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## IMPLEMENTATION OF TELEMEDICINE SERVICES IN LOWER-MIDDLE INCOME COUNTRIES: LESSONS FOR THE PHILIPPINES

Romeo Luis A Macabasag RN<sup>1</sup>, Kristine Mae P Magtubo MD, MPM<sup>1</sup>, Portia Grace H Fernandez-Marcelo MD, MPH<sup>1,2</sup>

<sup>1</sup>National Telehealth Center, National Institutes of Health, University of the Philippines Manila

<sup>2</sup>Department of Family and Community Medicine, College of Medicine, University of the Philippines Manila

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### Abstract

Regardless of the promising potential of telemedicine to address healthcare problems, especially in lower-middle income countries, its success rate has been unsatisfactory and many telemedicine services fail to sustain their implementation shortly after initial funding or after a pilot phase. Therefore, it is important to document existing models of telemedicine implementation in these countries, to identify commonalities and extract experiences that would be useful for implementers, policy makers and future researchers. This review seeks to review and describe the experience of Low and Middle Income Countries (LMICs) in implementing telemedicine services. Evidence extracted from the included studies were analysed through a narrative synthesis which suggests a multi-sectoral approach for implementing telemedicine. It highlights the importance of education, financing options, policy, technology, governance, and partnership, in the wider picture of a sustainable telemedicine implementation among developing countries such as the Philippines. Moreover, the literature reveals both top-down and bottom-up approach for successful telemedicine implementation. These approaches include strengthening the local health workers and integrating telemedicine into the health system. Studies included in this review have been helpful, but there is an obvious lack of studies with high level of evidence that can yield generalisable, thus findings must be inferred with prudence. Even so, this review described and summarised the data which allowed description of factors and lessons in the implementation of telemedicine in LMICs.

**Keywords:** Telemedicine; telehealth; eHealth; implementation; lessons; developing countries; Philippines

### Introduction

The potential of telemedicine is being realised globally. Telemedicine has already demonstrated its potential in enhancing delivery of healthcare services by improving access, cost-effectiveness, quality and efficiency of health services. Researchers foresaw that delivery of health services especially in industrialised nations will be transformed through telemedicine by gradually shifting the delivery of health services away from clinics and hospitals into homes.<sup>1</sup> As such, highly industrialised countries had already initiated the integration of telemedicine into their healthcare system in an attempt to deliver better healthcare services especially in rural or isolated areas where specialists are at a distance.<sup>2</sup>

Due to the recognised positive influence of telemedicine in bridging gaps and inequities in healthcare (e.g. improving access to healthcare services, especially in isolated areas), low and middle income countries (LMICs) have similarly engaged in the use of telemedicine. Projects and programmes on telemedicine in low resource settings allow distant health workers to diagnose, manage patient care, follow-up, evaluate care to patients,<sup>3</sup> and improve access to tertiary level care advice.<sup>4</sup> Outcomes of such programmes have demonstrated the capacity of telemedicine to improve healthcare service delivery and even patient health outcomes (i.e. quality of life of patients with chronic conditions).<sup>5</sup> However, regardless of the promising potential of telemedicine in addressing healthcare problems, its success rate has been unsatisfactory. Many telemedicine services fail to sustain their implementation shortly after initial funding or after a pilot phase.<sup>6</sup> Furthermore, there is a paucity of research surrounding effective implementation within LMICs.<sup>7</sup> Available literature on eHealth in LMICs mostly consist of articles that depict single uses of technology in the delivery of healthcare

services<sup>8</sup> with no documentation on their implementation process. The identified gaps affirmed the need for further research to document existing models of telemedicine implementation in LMICs to identify commonalities and extract experiences which would be useful for implementers in LMICs.

This study reviews and describes the experiences of LMICs, excluding the Philippines, in implementing telemedicine services. In particular, the study characterises how telemedicine services are being implemented within LMICs in terms of type of use modality, financing, and channel, and identifies lessons for sustainable implementation of telemedicine services in LMICs. The specific objective was to develop recommendations for implementing sustainable telemedicine services in the Philippines.

## Methods

This review used the PRISMA framework for reporting the literature search. Computerised literature searches were performed using PubMed, EBSCOhost, Google Scholar and Google Search Engine. The search strategies, using the search terms and Boolean operators, are presented in Appendix A. A literature search on Google Scholar and Google Search engines were also conducted in order to capture grey literature, to diminish the possibility of publication bias.<sup>9</sup> Google Search were recommended as a source grey literature provided that customised search terms will be used.<sup>10,11</sup> The first 10 pages of hits were reviewed. Telemedicine was defined as the delivery of health services (preventive, curative and rehabilitative) using information and communication technologies (ICTs) at a distance where patient and the health worker are not present at the same location and patients' data are electronically transmitted,<sup>12</sup> and 'lower-middle income countries' as those with gross national income (GNI) per capita of \$1,036 to \$4,085 as categorised by the World Bank. Low- and middle- income countries are considered to be developing countries.<sup>13</sup>

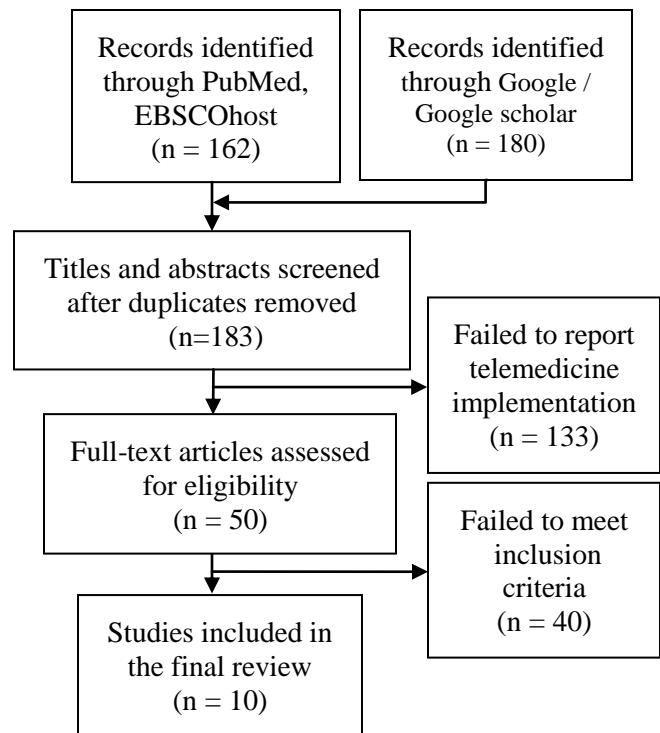
For inclusion, studies must: show experiences and lessons in implementing telemedicine services in an LMIC; be published between January 1, 2005 and December 31, 2015; be written in English; and be with published abstract and free full-text downloadable version in portable document format (pdf). The authors were in consensus in selecting the articles for the study. Titles and abstracts of each retrieved study were assessed by one of the reviewer (RLM) against

the inclusion criteria and were verified by the second reviewer (KMM).

Articles included were scanned for: country of telemedicine implementation, type of financing, telemedicine use, modality of telemedicine and channel of communication. Thematic analysis was started through independent free line-by-line coding of the findings by the authors. After which, texts were organised in an excel sheet to establish commonalities. Similar or related descriptive themes were organised under one analytical theme. This review produced five analytical themes which are summarised in Table 1. The quality of each study was assessed using the strength of evidence classification of Jovell and Navarro-Rubio,<sup>14</sup> where the levels are described in descending manner of strength.

## Results

A total of 342 articles were identified using the search strings for this review. After 159 duplicates were removed, 183 articles were subjected to title and abstract review and 50 full text articles were reviewed against the inclusion criteria. Of these, 10 were considered eligible for the final review. (Figure 1)



**Figure 1.** The literature search process.

A descriptive summary of the type of telemedicine reported in the 10 papers is shown in Table 1.

**Characteristics of included studies**

Of the ten studies in this review, seven (70%) discussed country wide specific telemedicine initiatives,<sup>15,17-20,22,23</sup> while the remaining three (30%) discussed telemedicine implementation in LMICs in general.<sup>16,21,24</sup> Most of the studies were descriptive in nature signifying poor strength of evidence.

**Financing.**

Most of studies revealed that telemedicine services were funded through combinations of different financial resources – government, private (local for-profit or non-profit) and foreign agencies – and were classified as such since financing mechanisms were not extensively discussed. Six studies reported collaboration between the government, private or-

ganisations, and foreign agencies in funding telemedicine services.

**Type of Telemedicine Use**

Telemedicine services were mainly used for clinical services.<sup>15-24</sup> Additionally, eight studies discussed telemedicine’s use for continuing education of health professionals,<sup>16-23</sup> while three studies specified use of telemedicine for disease surveillance along with clinical and educational use.<sup>16,20,22</sup>

**Telemedicine Modality**

The modality of telemedicine services were classified into real-time (synchronous) and store-and-forward (asynchronous). Most (80%) of the implementers used both asynchronous and synchronous telemedicine modalities,<sup>15,17,18,20-24</sup> while the remaining studies described use of asynchronous<sup>16</sup> and synchronous modalities<sup>19</sup> separately.

**Table 1.** Descriptive summary of telemedicine implementation.

Author	Type of Study	Setting	Financing	Type of Telemedicine	Modality of Telemedicine	Channel of Communication
Luk et al. (2008) <sup>15</sup>	Descriptive	Ghana	G, P, F	C	A, R	M, W
Mechael et al. (2010) <sup>16</sup>	Descriptive	LMIC (not specified)	not specified	C, E, S	A	M
Nessa et al. (2010) <sup>17</sup>	Descriptive	Bangladesh	G, P, F	C, E	A, R	M, W, V
Hussein et al. (2012) <sup>18</sup>	Descriptive	Egypt	G, P, F	C, E	A, R	M, W, V
Agrawal et al. (2013) <sup>19</sup>	Case Report	India	G, P	C, E	R	V
Ahmed et al. (2014) <sup>20</sup>	Descriptive	Bangladesh	G, P, F	C, E, S	A, R	M, C
Bediang et al. (2014) <sup>21</sup>	Descriptive	Mali, Bolivia, Nepal	G, F	C, E	A, R	M, W, V
Jaroslawski and Saberwal (2014) <sup>22</sup>	Descriptive	India	G, P, F	C, E, S	A, R	C, M, W, V
Latifi et al. (2014) <sup>23</sup>	Case Report	Cape Verde	G, F	C, E	A, R	W, V
Wootton and Bonnardot (2015) <sup>24</sup>	Descriptive	Nepal, Bostwana, Africa, Jordan	G, P, F	C	A, R	M, W, V

*Type of Use:* C - Clinical; E - Education; S - Surveillance (disease)  
*Modality:* R - Real-Time; A - Asynchronous;  
*Channel:* V - Videoconference; M- Mobile Phone; C - Call Centre; W - Web-Based Applications  
*Financing:* G - Government; P - Private (for profit or non-profit); F – Foreign

*Channel for communication*

All studies showed that more than one channel for communication was used for telemedicine services. These were mobile phones (9 studies), videoconferencing (7 studies), web-based applications (7 studies), and call centres (2 studies).

Results of the thematic analysis highlighting the lessons about successful implementation of telemedicine services in LMICs are shown in Table 2.

*Lessons for sustainable implementation of telemedicine services*

*Capacity building for health human resources*

One of the themes that emerged in this review was the need to invest in health human resources. Specifically, this theme suggested the creation of training programmes for telemedicine for health workers<sup>15,16,19,21-23</sup> particularly among non-IT savvy health personnel,<sup>17</sup> paramedical, and non-medical

**Table 2.** Lessons for sustainable implementation of telemedicine.

Themes	Key Lessons
Capacity Building for Health Human Resources	Introduce training programmes for physicians, allied health professionals <sup>15,16,19,21-23</sup> and non-medical staff, even the non-IT savvy <sup>17</sup> and non-medical personnel <sup>19,22</sup>
	Offer academic courses leading to professional certification or accreditation in the practice of telemedicine for health workers <sup>20,22,23</sup>
	Hold regular national or regional conferences for all telemedicine users / implementers <sup>21,23</sup>
Financing of Telemedicine Services	Better match funds and needs - must be needs-driven, not donor driven <sup>22</sup>
	Focus telemedicine funding to address overall healthcare, rather than specific diseases, and shift attention from curative to preventive <sup>22</sup>
	Use a collaborative funding approach between various government agencies <sup>20</sup>
	Transfer to Government funding after initial (pilot) support from private or foreign institutions <sup>21</sup>
	Consider public-private partnerships <sup>15,16,18,20,</sup>
Need for the Creation of Policies and Governance in eHealth	Develop health human resources policy for telemedicine <sup>20</sup>
	Develop policies to facilitate integration of telemedicine into the delivery of health services, <sup>15-17,22</sup> and align telemedicine initiatives with local needs and national health strategies <sup>21</sup>
	Create necessary legal and ethical frameworks <sup>17</sup>
	Develop policies on the use of electronic records <sup>22</sup>
	Decentralise governance of telemedicine <sup>21</sup>
	Consider the ‘Initiate-Build-Operate-Transfer (IBOT) approach <sup>21,23</sup>
Fostering Collaborations and Partnerships	Consider partnerships between government and foreign agencies <sup>15,21,23,</sup>
	Consider partnership between different government agencies <sup>12,22</sup>
	Consider partnership between government and local health workers <sup>24</sup>
	Integrate telemedicine into the informal, social, and professional network of health workers <sup>15</sup>
	Involve scientific societies to help lead regional, national or international workshops <sup>15</sup> and sessions, along with key national political and scientific actors <sup>21</sup>
Technology	Funding should be used for deployment of existing functional technologies, rather than in development of new pilots of existing functional technologies <sup>22</sup>
	Use inexpensive smart phones (i.e. open-source Android devices); better suited for individuals with low literacy <sup>22</sup>
	Offer and optimise extend learning for novel technologies for both manufacturers and implementers <sup>22</sup>
	Use satellite-based connectivity instead of the Internet <sup>22</sup>
	Use wireless telemedicine equipment options; preferable to wired devices <sup>17</sup>
	Address interoperability issues through designing a technical architecture to address <sup>16</sup>

personnel.<sup>19,22</sup> The creation of professional certification or accreditation through formal academic courses<sup>20,22,23</sup> was also mentioned to standardise the practice of telemedicine.

#### *Financing of Telemedicine Service*

Many of the telemedicine services described in this review were financed by foreign or private donor agencies, as well as from government support. Better matching of funds with the needs of the population will ensure that initiatives are needs-driven not donor driven, and shift the focus towards addressing the overall healthcare situation, and avoid focusing on specific diseases. To ensure population health into the future, priority must be shifted from curative to preventive use of telemedicine.<sup>22</sup>

While foreign or private donors are still funding telemedicine services, the literature noted that governments must strategically prepare to shoulder the ongoing funding of proven telemedicine initiatives.<sup>21</sup> A collaborative rather than vertical approach to financing telemedicine was suggested to efficiently utilise government funding.<sup>20</sup> Also, involvement of the private sector through well-defined public-private partnerships was emphasised.<sup>15,16,18,20,</sup>

#### *Need for the Creation of Policies and Governance for Telemedicine*

Several studies suggested the importance of policies that will govern the practice of telemedicine. Two studies emphasised the necessity to create a policy on human resources<sup>20</sup> simultaneously with a policy for the integration of telemedicine into health service delivery,<sup>15,18,17,22</sup> and the alignment of telemedicine initiatives to local needs and national health strategies.<sup>21</sup>

To facilitate local ownership, one study suggested the decentralisation of governance in the implementation of telemedicine<sup>21</sup> along with the legislation of legal and ethical frameworks.<sup>20,21</sup> An ethico-legal framework is needed for the use of interoperable electronic records in telemedicine.<sup>17</sup> In addition, one study affirmed the Initiate-Build-Operate-Transfer (IBOT) approach as an effective method in sustainable implementation of telemedicine.<sup>21,23</sup>

#### *Fostering Collaborations and Partnerships*

Different partnerships were emphasised in this review. Partnerships between local and foreign agencies<sup>15,21,23</sup> were seen to be important as well as strengthening the relationship between different government agencies<sup>18,20,22</sup> and their relationship with health

workers at the grass roots level.<sup>20</sup> The involvement of scientific societies was recognised to facilitate continuous development in telemedicine.<sup>21</sup> Informal, social and professional networks of health workers were also seen as a vital factor in implementing telemedicine.<sup>15</sup>

#### *Development of Technology for Telemedicine*

In terms of technological development, there is a trend to continuously improve applications while existing software are still functional. Finances are sometimes used in developing new pilot technologies, instead of focusing on the wider implementation of existing functional technologies. In effect, this may lead to rapid obsolescence of existing hardware and software technologies. Furthermore, the development of technologies must be put into appropriate context considering its users. Open-source Android devices are preferred for personnel with poor literacy. Although novel technologies are better, it may require additional time for optimisation and learning, both for implementers and manufacturers – thus slowing the adoption and use of technology.<sup>22</sup> Satellite-based connections were used in some LMICs<sup>17</sup> thus wireless telemedicine devices are more preferred than wired devices.<sup>21</sup> There is a clear need for an eHealth technical architecture to promote interoperability among different health systems.<sup>16</sup>

## **Discussion**

In all of the papers in this review, telemedicine services were used to provide clinical services to patients, corroborating the work of the Lustig<sup>25</sup> and Ahmed et al.<sup>20</sup> Additionally, eight studies discussed telemedicine's use for the continuing education of health professionals,<sup>17-21,23,24</sup> while two other studies specified the use of telemedicine for disease surveillance along with clinical and educational use.<sup>16,20</sup> The studies further supported the use of telemedicine as a means to deliver healthcare remotely, especially in developing countries where issues such as a lack of specialists and medical infrastructure prevail.<sup>26</sup> In Bangladesh, part of their health service delivery is teleconsultation via call centres, short messaging services (SMS), and videoconferencing which enable remote diagnosis, prescription, disease management, and/or referral. Telemedicine and health information systems of public health institutions are connected to the Directorate General of Health Services (DGHS), which helps in

the regular reporting of health indicators and disease surveillance throughout the country.<sup>20</sup>

Implementers used both asynchronous and synchronous telemedicine modalities<sup>15,17,18,20-24</sup> in eight papers, while one study focused on an asynchronous modality<sup>16</sup> and one used real-time modality.<sup>19</sup> For example, Latifi et al. documented a total of 63 teleconsultations in the initial 7 months of implementation of asynchronous and synchronous telemedicine in Cape Verde; the majority (84%) used a synchronous modality while 16% were facilitated through an asynchronous modality.<sup>23</sup>

Asynchronous telemedicine is more feasible and the preferred modality for telemedicine in rural areas and developing countries since the approach is cheaper to implement than traditional face-to-face medicine, and is less expensive than synchronous telemedicine.<sup>27</sup> The use of synchronous telemedicine is now being explored among LMICs.<sup>28</sup> The emergence of studies detailing the use asynchronous and synchronous modalities in LMICs shows that both modalities of telemedicine can be implemented in developing countries.

Eight articles show combined use of either videoconference applications, mobile phones, web-based applications and call centre.<sup>15,17,18,20-24</sup> One article described the use of mobile phones<sup>16</sup> while the other presented videoconferencing.<sup>19</sup> This shows there are already lower-middle income countries who have experienced using synchronous telemedicine. Bediang et al.<sup>21</sup> described Réseau en Afrique Francophone pour la Télé-médecine (RAFT) Network's involvement in deploying such interventions in developing countries. Teleconsultations are done using web applications and videoconferencing. Existing communications technologies can connect healthcare professionals and information systems located at distant sites, thereby supporting clinical services, healthcare management, administration, and medical and patient education.<sup>29</sup> Development of telemedicine in LMICs is continually explored amidst infrastructure problems.<sup>20</sup>

Maintaining adequate health human resources is indeed essential in implementing telemedicine. Telemedicine is a new approach to delivering health services and empowering health workers – the primary users of telemedicine.<sup>19</sup> Training programmes should be offered to enable users to adapt to this new technology,<sup>21</sup> for example by offering academic courses leading to professional certification or

accreditation in the practice of telemedicine,<sup>20</sup> or training programmes in eHealth and health informatics to help build the capacity of health professionals.<sup>21</sup> Such initiatives serve as a knowledge multiplier in the local area.

Financial constraints are considered as one of the reasons for the discontinuation of eHealth initiatives.<sup>20</sup> Most financing schemes for telemedicine in LMICs are from foreign agencies and government institutions. Donors lean towards telemedicine initiatives for specific disease, while the need is for a more general health approach. Most government funding targets higher tiered levels of care (i.e., hospitalisation) instead of preventive care.<sup>22</sup> Collaboration between Ministries is essential. For example, in Bangladesh, eHealth initiatives are principally financed by the Ministry of Health, but ICT infrastructure is independently financed by the Ministry of Information and Communication Technology.<sup>20</sup>

The final goal of donor funding of telemedicine services should be to integrate initiatives into government plans. The RAFT network's funding scheme included provision of two years worth of connectivity fees, following which the receiving institution had to provide ongoing funding. RAFT believed that two years was enough for the partner country to demonstrate the benefits of telemedicine, and convince their executives to shoulder the operational costs.<sup>21</sup>

Hussein and Khalifa<sup>18</sup> proposed to develop funding models to facilitate public-private partnerships for sustainable telemedicine services. This model must now focus on wider national programmes with clear targets through well-informed public-private partnerships.<sup>24</sup>

Policy and governance in the practice of telemedicine was also highlighted. In Bangladesh, the absence of national eHealth and telemedicine policy along with financial issues was seen as a crucial barrier to successfully implementing telemedicine services. Policies concerning eHealth (including telemedicine) should focus on complementing the building blocks of the health system. Effective policy on human health resources with defined roles was also seen to be important.<sup>20</sup>

Policies on human health resources and policies on integrating telemedicine into delivery of health services are necessary. An example of such policy is in Cape Verde, where the Ministry of Health ordered telemedicine to be mandatory before any medical

evacuation, except when the referring physician considers the condition of the patient to be life threatening and warrants immediate referral.<sup>23</sup> In contrast, in India, the lack of such policies demotivates physicians to use telemedicine, since it is neither mandatory nor does the physician earn for this work.<sup>22</sup>

RAFT Network's decentralisation model is another example of a policy and governance initiative in telemedicine. In each country, the RAFT Network organises a local team that will be responsible for crafting the strategy, implementation, and coordination at the national level. The central team of RAFT's Network in Geneva ensures general coordination within the RAFT network. The Network also assists in the development of national eHealth strategies as in Burkina Faso where the RAFT medical coordinator serves as officer-in-charge for eHealth within the Ministry of Health.<sup>21</sup>

Improving partnership and cooperation among key telemedicine players (local, national and international), is considered an important lesson. The partnership between government and foreign agencies is seen to be beneficial. Cape Verde developed a partnership with the International Virtual e-Hospital (IVeH). The Ministry of Health committed to the provision of personnel, facilities, integration of the services of the Ministry, and the mandate for telemedicine transfer; the IVeH provided the funding for the programme and endowed support in terms of clinical support, technical assistance, policies, training, equipment and procedures.<sup>23</sup> The RAFT Network also facilitates partnerships between its member countries which are conducted through workshops with participants from the members of the network, and organised to support sharing of ideas and strengthening of interpersonal links.<sup>21</sup>

It is vital to strengthen the partnership and collaboration between the Ministry of Health and local health workers to facilitate local ownership of a programme and demonstrate senior management support. From experience, scaling small pilot projects through a bottom-up approach together with local health workers, government and senior management support can guarantee success.<sup>24</sup> Integrating telemedicine in the current network and developing a system that will enable referring physicians to contact their informal, social and/or professional network is seen to be significant.<sup>15</sup> Involvement of scientific societies can help in leading regional, national or

international workshops and sessions along with key national political and scientific actors.<sup>21</sup>

Different technologies used in telemedicine were briefly explained in the majority of the studies. Most used videoconferencing equipment, complemented with other technologies. One study described the use of a deployable eHealth centre made up of two half shipping containers that can traverse narrow roads or hilly terrain.<sup>19</sup> A remote health cloud linked through the nearest mobile phone tower connects their electronic medical record. Telemedicine was enabled between the eHealth centre and other tertiary level facilities via the health cloud. In Cape Verde, technologies for telemedicine included telemedicine carts, videoconferencing equipment, e-electrocardiographs, e-stethoscopes, vital signs monitors, and ultrasound probes.<sup>23</sup>

LMICs were able to avail videoconferencing technologies through support from outside organisations, like in Cape Verde.<sup>23</sup> Although the majority showed use of sophisticated technologies for telemedicine, it is affirmed that store-and-forward (asynchronous) telemedicine – which does not require sophisticated videoconferencing technologies – is clinically useful, sustainable and potentially cost-effective.<sup>24</sup>

#### ***Implications for telemedicine implementers, policymakers, and future researchers in the Philippines***

There are formal and informal educational programmes in the Philippines that seek to expose health workers to the practice of telehealth. These programmes are mostly at the graduate level of education.<sup>30,31</sup> Initiatives in embedding telehealth in the education of health sciences students at the undergraduate level must be sought, to increase their awareness of the usefulness of ICTs in health services. Discussions regarding the applicability of telehealth and telemedicine between academic institutions and research consortia should be pursued.

Administrative orders, executive orders, and house bills<sup>32,33</sup> have already been drafted to set directions for telehealth in the Philippines. These policy papers recognise the role of telehealth and telemedicine in complementing existing health programmes of the government. Hence, it is reasonable to revive the initiative and to push for the passage of this legislation into law. The National eHealth Steering Committee (NeHSC), co-chaired by the Secretaries of the

Department of Health and Department of Science and Technology, should be revitalised once again and lead to the formalisation of telemedicine as a common health service. Clear policy and governance can also pave the way to better financing options.

Collaboration and partnership are indeed important. The Philippines can learn from other neighbouring countries who also strive to implement or have already implemented a nationwide telemedicine service. Organisations such as the Asia eHealth Information Network<sup>31</sup> is one avenue where the Philippines can learn, share and connect ideas with fellow eHealth and telemedicine advocates. Collaboration must be two-way, and so partnership must also exist further strengthening the grassroots level by providing necessary resources, tangible and intangible. Ultimately, the success of telemedicine depends on whether the local health workers will use the service or not.

While the literature calls for wider implementation of existing functional telemedicine technologies, developing new pilot technologies that address same problems with that of the previous cannot be prevented. Thus, technologies must complement, and not compete with each other. In the Philippines, there are at least six different electronic medical records system.<sup>35</sup> Harmonising these technologies can be done by following standards for seamless integration. In fact, the NeHSC has already initiated the creation of a national framework for adoption and management of mandatory common standards for the health sector, with the aim of institutionalising the national implementation of health data standards for eHealth standardisation and interoperability at all governance levels.<sup>36</sup>

Overall, LMICs commonly used both synchronous and asynchronous telemedicine. Existing asynchronous telemedicine technologies must be strengthened while financing for telemedicine is not yet clear. Use of more sophisticated telemedicine modalities should be explored as infrastructure permits.

**Limitations**

Methodological insufficiencies were common, thus, findings must be inferred with prudence. There are also disagreements on the use of Google that it is a poor choice for a systematic review.<sup>37</sup> Articles not written in English and not published between January 1, 2005 and December 31, 2015 were excluded. Thus evidence is limited and the studies included in this

review were of low quality, thus, the generalisability of the included studies was also low. The paucity of publications documenting the implementation of telemedicine among LMICs indicates the need to provide further evidence on implementation. Meta-analysis could not be executed because of non-homogeneity (e.g., study setting, sample size, and research design). Even so, this review collated and summarised the data about factors influencing, and lessons learnt from, implementation of telemedicine in LMICs.

**Conclusion**

This review shows general lessons for the Philippines and other LMICs to achieve successful implementation of telemedicine services. Studies included in this review were helpful, but there is an obvious lack of studies with a high level of evidence that can yield generalisable results. Research establishing a high degree of evidence must be conducted, especially in LMICs.

The literature reveals simultaneous top-down and bottom-up approaches for successful telemedicine implementation. These approaches include capacitating the local health workers who are at the grassroots, simultaneously with strengthening the integration of telemedicine into the traditional health system. Policies on governance and financing have been emphasised. Implementing other modalities of telemedicine such as synchronous telemedicine should also be explored, alongside strengthening existing asynchronous telemedicine. Implementing telemedicine is a multi-faceted initiative and a multi-sectoral collaboration among stakeholders determines success or failure.

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**Corresponding author:**

Romeo Luis A. Macabasag, RN  
 Research Associate  
 3<sup>rd</sup> Floor, Information Technology Complex Bldg.  
 Philippine General Hospital, University of the  
 Philippines Manila  
 Taft Ave., Ermita, Manila, Philippines 1000  
 Mobile: (+63) 915 513 6520  
 Email: [mromeoluis@telehealth.ph](mailto:mromeoluis@telehealth.ph)

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## Appendix A.

### Database search terms and strings.

Concept	PubMed	EBSCOhost	Google Scholar/Google Search Engine
Telemedicine	Telemedicine[tiab] OR tele-medicine[tiab] OR tele-consult*[tiab] OR teleconsult*[tiab] OR eMedicine[tiab] OR e-Medicine[tiab] OR “mobile health” [tiab] OR “health mobile” [tiab] OR mHealth*[tiab] OR telehealth[tiab] OR tele-health[tiab] OR eHealth[tiab] OR e-Health[tiab]	Telemedicine OR tele-medicine OR tele-consult* OR teleconsult* OR eMedicine OR e-Medicine OR “mobile health” OR “health mobile” OR mHealth* OR telehealth OR tele-health OR eHealth OR e-Health	telemedicine OR telehealth OR eHealth
Implementation	Project[tiab] OR service[tiab] OR implement*[tiab] OR operate*[tiab] OR execute*[tiab] OR running[tiab] OR “carrying out” [tiab] OR deploy*[tiab]	Project OR service OR implement* OR operate* OR execute* OR running OR “carrying out” OR deploy*	service OR project OR program OR implementation OR deployment
Lower-Middle Income Countries	Armenia[tiab] OR Bangladesh[tiab] OR Bhutan[tiab] OR Bolivia[tiab] OR “Cabo Verde” [tiab] OR Cameroon[tiab] OR Congo[tiab] OR “Cote d’Ivoire” [tiab] OR Djibout[tiab] OR Egypt[tiab] OR “El Salvador” [tiab] OR Georgia[tiab] OR Ghana[tiab] OR Guatemala[tiab] OR Guyana[tiab] OR Honduras[tiab] OR India[tiab] OR Indonesia[tiab] OR Kenya[tiab] OR Kiribati[tiab] OR Kosovo[tiab] OR Kyrgyzstan[tiab] OR Laos[tiab] OR Lesotho[tiab] OR Mauritania[tiab] OR Micronesia[tiab] OR Moldova[tiab] OR Morocco[tiab] OR Myanmar[tiab] OR Nicaragua[tiab] OR Nigeria[tiab] OR Pakistan[tiab] OR “Papua New Guinea” [tiab] OR Philippines[tiab] OR Samoa[tiab] OR “Sao Tome and Principe” [tiab] OR Senegal[tiab] OR “Solomon Islands” [tiab] OR “Sri Lanka” [tiab] OR Sudan[tiab] OR Swaziland[tiab] OR Syria[tiab] OR Tajikistan[tiab] OR “Timor Leste” [tiab] OR Ukraine[tiab] OR Uzbekistan[tiab] OR Vanuatu[tiab] OR Vietnam[tiab] OR “West Bank and Gaza” [tiab] OR Yemen[tiab] OR Zambia[tiab]	Armenia OR Bangladesh OR Bhutan OR Bolivia OR “Cabo Verde” OR Cameroon OR Congo OR “Cote d’Ivoire” OR Djibouti OR Egypt OR “El Salvador” OR Georgia OR Ghana OR Guatemala OR Guyana OR Honduras OR India OR Indonesia OR Kenya OR Kiribati OR Kososvo OR Kyrgyztan OR Laos OR Lesotho OR Mauritania OR Micronesia OR Moldova OR Morroco OR Myanmar OR Nicaragua OR Nigeria OR Pakistan OR “Papua New Guinea” OR Philippines OR Samoa OR “ Sao Tome and Principe” OR Senegal OR “Solomon Islands” OR “Sri Lanka” OR Sudan OR Swaziland OR Syria OR Tajikistan OR “Timor Leste” OR Ukraine OR Uzbekistan OR Vanuatu OR Vietnam OR “West Bank and Gaza” OR Yemen OR Zambia	lower-middle income country OR lower middle income country OR low-middle income country OR low middle income country