Research Report

Developing a Strategic Program for Chilean Health Information Technology

Environmental Scan and Key Informant Interviews

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Preface

This report presents the results of an environmental scan and key informant interviews describing the current state of health information technology adoption and implementation in Chile. It also addresses challenges and opportunities faced by the Chilean health care system in encouraging development in the health information technology sector over the next ten years. This is the first phase of a larger project that will develop a roadmap for the Chilean government's Strategic Program in health and technology. The objective of this Strategic Program is to foster the development of the health and technology sector in Chile over the short, medium, and long terms. This work was conducted by RAND Health for the Chilean Ministry of Economy.

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Summary

To foster development in a variety of economic sectors, the Chilean government created "Strategic Programs for Smart Specialization" (referred to in this report as "Strategic Programs"). One of these programs is in the area of "health and technology." The Ministry of Economy has tasked RAND with exploring the current state of health information technology (health IT) in Chile and developing a roadmap for its further development over the short (one to two years), medium (four to six years), and long (ten years) terms.

This report presents the results of the first phase of this work, an environmental scan and key informant interviews designed to gather information on the current state of health IT investment in Chile and the challenges and opportunities associated with further development of health IT in the coming years. We reviewed documents from a number of publication databases, including PubMed, Scopus, LILACS, and SCIELO, as well as the grey literature. We also conducted ten key informant interviews with two types of stakeholders: (1) key stakeholders in health policy in Chile, including those from government and academia, and (2) directors of projects associated with health IT that have received funding from the Ministry of Economy. While ten is a small number of interviews, which limits our ability to generalize the results to the entire health care system, we were able to capture some key themes and important recommendations as part of this process.

Our findings indicate that a number of health IT projects have been or are currently underway in Chile. The Ministry of Health (MINSAL) has developed a "Digital Health Strategy," which is working to implement four phases of health IT adoption and implementation in the public health care system in Chile. In addition, universities, private businesses, and regional and international players have been working to develop health IT projects in areas including telemedicine, electronic health records (EHRs), referral and appointment systems, and resource management tools. All of these projects are designed to help reduce challenges faced by the health care system, which include inequitable access to care, significant wait times, and a low proportion of providers.

The interviews identified challenges and opportunities associated with the implementation of health IT in Chile. We found three closely related key challenges. The first is the lack of interoperability standards and requirements for new health IT projects. The second key challenge is the fact that most health IT projects in Chile have been implemented only on an individual clinic level—for example, in only one or a few hospitals or one region. A third important challenge is the lack of coordination among different stakeholders seeking to implement new health IT projects.

Respondents did indicate that there are a number of opportunities for the Ministry of Economy to foster development in health IT, for example, via the creation of a new center to

encourage standardization (which is currently underway). The Ministry of Economy could also help to reduce the barriers to entry in health IT by funding additional smaller projects and helping to encourage adoption and implementation of health IT products via a certification process designed to demonstrate the value of these projects.

The results of this work will be used in the next phase of this project, which will develop the roadmap of activities that can be undertaken in the short, medium, and long terms in order to foster the further successful development and implementation of health IT in Chile.

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1. Introduction

The 2014 "Productivity, Growth, and Innovation" agenda for Chile has the primary objective of encouraging the development and growth of the economy in a variety of sectors. As part of this agenda, the government has worked to develop "Strategic Programs for Smart Specialization" (referred to in this report as "Strategic Programs"). The Strategic Programs are designed to foster economic growth in different sectors using targeted government resources. Each Strategic Program has a roadmap that defines activities that will meet certain development targets over the short (one to two years), medium (four to six years), and long (ten years) terms.

To date, the Corporación de Fomento de la Producción (CORFO), which is part of the Ministry of Economy, has named 11 Strategic Programs. One of these programs is within the area of "health and technology." In what follows, we describe the early efforts of a project that is seeking to develop the roadmap for this Strategic Program, focusing on the health care sector with specific emphasis on health care information technology (health IT).

There are two phases of this project. The first consists of an environmental scan and key informant interviews that seek to characterize the health care system and the state of the health care technology industry in Chile. The second phase of the project will use the results of the environmental scan and the interviews to develop the roadmap.

This report presents the results of the environmental scan and key informant interviews, which focused on the following areas:

- an overview of the health care system, including a description of the key players and challenges
- a description of the current state of health IT in Chile
- challenges and opportunities associated with the implementation of health IT
- key considerations for the health system and health IT sector over the next ten years.

The report is organized as follows. Chapter Two presents the methods we used as part of this phase of the project. Chapter Three describes the Chilean health care system, along with some key strengths and weaknesses of the system identified as part of the environmental scan and by our interview respondents. Chapter Four discusses current health IT projects in Chile, and Chapter Five describes challenges and opportunities associated with efforts to implement health IT projects over the next ten years. Finally, Chapter Six offers some conclusions and recommendations leading into the second phase of the project, designing the roadmap.

2. Methods

We conducted a search of the available literature, searching the PubMed, Scopus, LILACS, and SCIELO databases to identify materials that characterize the current state of the Chilean health system and its IT capacity. We did not apply language limits to our searches, but we did restrict our search years to 2000 to the present for contextual literature and 2010 to the present for more technical search terms.

In general, searches focused on Chile and the Chilean health care system. Examples of search terms used include *health IT*, *health information technology*, *information and communication technology*, *ICT*, *health care system*, *health care delivery*, *health policy*, *sistema de salud*, *medical care*, *e-health*, *medical care*, *universal health coverage*, *servicios de salud*, *telemedicine*, and *electronic health record*.

The initial searches resulted in 215 total articles, of which only a subset were relevant to the project. We excluded articles that were significantly out-of-date or that focused on health technology assessment, as this term is more related to cost-benefit analysis of medical devices and interventions as opposed to the use of health IT specifically.

We also performed additional searches of the grey literature using the New York Academy of Medicine Grey Literature Database, as well as Google Scholar. We also directly searched relevant organization websites, including those of the World Health Organization, Pan American Health Organization (PAHO), and E-Health Reporter. Additional references were obtained by searching the citations of identified articles.

In addition to this literature search, we conducted ten key informant interviews with industry representatives and other health care stakeholders in Chile. The interviews were split between two different types of stakeholders: (a) the directors of projects currently funded by CORFO (three interviews) and (b) key health care stakeholders and policymakers in Chile (seven interviews). This second group of interviewees was composed of three directors of important health-related government agencies, one director of a group of primary health units, one person with vast experience in a big IT company, and two experts in health IT entrepreneurship. We developed a semistructured interview guide, covering the following subjects: general health system performance, current health care IT utilization, future planning for health IT implementation, and measures of success.

The interviewees were selected based on a short list provided by CORFO, which took responsibility for securing their consent to participate. The interviews were conducted in person in Spanish by a native Spanish-speaking interviewer. Interviews were conducted between October 21 and October 30, 2015. Each interview lasted approximately one hour. All respondents gave their consent to have the interview recorded. The Spanish-speaking research assistant who conducted the interviews in Chile provided both notes in English summarizing the

responses given during the interviews and his impressions of the key lessons learned from all of the interviews. In addition, two native Spanish-speaking research assistants listened to five interviews each and wrote summaries of the main points for each question in English. Therefore, eight of the ten interviews had two separate sets of notes, and two interviews had one set of notes. The notes were then consolidated into one document, and the entire team reviewed the notes to extract themes.

3. Health Care System Overview

Chile has experienced economic growth at an average of nearly 5% per year from 2003 to 2013 (Central Intelligence Agency, 2015). This growth has contributed to advances in Chile's socioeconomic development, including the achievements of nearly universal access of in-house piped water (93% of households) and improved sanitation facilities (96%) (World Bank, 2014). The nation has also seen an improvement in average health outcomes, with an increase in life expectancy from 50 years in 1952 to 79.8 years in 2014 and a drop in infant mortality from 117.8 per 1,000 live births to 7.2 per 1,000 live births over the same time period (Goic, 2015).

The Chilean health system is characterized by dual subsystems of public and private health insurance and health care service provision. Both sectors are overseen by the Office of the Health Superintendent (Pan American Health Organization, 2007). The State's Ministry of Health (Ministerio de Salud de Chile, or MINSAL), which was created by Decree Law No. 25 of 1959, serves as the lead and regulatory agency of the national health system (MINSAL, n.d.-b; Pan American Health Organization, 2007, 2012). MINSAL establishes health policies, develops general plans, and supervises and assesses compliance with those plans (Pan American Health Organization, 2007).

3.1 Health System Financing and Insurance Provision

Chile's mixed health system is financed through both public funds, consisting of the state's general budget and tax revenue, and private funds, including out-of-pocket expenditures and premiums paid for private health plans (Pan American Health Organization, 2012). By law, all employed individuals are required to pay 7% of their monthly wages into public or private health insurance (Bitrán, Escobar, & Gassibe, 2010; Pan American Health Organization, 2007). With some exceptions, including the military and those who are self-employed, all Chileans are covered by public insurance (Fondo Nacional de Salud or FONASA) unless they choose to enroll in private health insurance (Instituciones de Salud Previsional or ISAPRE). Beginning in 2018, self-employed individuals will also be required to contribute 7% of their taxable income toward public or private health insurance (Nuñez & Chi, 2013). Also, according to the recent Law No. 20.864, the mandatory contribution of pensioners of ages 65 and older in the most vulnerable quintile was reduced from 5% to 3% on November 1, 2015, and will be further reduced to 0% on November 1, 2016 (Chile Atiende: Personas a tu servicio, 2015).

Chileans with lower incomes are overwhelmingly covered by FONASA, while enrollment in ISAPREs is only substantial for those with the highest incomes. Results of the 2013 National Socioeconomic Survey by the Ministry of Social Development (Encuesta de Caracterización Socioeconómica Nacional, CASEN) show coverage by FONASA to be highest among the

population in the lowest three income deciles (92.9% for those in the first decile; 92.8% for those in the second decile; 90.3% for those in the third decile). The share of the population covered by FONASA decreases gradually for higher-income deciles but still includes 67.9% for those in the eighth decile and 52.0% for those in the ninth decile. In contrast, 67.5% of the population in the tenth income decile is covered by the ISAPRE system (Ministerio de Desarrollo Social de Chile, 2015). Those enrolled in an ISAPRE plan contribute an average of 9% of their salary to premiums, compared with the 7% contributed by the publicly insured (Ministerio de Desarrollo Social de Chile, 2013).

In 2005, Chile passed comprehensive health reform, known as the General Regime of Health Care Guarantees. This reform established the Explicit Guarantees in Health Care (Garantías Explícitas en Salud, or GES) or Universal Access Plan with Explicit Health Guarantees (Acceso Universal con Garantías Explícitas, or AUGE) Plan (Law No. 19,966), and the Health Authority and Network of Autonomous Hospitals (Law No. 19,937) (Superintendencia de Salud de Chile, n.d.-b). The AUGE Plan was designed to address health disparities and to target a list of 80 priority diseases and health problems that were selected based on their epidemiological prevalence and public concern; of these, 19 are chronic conditions. The AUGE Plan specifies four basic guarantees of access, quality, opportunity or timeliness, and financial protection for patients diagnosed with these priority diseases (Superintendencia de Salud de Chile, n.d.-a). Patients enrolled in either FONASA or an ISAPRE plan pay equal copayments that are small relative to monthly household incomes for services covered by the AUGE reforms but are subject to different cost-sharing amounts for other services (Bitrán et al., 2010).

Ten years into the reform, assessments point to some positive results of AUGE/GES, such as increased access to diagnosis and treatment for the listed health problems, increased population coverage (especially among FONASA enrollees), savings for patients suffering some covered diseases (ranging from US$49 annual costs for hypertension cases to US$1,255 for type 1 diabetes), and a reduction of mortality associated with some diseases (such as hypertension and epilepsy) (Bitrán et al., 2010). FONASA's expenditures in both GES-priority and non-GES health problems increased by 35% between 2005 (the year the reform was passed) and 2009 (MINSAL, 2011). According to a public survey administered in 2013, respondents gave AUGE a score of 5.6 (on a scale from 1 [low] to 7 [high]), with positive assessments of the financial coverage for catastrophic diseases but negative assessments of waiting lists and the scarcity of specialist physicians (Paraje & Infante, 2015).

Associated with the AUGE/GES reform, in 2005 the SIGGES[1] information system was put in place in public-sector health units, with the purpose of monitoring the reform's implementation, supporting local management of cases, and generating statistics for local, regional, and central authorities (MINSAL, 2009). Interview respondents agreed that SIGGES has achieved its

[1] Sistema de Información de Apoyo a la Gestión de las Garantías Explícitas de Salud.

objective in terms of generating statistical information to track the performance of AUGE/GES but also observed that the SIGGES is somewhat outdated and is not interoperable with other informational platforms. One respondent stated that SIGGES met only the needs of FONASA to collect statistical information, is not useful to other actors within the system (such as physicians or hospital units), and takes a large amount of personnel time to digitize all the required information.

3.2 Health Care Services Provision

The National Health Service (Sistema Nacional de Servicios de Salud, or SNSS) is responsible for the delivery of public health services. Primary care services are provided through local health centers administered by municipalities. Secondary and tertiary care services are provided by a network of public outpatient and hospital facilities (Bastías, Pantoja, Leisewitz, & Zarate, 2008). The private sector focuses on secondary and tertiary care delivery through a series of clinics, centers, laboratories, and pharmacies managed by private individuals or companies (Bastías et al., 2008; Pan American Health Organization, 2007), while still providing primary care to those who choose to receive it from private providers per the Free Choice Modality, explained below. ISAPREs may enter agreements with public health institutions for certain services, such as emergency or intensive care (Pan American Health Organization, 2007). Low-income and high-risk populations tend to acquire health services primarily through the public sector, and the private sector generally treats higher-earning and low-risk populations (Bastías et al., 2008).

Beneficiaries who make the 7% monthly contribution have the freedom to choose to receive prepaid health services in public or private facilities under the Modalidad Institucional or the Free Choice Modality (Manuel, 2002). In 2012, 43% of services provided by the private sector were used by FONASA beneficiaries (Clínicas de Chile A.G., 2013). On average, 18.2% of public expenditures between 2008 and 2011 were spent on services provided by the private sector (Ministerio de Hacienda de Chile, 2013). In contrast, only an average of 3.2% of ISAPRE expenditures were spent on public services.

3.3 Health System Strengths

Three respondents agreed that the Chilean health system is notable for its widespread coverage of the population. Though limited in resources, the public system's foundation in primary care and "strong tradition of public health" has allowed it to address the basic needs of the population and yield improved health outcomes. Diverse public health programs provide vaccinations and complimentary nutrition, maternal, and child care, and address chronic illnesses. The private sector, which serves a smaller portion of the population, was described by respondents as providing higher-quality care and utilizing more advanced technology, comparable to the standards of other developed countries.

Another system strength that was mentioned during discussions with RAND team members and others is the ability to track patients using a unique identifier that is already assigned to every Chilean at birth. Called the Rol Único Tributario, or RUT, this number is used in all transactions in Chile, including banking, health care, and credit cards. The presence of a single unique identifier for each patient can facilitate the implementation of health IT systems that seek to connect patients across different health care locations and types.

3.4 Health System Challenges

Despite stellar improvements across several health indicators in the past decades, Chile's health system still faces several challenges, especially in the areas of (1) meeting the needs of an aging population; (2) addressing the shift toward caring for more chronic as opposed to acute diseases; (3) access to and quality of health care; (4) infrastructure of primary and secondary care, both in terms of professional staff and facilities availability; (5) efficiency in and coordination of care between health units in both public and private sectors; and (6) leadership and organizational structure. In this section, we introduce these challenges (Section 3.4.1) and describe interview responses suggesting where health IT could mitigate them (Section 3.4.2).

3.4.1 Health System Challenges: Overview

The Chilean health system faces new challenges as the population ages and noncommunicable diseases become more prevalent than infectious diseases (World Bank, 2014). Historically, according to one interview respondent, health care in Chile has focused on child and maternal care, but is continually evolving as the nation's epidemiological profile changes.

Despite dramatic improvements in health outcomes, the life expectancy at birth in Chile (78.8 years) remains less than the Organisation for Economic Co-operation and Development (OECD) average of 80.5 years as of 2013 (OECD, 2015c). The rate of obesity in Chile was 25.1% in 2009, higher than the OECD average of 22.7% but less than the 35.3% in the United States and 32.4% in Mexico in 2012 (OECD, 2014). The steadily growing prevalence of obesity suggests future occurrences of such noncommunicable diseases as diabetes and cardiovascular problems and increasing costs of care (OECD, 2014). The rise of chronic diseases requires ways to track individuals throughout their lifetimes and sufficient health personnel who can do so (World Bank, 2014).

Chile's public investment in health is among the lowest of OECD countries. National health expenditures were 7.7% of Chile's gross domestic product in 2013, less than the average of 8.9% in OECD countries (OECD, 2015b). Chile spent an equivalent of US$1,623 per person on health, compared with an OECD average of US$3,453 (OECD, 2015a).

Chile faces a scarcity of equipment and medical personnel, such as primary care physicians, specialist physicians, emergency medicine physicians, medical technologists for radiology, and specialized nurses. Relative to countries of similar economic development, Chile ranks among

those with the smallest density of doctors per capita: There are only 10.3 physicians per 10,000 inhabitants, compared with 17.6 for Brazil, 9.2 for Peru, 37.4 for Uruguay, and 24.2 for the United States (Goic, 2015; Kaiser Family Foundation, n.d.), with significant variation across regions and socioeconomic groups within Chile.

Access to care is especially inadequate among indigenous populations and among those living in poverty or in rural areas, with barriers related to living far from health services and unaffordable transportation costs (Pan American Health Organization, 2012; World Health Organization, 2011). Additionally, health providers have become concentrated in urban areas, resulting in inequitable geographic distribution of physicians (Pan American Health Organization, 2012). In 1996, the most recent year for which we found information, 60% of practicing physicians were in Santiago, which contained only 40% of the population (Mena, Badía, Neira, & Ríos, 1996). Disparities in health indicators among regions in Chile reflect this. In 2011, the infant mortality rate was 2 deaths per 1,000 live births in Vitacura, an affluent district in Santiago, but about 45 deaths per 1,000 live births in Puerto Saavedra, 700 km away from Santiago in the Araucanía region (World Health Organization, 2011).

Similarly, those most isolated and economically vulnerable are also those at the highest risk for developing chronic diseases, such as type 2 diabetes, cardiovascular diseases, and obesity (Keane, 2007), conditions that are often preventable. Lack of timely primary and preventive care access is often a consequence of poor coordination between health provider networks in terms of either knowledge and information sharing or operational tasks between primary and secondary health care settings and between the public and private sector. For instance, interview respondents shared that the public and private sectors lack coordination, integration, and central planning, and that they compete for qualified medical and other health-related personnel, resulting in increased costs and waiting lists. Additionally, there is little coordination between primary and secondary care providers, as most of the primary care services are not integrated with hospital networks.

MINSAL has recognized and recently developed a committee to initiate reforms toward a more integrated system (MINSAL, 2014). Despite these efforts, interview respondents asserted that there is a general lack of vision for the health system and insufficient initiative on the part of the government to successfully develop and implement strategic plans. Some of the problems in the health system, according to some respondents, have been a consequence of ineffective leadership and organizational structure in the government ministries. Specifically, interviewees observed that the high turnover of government leadership has prevented the creation of sustainable solutions. These respondents voiced the need for more experienced professionals within the Ministry of Health to ensure implementation of strategic plans. One respondent also noted that the political context has favored attention to short-term agendas despite evidence showing that long-term plans are needed to address current problems.

Finally, interviewees criticized the health care system for its heavy focus on administrative rather than clinical processes. One respondent noted that the public sector has paid private

providers to provide care to FONASA enrollees since the implementation of the AUGE reform and its mandated service for a set of priority diseases. According to the respondent, these private providers have been costly for the public sector, given their high hourly wages. This respondent suggested that one way the health system could minimize costs would be to base physician payment on diagnosis, rather than the number of visits or services provided. Payments based on diagnosis would require detailed monitoring of patient status, which presents some potential for health IT applications.

3.4.2 Health System Challenges: Health IT

One expert pointed out that a number of the problems within the health system could at least in part be attributed to shortcomings in how technology is used to support it. The absence of health IT that is interoperable across health centers and organizations hinders coordination between private and public care, and between primary and secondary care. There is also an increasing need for real-time data collection to more efficiently and accurately track patient status and outcomes. Such data and a robust health IT infrastructure would support health monitoring and better assessments of variability in medical practices. As mentioned by a few interviewees, detailed monitoring might help the public system in particular by allowing it to change the physician payment system to one based on the quality of health outcomes, rather than the number of visits. Additionally, real-time and reliable data collection will help monitor variations in physician practice, which in turn can help ensure physicians are practicing based on the latest medical guidelines.

Many respondents agreed that health IT implementation is key to effectively addressing the issues of efficiency and unequal access to care. Respondents indicated two of examples of ways that health IT can improve efficiency of care: through the use of computers for scheduling, and through devices that enable patients to monitor their conditions, which in turn can reduce the use of ambulances and hospital visits. Respondents did mention, however, that health care personnel and sector leaders lack proper training in the complex nature of the health system and the potential role that health IT can play.

3.5 Summary

The Chilean health care system has a complex set of key stakeholders who all play a role in health IT adoption and implementation. The system has some strengths, most notably its near-universal health insurance coverage of its population, but also has some weaknesses. These weaknesses include low public financing of health care, relative to other OECD nations; a divided public-private system that lacks integration; and a lack of strong leadership focused on long-term solutions. The next chapter focuses on current efforts to implement health IT in Chile.

4. Current Efforts to Implement Health IT in Chile

Chile has been and continues to undertake a variety of activities related to the implementation and adoption of technology in its health care system. These efforts have been particularly successful in the primary care sector, where 68% of the primary care network, 73% of community hospitals (Frenz et al., 2014), and, according to one interview respondent, 50% of hospital emergency care units are now using electronic health records. Additionally, to inform the public on current health trends and projects, MINSAL collects and makes accessible vital statistics, as well as statistics on emergency care, immunizations, hospital admissions, and expenditures. Additionally, its online portal gives information on public health interventions carried out by the health authority across various areas (e.g., food, prevention, hazard surveillance).[1]

This chapter describes current government efforts to encourage adoption of health IT and the level of success of such efforts.

4.1 Defining Health Information Technology

In conducting the environmental scan and key informant interviews, we found that it was helpful to categorize and define the different types of health IT. Broadly speaking, *e-health* is a term used to describe the use of information and communication technologies to support the provision of health care, health care surveillance and health education, knowledge, and research (HealthIT.gov, 2015b; Pan American Health Organization & World Health Organization, n.d.-a). E-health includes a number of different types of health IT. Table 1 presents each of these different types with a brief definition and lists some of the benefits associated with each type of health IT, as well as challenges each type might face. The last column presents a list of the relevant health IT projects in Chile that fall into each category.

[1] See more details on MINSAL's Department of Statistics and Information homepage (Ministerio de Salud de Chile, Departamento de Estadistícas e Informacíon de Salud, n.d.).

Table 1. Health IT Categories, Definitions, Key Challenges, and Current Projects

Health IT Category	Definition	Potential Benefits	Key Challenges	Current Projects
Telemedicine	Delivery of health services using IT (Pan American Health Organization & World Health Organization, n.d.-a)	Improves access to health care services to rural or underserved areas	Slow technology adoption by physicians, lack of standards for distance care, lack of information and communication technology infrastructure (esp. in more rural regions), no face-to-face contact	Tele-electrocardiogram service; e-advice; DART; Visita Virtual; COSMOS model
Electronic health records (EHRs)	Digital records of a patient's medical and treatment history shared across all health providers involved in the patient's care. May also incorporate decision support tools.	Allow tracking patient information across different providers, enabling better care coordination	Lack of interoperability, regional variation in computer literacy and facility availability, privacy concerns	Mas Salud Occidente; the Pulso Project; Electronic Medical Leave system
Appointment, referral, and counter-referral systems[a]	Systems that optimize patient and facility management (World Health Organization, n.d.)[b]	Reduce inefficiencies in scheduling and referring of patients	Staff shortage, regional variation in system utilization, lack of providers' enrollment	Waiting list and referral and counter-referral register system, online scheduling
Pharmaceutical and medical device tracking and management	Systems monitoring pharmaceutical and medical device/supply stock to enable traceability (Cerón Reyes, 2010)	Allow for better stock management, enable tracking in the case of tainted products	Lack of integrated national system with common standards allowing for the exchange and monitoring of drug and medical supply information	Implementation of GS1 standards; standardized drug usage model development
Other	Other types of IT include clinical terminology and data standardization, online education and information sharing	Improve interoperability using common terminology, better data and knowledge sharing	Unequal access to information and education across regions, lack of technology for timely and standardized data collection and sharing across health units	Clinical Terminology Server; Virtual libraries (EVIPNet-Chile; Sectoral Intranet Salunet; Minsal Net); SYNCO

[a] Referral systems either allow patients to be referred to other institutions for further medical care, or allow for transferring relevant information alone. Counter-referral systems enable the receiving facility to send the client back to the initiating one with information about services provided there, potentially combined with the follow-up details (Carolina Population Center et al., 2013; Fernández & Oviedo, 2011).
[b] Including, for instance, keeping track of the availability of hospital beds.

4.2 Map of Key Stakeholders in Health Information Technology

Based on the environmental scan, the key informant interviews, and discussions with CORFO, we have created a map of the key stakeholders in health IT and indicated their role in developing this sector. This map appears in Figure 1. There are a number of government players, including the Ministry of Economy, which provides project funding and support for various health IT projects, and the Ministry of Health (MINSAL), which establishes health care and health IT policy via SIDRA (Sistemas de Información de la Red Asistencial, which roughly translates to "Care Network Information System") and its Digital Health Strategy. The Ministry of Education

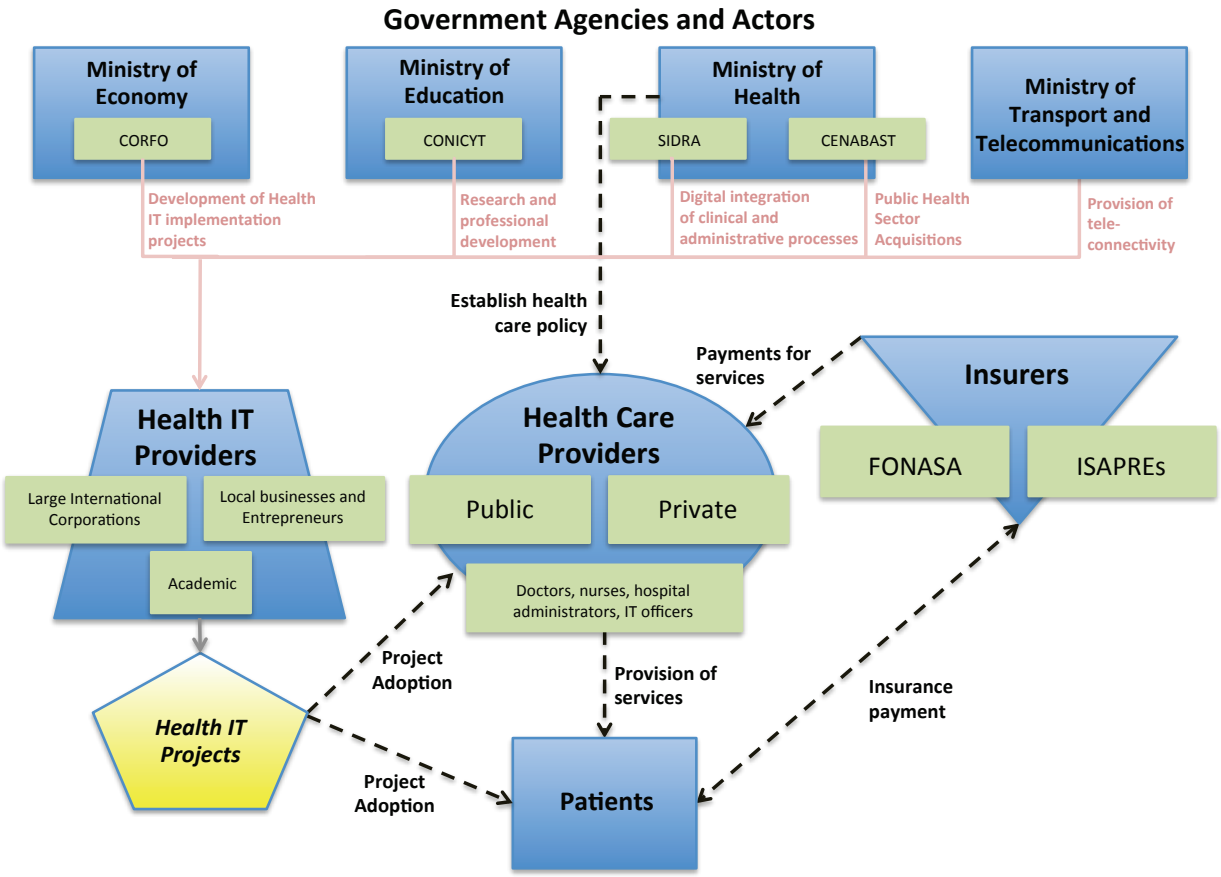
and Ministry of Transport and Telecommunications also play a role in providing research and professional development and tele-connectivity.

Health IT providers receive funds from CORFO, which is housed within the Ministry of Economy, and other government agencies (especially MINSAL) to develop health IT projects. Based on our interviews, it appears there are two main players in health IT: international businesses and local, smaller entrepreneurs. These organizations in turn create health IT products that are adopted and implemented by health care providers; these may be either commercialized or produced by government funds for the public good. Universities also play a role in helping to develop health IT products and in training medical and other professionals in how to use the tools.

Health care providers play a key role in these efforts, as they respond to health care and health IT policies established by MINSAL, receive payments for services from both FONASA and the ISAPREs, and have the opportunity to choose to adopt and implement products produced by the projects funded by the Ministry of Economy. Health care providers offer services in both private and public clinics, both of which can be affected by changes in health policy made by MINSAL. It is important to note that projects may be adopted in either Santiago or in separate regions in Chile; further development of health IT projects must take into account the differences between these areas in order to best target the product and encourage successful adoption and implementation efforts.

Finally, patients and other individuals may also make use of health IT products, especially those designed to encourage healthier living habits and to enable patients to make appointments with providers.

Figure 1. Map of Key Stakeholders in Health Information Technology



SOURCE: Authors' analysis based on environmental scan, key stakeholder interviews, and discussions with CORFO.
NOTES: CONICYT = Comisión Nacional de Investigación Científica y Tecnológica; CENABAST = Central de Abastecimiento del Sistema Nacional de Servicios de Salud.

4.3 Government Efforts: The Digital Health Strategy

MINSAL implemented the "Digital Health Strategy" (Estrategia Digital en Salud), which sought to improve public health services by creating a unified information system that would allow for real-time information and communication exchange and the ability to track patients through the health system using integrated electronic platforms (MINSAL, n.d.-a). SIDRA is the focus of the Digital Health Strategy (Weaver, Delaney, Weber, & Carr, 2010). SIDRA has four main objectives (MINSAL, 2013):

- Use electronic health records to allow for communication and coordination of care between providers and across the country.
- Use technology to generate statistics and management indicators to better measure and plan care.
- Use technology to improve access to care by measuring and improving efficiency and equity.

- Increase patient engagement and empowerment through technology.

These objectives are to be achieved by improving (1) hospital management systems, (2) resource management systems, (3) primary health care systems, and (4) referral and counter-referral systems (MINSAL, 2013; Fernández & Oviedo, 2011). There are five information system modules being developed to support these initiatives: (1) appointment scheduling system; (2) a referral and counter-referral application enabling patients to be referred from one health provider to another, together with their medical record history; (3) EHRs; (4) an emergency unit; and (5) a pharmacy unit (MINSAL, 2013; Fernández & Oviedo, 2011).

The first stage of SIDRA (2008–2011) focused on the development of the appointment and referral system, while the second stage (2012–present) focuses on automation, implementation, and integration of EHRs between the emergency rooms and pharmacy units (MINSAL, 2013).

4.4 Telemedicine

A variety of telemedicine projects are already developed or underway, including a number of applications or services that make use of devices and tools such as mobile phones, email, video-conferencing or remote monitoring. To ensure timely access to patient care, high quality of care, early diagnosis and treatment, and resource use efficiency, hospitals and primary care medical centers use telemedicine technology to transmit images (e.g., electrocardiograms and osteopulmonary tests) from medical centers in remote areas to specialists in order to receive a diagnosis (Asociación Chilena de Informática en Salud, 2011; Servicio de Salud Viña del Mar-Quillota, 2013; Escobar, Véjar, & del Pino, 2009; Fernández & Oviedo, 2011). There is already a nationwide telemedicine system for the diagnosis of early stage acute myocardial infarction (Weaver et al., 2010).

MINSAL has run a nationwide tele-electrocardiogram, or tele-ECG, service since 2005 (Asociación Chilena de Informática en Salud, 2011). Private companies also provide telemedicine services; these companies are staffed with medical specialists from both the public and private sector who provide the public emergency service, ambulatory care, and critical care patient units with "e-advice." This service bridges gaps in service delivery between the public and private sectors (Asociación Chilena de Informática en Salud, 2011). One project mentioned during the interview process is DART, which uses technology to detect diabetes through an eye exam using imaging and diagnostics conducted by physicians at a distance. The implementation of this project began in the primary care sector in 2013. According to one respondent, the project has so far shown promise but has struggled with the process of automating the diagnostic process.

Another project allowing for remote diagnostics is the project Visita Virtual. This is a tool that enables patient and health providers to have a virtual visit via videoconference. Patients have access to the virtual visit from different locations (telecenters, infocenters, schools, and libraries) that have the necessary equipment (e.g., webcam, headsets, computer). A trained operator

establishes the connection to the hospital. The pilot work for this project was conducted at the Hospital of Temuco (Healthcare Information and Management Systems Society & the Global Enterprise Task Force, 2010).

Telemedicine and mHealth (mobile health technology) can aid in providing remote diagnostics and helping chronically ill patients care for themselves. These tools make use of sensors that monitor vital signs and then transmit the data to medically trained staff who can promptly recommend next steps in care. For instance, in 2011, a 13-month pilot study of the COSMOS model (Modelo de Comunicación y Seguimiento Móvil en Salud) was implemented in two selected health centers in Puente Alto for the care of patients with type 2 diabetes via automated interactive voice response calls. If successful, this pilot will be then tested at the national level (Alcayaga et al., 2014). Additionally, the use of mobile phones for disease surveillance (e.g., identifying infectious diseases with global positioning systems, or GPS) may prove valuable in a natural disaster (Mechael et al., 2010). The information gathered via these tools may be used as part of predictive models designed to signal early onset of diseases or medical emergencies to direct patients to the hospital on time (Molinari, 2013).[2]

4.5 Appointment, Referral, and Counter-Referral Systems

Chile has prioritized an integrated online scheduling, referral, and counter-referral system in order to reduce waiting times (MINSAL, 2013, n.d.-a; Rodríguez, 2014). Referral systems allow patients to be referred between institutions either for further medical care and allow transfer of relevant information in medical records. Counter-referral systems enable the receiving facility to send the client back to the initiating one with information about services provided there, potentially combined with the follow-up details (Carolina Population Center et al., 2013; Fernández & Oviedo, 2011). In 2008, MINSAL created an interim waiting list register system together with a referral and counter-referral system (Capurro, 2007; Fernández & Oviedo, 2011). As of 2013, it covered more than 80 percent of health care providers (MINSAL, 2013). Overall, these types of tools are intended to reduce hospital readmissions, reduce utilization of the overutilized public hospital and emergency room infrastructure, and potentially reduce government spending over the long term (Molinari, 2013).

4.6 Electronic Health Records

One way that IT can greatly influence health is through electronic health records (EHRs), a digital format of the traditional medical record that increases legibility, access, backup, and

[2] A related example of the use of data analytics in preventative care is the cooperation of Chile in the Google Flu Trends project, where Google assesses regional activity of flu by analyzing search terms across regions (see, for example, GigJets, 2014). Similar approaches may be adopted for other diseases of interest.

potential for research. Chile is following worldwide trends of increasingly digital medical records, setting the nationwide implementation of EHRs next on the SIDRA strategy agenda.

In 2008, MINSAL began the first step toward collecting, processing, and storing clinical and administrative health data in Chile. The Metropolitan West Health Service in Santiago created an electronic health record system for the entire Western region population in Santiago, called "Mas Salud Occidente," an EHR pioneer in the Chilean health care system (Cerón Reyes, 2010). However, as of 2013, more than 80 percent of medical records in Chile were still paper-based, indicating significant room for expansion of EHRs (MINSAL, 2013).

In the future, hospitals will need to obtain a quality certificate (proceso de acreditación, described in Decreto No. 15, 2007; Ministerio de Salud de Chile, 2007) to serve patients with the prioritized conditions, as specified in the AUGE health reform. One of the requirements for the certificate will be based on their performance (e.g., timely and high-quality patient care). As a consequence of these incentives and the SIDRA objectives regarding a nationwide EHR implementation, many more hospitals are announcing the implementation of EHRs (Capurro, 2007). Recently, the largest hospital in the SIDRA network, Dr. Sótero del Rio Hospital, implemented EHRs that will enable hospitals to perform several functions from a single location (called the "Pulso Project"). These functions include the ability to request and view imaging tests, issue prescriptions for serious and chronic conditions, or gather emergency care information. In addition, this project plans to connect patients' treatments to the management systems of the Primary Healthcare System (Atención Primaria de Salud or APS), which already has extensive electronic clinical record coverage, as described above[3] (Hospital Dr. Sótero del Río, 2014). The project initiating EHR developments in APS was first created in 2007 (and is still underway), aiming for EHRs to contain all of a patient's longitudinal data and information, regardless of location, and allow for permanent, safe, and confidential access to the information (Healthcare Information and Management Systems Society & the Global Enterprise Task Force, 2010).[4] Other private clinics have EHRs, but there is no clear system for exchange of data between them or between the rest of the system.

Finally, the National Health Fund (Fondo Nacional de Salud, or FONASA) has been working on implementing an electronic medical leave system for its beneficiaries. This is considered one of the country's greatest efforts to automate and modernize the public health system, as stated by René Prieto, former director of the ICT Department of the Ministry of Health, and the project

[3] As mentioned above, 68% of the primary care network, 73% of community hospitals, and, according to one interview respondent, 50% of hospital emergency care units digitized and using electronic health records (Frenz et al., 2014).

[4] An additional EHR project currently underway is the development of the ICARO system (Systema de Información de Atención Pre-hospitalaria), which stores information about ambulatory care and integrates different components of telephone, radio, or global positioning system (Capurro, 2007; Weaver et al., 2010). However, this project was not mentioned during the interviews, and we were unable to find further information about its current status.

has been honored with the "Best Project of the Year" award (Pan American Health Organization & World Health Organization, n.d.-b). It is important to note that it was first successfully implemented within the ISAPREs in 2007. The way that FONASA has built on the ISAPREs' experience provides a good example of integration and positive spillovers between public and private sectors. The pilot project under FONASA started in November 2011, and this was followed by a five-month testing phase. To date, more than 100,000 electronic medical leaves have been processed, with processing time decreasing from 90 to only 15 days. Today, this system serves 10,000 medical professionals, 8,000 employers, and nearly 6 million patients under FONASA, and it also connects them to COMPIN (Comisión de Medicina Preventiva e Invalidez, or Committee on Preventive Medicine and Disability), Compensation Funds, FONASA, and the Social Security Authority (Asociación Chilena de Informática en Salud, 2011; MINSAL, 2013; Pan American Health Organization & World Health Organization, n.d.-b). Most of the users currently cluster in the Santiago metropolitan region. The plan is to implement this solution to other regions over the coming years (Pan American Health Organization & World Health Organization, n.d.-b).

Other related projects involve creating additional automated or electronic services, such as self-service kiosks, e-vouchers confirming patients' coverage with private providers in agreement with FONASA, and e-forms enabling patients to change health care providers (Fondo Nacional de Salud, 2015; MINSAL, 2013). As there are more than 200,000 people per month currently using these services in-person, moving them online may reduce time and red tape for patients and health care providers (Fondo Nacional de Salud, 2015).

4.7 Pharmaceutical and Medical Device Tracking and Management

Improvements in the area of resource management and pharmacy utilization under the SIDRA strategy are in development as well. The Western Metropolitan Healthcare Network is working to implement GS1 standards for its supply chain data so that it can better monitor stock and enable traceability of drugs and medical supplies (Cerón Reyes, 2010). In addition, Megasalud, the largest outpatient medical and dental network in Chile, covering areas from Arica to Punta Arenas, has been working since 2011 to implement a standardized and customized drug dosage model for more than 8,500 pharmacy products in EHRs (Megasalud, 2008). The objective of this model is to reduce time and typos when entering drug indications (dosage value, dosage unit, frequency, frequency unit, time span, and time span unit), and to allow for structured data that are more easily suited for empirical analysis (Asociación Chilena de Informática en Salud, 2011).

4.8 Other Efforts: Evidence-Based Medicine, Clinical Terminology Server, and Monitoring Efforts

Evidence-based decisionmaking processes concerning medicine and health technology coverage in Chile are growing fast. Efforts to formalize evaluation standards concerning health intervention effectiveness and safety through reports, technical notes, and evidence-based recommendations date back to the 1997 establishment of the Health Technology Assessment Unit (HTA or ETESA) in MINSAL. Chile recognizes a high demand for knowledge dissemination through networks of health professionals and organizations. This, combined with its goal of advancing evidence-based decisionmaking in health care, led Chile to start collaborating with EVIPNet-Chile in 2011 (Moat & Lavis, 2014). This portal, along with the Sectoral Intranet (Salunet), or the institutional web portal, assists with the timely retrieval and exchange of new, existing, or inaccessible literature and information (Espinoza, & Alcayaga, 2015; Capurro, 2007). These virtual libraries, combined with several online workshops and seminars, are helpful not only to policymakers but also to patients, key stakeholders, and medical professionals, especially those in remote areas who may lack access to continuing medical education and training, both in Chile and across Latin America (Keane, 2007; Moat & Lavis, 2014).

Another system is the Clinical Terminology Server, which will standardize, automate, and improve the accuracy and interoperability of clinical terminology and enable health care professionals to write in their native languages, with automatic coding into international classifications. Since 2009, Megasalud has been working in collaboration with the Hospital Italiano de Buenos Aires to test and improve the current methods of terminology services (MINSAL, 2013). Server implementation will provide a very detailed understanding of population diagnoses and will help in creating programs to monitor pathologies and deploy support systems for timely reporting of disease statistics to MINSAL (Asociación Chilena de Informática en Salud, 2011).

Interview respondents also mentioned two projects designed to monitor different aspects of the health system. One such project, called SYNCO, is designed to monitor the national health strategy by assisting in planning and management activities for the public health care network. Another system that is designed to integrate 20 different epidemiological monitoring systems into one unified approach is currently in the design and development phase.

4.9 Summary

A number of health IT–related projects have either already been implemented or are underway in Chile. A key supporter of these projects is MINSAL, which has created the Digital Health Strategy and implemented a roadmap for the adoption and integration of health IT systems in Chile. Additionally, private sector firms, universities, and other organizations are participating in

a variety of projects and activities designed to foster the development of health IT in a variety of provider and patient settings. The next chapter discusses challenges and opportunities associated with the implementation of health IT in Chile.

5. Health IT Implementation: Challenges and Opportunities

The environmental scan and interviews highlighted a variety of challenges and opportunities associated with the implementation of health IT in Chile. Challenges include lack of interoperability; lack of regular, timely, and reliable micro-level data collection; staff shortages; and resistance to technology adoption.

One key challenge is connectivity. The presence of an information and communication technology (ICT) infrastructure, including both access to hardware such as computers and other devices and Internet access to other systems as needed, is critical to being able to use health IT to improve health but it is missing in the more rural areas of Chile. This makes implementation of health IT challenging or impossible. As one respondent noted, 80% of ICT projects fail during the first ten years after implementation, and the same respondent confirmed that Chile's experience is in line with this statistic.

Given these challenges, opportunities are great for private businesses, academics, and others to become involved in the implementation of health IT projects.

5.1 Information and Communication Technology in Chile

Chile appears well positioned to adopt and implement new health IT projects. In 2013, Chile ranked 56th worldwide on the ICT Development Index, below Uruguay and Saudi Arabia and Kazakhstan but above Brazil, Colombia, Venezuela, and Panama. In the Americas, Chile ranks 7th, after only the United States, Canada, Barbados, Uruguay, St. Kitts and Nevis, and Costa Rica. While only 50% of households in Chile have Internet access today, "handset-based mobile-broadband services are affordable for almost the entire population" (International Telecommunication Union, 2014). This suggests that projects targeted to people with mobile devices may be able to reach a significant portion of the Chilean population.

Digital literacy, meaning the ability to use information and communication technologies to locate, evaluate, use, and create information, varies across regions and socioeconomic groups. While 78% of Chilean schools are connected to the Internet, very few teachers in Chile have been trained to teach basic computer skills (International Telecommunication Union, 2014). According to nationwide standardized computer-based test digital literacy measures (SIMCE TIC), 51% of students in Chile have intermediate-level IT skills, yet 47% of students' digital skill set is very low, particularly for those of lower socioeconomic groups (Enlaces del Ministerio de Educación de Chile et al., 2013).

One interview respondent estimated that 30% of primary care units, particularly in rural areas, have issues with connectivity. Ten percent of hospitals (about 100) have failed to update their basic electric infrastructure, meaning that they cannot implement health IT solutions. A

second individual used the term *red zones*, referring to areas for which phone companies do not provide services, either for lack of density or because of distance, and those locations have limited connectivity. However, another interviewee who founded a health startup said that in the 20 municipalities in which his company has contracts, there have been no connectivity issues.

Spatial variation in ICT connectivity also poses a challenge to scalability of projects at a national level, with required standards for health IT implementation being reached mostly in urban areas alone (e.g., Santiago, Viña-Valparaíso, and Concepción). One example of this is a project "Mas Salud Occidente," described in Section 4.6 above, which is limited to a subset of Santiago residents (Cerón Reyes, 2010).

5.2 Challenges to Health IT Adoption and Implementation

Key stakeholders participating in the interviews were clear that the first stage of SIDRA (2008–2011) faced a series of significant implementation challenges. According to five respondents, these challenges included insufficient tailoring of strategic plans to the local environment, significant staff turnover at high levels leading to lack of continuity in implementing the plans, misaligned incentives between the private and public sector, and a lack of contract and process monitoring between IT providers. In developing SIDRA, however, MINSAL did recognize that certain challenges would arise. These challenges can be broadly divided into the categories presented in Table 2.

Table 2. Challenges Identified with the Implementation of SIDRA

Issue	Description
Municipal autonomy	Municipalities, which control most primary health services, may choose whether or not to participate in SIDRA, which can limit the ability to achieve standardized implementation.
Lack of standardized clinical and administrative processes	Health care providers initially tried to build information systems that adapted to their own processes, making standardized systems difficult to implement. To address this issue, MINSAL launched a project to standardize clinical and administrative processes in the public health network.
Fragmented implementation in complex hospitals	Implementation of modules relating to different processes occurred at different times, generating problems for hospitals offering a complex set of services.
Shortage of experienced and competent professionals	A nationwide shortage of experienced and competent professionals and technicians has led to difficulties with implementation.
Lack of standards for a national clinical registry	Establishing standards has been difficult, and the emphasis has been on producing statistics, not in generating adequate informational support for clinical services.
Low quality of recorded information	Information that is captured as part of SIDRA can be of low quality, which is partly a reflection of the above issues.

SOURCE: MINSAL, 2013, pp. 113–119.

Below, we describe and discuss some of the challenges identified as part of the environmental scan and interviews in greater detail.

5.2.1 Lack of Coordination Across Key Stakeholders

A key theme that arose during the interviews was the lack of coordination across key stakeholders when it came to developing and implementing plans for health IT. This lack of coordination is evident in the fact that MINSAL appears to have funded or supported most of the health IT projects summarized in Chapter Four, but projects funded by CORFO and other government agencies are difficult to identify. Another aspect of the lack of coordination can be seen in some of the challenges described below. For example, lack of system interoperability is partly the result of the inability of the public and private sectors of the health care system to coordinate with each other in adopting and implementing new projects. As part of the design of the roadmap, CORFO may be able to take a lead role in encouraging the different stakeholders to coordinate in moving health IT projects forward to successful implementation.

5.2.2 System Interoperability

Despite a significant number of projects related to health IT, lack of interoperability remains one of the major challenges in implementing successful health IT systems. Interoperability has multiple layers: It can refer to the software and communications (data formats and clinical terminology) used within health IT systems, but also to the different units providing health care (primary, secondary, or the emergency room), and, at its broadest level, to the ability of the

public and private health care sectors to communicate and coordinate with each other. Some interview respondents noted that waiting list and referral systems have largely been unsuccessful to date, largely because of the coexistence of many non-integrated systems that collect information following varied standards and procedures. As a result, the lists are not updated regularly and are not used by medical or management staff, because of their low quality in data collection and/or system functionality. Related to this, many respondents expressed a serious concern about the lack of coordination across health units, their medical staff, management, and other agents between the public and private sector.

One of the reasons for these interoperability issues lies in the differences in standards, norms, and IT infrastructure developments. These issues are, in turn, exacerbated by the unsystematic start of SIDRA due to decentralized municipal autonomy over primary health care units. For instance, while some areas opted out of participating in SIDRA's EHR initiative (e.g., most rural health units, such as Servicio de Atención Primaria de Urgencia [SAPU] and Centros Comunitario de Salud Mental Familiar [COSAM], which still base their work on paper patient records), others initiated individual, localized health IT projects. While these localized health IT projects were sometimes successful within the unit, they were also mainly adapted to their own standards, semantics, IT processes, and infrastructure development (Frenz et al., 2014).

Respondents generally noted that many successful health IT projects in Chile are only localized in nature and have not been scaled to a regional or national level. Similarly, according to one respondent, the only standardized element across patient records so far seems to be the international classification of diseases, ICE-9/10. Additionally, as noted by most interview respondents, lack of institutional and legal privacy standards and software certificates prevents timely sharing of patient information through secure and confidential means.

5.2.3 Slow Technology Adoption

One reason for slow technology adoption in Chile is the broad ICT connectivity issue described above. In addition, as mentioned above, there is significant variation in digital literacy. This plays an especially important role in the area of telemedicine, as digital literacy is particularly low in remote areas that might benefit from telemedicine the most. In addition, both physicians and patients may be averse to increased computer use by physicians out of concern, real or imagined, that it will decrease face-to-face contact. Physicians are also hesitant to engage in remote diagnostics because of lack of legal protection and well-established rules for handling medical errors. Additionally, there are currently no economic incentives in place to provide remote services. Lastly, the government and private ISAPREs have yet to define how e-health medical claims and services are integrated with or covered under insurance.

5.2.4 Health IT Workforce Shortages

There is a substantial lack of qualified staff, including health IT specialists, medical informatics experts, health economists, and evaluation professionals that can help develop, implement, and

evaluate new health IT projects with a deep understanding of the health care system and the end user in mind. A few interview respondents noted that IT entrepreneurs often take a backward approach to invention by starting with a profitable technology instead of first considering the goals of the end user, whether patient, provider, or management staff. In addition, a lack of highly trained IT specialists with a deep understanding of the health system can result in poor purchasing decisions of either software, hardware, or IT services on the one hand, and a lack of innovation in general on the other.

To fill this shortage in the supply of specialized health IT services, some interview respondents suggested hiring health IT professionals from abroad and partnering with big enterprises (for instance, Accenture, following the examples of Canada, Singapore, and Australia). However, respondents also noted that caution is needed when working with international companies due to difficulty in assessing the quality of the products purchased. In the future, health IT courses could be provided at graduate and undergraduate levels across health disciplines, such as courses for physicians in training on how to adopt health IT.

5.2.5 Workflow Disruptions During Health IT Implementation

Another important challenge is associated with workflow disruptions during health IT implementation. When first implemented, new technology infrastructures can impose substantial disruptions in usual clinical and administrative workflows. In addition to common early implementation issues that might increase over time, such as user complaints and increased need for IT support, (Capurro, Soto, Vivent, Lopetegui, & Herskovic, 2011), aversion to new technology by both patients and medical staff seems to be an important deterrent in its adoption, according to about half of respondents.

Resistance by medical staff and their aversion to technology can impede its adoption in several ways. First, for the physician, entering data into an EHR often takes longer than keeping a patient's records on paper—not because of the data entry alone, but also because of the EHR's structured format, which often prevents medical staff from skipping steps in providing clinical information. Second, adopting EHRs is even more burdensome due to the lack of standardization across EHRs, leading to duplication of data entry. Third, according to three interviewees, information systems allow for stronger monitoring and accountability for medical staff, giving more control to patients, either through access to their EHR or through the ability to self-manage through tools of e-health or telemedicine.

Thus, the costs associated with adoption of EHRs are not just the upfront financial costs of purchase and installation but also the significant decrease in productivity at first due to system change and a potential long-term increase in time spent documenting, which is often associated with better data and care quality and increased patient safety but which is still seen as a cost to the provider. These costs of digital record adoption are not transparent and thus often come as a surprise to new adopters. Therefore, every time a new IT system is implemented, what is called "change-management" training must be considered alongside technical training, and the benefits

of the new systems should be promoted alongside a realistic estimation of the time and financial costs.

5.2.6 Other Challenges

There are other important challenges slowing down innovation processes, leading to unnecessary duplication of developments (or errors) and inflating IT implementation and utilization costs. According to most interview respondents, one important problem driving these challenges is that outsourced IT providers get exclusive access to data, software development, and maintenance. As noted by one respondent, many contracts for EHR implementation by SIDRA permit outsourced IT companies' sole ownership of the data and access to software for maintenance. Another interviewee confirmed this challenge, saying that most successful projects are those that manage their systems "in-house." A recent example of this is the FONASA systems, which are managed by FONASA personnel, who also undergo intensive trainings either at home or abroad. FONASA controls its systems and requires, for example, updated electronic data delivery on patients' dialysis from the laboratories within FONASA's own payment systems. This not only results in laboratories getting a faster payment but also provides FONASA with updated information about some critical conditions of the population that needs dialysis, as well as the ability to generate statistics and health indicators of interest. However, there are still limitations within this particular system, which is focused on payment and not other measures of health outcomes, which could be addressed going forward.

Patient privacy and data security pose another challenge to any effort to digitize data. Chile may have to implement a number of preventive policies and tools as it plans health IT development and infrastructure, some of which have been described by policymakers in the United States (U.S. Department of Health and Human Services, Office of the National Coordinator for Health Information Technology, 2015). While standards and norms are important for the purposes of interoperability, certification provides the additional benefit that health IT products are tested and shown to be compliant. This ensures that the patient, the physician, or management can safely verify products' quality before purchasing them. So far, however, there are no established certification or accreditation public agencies in Chile. Many interview respondents suggested establishing an organization or agency of this type.

5.3 Opportunities for Health Care System Growth

Interview respondents uniformly agreed that the Chilean health care system has great potential for growth over the next ten years, and most saw the role of health IT as being fundamental to this growth. Two respondents indicated that the adoption of health IT, especially if it is interoperable across different settings of care (clinics, hospitals, emergency departments, etc.) and across both the public and private sectors, could not only help prevent issues that might impede growth but could also improve quality and efficiency of the system. Health IT, noted

another respondent, is a necessary tool to enable coordination and integration of health care system finances, but can also help focus the system on specific areas of need.

Over the short term, respondents expressed that it will be important to focus efforts on interoperability, especially establishing standards for health IT projects via the center CORFO is developing, focusing on developing a system that is user-friendly, and ensuring that health IT can be used to capture data in order to enable calculation of health statistics. Respondents also noted that helping to manage the process for implementing health IT (or "change management") could help ensure that new products are used in the long term as opposed to being implemented and then languishing. Finally, one respondent suggested an increased focus on telemedicine, as this type of health IT can help shift the treatment paradigm from treatment to prevention, especially in areas covered by AUGE that suffer from longer wait times due to a lack of specialists. This may also help address the problem of unequal access to care for those who are more likely to suffer from chronic conditions.

In the medium to long term (four to ten years), respondents indicated that changes might occur related to the public versus private sector split in services. A few respondents believe that the public sector will provide all health insurance for all Chileans, with some additional room for added private coverage for those who can afford to purchase it. Other respondents indicated that the public-private split system as it currently stands is not sustainable. Going forward, one respondent suggested that it would be very important to ensure that the public and private sectors are connected via interoperable health IT tools, and to use the information generated by these tools to monitor the system, especially in terms of quality. Two other respondents indicated that it will be important to lower the entry barriers for smaller IT companies to participate in the system and offer products, and to protect innovation for smaller projects. Another respondent believes a centralized certification agency, whose role would be to certify the value of new health IT projects, would be an important aspect of the health IT sector in the long term. This agency could help resolve the challenge of untested products being sold.

5.4 Entrepreneurship and Business Opportunities and Barriers in Health Information Technology

Businesses are key players in health care technology in Chile, according to three of the stakeholders we interviewed. However, many interviewees also had concerns about the role businesses are currently playing in the health IT environment.

Concerns focused on business support and longevity. One respondent noted that businesses may not be committed to the health care market, instead seeing it as a place they can easily enter and exit, rather than committing for the long-run and developing expertise, as he sees happen in developed countries. Another expressed concern that current health-related businesses are at present mostly linked to academia and are thus not self-sustaining. Another said that, given trends, he does not predict the entrance of new competitors into the existing market, which will

remain dominated by the current few, who are not very innovative. Calling them "entrenched economic interests," he talked about how both software providers (the businesses) and the health care providers have little motivation to share information and thus may resist interoperability: "Those two are the stakeholders who have the most to lose." These large businesses, "the incumbents," as another called them, already have a lot of information, potentially making it harder for new businesses to enter the market.

One person mentioned that there is not enough work being done on business intelligence or big data, but he thinks that is where Chile is headed; such research could be used to identify correlations and allow for more personalized health care. Another noted that there is a new CORFO project focused on business intelligence software.

Interviewees saw a number of barriers to participation of businesses in the health care marketplace. One said that some clients expect technology to solve their problems, but that technology cannot solve clinical or organizational problems. He later noted that national businesses offer lower prices and therefore often win bids, though in the end the final costs are often higher than the bid. Another suggested that a key bottleneck is that the budget office has trouble creating contracts or bids for new products.

One interviewee expressed the opposite concern: that businesses are given too much control. For example, in the implementation of EHRs, the interviewee reported that SIDRA gave too much power to businesses, leaving clients (purchasers) with little control or ability to make demands, resulting in solutions without interoperability, data quality, or easy database maintenance. This issue could be addressed via improved coordination among stakeholders seeking to purchase new health IT systems.

These concerns may explain the pattern that exists in Chile of small pilots getting started but little structural work in the e-health domain. For businesses to flourish in health care, the investment needs to be proven to be sustainable and worthwhile. CORFO could facilitate this using a number of tools suggested by stakeholders, including support for early innovation, standards for interoperability to ease data staring and integration, and certification for uniform demonstration of quality and value.

5.5 Potential Measures of Success

We also asked interview respondents about possible measures of success of a roadmap designed to foster further investment in and implementation of health IT projects over the next ten years. Some possible measures of success suggested by both respondents and based on our environmental scan include:

- percentage of clinics or providers with EHRs
- percentage of clinics using telemedicine and health monitoring systems
- percentage of services provided by telemedicine
- percentage of providers able to exchange information via the EHR system

- number of startups and new companies related to health IT in Chile
- management indicators
  - reduction in use of paper records
  - reduction of service/waiting times
  - reduction of payment times
- measure(s) that capture how easy/difficult it is to transfer patient information between sites of service
  - level of development related to data mining or data intelligence
  - level of interoperability
- measures describing the effect of health IT on outcomes
  - quality-of-life measurements
  - length of time to see a provider
  - mortality indicators
- whether standards meet international benchmarks.

5.6 Summary

Our findings indicate that there are a number of challenges associated with the implementation of further health IT products over the next ten years. The key challenges are interoperability, lack of incentives for end users to adopt and implement the technology, and workforce shortage issues (in health IT). Respondents noted a number of opportunities for CORFO to assist with the further development and implementation of health IT, including the creation of standards for interoperability and support in increasing the workforce dedicated to health IT.

6. Implications

The results of the environmental scan and key informant interviews indicate that there are a number of efforts underway to implement health IT projects, especially those focused on health care management and EHR systems. However, key stakeholders generally indicate that projects have been mostly successful on a local, as opposed to national, level. As a result, health IT in Chile is generally lacking in interoperability, which respondents stated was a very important aspect of a successful health IT system. In addition, most health IT projects to date appear to originate within MINSAL, as opposed to CORFO, within the Ministry of Economy, which suggests an opportunity for CORFO to expand its presence in the health IT sector in a variety of ways.

6.1 Implications and Opportunities for CORFO

Respondents identified a number of potential important contributions that CORFO could make in the health IT landscape, especially in the areas of (1) coordination; (2) development of standards and norms; (3) incubating, supporting, and certifying health IT solutions; (4) fostering human capital development in health IT; (5) investment in cross-country IT infrastructure; and (6) support for entrepreneurs, among other potential efforts that we will address in more detail in our final report.

A major weakness of the Chilean system, identified both in the literature and in many interviews, is the lack of coordination across the diverse actors involved in organizing, funding, providing, and using health care in the country. Better coordination is critical for development of a robust, interoperable system that will be usable nationwide. CORFO could play a central role in this coordination effort, in a number of ways. For example, CORFO is already working to create a center designed to create standards and norms for health IT systems. These standards can help different parts of the health care system move toward a single, coordinated system that uses the same standards. A number of respondents noted CORFO's efforts in this area and applauded them.

Most of the respondents (seven out of ten) identified CORFO as a key player in incubating and supporting the scale-up of health IT projects and solutions. According to their views, CORFO could do so by sponsoring or facilitating access to financial support to health IT entrepreneurs and innovators in coordination with agencies and organizations such as MINSAL, CONICYT, Hacienda (Ministry of Treasury), Inter-American Development Bank, and the World Bank, where funding and promoting should focus especially on proven health IT solutions for widespread adoption and scale up. Additionally, CORFO could incentivize health IT innovation by lowering market entry barriers for small and medium-sized enterprises. Some examples of

ways to lower barriers to entry provided by respondents included providing new market entrants with access to seed capital to get started and facilitating the adoption of new technologies by helping to guarantee some of the potential losses that might be associated with implementation.

Certification or some other oversight method was recommended as a way to ensure that products are of high value and to increase motivation in investment. A reliable body with such expertise is needed for creating and maintaining oversight over health IT products. Therefore, some respondents suggested that CORFO establish a certification agency, so that public and private health providers could verify certification before purchasing the (often untested) health IT solutions. However, as one respondent noted, there is a risk of such an agency being dominated by private interests, and thus safeguards must be put in place to ensure that the certification remains independent.

A common theme among respondents was that CORFO could help to demonstrate the value of health IT products to the key adopters of new technologies: physicians and hospital administrators. Health care providers were frequently described as averse to change and lacking incentives to do so. CORFO could accredit some innovations or provide some type of guarantees in order to share the risks of adoption. CORFO could also encourage the government to tie health care budget levels to requirements to meet certain levels or benchmarks of technological adoption, similar to requirements in the United States associated with adoption and utilization of health IT ("meaningful use") (HealthIT.gov, 2015a). Furthermore, if rigorous evidence on effectiveness of local health IT were available, adoption rates could increase among potential users. Consequently, this increased demand could lead to scaling up projects that have been proven to work beyond the local level, which could potentially attract more funding from either the private or public sector. CORFO could possibly take up the role as a funding agency for rigorous evaluations, either of existing health IT initiatives or proposed randomized controlled trials.

To address the existing gap between health experts and general IT innovators, CORFO should work on establishing mechanisms for bridging it. One way to do so is by fostering human capital development in health IT: To address the current scarcity of highly qualified personnel, CORFO could support a project similar to Nueva Ingeniería 2030, which is working to improve engineering schools in Chile to the world's standard. In addition, medical schools could incorporate health informatics training for their students.

Government support can also improve connectivity in rural regions that are lagging behind. In areas without connectivity, it is impossible to implement most e-health applications. Respondents suggested that the Transport and Telecommunications Ministry, with the support of CORFO and MINSAL, could help with this particular objective. Without Internet connectivity, health IT tools lose much, if not all, of their functionality. Support of and investment in a robust communication and electric infrastructure is needed for any progress in health IT.

Lastly, some key stakeholders expressed concern about the limited role business has played thus far in health IT innovation, attributing this to the difficulty in entering and staying in the

health care market. Startup support and motivation, whether directly financial or through training or contests, could be another role for CORFO.

6.2 Other Considerations

Health IT can have great impact beyond health. Evidence is growing that health IT shows positive results, not just for patient quality and safety and savings (Buntin, Burke, Hoaglin, & Blumenthal, 2011; Jones, Rudin, Perry, & Shekelle, 2014), but also potentially on patient satisfaction (Rozenblum et al., 2013). However, these investments have even broader impact. Infrastructure investments add value that could affect areas such as education. A population that is engaged in telemedicine might miss less work for doctor's appointments. In addition, a healthier workforce makes for a stronger economy and country. Health IT expansion is a continuous process, and it can have many positive externalities for the country as a whole.

Privacy and security, though not addressed by many of our interviewees, will be important considerations as Chile expands its health IT presence. Best practices include efforts to (U.S. Department of Health and Human Services, Office of the National Coordinator for Health Information Technology, 2015b)

- maintain accurate information in electronic records
- allow patients to gain electronic access to their medical record and ensure they know how to do so
- handle health information carefully to protect privacy
- ensure health information is accessible to authorized representatives when needed.

The unique identifier that Chile already uses, the RUT, could be a strength in enabling data exchange across the country. If the RUT is used to identify personal health information (PHI), measures will need to be put into place to protect such information. At the same time, this identification will greatly ease transfer of critical information across the health network, from hospital to pharmacy to clinic, without concern for misidentification.

6.3 Summary

There are a number of implications associated with our findings to date. First and foremost, most key informants agreed that CORFO can play an important role in helping to foster the development of health IT in Chile over the coming years. CORFO's involvement could come as an incubator and central coordinator of health IT efforts, especially those associated with standardization and certification and those that seek to help reduce the entry barriers for smaller businesses and projects. Since evidence is growing that health IT can have important impacts on health and well-being, Chile's ability to make use of a unique patient identifier can be a significant strength in enabling data exchange and helping patients and the government achieve the benefits of health IT.

7. Conclusions

Our findings suggest that there are great challenges and great opportunities in Chile's path toward increased health IT, particularly related to coordination, connectivity, and funding. We have suggested in previous chapters some ways that CORFO can contribute its resources to address the biggest challenges Chile faces. Below, we identify some of the limitations that should be kept in mind as our findings are considered. We close with some preliminary recommendations suggested by our efforts thus far.

7.1 Limitations

The primary limitation of this report is the fact that we were able to conduct only ten interviews, due to budget and time constraints. As a result, the key themes and ideas highlighted in this report may not be representative of the views of the full range of stakeholders regarding the Chilean health system as a whole, and in particular of the current status of health IT. However, we were able to interview a number of key informants in high levels of government, as well as entrepreneurs with significant experience in the Chilean health IT market, which enables us to draw some conclusions about the current state and potential future of health IT in Chile. It is important to note, though, that the small sample size allows us to address only some of the issues, challenges, and opportunities at play in the health IT market in Chile. The next phase of this work, which is to develop the roadmap for development, will bring together additional stakeholders as part of an effort to achieve consensus on the path forward. This approach may help mitigate the limitations inherent in a small sample of interviews.

7.2 Recommendations

While this is an interim report, which summarizes findings from our efforts thus far to gather information, we do want to highlight four key recommendations that arose from the interviews. These recommendations pertain to CORFO's role in promoting health IT in Chile, and are as follows:

1. **Serve as coordinator of future efforts to adopt and implement health IT.** This coordination role could take the form of establishing centers for the creation of standards, as well as encouraging certification of new products.
2. **Help to incubate and scale-up new health IT projects.** CORFO can use its funding and its role as overall health IT sector coordinator to further encourage the development of new health IT solutions, as well as to assist with scaling up currently existing solutions that have a proven track record.
3. **Support training in health IT at local universities.** This could be conducted in conjunction with the Ministry of Education, with a goal of creating new generations of health IT professionals capable of addressing the newest challenges in health IT.

4. **Conduct evaluations of the success and value of health IT.** CORFO could use the data captured as part of the measures of success that will be developed as part of this roadmap to conduct evaluations of the effects of health IT projects on patients, providers, and payers. The results may help encourage additional innovation and adoption of health IT solutions.

7.3 Next Steps

Data gathered for this report suggest many areas where Chile has critical needs that can be addressed by health IT expansion. CORFO could play a central role in improving the system. In the next phase of this project, we will use the findings from the environmental scan and key informant interviews to design a draft roadmap of changes that can help foster the development of health IT in Chile over the short, medium, and long term.

Abbreviations

APS	Atención Primaria de Salud
AUGE	Acceso Universal con Garantías Explícitas
CASEN	Encuesta de Caracterización Socioeconómica Nacional
CONICYT	Comisión Nacional de Investigación Científica y Tecnológica
CORFO	Corporación de Fomento de la Producción
FONASA	Fondo Nacional de Salud
GES	Garantías Explícitas en Salud
EHR	electronic health record
ICT	information and communication technology
ISAPRE	Instituciones de Salud Previsional
IT	information technology
MINSAL	Ministerio de Salud
OECD	Organisation for Economic Co-operation and Development
PAHO	Pan American Health Organization
RUT	Rol Único Tributario
SIDRA	Sistemas de Información de la Red Asistencial
SIGGES	Sistema de Gestión de las Garantías Explícitas de Salud
SNSS	Sistema Nacional de Servicios de Salud

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