JOINT LEARNING NETWORK

For Universal Health Coverage

Connecting Health Information Systems for Better Health

Leveraging interoperability standards to link patient, provider, payor, and policymaker data

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PATH

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ABOUT THE JOINT LEARNING NETWORK

The Joint Learning Network for Universal Health Coverage (JLN) is a unique practitioner-to-practitioner learning network that is connecting low-and middle-income countries with one another so that they can learn from one another's successes and challenges with implementing UHC, jointly solve problems, and collectively produce and use new knowledge, tools, and innovative approaches to accelerate country progress and avoid 'reinventing the wheel'. For more information, please visit www.jointlearningnetwork.org.

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The Rockefeller Foundation supports work that expands opportunity and strengthens resilience to social, economic, health and environmental challenges – affirming its pioneering philanthropic mission since 1913 to promote the well-being of humanity. For more information, please visit www.rockefellerfoundation.org.

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Preface

In many developing countries, information and communication technology (ICT) leaders are working to implement universal health coverage (UHC). They are grappling with the fact that although their insurance information systems are just now being formed, there are often underlying legacy health information systems that have been used to collect data for managing health care service delivery quality and that have provided important clues to emerging health issues (e.g., the rising incidence of noncommunicable diseases). Similarly, national electronic health (eHealth) leaders at ministries of health struggle with how to link disparate information systems and harmonize many primary care projects that are often funded outside of the official health system—projects that collect data in slightly different ways, each in different information systems.

In our work over the past few years as technical facilitators for the Information Technology (IT) Initiative of the Joint Learning Network (JLN) for Universal Health Coverage,[1] we have been struck by several things. First, the payor or insurer and the ministry of health rarely have opportunities to coordinate efforts, particularly in the area of health information systems. Second, they are often building similar if not almost duplicative systems (e.g., facility and provider registries). And third, although both groups are deeply interested in using standards (i.e., code sets, communication formats) to drive interoperability, they often struggle with how to get started. Despite these challenges, we also have seen first-hand the success and efficiency gains in quality of care and reduced medical costs that some countries (e.g., Abu Dhabi, Canada) have achieved when aggressively using standards.

If taking a standards-based approach is so great, why has it not been more widely touted or adopted? Factors inhibiting adoption include:

- Standards debates are often not well understood.

- These debates are not supported financially or politically.

- Choosing standards is difficult without a lot of personnel, expertise, and money, which most health systems do not possess.

Recognizing these challenges and at the request of our JLN IT Initiative collaborative members, we have developed this eBook as a reference guide for countries interested in linking their UHC and eHealth information systems using a standards-based approach. The eBook provides a set of specific actionable steps and links to resources that a country can leverage to develop a national eHealth standards framework (NeSF). The development of national-scale infrastructure based on the NeSF can, and should, be done over time. The pieces do not all need to be put in place at once; rather, they can be brought together as national needs and systems evolve. Standards-based systems will be interoperable, regardless of the underlying technology, as long as there is agreement regarding content, coding, and communication formats. This opens up opportunities; new interfaces can enable the use of existing investments.

A growing number of resources are available on the topic of standards and interoperability. These include published national eHealth standards frameworks (from both developed and developing countries) and published and in-press guidance documents from international organizations such as the World Health Organization (WHO), International Telecommunication Union (ITU), and World Bank. Here we collect relevant references and additional resources, which are cited where appropriate and listed at the back of the eBook. We extend some of the existing work to provide specific context with a UHC perspective. We also document anecdotal, real-world perspectives from a select group of eHealth experts who have shared lessons learned from their countries' eHealth and UHC journeys.

We believe that national eHealth architecture and the underlying standards decisions must be driven by the interests of each country and its citizens, and those national-level policymakers are in the best position to make those decisions. This eBook does not recommend which standards should be used or which IT systems should be implemented. Our goal is simply to unpack some of the complexities in the standards discussion and provide a way in which countries can practically use this information to start a standards-based information systems journey grounded in examples from countries already on this path.

We thank our interviewees [Mr. Cees Hesp (Netherlands), Dr. Alvin Marcelo (Philippines), Dr. Rosemary Foster (South Africa), Mr. Ramiro Guerrero (Colombia), and Dr. Boonchai Kijsanayotin (Thailand)] and our sidebar authors [Ms. Anne Belford (Telus Health Systems, Canada) and Dr. Somil Nagpal (World Bank, India)], who contributed their experiences to this eBook. This eBook was produced with the generous support of the Rocke-feller Foundation as part of the Joint Learning Network for Universal Health Coverage.

NOTES

1. The authors work with nine countries in Asia and Africa pursuing universal health coverage. Please see www.jointlearningnetwork.org for more information on the network and countries involved.

1. Overview

Globally, many countries are contending with how to make multiple information systems across the health care domain "speak the same language." This ability of applications and systems to connect and share health information—to interoperate—supports important capabilities, including continuity of care, health system management and surveillance, and the financial transaction processing needed to support UHC and monitor progress of UHC initiatives.[1] Thus, eHealth infrastructure, interoperability and standards, and UHC initiatives are inextricably intertwined.

If the key messages of this eBook had to be summarized in a single core piece of advice, it would be that a common, standards-based, national-scale eHealth infrastructure should support both care delivery and financial payments workflows as well as produce the analytics necessary to monitor and manage these.

This eBook is grounded in the JLN's prior work to develop guidance and tools on the subject of interoperability of health insurance information sys-

tems. A first step a country should consider when planning for interoperability is the creation of a health data dictionary (HDD) to define and document common terminology. An HDD supports consistent, accurate, and systematic data definitions, which become extremely valuable when planning how organizations and systems will collect and exchange information. This topic is explored further in a JLN paper titled *Promoting Interoperability of Health Insurance Information Systems through a Health Data Dictionary*, available on the JLN website.[2] The JLN also developed the openHDD tool, which is a freely available, collaborative, web-based, open-source tool for creating data dictionaries in general and HDDs in particular. The tool contains HDDs from several countries, which can be used as examples or starting points in defining a dictionary, and is available on the JLN website.[3]

The need for interoperability of health information systems is well stated by the UN Commission on Information and Accountability:

> The use of eHealth and mHealth [mobile health] should be strategic, integrated and support national health goals. In order to capitalize on the potential of ICTs, it will be critical to agree on standards and to ensure interoperability of systems. Health Information Systems must comply with these standards at all levels, including systems used to capture patient data at the point of care. Common terminologies and minimum data sets should be agreed on so that information can be collected consistently, easily and not misrepresented. In addition, national policies on health-data sharing should ensure that data protection, privacy, and consent are managed consistently. [4]

In many countries, health care providers and facilities are not yet using electronic information systems. In such a context, connectivity among systems is not an initial concern and is often not a high priority for policymakers. However, as the use of ICT inevitably grows and the cost to a nation for supporting UHC grows, system-to-system interoperability increasingly becomes a concern for all the providers, patients, payors, and policymakers who need

data from information systems to monitor and manage health services. By establishing a standards-based approach early in the process, a *network effect* can be created that unlocks value from the many individual, disparate investments in eHealth and mHealth. Communication between providers, payors, policymakers, and even patients is critical to enabling transactions across the national health system to support care delivery, provider payments, and the generation of important health and health system metrics.

Interoperability between disparate health applications relies on the adoption of standards. Various chapters in this eBook:

- Outline the value proposition behind national-scale, eHealth infrastructure in a way that policymakers and IT professionals alike can readily understand.

- Provide examples of key implementation issues faced by countries on the journey toward developing national-scale, standards-based eHealth infrastructure and how they dealt with them.

- Introduce four key stakeholders—patients, providers, payors, and policymakers (the four P's)—and their differing perspectives on the care delivery value chain.

- Describe a "storytelling approach" that may be employed to develop eHealth standards specifications appropriate to a country's interoperability requirements.

- Provide a set of practical steps forward that a country may follow to develop this framework.

Although this eBook presents user stories and examples specifically related

to UHC, its how-to guidance is generally applicable to any country addressing interoperability between health information systems.

Understanding Key Concepts

Let's begin with some definitions and context of common terms and concepts used throughout this book.

WHO defines eHealth as "the use of information and communication technologies for health."[5] And what is eHealth infrastructure? It is the collection of applications, databases, and networks that support sharing of health information. For the purposes of this eBook, we use the term eHealth to denote the full gamut of health-related ICT, including care delivery systems, insurance systems and health system management, and reporting and surveillance systems.

This broad use of the term "eHealth" underscores the eBook's main message. Wherever a country may be on its eHealth journey and whatever its infrastructure implementation agenda, financial payment mechanisms should be considered a key requirement during the analysis and design phase of any new care-focused initiative, even if today those payments are covered by other sources (e.g., donors). Likewise, as UHC initiatives are launched and payment processing systems are being planned, ICT requirements related to care delivery should be taken into account. An eHealth infrastructure must be a bridge between the policies that apply to care delivery and those that apply to health system financing. It is expected that this shared infrastructure will also support the data analytics that enable disease surveillance, public health reporting, UHC progress monitoring, and overall health system management. As we will see in the chapters that follow, there is a high degree of commonality between the ICT assets needed to support these related sets of requirements and each of the actors in the system.

A definition for *eHealth interoperability* has been developed by the Healthcare Information and Management Systems Society:

> In healthcare, interoperability is the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged. Data exchange schema and standards should permit data to be shared across clinicians, lab, hospital, pharmacy, and patient regardless of the application or application vendor. Interoperability means the ability of health information systems to work together within and across organizational boundaries in order to advance the health status of, and the effective delivery of healthcare for, individuals and communities. [6]

This book is focused on how eHealth standards can be leveraged to support national interoperability among multiple systems. There is a crucial point that must be appreciated: there is no interoperability without standards. Some could argue that a point-to-point integration between two systems can be implemented without either party adopting standards—and this is true. Interoperability, however, can be thought of as many-to-many integration where the integrating parties do not know ahead of time with whom they will be connecting. To do this, there must first be agreement regarding how the connectivity will be achieved. This pre-agreement is accomplished via the adoption of standards.

Value Proposition for an eHealth Infrastructure

Many countries find themselves in the situation of having numerous disparate systems deployed that are not based on the same eHealth standards (and some are not based on *any* standard at all). These countries have many eHealth implementations, but they are pilot projects that cannot scale and "islands of automation" that are unable to share data.

A frustrating situation such as this can be avoided or addressed by developing and specifying a NeSF and eHealth architecture.[7] The NeSF provides a way to achieve interoperability among disparate applications, and the eHealth architecture describes the ICT assets that currently exist or should exist to execute the workflows and processes of the health system. As a fundamental starting point, countries must determine where and how eHealth infrastructure will be implemented. To inform this decision, it is useful to trace the role standards-based eHealth infrastructure plays in supporting the overall *health production system*.

Figure 1 illustrates a model of how eHealth affects population health. To see the Figure 1 video, click the play button in the graphic below or follow the link here: https://vimeo.com/108627029.

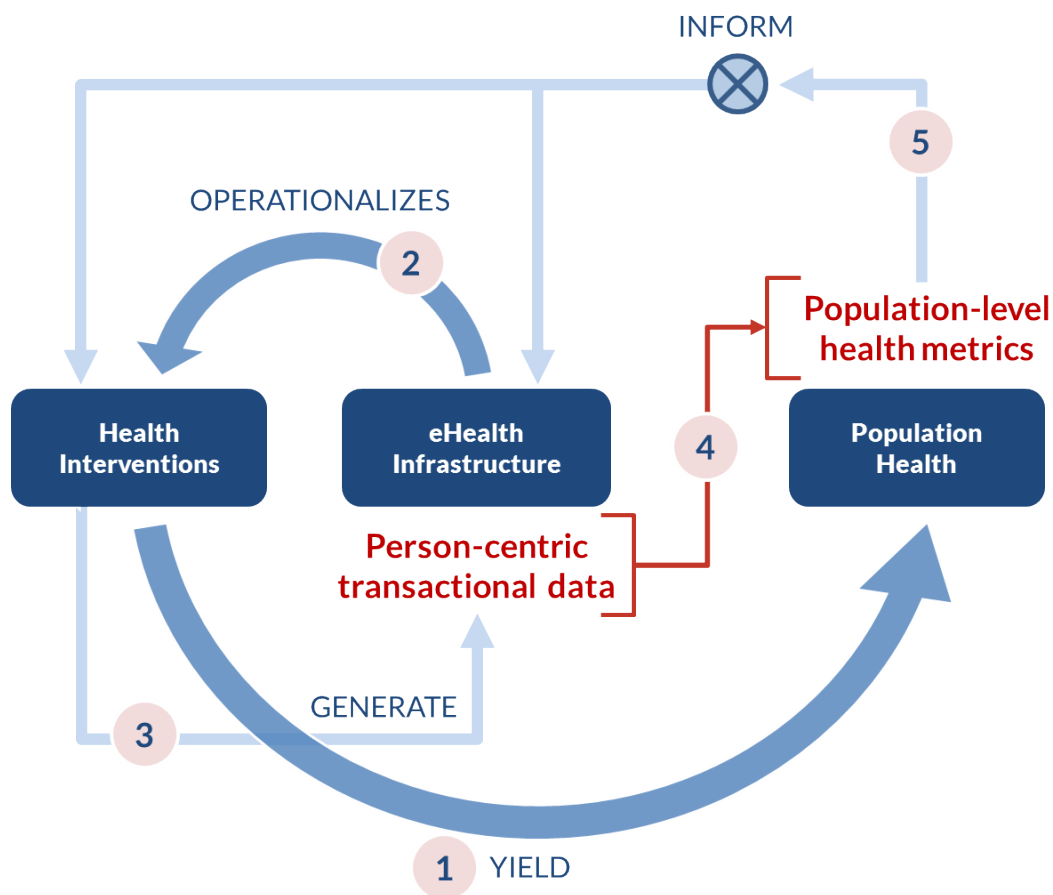Figure 1. How eHealth affects health outcomes

As shown in Figure 1:

1. Health interventions yield population health.
2. eHealth infrastructure operationalizes, or puts into effect, health interventions (e.g., information systems that support care delivery and financial payments).
3. Health interventions generate person-centric transactional data (e.g., electronic health records and claims records).

4. Person-centric transactional data may be aggregated to develop population-level health metrics.
5. Population-level metrics guide the development of new health interventions and the eHealth infrastructure that will operationalize them.

As shown by Figure 1, the eHealth infrastructure plays two key roles. First, it helps measure the health system's performance. Person-centric transactions—if they are captured in a standards-based, computable format—provide consistent, comparable data that can be collected and analyzed to determine how a nation is doing in delivering health care services and paying providers for services rendered.

Second, the eHealth infrastructure provides a mechanism to exert process control, or feedback, upon the very system it measures. This idea of a feedback loop is at the heart of the World Bank's "control knobs" model of health system management[8] and the US National Institute of Health's concept of a "learning health system."[9] A health system that is metered and has feedback (and "feed-forward") process control loops can set itself on a path of continuous quality improvement. This can be incredibly effective over time.

Fully realizing the investment value requires taking steps to operationalize the eHealth strategy, and a NeSF is a critical part of that strategy. In June 2012, the WHO and the International Telecommunication Union (WHO-ITU) *National eHealth Strategy Toolkit*[10] (henceforth referred to as "the WHO-ITU Toolkit") was released. It recommended a step-by-step process to establish and document a NeSF that supports both care delivery and UHC-focused workflows. Figure 2 shows the context of the NeSF in relation to the other foundational elements of a national eHealth strategy.[11]
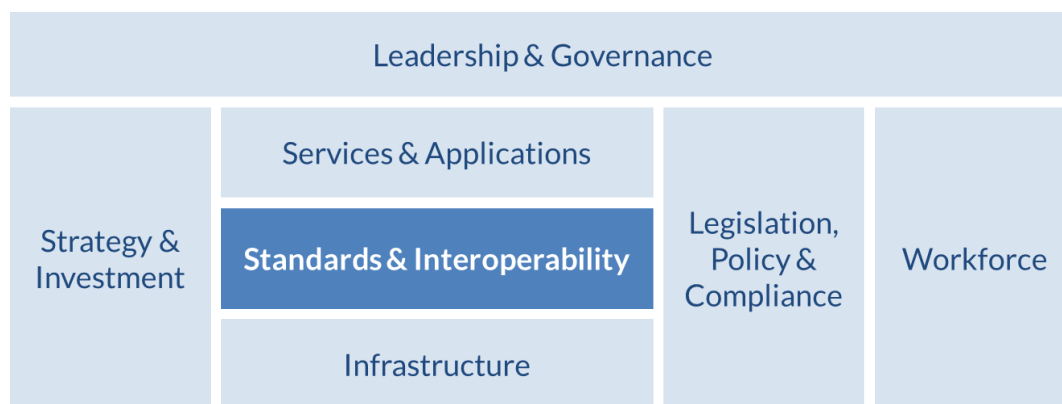
Figure 2. Context of the NeSF within the WHO-ITU *National eHealth Strategy Toolkit*

The NeSF is illustrated by the "Standards & Interoperability" block, which is only one of a number of foundational building blocks needed to operationalize a national eHealth strategy. Overarching any eHealth strategy initiative is the all-important leadership and governance, which oversees strategy and investment, the legislative and policy frameworks, the people who will implement the system, and those who will use it. The operational elements are also under the purview of the strategy's leadership and governance; these include the NeSF and the standards-based services, applications, and infrastructure that "make it go." All these are covered in more detail in the WHO-ITU Toolkit.

The eHealth infrastructure "footprint" and maturity differ by country. In some countries, eHealth investments are highly fragmented, focused on primary care delivery, and funded by multiple sources. In others, the investments are being driven by UHC initiatives addressing health financing. Although these investment strategies might logically be divided into chronological phases, in reality the investments are usually being made simulta-

neously with few linkages between them, despite needing similar data and infrastructure.

Regardless of the starting point, each country needs to:

- Articulate a health strategy.
- Articulate an eHealth strategy, aligned with the health strategy and sensitive to the existing eHealth landscape.
- Develop an implementation plan for national eHealth infrastructure that operationalizes the strategy.
- Secure funding to implement the plan.

To illustrate how these steps work in practice, experts from five countries provided background on how this process unfolded in their home country and lessons they learned from the experience. Insights from these interviews are discussed in the following chapter.

NOTES

1. World Bank. *Monitoring progress towards universal health coverage at country and global levels: framework, measures and targets.* Washington, DC: World Bank Group; 2014. Available at: http://documents.worldbank.org/curated/en/2014/05/19631447/monitoring-progress-towards-universal-health-coverage-country-global-levels-framework-measures-targets.
2. PATH. Promoting Interoperability of Health Insurance Information Systems Through a Health Data Dictionary. A series by Dennis J. Streveler and Cees Hesp. Seattle: PATH; 2012. Available at: http://jointlearningnetwork.org/uploads/files/resources/-HealthDataDictionarySeries_8.5x11.pdf.
3. Page on openHDD. JLN website. Available at: http://www.openhdd.org/.

4. United Nations. *Keeping promises, measuring results, First report of the UN Commission on Information and Accountability.* New York: United Nations; 2011. Page 14.

5. Page on eHealth. World Health Organization website. Available at: http://www.who.int/ehealth/en/.

6. Page on the definition of interoperability. HIMSS Website. Available at: http://www.himss.org/library/interoperability-standards/what-is?navItemNumber=17763

7. An excellent overview of health enterprise architecture was published by the Health Metrics Network: http://www.who.int/healthmetrics/tools/1HMN_Architecture_-for_National_HIS_20080620.pdf.

8. Page on What is a Health System. World Bank website. Available at: http://go.worldbank.org/PZSJEFTTZ0.

9. Olsen LA, Aisner D, McGinnis JM. *The Learning Healthcare System: Workshop Summary.* Washington, DC: National Academies Press (US); 2007. Available at: http://www.ncbi.nlm.nih.gov/books/NBK53481/.

10. World Health Organization. National eHealth Strategy Toolkit. Geneva: World Health Organization and International Telecommunication Union; 2012. Available at: http://apps.who.int/iris/bitstream/10665/75211/1/9789241548465_eng.pdf

11. Figure 2 references Part I, page 8 of the *WHO-ITU Toolkit*.

2. Country Experiences

Chapter 1 discussed the needs for an eHealth strategy and infrastructure. In this chapter, we look at some "real-world" examples of countries and their experiences with planning for and implementing standards and interoperability initiatives. The path a country takes as it undertakes development and operationalization of a national-scale, interoperable eHealth infrastructure depends upon its unique context. The differences, and the similarities, among national experiences provide valuable insights.

We interviewed eHealth leaders to hear their stories regarding eHealth initiatives in Colombia, the Netherlands, the Philippines, South Africa, and Thailand.[1] Each interviewee was asked for insights from his or her experiences regarding:

- *Setting national health goals and objectives*: What key national health goals and objectives have been articulated by the government? Have specific metrics been developed to track progress against these goals?

- *Developing an eHealth strategy*: Has an official strategy been developed regarding how eHealth infrastructure will play a role in supporting these national health goals? How was this strategy developed (e.g., expert advisor, stakeholder committee, WHO-ITU Toolkit)?

- *Working in the current eHealth landscape*: What is the landscape of eHealth implementations in the country to date? What are some of the interoperability challenges and successes so far?

- *Implementing interoperability standards*: What is the present status regarding national eHealth interoperability standards? What has been the path to date and what are the anticipated next steps?

The interviewees have graciously shared their personal experiences and opinions of their countries' initiatives and are not representing any official point of view or perspective. This informal and valuable sharing of country experiences provides the opportunity to learn from each other in a personal way that reflects the peer learning values of the JLN. The video interviews are included here for viewing. The videos range from approximately 10 to 40 minutes long; if you would like to gain some first-hand perspectives of the approaches, trials, and successes of countries actively engaged in addressing the challenges and complexities of standards and interoperability, then you will find watching the interviews to be very worthwhile.
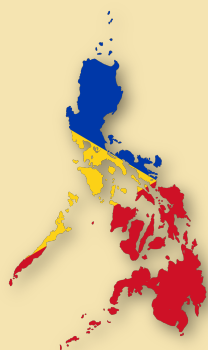
Population (million)[2]	94.9
Mobile phones (SIM per 100 pop)	99
Life Expectancy (years)	69
Health Expenditure per Capita (PPP$)	164
Health Expenditure % GDP	4.1
Public expenditure on Health (% of total)	36.1

Dr. Alvin Marcelo, Co-chair, Asia eHealth Information Network

Link to video:
https://vimeo.com/102777164

"In an archipelago like this, where connectivity can be a challenge, you have to look at SMS and GPRS as the connectivity technologies… you have to make most use of low bandwidth types of [connections]."

Population (million)[3]	69.5
Mobile phones (SIM per 100 pop)	112
Life Expectancy (years)	74
Health Expenditure per Capita (PPP$)	331
Health Expenditure % GDP	3.9
Public expenditure on Health (% of total)	75.0

Dr. Boonchai Kijsanayotin, Co-chair, Asia eHealth Information Network

Link to video:
https://vimeo.com/103276077

"You cannot look at health IT or eHealth as a kind of black box, a computer, an application...you have to look at the sociotechnical, you have to look at the standards."

Population (million)[4]	16.7
Mobile phones (SIM per 100 pop)	116[5]
Life Expectancy (years)	81
Health Expenditure per Capita (PPP$)	5112
Health Expenditure % GDP	12.1
Public expenditure on Health (% of total)	84.8

Mr. Cees Hesp, Director Joint Learning, PharmAccess Foundation

Link to video:
https://vimeo.com/102780225

"When these technologies become mature, then you can drop the m from mHealth and you can drop the e from eHealth… it is just health."

Population (million)[6]	46.9
Mobile phones (SIM per 100 pop)	98
Life Expectancy (years)	78
Health Expenditure per Capita (PPP$)	614
Health Expenditure % GDP	6.5
Public expenditure on Health (% of total)	74.6

Mr. Ramiro Guerrero, Director, PROESA – Centro de Estudios en Protección Social y Economía de la Salud, Universidad Icesi

Link to video:
https://vimeo.com/103277570

"If the standards are properly set, and the rules of the game are properly set, an industry of information operators could emerge that could connect the payors and the providers and charge a fee per information transaction… Hopefully the government will issue the standards; it is very difficult to create any standard without the buy-in from government."

Population (million)[7]	50.5
Mobile phones (SIM per 100 pop)	127
Life Expectancy (years)	58
Health Expenditure per Capita (PPP$)	915
Health Expenditure % GDP	8.7
Public expenditure on Health (% of total)	46.6

Dr. Rosemary Foster, Independent eHealth Consultant

Link to video:
https://vimeo.com/103277288

"[T]here should be a finalized eHealth strategy as part of the goal to strengthen the effectiveness of health information systems."

"Standards and interoperability are one of the most important foundational elements that have to be dealt with."

Country Experiences with Setting National Health Goals and Strategies

Interviewees referenced national health strategies that laid out explicit goals and objectives and the metrics that would be used to measure success. Dr. Rosemary Foster described the four outputs articulated in South Africa's 2010 National Service Delivery Agreement: increasing life expectancy; decreasing maternal and child mortality; combating HIV/AIDS and reducing the burden of disease from tuberculosis; and strengthening health system effectiveness. Similarly, Dr. Alvin Marcelo described the four strategies laid out in 2013 by the Philippines' secretary of the Department of Health (Hon. Secretary Enrique T. Ona): decreasing maternal mortality (Millennium Development Goal [MDG] 5); extending universal health coverage; progressing the health facility enhancement program; and ICT implementation in government health facilities.

In contrast, Dr. Boonchai Kijsanayotin referred to Thailand's relative success in addressing the MDGs and in achieving universal health coverage; he suggested that the focus had now shifted to issues of equity, sustainability, and overall health system quality. This sentiment was echoed by Mr. Ramiro Guerrero, who noted that Colombia has, over the past 20 years, effectively achieved full health coverage through its universal social health insurance system and is now turning its focus to access and utilization of services. Mr. Cees Hesp commented that the Netherlands' strategic focus is on cost control, health promotion, and disease prevention, driven very much by its aging population (a Dutch citizen born today will expect to live to be 100 years old).

Country Experiences with Developing an eHealth Strategy

Ideally, eHealth strategies will precisely track national health strategies.

Generally, this was so. Mr. Hesp noted that, in the Netherlands, eHealth strategies are largely driven by the private sector; the government's role is almost exclusively as a regulator. Discussions regarding a national patient record have given way, instead, to point-to-point sharing of electronic medical record databases between Dutch physicians to facilitate off-hours and weekend support for patient care. South Africa's 2012 eHealth strategy, in contrast, articulated plans for a national eHealth infrastructure that is directly aligned with national health goals. This 2012 strategy was accepted after multiple unsuccessful attempts over the preceding five years to achieve consensus on a national eHealth plan. The strategy was developed by a small core team, which included Dr. Foster. Although the approach was successful, there was the sense that a larger group with stronger stakeholder inclusion and dedicated resources would have been more in line with the governance approach recommended in the WHO-ITU Toolkit.

In Colombia, the eHealth strategy was reactive to the information demands of the sophisticated social health insurance system. The first stumbling block was enrollment, and the eHealth efforts focused on solving this issue. Other problems were addressed, in turn, including the capturing of contributions from employers and the issuing of payments to providers.

The Filipino eHealth strategy process began in late 2010, led by the Department of Health. This strategy was revisited, however, in September 2013. The new strategy was informed by the WHO-ITU Toolkit, was co-developed by the Department of Health and the Department of Science and Technology, and will be jointly governed and executed by them. The strategy has benefited from public consultations and is evolving based on lessons learned from similar international projects.

Dr. Kijsanayotin's sense is that Thailand does not yet have buy-in around a

clear eHealth strategy. Independent, uncoordinated groups remain focused on the specific financial and ICT aspects to the detriment of focusing on the sociotechnical[8] and governance aspects. Attempts to develop a national multi-stakeholder engagement to embrace, for example, the WHO-ITU Toolkit, have so far been unsuccessful.

Country Experiences with Working in the Current eHealth Landscape

Tellingly, Dr. Marcelo's characterization of the present eHealth landscape in the Philippines focuses not on the IT aspects but on the governance structure that has been established. This new structure aligns the governmental departments (Health, Science, and Technology, and Budget and Management), the national insurance body (PhilHealth), and academia around the new strategy that was released in early 2014. This collaborative governance structure has secured funding for the development and rollout of a new national infrastructure: the Philippine Health Information Exchange (HIE). This HIE will operationalize the Philippines' eHealth standards framework.

In contrast, Dr. Kijsanayotin notes that Thailand has been slow in making progress regarding governance, and the present state of implementation reflects this. Although billing infrastructures for diagnosis-related group-based claims processing have been in place for years, the clinical infrastructure, strategies, and sociotechnical structures needed to implement and govern such systems are not set up.

In South Africa, provinces have been able to implement their own systems according to broad guidelines that were nationally set. Because of this, Dr. Foster describes South Africa's landscape as "ranging pretty widely" and achieving varying degrees of success. Some of these systems are quite limited, whereas others (such as those in the Western Cape province) have

made significant strides and support large-scale, interoperable care delivery operations.

In Colombia, provider organizations have only recently begun to make investments in enterprise resource planning (ERP) systems that enable them to automate their operations. Today, many of the larger hospitals have such systems, but most have been implemented in only the past three years. For small and medium-sized institutions, the IT penetration is much lower. It is rarer still to find organizations that have implemented patient-centric electronic medical records (EMR) systems. Across all of the systems, both ERP and EMR, there is a general lack of standards.

In the Netherlands, eHealth implementations have focused mainly on the financing side. Electronic claims (eClaims), for example, have been operational since 2005. Virtually everyone is covered by health insurance. The insurers, through a joint venture, manage the insurance messaging and content standards. Market forces have led to very broad adoption of these standards. Clinically coded claims are routed through a centralized transaction processing hub, and the data are used to generate population-level metrics regarding health system usage and burden of disease.

Country Experiences with Implementing Interoperability Standards

Dr. Kijsanayotin notes that Thailand seems to have skipped the important step of establishing architecture and moved straight to standards specification. This has led to challenges, including the present efforts to support clinical information sharing in addition to financial (billing code) exchange. There is, however, also an opportunity for Thailand. In the absence of a large legacy base of proprietary national standards, the country can move directly to the adoption of modern, ontology-based standards such as SNOMED-CT[9].

The key, he believes, will be to overtly leverage such specifications to support Thailand's national agenda regarding the monitoring of expenditures as related to care quality, equity, and system efficiency. Connecting financing metrics to care metrics will be the incentive to drive adoption.

Colombia faces challenges related to the lack of a NeSF. For many years, the country operated with three differing HDDs for health services. Although this situation has recently been addressed, Colombia still lags behind current technology. There are issues regarding coding for medications and implantable medical devices (such as stents). Even with the use of very common specifications such as International Classification of Diseases (ICD), there are problems (multiple versions are in use, and physician training is needed regarding sound coding practices). A law was passed that mandated the use of EMRs by 2014, but the adoption rate has been very low. In Mr. Guerrero's view, this rate will remain low until the underlying standards issues are sorted out. The government is incentivized to do so; it has slowly and organically, as the private sector has grown, moved away from care delivery and now is more involved in the system as a financer and regulator. In this role, it needs data. A key challenge has been to find ways to get the data without overburdening the care delivery system it is trying to meter and manage. Presently, the progress in standards setting is lagging the demand for such specifications.

In South Africa, interoperability and standards were highlighted as a core element of the national eHealth strategy. In 2012 and 2013, the Department of Health funded a project to establish the National Standards Framework for Health (HNSF).[10] The project developed typical use cases and scenarios and determined the data that flowed out of these use cases, what the information exchange requirements would be, and what standards would be needed to support them. The HNSF also recommended that an eHealth

standards authority or board be established that would be responsible for governance issues, customization to local contexts (localization), adoption, and the ongoing evolution of the specifications to accommodate new use cases. This board would also play a role in procurement and would assist the provinces in procuring conformant software products. It is expected that this key recommendation would overcome previous issues where billions of rand were spent, in an uncoordinated way, on systems that were unable to speak to each other.

Health care in the Netherlands follows well-established referral patterns: citizens have a family doctor, and primary care clinicians provide a gate-keeper function for escalation to secondary care. Mr. Hesp notes an important aspect of standards and interoperability: consistent standards of care. Primary care practitioners will typically use computers (EMR adoption is very high, over 98 percent) to support protocol-driven, standardized care delivery processes to keep the costs down and the quality high.

The level of health IT adoption in the Philippines is low but growing, so the rollout of the new HIE provides an opportunity, in Dr. Marcelo's view, to spur IT adoption in the health sector. By leveraging the standards set by the HIE, existing solutions will have a clear way to communicate with each other, and this can start to create an ecosystem of interoperable products. Dr. Marcelo believes such an ecosystem would help unlock innovation within both the public and private sectors, because of the network effect made possible by having created a platform for communication and interoperability.

NOTES

1. Mr. Ramiro Guerrero (Colombia); Mr. Cees Hesp (Netherlands); Dr. Alvin Marcelo

(Philippines); Dr. Rosemary Foster (South Africa); Dr. Boonchai Kijsanayotin (Thailand).

2. All data from *The Atlas of Health and Climate* (WHO: 2013).

3. All data from *The Atlas of Health and Climate* (WHO: 2013).

4. All data from *The Atlas of Health and Climate* (WHO: 2013).

5. Index Mundi. Available at: http://www.indexmundi.com/g/r.aspx?v=4010.

6. All data from *The Atlas of Health and Climate* (WHO: 2013).

7. All data from *The Atlas of Health and Climate* (WHO: 2013).

8. Page on Sociotechnical Systems. Wikipedia website. Available at: http://en.wikipedia.org/wiki/Sociotechnical_system.

9. SNOMED-CT (Systematized Nomenclature of Medicine – Clinical Terms) is a comprehensive clinical terminology, originally created by the College of American Pathologists (CAP) and, as of April 2007, owned, maintained, and distributed by the International Health Terminology Standards Development Organisation (IHTSDO), a not-for-profit association in Denmark.

10. CSIR and National Department of Health. *National Health Normative Standards Framework for Interoperability in eHealth in South Africa*. Pretoria: CSIR and Department of Health; 2014. Available at: http://hufee.meraka.org.za/Hufeesite/staff/the-hufee-group/paula-kotze-1/hnsf-complete-version

3. Introducing the Key Stakeholders: Patients, Providers, Payors, and Policymakers (the Four P's)

Chapters 1 and 2 introduced the idea of eHealth infrastructure, explained why such infrastructure is important, and described the progress that has been made by selected countries toward establishing national-scale systems. This chapter introduces the four key actors who will provide information into and extract information from the eHealth infrastructure and the roles they play in relation to each other (see Figure 3).
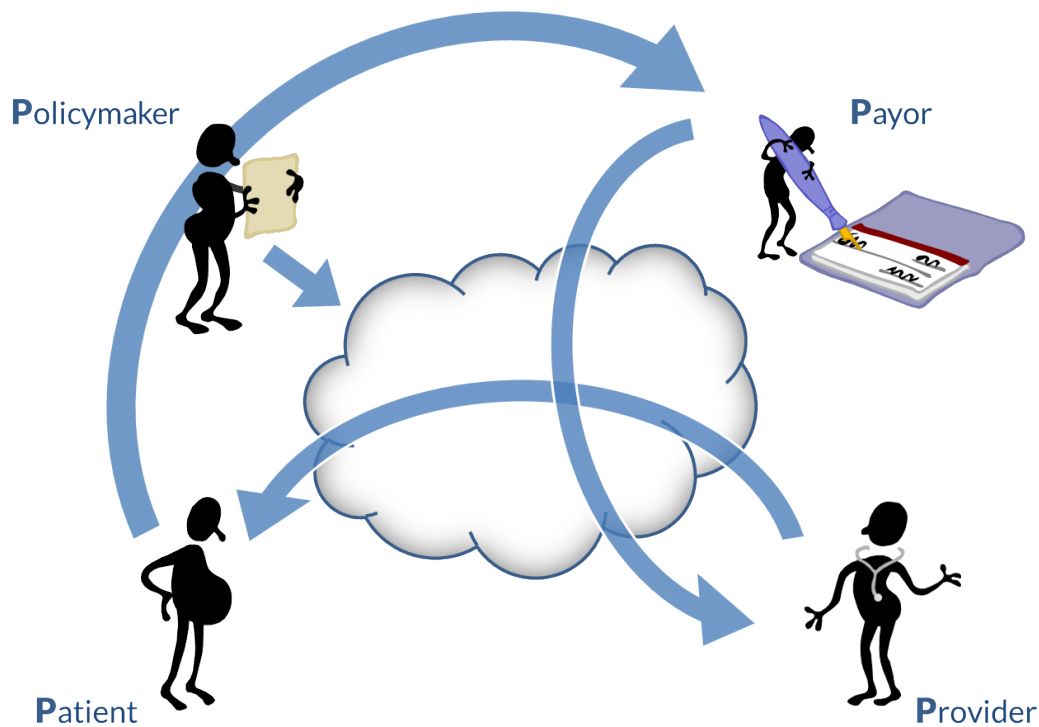
Figure 3. The stakeholders: patients, providers, payors, and policymakers

Developing a NeSF begins first by documenting a country's representative health stories. We use health stories to denote common or characteristic healthcare scenarios expressed in a storytelling format. Here we look at four of the main characters in these stories:

- **Policymakers**. Policymakers establish the framework within which health care is provided to the country's citizens. In this book, "policymaker" is a synonym for "ministry of health" or whatever jurisdictional entity is responsible for the health of the population. The policymakers aggregate data from patients, providers, and payors to develop population-level metrics that inform their health and health economic policies. In this context, policies answer the crucial questions:

- Who is eligible to receive care?

- What care services are provided; how; where; by whom?

- How are services paid for?

- Are the services being delivered well? Are they accessible?

- Are the needs of vulnerable or marginalized populations adequately served?

- What health care concerns do we need to plan for next?

- **Patients**. All of us—at one time or another—are patients. Patients are typically citizens, and voters, and sometimes taxpayers. Policymakers have a fiduciary duty to this population, and the country's policy framework is established to benefit patients. Patients receive care services from providers and are the beneficiary customers of the payors. Patients also may want to access information about their care via an electronic device (e.g., personal computer, mobile phone).

- **Providers**. Providers operationalize care delivery within the policy framework. They provide health services to patients and maintain health information about them. The providers coordinate patient care with other providers as care team members. Many providers are independent businesses that must manage their own operations and finances.

- **Payors**. Payors operationalize the financial elements of the policy framework. Payors enroll patients as beneficiaries. They procure care services from the providers on behalf of their patient beneficiaries. They also must take on the actuarial task of ensuring the financial sustainability of the care program. They report to policymakers.

Each of these stakeholders plays a different role in relation to the others (Figure 4). Each has a different viewpoint on the health care *value chain*[1] and on the eHealth infrastructure needed to support it.
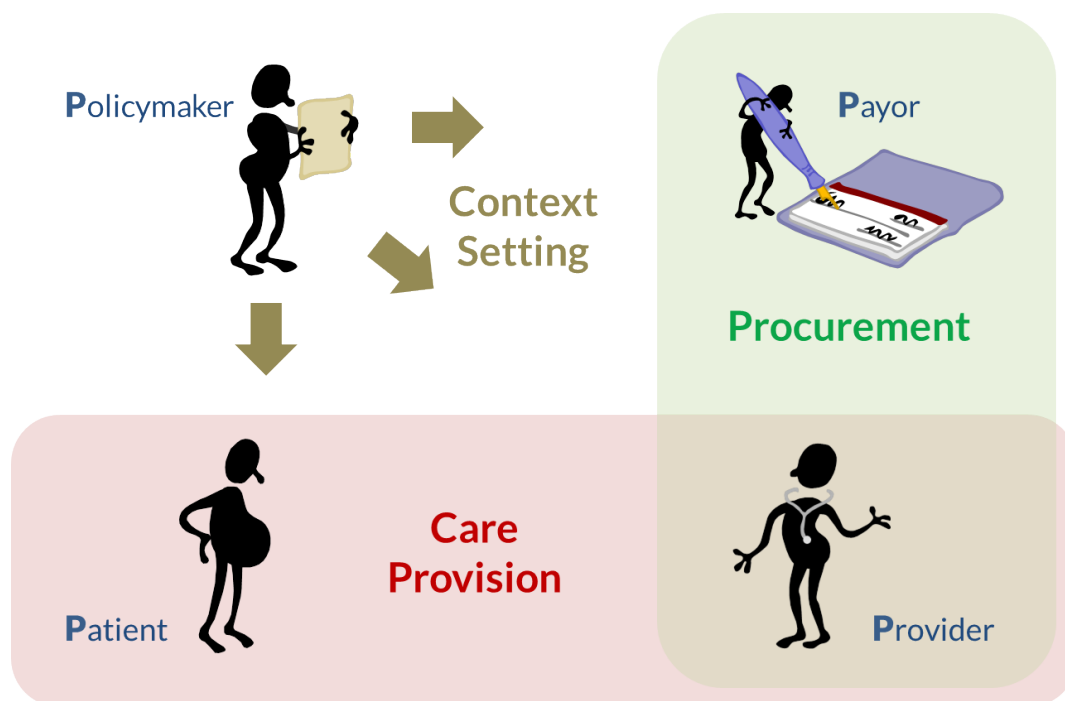
Figure 4. The relationships between the four Ps

Policymakers set the context within which the health care system operates (Figure 5). Providers and payors are regulated by these policies and operate within them. Ideally, the policies are designed to maximize the health of the population within the country's financial and resource constraints (recall the flows described in Figure 1).

Policymaker

Regulates coverage: Policymakers establish the eligible beneficiaries, patients' costs, and the portfolio of insured services.

Payor

Maximizes health: Policymakers want to maximize population health. They operate within the system's resource constraints. They marshal new resources as they can.

Regulates service providers: Policymakers establish regulations regarding who can legally provide health services within their jurisdiction.

Patient

Provider

Figure 5. The policymakers' viewpoint

The payors' view (Figure 6) is dominated by their role as procurers of services on behalf of their beneficiaries. In financial terms, payors and providers have a customer/supplier relationship. Of course, in turn, patients may have a choice of payors, and so payors may have a supplier/customer relationship with their patient beneficiaries. To be sustainable, payors endeavor to minimize the costs of funding their portfolios of care services. This incentivizes payors to encourage and even invest in the uptake of healthy-living initiatives within their beneficiary population.

Policymaker

Regulated service: Payors must conform to applicable legislation and policy.

Payor

Customer: Payors want to procure and pay for efficient, high-quality, cost-effective services for their beneficiaries.

Care funder: Payors need to be financially sustainable; they must minimize the costs for the benefits package offered.
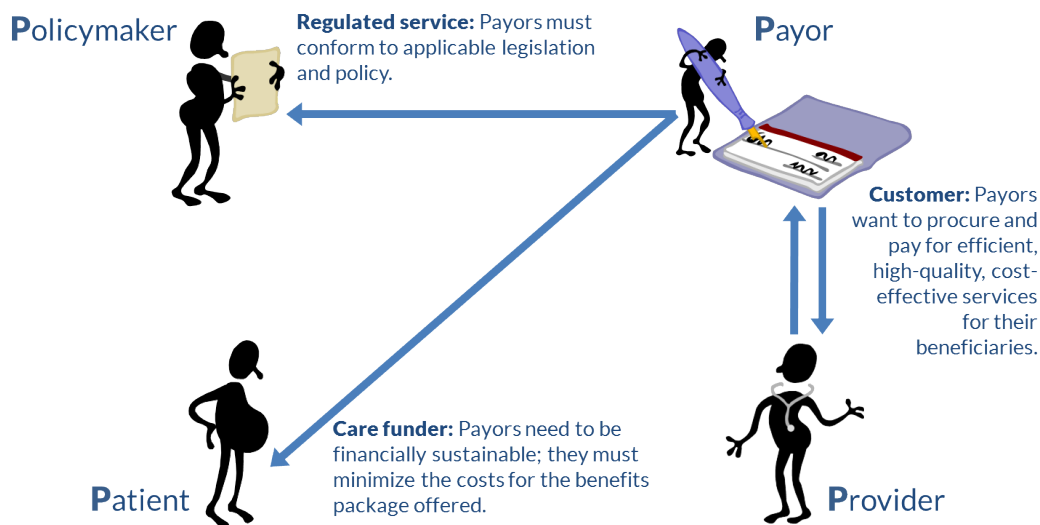
Patient

Provider

Figure 6. The payors' viewpoint

The providers' viewpoint (Figure 7) is defined by their care provision relationship with the patients and their supplier relationship with the payors. These relationships exist within the providers' contextual relationship with policymakers as regulated professionals. In situations where care must be coordinated, providers also find themselves managing relationships with other members of the care team, as they collaborate on behalf of a shared patient.

Policymaker

Regulated professional: Providers must conform to applicable legislation and policy.

Payor

Supplier: Payors will have reporting and invoicing requirements (e.g. level of detail, frequency) that can impact payment (i.e. speed and amount).

Patient

Care provider: Clinicians provide care to their patients, sometimes as members of a care team.
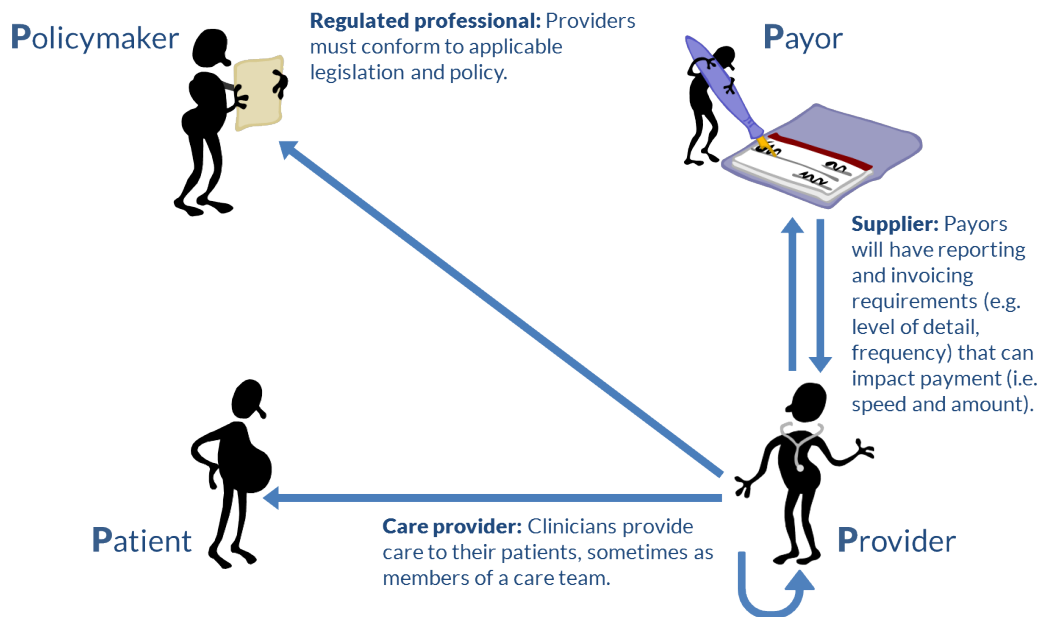
Provider

Figure 7. The providers' viewpoint

The patient's viewpoint (Figure 8), in times of good health, may be turned to their role as influencers of health policy (perhaps during an election). As consumers, patients may be able to exercise purchase discretion regarding their choice of payors. In times of poor health, patients are often powerless consumers. When we are ill, we want to become healthy again. This is what makes the patient-provider relationship powerful, and underlies the moral and ethical imperatives that are important to it.

Policymaker

Customer: Patients pay for insurance (e.g. directly, through taxes). They may have a choice of insurer.

Payor

Influencer: Many patients are voters and taxpayers.

Care seeker: Patients' care-seeking behavior is influenced by numerous factors (e.g. proximity, fees, quality)

Patient

Care recipient: Patients want to be (or become) healthy. They also need to know they will not suffer catastrophic financial hardship.

Provider

Figure 8. The patients' viewpoint

How do these viewpoints relate to eHealth infrastructure supporting the operation of the health system? The different perspectives may be illustrated by looking at four common eHealth infrastructure elements (Figure 9):

- Patient database

- Facility database

- Provider database

- Health transactions database

The term *patient database* should be taken loosely; at any given moment, everyone is a potential patient. From the point of view of the policymaker, then, this all-person database is the client registry (CR)[2] and contains demographic information about all citizens, including information about each individual's insurance plan and his or her preferred primary provider (PPP).

From the payor's viewpoint, the subset of the CR that references its customers constitutes a database of the payor's beneficiaries. The subset of the CR that is related to a particular provider represents that provider's patient list; for an individual patient, he or she thinks of the demographic record in the CR as a record about "me."
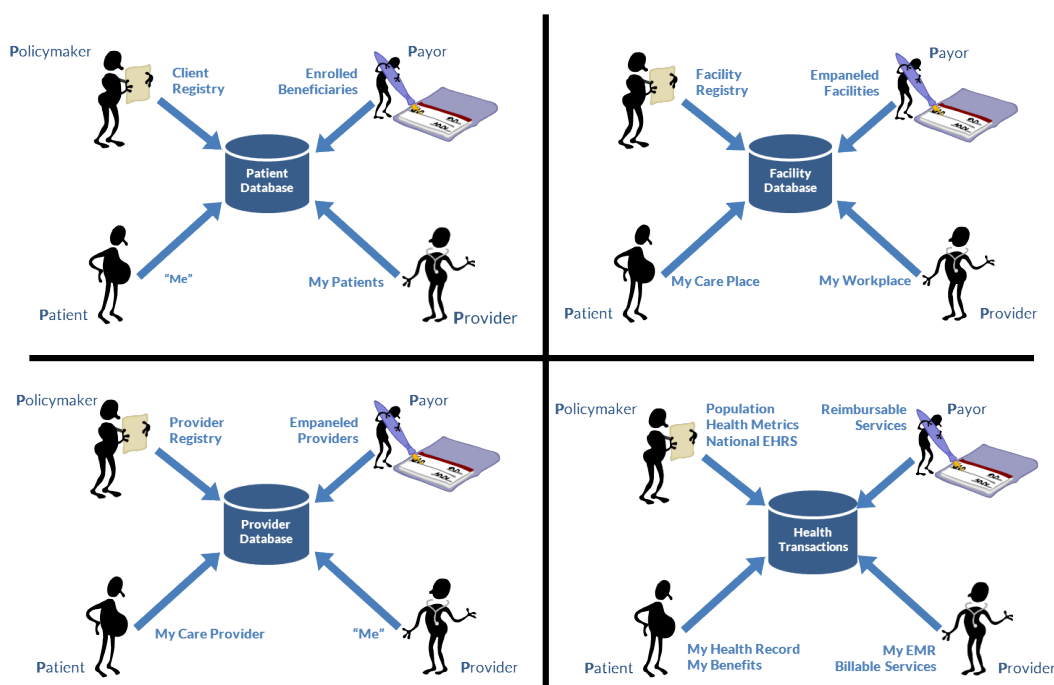
Figure 9. Stakeholders' differing views on ICT assets

To the policymaker, a *facility database* represents the national facility registry or master facility list and is a tool for supporting health system management and planning. A subset of this national list, however, may have been empaneled[3] by the payor and would represent the payor's list of authorized suppliers. To the provider, the facility registry includes the locations from which he or she delivers care. From the patient's perspective, it is a *provider database*, listing the places where the patient receives or can receive care.

On a national basis, the policymaker views the provider database as the provider registry and uses it to support health human resource planning. For the payor, a subset of this list represents its empaneled list of suppliers. To an individual provider, his or her record in the provider registry is a demographic and professional record about "me." From the patient's prospective, this database contains current care providers and possibly a list of potential new providers.

It is interesting to consider the multiple viewpoints on the *health transactions database*. From the point of view of a policymaker, this database represents a national-scale electronic health records (EHR) system. Anonymized data from this EHR can be used to generate powerful analytics to inform health system management and planning, support disease surveillance, and generate public health metrics. From the payor's viewpoint, this database contains an audit trail of reimbursable services. Likewise, for the provider, this is potentially a database of supporting documentation for the provider's billings as well as an electronic medical record (EMR) for his or her patients. Of course, for the patient, this database represents the individual's person-centric, longitudinal health record and, from an insurance standpoint, an audit log of his or her benefits.

A national eHealth infrastructure will contain ICT assets that serve multiple purposes. If these multiple viewpoints and purposes are understood during design, then these ICT assets can be deployed as *shared* assets rather than, inefficiently and expensively, as *duplicative* assets.

NOTES

1. Michael Porter, of the Harvard Business School, coined the term "value chain" to

describe the entire production chain, from raw material and service inputs right up to final product or service ultimately consumed by the end user. For our purposes, the health care value chain includes the entirety of public health; preventive, primary, and acute care; and the management, supply chain, and financial systems that support these.

2. A client registry is sometimes also referred to as an Enterprise Master Patient Index (EMPI).

3. A payor establishes the criteria that must be met to be eligible for reimbursement as a service provider to its beneficiaries; the eligible services providers are said to be "empaneled" by the payor.

4. Plan for Current and Future Requirements as the National eHealth Infrastructure Matures

The scope and focus of the eHealth infrastructure is different for each country. Some countries have focused on eGovernment[1] systems (e.g., national identification). Some have focused on UHC initiatives and have made investments in implementing the infrastructure necessary to support provider payments. For others, the focus is on directly supporting the care delivery network for primary care; this is the area where government and donor investments are being made.

Figure 10 illustrates a possible eHealth infrastructure design, generally reflective of the system architecture for OpenHIE,[2] a global open-source collaboration initiative that assists in the strengthening of national health information exchanges for the underserved.

BACK-END SYSTEMS (INFRASTRUCTURE)

| INSURANCE SYSTEMS | CARE DELIVERY SYSTEMS | eGOVERNMENT SUPPORTING SYSTEMS |

Beneficiary Registry	Client Registry
Empaneled Providers	Health Worker Registry
Empaneled Organizations	Facility Registry
Billing Codes	Terminology Service
Claims Database	Shared Health Record

Other Insurance Systems

Other Care Delivery Systems

National ID Database

Vital Registration Database

Privacy & Security Rules

INTEROPERABILITY LAYER

END-USER APPLICATIONS

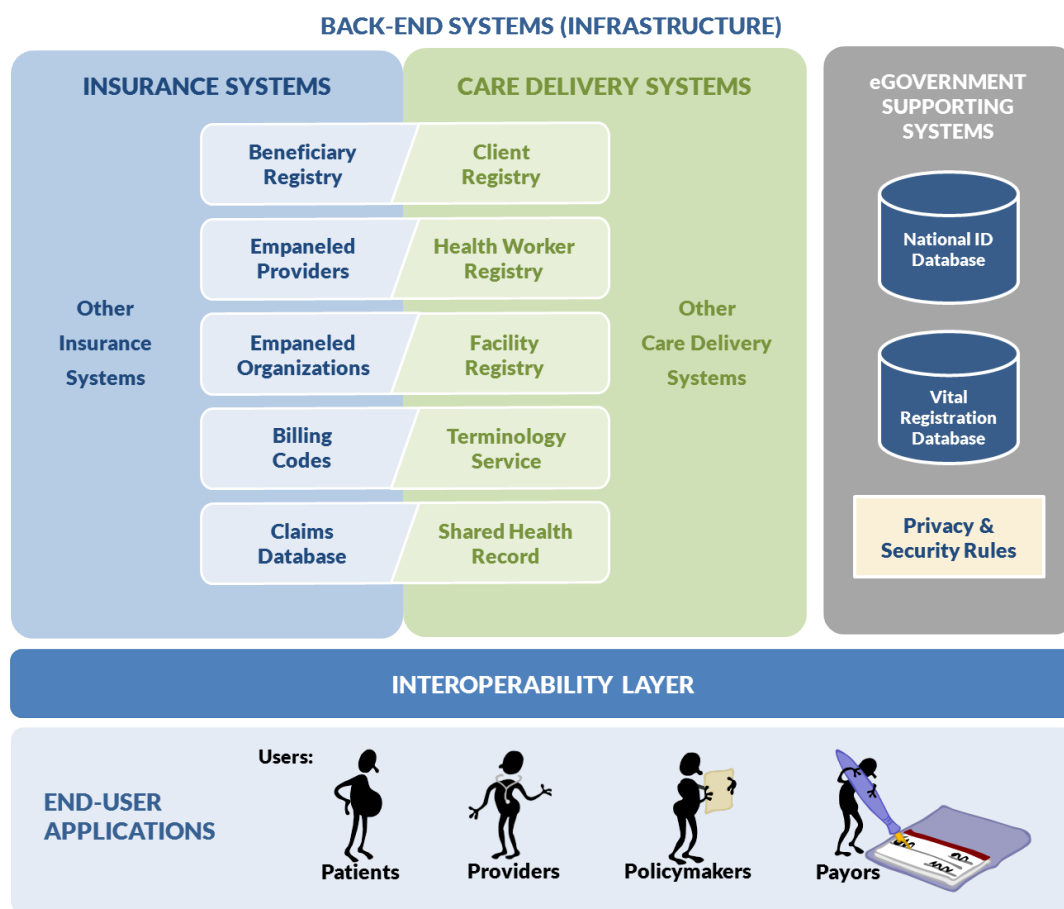Users:

Patients   Providers   Policymakers   Payors

Figure 10. eHealth architecture and shared infrastructure

Figure 10 underscores a key message: reusable, standards-based eHealth infrastructure can and should be shared by the care delivery, insurance or payor, and "eGovernment" systems. Such shared infrastructure can then be leveraged by end-user applications that support transaction processing workflows and management analytics on behalf of patients, providers, payors, and policymakers. Data sharing topologies,[3] such as the interoperability layer-based design shown in Figure 10, can then be used to expose this

shared infrastructure via standards-based "connectors" (application programming interfaces, or APIs). IT systems implemented on the insurance side can be leveraged by the care-delivery side; likewise, systems implemented to support care-delivery workflows can be leveraged to support provider payment transactions.

As an example, a country may have implemented a national facility registry (FR) to support specific care delivery initiatives (such as HIV, tuberculosis, or maternal care, for instance). At the most basic level, the "empaneled organizations" view of a facility registry provides sufficient information to support payments based on the global budget method. Using the global budget method, provider organizations are funded in advance of providing services based on their size, scope, and range of services. At higher levels of sophistication, adjustments might be applied to the global budget value based on factors such as service volume, services mix, or size of served population (catchment).

In contrast, if a country were implementing a UHC-focused insurance scheme that included a fee-for-service (FFS) payment method, more eHealth infrastructure would be needed. In FFS, individual providers (or sometimes, provider organizations) are funded, after delivery of care services, based on the services they have delivered. An empaneled provider (health worker) registry, a beneficiary (client) registry, and a claims database (shared health record) can be used to support FFS payments. Because the fee schedule is based on the specific services delivered, these billing codes must be part of the care service transaction record; a terminology server may be necessary to map between local and system-level codes (and enforce use of standardized codes, such as diagnosis codes based on ICD-10).

Regardless of which direction they are coming from (insurance to care deliv-

ery, or vice versa), a country's eHealth infrastructure could be described using a capability maturity continuum and very simple descriptions for low, medium, and high (see Figure 11). Growing sophistication of the overall health care delivery and financing system will drive increased requirements for interoperability but will also provide increased value in the capabilities that can be derived from consistent connected data.

National eHealth Infrastructure Capability Maturity Continuum		
	CHARACTERISTICS	CAPABILITIES
LOW	• IT systems may not be in place for all provider and facility locations. • Person-centric service level data is not being captured.	
MEDIUM	• Focus on enabling electronic transactions for operationalizing business processes—enrolling members, paying claims. • Some program-specific, person-centric, service-level data is being captured (e.g., HIV, maternal care, etc.).	• Increased efficiencies as processes are automated. • Improved care delivery within the scope of supported programs. • More detailed analytics available regarding supported programs' outcomes and impacts.
HIGH	• IT systems are in use across health domain. • Service-level data is captured for care delivery and/or financial transactions. • National data repositories are shared.	• More options available for provider payment methods. • Person-centric, longitudinal shared health records. • National data available to support care management, quality measures, fraud detection, surveillance, population health metrics.

Figure 11. eHealth infrastructure capability maturity continuum

Wherever a country is starting on the continuum will define current requirements for interoperability. Equally important is the general recognition that countries will tend to move from low to high on the continuum, evolving toward greater levels of maturity. Greater maturity brings increased levels of complexity and increased needs for interoperability to support new capabilities and new demands for data.

Examples of drivers that cause a country to evolve its eHealth infrastructure include:

- Adoption of new technology and information systems.

- Patients paying premiums and being more invested in their health and the health services they receive.

- More sophisticated provider payment methodologies (e.g., performance-based financing) that require measuring quality and outcomes.

- Increased national demand for quality health care information to evaluate population health.

- Demand for measurements and evaluation of UHC reforms and progress, such as how much of the population is covered and enrolled, how equitable the coverage is, what services are covered, and at what cost are services covered.

What is the value of higher levels of maturity and interoperability? Information systems help to capture data in a standard format that enables them to be collected, reported on, analyzed, and used. Information systems also help to automate manual processes. Information systems can share information

across or between systems so it can be collected, analyzed, and reported on across the broader health care system.

The following are examples of capabilities that can be enabled or supported by a national eHealth infrastructure that supports standards and interoperability:

- More options are available for provider payment methods. The capture of service-level data at the point of care and the standardization of service codes to be used for clinical care and for billing give the payor more options for using different provider payment methodologies. (See the paper *Provider Payment Reform and Information Technology Systems: A Chicken and Egg Question for National Health Coverage Programs*[4] for more information).

- The national use of shared health records would require standardized service-level coding and interoperability between point-of-care systems used by providers and facilities, national registries for patient identification and provider identification, and payors.

- Standardized data that can be collected and analyzed at a national level can be used to support population health metrics and feedback/input back to health policies.

- Billing data collected by payors can be used to evaluate potential fraud and abuse.

- National-level data can be used to support measurement and evaluation supporting UHC efforts, looking at how much of the population is covered, what services are covered, and at what cost services are covered.

NOTES

1. eGovernment refers to digital interactions between a government and its citizens. In the United Nations E-Government Survey 2012, it is defined as as "The employment of the Internet and the world-wide-web for delivering government information and services to the citizens."

2. Page on OpenHIE's Architecture. OpenHIE website. Available at: http://ohie.org/architecture/.

3. Data-sharing topologies can include options such as peer-to-peer, enterprise service bus (ESB), or hybrid network designs.

4. *Provider Payment Reform and Information Technology Systems: A Chicken and Egg Question for National Health Coverage Programs*. Wilson K, Latko B, Cashin C, Garabrant A, Hesp C, Stepney P, *et al*. The Joint Learning Network for Universal Health Coverage; 2013. Available at: http://jointlearningnetwork.org/uploads/files/resources/IT-PPM_FINALlores_online.pdf.

5. Developing Enterprise Architecture through Storytelling

The ways that people and processes and information and communication networks all work together to "make it go" are described by enterprise architecture (EA). The US National Institutes of Health uses urban planning[1] as an analogy for what EA is and why it is important. This is a useful analogy. For a city to "work" (for automobile traffic to flow, for sewer and water systems to be appropriately sized, etc.), there needs to be a city plan. The plan reflects civic goals and aspirations, articulates designs for infrastructure and services (roads, water, sewage, electricity, fire, police, etc.), and guides how construction and growth can occur while remaining consistent with the overall blueprint. Such guidelines may even specify precise details regarding the standards that must be adhered to, right down to the size and rating of water and sewer pipe connections, for example.

As we learned in Chapter 2, Country Experiences, nations have goals and aspirations for their country's health systems, and these are often quite pre-

cisely described and documented by the ministry of health. Some countries have developed eHealth strategic plans that map how ICT can be used to realize and support these health system goals and aspirations. Some have developed, or are developing, blueprints that articulate how shared eHealth infrastructure will be built, and these blueprints may even describe the standards-based "connectors" that will be used to ensure that ICT applications can interoperate with the overall health system. Taken together, these many viewpoints describe the health enterprise architecture.

Enterprise Architecting

Over time, a number of methodologies and frameworks have been developed to help architect large, multifaceted systems. One such framework is TOGAF (an Open Group Standard architecture framework).[2] Figure 12 shows a high-level diagram of the TOGAF methodology.
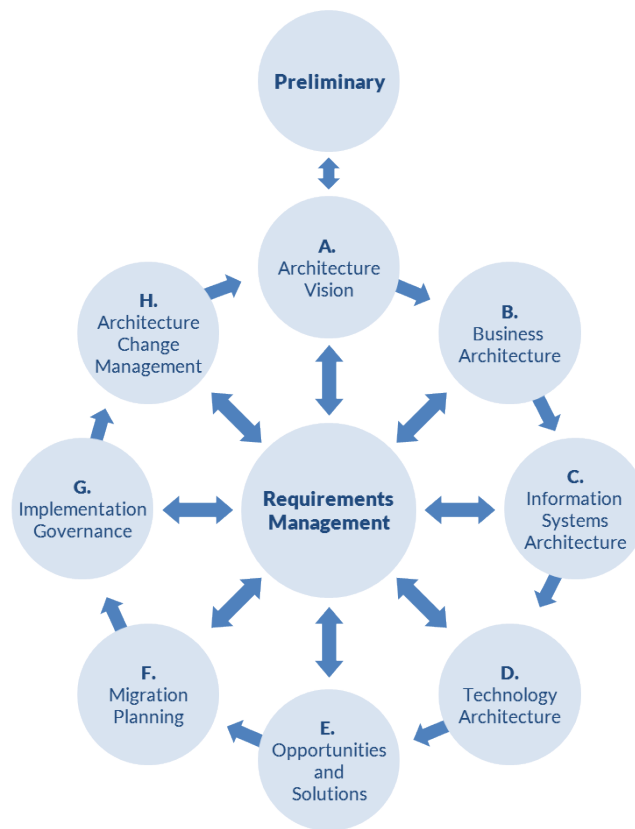
Figure 12. TOGAF framework

The TOGAF process, in a rigorous managed way, covers three key questions that must be addressed by the enterprise architecture:

- **Why are we doing what we're doing?** This is addressed by the Preliminary step and by step A (Architecture Vision).

- **What are we doing?** This is where the overall infrastructure and its requirements are described from the business, information, communication, and engineering/technology viewpoints. It is the scope of steps B, C, and D.

- **How are we doing it?** This is where crucial issues of implementation

science, project management, and governance are brought to bear. It is the scope of steps E, F, G, and H.

Specifically focusing on the "What are we doing?" aspect of the EA, there is another useful framework that can be used to articulate the multiple viewpoints of the health information system. This framework is called RM-ODP.[3] RM-ODP provides us with a way to define and describe the eHealth infrastructure; it maps to steps B, C, and D of the TOGAF methodology. Figure 13 illustrates the RM-ODP-based viewpoints of a health information system (shown as HIS in Figure 13).
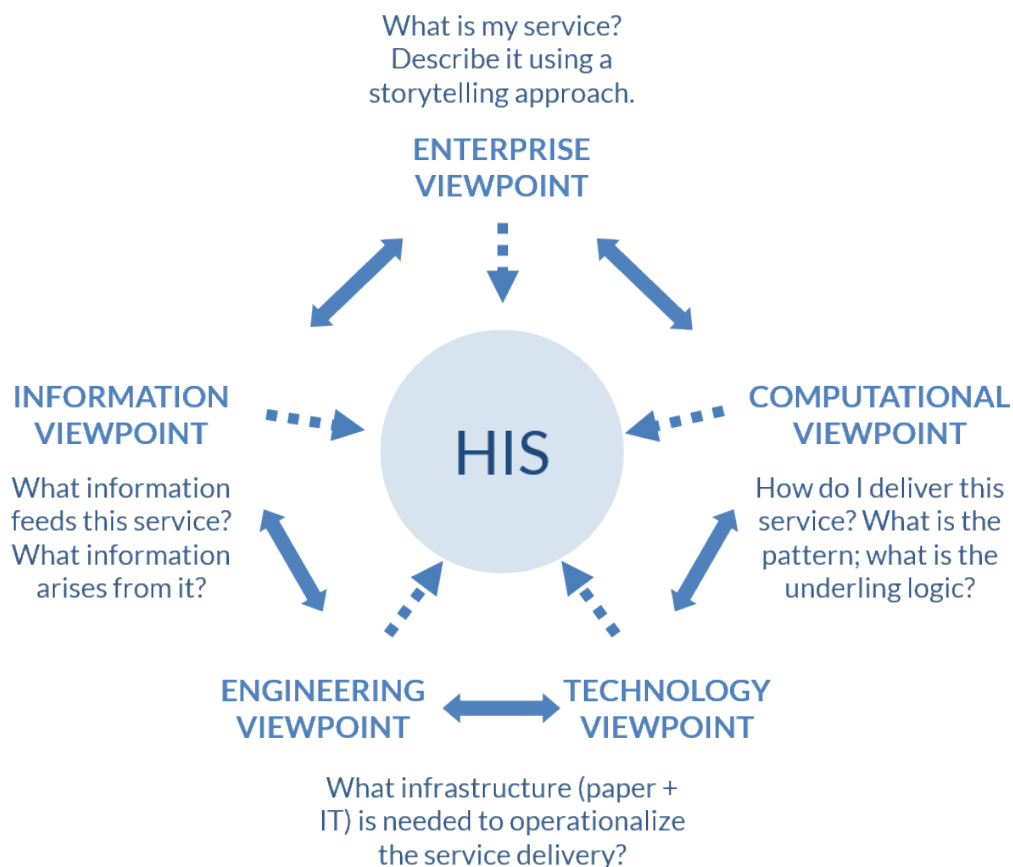
Figure 13. RM-ODP-based viewpoints of a health information system

The vision and execution/governance aspects of the TOGAF process are crucial to the successful architecting of a health information system. For the balance of this book, however, we will focus on the enterprise, information, computational, and engineering/technology viewpoints of the health information system. In the following section we will introduce a straightforward, storytelling approach that can be used to develop and describe a standards-based, national-scale, eHealth infrastructure.

Leveraging a Storytelling Approach

Everyone understands storytelling, which is at the heart of many cultures. In a useful way, we will use a familiar storytelling technique to make enterprise architecture more approachable and easier to take on. Although the underlying process is based on formal practices, to get started developing our health EA, we just need to be able to tell a "health story."

We will illustrate the relationship between eHealth infrastructure, care delivery, and UHC by following the story of a young woman named Mosa. This story's context describes a national eHealth infrastructure with a relatively high level of maturity, so it might represent a "future state" for some countries. Step by step, we will use this storytelling technique as a way to identify process workflows, develop system requirements, and show what information needs to be shared across the health care system, thus identifying where eHealth standards and interoperability are most needed.

Using characteristic health stories is a very powerful technique that has been used by many countries to design their national eHealth systems (for example, Canada, the United States, Rwanda, and South Africa). It usefully connects health-affecting functionalities and workflows "on the ground" to the ICT assets "in the cloud" that are needed to operationalize them. Countries do not need to implement all of these infrastructure pieces at once and can take a "crawl, walk, run" approach to grow their capabilities over time (this is discussed further in Chapter 7).

Our example story takes place in a country with a national health insurance scheme (NHIS) that includes in its service bundle free (no out-of-pocket fees) maternal care services for its beneficiaries. These services are funded via a combination of capitation and diagnosis-related group (DRG) provider payment methods for antenatal care (ANC) and attended labor and delivery

(L&D), respectively. The country has implemented a national eHealth infrastructure for tracking ANC information and for supporting provider payment.

The Story

Mosa is the main actor in our story. She is 19 years old, lives in a rural village, and is pregnant with her first child. Grace is another actor in our story. She is a primary care practitioner who provides services through a community clinic near Mosa's village.

There is important background information for our story, and these details affect the flow of activities and information. Mosa is enrolled in her country's national health insurance program and has a health insurance card; this card has an identification number that uniquely identifies her. Mosa has a care relationship with Grace, who is designated as her preferred primary provider (PPP). There is an important nonhuman actor in our story, too—Grace's mobile phone. The phone is important because Grace uses it to exchange text messages (via SMS or USSD)[4] with a national mHealth application specifically designed to support primary care services. Figure 14 outlines how Mosa and Grace use ICT and interact for antenatal care services.

Antenatal Care

❑ Grace uses SMS to submit Mosa's health insurance ID# to the mHealth application.

❑ Mosa's health coverage is confirmed; the mHealth application connects the ANC visit to Mosa's health record.

❑ Based on the national maternal care guidelines, Grace records clinical observations (weight, temperature, blood pressure, etc.) and counsels Mosa regarding nutrition, lifestyle, and general good practices during her pregnancy.

❑ Grace uses her mobile phone to log Mosa's readings to the mHealth application.

❑ If Mosa's health condition warrants it, Grace creates a care referral to the district hospital; otherwise, she schedules the next ANC visit with Mosa. Mosa's record is updated.

Figure 14. Mosa's antenatal care visit with Grace

Grace has told Mosa that she should come for four ANC visits during her pregnancy.[5] ANC coverage is included in Mosa's health insurance plan. As a first step in the story, Grace uses her mobile phone to access a mHealth application; she enters Mosa's health card number into the application to establish that Mosa is eligible for services under the plan.

Grace maintains a paper-based medical record that she updates each time she sees Mosa. At each ANC visit, Grace logs information by filling in an MOH-mandated form that tracks key health indicators based on WHO maternal care guidelines (e.g., weight, temperature, blood pressure). Grace also uses her phone to execute rudimentary eHealth transactions. These transactions about Mosa save key data (e.g., weight, temperature, blood

pressure) to a national shared health records (SHR) repository that Grace, or any other clinician, can access from anywhere in the country, based on proper security. This shared information is important in helping to provide continuity of care for Mosa over time and, if necessary, in situations where Mosa may need to be referred to the district hospital.

Importantly, we can think of Grace's mHealth application and the national eHealth infrastructure (CR, health worker registry [HWR], SHR, etc.) as non-human actors in our story. In the context of UHC, we can also think of the insurance scheme (the payor) as an actor, too. This is the actor that pays Grace for the services she provides to Mosa.

In our story, Grace is paid by the health insurance scheme under a capitation provider payments model.[6] Each month, she receives a set fee for each of the patients she has under her care. Grace also acts as the gatekeeper regarding Mosa's care referrals, should they be necessary. When it comes time for Mosa to deliver her baby, Grace (or whoever is the skilled attendant at the birth) is paid by the insurer on a DRG payments model.

The Story's "Information Viewpoint"

What information is needed to support the story of Mosa's ANC visit with Grace? What information arises from this story (e.g., as reportable indicators or metrics)? As we answer these questions, we are documenting an "information viewpoint" of the underlying systems that support our story of Mosa and Grace. Figure 15 shows the "information" elements inherent in our example story.
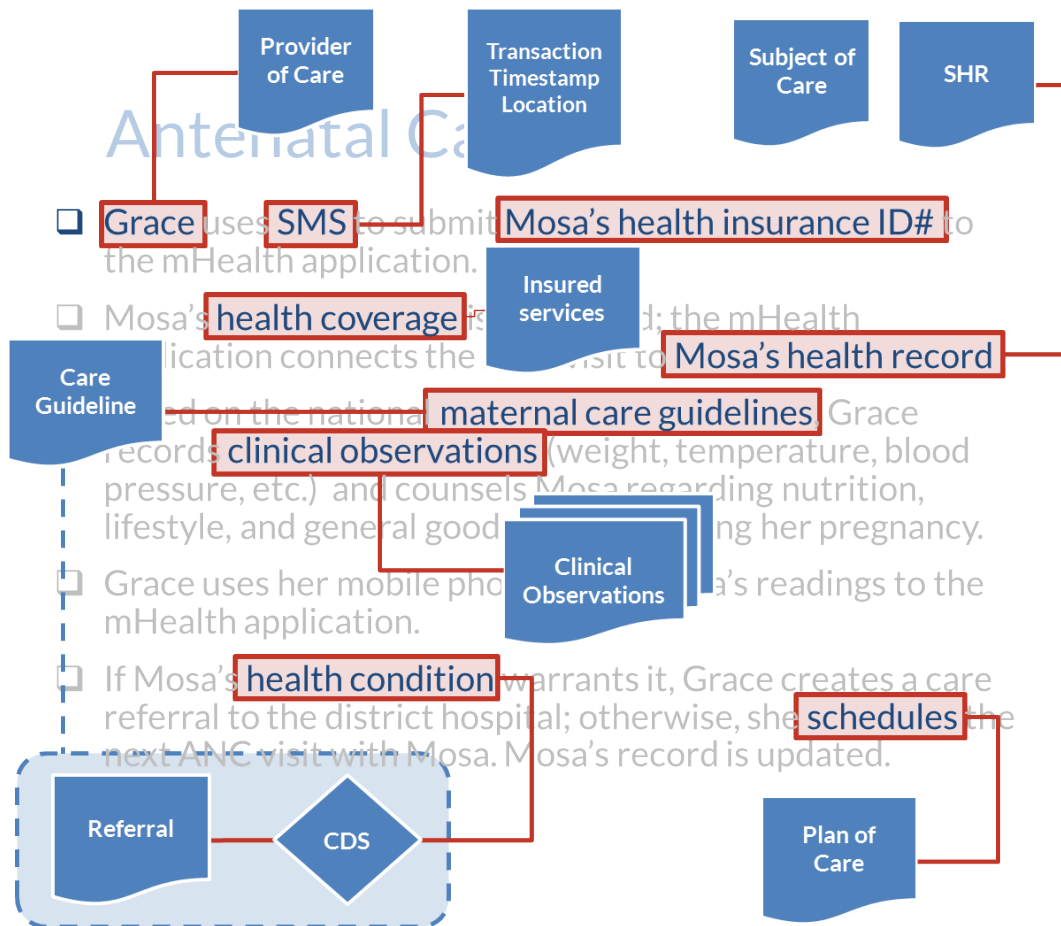
Figure 15. The information viewpoint of Mosa's ANC visit

From Figure 15, we see:

- Grace is the *provider of care*.

- Mosa is the *subject of care*.

- The ANC visit is a *care encounter* between Mosa and Grace that happens

at a certain date and time at a specific location; this information may be derived from the SMS message and sets the *care context.*

- Mosa's health insurance identification number relates to her demographic record in the *client registry (CR)* and to her electronic *shared health record (SHR).*

- As shown in Figure 9, from the payor's point of view the CR serves as a *beneficiary database.* The beneficiary database, along with a database of *insured services,* is used to determine whether Mosa is covered for ANC services under her health insurance plan.

- Grace is designated as Mosa's PPP. This relationship is stored in Mosa's record in the CR (beneficiary database). Grace is paid each month by the insurance plan based on the size of her roster of patients; Mosa is in this roster.

- *Health observations* (weight, temperature, blood pressure, etc.) about Mosa are collected as per maternal *care guidelines.* These are stored in Mosa's SHR.

- If Mosa's readings are outside guideline-based ranges (the *clinical decision support* logic), Grace makes a *referral* for Mosa to go to the district hospital.

- If Mosa's readings are normal, then her next ANC visit will be scheduled based on the guideline-based interval between visits (*plan of care*).

The information elements in Mosa's story can be described using data modeling techniques. Data model artifacts, such as entity-relationship diagrams[7] (see Figure 16) or UML class diagrams,[8] are typically used by IT professionals to translate the user story and document the information viewpoint of a system. Data models are also implied by the content standards that have

been developed for certain clinical documents. The fields that are on Grace's MOH-mandated paper ANC form, for example, represent the content standard (and the associated data model) for documenting an ANC visit. These ideas will be further explored in the following sections.
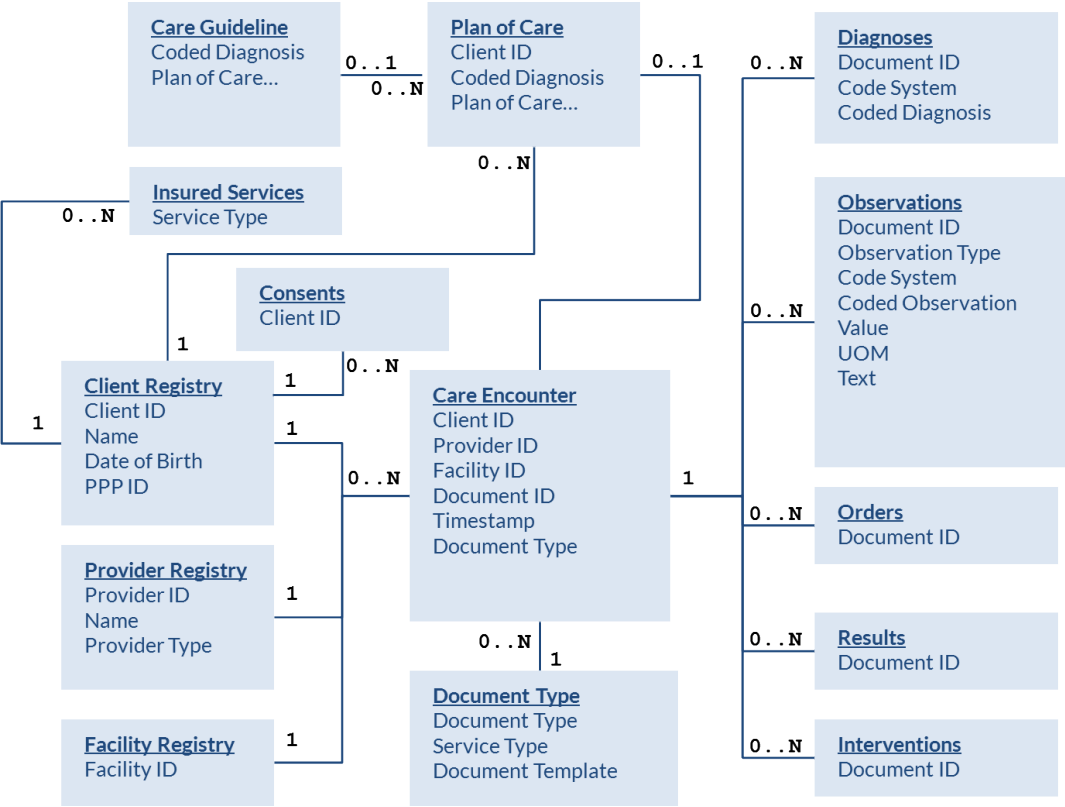

Figure 16. Example entity-relationship diagram

The Story's Data Communication Patterns

The information in our story is shared among the story's actors. Some of this

information is shared between the human actors, Mosa and Grace. Some-times, however, the information is being shared with nonhuman actors. This is the case, for instance, when Grace is using her mobile phone to capture health observations about Mosa and save them to Mosa's SHR. As illustrated in Figure 17, our story can be broken down into a set of distinct information-sharing patterns.

Antenatal Care

☐ Grace uses SMS to submit Mosa's health insurance ID# to **1** the mHealth application.

2 Mosa's health coverage is confirmed; the mHealth application connects the ANC visit to Mosa's health record. **3**

☐ Based on the national maternal care guidelines, Grace
4 records clinical observations (weight, temperature, blood pressure, etc.) and counsels Mosa regarding nutrition, lifestyle, and general good practices during her pregnancy.

☐ Grace uses her mobile phone to log Mosa's readings to the mHealth application.

☐ If Mosa's health condition warrants it, Grace creates a care
5 referral to the district hospital; otherwise, she schedules **6** next ANC visit with Mosa. Mosa's record is updated.

Figure 17. Information-sharing patterns in Mosa's ANC visit

These information-sharing patterns are further described below:

1. There is an SMS-based communication between Grace and the mHealth application. This launches the workflow.
2. Standards-based messaging occurs between the mHealth application

and the MOH's eHealth infrastructure where Mosa's CR record and her SHR are maintained.

3. The mHealth application authorizes Mosa's benefits eligibility and establishes the care context for her ANC visit with Grace, including referencing the applicable care guidelines.

4. A back-and-forth conversation occurs between Grace and the mHealth application that captures key health observations about Mosa. The SMS conversation is based on the maternal care guidelines applicable to Mosa's ANC visit.

5. If Mosa's health condition warrants escalation of her care, Grace will send an SMS message to the mHealth application to refer Mosa to the district hospital. The mHealth application will send a standards-based message to update Mosa's SHR, and the district hospital will be informed of the referral.

6. If no care escalation is needed, Grace will send a standards-based message scheduling Mosa's next ANC visit as per the maternal care guidelines. The mHealth application will update Mosa's SHR.

Figure 18 illustrates the information-sharing patterns using a sequence diagram.[9] A sequence diagram documents the sequence of communications between the story's actors.

Authenticate & Authorize

Establish Care Context

Guideline-based Care Delivery
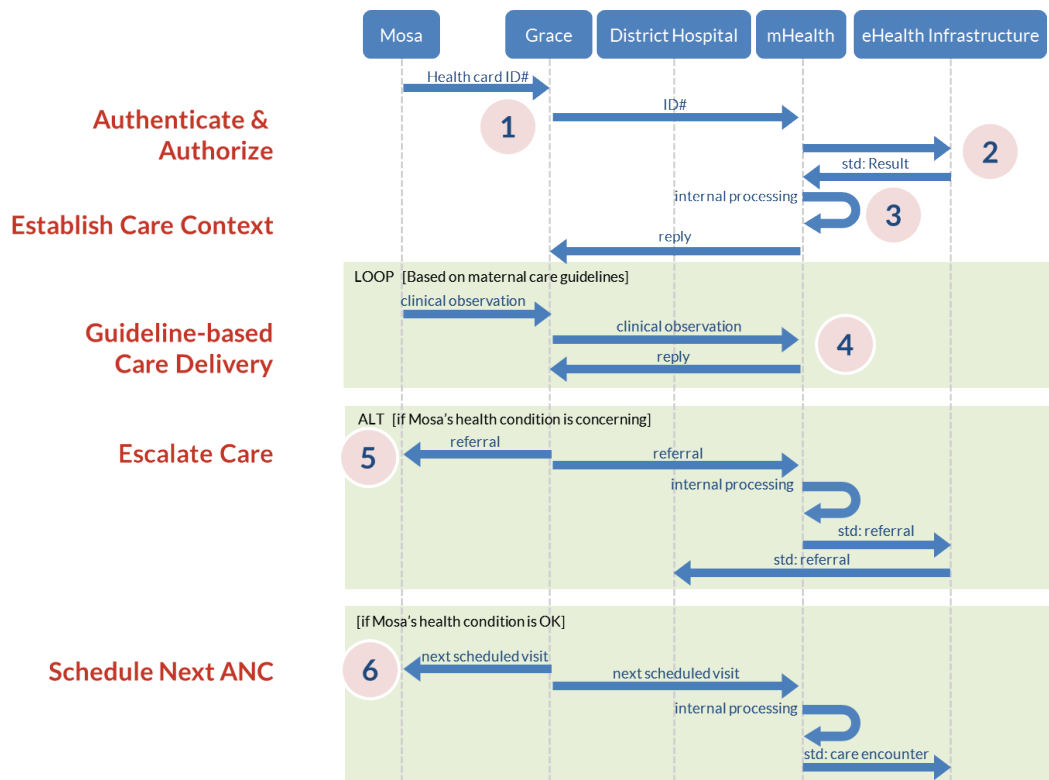
Escalate Care

Schedule Next ANC

Figure 18. Information-sharing patterns in Mosa's ANC visit as a sequence diagram

In this sequence diagram, each actor is listed across the top with "life-lines" running vertically down from each one. Communication between actors is indicated by horizontal communication arrows that connect their life-lines. Some communication patterns repeat, or loop; these communications are drawn inside a "loop" box on the diagram. Sometimes there are alternate communication patterns based on one condition or another; these communications are drawn inside an "alt" box on the diagram that shows when and how the communication happens for each alternative.

In this example, our story depicts a guideline-based maternal care workflow. The story, the story's information content, and the communication among the story's actors can be thought of as representing three of the "architectural" viewpoints of the underlying health information system (recall Figure 13). A fourth viewpoint—the "engineering" viewpoint—describes the ICT design that operationalizes the other three viewpoints. The engineering viewpoint is where a country's eHealth standards (the NeSF) are expressed. Chapter 6 describes how we leverage our three "storytelling" viewpoints to develop a NeSF.

NOTES

1. Page on Enterprise Architecture. National Institute of Health Enterprise Architecture website. Available at: https://enterprisearchitecture.nih.gov/pages/what.aspx.

2. The Open Group. *TOGAF Version 9.1 "Enterprise Edition."* Available at: http://www.opengroup.org/togaf/.

3. RM-ODP is the Reference Model for Open Distributed Processing. It is a standards-based (ISO/IEC 10746) approach for expressing the multiple viewpoints of a large-scale system. An overview of RM-ODP can be found here: http://en.wikipedia.org/wiki/RM-ODP.

4. Page on Short Message Service. Wikipedia website. Available at: http://en.wikipedia.org/wiki/Short_Message_Service. Page on Unstructured Supplementary Service Data. Wikipedia website. Available at: http://en.wikipedia.org/wiki/Unstructured_Supplementary_Service_Data.

5. The WHO guidelines for maternal care recommend four ANC visits for pregnant women.

6. An example of the workings of such a payment scheme (Ghana) is described here: http://thechronicle.com.gh/understanding-the-nhis-provider-payment-system-and-capitation/

7. Page on Entity–relationship model. Wikipedia website. Available at: http://en.wikipedia.org/wiki/Entity–relationship_model.

8. Page on UML basics: The class diagram. IBM Developer Works website. Available at: https://www.ibm.com/developerworks/rational/library/content/RationalEdge/sep04/bell/.

9. Page on Sequence Diagram. Wikipedia website. Available at: http://en.wikipedia.org/wiki/Sequence_diagram.

6. Relating the Story to the Standards

Why and how does interoperability matter to our story? How does something as arcane as an eHealth standards framework make any difference to Mosa or to Grace?

Quite simply, we care about eHealth standards because we care about health. The ability to share health information among health system participants and stakeholders contributes to better care delivery and better health outcomes. Mosa's health relies on continuity of care, over time and across different care delivery sites. Continuity of care relies on interoperability. Interoperability, as we will see, relies on eHealth standards.

Interoperability and the Five C's

There are different types of eHealth standards. We can think of them in terms of the five Cs:

- **C**are guidelines. These are guidelines such as the country's maternal care guidelines, or the Expanded Programme for Immunization (EPI), or the DOTS guideline for tuberculosis treatment.

- **C**ontent. Think of this as the list of "fields on a paper form," such as the paper-based ANC form that a provider fills out.

- **C**oding. Think of this as the "allowable values" that would apply to a specific field on a form, such as the ISO 5218 specification for Sex: 0=unknown, 1=male, 2=female, 9=not applicable.

- **C**ommunication. This is message exchange standards such as HL7 or XDS.

- **C**onfidentiality. This is the set of specifications for managing privacy, security, and patient consent; examples are web protocols and privacy profiles such as secure HTTPS, PKI, the BPPC profile of Integrating the Health Enterprise (IHE), and OAuth.[1]

Interoperability Profiles: Reusable eHealth Building Blocks

Multiple standards are needed to support the telling of a health story like our story of Mosa and Grace. At this point it is useful to introduce the idea of an *interoperability profile*. Profiles are not standards, per se. They are better thought of as implementation guides. A profile defines how a set of standards can be used to execute coarse-grained tasks such as "retrieve Mosa's information based on her ID" or "refer Mosa to the district hospital" or "save the information captured during Mosa's ANC visit." Standards-based interoperability profiles provide us with reusable eHealth building blocks that we can employ to operationalize our guideline-based care workflows, as shown in Figure 19.
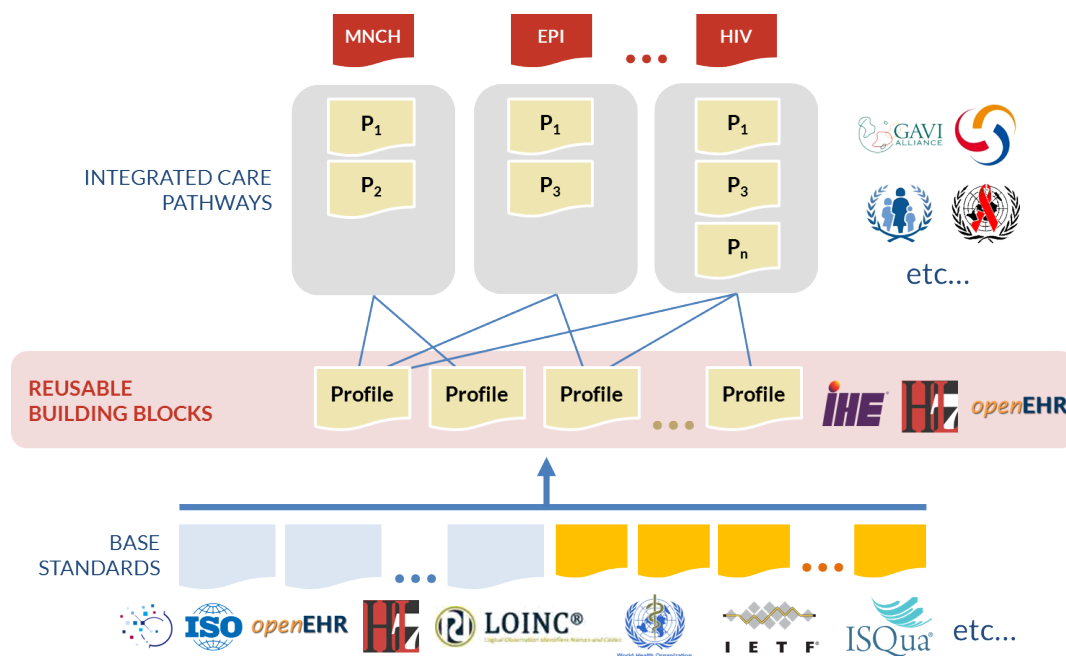
Figure 19. Reusable eHealth building blocks

There are a few important things to note about Figure 19. First, eHealth standards are developed by standards development organizations (SDOs) such as HL7, ISO, WHO, and others. These standards go through long, involved, international balloting processes, and it can be expensive to participate. Developing countries are typically under-represented on SDOs, with the notable exception of the WHO. The good news, however, is that the *base standards* (the bottom layer in Figure 19) are usually generic and applicable in any context (developed country or developing country).

Second, interoperability is achieved at the *profile* layer. To achieve interoperability, there must be agreement about which standards will be used and how their options will be "constrained." This is a very important point (and some-

what of an inconvenient truth): **it is possible to be standards-based without being interoperable**. System-wide interoperability comes from adopting and implementing *profiles* that work together.

A collection of interoperable profiles can be thought of as a *stack*, i.e., a set or group of profiles that work together. In the whole universe of eHealth standards, there are really only three profile stacks that have been internationally balloted: HL7v3,[2] ISO-13606 (the balloted version of the OpenEHR specifications),[3] and IHE.[4] Countries can mitigate risk by selecting one of these stacks as the basis for their NeSF.

Third, integrated care pathways (ICPs) are at the heart of our health care stories. ICPs are the long-running cross-enterprise workflows that describe how guideline-based care is to be delivered within a care delivery network. They play a hugely important role in improving health outcomes. ICPs help close the know/do gap: the chasm between what we *know* are the most effective care practices and what we actually *do* in our day-to-day care delivery activities. As we can see from the top half of Figure 19, the reusable eHealth profiles give us a way to operationalize ICPs; profiles are what we leverage to tell our health stories.

Using Standards to Tell the Story

A country's guideline-based maternal, newborn, and child health (MNCH) ICP underpins the very heart of our example story. The scheduling of Mosa's ANC visits is based on the country's MNCH care guidelines, and so are the list of health observations that Grace captures about Mosa and saves on the paper form and in Mosa's shared health record. Even the rules about when Mosa should be referred to the district hospital are guideline-based.

Figure 20 shows how base standards (content standards in blue, and coding

standards in orange), profiles (in yellow), and the MNCH ICP (in dark red) map onto the sequence diagram for Mosa's ANC visit.
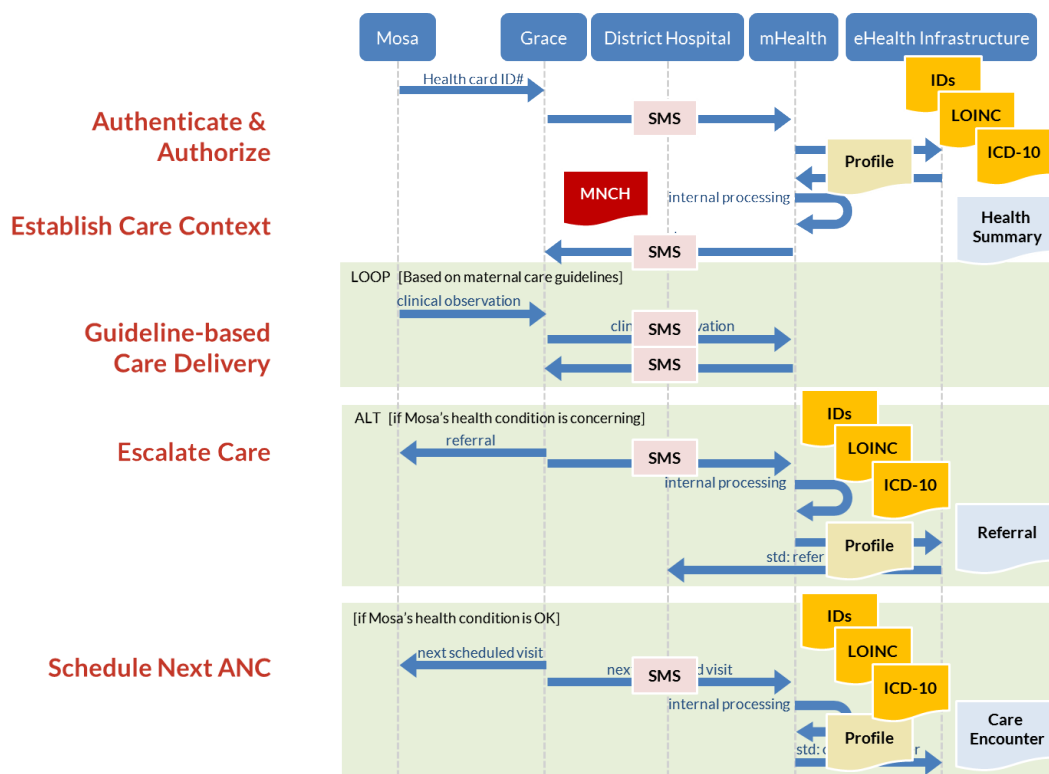
Figure 20. Mapping eHealth standards to Mosa's story

The content and coding standards map directly to the information viewpoint of our story. The MOH-mandated ANC content specification applies to the paper form that Grace fills out. It defines what information should be collected—and which fields are mandatory, which optional. The eHealth equivalent of this paper-based form might be expressed as an antenatal care clinical document (HL7 CDA)[5] or an OpenEHR archetype,[6] for example. In both

cases, the content specification indicates what data should be captured during the care encounter.[7]

The MOH's coding specification further refines the content specification. On Mosa's paper-based ANC visit form there are specific units of measure mandated for her temperature, blood pressure, etc. This is so that anyone reading Mosa's form can quickly understand the values and know whether they are "normal" or "in a danger range." If Mosa's blood pressure, for example, was sometimes recorded in millimeters of mercury (mmHg) and sometimes in kilopascals (kPa), it could lead to confusion and, more seriously, could potentially lead to safety issues for her. The same is true for information about Mosa that is shared electronically. On the eHealth side, coding standards ensure that exchanged information is "understood" by the receiving system. This consistency of content and coding is referred to as *semantic interoperability*.[8]

Importantly, content and coding standards come into play for our health insurance workflows, too. For example, if Grace were paid via a provider payment model based on FFS or DRG, then the clinical coding she used to document Mosa's ANC visit would directly map to how much Grace would be paid for the service. Harmonization between the clinical coding and the insurance fee schedule is a crucial step. This is discussed in detail in Anne Belford's sidebar on using eHealth transactions to support provider payments.

The sharing of information relies on message exchange specifications. In the paper-based world, the fax machine's standards ensure that the dots that are scanned at one end are the dots that are printed at the other end. For sharing coded eHealth content, there are communications standards that ensure that the information captured about Mosa is securely and successfully conveyed from the source system to the destination system. Common

eHealth communications standards include HL7v3 messaging,[9] cross-enterprise document exchange (IHE XDS),[10] or ISO 13606[11]/openEHR archetype[12] communication.

Last, but definitely not least, is the family of confidentiality standards. Many of these standards are used by other sectors (such as banking) that also need to manage the exchange of private information. Some, however, are specific to health care—such as standards for the management of patients' consents regarding the sharing of health information. In aggregate, these standards regarding elements such as authentication, authorization, and encryption are used to ensure that personal health information (PHI) is safely kept and securely shared.

Which Building Blocks Do We Need?

How do the five C's get operationalized as a NeSF? A "storytelling" technique such as the one used for Mosa's ANC visit can be employed to develop the requirements for information, communications, and, from these, the requirements for standards-based interoperability profiles. To develop the NeSF, it is important to run through this process for the key health stories representative of the country's health strategic plan and to use these to come up with the core eHealth "building blocks" needed to bring this set of stories to life. Figure 21 shows the mapping between the RM-ODP viewpoints and the eHealth building blocks.
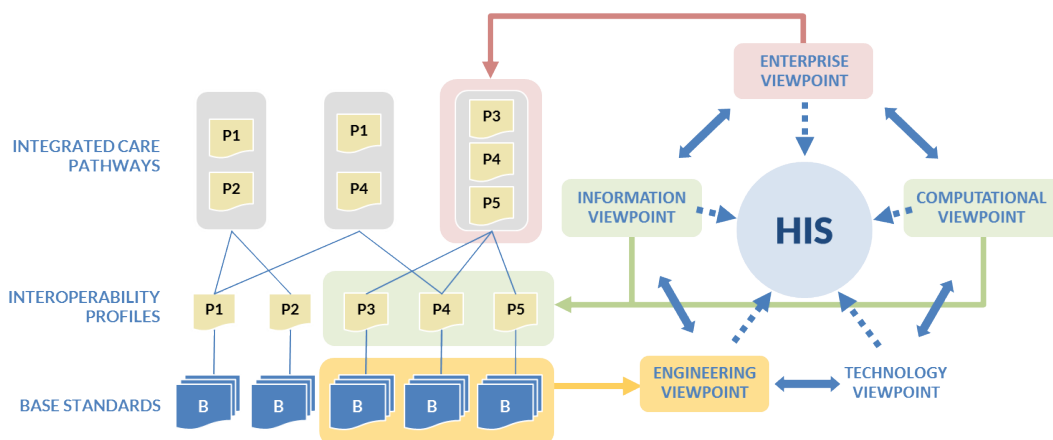
Figure 21. Mapping between RM-ODP viewpoints and eHealth building blocks

One of the advantages of the building blocks approach is that interoperability profiles are highly reusable across many health stories. What is the key set of building blocks? It turns out that a wide array of guideline-based ICPs can be constructed from a relatively small number of interoperability profiles:

1. Insert or update demographic information; for example, when Mosa's baby is born, create a new CR record for him or her.
2. Query for demographic information; for example, when Mosa shows up for her ANC, query for her demographic record based on her insurance identification number.
3. Record health observations about a subject of care; for example, save Mosa's weight, temperature, and blood pressure readings to her SHR.
4. Query for summary health information about a subject of care; for example, when Mosa's ANC visit starts, the mHealth application can fetch her health summary from the SHR.
5. Order lab tests; for example, if Grace becomes worried about Mosa's

condition, she may obtain a sample (e.g., blood, sputum) and send it to the lab for testing.

6. Record test results; for example, the lab saves Mosa's lab test results to her SHR and (potentially: see final bullet) alerts Grace that the results are available to be reviewed.

7. Order medications; for example, based on the lab results, Grace may decide to prescribe a course of medications for Mosa.

8. Dispense medications; for example, Mosa may have her medications order filled at the pharmacy at Grace's clinic, or at another pharmacy in the community.

9. Provide a referral; for example, Grace may refer Mosa to the local district hospital for specialized follow-up.

10. Communicate information at discharge; for example, after her stay at the district hospital, a discharge summary is saved to Mosa's SHR outlining the care Mosa received and providing instructions regarding her ongoing plan of care.

11. Send alerts; for example, an mHealth application can send SMS alerts to Mosa, or to Grace, as reminders, or to provide educational "factoids," or to provide specific information (such as "lab results ready for viewing").

This is not an exhaustive list of all possible eHealth transactions. Rather, it is a representative list of important transactions that can be very flexibly employed to operationalize a wide array of ICPs.[13]

What information workflows are needed on the insurance side? The *Provider Payment Reform and Information Technology Systems* paper[14] produced by the JLN describes five core operations for health insurance information systems:

- Beneficiary management

- Provider management

- Premium collection

- Claims management

- Accounting

Premium collection and accounting are purely financial workflows, and there are separate ICT stacks that would support these activities. Beneficiary management, however, can be supported as part of the first workflow in the representative list of 11 eHealth transactions shown previously. Indeed, the HL7 schema for a client record includes the common elements of demographic information (e.g., name, date of birth, gender, address) plus explicit space to save details about the client's insurance coverage (the "IN1" segment in the HL7 schema) and relationships with specific care providers (the "ROL" segments in the HL7 schema), including providers empaneled by the insurer.

Provider management workflows are not included in the previous list of eHealth transactions but are explicitly supported by profiles in all three standards-based stacks: HL7v3, OpenEHR, and IHE. The IHE Care Services Discovery (CSD) profile, for example, supports explicitly associating empaneled providers with insurers (identified as an insurance "organization" in the CSD data model).

Claims management is supported by the transactional workflows listed in the eHealth transaction list and the eHealth transactions that arise from these. Price lists would be separately maintained by insurers in their accounting systems. To support adjudication of claims, eHealth documents cross-referenced to the facility ID, client ID, and provider ID—and which include coded diagnoses, observations, and procedures—can be matched

up against the price lists. In this way, the eHealth documents can support provider invoices submitted under, for example, FFS or DRG payment methods.

Can a health insurance claim be created or derived from an EHR transaction?

I think that success in leveraging an EHR transaction to create a health insurance claim lies in the ability to achieve interoperability across the EHR and claim data standards, while accommodating a variety of providers and access methods on the front end and a broad range of insurer plan design and adjudication rules on the back end.

There will be a variety of EHR messages used across the spectrum, including lab, pharmacy, hospital, and outpatient events, and in all cases the core content of the EHR event fits nicely with the claim requirements. At the highest level, both an EHR message and a claim message contain data to describe a patient and to identify the servicing provider, the services, procedures, and events that occurred, the reason for the event, and the diagnosis and referral information. Taking a closer look though, interoperability is not determined by the messaging format and the presence of like fields; rather it is determined by the actual data content and the successful alignment of clinical nomenclatures, terminologies, and identifiers between the source EHR and target claim requirements. Will providers always submit using coding systems or textual descriptions only? Will the codified EHR service code system match the codified claim service code system, or are they able to be mapped? Data is the key challenge, so we will take a closer look at that aspect.

From a claims perspective, payment systems will use a range of terminologies and code sets. These will vary by payment method (examples: fee-for-service, case-based), by benefit type (examples: pharmacy, hospital, vision), and by the payment plan designs (examples: in a fee-for-service model, service code "x" pays "y" per unit; in a case-based model, event type "x" pays "y" per diagnosis "z"). The level of granularity in the coding schemes used between the EHR and claim systems must be resolvable in each case, as they may not always be identical.

As an example, the insurer plan design rules may pay on a per "visit" basis, but the EHR source message may utilize more granular service codes such as "exam, manipulation, massage" instead

of a single visit code. In this case, the three codes can be rolled up into a single visit code to match the more simplistic payment rules that are implemented. Identical codes are not required, though the transformation service that is employed to derive the claim message will need to execute these types of mapping rules. The level of mapping and its complexities will only be discovered though detailed analysis on a case-by-case basis. I would not expect that the EHR coding would be less granular than the claim coding (example: EHR submits "visit" and insurer requires "exam, manipulation, massage,"—but this would of course be problematic). It is notable that the more granular coding schemes can be beneficial to an insurer, as they allow for the creation of more sophisticated plan designs. In addition to terminology, the key patient and provider identifiers must align. Ideally, claim and EHR systems will share identifier enrollment, but otherwise they must be resolved at claim creation time. A centralized patient and provider registry is ideal to perform mapping, should this be required.

In addition to data alignment, the rules for triggering the creation of a claim must be established, as there is not a 1:1 relationship between EHR events and claims. If we consider a hospital setting, a wide range of clinical events are recorded in an EHR repository, only a portion of which are billable. It may be that the discharge event triggers a claim but an admission event will not. These rules are quite straightforward, but the rules relating to updating EHR records are a bit more sophisticated. This is best demonstrated in an example. If a claim has been created for a lab order and the lab order is subsequently updated, the claim data may also need to be updated (claim reversal and resubmission), but this may depend on what data has been updated in the order. If the claim payment rule is tied to the occurrence of an order event (plan pays for every lab order) there may be no impact, but if payment rule is tied to the order detail (plan only pays for order type "x") then the claim is updated when the order detail is updated. To summarize, the act of deriving a claim event from an EHR event will need to occur based on a series of rules that are applied. These rules may vary in direct relation to the insurer's plan design, as in the example above.

Lastly, there may be some claims that cannot be purely derived at the interface layer, for the simple reason that required claim information will not exist in the EHR message. For case-based payment models that are event driven (example: discharges from a hospital with diagnosis), it is reasonable to expect that all data is present in the EHR message. If we compare the data requirements in the fee-for-service model against an EHR message, we may find some gaps in

the areas of costing and policy information. It is notable also that mature claims standards will distinguish between the concepts of servicing provider (found in the EHR messaging) and the billing provider or billing organization, and this type of data is not found in the EHR message. To convey additional data, a billing segment could accompany the EHR transaction, and the claim is therefore initiated by the provider system. It is worth considering that where provider capabilities exist, having the claim submitted from sophisticated provider systems is beneficial, as it provides the ability to track submitted claims, reconcile payments, and so forth. Again, this is case driven.

In summary, and as outlined above, there are a few core conditions that must be met in order to successfully derive claims from EHR transactions. Given the many benefits to be gained from doing so, an in-depth analysis to determine when this approach is viable for this environment would be a worthwhile endeavor. The alignment of shared data sets and identifiers between the EHR and payment systems will largely determine the ease with which this can be implemented and the efficiency of the solution. If the ability exists to influence the selection of like EHR and claim vocabularies from the onset, it is very desirable.
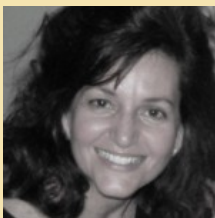
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About TELUS Health
TELUS Health (www.telushealth.com) is a leader in telehomecare, electronic medical and health records, consumer health, benefits management, and pharmacy management. Within Canada's claims and benefits management sector, TELUS provides drug claims processing for more than 12 million Canadians.

Leveraging the NeSF to Support UHC
It is important to recall the discussion regarding how eHealth affects popula-

tion health (as illustrated by Figure 1). Ravindra Rannan-Eliya has postulated that "health financing is the most important control knob that policymakers have to influence the operation of a health system."[15] Indeed, many UHC initiatives have strong motivation for improving quality as well as increasing access, broadening services, and reducing financial risk.

The World Bank's health system performance model is shown in Figure 22[16]. This model illustrates how policy interventions, including financing and payments, can be leveraged as process control feedback loops on the system. Such a model may be thought of as complementary to the UHC "cube" shown in Figure 23.[17] We could say that the UHC cube model illustrates the "what" and the process control model illustrates the "how."
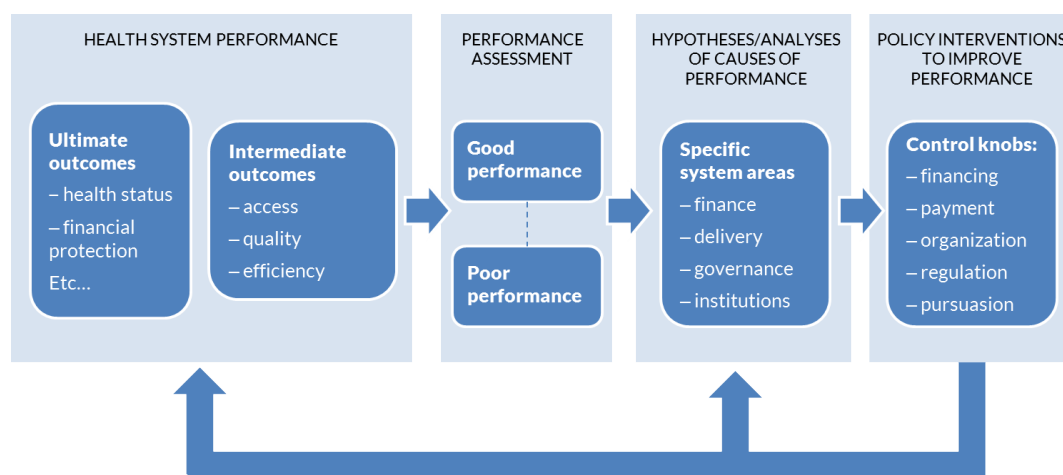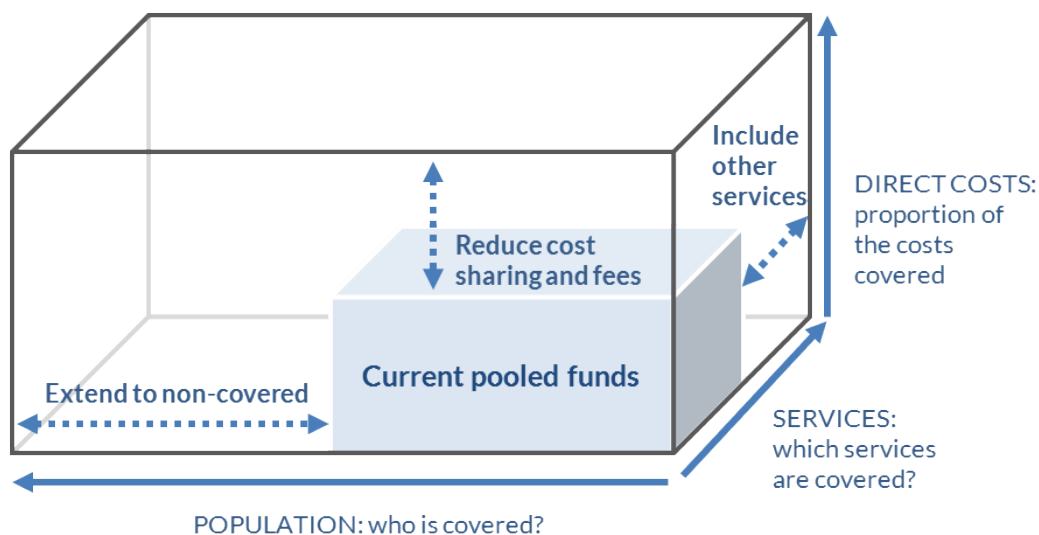

Figure 22. World Bank health system performance model

Three dimensions to consider when moving toward universal coverage.

Figure 23. WHO's UHC "cube"

The experience of government-sponsored health insurance schemes in India

The recent wave of government-sponsored health insurance schemes in India (GSHISs) represents a new form of mobilizing and allocating government resources for health care for the poor, at least in the Indian context. An explicit (and delivered) package of services, greater accountability for results, and a "built-in" bottom-up design to reach UHC by first achieving coverage of the poor are building a promising foundation for the country's future health system. The new generation of GSHISs has successfully leveraged and built upon the earlier development of the health insurance sector in the country, which has enabled them to scale up rapidly and achieve a significant increase in the breadth of coverage of health insurance in the country. By 2013, over 360 million Indians were covered by GSHISs. This represents about 30 percent of the country's population and constitutes the vast majority (over four-fifths) of the insured population base in the country. Such broad coverage by GSHISs indicates their huge leverage in bring-

ing about incremental changes in India's health financing and overall health system space.GSHISs have introduced a number of IT solutions on a mass scale, including biometric enrollments, electronic preauthorization, online claims and payment processes, and monitoring of field functionaries through video surveillance. ICT has the potential to play an increasingly important role for reducing fraud, containing administrative costs, and generating data for monitoring and analysis. The future success and sustainability of GSHISs hinge on the development of key governance and information systems that will help them carry out their core functions of program design, implementation, purchasing, cost containment, quality improvement, supervision, and enhancing consumer satisfaction, among others.

In this context, the World Bank's India health team, in collaboration with the World Bank Institute (WBI), has been organizing a series of practitioner-to-practitioner knowledge exchanges christened as the "Forum of Government Sponsored Health Insurance Schemes in India."[18] This knowledge-sharing venue, which has evolved into a unique semi-annual event, brings together senior government decision-makers for thematic discussions on specific areas deemed to be important by them. The seventh forum in this series was organized in Mumbai from November 20 through 22, 2013, and focused on the central theme of "Information Systems and Standards." The event closely followed the announcement, by the Government of India, of the first-ever National EHR standards and benefited from participation by the group closely involved in the standards effort. As such, this event provided a platform for discussion on India's national eHealth standards and their application and relevance to the GSHISs.A series of presentations and discussions were held, involving the CEOs of the GSHISs and senior officials from the Government of India and state governments, by the EHR group that drafted the national standards and by international resource persons. The group discussed the value proposition for a standards-based eHealth infrastructure and explored how such infrastructure can be employed to both monitor the health care system and exert process control upon it. Discussion regarding health system process control generally referenced the World Bank's "control knobs" techniques as well as, specifically, a recent in-depth analysis of GSHISs in India.[19] Leveraging such techniques importantly provides an opportunity to operationalize continuous quality improvement of the health care delivery network. The Forum also explored ways to leverage big data analytics (BDA) against the resulting eHealth data. GSHIS members undertook facilitated group work to

develop, articulate, and explore three key BDA application areas: institutional quality, disease prevalence/trends, and detection of provider fraud.

There are several key areas where the application of standards-based eHealth information systems by the GSHISs will enable their functionality even more. By enabling the assessment and comparison of performance parameters within and across schemes, the adoption of standards will make possible closer and more effective management and monitoring of data on utilization, claims, payments, quality, grievances, patient satisfaction, and outcomes. This has important implications. Cost containment requires timely information on utilization patterns and spending, benchmarked with peers. Strengthening the precision of package rates is also dependent on sound data on diagnoses and costs. Enabling facility-level quality metrics and implementation of evidence-based treatment guidelines would also depend on such standards-based data sets being introduced, implemented, and reported upon. Clearly, the GSHISs are uniquely placed to be key players in India's ambitions for UHC, and the support of eHealth standards will be a powerful tool in their armory.

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NOTES

1. HTTPS (Hypertext Transfer Protocol Secure), PKI (Public Key Infrastructure), BPPC (Basic Patient Privacy Consents), OAuth (Open standard for authorization).
2. Page on HL7 Version 3 Product Suite. Health Level Seven International website.

Available at: https://www.hl7.org/implement/standards/product_brief.cfm?product_id=186.

3. Page on Example openEHR templates. Wikipedia website. Available at: http://www.openehr.org/wiki/display/healthmod/Example openEHR Templates.

4. Page on IHE Profiles. IHE website. Available at: http://wiki.ihe.net/index.php?title=Profiles.

5. Page on Clinical Document Architecture. Wikipedia website. Available at : http://en.wikipedia.org/wiki/Clinical_Document_Architecture.

6. Page on Introduction to Archetypes and Archetype classes. OpenEHR website. Available at: http://www.openehr.org/wiki/display/healthmod/Introduction-+to+Archetypes+and+Archetype+classes.

7. It is noteworthy that Grace's SMS messages are not "standards-based" per se, but that the traffic between the mHealth application and the eHealth infrastructure is. From the point of view of the eHealth infrastructure, the mHealth software is just another point of service application—so all the communication is standardized between these two actors. From the point of view of the mHealth software, however, Grace's SMS messages are just a realization of the application's user interface (UI)—so the specific form of this interaction will depend entirely on the software's UI design.

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9. Page on HL7 Version 3 Product Suite. Health Level Seven International website. Available at: https://www.hl7.org/implement/standards/product_brief.cfm?product_id=186.

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7. Practical Steps Forward

What practical steps can a country take to begin to develop a NeSF that supports care delivery and UHC initiatives? Based on what has been covered so far, the following are recommended as useful, actionable steps:

1. **Storyboard**: Develop a set of characteristic user stories that illustrate both the care workflows and the health insurance workflows common to the country. These stories should be aligned with the country's health strategic goals (e.g., if improving maternal health outcomes is a strategic goal for the MOH, draft stories describing maternal care delivery activities).

2. **Stack**: Based on the requirements and the constraints in the country, choose a "stack of standards." The authors recommend that countries mitigate risk by selecting one of the three internationally balloted stacks: HL7v3, OpenEHR, and IHE.

3. **Scope**: Narrow the initial implementation scope and grow the scope over time. Any country embarking on a national-scale eHealth

infrastructure effort will be well served by focusing on a few key areas. A "crawl, walk, run" strategy is usually best.

Develop the Stories

Each country's stories are unique; they reflect the nation's burden of disease and the resources that are available to be brought to bear to improve health. As such, the health stories that are to be operationalized by a national, standards-based eHealth infrastructure should be those that speak most directly to the strategic priorities of the country's MOH. As described in the WHO-ITU Toolkit, the eHealth strategy is driven by the health strategy. As we have seen in Chapters 5 and 6, the standards are driven by the stories (and the information and the communication patterns these stories call out). It is worthwhile to note that the "storytelling approach" described in this book is based on rigorous health enterprise architecture practices and methods that were explored in more detail in a JLN webinar held in September 2013.[1]

Developing the health stories is the crucial first step. The opportunity should not be missed, in developing these characteristic stories, to accomplish three important objectives:

- Relate the stories to guideline-based ICPs. There is a significant benefit to be realized by closing the know/do gap. We should use our stories to describe the care scenarios we want (especially if what we want is different from the scenarios we presently have).

- If the story is part of an insurance initiative, connect it to the care delivery workflow. If the story is a care initiative, connect it to the insurance workflow. Use every initiative as an opportunity to further harmonize the care delivery and health financing systems.

- Connect the data that arise from routine transaction processing to the data needed for surveillance, population health metrics, and health system management. One of the very powerful benefits of embracing eHealth standards is that the resulting data are in a computable format and may be leveraged to support the generation of important analytics and aggregated indicators.

Choose the Stack

Many countries are presently engaged in eHealth initiatives. These initiatives may be approaching eHealth infrastructure from the care delivery side or from the health insurance side, or both. In any case, it will be important to ensure interoperability of systems so that the all-important network effect can be realized.

Interoperability is achieved by adopting and implementing standards-based profiles. As described in the opening of this chapter, the most effective way to ensure the interoperability of profiles is to select a standards stack and then choose and implement profiles from within that stack, recognizing that some adaptions will be needed to address specific country requirements.

As introduced in Chapter 6, the three internationally balloted stacks of eHealth standards are HL7v3, ISO-13606 (the balloted version of the OpenEHR specifications), and IHE.

Standards stacks	Websites for additional information
HL7v3	https://www.hl7.org/implement/standards/ product_brief.cfm?product_id=186
OpenEHR	http://www.openehr.org/wiki/display/healthmod/Example openEHR Templates
Integrating the Health Enterprise (IHE)	http://wiki.ihe.net/index.php?title=Profiles

How do we choose between these three options? Large IT projects are risky. We recommend that countries favor their lowest-risk option. Ideally, this option is the one that is likely to enjoy the broadest uptake at the lowest cost and in the shortest time.

But which option is the lowest-risk option? For some countries, the answer will be simple: go with the stack that is, today, most commonly found within the health care sector. For other countries, however, there will be few existing eHealth implementations—or worse, numerous isolated pilots, none of which can interoperate with each other—making it harder to choose. The "right" option for a NeSF will be the one that best fits the country's needs and its constraints and is least likely to fail.

A tool for assessing risk is available from the HingX.org website.[2] An example spreadsheet is available at the site that illustrates how the tool might be employed to assess the relative risks associated with implementing each of the three candidate stacks. The key message is: do a risk assessment and select a standards stack; this way, eHealth profiles that are implemented will be interoperable with each other.

Expand the Scope over Time

Countries are at different stages of implementation and different stages of readiness to deploy new eHealth infrastructure. These differences are related to many factors, including political will, budget, and resources. Countries often have many non-interoperable pilot projects, and lack a national-scale infrastructure. How do we choose what to do first, and then next, and so on? Applying some basic principles will help, as outlined below.

Harvest the low-hanging fruit. For many countries, even establishing a facility registry will provide immediate benefits from a health system plan-

ning and management standpoint. Likewise, where there are databases of regulated professionals (such as physicians and nurses) in place, these can be readily collected together to develop a provider registry. Both of these registries also serve health insurance workflows and can be used to support the basic implementation of provider payment methods.

Identify the people being served. There is no escaping the fact that effective care delivery relies on identifying the subject of care. Also, insurance eligibility relies on being able to correctly identify the beneficiary. As challenging as it is to establish, a client registry[3] (CR) is the cornerstone of a well-functioning health system. Some ways to make this easier are described in the following points.

Bootstrap rather than big bang. Using the CR as an example, consider as a first step establishing a national registry of pregnant mothers, a registry of babies that need immunization, or a registry of government employees. It may be very difficult to find a database with high-quality records that can be readily used to "seed" the CR. Where a small database exists, use it to get started and then invest in making it easy to "onboard" new clients when they visit a care facility. Always, however, make sure that new records are being added to the national CR and not to siloed databases. This "bootstrapping" idea can be applied to other ICT assets, too. Start with a small database and plan to grow it organically as it is used to support new care scenarios.

Choose mobile phone–friendly identifiers. There are a number of national-scale IDs that must be established as part of the eHealth infrastructure (facility ID, provider ID, client ID, etc.). In many low-resource settings, mobile phones will play an important role as the data entry devices for rudimentary eHealth transactions. Plan for this by ensuring that IDs are numeric and have a check digit.

Favor clinical code systems as billing codes. As Anne Belford mentioned in her sidebar, when it comes time to start saving person-centric health trans-actions to an SHR, ensure that insurance billing codes readily map to the clin-ical codes (e.g., LOINC, ICD-10, ICHI, ATC).[4] Ideally, clinical codes should be used as the insurance billing codes; it will make the adjudication of FFS and DRG claims fundamentally easier.

Look for ways to evolve toward an EHR. Some countries have quite sophis-ticated health insurance infrastructure but nascent or weak care delivery eHealth systems. A strong health insurance transaction processing capabil-ity can be used as a first step toward person-centric EHRs. This is especially true if FFS or DRG payment methods are already implemented. Opportunis-tically, financial incentives/disincentives can be employed to strengthen the coding of physician claims submissions so that, over time, the usefulness of these data as health records will grow. The incentives may also prove "mar-ket making" for growth in the use of EMR systems within hospitals, clinics, and general practitioner offices. Approaching the challenge from the care delivery side, consider capitalizing on the bootstrapping ideas to expand the scope of care-specific databases (e.g., HIV/AIDS or tuberculosis databases) to become national-scale, all-person, shared health records repositories.

Final Thoughts

It is a core premise of this book that interoperability among disparate eHealth and mHealth applications relies on the system-wide adoption of standards. Our goal for this book has been to articulate the value of such interoperability; to relate country experiences on the path to interoperable eHealth; to frame various points of view of the health information system by introducing the four P's; and to describe a "storytelling approach" that can

be employed to develop eHealth standards specifications appropriate to a country's interoperability requirements.

We conclude by reiterating a single piece of overarching advice:

> If the key messages from this book had to be summarized in a single, core piece of advice, it would be that a common, standards-based, national-scale eHealth infrastructure should support both care delivery and financial payment work-flows as well as produce the analytics necessary to monitor and manage these.

NOTES

1. Webinar on Developing a National eHealth Standards Framework. Joint Learning Network website. Available at: http://jointlearningnetwork.org/initiatives/information-technology/webinars.

2. Page on Risk Assessment Toolkit. HingX website. Available at: http://hingx.org/Risk%20Assessment%20Toolkit.

3. For our purposes in this book, a client registry and a beneficiary registry can be thought of as synonyms.

4. LOINC: http://loinc.org; ICD-10: http://www.who.int/classifications/icd/en/; ICHI: http://www.who.int/classifications/ichi/en/; ATC: http://www.who.int/classifications/atcddd/en/.

Glossary

eGovernment	In the United Nations E-Government Survey 2012, it is defined as "The employment of the Internet and the world-wide-web for delivering government information and services to the citizens."[1]
eHealth	eHealth (electronic health) can be defined as the use information and communication technology to improve the efficiency and effectiveness of health systems.
eHealth infrastructure	In this eBook, we use the term *eHealth infrastructure* to mean shared networks and databases that facilitate health information exchange and analysis for care delivery, payment, surveillance, and health system management purposes.
Enterprise architecture	Enterprise architecture, as defined by the National Institute of Health Enterprise Architecture, "is a comprehensive framework used to manage and align an organization's Information Technology (IT) assets, people, operations, and projects with its operational characteristics. In other words, the enterprise architecture defines how information and technology will support the business operations and provide benefit for the business."
Entity-relationship model	"In software engineering, an entity–relationship model (ER model) is a data model for describing the data or information aspects of a business domain or its process requirements, in an abstract way that lends itself to ultimately being implemented in a database such as a relational database." (Source: Wikipedia).
Fee-for-service	"Fee-for-service (FFS) is a payment model where services are unbundled and paid for separately." (Source: Wikipedia).
Global budget method	A method of paying providers for healthcare services by paying a prospective lump sum to providers determined solely by the financing agency, regardless of actual services provided.
Interoperability	Defined by HIMSS as: "Interoperability describes the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user."
mHealth	mHealth is an abbreviation for mobile health, a term used for the practice of using mobile technology (e.g., phones, tablets) to support health services and systems.
Profile	According to IHE, "a profile documents how standards will be used by each system's Actors to cooperate to address the problem."
Sequence diagram	As defined by Wikipedia, "a 'Sequence diagram' is an interaction diagram that shows how processes operate with one another and in what order."
Short message service	"Short Message Service (SMS) is a text messaging service component of phone, Web, or mobile communication systems. It uses standardized communications protocols to allow fixed line or mobile phone devices to exchange short text messages." (Source: Wikipedia)
Sociotechnical system	"Sociotechnical systems in organizational development are an approach to complex organizational work design that recognizes the interaction between people and technology in workplaces." (Source: Wikipedia)
Stack	A set or group of profiles that work together.
Standards	Norms or requirements that must be met.

Terminology server	"A terminology server is a piece of software providing a range of terminology-related software services through an applications programming interface." (Source: Wikipedia)
Value chain	Michael Porter, of the Harvard Business School, coined the term "value chain" to describe the entire production chain, from raw material and service inputs right up to final product or service ultimately consumed by the end user. For our purposes, the health care value chain includes the entirety of public health; preventive, primary, and acute care; and the management, supply chain, and financial systems that support these.

NOTES

1. United Nations. United Nations E-Government Survey 2012: E-Government for the People. New York: United Nations; 2012. Available at: http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf.

List of Acronyms

ANC	Antenatal care
CR	Client registry
CSD	Care Services Discovery
DRG	Diagnosis-related group
eClaims	Electronic claims
eHealth	Electronic health
EHR	Electronic health record
EMR	Electronic medical record
EPI	Expanded Programme for Immunization
ERP	Enterprise resource planning
FFS	Fee for service
GSHIS	Government Sponsored Health Insurance Scheme
HIE	Health Information Exchange
HL7	Health Level Seven
HNSF	National Standards Framework for Health
HWR	Health Worker Registry
ICD	International classification of diseases
ICP	Integrated care pathways
ICT	Information and communication technology
IHE	Integrating the Health Enterprise
ISO	International Organization for Standardization
IT	Information technology
ITU	International Telecommunication Union
JLN	Joint Learning Network
L&D	Labor and delivery
mHealth	Mobile health
MNCH	Maternal, newborn, and child health
MOH	Ministry of health
NeSF	National eHealth Standards Framework

NHIS	National health insurance scheme
PHI	Personal health information
PPP	Preferred primary provider
SDO	Standards development organizations
SHR	Shared health record

Additional Resources

In 2012, the WHO and International Telecommunication Union (ITU) National eHealth Strategy Toolkit was released. It recommended a step-by-step process to establish and document a NeSF that supports both care delivery and UHC-focused workflows. The WHO-ITU Toolkit is available here:
http://apps.who.int/iris/bitstream/10665/75211/1/-9789241548465_eng.pdf.

In 2013, the Joint Learning Network released a white paper entitled "Provider Payment Reform and Information Technology Systems: A Chicken and Egg Question for National Health Coverage Programs". This paper provides a conceptual framework for understanding the Information Technology requirements of various payment methods. It explores the choices, trade-offs, and implications by highlighting areas where complexity and costs arise from these decisions. The paper may be found here:
http://jointlearningnetwork.org/uploads/files/resources/IT-PPM_FINALlores_online.pdf

WEBINARS:
Developing a National eHealth Standards Framework: Presented by Derek Ritz, hosted by the Joint Learning Network Information Technology Initiative. Recording and slides are available at:
http://jointlearningnetwork.org/initiatives/information-technology/webinars

Health Data Dictionaries and the Philippines Experience: Presented by Michiel Berende and Arturo Alcantara, hosted by the Joint Learning Net-

work Information Technology Initiative. Recording and slides are available at: http://jointlearningnetwork.org/initiatives/information-technology/webinars

Leveraging eHealth Standards to Connect National Healthcare Stake-holders: Presented by Derek Ritz, hosted by the Joint Learning Network Information Technology Initiative. Recording and slides are available at: http://jointlearningnetwork.org/initiatives/information-technology/webinars