

ATTITUDES AND PERCEPTIONS OF HEALTHCARE WORKERS IN HEALTH FACILITIES WITH REGARDS TO THE 'INTENTION TO USE' OF THE ROAD TO HEALTH BOOKLET (RTHB)

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Abstract

Introduction: That low and middle income countries (LMICs) are plagued with high burdens of disease and limited health resources is well documented in the literature. These two realities necessitate the availability of good quality and reliable information to enable the efficient distribution of recourses and services. Growing recognition of the importance of health information has seen the introduction of numerous health information systems (HIS). The goal of these HIS is to attain preventative and curative treatment for those that need them, in adequate quantities, promptly, reliably and at equitable cost. Amongst the variety of HIS is the Road-to-Health Booklet (RtHB) in South Africa. This is a paper-based, patient-held medical record given to new mothers, intended to monitor all contact children have with the healthcare system. Due to the dearth of local research and increasing need for strong HIS, more research is needed in the implementation of the HIS and its use by healthcare workers (HCWs) in the African context.

Methods: The aim of this study is to explore and understand the influence HCWs' attitudes and perceptions have on the implementation of the RtHB within the Khayelitsha Sub-District of Cape Town, South Africa. A qualitative case study was conducted utilising in-depth interviews, naturalistic observations, document review and mind mapping to explore HCWs' attitudes and perceptions on the RtHB. A combination of purposive and snowball sampling was used to identify participants with insights on the RtHB.

Results: Study findings indicate that the majority of HCWs acknowledge the benefits of the RtHB and have an understanding of the gains that the RtHB can achieve. This understanding is important to the successful implementation of the RtHB. The study indicated that HCWs' intention to use the booklet is influenced by the design of the RtHB, availability of training,

social influences, as well as perceptions of the booklets' usefulness and ease of use. HCWs identified lack of training on the multiple elements of the RtHB and social influences (caregiver's objections to certain information being included) to be notable barriers to its implementation.

Conclusion: In conclusion, HCWs mainly perceived the RtHB as a user-friendly, effortless and convenient tool. Intentions to use the RtHB were influenced not by perceptions on the booklet but on perceptions of the mothers' desires, knowledge and behaviours. Mandatory initial training courses within facilities in the Khayelitsha Sub-District, regular ongoing refresher courses, and improved education of mothers and caregivers is required to improve understanding of information being collected and increase compliance.

List of Acronyms and Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ASR	Age-Standardised Mortality Rates
CDS	Clinical Decision Support
Comm	Communication
CPOE	Computerized Physician Order Entry
DHIS	District Health Information System
DoH	Department of Health
eHealth	Electronic Health
EMR	Electronic Medical Records
GMP	Growth Monitoring and Promotion
HCW	Healthcare Workers
HIS	Health Information Systems
HIT	Health Information Technology
HIV	Human Immunodeficiency Virus
LMICs	Low-And Middle-Income Countries
Mat	Maternal
mHealth	Mobile Health
MOU	Maternity and Obstetric Unit
MPH	Master of Public Health
MUAC	Mid-Upper Arm Circumference
NDoH	National Department of Health
Nut	Nutritional
Peri	Perinatal
PHC	Primary Health Care

PDoH	Provincial Department of Health
PEoU	Perceived Ease of Use
PHMR	Patient-Held Medical Record
PMTCT	Prevention of Mother-To-Child Transmission of HIV
PRHC	Provincial Research Health Committee
PU	Perceived Usefulness
RMR	Routine Monthly Report
RtHB	Road-To-Health Booklet
SAM	Severely Acute Malnourished
STI	Sexually Transmitted Infections
TAM	Technology Acceptance Model
TB	Tuberculosis
TRA	Theory of Reasoned Action
UCT	University Of Cape Town
UMICs	Upper-Middle-Income Countries
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UWFA	Under-Weight for Age
WBC	Well-Baby Clinic
WCDoH	Western Cape Department of Health
WHO	World Health Organization

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PART A: STUDY PROTOCOL

The influence of healthcare workers' attitudes and perceptions towards the use of the Road-to-Health Booklet (RtHB) in the Khayelitsha Sub-District of Cape Town

Introduction

The initial five years of life for a child are crucial for growth and development. Child growth monitoring and promotion allows mothers and care givers to be well-informed and empowered with a simple tool for monitoring the growth and the development of their children.

In South Africa, the Road-to-Health Booklet (RtHB) is intended to provide a simple, cheap, practical and convenient method of monitoring individual child growth and development to foster child well-being [1]. It enables early detection of child ill-health at an early stage to facilitate prompt intervention. The RtHB is a tool that is given to the mother when her child is born, providing a means of monitoring all contact the child has with the healthcare system after birth. It facilitates the recording and monitoring of key information, such as immunizations, vitamin A supplementation, tuberculosis (TB) status, prevention of mother-to-child transmission (PMTCT), HIV testing, infant and young child feeding information, hospital admissions, and child growth and development. It is also used to monitor the development of the child according to standard milestones for a growing child [2]. The booklet should be used until the child reaches age 12 as it is required for school admission pre-high school [3]. If used correctly, the booklet is a mobile data bank that acts as a channel of communication among clinicians, and between clinicians and caregivers, allowing for a continuous flow of information, and reducing redundancy and erroneous records.

The RtHB is a modification of the previously used card and educational material provided to mothers to support ‘well-baby’ health care [4]. A study by Harrison *et al.*, found that healthcare workers (HCWs) and mothers wanted a replacement of the card and materials into a more integrated and amalgamated tool that contained all the information regarding child wellbeing and general health matters [5]. The refurbished RtHB has gone some way to resolving the challenges associated with multiple, disparate records having to be completed and filed appropriately. The new design provides a means of both growth monitoring and health promotion in a single space. Tarwa and De Villiers confirmed the importance of the tool, stating that “...the RtHB can be seen as a mobile databank. In some circumstances it may be the only reliable source of information, particularly in a population with fragmented health services or migrating families, which are common in developing countries” [1]. Because the RtHB is kept by mothers, when used correctly it presents a well-organized and easy to use method of record-keeping that can be communicated with a variety of HCWs as the need arises.

The RtHB falls within the realm of routine health information systems (HIS), as it is a tool for collecting and managing data that can be used for several purposes at different levels of the health system; including healthcare delivery and health promotion. Through the RtHB, the Integrated Nutrition Programme of the National Department of Health (NDoH) is able to establish health needs according to age, nutritional status, disease state and geographical areas, enabling appropriate and well-targeted intervention [3]. The information collected through the RtHB at provincial, district and municipal level is intended to be fed into the national health information system [6] to measure and monitor the health and nutritional status of the population, acting as a potential surveillance system and a means to monitor behavioural patterns [7]. This is done through the collection of information such as

immunization, under-weight for age (UWFA) and severely acute malnourished (SAM) children that feeds into the 'routine monthly report' (RMR).

Statement of the Problem

An initial RtHB implementation assessment was conducted by Visser and Blaauw of Stellenbosch University on behalf of the Road-to-Health Booklet Survey Research Group in 2012 and the results indicated that the use of the booklet was sub-optimal, with less than 75% completion [8, 9].

In the Western Cape of South Africa, the RtHB was introduced in 2011, where it was rolled out in stages, beginning with new mothers and expanding to mothers visiting healthcare facilities with older infants. The assessment comprised of 45 primary healthcare facilities in the Cape Town Metropole and 26 in the Cape Winelands focusing on caregivers with infants aged 0-12 months in possession of the new RtHB (Phase 1). The study found that in the two districts the immunization section was completed on only 81.9% of RtHBs [8, 9].

With regards to the PMTCT/HIV section, the study findings indicated that 49.4% of the mothers' HIV status was not recorded [8]. When looked at separately, 61.7% of the Cape Metropole RtHBs had that section incomplete. The Khayelitsha and Eastern sub-structure had the highest incompletions of 70.7%, with Khayelitsha and Eastern at 88.6% and 65.7% respectively [9]. In some cases, it was found that the PMTCT/HIV section had been torn out of the booklet completely.

Visser and Blaauw also assessed the plotting of infant weight measurement in the booklet, identifying that 73.8% of these were done correctly, whilst 13.5% were not plotted at all, with

the Khayelitsha and Eastern sub-structure having 13.4% not plotted [8, 9]. Eastern and Khayelitsha respectively had 9.9% and 23.6% weight measurements not plotted. Furthermore, it was found that although the use of the RtHB for plotting measurements was fairly high, 51.6% of HCWs could not identify stunting and a further 31.7% wasting in infants from the booklet [8].

When HCWs were surveyed with regards to the implementation of the RtHB, 74.3% reported that the introduction of the booklet had increased their workload [8]. The assessment also identified a variation from sub-structure to sub-structure and from facility to facility in the use of the booklet. Hence it is important to analyse the attitudes and perceptions of those expected to implement the RtHB and understand how they perceive the required use of the booklet (its perceived usefulness and perceived ease of use) and their understanding of the importance of the booklet. The Western Cape Department of Health (WCDoH) is concerned about the utilization of the RtHB in healthcare facilities, particularly in the Khayelitsha and Eastern sub-structure, and requested assistance in understanding how healthcare providers in facilities are using the RtHB and the reasons for the suboptimal use of the booklet.

During the first quarter of 2014 the Western Cape Department of Health Nutrition Directorate – made up of the Deputy Director: Integrated Nutrition Programmes, the Deputy Director: Child Health and EPI, the Assistant Director: Nutrition Community Healthcare Worker Advisor, and the PMTCT Advisor – approached a student from the University of Cape Towns' Master of Public Health (MPH) programme to undertake further research into the use of the Road-to-Health Booklet within the Western Cape. This was subsequent to the study by Visser and Blaauw of Stellenbosch University [8]. From May 2014, a series of initial meetings were held by the Nutrition Directorate to discuss their expectations of the research

and the researchers' obligations with regard to the requirements of the MPH mini-thesis. During the second quarter of 2014, monthly meetings were held for further discussions on the research, and a concept note was written by the researcher for presentation to the Directorate (*see Appendix 1*).

The concept note allowed the researcher to present initial an understanding of the WCDoH's research requirements and ideas for the research question, objectives and study design. The monthly meetings, together with the concept note, allowed for the clarification of study sites (*see below*). Together the researcher and the Directorate chose the Khayelitsha and Eastern sub-structure. This decision was made on the basis of the the high burden of disease with regards to HIV, AIDS, tuberculosis (TB), malnutrition; the findings from the Visser and Blaauw study [8]; and practical considerations such as funds and time available.

Purpose of the Study

While the Visser and Blaauw [8] study quantified the position, effectiveness, and efficiency of implementation, this study will try to give explanation and elaboration for those findings, to provide key stakeholders' insight on the use of the RtHB and make recommendations for improved implementation.

The purpose of this study is therefore to bring about a deeper understanding of HCWs' attitudes towards, and perceptions of the utilization of the RtHB in the Khayelitsha and Eastern sub-structure in Cape Town. The study aims to enable an exploration of the policy, environmental and organizational factors that may have influenced the implementation of the RtHB in an operational setting.

Objectives

The objectives of this study are:

- i. To explore the factors influencing the effectiveness in the full implementation of the RtHB.
- ii. To explain how those factors have a bearing on HCWs' use of the RtHB.
- iii. To determine the linkages between HCWs understanding of HIS and how the RtHB is used, and policies stipulating how data should be collected and managed

Justification

In South Africa, and in the Khayelitsha and Eastern sub-structure in particular, the high burden of disease in South Africa (especially HIV/AIDS, malnutrition and TB) coupled with frequent disruptions in child healthcare, mean there is an urgent need to have a way of collating all interactions children have with healthcare professionals and all treatments they receive. Through the introduction of the RtHB and meetings held by the Nutrition Directorate, the WCDoH has demonstrated an increase in political will for a more integrated continuum of care child.

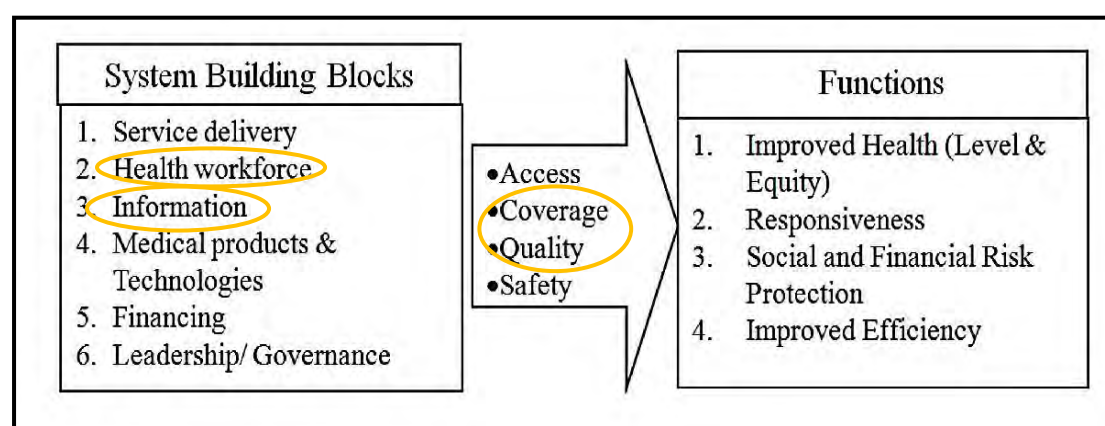
However, if the RtHB is to fulfil this function, there is an urgent need to better understand healthcare professionals' perceptions of, and intention to use the booklet. The results of this study will be useful in helping key stakeholders to better understand the factors underlying the implementation gap with regards to the RtHB, and to identify possible recommendations.

Background

The health system is a dynamic and complex adaptive system with mixed intertwining boundaries through the relationships and interactions of its building blocks [10, 11]. The

RtHB assists in the evaluation of the intermediary components of the health systems framework, “quality” and “coverage”, which link the building blocks (inputs) to the overall goals (outcomes). The RtHB allows for the measurement of quality and coverage of service, as those illustrated in the health systems building blocks (*see* Figure 1). The implementation of the RtHB is an example of the complexity of the health systems in that although it falls under the “information” umbrella of the system, it is significantly impacted by the “human resources” umbrella for its successful implementation and utilization.

Figure 1 Health Systems Building Blocks



Source: World Health Organization 2007 [12]

If the information in the RtHB is properly collected and analysed, it can be used to obtain information such as coverage of healthcare services received by children, and may also inform district managers regarding if and when children receive their scheduled routine care and where they receive it. In the case of disease outbreaks, it can be employed as an assessment to identify coverage of vaccinations and other treatments. As a portable information system, it can be a means to identify facilities that have quality and access problems. This may be a solution to LMIC such as South Africa that do not have a single centralized patient database. For example, the information contained in the booklet can be

used to determine whether parents and caregivers bypass a nearer health facility in favour of a more distant one, indicating possible access barriers of low quality of care.

LMIC health systems suffer from significant problems such as poor service quality, inequitable delivery of services and resources, inadequate procurement arrangements, and ineffective management and administration, combined with a high burden of disease [13, 14]. Therefore, the RtHB can usefully inform HCWs of services rendered to children. Incorrect use of the booklet may allow for duplication of services, which could lead to delay or receiving treatment twofold due to lack of information on services carried out. This may be detrimental to the child and not cost effective to the health system.

For public health, the full utilisation of the RtHB has the capacity to be a means of assessing demand for services, improving efficiency through saving time from non-duplication of services giving health professional the time to deal with other services. Additionally, the RtHB has the potential to play a role in the allocation and distribution of medical supplies according to the need indicated by the booklets. Ultimately, information in the RtHB can assist in identifying the need for essential interventions, ensuring the improvement of child health.

All such potential information uses are dependent on proper utilization of the RtHB, and in particular a full inputting of data into all the sections. It is evident from the RtHB implementation assessment conducted by Visser and Blaauw in 2012 that the implementation of the booklet is failing to reach its goal [8]. The study revealed that implementation of the booklet varied between facilities, and that in most cases data was not being fully inserted.

The complexity of implementation, and the central role HCWs play in policy implementation at the facility level, is well recognised in the literature. In particular, HCWs are commonly identified as the gate-keepers of social service delivery and policy implementation. This literature recognizes that HCWs generally exercise some level of discretion when implementing policy and delivering services; indicating that their actions and behaviours are influenced by their own personal attitudes and value systems [15–17]. This discretion in performing duties and responsibilities is understood to be related to the ways HCWs cope with the day to day demands of their jobs; the complexities brought on by their values and beliefs, their working conditions, conflicting policies, the demand for service, and resource allocation [16]. The implementation of the RtHB is similarly understood to be dependent on the value systems, beliefs, attitudes and perceptions of HCWs. It is important to analyse the attitudes and behaviours of those expected to implement the RtHB and understand how they interpret the required use (its perceived usefulness¹ and perceived ease of use²), and their understanding of the importance of the booklet.

In this study, “behaviours” are understood to result from HCWs working environments as well as the nature of their jobs, their attitudes and belief systems [18]. The daily workings of HCWs involves regular contact with the vast majority of the population, learning about the patients’ social situation, providing continuous care and referral service resources within the healthcare system and through the community. This gives HCWs power of discretion as to the services they provide to their patients[19]. However, HCWs also deal with complex issues in their day to day work activities that make realistic measurements of outputs difficult, as the goals set for them “...tend to have idealized dimensions that make them

¹ *Perceived usefulness*’ is the extent to which an individual judges that using a particular system would enhance their job performance.

² *Perceived ease of use*’ is the extent to which an individual judges that using a particular system would be free of effort and assessment.

difficult to achieve, confusing and complicated”, thus making performance measurements effectively non-existent [16]. Empirical evidence has shown that the level of education and chronological factors of practice have a bearing on HCWs such as nurses’ opinion on their work environment [20]. Individuals employed under a governance structure they perceive to be unfair or detrimental, irrespective of the reality of these opinions, will perceive their practice environment as unfair or detrimental as well [21]. This may have an impact on the quality and level of services they provide.

A study by Walker and Gilson looking at implementation of a “free care (removal of user fees)” national policy highlighted that the removal of user fees for healthcare increased the demand for services, consequently increasing the workload of an already stretched staff with inadequate resources [22]. The study found that nurses appeared to draw a pragmatic distinction between aims and policy implementation. They did not reject the policy or its aims and objectives but articulated trepidation about the direct consequences they perceived it to have had on them, and questioned the methods through which it had been implemented [22]. Furthermore, a high number of the nurses in the study reported that their workloads had increased considerably, further stating that the surge in workload seriously compromised key components of their professional practice [22].

Similarly, in a study by Rubio-Valera *et al.* assessing the facilitators and barriers for implementing “primary prevention and health promotion” activities, primary healthcare professionals exhibited resistance to implementation citing difficulties such as increased workload, lack of knowledge and skills, challenges relating to the professional-patient relationship, as well as the lack of confidence in the effectiveness of the intervention [23]. The cultural, social and community context where the patient- professional exchange occurs

will affect the choices that the healthcare providers make with respect to the development and initiation of primary prevention and health promotion activities [23].

Research has indicated that HCWs, and other civil servants, continuously make decisions regarding whether or not to apply guidelines, and as to how these should be translated in a specific case. Policy comes alive in the daily practice of HCWs [24]. Despite detailed regulations and guidelines, the reality of daily practice reveals implementation to be far more complex and varied than policy-makers commonly assume. This gap gives rise to opportunities for frontline workers to use their discretion in implementing policy, making them policymakers in addition to being implanting agents [25]. This can be seen in the implementation of the Road to Health Booklet (RtHB) and other health information technology (HIT).

HCWs' existing values, prior experiences and practice needs influence their support of an HIS and gives them confidence in using said system. The HCWs also demonstrate a better level of awareness of the advantages of the system, thus increasing the likelihood of using it [26]. Studies have also been conducted about HCWs acceptance and intention to use HIS, particularly electronic health records [27–29], but little research has been conducted into the intention to use and perceptions of HCWs towards paper-based health information systems such as paper-based patient medical records. To resolve this, this study will attempt to document HCWs' attitudes and perceptions with regards to their intention to use the Road to Health Booklet (RtHB), a paper-based health information system.

Research Question

How do the attitudes and perceptions of HCWs in the Khayelitsha and Eastern sub-structure of Cape Town affect their use of the Road-to-Health Booklet (RtHB)?

Sub-questions

The study will aim to answer the following questions:

- i. How do the attitudes and perceptions of HCWs in the Khayelitsha and Eastern sub-structure of Cape Town towards the RtHB influence their behaviours with regards to its utilization?
- ii. Do primary HCWs have the same understanding of the importance of the information to be recorded in the RtHB as policy makers?
- iii. What factors are steering the variations in utilization of the RtHB across facilities in the Khayelitsha and Eastern sub-structure?

Theoretical Framework

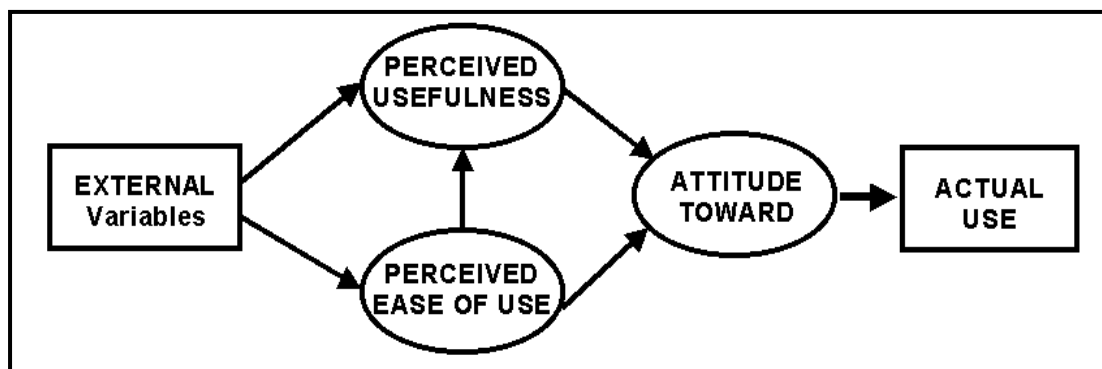
Technology Acceptance Model (TAM)³

Through the initial review of literature the Technology Acceptance Model (TAM) (*see* Figure. 2) has been identified as an appropriate a theoretical framework, to inform data collection and analysis. This theoretical framework will be used to guide the questions during the interviews as it addresses attitudes, behaviours and perceptions, which is the main focus of this research. The TAM is an adaption of the ‘Theory of Reasoned Action (TRA). TAM hypothesizes that perceived usefulness and perceived ease of use influences an individual’s intention to use a system, with intention to use serving as an intermediary of actual system use. Perceived usefulness (PU) is also seen as being directly impacted by perceived ease of

³ The TAM has not been written into the journal manuscript as it will be included in another forthcoming article.

use (PEoU) [30]. The TAM originates from sociological, psychological and an information system disciplines [31]. Figure 2. illustrates the TAM psychological flow, detailing how perceived usefulness and perceived ease of use influence attitudes towards actual use of an information system. Although the TAM has mainly been used to assess the intention to use and acceptability of electronic information systems, in this study the TAM will be used initially to guide the assessment of what influences HCWs' intention to use the RtHB (a paper-based data management and information system) (see Appendix 2). However, as additional literature is read and data collection begins, new factors may emerge leading to new and/or additional inquiry.

Figure 2 Technology Acceptance Model (TAM)



Source: Davis FD. 1993 [32]

Perceived Usefulness (PU): Literature has defined perceived usefulness (PU) as “...the degree to which a person believes that using a particular system would enhance his or her job performance” [33].

Perceived Ease of Use (PEoU): Perceived Ease of Use (PEoU) refers to the extent to which a person believes that using a specific system would be free of effort [33]. This description follows the definition of the word “ease” that is defined as the “...absence of difficulty or

effort” [34]. The definition of PEOU was later refined by Davis to focus on freedom of effort physically and mentally [33].

Attitude: Attitude represents the extent to which a person has an unfavourable or favourable evaluation of the behaviour of interest. It involves the contemplation of the outcomes of performing the behaviour [35].

Intention to Use (sometimes referred to as “Acceptance”): It has been suggested that the feelings an individual has towards the usefulness of an HIS or their confidence in executing tasks on the system and it’s the level of complexity, all affect the individual’s intention to use the HIS [36–39].

Within this study the theoretical framework will work to provide direction whilst the case study will place greater emphasis on context. The advantage of using a theoretical framework in a case study design is that it guides the research process. While the case study design allows for the exploration of a case to be guided by a theoretical framework, it also has the advantage of allowing for the flexibility to discover and address issues as they arise.

Methodology

Study Design

The design will be a qualitative study with a flexible design, investigating the interrelationships, cultural dynamics, beliefs and interactions, with regards to history and progression of individual’s behaviours. The qualitative study design will be a case study, which is defined as “...empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context

are not clearly evident” [40]. The case is the utilization process of the RtHBby HCWs in the Khayelitsha and Eastern sub-structure of Cape Town. It would be difficult to study attitudes and perceptions towards the intention to use the RtHB without relating it to the clinic environment (context) within which HCWs are to utilise the booklet.

Huberman and Miles identified that a characteristic of case studies is that they are bound through clear definition and context [41]. This is in order to prevent answering too broad a question and/or too large a study for the funds and time available [40, 42]. For this study the boundaries will be English speaking HCWs, working within the Khayelitsha and Eastern sub-structure (Michael Mapongwana CDC, Macassar Clinic and Site B CHC) providing well-baby and new-born services. These boundaries are similar to the exclusion and inclusion criteria of quantitative studies.

This case study will be exploratory and descriptive in nature as the topic of study has no single or clear outcome. It will entail a single case with embedded units as this allows for the exploration of healthcare worker’s attitudes and perceptions towards using the RtHBwithin the three chosen healthcare facilities (the units). This will permit analysis either between the different healthcare facilities (between case analysis), across all the healthcare facilities (cross case analysis) or within the healthcare facilities separately (within case analysis) [40].

Study Setting

The Khayelitsha and Eastern sub-structure of Cape Town⁴ will be the setting for this study, due to having the lowest utilization of the booklet (ascertained from the 2013 Visser and Blaauw study) and a high burden of disease (HIV, AIDS and Tuberculosis). It will include the point of birth in the ‘birthing units’ and ‘well-baby’ services. The facilities to be included with both these elements will be:

- Michael Mapongwana CDC,
- Macassar Clinic, and
- Site B CHC

Population and Sampling

The population will include stakeholders who have an active interest in the use of the Road to Health Booklet (RtHB), that is nurses, managers and key stakeholders. The sampling strategy for this study will employ a combination of purposive and snowball/chain sampling. It will initially purposively focus on frontline HCWs that deal with well-baby services in facilities that were originally included in the study conducted by Visser and Blaauw [8]. The snowball/chain method will allow a certain amount of trust to be built with participants, as the researcher will be directed to additional participants who could be potential sources of information by the initially recruited participants [43]. For this study, this method of sampling will be beneficial because it may provide participants with the assurance that the research is legitimate and the research is trustworthy, which in turn will make them more candid.

⁴ Due to lack of approval for one site (Macassar Clinic), data collection was limited to Khayelitsha, a sub-district of Cape Town.

Case studies generally include a small sample of participants and are usually time-limited [41, 42]. The estimated number of participants to be purposefully sampled is 18 participants, with the intention to identify approximately three facility managers, 12 HCWs and three key stakeholders for the in-depth interviews. As an exploratory study it is difficult to state the exact number of participants that will be required. This type of study allows for the flexibility to interview as many people as required to reach the point of data saturation. The point of data saturation will be reached when the responses from data collection continuously produce the same themes from participant to participant, with no new insights being attained.

The respondents will be selected based on their knowledge about and involvement in the use of the RtHB and performance of well-baby services. The information generated will be assumed to be representative of the views of the HCWs in health facilities utilizing the RtHB, and will therefore be regarded as sufficient for providing a holistic picture of the problem being investigated. These participants will be chosen because of their experiences in the use of the RtHB and their interest in the way it is used. The HCWs have been chosen because of their day to day experiences in the use of the RtHB within their work. The facility managers have knowledge of how the HCWs are expected to use the RtHB and a familiarity its current usage within the healthcare facilities they manage. Key stakeholders will be selected as they represent policy overseers and have familiarity on the expectations on how the booklet is to be implemented and used.

Participant Recruitment

The recruitment process for this research study will be through letters of invitation in an envelope given to those HCWs who perform routine well-baby services including routine growth monitoring and promotion (GMP). Letters of invitation will be sent out to potential

participants to take part in the in-depth semi-structured interviews. Attached to the letters will be a copy of the approval letters from the Western Cape Department of Health and the Human Research Ethics Committee in the Health Sciences Faculty from the University of Cape Town. The invitation letters will briefly explain the purpose of the study, what is expected of the participants by participating in the study, and the risks and benefits of the study. The envelope will also include a participant information sheet and a copy of the consent form.

Nurses: For the nursing staff undertaking the performance of routine well-baby services including routine growth monitoring and promotion (GMP) letters of invitation to the in-depth interviews will be handed out to each of them.

Healthcare Facility Managers: Health facility managers will be invited to participate in individual in-depth semi-structured interviews through a letter of invitation.

Key Stakeholders: Key stakeholders within the Department of Health will be invited to participate in the in-depth interviews regarding their perceptions on the use of the Road-to-Health Booklet (RtHB), as well as their expectations of utilization. A letter of invitation will be given to the key stakeholders that have a stake in the RtHBs utilization and to those who initiated the implementation of the booklet at its conception.

Data Collection Methods

This study falls under the umbrella of qualitative research, seeking to explore the understanding, attitudes and behaviours of HCWs in health facilities with regards to the utilization of the Road-to-Health Booklet (RtHB). It will employ qualitative research

techniques and tools for data collection. Qualitative research is ideal for gaining an understanding of a subject that is complex and subjective in nature.

The data collection methods to be employed will fall within the realm of ethnographic research. Three methods will be used for this research study: in-depth semi-structured interviews, participant concept webbing (mind mapping) and naturalistic observations. In-depth interviews and observations are some of the main data collection methods used for case study research. Whilst participant concept webbing (mind mapping) is a method utilised frequently in social science research. Interviews will be facilitated using a topic guide developed using the ‘technology acceptance model’.

A predominate characteristic of case study research is the multiple sources of evidence. This is to increase the validity and reliability of data gathered [40]. Thus, for this study the data collection tools to be utilised are in-depth semi-structured interviews and participant concept webbing (mind mapping). If time constraints allow during the research process then direct observations may be performed, as an additional source of evidence. This use of multiple data sources will provide a multidimensional profile of the case being studied by enabling triangulation through the cross checking of data.

In-depth Semi-structured Interviews

The in-depth semi-structured interviews have been selected as they are a main characteristic of data sources for case study research. They allow the participants to reveal what and how they think of situations, as well as how they construct reality. The interviews will allow the study to depict a more textured, deep, multifaceted and rich picture of the study topic [44]. The interviews will enable HCWs, managers and key stakeholders to express reflections,

viewpoints and observations HCWs, while also allowing for further probing into interpretations and conceptualizations to achieve deeper understanding and clarity. These interviews will be conducted using semi-structured open-ended questions both theoretical and substantive in nature.

In-depth interviews will be held at the selected healthcare facilities with HCWs who perform growth monitoring and promotion (GMP) and well-baby activities. Interviews will last approximately an hour, and will be conducted in a private room within each facility to prevent disruptions. With the permission of the participant, a dictaphone will be used to make an audio recording of each interview. These recordings will be made concurrently with hand written observation notes.

Through open-ended questions, the interviews will seek to elicit information on:

- a) Healthcare workers' perceptions of the RtHB
- b) Healthcare workers' attitudes towards the utilizations of the RtHB
- c) The perceived usefulness of the RtHB
- d) The perceived ease of use of the RtHB
- e) The role and utilization of the data collected in the RtHB

Afrikaans, English and isiXhosa are the more dominantly spoken languages in Cape Town, however English will be the language used for the interviews. English has been chosen because all participants will be in a professional setting in which English is the main language used. All interviews will be conducted by the Researcher with the assistance of a Xhosa interpreter for situations where explanation and clarification is required.

Participant Concept Webbing (Mind Mapping)

Participant Concept webbing (mind mapping) is the method used to describe the ideas of individuals or groups regarding a specific topic in pictorial form [45, 46]. For this study concept webbing (mind mapping) will be utilised to frame participants' perceptions of the flow of data routinely collected in the RtHB. This will enable the participants to visually depict their perceptions of the movement of information collected or recorded in the booklet, how it is used and its importance.

Concept webbing (mind mapping) will be done in conjunction with the in-depth semi-structures interviews. During the interviews the webbing will provide the individual perspective (*see Appendix 3*).⁵

Observations

One of the most distinctive features of case study research is observations. Observations provide data that is impartial to participants' thoughts and opinions. Using observations draws on the detailed evidence of sight to witness actions first hand [47]. This research will observe the movement of the RtHB and its usage in communal areas only to preserve confidentiality and privacy during consultations. The method will enable the researcher to observe the booklet's movement and use in a naturalistic settings, ensuring that the presence of th researcher does not impact the actions of those using the booklet. The researcher will undertake the role of complete observer, having little to no interaction with the participants, only following the booklet and observing healthcare worker interaction with mothers and/or caregivers within the clinic [48].

⁵ Due to the availability of documents such as minutes from meetings and workshops in which the researchers participated with the Western Cape Department of Health Nutrition Directorate, it became evident that review of these documents would enhance the research process and were included in this study. Document analysis is a method that is of great value in case study research by providing supplementary research data and the added insight to the knowledge base [56].

Data Management

As the interviews will be recorded, they will be saved as digital audio files. These recorded files will enable the transcribing of each interview and discussion for efficient and effective data coding and analysis. It will also enable the data to be captured verbatim. The recordings and transcriptions of the recordings will be stored electronically in password protected files for a period of three years before they are destroyed.

Data will be anonymized during transcription by removing identifying information given during interviews to preserve participant anonymity. Names and specific job titles will be replaced by an identifier.

The concept webs (mind maps) will be scanned and uploaded to an external hard drive as password protected electronic copies. All electronic data will be store on an external password protected hard drive, which will be kept in a locked cabinet with the hard copies of data obtained. The data will be sorted for three years before it is destroyed.

Data Analysis

Both a deductive and inductive approach will be for codebook development during the analysis process. The deductive approach will use the ‘technology acceptance model’ to provide a framework for analysis. The inductive approach will be a more comprehensive approach to condense the raw data into summative form. The goal of the inductive approach is to establish clear links between the research objectives and the summative findings of the raw data [49].

The data analysis will be done using thematic analysis, utilizing the constant comparative method, which allows for the continuous comparison of themes and categories identified in the inductive thematic analysis [50]. The constant comparative method involves the constant comparison of already existing codes, categories, themes and concepts with new ones as they develop, ensuring they emerging concepts and theory remain substantiated in the data [47].

Inductive thematic analysis will be used for “...identifying, analysing and reporting patterns or themes from the data” [51]. This will allow for the interpretation of the various aspects from the research identified using the framework. The inductive thematic analysis will be used to analyse the in-depth interviews. Continuous data collection and analysis simultaneously inform the research process.

Duration of Study

The study will take approximately 6 months from the initial ethics approval request, through to recruitment of participants, the write-up, dissemination of findings and recommendations. Table 1 provides a schedule of the studies activieis.

Table 1 Schedule of Study Activities

SCHEDULE OF STUDY ACTIVITIES									
2014/2015									
Date (Month)	Dec 2014	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2015	Jun 2015	Jul 2015	Aug 2015
Activity									
Research Protocol Development									
Literature Review									
Development of Interview Questions									
Ethical Approval									
Participant Recruitment Phase									
Data Collection (In-depth Interviews and FGD)									
Transcription Phase									
Preliminary Data Analysis									
Final Data Analysis									
Write-up									
Submission									
Final Feedback Session									

Dissemination of Information

Upon completion of the study and of the writing stage a feedback session will be held with the participants of the study. It will provide an overview of the findings from the study. It will also give the participants an opportunity to comment on the interpretation the study has given to their perceptions, attitudes and choices.

The findings from the study will also be of interest to the Western Government Department of Health, which will provide an elucidation and interpretation.

Further write-up will be for an article tailored for a peer-reviewed journal that focuses on health policy and systems implementation. As this research is an interdisciplinary health

systems study linking elements of information systems, health policy implementation, and health workforce, the selected journal will be one appropriate for the publication of this research and its findings

Study Budget

This research study will be self-funded by the researcher and Table 2 gives details of the anticipated expenses. The total estimated budget for this study is R 3 790.25.⁶

Table 2 Budget Estimate for Research Study

Item #.	Item	Cost per Item	No. of Items	Total Cost (ZAR)
1.	Transportation	R32/day	60	1 920.00
2.	Printing colour	R0.75	120	90.00
3.	Printing black	R0.35	515	180.25
4.	Refreshments (<i>18 participants plus 1 Researcher</i>)*	R40	20	800.00
5.	Stationary	R200	1	200.00
6.	Mobile phone costs	R10	60	600.00
TOTAL				R 3 790.25

*Refreshments will be for approximately 18 participants with an additional 2 extra meals, (18 in-depth interviews).

Ethical Considerations

The ethical approval for this study will be obtained from the University of Cape Town's Human Research Ethics Committee for the Faculty of Health Sciences, as well as the Department of Health, Western Cape Provincial Research Health Committee (PHRC). This is in accordance with the South African Human Sciences Research Councils guidelines, which specify that all health research in South Africa must go before a South African-based ethics committee before commencement to ensure ethicality and rigour [52].

⁶ This study was supported by the University of Cape Town's Health Policy and Systems Division thesis grant provided by the International Development Research Centre, Canada (IDRC-Canada) through the Collaboration for Health Systems Analysis and Innovation (CHESAI).

Additional permission will be sought from the managers of the healthcare facilities. Individual informed consent will be obtained from the participants recruited for the study.

Before participation in the study, potential participants will be provided with written details of the study. These will be in the form of an information sheet and consent form for the in-depth semi-structured interviews (*see* Appendix 4 and 5), providing information on the purpose of the study, the type of data to be collected, the procedures for participation and withdrawal from the study, confidentiality, and the potential risk and benefits of the study.

The consent form and information sheet will be provided in English, as English proficiency is a requirement for working in Cape Town healthcare facilities. Participants should read the information form and sign the consent form if they agree to participate, providing signed documentation of their informed willingness to participate in the study.

Both the South African Human Science Research Council guidelines and the 2013 revised version of the Declaration of Helsinki (Fortaleza, Brazil) will be observed. These provide the fundamental principles of the participants' right to informed decision-making and self-determination, autonomy/respect of persons, justice, beneficence and non-maleficence.

Autonomy/respect of persons will be assured through the informed consent process. This principle recognizes that participants to studies are autonomous individuals with the right and ability to make their own choices through informed decisions [53].

Selection of participants will be done with due consideration of the research question in a non-discriminatory manner, addressing the principle of justice.

The principle of beneficence and non-maleficence refers to the prevention of harm and the maximization of potential benefits from the study [54]. It places a responsibility on the researcher/s to ensure where possible the protection of participants through the minimization of potential harm [53].

The researcher has the ethical obligation to inform the study participants and facilities of the study findings which will be done upon completion of the study (*see* Appendices 6 and 7).

Risks and Benefits

One potential risk is the assumption of mandatory participation within the study and fear of declining to participate. This fear might be exacerbated by the fact that the study was initiated by the Western Cape Department of Health (WCDoH). This risk can be classified as moderate and must be minimized and managed.

To manage this, participants will be informed that, although the DoH requested the study, their participation is their own choice and they may withdraw at any time without consequence. This will be reiterated in the information sheet and consent form that participants will be provided.

A second potential risk is the fear by participants of their responses being reported to superiors and the DoH.

The classification of this risk is high as it may lead to a type of response bias with the participants giving answers that they deem to be socially desirable. Participants may be reluctant to admit to disagreeable activities and attitudes, instead giving responses that may be more biased towards what they believe to be socially acceptable. The minimization of this risk is vital to maintain validity of the study.

To minimize this risk, participants will be informed during the informed consent process that they are under no obligation to participate in the study, and that under no circumstances will their personal information be disclosed to managers or the Department of Health. They will also be informed that their personal details and responses will be kept anonymous for privacy and confidentiality purposes, with numbering used as identification.

Influence of Researcher on Participants

It has been important to consider the potential that a relationship may develop between the researcher and the participant. The initial introduction of the researcher and study to the participants may influence participant's perceptions of the research and researcher. Studies have found that in studies where the researcher has a similar background to the participant, the participant is more comfortable and willing to share intimate information. Equally, where participants feel there is a possibility of reprimand from an interviewer perceived as having the ability or responsibility to act on information gained, participants may be more closed and withhold particular information. This is a minor risk for this study with a high/moderate probability of occurring; however it would require effective management by the researcher during data collection.

It is imperative for the researcher to remember that they too are a data collection tool and have the potential to influence the participants during data collection, be it emotionally or psychologically [55]. The researcher should at all times be aware of this and seek to address it. The researcher should ensure that they ask the participants a question in more than one way and should also ensure that they ask their question in a neutral manner that does not lead the participant to a particular response.

Potential Benefits

There are no identifiable immediate benefits to participants from this study. However, the results may help key stakeholders better understand what influences HCWs' use of the RtHB in order to amend or change the guidelines for usage. Additionally, as a healthcare worker you may gain a better understanding of the flow of information gathered in the RtHB and the role the booklet has in the continuation of provision of care.

Privacy and Confidentiality

The researcher will protect the confidentiality of individuals by removing personal information from transcriptions of the in-depth interviews during the write-up of the findings. Numbers will be assigned to each participant's name to ensure privacy. All data will then be entered and stored into a secure, password protected laptop with only the researcher and the supervisor having access to the information stored, in order to avoid unauthorised access to the research findings. All data will be backed up on an external hard drive to ensure there is no loss of data.

Reimbursement for Participation

Reimbursement of the participants will be in the form of light refreshments. As clinics are classically very busy, interviews will be conducted during either tea or lunch time making light refreshments appropriate.

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PART B: STRUCTURED LITERATURE REVIEW

Factors influencing implementation of health information systems in low- and middle-income countries

Introduction

Low- and middle-income countries (LMICs) are well documented to be plagued with high burdens of disease and limited health resources. The combination of these two realities necessitates the availability of good quality and reliable information to enable the efficient distribution of said limited resources. This is in order to ensure the attainment of preventative and curative treatment on time, in sufficient quantities, reliably and at equitable costs – for those that need them [1].

As a result there have been strong arguments made for prioritization of investment in well-organised and reliable health information systems (HIS) to enable the collection, storage and retrieval of patient and service delivery records in a timely manner, and to enable evidence-based decision making [2, 3]. As noted by the World Health Organization, “[a] well-functioning health information system is one that ensures the production, analysis, dissemination and use of reliable and timely information on health determinants, health system performance and health status” [1].

Evidence-based decision-making is considered critical for the appropriate use of limited resources particularly in resource poor settings. Nyamtema notes that such settings are often plagued by decisions made based upon rudimentary disease estimates; a problem largely due to under-reporting, driven by a lack of knowledge and experience among HCWs [4]. Through well-functioning HIS, inaccurate estimations can be reduced, ensuring an optimal allocation,

distribution and utilization of resources through strategic decision-making, especially in resource poor setting such as LMICs [1, 5–7]. As AbouZahr and Boerma emphasize: “[i]t’s not because countries are poor that they cannot afford good health information; it is because they are poor that they cannot afford to be without it [6].”

However, while strong information systems are even more necessary in resource-poor settings – they are also more difficult to implement in such contexts. Particular challenges include a lack of basic infrastructure (such as computers and electricity), poor basic information system skills among healthcare workers (HCWs), and multiple over-lapping information systems being implemented. [6, 8–11]. The challenges to HIS implementation in resource poor settings have been identified as: inadequate investment in HIS and its technologies; shortages of personnel dedicated to, and/or skilled in, health information; limited data analysis capacity among facility staff; and poor interpretation of health data. This leads to partial appreciation of information being collected; poor cultures of data use; inadequate infrastructure and support; and difficult work environments such as limited time and over burdensome workloads [3, 12–15]. Public health challenges can be recognised and tracked through the development and strengthening of mechanisms that ameliorate data for better accountability [16]. Implementation of, and intervention in, HIS in resource poor settings is therefore a key area of interest, although as we will show in this review, not as yet a well-developed area of research.

Previous research has acknowledged that policy implementation occurs during the daily practice of HCWs, where they are constantly making discretionary decisions regarding whether or not to adhere to policies and procedures, and selectively implementing and translating policies and guidelines. [17, 18]. There is a growing body of literature on the

implementation of HIS by the intended users (who in this particular study are HCWs) [3, 5, 6, 12, 19–22]. According to Dawson, the accuracy of HIS data is heavily reliant on the HCWs who input the data [23]. As such the adaption and sustainability of a system is dependent on HCWs [24].

In this section, we report on a scoping review of important factors in HIS implementation, as well as the intervention experiences that strengthen these systems in resource poor settings - with a particular focus on the factors influencing HCWs acceptance or non-acceptance of HIS in LMICs (and in Africa in particular).

The objectives of the literature review are to identify factors influencing the implementation of HIS and to highlight gaps in literature regarding implementation of HIS.

Literature Search Strategy

A scoping (or landscaping) review was conducted. Key databases were searched, including the ALEPH Library catalogue at the University of Cape Town (UCT), as well as key electronic databases: EBSCO (Academic Search Premier), Google Scholar, InterScience (Wiley), Science Direct (Elsevier), MedLine and PubMed. This review considered both relevant peer-reviewed materials as well as some robust grey literature (un-peer reviewed paper and reports). After an initial collection of materials, a further search of the reference lists of these materials was conducted. Key institutional databases (and websites) were also searched – including the electronic databases of the World Health Organization (WHO), United Nations Development Programme (UNDP), and the United Nations Children’s Fund (UNICEF) – in particular policy and guidance documents from these.

The following key literature search terms were utilized to enable the identification of possible relevant information: “health information system OR health information technology OR medical documentation OR electronic medical record OR electronic health records AND/OR district health information system OR paper-based health records OR mobile health OR clinical decision support”, “healthcare worker OR health personal OR healthcare professional personal OR nurse OR doctor OR physician (attitudes AND/OR experiences) AND implementation of health information systems”, “patient-held medical record AND patient-retained health records AND personal health record AND clinical handover”, “healthcare worker OR healthcare professional OR health personal OR nurse OR doctor OR physician OR health worker OR community health worker”, “Africa OR lower to middle income country OR resource poor setting OR developing countries OR Asia”, “acceptance OR technology acceptance OR technology adoption”, “improvement AND strengthening AND intervention AND policy implementation AND attitudes AND referral”.

To determine the significance and quality of the literature obtained, the following criteria were used for screening: the literature had to include any of the keywords and terms individually or in combination; and journal articles from 2000 to the present date, and books from 2005 to present were selected for further review. The time periods were applied in order to bring focus the review towards more current literature whilst ensuring that all relevant literature is included. However, through chain referencing, articles that were heavily cited by the included articles, including publications outside of these time periods, were included to ensure all relevant literature were incorporated.

Study validity for research articles was based on relevance and robustness of the materials gathered. Only publications and documents in English were included during the literature

search and review, with the parameters being date, topic, language and LMIC-focus with a concentration on Africa.

Results

The initial search revealed around three thousand broadly relevant articles. After further refinement 292 articles were identified, and of these 12 were identified as directly relevant, through screening carried out on their title and abstract content. A total of 73 documents were found through a further snowballing within identified document reference lists. In total 87 documents inclusive of journal articles, reports and conference proceedings with qualitative and quantitative data were reviewed for this review (*see* Table 1 identifying most relevant articles).

Table 1 Listing of top relevant articles identified

No.	Author/s & Year of publication	Study Country & Study Design	Objectives	Findings
1.	Akanbi <i>et al.</i> , 2014 [12]	Sub-Saharan Africa <i>Literature review</i>	To document the availability of EHR, in sub-Saharan Africa, and highlight the challenges hindering its wider adoption in the region	OpenMRS was the most widely used Open Source healthcare software, with 91% reporting using it. The high cost of procurement and maintenance, poor infrastructure as well as the comfortability of HCWs with EMRs was one of the barriers to adoption.
2.	Alquraini <i>et al.</i> , 2007 [25]	Kuwait <i>Survey</i>	To identify the factors influencing nurses' attitudes towards the use of computerized health information systems in Kuwaiti hospitals	There was a generally positive attitude toward computerized HIS. Substantial disparities in attitudes in relation to nationality, level of education, previous computer use experience, and computer skills. Education levels, length of computer use, gender, nationality, and were statistically significant predictors of attitudes toward HIS.
3.	Chaplin, Melon, Eisen <i>et al.</i> , 2015 [26]	Nigeria <i>Action Research</i>	To describe the development of EMR for HIV/AIDS care and treatment programs in Nigeria	Ongoing trainings for data managers, along with an iterative process of implementing changes to the databases and forms based on user feedback, were needed.
4.	Cilliers and Flowerday, 2013 [27]	South Africa <i>Case study</i>	Survey of user acceptance of Telemedicine in the public health care system in the Eastern Cape Province, making use of the Unified Theory of the Use and Acceptance of Technology	HCWs understood the benefit and value of HIS to improving the efficiency and effectiveness of the health system. Barriers to the effective implementation of an HIS include the lack of knowledge and awareness regarding the Telemedicine system.
5.	Garrib <i>et al.</i> , 2008 [9]	South Africa <i>Retrospective study</i>	Evaluation of the quality of reported health data by nurses from 10 clinics of one District	There was a good understanding of data collection but rare feedback to health facilities. Health data management was perceived to be a high burden.
6.	Källander <i>et al.</i> , 2013 [28]	Africa <i>Thematic review</i>	To identify approaches of mHealth projects focusing on Community Health Workers (CHWs), as well as challenges and opportunities of integrating mHealth to national health systems.	There are limited evaluations of the impact on clinical outcome of mHealth projects in LMICs. Clinical decision support tools, job aids and data submission are amongst the innovative mHealth applications used by CHWs.
7.	Kijsanayotin <i>et al.</i> , 2009 [29]	Thailand <i>Cross-sectional study</i>	To identify factors that influence HIT adoption in community health centres (CHCs) in Thailand and to validate this extant IT adoption model in a developing country health care context.	There was a high degree of IT acceptance and use amongst people who worked in. Social influence, effort expectancy, performance expectancy and voluntariness were influencers of IT. Previous IT experiences, facilitating conditions, and intention to use the system were predictors of HIT use.
8.	Kimaro and Twaakyondo, 2005 [11]	Tanzania <i>Case study</i>	Analysing the hindrance to the use of information and technology for improving efficiency of health care delivery system: Action research in 5 districts	The hindrances to the use of information and technology were identified as the lack of: Data interpretation and utilization skills. Human capacity building and clear policy guidelines on information. A flexible system hinder proper HIMS management
9.	Krickeberg, 2007 [8]	General <i>Discussion paper</i>	Description of the basic principles required for any well-functioning HIS	There are seven identified principles: A health information system needs to have a logical and transparent structure. An integrated HIS should be designed that functions for all users. There should be an individual register per target population within a health institution. An HIS must be flexible in order to adapt itself to changes of all kind such as evolving sociologic and economic conditions, changes of the epidemiological situation and the state of health of the population, scientific progress in public health and medicine, and changes in information technology. There need to coordinated reporting and forms registers. A health institution sends a report on paper only to the higher-level institution that needs it most or most urgently. It is then up to the latter to distribute it horizontally to those who require it. A higher-level office never requires 'summary' reports from the lower level.

				<p>The use of information needs to be developed within health institutions through the setting up of data or indicator banks.</p> <p>Well-defined methods and rules for handling erroneous or missing indicators and data should be included with HIS.</p> <p>Correction algorithms should be developed.</p> <p>All possibilities should be explored of exploiting an HIS for conducting, or facilitating, research studies.</p>
10.	Kumalo, 2006 [3]	South Africa <i>Descriptive</i>	Explores the importance of locating a health management information strategy within a conceptual framework that captures the fundamental essence and purpose of HMIS.	<p>Over 95% of public facilities submit routine health information regularly on a monthly basis.</p> <p>Challenges to health and management information in SA: Inadequate investment in the HMIS system; lack of an information culture in the public health sector; lack of clear policies and guidelines to guide data management processes and standardise practice; and lack of integration of hospital information systems.</p>
11.	Ludwick and Doucette, 2009 [30]	Global <i>Systematic review</i>	The adoption of EMRS in primary care.	<p>Quality of implementation process</p> <p>Health system usability</p> <p>Computer skills</p> <p>Organisational culture.</p>
12.	Mutale <i>et al.</i> , 2013 [5]	SSA: Ghana, Rwanda, Mozambique, Zambia, Tanzania <i>Comparison study</i>	Description, comparison, and contrast of 5 PHIT Partnership approaches to strengthen HIS and promote the use of data for decision making.	The engagement of managers and frontline staff were highlighted as important for improving data collection and its use for informing system improvement.
13.	Nakate <i>et al.</i> , 2015 [31]	Uganda <i>Mixed methods intervention study</i>	Evaluation of nurses' response to a designed nursing documentation form from 6 wards of a Ugandan health institution.	<p>Participants' knowledge about documentation improved by 20% following the intervention, there was no significant change in attitudes toward documentation.</p> <p>Participants consistently reflected on documentation as an important practice, but highlighted contextual constraints limiting implementation and quality of documentation.</p>
14.	Nyamtema, 2010 [4]	Tanzania <i>Cross-sectional descriptive study</i>	Exploration of the gaps and factors influencing HMIS in the context of a changing health sector in Tanzania.	<p>81% had never been trained on HMIS, 65% did not properly define this system, 54% didn't know who is supposed to use the information collected and 42% did not use the collected data for planning, budgeting and evaluation of services provision.</p> <p>Although the attitude towards the system was positive among 91%, the reviewed HMIS booklets were never completed in 25% - 55% of the facilities.</p> <p>Nurses and clinicians did not display any difference between their knowledge, attitude and practice on HMIS.</p>
15.	O'Mahony <i>et al.</i> , 2014 [22]	South Africa <i>Qualitative study</i>	To explore nurses' knowledge, attitudes and perceptions regarding ICT.	Many nurses knew about health ICT and articulated clearly the potential benefits of an EMR.
16.	Okaisu <i>et al.</i> , 2014 [32]	Uganda <i>Action research</i>	To improve nurses' documentation of their patient assessments at the CURE Children's Hospital of Uganda in order to enhance the quality of nursing practise.	<p>Project goals were unattainable solely through staff training.</p> <p>Improved documentation, broader changes were necessary, including building a critical mass of competent staff, redesigned orientation and continuing education, documentation form redesign, changes in nurse skill mix, and continuous leadership support.</p>
17.	Simba, 2009 [33]	Tanzania <i>Cross-sectional study</i>	To explore the extent to which RTH cards can serve as a sustainable database for monitoring health status and interventions targeting <5 year children.	<p>There was an over 70% possession rate of RTH cards.</p> <p>The possession rate of RTH cards was higher amongst educated and married caretakers.</p> <p>Possession of RTH cards was adequate to serve as a community database for monitoring health status and evaluating health interventions targeting the <5s.</p>
18.	Williamson and Kaasball, 2009 [34]	Developing Countries <i>Exploration study</i>	To explore the nature of management at the operative level and how this relates to the information system designed to support the management processes.	<p>There was a high dependency on soft data obtained from informal information systems rather than information generated in the formal system.</p> <p>Knowledge on what information is relevant, as well as where and how to obtain it, is strongly influenced by the tacit knowledge gained through experiential learning.</p>

Overview of Types of Health Information Systems in LMICs

In the last two decades there has been increased acknowledgement of the importance of reliable information within the health systems, and this has resulted in advancements in the development of different HIS varieties. These advancements range from paper-based health records (PBHR), to electronic medical records (EMR), to clinical decision support (CDS) systems, to mobile health (mHealth), amongst others [28, 35–37]. Table 2 provides detailed functions of the various HIS.

Table 2 Function of HIS

Type of HIS	Function of HIS
patient-held medical records (PHMRs)	Patient-held medical records are structured, standardized and formal health records that are kept by patients with the aim of improving communication between patients and multiple service providers engaged in patient management [38, 39].
Paper-based records (PBR)	PBR are the combination of tally sheets, registers and monthly data collation forms usually handwritten and compiled into a patient file, booklet or card. PBR can be divided into facility-based and patient-held [9, 40].
Electronic medical records	Electronic medical records are sources of patient data such as demographics, progress notes, medication, immunization, and medical history in digital form that are securely stored and exchanged, allowing for multiple authorized users to access it. The main aim of supporting the continuity of care through efficient, quality integrated healthcare [12, 41].
Clinical decision support systems	Clinical decision support systems consist of software designed as an aid for clinical decision-making. The characteristics of a patient are matched to an electronic medical record to support patient-specific recommendations and assessments to the health professional and/or the patient for evidence-based decision-making [42].
Mobile health (mHealth)	mHealth is an incorporation of all portable and wireless communication devices that manage patient information and deliver health services through uploaded software applications [43]. mHealth is believed to support the performance and operations of healthcare professionals through the collection, dissemination of clinical updates, learning and promotional materials and reminders [28].

Through information gained from clinical decision support systems (CDS), the practice of medicine and other healthcare can be improved through the utilization of the best available scientific evidence, bridging the gap between actual clinical practice and optimal practice [35]. In LMIC settings, mHealth is being introduced with the intention of providing a portable means of case management for efficient and effective care in communities where integrated community healthcare is often delivered by community health workers who travel

far and wide [28]. mHealth platforms are also used to providing patient messaging for maternal and child health, infectious diseases and adherence treatment [44, 45].

Although there have been great advancements in the use of computerized health records, paper-based health records are still in use in LMIC settings where electronic systems are often still too challenging to implement broadly or effectively [12]. Of those paper-based records, the patient-held medical records (PHMRs) are still particularly utilized in child and maternal health, as well as emergency and curative care. Patient-held medical records function as a portable database that can provide a quick reference for HCWs about a patient's previous encounters with other health providers [33, 39, 46].

Paper-based records have been described as laborious due to the amount of writing required by HCWs [9, 40]. They require HCWs to recall a substantial amount of data and make real-time decisions about what to document. In a study from Uganda for example, nurses only had ruled paper to note down initial full health assessments, noting that the excessive amount of time needed for complete recording leads to omission of information and incomplete records [32]. Similarly in South Africa it was identified that inaccuracies in recordkeeping were mainly due to the high workload from lack of a chronological patient records, misfiling, duplication of data, excessive time in recording and reduced time for patient care [22]. It has been highlighted that in a paper-based records systems, medical records are commonly misfiled and HCWs have the additional work of identifying where the correct records have been placed [47].

Barriers To Implementing HIS at Different Levels of LMIC Health Systems

With growing recognition of the need for information and the development of new HIS there has been increased focus on *HIS implementation practice*, especially in upper-middle income countries (UMICs). This is a result of the realization that the successful development of an HIS relies not only on the technical (hardware and/or software) system being in place, but also on the capacity of people within the system (workforce and management) to implement and utilize the HIS successfully [48]. In this way HIS implementation is similar to other health policy implementation in which HCWs practice a certain amount of autonomy and discretion during the implementation process [49, 50], as they seek ways of coping with their day to day routines while simultaneously implementing a new policy [20, 34, 48–51].

Despite the progress in HIS development and usage in LMICs for monitoring and planning, there are still challenges in implementation. These include: inadequate resource allocation and distribution; poor and/or ineffective leadership; unsuitable system design; limited infrastructure, limited technical support; poor administration, and users' perceptions of the system (these are unpacked in more detail below) [25–28, 52]. As a result of these challenges, there are extensive differences noted between the intended policies introducing HIS, and actual practice in terms of HIS implementation. This has led to a substantial body of research being conducted into HIS implementation (*see* Table 1). The factors that influence implementation of HIS can be understood as influencing implementation at three levels: macro, meso and micro. The macro level is the design and administration of the system; the meso level consists of the systematic interventions and function of organisations within the health system. The micro level centres on the individuals involved in the various activities of health provision, utilisation and governance [53].

Macro Level Considerations: HIS Policy and Implementation at a Macro Level

The health system is a dynamic and complex adaptive system with mixed intertwining boundaries through the relationships and interactions of its building blocks [54, 55]. The World Health Organization has defined the goal of a health system as “improving health and health equity in ways that are responsive, financially fair, and make the best, or most efficient, use of available resources” [1]. Health systems in LMICs are generally characterised by inadequate resource allocation and distribution; poor and ineffective leadership; and inequitable distribution of services, which undermine health systems functioning [13, 56, 57]. To assist country health systems to achieve their objectives HIS can be used to monitor and evaluate health outcomes and progress against national and global goals such as the health-related Sustainable Development Goals (SDGs). The SDGs will succeed the Millennium Development Goals (MDGs) [58, 59] which *inter alia* seek to promote human development by addressing inequalities.

HIS provide a means of monitoring the status of the population which may facilitate the redress of imbalances of demand and supply by capturing key indicators [60]. The availability of sound, reliable data enables policy-makers to make informed decisions when setting national priorities [6, 58] and, through monitoring health-related SDG indicators and other socioeconomic indicators, to guide governments and donors as to resource allocation for equitable health service delivery [57, 61]. HCWs, health facilities and organisations are all part of the health system. As such, it is crucial to focus on the health systems factors influencing the implementation and adoption of HIS. These influencing factors - including system design, financing leadership, and all elements of the health systems building blocks [1] - may be the difference in the level of HIS implementation.

Lack of Health Worker Engagement in HIS Design

There is literature which shows that there are agendas that set which HIS are in place at a macro level and these rarely take into consideration HWCs perception or ease of use indicating a disconnect [62, 63]. According to Urquhart and Currell the type of health data collected by HIS appears to give the impression of being more suited to epidemiological research and for managerial aims with the goal of avoiding litigation rather than for use by HCWs [63].

The implementation process of an HIS begins at the decision-making stage at both policy and organisational level, where decisions regarding the design and selection of the systems to be introduced are made. HIS that feed into national systems benefit from a design incorporating methods of collecting variables that provide national indicators to monitor the success of a variety of services and programmes, or to justify decisions made [8, 63, 64]. The design of an HIS plays an integral part in the position intended users take during the implementation process. HCWs in facilities face several pressures in their daily workings from dealing with numerous clients to working in environments that have limited resources allocated and distributed to them. These pressures, combined with conflicting organisational expectations, make the design of an HIS being implemented very important [8].

Because many HCWs perceive themselves to be overworked, it is understandable that the HIS to be selected should be user friendly and fit the jobs and tasks they are performing [2, 65, 66]. This can be done through eliciting HCW ideas of how they believe the HIS design may enhance their job performance and be effortless to use, by incorporating those ideas into the design. In a Nigerian study on the scale-up of networked HIV treatment (an electronic medical records system) a key consideration identified by implementers was the HCW's

avoidance of a system that requires highly specialized training every time the system required modifications. It was found that systems to be adopted should fit the HCWs and they should not be expected to repeatedly adapt to new systems [26]. This corresponds with the findings from numerous studies suggesting that the design of a system is essential to HCWs' perceptions of and attitudes towards an HIS [67, 68]. In other words, the more complicated a system is the more it may be perceived to take time away from the job they provide.

A meta-analysis by Rahimi *et al.*, on HIS implementation documented that during the formulation of most public policies, including health policy, the intended implementers of said policy are rarely drawn in until the implementation stage [62]. The process of selection or design is rarely inclusive but more frequently is brought to facilities through a top-down approach [62], failing to take into account whether the new HIS system will fit into the existing system [30]. HIS tend to be comprised of numerous different forms and registers for data collection that are not coordinated in layout, without corresponding variables and goals, leading to duplication of information, and further adding to the already heavy administrative burden borne by HCWs working with disparate methods of collection and beholden to numerous reporting mandates for multiple and sometimes conflicting programmes [7]. These numerous reporting mandates and varying methods of data collection often cause discrepancies in health information as they may be collecting data for the same indicators [6]. Research by Law *et al.*, revealed that HCWs felt that information duplication in particular led HCWs to feel reluctant to complete documentation thoroughly [69]. Cheevakasemsook *et al.* and Owen emphasize that nurse record-keeping may be improved by a reduction in duplication [70, 71]. These findings reinforce those of Krickeberg who emphasizes that registers and forms in HIS should have coordinated layouts with consistent variables, thereby reducing work-load caused by duplication, and increasing intentions to use the system [8].

A systematic review by Ludwick and Doucette on the adoption of electronic medical records in primary care found that the implementation of a system is more likely to succeed if the design is relevant to the services HCWs provide and has the potential to enhance their job performance [30]. While Krickbeberg goes further to suggest that successful adoption of an HIS can be affected by whether or not it coordinates with other methods of recordkeeping already in place [8], other studies have shown that facilities that undertake to introduce HIS that are job-relevant are able to encourage and urge their staff to utilize the system being introduced more effectively and efficiently [30, 67, 72], with a better quality of outputs [73]. This suggests that careful thought into users' potential application of an HIS for enhanced productivity is required for optimal implementation.

Lack of Adequate Resourcing of HIS Implementation

Financing within the overall health system plays a vital role in HIS implementation in three ways [15, 74, 75]. Firstly, it affects the decision-making process of the system to be selected – whether the system is generic or customized to fit the jobs HCWs perform, and if there are enough points of access to the HIS. Secondly, it influences the availability and timing of training – the provision, quality and quantity of training may be decided upon according to funds available [11]. Finally, it may be the difference between hiring a dedicated staff for the system or training already inundated HCWs [11]. This demonstrates the importance of ensuring adequate resourcing of HIS implementation.

Effective Leadership and Governance within the Health System

The information collected by a well-functioning HIS provides essential data to ensure a health system functions efficiently through the provision of data that is able to encourage equitable delivery of health services and adequate distribution of limited resources [61, 76]. Through effective governance within health facilities, and the health system as a whole, there can be efficient distribution of roles and responsibilities that can encourage adoption of HIS. Governance encompasses authority, power, and decision-making, such as deciding on the HIS to be adopted, who should use the system and/or how usage should be monitored and audited, and how services should be distributed for improved equity [77].

In a Malawian assessment on the implementation of health management information systems it was identified that managers were not serious about their managerial and accountability duties and not prepared to hold their subordinates accountable for performance [52]. The level and rate of adoption of an HIS is significantly influenced by whether policy-makers and management support the use, and understand the benefits, of a system [78, 79]. A discussion paper on the lessons learned from the Pacific for health information priorities for more effective implementation and monitoring of non-communicable disease programs identified strong leadership and improved country-level organisation as key to making perceptible advancements in monitoring and control of health challenges [16].

Meso Level Considerations: HIS at a Facility Level

The environment in which an HIS is being introduced is a significant consideration to take into account. The resources available, including infrastructure, administration, health workforce uptake and technical elements have been highlighted in previous research as important influencing factors for implementation [34, 72, 79–82].

Lack of Sufficient Technical Infrastructure

In the design of HIS, the infrastructure available where the system will be introduced is important. The infrastructure includes, but is not limited to, space, equipment and power supplies available - which some researchers refer to as 'facilitating conditions' [27, 83]. The system being introduced needs to be in balance with basic levels of infrastructure available, including other systems already in use [3, 84].

According to Archer *et al.*, inadequate access to HIS infrastructure is amongst the limiting factors to optimal implementation of a system cited by users [85]. This is consistent with findings from a study in Taiwan assessing nurses' concerns regarding use of information systems. The study found that nurses' interest in information technology was inhibited due to their trepidations about the hardware and computer skills required for inputting information onto the computerized nursing care plan system [80]. Similarly, Ajami and Bagheri-Tadi identified that in addition to access to computers, the availability and placement of computers for data inputting affects HCWs' use of systems [86]. This indicated that for a health system to fully benefit from the envisioned benefits of an HIS it is necessary to provide adequate resources to support both the system infrastructure and the implementation by the intended users. For these reasons, in contexts that have limited financing, shortages in workforce and inadequate infrastructure, the availability of adequate infrastructure becomes an essential prerequisite for optimal implementation.

Overlapping and Poorly Integrated HIS Administration

In addition to adequate resources, researchers have highlighted that when implementing a new system, or revamping an existing HIS, it is vital that the HIS is integrated into healthcare

processes by considering how facilities may need to adjust their existing working practices in order to maximize utilization of the HIS [62]. In view of that, the introduction of any HIS aimed at recordkeeping in health facilities requires good management, consisting of supervision, coordination and communication. Notably, Cresswell and Sheikh recommend ‘strong administration and management’ could ensure strategic uniformity so that all individuals within the organisation could be driven by common goals, optimally utilizing systems [79]. This is supported by Wu *et al.*, who suggest that robust management is essential to diminishing users’ unenthusiastic attitudes towards a system [65].

Studies have indicated that there is a critical need for supervision and regular auditing to ensure comprehensive performance of the documentation process [70, 82]. Effective management and regular auditing can provide a means for monitoring the level of system implementation and identify areas for review. In addition to assessing how the system is being used it provides users with an idea of how much top management is concerned with their satisfaction with the system and how much they support it [72]. This infers that besides administrative skills for a system to be introduced successfully there is a need for a balance with the provision of technical skills. This is achieved through training of users and support both technical and administrative [87].

Healthcare Workforce Uptake

For a health system to function satisfactorily it is essential to have both a skilled healthcare workforce and a dedicated HIS workforce [6]. Literature into health policy implementation, including HIS implementation, has recognised the complex and indispensable role HCWs play, acknowledging their personal perceptions, attitudes and value systems influencing methods and levels of implementation [24, 88, 89]. Policy comes alive in the daily practice of

HCWs and their values, practices, needs and prior experiences influencing their support and implementation of policies such as HIS implementation [17, 49]. Some studies have indicated that having dedicated staff trained in the requirements of an HIS can identify systemic problems, and take action to resolve these by relaying information, creating an information exchange for an iterative and interactive process [26]. This suggests that the quantity of essential HCWs, as well as their morale and motivation should be addressed.

Lack of Sustained Technical Support

The abovementioned recognition for a balance between administrative and technical skills and support is borne out by a body of literature underscoring the significance of adequate training and education to the intended users of the HIS to be implemented [62]. An Ethiopian study assessing the factors motivating HCWs' use of mHealth identified the need for specially trained technical personnel to assist HCWs, a lack of which can allow numerous technical complications to limit implementation [90]. Similarly, in two South African studies assessing the knowledge, perceptions and practices of HCWs with regard to a child health and well-being patient-held medical record (PHMR), it was found that knowledge influenced efficiency and levels of utilisation and that continuous training enhanced utilisation [91, 92]. Correspondingly, Øvretveit *et al.*, argue that although training is important, its timing and availability (including availability of technical support post implementation) is critical [19].

These arguments indicate that the user's experience with a system can be significantly influenced by their knowledge of the system and the type of support available should they have problems with it. It can also be assumed that if the system being implemented affects organisational performance, then investment in providing technical skills for the intended users could contribute to successful implementation of the system and levels of use.

Micro Level Considerations: (Emphasis on Healthcare Workers)

The nature and type of work that HCWs do, and the pressures they face, influence the efficiency of policy implementation. Facility managers and nurses deal with the day-to-day running of their facilities. They also deal with clients, while facing numerous pressures from limited resource allocations and distributions. They therefore can face conflicts of constrained resources and an ever increasing demand for their services, as well as conflicting organisational expectations, all of which necessitate the development of various coping mechanisms [49, 93, 94]. However, HCWs play a large and vital role in the successful implementation of any policy, and understanding what influences the decisions they make during the implementation process could be the difference between its success and failure [49, 94]. Studies have identified various factors that play an essential role in influencing HCW implementation of HIS [27, 29, 95]. Individual factors include, but are not limited to, perceptions of usefulness and performance expectancy, perceptions of effortlessness, and societal influences [27, 29, 72, 84, 95, 96]. Notwithstanding the identification of the role individual factors play, more often than not these influences are not formally recognised by policy-makers, many of whom mainly focus on the intentions of the HIS and method of implementation.

Beliefs as barriers: Perceptions of Effort (or Effortlessness)

Researchers such as Davis, and Venkatesh *et al.*, have identified ‘perceptions of effort (or ‘perceptions of effortlessness’ as commonly described in the literature)’ as playing a vital role in HIS implementation [84, 96]. These perceptions are the idiosyncratic beliefs users have of the level of ease linked with using a health information system [29, 84, 96]. Factors

that may influence perceptions of effortlessness are: training and education, and frequency of use.

Training and education have been identified by a number of studies as influencing attitudes towards HIS [25, 27, 97]. According to Miller and Sim (and mentioned briefly above), the level of complexity of a system being introduced influences attitudes towards said system as a result of the additional time involved in acquiring the newly required knowledge [98]. This leads to decreased utilization of the system due to the perceived effort involved. These findings are supported by a recent study by Cilliers and Flowerday which highlighted that training and education would increase knowledge amongst HCWs, leading to a decrease in apprehension, and increasing effortlessness [27]. Increased knowledge can increase self-efficiency in the system thus increasing usage [24, 66, 75].

Frequency of using a system can work hand-in-hand with increased self-efficiency to influence attitudes of HCWs towards a system [99]. The more an HIS is used, and the longer it is used for, the more experience users will obtain, and the more likely they are to become comfortable with the system and accept it [25, 100]. A study in Kuwaiti hospitals assessing the factors influencing nurses' attitudes towards the use of computerized health information systems emphasized that the more experience a user has with a new system, the more she/he recognises its potential benefits, which in turn ensures a more positive attitude towards the new system [25]. With regards PHMRs, frequency of use is dependent on patients carrying the record to all encounters with the HCW; if PHMRs are not brought into facilities, HCWs may not become fully accustomed to the system [46].

The more confident a user is with the system the more likely they are to increase their use of the system. With this in mind, it is necessary to highlight again that continuous availability and timing of training is crucial as this may raise levels of usage by providing users with additional knowledge [19, 86].

Perception of Usefulness and Performance Expectancy

It has been broadly identified in the literature that HCWs' perceptions of an HIS usefulness has an influence on their acceptance and implementation of it. Perception of usefulness is understood as the idiosyncratic beliefs users have that using an HIS will help them achieve their job goals and gain in performance within their medical practice [29, 72, 84, 90, 96]. It is important to note that "perception of usefulness" is at times used interchangeably with "performance expectancy" in the literature. In addition, some literature has identified that certain factors, such as knowledge and training of an HIS, previous experience with and frequency of its use, trust and confidence in the system, may all influence the level of its adoption [10, 25, 29, 30, 101].

Knowledge and education were found to be among the most significant factors impacting successful implementation and adoption of HIS [97]. A mixed method study by Nakate *et al.*, in Uganda describes the connections nurses made between type and timing of training and successful utilization of documentation [31]. However, when a system is adequately intuitive, flexible and user-friendly, training is no longer a necessary condition for successful implementation, becoming instead a means of encouraging user engagement [21]. Knowledge and training are dependent on training received, the availability training after initial implementation and previous experience HCWs have with the system [21]. This indicates that knowledge and education of a system influence the perceptions intended users have of

the system's usefulness; provision of training can enhance implementation by increasing user's perceptions of the system's benefits.

Individuals tend to frequently use technology and systems they trust and have confidence in, be it mobile phones, computers or software. The information HCWs use on a daily basis is generally sensitive, involving patient medical histories, demographics and other information necessitating confidentiality. Lack of trust and confidence in a system have been identified in numerous studies as factors influencing systems utilization. Ultimately, belief in the integrity of information being generated, and trust in a system, indirectly influenced the system's perceived usefulness thus its adoption [25, 102, 103].

Previous experience with a specific system has been identified as having a bearing on how useful HCWs found a system [104–106]. A descriptive study by Moody assessing the perceptions, preferences and needs of nurses regarding electronic medical records identified that more experienced nurses had more favourable attitudes toward using electronic medical records than those less experienced [106]. These findings are similar to those by Ward *et al.*, who found that users with higher levels of previous experience with HIS were inclined to have more positive attitudes towards its introduction and use [67]. This indicates that HCWs with more expertise with a system have more favourable dispositions toward the use of systems and their potential to achieve job goals and increase performance. It can also be assumed that the more favourable HCWs feel towards a particular HIS, the more frequently they might use it.

In the literature, frequency of use has been identified by several writers as possibly influencing perceptions of usefulness and performance expectancy, as well as perceptions of

effortlessness [29, 95, 99]. A qualitative study exploring doctors' perspectives on using handheld computers found diverse patterns of use, with doctors noting that the devices improved their performance and increased their productivity [95].

Social Influences

A literature review on health professional's attitudes towards HIS highlighted that social influences (also referred to as social norms or subjective norms) are notable factors influencing HCWs' intention to use HIS [103]. Social influence is the degree of influence that the opinions of others have on the decisions an individual makes to use an information system [29, 84]. This can also be viewed as pressures to accept and use a system or the approval views of using an HIS within in the facility. Social influences have a bearing on the way HCWs use it [65, 107]. The approbation or support an individual expects to achieve from peers and superiors, and individuals ideas about how their peers would behave in similar situations, and an individual's desire to conform, significantly impact their behaviour. In their study, Cilliers and Flowerday found that the majority of HCWs admitted that other people influenced their use of a system [27]. These findings mirror those of a study exploring the influences on the acceptance of an adverse event reporting systems by healthcare professionals in Taiwan, which found that social influences were a precursor to successful utilization [65]. This suggests that the support of coworkers and others can lower levels of anxiety, aggression and unenthusiastic attitudes.

Values and Attitudes

Individuals' reactions to the work environment, and their values and beliefs, guide their attitudes and perceptions of policies and systems [70, 99, 102, 108]. Both positive and negative attitudes of HCWs towards a system influence its adoption [22]. A few studies

found that the predominant elements of attitudes towards usage were: apprehension, anxiety, confidence, fear, distrust and uneasiness of systems influenced by aspects such as experience, job fit, flexibility of the system, exposure and access to the system [10, 25]. A South African study on knowledge and attitudes of nurses in community health centres regarding electronic medical records, found that positive attitudes towards a system increased the probability of successful implementation of systems, highlighting that the recognition of the challenges associated with the system already in place can effect more positive attitudes towards new systems [22]. Because attitudes significantly impact adoption of new systems, all available means to alleviate negative attitudes should be utilised.

Conclusions

HIS play a fundamental role in the functioning of a health system, and, therefore, their adoption is of significant importance. The implementation or strengthening of an HIS is a multidimensional process influenced by various factors at the different levels of the health system, including policy, facility and individual factors.

There are, however, multiple challenges to the effective implementation of HIS – and varied aspects of the health system that need to be appropriately engaged at multiple levels. These challenges could include: lack of health worker engagement in HIS design; lack of adequate resourcing of HIS implementation; ineffective leadership and governance within the health system; lack of sufficient technical infrastructure; overlapping and poorly integrated HIS administration; lack of sustained technical support; healthcare workforce uptake; HCWs beliefs as barriers; perception of usefulness and performance expectancy; social influences; and values and attitudes of HCWs.

HIS policy involves the selection of a system that is designed to provide health information that can be used for decision-making by all members of the health system, whilst enhancing the users' productivity. However, it is important to note that HIS design and selection is commonly driven largely by financing concerns. Similarly, resource constraints impact the human resources and training available for system implementation.

In addition to HIS policy, the type of administration, infrastructure and technical support within health facilities have been found to impact the adoption of HIS. The implementation of immensely technical HIS without adequate user support has been found to lead to implementation failure. Similarly, HIS that exceed the capacity of the available infrastructure are unlikely to be successfully implemented or sustainable. With this in mind, it has been suggested that administration may play a major role in HIS adoption through the adjustment of working practices and good management within facilities. However, the importance of administration in the adoption of HIS remains unclear, especially in terms of a paper-based HIS.

The successful implementation of HIS policy is influenced by HCWs as the intended users of the system. As such, HCWs have been generally recognised as having a significant role in HIS adoption. It has been identified that the potential gains an HIS presents need to be fully recognised by HCWs, to ensure adequate up-take. Furthermore, as instruments to HIS adoption, HCWs' perceptions of how useful an HIS is, and how much effort using an HIS will involve, in addition to HCWs' values, attitudes and social influence, all impact on levels of HIS adoption. However, the extent to which these factors influence HIS implementation remains undetermined, especially within the LMIC context.

The topics presented by this literature search have implications for HIS decision-making and implementation planning. It is imperative that the influencing factors that create challenges are taken into account during the planning process. While extensive literature explores the factors influencing HCWs' implementation of HIS in UMICs, little research on these topics has been conducted in LMICs, particularly in Southern Africa. The limited resources and overburdened health systems in LMICs necessitate further research exploring the perceptions and adoption of HIS by HCWs in these settings.

Furthermore, the majority of literature identified related to various forms of electronic medical records and computerized HIS, with little literature on paper-based (or patient held) records. This indicates the need for further research into HCWs' attitudes and perceptions towards paper-based HISs, which have continued relevance in LMIC health systems.

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PART C: JOURNAL ARTICLE MANUSCRIPT

Article in line with *BMC Public Health Journal*

Assessing healthcare worker attitudes and perceptions towards health information systems implementation in South Africa: A case study of the Road-to-Health Booklet^{†‡}

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Abstract

Background: The growing acknowledgement of the importance of health information has seen the introduction of numerous health information systems (HIS). Amongst these is the Road-to-Health Booklet (RtHB) in South Africa, a paper-based patient-held medical record given to mothers upon the birth of their children to monitor all contact children have with the healthcare system. The study objectives were to understand how the attitudes and perceptions of healthcare workers (HCWs) have influenced the implementation of the RtHB and what factors are steering variations and limitations in uptake and utilization.

Methods: This study aimed to explore the influence HCWs' attitudes and perceptions have on the implementation of the RtHB within the Khayelitsha Sub-District of Cape Town, South Africa. A qualitative case study design was utilised, which integrated in-depth interviews, observations, document review and mind mapping.

[†] Article in line with *BMC Public Health Journal* – Instructions for Authors (Appendix 6)

[‡] Article quotation style and referencing style adopted from: Letona P, Chacon V, Roberto C, Barnoya J: **A qualitative study of children's snack food packaging perceptions and preferences.** *BMC Public Health* 2014, **14**:1247

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Results: The majority of HCWs acknowledged the benefits of the RtHB and correctly understood its stated intentions. The RtHB design, availability of training, social influences, as well as perceptions of the booklets' usefulness and ease of use, influenced the HCWs' intention to use. HCWs identified lack of training on the RtHB, as well as social influences (in the form of caregiver's objections to certain information being included), as a notable barrier to utilisation.

Conclusion: The RtHB was perceived to be a useful and 'effortless' tool by the majority of HCWs. Design is crucial to the level of utilisation of the RtHB; the user-friendly and convenient design of the booklet positively influenced HCWs attitudes towards the booklet. The inclusion of objectionable information negatively influenced intention to utilise particular elements of the RtHB. Numerous systems of collecting similar information increases negative work experience and feelings of being overburdened. Mandatory initial training, regular refresher training courses, and improved education of mothers and the community, are required to improve understanding of information being collected and enhance compliance. Intentions to use the RtHB were influenced not by perceptions on the booklet but on perceptions of the mothers' wants, knowledge and behaviours. Multiple variables from different health systems levels influenced the successful implementation of this particular HIS, and all such factors need to be considered.

Keywords: Healthcare workers; Implementation gaps; Health information systems; Patient-held medical records; Attitudes and perceptions; South Africa

Background

Primary healthcare facilities are the first point of contact with the health system for the majority of public health service users in most low-and middle-income countries (LMICs) such as South Africa. Healthcare professionals providing these public services routinely work in contexts of high burden of disease coupled with limited resources, inadequate procurement arrangements, inequitable distribution of services, ineffective management and conflicting policies and procedures [1–5]. These conditions make the availability of reliable, timely, good quality information a necessity in the allocation, distribution and utilization of limited resources [6–8]. HIS can facilitate population-level monitoring that enables imbalances in the supply and demand of health services and resources to be redressed. [9]. The availability of sound and reliable data enables policy-makers to make informed decisions when setting national priorities [10, 11], and accurate monitoring of health-related indicators and other socioeconomic indicators can guide governments and donors in resource allocation, ensuring equitable health service delivery [5, 12].

Increased demands for health information for the good functioning of health systems has led to growth in health information systems (HIS) implementation research. This research has stressed that the intended users of the systems are crucial to the successful implementation of the system, and realisation of potential gains. In most cases these users are the HCWs, rather than the patients. There are multiple health systems' level influences on HIS implementation which may provide challenges to the implementation of the R4HB. These levels are: macro, meso and micro. The macro level includes the architecture and supervision of system; the meso level centres on systematic interventions and organisational functioning; and the micro level focuses on the individuals involved in the various activities of health provision, utilisation and governance [13]. The macro, meso and micro-level health system factors

influencing HCWs' implementation of HIS have been studied quite extensively in upper-middle-income countries (UMICs), but similar research in LMICs is limited, in Africa [14–16]. There is a significant evidence gap regarding HCWs' attitudes and perceptions of HIS in LMIC. .

The Road-to-Health Patient-Held Record in South Africa

The growing acknowledgement of the importance of health information has seen the introduction of numerous health information systems (HIS). Amongst these is the RtHB in South Africa, a paper-based patient-held medical record (PHMR) designed to be a portable health information system. The overall goal of the RtHB is to provide an effortless, inexpensive, user-friendly and accessible method of monitoring individual child growth and development to foster child well-being, by monitoring all contact the child has with the healthcare system after birth until the age of 12 years [17].

The RtHB was introduced to the Western Cape Province of South Africa in February 2011, where it was rolled out in stages, beginning with new mothers and subsequently rolled out to mothers visiting healthcare facilities with older infants. There were multiple intentions underpinning the roll-out of the booklet. These included: enabling the early detection of child ill-health to facilitate prompt intervention; monitoring child development according to standard milestones for a growing child [18]; acting as a channel of communication among HCWs, and between HCWs and caregivers (which allows for a continuity of information and care, reducing redundancy and error) [19]; and to feed collected information into the national HIS [20], to enable evidence-based decision-making for efficient and optimal allocation, distribution and utilization of resources.

The intentions of the RtHB can be seen as being aligned with the Western Cape Provincial Government's 16 year strategic plan 'Healthcare 2030: The Road to Wellness' (2014) [21]. This plan stresses person-centeredness through the integration of health information to improve clinical management and enable continuity of care at clinical level, enhancing the patient experience through better encounters with the health system [21, 22].

With respect to the delivery of health services, the Western Cape Province has a fragmented multi-player health system managed by two administrative structures: Metro District Health Services (Metro Health) overseen by the provincial government and City Health overseen by the local government [23]. The two administrative structures use different HIS and data entry systems working parallel to one another for the collection of health information. As the RtHB is presented at all healthcare facilities the child interacts with, whether it be City Health or Metro Health facilities, it provides HCWs with the ability to interact with each other for service delivery.

In a prior assessment on behalf of the Western Cape Department of Health Nutrition Directorate by members of the Road-to-Health Booklet Survey Research Group, physical examination of the RtHB revealed that many booklets were incomplete (Visser M and Blaauw R, 2013, "Unpublished observation"). This assessment was conducted in early 2012, a year after the introduction of the RtHB, assessing the implementation of the new RtHB in primary health care facilities in the Cape Town Metropole and Cape Winelands Health Districts. The results indicated that the use of the booklet was sub-optimal, with less than 75% of booklets completed. In the Khayelitsha health district it was found that 88.6% of the RtHBs reviewed did not have the human immunodeficiency virus (HIV) status recorded. Furthermore, 23.6% of the booklets reviewed did not have the weight measurements plotted

in the charts, and none of the booklets reviewed had the mid-upper arm circumference (MUAC) measurements taken or recorded for children younger than 6 months (Visser M and Blaauw R, 2013, “Unpublished observation”).

Khayelitsha is the largest poor urban township in the Western Cape Province, South Africa, with an estimated population of just below 392,000, of which 55% of the inhabitants live in informal dwellings [24]. The township is situated in the Khayelitsha Sub-District on the outskirts of Cape Town. Khayelitsha has a high burden of disease, particularly tuberculosis (TB), in addition to a high prevalence of HIV, which increases vulnerability to opportunistic infections [25]. Khayelitsha also has among the highest rates of: 1) age-standardised mortality (ASR) for maternal, perinatal and nutritional conditions (Comm/Mat/Peri/Nut); 2) injury; 3) and ASR of HIV/AIDS and TB in the Western Cape [25]. With a TB case notification rate of 1 158 per 100 000 per year of which approximately 70% are co-infected with HIV, Khayelitsha has the highest TB and HIV co-infection rate in South Africa, and amongst the highest globally [26]. For effective health gains that can see the improvement of the above figures, the RtHB presents as a potential tool to assist in monitoring necessary health outcomes in young children.

Hence this study expanded on the findings from the previous study that quantified, but did not explain, the inadequacies found with the use of the RtHB (Visser M and Blaauw R, 2013, “Unpublished observation”). This study aimed to provide insight into the inadequacies in implementation identified in the assessment through the exploration of the factors influencing the implementation of the RtHB. In doing so, this study explored the links between HCWs’ perceptions, attitudes and understanding of the information system, and their use of the system.

Method

We employed an exploratory embedded case study approach. The approach was selected because it would be difficult to explore the case without relating it to the clinic environment within which HCWs utilise the RtHB. This study was conducted from January to December in 2015, and included two primary health care facilities providing maternal and obstetric care and ‘well-baby services’ within the public health system. The two research sites were based in in the Khayelitsha sub-district of Cape Town within the Western Cape Province of South Africa. The clinics purposefully selected as the sites of investigation each had a ‘point of birth’ (maternity and obstetric unit (MOU)) and ‘well-baby’ services similar to the Visser and Blaauw study (2013, “Unpublished observation”). The child healthcare service package provided by both clinics includes curative care, HIV testing and growth monitoring and promotion.

Study participants were purposefully selected to include participants with a range of insights to give a wide variety of perceptions towards the RtHB. Study participants included those expected to utilise the RtHB, and those who hand it down to the expected utilisers (HCWs, key stakeholders and policymakers). A snowball strategy was used, with participants recommending other participants for interviews. All interview respondents were female and worked with children at a primary care level. The participants’ roles in the health facilities included: advanced midwives (n=2), clinical nursing practitioners (n=3), health promoters (n=1), prevention of mother-to-child transmission of HIV (PMTCT) nurses (n=2), department manager (n=1) and key stakeholders (n=1). Of the ten HCWs interviewed, three worked solely in the maternal and obstetric unit.

The methods employed for collecting data were ten in-depth interviews, naturalistic observations, document review of minutes from meetings held with the Western Cape Department of Health Nutrition Directorate, and mind mapping exercises with eight HCWs. Observations were made in both sites during morning sessions and field notes were taken during observations throughout the day. Data collection and analysis were conducted concurrently, using a repetition process, to permit the interview guide to be refined and to allow for the development of new avenues of investigation. A qualitative thematic analysis approach utilizing a constant comparative method was employed to analyse data, allowing for themes and categories across data to be identified and analysed. All data was systematically reviewed by the researcher and a preliminary list of codes was developed. Initial categories for analysing data were pulled from the interview guide themes with analysis of data driven by patterns identified after examining the data. Themes and categories were cross-checked by an independent researcher. Respondent validation was conducted to provide external validation and to ensure interpretation of data and emerging findings were representative of HCWs main views and to help refine interpretations.

The Human Research Ethics Committee, Health Sciences Faculty, University of Cape Town (approval number HREC/REF: 044/2015) and the Western Cape Provincial Health Research Committee (approval number WC_2015RP27_18) approved the study. Informed consent to participate in the study was obtained in writing from each participant after full explanation of the study was provided and it was clearly explained that participation in this study was voluntary.

Results and Discussion

We divided our findings into three central sections and have arranged the results and discussion relative to macro, meso and micro level challenges or constraints to the effective implementation of the RtHB, as these levels are the different levels that shape the health system. As is common in the reporting of case studies, we have integrated our findings with the results of the literature review, which identifies multiple systems-level barriers and facilitators on HIS implementation in LMICs. Table 1, provides a summary of themes and sub-themes explored in the findings.

Table 1. Summary of themes and sub-theme challenges

Influencer Level	Theme	Sub-theme
Macro	System Design	
	Healthcare Workforce	
	Governance and Leadership	
Meso	Administration	
	Technical Support	
Micro	Perception of Effortlessness	Amalgamation of Information
	Perception of Usefulness & Performance Expectancy	Job Relevance
		Health Promotion
		Mothers Empowerment
	Social Influences	
Values and Attitudes		

The themes fell into different levels of the health systems according to where the challenge or constraint were seen to originate and/or could be alleviated. These were either policy factors, facility factors or individual HCW factors associated with culture and practice.

Macro Level Challenges and Influences

HCWs' access to the RtHB, and therefore their perceptions and attitudes towards the booklet, are influenced by external factors. For example, because the RtHB is kept by the mother, HCWs' use of the booklet is partially determined by whether or not the mother presents the booklet at the health facility. Similarly, the large numbers of patients seen by each HCW, and the rights of the patient, impact HCWs' use of the booklet. For these reasons it is important to consider the various macro level challenges that influence a mother's decision to bring the RtHB to the health facility.

Challenges within the System Design

The design of a system can be seen as a challenge to the full way in which an HIS is implemented and has previously been identified as an important factor influencing the perceptions and attitudes of HCWs [27, 28]. That the HIS is user-friendly and easy to use is a vital consideration for successful implementation, especially because HCWs are generally overworked and under-supported [29–31]. In the case of the RtHB, the design of the booklet can be judged as acceptable to the majority of respondents in terms of the effort involved when using it, as all respondents emphasised that completing the RtHB did not cause them any additional thought due to the step by step guidance elements of its design. As noted in previous studies, design of an HIS, particularly whether it is easy and convenient to use, is a factor in users' acceptance of, and attitudes towards, the HIS [32–34].

Although the overall design of the RtHB can be deemed to be acceptable to HCWs, some indicated concerns about the inclusion of sensitive information, such as PMTCT information, which has been previously found to be unacceptable to caregivers. HCWs indicated that although the information is vital for the treatment of both the mother and the child, it was too

explicit and easily interpretable by anyone with access to the booklet, leading mothers and HCWs to feel anxious about the use of the booklet.

“Right now everything is just too obvious, really ‘PMTCT/HIV Information’. How obvious can you be with this information? So immediately another person will ‘put their sneaky eyes’ and see ‘latest HIV test...positive’ you see. And they will also be able to see when the mother was tested... So I think we should have codes that medical practitioners know and can refer to, where we [the HCWs] know that this code represents HIV or what. We should use codes” (Clinic X, MOU2).

This quote shows that although particular information may be regarded as essential, the manner in which the information is collected and recorded may undermine HCW’s confidence in the booklet, and lower their willingness to use it. Respondents also articulated concerns about the development process of the RtHB - specifically that they were not consultant during these initial stages. Many HCWs felt that this omission was a critical error on the part of DoH. Had HCWs been consulted early in the development process, issues around the sensitivity of information could have been addressed.

“I think if we, the staff at the ground roots had been consulted then the booklet would have been different. We [facility staff] know better and what will work and what won’t work. Like pg.7 and 8, surely they [facility staff] would have known that it shouldn’t have been included here or it should have been made the way I was telling you with coding and so forth and so forth” (Clinic X, MOU2).

Top-down approaches are typical in the selection or design of national HIS; users and implementers are rarely consulted in the development process [35]. With regards to the RtHB, this lack of consultation has meant that the inclusion of PMTCT and HIV testing information is currently superfluous.

One of the strongest themes to emerge from the interviews and observations was the duplication of information, much of which is recorded in multiple platforms. These numerous reporting mandates and varying methods of data collection often cause discrepancies in health information as they may be collecting data for the same indicators [36]. While the RtHB is intended as a “one stop shop” for information on the child, integrating information from a variety information systems through the compilation of all interactions the child has with the health system, some of the respondents mentioned that they had numerous different records to fill in.

“...we write [the] information here [in the Birth Register and the patient folder]. The other information we write here also [the back of the RtHB – Clinical Notes], what we have done for the baby. We also write the information in a discharge sheet”
(Clinic Y, MOU01).

The above statement is supported by observations made in both clinics, where it was observed that there are a variety of different records, representing the fragmented information systems at work, earmarked for different activities and programmes. The World Health Organization [7] has previously highlighted that this is a typical problem with HIS in LMICs, where HCWs collect the same information in numerous forms and registers for all the multiple, and at times conflicting, intervention programmes. The majority of respondents

spoke about multiple systems for recording routine health information for the District Health Information System (DHIS).

“They introduce new systems of care, of recording. New information they want from us or a new way to record that information, and they want it all and we must learn them all” (Clinic X, MOU02).

Most of the HCWs interviewed expressed this same frustration, noting that documentation took up too much of their time. These findings are similar to a previous Sri Lankan study on paper-based patient-held medical records (PHMR). This previous study identified that HCWs found entering information into both PHMR and other clinic systems increased their workloads [37]. In addition to the numerous systems of record-keeping for the variety of programmes, duplication of information is exacerbated by other factors discussed later in this paper. It has been suggested that registers and forms in HIS should have coordinated layouts with consistent variables, thus reducing work load caused by duplication increasing intentions to use the system [38]. The importance of this is emphasised by the majority of respondents.

“It’s tiring, it’s tiring really (sigh). Especially when you are in an institution that is very busy, then you are writing the same thing over and over again. Really there needs to be one document that would carry on and on that would be much better and less time consuming” (Clinic X, MOU02).

It has been suggested that facilities that utilise both PHMR and electronic medical records (EMR) could use the EMR as a solution to reducing the duplication of work, as information could be entered into the electronic system and printed out for the patient, who could then

enter the information into the PHMR [37]. The infrastructure in Cape Town facilities is suitable for this solution.

Meso Level Challenges and Influences

The work environment can act as a barrier to implementation and is a significant factor to be considered during the implementation process of health policy and HIS within healthcare facilities. Thus, administration within facilities, infrastructure, and technical support available have the potential to play a significant role in the level of implementation that takes place [34, 39–42].

Lackadaisical Administration

Regular auditing and supervision is vital to ensuring thorough record-keeping during the documentation process [42, 43]. Effective management and regular auditing can provide a means for monitoring the level of system implementation and identify areas for review. However, when asked to participate in the research, a manager at one health facility declined, stating:

“I don’t know anything at all about the booklet. I would only have to know something if anything was wrong. As long as everyone is doing their jobs properly I don’t need to know anything about the booklets or know anything about it. So nothing is wrong as I do not get reports about it” (Clinic X, Facility Manager).

This finding is supported by a Malawian study that revealed that managers are reluctant to hold individuals accountable for their performance, and that many managers were selective

about their duties [44]. These findings underscore the importance of management styles and accountability within the facilities to HIS implementation. The findings also raise the question of who bears responsibility or accountability for monitoring the actual utilisation of the RtHB, and how systematic problems are dealt with in cases where managers display a lack of interest in the booklet and its implementation. ‘Strong organisational support and management’ could ensure strategic uniformity, ensuring that all individuals within the organisation are driven by common goals, optimally utilizing systems [16].

Limited Healthcare Workforce

Having well-trained or specifically dedicated HCWs is central to the successful implementation of HIS, as well as to the identification of systematic problems [45]. Respondents in Clinic Y identified that they lacked time and manpower to perform certain routine activities required of them such as MUAC measurements, and added that they did not have the knowledge to read and interpret the charts correctly. Some respondents revealed that they thought anthropometric measurements, such as MUAC measurements, required specially trained staff who could collect and record the measurements, and that these staff were already inundated with other activities.

The South African health system, like those of other LMICs, has a health workforce shortage, and HCWs commonly feel overburdened by the magnitude of work they are expected to perform [46–48]. Facilities that manage to have more efficient and effective implementation – enabling better quality data collection – are those that introduce systems that are job-relevant, and those that promote a system as being effortless and useful for HCWs [14, 28, 34, 49].

Lack of Technical Support

By analysing growth monitoring information – such as the weight-for-age charts, mid-upper-arm-circumference (MUAC) and screening development – HCWs identify children at risk of malnutrition for referral to the appropriate services.

“The developmental screening is very important. If it [the child] can fail this developmental screening, the child at a later stage can develop a lot of complication like undescended testis, squint and tongue tied” (Clinic Y, WBC01).

Despite knowledge of the intentions and possibilities of the booklet, the majority of respondents working in the well-baby clinics revealed that this information is generally completed incorrectly or not at all. Further exploration revealed that respondents were unsure about how to complete the chart, and lacked understanding of MUAC and weight-for age charts.

Inadequate training is a theme that continuously arose as perceived to be a barrier to the effective implementation of the RtHB. The majority of respondents suggested that their lack of confidence was due to lack of training in the RtHB, particularly in those tasks. Only two respondents acknowledged having ever received any training. This is in direct contrast to the findings from the Visser and Blaauw assessment which indicated more than 77% of those surveyed had received official training on the RtHB. The timing of training may account for this discrepancy. The initial training was conducted on introduction of the RtHB, when most HCWs are likely to have been trained. Nonetheless, key stakeholders maintained that training and support are given to HCWs on a continuous basis. Researchers have highlighted in

previous articles that adequate training [35] and timing of training – pre and post implementation – is crucial [50] to systems implementation.

“This booklet is good because everything is in one place and everything is there that we need. You cannot leave anything out by forgetting because it’s all there for you to fill out. You just ask the mother or caregiver everything at once because it is all there. It’s just quick, yah its quick you see” (Clinic X, WBC04).

The majority of the respondents expressed concerns as to the manner in which the RtHB was introduced to them by management and the DoH, and their expectations with regard to the booklet’s implementation. The importance of training of HCWs on HIS to be introduced is clear from the impact of training on the individuals’ perceptions of effortless.

“They just give us here in the site to use but not tell us anything. One day we are told ‘now you must use this [the RtHB] and not the card’. They didn’t even tell us [what] information goes where and what pages to fill in” (Clinic Y, WBC01).

The above quote is in direct opposition to a response from a DoH Key Informant who adamantly insisted that training was given to clinic representatives in line with the Training and Orientation Guide of the Western Cape Road-to-Health Booklet Training Package 2010. This demonstrates an inconsistency in perceptions of the lines of training responsibility, especially as none of the respondents could clearly identify colleagues who had been formally introduced to the booklet, or who had received training. Similarly, HCWs could not identify the individual responsible for training within the health facility, or at the DoH.

Micro Level Challenges and Influences

There have been numerous studies that suggest individual factors play an essential role in influencing HCW implementation of HIS and may present as challenges [15, 51, 52]. We identified perceptions of effortlessness, perceptions of usefulness and performance expectancy, societal influences, and attitudes towards the RtHB as influencers to its implementation.

Perceptions of Effortlessness

Of equal importance to the design of the RtHB is the knowledge HCWs have of it. A previous study on the knowledge and perceptions of nursing staff on the RtHB in a sub-district in Cape Town found limited knowledge of the booklet among HCWs, and recommended continuous training on the RtHB [53]. The study further found that knowledge influences efficiency of utilization but not necessarily attitude towards usage. These findings are further borne out by the present study.

“I am not sure how it’s used because we were not trained on how the booklet is actually used and what it is important for. You know you just fiddle and figure it out on your own. You look at it yourself and see what you have to fill in and how you have filled it in and all of that” (Clinic X, MOU02).

The above statement indicated that although some HCWs might not know much about the RtHB, they were still willing to try and figure it out on their own, indicating a positive attitude towards the booklet. This is similar to findings of previous studies which indicated that with regular use of a system, familiarity with the system increases, further increasing

perceived usefulness [54], as HCWs discover more elements of the system that may enhance their job performance.

It has been previously emphasised that the more experience a user has with a system, the better its potential benefits are understood [32], and that the continuous availability and timing of training is imperative [50, 55].

An additional intention of the RtHB was to provide an uncomplicated, cost-effective and user-friendly approach to monitoring child growth and development [17]. Some respondents revealed that the RtHB provides a quick and convenient referral system to monitor individual child growth and development if completed properly. Observations from both sites revealed that HCWs did not hesitate to consult the booklet when presented by mothers as it would guide their course of treatment for the child, and decrease duplication of services. This is indicative of a positive attitude towards using the RtHB.

“If they fill it I know, then you this person is like this, like this, like this. Then you know that this child I must do this, and that and that. And the mother I can help her like this, and this and this. It reflects the true picture of the patient you are dealing with now” (Clinic X, WBC04).

Dearth of Amalgamation of Information

The amalgamation of information is comprised of the reduction of documentation and integration of information systems. The RtHB is intended to improve the problematic issue of there being too many documents used for record-keeping, which may affect the quality of information being gathered. Two previous studies found that a reduction of duplication could

improve quality of recordkeeping [43, 56]. Regardless, according to most respondents at both clinics, duplication in record-keeping was unavoidable. They recognized that due to the demands of the various programmes and interventions running simultaneously within the clinics, they had to complete numerous other documents which usually contain the same information as the RtHB.

In addition to the everyday tasks of recording information in the different documents, a number of participants commented on the need for alternative methods of documenting HIV and PMTCT information.

“If the mother says ‘no’, then we fill in that extra page [the facility made photocopy]. Which is still the page but then you tell the mother that these pages [the photocopy] you will take it with you when you go to the clinic with the baby” (Clinic X, MOU02).

The above statement gives the impression that although there is duplication in documentation processes, HCWs view it as a necessity. This corresponds with observations undertaken at both clinics where HCWs were seen to be recording information in several other documents. Participants from MOUs in both clinics fill in the PMTCT register and photocopy the PMTCT information from the RtHB, to supply the mother with a copy and prevent mothers tearing pages out.

“The problem is that the mothers they don’t want their status [HIV/AIDS status] to be known there...that is one of the problems, because wherever they go no one knows about their status. As a result some of them they tear out the front pages with their status filled in” (Clinic Y, WBC01).

Stigma regarding HIV status appears to play a considerable role in HCWs' willingness to complete PMTCT information in the booklet. Trust and confidence in a system have been identified in a number of studies as factors influencing systems utilization [32, 57, 58]. Privacy of a PHMR is mainly the responsibility of the patient but problems occur when it is left unattended. Privacy considerations make some patients reluctant to have certain information, such as that relating to sexually transmitted infections (STIs), recorded. Patients fear that recording the information in the PHMR may lead to other finding out sensitive information [37]. This is seen in the extract of an interview below:

“I think the problem with pg.7 and 8 is just stigma around HIV and AIDS. People don't want to disclose firstly because their status is not known. Even if their families don't know that they are HIV positive, and they are not known to the community. And they don't want to be known [for being HIV positive]” (Clinic X, MOU2).

HCWs suggested that many mothers do not want their HIV status recorded in the RthB, as many mothers commonly entrust the care of their children to family members who are unaware of the mother's HIV status.

“This [the booklet] is supposed to be with the baby at all times, so whoever the carer is can go through the pages and then there is no more confidentiality about the patients' [the mother] status” (Clinic X, WBC02).

In relation to trust and confidentiality HCWs use photocopied pages to protect the mother's privacy when entrusting their children to caregivers. While duplication of recording was a

concern for all respondents, respondents also perceived a certain level of duplication to be routine, as this duplicated information serves as a back-up and protects the privacy of mothers.

While there was a general consensus that duplication was inevitable, some respondents indicated that duplication was time consuming and proved detrimental to the patient. A respondent from Clinic X implied that as a result of duplication of recordkeeping (due to the numerous forms of documentation) patient care was on occasion neglected in favour of recordkeeping, especially when record-keeping is considered to be a marker of HCW's job performance. These findings are similar to those from previous studies [59, 60] that highlighted that recordkeeping consumed between 15 -20% of clinical practice time, detracting from patient care.

The minimal level of effort involved in obtaining information from the RtHB, indicates that HCWs are encouraged to ensure they keep the booklet up-to-date for other HCWs to be informed. However, it was acknowledged by another respondent that there could be better appreciation of the RtHB if there was additional training.

“We need more [training] here in Khayelitsha but we don't get it. Maybe if we got more [training] we [healthcare workers] would all promote it [the RtHB] more to the mothers” (Clinic X, WBC03).

Perception of Usefulness and Performance Expectancy

The introduction of HIS is dependent on how useful users perceive it to be. For HCWs, in particular, dimensions such as their knowledge of the RtHB and job relevance (in terms of

communication and continuity of care, mother's empowerment, health promotion and productivity value) all affect the implementation of the system.

All participants asserted that the RtHB is an important and effective communication tool, noting that the booklet facilitated communication among HCWs, between HCWs and child caregivers, and c with the community through health promotion. This was further validated by the concept webs completed by participants, with all concept webs visually displaying the movement of the booklet communicating information within the health system.

The RtHB was further acknowledged by all respondents to be a valuable tool for continuity of care, collating all interactions and treatments children have with the health system. Respondents indicated that by referring to the RtHB they were able to ascertain what treatment children needed.

“The information in the RtHB is a continuation information for us in the clinic. Even other clinic...even the mother can go to the Eastern Cape it's easy to see the care the child has received if everything is written inside the book” (Clinic Y, WBC01).

However, many of the respondents highlighted that although they perceived the RtHB to be a great communication tool, many HCWs still left sections incomplete, compromising continuity of care. Although it is clear that most of the respondents understood the significance of the RtHB and the advantages of its utilisation for HCWs and the child, there was no evidence of a policy stipulating how information should be collected and managed. This is demonstrated by one of the respondent's comments:

“My experience with the booklet is sometimes very difficult not all the information is always put in there [the booklet] so you tend to use the file from the clinic more...that is a problem sometimes. Sometimes it just comes empty, nothing filled in. Then you must go to the MOU if the baby was born here in Khayelitsha and obtain the information” (Clinic X, WBC03).

The above quote suggests that, when left incomplete, the RtHB generates increased workloads for HCWs, necessitating that HCWs request missing information from other health facilities that the child has visited, and, when this information is unavailable, leading to duplicated service provision. Furthermore, some respondents went on to describe how some HCWs shifted responsibility for completing the RtHB, leaving sections blank in hopes that others would complete the form.

The RtHB system does not appear to include any accountability measures to enable the identification of HCWs who leave sections incomplete, and HCWs must grasp the importance of the system in order to feel any responsibility of complete information recording. As such, a robust management system is essential to diminishing users' reluctant attitudes towards the system [31]. ‘Strong organisation and management’ could ensure strategic uniformity so that all individuals within the organisation are driven by common goals, optimally utilizing systems [16]. Supervision and regular auditing helps to ensure comprehensive performance of the documentation process [42, 43], and demonstrates to HCWs that management endorse the system and is concerned with the appropriate use of the system [34].

In addition to aiding communication among HCWs, the RtHB was intended to be a communication tool between HCW and caregivers. Interviews revealed that the majority of participants grasped the opportunities afforded by the booklet.

“...So if she [the mother] has the booklet, immediately...they carry this book and they are being taught immediately if I get BCG, if I [the nurse] talk about BCG they know why..., the baby is supposed to have the BCG...[t]he booklet is evidence” (Clinic X, MOU01).

“The information also goes to the child’s crèche and school, to know what immunizations the child received and what needs to be updated before the child starts school” (Clinic X, MOU2).

Ironically, although the respondents appreciated the opportunities the booklet affords and the possible flow of information it contained, their attitude on its actual usefulness as a tool for communication with mothers seems to be influenced by their perceptions of the mother. Some respondents identified the major limitation to the RtHB to be the mothers’ lack of interest in, or appreciation for, the booklet.

“If we depend on the mothers there is no continuity of care the mothers don’t know the great value of this book or the information inside... So many mothers don’t take care of their booklets; the books will be torn, lost and mismanaged” (Clinic X, WBC03).

The above statement implies that HCWs' perception is that mothers do not know what information is contained in the booklet, or appreciate the importance of the booklet. It can be assumed that for the booklet to work effectively as a communication tool, the mother would need to value the booklet and insist on its completion, in addition to HCWs taking responsibility to complete it. Mothers need to be educated about the contents of the booklet at least briefly so that they understand its value and hold HCWs accountable for completing all sections of the booklet.

Mixed findings with regard to health promotion were identified from both interviews and observations. Observations from Clinic Y found that whilst caregivers were in the waiting room awaiting either treatment or growth monitoring of the child, a health promotor centred the messages on sexual health behaviour and family planning, at no occasion referring to the RtHB. These observations are in direct conflict to comments made by a health promoting respondent in Clinic Y, who stated that they read the promotional material from the booklet to the mothers or caregivers individually, explaining particular elements such as health danger signs.

Whilst in Clinic X the health promotor read through the RtHB for everyone to hear, going through the health messages contained within the booklet, the health promoter at no time spoke to any of the mothers or caregivers individually. However, health promoters did encourage questions to be asked on anything that was unclear. These observations may be reflective of the findings from the interviews in which most of the respondents perceived the mothers to have no knowledge or interest in the booklet.

“No! The booklet doesn’t work for health promotion at all. The mothers don’t read the booklet; they don’t know what is in the booklet. They only know what you tell them and that is only when they decide to listen” (Clinic X, WBC03).

Previous studies have suggested that mothers prefer receiving their health information directly from healthcare providers. This may underlie the findings with respect to mother’s reluctance to engage with the RtHB [61], as of course could the mothers’ literacy levels. Nonetheless, it can be assumed that group health promotion can be used to fulfil the health education needs of the mother where nurses cannot.

Although not an original intention of the RtHB, the empowerment of mothers is something that HCWs feel the booklet may achieve and is their responsibility. A few of the respondents indicated they saw the RtHB, and the information contained within it, as a means for empowering the mother. Some HCWs interviewed went as far as to distinguish between the general education of the mother and the *empowerment* of the mother.

“The information is good because we are no more trying to educate the mother but to empower them, because knowledge is power....” (Clinic X, MOU01).

Social Influences of Others

The existing literature draws attention to the degree to which the opinions of others impact intended users’ decision to implement a system [52, 62]. Research into the implementation of HIS has found that the opinions of other people influence the behaviours of HCWs towards a system [15, 58]. Although the research mainly focuses on the influence of colleagues, this study identified that the caregivers’ influence is just as important. The RtHB is intended to

record and monitor key child information, however, the far-reaching influence of HIV/AIDS-related stigma entails that many mothers feel uncomfortable with the inclusion of PMTCT and HIV testing information in the booklet, leading to mothers developing negative attitudes towards the booklet. These negative attitudes, combined with HCWs' perceptions on the mother's rights, undermines thorough recording of information and leads to booklets being left incomplete.

All respondents highlighted that mothers frequently did not want their HIV status recorded in the booklet. Furthermore, HCWs suggested that disregarding the mothers' preferences in this regard could have negative consequences. It is of some interest that in both clinics only the respondents from the MOUs highlighted the legal consequences of recording the PMTCT data without the mothers' permission.

“If the patient doesn't want, they don't want [to have PMTCT information input in booklet]; you can't fill it [pg.7]. They can take you to court and you can be charged for that. You know!” (Clinic Y, MOU01).

Thus, recognition of the mother's rights, prevents HCWs from thoroughly recording the information, and in some instances exacerbates HCWs' negative attitudes towards the RtHB.

“They are saying to us that this No.7 is a must. We must fill it, but how must you fill No.7 without the permission. And you can't force the patient. If the patient doesn't want, it [the patient] doesn't want. You can't force you see...” (Clinic Y, MOU01).

From the above quote, it is clear that the right of the mother to refuse to have their HIV/AIDS information recorded in the RtHB leaves HCWs powerless to fulfil their responsibility to complete the booklet. The mother's opposition and the HCW's resignation to the fact that they cannot record the information against the mother's wishes, is in direct opposition to the expectations of Key Stakeholders, including those at the DoH.

“...yes, they have to complete the PMTCT information within the booklet [RtHB] as this information is vital in planning the care of the child” (DoH, Key Informant).

In both facilities, implementation was linked to training, with most of the respondents identifying the need for initial and further training to help deal with the implementation gaps and ensure thorough completion of all booklets.

Based on the review of meeting minutes and literature on PHMR, the RtHB provides the means for recording and monitoring key information, that is, immunizations, TB status, MUAC, PMTCT and HIV testing. However, the results from the Visser and Blaauw (unpublished observations) assessment indicate that there is a noticeable lack of completion of some sections of the booklet. These findings correspond with observations made during this research.

Interviews highlighted a lack of clarity in the information required when completing certain sections – such as TB status – leading to a lack of uniformity in what information is input.

“Should I write brother is on RX [a TB drug] and sometimes I see some people will have just written RX? And for me it is difficult to ask if brother is on RX or father is on RX since I can already see there is RX there, just not specific” (Clinic X, WBC01).

In addition to the lack of clarity, a number of respondents stated that booklets are not always presented when children are brought into facilities. This suggestion was borne out by observations conducted at the health facilities. HCWs indicated that they thought this was a way mothers tried to ‘cheat the system’ if they did not want information to be seen by HCWs, or if they have missed a previous appointment. All respondents indicated that the loss of the RtHB was the excuse most frequently given by mothers or caregivers for not bringing the booklet to the facility.

Values and Attitudes of the HCWs

Values and attitudes towards a system have been found to challenge the level of implementation of a system, with research indicating that positive attitudes towards a system increase the probability of successful implementation of systems [47]. Previous studies have identified attitudinal factors such as apprehension, anxiety, confidence, distrust and uneasiness of systems – which are influenced by aspects such as experience, job fit, flexibility of the system, exposure and access to the system – as impacting implementation [32, 63]. This study revealed that the attitudes HCWs, and HCWs’ perceptions of mothers’ attitudes towards the RtHB, influence levels of use.

Respondents suggested that some HCWs felt negatively towards the RtHB, and further revealed that these negative attitudes influence their intention to use the booklet. Some HCWs revealed their own attitudes towards the RtHB ought to improve.

“It is just us [HCW] we mustn’t have this attitude of saying it [the booklet] must be filled by somebody else, it must be done by somebody else. We must just do it, say ‘I’m a nurse as well, let me do my job. That’s all really’” (Clinic X, WBC04).

Although all respondents indicated high confidence in using the RtHB, the findings reveal that attitudes towards usage of the RtHB are be linked to design, perceptions of usefulness or ease.

Study Limitations

Limitations to this study include the following:

- 1) The sample size – while this was small, information saturation was reached with those ten interviews, and researchers established that findings were sufficient at the time.
- 2) The research consisted of only two PHC facilities within the Khayelitsha Sub-District. However, the findings are transferable throughout the facilities within that sub-district as working conditions and staff profiles are comparable.
- 3) Lack of management and limited key stakeholder perspective. The focus on the perspectives of HCWs may undermine the robustness of the study. Nonetheless, clarification of decision-makers’ intentions of the booklet were obtained from the review of meeting minutes from previous Nutrition Directorate meetings.
- 4) The purposive sampling undertaken may be viewed as a limitation. However, the researchers do not consider this a limitation as the selected participants are those that have a day-to-day encounters with the RtHB and were best suited to provide insight.
- 5) Analysis and interpretation of qualitative data is regarded by some as subjective and open to researcher bias. To minimise this risk, the researchers undertook respondent validation

throughout the data collection phase through follow-up discussions to substantiate their interpretations.

6) Due to the diverse cultures within the Western Cape Province the findings of this study may not be generalizable. However due to the study design they study may be replicated from province to province with some slight modifications for more comparable contextual results. Consequently, caution should be taken in generalising too broadly.

Conclusion and Recommendations

It has been shown that there are barriers to effective HIS implementation at several different levels of the health system. This study identified multiple health systems factors that influenced the implementation of the RtHB. These include: challenges within the system design; lackadaisical administration; limited healthcare workforce; lack of technical support; dearth of amalgamation of information; and the values and attitudes of the HCWs. Our findings identified some important points for reflection and consideration regarding the strengthening of the RtHBs' implementation.

First, it is clear from the research that design is crucial to the level of utilisation of the RtHB. As our findings illustrate, the user-friendly and convenient design of the booklet positively influenced HCWs' attitudes towards the booklet. However, the inclusion of objectionable information negatively influenced HCWs' intention to use the booklet, particularly in some sections.

It is imperative to recognize that HCWs' utilization of the RtHB was mainly influenced by their perceptions towards and interpretations of the mothers' wants, knowledge and behaviours regarding the booklet. The perceived effortlessness and usefulness in the design

of the RtHB was found to affect attitudes towards the booklet - but was less influential on the intentions to use and actual use of the RtHB.

Second, HCWs had a largely positive attitude towards the booklet, acknowledging all its potential benefits despite the self-identified lack of training and knowledge. However to increase utilisation there needs to be mandatory initial, and regular ongoing refresher, training courses within facilities in the Khayelitsha sub-district. The training should include a policy detailing how information should be recorded and managed. This training could assist in improving understanding and appreciation of the information being recorded within the booklet, thus further increasing perceptions of effortlessness. It could also enhance data utilisation to reduce duplication of services.

Third, it is clear that the RtHB system was inserted into the health system with limited consideration of its impact on existing systems, and the implications for HCWs. The multiple overlapping parallel HIS and data entry systems overburden the HCWs, leaving them resistant to the potential benefits of the booklet. The resolution of this issue requires routine mapping of systems and data to assess whether or not the information being collected within the different health systems cannot be streamlined or simplified. This would assist in diminishing HCWs' workload and sub-optimal working conditions caused by increased workloads that are a direct result of the proliferation of data collection mechanisms. These concerns are particularly troubling in the context of severe shortages in human resources for health.

Fourth, South Africa is a LMIC that is rapidly modernising, particularly within its health system which is moving more towards computerisation of its HIS. This indicates that the

introduction of a new paper paper-based HIS may be questionable. However, as identified, HCWs appreciated the relevance of the RtHB as one of the only HIS in a heavily fragmented health system that informs and provides for interaction between HCWs and users. This indicates that the RtHB is an important innovation even in the rapidly modernising health system in the Western Cape Province. The HIS plays an important role in this shifting landscape by providing information on the services children receive in disparate parallel health systems, potentially reducing duplication of services, reducing HCW workloads, and allowing HCWs to focus on ensuring a positive patient-centred experience. Additionally, by being a tool that informs both the HCWs and the caregivers of the child's wellbeing, the RtHB in the context of the Western Cape Province is in the perfect position to play an integral role as an integrated cross-cutting HIS for the 'Healthcare 2030: The Road to Wellness' initiative.

Fifth, there is a need to improve the education of mothers and caregivers to encourage better appreciation of the role the booklet can play in the wellbeing of their children. Informing and empowering mothers may well lead to enhanced compliance. The inclusion of objectionable information, such as the HIV status of the mother and child, needs to be fully explained to mothers in order to reduce mothers' resistance to the inclusion of this information. Until mothers clearly understand why the information is being collected, the gaps in the implementation of the RtHB will persist.

Sixth, there is a need to promote the RtHB within the system to enhance visibility and acceptance – interventions such as the RtHB geared to specific population groups seem to be routinely introduced only to mothers and not in the system as a whole, which includes the community. If the RtHB utilisation is to be intensified, policy makers need to ensure broad

buy-in from the numerous players within the system with power to effect successful implementation. Failure to promote the RtHB to community-level health system actors will undermine its implementation and scale-up.

Lastly, we reiterate that the intentions to use the RtHB were influenced not by the HCW's perceptions of the RtHB, but by their perceptions of the mothers' wants, knowledge and behaviours. The perceived effortlessness and usefulness in the design of the RtHB was found to affect HCWs' attitudes towards the booklet but not their intentions to use or actual use of the RtHB.

It would be of interest to undertake three follow-up studies: 1) a larger study of the Western Cape Province to examine whether findings are similar in different contexts across the province. 2) A study of mothers' and caregivers' perceptions of the RtHB and their attitudes towards it, to verify whether HCWs' perceptions of the mother's attitudes and experiences are accurate, and quantify mothers' knowledge of the benefits of the RtHB. 3) Finally, a provincial study within the Western Cape measuring health outcomes against usage of the RtHB could provide further evidence on the effectiveness of the booklet to overall child health and wellbeing.

Overarching in child health, with the recent introduction of the National Health Insurance (NHI) and the re-engineering of primary health care (PHC) within the South African health system the RtHB can assume a lead role in assessing the effectiveness of both. Through the continuous monitoring of information collected in the booklet, such as number of visits and type of treatment given, an opportunity is offered to evaluate healthcare provision to ensure equity in health.

Abbreviations

ASR: age-standardised mortality rates; Comm/Mat/Peri/Nut: maternal, perinatal and nutritional conditions; DHIS: District Health Information System; DoH: Department of Health; EMR: electronic medical record; HCW: healthcare workers; HIS: health information systems; HIV: human immunodeficiency virus; LMICs: low-and middle-income countries; MOU: maternity and obstetric unit; MUAC: mid-upper arm circumference; PHC: primary health care; PHMR: patient-held medical record; PMTCT: prevention of mother-to-child transmission of HIV; RtHB: Road-to-Health Booklet; STI: sexual transmitted infection; TB: tuberculosis; UMICs: upper-middle-income countries; WBC: Well-baby Clinic; WCDoH: Western Cape Department of Health

Ethical approval and consent to participate

The study protocol was approved by the Human Research Ethics Committee, Health Sciences Faculty, University of Cape Town (approval number HREC/REF: 044/2015) and permission to undertake the research in public health care facilities was obtained from the Western Cape Provincial Health Research Committee (approval number WC_2015RP27_18).

Written consent was obtained from all participants. Participants were assured of the anonymity and confidentiality with respect to the dissemination of findings. All data were stored in password protected computer files.

Competing interests

The authors declare no competing interests.

Authors' contributions

NK conceived of the study, its design, data collection, analysis, interpretation of data and completed the manuscript.

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APPENDICES

Appendix 1: Concept Note Presented to Department of Health

1.0 Introduction

1.1 Background to Study

The Road to Health Booklet (RtHB) is a modification from the previously used card and educational materials provided to mothers. The refurbished RtHB has been an investment as a resource to improve the most problematic issue of record-keeping; too many documents to keep track off and record.

The RtHB provides a simple, cheap, practical and supposedly convenient method of monitoring child health. It is a record of immunization, vitamin supplementation and child growth rate that is given to the mother when their child is born. It is used to monitor the development of the child according to the milestones for a growing child and should be retained until the child is to attend Grade R between the ages of 5 and 6.

The Road to Health Booklet (RtHB) falls within the realms of [routine] health information systems (HIS), as it is a tool for collecting and managing data that can be used for several purposes at different levels of the health system; including healthcare delivery and health promotion. Through the RtHB the Integrated Nutrition Programme of the National Department of Health is able to establish need according to age, nutritional status, disease state and geographical areas for intervention. The information collected through the RtHB at provincial, district and municipal level can be fed into the national health information system to measure and monitor the health and nutritional status of the population; acting as a potential surveillance system and a means to monitor behavioural patterns.

The RtHB was introduced in the Western Cape in 2011. The Provincial DoH in the Western Cape is still concerned about the use of the Road to Health Booklet (RtHB) in Primary Care Clinics, particularly in the Khayelitsha area, and has requested assistance in understanding how health care providers in clinics are using the RtHB, and what the reasons are for suboptimal use of the booklet.

An initial RtHB implementation evaluation conducted by Stellenbosch University (dates) indicated that the use of the booklet is not optimal. The evaluation identified a variation from facility to facility in the use of the booklet. It is important to analyse the attitudes and behaviours of those expected to implement the RtHB and understand how they interpret the required use (its perceived usefulness and perceived ease of use) and importance of the booklet.

1.2 Research Question

What are the critical factors affecting the acceptance of the Road to Health Booklet (RtHB) among healthcare workers in the Cape Town Metropolis area? How do these factors affect the healthcare workers' acceptance of the RtHB?

1.3 Sub-questions

The study will aim to answer the following question:

- How do the beliefs and attitudes of healthcare workers in the Cape Town Metropolis area towards the Road to Health Booklet (RtHB) influence their behaviours with regards to its utilization?

- Do primary care healthcare workers have the same understanding of the importance of the information to be recorded in the Road to Health Booklet (RtHB) as policy makers?
- What role do nurses play in the acceptance of the Road to Health Booklet (RtHB) in the Cape Town Metropolis area?
- What factors are steering the variations in utilization of the Road to Health Booklet (RtHB) across facilities in the Cape Town Metropolis?

1.4 Purpose of Study

To explore the beliefs, attitudes and understandings of the use of information gathered in the Road to Health Booklet by the healthcare workers in the Cape Town Metropolis area and explain how those beliefs, attitudes and understandings influence the individual's utilization of the RtHB.

It will additionally, to investigate why primary healthcare workers are not following clinical guidelines and completing the RtHB by exploring the reasons they are not integrating the booklet into their recordkeeping routines. To explore the factors influencing the low uptake in the full implementation of the RtHB and explain how those factors have a bearing on healthcare workers' use of the RtHB.

With the aim to detail the linkages between culture, beliefs and understanding of the information flow process and how it influences acceptability of the booklet.

2.0 Research Methodology

2.1 Research Design

The design will be qualitative of an anthropologic discipline, an ethnographic study. Ethnography ‘is a methodology primarily derived from the discipline of anthropology...’ that investigations interrelationships, cultural dynamics, beliefs and interactions, with regards to history and progression of individuals.

2.2 Study Setting

The Cape Metropolis area will be the setting for this study, with a focus on facilities in the Khayelitsha Health District.

2.3 Population and Sampling

The will include stakeholders who have an active use of the Road to Health Booklet (RtHB), these include nurses and doctors.

2.4 Data Collection

2.4.1 Data Collection Tools

Due to this study falling under the umbrella of a qualitative study seeking out the exploration of beliefs, behaviours and understanding of individuals, that are complex and subjective. The data collection tools to be used for this study all fall within the realm of ethnographic research:

- Activity observation,
- In-depth semi-structured interviews (to obtain one-on-one in-depth perspective), and

2.5 Data Analysis

Will be through the ‘thematic analysis’, and will utilize the ‘constant comparative method’. This method allows for the continuous comparison of information sourced from the data collected. It also allows for the identification of recurring themes and organized data collected from the interviews. The data will be studied closely to identify similar ideas, concepts and themes and put into categories

2.6 Ethical Considerations

The ethical approval for this study will be obtained from the University of Cape Town’s Human Research Ethics Committee for the Faculty of Health Sciences, as well as the Department of Health, Western Cape Provincial Research Health Committee (PHRC).

Appendix 2: Interview Guide

Section A - Perceived usefulness (PU) will have a significant influence on attitude towards usage (ATU) of the RtHB

1. How do you think using the Road to Health Booklet (RtHB) will affect the effectiveness of your work?
2. Do you think using the RtHB increases/decreases your productivity? Why do you think this way?
3. Did you find using the RtHB useful and why?
4. Do you find the RtHB offers you freedom, flexibility and convenience during record-keeping? And why?
5. Would you recommend everybody to use the RtHB due to its usefulness and why?
6. Do you find the booklet useful for referring to a child's previous health status?

Section B – Perceived ease of use (PEOU) will have a significant influence on attitude towards usage (ATU) of the RtHB

1. How easy do you find the Road to Health Booklet (RtHB) to use?
2. Do you find learning to fill in the booklet easy?
3. Is your interaction with and understanding of the booklet clear (what are you supposed to do and how you are supposed to use it)?

Section C – Attitude towards usage (ATU) will have a significant influence on users' behavioural intention to use (BIU) the RtHB

1. How do you feel about using the Road to Health Booklet (RtHB)?
2. Do you feel it is a good idea to use the RtHB for your record keeping?

3. What do you like and/or enjoy about using the RtHB?
4. Why and what do you or do you not enjoy about using the RtHB?
5. What do you feel is your overall attitude towards the booklet? And why do you feel the way you do?

Section D – Intention to Use (sometimes referred to as ‘Acceptance’)

1. What would make you want to use the RtHB more than you use it, if you could?

Section E – Perceived Flow and Use of Information Obtained in the Road to Health Booklet (RtHB)

1. How do you see the movement of information obtained by the RtHB?
2. How and where do you think the information obtained in the RtHB is used?
3. Do you think all the information collected by the RtHB is useful? Why?
4. The PMTCT information collected in the RtHB is to ensure there is a record of the mother and child’s HIV status. How do you feel about that information being included in the booklet?

Appendix 3: Concept Webbing (Mind Mapping)

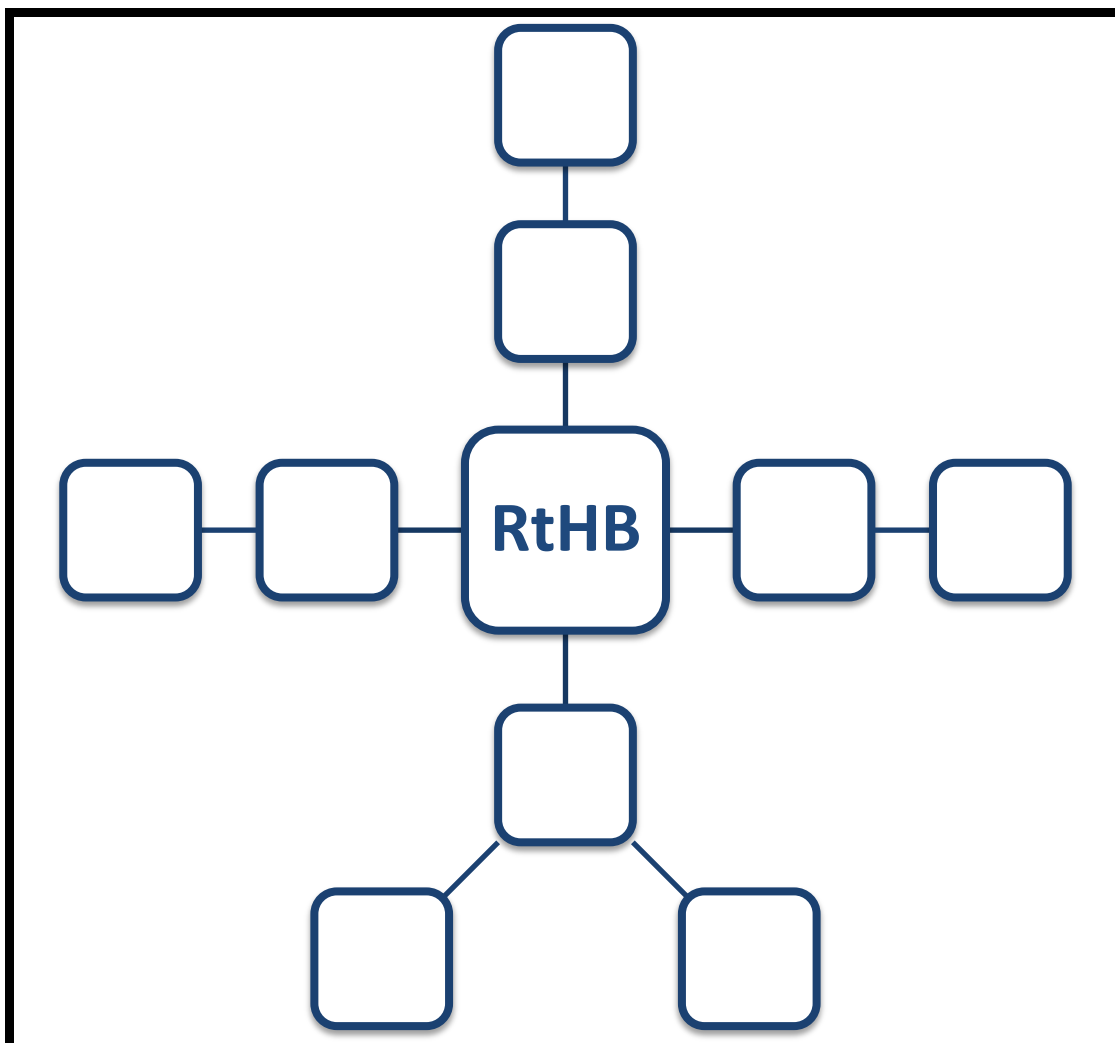
Facility:

Date:

Participant:

Please give details through a diagram of how you think the information capture inside the Road-to-Health Booklet (RtHB) is used after you have filled it in.

- You can add more details to the diagram below or may decide to draw a different diagram at the back of the page.



Appendix 4: Interview Information Sheet



School of Public Health and Family Medicine

Researcher: Nanziwe Khumalo

Principal Investigator and Supervisor: Dr Jill Olivier

Private Bag X3, Rondebosch, 7701, South Africa

Faculty of Health Sciences, Anzio Road, Observatory, 7925, South Africa

Tel: +27 (0) 78 537 4385

E-mail: nanzi.khumalo@gmail.com

Internet: www.publichealth.uct.ac.za

Title of Study: Attitude and Perceptions of Healthcare Workers in Health Facilities with Regards to the ‘Intention to Use’ of the Road to Health Booklet.

Researcher: Nanziwe Khumalo

Introduction: You have been invited to participate in the above stated study to be conducted by N. Khumalo from the University of Cape Town’s (UCT) School of Public Health.

***Please be advised that this study is undertaken in collaboration with the Western Cape Department of Health.**

What is the Purpose of the Study?

The purpose of this study is to have a deeper understanding of the attitudes and perceptions of healthcare workers towards the utilization of the Road to Health Booklet (RtHB) in the Khayelitsha and Eastern sub-structure in Cape Town.

Why you have been asked to participate:

You have been asked to participate in the study because as a healthcare worker and/or key stakeholder in the utilization of the RtHB. Your knowledge about and involvement in the use of the RtHB and performance of well-baby services is greatly valued.

The study would like understand how you see the uses and flow of information collected in the booklet, where you think the information goes and how important you think it is to the health system as a whole. The study would also like to find out how you feel about using the booklet, when you think it should be used and what influences you to use it the way you do is important to understanding how the Department of Health can improve the booklet for better use. ***There are no right or wrong answers, the interest is your feelings, thoughts and beliefs.**

Who are conducting the Study (the Researcher and the Principal Investigator)?

The research study is being conducted by a Master student from the University of Cape Town who is the Researcher (Nanziwe Khumalo) and the Principal Investigator is the person who is in charge of the research study (Dr Jill Olivier). The PI makes sure that everything is done properly by the researcher.

Where the interviews will take place:

The interviews will take place in the clinics meeting room because it will provide a quiet place where there will be no disturbance.

What are the Processes and Procedures during the Interviews?

During this study you will be asked to:-

- Take part in an in-depth interview which will take between 1 to 1.5 hours with the researcher asking you questions about how you feel about using the RtHB, how you think the information collected in it is used and your experiences using the booklet. All interviews will be audio recorded to ensure for accuracy, later to be transcribed. You may refuse to be recorded without any penalty and the researcher will take handwritten notes.

- Take part in a concept webbing (mind mapping) exercise during in-depth interview. The exercise will provide you with the opportunity to illustrate/visual display how you think information collected in the RtHB moves around and how it is used.
- Feedback session, in which the researcher will inform you about that study and you, will have the opportunity to clarify any questions you may have. It will aim to ensure the research has captured your experiences and views correctly. The feedback session will take approximately 15 to 20 minutes.

What are the Potential Risk and Confidentiality Issues of taking part in the Study?

Please be advised that some of the questions you will be asked within the study may make you feel slightly uncomfortable; as you think we will pass on responses to your superiors. However, you are under no obligation to answer any question that makes you uncomfortable. All your personal information will be kept anonymous for confidentiality purposes and not given to your manager or the Department of Health.

What are the Potential Benefits of taking part in the Study?

There are no identifiable immediate benefits to you from this study. However, the results may help key stakeholders better understand what influences healthcare workers use of the RtHB in order to amend or change the guidelines for usage. Additionally, as a healthcare worker you may gain a better understanding of the flow of information gathered in the RtHB and the role the booklet has in the continuation of provision of care.

What will happen to the results of the study?

Upon completion of the study and of the writing stage a feedback session of 15 to 20 minutes will be held with the participants of the study, it will provide an overview of the findings from the study. A copy of the report will be given to the Western Cape Department of Health Nutrition Directorate. Further write-up will be for an article publication tailored for the peer-reviewed journal of 'Health Policy and Planning'.

Who will see the information that has been collected in this Study?

Your information or that of other participants will not be given to anyone apart from the researcher and the Principal Investigator (and Supervisor) involved in conducting the study. All the electronic documents and recordings will be kept in files on a computer that are password protected and destroyed after 3 years. Interview sheets and documents will be kept in files that will be stored safely in a locked cupboard.

What will happen if you choose to withdraw your Participation?

Participation within this study is voluntary and you are under no obligation to participate. If you do participate you **CAN** withdraw from the study at any time without any consequences. Refusing to take part or withdrawing from the study will not affect current or future employment with the Department of Health, or the relationship with the health care facility. You are also within your right to refuse to answer any questions you may find uncomfortable to answer.

Do you have to agree to be contacted for clarification?

You may be asked to be contacted for clarification of some of your answers and you do not have to agree to this contact without any penalty.

Who to Contact if you have questions about the Study:

If at any time you feel you have any concerns and/or questions about the study, please free to contact the researcher:

Miss Nanziwe Khumalo nanzi.khumalo@gmail.com; **Mobile:** 07853 74385

Who to Contact if you have concerns about the Researcher:

For concerns about the researcher or the method in which the interviews have been conducted, please contact:

Principal Investigator and Supervisor: Dr Jill Olivier at: jill.olivier@uct.ac.za

Who to contact if you have questions about your ‘Right as a Research Participants’:

This research has been approved by the Human Research Ethics Committee of the Health Sciences Faculty, University of Cape Town, South Africa. If you have questions about this study and need independent and objective information, please contact the Ethics committee directly, on: **+27 (0)21 406 6338**.

Department of Health Approval

Additional approval has been received from the Western Cape Department of Health. For further information relating to the study, please contact **Charlene Roderick: +27 (0)21 483 6857** or **Email:** health.research@westerncape.gov.za

Appendix 5: Interview Informed Consent Form

Facility:

Date:

Participant:.....

Title of Study: Attitude and Perceptions of Healthcare Workers in Health Facilities with Regards to the ‘Intention to Use’ of the Road to Health Booklet.

Researcher: Nanziwe Khumalo

Declaration and Signature of Participant:

I have consented to participate in interview for the *‘Attitude and Perceptions of Healthcare Workers in Health Facilities with Regards to the ‘Intention to Use’ of the Road to Health Booklet’* study.

I have understood the information contained within the information sheet provided. I understand the reason for the research and what is required. I have had the opportunity to ask questions and choose to participate in this research study. I understand that I will not be disadvantaged if I decide not to participate and that my participation within this study is voluntary and I can at any time choose to withdraw my participation without any consequences.

I agree to be interviewed YES / NO

I agree to be recorded YES / NO

I agree to be contacted for clarification YES / NO

Name of Participant Participants' Signature Date

Researcher Researchers' Signature Date

Appendix 6: University of Cape Town Faculty of Health Sciences Human Research

Ethics Committee Approval



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room E52-24 Old Naïn Building
Groote Schuur Hospital
Observatory 7925

Telephone [021] 406 6492 • Facsimile [021] 406 6411

Email: Sumayah.ariefdien@uct.ac.za

Website: www.health.uct.ac.za/hrs/research/humanethics/forms

13 March 2015

HREC/REF: 044/2015

Dr J Olivier
Health Policy & Systems Division
Room 1:42 Level 1
Fairmouth building
FHS

Dear Dr Olivier

Project Title: ATTITUDES AND PERCEPTIONS OF HEALTHCARE WORKERS IN HEALTH FACILITIES WITH REGARDS TO THE 'INTENTION TO USE' OF THE ROAD TO HEALTH BOOKLET (RtHB) (Masters- candidate-Dr N Khumalo)

Thank you for your response letter dated 6 March 2015, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above mentioned study.

Approval is granted for one year until the 28 March 2016.

Please submit a progress form, using the standardised Annual Report Form, if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

We acknowledge that the following student:-Dr Nantziwe Khumalo is also involved in this project.

Please note that the on-going ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence.

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Hrec/ref:044/2015

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Hrec/ref:044/2015

Appendix 7: Western Cape Government Strategy & Health Support, Health Research



STRATEGY & HEALTH SUPPORT
 Health.Research@westerncape.gov.za
 Tel: +27 21 483 6857; fax: +27 21 483 5679
 311 Third, Beatrix-Koseki-Boulevard, Plettenbergstrand, Cape Town, 8001
www.westerncape.gov.za

REFERENCE: WC_2015RP27_18
 ENQUIRIES: Ms Charlene Roderick

University of Cape Town
 Anzio Road
 Observatory
 Cape Town
 7935

For attention: Dr Jill Olivier and Ms Nanzlwe Khumalo

Re: ATTITUDES AND PERCEPTIONS OF HEALTHCARE WORKERS IN HEALTH FACILITIES WITH REGARDS TO THE 'INTENTION TO USE' OF THE ROAD TO HEALTH BOOKLET (RTHB).

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research. Please contact the following people to assist you with any further enquiries in accessing the following sites:

Khayelitsha SITE B
 Michael Mapongwana CDC

D Binza
K Jacobs

Contact No: 021 366 1121
Contact No: 021 361 3353

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final report within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. The reference number above should be quoted in all future correspondence.

Yours sincerely

Signed by candidate

DR A HAWKRIDGE
DIRECTOR: HEALTH IMPACT ASSESSMENT
 DATE: 24/06/2015
 CC: G PEREZ

ACTING DIRECTOR: KHAYELITSHA/ EASTERN

Appendix 8: BMC Public Health Instructions for Authors

About *BMC Public Health*

This page includes information about the aims and scope of *BMC Public Health*, editorial policies, open access and article-processing charges, the peer review process and other information. For details of how to prepare and submit a manuscript through the online submission system, please see the instructions for authors.

Scope

BMC Public Health is an open access, peer-reviewed journal that considers articles on the epidemiology of disease and the understanding of all aspects of public health. The journal has a special focus on the social determinants of health, the environmental, behavioral, and occupational correlates of health and disease, and the impact of health policies, practices and interventions on the community. *BMC Public Health* is part of the BMC series which publishes subject-specific journals focused on the needs of individual research communities across all areas of biology and medicine. We offer an efficient, fair and friendly peer review service, and are committed to publishing all sound science, provided that there is some advance in knowledge presented by the work.

Instructions for authors

Research articles

Assistance with the process of manuscript preparation and submission is available from BioMed Central customer support team. See 'About this journal' for information about policies and the refereeing process. We also provide a collection of links to useful tools and resources for scientific authors on our page.

Criteria

Research articles should report on original primary research, but may report on systematic reviews of published research provided they adhere to the appropriate reporting guidelines which are detailed in our [Editorial Policies](#). Please note that non-commissioned pooled analyses of selected published research will not be considered.

Submission process

Manuscripts must be submitted by one of the authors of the manuscript, and should not be submitted by anyone on their behalf. The corresponding author takes responsibility for the article during submission and peer review.

Please note that *BMC Public Health* levies an article-processing charge on all accepted Research articles; if the corresponding author's institution is a BioMed Central member the cost of the article-processing charge may be covered by the membership (see About page for detail). Please note that the membership is only automatically recognised on submission if the corresponding author is based at the member institution. To facilitate rapid publication and to minimize administrative costs, *BMC Public Health* prefers online submission. Files can be submitted as a batch, or one by one. The submission process can be interrupted at any time; when users return to the site, they can carry on where they left off. See below for examples of word processor and graphics file formats that can be accepted for the main manuscript document by the online submission system. Additional files of any type, such as movies, animations, or original data files, can also be submitted as part of the manuscript.

During submission you will be asked to provide a cover letter. Use this to explain why your manuscript should be published in the journal, to elaborate on any issues relating to our editorial policies in the 'About *BMC Public Health*' page, and to declare any potential competing interests.

Assistance with the process of manuscript preparation and submission is available from BioMed Central customer support team. We also provide a collection of links to useful tools and resources for scientific authors on our Useful Tools page.

File formats

The following word processor file formats are acceptable for the main manuscript document: Microsoft word (DOC, DOCX), Rich text format (RTF), Portable document format (PDF), TeX/LaTeX (use BioMed Central's TeX template), DeVice Independent format (DVI)

TeX/LaTeX users: Please use BioMed Central's TeX template and BibTeX stylefile if you use TeX format. During the TeX submission process, please submit your TeX file as the main manuscript file and your bib/bbl file as a dependent file. Please also convert your TeX file into a PDF and submit this PDF as an additional file with the name 'Reference PDF'. This PDF will be used by internal staff as a reference point to check the layout of the article as the author intended. Please also note that all figures must be coded at the end of the TeX file and not inline.

If you have used another template for your manuscript, or if you do not wish to use BibTeX, then please submit your manuscript as a DVI file. We do not recommend converting to RTF. For all TeX submissions, all relevant editable source must be submitted during the submission process. Failing to submit these source files will cause unnecessary delays in the publication procedures.

Publishing Datasets

Through a special arrangement with [LabArchives](#), LLC, authors submitting manuscripts to BMC Public Health can obtain a [complimentary subscription to LabArchives](#) with an allotment of 100MB of storage. LabArchives is an Electronic Laboratory Notebook which will enable scientists to share and publish data files in situ; you can then link your paper to these data. Data files linked to published articles are assigned digital object identifiers (DOIs) and will remain available in perpetuity. Use of LabArchives or similar data publishing services does not replace preexisting data deposition requirements, such as for nucleic acid sequences, protein sequences and atomic coordinates.

Instructions on assigning DOIs to datasets, so they can be permanently linked to publications, can be found on the LabArchives website. Use of LabArchives' software has no influence on the editorial decision to accept or reject a manuscript. Authors linking datasets to their publications should include an [Availability of supporting data](#) section in their manuscript and cite the dataset in their reference list.

Preparing main manuscript text

General guidelines of the journal's style and language are given [below](#).

Overview of manuscript sections for Research articles

Manuscripts for Research articles submitted to *BMC Public Health* should be divided into the following sections (in this order): Title page, Abstract, Keywords, Background, Methods, Results and discussion, Conclusions, List of abbreviations used (if any), Competing interests, Authors' contributions, Authors' information, Acknowledgements, Endnotes, References, Illustrations and figures (if any), Tables and captions, Preparing additional files

The **Accession Numbers** of any nucleic acid sequences, protein sequences or atomic coordinates cited in the manuscript should be provided, in square brackets and include the corresponding database name; for example, [EMBL:AB026295, EMBL:AC137000, DDBJ:AE000812, GenBank:U49845, PDB:1BFM, Swiss-Prot:Q96KQ7, PIR:S66116].

The databases for which we can provide direct links are: EMBL Nucleotide Sequence Database ([EMBL](#)), DNA Data Bank of Japan ([DDBJ](#)), GenBank at the NCBI ([GenBank](#)), Protein Data Bank ([PDB](#)), Protein Information Resource ([PIR](#)) and the Swiss-Prot Protein Database ([Swiss-Prot](#)). For reporting standards please see the information in the [About](#) section.

Title page

The title page should: provide the title of the article, list the full names, institutional addresses and email addresses for all authors, indicate the corresponding author

Please note: the title should include the study design, for example "A versus B in the treatment of C: a randomized controlled trial X is a risk factor for Y: a case control study"

Abbreviations within the title should be avoided

If a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the "acknowledgements" section in accordance with the instructions below. Please note that the individual names may not be included in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Abstract

The Abstract of the manuscript should not exceed 350 words and must be structured into separate sections: **Background**, the context and purpose of the study; **Methods**, how the study was performed and statistical tests used; **Results**, the main findings; **Conclusions**, brief summary and potential implications. Please minimize the use of abbreviations and do not cite references in the abstract. **Trial registration**, if your research article reports the results of a controlled health care intervention, please list your trial registry, along with the unique identifying number (e.g. **Trial registration**: Current Controlled Trials ISRCTN73824458). Please note that there should be no space between the letters and numbers of your trial registration number. We recommend manuscripts that report randomized controlled trials follow the [CONSORT extension for abstracts](#).

Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should be written in a way that is accessible to researchers without specialist knowledge in that area and must clearly state - and, if helpful, illustrate - the background to the research and its aims. Reports of clinical research should, where appropriate, include a summary of a search of the literature to indicate why this study was necessary and what it aimed to contribute to the field. The section should end with a brief statement of what is being reported in the article.

Methods

The methods section should include the design of the study, the setting, the type of participants or materials involved, a clear description of all interventions and comparisons, and the type of analysis used, including a power calculation if appropriate. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses in the Methods section.

For studies involving human participants a statement detailing ethical approval and consent should be included in the methods section. For further details of the journal's editorial policies and ethical guidelines see 'About this journal'. For further details of the journal's data-release policy, see the policy section in 'About this journal'.

Results and discussion

The Results and discussion may be combined into a single section or presented separately. Results of statistical analysis should include, where appropriate, relative and absolute risks or risk reductions, and confidence intervals. The Results and discussion sections may also be broken into subsections with short, informative headings.

Conclusions

This should state clearly the main conclusions of the research and give a clear explanation of their importance and relevance. Summary illustrations may be included.

List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations can be provided, which should precede the competing interests and authors' contributions.

Competing interests

A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organizations. Authors must disclose any financial competing interests; they should also reveal any non-financial competing interests that may cause them embarrassment were they to become public after the publication of the manuscript. Authors are required to complete a declaration of competing interests. All competing interests that are declared will be listed at the end of published articles. Where an author gives no competing interests, the listing will read 'The author(s) declare that they have no competing interests'. When completing your declaration, please consider the following questions:

Financial competing interests

In the past three years have you received reimbursements, fees, funding, or salary from an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? Is such an organization financing this manuscript (including the article-processing charge)? If so, please specify.

Do you hold any stocks or shares in an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? If so, please specify.

Do you hold or are you currently applying for any patents relating to the content of the manuscript? Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript? If so, please specify.

Do you have any other financial competing interests? If so, please specify.

Non-financial competing interests

Are there any non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript? If so, please specify.

If you are unsure as to whether you, or one your co-authors, has a competing interest please discuss it with the editorial office.

Authors' contributions

In order to give appropriate credit to each author of a paper, the individual contributions of authors to the manuscript should be specified in this section.

According to [ICMJE guidelines](#), An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; 3) have given final approval of the version to be published; and 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

We suggest the following kind of format (please use initials to refer to each author's contribution): AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

All contributors who do not meet the criteria for authorship should be listed in an acknowledgements section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, a department chair who provided only general support, or those who contributed as part of a large collaboration group.

Authors' information

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

Acknowledgements

Please acknowledge anyone who contributed towards the article by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include the source(s) of funding for each author, and for the manuscript preparation. Authors must describe the role of the funding body, if any, in design, in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication. Please also acknowledge anyone who contributed materials essential for the study. If a language editor has made significant revision of the manuscript, we recommend that you acknowledge the editor by name, where possible.

The role of a scientific (medical) writer must be included in the acknowledgements section, including their source(s) of funding. We suggest wording such as 'We thank Jane Doe who provided medical writing services on behalf of XYZ Pharmaceuticals Ltd.'

If you would like the names of the individual members of a collaboration Group to be searchable through their individual PubMed records, please ensure that the title of the collaboration Group is included on the title page and in the submission system and also include collaborating author names as the last paragraph of the “acknowledgements” section. Please add authors in the format First Name, Middle initial(s) (optional), Last Name. You can add institution or country information for each author if you wish, but this should be consistent across all authors. Please note that individual names may not be present in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information. Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.

Endnotes

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

References

All references, including URLs, must be numbered consecutively, in square brackets, in the order in which they are cited in the text, followed by any in tables or legends. Each reference must have an individual reference number. Please avoid excessive referencing. If automatic numbering systems are used, the reference numbers must be finalized and the bibliography must be fully formatted before submission.

Only articles, clinical trial registration records and abstracts that have been published or are in press, or are available through public e-print/preprint servers, may be cited; unpublished abstracts, unpublished data and personal communications should not be included in the reference list, but may be included in the text and referred to as "unpublished observations" or "personal communications" giving the names of the involved researchers. Obtaining permission to quote personal communications and unpublished data from the cited colleagues is the responsibility of the author. Footnotes are not allowed, but endnotes are permitted. Journal abbreviations follow Index Medicus/MEDLINE. Citations in the reference list should include all named authors, up to the first six before adding 'et al.'

Any *in press* articles cited within the references and necessary for the reviewers' assessment of the manuscript should be made available if requested by the editorial office.

An Endnote style file is [available](#).

Examples of the *BMC Public Health* reference style are shown [below](#). Please ensure that the reference style is followed precisely; if the references are not in the correct style they may have to be retyped and carefully proofread.

All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the manuscript. They should be provided in full, including both the title of the site and the URL, as well as the date the site was accessed, in the following format: The Mouse Tumor Biology Database. <http://tumor.informatics.jax.org/mtbwi/index.do>. Accessed 20 May 2013. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

Authors may wish to make use of reference management software to ensure that reference lists are correctly formatted. An example of such software is [Papers](#), which is part of Springer Science+Business Media.

Examples of the *BMC Public Health* reference style*Article within a journal*

Smith JJ. The world of science. *Am J Sci*. 1999;36:234-5.

Article within a journal (no page numbers)

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. *BMC Medicine*. 2013;11:63.

Article within a journal by DOI

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. *Dig J Mol Med*. 2000; doi:10.1007/s801090000086.

Article within a journal supplement

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. *Blood* 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. *International review of cytology*. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. *Top Curr Chem*. 2007. doi:10.1007/128_2006_108.

Complete book, authored

Blenkinsopp A, Paxton P. *Symptoms in the pharmacy: a guide to the management of common illness*. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: *The dictionary of substances and their effects*. Royal Society of Chemistry. 1999. [http://www.rsc.org/dose/title of subordinate document](http://www.rsc.org/dose/title%20of%20subordinate%20document). Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. *US Pharmacopeia*, Rockville. 1998. <http://www.healthwise.org>. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. <http://www.privatehomepage.com>. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. <http://www.uni-heidelberg.de/mydata.html> (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. <ftp://ftp.isi.edu/in-notes/rfc2169.txt> (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. <http://www.issn.org> (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (*Sorghum bicolor*). *GigaScience Database*. 2011. <http://dx.doi.org/10.5524/100012>.

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