ABSTRACT
Personal Health Records (PHRs) play a pivotal role in improving the delivery of patient-centric healthcare services. They have proven to be an indispensable tool in the self-management of personal health and wellbeing. Most high income countries have managed to implement PHRs in the provision of patient-centric healthcare services. However, resource constrained settings such as developing countries encounter a lot of challenges in utilizing PHRs in the delivery of patient-centric healthcare services. This paper therefore gives a comprehensive discussion on the comparative analysis of viability of the deployment of PHRs in both developed and resource constrained settings in providing patient-centric healthcare services. It is envisaged that the findings from this study will be the starting point towards the formulation of guidelines in deploying PHRs that will facilitate the provision of patient-centric healthcare services. Furthermore, the study will provide valuable information for PHR designers, health providers and patients for patient-centric systems in a resource constrained setting.

KEY WORDS
Personal health records, Patient-centric, Valorisation, Resource Constrained, Healthcare system integration, Personalised telehealth

1. Introduction
Information and Communication Technologies (ICTs) have been shown to valorise the quality of healthcare services across the globe [1]. ICTs have played a pivotal role in improving the delivery of patient-centric healthcare services [2]. These are the services that place the patient at the centre of healthcare. Patients are empowered to manage their own health and wellbeing. As a result, patients are able to prevent illnesses and even get particular treatment based on their personal preferences, beliefs, desires and values [3]. PHRs still remain significant in the provision of patient-centric healthcare services. PHRs provide a lifelong health information that is managed and controlled by an individual. Patients are motivated to use PHRs due to a number of factors. Firstly, PHRs have proven to be an indispensable tool in the self-management of personal health and wellbeing [4]. Secondly, the proliferation of social networking tools and Health 2.0 tools have enabled patients to have an ubiquitous access to their PHRs [5]. There are a numbers of benefits that come with the usage of PHRs such as: i) Patients can be more engaged to manage their own health; ii) It improves the coordination of healthcare since information can emanate from various sources; iii) It improves the ubiquitous access to health information; iv) Less time is spent on searching for information thereby reducing administrative costs; v) It enables faster and easier communication between the health provider and health consumer thereby improving provider and patient relationship; and all these benefits improves the quality of healthcare [6, 7]. Patients and caregivers appreciate the amelioration of their health outcomes when using PHRs for emotional support from friends and families [8]. Health providers have an increased access to data from other providers and patients with the use of PHRs [9]. In addition, security of health information may be enhanced as PHRs give the patient the flexibility to limit who can access their records and also limit what can be accessed by other parties. Most high income countries have managed to implement PHRs in the provision of patient-centric healthcare services. However, resource constrained settings such as developing countries encounter a lot of challenges in utilizing PHRs in the delivery of patient-centric healthcare services. This paper therefore gives a comprehensive discussion on the comparative analysis of viability of the deployment of PHRs in both developed and resource constrained settings in providing patient-centric services.
healthcare settings. It is envisaged that the findings are the starting point towards the formulation of guidelines in deploying PHRs that will facilitate the provision of patient-centric healthcare services in a resource constrained environment. Furthermore, the study will provide valuable information for PHR designers, health providers and patients for patient-centric systems in a resource constrained setting.

2 Method

The paper endeavoured to answer the following research questions:

i) What is the comparative uptake of PHRs in supporting patient-centric health care services between high income countries and resource constrained countries?

ii) What impact do challenges have on the adoption of PHRs that can support patient centric healthcare services in a resource constrained setting?

iii) What are the potential solutions to address the challenges that can be encountered in implementing PHRs in a patient-centric healthcare system in a resource constrained setting?

A systematic review of different journal articles, peer reviewed conference papers and books was conducted in order to answer the aforementioned research questions. This involved the following process: searching of relevant work from multiple sources; describing study characteristics; summarising the evidence and finally interpreting the findings [10]. Articles that were analysed came from the following electronic databases such as Science Direct, Google Scholar, web of science and EBSCOhost. These articles were mostly between 2002 and 2016. A number of keywords such as, patient-centric, ICT, valorisation, resource constrained setting, public healthcare, developing, underdeveloped, poor setting, implementation, challenges, barriers, and personal health record were used to select appropriate articles. This resulted in displaying more than 4,251 articles. Special Boolean operators like AND, OR and NOT were employed in order to alter the scope of the search. These articles were further filtered by year and title of the publication with their relevance to the implementation of PHRs in patient-centric environment in a resource constrained setting.

3 Overview of PHRs

PHR is the tool that enables a patient to manage and control their own health and wellbeing. With PHR, patients take an active role in their own care. To accomplish this, patients require self-management skills besides having a conducive platform to access their health information. Much as the keeping of PHRs on paper is equally important, electronic PHRs enable easy and ubiquitous access of the patient record from multiple sources. It is important that measures must be put in place to ensure that health information is kept up-to-date, accurate and transparent such that there is a mechanism for a patient to know who accessed any part of the record. Usually PHRs empower the patient to give access rights to a particular individual. This also may depend on whether the PHR is paper based or electronic. In addition,
Table 1: Deployment of PHRS for patient-centric healthcare services in some of the developed countries.

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>PHR Project</th>
<th>Application of PHR to patient-centric healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>Sundhed.dk Portal</td>
<td>This portal empowers every citizen to find accurate and up-to-date information about diagnoses and treatments. Health providers too access securely health information about their patients [11].</td>
</tr>
<tr>
<td>2</td>
<td>UK including 7 other countries</td>
<td>Patients Know best Portal</td>
<td>Patient-controlled medical record portal that also allows patients and clinicians to share health information.</td>
</tr>
<tr>
<td>3</td>
<td>Canada</td>
<td>mydoctor.ca Health Portal</td>
<td>This connects physicians and patients for better health in Canada [12].</td>
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<tr>
<td></td>
<td></td>
<td>TelusHealth</td>
<td>This offers multiple patient and consumer health platforms such as Home Health Monitoring (HHM) and PHRs [13].</td>
</tr>
<tr>
<td>4</td>
<td>United States of America and accessed globally</td>
<td>Microsoft HealthVault</td>
<td>This is untethered web-based personal health record which may store and maintain patient health and fitness information which can also be accessed by legitimate health providers [14].</td>
</tr>
<tr>
<td>5</td>
<td>France</td>
<td>Dossier Medical Personnel (DMP)</td>
<td>Every citizen has a right to control their own personal health record. They may add more data and even choose which health professional can access their data. They are usually used for health insurance purposes [15].</td>
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</table>

Paper based PHRs are read only while some PHRs can be easily updated periodically or in real time with health providers. It is noteworthy that PHRs can also be either tethered or untethered. Tethered PHRs can be held by the specific healthcare provider thereby providing a patient a limited flexibility to the patient to access and update their personal data. On the other hand, untethered PHR is fully controlled by the patient. Figure 1 illustrates the concept the hub and spoke model of the PHR System that enables the patient to share information from multiple sources. It must be emphasised that the more the functions the PHR provides, the more the patient-centric, the system evolves. Related to PHR is the concept of shared social records which is boarder and covers information of both a person and those who may provide health and social care.

4. PHRs in the developed countries

The proliferation of PHRs in the developed countries has ameliorated the quality of the delivery of healthcare services. There are a number of factors that have contributed to the adoption of PHRs in these countries. One of them is that they have good and well established ICT infrastructure which facilitate the exchange of health information. In addition, literacy levels are also high which enable the patient to understand and appreciate the benefits of using the technology in managing their own health.
<table>
<thead>
<tr>
<th>No</th>
<th>Challenge in PHR adoption</th>
<th>Description</th>
<th>Impact on patient-centricity in resource constrained setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Privacy and security concerns [16] [17] [18]</td>
<td>Patients are afraid that storing health information online is vulnerable to unauthorised access</td>
<td>Very few patients make use of PHRs in order to manage their own health and well-being.</td>
</tr>
<tr>
<td>2</td>
<td>Cost [6]</td>
<td>It is costly to maintain a PHR and yet most patients prefer that they access their record free of charge.</td>
<td>With poor network infrastructure in developing countries, accessing PHRs online still remains costly. This has an impact on the availability of health information for both the health provider and consumer.</td>
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<tr>
<td>3</td>
<td>Health literacy [19] Internet literacy [17]</td>
<td>Health literacy determines the capacity of patients to obtain, interpret and understand basic health information. Internet literacy entails the competence of patients to communicate and share information on the internet.</td>
<td>Citizens with low levels of health literacy in developing countries have difficulties in appreciating the use of PHRs and therefore they tend to lack confidence in managing their own health.</td>
</tr>
<tr>
<td>4</td>
<td>Interoperability [20] [21]</td>
<td>Physicians and patients are not able to share information because systems are not able to exchange data.</td>
<td>This limits the extent to which a patient and health provider collaborate in sharing health information.</td>
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<td>5</td>
<td>Internet Access [22]</td>
<td>Patients have difficulties in accessing internet due to poor network infrastructure, lack of computers and mobile devices.</td>
<td>Patients may not access their PHRs due to lack of these resources in developing countries.</td>
</tr>
<tr>
<td>6</td>
<td>Perceived ease of use and perceived usefulness [23] [24] [25]</td>
<td>PHRs must be perceived to be easy to use and learn while collaborating between health consumers and health providers.</td>
<td>Early PHRs were not easy to use and learn and this discouraged patients from using them.</td>
</tr>
<tr>
<td>7</td>
<td>Diverse culture [26] [27]</td>
<td>In developing countries, there is a diversity of cultural and religious values and beliefs.</td>
<td>Language barriers, for example, have an impact on adoption of PHRs.</td>
</tr>
<tr>
<td>8</td>
<td>Policies and legal framework [28]</td>
<td>Most developing countries lack good policies and legal framework.</td>
<td>Lack of legal framework discourages both health provider and consumers from embracing PHRs since they do not feel protected.</td>
</tr>
</tbody>
</table>

### 4.1 Uptake of PHRs in the developed countries

There are a number of initiatives pertaining to the deployment of PHRs in the developed countries. It is noted that Denmark is leading in the usage of electronic health records and PHRs in Europe. In fact, the national PHRs are available to every citizen in Denmark [11]. Table 1 provides a snapshot of PHRs in the developing countries with regards to patient-centric healthcare services.
4.2 Challenges in deploying PHRs in developed countries

Despite success stories of the deployment of PHRs in the developed countries, the adoption and usage of these PHRs has encountered a number of barriers. Firstly, patient are concerned about the privacy and confidentiality of their health information. They are afraid that their health records may be tampered by an unauthorised person. As a result, they are reluctant to share their health information online with health providers and other patients. Besides this, managing one’s health requires that a patient is empowered with appropriate skills, some people may have difficulties in understanding medical data and patients may not understand the medical data. They may easily confuse medical terminologies and therefore there is chance of misinterpretations. There are still some people who are ICT illiterate such that they are not confident enough to use the emerging technology to manage their own health. For example, in 2013, the percentage of adults in England with low proficiency in literacy, numeracy and problem solving was 17, 24 and 18 respectively [29]. In addition to this, not everyone has an access to the computer and other portable devices.

5. PHRs in resource constrained settings

The use of ICTs has impacted on the provision of quality healthcare care in the public sector. In general, ICTs have proven to valorise the provision of patient centric healthcare services in a resource constrained setting [30]. It is therefore not surprising that an ICT framework was proposed to transition from provider-centric to patient-centric healthcare services in resource constrained settings [31]. For instance, ICTs in the developing countries have assisted to provide the following: i) Improvement in the dissemination of public health information; ii) Better remote consultation, diagnosis and treatment through telemedicine; iii) Facilitation of collaboration and cooperation among health workers thereby enhancing the sharing of health information; support of research in health; and iv) Improvement of efficiency of administrative systems in health care facilities [32]. It is noteworthy to highlight that ICT will continue to play a pivotal role in implementing PHRs to make healthcare systems more patient-centric.

5.1 Barriers in adopting PHRs for patient-centric healthcare services in resource constrained settings

There are many challenges that developing countries face in an effort to deploy PHRs which facilitate the provision of patient-centric healthcare services. These challenges influence the extent to which health consumers and health providers embrace the usage of PHRs. The adoption of PHRs can be hampered by technological, economic, technological, behaviourial, and organizational barriers [33]. Table 2 provides a summary of the impact of these challenges with regards to the delivery of patient-centric healthcare services in a resource constraining setting.

5.2 Deployment of PHRs to support patient-centric systems in resource constrained settings

Despite the barriers resource constrained countries face, efforts have been made to deploy PHRs that can support patient-centric systems. As already mentioned, these efforts are fruitful because the usage of the PHRs has shown some of the following benefits: data can be integrated from multiple sources such as Electronic Medical Records (EMRs) and PHRs; it gives control to patients to add and modify their own data towards management of chronic diseases; and finally it enhances dynamic and continuous communication among all health players for the delivery of effective and efficient healthcare services [34]. Table 3 summaries some of the initiatives in deploying PHRs in selected countries.

6. Discussion

With the global trend of adoption of patient-centric healthcare services, resource constrained settings such as developing countries are not remaining behind to take control of their own health and wellness. For this to be a success, resource limited countries need to apply extra effort to surmount the challenges that are specifically encountered in these settings. Two main mechanisms to mitigate the aforementioned challenges for the adoption of PHRs are education and research [33]. It can therefore be suggested that deliberate initiatives must be put in place to reach out to the general public on sensitising the general public about the benefits of PHRs including vulnerable and minority groups. This would allow them to appreciate the usage of PHRs. Since patients are very much concerned about the privacy of their personal health information, health providers must ensure to initiate mechanisms to preserve security and privacy of data. One way is to provide guidance on how patients can access their records safely and securely. This will enable patients to trust the health system with their personal data. It is a well-known fact that most people who live in a resource constrained setting may not have computers and other electronic devices to access the internet.
Table 3: Deployment of PHRs that support patient-centric systems in some of resource constrained settings

<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>Project</th>
<th>Applicability to patient-centricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>South Africa</td>
<td>LifeDoc</td>
<td>Launched in 2015, LifeDoc is the first independent personal health record in South Africa. It is able to record, store, track, manage and share health records of its members from one place [35].</td>
</tr>
<tr>
<td>2</td>
<td>Nigeria</td>
<td>Integrated Maternal, New born and Child Health</td>
<td>This PHR empowers mothers and midwives in improving maternal and new born babies care [36].</td>
</tr>
<tr>
<td>3</td>
<td>India</td>
<td>Healthrecordsindia</td>
<td>An advanced PHR designed for Indian healthcare system. It is cloud based solution that empowers patients. It collects, digitises and optimises any type of medical records [37].</td>
</tr>
<tr>
<td>4</td>
<td>Malaysia</td>
<td>IPHR</td>
<td>This individual personal health record empowers patients to record, monitor, and store and deliver personal health information to any healthcare provider [38].</td>
</tr>
<tr>
<td>5</td>
<td>Ghana</td>
<td>Mpedigree</td>
<td>This allows patients to see, update and share the information that is held by health and social care professionals [39].</td>
</tr>
</tbody>
</table>

It is therefore recommended that places such as libraries or internet café must be designated where people can access their patient records. Training and support must be provided to the ICT illiterate so that they may appreciate the ICT intervention not only in the management of their health but also in their daily life such as education sector [40]. In fact, there is a need to tailor the technology to target the most vulnerable such as those with disabilities or those who are ICT illiterate. In case of patient-centric health systems, help features must be included by PHR designers to assist users to understand the system. To further motivate the patients to appreciate the use of health systems, users must be involved in the design of the PHR services. Caution must be taken to balance the ease of access of using the healthcare systems without compromising the security and confidentiality of their records.

7. Conclusion

There is much emphasis on the adoption of patient-centric approach in the delivery of healthcare services across of the globe. The motivation is that this approach encourages patients to manage their own health and wellbeing. This consequently has improved the quality of healthcare services. PHRs have played a pivotal role in the delivery of patient-centric healthcare services. The benefits of adopting PHRs are enormous to all health players including patients, healthcare providers and payers. For instance PHRs have been shown to improve access to health information thereby empowering patients to manage their own health. This has consequently improved health outcomes. Despite these benefits, there is still low uptake of PHRs in the developing countries. This paper has therefore attempted to provide a comprehensive comparative analysis of the uptake of PHRs between high income and resource constrained countries with reference to the patient-centric care delivery. It has also highlighted the barriers that are encountered in adopting PHRs both in developed and developing countries. Finally recommendations to circumvent the aforementioned barriers in a resource constrained setting have also been elucidated. It is therefore envisaged that this valuable information will assist towards the formulation of guidelines in deploying PHRs for PHR designers, health providers and patients for patient-centric systems in a resource constrained setting.

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[27] Xie, J., et al., Barriers and Facilitators of Personal Health Record Adoption. n.d.


