Integrated Knowledge Management (IKM) Volume 13

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Part I. Global Health and International Collaboration

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1. Global Health and International Collaboration

1.1. IKM Relevance to Global Health and International Collaboration

Before shifting our discussion to the topic of health and Integrated Knowledge Management (IKM) collaboration at the global scale, the intention of this section is to take a moment to summarize our discussion at the national level before discussing various aspects of international collaboration. The previous volumes in this Book define the importance of IKM in healthcare to achieve coordinated and standardized ways to integrate healthcare data across systems. In addition, the volumes explore the course of data management in various service lines, highlighting emerging IT challenges and legal issues for maintaining and exchanging healthcare data. We can summarize the challenges we have discussed in two main areas: a challenge in the clinical setting and a challenge in the laboratory setting.

In the clinical setting, Healthcare IT is intended to ease provider workload and ultimately improve patient care. However, the current inconsistencies can impact patient safety, provider efficiency, and other areas of patient care. For example, a patient's primary care physician discovers a potentially pre-malignant mole on the patient's back and flags it for follow up. When this patient moves across the country and receives care at a different healthcare system, the patient's information is transferred to their new provider. Yet, this is where the "pre-malignant" description of the mole is lost because of a difference in the systems' encoding standards. Neither the clinician nor the patient receives further signals to revisit the dermatologist for follow-up on the pre-malignant mole. The patient later presents with lower back pain and the mole is determined to be malignant and metastatic. Although the rapid development of healthcare IT has enabled organizations to transfer and exchange patient data at a more advanced level, the quality and accuracy of that transfer is impacted by the use of disparate terminology standards and differences between healthcare systems.

In the laboratory setting, the goal has always been to move laboratory data through numerous systems while maintaining the data's original structure and meaning. However, ever-increasing system complexity and reliance on low-quality data has ultimately decreased the quality of care across the healthcare ecosystem. While lab data is analyzed and transferred from the Laboratory Information System (LIS) to Provider Electronic Health Records (EHRs) to appropriate end users, much of the meaning of the original report is lost. Only 22 - 26% of the single-trip data integrity is achieved, highlight the need for greater interoperability standards. [1]

Efforts to standardize clinical terminology systems is often impacted by data siloes and incompatible Healthcare IT systems that make data difficult to exchange and interpret at a national level. [2] Health information specialists around the world noted the lack of interoperability standards between different systems during the COVID-19 pandemic. Recently, we have seen a growing awareness and recognition of the need to standardize clinical terminology across the US and around the world. This volume intends to explore various ongoing efforts to achieve interoperability at the international level, the current utilization of IKM in the areas of global health, on-going international collaborations, challenges, and potential opportunities for further international collaboration to improve the quality of healthcare around the world.

1.2. Introduction

Numerous international organizations have been established to collaborate on global health initiatives and to expand upon certain areas of focus, like public health. [3] This volume will introduce the overall land-

scape of international healthcare organizations participating in global health, on-going efforts to achieve international interoperable digital health infrastructure, challenges with global interoperability, and potential solutions. Healthcare IT has been one of the rapidly growing areas that has gained further momentum following the COVID-19 global pandemic.

1.3. Brief History of Global Health

Global health originates from efforts to control infectious diseases and individual health through the delivery of healthcare to 16th and 17th century European colonies. [4] Great Britain, France, and Portugal established colonies in India, China, Africa and elsewhere, where infectious diseases were devastating to both the native and European colonist populations. [5] Diseases spread rapidly, wiping out large portions of the population in the first years of colonization and giving birth to the field of Tropical Medicine. [6] Tropical Medicine bloomed throughout much of the 19th century and expanded to the field of public health with the development of military medicine and medical missions as more people traveled across the world.

The formation of three organizations served as the precursor to forming a Health Committee under the League of Nations after World War II. [7] The International Sanitary Convention was formed in 1851 to create an international code for containing epidemics when a series of six cholera pandemics claimed the lives of thousands of tradesmen on the Silk Road between Rome and China. The Pan-American Sanitary Bureau was formed by the US and their trade partners in Central and South American in 1924, addressing the outbreak of yellow fever and starting the immigration health conversation. [8] The third group was the Rockefeller Foundation International Board of Health in 1913 as the single largest funder of global health in the early part of the 20th century, constructing public health schools in North America and Europe to train personnel to send to Latin America and the Caribbean to treat “tropical diseases”. [9]

After World War II, the UN was formed and approved a constitution for the formation of the World Health Organization (WHO) that provided a wide range of aid to developing countries in the midst of the Cold War. After World War II, the creation and participation of non-governmental organizations (NGOs), such as the International Monetary Fund (IMF) and the World Bank, increased to support re-building global infrastructure in the post-war era. [10] [11]

Much of global health in the earlier years was shaped around tropical medicine and the public health work of overseas colonies. This trend was expanded to the work of medical missions and military medicine that provided a strong foundation for international collaboration in the latter half of the 21st century. [12]

1.4. International Organizations Collaborating on Healthcare IT

The global trend of adopting computerized medical record systems was spearheaded by digital movements in the United States. In 2003, the Institute of Medicine, a division of the national Academies of Sciences, Engineering, and Medicine chose to coin the term, *electronic health records*, with the goal of computerizing medical records to improve safety and quality of patient-centered care. In 2005, the World Health Assembly adopted the resolution WHA58.28 on eHealth and urged Member States “to consider drawing up a long-term strategic plan for developing and implementing eHealth services… to develop the infrastructure for information and communication technologies for health … to promote equitable, affordable and universal access to their benefits.” [13] Passing this resolution encouraged more than 120 Member States, including low-and middle-income countries, to direct their efforts towards implementing eHealth to meet their country’s health priorities and resources through action-oriented steps.

The U.S. federal government’s announcement of Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 set aside $27 billion for an incentive program that encouraged hospitals and healthcare systems to adopt EHRs. [14] In 2010, WHO and Systematized Nomenclature of Medicine

(SNOMED) International initiated a formal collaborative relationship. SNOMED International and WHO began aligning their respective standards by enabling SNOMED CT® users to use WHO classifications, creating a joint and interoperable medical terminology system. [15]

Additional U.N. Health Assembly sessions in 2013 and 2018 continued encouraging Member States to adopt eHealth strategies and identify priority areas, creating online public forums, providing technical consultations, and utilizing WHO regional committees to improve the global strategy on digital health. [16]

Below is a list of several international organizations that have joined collective efforts to achieve standardization in a particular domain of healthcare and are actively collaborating with one another worldwide. While this list provides some key examples, it is not exhaustive and there are many other international organizations that contribute to standardizing clinical terminology or language in healthcare.

1.4.1. Digital Imaging and Communication in Medicine (DICOM)

DICOM provides the international standard for medical images and related information, defining formats for medical images that "can be exchanged with the data and quality necessary for clinical use". [17] Established in 1993, DICOM has been an established name in cardiology imaging, radiology, dentistry, ophthalmology, and other medical service lines that involve any radiologic devices including X-ray, CT, MRI, and ultrasound. DICOM drove efforts to replace X-ray film with digital images, eliminating industry waste and improving the transfer of high-quality images. [17]

1.4.2. Global Medical Device Nomenclature Agency (GMDN)

When a medical device is developed, it needs to go through a number of regulatory approval steps. GMDN provides a standardized common language for all medical technology and collaborates with medical device regulators, manufacturers, and other relevant healthcare stakeholders to incorporate and develop established standards. Established in 1991 as the Global Harmonization Task Force that took over its precursor organization called the International Medical Device Regulatory Forum (IMDRF), GMDN helps accelerate and standardize medical device regulation globally with more than 70 national medical device regulators across more than 145 member countries worldwide. [18] [19]

1.4.3. Health Level Seven International (HL7)

Founded in 1987, HL7 is a not-for-profit standard-development organization that provides a digital framework and relevant standards "for the exchange, integration, sharing and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services." [20] HL7 collaborates with over 25 benefactors from both private and public spheres across the US and around the world.

1.4.4. Integrating the Healthcare Enterprise (IHE)

IHE is an international organization with the vision of "enabling seamless and secure access to health information that is usable whenever and wherever needed". Established in 17 countries around the globe with IHE national deployment committees and other stakeholder organizations from 21 countries, members come from four main sources:

1. Health IT and Consulting Companies

2. Government Agencies or Not-for-Profit Organizations

3. Provider or Research Organizations

4. Standards Development Organizations [21]

Healthcare professionals and relevant stakeholders collaborate to configure the way computer systems in healthcare share information through the coordinated use of DICOM and HL7. [21]

1.4.5. International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH)

ICH owns a Medical Dictionary for Regulatory Activities (MedDRA) in the United Kingdom and supports the approval of regulatory activities for medical devices by developing highly specific standardized medical terminology to facilitate sharing of regulatory information globally. ICH uses MedDRA to catalyze the process of registration, documentation, and safety monitoring of medical products before and after a medical device is fully authorized for use. MedDRA focuses on key pharmacovigilance terms from the European Medicines Agency and the UK's Medicines & Healthcare products Regulatory Agency. [22]

1.4.6. Logical Observation Identifiers Names and Codes® (LOINC®)

As we have discussed in the previous volumes, LOINC®, is an effort by the Regenstrief Institute, a nonprofit international research organization that successfully collaborated with SNOMED International. The collaboration resulted in producing a LOINC®/SNOMED CT® Expression Association and Map Sets file based on SNOMED CT® International Release, July 2017 and version 2.58 of LOINC® in December 2016. Their 2022 collaboration also produced The LOINC Ontology: A LOINC® and SNOMED CT® interoperability solution, a standardized terminology system that combines clinical and regulatory requirements in a single solution. SNOMED CT® provides the computerized framework while LOINC® provides laboratory and pathology content in easy-to-read format to countries that have not adopted LOINC® yet. [23]

1.4.7. SNOMED International

SNOMED started in 1965 as a Systematized Nomenclature Pathology (SNOP) and created SNOMED CT® in 1991 and SNOMED International in 2007. [24] The Systematized Medical Nomenclature for Medicine (SNOMED) International is the trading name for a not-for-profit organization called The International Health Terminology Standards Development Organization (IHTSDO). [25] The purpose of IHTSDO is to support safe, accurate, and effective health information exchange, with over 29 member countries that support four major areas; customer relations, operations, products and services, and strategy.

1.5. Medical Terminology Standards Used in Healthcare IT Collaboration

Below is a list of common terminology standards used in health information and technology.

1.5.1. Current Procedural Terminology (CPT®)

CPT® is a code set by the American Medical Association to bill outpatient and office procedure. [27]

1.5.2. Healthcare Common Procedure Coding System (HCPCS)

The Centers for Medicare and Medicaid Services (CMS) generates the HCPCS, a collection of standardized codes that represent medical procedures, supplies, products and services. Health insurance entities utilize the HCPCS to process claims by Medicare and other insurers. Level I of HCPCS consists of Current Procedural Terminology® (HCPT). Level II of HCPCS includes the Current Dental Terminology (HDT) codes. [28]

1.5.3. Tenth Revision International Classification of Disease (ICD-10)

The tenth revision of the International Classification of Disease (ICD) is designed primarily for validating mortality statistics. ICD-10 promotes international comparability for collecting, processing, classifying and presenting mortality data. ICD-10 consists of tabular lists containing cause-of-death titles and codes, inclusion and exclusion terms for cause-of-death titles, an alphabetical index to diseases and nature of injury, external causes of injury, table of drugs and chemicals, and description, guidelines, and coding rules. [29]

1.5.4. LOINC®

The Regenstrief in Germany started the Logical Observation Identifiers Names and Codes in 1994 with Clem McDonald's idea of developing a common terminology for laboratory and clinical observations because the growing trend demonstrated the use of laboratory data not only for clinical care but also for research and management purposes. The terminology system that began at Indiana University now collaborates with HL7 to send numerous lab results with painstaking efforts to continue standardizing existing codes with the addition of new codes or other codes from the growing number of various other sources. [30]

1.5.5. MEDCIN

MEDCIN is an electronic medical record engine that allows healthcare workers to enter, retrieve, and maintain relevant clinical information efficiently at the point of care, store information as coded data elements, and produce narrative reports from the same data. Medicomp Systems, Inc. created MEDCIN and continues developing the advanced version available for healthcare providers. As a leading provider of clinical documentation tools, Medicomp has spent over 45 years with the goal of driving better patient care through better management of patient's clinical data and is now looking into adopting artificial intelligence (IA) technologies and interoperability to enhance its current documentation technology. [31]

1.5.6. Radiology Lexicon (RadLex)

RadLex is a radiology terminology system by the Radiologic Society of North America (RSNA). It is a reservoir for a unified language of radiology terms for standardized indexing and retrieval of radiologic information resources. It unifies and supplements other lexicons and standards including SNOMED CT® and DICOM. [15]

1.5.7. RxNorm

RxNorm is one of the Unified Medical Language System®. The NIH website describes it as a source of "normalized names for clinical drugs and links its names to many of the drug vocabularies commonly used

in pharmacy management and drug interaction software, including those of First Databank, Micromedex, Multum, and Gold Standard Drug Database." [15] The National Library of Medicine started the RxNorm Project in 2001 and has continued to grow the effort with collaboration from HL7. [15]

1.5.8. SNOMED Clinical Terms® CT (SNOMED CT®)

SNOMED CT® was created in 1999 and released in 2002. The Systematized Nomenclature of Pathology (SNOP), founded in 1965, is the origin of SNOMED that developed its own terminology system and gave the name SNOMED CT® that has been widely used in the United States. In 2013, EHR systems in the United States were required to include SNOMED CT® for the Stage 2 Meaningful Use certification of the clinical software systems installed in medical settings. [15]

1.5.9. UCUM

The United Code for Units of Measure (UCUM) is a code system intended to include all units of measures being contemporarily used in international science, engineering, and business. [15]

The list of the commonly used healthcare standards is growing faster than ever before. One challenging aspect of developing global healthcare standards is that the act of developing the standard needs to start somewhere on a small scale with testing, iterative improvements, and gaining credibility before it can expand. It takes both time and painstaking efforts to develop a standard and tool that delivers the standard to end users.

1.6. Application of IKM in Global Health and International Collaboration During the COVID-19 Pandemic

While efforts to standardize various types of healthcare terminology are underway, the Covid-19 pandemic demonstrated the need for interoperable and lossless data transfer.

1.6.1. eHealth Exchange to improve the exchange of patient data between agencies and medical entities

eHealth Exchange is an interoperability system a "one connection-to-many" model, creating the principal network that connects federal agencies and non-federal organizations, including over 75% of U.S. hospitals, health systems, and clinics of various types and sizes, to share patient records for better access of care of better quality. [34] The eHealth Exchange further supports reporting of the social determinants of health, such as public health reporting, quality reporting, and disability and insurance determinations. The eHealth Exchange uses InterSystems HealthShare™ Managed Solutions to make a more powerful information exchange, scale its network and maintain added features such as push notifications and discrete data-level queries using HL7 Fast Healthcare Interoperability Resources (FHIR®). [34]

1.6.2. Working with a better early warning system for emerging infectious diseases

The Covid-19 pandemic also provided an opportunity to catalyze an existing data-sharing methodology. WHO's Epidemic Intelligence from Open Sources (EIOS) was established 2017 with the purpose of building a global community of public health stakeholders to share ideas, expertise, and best practices for facilitating early threat detection. WHO then launched its hub for Pandemic and Epidemic Intelligence which

empowered traditional data sharing with artificial intelligence, further contributing to the exchange of emerging information about coronavirus throughout the pandemic. This system is activated not only for COVID-19 but other infectious diseases including zoonotic diseases around the globe now. [35]

1.6.3. Challenges in global collaboration

Many international organizations discuss the importance of interoperability and the dire need for connected and translatable systems to exchanges health data, scripts, and imaging in a standardized format. In this section, we discuss the challenges of interoperability in general and at the international level and potential solutions.

The first challenge is the sheer amount and types of data that must be made interoperable. There is a wide range of data, disciplines, and file types in healthcare, all of which must be exchanged without losing structure or meaning. As demonstrated by the different terminology languages and respective organizations, there are a multitude of areas that require standardization, such as laboratory and pathology reports and images, diagnostic imaging reports, medication management, electronic prescriptions, patient access, and regulatory approval for medical devices. Determining the priority for which data to make interoperable first or which components would provide patients and providers with the greatest value add is a difficult question. [36]

The next challenge is that efforts to improve interoperability require extensive research, trial and error, time, and resources to create a successful model. The desire to achieve interoperable EHRs or EMRs has been around for a long time in many developed countries like the United States, Canada, and United Kingdom, but even in these developed countries, the existing EMR has a long way to go to achieve the data quality needed to provide safe patient care and improve provider satisfaction. [36] Even before discussing interoperability, rolling out EHRs can pose a challenge in many countries.

Third, we need to provide a more equitable approach for middle or low-income countries, instead of merely generalizing the implementation of IKM with the promise of unconditionally improving the quality of medical care. [36]. Some countries do not have the necessary medical professionals due to brain drain or the lack of medical infrastructures and cannot afford to have a separate pool of IT professionals or researchers in the field of medicine. International organizations need to assess different situations in different parts of the world, research every situation judiciously, and allocate appropriate IKM resources to provide impactful assistance.

Fourth, not all nations in the world have the equal need for all interoperable systems or a-la-carte terminology systems in all service lines. [36] While some nations have a more need for the standardized clinical terminology in the field of tropical medicine, other nations have a more need for standardized cancer terminology and relevant interoperable system to exchange lab data and radiologic images. Achieving the global interoperability may neglect what’s most needed in a particular area of the world or at the scale of each continent.

Finally, new technologies evolve more rapidly than ever before, bringing new legal and logistical challenges over data management, including emerging healthcare or well-being apps, telemedicine, and managing international patient data. [36] We need reliable international organizations that oversee these emerging interdisciplinary areas while identifying and developing standardization and technical tools for deployment around the world.

1.6.4. Summary on Lessons Learned

According to the research survey conducted by the Global Digital Health Partnership, the following four top-three barriers in advancing the global interoperability were identified (Items 3 and 4 were tied): [36]

1. EHRs lack the capability to take action based on exchanged data

2. Poor usability and negative impact on providers' workflows

3. Difficulty managing coordinated collective action among multiple organizations

4. Increasing cost due to interoperability that entities cannot afford

Most countries have systems that generate and communicate data to other providers but they lack the necessary functions to achieve truly interoperable data exchange and management. One area for the global effort to improve healthcare IT to focus on is recognizing the lack of EHR capabilities as the most important barrier to overcome. This barrier is directly tied to the "poor usability" barrier in cases where EHRs possess capabilities that are underused because adopting the new language takes significant training and time. [36] Redesigning clinical process is often an external quality improvement initiative in addition to implementing a good EHR system, adding more burden and disrupting the on-going flow within the existing EHR capability.

Interoperability in healthcare is inherently more complex than in any other fields because achieving the purpose of interoperability involves multiple stakeholders on different sectors within healthcare and each of their agreement with the following stakeholders: payers, providers and pharmaceutical components. In addition, different countries operate on various models of healthcare insurance and network management that its own EHR system and interoperability planning need to scrutinize. Local, state, and federal regulations must cooperate with private and NGO institutions to solve these challenges. [36]

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