Discoursing Terminology Standards and Interoperability in relation to the Philippine eHealth Strategy

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ABSTRACT

Background. eHealth is the use of information and communication technologies (ICT) for health. It helps in improving the flow of information, through electronic means, in support of the delivery of health services, and the management of health systems. eHealth is used as the strategic context and tool in achieving population health, improved health system status, and socio-economic development goals.

Objectives. This study is aimed at looking at the Philippine National eHealth Strategy, particularly the components of Terminology Standards and Interoperability concerning the eHealth strategy in the Philippines, and to assess the barriers and gaps in the integration of these two components.

Methods. This study used secondary literature, internet search, Philippine laws, administrative orders, memorandum circulars, and grey literature to discourse terminology standards and interoperability in the Philippine eHealth system, and issues and gaps related to these components that may impede the delivery of Universal Health Coverage in the country.

Results. The current Philippine National eHealth strategy includes the following sector governance, legislation, policy and compliance, eHealth solution (i.e., services and applications), strategy and investment, infrastructure (government), human resources, and standards and interoperability. Philippine Health Information Exchange (PHIE) is a software platform in the country that aims to connect many isolated electronic health systems. The proposed interoperability layer across health systems and services in the Philippines includes Patient's Primary Healthcare Consultation at the Rural Health Unit, health research, legal information, patient healthcare at tertiary hospital, and health insurance claims. The study results showed that issues and gaps related to the interoperability of eHealth in the Philippines include technical issues such as lack of common semantics, lack of an institutional mechanism to regulate EMR, lack of incentives among eHealth providers and stakeholders to adopt standards for interoperability.

Conclusion. The effort of the Philippines to achieve interoperability and standards in eHealth goals can be characterized as a work in progress. The government, private sector, physician, patient, and other stakeholders are deemed to continuously develop a shared vision and interoperate under a standardized guide as eHealth is a complex endeavor that covers many aspects.

Key Words: Philippines' e-Health, eHealth strategy, terminology standards, and interoperability of eHealth

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INTRODUCTION

eHealth is essentially defined as the use of information and communication technologies for the health of people and the management of health systems.[1] Locally, the Department of Health (DOH), in its broadest sense, eHealth facilitates the delivery of health services and the management of health systems through electronic means.[2] It involves an extensive array of health-related information and communication technologies such as electronic health records, electronic prescribing systems, health information exchange systems, and clinical decision support systems.[3] It also refers to the use of cost-effective and secure information communication technology for health.[4] It has three main parts which are the 1) delivery of health information, 2) use by health professionals, and 3) access by health consumers.[5] The various component areas include health informatics, telehealth, telemedicine, e-learning, e-prescriptions, virtual health teams, and mobile health or m-health. Furthermore, eHealth is the use of ICT when patients and health care providers are limited by certain barriers such as geography,[6] professional availability,[7] limitations of transportation, infrastructure,[8] and even socioeconomic disparity.[9] Hence, it is a vital health care tool in preventing health disparities,[10] promoting a better patient journey, and avoiding the duplication of care processes.[11]

In addition, there is a need for both Interoperability and Terminology Standards in managing the eHealth data for decision making in the Philippines as this enables consistent and accurate collection and exchange of health information across health systems and services, and geographical and health sector boundaries using common standards on data structure, terminologies, and messaging. The gaps and issues in eHealth include a lack of a clear definition of roles and processes in the interoperability of eHealth across systems and boundaries, as well as the need for standard health and medical terminologies among users. This in the long run will be the key to the success of the national electronic health information system.

Over the years, health information systems have been introduced to the local government units in the country to comply with the requirement of recording and reporting. Traditionally, eHealth technologies which are known to be "health services delivered or enhanced through the Internet and related technologies" were developed as stand-alone devices.[12] Various government units and field users express difficulty in sync and harmonizing their work using several information systems. This points to a problem of interoperability of the system. Boone (2012) defines interoperability as the ability of a system or product to work with other systems or products without special effort on the part of the customer.[13] There is a need for interoperability for various reasons – to allow conversation among users across the border and in this case, among local government units and health centers; to allow harmonization of health and medical data for healthcare provision by other health units or facilities in the context of privacy and ethics; and to promote and facilitate the long-term integration of technologies. Concomitant with the use of electronic medical records and patient electronic data, there is also the issue of preserving mechanisms to achieve security and privacy requirements instituted at the institutional level. This is an accepted paradigm in providing healthcare with the use of information and communication technologies (ICTs), while at the same time ensuring privacy and confidentiality.[14]

One of the known organizational obstacles to the successful implementation of e-health is the lack of inter-operability which means that long-term integration of technologies has not been affected. Piecemeal development of the telecommunications infrastructure has resulted in health care which promotes the adoption of health information technologies that cannot "speak" to one another. In other words, there is no connectivity with other systems because they do not share the same software and hardware, or these tools are incompatible with each other across locations and geographies. In devolved structures, the decentralized health care system may not be compatible with the centralized system, or in some cases, the local unit is hesitant to adopt the e-health model of the central unit. Hence, the objective of mainstreaming eHealth is undermined because of the problem of interoperability.

According to Scott and Mars (2016), clear and concise communication of ideas, principles, and instructions during construction play a central role in successfully implementing and scaling e-Health solutions.[15] With e-Health's networked nature, having uniformity in understanding of the words exchanged allows for the crossing of many barriers or boundaries, and is vital in building a strong foundation for every project, intervention, or policy. This may be hard to achieve because eHealth is still sprouting, full of new ideas and technologies, and evolving capabilities that make it in a constant state of flux. But without this, inconsistencies will arise, which can harmfully impact the quality of evidence. Furthermore, these can damage effective communication, interaction, and consultation among and between stake-holders including the public, healthcare providers, health system managers, researchers, and policymakers.[15]

Van Velsen and Nijeweme-d'Hollosy (2016) proposed a maturity model for interoperability in eHealth which has five stages: Level 0: The System as Silo – eHealth application consists of a single technology and have no connection with any other application; Level 1: Peer-to-Peer Systems – a single eHealth application is directly linked to another application for simple data exchange; Level 2: Disturbed Systems – eHealth applications are linked to achieving a common objective; Level 3: Integrated Systems – eHealth applications from different suppliers are linked; and Level 4: Universal Interoperability – all eHealth applications are free to connect and disconnect in an open, interoperable infrastructure.[16]

Networked care deals with the interconnected nature of healthcare systems. This highlights the importance of enabling the smooth flow of information to ease the transfer of patient information and care from one provider to another. In the Philippines, the integration of healthcare providers into one network is not well-defined especially in the context of devolution where the provision of health services is lodged at different levels of often uncoordinated providers.

Integrated primary health care (PHC) relies on connectivity and seamless information sharing across primary, secondary, acute, aged, and social care.[11] The national eHealth environment is made up of components, or building blocks, and is strengthened through the eHealth strategy. These components are: 1) Leadership and governance, 2) Strategy, 3) Services and applications, 4) Standards and Interoperability, 5) Infrastructure, 6) Legislation, policy and compliance, and 7) Workforce.[1] These components also serve as the basis and foundation for the achievement of eHealth goals geared towards the desired eHealth outcomes for the health system, and positive impact on stakeholders' groups in eHealth. In the final analysis, eHealth is used as the strategic context and tool in achieving population health, improved health system status, and socio-economic development goals. This study aims to look at the Philippine National eHealth Strategy, particularly the components of *Terminology Standards and Interoperability* in relation to the eHealth strategy in the Philippines, and to assess the barriers and gaps in the integration of these two components.

METHODS

This study used secondary literature, internet search, Philippine laws, administrative orders, memorandum circulars, and grey literature to discourse terminology standards and interoperability in the Philippine eHealth system for all the years until 2021. The system covered the contextual history of health information systems in the Philippines. The review was in the form of a literature search of relevant guidelines, policies, and laws on the two components of eHealth- interoperability (IO), and terminology standards (TS) through both document searches and internet resources. The information sought for the review included guidelines in eHealth that are pertinent to the discussion of eHealth Interoperability and Terminology Standards.

The components of discourse covered — the Philippine national eHealth strategy framework and operationalization of interoperability and terminology standards in the Philippines. The conceptualization of the proposed interoperability layer across health systems and services in the Philippines was also discoursed. Among the issues and gaps, the following were targeted for interoperability – 1) Framework revisited – Patient-centered or facility-Centered; the essential components in achieving interoperability; 2) eHealth for Health service provision vs. data analysis for policy use; 3) Interoperability of EMR Systems; 4)

Common terminologies and semantics; 5) Organizational interoperability through regulation and ethical standards; and 6) Roles of research, consultation, and advocacy in fostering interoperability. The issues and gaps for terminology standards covered the following: 1) Fragmented EMRs and dictionary of terms; 2) Use of different terminologies; 3) Use of several dial, and 4) Focus of EMRs on insurance billing.

This study aimed to look at the components of *Terminology Standards and Interoperability* in relation to the eHealth strategy in the Philippines and to assess the issues and gaps in the integration of these two components.

RESULTS AND DISCUSSION

We will define terminology standards and interoperability, describe the current Philippine National eHealth Strategy, and discuss issues and gaps related to interoperability and terminology standards.

Definition and Components of Interoperability

Interoperability is an enabling environment achieved through the setting of standards for consistent and accurate collection and exchange of health information across health systems and services.[1] It is the ability of two or more systems or components to exchange information and to use this information.[17] It can also be defined as the efficient transition of data and services that will ensure the continuity of care across organizations and providers in terms of data, process and context.[18]

Interoperability is a top priority of today's governments as services are being integrated across different departments towards their improved effectiveness and efficiency.[19] In eHealth, interoperability enables two or more diverse government information systems or components to exchange data and information meaningfully and seamlessly.[20,21]

Presently, there is an increasing need for an interoperable healthcare data system that will provide a shared common view of essential patient data to any healthcare provider involved in patient care, regardless of the professional's physical location or organization. Through this interoperability, wastage of repeated collection of patient information, and missed patient critical information will be avoided.[19]

The components of interoperability are standards for data structures and common terminology standards.[1] Data structures direct the way health datasets are stored using consistent data structures. This is presented with consistency in software applications to ensure accurate, reliable, and timely information. There are criteria with which eHealth software products and service providers should comply to be certified as able to exchange health information with the national eHealth environment: 1) organizational interoperability (e.g., service providers must agree on what information to exchange, when it is exchanged, and how it is exchanged); 2) technical interoperability (e.g., interconnection to enable communication between systems,
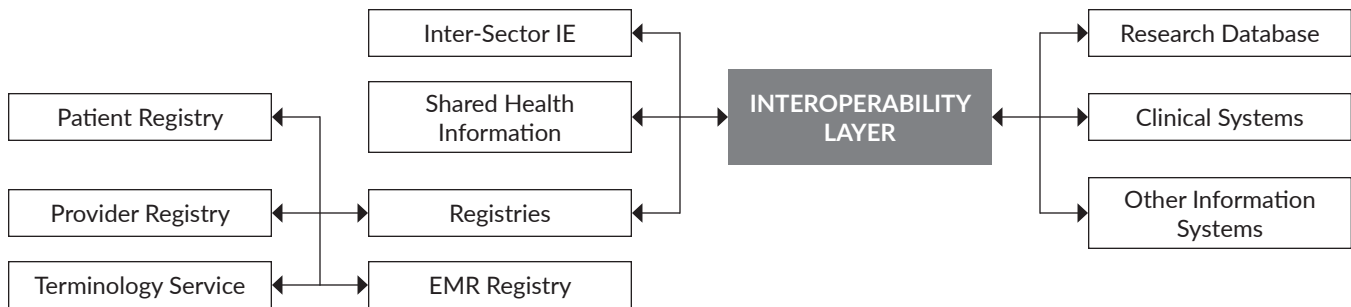
Figure 1. Interoperability Layer operationalized in relation to the Philippine eHealth.

data integration, harmonized information access and presentation of data via various modes, and common content management for retrieving and managing information); and 3) informational interoperability (for service providers to agree on the characteristics of the data to be exchanged, the data structure, and data attributes such as units, validity, and time period).[21] According to Weber and Kuziemsky (2018), instead of looking at eHealth system interoperability as mere technical functions of certified devices, it should be modeled as dynamically evolving social-technical processes.[22] Therefore, technical standards should be used to build standard specifications that will support interoperability but must also require a strong involvement of the professional care milieu.[23]

Definition of Terminology Standards

Terminology is defined as the vocabulary of technical terms used in a particular field, subject, science, or art. In eHealth, terminology is a vocabulary of specialized terms that focus on clearly transmitting meaning and conveying concepts. Terminology standards are structured sets of terms and codes commonly developed by Standards Developing Organizations (SDOs), accepted and used across a sector, industry, or domain. Health terminology standards allow efficient and effective information exchange[24] of current and historical data sets despite disparities between formerly isolated information systems.[25] In addition, data analysis requires standardization, and standard-compliant data sets have increased in value when derived from big data collated from various sources and across platforms.[25]

In the country, the Philippine Health Information Exchange (PHIE) is still at the inception stage of developing the structure for terminology service. Variations in the functionality of use and purpose for recording data serve as a challenge to the national rollout of the health information exchange. In Kenya, particularly in their strategy to monitor HIV response, the Kenya Ministry of Health developed electronic medical records (EMR) standards and guidelines as a preset for a national roll-out.[26] The criteria included health information and reporting. followed by security, system features, core clinical information, order entry, clinical decision support, and interoperability criteria.

A terminology service (TS) can be used as a library of various established and standard terminologies and as a delivery service to effectively curate and distribute content and updates to such content across the connected participants in the health sector. A dictionary within the database of the TS can contain the following: metadata on the concepts and terms (properties); metadata on the relationships between these concepts and terms (associations); and metadata on concept semantic groupings (subsets). Mapping through associations can create cross-references among established dictionaries so participants in exchange need not modify the data dictionaries integrated into their systems; the TS can associate data passed by an information system to another through such mappings, and such is a way that the TS can facilitate information exchange processes.

An interoperability layer is a common component in information exchange and can serve as the gateway between services such as a patient registry, provider registry, terminology service, clinical systems, research databases, and other health information systems. This is shown in Figure 1.

Philippine National eHealth Strategy Framework

In reference to the World Health Organization and International Telecommunications Union (2012) framework for national eHealth strategy[1], the Philippine government through the DOH has come up with the operationalization of its National eHealth Strategy (Figure 2). As shown in Figure 2, standards and interoperability defer to data structures, messaging, terminology, software certification, and research and development.

The third policy which is the National eHealth Information Interoperability Standards Catalogue contains all eHealth information interoperability standards for implementation in electronic health transactions by local and national health information systems and applications. It also establishes the core set of mandatory standards for informational interoperability across disparate health information systems and applications.

Meanwhile, the PHIE is a software platform in the country. Its primary goal is to connect the many isolated electronic health systems throughout the Philippines. It is connected via the Enterprise Service Bus (ESB), a port
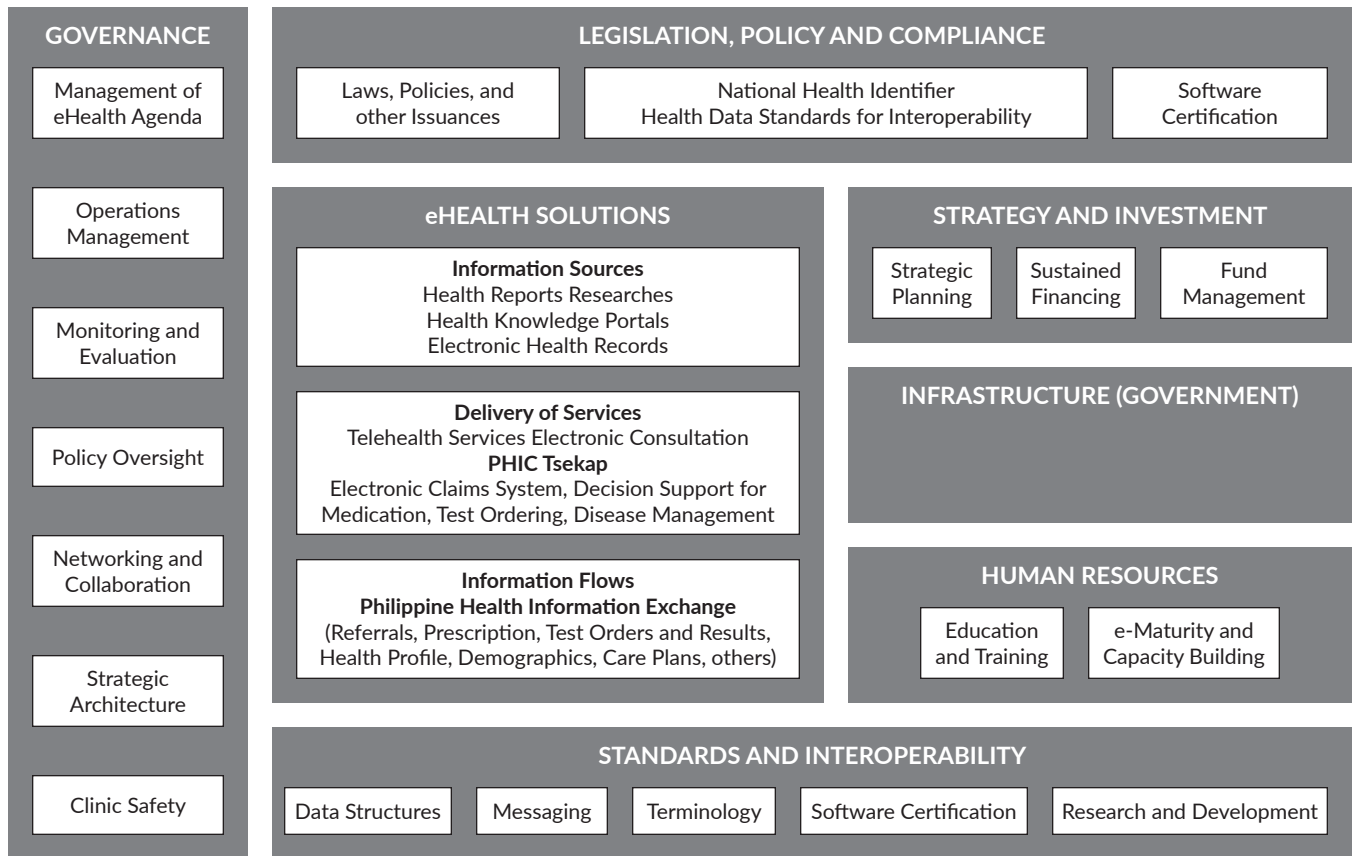
Figure 2. Framework for the Philippine National eHealth Strategy.

where all the data are gathered and processed, connecting existing health systems. Once a specific data is passed to the ESB, various 'services' process the data into meaningful forms – e.g., it can be transformed by a translation service into another language or stored in a database service. It can trigger an SMS service to notify a person or can be passed to another electronic medical record, depending on the purpose of the data. This architecture is called a Service-Oriented Architecture (SOA). In the Philippines, a SOA for the health information exchange has been agreed upon by the various concerned agencies and institutions, thus, making the PHIE a platform for interoperability of electronic health information systems. In turn, these electronic health information systems are 'interfaces' connected to an Interoperability Layer (usually an Enterprise Service Bus or ESB) supported by 'services' such as the Service-Oriented Architecture (SOA). Data are transmitted, processed, and stored between services and interfaces depending on the designed tasks that define the overall transaction. Within this scheme, standardization efforts require precise architectural expression in both business and policy contexts for eHealth. The tools-based architectural design should be precise to support traceability between requirements, design, and implementation.[27] This is akin to the service-oriented architecture that the Philippine National eHealth Strategy is envisioning.

Operationalization of Interoperability and Terminology Standards in the Philippines

There is a need for both Interoperability and Terminology Standards in managing the eHealth data for decision-making in the Philippines. The national health agency in the Philippines which is the Department of Health has implemented the DOH Administrative Order No. 2015-0037 for the following policy objectives — 1) set direction and define the overall governance and management structure on the adoption, implementation, monitoring, and compliance with national health data standards; 2) provide the operational and management guidelines on the adoption and implementation of national health data standards through the operationalization of the National eHealth Information Interoperability Standards Change Management Protocol, and 3) institutionalize the National eHealth Information Interoperability Standards Catalogue as the national reference directory of all health data standards for implementation across the entire health sector.[28] Both Interoperability and Terminology Standards enable consistent and accurate collection and exchange of health information across health systems and services, and geographical and health sector boundaries using common standards on data structure, terminologies, and messaging.[29] All these components can be built into a terminology service.

A TS is a service that has a vital role in an information exchange platform that serves a non-homogenous set of interconnected systems. It can facilitate the transfer of information through associative mapping of terms between disparate dictionaries. In addition, it contains knowledge linked to terms and concepts that a 'user' can easily understand without ambiguity as references for terms in a central canonical terminology dictionary and can define some parameters based on, and thus promote compliance to, clinical practice guidelines, for instance, certain laboratory value thresholds that influence diagnoses. Terminology standards like ICD-10 and SNOMED are commonly used in exchanges between health information systems in different countries. Different terminology standards may serve different purposes — ICD-10 and CPT for instance are preferred for insurance claims and billing, and SNOMED and HL7 are preferred for more for symptomatology in clinical practice and research.[30] Table 1 below describes terminology standards mandated by the DOH for health information systems in the country.

The ontologic structure of the terminology is an aspect to be considered in developing standards. MuthamilSelvan and Balamurugan (2016) showed how ontology structure, a core of semantic web is an excellent tool for knowledge representation and semantic visualization.[31] This is beneficial in eHealth applications, e.g., terminology service and service-oriented architecture, for document retrieval, information extraction, and domain dictionary construction.

In the above scenarios, roles and processes are defined, documented, and developed for the various components (IOL, registries, SHR), and the clients (Inter-sector IE, research databases, clinical systems, other information systems). Based on the international survey in 13 countries with mature electronic medical record systems conducted by Fragidis and Chatzoglou (2017), they also documented how these processes of interoperability among health information systems are key to the success of a national electronic health information system. This interoperability includes both the technical and semantic aspects.[32] Interoperability layers allow, for instance, the care delivery operators to integrate semantically aligned medical data streams into information systems without the need to reconfigure integration into the system. This works as a seamless operation of various layers of systems to connect the user with the system for various purposes.[33]

Issues and Gaps in the Implementation of Components of Interoperability in the Philippines

While information technology undeniably brings about many advantages when applied to health, most developing countries such as the Philippines are faced with serious barriers to its effective implementation.[5]

The problem related to eHealth interoperability in the country arises from any or all the following- technical issues on interoperability such as lack of common semantics, lack of an institutional mechanism to regulate EMR providers including companies seeking to profit in a lucrative e-Health industry, and lack of incentives among eHealth providers and stakeholders to adopt standards for interoperability. These are elaborated below.

Table 1. Mandatory health standards that have been adopted in the Philippines

	Clinical Procedures	Disease Classification	Clinical Health Terminology
Standard Code Set	Current Procedural Terminology (CPT)	International Statistical Classification and Related Health Problems 10th Revision (ICD 10) with Philippine ICD 10 Modifications	Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT)
Version	CPT 2011	ICD 10 v. 2013 Philippine ICD-10 Modifications 2nd edition: May 2014	SNOMED CT International edition
Custodian	American Medical Association (AMA)	World Health Organization (WHO) Department of Health	International Health Terminology Standards Development Organization (IHTSDO)
Description	The current procedural terminology (CPT) describes medical, surgical, and diagnose services and is designed to communicate uniform information about medical services and procedures among physicians, coders, patients, accreditation, organizations, and payers, for administrative, financial, and analytical purposes. (Administrative Order 201-0025)	The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) is a coding of diseases, signs and symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO). The code set allows more than 14,000 different codes and permits the tracking of many new diagnoses. (Administrative Order 2013-0025)	SNOMED CT is a clinical terminology with global scope covering a wide range of clinical specialties, disciplines and requirements. Specifically, it provides a standardized way to represent clinical phrases captured by clinician and enables automatic interpretation of these.
Remarks		ICD-10 is commonly used for: • Statistical reporting on major diagnoses and health problems; • Mortality and morbidity statistics; and • Billing, reimbursement, and resource allocation	SNOMED CT is commonly used for: • Point of care analytics (historical summaries, decision support) • Population analytics (pharmaco-vigilance, audit and planning); and • Clinical research (cause)

Framework Revisited — Patient-Centered or Facility-Centered: The essential components in achieving interoperability

The political value of the overall eHealth system is vital in achieving the success of eHealth in general and adopting interoperability. The local government units and various health units are the primary providers and agents as they engage in face-to-face interaction with patients and the people of their respective jurisdictions. The political posturing for effecting the least conflict among juridical bodies necessitates addressing both the overarching framework of eHealth and the strategies for achieving interoperability.

Since eHealth is premised on an overarching principle of greater coverage for the healthcare of the greater number of people and anchored on the principles of justice, fairness, and right, the value orientation is, therefore, patient-centered, and not merely facility-based. Corollary to this, health service provision is patient-based, over and above, or in conjunction with facility-based orientation.

A mechanism can be instituted to facilitate and allow patient data transfer from one health facility to another, as well as a system for claims, capitation, and payments under such situations. Likewise, a patient from one juridical body should not be hindered in seeking healthcare from another health facility when the need arises.

A study has demonstrated that an interactive patient-centered system for continuous monitoring is paramount in service quality.[34] This is premised on the fact that effective communication between patients and health service providers is integral to inpatient care. In their study, they created a closed-loop control system for the outpatient service, where patients' complaints and comments represented a feedback mechanism for further improvement of the services.[34]

The patient-centric paradigm incorporates both the context and interaction between and among the actors, and in this case, between the patient and the primary care physician. This is a type of developing a health ecosystem involving the quality of experience and quality of service in eHealth systems, and a key factor to determine the level of acceptance among end-users.[35]

eHealth for Health Service Provision vs. Data Analysis for Policy Use

Since the framework of eHealth and its interoperability is hinged on principles of patient care (patient-centered), the mechanisms and strategies for achieving interoperability in eHealth should likewise focus on health service provision. The processes of collection, storage, analysis, and use of aggregated data and EMRs for policy use can be pursued however, this is underpinned foremost and primarily by quality service, patient satisfaction, and population health.

Interoperability of EMR Systems

Technical interoperability requires adopting standards for data structure, data storage for EHRs, health event summaries, and test orders and results for effective monitoring and reporting outcomes. Through standardization of electronic health records, data can be aggregated for health policy use, and quality healthcare service is achieved.

This domain also includes standards for fostering interoperability and the feasibility of the technology for interoperability. The issues to be addressed for coming up with standards for fostering interoperability are- inter-connectivity across regional, provincial, territorial, and national networks; adequacy of the human capacity to manage, operate, and monitor the telehealth infrastructure; harmonization of the information system; and potential for regulatory fraud and misconduct. Meanwhile, the issues to be addressed on the feasibility of the technology for interoperability are – perceived technology complexity; concern over practitioner competence; start-up costs and the increasing cost to maintain the equipment; and compatible information systems.

Common Terminologies and Semantics

Effective interpretation of health data at the individual level, and health data structures at the macro-level requires the adoption of common medical terminology across EMRs. Examples of these are common semantics for describing symptoms, diagnoses and treatments, and common indicators of health and illness. At present, there is a need to come up with common health and medical vocabulary as well as standardized medical acronyms for EMR users and providers as they are prerequisites for a standardized data exchange format. This also includes the information the EMR provider is willing to share, the type and granularity of information to be shared, and the minimum shareable information.

Organizational Interoperability through Regulation and Ethical Standards

The successful adoption of eHealth concerns all stakeholders including health care professionals, health care informatics professionals, soft and hardware providers, as well as outsourced eHealth providers and depends on several factors. First, the environment must be ready to accommodate eHealth such as information technology (IT) standards for fostering interoperability and inter-connectivity across regional, provincial, territorial, and national networks, along with the adequate human capacity to manage, operate and monitor the telehealth infrastructure, hence the need for regulation. Second, health should also be understood as having a unique cultural component because traditions and religious beliefs shape the consumer's health practices and beliefs, hence the need for adaptability as an ethical issue. All these come into play in evaluating the totality of eHealth and its interoperability.

The transfer of electronic health information, potentially with patient identifiers, also poses a challenge in health care in this information age. Even as eHealth is useful, its practice is not without any issue due to certain ethical issues such as patients' safety, privacy and confidentiality,

the duty of care, primary responsibility and accountability for patients enrolled in telemedicine, and offering health services from a distance over the internet. There are also issues about the eHealth system's safety and reliability, professional accountability, technical standards in the management of clinical data, copyright, authorization and regulation, and licensing of telemedicine.

Given the above, a regulatory body should be established to oversee, monitor, regulate, and evaluate EMR providers and the eHealth practice itself. The regulatory issues should address problems related to perceived technology complexity, concern over practitioner competence, start-up costs, the potential for unethical billing practices, accountability concerning patient care, the need for professional certification requirements, the lack of compatible information systems standards, and the potential for regulatory fraud and misconduct. The ethical concerns on interoperability such as the unique cultural component because traditions and religious beliefs shape the consumer's health practices and beliefs, and concerns on privacy, security, and confidentiality should likewise be addressed.

Roles of Research, Consultation, and Advocacy in Fostering Interoperability

Policy analysis has a rapid turnaround because of the need and practicability of coming up with legislation based on policy analysis. Policymakers and decision-makers need to have a framework on how to best evaluate existing or proposed policies that will benefit most of their constituents and stakeholders. This framework should also be backed up by evidence from existing studies and research conducted in the field of eHealth.

The stakeholders do not only come from the health sector, but from those outside health and informatics, and are keen to engage in the process of contributing to the eHealth objectives including interoperability. This is a vital step in consensus building among stakeholders, gaining their valuable insights and experiences so that the interests and agenda of diverse groups are not merely included but nurtured along the process, in coming up with standards for interoperability. Consultative workshops and other interactive learning contexts will be tapped to encourage discussions and agreements on interoperability, as much as various perspectives and insights give a fuller and more comprehensive picture of eHealth in the Philippines. There is a call for fostering an inclusive approach involving both the center and periphery, all sectors, and players, in the private and public domains, and local and international arena, to achieve the goals of interoperability, in particular, and eHealth outcomes in general.

Issues and Gaps in the Implementation of Terminology Standards in the Philippines

For the issues and gaps in the aspect of Terminology Standards, the salient points are shown below.

Fragmented EMRs and Dictionary of Terms

The interfaces between and among the EMR systems are an interoperability platform that will connect data and information among various systems, agencies, and institutions. All data go through the interoperability system and then are connected to various services at the backend. This is the enterprise service bus, a service-oriented architecture. At present, the health information system in the Philippines is a multi-agency setup without a service-oriented architecture. The health data, for instance, at the rural health unit cannot be transferred to another hospital. Likewise, the Philippine medical specialties have their dictionary of terms, but not yet collected into one single dictionary. The use of electronic medical records is individualized per clinic, and not currently interoperating with each other and hence presents a difficulty in creating a central database.

At the national level, the focus is not on the standardization of terminologies, but the implementation and adoption of EMR in medical practice. The focus is connecting EMR systems over and above developing canonical terminologies. Transitioning from paper-based to EMR is another concern. Some users still prefer doing things manually due to the age factor, the limited knowledge on the use of information technology, and lengthy forms to be filled out.

Use of Different Terminologies

Mapping of terms is integral in the Terminology Service because currently in the country, there are terms that do not appear in EMRs. For instance, in the case of pulmonary tuberculosis, merely encoding 'pulmonary' will not yield any result, as the term in the current system refers to 'respiratory'. Another example is a variation of abdominal pain, either colicky or crampy, which is not captured by the EMR. The local terminology service should be a mapping of these related concepts to yield accurate diagnosis. It is akin to producing a local Philippine name space or dictionary and then mapped also to the different external standards.

There is also variance in the terminologies being used at the rural health units compared to the hospitals, as well as overlapping concepts. In the study of Kim, et al (2014), they found that there are degrees of overlapping of concepts in health practice and diagnosis.[36] They also found that while most of the mappings were one-to-one mappings, there were ambiguities in both terminologies, leading to difficulties in encoding and classification. There were differences in content coverage, and lexical variations and semantic differences. The same hurdles were seen by the clinicians in the round table discussion and key informant interviews.

Use of Several Dialects

The Philippines has several languages and dialects, and as such there are several descriptions of particular symptoms. Currently, medical practitioners and clinicians use different terms for a particular diagnosis. This can be addressed by

the structure of the National Health Terminology Service (NHTS) that can expand to accommodate all the other dialects and terms/synonyms.

Use of EMRs is focused on Insurance Billing

Currently, the mandatory use of EMRs is limited to insurance and billing as required by the Philippine Health Insurance System (PHIS). For instance, there seems to be an epidemic of myocarditis in the country because it has the larger reimbursement from the Philippine Health Insurance, however, this may not be reflective of the true profile of diseases of the population. This points towards the need for extensive classification for costing.

The Way Forward for Interoperability and Terminology Standards

There are mechanisms that can be carried out to address the lack of interoperability. In the Philippines, an administrative order (AO) was recently drafted by the DOH, a result of several consultative fora initiated and participated in by various sectors. Consisting of representatives from relevant government agencies, private sector and academe, recommendations emanating from broader consultations were presented in areas of enterprise architecture, standards to ensure interoperability and compliance with these standards, and capacity building. The result of these consultative fora became the basis of the said AO. The Philippine Department of Budget and Management also launched the government-wide Medium Term Information and Communications Technology Harmonization Initiative (MITHI) in order to harmonize all resources, programs and projects in the entire government, and resolve problems of restricted databases, turf wars, and lack of interoperability (DICT, n.d.).[37] However, the transfer of information among and across different health facilities remains to be a challenge given the current health system in the country. Additionally, there may be potential flashpoints between easing transfer of data from one facility to another due to the Data Privacy Act.

The proposed solutions to address the aforementioned issues were laid out during the consultative workshop and roundtable discussions. First, there should be an understanding that it will take time to build the language dictionary as it involves incorporating several terms based on individual existing terminologies of various subspecialty groups in medicine. A concept is a broad array of variables, terms and definitions and encompasses related understandings. It may also mean that one concept has many qualifiers, e.g., abdominal pain expanded to colicky abdominal pain. It can also accommodate time element, e.g., tuberculosis with previous signs of pneumonia rather than merely stating tuberculosis. The goal of TS is aligned with an evolutionary process as it is inclusive rather than exclusionary or absolute. A gathering of concepts can be carried out, and then their translations from the vernacular to the standard English language.

Interoperability and data integration are important in retrieving and matching patient data from electronic data sources. In the study of González-Ferrer and Peleg (2015), they used the Knowledge-based Clinical Decision Support Systems (KB-DSSs) to provide patient-specific recommendations, generated by matching the KB with electronic patient data from various sources.[38] First, they made the system interoperable by simplifying data via inclusion of selected data sources into an integrated Personal Health Record (PHR). In the study of Viji Rajendran and Swamynathan (2015), they created a system of ontology to represent concepts in various domains of interest.[39] The search engine was based on multiple ontologies to retrieve information and terms more efficiently, in a way that the user query is rewritten through addition of semantic information, after consulting multiple ontologies.

There is indeed a need for agreement among users and clinicians on the correct usage of concepts and terminologies. This mapping will start with the specialty concepts as the intent is not to force standards when disruptive to current practice. In the country, the pediatrics specialty has developed their basic terminologies, but the cardiology sub-specialty has not yet started. This poses a challenge to the practice of several sub-specialties, and hence, a National Terminology Service may be assisted by a mandatory implementation emanating from a law or administrative order.

Health informatics cannot be a top-down approach as there is always a challenge in the cooperation and communication between health informatics professionals and the clinicians. The approach suggested by Petersen, et al. (2013) is to start with the catalogue of clinicians and then reference existing international standards in order to capture nuances in the standard practices among clinicians.[40] A point of convergence can also be mapped out between and among the specialty groups. The way forward is to collect the classification system and the terminologies currently being used by various sub-specialty groups for inclusion in the Terminology Service so that a medical concept now encompasses related terms and definitions. The service will also be able to generate aggregated health data such as the number of patients having a particular medical diagnosis. The latter will serve as a registry of diseases. This mapping of concepts and terminologies can then expand the vocabulary of terms. In this scheme, the local practice that is culture-specific can be added into the dictionary of terms. Even nuances in the local setting can be captured to build an inclusive terminology standard. In a way, this does not disrupt the already-existing terminologies. The services in the interoperability layer add on what is already inputted into the system.

It is well recognized that eHealth is one of the enabling factors and drivers of health care, both at the global and national levels. However, there is diversity of health information due to unavailability of health information, varying information seekers, differing languages and cultures. Such diversity signifies that e-health applications must be

adopted to satisfy specific needs.[41] When such challenges occur, the authors posited that there is a need to develop principle-related standards understandable by users and captured by the electronic medical record system. The continuous improvement is through the addition of new knowledge and concepts. This type of service will basically map all the ethno-linguistic translations so that a native user or a clinician attending a native patient can still be serviced by the terminology architecture.

The social science approach has also been proven to contribute to a wider understanding of the relevance of accommodating local conditions and practices in health informatics. This suggests that eHealth applications in varied concerns should be able to tap into shared concerns cutting across various stakeholders and communities. In a related study, the framework for understanding eHealth applications included five categorizations – access, availability, appropriateness, acceptability, and applicability.[42] All components are deemed important in the successful implementation of IO and TS.

The development of the standards catalogue can also be referenced to the existing international catalogue standards. There are suggestions that the core patient data conform to related rules of health information resource management and be based on international health coding and classification systems.[43] Referencing can start with adoption of international terminologies such as SNOMED for clinical symptoms, ICD for medical assessment, and LOINC for laboratory findings.

An important aspect in interpreting healthcare information consists of eHealth skills through capacity building and training.[44] This is culled from national analyses of composite measures of eHealth skills such as searching, locating, understanding, evaluating and using online health information. Similar to the research of Vicente and Madden (2017), there is a need for targeted training actions to improve eHealth skills.[44] In another study, the Greek hospitals and health facilities despite implementing well-known data coding schemes such as ICD-10, ICPC, GMDN family, showed that less than a third of doctors adopted the scheme in their clinical assessment.[43] The study cited that this was due to lack of health information management education and training on ICT among clinicians. The authors suggest that hospitals should train doctors in accessing and managing clinical information.

Table 2. Conceptualization of the proposed interoperability layer across health systems and services in the Philippines

Contextual Application	Hypothetical Example	Mechanism for Interoperability		
		Data Cycle 1	Data Cycle 2	Data Cycle 3
Patient's Primary Healthcare Consultation at the Rural Health Unit	Patient A visited the RHU and was found to have a blood pressure of 140/90. The EMR packages the data into a message.	The EMR submits data for the shared health record (SHR). The message is sent through the interoperability layer (IOL).	The IOL refers to the Registries to authenticate the EMR. Upon authentication, the data is transformed in terminology and format.	Upon transformation, the data is passed to the SHR for storage. The SHR registers Patient A as a new patient in the system.
Health Research	The National Institutes of Health (NIH) is conducting research on the incidence of blood pressure elevation and factors that may cause the disease.	The IOL confirms with the Registries if NIHSys is registered in the system. Upon confirmation, it asks the TS to what the concepts are mapped.	The IOL then passes the message to SHR with the proper terminology. SHR will return the message with the proper results.	The IOL receives the result and transforms the terminology back in a terminology that NIHSys can understand and then confirm the validity.
Legal Information	Patient B was charged with stealing from a Bank. Defense claims that this is impossible because he cannot run, he has high blood pressure	After confirmation on the existence of CourtSys in the system, IOL refers to TS for standard definition of concepts.	With the definition from TS, IOL turns to SHR to search for the record and confirm the query if true or otherwise.	With the results from SHR, the IOL transforms the data back, and turns back to CourtSys and relays the information so CourtSys will understand.
Patient Healthcare at Tertiary Hospital	After his legal battle, Patient B Sylim fainted and was rushed to a tertiary hospital emergency room (ER). The hospital (H1) sends a request to IOL.	After confirmation with EMR Registry that H1ERSys is legitimate, IOL turns to TS for confirmation on the concept of "date" and its format.	The IOL asks SHR for records after the date specified. SHR returns all records that satisfy the conditions from H1ERSys.	The IOL sends the converted data back to H1ERSys, which receives and acknowledges receipt of the data.
Health Insurance Claim	The RHU wants to submit a claim to PhilHealth for covering Patient C for elevated blood pressure. The EMR1 contacts IOL again.	The IOL confirms with the EMR Registry, then asks TS what about claims for elevated blood pressure. The TS returns with the information.	The IOL answers EMR1. Prior to this, IOL asks TS what "HPN med given" means for EMR1. It then transforms the message.	

Legend: RHU – Rural Health Unit; SHR – Shared Health Record; IOL – Interoperability Layer; NIH – National Institutes of Health; TS – Terminology Service; H1ERSys – Hospital 1 Emergency Room System (hypothetical); CourtSys – Court information system (hypothetical); EMR1 – Electronic medical record of rural health unit (hypothetical)

In the Philippines, training and capacity building can come in the form of an EMR support for the various sub-specialty groups, and strategies on how to connect to the Philippine Health Exchange Information. These are concepts related to 'language-games', 'shared design spaces', and cross-boundary interaction between the IT professionals and the healthcare professionals.

In summary, Table 2 shows the current landscape of IO and TS in the Philippines, and the projected trajectory based on the initial policy-advocacy strategies carried out in this study, in relation to and in the context of the National eHealth Strategy in the country, and the PHIE framework.

Table 2 shows how interoperability will allow seamless integration and communication between and among systems. This model is proposed to be adopted for the Philippine Interoperability Layer.

CONCLUSION

The National eHealth Strategy in general is a large leap towards the adoption of information technology in the healthcare system in the Philippines which is important as the development of technology is continuously evolving. This just shows how the government is coping with the advancements and demonstrates how the country is trying to be globally competitive. The adoption of eHealth in the long run could provide convenience not only to the patients and healthcare providers themselves. There were also issues and gaps found dealing with technical interoperability (i.e., lack of common semantics, lack of institution mechanism to regulate EMR, lack of incentives among eHealth providers and stakeholders, interconnectivity across regions and national network, inadequate human capacity, potential of regulatory fraud and misconduct, and start-up cost). All these were found to be vital in sustaining and managing interoperability of eHealth in the Philippines. It is also vital that the government, private sector, physician, patient, and other stakeholders continuously develop a shared vision, gain insights and experience. In this way, the interests and agenda of diverse groups are nurtured to come up with standards for interoperability as eHealth is a complex endeavor that covers many aspects.

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All authors contributed in the conceptualization of work, acquisition and analysis of data, drafting and revising and approved the final version submitted.

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