.*, 2010:244) to establish their quality. Please refer to addenda 4 and 5 for the McMaster University's critical review form for qualitative studies (version 2.0) by Letts *et al.* (2007) and the evaluation tool for quantitative research studies by Long *et al.* (2002) from the University of Leeds used to critically appraise the articles. Both these critical appraisal tools thoroughly consider the methodology. The researcher established a meticulous list of interventions that were to be included/excluded. End users of appropriate interventions were limited to the community in rural areas, PLWH and their families; any findings unrelated or did not demonstrate the appropriateness of ICT in HIV management were therefore excluded. Of interest were systematic reviews that focused on the "ease-of-use" and "usefulness" of ICT in HIV management. The studies to be included for review were reviewed independently by another reviewer

In addition to the appraisal of the literature's quality, the literature was also assessed for bias. Bias refers to systematic errors that may occur during the course of the research process, leading to a deviation of the truth of the research findings (The Cochrane Collaboration, 2016). According to the Cochrane Risk of Bias Tool, there are six (6) domains in which bias can occur, namely selection bias; performance bias; detection bias; attrition bias; reporting bias and other non-categorised types of bias. In this research, these domains of bias were considered when evaluating the types of methodologies used (as presented in Table 1-6 below). The following four (4) criteria were used to evaluate each selected study's risk of bias: selection bias (reporting any bias in sampling, sample size); attrition bias (referring to the completeness of outcome of the data); reporting bias (enquiring about possible selective reporting regarding the significance or insignificance of the research results); and other sources of bias, such as the researcher(s) own bias. In Table 1-6, the following symbols were used to indicate the proposed risk of bias: + implied that the study has a high risk of bias; - implied that the study has a low risk of bias; ? implied that the researcher was uncertain about the risk of bias.

Table 1-6 Assessment of the risk of bias

Selected studies	Selection bias (bias in sampling, taking sample size and method into consideration)	Attrition bias (completeness of outcome data)	Reporting bias (selective reporting regarding significant/ insignificant results)	Other sources of bias (researcher, interviewer)
Onono <i>et al.</i> (2011)	+	?	-	-
Kebede <i>et al.</i> (2015)	-	-	-	?
Stephan <i>et al.</i> (2015)	-	+	-	-
Chib <i>et al.</i> (2012)	+	-	-	-
Natarajan and Parikh (2013)	+	-	-	-
Siedner <i>et al.</i> (2015)	-	+	-	?
Shet and de Costa (2011)	+	+	-	-
Madhvani <i>et al.</i> (2015)	-	-	-	-

1.6.1.6 Step 6: Data collection and extraction

During step six, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flow diagram was updated (Figure 1-4) to illustrate the data collection process (Moher, Liberati, Tetzlaff, & Altman, 2009). As an evidence-based minimum set of items to be reported in the systematic review, the PRISMA can be applied to non-randomised controlled trial (RCT) reviews although it mostly focuses on such reviews (PRISMA, 2015). The following elements were reported in the PRISMA: description of all information sources in the search, date of inquiry and person who conducted the search, the complete search strategy of at least one database used, including all the search terms and combinations (Godin *et al.*, 2015:3). A data extraction tool was formulated (Botma *et al.*, 2010:244) as a control mechanism to present data in a similar format to ease analysis and synthesis. Separate data extraction tools were used for quantitative and qualitative methodologies. For quantitative studies, the MASTARI data extraction tool (JBI, s.a) was adapted, while the NOTARI data extraction tool (JBI, s.a) was applied to qualitative methodologies (see addendum 2 for the completed extraction tools). Data was extracted and entered into the pre-specified data extraction tools (Joanna Briggs Institute [JBI], s.a; Dickson *et al.*, 2013:3) for both quantitative and qualitative research to extract the essential information from the selected literature.

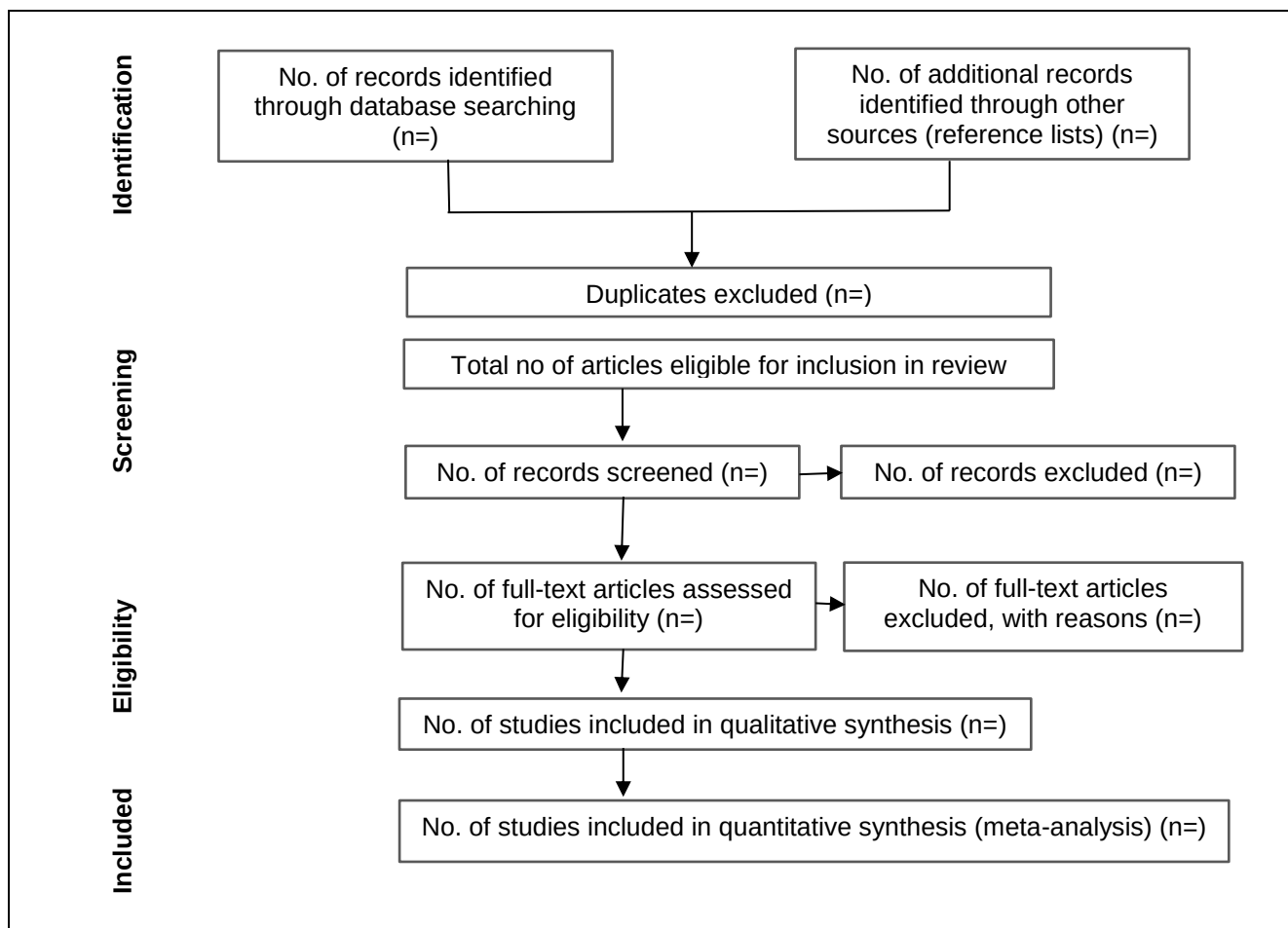


Figure 1-4: Proposed PRISMA (2015) flow of information through the different phases of the systematic review (Liberati et al., 2009:3)

The following extracted content was summarised into a summary table, from where data synthesis and analysis were conducted (see Table 1 in Chapter 2):

- Record number: the article analysed.
- Author, year of publication, journal and title of publication.
- Methodology: the design and methods, population, sampling and sample size.
- Research setting: the physical context where the research was conducted.
- Geographical location.
- Types of ICTs used: for example cellular phones, text/sms reminders, computers, Internet, telephonic follow-ups, mhealth, mobile devices, etc.
- Ease-of-use: participants' feedback that using a particular ICT would be free from effort.

- Usefulness: feedback that using a particular ICT was beneficial.
- The 5 Cs from the eHealth model for development countries:
 - **Context:** poverty, resource-limitations, rurality, how ICT supported healthcare workers.
 - **Content:** content provided on the ICTs and the migration path from paper-based to digital format.
 - **Connectivity:** wireless connectivity between health systems supporting the transfer of information provided for entry-level information infrastructure.
 - **Capacity:** ICT empowering the PLWH and/or healthcare workers towards improved care.
 - **Community:** information transfer empowering the community towards development and decision-making.

1.6.1.7 Step 7: Synthesis and summary of data

The data were critically synthesised (Botma *et al.*, 2010:244) and reported in a narrative style based on the tabulated data extraction table. This involved summarising the main research findings on the most appropriate ICT in health education in HIV management in rural communities. Thematic synthesis was conducted to identify themes.

1.6.1.8 Step 8: Document review report

The final step in the systematic review was to complete the research report and to disseminate the findings. In this study the synthesised results were reported (Botma *et al.*, 2010:244) in a dissertation and disseminated by means of a manuscript submitted for publication in the *South African medical journal* (SAMJ) and a policy brief. The research report included the final implications of the review and recommendations (Cochrane Collaboration Handbook, 2006:41).

1.7 TRUSTWORTHINESS

The criteria and strategies to enhance trustworthiness in qualitative research (Lincoln & Guba, 1985) were applied to the systematic review (see table 1-5). These criteria are truth value, applicability, consistency and neutrality. Botma *et al.* (2014:241-247) later added authenticity as a fifth criterion. Strategies to enhance trustworthiness are not traditionally deployed in systematic reviews. Yet, the researcher experienced the criteria and associated strategies as a user-friendly framework. In addition, the researcher followed the expert knowledge of the co-supervisor, who obtained training in evidence-based nutrition (ICEN) in 2013 at the Institute of Tropical Medicine in Antwerpen (Belgium). The criteria as defined and applied are presented in Table 1-7.

1.8 ETHICAL CONSIDERATIONS

Prior to data collection, the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences from the North-West University gave ethical clearance. This review did not make use of any human participants and presents as a no-risk study. Although ethical permission for this type of review was not required, the HREC had to be notified when a researcher is conducting such a review and certain ethical factors had to be taken into consideration. It is the responsibility of the researcher to conduct quality research and to follow the eight steps of a systematic review. The researcher ensured inter-relater reliability by conducting the search strategy with the promoter. The researcher also took care not to commit plagiarism by including the authors in the reference list where applicable. The researcher also kept a well-documented record of all database searches and inclusion and exclusion criteria.

Table 1-7: Criteria for and strategies to enhance trustworthiness in this research (*adopted from Guba & Lincoln, 1985 and Botma et al., 2010:233*)

Criteria and strategy	Application of strategies to this research
Truth value determines whether the researcher has established confidence in the truth of the research results, which refers to the synthesised research findings. The strategy to improve the truth value is <i>credibility</i> .	Only good quality studies were included for the review. All the elements in the study met the inclusion criteria (Dickson <i>et al.</i> , 2013:3) and the researcher was sensitive for bias in the selected literature. Each selected source of literature was assessed for methodological quality using an appropriate CASP instrument. The researcher declared the quality evaluation of the selected literature within the research report.
Applicability refers to the degree to which the findings can be applied to different contexts and groups and the ability to generalise from the findings. <i>Transferability</i> is the strategy to improve <i>applicability</i> .	A systematic review cannot be fully applicable in the true meaning of qualitative research. Yet, the researcher supported transferability by reporting the synthesised results in a narrative style (Botma <i>et al.</i> , 2010:244). In addition, the researcher kept a detailed audit trail of the steps of the systematic review and declared limitations in this research.
Consistency considers whether the findings will be consistent if the inquiry is replicated in a similar context and can be enhanced by means of <i>dependability</i> .	Consistency can be enhanced through inter-reliability when the data collection, data extraction, data analysis and synthesis of the systematic review are replicated by a co-reviewer and when consensus is captured within an inquiry audit (Polit & Beck, 2004:434). The researcher used a data extraction form presented by the Joanna Briggs Institute and tabled the information extracted from each reviewed study (Uman, 2011:57-59) in an organised manner. The research is founded on a rich theoretical assumption based on the TAM and the eHealth model in developing countries.
Neutrality entails freedom from bias during the research process and describing the results. It refers to the degree to which findings are solely a function of the conditions of the research. The strategy to improve neutrality is through <i>confirmability</i> .	There should be congruency between the researcher and a co-reviewer about the accuracy, relevance and meaning of the data. Therefore, the researcher ensured inter-reliability between herself and her supervisor, who conducted the co-review. Once a comprehensive list of titles and abstracts were retrieved and reviewed, any studies appearing to meet the inclusion criteria were obtained and reviewed in full (Uman, 2011:57-59). The researcher utilised the Cochrane Collaboration's risk of bias assessment tool to monitor the bias declared in the research report.
Authenticity refers to the extent to which the research shows fairly and faithfully a range of different realities. Authenticity can be enhanced through <i>fairness</i> .	The researcher followed the inclusion and exclusion criteria to the point (Uman, 2011:57-59) and deployed the services of the information manager at the library to source unobtainable literature to ensure that all possible data were included. After examining abstracts, only relevant literature was critically reviewed and synthesised. The researcher views the process of data collection, extraction, analysis and synthesis as an intensive process of consideration and re-consideration, of deliberation and interpretation, rather than a superficial process directed by sequential steps as could easily happen in a systematic review. On the contrary, the researcher understood at the very beginning of the systematic review that this methodology had to be rigorous and intense.

The researcher can competently search, select and interpret data stemming from her employment history within the AURUM research institute. It entails private and consultative research that includes data collection, analysis and interpretation within rural communities. The researcher completed a 32-credit research methodology module in 2014 as part of the MCur-curriculum. The supervisor has supervised a number of MCur-dissertations successfully following a systematic review methodology. The co-supervisor attended a systematic review workshop at the Institute for Tropical Medicine in Antwerpen, Belgium.

1.8.1 The Ferdinand Postma Library of the North-West University (Potchefstroom Campus)

This library has state of the art equipment, databases and search engines, was easily accessible and the researcher had assistance from the skilled librarians to refine keywords and to access databases and documents. The researcher used the search engines that the library is affiliated to and that cannot be accessed outside its domain. The library has sufficient space for the researcher to continue with data collection with minimal disturbances.

1.8.2 Management of data collection

Data were collected through a process of accessing search engines and databases available in the Ferdinand Postma Library and according to a specific written search strategy. The study supervisor monitored the data collection by means of daily reflections on the data collection process. Any changes to the stipulated plan was declared.

1.8.3 Legal requirements/ plagiarism

Getting approval from the Health Research Ethics Committee (HREC) was a prerequisite for the systematic review even though it did not involve human participants. The ethics approval process safeguards other researchers' work and provided guidance for the researcher. The researcher maintained confidentiality and avoided plagiarism.

1.8.4 Dissemination of research

The results of the systematic review were shared with other researchers to promote exchange of information and hard copies of the thesis will be kept at the University library and e-database/repository. The researcher aims to participate in a research day to disseminate the results in a presentation to fellow researchers (Chapter 2).

1.8.5 Conflict of interest

There was no known conflict of interest.

1.8.6 Data management and storage

All data were stored on the researcher's password-protected computer during data collection. From there data were secured on an electronic device and it will be kept in the supervisor's lockable office for at least five (5) years. Thereafter all digital data will be destroyed according to the document management standard operating procedure of the NWU.

1.8.7 Monitoring the progress of the study

This research was monitored through monthly feedback sessions with the supervisor, a study plan for 2016 and six monthly monitoring reports.

1.9 DISSEMINATION PLAN

The dissertation is organised into the following sections: Chapter 1 is an overview of the research and refers to the background and motivation for this systematic review. It provides an outline of the research methodology, trustworthiness and ethical considerations. In Chapter 2 a manuscript that will be submitted to the SAMJ follows. Chapter 3 provides an evaluation of the research, limitations, recommendations and a policy brief.

1.10 SUMMARY

It is important that professionals involved in the delivery of healthcare have an understanding of systematic reviews and how to implement them in practice. Besides health interventions, systematic reviews may examine clinical tests, public health interventions, environmental interventions, social interventions, adverse effects and economic evaluations. Systematic reviews are not limited to medicine and are quite common in all the sciences where data are collected and published, and an assessment of methodological quality for a precisely defined subject would be helpful (Cochrane Library, 2005).

This chapter examined both national and international studies to sketch the background to the study and to generate a problem statement. The research question, aim and objectives were described in detail in this chapter. The research methods used for this systematic review were explicitly addressed. Strategies to ensure trustworthiness and ethical considerations were explained. The researcher's perspective was outlined, focusing on meta-theoretical assumptions. Ethical considerations were evaluated according to university requirements.

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CHAPTER 2: MANUSCRIPT FOR PUBLICATION

2.1 INTRODUCTION

The manuscript titled “*No time to fail: get the right ICT for health education in HIV management in rural South African communities – A systematic review*” is intended for submission to the *South African medical journal* (SAMJ). Chapter 2 presents the manuscript and the author guidelines and the different authorship contributions. This manuscript is presented in accordance with the journal specification. It is written in 12-point Times New Roman single spaced, and the Vancouver referencing style was used.

2.2 AUTHORSHIP

The table below lists the contributions of the different authors to this manuscript. They each made a substantial contribution to conceptualisation, design, analysis and interpretation of data.

Author	Contribution	Signature
Thobile Malinga	As the MCur-candidate, T. Malinga took the lead in writing the research report, conducting the actual systematic review. She is the first author of the manuscript and the primary reviewer for the systematic review.	
Petra Bester	P. Bester conceptualised the research project, supervised all the steps in the research process, was a critical reader of the manuscript and co-authored the research results. She served as a secondary reviewer for the systematic review.	
Karliën Smit	K. Smit was a critical reader, assisted with the systematic review process and co-authored the methodology of the manuscript. She was the third reviewer for the systematic review.	

2.3 AUTHOR GUIDELINES

The SAMJ has launched a new submission and tracking system. Authors will be required to register a profile on the Editorial Manager platform in order to submit a manuscript. To submit a manuscript, please proceed to the SAMJ Editorial Manager website: www.editorialmanager.com/samj.

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The SAMJ will no longer limit the articles accepted to those that have 'general medical content', but is intending to capture the spectrum of medical and health sciences, grouped by relevance to the country's burdens of disease. This content will include research in the social sciences and economics that is relevant to the medical issues around our burden of disease. Please see 'A new vision for the SAMJ – and a call for papers' for a full discussion of the new directions for the SAMJ. We accept the following types of articles: research, reviews, clinical trials, editorials in practice, correspondence, obituaries, book reviews, ad hoc supplements e.g. guidelines, conference/congress abstracts.

Authorship

Named authors must consent to publication. Authorship should be based on: (i) substantial contribution to conceptualisation, design, analysis and interpretation of data; (ii) drafting or critical revision of important scientific content; or (iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org). If authors' names are added or deleted after submission of an article, or the order of the names is changed, all authors must agree to this in writing. Please note that co-authors will be requested to verify their contribution upon submission. Non-verification may lead to delays in the processing of submissions.

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Preparing an article for anonymous review

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- Scientific measurements must be expressed in SI units except: blood pressure (mmHg) and haemoglobin (g/dL). Litres is denoted with an uppercase L e.g. 'mL' for millilitres). Units should be preceded by a space (except for % and °C), e.g. '40 kg' and '20 cm' but '50%' and '19°C'.
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- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
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Journal references: Price NC, Jacobs NN, Roberts DA, *et al.* Importance of asking about glaucoma. *Stat Med* 1998;289(1):350-355. DOI:10.1000/hgjr.182

Book references: Jeffcoate N. Principles of Gynaecology. 4th ed. London: Butterworth, 1975:96-101.

Chapter/section in a book: Weinstein L, Swartz MN. Pathogenic Properties of Invading Microorganisms. In: Sodeman WA, Sodeman WA, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974:457-472.

Internet references: World Health Organization. The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. Geneva: WHO, 2002. <http://www.who.int/whr/2002> (accessed 16 January 2010).

Legal references

Government Gazettes:

National Department of Health, South Africa. National Policy for Health Act, 1990 (Act No. 116 of 1990). Free primary health care services. Government Gazette No. 17507:1514. 1996.

In this example, 17507 is the Gazette Number. This is followed by 1514 - this is the notice number in this Gazette.

Provincial Gazettes:

Gauteng Province, South Africa; Department of Agriculture, Conservation, Environment and Land Affairs. Publication of the Gauteng health care waste management draft regulations. Gauteng Provincial Gazette No. 373:3003, 2003.

Acts:

South Africa. National Health Act No. 61 of 2003.

Regulations to an Act:

South Africa. National Health Act of 2003. Regulations: Rendering of clinical forensic medicine services. Government Gazette No. 35099, 2012. (Published under Government Notice R176).

Bills:

South Africa. Traditional Health Practitioners Bill, No. B66B-2003, 2006.

Green/white papers:

South Africa. Department of Health Green Paper: National Health Insurance in South Africa. 2011.

Case law:

Rex v Jopp and Another 1949 (4) SA 11 (N)

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1949: Date of decision (or when the case was heard)

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(N): In this case Natal - where the case was heard. Similarly, (C) would indicate Cape, (G) Gauteng, and so on.

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Other references (e.g. reports) should follow the same format: Author(s). Title. Publisher place: Publisher name, year; pages.

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Unpublished observations and personal communications in the text must not appear in the reference list. The full name of the source person must be provided for personal communications e.g. '... (Prof. Michael Jones, personal communication)'.

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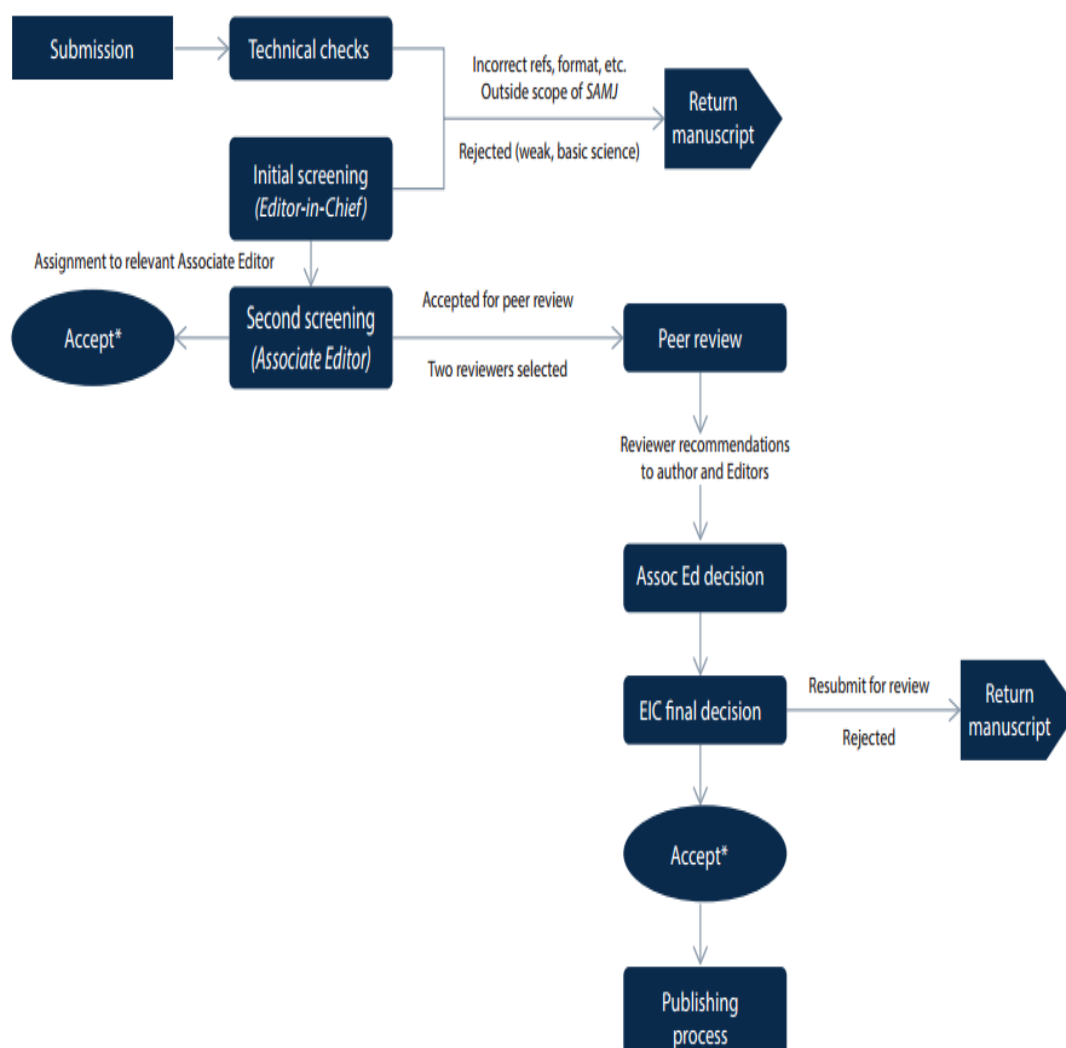
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- An abstract has been included where applicable.
- The research was approved by a Research Ethics Committee (if applicable)
- Any conflict of interest (or competing interests) is indicated by the author(s).

Title page

No time to fail: get the right ICT for health education in HIV management in rural South African communities – a systematic review

Thobile Malinga has a BCur-degree and is a MCur candidate at the School of Nursing Science, INSINQ, North-West University, Potchefstroom, South Africa, lyena@webmail.co.za, 084 652 7053.

Petra Bester holds a PhD in Nursing and is the director for the Africa Unit for Transdisciplinary Health Research (AUTHeR), North-West University, Potchefstroom, South Africa, petra.bester@nwu.ac.za, 018-299 2094.

Karliën Smit has an MSc in Nutrition and is a researcher at AUTHeR, North-West University, Potchefstroom, South Africa, karlien.smit@nwu.ac.za, 018-299 2090.

Corresponding author

Petra Bester, petra.bester@nwu.ac.za, 018-299 2094.

Conflict of interest

There is no conflict or competing interest.

Research ethics approval

The researchers declare that this study was approved (NWU-00334-16-S1) by the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences of the North-West University, Potchefstroom Campus.

ABSTRACT

Background: Human immuno-deficiency virus (HIV) management (testing, disclosure, ART, etc.) implies complex regimes within overburdened health systems. Innovative health education that extends beyond facility borders is needed to inform and empower citizens. Information communication technology (ICT) has such potential as the rural context entails typical barriers. Nearly two decades into eHealth and multiple ICT-related research, the most appropriate ICT in rural communities remains uncertain.

Objective: The objective is to identify the most appropriate ICTs for health education in HIV management in rural communities through a systematic review.

Methods: Systematic review methodology was rigorously followed. The technology acceptance model (TAM) and eHealth model for developing countries framed this review. Articles published on appropriateness of ICT for HIV management in rural communities were eligible for inclusion. Several databases were search by using a combination of MeSH and key terms separated by Boolean operators. Searches were limited to the period between 2000 and 2016.

Results: Forty-five articles were retrieved (through electronic searches and other resources), of which n7 were eligible for inclusion (n4 quantitative-, n5 qualitative design). The articles were analysed according to ease-of-use and usefulness, context, content, connectivity, capacity, community. ICT used: sms/mobile phones (n4); personal development assistant (PDA) (n1), website (n1); various/non-specified (n3). Ease-of-use was acknowledged (n8), but usefulness was less prominent. Awareness of rural context was reported. Connectivity wasn't always possible, but not a limiter. There were multiple mobile phones within groups. ICT may fortify inequality, but can also unlock capacity.

Conclusions: Despite the known potential of ICT, evidence remains scattered. Short message service (SMS) remains feasible within rural communities. Ease-of-use exceeded usefulness; context and connectivity exceeded content.

(268 words)

MAIN MANUSCRIPT

Background The prevalence of the human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS) in South Africa (SA) is at 12.2% of the population, which accounts for 6.4 million individuals living with the virus.² Although the mortality rate of the epidemic is decreasing, it has adverse impacts on the socio-economic development status and human capital of South Africa.² As one author put it “it will be impossible for us to eradicate HIV as long as any corner of the world is cut off from the education and services that we know helps stop the spread of this disease”.² The limited healthcare budget, chronic shortage of healthcare workers and lack of incentives to retain those in remote areas further jeopardize the national healthcare delivery system. Recently, the application of information communication technology (ICT) to healthcare delivery and the use of telemedicine have raised hope.⁴

Currently, there is considerable consensus that an effective response to the epidemic should be a comprehensive one, requiring prevention, treatment, and the protection of human rights. These elements are part of a continuum, with prevention enhanced by the availability of treatment, which in turn reduces the stigma of an illness that is perceived to be a death sentence. Effective prevention also relies on the reduction of vulnerability to infection in high-risk groups like women and youth through the protection of human rights and other means. ICT is a core thread running through this response, providing both form and content to prevention, treatment and vulnerability reduction. Despite resource limitations and infrastructural gaps that hamper both extensive ICT connectivity and significant scaling up of a comprehensive response to HIV, the African continent is rich in the human resources and initiatives necessary to enable an effective response to HIV.¹⁵ Significant obstacles to effectiveness of ICT interventions in the fight against HIV are limited resources, stigmatization and discrimination of People Living with HIV/AIDS (PLWHA), a lack of information to enable appropriate behavioural changes and to counter the dangerous social consequences of misinformation and myths about the disease and continuing social and political silence and denial about the disease.⁸

Effective communication with appropriate information is one of the main problems in South Africa in the fight against HIV. There are misconceptions, myths and lacking information about the cause, symptoms and treatment of HIV. ICT plays a major role in reducing the communication gap in the general population. Appropriate information about how HIV is transmitted, its symptoms and the treatments that are available can develop a person's capacity to act quickly before infection and to take the necessary steps infection with HIV. Information and communication form a core regimen in fighting against this deadly disease. It includes prevention, education, treatment, awareness and research. HIV projects that aim to connect risk groups with appropriate information should consider different factors, such as where the appropriate programme or campaign can work on a different sector to fight HIV. Several case studies illustrate ICT applications in HIV management in different countries. These studies can help us formulate and integrate new interventions in addressing HIV prevention, education, research and connection in rural and marginalized South African communities. Projects using ICTs to combat HIV have been initiated throughout Africa, but many remain small-scale and operate in relative isolation. ICTs hold the potential to help Africans combat HIV through improving treatment and prevention programmes, assisting in changing sexual behaviours and practices, and enabling shared effective precautions.⁴ Since HIV requires massive, sustained interventions, the effective use of ICTs as a sustainable valuable proposition requires applying the right type of ICT to the right business case.

mHealth interventions are increasingly being used in HIV management and other sexually transmitted diseases (STDs).

These initiatives are designed to promote prevention messages, to facilitate test result notification, improve HIV medication adherence and increase adherence to clinic appointments. Although mobile device-based interventions have typically used the voice or text-based Short Message Service (SMS) features of mobile phones, the increasing popularity of smartphones and applications (apps) expands the potential health education interventions⁵. These interventions are critical for reversing the HIV epidemic. However, huge challenges lie ahead. In 2015, there were between 1.8 to 2.4 million new HIV infections worldwide, adding up to a total of between 34.0 to 39.8 million people living with HIV.⁶

There is not a “one size fits all solution” for health education but considering the cost of technology, and after more than a decade since the launch of mHealth, we need to consider applying the right technology to rural communities as consumer and health worker literacy is of paramount importance. To make the best use of mhealth applications, target audiences must understand central concepts about health and ICT. mHealth apps can help raise health literacy. However, patients still have to know enough about their diseases to make use of compliance reminders and treatment advice. Similarly, the ability to operate handsets, including SMS, email, Web browsing, and other applications, determine the extent to which mHealth can assist end-users in a cost-effective manner. Health workers need the same technology skills at a higher level of competence than consumers. mHealth apps can enable health workers working outside hospitals and clinics to perform a wider range of functions, but only if they have sufficient literacy in health and ICT. Social intermediaries can help with training and building the capacity of health workers.⁷

This research was directed by the Technology Adoption Model (TAM)⁹ and the 5Cs of the eHealth model in developing countries⁹. TAM relates to the information system theory. The model of user adoption applied here includes perceived *ease-of-use* (using particular technology as effortless) and *usefulness* (technology to address particular concern on end user’s level of capability). The 5C’s can be described as the *context* (the role ICT plays to enable healthcare within resource-limited realities), *community* (community development through information to enable health-related decision-making), *content* (provide current knowledge in an appropriate format, including migration from paper-based to digital), *connectivity* (availability of broadband, cell phone towers, computers, phone ownership, electricity to charge devices) and *capacity* (using ICT to capacitate healthcare workers’ skills fast, at low cost, close to their workplace).⁸

Objectives The objective of the research was to identify and describe the most appropriate ICTs for health education in HIV management in rural communities by means of a systematic review.

Methods A systematic review methodology was deemed most appropriate to find the best available evidence of the most appropriate ICTs used in health education in HIV management in rural communities. Two independent reviewers followed the rigorous eight-step methodology¹⁷ in accordance with a pre-developed protocol to ensure inter-rater reliability. Disagreements were resolved by consulting until there was consensus. If a consensus could not be reached, a third reviewer was consulted. Preliminary scoping searches were done to formulate the review question and title. The PICOT framework was used as roadmap to define inclusion and exclusion criteria. *Inclusion criteria* included articles on appropriate ICTs for health education in HIV management; conditions explicitly related to rural communities. *Exclusion criteria* included articles addressing ICT or health education or HIV management or rural realities with unrelated relationships.

Search strategy Initial selection criteria for the comprehensive literature search were broad to include the most relevant literature. The Cochrane Library, the Campbell Collaboration and DARE were screened for possible reviews, although none were found. The search strategy was developed by the researcher in PubMed (Medline).

It consisted of a combination of MeSH and key terms that were separated by Boolean operators. Searches were limited to the period from 2000 to 2016 because eHealth/mHealth were absorbed into healthcare by the World Health Organisation in 1999. Searches were not limited based on study design or language. The search strategy was adapted for the following additional databases: Academic Search Premier, Business Source Premier, Cinahl with full text, Health Source Nursing Edition, MasterFILE Premier, PsycINFO (via EBSCOhost), Emerald, Google Scholar, JSTOR and ScienceDirect. These databases were chosen because they were deemed sufficient based on the preliminary searches. The final search strategy was: (“HIV-positive” OR “people living with HIV” OR HIV/AIDS OR AIDS”) AND (“health education”) AND (“HIV management” OR “HIV prevention, diagnosis, treatment and care” OR “comprehensive HIV care” OR “management of HIV” AND (“information communication technology” OR ICT OR “information technology” OR “telecommunications” OR computing OR eHealth OR mHealth) AND (“rural communities” OR “rural health services”).

Selection of articles The process of selecting articles is presented in Figure 1 according to the Preferred Reporting Items for Systematic Reviews and meta-analysis (PRISMA). Titles and abstracts were scrutinized for suitability before relevant full text articles were obtained and screened for eligibility against inclusion criteria. Reference lists of retrieved articles were screened for possible identification of primary studies that had been missed during the electronic searches. Whenever full text articles were unavailable or not in English, the authors were contacted. If the authors did not respond within the timeframe of this review or no English version could be obtained, it was rejected.

Critical appraisal and data extraction

The eligible full-text articles retrieved were critically appraised for methodology according to standardised critical appraisal tools. The 2nd version of the McMaster University’s¹⁹ review was used for qualitative articles and the Long *et al.*, review of the University of Leeds²⁰ for quantitative articles. The Cochrane Collaboration Risk for Bias Tool²¹ was adapted for both qualitative and quantitative articles. Data were extracted and entered into a pre-specified data extraction form for qualitative articles (NOTARI data extraction tool) and quantitative articles (MAStARI data extraction tool) adapted from the Joanna Briggs Institute¹⁸. Inter-rater reliability enhanced trustworthiness.

Results There were seven (n7) articles, of which four (n4, articles 3, 4, 7, 8) were quantitative and three (n3, articles 1, 2, 3, 4, 5) qualitative. The types of ICT used were mobile phones, including text messages used in quiz’s, medication adherence and laboratory results (n4, articles 2, 4, 6, 7). One (n1, article 1) article used PDAs at nine health facilities in two rural Ugandan districts and one (n1, article 4) article described the development and implementation of a prevention of mother-to-child-transmission (PMTCT) website in Tanzania accessible to various stakeholders. Interestingly, no articles covered social media.

Figure 1: PRISMA flow diagram

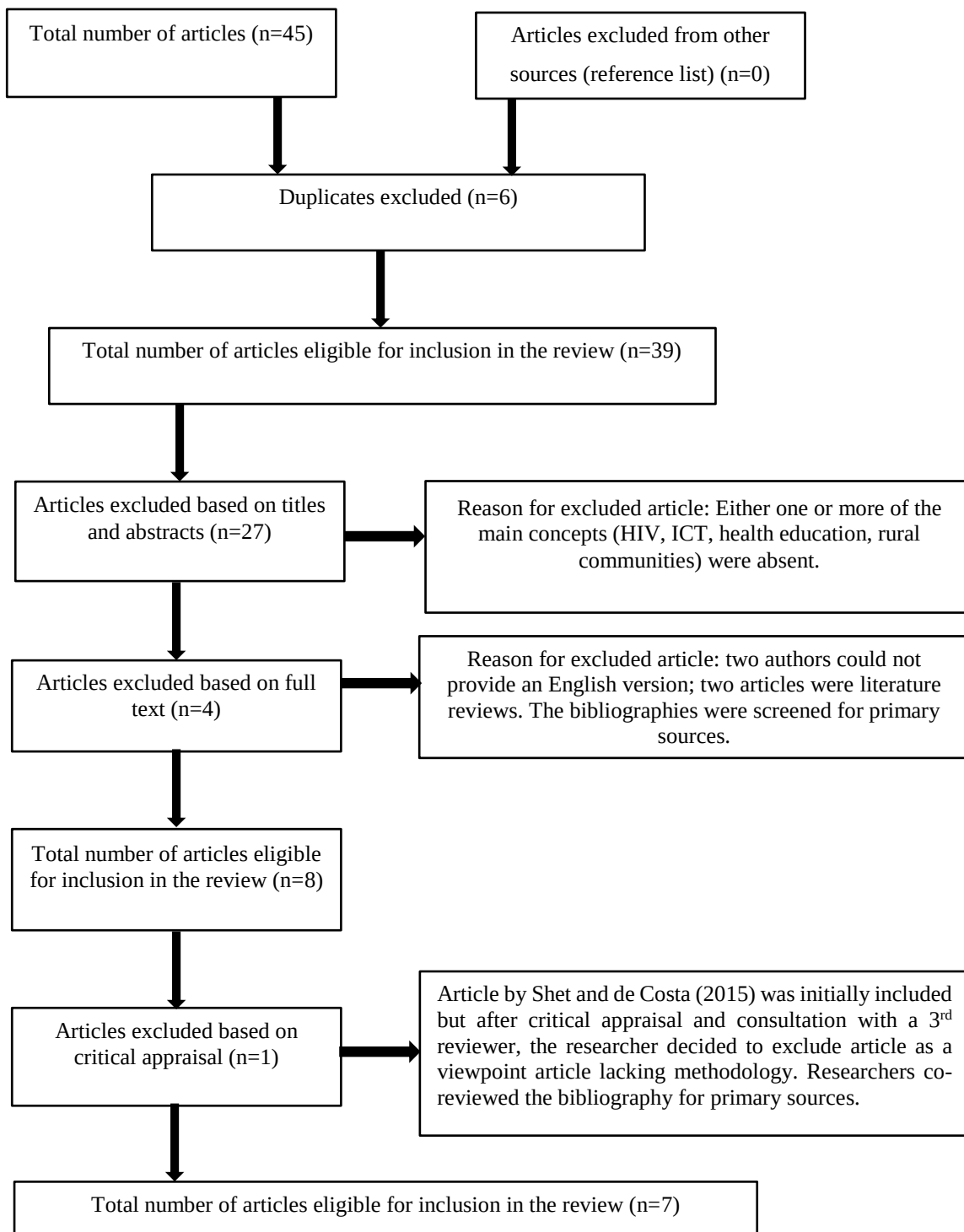


Table 2: Summary of findings table

Nr.	Summary and conclusion	Technology Adoption Model (TAM) (Davis, 1993)		eHealth model in developing countries (Drury, 2005)				
		Ease-of-use	Usefulness	Context	Content	Connectivity	Capacity	Community
1	A PDA-based electronic system was used in a PMTCT programme as part of an HIV/AIDS stigma study. PDAs were feasible as an ICT in a multisite, observational study in remote health facilities. Absent back-up systems and use of paper for back-up is still a reality in resource-poor, rural settings.	Convenient (small, mobile), usable in any weather, over long distances, storage friendly, echo-friendly, more cost-efficient than paper.	The use of PDAs was feasible but lack of sufficient backup systems required paper trail as well.	One PDA was stolen, data should be encrypted on SD cards, extra security required. Lack of electricity, poor connectivity and poor backup required paper backup.		Quick turnaround time, but internet dependent.	Interviewers (n=24) had no techno-literacy, became comfortable to use the PDAs after two days training and mastered PDAs, led to high quality data collection with low error rate.	Lack of local skills for programming and support.
2	The study measured access to cell phones, willingness to receive text message medication reminders and to identify any associated factors in ART. The majority of participants had cell phones and were willing to receive text messages as medical reminders. Willingness was associated with disclosure status of HIV, age, educational status and internet usage.	Preferred over telephone calls and text messages. Willingness to get reminder messages are not linked to privacy or access or use of one phone by multiple users.	Only 51% of participants were willing to use cell phone for medication reminders. Willingness to get ART reminder messages on a cell phone was influenced by age (younger adults), educational status (secondary or higher education), and the use of the Internet and HIV disclosure status.	PLWHA in a town at an ART clinic at the hospital in North West Ethiopia and 76.1% of participants owned their own cell phone, with the mean age being 34.03 years. 72.2% of the participants could read and reply on text messages.		19.6% participants accessed the Internet and predominantly use Facebook and other social media with lower cell phone accessibility than similar studies due to the digital divide. Using the internet was an indicator for willingness to get reminder sms.	People who used internet on the cell phone usually have improved health information access and awareness of the importance of text messages.	

3	The study examined the development, promotion and the first evaluation of a national website with PMTCT information and resources for stakeholders and healthcare workers. The website is dependent on continuous involvement and increased subscription. There is a need to explore how this website could support the implementation of national PMTCT guidelines and services.	PMTCT website, provided easy access to online information. Content categorised by resources and topic. Searches for novice internet users. Large documents split into sections facilitated online access and downloads. Limited search time and downloading of needed resources only reduced the internet usage fees.	A national resource centre website for PMTCT within a resource poor Tanzania. All levels of healthcare service delivery and all health professionals as well as non-health professionals and citizens as healthcare users can access and use the information. Development and promotion of website is a continuous and critical process, with a combined online and offline approaches.	One-stop access point for information in various formats that are obtainable and downloadable. National PMTCT guidelines and associated training manuals provide core resources for PMTCT services and healthcare worker training.	Website is mobile-device friendly, enabling access to resources by those who have mobile devices with internet services. Website visits originated in urban area (62 %) and about 32 % visits from unspecified locations including smaller areas consistent with limited internet access outside urban centres.	Ministry of Health and Social Welfare worked with more than ten partner organizations to build health system capacity and deliver PMTCT services in all regions.	Continuous involvement and commitment of Ministry of Health and Social Welfare and key stakeholders to ensure growth, credibility, sustainability and effectiveness of the website. Continued development, promotion, evaluation to enhance increased user numbers as internet access expands.	Separate website for PMTCT provided easy access to online information through a website focused on this topic. Content categorized by type of resource and topic. Website focuses on PMTCT facilitates site navigation and searches for novice internet users. Large documents split into sections facilitated online access and downloads. Limited search time and downloading of needed resources only reduced the internet usage fees.
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4	The study explored if sms-based campaigns were suitable for developing countries. Explored a sms-campaign and conducted a sms-based quiz to evaluate participants' knowledge about HIV. Participants responded poorly to a sms-based quiz. There were limited positive outcomes in respect of increased knowledge levels on a massive scale and the study confirmed integrated knowledge gaps. SMS-based campaigns does have potential as a mass communication, but the study suggests that researchers should be conservative about its overall potential.	Low response rate linked to hierarchy-of-effects model (McGuire, 1990), where people follow a sequential progress from cognitive to affective, to behavioural responses, each stage viewed as degradation in the response.	Limited success of mHealth HIV campaigns in resource-poor settings.	Combine sms/mobile phone with interpersonal or mediated forms of data dissemination in countries where literacy and income are disparities.	Answering only correct answers may impact negatively on participation in quiz.		SMS campaign might have reinforced an already existing knowledge gap.	Although the general level of knowledge on HIV was high in rural Uganda, the critical health education did not reach the necessary community.
5	The study explored why disclosure models fail with information dissemination of married HIV+ women in heterosexual relationships. mHealth should reflect on the possible impacts of the present values of standardisation, competence, measurement, scale, universalisation and proactivity on social and health outcomes. Researchers should consider the current limits of access models and focus on personalisation, engagement, trust, context-specific usability of information as functional outcomes.	Context-specific usability of information is motivated.		For mHealth first reflect on possible impacts on current values of standardisation, efficiency, measurement, scale, universalisation and proactivity on health - /social outcomes.			Recommended that personalisation, engagement and trust should be considered.	HIV disclosure remains a time consuming process irrespective of technology.
6	The study examined the implementation of an sms application in an HIV management programme aimed at PLWH with lower literacy levels. SMS messages were sent about normal/abnormal laboratory results. A pin code was used for security. Established literacy at the time of registration was a strong forecast of SMS efficiency. PIN-protected messages decreased the probability of clinic returns, while coded messages were as operational as direct messages and can increase privacy.	The majority of PLWH preferred to get laboratory results via sms, irrespective of their literacy levels.	Using mobile phones to communicate basic laboratory information experienced as a useful function even in resource-limited, rural communities.	Despite resource-limiting barriers, rural PLWH still have multiple access to mobile phones.	Receiving potential negative content (bad news) increased anxiety and PLWH wanted a follow-up phone conversation.	Households presented with multiple phones and multiple numbers with an indication of the most preferred number(s) suggested.		In the event of illiteracy, PLWH could find a literate person within their immediate environment to assist with reading the sms.

7	The study aimed to identify the patient demographic groups least probable to use mobile phones as reminder tools in HIV management. Being female, older aged, from a lower socio-economic stratum and having lower education are all risk factors for lower use of mobile phones as reminder benefits.	After one year of implementation, the model had positive educational impacts and additional psychological benefit.	Preferred to use mobile phone calendar as a medication reminder. PLWH used different types of ICT for different aspects in HIV management.	PLWH and on first regime ARTs, attending public healthcare at Chris Hani Baragwanath Hospital, Soweto, South Africa. 66% unemployed.			Further exploration into mHealth uptake required prior to integration of mHealth into national strategies.	
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The ease-of-use and usefulness (n7, articles 1, 2, 3, 4, 5, 6, 7) are discussed as a secondary matter as none of the articles intentionally reported on ICTs related to users' belief that using the particular ICT was effort-free or that using it would enhance the outcome of healthcare. The results were also analysed according to the eHealth model in developing countries⁹ with specific reference to context, content, connectivity, capacity and community. All seven articles (n7, articles 1, 2, 3, 4, 5, 6, 7) described the **context** and rural-related realities. Three (n3, articles 2, 6, 7) advocated mHealth/mobile phones/sms as accessible options. Three (n3, articles 3, 4, 6) articles reported on the **content** used. Interestingly, **connectivity** was not such a prominent theme with four (n4, articles 1, 2, 3, 6) articles reporting on connectivity. One (n1, articles 1) article acknowledged the lack of Internet coverage and insufficient local technical support in a rural context. **Capacity** was reported non-intentionally by five (n5, articles 1, 2, 3, 4, 7) articles with one (n1, article 1) article describing the capacity development associated with the implementation of PDAs into HIV management. Five (n5, articles 1, 3, 4, 5, 6) articles reported on the **community** as the larger collaborator in various ICTs, while acknowledging that privacy needs further investigation.

In addition, the following themes emerged from the analysed data: mHealth prominent ICT in rural communities (1st theme); context is first, then capacity and community, connectivity and content (2nd theme); context as a resilient reality-check (3rd theme); and potential versus lack of evidence (4th theme). mHealth is presented as a prominent ICT in rural communities. Mobile phones are readily available and text messaging is a functional communication medium for especially reminders and laboratory results. Text messaging was not efficient to increase knowledge. The context was the most prominent criterion presented in seven of the eight articles. After the description of the context followed capacity and community, then connectivity and content. It was interesting that content was reported as the fifth criterion. Closely linked with the 2nd theme, the context as prominent criterion was reported as a surmountable barrier. Rural communities present with specific resource-limitations that should be acknowledged when incorporating ICT. ICTs within the contextual challenges of rural communities require a resilient reality-check where implementers acknowledge strengths (such as multiple mobile phones available in each household) and adapt to barriers (such as limited local technical capacity). Despite the adoption of eHealth (and mHealth) into rural healthcare and acknowledging its potential from smaller to mass user scale, empirical evidence is project-specific. More research is encouraged before ICT for health education can truly be absorbed into national policy.

Discussion The potential of ICT in healthcare depends on feasibility, affordability, access to appropriate knowledge and information, health promotion and alleviation of poverty¹⁰. Mobile phones, including smart phones, are widely accessible in South Africa and more than 75% of people in low-income groups who are 15 years or older own a mobile phone¹¹. Mobile devices, one example of ICT, are one of the most accessible ways to access the Internet in a country with unreliable access to broadband connectivity and economic inequality. Statistics South Africa¹² reported that more than a third of South African households (41%) have at least one member who use the Internet either at home and/or workplace. Connectivity is necessary. Although villagers in Mpumalanga have access to the electricity grid, it is unaffordable due to unemployment. The South African DoH adopted eHealth, yet progress in telemedicine and training opportunities are limited.¹³ The secondary ranking of content to context was not confirmed in literature.

Conclusions mHealth (mobile phones with SMS/text messaging) is presented as the most appropriate type of ICT for health education in HIV management in rural communities. Yet, mHealth was more functional in reminders and laboratory results and less functional to enhance critical HIV knowledge levels. Ease-of-use and usefulness were not directly reported in the articles. Content was the least reported consideration in ICT in rural communities.

The suggested first step is to understand and work with the context and to be resilient when it comes to the barriers within the context to select the most appropriate type of ICT for health education in rural communities. The capacity of ICT users can increase with hands-on use, while the lack of capacity does not have to serve as a limiter. Communities can be active participants in adopting to and using ICTs for health education in HIV management. Recommendations include adapting to resilient thinking to adjust to rural-related barriers such as limited connectivity and limited technical capacity continuously. Healthcare workers should work with the strengths in rural communities, such as the availability of mobile phones in every household.

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Table 1: Demographic table

Author, article number	Yr	Article title	Article type	Summary and conclusion	Type of ICT used							Setting	
					Mobile phone	Web	Social media	Health information	PDA	ICT unspecific	Other	Population	Region
Number 1: Onono, Carraher, Cohen, Bukusi and Turan ²²	2011	Use of personal digital assistants for data collection in a multi-site AIDS stigma study in rural south Nyanza, Kenya	Case study, data collection: screening, interviews, capturing data from medical records. Part of Maternity in Migori and AIDS stigma (MAMAS) study, comprehensive family-based HIV programme.	PDA-based electronic system used in a PMTCT programme as part of a HIV/AIDS stigma study. PDAs were feasible ICT in multisite, observational study in remote health facilities. Absent back-up systems and use of paper for back-up is still a reality in resource-poor, rural settings. PDA specifications were: Dell Axim v50 and 8 Hewlett Packard iPAQ hx 2400, 20 x 1-gigabyte secure digital (SD) memory cards, 2 x SD card readers to upload data to laptops, 6 extra batteries for the PDAs.					Used 9 PDAs for data collection in HIV care			Pregnant women antenatal clinics (9 clinics, n=1 270)	Kenya, Migori and Rongo districts, rural south Nyanza.
Number 2: Kebede, Zeleke, Asemahagn and Fritz ²³	2015	Willingness to receive text message medication reminders among patients on antiretroviral treatment in North West Ethiopia: a cross-sectional study	Cross-sectional survey	Measured access to cell phones, willingness to receive text message medication reminders and to identify any associated factors in ART. The majority of participants had cell phones and were willing to receive text messages as medical reminders. Willingness was associated with age, educational status and internet usage.	Reminder SMS messages							PLWH, ≥15 yrs, ART (N=10000, n=432)	Ethiopia, academic hospital

Number 3: Stephan, Hoyt, Storm, Shirima, Matiko and Matechi ²⁴	2015	Development and promotion of a national website to improve dissemination of information related to the prevention of mother-to-child HIV transmission (PMTCT) in Tanzania	Descriptive, participatory approach	Development, promotion and the first evaluation of a national website with PMTCT information and resources for stakeholders and healthcare workers. The website is dependent on continuous involvement and increased subscription. There is a need to explore how this website could support the implementation of national PMTCT guidelines and services. Used Google analytics: launched July 2013, received 28 400 visits, 66 463 page views over 2 yrs.; 30% returning visits; in 1 st year 80% increase in visits; monthly visits spiked by approx. 70% Oct. 2013 to Jan. 2014 in response to release of revised national PMTCT guidelines, training manuals.		Information on PMTCT						Healthcare workers, PMTCT stakeholders, civil society	Tanzania and other African countries
Number 4: Chib, Wilkin, Xue Ling, Hoefman and Biejma ²⁵	2012	You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in Northwest Uganda	Survey	Explored if sms-based campaigns were suitable for developing countries. Explored an sms-campaign and conducted an sms-based quiz to evaluate participants' knowledge about HIV. Participants responded poorly to sms-based quiz. There were limited positive outcomes to increase knowledge levels on a massive scale and confirmed integrated knowledge gaps. SMS-based campaigns can have potential in mass communications, but researchers should be more conservative about its overall potential.	Sms-based HIV and AIDS quiz							10 000 active MTN mobile subscribers (n=2363)	Uganda

Number 5: Natarajan and Parikh ²⁶	2013	Understanding barriers to information access and disclosure for HIV+ women	Ethnographic, grounded theory approach	Explored why disclosure models might fail in information dissemination of married HIV+ women in heterosexual relationships. mHealth should reflect on the possible impacts of the present values of standardisation, competence, measurement, scale, universalisation and proactivity on social and health outcomes. To consider current limits of access models and focus on personalisation, engagement, trust, context-specific usability of information as functional outcomes.	Overall exploration of ICT with a focus on mHealth, but no specific type of ICT isolated.							HIV+ women in an NGO	Chennai (India)
Number 6: Siedner, Santorino, Haberer, David, Bangsberg ²⁷	2015	Know your audience: predictors of success for a patient-centred texting app to augment linkages to HIV care in rural Uganda	Randomised clinical trial of a sms app, inclusion criteria > 17 yrs, self-reported access to a cell phone.	Implementation of an sms application in HIV management programme aimed PLWH with lower literacy levels. SMS messages were send about normal/abnormal laboratory results, a pin code for security was used. Established literacy at the time of registration was a strong forecast of SMS efficiency. PIN-protected messages decreased the probability of clinic returns, while coded messages were as operational as direct messages and can increase privacy.	SMS messages of laboratory results, given as direct, PIN-protected and coded messages							PLWH - lower literacy levels (n=50)	Uganda, Immune Suppression Syndrome clinic, Mbarara District
Number 7: Madhvani, Longinetti, Santacatterina, Forsberg and El-Khatib ²⁸	2015	Correlates of mobile phone use in HIV care: Results from a cross-sectional study in South Africa	Cross-sectional questionnaire	Aimed to identify patient demographic groups least probable to use mobile phones as reminder tools in HIV management. Being female, older, lower socio-economic levels and lower education are all risk factors for lower use of mobile phones as reminder benefits.	Interviews about reminder messages							PLWH with first regiment ART (n=883)	South Africa, SAVE-study, Soweto

CHAPTER 3: CONCLUSIONS, EVALUATION, LIMITATIONS, RECOMMENDATIONS AND POLICY BRIEF

3.1 INTRODUCTION

Chapter 3 concludes the research. After formulating the final research conclusions, the chapter offers a self-reflective evaluation of the research and declares the limitations experienced. Recommendations are formulated for the most appropriate ICT for health education in HIV management in rural communities. A policy brief, which was compiled by the researcher, aimed at district and provincial DoHs in South Africa is presented after the completion of this research.

3.2 CONCLUSIONS

The following concluding statements are presented:

- mHealth using sms/text messaging is proposed as the most appropriate type of ICT in HIV management in rural communities. It is used for basic massaging, appointment and medication reminders and laboratory results.
- mHealth by means of sms/text messaging is a less appropriate type of ICT for health education in HIV management in rural communities.
- The most appropriate type of ICT for health education in HIV management in rural communities may best be realised by a combination of mHealth and contextual understanding and contextual adaptation.
- Content in health education in HIV management comes second to understanding the context.
- Although ease-of-use and usefulness are two concepts within the Technology Adoption Model (Davis, 1989), these two concepts are not directly explored.
- The proposed sequence of the characteristics in the eHealth model in developing countries (Drury, 2005:19-26) is first context, then capacity and community, then connectivity, then content.

3.3 EVALUATION

The research is evaluated by means of a self-reflection related to the research question, initial research objective, realisation of the proposed methodology, central theoretical statement and the focused question asked within the systematic review.

3.3.1 Research question

The research question “*What is the most appropriate ICT for health education in HIV management in rural communities?*” was a sensible question because the background argued the absence of the most appropriate ICTs for health education, specifically in rural communities.

3.3.2 Objective

The proposed research objective was reached because after critically appraising, analysing and synthesizing selected articles; the researcher concluded that the most appropriate ICT in rural communities is mHealth (mobile phones, mobile devices, using SMS and text messaging).

3.3.3 Realisation of the methodology

The researcher conducted a systematic review to address the research question, and this was an appropriate approach as the researcher wanted to explore the best evidence available regarding the use of ICT for HIV management. Since the launch of the concepts eHealth and mHealth, there has been an influx of research. The majority of research referred to SMS and text messaging in adherence management. The researcher could only isolate seven (n=7) articles during the systematic review. Literature searches on HIV management and health education and rural communities and ICT were limited. The researcher identified two articles with valuable content, but these articles were literature reviews and this systematic review utilised only primary data.

3.3.4 Central theoretical statement

The central theoretical statement declared in 1.5.2.4 is still supported on conclusion of this research. The review shows that mHealth in various formats can be viewed as the most appropriate type(s) of ICT(s) for health education in HIV management in rural communities. Yet, mHealth requires that content (which might be seen as the typical starting point for health education) now be adopted to the context, connectivity, capacity and community.

3.3.5 Focus question

The PICOT framework was adopted to address the formulated research question (see Figure 1-3 in Chapter 1). The PICOT led to an extensive search strategy that was simplified during various searches. A gap identified in the PICOT is the difficulty of finding articles that fit the inclusion criteria. Multiple articles were available on mobile devices, mHealth and text messaging for adherence. Limited articles were available on health education and ICTs.

3.4 LIMITATIONS

The following limitations are declared:

- Despite the initial and subsequent searches, the researcher found that there is limited research available on ICT and more research available on mHealth. It was a difficult process to decide when mHealth included wider ICT. In this event, a third reviewer had to be approached for assistance.
- There was incongruence within literature about the use and meaning of mHealth and eHealth.

- There was a limited amount of literature available that reported on the four main concepts of appropriateness of ICT and health education, and HIV management and rural communities. In most literature, health education and rural communities were the two missing concepts.
- The TAM was used as theoretical framework, but the selected literature did not provide an undeviating report on ease-of-use and usefulness.

3.5 RECOMMENDATIONS

Recommendations are clustered into health education, healthcare practice and further research.

3.5.1 Health education

- This research displays the need to train healthcare professionals regarding the use of ICTs for health management. There is potential to implement web-based continuing education in developing countries through online courses that can train and provide current information to health-care professionals in the management of HIV (Curioso *et al.*, 2007:11).
- eLearning or web-based continuing education can improve health-care professionals' practical skills, with an added advantage as it is done in the comfort of their environment, thus saving costs.
- In-service training of healthcare professionals to keep abreast of current and appropriate ICT can be used as part of a lifelong learning culture.
- Healthcare professionals are taught to develop material for health education in general. Healthcare professionals should be trained to integrate more media and communication technology in health education to be able to provide the same health education in less words or animated format.

3.5.2 Healthcare practice

- Nurses as change agents are motivated to adopt to ICT solutions for health education in HIV management within clinical practice. It starts with each nurse being an advocate for the most appropriate type of ICT and adapting health education practices within especially overburdened health facilities. These can be provided via ICT.
- A contextual analysis of patients in need of health education in HIV management should be conducted and a mHealth project within health facilities aimed for health education should be launched.

- Healthcare professionals can work with patients to establish the content that should be conveyed to patients and the format health education should take. It is also recommended that healthcare professionals should be experienced in providing typical health education in HIV management fortified by providing the same health education messages in less words (saying more with less words).

3.5.3 Further research

- The researcher recommends further research on how ICT can be integrated in everyday HIV management routines without causing an extra burden for healthcare professionals.
- The issue of ease-of-use and usefulness of ICT in health education in rural communities should be studied further.
- End-user needs for and adoption to eHealth and mHealth in health education in HIV management in rural communities should be studied.

3.6 POLICY BRIEF

According to Eisele (*cited by* Anon, s.a) a policy brief is a short, neutral summary of what is known about a particular issue or problem. Policy briefs are a form of report designed to facilitate policy-making. In short, the purpose of the policy brief is to convince the target audience of the urgency of the current problem and the need to adopt the preferred alternative or course of action outlined and therefore, to serve as an impetus for action. As the first step, out of six, the following considerations must be kept in mind: the audience that the researcher is targeting; the issue being addressed; the policy actors for, example policy makers from the DoH; these actors' interests; the recommendations and how to sell the idea to the community. Policy actors cannot read full-length academic papers. On average, policy actors spend 30 minutes reading a policy brief (Jones & Walsh, 2008:6). Thus, policy briefs are an effective way of bringing important research to the attention of policy actors because they can be read in a short amount of time. They have the potential to reach large audiences through different networks because of the condensed format. Research has found that a policy actor will pass a policy brief on to colleagues if they perceive it to be important (Benyon *et al.*, 2012:76). The target audience are people who have influence in policy making, both in the private and public health sectors, and who can assist in spreading the word to other stakeholders. This expands the area and number of people who accesses and reads the brief. The policy brief formulated by the researcher as final contribution to this research, is presented after the summary.

3.7 SUMMARY

In Chapter 3, the researcher evaluated the research done and made recommendations for future considerations regarding the use of ICT in health education in HIV management in rural communities. Additionally, the researcher formulated a policy brief to disseminate the information in a simpler format. In conclusion, this research resulted in useful information. It argued that although mHealth was introduced in the late 90's, the associated ICTs were focused predominantly on adherence management and laboratory results. The identified gap of using ICT for health education in HIV management in rural communities remains underexplored and needs advocates.

EXECUTIVE SUMMARY

A rigorous systematic review was done until November 2016 to isolate the most appropriate type(s) of ICT for health education in HIV management in rural communities. Nine studies were analysed and synthesised. Appropriateness was based on:

- ease-of-use;
- usefulness;
- context;
- content;
- connectivity;
- community; and
- capacity.

Results

- Mobile phones (SMS) most appropriate.
- A resilient adaption to context critical.
- Health education through mHealth is possible but under-explored.



POLICY BRIEF

Most appropriate ICTs for health education in HIV management in rural communities

CONTEXT

This policy brief is aimed for decision-makers in government departments and NPO's regarding mHealth and eHealth. Almost two decades after the launch of eHealth, there are multiple, isolated studies on ICT in HIV, but evidence remains scattered. With overburdened health facilities and limited time for health education, ICT can bring health information to each South African citizen. ICTs have the potential to accelerate the development and implementation of productive HIV prevention programmes, increasing access^{1,2}.

Technologically, although South Africa has the most advanced ICT platform in Africa, there remains a digital divide between urban and rural settings and between the rich and poor. There are also different levels of eHealth maturity across and within South African provinces with a wide range of legacy information systems, with poor interoperability³. Don't waste unnecessary resources on ICTs less appropriate for rural South Africa.

RESULTS

- Ease-of-use/usefulness not directly addressed.
- mHealth (mobile phones/devices, SMS) most accessible options and appropriate in rural communities.
- Consider context first then capacity and community, connectivity and content.
- Embrace the challenging context, adapt to contextual rural challenges as a continuous resilient reality-check.

- Challenges in connectivity are surmountable.
- Weigh-off the potential of mHealth versus the lack of evidence.

CONCLUSIONS

mHealth (mobile phones with SMS/text messaging) is the most appropriate type of ICT for reminders in HIV management in rural communities. Yet, mHealth less functional to enhance critical knowledge levels about HIV. The suggested first step is to understand and work with the context and being resilient to the barriers within the context to select the most appropriate type of ICT for health education in rural communities. ICT users' capacity can increase and lack of capacity doesn't have to serve as a limiter. Communities can be active participants in adopting to and using ICTs for health education in HIV management.

RECOMMENDATIONS

- Work with strengths such as multiple mobile phones available in each household.
- Adapt continuously to barriers such as limited local technical capacity.

Contact person: Thobile Malinga
lyena@webmail.co.za, 082 298 3567



- Consider first the context and then format education content to suit the context, community, capacity and connectivity, not vice versa.
- More research is promoted before ICT can truly be absorbed into national policy.

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ADDENDUM 1: ETHICS CERTIFICATE



NORTH-WEST UNIVERSITY
YUNIBESITHI YA BOKONE-BOPHERIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 269-1111/2222
Web: <http://www.nwu.ac.za>

Faculty of Health Sciences
Health Sciences Ethics Office for Research,
Training and Support
Health Research Ethics Committee (HREC)

Tel: 018-269 2291
Email: Wayne.Towers@nwu.ac.za

4 November 2016

Prof P Bester
AUTHeR

Dear Prof Bester

APPROVAL OF YOUR APPLICATION BY THE HEALTH RESEARCH ETHICS COMMITTEE (HREC) OF THE FACULTY OF HEALTH SCIENCES

Ethics number: NWU-00334-16-S1

Kindly use the ethics reference number provided above in all correspondence or documents submitted to the Health Research Ethics Committee (HREC) secretariat.

Study title: Most appropriate information communication technology for health education in HIV management in rural communities: A systematic review

Study leader/supervisor: Prof P Bester

Student: TL Malinga

Application type: Single study

Risk level: Minimal

You are kindly informed that your application was reviewed at the meeting held on 15/09/2016 of the HREC, Faculty of Health Sciences, and was approved on 04/11/2016.

The commencement date for this study is 04/11/2016 dependent on fulfilling the conditions indicated below. Continuation of the study is dependent on receipt of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation up to a maximum period of three years when extension will be facilitated during the monitoring process.

After ethical review:

Translation of the informed consent document to the languages applicable to the study participants should be submitted to the HREC, Faculty of Health Sciences (if applicable).

The HREC, Faculty of Health Sciences requires immediate reporting of any aspects that warrants a change of ethical approval. Any amendments, extensions or other modifications to the proposal or other associated documentation must be submitted to the HREC, Faculty of Health Sciences prior to implementing these changes. Any adverse/unexpected/unforeseen events or incidents must be reported on either an adverse event report form or incident report form at Ethics-HRECIncident-SAE@nwu.ac.za.

A monitoring report should be submitted within one year of approval of this study (or as otherwise stipulated) and before the year has expired, to ensure timely renewal of the study. A final report must be provided at completion of the study or the HREC, Faculty of Health Sciences must be notified if the study is temporarily suspended or terminated. The monitoring report template is obtainable from the Faculty of Health Sciences Ethics Office for Research, Training and Support at Ethics-Monitoring@nwu.ac.za. Annually a number of studies may be randomly selected for an external audit.

Please note that the HREC, Faculty of Health Sciences has the prerogative and authority to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.

Please note that for any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the HREC, Faculty of Health Sciences. Ethics approval is required BEFORE approval can be obtained from these authorities.

The HREC, Faculty of Health Sciences complies with the South African National Health Act 61 (2003), the Regulations on Research with Human Participants (2014), the Ethics in Health Research: Principles, Structures and Processes (2015), the Belmont Report and the Declaration of Helsinki (2013).

We wish you the best as you conduct your research. If you have any questions or need further assistance, please contact the Faculty of Health Sciences Ethics Office for Research, Training and Support at Ethics-HRECAppl@nwu.ac.za.

Yours sincerely



Dr Wayne Towers
HREC Chairperson



Prof Minnie Greeff
Ethics Office Head

Current details: (13210572) C:\Users\13210572\Documents\FHREC-HREC - Applications\2018 Applications\Applications 08-15 September 2018\NWU-00034-18-01(P Bester-TL, Matlaga)\NWU-00034-18-01(P Bester_TL, Matlaga)-AL\NWU-00034-18-01(P Bester-TL, Matlaga)-AL.docx
4 November 2018

File reference: 8.1.5.3

ADDENDUM 2: NOTARI DATA EXTRACTION TOOL

NOTARI data extraction tool					
Reviewer		Date		Record nr	
Author(s)					
Year		Journal			
Method					
Participants					
Setting					
Geographical					
Cultural					
Population					
Sample size					
Interventions					
Data analysis					
Author conclusions					
Reviewer comments					

ADDENDUM 3: MASTARI DATA EXTRACTION TOOL

MAStARI data extraction tool						
Reviewer			Date		Record nr	
Author(s)						
Year			Journal			
Method	RTC	Retrospective	Quasi-RCT	Observational	Longitudinal	Other
Participants						
Setting						
Population						
Sample size						
Interventions						
Author conclusions						
Reviewers conclusions						
Study results						
Dichotomous	Outcome			Intervention (n, N)	Intervention (n, N)	
Continuous	Outcome			Intervention (n, N)	Intervention (n, N)	

ADDENDUM 4: CRITICAL APPRAISAL TOOL FOR QUALITATIVE STUDIES

Critical Review Form – Qualitative Studies (Version 2.0)

© Letts, L., Wilkins, S., Law, M., Stewart, D., Bosch, J., & Westmorland, M., 2007
McMaster University

CITATION:

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	Comments
STUDY PURPOSE: Was the purpose and/or research question stated clearly? ☐ yes ☐ no	Outline the purpose of the study and/or research question.
LITERATURE: Was relevant background literature reviewed? ☐ yes ☐ no	Describe the justification of the need for this study. Was it clear and compelling?
	How does the study apply to your practice and/or to your research question? Is it worth continuing this review? ¹
STUDY DESIGN: What was the design? ☐ phenomenology ☐ ethnography ☐ grounded theory ☐ participatory action research ☐ other _____	Was the design appropriate for the study question? (i.e., rationale) Explain.

¹ When doing critical reviews, there are strategic points in the process at which you may decide the research is not applicable to your practice and question. You may decide then that it is not worthwhile to continue with the review.

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Qualitative Review Form

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ADDENDUM 5: CRITICAL APPRAISAL TOOL FOR QUANTITATIVE STUDIES

Evaluation Tool for Quantitative Research Studies

Evaluation Tool for Quantitative Research Studies

Building on work within a project exploring the feasibility of undertaking systematic reviews of research literature on effectiveness and outcomes in social care, a set of evaluation tools have been developed to assist in the critical appraisal of research studies. The evaluation tool for quantitative studies contains six sub-sections: study evaluative overview; study, setting and sample; ethics; group comparability and outcome measurement; policy and practice implications; and other comments. It provides a template of key questions to assist in the critical appraisal of quantitative research studies.

Review Area	Key Questions
(1) STUDY OVERVIEW	
Bibliographic Details	0. Author, title, source (publisher and place of publication), year
Purpose	1. What are the aims of the study? 2. If the paper is part of a wider study, what are its aims?
Key Findings	3. What are the key findings of the study?
Evaluative Summary	4. What are the strengths and weaknesses of the study and theory, policy and practice implications?
(2) STUDY, SETTING, SAMPLE AND ETHICS	
The Study	5. What type of study is this? 6. What was the intervention? 7. What was the comparison intervention? 8. Is there sufficient detail given of the nature of the intervention and the comparison intervention? 9. What is the relationship of the study to the area of the topic review?
Setting	10. Within what geographical and care setting was the study carried out?
Sample	11. What was the source population? 12. What were the inclusion criteria? 13. What were the exclusion criteria? 14. How was the sample selected? 15. If more than one group of subjects, how many groups were there, and how many people were in each group? 16. How were subjects allocated to the groups? 17. What was the size of the study sample, and of any separate groups? 18. Is the achieved sample size sufficient for the study aims and to warrant the conclusions drawn? 19. Is information provided on loss to follow up? 20. Is the sample appropriate to the aims of the study? 21. What are the key sample characteristics, in relation to the topic area being reviewed?
(3) ETHICS	
Ethics	22. Was Ethical Committee approval obtained? 23. Was informed consent obtained from participants of the study? 24. Have ethical issues been adequately addressed?

ADDENDUM 8: LANGUAGE CERTIFICATE



Director: CME Terblanche - BA (Pol Sc), BA Hons (Eng), MA (Eng), TEFL

22 Strydom Street
Baillie Park, 2531

Tel 082 821 3083
cumlaudelanguage@gmail.com

DECLARATION OF LANGUAGE EDITING

I, Christina Maria Etrechia Terblanche, hereby declare that I edited the following research study:

Most appropriate information communication technology for health education in HIV management in rural communities: a systematic review

for **TL Malinga** for the purpose of submission as a dissertation for examination. Changes were suggested in track changes and implementation was left up to the author.

Regards,

CME Terblanche

Cum Laude Language Practitioners (CC)

SATI accreditation nr: 1001066

Registered with PEG