1 TITLE PAGE

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3 **A model to facilitate research uptake in health care practice and policy development for low-**
4 **resource countries**

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ABSTRACT

BACKGROUND: Despite the availability of numerous models for knowledge translation into health care practice and policy development, research uptake remains low in resource-limited countries. Recent reports have indicated that this trend of low research uptake is likely to continue for some time in low-resource countries unless initiatives to promote research uptake strategies consider challenges faced by these countries. This paper aimed to develop a tailored model to enable the optimal uptake of public health research findings for health care practice and policy development in a low-resource country.

APPROACH: The study used a two-phase exploratory sequential approach. Qualitative data were collected through semi-structured interviews with 21 participants. Quantitative data were collected through an online cross-sectional survey administered to 212 respondents who conducted research studies in the study area between 2014 to 2019.

HIGHLIGHTS: The findings indicated a lack of awareness of research results and champions to lead engagements among research stakeholders. Researchers also fail to align public health research projects to existing local contexts and available resources as well as establish and sustain beneficial collaboration between all research stakeholders. The survey indicated a total of 13 factors needed for research uptake, namely four individual factors (support, experience, motivation & time factor); four organisational factors (research agenda, funding, resources & partnerships), and five research characteristics factors (gatekeeping, local research committees, accessibility of evidence, quality of evidence and critical appraisal skills). The Spearman's correlation coefficient revealed that of the 13 factors, only six factors had a significant positive correlation with research uptake, namely: support, experience, motivation, time factor, resources, and critical appraisal skills.

CONCLUSION: In the context of research uptake for healthcare practice and policy development, we consider this model unique and appropriate for low-resource countries in that it integrated the PARIHS framework with the logical framework to streamline the research uptake process.

KEYWORDS: Healthcare Policy, Healthcare Practice, Low-resource countries, Research Uptake, Model

BACKGROUND

For a considerable period, private funders, governments and individual researchers have been funding research projects to produce a foundation of health-related knowledge for healthcare practice and policy development. Yet, the gap between research produced and research uptake is increasingly being recognised as a challenge by scholars in the conversation around health policy formation [1]. The situation is worse in low-resource countries where enormous time-lags between discovery and integration in practice and policy development is affected by a shortage of resources and competing priorities [2]. Scholars have indicated that the trend is likely to continue for some time in low-resource countries unless initiatives to promote research uptake strategies consider challenges faced by these countries [3].

Relationships between health researchers and end-users have varied. In some instances, limited engagements have negatively affected health research uptake for practice and policy development [4]. Generally, researchers produce research evidence that requires end-users such as policymakers and health practitioners to have analytical skills and clinical knowledge necessary to adopt and implement the research evidence. In this instance, end-users become involved in the research project's tail-end when findings are ready for dissemination through presentations or publication in academic journals. Ultimately, it renders the process of knowledge translation into practice and policy development as an uncoordinated activity between knowledge producers and knowledge users rather than a holistic process [5].

The concept of 'research uptake' is intended to close the gap by affording end-users and relevant stakeholders an opportunity to be immersed in shaping the research project in one way or another, so they know about the existing research project [6]. Grobbelaar defines 'research uptake' as a process by which knowledge generated through research enters the domain of audiences such as practitioners, scholars, end-users, policymakers in government and other agencies [7]. Accordingly, research uptake starts from the inception of a research project. The Development Research Uptake in Sub-Saharan Africa emphasised that research uptake is a comprehensive process that focuses on the entire research cycle, from the proposal right through to practice and policy development [8]. This process is significant for all stakeholders as they become aware and can shape the project from the onset, stimulating interest in the research project [6,7,8].

The successful implementation of research uptake is a joint effort. It requires a mirrored identification and selection of appropriate stakeholders from the onset of a research project to stimulate ownership and understanding among stakeholders. Uprety indicates that when research uptake is embedded

within relevant programmes, the probability of research outcomes being considered for its intended audience becomes high [9]. According to the United Kingdom's Department for International Development, there are varied healthcare research stakeholders and include anyone with the potential or an interest in health research [10]. Importantly, Reed et al. recently argued that a health research stakeholder has a possible two-way interaction of influence, either influencing or influenced by organisational actions, decisions, policies, practices, or goals [11]. A further important part is that engaging stakeholders begins with mapping who are the relevant stakeholders [12]. Essentially, engagements and communications with relevant stakeholders are integral in realising health research's impact [13]. The mapping process is facilitated by determining each stakeholder's potential interest and the nature and extent of the required engagement to facilitate research uptake [14].

MODELS AND FRAMEWORKS ASSOCIATED WITH RESEARCH UPTAKE

Increasing demands for accountability from research stakeholders have placed pressure on researchers to provide information systematically, timely, and thoroughly to funders and end-users [15]. To comply with the demands for accountability, various theories, frameworks and models have been developed in a quest to describe the process of implementing research findings for healthcare practice and policy development [16]. The table below depicts a fraction of prominent models and frameworks associated with research uptake. Most of these frameworks/models have been used in high-income countries to determine the impact of health research, accountability (value for money), advocacy (increase awareness), and the learning purposes for identifying opportunities, challenges, and successes emanating research performed in an institution.

Table 1

Most of these developed frameworks were tailored to the context of respective countries of origin, which were mainly high-income countries. There is a common assertion from scholars that public health research uptake depends on considering several local barriers and applying tailored research uptake strategies to overcome those barriers [28]. While there seems to be an agreement on developing tailored strategies for research uptake, traditionally, very little is done actively to promote research uptake. Hence, the researchers in this study developed a tailored model for research uptake, which is easy to understand and practical to solve real-life problems. The novelty of the research uptake model discussed in this paper promotes accountability by all research stakeholders. The local research committee plays a central role in availing essential strategies to enable research uptake in low-resource countries.

THEORETICAL FRAMEWORK

The Promoting Action on Research Implementation in Health Services (PARIHS) framework, advanced by Rycroft-Malone, guides the study's overall conduct [29]. The PARIHS framework was developed and tested in international arena research within the nursing fraternity to signify the complexities of undertaking research uptake [30]. The study could not wholesomely adopt the PARIHS framework guiding statements; instead, statements were amended for the framework to suit the local context. The PARIHS framework views successful research uptake as a function of the relationships between three domains: evidence, context, and facilitation. In other words, for research uptake to succeed, there should be clarity about the strength of evidence used, the environment (context) in which research will be used, and the method required for facilitating research uptake [31]. The PARIHS framework for determining research uptake factors was integrated with the logical framework to offer a more practical approach towards improving research uptake [32].

RESEARCH DESIGN AND METHODS

The study followed a mixed-methods design with an exploratory sequential approach to develop a model for the uptake of research for healthcare practice and policy development [33]. Inductive reasoning was used during phase one of the study, followed by deductive reasoning during phase two. Phase three of this study mainly focused on abductive reasoning to develop a model for the uptake of research. This blending of data types yields greater validity of research results using the richness and breadth of qualitative findings, coupled with quantitative data precision, to comprehensively understand the studied phenomenon [34].

Study setting

The study was conducted in Mpumalanga Province, located in the north-eastern part of South Africa, sharing borders with Mozambique to the east and Eswatini to the south-east. The province shares common borders with Limpopo Province to the north, Gauteng Province to the west, Free State Province to the south-west and Kwa-Zulu Natal to the south-east. It has a population size of just over 4.6 million people, representing 7.8% of the total country's population [35]. Due to the international borders and health challenges associated with people's migration across borders [36], the province is an ideal research hub for several research organisations. Public health research in Mpumalanga Province is carried out in all three districts, namely Gert Sibande, Nkangala, and Ehlanzeni District Municipalities, which share 23 district hospitals, five tuberculosis specialised hospitals, three regional

hospitals, two tertiary hospitals, and 279 primary healthcare facilities. These facilities service just over 90% of the Mpumalanga Province population [37].

Population and Sampling

According to data from internal records (research files) of our province, 399 public health research studies were conducted from 2014 to 2019. This translates to an equivalent of 67 public health research studies conducted per annum. Postgraduate students conducted research studies for academic purposes, research institutions for academic or non-academic reasons, and in-house research, mainly for quality improvement plans. We, therefore, used 399 primary investigators who conducted public health research studies as the primary sources of data for both the qualitative and quantitative phases of this study. Initially, participants were not categorised as researchers, frontline workers, programme managers, senior managers or directors at higher education institutions, but participants were allowed to categorise themselves into any group. For this first cohort, non-probability purposive sampling was used [38]. In phase two of this study, no sampling procedures were used, as the total target population was studied.

Data Collection Methods

This study was conducted through a phased approach.

Phase one: Qualitative Phase

The first phase of this study involved a qualitative approach intended to explore and describe key stakeholders' perceptions of research uptake in healthcare practice and policy development from an insider's perspective [39]. The findings contributed to the development of an online questionnaire for phase two of this study.

Data Generation

Semi-structured interviews were used, organised around an interview guide to generating data for this phase [40]. With permission from participants, we audio-recorded the interviews to be transcribed later in preparation for data interpretations. Participants who were interviewed included frontline workers (7), researchers (6), programme managers (4), senior managers or directors at higher education institutions (4) who are knowledgeable and experienced about the focus of the study. A total of 21 interviews were conducted to gather information from as many perspectives on the uptake of research findings in healthcare practice and policy development. A journal was used for taking detailed field

notes during the interviews [41]. Although each interview lasted for about 42 minutes, the overall time spent with the interviewee was approximately 90 minutes.

Data Analysis

Interviews were transcribed verbatim in preparation for data analysis and interpretation. Transcripts were read repeatedly to develop a final edited set of transcripts ready for analysis. All transcripts in Word format were uploaded onto the Atlas. Ti 7.5.18 software program for further analysis. The data analysis process followed guided thematic analysis proposed by [42]. To enhance the analysis' credibility, two coders independently reviewed the data. Transcripts were carefully read to develop a general understanding of the data. Ideas that came to mind were recorded by writing short memos. A qualitative codebook contained statements of the codes for the database. After completing the data analysis, a meeting was held with the independent coder to finalise the findings. In addition to using an audio recorder, a paper trail (reflective journal) was kept to track all the study's steps and processes to ensure confirmability.

Phase two: Quantitative Phase

The qualitative phase findings were quantitatively tested in a structured online questionnaire including all stakeholder groups (i.e. researchers, programme managers, frontline workers and senior managers or directors).

Data Collection

After establishing the total number of research studies that were conducted within the sampled period (from the year 2014 to 2019), an online email Likert Scale (5 scales) survey questionnaire [43] was sent to all identified stakeholders who conducted research in our province to assess whether research uptake relates to healthcare practice and policy development.

Initially, a questionnaire was sent to five respondents for piloting purposes. These responses did not form part of the study but were only used for testing purposes. Inputs from the five respondents were used to modify or improve the instruments' content before being used in the main study. A statistician was consulted for input, which further assisted in refining the data collection instruments. The pilot study's responses were also exposed to a reliability test using 'Cronbach's alpha coefficient [44]. The overall 'Cronbach's alpha for four primary constructs (Research uptake [questions B2-B6], individual factors [questions C1-C21], organisational factors [questions D1-D20], and research characteristics

[questions E1-E20]) representing 66 items was 0.706, illustrating that the questionnaire was reliable. Scholars have proposed a Cronbach's alpha value of 0.5 or more significant in assessing an instrument's internal consistency [45].

Data Analysis

Data gathered from research records were collected using REDCap Survey (web-based secure application). SAS Version 15 and Microsoft Excel were used to analyse data with a statistician's assistance.

STUDY OUTCOMES

Main Qualitative Findings

Biographical information of participants

Table 2 indicates four programme managers, four directors of various institutions (three from academic institutions and one from a private healthcare institution), six researchers, and seven frontline staff members who participated in the semi-structured interviews. Most participants (57%) were females. Three participants were aged 25-34 years (14%), five aged 35-44 years (24%), six were aged 45-54 years (29%), and seven were aged 55-64 years (33%), with a mean age of 47.6. In total, participants had a mean of 19.4 years of work experience.

Table 2

Overview of the themes

The analyses indicated six main themes attributed to research uptake for healthcare practice and policy development.

1. Understanding of the concept: Research uptake

A repeated and persistent theme was that research uptake is vital in ensuring that health research findings find their way into healthcare practice and policy development; otherwise, there is no point in conducting research. Participants emphasised research uptake as a process requiring adequate

involvement of all relevant stakeholders for the duration of the research project, and two cases are used to illustrate this:

'Research uptake, I think it's these activities that contribute to the use of research in practice and that also will influence policy or decision making to those people that are supposed to make a decision for the department.' (Participant 4)

'What is vital is that, from very, very early on, we [short pause affirming that it is currently not happening] researchers should be talking and engaging with people in the services, at different levels: provincial, district, national.' (Participant 7)

2. Research use for decision-making

A fair requirement for considering research evidence was good quality research, conforming to rigorous, acceptable standards of scientific investigation as indicated by participants. Participant 10 described adequate and quality research concerning his daily routine practice.

'So, in my environment, we are recipients of outputs of research and that informs what we do, from time to time. Even the strategies that we utilise in doing them, they are usually based on research.' (Participant 10)

Another persistent theme was that for research uptake to occur, the quality of research findings ought to be acceptable to research users. In this regard, a participant said the following:

'So, if you have reliable data, then you can actually focus on the real problem areas.' (Participant 12)

Some participants acknowledged a growing trend of using raw administrative/clinical data (*informal research*) for decision-making. It appeared that the driving force behind using *informal research* was often the need to make quick decisions.

'Our environment is very, very fast-paced, so we do not always have the luxury of waiting to conduct full structured formal research before we take decisions. We can just identify a problem...we go through the steps of a typical research but it's a very quick process where we identify a problem and we say which method will be used to understand what is the problem.' (Participant 10)

3. Role of government

Most participants indicated that the government is lagging in promoting research uptake as they seemed not to be research or academically oriented. This results in research not adequately prioritised and selective in picking which areas of health conditions must be prioritised.

'[Looking distressed about lack of research uptake] ...we also feedback to district management and...provincial management ...to district management and to the facilities, like the hospital management, they were not very receptive.' (Participant 13)

Participant 21 indicated an existing and continuing culture of insufficiently prioritising research within various government departments.

'...as a department, I will be talking as a department, we don't take research seriously, to be honest. We don't take research as one of the key aspect(s) in the department.' (Participant 21)

4. Research uptake stakeholders

Unlike part-time researchers, there are those whose core function is research. These are students at universities who research the duration of their master's degrees or PhD, and international researchers affiliated with independent research units who arrive for a specified period to conduct research. One of the challenges experienced with these researchers was that their primary focus was on getting their studies published.

'When the research ends and I want information to go back to the community, it's so hard to get because they're out the field now. They don't really care about us,... about the community here. They care about their peer-reviewed papers. So, while they're busy writing peer-review papers, they're not thinking about what ... this mean(s) for South Africa, ... the South Africans.' (Participant 5)

The need for researchers, research units and funders to give back to the province and assist with local up-skilling and capacitating was deemed imperative for research uptake.

'I would like to see our young scientists being up-skilled and doing research that's relevant for us without people coming in from outside doing the research and taking what they want back out. I feel very strongly about that. I feel that it's fine to have people coming in to up-skill and allow our

younger generation to be the future, not people coming in and going out and not capacitating locally.' (Participant 6)

5. Dissemination of research findings

Participants indicated insufficient dissemination of relevant information and results regarding research projects within the local settings.

'So, is it the understanding of clinicians on the ground that this research is going to benefit their practice? And that comes to really how does it get communicated back?' (Participant 3)

This was further identified as an essential research uptake gap that needs to be addressed.

'...most of the time research gets conducted, a lot of research gets conducted, and you don't get to know the results, the recommendations, and how that can inform policy. So, it's a gap to me.' (Participant 19)

6. The local research committee

On a critical note, most participants mentioned the local research committee's need to develop health research priorities and agenda. Once developed, research conducted in the province should be aligned with research priorities, which, as noted by participants, does not always occur in practice. The following narratives by the participants were some of the envisioned roles for the health research committee:

'Then you could use your committee to read those, decide what are important for uptake, and channel those up to decision makers at the right level in the province where you really hope that there will be uptake at the right policy level. That's what I think how you could use your committee and that could be really effective.' (Participant 17)

There was also confusion and frustration expressed on who to contact within the department.

'They need to be more visible. And we have to understand mostly the roles of that committee. I think perhaps there is a gap there in terms of their roles and functions.' (Participant 2)

Main Quantitative Research Results

The statistical analysis of research uptake factors that emerged from the interviews is presented.

Biographical information of respondents

In Table 3, the age group composition for this study is illustrated. Of the total 212 respondents, 55 (26%) were aged between 35-44 years, followed by 25-34 years, which contributed 54 (26%) respondents. It could thus be noted that those with ages 25-34 years, 35-44 years and 45-54 years represented approximately 77% of the sample size.

Table 3

Both the median and the mode scores were 3, representing the age group 35-44 years. The mean age for respondents was 43.7, ± 0.7 standard deviation, which indicates a heterogeneous sample regarding age. Overall, the 'respondents' age groups suggest that they were reasonably experienced to provide insight into research uptake factors. Qualifications obtained by respondents were of particular importance for this study. As reflected in Table 3, about 12% of the respondents had an undergraduate qualification degree or equivalent. This leaves approximately 88% of the respondents with a postgraduate qualification, of whom 13 (6%) had an honours degree, and 92 (44%) had a master's degree. Respondents with a doctorate and above contributed 38% of the study population.

Respondents were asked to indicate their employment sector during the completion of the questionnaire. The researcher could thereby attempt to establish the pattern that mainly contributed to health research in the province, which was also significant for this study. The majority of the 212 respondents who conducted research were from institutions of higher learning (universities and colleges for obtaining a degree or diploma), contributing approximately 36.0%, while 35% were working at government institutions. The remaining participants either worked for the public sector (16%), were full-time students (6%), or other (7%). Cross-tabulating, the employment sector with work experience revealed that the most experienced respondents had ten years or more work experience and contributed 39% of the sample size.

In comparison, the least experienced had between zero to two years' work experience, contributed only 2% of the sample size. Cumulatively, respondents who had five years and above contributed approximately 72% of the sample size. The result revealed that those with ten or more years' work

experience were four times more likely to contribute to health research than those with zero to two years, three times more likely than those with two to five years' work experience, and just above one times more likely to contribute to health research than those with between five to ten years' work experience. From Table 3, it is evident that researchers accounted for 37% of the respondents, with senior managers and frontline workers accounting for 23% and 22%, respectively, of the sample size. Policy/programme managers only contributed 18% of the sample size for this study. Approximately 62% of frontline workers who participated in this survey were from government institutions. A total of 39% of programme managers who participated in this study were from government institutions, while a further 39% were programme managers at higher education institutions. Senior managers who participated in this study included 42% of directors from institutions of higher learning and 33% of directors from government institutions. Private institutions contributed 23% of the senior managers of the sample size.

Factors Affecting Research Uptake

Considering this research area is new in the current setting, the items were tested using Exploratory Factor Analysis (EFA) to measure the items' internal consistency and determine the number of factors and items for each construct. EFA is a technique that statistically explores the underlying factors of a variable through factor rotation based on factor loading values so that researchers assume that some indicators may be related to several factors [46]. EFA was conducted in this study and employed principal component analysis (PCA) as the factor extraction method and a Varimax rotation as the rotation method.

The EFA indicated a total of 13 components from the survey responses which were categorised as individual factors (support, experience, motivation & time factor), organisational factors (local research agenda, funding, resources & partnerships), and research characteristic factors (gatekeeping process, local research committee, accessibility of evidence, quality of evidence & critical appraisal skills). Figure 1 indicates the average mean on research uptake factors per classification. A mean average of 3.00 showed that respondents were neither agreeing nor disagreeing with the listed items of factors affecting research uptake. In contrast, a mean average of 1.00 indicated a strong disagreement and 5.00 strong agreement with detailed items

Figure 1

In comparison with the other groups of respondents, researchers had higher mean average values on the variables 'time factor' (mean= 3.69), 'support' (mean= 3.55), 'resources' (mean= 3.72), 'research

agenda' (mean= 2.94), 'partnerships' (mean= 2.93), and 'critical appraisal skills' (mean= 4.10). Whereas, senior managers/directors had higher mean average scores on the variables: 'experience' (mean= 4.41), 'motivation' (mean= 4.54), 'private funders' (mean= 2.93), and the 'quality of research evidence' (mean= 3.48) compared to the other groups of respondents.

Figure 2 illustrates the average overall mean for research uptake factors against respondents' employment sector, namely government employee, private or non-governmental research institution, universities or institutions of higher learning, student at academic institution, and other or unemployed.

Figure 2

The results show similar patterns regarding the overall mean averages among respondents as per the employment sector. However, the mean averages for government employees were lower on a number of variables than for respondents from other employment sectors. Evidently from the figure above, low average mean scores for government employees were observed in almost all variables except on 'critical appraisal skills', 'gatekeeping processes' and 'research committees' in comparison with the other employment sectors. Variables 'time factor' (mean score = 2.68), 'support' (mean score = 2.32), and 'resources' (mean score = 2.4) were the most predominant outliers with low mean average scores for government employees.

Spearman's Correlation

A correlation was conducted to examine a relationship between research uptake and various potential predictors [47].

1. Individual factors

The results indicated that there was a significant positive association between research uptake and research experience ($r_s[212] = 0.421$, $p < 0.01$), and research uptake and motivation ($r_s[212] = 0.398$, $p < 0.01$). These suggest a moderate concurrence between research uptake and the two variables (experience and motivation). However, there was a significant positive association between research uptake and time factor ($r_s[212] = 0.283$, $p < 0.01$), and research uptake and support ($r_s[212] = 0.260$, $p < 0.01$). The results suggest a weak concurrence between research uptake and the two variables (time factor and support).

2. Organisational factors

Results of the Spearman correlation indicated that there was a non-significant weak positive association between research uptake and organisational factors of ($r_s[212] = 0.172$, $p < 0.05$) for resources, ($r_s[212] = 0.079$, $p < 0.01$) for local research agenda, ($r_s[212] = 0.088$, $p < 0.01$) for partnerships, and very weak positive association of ($r_s[212] = 0.007$, $p < 0.01$) for funding. However, there was a significantly strong positive correlation of ($r_s[212] = 0.565$, $p < 0.01$) between partnerships and local research agenda.

3. Research characteristics

Furthermore, the results of the Spearman correlation indicated that there was a significant weak positive association between research uptake and critical appraisal skills of ($r_s[212] = 0.203$, $p < 0.01$). There was a non-significant weak positive association between research uptake and the other research characteristic factors. However, there seems to be a significant moderate association between critical appraisal skills and quality of evidence ($r_s[212] = 0.340$, $p < 0.01$), and between accessibility of evidence and quality of evidence ($r_s[212] = 0.403$, $p < 0.01$).

DESIGNING THE RESEARCH UPTAKE MODEL

As an exploratory study seeking to understand factors associated with research uptake for healthcare practice and policy development, the researchers adopted the logical framework to develop a research uptake model with the hope of improving the uptake of research findings to practice and policy. In terms of utilisation of the logical framework, an important consideration is that logical framework is a bottom-up approach that begins by observing views from the target group on the assessment of the phenomenon investigated and their needs [48]. The approach enabled the development of a user-friendly tailored model which is practical to apply despite limited resources. This incorporated the establishment of specific long-term outcomes as it is necessary when applying a logical framework [49].

Research uptake model structure

Based on the findings of the two phases (qualitative and quantitative) of the current study, the essential elements of the research uptake model for healthcare practice and policy development in a low-resource setting are visually represented in Figure 3.

Figure 3

In this research uptake model, the evidence domain of the PARIHS framework was associated with individual factors affecting research uptake as was evident within the empirical research phases of this study. The research uptake model proposes that for low-resource countries, support, time, motivation and experience represent the initial stimulating process of the research planning stage (inputs). As a result, a well-motivated health research stakeholder will have the urge to successfully contribute to research uptake initiatives. Furthermore, an experienced health research stakeholder will enhance the health research uptake systems' credibility.

The context domain of the PARIHS framework is associated with both the local research committee (LRC) for quality assurance and research project permission stages of the model. The research results confirmed the factor 'resources' and several strategies which are critical for these stages. It is clear from the empirical data that the local research committee is essential to creating strategies to facilitate research uptake. Implementing the model depends on the availability of an up-to-date research repository for enabling communication between research users and producers (activities).

The facilitation domain of the PARIHS framework was associated with three stages of the research uptake model: rolling-out (intermediate outputs), facilitated uptake (outputs), and research impact stages (outcomes). The empirical research phases of this research confirmed the critical appraisal skills as essential for these stages. For a successful research uptake, from stage two to stage six of the model, the LRC assumes an active role in facilitating the processes. Timeous feedback and consistent engagements are the cornerstones of this research uptake model (outputs). They are critical to sustaining interest and buy-in for the research project. A significant investment is needed in low-resource countries to improve critical appraisal skills for practitioners and policy developers to impact health outcomes. The subsequent section provides details on how this model could be used to enhance research uptake.

Research uptake model elements

The current research uptake model indicates that improving research uptake can only be successful when the process is systematically and logically managed.

Research planning stage

The stage refers to the drafting of a research proposal to conduct a study. This process is either done in-house, outsourced, or initiated by a third party in the study's current settings. Importantly, participants in this current study highlighted the need for all relevant stakeholders to be involved during

the initial stages of the research for research uptake to succeed. Scholars agree that research uptake benefits from involving research stakeholders in the design, execution and dissemination phases of a research project [7,8,50]. Institutionalising a culture that supports research uptake through researchers, decision-makers, and relevant personnel within the institutions would aid with the implementation process.

Local research committee for quality assurance

The use of LRCs in preparing contextual knowledge and expertise for promoting research uptake has been established in the literature [50]. This model suggests that LRCs should serve as a bridge between research producers and research users by proactively availing different strategies to enable research uptake. These strategies include an up-to-date local research agenda, capacity building strategy, research appraisal strategy, research communication strategy and stakeholder engagement strategy.

Research project permission

Following the approval of a research project by an ethics committee, the research is uploaded to the research repository for the gatekeeper's permission process. A well-designed research repository will facilitate communication between researchers and gatekeepers by providing updates on the status of the research while also serving as a storage facility for research documents. Since most low-resource countries are affected by a shortage of resources, personnel and competing priorities [2], this paper proposes that a research project should be evaluated based on two fundamental questions:

First, the availability of resources at the local institutions to support the research, these include personnel, facility equipment, availability of space, and others. Failure to understand these requirements from the onset of a research project could result in misunderstanding, which could have a devastating effect on an organisation (service delivery) and the researcher, and this without any malice being intended. The LRC is expected to decide to either accept, review, or as a last resort, reject the research project. Second, the suitability of the research project for adoption and subsequent research uptake. In this instance, LRCs consider its strategic research documents in consultation with experts in a related field to determine whether the project addresses any locally identified research priorities.

Rolling-out stage

This stage refers to the actual data collection process. Not enough can be said about effective communication, which is perhaps one of the most critical missing links observed in this current study. All stakeholders must receive regular feedback during the data collection process [51]. This is important to highlight research progress, challenges, and engage with stakeholders to solicit research ideas. Should the research project meet the criteria for adoption by the LRC, stakeholders are identified. These would include experts nominated because of expertise in a particular field of study, who will play a significant role in further assisting and 'shaping' the research project for successful research uptake. Relevant experts could be clinical experts, decision-makers, and a community member, all of whom may provide different expertise.

Facilitated research uptake and research impact

When communicating research findings, it is also important to understand the types of audience for which the research is intended to benefit research uptake. This refers to produced research evidence that must be disseminated to appropriate audiences using an appropriate platform. Research findings deemed suitable for healthcare practice and policy development are adopted by stakeholders to inform practice and policy. All research findings/reports are uploaded on the repository for future access and utilisation of the information. A successful research uptake study should improve service delivery or healthcare practice, advances in policies, improved research capacity, and improved health research systems. The benefits are improved patients' outcomes [52].

LIMITATIONS

Research uptake is a complex process that requires the involvement of all relevant stakeholders, and the researchers felt that several stakeholders were left out in this study, which is a selection bias. In developing this model for low-resource countries, the researchers could not gather data from two key stakeholders for research uptake. These include members of the public and politicians in leadership who are responsible for policies. It would have been beneficial in this study to get their views and strategies for improving research uptake. De Freitas established the importance of involving lay citizens in research projects [53]. This enables them to have a voice in health decision-making processes to improve the quality of health research, healthcare practice and public health interventions. Furthermore, the need to speak to politicians in a more engaging narrative with the attention on returns on investment is critical to research uptake [54].

CONCLUSION

Several conclusions were drawn from the results that could be generalised across the general study population. It is clear from the empirical data that the LRC is critical in creating strategies which will facilitate research uptake, whereas the success of implementing the model depends on the availability of up-to-date research repository for enabling communication between research users and producers (activities). The findings suggest that it is critical to institutionalise a culture that supports research uptake through the engagement of researchers, decision-makers, and relevant personnel within the institutions to facilitate buy-in at the initial phase of the research process; this would aid with the implementation process. It is also critical to governments, particularly in low-resource countries, to invest substantially in developing strong research skills amongst government employees and retaining such skilled healthcare workers contributing to research uptake. Timeous feedback and consistent engagements are the cornerstones of this research uptake model (outputs).

This model is unique in that it successfully integrated the PARIHS framework with the logical framework to streamline the research uptake process for public healthcare practice and policy. The model encourages specific behaviours and activities associated with research uptake for individual stakeholders through the development of various essential strategies. Despite the model providing a comprehensive list of activities required for a successful research uptake process, the researchers are mindful that all the processes detailed in the model were designed specifically to address issues associated with low-resource countries as identified during the model conducting of the study. However, the model and its application can be modified for use in other settings based on conditions associated with respective settings, such as resource availability and critical appraisal skills. The model process is cyclic in nature, allowing a continuous engagement between the LRC, researchers, and all other relevant public health research uptake stakeholders. This assists in curtaining the existing gap between research producers and research users whilst promoting long-lasting partnerships.

LIST OF ABBREVIATION/ACRONYMS

CAHS:	Canadian Academy of Health Sciences
DRUSSA:	Development Research Uptake in Sub-Saharan Africa
EFA:	Exploratory Factor Analysis
KTA:	Knowledge to Action
LRC:	Local Research Committee
OMRU:	Ottawa Model of Research Use
PARIHS:	Promoting Action on Research Implementation in Health Services

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827 END MATERIALS

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830 the process and sharing their time, knowledge, and perspectives regarding
831 factors affecting research uptake in low-resourced settings.

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834 collected the data; both authors were involved in the data analysis and writing
835 of the article. Both authors read and approved the final version.

836

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839 *Ethics and consent:* Ethical conduct was considered in terms of control over the process, and a
840 high degree of was placed on the research participants. All participants gave
841 written informed consent anonymity and confidentiality were provided for all.
842 Permission to conduct the study was sought from the Research and Ethics
843 Committee of the University of South Africa (Department of Health Studies
844 (HSHDC/712/2017). The study was also approved by the Provincial Health
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850 *Paper context:* Research uptake is significant to healthcare practice and policy development.
851 However, research uptake is a lengthy, complicated process, and despite a
852 growing body of literature on effective strategies, many low-resourced
853 countries continued to struggle. To our knowledge, there is no other research
854 uptake model developed for low-resourced countries uncovered during the
855 appraisal of literature that considered improving research uptake despite
856 limited resources. The primary value of the research uptake model is its
857 usability in low-resource countries experiencing competing priorities. The
858 model encourages specific behaviours and activities associated with research
859 uptake for individual stakeholders. Not only does it lead to a better working
860 relationship between researchers and research users, but it is vital for making
861 an improved decision about Public Health.

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863 *Data availability:* Supplementary data is available at the Health Research Policy and Systems
864 Journal online, and additional data that support these finds are available from
865 the authors on reasonable request.
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Model or framework and Origin	Description	Limitations	Sources
CAHS framework: The Canadian Academy of Health Sciences (CAHS) framework is mainly referred to as the CAHS Payback Framework, adapted from the payback model developed by Buxton and Hanney in 1996.	The framework aims to capture specific impacts in multiple domains, at various levels, and for a wide range of audiences to determine how research activity influences decision making.	Labour intensive and could require substantial investment in some circumstances, and the framework itself is tailored to the Canadian context.	[17,18].
IOWA model: The Iowa Model was founded by a group of nurses from the University of Iowa Hospitals, Iowa Clinics, and Nursing College in 1994.	The model is intended to use research findings to improve healthcare quality, monitor healthcare costs, and improve nursing practice.	Although the literature has shown increasing trends in applying this model, many low-resource countries lack interest in using the model, mainly due to healthcare practice barriers such as lack of time, relevant research studies, resources, and insufficient organisational support.	[19,20,21].
Ottawa Model of Research Use: The Ottawa Model of Research Use (OMRU) was established by Logan and Graham in the late nineties for use by policymakers with an interest in evidence-based research for healthcare practice by practitioners and researchers.	The model assists administrators to control factors that will influence the likelihood of organisational-level changes occurring and how the changes occur. In this model, patients play a significant role when the innovation is developed, implemented and evaluated	Using OMRU requires considerable time and resources to plan and implement strategies to change practice. The model does not yet provide detailed information on specific strategies to use in various circumstances to translate new knowledge. This could likely results in limited use in low-resource countries.	[22].
Knowledge-to-Action framework: First reported in 2006, the Knowledge to Action (KTA) framework is a	The KTA Framework is based on the analysis of 31 planned action theories to offer a holistic view of the phenomenon by integrating	The framework does not prescribe specifically what needs to be done at each phase, making it difficult for	[23].

conceptual evidence-based framework developed in Canada in response to confusion caused by the numerous terms used to describe the process of translating knowledge into action.	concepts of knowledge creation and action (Action cycle). It is viewed as a cyclical process in which research features, knowledge transfer intervention, and the evaluation process lead to the identification of novel problems. KTA allows the identification of barriers to the use of knowledge, while it allows the transfer of knowledge to action into manageable sections.	adoption in low-resource countries.	
PARIHS framework: The Promoting Action on Research Implementation in Health Services (PARIHS) framework was founded in 1998 by Kitson and colleagues, to provide an alternative to existing one-dimensional models of transferring research to practice.	The PARIHS framework was developed and tested in an international arena, mainly for research within the nursing fraternity to signify the complexities of undertaking research uptake. The PARIHS framework views successful research uptake as a function of the relationships between three domains, namely evidence, context, and facilitation.	There is no scaling provided with statements of the framework (constructs are not operationalised), which implies the need for further developmental work on these measures to provide usable scores for easy application	[24,25].
STAR model of Knowledge Transformation: Founded by Stevens in the early 2000s at the Academic Centre for Evidence-Based Practice at the University of Texas Health Science Center in San Antonio.	The Star Model of Knowledge Transformation was aimed at providing an understanding of the cycles, nature, and characteristics of knowledge used in several aspects of evidence-based practice. The model helps in the systematic conversion of the best available evidence through different stages to impact health outcomes.	A disadvantage of this model is the long period it takes to translate evidence due to the rigorous practice involved in understanding the cycle.	[26,27].

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910 **Table 2: Biographical information of participants (phase one)**

		Frontline staff (N=7)	Researchers (N=6)	Programme managers (N=4)	Academic institution & private healthcare institution (N=4)
Participants ID:		1; 3; 8; 11; 12; 13; 15	4; 6; 7; 14; 16; 18	2; 19; 20; 21	5; 9; 10; 17
Age Group: N (%): (Mean±SD) = 47.6±2.4					
25-34		2 (28.57)	1 (16.67)	0	0
35-44		2 (28.57)	1 (16.67)	0	2 (50)
45-54		2 (28.57)	3 (50)	0	1 (25)
55-64		1 (14.29)	1 (16.67)	4 (100)	1 (25)
Gender N (%)					
Female		4 (57.14)	3 (50)	3 (75)	3 (75)
Male		3 (42.86)	3 (50)	1 (25)	1 (25)
Years of work experience: N (%): (Mean±SD) = 19.4±1.9					
2-5 years		1 (14.29)	1 (16.67)	0	0
6-10 Years		1 (14.29)	2 (33.33)	1 (25)	0
11-38 years		5 (71.43)	3 (50)	3 (75)	4 (100)
Educational level: N (%)					
Degree		4 (57.14)	0	0	0
Honours degree		1 (14.29)	0	2 (50)	0
Master's degree		2 (28.57)	4 (66.67)	2 (50)	1 (25)
Doctoral degree		0	2 (33.33)	0	2 (50)
Post-doctoral degree		0	0	0	1 (25)
Employment sector: N (%)					
Government Institution		4 (57.14)	1 (16.67)	4 (100)	0
Institution of higher learning		1 (14.29)	2 (33.33)	0	3 (75)
Private institution		2 (28.57)	2 (33.33)	0	1 (24)
Student at academic institution		0	1 (16.67)	0	0

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916 **Table 3: Biographic information of respondents (phase two)**

Education versus age group								
Count								
		Age group						Total
		18-24	25-34	35-44	45-54	55-64	65+	
Education	Degree	5	10	6	1	3	1	26
	Honours degree	0	10	1	2	0	0	13
	Master's degree	0	26	24	29	13	1	93
	Doctoral degree	0	6	18	16	17	5	62
	Post-doctoral	0	2	6	5	3	2	18
Employment sector versus age group								
Employment sector	Government	2	27	14	20	11	1	75
	Universities/ Institutions of Higher Learning	0	8	24	20	18	7	77
	Private/Non-Governmental Research Institution (NGOs)	0	9	11	10	4	0	34
	Student at academic institution	2	5	4	1	0	0	12
	Other/Unemployed	1	5	2	2	3	1	14
Position versus age group								
Position	Frontline staff or Practitioner	2	23	10	6	6	0	47
	Researcher	3	22	22	16	13	3	79
	Policy level/Programme Managers	0	7	9	15	5	2	38
	Senior Management / Director	0	2	14	16	12	4	48
Work experience versus age group								
Work experience	0-2 years	1	11	8	3	0	1	24
	2-5 years	2	16	9	4	0	0	31
	5-10 years	1	22	24	12	9	1	69
	10+ years	0	2	14	33	27	7	83
	not applicable	1	3	0	1	0	0	5
Total (in each category)		5	54	55	53	36	9	212

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Figure 1: Average mean on research uptake factors per classification

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954 **Figure 2: Average mean on research uptake factors per employment sector**

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Figure 3: Research Uptake Model for Healthcare Practice and Policy Development