Mobile Technology to give resource-based knowledge management advantage, to community health nurses in an emerging economies context.

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Abstract

Purpose

Knowledge is a key success factor in achieving competitive advantage. This paper examines how mobile health technology facilitates knowledge management practices to enhance a public health service in an emerging economies context. Specifically, the acceptance of a knowledge-resource *application* by community health workers to deliver breast cancer healthcare in India, where resources are depleted.

Design/methodology/approach

Fieldwork activity conducted twenty semi-structured interviews with frontline community health workers, which were analysed using an interpretive inductive approach.

Findings

The *application* generates *knowledge* as a resource that signals quality healthcare and yields a positive reputation for the public health service. The community health worker's acceptance of technology enables *knowledge generation* and *knowledge capture*. The design facilitates *knowledge codification* and *knowledge transfer* of breast cancer information to standardise quality patient care.

Practical Implications

Knowledge management insights are provided for implementation of m-health technology for frontline healthcare professionals in an emerging economies context.The knowledge-resource *application* can deliver breast cancer care, in localised areas with the potential for wider contexts. The outcomes are valuable for policymakers, health service managers and knowledge management practitioners in an emerging economies context.

Originality/value

First, this study contributes three propositions to knowledge management scholarship, in a public healthcare, emerging economies context. Second, via an interdisciplinary theoretical lens (Signaling Theory and Technology Acceptance Model), we offer a novel conceptualization to illustrate how a knowledge-resource *application* can shape an organizations knowledge management to form a resource-based competitive advantage.

Social Implications

The legacy of the mobile heath technology is the normalisation of breast cancer discourse and the technical up-skilling community health workers.

Keywords: Breast Cancer, India, Knowledge Management, Signaling Theory, TAM.

Paper Type: Research Paper

Introduction

India is facing a significant public health challenge as breast cancer rates of incidents and mortality steadily increase (Khokar, 2018). Statistics show by the end of 2020, 2.5 million Indian women will be living with a biologically aggressive breast cancer due to late diagnosis and a lack of awareness about self-examination (Breast Cancer India, 2016; Rath and Gandhi, 2014). In Western countries incidence rates increase with age unlike India, where the rate is reversed with the highest female mortality rate found in those aged 25-50 years of age (Khokhar, 2018). Limited knowledge about breast cancer and poor public health information, combine to prevent early diagnosis and cause a rise in cancer rates. There are two main reasons for this situation. First, excluding India's National Cancer Control Programme in 1976, there has been no large scale implementation of breast cancer prevention or knowledge management (KM) strategies to date (Pramesh *et al.,* 2014). The second is bound in India's cultural complexities surrounding the female body, meaning discussions about female cancers are rare and taboo (Fletcher-Brown *et al.,* 2020).

India therefore, operates a fragmented approach to constructing a nationwide KM system for breast cancer healthcare. This is evidenced by the limited understanding of the Ministry of Health and Family Welfare (MoHFW) about the nature of medical knowledge flow, the types of KM tools suitable to disseminate breast health information and the barriers to enablers of KM (Chib, 2010; Nicolini *et al.*, 2008). Observers have also witnessed a less than substantive investment in educational resources as to normalise breast self-examination, or technological innovations to assist prevention activities (Gupta *et al.,* 2017).

The management of healthcare to India's population of over one billion citizens, is the responsibility of the state governments, with overall control, held by the central MoHFW. During the last two decades, the inadequate flow of public health information

about breast cancer has not enhanced patient care or positively affected the efficiency and effectiveness of the organisation (Dey, 2017). The ineffective knowledge management system has continued to substantially reduce MoHFW's reputation as a quality health provider (Fletcher-Brown *et al*., 2018; Sheffield, 2008). Consequently, without an effective KM strategy the capability of the organisation to establish an excellent situational awareness of the ensuing breast cancer crisis will inevitably mean the MoHFW will be coping with an epidemic in the foreseeable future (Khokhar, 2018).

Knowledge is a key success factor in achieving competitive advantage in fast paced economic environments like India and has been found to improve organisational performance (Mehralian *et al*., 2018). Furthermore, while knowledge has been highlighted as the most precious asset for many organizations, accumulated knowledge can manifest as a source of sustainable competitiveness (Nguyet *et al*., 2018). Whilst, extant literature has extolled the potential of KM to influence and improve private sector performance, fewer authors have investigated public sector themes that yield recommendations for professional practice (Massaro *et al*., 2015). Indeed, if KM can enable innovation in organizational systems to positively affect performance of employees and benefit all stakeholders, then examination of a public health sector organization is worthwhile (Papa *et al*., 2020).

Research evidences incorporating information communication technology (ICT) in a healthcare organisation, enriches complex channels of knowledge flow among stakeholders at every stage of the healthcare process (Singh *et al*., 2018). Furthermore, innovations such as mobile health (m-health) technologies may be useful KM tools for frontline health workers. In particular, for those in an emerging economies context with a large geographical area, and who operate from a low resource setting (Chandwani and Dwivedi, 2018). M-health innovations may therefore, expedite KM (including knowledge sharing and seeking) to enhance the flow of public health information about breast cancer and improve the

reputation of the public health service provider. However, in order to embed facilitating KM practices, the skills, capabilities and competencies of employees must be assessed in order to develop efficient processes that produce quality products or services to meet the market's demands (Baines and Smith, 2020; Kuciapski, 2017).

The World Health Organisation (2016) reports that m-health initiatives to enhance healthcare delivery have risen significantly. India has experienced some success with m-health to facilitate information efficiency about type two diabetes and childhood diseases, but a sustained robust KM system is still required (Ilozumba *et al*., 2018; Muralidharan *et al.,* 2017). Furthermore, there is scant insight into the ability of m-health technology to relieve the complexities of the breast cancer problem with an effective and efficient outflow and inflow of KM (Dwivedi *et al*., 2008; Pereira *et al*., 2019).

Recent research in India revealed the essential cog in the KM wheel are community health workers (CHWs) (Fletcher-Brown *et al*., 2018) known as Accredited Social Health Activists (ASHAs) and Anganwadi, (AWW), both key cadres in India's health prevention programme. In particular these workers are responsible for disseminating maternal and child health knowledge and treatments. It is their unique standing within the community, which provides the potential for an m-health innovation to manage breast healthcare knowledge effectively to all stakeholders and therefore, requires further exploration.

Against this backdrop this study undertakes an in- depth inquiry into KM practices and strategies for enhancing breast healthcare delivery with a knowledge-resource application (*App*) (run on a mobile tablet) and posit the following research objectives:

1. To explore the effectiveness of m-health technology as a KM tool, to reduce asymmetry of breast cancer information,

2. To examine how m-health technologies can shape breast cancer KM as a resource-based competitive advantage for a public health organisation

The complexity of this KM problem in India, demands a theoretical interdisciplinary approach to enhance the KM domain. In so doing this paper answers the call for theory development to deliver new models, tools and techniques, specific to the health sector (Van Beveren, 2003). This empirical study utilises Spence's (1978) signaling theory as a lens to explore m-health technology as a resource-based KM advantage for the MoFHW, to reduce breast cancer rates. Therefore, it is pertinent to assess the MoHFW's potential to deliver these core expectations. Rarely in published literature is signaling theory explored in a health KM setting, but greater investigation has been invited (Simaens and Koster, 2013).

The effectiveness of m-health technology to facilitate KM by CHWs will be explored using an adapted Technology Acceptance Model (TAM) devised from earlier models (Davis, 1989; Venkatesh and Bala, 2008; Maruping *et al*., 2016). Originally conceived for business use, this model is increasingly applied in m-health research to gauge the usefulness of technology to improve the access to, and quality of healthcare information (Yarbrough and Smith, 2007; Kalnad *et al.,* 2017). It is the most frequently applied research model to predict use, of a person's intention to perform a particular behaviour, and acceptance of information systems and technology by individual users (Rahimi, 2018).

The overall structure of the study takes the form of the following sections including, a development of the theoretical framework, frontline healthcare delivery in India, research design, findings and discussion, theoretical and managerial contributions and limitations of the study including directions for future research.

The development of the theoretical framework

Situational context

India has grown rapidly over the last decade to achieve the status of the fastest growing economy in 2018. The McKinsey Global Institute report identified employing more women in the workforce would add an additional $2.9 trillion to India's annual GDP by 2025

(Woetzel *et al*., 2015). Therefore, a healthy female Indian workforce is crucial if the country is to benefit from its demographic advantage and sustain its economy. However, one in twelve women in India are at high-risk because women seek medical care extremely late due to a lack of public health resourcing and India's unique socio-cultural complexity (Gupta *et al*., 2017). Various cultural and religious issues prevent women from accessing health services, including a reluctance to consult with male doctors, family obligations and little autonomy to control their own medical care (Deshpande *et al*., 2013).

Recent initiatives in India suggest the government is recognising its own resource limitations in women's healthcare and has begun to partner with private players to provide affordable services to the underserved such as The Pink Initiative. However, the majority of the population of India remain reliant on the state for their primary healthcare (Saxena, 2015). In the latest Indian National Health Policy (2017) the percentage of GDP by 2020 for healthcare, rose to 2.5%, a rise of 1.5%, but without a strategic focus on cancer. This has an impact on the reputation of MoFHW as an efficient provider of women's healthcare (Gangane *et al*., 2016).

While the international resourcing standards state a minimum of 25 health workers per 10,000 population, India's scarcity of skilled medical staff remains high with only a little over 8 health workers per 10,000 population. This situation of poor resourcing impacts on the amount of knowledge that can be captured by health workers and transferred in to the community (Srinivasan and Chandwani, 2014). Wide interstate disparities and rural-urban differentials in the availability of a medical workforce, affect the ability to capture knowledge about breast cancer health in the communities (Esposito *et al*., 2012). For example, Tamil Nadu is the only state that has scaled up services for prevention of common cancers. This was a successful programme that revealed the link between the need for knowledge about screening, diagnosis and treatment, to be presented in the correct manner for successful

knowledge transfer (Krishman *et al*., 2013). However, there is limited evidence of investment by MoHFW in a breast cancer KM resource.

An interdisciplinary theoretical approach

Previous research has examined resource-based knowledge management in Western healthcare contexts (Mason and Pavia, 1998; Kim *et al*., 2012). An array of resources were highlighted including information about particular cancers, access to support groups, cancer workshops and rehabilitation advice, all available to women on and offline. The large amount of knowledge produced by these healthcare resources (e.g. electronic health record systems, pharmaceutical R&D reporting systems) galvanized the healthcare organisations into making considerable investments in technology to strengthen their organisational resource capability (Wang and Byrd, 2017). According to Hoffman *et al*. (2005) technology can facilitate the four main processes of KM: *generation of knowledge*, (all activities that discover ''new'' knowledge); *knowledge capture*, (the continuous scanning, organizing, and packaging of knowledge after it has been generated); *knowledge codification* (representation of knowledge in a manner that can easily be accessed and transferred) and *knowledge transfer*, (the absorption of that knowledge) To leverage knowledge is an organisations most critical resource (Desouza and Awazu, 2006) and, knowledge sharing is recognized as one of the most important ways to improve organisational performance (Kim *et al*., 2012). Furthermore, knowledge is valuable, rare, hard to imitate and non-substitutable, and has been noted as a strategic asset for any organization to gain and nourish competitive advantage (Jha and Varkkey, 2018).

With this appreciation of KM, it is important to understand India's healthcare infra structure. Organisations improve their efficiency and effectiveness through a possession of valuable knowledge relating to their products, processes, management and technologies. However, the absence of the four specified KM processes, indicates the necessity for

MoHFW to control the flow of consistent communication about breast health information for maximum advantage (King *et al*., 2002). The lack of motivation by the India government to establish a KM system to oversee breast cancer health delivery, portrays them as woefully inadequate (Gupta *et al*., 2017). This study aligns to the WHO (2016) strategic focus to increase the incorporation of m-health technology to improve global healthcare. Using signaling theory as a lens we explore the effectiveness of m-health technology as a KM tool, to reduce asymmetry of breast cancer information.

Signaling theory is fundamentally concerned with reducing information asymmetry between two parties, striving for perfect information in a situation where the 'signaller' or sender, conveys some meaningful information about its products or services to another party, the receivers (Spence, 1978; 2002; Stiglitz, 2000). In this investigation, the sender is the MoHFW and the receivers are CHWs and Indian women. Receivers are important in the signaling cycle because on receipt of the message they can determine if the organisation is genuine in the practice, they espouse. Their belief in the sender's reputation links to the notion of quality, which shares some characteristics with reputation and prestige (Khartri *et al., 2*016). Careful management of information encourages trust between sender and receiver, fostered via a two-way dialogue, rather than a one-way signal transmission. In this study the knowledge-resource *App* would incorporate accessible breast cancer knowledge represented in different formats including audio and 3D visual imagery (see Appendix 1).

However, research states that to be effective the signals must be observable and costly to imitate (Bruton *et al*., 2009; Connelly *et al*., 2011). Often the level of cost invested has a two-fold effect; (i) it reduces information asymmetry and (ii) highlights the organization's commitment to the cause (Vargo and Lusch, 2017). Therefore, investment by the signaler in a knowledge-resource application could, reduce asymmetry of breast cancer information and improve reputation through superior performance.

The technology acceptance model (TAM) has gained significant interest and is widely used in m-health interventions and is therefore viewed as an influential model to explain intervention for technology use (Bagozzi, 2007; Hoque, 2016). TAM was devised by Davis (1989) as a need to gauge technology acceptance in the workplace for effective and effective organisational practices. Based on the psychology theory Theory of Reasoned Action and Theory of Planned Behaviour (Ajzen and Fishbein 1980), TAM was conceived to predict the willingness of users to embrace new technology and to understand attitude and beliefs as cause of intention and to better understand the behaviour relationship between humans and technology.

To fully understand resistance to technology this model consisted of two core elements (PU) perceived usefulness; (PEU) perceived ease of use; which in turn describe the behavioural intention to adopt an m-health system. PU is centred on the idea that by using the technology it will enhance both current and continuous job performance. PEU, measures the degree to which the technology is effortless and easy to use. Further models have incorporated the impact of personal/professional experiences, organisational factors and social/political influences which in later models are referred to as external variables (Venkatesh and Davis, 2000). Studies suggest that external influences cannot be ignored in adequately assessing technology acceptance (Burton-Jones and Hubona 2006; McKechnie *et al.*, 2006). Thus, later models of TAM such as TAM 2 and the Unified Theory of Acceptance and Use of Technology consider external factors such as subjective norm, job relevance, output quality, social influence, organisational influences and facilitating conditions.

These later models have become useful in determining the acceptance of technology in health, delivering solutions for physicians and health workers world-wide. The m-health expansion following e-health, has revolutionised the way in which health services can deliver essential health interventions. Literature searches and studies have critically examined TAM

as a theoretical model for understanding resistance to technology (Marangunić and Granić, 2015; Durodolu and Olumide 2016), whereas Holden and Karsh (2010) and Yarbrough and Smith (2007) relate TAM specifically to healthcare literature and studies.

Different situations require different variations of the TAM model and the external variables can be added after an initial beliefs elicitation study and in so doing, contextualising TAM offers the researcher better predictive power. As a framework for predicting technology acceptance TAM remains the most popular model for researchers and continues to be the most "robust parsimonious, and influential in explaining technology adoption behaviour" (Lu et al., 2003; Marangunić and Granić, 2015). This research draws on the TAM model to gauge the acceptance of technology by the CWHs as a potential resource-based KM system for breast cancer care.

In the research framework TAM is central to predicting the CWHs use of technology in their current role. The design element of the *App* is reliant on 'modality', the concept that knowledge can be disseminated through two communication channels visual and auditory.

Frontline healthcare delivery in India

The majority of India's population live in rural regions but, Esposito *et al*. (2012) estimate most of India's 16,000 hospitals are located in urban areas cultivating insurmountable healthcare challenges in rural populations. Globally, there is collective interest to develop the influence of CHWs, as frontline health workers, but research has been limited to their role in matters of women and children's nutrition (Saprii *et al*., 2015). ASHAs are CHWs instituted by MoHFW as part of the government's National Rural Health Mission (NRHM, 2012). The set target of 2,500,000 ASHAs in 10 states by 2012, has fallen short as only 700,000 are currently operational (Fathima *et al*., 2015). The ASHAs have responsibility for the execution of the community health programme. This includes, regular surveys of families, to organize pre-school activities, to provide health and nutrition education and to show pregnant women

how to breastfeed, to promote family planning and to educate parents about child growth and development.

Indian villages are autonomous communities, with little interaction with the central government. A democratically elected village council which represents all major groups (caste or religious) makes most day-to-day decisions. In practice, the support of the council or chief ensures the CHW is effective and accepted within the community, encouraging people to utilize their services (Hariprasad and Mehrota, 2016; Ramachandran *et al.*, 2010). Their role places them central to the development of a sustainable m-health KM system with the potential to communicate breast cancer awareness knowledge and healthcare in an emerging economies context (see Figure 1). Ownership by the Indian government to fund the technology could signal a positive trustworthy reputation for India's MoHFW. Hence, this paper seeks to address the gap in published literature concerned with m-health technology as a KM resource for a healthcare organisation to achieve competitive advantage, in an emerging economies context (Modi *et al.*, 2015).

[Insert Figure 1 here]

A KM system supported by m-health technology has the opportunity to enhance the skills of non-physicians such as CHWs and empower them to deliver timely and quality frontline healthcare. However, in an emerging economies context there are several factors that need to be addressed prior to implementation including the CHW's acceptance of technology as part of their role. Furthermore, the *App* is designed to improve current processes of *knowledge capture* and *codification* and facilitate access to up-to-date breast cancer information. Over the last few decades the recognition of mobile technology as a powerful communication tool has grown and its ability to provide communities with essential health information (Desouza *et al.*, 2014). However, acceptance of its sustainability, effectiveness and efficacy in the

community need to be addressed. This study seeks to consider the operator (CHW), their needs and requirements prior to technical innovation. Table 1 provides a critical overview of the literature addressing KM related to m-health technology as a resource-based advantage in an emerging economies context. This has led to the identification and framing of the research objectives outlined previously.

[Insert Table 1 here]

Research Design

This investigation set out to explore the effectiveness of m-health technology as a KM tool, to reduce asymmetry of breast cancer information and operate as a resource-based competitive advantage. To achieve the research objectives, the qualitative data was collected from Gujarat, India, where breast cancer accounts for 31.5% of all cancers in women. Furthermore, the MoHFW (signaler) has public health hospitals and PPP activities are also present (Breast Cancer India, 2016). Researchers conducted 20 interviews with frontline medical staff in this geographical location. An interpretative-inductive exploratory methodology follows the directives of *Gioia* et al. (2013) to imbue qualitative rigor. The methodological strength of this approach is the heterogeneity of CHW's expert opinion collected via semi-structured interviews producing rich qualitative data (Krueger and Casey, 2014).

Sample and Data collection

To explore the feasibility of m-health technology as a KM resource-based advantage, it was important to determine the CHW's socio-cultural understanding of breast cancer and their technological skills base. The characteristics of the CHWs are contained in Table 2. The CHW's culturally determined thought processes, anchored in India's complex historical,

religious, ethnic, political and social influences, provided valuable insight (Usher-Smith *et al*., 2016). This research design aligns with ethnography where the importance is placed on the thoughts and opinions of the participants about the issues discussed, and thereby viewed in the context of their experience (Hammersley and Atkinson, 2007).

[Insert Table 2 here]

All interviews were conducted in the local dialect, audio recorded and transcribed by the research team using a protocol guide. A semi-structured discussion guide was solely used to facilitate the discussion, when needed, to avoid loss of direction. Given the exploratory nature of this study, the idea was to avoid imposing preconceived frameworks or opinions upon participants, seeking instead to obtain their understanding (of KM and the suitability of the knowledge- resource *App)*, within their own frames of reference (Greenwood et al., 2014). Hence, the questions were mostly open-ended and discovery-oriented to facilitate open discussions and probing as the research design was inductive and exploratory. Questions were posed to explore their current technical skills level and to predict the usefulness and ease of implementation of introducing technology to their current role.

Coding Procedure

The data was analysed using a three-tiered coding system following the *Gioia* method (Gioia *et al.,* 2013). In the first stage of the analysis the first researcher independently read and coded the online comments. These comments were organised manually into a set of 1st- order themes garnered from the verbatim comments of the CHWs. The second stage, involved a 2nd- order thematic analysis whereby the researchers sought to understand links between the data and new emerging themes *Knowledge Generation, Knowledge Capture, Knowledge Codification and Knowledge Transfer*. This '*sensegiving*' provided an opportunity for concept development and theory building (Gioia and Chittipeddi, 1991). In the third stage, all the researchers aggregated key themes to provide a set of summative dimensions to the data

(see Table 3), *m-health technology signals quality healthcare, m-health technology enables KM* and, *m-health technology embraces local characteristics.* In contrast to other methods for analysis, such as content analysis, the use of the *Gioia* method approach allowed for alternative theoretical explanations to emerge from the data. The method has been used effectively to understand phenomenon in other healthcare studies (see Furstenau and Auschr, 2016; Schölmerich *et al*., 2016). Furthermore, Maas *et al*. (2016) also applied the method to a study of the development of new practice resources.

Findings and Discussion

To be able to theorise m-health as a resource-based KM advantage, the findings presented reflect the CHW's responses to the semi-structured interviews. As a result, three propositions support the proposed conceptual framework. This allows for an understanding of the role technology in KM for frontline health workers in the healthcare sector in an emerging economies context. Three aggregate themes emerge explicated from the data: *signaling quality healthcare, m-health technology enabled KM* and, *m-health technology embraces local characteristics*. These themes highlight how technology connects and empowers healthcare stakeholders, which manifests as a resource-based KM advantage to the MoHFW. To offer a better understanding of the qualitative findings, an illustration of each theme with a selection of extracts from the data is presented in Table 3.

Theme 1. *Signaling quality healthcare*

The first goal was to explore the effectiveness of m-health technology as a KM tool, to reduce asymmetry of breast cancer information. The considerable challenges to the MoHFW to fulfil its duty as a healthcare provider have been outlined (Fletcher-Brown *et al*., 2018). The MoHFW's inadequate resourcing of breast cancer KM culminates in a poor reputation to provide an effective and efficient healthcare system. For example, the absence of any regular time set aside for training in breast cancer knowledge, suggests the disease remains low

priority in public health policy and the reputation of the MoHFW to deliver effective breast healthcare remains weak. From the sample, AWW did not possess any knowledge about breast cancer in terms of diagnosis or treatment, either in their personal or professional role which suggests a break down in signaling effective information about breast cancer to essential workers.

ASHAs however, confirmed the need to visit women in their locale because of India's complex cultural values about women in a patriarchal society, *"women are not allowed to go out without their husband"*. This suggests, any *knowledge capture* must be garnered at the point of face-to-face consultation. The functionality of the *App*, allows for *knowledge generation* and *knowledge capture* by ASHAs to be efficiently transferred to women in their individual homes. What is also apparent from the interviews is that ASHAs are highly trusted by the leaders of the villages to enter homes where necessary and distribute healthcare information.

Cancer as a healthcare topic, is discussed in monthly reported meetings but nothing, *"specifically about breast cancer"* and, there are no current protocols to report and store the accumulated knowledge. They identify that breast cancer knowledge gathered at the frontline is valuable but not leveraged to its full potential. They acknowledge the perceived usefulness of the breast cancer knowledge-resource *App* would facilitate temporal research for *knowledge capture* and enable swift *knowledge transfer* to women. Findings therefore identify the equipping of ASHAs with an m-health *App* can *generate knowledge* as a resource that signals quality healthcare provision and is implicit to reducing asymmetry of breast cancer information. Furthermore, a knowledge-resource *App* in this research context, has the capacity to manage knowledge to benefit each stakeholder in the information flow. We illustrate this by suggesting,

Proposition 1. Technology equipped ASHAs send signals of quality breast cancer information to all healthcare stakeholders.

Theme 2. *M-health technology enables breast cancer KM at the frontline of healthcare.*

The second thrust of this investigation was to examine m-health technology as a resource-based competitive advantage in KM. It is known that knowledge is a key success factor in achieving competitive advantage for an organisation (Mehralian *et al*., 2018; Nguyet *et al.,* 2018). However, the skills, capabilities and competencies of employees responsible for gathering knowledge must be ascertained before investment in technologies (Baines and Smith, 2020). Hence, we explore the relationship between user (ASHAs), the ease of use, and perceived usefulness of the technology in order to comprehend the levels of resistance to using the *App*. The ASHAs were found to be functional in some areas of technology with scope for improvement in others (see Table 3). All used a mobile phone in their personal lives and in their public health role operated 'Corporate user group' technology. This facilitates free calling/ messaging amongst CUG members and is provided by many public sector organizations in India. Sixteen ASHAs used mobile phones with traditional keyboard functions, four ASHAs possessed smart phones which were referred to as 'touch screen' phones, which demonstrated a level of competency.

The cognitive constructs of the TAM model are perceived usefulness and perceived ease of use which identify an intention to use the *App* in their role. The ASHAs were vocal in their agreement of the advantages the m-health technology would bring to their work, "*If I could find the information on the App I would be happy'* and*, "I would like to learn more technology to help my job where I can keep notes of my visits".* The participants showed an overwhelming appetite to learn new technology for personal and professional development. They agreed the dynamic capabilities of the resource would facilitate agile KM, *"I would like to use it in my work because I could take down patient details for use in future*

appointments". The gathering and storing of patient information would form a knowledge resource for forward planning workloads and patient care, which illustrates a resourced-based organization can improve healthcare capabilities (Wang and Byrd, 2017).

Perceived usefulness was identified through suggestions for content such as video, animation and images, *"Pictures on the tablet provides information, awareness and abnormalities this is useful"* and, they agreed the touch screen function would make the *App* easy to use. In terms of m-health technology to give a resource-based advantage, this study found the *App*, could capture *new* knowledge and *transfer* breast cancer awareness knowledge to patients in the community, *"We can use pictures and sound to show women about the signs, some girls don't read".* In addition, the *App* facilitates visualisation of data as an infographic about breast cancer, *"The women can be informed about breast cancer signs with the help of pictures"* (See Appendix 1). The technology improved the ASHA's self-efficacy, through the access to knowledge and in autonomy of operating the device. Overall the ASHA's response to embracing new technology is positive and motivated to develop the required skills.

Perceived ease of use would therefore, suggest a relationship between design, mobile technology and on-going training to ensure a resource-based KM advantage for the MoHFW. Over time a CHW's confidence is likely to develop through their dynamic capabilities, agility and knowledge management (Pereira *et al*., 2019). Over the last few decades the recognition of mobile technology as a powerful communication tool has grown and its ability to provide communities with essential health information essential (Rahimi, 2018) However, the use of mobile technology sustainability, effectiveness and efficacy and the uncertainty of how technology will be accepted in the community is rarely researched. This study, alongside other recent innovations have utilized an adapted TAM model, to understand the potential use

of knowledge technologies with the training of nurses to deliver patient centred care (Barzekar *et al*., 2019; Ho *et al.,* 2020; Taipale 2019). We therefore posit,

> **Proposition 2.** Knowledge-resource technology improves quality of breast cancer KM where resources are currently depleted.

Theme 3. *M-health technology embraces local characteristics*.

ASHAs are pivotal for the effective and efficient outflow and inflow of KM in the community, in their role as mediator of the signaler's message. They are indigenous to the community and comprehend the cultural complexities that present as obstructions to KM. Their insider knowledge accentuates their position to one of privilege and to the nuances of community protocol. In so doing, the knowledge-resource *App* facilitates *knowledge transfer* to Indian women who are most at risk, *"Any information [on breast cancer] we will spread it in the community"* and, *"Women are shy in front of their in- laws [no discussion about breast cancer]but if I show pictures this will help with the embarrassment."* Their cultural knowledge and nursing skills are integral to overcome societal ignorance about breast health and self-examination. In fact, they utilise cultural familiarity to their advantage for *knowledge codification*, rather than viewing culture as a barrier to effective *knowledge transfer, "When [we visit] these women discussion on breast cancer should take place with the help of these images"* and, *"Showing a video is better for understanding and the woman looks similar to them".*

The role of the ASHA is established as an essential facilitator of breast cancer education and empowerment with potential to normalise breast cancer discourse in the community. In other words, the *App* would be used to disseminate breast care knowledge, *"when all women are sitting together and chatting".* Therefore, this is an opportunity to stimulate a normalisation of self-examination, *"To give information of breast cancer to*

women there should be community meetings" that opens the potential for engagement and exchange of knowledge as it enriches the value of the breast healthcare knowledge. The *App* technology is adaptive to local characteristics to facilitate a purposive outflow and inflow of breast cancer care knowledge transfer, to empower women in sustainable breast cancer knowledge such as, preventative self-examination techniques. Hence we propose,

Proposition 3. Resourced-based KM assists to normalise breast cancer discourse in the community.

This study highlights the importance of TAM to validate and measure determinates that affect behaviours to better understand the implementation of technology in healthcare delivered by non-physician health workers. In so doing, the technology acts as a resource-based advantage leading to:

- *generation of breast cancer knowledge* is acquired from frontline CHWs to increase patient wellbeing,

- *knowledge capture*, stakeholders continually scan the abundance of breast cancer knowledge obtained through interaction with women in their communities,

- *knowledge codification of local characteristics* engage women in breast familiarity, awareness and abnormalities through 3D technology and design,

- *knowledge transfer*, knowledge-resource *App* facilitates a sustainable breast cancer discourse to empower CHWs and Indian women.

Theoretical Contributions to KM in the public healthcare sector in an emerging economies context.

This study extends the scope of research on KM by examining how m-heath technology can give a resource-based competitive advantage to the public health service sector in an emerging economies context. We establish three clear original contributions to KM scholarship. Firstly, through analysis of the empirical evidence we contribute three new

propositions **Proposition 1**. Technology equipped ASHAs send signals of quality breast cancer information to all healthcare stakeholders; **Proposition 2.** Knowledge-resource technology improves quality of breast cancer KM where resources are currently depleted and, **Proposition 3.** Resourced-based KM assists to normalise breast cancer discourse in the community.

Specifically, how m-health technology operated by CHWs can *generate knowledge* as a resource for breast cancer and signals quality healthcare provision. The public healthcare provider is subsequently imbued with an authentic reputation. Additionally, through the lens of the TAM model we reveal the CHWs perceived usefulness and perceived ease of use of the m-health technology has the potential for *knowledge capture* from consultations with individual women to standardise quality at the centre of patient care. The accumulation of knowledge can be a source of sustainable competitiveness (Nguyet *et al*., 2018) which presents m-health technology as an organizational resource-based competitive advantage. Furthermore, our findings illustrate the agility of m-health technology to assist KM. Using exclusive design features, the *App* (in this investigative context) facilitates an adaptive response to local idiosyncrasies via the incorporation of *knowledge codifications* of breast cancer information. Such *knowledge codifications* were found to enable breast cancer discourse with the women at the point of frontline treatment situations. Hence we show an innovative m-health *App* operated by frontline workers shapes a sustainable strategy to impact India's breast cancer problem.

Second we contribute a conceptual framework to illustrate how m-health technologies used by frontline community health workers, operates as a resource-based knowledge management advantage in emerging economies context. Hence, m-health technology can facilitate a purposive outflow and inflow of breast cancer care knowledge in a manner that can easily be accessed and transferred to others. In so doing, the flow of information at every

level reduces asymmetry of breast cancer information to shape a sustained superior performance in breast cancer healthcare (see Figure 2).

[Insert Figure 2 here]

Finally, we contribute specifically to professional healthcare management and practice with proposals for implementing m-health technology and broaden their generalizability with suggestions for its use in other public sector organizations. Using an integrated model in studying the association between signalling theory and TAM to effect a resource-based KM advantage is a significant contribution KM scholarship. Earlier research has separately investigated the impact of each discipline on performance; however, there is dearth of research looking at how integration of signaling theory and TAM affects organisational KM. This research was conducted in an attempt to fill this gap in the literature. The results and arguments presented in the current study promote a better understanding on how KM and m-health activities can facilitate a purposive outflow and inflow of breast cancer care knowledge in a manner that can easily be accessed and transferred to others.

It is noted in literature that knowledge activities disseminated in a firm are strongly affected by the skills, capabilities and competencies of employees must be ascertained (Baines and Smith, 2020). More specifically, knowledge workers in the knowledge-intensive industries such as public health service, through their professional knowledge, experience and capabilities, play a pivotal role in developing the depth of knowledge transferrable to all stake holders within a company over time (Mehralian et al., 2018). Therefore m-health technology has the potential to increase the value of the relationship with customers by equipping MoHFW with qualified and knowledgeable human capital who are involved in establishing and maintaining mutually beneficial relationship with women in the community, to develop a discourse about breast cancer. Therefore, this study illustrates how knowledge acquired

through m-health technology is a key success factor in achieving sustainable competitive advantage, in breast cancer healthcare.

Contributions to professional healthcare management and practice.

This research provides useful insights concerned with implementing m-health knowledge management systems, specifically for frontline healthcare professionals in an emerging economies context. This study not only provides practical implications for the managers involved in the MoHFW, but also similar public sector organisations with a poor resourcing arrangements. Particularly, we emphasize the need to focus on understanding the skills and capabilities of frontline workers prior to developing the resource innovation. This reinforces the need for sector managers to plan ongoing training for operators of the technology, to encourage self-efficacy and the acceptance of technology in their work as a consequence. In so doing, the organization will benefit from the value derived from the flow of knowledge collected through the implementation of the technology and improve organizational performance.

The main reason that KM is of great interest to managers in the public healthcare sector is that knowledge vital for designing innovative products and services that benefit consumers (Mehralian *et al*., 2018). In particular we reveal how the design element of the knowledge-resource *App* has potential to capture, codify and transfer knowledge through visual and auditory channels thus rendering it transferable across states and potentially different countries. For example, a knowledge-resource *Apps* could be designed and operated quickly in times of global pandemic to protect consumers and healthcare operations alike.

Furthermore, the results demonstrate how to improve organizational performance by integrating technologies in KM initiatives where few previously exist. Therefore, it might be beneficial for the managers of public sector organizations to prioritize and place emphasis on

KM strategies that encourage innovative mobile technology assets for rapid repayment of capital investment.

Limitations and future research agenda

In consideration of the outlook for healthcare in emerging economies, this study has answered the call for more robust examination into KM practices and use of m-health by frontline CHWs (Singh et al., 2018). The purpose of this research was to undertake an in-depth inquiry into the application of a knowledge –resource *App* to enhance breast healthcare delivery. However, this research paper is investigative in nature and therefore, does have limitations in terms of its generalisability. First, the analysis has identified three new propositions within this research context: **Proposition 1**. Technology equipped ASHAs send signals of quality breast cancer information to all healthcare stakeholders; **Proposition 2.** Knowledge-resource technology improves quality of breast cancer KM where resources are currently depleted and, **Proposition 3.** Resourced-based KM assists to normalise breast cancer discourse in the community. This contribution may be specific to this country context (India) and will therefore limit the extent to which these findings may be generalised. We encourage further investigation of a knowledge-resource *App* to enhance breast healthcare delivery in other emerging economies contexts, to develop a richer understanding. Furthermore, this study focuses on a single country and it would be useful if a multi-country comparison was undertaken given the variance in religion, background, cultural, and economic structures within emerging economies. Thus, other emerging markets such as Brazil, South Africa, China and Thailand present as future KM research opportunities.

Secondly, although exploratory data via semi- structured interviews were deemed most appropriate for the purpose of this study, there is scope for future research using quantitative data to enhance the generalizability of the findings between the Western (developed) perspective and emerging economies context. Our sample was limited to only

one emerging economy. Future investigations could examine whether the results from the present study apply to other developing or developed countries.

Lastly, the study of m-technology in any guise is fast moving and observations and contributions to theory are frequent. Therefore, whilst this study has contributed three prevailing propositions of m-technology to KM in the public healthcare sector, it is important to encourage academics to undertake a longitudinal study of the adoption of m-health technology by CHWs to assess changes over a specific time period, and make further valuable contributions to the body of work on knowledge management.

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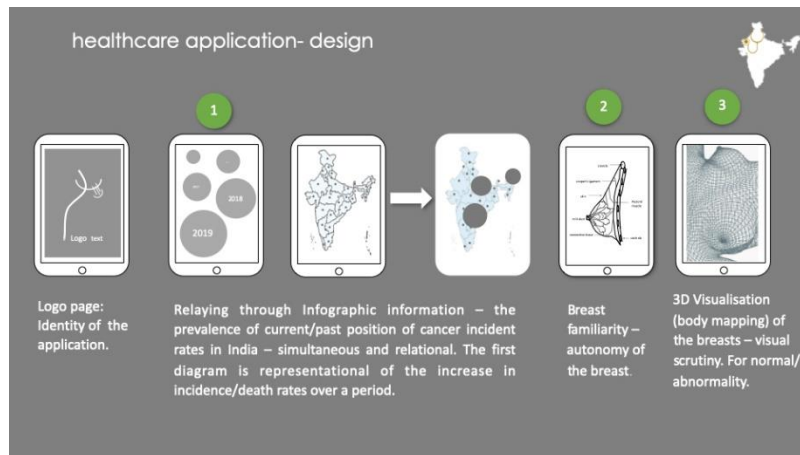
Appendix 1: m-health knowledge-resource Application prototype (author's design)

Author(s)	Concept	Definition	KM antecedents	KM consequences
A review of KM in healthcare (Nicolini et al.,2008) (Literature Review)	Three overarching themes in KM	KM tools and initiatives	• Knowledge management in healthcare: towards 'knowledge-driven 'decision-support services (Abidi, 2001). • Inflow and outflow of information to benefit KM (Sheffield, 2008). • The most important issues in knowledge management (King *et al*., 2002). • Criteria for KM (Desouza and Awazu, 2006). • Knowledge management for superior advantage (Hoffman *et al.,* 2005). • Fewer studies on public sector themes for professional practice (Massaro *et al*., 2015).	• Accumulated knowledge can be a source of sustainable competitiveness (Nguyet *et al*., 2018). • Dynamic capabilities, agility and knowledge management (Pereira *et* al., 2019). • Technology to facilitate knowledge sharing and knowledge seeking in health (Singh *et al*., 2018). • Knowledge is a key success factor in achieving competitive advantage (Mehralian *et al.,* 2018). • KM can enable innovation (Papa *et al*., 2020). • Ascertain skills, capabilities and competencies of employees (Baines and Smith, 2020). • Knowledge is a strategic competitive asset for competitive advantage (Jha and Varkkey, 2018).
Dwivedi et al., (2008). (Conceptual)	Designing intelligent healthcare organisations with KM and ICT.	ICT strategies for healthcare KM.	• m-health KM for frontline workers (Chib, 2010). • Mobile health assist treatments (Free *et al.,* 2013). • Mobile phones: the next step towards healthcare delivery in rural India (DeSouza *et al*., 2014). • There is a paucity of literature regarding m-technology to communicate health messages in India (Ramachandran et al.,2010). • Knowledge sharing (Kim *et al*., 2012).	• Information shapes knowledge, which in turn is a driver of health-related change (WHO, 2016). • Need of a New Frontline Health Functionary for Non-Communicable Diseases in India (Gupta et al., 2017). • Technology has emerged as an opportunity for KM *(Kalnad et al*., 2017). • Resourced-based organization can improve healthcare capabilities (Wang and Byrd, 2017).
Spence, (1973) *(Empirical)*	Reducing asymmetry of message to achieve perfect information.	Signal genuine regard to the social issue may signaler a positive *reputation.*	• Receivers are outsiders who lack information about the organization in question but would like to receive the information (Spence, 1973). • Signal genuine regard KM may yield a positive *reputation* (Kreps and Wilson, 1982). • Quality refers to the ability of the signaler to fulfil the needs or demands (Connelly *et al*., 2011).	• The importance of receivers responding to signalers about the effectiveness of their signals (Gupta *et al*., 2017). • Service –centred organisation (Vargo and Lusch, 2017) • "Perfect information" (Stiglitz, 2000). • A positive perception about a firms' social position can reduce any uncertainty with consumers (Stiglitz, 2000).
Davis, (1989) *(Empirical)*	Technology Acceptance model	PU and PEU model	• "TAM the influential and commonly adapted theory for describing an individual's acceptance of information systems" (Bagozzi, 2007). • External influences cannot be ignored in assessing technology acceptance. (McKechnie *et al.,* 2006). • TAM influential in explaining technology adoption behaviour" (Lu *et al*., 2003). • To gauge the usefulness of technology the access to and quality of healthcare (Holden and Karsh, 2010).	• There is a paucity of literature about mobile technology to communicate health messages in India (Ramachandran *et al.,* 2010) • M-health technology can help in the expanding the scope of service delivery, reducing the response time by using trained non-physicians (Bassi et.al., 2016). • Workers should update their knowledge and skills to keep up with the changes Kuciapski, 2017). • Adoption of Hospital Information System Among Nurses (Barzekar *et al.,* 2019). • Factors affecting nurses' acceptance (Ho et al., 2020).

			• TAM continues to be the most "robust parsimonious, and influential in explaining technology adoption behaviour" Marangunić and Granić, 2015).	• Integrating behavioral expectation of technology (Maruping *et al.*, 2017). • Technology acceptance among public sector nurses in cancer care (Taipale, 2019).

Table 1: Outline of research addressing KM related to m-health technology as a resource-based advantage in an emerging economies context: conceptualizations, antecedents and consequences.

Occupation	Length of service (Years)			Gender	Community Responsibility	Place of dissemination
Accredited Social Health Activist (20)	0-5 12	5-10 4	11-15 4	Female	Women and children's health including anti and post-natal care, ideal weight and nutritional advice. Vaccination advice including Malaria, Denge Zika virus,	Urban and rural individual homes
Anganwadi workers		Not known		Female	Anti and post-natal care, girl child, children's vaccinations.	Rural Individual homes

Table 2: *Characteristics of Participants in semi-structured interviews.*

1st order themes- from verbatim comments from ASHAs concerning m-health *App*			2nd Order themes	Aggregate Themes
"We never received information on breast cancer so if I could find out on the App I would feel comfortable"	*"We ASHAs are familiar with technology. I have mobile phone"*	*"Information on malaria dengue zika virus has been given but never on breast cancer, so this App is useful"*	Knowledge Generation	m-health technology signals quality healthcare
I have little knowledge about breast cancer to finding it here would help me"	*"I would like to know more about the App on the tablet and how to find to find information"*	*"We have never received enough information on this topic [breast cancer] that's why we rarely give out knowledge"*		
"We had a 10 min talk this month but was not [specifically] on breast cancer knowledge or treatment. If I could find the information on the App I would be happy"	*"This will be useful for training others especially with the help of pictures about the body"*	*"There has been no information on this, whether individually or in community, it would be useful to have".*		
"We have CUG [corporate user group] provides free calling/ messaging amongst CUG members"	*"I could take down patient details for the future"*	*"I have a touch screen phone at home so I am able to enter in information"*	Knowledge Capture	m-health technology enables KM
"I would like to learn more technology to help my job where I can keep notes of my visits"	*"We could help them to visit a doctor if there is any problem and show them where they are located"*	*"Women should be informed about breast cancer at regular intervals with this "*		
"Showing *a video is better for understanding and the woman looks similar to them"*	*"They [women] informed about breast cancer signs with the help of pictures on App"*	*"Women are shy in front of their in- laws [no discussion about breast cancer]but if I show pictures this will help with the embarrassment "*	Knowledge Codification	m-health technology facilitates local characteristics
	"This topic is uncomfortable for them I can now show them information"			
"If we get any information [on breast cancer] we will spread it in the community."	*"We can use pictures and sound to show women about the signs, some girls don't read"*	*"It is better to talk on this matter when all women are sitting together and chatting."*	Knowledge Transfer	
"To give information of breast cancer to women there should be community meetings"	*"Pictures on the tablet provides information, awareness and abnormalities… this is useful"*	*"When [we visit] these women discussion on breast cancer should take place with the help of these images"*		

Table 3: Illustrative coding of key themes related to m-health technology as a KM resource-based advantage in an emerging economies context.
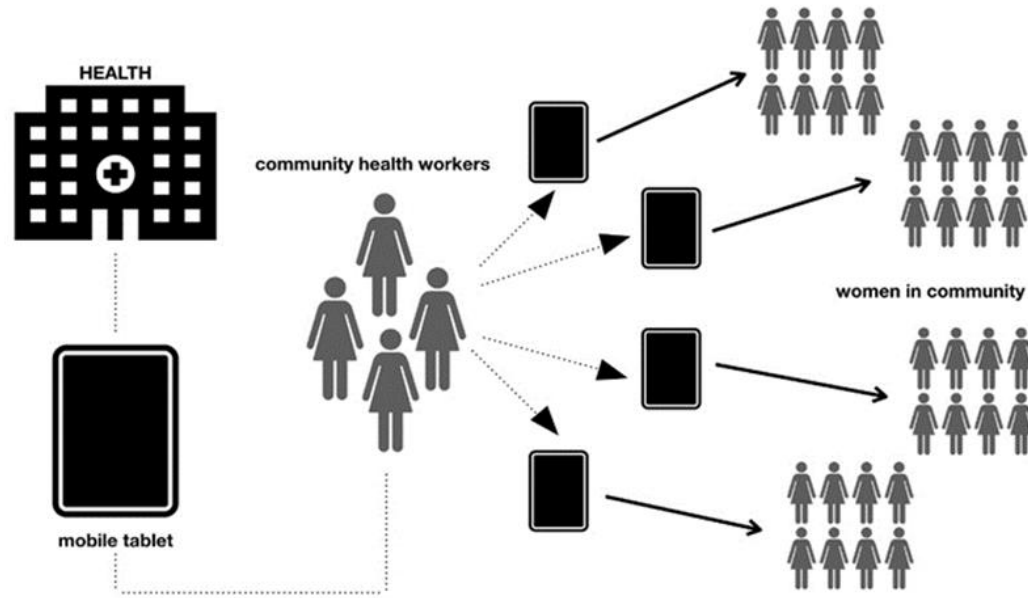
Figure 1: *M-health technology to give resource-based knowledge management advantage, to community health workers in rural communities in India*. (Authors own design)
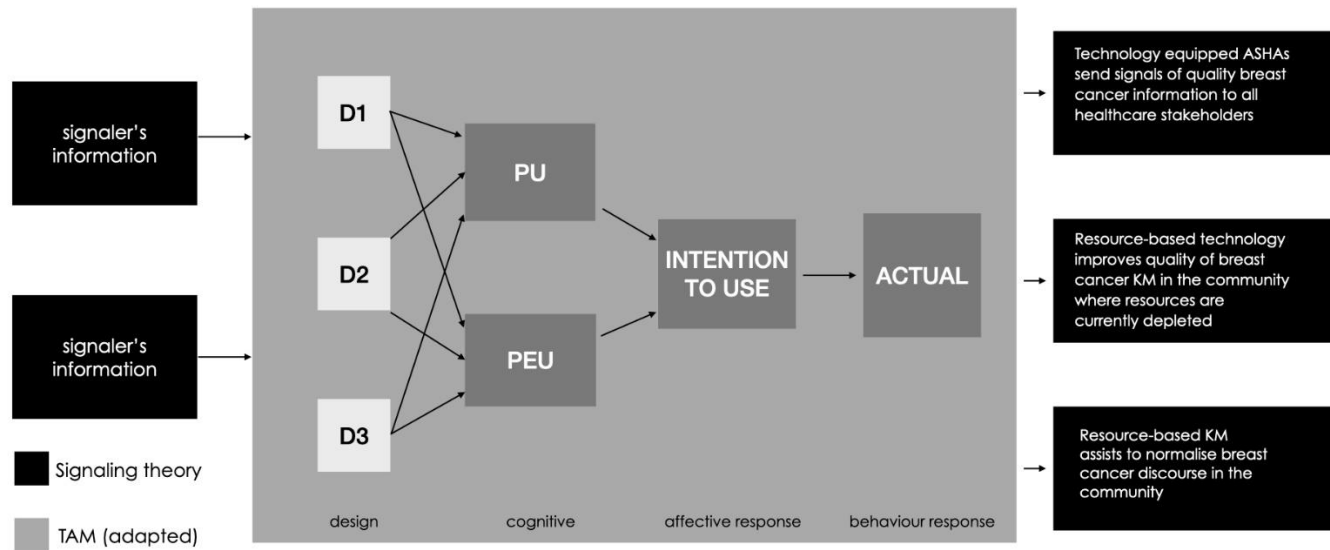
Figure 2: An interdisciplinary conceptualization to illustrate how an m-health knowledge-resource application used by frontline community health workers, can shape knowledge management to form a resource-based competitive advantage for an organization.