MEASUREMENT OF DIGITAL HEALTH

Methodological recommendations and case studies

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Methodological recommendations and case studies

→ *Ana Laura Martínez,*
David Novillo Ortiz
& Fabio Senne (coordinators)

Brazilian Internet Steering Committee (CGI.br)
SÃO PAULO, 2018

Pan American Health Organization

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INTRODUCTION

→ *Alexandre Barbosa and David Novillo Ortiz*

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Nowadays, practically every production sector in society has appropriated new information and communication technologies (ICT). The health sector has followed the same trend as other sectors and has been intensifying its investment in such technologies in health facilities. The potential results of this adoption will be reflected in progress in the quality of health services and greater accuracy in the diagnosis and treatment of diseases. In recent years, ICT has become a critical component of improving medical care and the efficiency of the health system, as well as an important tool for helping healthcare professionals to provide better services and avoid medical mistakes. The World Health Organization (WHO) and its regional office in the Americas, the Pan American Health Organization (PAHO), have published recommendations and strategic guidelines for the adoption of ICT in the health sector.

WHO refers to the use of ICT for health as eHealth (OMS, n/d)[1] and recognizes its potential to strengthen health systems and improve healthcare quality, safety and access. eHealth also plays a crucial role in making universal health coverage possible and improving capacity building programs for healthcare professionals. More recently, WHO also recognized the role of mobile devices in the health sector and has adopted the term mHealth to describe the use of mobile wireless technologies for public health. This is strongly aligned with the growing importance of this resource in people's daily lives and, especially, with its importance in the provision of health services and increased access to information about health.

The implementation of digital health solutions has spread globally in recent years in an effort to continue enhancing the efficacy of health systems and services, and thereby improve provision of services and the quality of life of the population. A WHO survey conducted in 2015, to which 125 countries responded, showed that around 60% of these countries had a national digital health or eHealth strategy. Despite this progress, it is still difficult to know the exact budget that countries allocate to investments in ICT in the health sector. However, there is a perception that the amount invested has increased in recent years and will continue to grow. The aforementioned WHO survey specifically showed that in most high or medium to high income countries, public funding sources predominated, whereas in low or medium to low income countries, funding by donors predominated.[2]

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1 References will be made in this document to the terms eHealth, digital health and use of ICT in the health sector. In order to standardize the terminology surrounding this concept and in accordance with current trends – where use of the term "digital health" predominates – all these terms shall be considered synonyms. World Health Organization (WHO) (n.d.). eHealth at WHO. Retrieved on 1 March 2018, from https://www.who.int/ehealth/about/en/

2 World Health Organization (WHO) (2016). Global diffusion of eHealth: Making universal health coverage achievable. Report of the third global survey on eHealth. Geneva: WHO. Retrieved on 1 March 2018, from https://www.who.int/goe/publications/global_diffusion/en/

The progress described earlier – related to the development of public policies and increased investment in the use of ICT in the health sector – is summed up by the recent commitment by countries during the 71st World Health Assembly, held in May 2018. During this meeting, a resolution on digital health was approved that urged member states to "assess their use of digital technologies for health" and "identify priority areas where normative guidance and technical assistance and advice on digital health would be beneficial," among other measures.

Once some of the possible funding sources are known, and progress in public policies and the recent commitments undertaken by the member states that are part of WHO are verified, the future use of ICT in the health sector will enable progress to be gauged, through valid and reliable measurements. With this goal in mind, the Brazilian Network Information Center (NIC.br) – through its Regional Center for Studies on the Development of the Information Society (Cetic.br) – and the Pan American Health Organization (PAHO) joined forces to make this publication available. It is made up of six chapters and provides an international perspective, case studies, and a vision of the future with respect to the measurement of digital health, which will help guide countries in tracking their progress in this area.

Due to the advance of digital agendas by governments, including the health sector, it is becoming increasingly necessary to systematically and regularly produce statistics and indicators on the adoption of ICT in the sector. In this regard, this publication is also a response to the growing need for reliable data and indicators to help governments develop and monitor ICT policies and strategies, compare their progress with other countries, and adopt solutions for meaningful and egalitarian use of these technologies in the health sector. Therefore, measuring universalization of access to ICT in health facilities and their use and appropriation by healthcare professionals is essential for formulating evidence-based public policies. Countries need to be able to rely on a common conceptual and methodological framework and to count on comparable indicators.

The first chapter, entitled "An overview of international approaches to the measurement of digital health," summarizes recent initiatives and approaches to improve measuring the adoption and use of ICT in health systems. These include an initiative led by the Organisation for Economic Co-operation and Development (OECD) carried out in 2013-2014, and another coordinated by the Working Group on Measurement of Information and Communication Technologies, of the Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC). Other initiatives include efforts by the Health Information and Management Systems Society (HIMSS) and the United Kingdom National Health Service (NHS). In addition, evidence and a selection of relevant data are presented to provide an overview of the state of the art in the measurement of ICT in health, aligned with the main trends and thinking at the international level.

The second chapter, which focuses on the design and implementation of ICT in health surveys, outlines in detail the necessary stages for carrying out a survey on ICT access and use in the health sector: planning (identification of available conceptual and methodological frameworks, definition of indicators, analysis plan, design of the questionnaire, and decisions regarding the sample and data collection); fieldwork, data processing (consistency control, weighting of the database and tabulation of indicators), data analysis and preparation of reports; and, finally, publication of reports and dissemination activities. This chapter describes each stage, reports decisions made, and highlights best practices based on the first national measurement of ICT and health in Latin America, carried out by Cetic.br/NIC.br.

The third chapter contains the document Methodological recommendations for the measurement of access to and use of information and communications technologies (ICT) in the health sector, prepared by SCA-ECLAC. This regional reference document presents a proposal for measuring ICT and health, with health facilities as the unit of analysis, accompanied by a questionnaire (see Appendix). This framework of recommendations was prepared in collaboration with countries in the region, based on a core document prepared by the OECD (2015), which was adapted to the Latin American reality. Up to the present, this document is the definitive benchmark for countries that want to organize measurement of ICT access and use in the health sector and obtain consistent, comparable, up-to-date and representative statistics at the national level.

Chapters Four and Five describe the cases of Brazil and Uruguay in terms of the measurement strategy carried out in each country and its relationship with ICT in health policies, including a selection of data of interest. Each country has been measuring ICT access and use in the health sector for a number of years, to inform policymaking decisions. In the case of Brazil, this survey, conducted since 2013, has provided an in-depth understanding of the opportunities and challenges in this sector. This regular production of data has guided the development of evidence-based public policies. In the case of Uruguay, this measurement was carried out in 2014 and 2016 and enabled the country to identify the significant progress that has been made, as well as the challenges that still exist in terms of training, integration of electronic medical records, interoperability of the system, and use of digital tools for making clinical decisions.

Finally, Chapter Six, entitled "Digital health measurement: progress and challenges in the Latin American and Caribbean Region," addresses the need for a integrated model that facilitates assessing results and impacts in the region's countries, and supplements and transcends access and use statistics. A model is proposed in this chapter that includes a proposal of the variables and indicators to be included for capturing effects (linked to investments in ICT and capacity development), results (improvements in efficiency, quality and access) and impact (focused on the challenges of the health system in each country).

It is undeniable that information and communication technologies play an increasing role as facilitators of health system reforms, to improve access to health services, care quality, and the productivity of the health system. The adoption and application of ICT in the health environment opens the door to new ways of providing care.

However, ICT and new care models based on new digital technologies represent a major change in traditional practices in the health sector which, in turn, gives rise to challenges. Although the potential benefits of more widespread use of these technologies has been apparent for years, many countries, especially those in the Southern Hemisphere, still face sizable challenges related to their application and adoption.

Not only do countries still need to universalize and improve the quality of ICT infrastructure in healthcare facilities, but they also need to develop the necessary digital competencies and skills for its use by healthcare professionals and managers. Electronic medical records, mobile technology in health (mHealth), wearable devices, telehealth services, teleconsultation, telemedicine, the management of enormous hospital databases (Big Data) and data analytics are only a few examples of ICT use in health that require new digital competencies and skills. Therefore, the demand for ICT in health training will continue to grow in countries that incorporate digital tools that are integrated with health management policies. In short, it is essential to train professionals in the sector, so that they can use the technological resources at their disposal in a productive and sophisticated way.

The main goal of all the effort invested in producing this publication is to disseminate methodologies and cases to facilitate the production of ICT data and statistics in the health sector. Therefore, it is our hope that public managers, academic researchers, companies in the private sector and civil society will be able to make good use of this publication, so that we can move forward with measurement initiatives that have a positive impact on the progress of public policies for ICT in the health sector, enhance the quality of health services and care, and enable more efficient management of the health systems in our countries.

Enjoy your reading!

AN OVERVIEW OF INTERNATIONAL APPROACHES TO THE MEASUREMENT OF DIGITAL HEALTH[1]

→ *Elettra Ronchi*[2] *and Heimar F. Marin*[3]

INTRODUCTION

Digital health is "the use of digital, mobile and wireless technologies to support the achievement of health objectives. Digital health describes the general use of information and communication technologies (ICT) for health and is inclusive of both mHealth and eHealth"[4] (WHO, 2016). Kostkova (2015) defines digital health as the "use of Internet and communication technologies to improve human health, healthcare services, and wellness for individuals and across populations."

These definitions reflect the broad scope of digital health, including mobile health (mHealth), health information technology (health IT), wearable devices, telehealth and telemedicine, and personalized medicine. Today, the sophistication of ICT and the range of possible uses in the health sector are enormous. The major drivers for deploying digital health continue to be to reduce inefficiencies, improve access to care, reduce medical errors, increase quality of care, and enable more personalized care for patients. There is growing evidence that ICT is also essential to improving access to health services, particularly in rural and remote areas where healthcare resources and expertise are often scarce or even non-existent to support the development of new, innovative models of care delivery (OECD, 2016).

There is also growing evidence that individuals use digital health to better track their health status and wellness-related activities and manage diseases and treatments. By giving patients greater access to their health information and enabling better transmission of information across the healthcare continuum, technologies such as smartphones, online social networking websites and internet applications have provided innovative ways to monitor health and well-being. Together, these advancements are leading to a convergence of people, information, technology and connectivity to improve health care and health outcomes (US FDA).

The use of mobile phones has primarily been monitored by the International Telecommunication Union (ITU). At the end of 2016, the ITU reported that there were almost as many mobile subscriptions as people on Earth, and 95% of the global population (or some seven billion people) lived in areas covered by mobile networks. Also, by the end of 2016, close to half of the world's population was accessing the Internet, thanks to the expansion of mobile networks (ITU, 2016).

1 Disclaimer: The views expressed in this paper are those of the authors and do not necessarily reflect those of the OECD or of the governments of its member countries.

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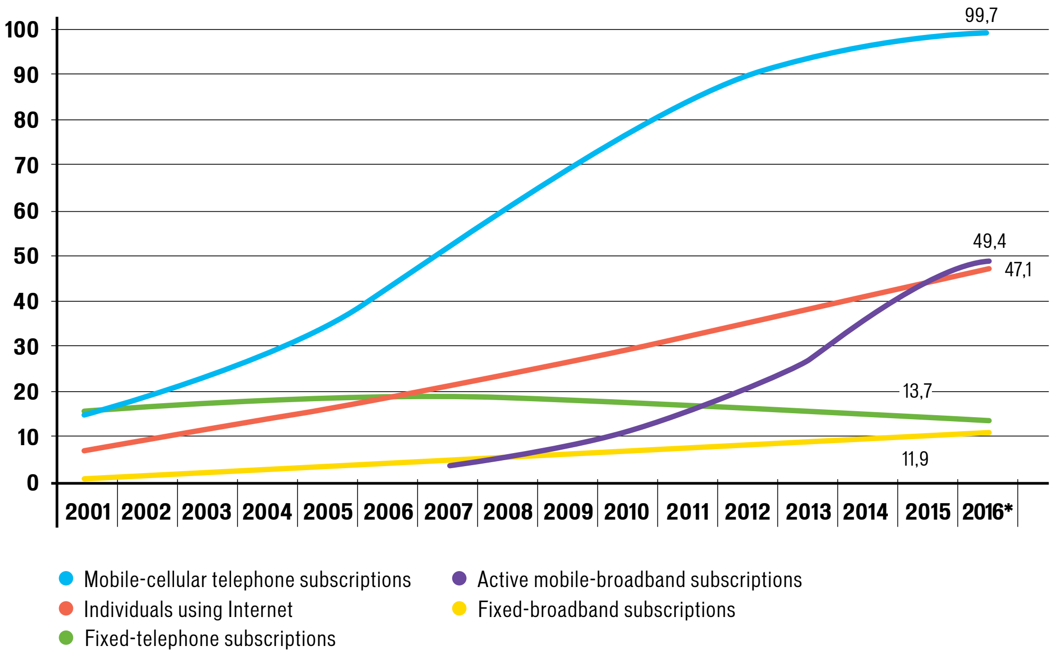
3 Full Professor (retired) in Health Management and Informatics at the Federal University of São Paulo (UNIFESP).

4 The term eHealth can be defined as "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research" (WHO, 2005).

FIGURE 1.

GLOBAL ICT DEVELOPMENT, 2001-2016

→ *Per 100 habitants*



NOTE: * ESTIMATE; SOURCE: ITU WORLD TELECOMMUNICATION/ICT INDICATORS DATABASE 2016.

As ICT availability rises, mobile phones provide growing opportunities to expand services, reaching larger numbers of patients. Mobile phone applications are being used today to monitor, evaluate and track patients' status, and integrate that information into clinical support systems and patient medical records to generate patient-specific recommendations. Despite these significant achievements, and the many examples of successful implementation of health information systems that have resulted in better patient outcomes and cost reductions (Sines & Griffin, 2017; Ammenwerth, Gräber, Hermann, Burke, & Konig., 2003), leveraging ICT to improve care is a complex undertaking that is compounded, in turn, by the increased complexity of healthcare systems due to scientific and technological advances. It has become necessary to incorporate models and methods for identifying best practices in the area of digital health. Governments and organisations need guidance to achieve widespread penetration of ICT and learn from successes and failures to inform policy development, in order to realize potential benefits. This requires a shared understanding of definitions and evaluation methods to allow validation of results and replication of good practices (Quintana & Safran, 2016)

HEALTHCARE IS EVOLVING WITH THE USE OF ELECTRONIC HEALTH RECORDS AND MOBILE HEALTH APPLICATIONS

Health sectors across countries are undergoing a profound transformation as they capitalise on the opportunities provided by ICT. In particular, electronic health records (EHRs) provide the foundation for more complex functionalities that promise greater care coordination and improved clinical management.

There is a large body of literature on the experiences of specific organisations and providers in implementing EHRs and other related applications, such as e-prescribing and computerized physician order entry systems (Chaudry et al., 2006; Goldzweig, Towfigh, Maglione, & Shekellen, 2009; Garg et al., 2005). There is currently robust evidence to demonstrate that the introduction of EHRs can contribute in particular to the reduction of medication errors and better coordination of care. The effective use of EHRs can also facilitate clinical research, effective public health planning, and evaluation of healthcare interventions and their quality at the practice level.

At the same time, risks can be introduced if EHRs are not implemented and used appropriately. The current literature also shows that, in hospital settings, full value for money is achieved when EHRs are high-level, integrated systems (according to the stages of the HIMSS Electronic Medical Record Adoption Model), and that satisfactory return on investment occurs only after 5-10 years (Amarasingham, Plantinga, Diener-West, Gaskin, & Powe, 2009). Successful deployment of EHRs requires strong long-term political commitment and leadership at the highest levels of government. Regardless of the maturity level of a country's digital health, the World Health Organization (WHO) guidelines for an effective strategy of EHR implementation can be a useful roadmap. It consists of six key actions: (1) review the current health record system; (2) emulate benchmark practices; (3) involve the anticipated users of the system; (4) train the users; (5) evaluate the benefits; and (6) update the system when needed (WHO, 2006).

A 2016 OECD survey of 30 OECD countries revealed that most countries are investing in the development of EHRs (OECD, 2017). Twenty-three countries reported that they were implementing national-level EHR systems. The implementation process at the national level is, however, a notoriously complex and expensive undertaking. Only a few countries have so far been able to achieve high-level integration and capitalise on the possibility of data extraction from EHRs for research, statistics and other secondary uses. Healthcare systems still tend to capture data in silos and analyse them separately. Standards and interoperability are key challenges that must be addressed to realise the full potential of EHRs.

In 2015, only five OECD countries reported some key aspects of record-sharing, and this was only at the subnational level, such as within provinces, states, regions or networks of healthcare organisations (Austria, Canada, Spain, Sweden and Switzerland). Seven countries indicated that they were not aiming to implement national-level EHR systems at that time (Chile, Croatia, Czech Republic, Denmark, Japan, Mexico and the United States). Croatia and Denmark reported aspects of record-sharing that were comprehensive at the national level. In the other countries, sharing arrangements differed among healthcare organisations and regions. Taken together, these results indicate that interoperability is still a significant challenge for most countries.

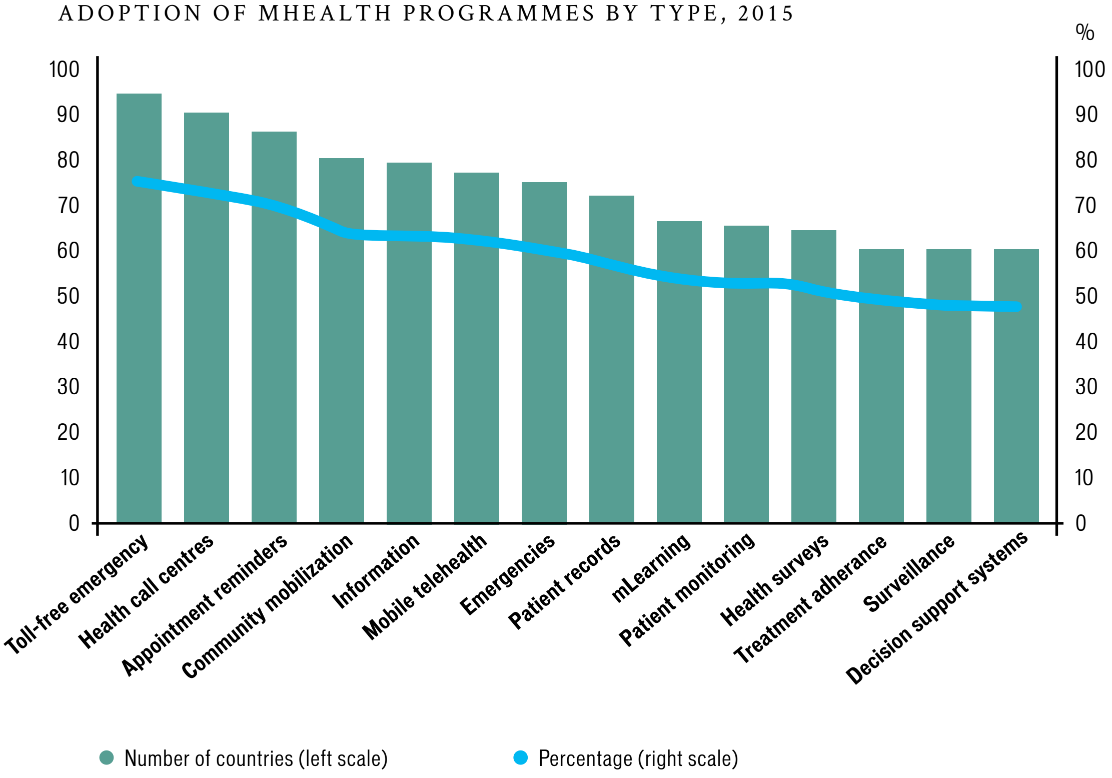
WITH AN INCREASING NUMBER OF INDIVIDUALS USING SMARTPHONES AND MOBILE DEVICES, MOBILE HEALTH IS BY FAR THE FASTEST GROWING SEGMENT OF ICT-BASED HEALTHCARE DELIVERY SYSTEMS.

Mobile technologies offer a wide range of smart modalities by which patients can interact with healthcare professionals or systems. These technologies provide helpful real-time feedback along the care continuum, from prevention to diagnosis, treatment and monitoring. Since mHealth services have low marginal costs and high availability, they have the potential to reach large numbers of patients between in-person clinical encounters. Low- and middle-income countries have perhaps the greatest potential to extend access to healthcare by using mHealth to integrate rural and remote areas into health systems. Countries such as Ghana, Kenya, South Africa and Tanzania have successfully integrated the use of mobile phones as support mechanisms in community-based healthcare systems (OECD, 2017). In 2013, the Boston Consulting Group reported 500 mHealth projects, and in 2015 the number of patients using mHealth applications was estimated to be approximately 500 million globally (OECD/Harvard, 2016).

In 2015, the World Health Organization surveyed over 125 countries on eHealth and mHealth activities at the national level. More than 80% of these countries reported government-sponsored mHealth programmes. mHealth projects were primarily extensions of existing health programmes and services at the national or local level (Figure 2).

FIGURE 2

ADOPTION OF MHEALTH PROGRAMMES BY TYPE, 2015



SOURCE: WORLD HEALTH ORGANIZATION (2016), ATLAS OF EHEALTH COUNTRY PROFILES 2015: THE USE OF EHEALTH IN SUPPORT OF UNIVERSAL HEALTH COVERAGE: BASED ON THE FINDINGS OF THE 2015 GLOBAL SURVEY ON EHEALTH.

mHealth is widely recognised as especially valuable for the management of non-communicable diseases such as diabetes and cardiac disease and other health conditions where continuous interaction is imperative. mHealth services can also help address physical, sensory and cognitive impairments of older populations to allow continued aging in place and avoid hospital admissions (WHO, 2015).

mHealth is also a fundamental resource that can be used to provide populations with health and wellness information and knowledge. Governments are gradually using mobile health apps to deliver medical information to consumers and promote the healthy lifestyles and behavioural changes that are often required to manage specific health conditions, particularly in vulnerable populations. With the broad dissemination of smartphones, mHealth is uniquely positioned to deliver prevention and wellness messaging to help people change their lifestyles and behaviours to prevent diseases and to maximise well-being. Today, promotion strategies include a wide range of solutions, such as the creation of websites, dedicated portals, social networks, and SMS text messaging. Several recent studies and reviews (Tumusiime et al., 2014; Biemba et al., 2017) have indicated that SMS may be an effective, low-cost method for promoting sex education and healthy behaviours among young people. Web 2.0 is particularly enticing to participants because of the potential of receiving individualised, tailored feedback.

mHealth initiatives have been implemented all over the world, in developed and developing regions, for more than a decade. Despite this phenomenal growth, the majority of these initiatives have failed to scale up (Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013; Iwaya et al., 2013). The challenges to these initiatives include privacy and data protection issues such as providing mechanisms to guarantee patient data confidentiality, data integrity, and quality assurance for mobile applications (Gutierrez, Moreno, & Rebelo, 2016).

TOOLS AND MEASUREMENTS FOR ASSESSMENT IN MEETING POLICY OBJECTIVES

In addition, digital health requires continuous evaluation starting from ICT availability and adoption, moving towards effective use and the extent of health information exchange, and ending with measuring outcomes and impacts on health and the performance of health systems. Improvement can be assisted by agile post-implementation reviews. This requires the establishment of evaluation criteria and measurement tools for specific applications related to the use of ICT and digital health deployment. Evolution can help assess health outcomes and inform resource allocation decisions (US FDA, 2016). Governmental and non-governmental organizations have begun to define management maturity models for the functionalities deployed and throughout the life cycle of technological implementation (Marin, Gutierrez, Costa, & Degoulet, 2015).

According to Friedman and Wyatt (2014), measurement is the process of assigning a value corresponding to the presence or degree of a specific attribute in a specific object. However, it can never be assumed, particularly in health informatics[5], that attributes of interest are measured without error. Measurement is of particular importance in health informatics because of the ongoing need to establish variables that need to be measured and instruments that can be applied across settings. Measurement challenges almost always arise in the assessment of the outcomes or dependent variables for studies. Since health informatics includes the collection, retrieval, storage, processing, and dissemination of healthcare information, many aspects can be evaluated. Evaluation in health informatics must address a wide range of questions, ranging from technical aspects of health information systems to human interactions, patient safety, impacts on health system, policies, people and population effects.

Under the right conditions, the use of ICT in health care can convey clinical, organizational and financial benefits as well as greater quality of care and patient satisfaction. New technological possibilities and fragmented care delivery systems make evaluation of the quality of healthcare

5 The National Library of Medicine defines health informatics as "the interdisciplinary study of the design, development, adoption and application of IT-based innovations in healthcare services delivery, management, and planning" (NML, 2016).

processes and outcomes increasingly important. Yet these very same developments make delivering care and evaluating its quality more difficult. Since its inception in 2001, the OECD Health Care Quality Indicators (HCQI) Project, in partnership with leading organisations and countries, has been instrumental in providing a conceptual framework and methodological basis for providing the required information about quality. Although there are data limitations on this effort, it has produced useful data covering the dimensions of clinical effectiveness, patient safety, and patient experience.

Alongside quality of care, governments are seeking to assess the financial benefits and gains in efficiency to be reaped from the implementation of ICT. However, these are not immediately realized after initial deployment, as shown by the experience of the last 40 years of ICT system implementation (Marin & Delaney, 2016).

The challenges to achieving widespread ICT adoption and meaningfully leveraging these technologies to improve care are complex. Many countries are looking to learn from others' successes and failures to inform their own policy development. However, this requires a shared understanding of terms and harmonised approaches to measuring availability, adoption and effects. This section focuses on efforts to measure ICT availability and use.

Since 2008, the OECD has led an effort to provide countries with reliable statistics to compare ICT development and policies in the health sector (Adler-Milstein, Ronchi, Cohen, Win, & Jha, 2014), assist governments in understanding the barriers and incentives to ICT use, and realise the far-reaching economic and social benefits of its application. A model questionnaire was completed and published in 2013 (OECD, 2013a). Part I of the survey is addressed to general, primary care, and family practitioners in ambulatory settings, Part II, to chief information officers and administrators in acute care settings.

In each part, indicators are organised into four broadly defined domains in which measurement of availability and use represent the current policy priorities for most countries:

- Provider-centric electronic records: systems that are used by healthcare professionals to store and manage patient health information and data, and include functionalities that support the care delivery process (e.g., EMRs[6], EHRs[7], and Electronic Patient Records [EPRs]).
- Patient-centric electronic records: systems typically used by patients and their families to access and manage their health information and organise their health care (e.g., personal health records (PHRs), patient portals, and other patient-centric electronic records).
- Health information exchange: the process of electronically transferring (or aggregating and enabling access to) patient health information and data across provider organisations (e.g., e-transfer of patient data between ambulatory care providers or e-transfer of data at the regional level).
- Telehealth: the broad set of technologies that support care between patients and providers, or among providers, who are not co-located (e.g., video-mediated consultations between physicians and patients, remote home monitoring of patients, teleradiology).

Further guidance on implementation is available in the Draft OECD Guide to Measuring ICT in the Health Sector (OECD, 2015a).

Since 2013, several countries have begun piloting the OECD model survey and/or mapping information from existing surveys and administrative data sources to indicators that can be derived from the model survey. In addition, related data for some additional countries is available through

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6 An EMR contains the standard medical and clinical data gathered in one provider's office. Electronic health records (EHRs) go beyond the data collected in the provider's office and include a more comprehensive patient history. For example, EHRs are designed to contain and share information from all providers involved in a patient's care. EHR data can be created, managed, and consulted by authorized providers and staff from more than one healthcare organization. Source: https://www.healthit.gov/providers-professionals/electronic-medical-records-emr

7 An EHR is "an electronic version of a patient's medical history, that is maintained by the provider over time, and may include all the key administrative and clinical data relevant to that person´s care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports" [CMS, 2016]. Centers for Medicare & Medicaid Services (2016). Electronic Health Records [Definition]. URL: https://www.cms.gov/Medicare/E-health/EHealthRecords/index.html

surveys of primary care physicians conducted by the Commonwealth Fund and of primary care physicians and hospitals commissioned by the European Commission.

The OECD model survey was also used as input for the development of a framework for the collection of ICT statistics in Latin American countries. In particular, Brazil has been cooperating with the OECD through the Regional Center for Studies on the Development of the Information Society (Cetic.br) since January 2012. In 2013, Brazil became one of the first countries to pilot the draft model survey questionnaire; later on, Uruguay also adopted the same framework. The survey was administered to a probabilistic sample of public and private healthcare facilities and to healthcare professionals (physicians and nurses). The results have enabled the mapping of the ICT infrastructure; the use of ICT systems and applications; and activities, motivations and barriers preventing the use of ICT by healthcare professionals. The use of this ICT in Health Survey has institutional and methodological support from an expert group made up of representatives from the government, academia, organisations from civil society, and international agencies.

In 2014, the government of Uruguay also started to collect data on ICT in the healthcare sector as part of Salud.uy program, its national eHealth strategy. The methodology is aligned with the OECD model survey and the Brazilian experience. The questionnaires were applied between March and June 2014. The overall objective was to establish a baseline on the extent and quality of access, use and appropriation of ICT in the management of health service providers in Uruguay, and gain insights into the appropriation of these technologies by healthcare professionals.[8]

In 2014, building on the OECD efforts and the experience of Brazil, the ICT Working Group of the Statistical Conference of the Americas (SCA) of the United Nations Economic Commission for Latin America and the Caribbean (UN ECLAC) delivered a model survey framework and questionnaire for measuring ICT access and use in the Latin American healthcare sector. It is worthwhile to emphasize again that measuring and monitoring digital health entails the collection of data at multiple points throughout a digital health intervention's life cycle, leading to adjustments and activities in order to maintain or improve the quality and consistency of deployment (WHO, 2016).

Other models worth mentioning are those developed by the Health Information and Management Systems Society (HIMSS), a non-profit organization founded in 1961 and located in Chicago (USA), that includes more than 50,000 members and 225 organizations distributed in various regions and countries. The Electronic Medical Record Adoption Model (EMRAM) of the HIMSS is aimed at improving quality, safety, cost-effectiveness, and accessibility in healthcare through the use of ICT and systems management. It incorporates methodology and algorithms to automatically evaluate hospitals against the accumulated capabilities of EHRs. It also establishes adoption levels that allow for comparisons between organisations, better planning of deployment processes to achieve the full capacity and potential of EHRs in clinical practice, research and education (Marin et al., 2015; Gutierrez et al., 2016).

Another example of an evaluation and measurement tool is the mERA checklist, which includes 16 items focused on the reporting of digital health interventions. The items include: infrastructure, technology platform, interoperability, intervention delivery, intervention content, usability, user feedback, access by individual participants, cost assessment, adoption inputs, limitations on delivery at scale, contextual adaptability, replicability, data security, compliance with national guidelines and regulatory statutes, and fidelity of interventions (WHO, 2016; Agarwal et al., 2016).

The National Health Service (NHS) of England has also developed a Digital Maturity Assessment guide to measure the extent to which healthcare services are supported by the effective use of digital technology. The guide helps identify key strengths and gaps in healthcare providers' provision of digital services at the point of care and offers an initial view of the current 'baseline' position across the country. The toolkit includes three key areas for self-assessment (level 1), 13 sections (level 2)

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8 For more information: a) Statistical Conference of the Americas (CEA) of the Economic Commission for Latin America and the Caribbean (CEPAL) – Methodological recommendations for the measurement of access and use of Information and Communication Technologies (ICT) in the Health Sector in chapter 3 of this publication; b) Regional Center of Studies for the Development of the Information Society (Cetic.br) – www.cetic.br c) Salud.uy (eHealth Strategy in Uruguay) - http://www.agesic.gub.uy/innovaportal/v/4422/19/agesic/que_es.html

and 133 questions (level 3): infrastructure, readiness (strategic alignment, leadership, resourcing, governance, information governance); capabilities (records, assessments and plans, transfers of care, orders and results management, medicine engagement and optimization, decision support, remote and assistive care, assets, resource optimization, standards) (NHS, 2015).

FINAL CONSIDERATIONS

Broad adoption of digital health will require that health information be easily and appropriately shared to support multiple users. An interoperable digital health ecosystem makes the right data available to the right people at the right time among disparate products and organizations in a way that can be relied upon and meaningfully used by recipients (NHS & US DSHS, 2016). Also, being digital means being literate about functionalities. It is imperative that people acquire the necessary digital skills in order to exploit the potential of the digital ecosystem (ITU, 2016). Adoption and deployment of digital health resources are dependent on training and education. It is mandatory to inform government leaders about the importance of patient engagement and that effective use of health records ultimately depends on their adoption by providers, clinicians, patients and citizens (Marin & Delaney, 2016).

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DESIGN AND IMPLEMENTATION OF ICT IN HEALTH SURVEYS: METHODOLOGY AND REGIONAL EXPERIENCES

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INTRODUCTION

The purpose of this chapter is to provide an overview of the stages for implementing surveys on access to and use of information and communication technologies (ICT) in the health sector in the Latin American context. It will examine general methodological aspects, based on internationally agreed methodological frameworks, as well as specific decisions and strategies adopted in Brazil and Uruguay, the countries in the region with the most empirical research on ICT and health.

There are at least five fundamental stages in implementing surveys and producing statistics: design and planning; carrying out fieldwork; data processing; data analysis and preparation of reports; and publication of results and dissemination activities (Groves et al., 2009; Statistics Canada, 2010). This chapter will briefly outline each of the stages in the case of ICT in health surveys, as well as share the specific decisions made in Brazil and Uruguay regarding the methodological, strategic and institutional options available. Best practices associated with the implementation of these stages will also be highlighted.

Hopefully, the content of this chapter will be a useful methodological point of reference, as well as an inspiration, for decision makers, data producers and researchers interested in the topic. Since Brazil and Uruguay were the only countries to have implemented a survey of this type at the time this article was written[6], and because both have rather different population dimensions, geographic characteristics and political-institutional challenges, presenting these cases in juxtaposition can be interesting for other countries in the region.

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6 After the preparation of this chapter, two more countries implemented their own versions of the ICT in Health survey: Costa Rica and Colombia. The first targets Basic Comprehensive Healthcare Teams (Ebais) and healthcare professionals, and the second, only health facilities. Chile has also already started to plan its national ICT in health survey.

FIRST STAGE: PLANNING

The survey planning stage is crucial, since it includes all the fundamental decisions for implementation. A best practice in this stage is to ensure the participation of the various professionals and institutional representatives who are instrumental in the success of the initiative and subsequent appropriation of its results, and not just the methodologists in charge of the survey.

The first stage of the planning process may be characterized as strategic planning. The decision to conduct a survey of this type requires taking into account at least three elements: the point in time when ICT policies are implemented in the health sector of the reference country; the demand for information by key actors; and the institutional and financial feasibility of conducting the survey.

The point in time of these policies is important: The ideal is for the first measurement to take place before their implementation. This way, the data produced will serve as a baseline for future evaluations of the policy, or will inform a diagnosis to be taken into consideration in its design. However, the process does not always unfold this way, and measurements often occur once the policy is in action. Nevertheless, any effort to collect rigorous data is valuable, and successive measurements can be made once implementation of the policy begins, as support for monitoring its evolution.

Processes associated with this stage are mapping of key actors, establishing the scope of the survey, generating agreements for its implementation, and defining roles and actions, including which party will be responsible for guiding the process. In short, it involves developing the design of the survey, as well as defining its purpose in relation to the country's situation and health policies and, particularly, the country's ICT in health policies. This point will not be covered in detail in this chapter, since it will be comprehensively addressed in two other chapters of this publication, which focus on the cases of Brazil and Uruguay, respectively.

In Brazil's case, the ICT in health survey is the responsibility of the Regional Center for Studies on the Development of the Information Society (Cetic.br), which is linked to the Brazilian Network Information Center (NIC.br) and Brazilian Internet Steering Committee (CGI.br), within the framework of its institutional mission to produce quality statistics in relation to different spheres that use ICT and, particularly, the Internet. In Uruguay's case, the measurement process occurred closer to the time of implementation of the policy: Therefore, the Salud.uy program[7] (a Uruguay eHealth initiative) and the Information Society department of the Agency for Electronic Government and the Information and Knowledge Society (Agesic) defined the survey design and the strategy to be followed.

The planning stage also involves key methodological definitions. The critical activities in this stage include: identification and selection of available methodological and conceptual frameworks; search for records and information sources; definition of key indicators; and design of the instruments to be used – in this case, a questionnaire for health facility managers and another for healthcare professionals (physicians and nurses).

IDENTIFICATION OF AVAILABLE CONCEPTUAL AND METHODOLOGICAL FRAMEWORKS

Why was identification of methodological and conceptual frameworks mentioned first? Conducting this type of survey generally entails finding a middle ground in order to avoid either of two extremes: applying international recommendations and

frameworks without any adaptation to national realities; or creating totally sui generis surveys that cannot be compared with surveys conducted in other countries or used as references.

Adopting internationally agreed conceptual and methodological frameworks is an essential condition for producing comparable data. It is advisable to take into account the general terms

7 The Uruguayan Salud.uy program promotes intensive use of information and communication technologies in the health sector. The program has defined medical information technology standards, as well as the technical and regulatory context to make national clinical records possible and safe (HCEN).

of available international frameworks, and adopt a set of key recommended indicators to facilitate international or regional comparability and enable benchmarking. It is also recommended to create modules and additional questions that respond to the specific needs and characteristics of each country.

In the specific case of Brazil, when it was decided in 2011 to conduct a survey on ICT in health, with institutional support from the Informatics Department of the Unified Health System of the Ministry of Health (Datasus)[8], a project of the Organisation for Economic Co-operation and Development (OECD), entitled Benchmarking ICTs in Health Systems, was taken into account. The objective of this multiparticipatory initiative, launched in 2010, was to improve the availability and quality of ICT in health indicators. Cetic.br/NIC.br was the main party responsible for adapting the resulting guide – Guide to Measuring ICTs in the Health Sector (OECD, 2015) – to the Brazilian and Latin American context. The center also collaborated in the project by providing input on the challenges involved in carrying out this type of measurement, and Brazil was one of the first countries to apply the OECD questionnaire model as a test pilot. Apart from taking into consideration a large part of the proposal from this body and making local adaptations, it was considered important to design an additional questionnaire aimed at healthcare professionals.

Brazil was the first country in the region to adapt the framework proposed by the OECD, which was especially considered in a subsequent adaptation of this framework to the regional reality. This contextualization was crystallized in a document entitled Methodological Recommendations for Measurement of Access and Use of Information and Communication Technologies (ICT) in the Health Sector, prepared by the ICT Working Group of the Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC). The mentioned document constitutes a referential methodological framework accompanied by a questionnaire model aimed at healthcare facilities, and it is reproduced in chapter 3 of this book (Statistical Conference of the Americas of the Economic Commission for Latin America and the Caribbean [SCA/ECLAC], 2014).

In 2013, when it was decided in Uruguay to conduct a survey of this type, international references and implementation experiences in the region were examined. The references identified were, precisely, the framework proposed by the ICT Working Group of SCA/ECLAC and the work carried out by Cetic.br/NIC.br.

At the time, collaborative and knowledge transfer work sessions took place between the researchers from both countries, in order to analyze the lessons learned and the feasibility of implementing in Uruguay an approach similar to the one adopted in Brazil. Experts from the National Institute of Statistics (INE) and the Ministry of Health were also invited to these meetings.

In Uruguay's case, as in Brazil's, it was considered important to conduct a survey aimed at healthcare professionals, as well as healthcare facilities, in order to measure use, appropriation and obstacles encountered by these professionals in relation to the incorporation of ICT in health services. Thus, efforts were made to align the methodology with international measurement standards and best practices.

THE ANALYSIS PLAN

A fundamental stage in planning a survey is developing a data analysis plan, which requires determining what information will be presented and by which variables of interest it will be disaggregated. It is recommended to perform this exercise before defining the questionnaire and sample, and not the other way around.

In Brazil, it was defined that the most relevant variables of interest according to which the information should be analyzed and presented were the legal status of the health facility (public or private), region of the country, location (state capital or non capital cities), and type of health facility (outpatient, inpatient with up to 50 beds, inpatient with more than 50 beds, and diagnosis and therapy services).

In Uruguay's case, this plan included an analysis of each of the units surveyed according to the

8 The main goal of Datasus is to structure health information systems, integrate health data, and provide support for managing the various levels of health care. Datasus is also responsible for the National Registry of Healthcare Facilities, which is the basis for operationalizing the Health Information Systems (SIS)

legal status of the institution (public/private). In some cases the information was processed by weighting the number of users of each institution, in order to determine the percentage of the population covered by each type of health service.

Therefore, the questionnaires and sample were defined based on the conceptual and methodological frameworks available, taking into account the proposed indicators, as well as those deemed necessary in relation to local information needs, and also taking into consideration the analysis plan to be implemented.

DEFINITION OF INDICATORS AND DESIGN OF THE QUESTIONNAIRE

The process of defining the questionnaire consists of several stages: determining the indicators of interest and the questions that will be posed to operationalize them is only the first stage.

In Uruguay's case, this stage of defining the indicators was extensively discussed, due to the multiplicity of institutions involved in the survey. Although it sought to follow the health facility questionnaire used by Cetic.br/NIC.br for the sake of regional comparability, it also incorporated a number of questions of interest to the actors involved in the country's health system. It is important to note that a project's success depends largely on the commitment of the different actors and, for this reason, it is necessary to take them into account in every stage. In the case of Uruguay, this was considered to be responsible, in large part, for the high rates of response to the survey.[9]

In Brazil's case, it is worth highlighting a relevant and widely applied practice in this stage, which consists of bringing in a set of experts from various sectors (academia, government institutions associated with health, international organizations and civil society) during at least two key moments in the development of the survey. The first occurs precisely during the stage of defining the indicators and the questions that will be included in the questionnaires. Therefore, the ICT in health survey conducted by Cetic.br/NIC.br has a scientific coordinator and a stable group of experts who voluntarily participate in discussion meetings with the technical team in reference to the survey design, indicators and questions to be included, as well as their interpretation, validity and interest for public policies.

Once the indicators to be measured have been defined, and taking into account the analysis plan previously mentioned, the next stage is designing the data collection instrument, i.e., the survey questionnaire. This is a delicate stage, since the way in which the questions are presented in this instrument impacts the validity of the survey.

After formulating the questions for the survey questionnaire, it is highly recommended to perform a number of cognitive interviews to validate the concepts and definitions included in the questionnaire. The cognitive interview is a qualitative technique that seeks to understand the cognitive path adopted by interviewees to arrive at their responses, by scrutinizing their interpretations of the questions and the way in which they understand the underlying concepts. This technique is not intended to be representative of the population to be surveyed, but explores the understanding of the questionnaire through a limited set of interviews corresponding to the strata of interest of the survey. It is a highly useful technique which enables the quality of the questionnaire to be substantially improved. Since having a structured questionnaire is one of the fundamental elements of the survey technique and, unlike other interview techniques, no modifications or adaptions can be made once the fieldwork is underway, every effort to perfect the instrument is an investment in the quality of the final results (Campanelli, 1997; Presser et al., 2004).Cognitive interviews were systematically conducted in both countries before the first application of the questionnaire and, later on, before each new edition of the survey if new questions were added or modifications were made to the existing ones.

9 In the survey for institutions carried out in Uruguay, 93 out of the 106 initially targeted were surveyed, which means a response level of 88% (97% of the providers). In terms of the survey for healthcare professionals, the rejection rate was 10.1%, similar to the rate registered in a 2014 survey of this population.

SAMPLE DECISIONS

The planning stage also includes defining the target and reference population of the survey, the units of analysis and reference, and the design of the sample plan, including the definition of the stratification variables based on the indicators and disaggregation levels defined in the previous stages. This stage also includes decisions about which types of units from the universe will be excluded from the sample, for justified reasons. Besides these conceptual aspects, the final decision regarding sample size normally takes into account the resources available.

THE CASE OF BRAZIL

In Brazil, there are approximately 200,000 healthcare service delivery locations. Of this total, for conceptual reasons and in the interest of the survey, the following were excluded from the sample:

- Facilities registered as individuals;
- Isolated clinics, defined as isolated rooms for the provision of medical or dental care or for services of other healthcare professionals with tertiary education;
- Facilities created on a temporary basis or for campaigns;
- Mobile healthcare units (terrestrial, aerial or fluvial);
- Facilities that do not have at least one physician or nurse on staff;
- Facilities that manage the system, such as health departments, regulatory agencies and other similar bodies registered in the National Registry of Health Facilities.

Once the decision was adopted based on the variables defined as being of interest for the analysis and dissemination of results, the representative sample was defined at the national level, stratified by region, type of facility, and location (capital city or non capital cities of the federative unit). The sample consisted of 3,566 health facilities.

Apart from these stratification variables, the size of the health facility, defined by the number of employed persons working in it, was taken into account for the sample. The objective of the design was to ensure representativeness in the sample of facilities of varied sizes, with higher probability of selection of larger facilities.

In the case of healthcare professionals, it was decided to survey a sample of physicians and nurses linked to each of the already selected facilities in the sample, so that the conclusions regarding their use of ICT and the difficulties they encountered could be associated with the characteristics of their workplace taken as a reference for the response.

THE CASE OF URUGUAY

In contrast, in Uruguay's case, in order to respond to the characteristics and dimensions of the health system, it was decided to conduct a census of health providers in the National Integrated Health System (SNIS). These providers offer comprehensive health services with inpatient options and cover 100% of the country's population (all the inhabitants of the country are affiliated with a provider). It was found that the institutions that provide comprehensive services themselves or through third parties included: private insurance plans; private professional medical care institutions (IAMPP), previously known as collective medical care institutions (IAMC); the State Health Services Administration (ASSE), the largest provider in the public sector at the central level; and police and military heath centers.

Mobile emergency services (MES) from around the country were included in the survey. MES provide emergency care services and have more than one million affiliates (30% of the population). In the case of MES, a stratified sample according to the size of the facility was drawn.

In relation to healthcare professionals, the survey for this population inquired into their overall level of ICT access, as well as the use and appropriation of ICT within the context of their everyday work. This survey included physicians from all areas, and registered nurses and nursing assistants registered with the Ministry of Public Health. A nonproportional random stratified sample was selected by type of profession (physicians, registered nurses and nursing assistants). At the time of the information analysis, the data was weighted according to the weight of each one of these segments in the total of healthcare professionals in the country. The total sample of professionals was 600, with 200 from each professional profile.

In the last measurement performed in Uruguay (2016), in addition to surveying institutions and professionals, a survey of SNIS users was incorporated, in order to measure certain indicators in relation to online services in terms of knowledge, use and preferences. The general population of users of the system 18 years old or older was surveyed, and the sample size was 1,000.

For the sample selection and the data collection method (covered below), a critical element is the quality and quantity of records available, which must be known before making subsequent decisions. In the case of Brazil, there is a database that identifies health facilities, including telephone numbers, which is regularly updated by a high proportion of the facilities, which have specific incentives for doing so. It is similar in Uruguay, where updated, good quality records exist in relation to health facilities and professionals.

DATA COLLECTION METHODS

In each of the existing data collection options, there is a balance between costs, time, response reliability, degree of privacy afforded respondents, and expected response rates (see a comparative chart in Table 1).

TABLE 1

DATA COLLECTION METHODS

	Differences in data collection methods				
	Face to face			Self-administered questionnaire	
	PAPI *1	**CAPI** *2	**CATI** *3	**CASI** *4	**CAWI** *5
Cost	High	High	Medium/Low	High	Very high
Data collection period	Long	Long	Medium/ Short	Long	Very short
Response rate	Very high/High	Very high/High	High/ Medium	Very high/ High	Low/Very low
Degree of confidentiality	Very low	Very low	Medium	High	Very high

Note: *1 Pen-and-paper interviewing;
*2 Computer- assisted personal interviewing;
*3 Computer- assisted telephone interviewing;
*4 Computer- assisted self-interviewing;
*5 Computer-assisted Web interviewing.

SOURCE: ADAPTED FROM GROVES ET., 2009.

When decisions are made, it is necessary to bear in mind the reality of the resources available and the desired outcomes in each case. The methodological chapter of the research project is used as a basis for these decisions.

The main options for carrying out ICT in health surveys are face-to-face or telephone interviews (in both cases, the responses can be entered, or not, on the computer). Surveys can also be sent by mail or email or offered online, via the Internet; these are referred to as self-administered, since there is no interviewer present during the response. There is also an intermediate option, the assisted self-administered survey, where people respond in the presence of a monitor, who does not conduct the interview, but provides guidelines, instructions and/or assistance if there are any questions.

Due to the geographic size and complexity of Brazil, face-to-face interviews are extremely costly, in terms of time and financial resources. In addition, locating the population of physicians and nurses in their workplaces to respond to a survey is highly challenging due to the nature of the activities of these professionals[10]. In view of these elements and the existence of up-to-date telephone records, Brazil chose to adopt a computer-assisted telephone interviewing survey for health facilities (answered by the IT manager or, if there isn't one, the manager of the health facility) as well as for professionals (physicians and nurses).

In Uruguay, since most of the full health providers are located in the country's capital, and the distances for reaching providers in the rest of the country are relatively short, it was decided to conduct face-to-face survey interviews at the healthcare facilities. Due to the complexity of the questionnaire and the variety of topics to be examined, it was possible to complete the questionnaire in different stages. Even though all of the institutions were visited, in many cases the information was completed via telephone or the Internet.

For healthcare professionals and the general public (SNIS users), the method chosen was computer-assisted telephone interviewing (CATI).

DEFINITIONS REGARDING FIELDWORK DEVELOPMENT

Once decisions have been made about the sample, questionnaires and data collection methods, it is time to define which institution will be responsible for collecting the data in the field. The main alternatives for carrying out the fieldwork are as follows: for the institution coordinating the survey to hire and coordinate a team of interviewers; creating agreements with the National Statistics Institute of the country; or outsourcing this work to a consulting firm or university. In the case of outsourcing, the degree of involvement of the survey coordination team must be defined. This involvement can range from defining and controlling the quality parameters of the final product, leaving the implementation in the hands of the contracted institution, to actively participating in and closely monitoring all stages of the fieldwork.

In both Uruguay and Brazil, private companies were hired to carry out the fieldwork. This process involves defining the terms of reference and performing a company selection process, taking into account time frames and local regulations, especially in cases of surveys financed with public funds. Once the consulting company has been selected, it is essential to establish work agreements with the company and define the delivery or joint design of the guidelines and instructions for carrying out the fieldwork, and agree on the controls to be applied during its execution.

Some fundamental organizational tools in this first stage of the process are similar to those normally used for organizing any project: mapping of actors; matrix of objectives and desired products; and definition and planning of actions for achieving them, organized in detailed schedules. At the same time, there are other specific tools that must be developed for each survey: a reference manual for the company that will carry out the fieldwork; a manual for interviewers; and a consistency control plan. The design of these manuals and instructions, which will guide the execution of the fieldwork, is crucial, and should include ways to respond to different situations that may arise.

10 In the first ICT in Health survey (2013) in Brazil, a mixed approach was tried (CATI in general and face to face interviews in large health facilities). However, the face to face approach did not work, since access to hospital environments was very difficult.

SECOND STAGE: CARRYING OUT THE FIELDWORK

Once the core planning aspects have been defined, the second stage begins: carrying out the fieldwork. The duration and complexity of this stage will be in relation to the aforementioned topics, but will also be connected to the quality and rigorousness of the support tools used during this stage.

Taking a survey into the field involves a series of preparatory activities. First of all, the project must receive approval from the corresponding ethics committee in each country. This process can vary in length, so it is recommended to take precautions and deal with this aspect in advance.

During the fieldwork preparation stage, authorizations need to be secured from the incumbent authorities. It is recommended to obtain, not only authorization, but also an expression of interest in the results of the survey, which can lead to a letter of endorsement to present to respondents. This will make a major difference in the participant's willingness to answer the survey.

A critical process to implement during this stage is the training of interviewers and coordinators. Each team responsible for the survey must determine if it will carry it out directly or delegate it to a consulting firm. In Brazil's case, given the size of the country, it was decided to delegate the training to a consulting firm and monitor their execution of this process.

In the case of Uruguay, however, due to the relatively low number of interviews to be performed and the possibility of easy access to all the health facilities, the decision adopted was to directly and intensely train a very small, carefully selected team of interviewers (eight), who were responsible for conducting the interviews in each of the institutions, through face-to-face or remote (telephone, email) contact. With respect to the interviews with healthcare professionals and the general public, which adhered to a more structured routine, 15 people from the call center of the contracted company were given a short induction on the questionnaire.

Once the fieldwork begins, there is a monitoring process that varies in degree and style according to the definitions established by the survey's coordination team. In Brazil's case, regular field audits are conducted and the databases are examined throughout the conducting of the survey. It is not advisable to leave the execution of these controls to the end of the field study, since that could be too late to detect problems such as biased rejection or any other aspect that affect the representativeness of the survey. This point is particularly important, since it permits timely intervention if difficulties are identified and enables the fieldwork to be carried out as planned.

THIRD STAGE: DATA PROCESSING

The data processing stage can be divided into three phases: database consistency control; database weighting; and tabulation of the indicators. Following is an explanation of each phase and how they were handled in Brazil and Uruguay.

DATABASE CONSISTENCY CONTROL

Proper data use and tabulation of the indicators should be preceded by an evaluation of the responses to the forms received during fieldwork. This evaluation should take into account the planning of the survey and questionnaire. In this data processing stage, it is determined whether the questionnaire completion rules were followed by all the respondents and if any fields were left blank (missing values). The questionnaire completion rules correspond to the filter or skip instructions for the questions. When checking consistency, the quantitative fields are compared (for example, there cannot be more physicians in the sample than the total declared by the health facilities), and the validity of the expected response codes is verified (for example, there cannot be a 0 code response in a question with codes from 1 to 3).

DATABASE WEIGHTING

This data processing stage is very important, since it will yield a sample that represents the entire target population of the survey. The weighting process consists of assigning a "weight" to each survey informant, which is a value that represents the number of units of analysis of the target population that are represented by the informant. The weighting process of a survey uses the following procedures: a) assignment of a basic weight to each respondent, equal to the inverse of their probability of being selected to be part of the sample (defined according to the sample plan); b) adjustment according to the nonresponse rate of the group or category to which the respondent belongs; c) calibration.

Nonresponse adjustment involves dividing the weight of the selected informants who did not respond to the survey by those who did, provided that there was no systematic bias between those who did respond and those who did not. This division does not follow a fixed rule: Nonresponse must be assessed to determine which characteristics of the nonrespondents stand out within the target population, and then the nonresponse adjustments are made according to these characteristics.

Calibration is the process by which, based on the data from the registry from which the sample was selected, or known population totals from other surveys (for example, a population projection), the corrected weights are adjusted for nonresponse, so that the totals calculated on the basis of the sample are identical to known totals. There are various techniques for making this adjustment, particularly ranking (Pfeffermann & Rao, 2009).

TABULATION OF THE INDICATORS

Once the consistency of the database has been controlled and the weighting has been completed, the next stage is tabulation of the data. Tables are generated during this stage with estimations of totals, proportions and error margins of the totals and proportions for each of the indicators defined in the planning stage of the survey. To build these tables, it is necessary to use data tabulation programs that take into account the sample design used in the survey. Programs such as SPSS, SAS and Stata are common proprietary software options, and R, Epi Info and CSPro are free software programs. Failure to take the sample design into account at the time of tabulating the indicators can lead to invalid results, whether in their point estimates (totals and proportions) or their precision estimates (error sums).

It is important to mention that all the steps taken and decisions made during the data processing stage must be documented. A best practice for this requirement is to document all the data steps and methodological options adopted in three separate reports: one on consistency; one on weighting; and another on tabulation.

In the Brazilian ICT in Health survey, as mentioned before, the data was collected through telephone interviews (CATI) for the sample of healthcare facilities and professionals. A data entry program was developed, through the filter and skip planning of the questionnaire. The development of this tool facilitated the consistency checking and database cleaning processes.

The weighting of the data followed the steps outlined earlier. In the case of health facilities, adjustment for nonresponse was done in the strata selected for the survey, with calibration in relation to known totals of facilities by region, administrative jurisdiction, location (capital/non capital cities) and type of facility.

The weighting of healthcare professionals, on the other hand, required a more complex method for adjusting nonresponse: a logistical model was used to calculate the professionals' propensity to respond according to the characteristics of the facility. The survey response rate by medical professionals in Brazil was generally low: in 2017, at least one physician in 38% of the eligible facilities responded to the questionnaire, and at least one nurse in 56% of the eligible facilities. For this reason, it was not possible to make adjustments by facility selection strata. After adjustment for nonresponse, the total number of professionals was calibrated in relation to the total numbers from the registry, based on the same characteristics as those for calibration of the facilities.

In the case of Uruguay, the consistency control processes were organized differently, according to the collection method of each survey. In the case of the heathcare professional and user surveys, which were conducted over the phone, the data was registered automatically, since the telephone surveys used CATI whose flow and valid categories were programmed before the fieldwork was done. After programming and pretesting the questionnaire, a database was generated with a data generator robot to evaluate whether the design of the database was correct, after which it was ready to be used in fieldwork.

In the case of the survey for institutions, due to the complexity of the questionnaire, the answers were registered on paper and then entered into the system. Specific software was developed for entering the data that controls the consistency of the information provided and avoids possible slips on the part of the data entry staff. In order to control the quality of the information and adjust the results, variables were used whose consistency could be controlled. Each questionnaire was evaluated in relation to its quality and, in turn, in relation to its consistency within the context of the different segments of health facilities. In certain questions and specific blocks of the survey (especially those that requested very specific quantitative data), a significant amount of information was lacking. In these cases, after the interview, there was a follow-up by phone or email to obtain the missing information.[11]

In the case of Uruguay, weighting factors were not used in the survey for institutions, since the objective was to conduct a census of the segment. The healthcare professionals' survey sample was stratified nonproportionally by type of professional (physicians, registered nurses and nursing assistants). Therefore, when the information was analyzed, the data was weighted according to the weight of each healthcare professional segment in the population universe, so that the total number of professionals would represent the existing distribution in the population universe. In addition, the distribution of the weighted sample was controlled so that it would be similar in terms of age, region and gender to the survey conducted in 2014 and to the parameters of each segment of professionals.

In the case of the survey for users, it was weighted based on a combination of three variables: gender, region (in two categories), and age (in five categories). To calculate the 20 weighting factors, the joint distribution of these variables in the total adult population residing in Uruguay, according to the data from the 2011 Census, was used as a reference. The weighted sample was also controlled according to other key variables (such as socioeconomic status, educational level and type of health facility), and no significant deviations were detected in relation to the distribution of the universe according to data from the 2015 Continuous Household Survey.

FOURTH STAGE: DATA ANALYSIS AND PREPARATION OF REPORTS

Although this stage and the previous one are linked to each other, their implementation may sometimes involve the participation of professionals with different profiles. It is essential in this stage to bear in mind the objectives of the survey and ensure that the research questions that were formulated are adequately answered, in addition to being open to an information analysis that may prove interesting during the actual processing and analysis.

There are various ways to organize this stage. In the case of Uruguay, both the analysis and preparation of reports were done by technicians from the Salud.uy program and Agesic, along with technicians from the consulting firm that was hired. This option is often chosen when survey firms do not have analysts specialized in the core subject of the contracted survey.

In the Brazilian case, the preliminary data analysis was performed by the consulting firm hired and then adjusted and enriched by the person specifically responsible for this survey, who had training and experience in the specific areas of ICT and health. In addition, outside experts are regularly invited to write articles that are included in the report publications, either through the use of data produced by Cetic.br/NIC.br or on topics related to their expertise in the field of ICT and health.

In both cases, the information is disseminated in a disaggregated and anonymized format, an important factor that respondents should be informed of right from the start of the survey.

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11 In the specific case of the survey for institutions, inconsistencies were detected in certain variables, which required contacting the institutions by phone or email to obtain the information or modify it.

PUBLICATION OF REPORTS AND DISSEMINATION ACTIVITIES

Unlike basic or academic research, the primary purpose of studies linked to public policy issues is that they will be known and, ideally, demanded and taken into account by decision makers and system administrators. For this reason, the report dissemination stage must be carefully planned.

Activities to disseminate the reports prepared in Uruguay were organized within the framework of the Technical Sessions of the Salud.uy program. In addition, presentations were made to the internal audiences of each segment studied, such as private professional medical care institutions (IAMPP), previously known as collective medical care institutions (IAMC), Fepremi Digital Health (of the Federation of Medical Providers of the Interior of the State), and the State Health Services Administration (Asse), among others.

In the case of Brazil, the practice of discussing and analyzing the preliminary data with a voluntary multisector group of specialists on the topic, composed of representatives from the government, civil society, academia and, in some cases, regional institutions, is implemented once again. This practice enables for discussing and validating the interpretation of the data, examining its strengths and weaknesses, and prioritizing which data will be published, depending on its interest for public policies and its robustness.

Only after having discussed the preliminary data with the aforementioned group of experts is the survey report published in Portuguese and English, which broadens the international dissemination of its content. The publication is launched within the framework of press conferences and presentations at seminars, conferences and ministerial meetings. A concrete example of this was the Third Interministerial Meeting held in Brasilia in 2017, where the indicators generated by Cetic.br/NIC.br and their contribution to building a Brazilian digital strategy were discussed, with a focus on three core agenda topics, one of them being ICT and health.

In addition to the specific diffusion of the reports, courses are held that focus on the dissemination of survey methodologies, in order to raise awareness and build capacities. An example of this is Workshop on Survey Methodology, which promotes annual meetings of data producers, decision makers and experts in cutting-edge themes for learning about and reflecting on innovative methodologies and their relationship with public policies, including ICT and health.

THE IMPORTANCE OF REGIONAL NETWORKS

This chapter sought to provide information about the basic elements for organizing and conducting ICT in health surveys with an approach that takes into account both international benchmarks and national needs and specific characteristics. The subject was also addressed from a perspective that considers the need to extend the practice of taking rigorous measurements in the region as a way to diagnose baseline situations and improve the formulation and implementation of digital transformation policies in health services, apart from serving as mechanisms of accountability towards society.

Regional collaboration was fundamental for materializing all these principles. The efforts presented in this chapter occurred within a framework of collaboration between Cetic.br/NIC.br and the Uruguay Salud.uy program, as well as the measurements made after the preparation of this article. In July 2017, a seminar was held in the city of São Paulo, entitled Capacity Building for Measuring the Maturity Level of ICT Use in the Health Sector in Countries belonging to the American Network of Cooperation in Electronic Health (Racsel), made possible through a cooperation agreement between Racsel and Cetic.br/NIC.br. The workshop was attended by representatives from the ministries of health and other bodies in Chile, Colombia, Costa Rica, Peru and Uruguay. As a result of the workshop, these countries designed their own national ICT in health measurement projects.

In November and December of 2017, Cetic.br/NIC.br held additional workshops in Costa Rica and Chile focused on developing national projects and data collection instruments. Follow-up and support virtual meetings were held with other countries. Of the five countries that participated in the workshop, four implemented surveys within just six months. In the mid-term, comparative reports will be available that will shed light on the progress of ICT policies in the health sector in the region.

In addition to the results obtained in terms of knowledge transfer and the consolidation of national studies, the participating countries agreed on a set of ten indicators to be included in their respective surveys, to enable regional comparability while also focusing on each country's specific information needs. This opens up the possibility of comparative analyses in the future, which will enrich and provide input for national analyses.

FINAL CONSIDERATIONS

In view of the regional progress in ICT in health measurement, certain pending challenges identified by the authors of this chapter should also be pointed out. The first is strengthening national information systems, or measurement ecosystems for public policies, through the integration of surveys such as those described in this chapter, with specific diagnostic assessments and evaluations of processes and results and impacts of the policies.[12]

Another challenge is adjusting the methodology for measuring maturity levels, so that it may be strengthened and, in time, be a support to other countries in the region, as a tool for improving adoption processes for ICT in health.

Finally, it should be pointed out that, despite the clear signs of progress made in the region, it is necessary to strive for the continuous improvement and sustainability of the initiatives implemented, through construction based on the knowledge and experience that have been generated. Regional collaboration is undoubtedly crucial for enhancing capacity-building in countries in the region, in order to increase measurement capabilities and bring about the necessary digital transformations in the field of health.

12 The importance and characteristics of these types of evaluation are explored in another chapter of this book.

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METHODOLOGICAL RECOMMENDATIONS FOR THE MEASUREMENT OF ACCESS TO AND USE OF ICT IN THE HEALTH SECTOR

→ *Working Group on Measurement of Information and Communication Technologies – Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC)*[1]

INTRODUCTION

In Latin America and the Caribbean, substantial inequalities persist in access to health services as a result of various factors that limit the possibility that people will receive timely and high-quality medical care. These factors include shortages of human resources, infrastructure, equipment, and medication, as well as physical and cultural gaps between public provision of health services and low-income populations that need them (Economic Commission for Latin America and the Caribbean [ECLAC], 2010).

Information and communication technologies (ICT) and eHealth[2] applications play an essential role in promoting access to health services. These tools alter the way in which people live, work and interact, and the ways in which health authorities and healthcare professionals can contribute to ensuring longer and healthier lives for citizens, wherever they live (Pan American Health Organization [PAHO] and World Health Organization [WHO], n.d.).

ICT are currently considered to play a leading role in generating, storing, transferring and managing information, and in generally contributing to the beneficial use of available communication networks. The use of ICT in businesses and other facilities has encountered a range of obstacles similar to those that the health sector will need to face over time. The main obstacles can be attributed to the fact that ICT involve the interaction of different areas with different views about use of the technology, infrastructure, applications, and solutions required to meet the specific and general needs of a given process. Among these obstacles, the limitations imposed by the human factor are also of crucial importance.

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1 Member countries: Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Panama, Dominican Republic, Surinam, Uruguay and Venezuela. September 2014.

2 The World Health Organization (WHO) defines eHealth as: "the cost-effective and secure use of information and communication technologies in support of health and health-related fields, including health care services, health surveillance, health literature, and health education, knowledge and research." (WHO, n.d.).

There are numerous areas of opportunity for measuring, assessing, and evaluating the inclusion of ICT in the health sector. In order to ensure that the data collected is coordinated and accurate, solutions must be found in important areas such as:

- Identification of target populations, in order to obtain information about smaller units of information.
- Absence of standardized statistics and calculation algorithms leads to data being collected and presented haphazardly, making comparisons difficult.
- There are no figures for many information variables. Even when data are reputed to be available, they are not included because they are not in standard formats.
- Lack of committed data collection schedules. Continuity in the measurement of all variables is not ensured.

Thus, with a view to harmonizing ICT health statistics, the Working Group on the Measurement of Information and Communication Technology of the Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC) – with valuable support from the Pan American Health Organization (the Regional Office of the World Health Organization) and its expert David Novillo, the Technical Secretariat of the Plan of Action for the Information and Knowledge Society in Latin America and the Caribbean (eLAC2015), and Brazil's Regional Center for Studies on the Development of the Information Society (Cetic.br) herewith submits methodological recommendations aimed at facilitating comparisons of health statistics in the countries of Latin America and the Caribbean. The authors of this document also wish to acknowledge and thank the various health ministries and specialists in the region for their support.

CONCEPTUAL FRAMEWORK

OBJECTIVE

The objective is to collect data on access to and use of ICT in the health sector, in order to generate consistent, comparable, up-to-date and representative statistics for reporting progress made by the countries in the region on implementing technological innovations aimed at enhancing the effectiveness and efficiency of their public and private health systems.

Based on the model survey of the Organisation for Economic Co-operation and Development (OECD), the module presented below is based on three fundamental principles. First, it is assumed that countries possess different levels of maturity in terms of eHealth. While the policy imperatives of some countries mean that data collection is based on availability, in others, the focus will be ICT use. Second, the survey is composed of independent and autonomous modules that ensure its flexibility and adaptability to changing environments. The core modules can be included in existing surveys or can be implemented as independent surveys, while the complementary modules can be used according to country needs. This approach allows broad measurement of core areas on an internationally comparable basis, while different countries can adapt the contents to meet their specific needs.

Finally, one of the key challenges is to ensure that the terminology is comparable between countries, so that if local adjustments are made to the questions, the indicators may still retain a basis of comparability. For example, in many cases, the terms used in electronic medical records (EMR) or electronic health records (EHR) can be interpreted differently. These differences between countries' interpretations can undermine comparative evaluations. In order to avoid such problems, the indicators focus on the use of ICT based on functionality, i.e., on consensus about the basic types of health care activities that can be performed by using different electronic systems. This approach is compatible with the principle of technological neutrality (i.e., the questions do not require or adopt a particular type of technology), and precludes technological obsolescence by having a forward view (i.e., they do not preclude the use or development of future technologies).

DEFINITIONS

Internet access (fixed and mobile): The Internet is a global public communication network that provides access to a series of services, including the World Wide Web (WWW), e-mail, news, entertainment, data and voice files, images and social networks, regardless of the devices used. (It cannot be assumed that services can be accessed only by computer. There are alternatives, such as mobile telephones, tablets, personal digital assistants [PDAs], gaming devices, digital TVs, etc.) Access can be through fixed or mobile networks (ITU, 2014).

Fixed networks (wide or narrow band) include cable technologies (e.g., dial-up, RDSI, DSL or fiber optic) and wireless (e.g., satellites, WiMax, fixed CDMA). Mobile networks involve the use of mobile access technology through telephones via 3G (e.g., UMTS), cards (SIM cards installed in a computer) or USB modems.

The International Telecommunication Union (ITU) (2014) has classified the types of Internet access as follows:

- Fixed narrow band (cable): includes analog modems (dial-up through standard telephone lines), ISDN (Integrated Services Digital Network), DSL (Digital Subscriber Line) at data transfer rates lower than 256 kbit/s, and other forms of access with data transfer rates lower than 256 kbit/s;
- Fixed broadband (cable): refers to technologies with data transfer rates of at least 256 kbit/s, such as DSL, cable modems, high speed leased lines, fiber-to-home/building, high-voltage lines, and other fixed band widths (by cable);
- Terrestrial fixed broadband system (wireless): refers to technologies with data transfer rates of less than 256 kbit/s, such as WiMAX and fixed CDMA;
- Satellite broadband (connection via satellite), at theoretical data transfer rates of at least 256 kbit/s;
- Mobile broadband (at least 3G, e.g., UMTS) via telephones;
- Mobile broadband (at least 3G, e.g., UMTS) with use of cards (e.g., SIM cards in computers) or USB modems.

Web presence and websites: Web presence: This involves websites, homepages, or presence on the websites of other entities. It excludes presence in online directories and in any other web pages where the entities have no control over the page's content. Web presence includes social network pages and other types of accounts (e.g., Facebook, YouTube and Twitter) if the entities have control over the content (Partnership and ECA, 2012).

Websites: Locations on the WWW identified by web addresses. Collections of web files on particular subjects include introductory files called homepages. The data is coded in specific languages -Hypertext Markup Language (HTML, XML, Java) - that can be read with the use of web browsers such as Internet Explorer (ITU, 2009).

TARGET POPULATION

The target population for ICT health statistics corresponds to all the active public and private health facilities in a national territory classified as facilities "without inpatient hospitalization" and "with inpatient hospitalization."

If a certain country is unable to cover the abovementioned target population due to time or resource constraints, or for other reasons, we suggest that priority should be given to the public health sector.

Health facilities without inpatient hospitalization:

- Primary care outpatient clinics: Health facilities that provide general medical and professional basic or primary care.
- Specialist outpatient clinics: Health facilities with specialized medical care.
- Emergency clinics: Health facilities that provide specialized medical services and emergency care.

- Diagnosis and therapy services: Health facilities that provide specialized diagnosis and/or therapy support services.

Health facilities with inpatient hospitalization[3]:

- Low-complexity facilities: Health facilities for inpatient care that possess all services except for intensive care units.
- Medium-complexity facilities: Health facilities that possess all services, including intensive care units, but with no facilities for cardiovascular and organ transplant surgery.
- High-complexity facilities: Health facilities that have all services, including intensive care units and facilities for cardiovascular and organ transplant surgery.

Facilities that are not subject to ICT health sector statistical surveys are:

- Private clinics run by autonomous healthcare professionals such as doctors, psychologists, nurses, etc., that do not meet the aforementioned criteria.
- Health facilities with a restricted client base, such as clinics or dental surgeries in the school network that cater exclusively to students and employees:
  - Outpatient facilities or dental surgeries run by private firms or public authorities that provide health care exclusively to their employees;
  - Medical clinics that are devoted exclusively to carrying out competency examinations (e.g., eyesight tests required by traffic departments).
- Health facilities devoted exclusively to research and teaching that do not regularly examine patients.
- Temporary facilities set up to support health campaigns, and mobile units (land, air, or water).

COVERAGE

Thematic coverage: Thematic scope corresponds to the availability and use of ICT in health facilities in a country, in the following areas:

- **Health facility profiles:** Characteristics of health facilities, types of care provided, number of people employed;
- **ICT infrastructure:** Internet access, use of computers, smartphones and other electronic devices, availability of networks, web presence, Internet services, availability of IT departments;
- **ICT-based services and applications:** Electronic medical records systems; telemedicine services; lists of electronic services; sending/receiving data to/from other health units; information security and protection; social networks; use of computers and the Internet to handle individual patient information; use of computers;
- **Education and training:** Professionals trained in ICT; ICT training programs.

Geographical coverage: The study aims to collect statistics that are consistent and representative of the country. Therefore, it is recommended that the data about the health facilities be obtained either by conducting a census or using a probability sampling approach. The study will have national- level coverage by political administrative divisions, according to the country's requirements.

STATISTICAL UNITS AND INFORMANTS

Statistical units: Statistical units refers to the health facilities described in item Target Population.

Informants: Informants are persons responsible for providing information about health facilities, assisted by IT persons in the facilities.

3 Inpatient health facilities: health establishments with inpatient beds, defined as specific physical facilities for accommodating patients for a minimum of 24 hours.

REFERENCE PERIOD AND PERIODICITY

In order to ensure data comparability, we recommend that the reference period for access and use indicators be three months (preferably the final quarter of the year). This period will however depend on each country's resources.

STUDY TYPES

Data collection can involve conducting a census of all of a country's health facilities, or using a sample design to represent health-related activity at the national level.

HEALTH FACILITIES CENSUS

If a country wishes to obtain ICT health statistics by conducting a census of health facilities, we recommend:

- Confirming that the health facility directory is fully up to date;
- Confirming the location, address and telephone number of facilities;
- Classifying the health facilities according to the country's political administrative divisions.

If all the health services have not been covered by the census, the results should specifically and clearly indicate which facilities were indeed covered, thematically and geographically, by the census.

SAMPLE DESIGN OF HEALTH FACILITIES

For countries that, for various reasons, prefer that a sample be drawn of their health facilities, we recommend probability sampling, stratified by type of healthcare facility with and without inpatient hospitalization.

Sampling frame: Preparation of the sampling frame will be based on a complete directory of all the health facilities in the country that can be classified as serving the target population defined for the study.

It is essential to use up-to-date and validated data for the sample frame. It is also important to include items such as number of beds, complexity rating of the health facility, number of annual health care interventions or average monthly interventions, number of workers, and address details.

Sampling methods: A possible sampling method would be to stratify by type of health facility, exclusively for purposes of selection, i.e., without sampling representativeness at this stage of disaggregation. Stratification can be replicated for geographical areas according to the country's political divisions, by zonal groupings (north, south, east or west), or by using other criteria according to each country's requirements.

Additional criteria can also be used to determine which facilities should be included for census-taking or mandatory inclusion, e.g., territorial importance, treatments offered, etc.

Estimate of sample size: To estimate the sample size at the national level, we recommend using probabilistic stratified random sampling, with a confidence level of 90% or higher, depending on the type of facility. To estimate the number of sampling units in each stratum, we recommend distributing the sample size proportionally to the size of the facility, according to the chosen stratification. The estimate levels will depend on the country and will correspond to the disaggregation level of the facilities that have sample representation. The sample design should permit representative sampling of:

The country's health facilities;

- The country's health facilities according to type (with and without inpatient hospitalization);
- The health facilities according to number of employees.

The representativeness levels of the sample design do not necessarily equal the disaggregation of the stratification. We recommend that these levels of representativeness be less disaggregated than the stratification.

Selection method: The selection of facilities for the survey is carried out in two stages. First, the health facilities where a census will definitely be conducted, those that fall into the "mandatory inclusion" category, are promptly selected for inclusion.

The second selection stage involves those facilities that will be subject to sampling. This will be done randomly and independently for each type of facility. If a sample frame is available that contains a directory of all duly classified health facilities, we recommend systematic selection in order to ensure a complete overview within each stratum.

Expansion factors: The data is obtained by surveying a sample of facilities. This means that in order to obtain estimates of the variables under study, the collected data needs to be expanded. In order to expand the data, the "mandatory inclusion" facilities must first be considered, given that they are "self-representing" sampling units subject to census. Second, for the randomly selected facilities, we apply the inverse of the selection probability obtained in each stratum, by type of facility or by the number of employees defined in the sample frame.

DATA COLLECTION METHOD

For conducting a survey, whether by census or sampling, we recommend that national statistics organizations coordinate their efforts with the health ministries of each country, so that they can make concerted efforts to determine the development of the conceptual and operational design of the contents of the instruments, as well as the collection and processing of the statistics and indicators, and the dissemination, use, and analysis of the data — all based on the institutional strengths of each country.

LIST OF ICT INDICATORS IN THE HEALTH SECTOR

1. PROFILE OF THE FACILITIES

For the purpose of determining the general features of the country's health facilities, the following details are required, in addition to the specific ICT indicators:

1.1 Geographical location of the health facility.

1.2 Operational status of the health facility:
- Functioning
- Partially functioning
- Temporarily closed
- Permanently closed

1.3 Number of facilities according to their legal status:
- Public
- Private

1.4 Number of facilities according to inaugural date.
1.5 Number of facilities according to type:
- Healthcare facilities without/with inpatient hospitalization (i.e., hospitals)

1.6 Number of beds (only for inpatient facilities).

1.7 Facilities that provide:
- General and specialized care, and care in a specialty area (standard classification)[4]

4 This variable, due to the large number of possible options, is excluded from measurements. This is the case, for example, of Brazil, due to operational difficulties. However, the variable can be included by those countries that wish to do so.

1.8 Number of people (by sex) employed in the health facility[5]:

- Health professionals (physicians, stomatologists/dentists, nursing staff)
- Non-health professionals
- Health technical personnel
- Non-technical health personnel
- Others

2. ICT INFRASTRUCTURE

2.1 Number of facilities that own each type of device, and quantity:

- Desktop computers
- Notebook computers
- Tablets
- Other mobile devices

2.2 Number of facilities with Internet access.

2.3 Number of facilities by types of Internet access and contracted connection speeds (ITU, n.d.)

	Type of access	
	Fixed	Cellular/Mobile
Less than 256 Kbps		
Between 256 Kbps and less than 2 Mbps		
Between 2 Mbps and less than 10 Mbps		
10 Mbps or more		

Internet access: This is considered to be access via a connection owned or paid for by an institution or company, while Internet access via devices belonging to (or paid for by) employees is not taken into account.

2.4 Number of employees (by sex) who use ICT in the course of their work in the health facility at least once a week:

- Health professionals (physicians, stomatologists/dentists, nursing staff)
- Non-health professionals
- Health technical personnel
- Non-technical health personnel
- Others

2.5 Number of facilities that have LAN networks.

LAN network: This is a network that connects a series of computers within a limited area, such as a building, department, or manufacturing plant. The network can be wireless and does not need to be connected to the Internet. A LAN requires only two or more computers to be interconnected.

2.6 Number of facilities that have:

- Intranet
- Extranet

Intranet: This is an internal communications network that uses Internet protocols and permits communication within the facility (and with other authorized users). An Intranet is normally protected by a security system (firewall) to control access.

Extranet: This is a closed network that uses Internet protocols that allows an institution or business to share data securely with suppliers, partners, vendors, customers and other commercial

5 With regard to this point (and points 2.4, 2.8, 4.3), classification by age can be included if the country requires it.

partners. An extranet can be a secure extension of an intranet that allows external users to access certain parts of the institution's or company's intranet. It can also be a private part of the website of an institution or business that is accessible to users after they have been authenticated on a login page.

2.7 Number of facilities that have one or more individuals who are specialized in (or responsible for) ICT.

2.8 Number of employees (by sex) in health facilities who are specialized in (or are responsible for) ICT.
Persons who undertake ICT-related functions are skilled in specifying, designing, developing, installing, operating, supporting, maintaining, managing, evaluating and researching ICT and ICT systems.

3. SERVICES

3.1 Number of facilities that have electronic medical record systems:

- All records are in electronic format.
- The majority of records are electronic, yet some of them are paper-based.
- The majority of records are paper-based, yet some of them are electronic.
- All records are paper-based.

Electronic medical records (or electronic health records): Electronic records containing information on a patient ́s health. They can assist healthcare professionals in decision-making and treatment (PAHO/WHO, n.d.).

3.2 Number of facilities, according to types of clinical data on a given patient that are available electronically in the facility:

- General patient data (address, telephone number, date of birth, etc.)
- Patient's medical history or clinical notes (including outpatient, hospital and surgery notes)
- Laboratory test results
- Radiology reports
- Radiology images
- Vital signs
- Vaccination records
- Allergies
- List of medication
- Diagnoses, health problems, or patient's health status

3.3 Number of facilities that provide telemedicine services:

- Radiology
- Pathology
- Dermatology
- Psychiatry
- Cardiology
- Ultrasonography
- Mammography
- Surgery
- Consultations
- Ophthalmology
- Nephrology
- Obstetrics/gynecology
- Diabetology
- Patient monitoring
- Pediatrics
- Home care
- Neurology
- Neurosurgery
- Stroke treatment
- Urology
- Oncology
- Otorhinolaryngology

Telehealth (including telemedicine): The delivery of health-related services via information and communication technologies, especially where distance is an obstacle for receiving health care (PAHO/WHO, n.d.).

3.4 Number of facilities according to types of functionalities available in their electronic systems:

- List of all patients by diagnosis
- List of all patients by laboratory test results
- List of all patients on specific medication
- Patient discharge summaries
- List of all medication that a specific patient is taking, including medication prescribed by other physicians
- List of all laboratory test results of a specific patient
- List of all the results of radiology tests, including reports and images related to a specific patient
- System enables consultations, tests or surgery to be prearranged
- System enables requests for laboratory tests
- System enables requests for imaging tests
- System enables requests for medication/medical prescriptions
- System enables ordering of materials and supplies

3.5 Number of facilities according to types of data electronically sent to or received from other facilities:

- Clinical data sent to healthcare professionals in other facilities
- Patient referrals to other facilities sent electronically
- Reports on types of health care received by patients that are made available on discharge or when patient are transferred to other facilities
- List of all the medication prescribed to patients on transferal to other health facilities
- Results of patients' laboratory tests that are made available to other facilities
- Results of patients' imaging tests that are made available to other facilities
- Nursing care plans

3.6 Number of facilities that have electronic data security tools:

- Anti-spam and anti-malware (malware includes viruses, worms, Trojans, rootkits, spyware, intrusive adware and any other malicious software)
- Firewalls, IDS (intruder detection systems), IPS (intruder prevention systems), WAF (web application firewalls)
- Data protection technology (database encryption), DAM (data access monitoring), DLP (data loss prevention systems)
- Authentication technologies (passwords, biometrics, tokens, OTP, intelligent cards, digital certificates)
- Safe communication technologies in client-server applications (HTTPS, VPN) with some blocking devices, such as for online stores, access to unwanted sites, music streaming, etc.
- Restricted access to Internet sites (security policy with some blocking functions such as for online stores, access to unwanted sites, music streaming, etc.)
- Security information and event management (SIEM)

3.7 Number of facilities with websites.

3.8 Number of facilities according to types of website hosting.

3.9 Number of facilities that use social media for advertising their services:

- Social networks (Facebook, Google +)
- Instant messaging networks (WhatsApp, Telegram)
- Microblogging networks (Twitter, Tumblr, FriendFeed)
- Professional networks (LinkedIn, Yammer)
- Image sharing networks (Flickr, Picasa, Pinterest, Instagram)
- Video networks (YouTube, Vimeo)

3.10 Number of facilities, by types of services that can be arranged by telephone:

- Appointment management
- Appointment reminders
- General patient information services
- General information about services provided by the facilities
- Free emergency telephone lines
- Community mobilization and health promotion
- Awareness raising

3.11 Number of facilities according to the types of online services provided:

- Booking medical appointments (electronic agenda)
- Booking appointments for tests
- Visualization of diagnostic test results
- Visualization of medical records or files
- Data insertion in medical records by patients
-

4. EDUCATION AND TRAINING

4.1 Number of facilities that use ICT training programs:

- Distance learning
- Classroom training

eLearning or virtual education (including distance training or learning): This is a means of applying information and communication technologies to learning. It can be used to improve the quality of education, to increase access to education, and to bring new and innovative forms of teaching within the reach of a greater number of people (PAHO/WHO, n.d.)

4.2 Number of facilities that have ICT training programs on:

- Electronic health records (or electronic medical records)
- Pharmacotherapy management
- Clinical-administrative management systems
- Digital medical imaging
- Information systems
- Telemedicine services
- Public or occupational health surveillance systems
- Health education distance learning programs

4.3 Number of employees (by sex) who have received ICT training organized by the health facilities:

- Health professionals (physicians, stomatologists/dentists, nursing staff)
- Non-health professionals
- Health technical personnel
- Non-technical health personnel
- Others

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EVIDENCE FOR SUPPORTING THE DEVELOPMENT OF HEALTH POLICIES: BRAZIL'S EXPERIENCE

→ *Luciana Portilho*[1] *and Fabio Senne*[2]

INTRODUCTION

As it is the case in a wide variety of sectors in society, the use of information and communication technologies (ICT) has had a major impact on the field of health. The opportunities they offer to the sector include improved care, greater safety and alignment with patients' needs, and more efficient provision of services, which involves more accessible care with less waste of resources. As alert systems, ICT can reduce drug prescription errors, by immediately providing information about possible inconsistencies. Furthermore, the use of telehealth tools broadens access to health services, particularly in rural zones and other areas that are distant from urban centers (Organisation for Economic Cooperation and Development [OECD] and Inter-American Development Bank [IADB], 2016).

The idea that the use of ICT has the potential to improve health care is increasingly common in international forums on the information society, and provides an incentive for adopting goals directly associated with eHealth. This concept was highlighted in 2003 by the Plan of Action of the World Summit on the Information Society (WSIS) as one of the fundamental applications of ICT for human and social development (International Telecommunications Union [ITU], 2003). Connecting healthcare facilities and hospitals to the Internet is one of the ten objectives outlined by the WSIS. This makes the health sphere one of the priority elements for the objectives established in the Summit.

Although not explicitly mentioning eHealth, the 2030 Agenda for Sustainable Development, formulated in 2015 by the United Nations, set targets for Goal 3, Good Health and Well-Being, that can be strengthened by the adoption of ICT. Telehealth tools can play an important role in achieving Target 3.8, which establishes that countries must achieve universal health coverage. The use of these tools is even more necessary in countries with large territorial areas and significant regional inequalities (United Nations [UN], 2016).

Within the context of Latin America, promotion of the use of ICT in various strategic sectors has been bolstered by the Plan of Action for the Information and Knowledge Society for Latin America and the Caribbean. One of its action lines is promotion of the use of ICT for health and social security activities: "Given the incipient development of digital technologies and networks in health-care systems, the major challenge is to integrate e-health with national strategies and regional cooperation in this sphere" (Economic Commission for Latin America and the Caribbean [ECLAC], 2010).

However, despite the potential benefits of these technologies and the growing recognition that they are a fundamental element in expanding healthcare coverage and improving services, the

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implementation and full incorporation of ICT into the daily activities of health facilities still involves major challenges that will require detailed planning, considerable investment of resources and coordination of the various actors involved. Some of these challenges do not depend solely on the choice of the technologies to be adopted, but also on changes in the organizational culture of health facilities and the appropriation of these technologies by healthcare professionals. It should also be taken into account that the results of incorporating ICT into health care are multidimensional; their scope is often uncertain, and they are difficult to control and measure.

Within this context of recognition of eHealth by international bodies and its growing incorporation in health facilities, there is also a need to identify the ICT infrastructure available in health facilities, as well as the appropriation of this technology by healthcare professionals. The production of such data allows, not only identification of the state of adoption of these technologies in health facilities, but also assessment of how they contribute to the formulation and evaluation of specific public policies in the health field, by generating information for public managers, healthcare facilities, healthcare professionals, the academic sector and civil society.

To meet this need, the Regional Center for Studies on the Development of the Information Society (Cetic.br) has been conducting the *Survey on the Use of Information and Communication Technologies in Brazilian Healthcare Facilities (ICT in Health)*, since 2013. Using internationally comparable indicators that were developed using as a reference the indicators recommended by the OECD and Statistical Conference of the Americas of ECLAC, the ICT in Health survey collects data annually on ICT infrastructure in Brazilian healthcare facilities and the appropriation of these technologies by healthcare professionals.

This chapter will offer a descriptive analysis of the main results of the ICT in Health survey, based on all the surveys conducted to date. After providing an overview of the adoption of digital health in Brazil, the article will describe in detail some of the main challenges for public policies in this sector.

THE ICT IN HEALTH SURVEY IN BRAZIL

Brazil has had a tool for monitoring the adoption of information and communication technologies in health since 2013: the ICT in Health survey, conducted by the Regional Center for Studies on the Development of the Information Society (Cetic.br), which is a department of the Brazilian Network Information Center (NIC.br), linked to the Brazilian Internet Steering Committee (CGI.br).

The overall goal of the survey is to understand the state of ICT adoption in Brazilian healthcare facilities and its appropriation by healthcare professionals. In relation to facilities, the objective is to identify the available ICT infrastructures and investigate the use of ICT-based systems and applications to support care services and management of facilities. With respect to healthcare professionals, the survey examines their skills and the activities they carry out with ICT; it also seeks to understand the motivations and barriers related to the adoption of ICT.

The target population of the survey is composed of Brazilian healthcare facilities and professionals, registered with the National Registry of Health Care Facilities (CNES), under the responsibility of the Department of Informatics of the Brazilian Publica Health System SUS (Datasus) under the Ministry of Health. The survey focuses on public and private healthcare facilities registered with the CNES and set up as legal entities, with physical facilities designated exclusively for healthcare activities, with at least one physician or nurse on staff.

The data collection is carried out in two stages. In the first, a questionnaire is administered to the managers of the facilities, preferably from information technology (IT) departments, who answer questions on the infrastructure for and availability of ICT services in the healthcare facilities. In the second stage, a questionnaire is administered to healthcare professionals (physicians and nurses) from the same facilities who, in turn, answer questions about their use and appropriation of these technologies in their work routines. The computer-assisted telephone interviewing (CATI) technique is used for interviews with both managers and healthcare professionals.

The sample plan of the ICT in Health survey is based on stratified sampling of healthcare facilities and selection with probability proportional to size (PPS). The sample design has 80 strata resulting from the combination of the categories of four variables: administrative jurisdiction (public or private); region (North, Northeast, Center-West, Southeast and South); type of facility (outpatient, inpatient with up to 50 beds, inpatient with more than 50 beds, and diagnosis and therapy services); and location (capitals or non-capital cities).

The data from the ICT in Health survey presented in this chapter refers to data from all the annual surveys conducted between 2013 and 2017. In the 2017 survey, the reference population of the survey consisted of 96,911 healthcare facilities throughout the country. A total of 2,336 managers responsible for the facilities and 4,281 healthcare professionals (1,629 physicians and 2,652 nurses) were interviewed. Since it is a probabilistic sample, it was possible to establish a selection of the units chosen, in order to generalize the survey results for the population considered in the survey.

DISCUSSION OF THE RESULTS

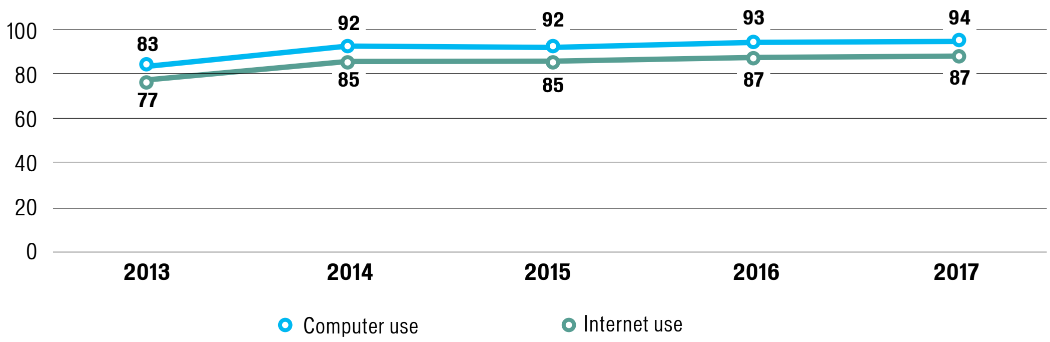
ICT INFRASTRUCTURE IN BRAZILIAN HEALTHCARE FACILITIES

Computer use and Internet access are essential requirements for building a digital health environment, but they are not sufficient on their own to ensure adequate incorporation of ICT in the sector. Data from the ICT in Health survey indicates that, between 2013 and 2014, there was growth in both computer use and Internet access: healthcare facilities that used computers rose from 83% to 92% and the percentage of facilities with Internet access increased from 77% to 85%. Nevertheless, an analysis of the last three years shows stagnation in these two indicators (Chart 1).

CHART 1.

HEALTHCARE FACILITIES THAT USED COMPUTERS AND THE INTERNET (2013 - 2017)

→*Total of healthcare facilities (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2013-2017).

In 2017, 94% of Brazil's healthcare facilities used computers and 87% had Internet access. There were still significant inequalities in terms of access to ICT infrastructure depending on administrative jurisdiction, type of facility, and location. Whereas computer use and Internet access were universal in private facilities, facilities located in capital cities, and those with more than 50 beds, this level of coverage had still not been achieved in public facilities, outpatient facilities, and those located in non-capital cities. In the case of the latter facilities, there was still a considerable difference between those that used computers, but did not have Internet connection (Chart 2).

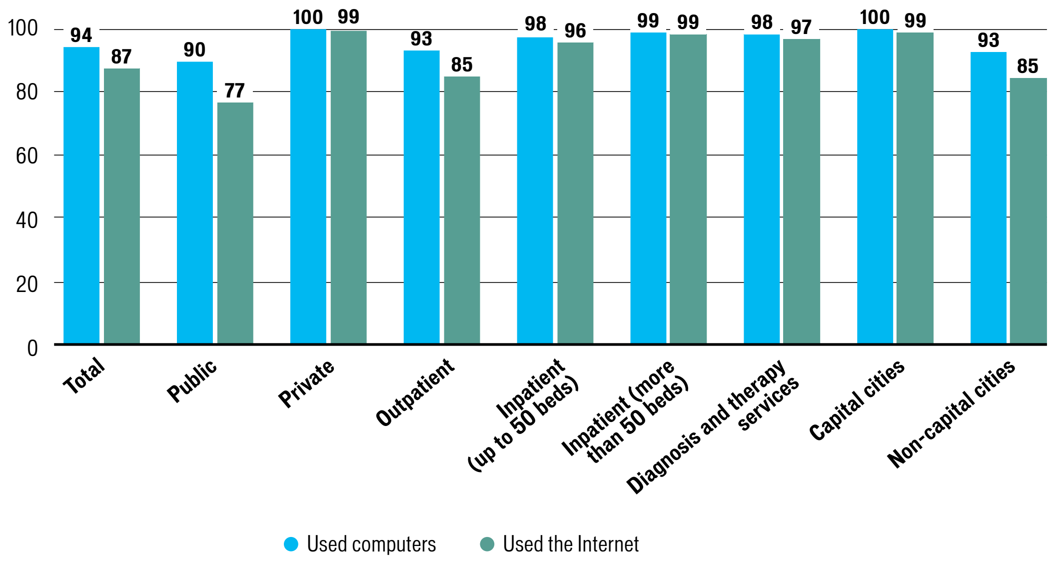
In relation to public healthcare facilities, it was found that 90% used computers and 77% had Internet connections in 2017. Facilities with inpatient hospitalization and those located in non-capital cities had the same percentages of computer use and Internet access: 93% and 85%, respectively.

Regional inequalities – a characteristic applicable to various sectors – were also replicated in the field of health, as shown by the fact that 14% of healthcare facilities in the Northeast did not use computers, and 24% and 25% of the facilities in the Northeast and North, respectively, did not have Internet connections.

CHART 2.

HEALTHCARE FACILITIES THAT USED COMPUTERS AND THE INTERNET DURING THE LAST 12 MONTHS (2017)

→ *Total of healthcare facilities (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

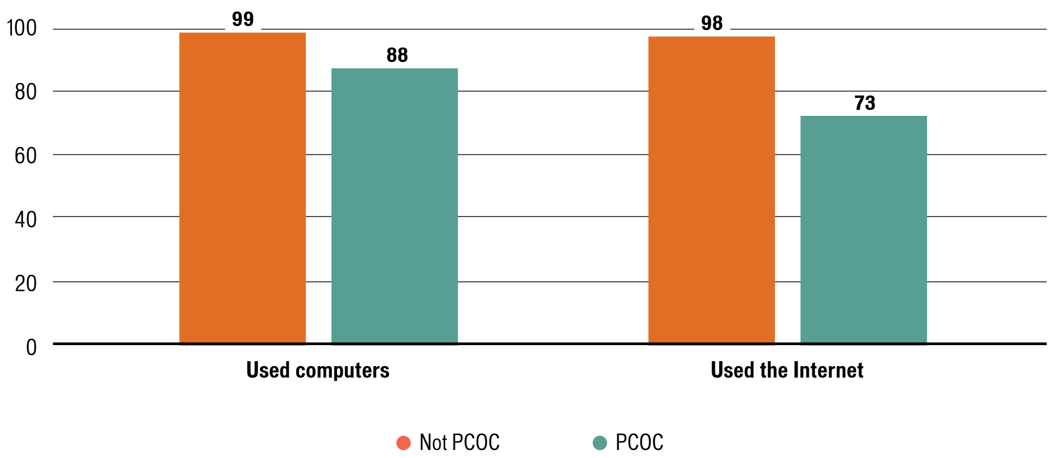
Despite these inequalities, the situation has improved in the last five years. Between 2013 and 2017, the percentage of public healthcare facilities that used computers increased from 68% to 90%; in outpatient facilities use climbed from 78% to 93%; and in those located in non-capital cities, it rose from 79% to 93%. In relation to Internet access, the percentage increased from 57% to 77% in public facilities from 71% to 85% in outpatient facilities, and from 79% to 93% in those located in non-capital cities.

A disaggregated analysis of public facilities more clearly demonstrates the deficiency in ICT use. According to the 2017 data, facilities classified as primary care outpatient clinics (PCOC) had the worst results for both computer use and Internet access; it should be noted that 12% of PCOCs did not use computers and 27% had no Internet access (Chart 3). It is estimated that out of the approximately 5,500 facilities that did not use computers, 98% were public (5,350) and 89% were PCOCs (around 4,850). In addition, it is calculated that approximately 6,500 public facilities and 5,900 PCOCs still lacked Internet access. Considering that these facilities are mostly located in regions distant from major urban centers and have poor ICT infrastructure, the data reflects the magnitude of the challenge and the urgency of making the necessary investments to improve the infrastructure of these facilities. In 2017, the Ministry of Health announced the Primary Care Computerization Program, in order to ensure technological infrastructure, as well as IT services that enable implementing and maintaining electronic health records in all the PCOCs of the country. The goal is to complete this before the end of 2018 (Ministry of Health, 2017a).

CHART 3.

HEALTHCARE FACILITIES THAT USED COMPUTERS AND ACCESSED THE INTERNET – PRIMARY CARE OUTPATIENT CLINICS (2017)

→ *Total of healthcare facilities (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

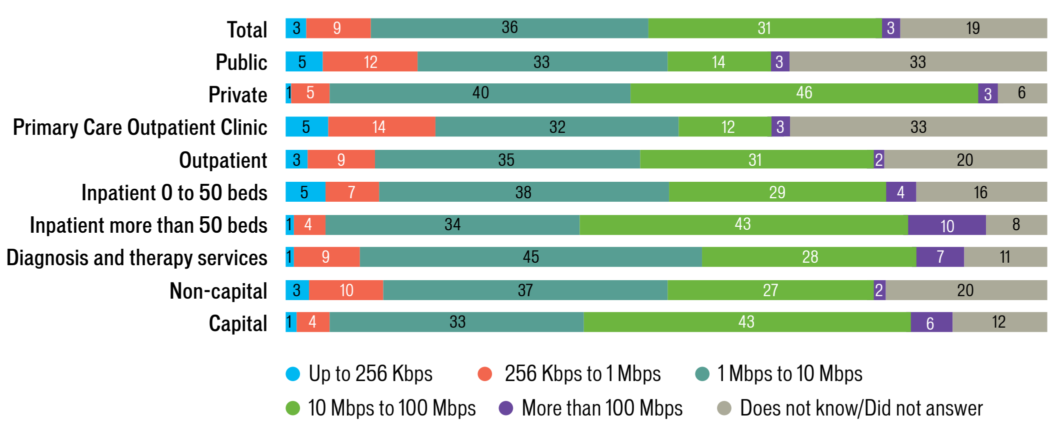
Internet access quality is also an important factor for full adoption of ICT in the health sector. According to the 2017 data, the connection speeds used the most by Brazilian healthcare facilities were more than 1 Mbps to 10 Mbps (36%) and more than 10 Mbps to 100 Mbps (31%). It should be noted that the latter connection speed range was used by 12% of the facilities, whereas speeds greater than 100 Mbps were only used by 3%.

The disaggregation of connection speeds, according to the analysis variables used in the survey, also reveals the persistence of significant disparities. Private facilities, inpatient facilities with more than 50 beds, and those located in capital cities used higher speed connections, on average, than public and outpatient facilities and those located in non-capital cities (Chart 4). Primary care outpatient clinics had the poorest results in terms of connection speeds.

CHART 4.

DOWNLOAD SPEED RANGE (2017)

→ *Total of healthcare facilities that used the Internet in the last 12 months (%)*



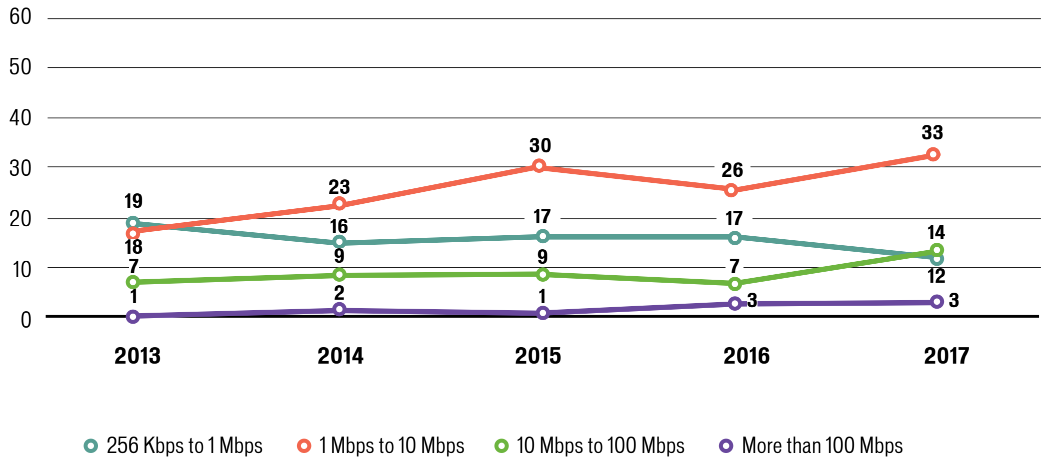
SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

It should be noted that since 2013 there has been an increase in connection speeds, in both private and public healthcare facilities. An analysis of all the surveys to date suggests that cheaper connections (up to 1 Mbps) are decreasing in public facilities, whereas intermediate speeds are increasing. In private healthcare facilities, the increase in connecwtion speeds of 10 Mbps to 100 Mbps is striking: rising from 11% in 2013 to 46% in 2017.

GRAPH 5.

PUBLIC HEALTHCARE FACILITIES BY MAXIMUM DOWNLOAD SPEED RANGE

→ *Total of public healthcare facilities that used the Internet in the last 12 months (%)*

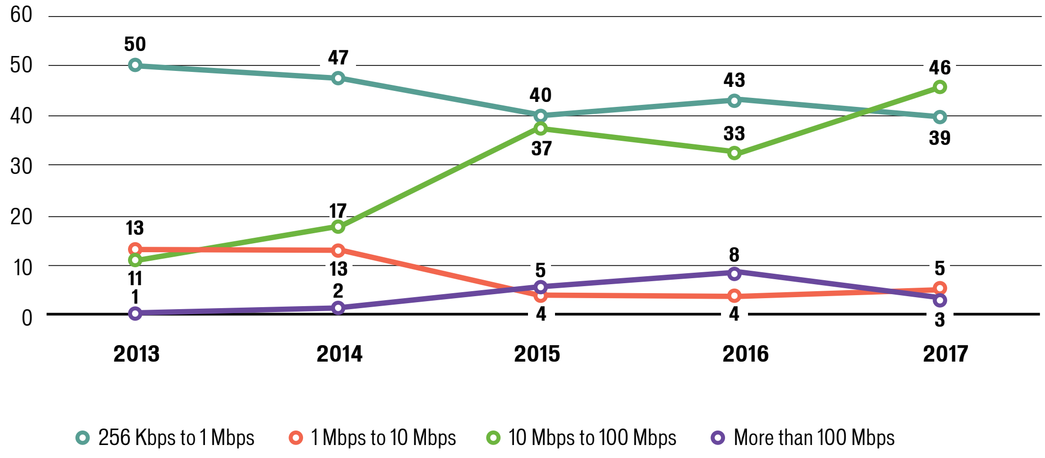


SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2013-2017).

GRAPH 6.

PRIVATE HEALTHCARE FACILITIES BY MAXIMUM DOWNLOAD SPEED RANGE

→ *Total of private facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2013-2017).

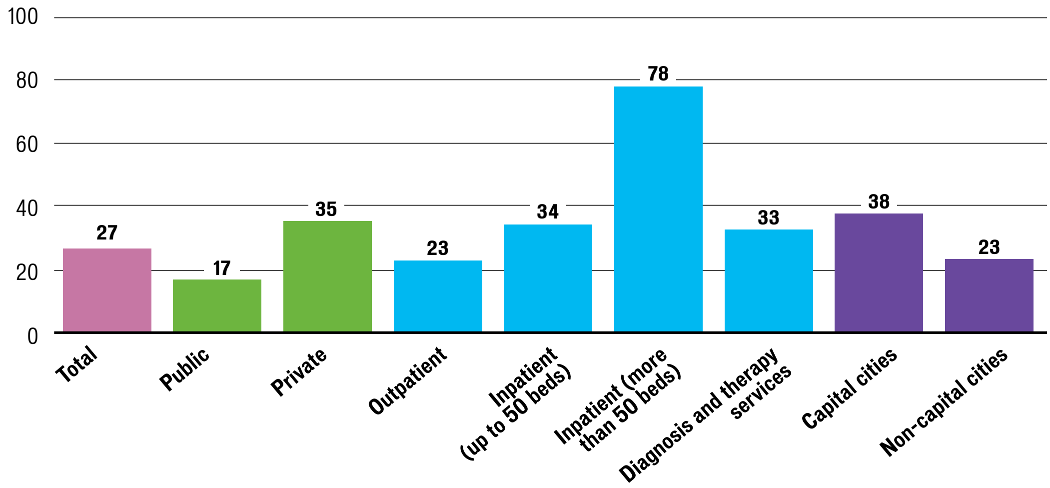
ICT MANAGEMENT IN HEALTHCARE FACILITIES

The presence of IT departments, as well as trained professionals to manage the IT resources of healthcare facilities, is another relevant factor for the use and appropriation of these technologies in health management and provision of care. In 2017, 27% of the facilities that had used the Internet during the 12 months prior to the survey had departments or persons in charge of IT management. The percentage of facilities with IT departments was higher among inpatient facilities with more than 50 beds (78%) and those located in capital cities (38%) (Chart 7).

CHART 7.

HEALTHCARE FACILITIES WITH INFORMATION TECHNOLOGY DEPARTMENTS OR AREAS BY TYPE OF FACILITY (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

The presence of professionals with health training in IT departments also has an influence on the appropriation of ICT for providing care. However, this is not very common in Brazilian healthcare facilities: only 11% of the facilities with IT departments had professionals with health training on their IT teams. In view of the increasingly intensive use of this type of technology in healthcare facilities, health information technology training policies are essential for incorporating this technology into the complex realm of health.

The ICT in Health survey also shows that, in 2017, only 22% of the facilities with Internet access had internal teams for providing IT support services. This percentage was higher among private facilities (26%) and those with more than 50 beds (64%). It should also be mentioned that in 67% of public facilities, the service providers were contracted by the Department of Health.

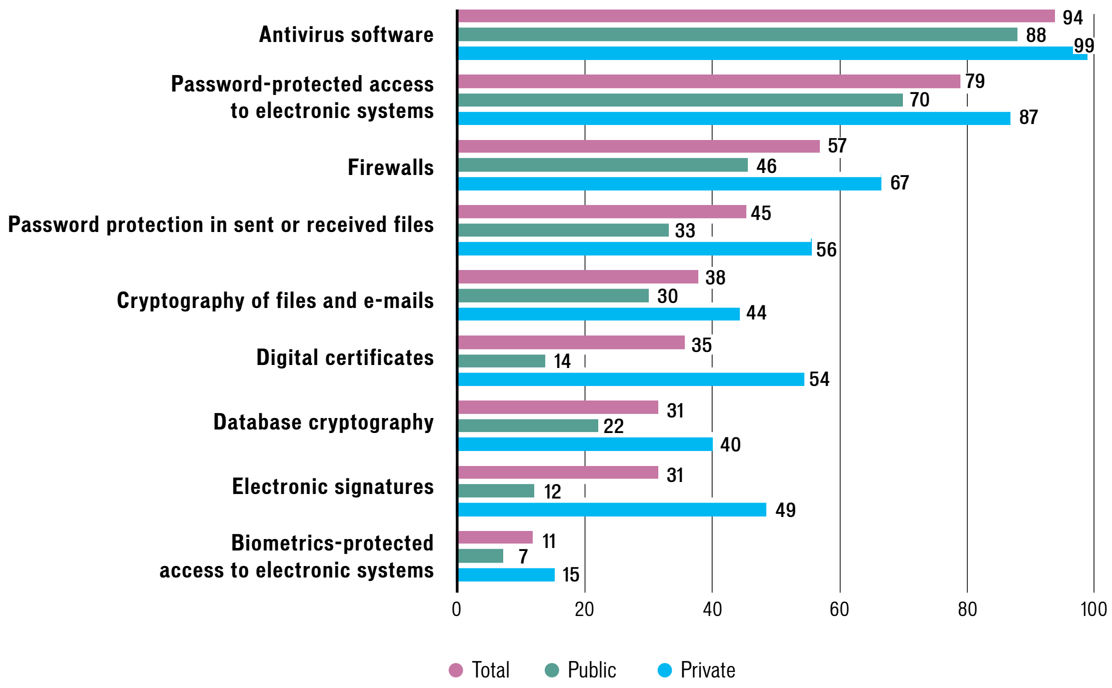
Another aspect worth highlighting is information security and privacy management. This issue is very important in healthcare facilities, since they work daily with sensitive patient data. Among facilities with Internet access, 29% reported having information security policies, and this was more common among facilities with more than 50 beds (54%).

Among the information security tools used, those with a higher degree of sophistication were not very common, such as biometrics-protected access to electronic systems (11%), electronic signatures (31%) and database cryptography (31%). The most frequently used were antivirus software (96%), password-protected access to electronic systems (79%) and firewalls (57%). Also worth noting is the difference between public and private facilities in the use of these tools, as shown in Chart 8.

CHART 8.

HEALTHCARE FACILITIES BY TYPE OF INFORMATION SECURITY TOOLS USED (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

ELECTRONIC HEALTH RECORDS AND DECISION-MAKING SUPPORT

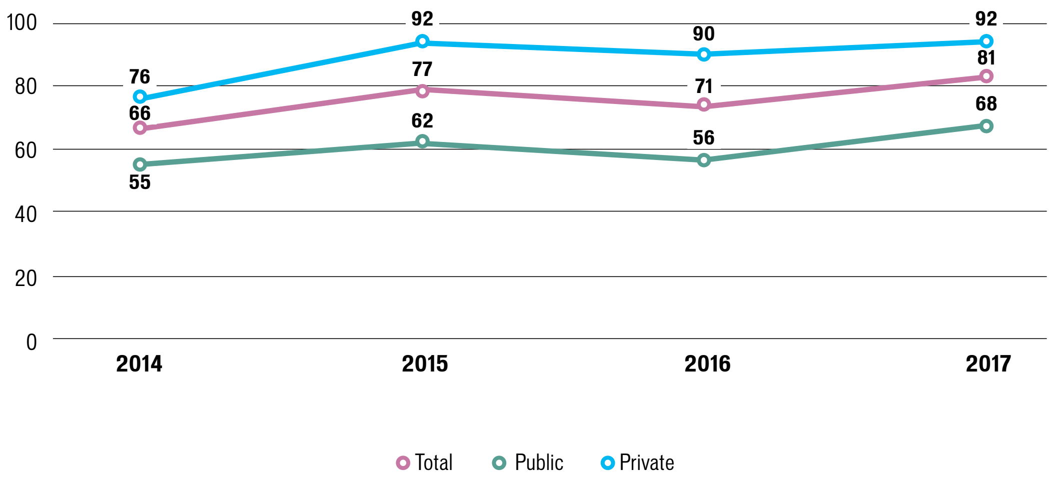
Although the use of computers and the Internet has been on the rise in most healthcare facilities, one of the main challenges in adopting ICT in the field of health is storage and sharing of patient information contained in electronic health records (Martins & Lima, 2014; Kruse, Kristof, Jones, Mitchell, & Martinez, 2016).

According to the data from all the ICT in Health surveys to date, the use of electronic health records by healthcare facilities has increased in the last four years. In relation to the total number of facilities with Internet access, 66% reported having electronic systems for recording patient information in 2014, compared to 81% in 2017. The difference between public and private facilities that use electronic health records is also worth examining. Whereas the percentage of private facilities that used electronic health records rose from 76% to 92%, the increase in public facilities was from 55% to 66% in the same period.

CHART 9.

HEALTHCARE FACILITIES BY AVAILABILITY OF ELECTRONIC SYSTEMS TO RECORD PATIENT INFORMATION (2014 - 2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2014-2017).

Among the types of facilities, diagnosis and therapy services (92%) and those with more than 50 beds (87%) stood out for the high percentage of facilities with electronic record systems of some kind. On the other hand, primary care outpatient clinics and facilities without inpatient hospitalization had the lowest percentage of electronic health record use (69% in both cases).

In relation to the clinical histories of patients, this information was stored entirely in electronic format in 21% of the facilities with Internet access, as opposed to 15% in 2015. In 24% of the facilities, this data was stored on paper only, with no change over the course of the history of the survey. With respect to storage, whether in electronic or paper format, the percentage of facilities dropped from 58% in 2015 to 53% in 2017. In the case of diagnosis and therapy services, 33% stored information in electronic format only. Inpatient facilities with up to 50 beds had the highest percentage of use of paper records only (34%).

Also worth noting is the high proportion of public facilities with Internet access that reported storing the registration and clinical information of patients on paper only (39%). This demonstrates the challenge in implementing integrated health information technology policies that enable individualized records of the health status of SUS users, such as electronic health records of citizens.

Toward the end of 2016, the Ministry of Health announced that Brazilian cities should adopt the use of electronic medical records in all primary care outpatient clinics, i.e., the e-SUS Primary Care System, with the electronic clinical history of each citizen being recorded on software that meets these requirements. This software would need to store all the clinical and administrative information of patients within the scope of primary care outpatient clinics. The main objective is to systematize the flow of patient care by healthcare professionals (MS, 2017b).

The ICT in Health survey also presents a set of indicators to identify the degree of maturity of electronic systems existing in the facilities. In accordance with the international benchmark used for measuring ICT in the health sector, the items were developed according to a functionality-based approach, i.e., a consensus regarding the basic types of clinical activities that are comparable among electronic systems (ECLAC, 2010).

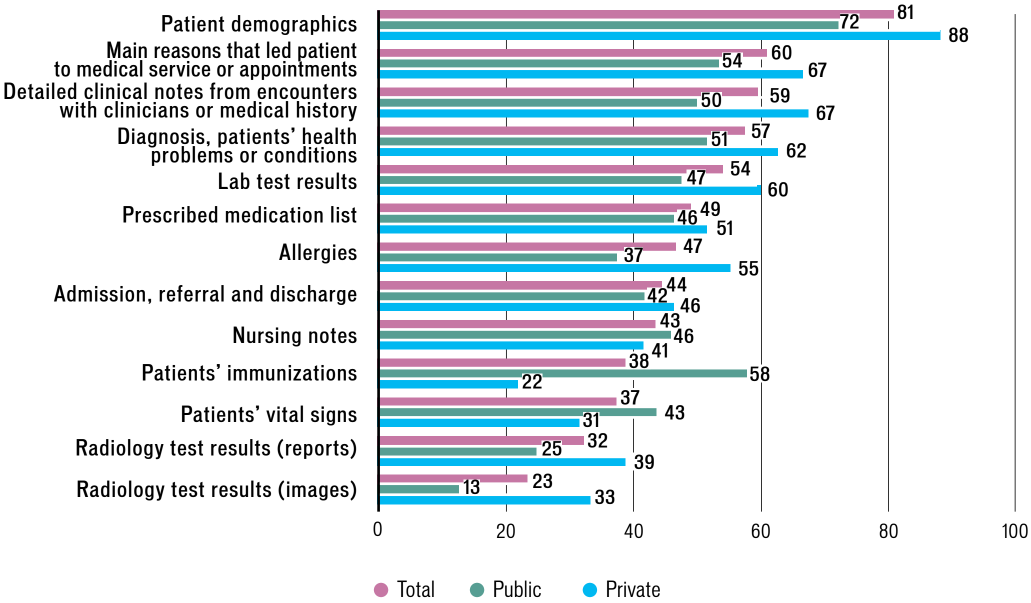
The information and functionalities found more frequently in healthcare facilities were generally administrative in nature, as opposed to electronic data and tools more related to clinical care and direct patient care support (Chart 10). The type of patient information available the most in electronic format in the facilities was registration data (81%).

Information regarding the clinical care of patients was less available in the systems of the facilities: detailed clinical notes from encounters with clinicians or medical history (59%); diagnosis, patients' health problems or conditions (57%); lab test results (54%), radiology test results (reports) (32%) and radiology test results (images) (23%). It is worth noting that the proportion of private facilities that made this information available electronically was higher than in public facilities.

CHART 10.

PATIENT DATA AVAILABLE ELECTRONICALLY (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

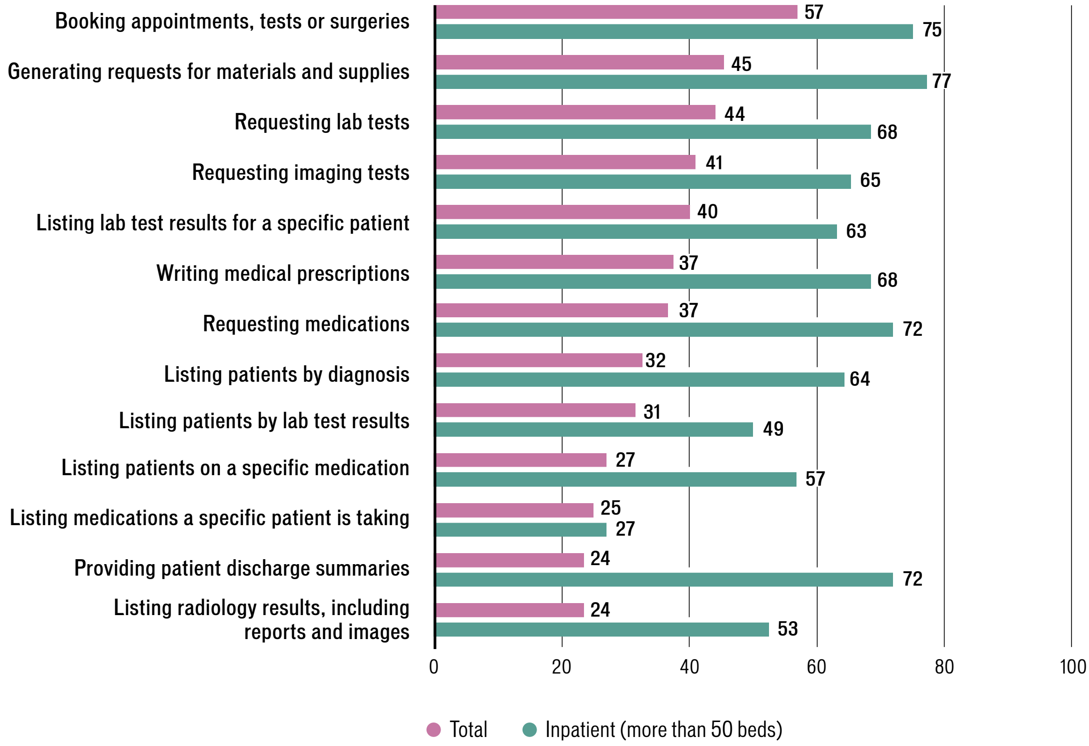
Similar to the types of information stored electronically, the functionalities made available by the health facilities were those related to management activities, over and above clinical functionalities. The most common were booking appointments, tests or surgeries (57%) and generating requests for materials and supplies (45%). The functionalities less available electronically were those related to the generation of disaggregated data, in list or report format. Actions such as listing radiology results, including reports and images, and providing patient discharge summaries took place in 24% of facilities. In turn, listing patients on a specific medication also occurred in 25%.

Comparison between the total number of facilities and those with more than 50 beds (Chart 11) allowed to evidence the differences between the types of facilities in which these functionalities presented higher proportions than in the mean of the facilities.

CHART 11.

FUNCTIONALITIES AVAILABLE ELECTRONICALLY (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



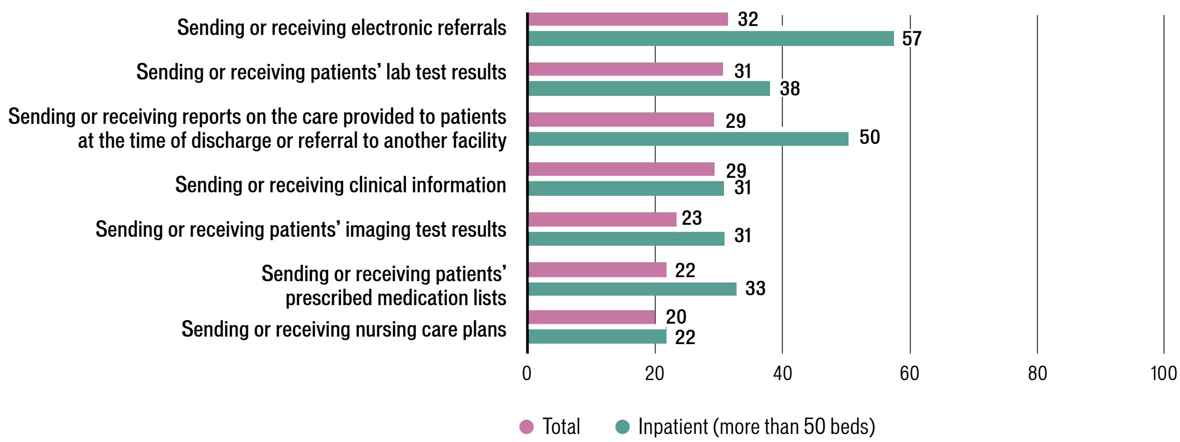
SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

In 2017, the most common functionalities were available in around one-third of the healthcare facilities. Facilities with more than 50 beds also provided these functionalities in higher proportions, as shown in Chart 12. An exception was noted in sending or receiving patients' lab test results to other facilities, a functionality that showed higher availability in diagnosis and therapy services.

CHART 12.

INFORMATION EXCHANGE FUNCTIONALITY AVAILABLE IN SYSTEMS (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

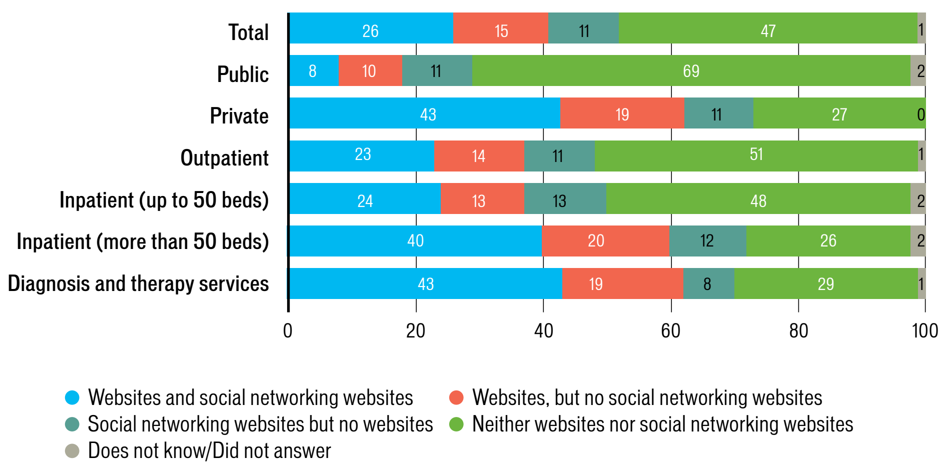
ONLINE SERVICES AND TELEHEALTH

The ICT in Health survey also examines the Internet presence of healthcare facilities, in the form of websites and social networking websites, as well as the provision of online services. In 2017, 26% of the healthcare facilities had their own website and profiles on social networking websites; 15% had websites but were not present on social networking websites, whereas 11% were only present on social networking websites, and 47% had no websites and were not present on social networking websites. Inpatient facilities with more than 50 beds and diagnosis and therapy support services were the types of facilities with greater Internet presence, as indicated in Chart 13.

CHART 13.

INTERNET PRESENCE THROUGH WEBSITES AND SOCIAL NETWORKING WEBSITES (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

The service most offered by healthcare facilities was viewing lab test results (31%), followed by booking lab tests (24%) and booking appointments (22%). Viewing electronic medical records was the service provided the least (by only 9% of facilities). Viewing lab test results (65%) and booking lab tests (40%) were provided in higher proportions by diagnosis and therapy support service facilities.

According to the World Health Organization, telehealth can be defined in broad terms as the use of information and communication technologies to deliver health care outside of traditional health-care facilities (WHO, n.d.). More specifically, it can be said that telehealth includes health activities such as distance learning and research, interaction among professionals through teleconferences, and remote patient monitoring and providing remote clinical services.

Due to these characteristics, telehealth is increasingly considered an important tool for enhancing health care, expanding and improving access to services in remote areas with few resources, and reducing procedural errors (OECD and IADB, 2016). Within the context of government and fulfillment of the Sustainable Development Goals of the 2030 Agenda of the United Nations, telehealth strategies are viewed as important tools for achieving established goals, such as universal health care (UN, 2015).

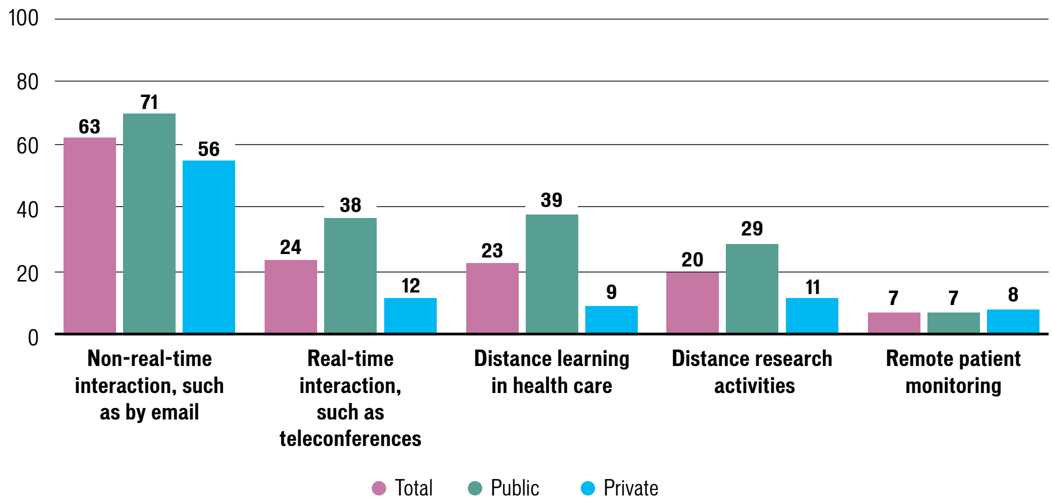
According to data from the ICT in Health 2017 survey, 63% of the facilities offered interactive services (although not in real time), such as by email; 24% offered real-time interactive services, such as by teleconferences; 23% offered distance learning in health care; 20% offered distance research activities; and only 7% offered remote patient monitoring. Over the history of the survey there has not been a significant change in the data in terms of the percentages of facilities that offer these telehealth services.

It is important to point out that, unlike the pattern observed thus far with the other indicators, in the case of telehealth, public facilities offered these types of services the most (Chart 14).

CHART 14.

TELEHEALTH SERVICES AVAILABLE (2017)

→ *Total of facilities that used the Internet in the last 12 months (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

It is important to point out that primary care outpatient clinics, which had the lowest percentages in relation to ICT infrastructure and presence of information technology systems, stood out in the indicator of availability of telehealth services. The type of service offered the most was that which did not occur in real time (72%), followed by distance learning in health care (46%), real-time interaction (42%) and, last, distance research activities (35%). The better results for primary care outpatient clinics in this indicator, compared to the other types of healthcare facilities, may be a reflection of the effect of public policies aimed at expanding the use of this type of technology.

It is necessary to bear in mind that one of the characteristics of primary care outpatient clinics is their presence throughout the country – from major urban centers to the most distant locations. In this sense, the use of telehealth tools is highly strategic in efforts to provide the entire population with quality health care.

USE OF ICT BY HEALTHCARE PROFESSIONALS

Adoption of ICT promotes changes in the organizational culture of healthcare facilities, through altering processes and procedures already assimilated by professionals. Possible resistance to new technologies and different organization of the workplace by health workers can reduce, or even prevent, the consolidation of the expected benefits. At the same time, lack of necessary training and involvement by professionals in the development of systems can also become factors that limit fully harnessing the potential of using ICT. In the health sector, which has highly complex processes and intensively uses very specialized manpower, the manner in which professionals embrace ICT is a fundamental element of successful implementation of these technologies.

Taking this into consideration, the ICT in Health survey has been investigating the appropriation of ICT by physicians and nurses in Brazilian healthcare facilities since its first edition. The 2017 data indicated intensive use of computers and the Internet by physicians and nurses who were in direct contact with patients. It was noted that 85% of physicians and 88% of nurses had access to computers in the facilities. With respect to Internet access, 91% of physicians and 90% of nurses had Internet access in the healthcare facilities.

In 2017, 40% of physicians issued prescriptions electronically. The second most common way to issue prescriptions was mixed: both electronically and manually (35%). Only 22% of physicians exclusively issued prescriptions electronically. Despite the high percentage of physicians who issued prescriptions electronically, only 14% signed prescriptions electronically, through digital certificates.

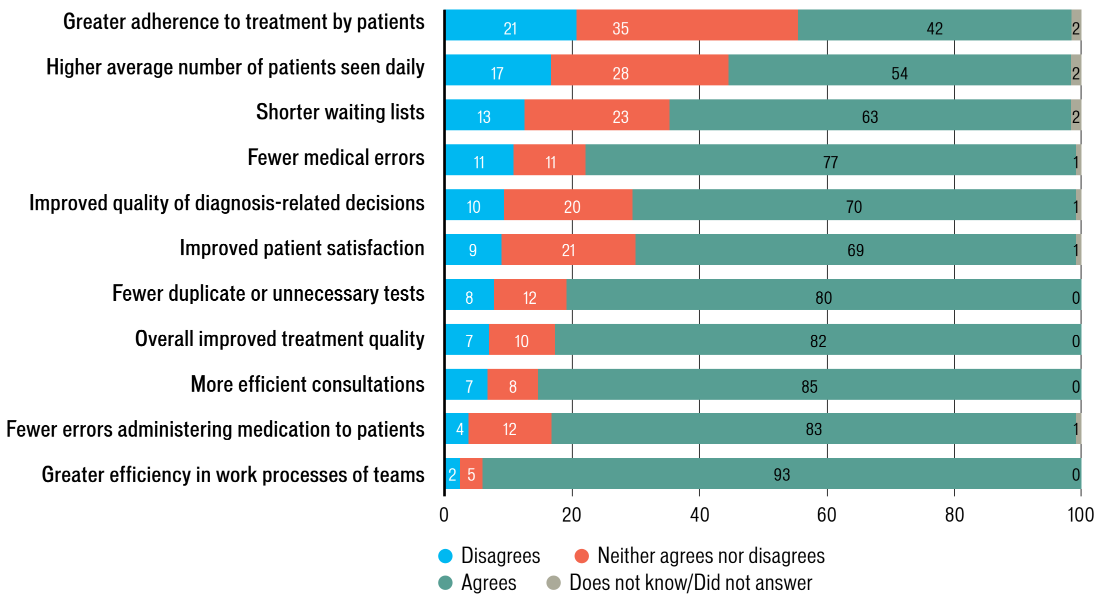
The increasingly intensive use of ICT in healthcare facilities and the rapid transformation of these technologies require professionals to constantly update their knowledge. Although effective use of these technologies depends partly on professional training, only 16% of physicians and 28% of nurses had taken ICT refresher courses in the 12 months prior to the survey.

Finally, the positive outlook of both physicians and nurses on the use of ICT in their healthcare facilities is worth highlighting. Most said that ICT has positive effects on enhancing patient care quality and reducing errors, among other impacts (Charts 15 and 16).

CHART 15.

PERCEPTION OF PHYSICIANS REGARDING THE IMPLEMENTATION OF ELECTRONIC SYSTEMS (2017)

→ *Total of physicians (%)*

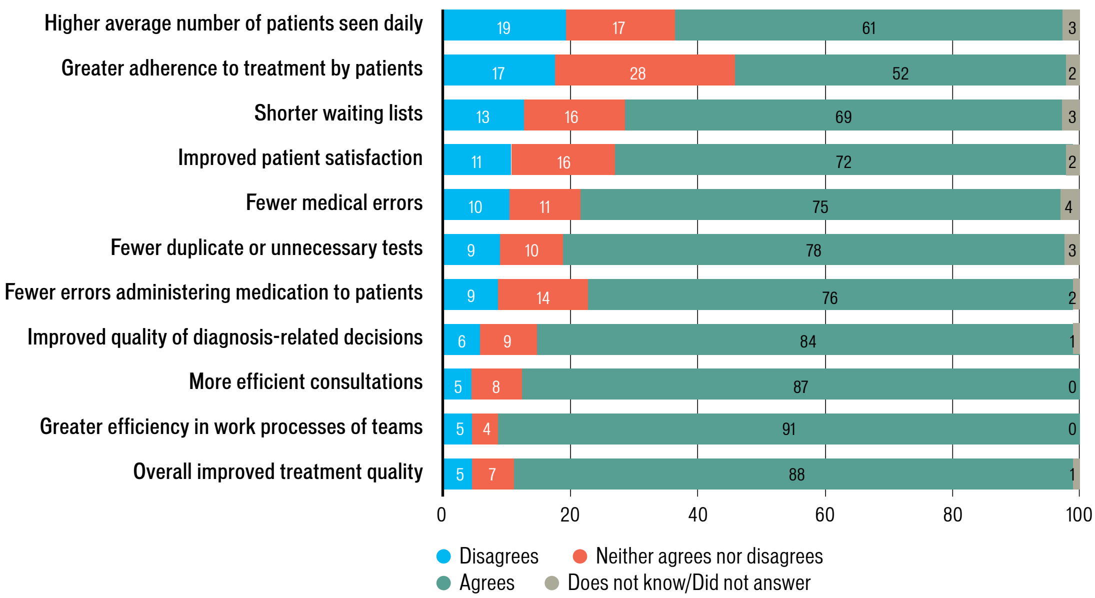


SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

CHART 16.

PERCEPTION OF NURSES REGARDING THE IMPLEMENTATION OF ELECTRONIC SYSTEMS (2017)

→ *Total of nurses (%)*



SOURCE: CGI.BR, ICT IN HEALTH SURVEY (2017).

FINAL CONSIDERATIONS

Over the last five years, regular monitoring of the adoption of ICT in the Brazilian health field has revealed in detail the needs and obstacles faced by the sector, in addition to providing guidance for drawing up public policies based on more effective and efficient strategies.

Although basic access to ICT infrastructure is reasonably widespread among Brazilian healthcare facilities, the data also indicates the existence of limitations, ranging from insufficient technological infrastructure in healthcare facilities to ineffective use of technologies to support clinical decisions.

The fact that there are still thousands of facilities without computers or Internet access, particularly in primary care outpatient clinics, continues to be a barrier that must be overcome in order to create electronic health records, which would enable computerizing the system at a national level.

In the case of electronic systems, their dissemination among public Brazilian healthcare facilities is a struggle due to the amount of resources needed to implement them – the positive impact of the use of these technologies is perceived more favorably when the systems are implemented in the various sectors of each facility – and due to the difficulty of adapting them to the reality of the health sector. One way to make progress is by expanding the IT areas or departments in healthcare facilities and by involving healthcare professionals with IT knowledge. This improves implementation of policies that meet the specific needs of the health sector.

Another important point is the progress that has been made in making telehealth services available in public healthcare facilities. Investments in developing policies for these types of strategies are especially important for the public health system which, according to Brazil's constitutional principles, must be available in all regions of the country and provide quality health care. Telehealth strategies enable connecting regions that are distant from major centers, thereby expanding access to health and enhancing care quality.

In sum, the data from the ICT in Health survey indicates that advances in the use of ICT in Brazilian healthcare facilities depends mainly on the digitization of public facilities, particularly primary care outpatient clinics; the development of information technology systems that offer more complex functionalities and tools; and the development of interoperability standards between information technology systems for better sharing of information and optimization of care effectiveness. In addition, the training of healthcare professionals is very important for the expansion and improvement of these technologies.

Whether these objectives can be achieved depends on the formulation of a government agenda that involves multiple stakeholders and coordinates the efforts of the actors in the three spheres of government in order to create an environment conducive to the development of ICT in the health sector.

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ADOPTION AND MEASUREMENT OF ICT IN THE HEALTH SECTOR: THE CASE OF URUGUAY

→ *Cecilia Muxi*[1], *Fernando Portilla*[2], *Juan Bertón*[3] and *Pablo Orefice*[4]

PRESENTATION

This chapter will outline the political-strategic definitions and development process for the measurement of information and communication technologies (ICT) in health in Uruguay, according to the country's needs, in addition to the progress made in incorporating ICT in the health sector.

First, the country's main characteristics will be presented, based on demographic and social data. The health sector, the main milestones of the recently implemented health reform process, its definitions and principles, the organization of the system, and the impacts of the reform in general terms will be covered.

Then the policy framework for conducting the surveys, the policy documents for the health sector, and the government's digital agendas will be set forth. In this context, the need for measuring ICT in Health, as well as its scope and development, will be addressed. Also included will be the international and regional precedents taken into account at the time of defining the type of survey to be carried out in order to meet the country's needs within the context of the digital transformation of the health sector. The objectives of the two surveys that have already been conducted will be described, in addition to the methodology used and the main challenges related to the country's digital transformation processes. Finally, relevant data obtained from these surveys will be presented.

URUGUAY

The total estimated resident population of Uruguay, according to the 2011 Census and the projection of the National Statistics Institute (INE) for 2016, is 3,480,222 inhabitants (National Statistics Institute [INE], 2011). Forty percent of the population is concentrated in the country's capital, Montevideo. An aging process has been taking place in the population of Uruguay, due to low birth rates and increased life expectancy, since the country completed its second demographic transition.

In terms of socio-political features, Uruguay stands out in Latin America for being an egalitarian society and for its high *per capita* income, low level of inequality and poverty, and almost total absence of indigence. In relative terms, its middle class is the largest in Latin America and represents 60% of its population (Inter-American Development Bank [IDB], 2016).

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ORGANIZATION OF THE HEALTH SECTOR

In 2007, the health sector transformation process began, which led to the creation of the National Integrated Health System (SNIS). This transformation was launched in conjunction with the promotion and development of comprehensive social policies.

The creation of the SNIS was a landmark in the history of the sector and a highly relevant turning point in Uruguay's health policies. From a conceptual point of view, the reform made a distinction between the SNIS, in reference to the coordination between comprehensive public and private healthcare networks, and National Health Insurance, which is the financing system for the SNIS through a common mandatory fund. Uruguayan law stipulates that all health service provider institutions must participate in the SNIS, whether public or private, or comprehensive or partial, and whether or not they receive funds from the National Health Fund (Fonasa) at this stage.[5]

In Uruguay, low- and medium-complexity health services are provided for most of the population through institutions that are part of the SNIS, Private Professional Medical Care Institutions (IAMPP) in the private subsector and, in the case of the public subsector, through the State Health Services Administration (Asse), which is linked to other public healthcare providers. High-complexity services are provided through the Institutes of Highly Specialized Medicine (Imae).

PUBLIC POLICIES AND THE DIGITAL AGENDA 2011-2015

The Uruguay eHealth initiative started in 2013, within the framework of the Digital Agenda 2011-2015, which included objectives and indicators linked to the health sector. It specifically included "ICT for improving the quality of medical services" in Objective No. 14, "Advanced Networks for Health and Electronic Health Records Integrated at the National Level" (Agency for eGovernment and the Information Society [Agesic], n.d.).

In relation to the Uruguay Digital Agenda 2020, health goals are covered under Objective 2, "Innovation for Social Welfare" (Agesic, 2016):

To promote the well-being of the population through integration efforts in education, health, social development, employment and culture, which enable timely and decentralized access to information and quality public services, by harnessing the potential of digital technologies (p. 12).

The commitments and goals linked to ICT and health are integrated in Commitment 8 of the agenda (Agesic & INE, 2016):

All comprehensive healthcare providers have the National Electronic Health Record (HCEN) incorporated in at least three areas (emergency, outpatient, inpatient, surgical or others);

All public and private oncology services have oncological electronic health records implemented;

Be equipped with regulatory and technical instruments that enable electronic medical prescriptions (p. 12).

It is worthwhile to highlight the importance of the country's digital policy for the continuity of these initiatives and the relevance of the information stemming from these ICT and Health surveys for their follow-up.

5 The principles that currently govern the health system are embodied in Law No. 18211 (2007) that created the National Integrated Health System.

OBJECTIVES OF MEASURING ICT AND HEALTH

The purpose of the surveys conducted in Uruguay has been to measure the level of access, use and appropriation of ICT, as well as the maturity level of their incorporation into the health sector, through indicators that reflect the situation in the country and that are comparable with the rest of the countries in the region.

The specific objectives of these surveys are:

To determine the current state of the infrastructure and access to ICT among the actors in the National Integrated Health System;

To consolidate the maturity index for measuring the progress of healthcare facilities in relation to the incorporation of ICT;

To ascertain the degree of progress of healthcare providers in reference to the functionalities linked to implementation of the National Electronic Health Record[6] and change and appropriation management processes in regard to healthcare professionals;

To know what applications and functionalities currently exist among the different providers, especially comprehensive healthcare providers, as well as their access by healthcare professionals;

To identify the knowledge, practices and attitudes of healthcare professionals with respect to the incorporation of ICT in the health sector.

At the time of preparing this article, progress was also being made in designing an impact assessment of the implementation of the National Electronic Health Record (HCEN) in Uruguayan healthcare services.

METHODOLOGY

METHODOLOGICAL CONSIDERATIONS: SURVEY IN HEALTCARE FACILITIES

Uruguay has carried out the ICT in Health survey twice: in 2014 and 2016. As a direct point of reference, it used the work carried out by the Regional Center for Studies on the Development of the Information Society (Cetic.br) which, in turn, had integrated and adapted the methodology proposed by the Organisation for Economic Co-operation and Development (2015). Uruguay also took into consideration the methodological guide of the Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC) entitled, *Methodological recommendations for measurement of access and use of information and communication technologies (ICT) in the health sector* (Statistical Conference of the Americas of the Economic Commission for Latin America and the Caribbean [SCA/ECLAC], 2014). Despite following this methodological framework, there were various points that needed to be resolved at the national level.

One of the issues is the level of complexity of the sampling definitions for surveys of this type. Due to the organization of the health system and the health reform implemented, users of the system receive care in only one of the different outlets of a specific healthcare facility. When assessing ICT access by the facilities, the provision of services, or the functionalities of the National Electronic Health Record by area, among others, it is necessary to take this reality into account. For this reason, the unit of analysis to be considered was discussed extensively (health facilities, considered as a unit, including their different outlets and outbuildings, or specific physical facilities), knowing that each alternative had advantages and disadvantages. In the end, the unit of analysis was defined as

6 The National Electronic Health Record of Uruguay has been overseen by the Salud.uy program under Agesic since 2013. Its main purpose is to promote and improve the continuity of the care process of users of the Uruguayan health system, through a mechanism that permits unifying and making available all the clinical information of the users of the health system.

the healthcare provider institution as a whole, although other options are being reviewed for the future. A census of comprehensive healthcare providers (which covered 40 of the total number of 42 institutions) was conducted, whereas stratified sampling was used for partial providers, in which 50% of the institutions were surveyed.

DATA COLLECTION OF INFORMATION IN HEALTHCARE FACILITIES

Although the questionnaire was for the most part similar to the one used in Brazil by Cetic.br/NIC.br in its ICT in Health survey, it included a number of additional questions, as well as a few minor adjustments implemented after the pretesting stage.

The fieldwork in relation to the healthcare facilities also presented certain challenges. The methodological decision to consider institutions as the unit of analysis, and the feasibility of visiting each of them in the Uruguayan context, gave rise to the possibility of completing the questionnaire in more than one stage. In fact, based on the pretests and first visits, it was clear that respondents (usually the directors of the institutions) may not know in detail all the information requested, such as technical issues related to connectivity. In view of this, the possibility was included of completing the questionnaire in subsequent sessions, via email, telephone, or even further visits.

In addition to surveying healthcare facilities (which represents the core of the investigation), a survey was also conducted with healthcare professionals (in both 2014 and 2016) and users of the country's health system (only in 2016).

SURVEY OF HEALTHCARE PROFESSIONALS

In the case of healthcare professionals, the survey was based on a design strictly adapted to the local reality. A registry of professionals authorized to practice their profession in the country was used for conducting the study, which made it possible to generate very good-quality samples. However, the results for the professionals were not linked to the institutions where they worked (unlike the survey conducted by Cetic.br/NIC.br in Brazil).

The method used for collecting the data was computer-assisted telephone interviewing, and each interview lasted between 12 and 15 minutes. High-quality information was obtained regarding the ICT knowledge of the professionals, their use of ICT at home and in the workplace, and their attitudes toward ICT in Health, specifically in relation to the Electronic Health Record and its functionalities.

SURVEY OF HEALTHCARE SYSTEM USERS

Last, the first survey of healthcare system users (over 18 years of age) was conducted. Through mobile phone surveys, it investigated ICT use both in general and in relation to health, visits to the portals of the institutions where users receive care, and use of the functionalities available, among other topics. The duration of this set of questions was approximately seven to eight minutes.

SELECTED DATA ANALYSIS

MAIN RESULTS: ICT INFRASTRUCTURE

With respect to ICT infrastructure, the first finding to highlight is that all of the comprehensive healthcare providers surveyed had Internet connections and internal networks or Intranet in 2016; and 90% of the institutions had fiber optic Internet connections.

As for computer use, some important changes occurred between 2014 and 2016, especially in the areas of inpatient facilities and medical offices. In medical offices, in particular, there was a 20 percentage point increase: The number of comprehensive healthcare providers who used computers rose from 72% in 2014 to 93% in 2016.

As in 2014, all of the healthcare providers had ICT or IT departments in 2016. What changed was the number of people working in these departments and their training: 48% of the institutions had professionals with health training in IT departments in 2016, compared to 16% in 2014. Table 1 shows the distribution of professionals with training in health who worked in IT departments, according to the type of training.

TABLE 1

PERCENTAGE OF INSTITUTIONS THAT HAD PROFESSIONALS WITH HEALTH TRAINING ON THEIR ICT TEAMS, BY TYPE OF TRAINING

→ *Total number of institutions that provide comprehensive care services*

	2014	2016
Medicine	16%	48%
Nursing	3%	13%
Medical	10%	28%

Note: *How many of the people who work in the information technology area have training in...?*

SOURCE: ICT IN HEALTH SURVEY (2014 - 2016) (AGESIC, 2017).

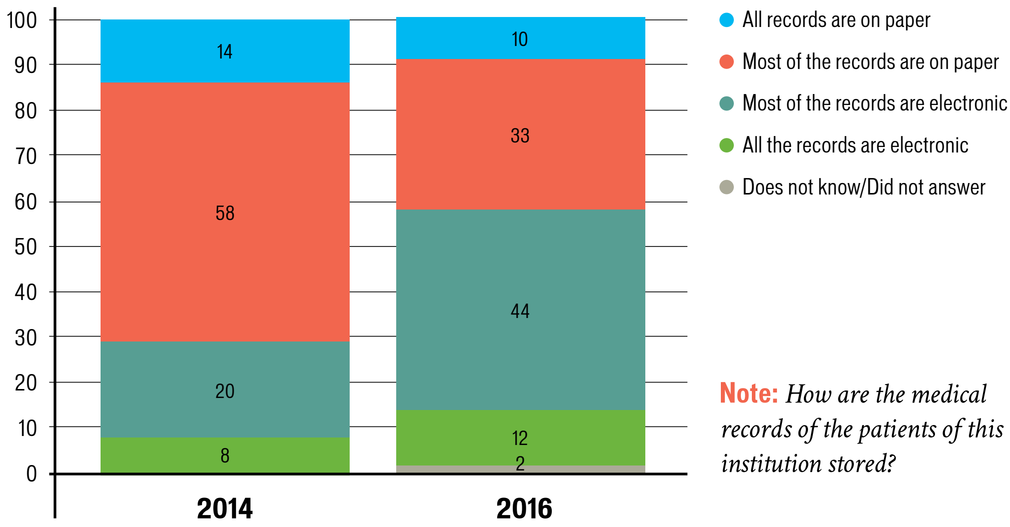
ELECTRONIC RECORDS

One of the most important changes noted in 2016 in relation to 2014 was the increase in the proportion of institutions that reported storing most of their patient health records electronically: Whereas only 28% did so in 2014, 56% stored them in this format in 2016 (Chart 1).

CHART 1

FORM OF STORING THE MEDICAL RECORDS OF PATIENTS (2014-2016)

→ *Total number of facilities (%)*



Note: *How are the medical records of the patients of this institution stored?*

SOURCE: ICT IN HEALTH SURVEY (2014 - 2016) (AGESIC, 2017).

ELECTRONIC HEALTH RECORDS

In relation to the implementation of electronic health record systems, a positive highlight in 2016 was that all the comprehensive healthcare providers surveyed reported already having implemented some type of electronic health record system in at least one of their areas of service (Table 2).

TABLE 2.

IMPLEMENTATION OF ELECTRONIC HEALTH RECORD SYSTEMS (2014-2016)

→ *Total number of comprehensive healthcare providers*

	2014	2016
YES	67%	100%
NO	33%	0%

Note: *Have you implemented an electronic health record system?*

SOURCE: ICT IN HEALTH SURVEY (2014 - 2016) (AGESIC, 2017).

PROFESSIONALS: ICT ACCESS IN THE WORKPLACE

In terms of access to computer equipment in the workplace, interesting changes were noted in 2016 in relation to 2014: There was a 15 percentage point increase in healthcare professionals who accessed computers for their work in the institutions (rising from 50% to 65%). At the same time, the proportion of those who never did so dropped from 27% to 12%.

PERCEPTIONS AND ATTITUDES TOWARD ICT

Overall, the opinion of professionals regarding the usefulness of ICT (computers and the Internet) and the perceived effect on their workload remained practically unchanged between 2014 and 2016. Half considered that it had no effect at all on their workload, whereas the other half was divided between those who felt that ICT increased their workload (29%) and those who consider that ICT reduced their workload (20%).

As in 2014, physicians continued, in comparative terms, to be the most critical segment regarding the impact of ICT. For practically all the points surveyed (except for fewer errors in administering medication to patients), they manifested the lowest levels of agreement as to the positive impact of the information and communication technologies measured, compared to registered nurses and nursing assistants.

USERS OF THE NATIONAL INTEGRATED HEALTHCARE SYSTEM

Ninety-one percent of healthcare system users over the age of 18 were able to access the Internet, and the main means of access were mobile phones or household connections. In the previous year, 51% of the adult population used the Internet to search for information on diseases or treatment, and 45% reported having sought information about exercise or nutrition.

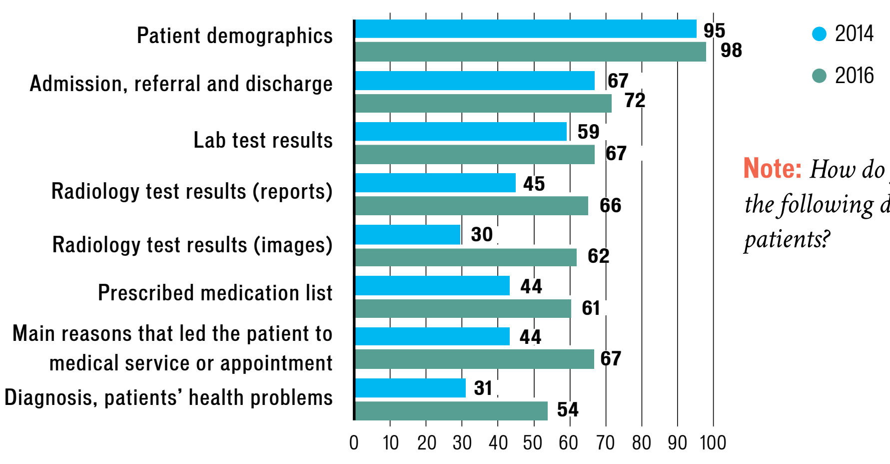
Searching for more specific information about healthcare providers was performed by almost one out of five Uruguayans over 18 years of age. This percentage was higher among young adults from ages 30 to 39 years (32%), women (22%), individuals with post-secondary education (27%), and residents of Montevideo (23%).

Between 2014 and 2016, there has been great progress in terms of the electronic recording of clinical data, such as radiology reports and images, reasons that led the patient to the medical service or appointment, and diagnoses (Chart 2).

CHART 2.

INFORMATION STORED TOTALLY OR MOSTLY IN ELECTRONIC FORMAT, ACCORDING TO THE TYPE OF DATA (2014-2016)

→ *Total number of comprehensive healthcare providers or conditions (%)*



Note: *How do you store the following data about patients?*

SOURCE: ICT IN HEALTH SURVEY (2014 - 2016) (AGESIC, 2017).

MATURITY LEVELS

The measurements performed in Uruguay included a section on the maturity levels of ICT incorporation by the facilities; it was calculated based on variables included in the aforementioned surveys. The purpose of identifying institutional maturity levels was to generate a comparable metric, over time, as a reference for the facilities themselves. This aspect is emphasized because, although maturity levels place healthcare facilities at a certain level of progress, they correspond to individual cases and are not presented as rankings of the institutions. However, it is considered appropriate to add maturity levels so that health facilities can see their evolution in the adoption of ICT use.

Taking certain indices used internationally to summarize this type of information as a reference, an effort was made to create a maturity index adapted to Uruguay's reality and to the indicators used in the survey for healthcare facilities. This resulted in a general index with seven levels: The first three are characterized as basic; the next two as intermediate; and the last two represent advanced levels of incorporation of ICT in Health. The characteristics of the levels are shown in Table 3.

TABLE 3.

MATURTY LEVELS → *Description*

Level 0	Level 0 is the default level. Facilities that do not achieve the minimum level of 1 will be classified as 0.
Level 1	This is a basic level. Some applications for use in laboratories and pharmacies, as well as primary patient data, have been developed.
Level 2	This is still a basic level. Applications in imaging, data recovery security, or system backup have been incorporated. In addition, it allows for coordinating agendas at the outpatient level and the functionality of the hospital management system for admission, referral and discharge.
Level 3	Intermediate level. Patient records must be kept electronically, at least in part. Sophistication is expected in some of the laboratory and pharmacy functions and the possibility of inputting the reasons that led the patient to the medical service or appointment. It requires institutions to have electronic records of some of the main clinical functions.
Level 4	Still an intermediate level. Compliance with certain standards in documents and sophistication in some of the laboratory and imaging functions. It incorporates the possibility of taking patient progress notes in outpatient consultations.
Level 5	Advanced level. It permits having information available in electronic health records in a way that enables incorporation with clinical functions, results summaries and clinical suggestions, as well as inpatient reports and discharges.
Level 6	Very advanced. All clinical histories are recorded electronically and standardized systems are used that enable sending and receiving patient information to other health providers/services. Users can access their clinical history through portals.

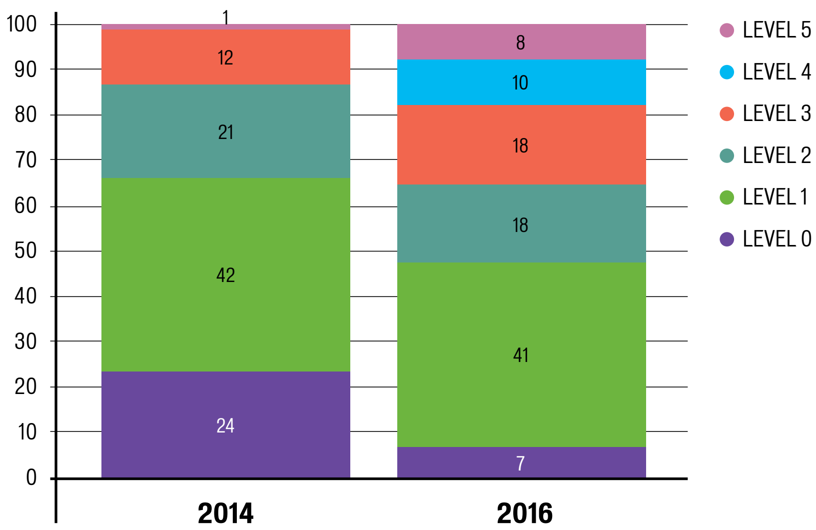
SOURCE: ELABORATED BY THE AUTHORS.

After the measurements performed in 2014 and 2016, it is worth noting that the level of maturity of ICT use generally increased in healthcare facilities. The first measurement showed a high proportion of manual processes, and few institutions were on the higher levels of the scale. As can be seen in Chart 3, between 2014 and 2016, the number of institutions at level zero dropped substantially, from 24% to just 7%. At the same time, there was a significant increase in facilities at the intermediate and advanced levels: In 2014, only 1% of the healthcare facilities were at the maturity level of 4, whereas in 2016, 18% of the facilities were at levels 4 or 5. In the second measurement (2016), there was a substantial reduction in the number of facilities in the lower levels and a significant increase among the higher maturity levels.

CHART 3.

PROPORTION OF HEALTHCARE FACILITIES ACCORDING TO MATURITY LEVEL (2014-2016)

→*Total number of comprehensive providers (%)*



SOURCE: ICT IN HEALTH SURVEY (2014 - 2016) (AGESIC, 2017).

COMMUNICATION AND USE OF SURVEY RESULTS

The results of the ICT in Health measurements were disseminated in public workshops led by decision-makers and health authorities in the country, who have supported and backed the conducting of the surveys. As mentioned earlier, the 2014 measurement constituted the baseline for the Salud.uy Program. The results and progress – or lack thereof – identified in the indicators measured in 2016 have been taken into account for working on the second stage of the project.

The 2016 measurement and its comparison with the 2014 survey were used to formulate the National Electronic Health Record Adoption Plan, in order to adjust the actions of this plan and consider key areas to work on with the health service providers and organizational units that need to be involved. Therefore, the survey indicators have become a point of reference for decision-making and are part of the monitoring mechanisms of the Salud.uy Program. They also serve as input for quantitative and qualitative studies that will be developed in the future.

It should be noted that the authorities have taken into account the data generated in the surveys regarding ICT appropriation by healthcare professionals and the need for training that was identified. Based on the findings of these surveys, the Ministry of Public Health incorporated a module on information systems and application of ICT in Health in its national training initiative for health employees for developing new competencies (including approximately 70,000 workers).

FINAL COMMENTS

The first survey, conducted in 2014, identified the existence of a favorable context, in terms of both the infrastructure of healthcare facilities (widespread use of computers in different departments, Internet connections, extension of internal networks to most healthcare outlets, and existence of IT departments) and the familiarity of professionals with the technology (generalized access to computer equipment and Internet in the home, and most having computers in their workplaces). However, in this same survey, important shortcomings were noted with respect to the effective use of computers for work purposes and the availability of clinical patient information in electronic formats.

The overall state of ICT in the health sector underwent important changes between 2014 and 2016. One of the main changes at the level of healthcare facilities was that, in 2016, most stored patient records electronically, and the use of electronic health record systems had spread significantly (being found in all comprehensive healthcare providers). On the other hand, it was estimated that, on average, the facilities entered half of their documents and clinical activities into electronic health record systems. The electronic systems of most of the facilities allowed information to be encrypted, and there was a substantial increase in the number of institutions that computerized the management of their imaging departments. Finally, most of the comprehensive healthcare providers stored images and reports electronically.

In this overall context, which would be considered positive, the main areas of progress identified in the second survey were associated with increased electronic availability of patient clinical data by healthcare facilities and major growth in the use of this type of data in electronic formats by healthcare professionals. In this two-year period, it was noted that ICT had penetrated into the physician-patient relationship.

Another very striking aspect of the survey was the scant development of online services and applications for patients and users. Most of the facilities still did not offer any type of services to patients on the Internet and limited themselves, in general, to providing information on their websites. Among the aspects surveyed in healthcare facilities, these services were the ones that manifested the least dynamism in the last two years. Taking these elements into account, as well as the interest of users in having access to these types of services, it will be necessary to promote their development in healthcare facilities, especially via the Salud.uy Program.

In 2016, mobile phones were the main means of Internet access for the adult population in Uruguay (Agesic & INE, 2016) and, at the same time, these devices can reduce existing social gaps in relation to Internet access. In this context, it will still be necessary and important that, when these online services for patients are developed or modified, specific applications for mobile phones or responsive web pages are created.

With respect to healthcare professionals, the increased levels of appropriation of the electronic systems implemented by the facilities are noteworthy. In particular, higher frequency of computer use during interactions between professionals and patients and increased electronic consulting of different types of patient data are very important. It should be pointed out, however, that this appropriation of ICT was not uniform when examining the different profiles of professionals. It was noted that physicians, professionals aged 35 to 44 years old, and those residing in non-capital cities used and consulted electronic systems more. These differences are important for formulating particular strategies for each segment, bearing in mind their specific characteristics. In the case of registered nurses and nursing assistants, it seems important to start incorporating their point of view in IT teams to a greater extent, as well as enhance their digital skills, since in some departments they record the largest volume of information in electronic systems.

The healthcare professionals perceived and were aware of the many benefits associated with the use of electronic management systems in the clinical realm, particularly those related to improving the efficiency of work teams and care, reducing errors, and decreasing duplicate tests. However, most professionals still did not consider that this had a positive impact on their productivity or workload.

The other essential aspect that should be taken into account when analyzing and carrying out interventions involves training healthcare workers in the use of the information technology tools and systems that are available. The need for training was noted more in the survey of 2016 than 2014, and represented one of the main barriers perceived by healthcare professionals to the development of ICT in the sector. Although the number of professionals who received some type of training in the use of ICT in Health rose, this increase was clearly less than the increase in the number of professionals who were using electronic systems daily in their work. Training given in the future will also need to prioritize the segments of professionals who use electronic systems the most.

The second survey demonstrated that significant progress has been made in incorporating electronic systems for clinical management among healthcare facilities and professionals in Uruguay in just two years. Despite this significant progress, it must be emphasized that the health system still faces major challenges. These are mainly related to the need for greater integration of information from distant regions into electronic health record systems and generalized adoption of the standards proposed within the National Electronic Health Record framework, in addition to broadening the interoperability functions of the systems and considerably increasing the availability of electronic tools that support professionals in clinical decision-making.

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DIGITAL HEALTH MEASUREMENT: PROGRESS AND CHALLENGES IN THE LATIN AMERICAN AND CARIBBEAN REGION

→ *Andrés Fernández*[1] *and Ignacio Carrasco*[2]

INTRODUCTION

Despite increased levels of investment in digital health, the measurement of its progress and development, as well as its impact, is still in the beginning stages in Latin America and the Caribbean (LAC). In fact, only in Brazil and Uruguay – whose experiences are presented in this book – is systematic national monitoring being carried out using a stable set of indicators, which allows comparisons to be made over time. Given this lack of regional measurements, and under the auspices of the Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC), the Working Group for Measuring Information and Communication Technologies was formed. This group developed a proposal for measuring ICT access and use in the health sector for the LAC region, presented in another chapter of this book (ECLAC, 2014).

A pioneer experience in LAC has been the one carried out by the Brazilian Internet Steering Committee (CGI.br). Through the Regional Center for Studies on the Development of the Information Society (Cetic.br), and using the conceptual and methodological frameworks created by the Organisation for Economic Co-operation and Development (OECD), CGI.br developed a set of monitoring indicators and has periodically applied them at the national level (*Comitê Gestor da Internet no Brasil* [CGI.br], 2014; 2015; 2016) since 2013. This experience has served as a benchmark for the SCA/ECLAC working group in designing its conceptual and methodological proposal for LAC.

These initiatives, however, focus particularly on progress related to the "preparation stage," with some indicators addressing the "intensity stage" – concepts that will be addressed later on in this paper. Therefore, the challenge we face as a region is to expand this perspective and develop an integrated monitoring and assessment (M&A) model. This will not only permit reporting on the progress of the incorporation of ICT in the health sector, which is undoubtedly a very important first step, but will also provide an opportunity to measure its effects on the performance of the health system and its results in the health of the population.

For this purpose, a conceptual model was formulated that makes it possible to distinguish observable effects in the production processes of health systems, and the results and impacts in terms of their efficiency. This is reflected in improvements in health care and the state of health of the population, and the reduction of inequalities between different population groups within each country (Fernández & Carrasco, 2016).

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Uruguay is probably the first country to make important efforts to put together an integrated M&A model (Agesic, 2016), although other countries, such as Chile, Brazil and Mexico, are starting to move in the same direction.

To continue moving forward in the construction of a common and shared measurement model, this chapter identifies some of the main challenges faced by health systems in the region, and where ICT is a valuable tool for overcoming them. These challenges, among others, should inform deliberations when designing an integrated M&A model. There is a description below of the dimensions that have guided the creation of indicators and enabled their differentiation. A distinction is made between the preparation, intensity and impact stages, linked to the implementation of ICT in health, establishing a relationship with the chain of effects, results and impacts.

In the following section, the core ideas and a proposal of additional indicators apart from those already available is formulated, in order to continue moving forward, in a consensually agreed way, in the creation of a measurement model. Finally, the last section includes suggestions of an institutional nature, in order to facilitate the adoption and application of the proposals formulated in the countries of the region.

THE ROLE OF ICT IN RELATION TO THE CHALLENGES OF HEALTH SYSTEMS IN THE REGION

The most vulnerable social groups systematically have a heavier load of disease, fewer years of life free from disability, and lower life expectancy. A clear illustration of this inequality can be seen in rates of child and maternal mortality, which present a ratio of around 3:1 between the first and fifth income quintiles. This ratio, in the context of full demographic and nutritional transitions, has also begun to be noted in relation to obesity and noncommunicable diseases, such as premature mortality associated with the two previous factors (Fernández & Oviedo, 2010a).

These inequalities can basically be explained by restricted access to timely and quality health care, due to economic and geographical factors. Healthcare costs and the concentration of supply in a few urban centers constitute a major barrier within the region's context of strong segmentation and low universal health coverage. This is also accompanied by an insufficient supply of experienced general physicians and medical specialists to serve more vulnerable populations.

Telemedicine can help reduce these shortages, through teleconsultation and teleconsulting[3], whether synchronous or asynchronous[4]. It should be pointed out that most of these resources do not require sophisticated equipment or broadband greater than 720 kb/s and, therefore, investments in infrastructure would not be high. However, the organizational redesign and resulting implementation could be costly, not so much due to logical training requirements, but to the need to manage the cultural changes needed to deal with the resistance that usually occurs during this type of social and technical transformation. Any additional operating costs of the implementation of digital health should be assessed, not in absolute terms, but relative to the efficiency incorporated into existing processes.

The second challenge corresponds to the pressing need to expand the ability of primary care to resolve patient health issues. Primary care represents the first level of contact by patients with health systems and is, consequently, a key instrument for promoting and ensuring equal access to care. However, a significant proportion of patients who resort to basic health centers are referred to higher care levels or seek such levels themselves in order to receive better quality care or to avoid long waits. This leads to excessive care demand on higher levels, including emergency situations.

Telemedicine or, in broader terms, telehealth, which includes continuous distance health education, is one solution to reversing this situation through a wide variety of tools and functionalities. Measurements

3 Bi-directional communication among healthcare professionals for care purposes and educational support.
4 Offline.

done in the fields of pediatrics and cardiology (Moreira Alkmim & Pinho, 2012), for example, showed that the use of telemedicine in basic health centers was able to reduce up to 80% of patient referrals. These results not only have direct positive impacts on the health of populations, but also reduce transportation costs and, in many cases, avoid long periods of separation of families.

Apart from the fact that advances in telemedicine help eliminate access barriers to health services, reducing disparities in quality also requires improving access to patient clinical information during the care process. In this regard, digital medical records play a key role.

The issue of digital medical records is related to the third challenge: improvements in care continuity. Eliminating the quality gap requires reducing the fragmentation of the region's health systems through standards for information exchange between different centers and care levels, as well as with patients – requests for and results of diagnostic tests, clinical and nursing reports and treatment plans, etc. Therefore, digital medical records[5] must be shared and, for this to occur, it is essential that information systems be interoperable – a requirement that entails the adoption of technological and semantic standards for the integration of applications (Indarte & Pazos, 2011).

The fourth challenge consists of improving research and epidemiological surveillance. In many countries in the region, health systems are managed with little epidemiological knowledge due to lack of continuity in these types of studies. Epidemiological studies are crucial for making decisions about protection and prevention, clinical care and service management, as well as for an adequate health planning. They help identify health problems in populations, establish priorities and assess interventions.

Primary care generates a significant volume of care and epidemiological information about large proportions of populations. However, this information is often recorded on paper in an illegible and unstructured way, which raises questions about its reliability. Even when recorded in some type of digital format, given the volume of data and the resources needed for its analysis, conclusions often end up being retrospective and, therefore, ill-timed for taking effective corrective measures (Carnicero, Fernández & Rojas, 2014). ICT applied to health information systems, particularly when based on digital medical records, makes it possible to overcome these difficulties and perform reliable and timely calculations of indicators to feed into the decision-making process.

Consequently, the integration of ICT into primary care activities is an opportunity to improve the quality of this level of care and is necessary for its sustainability. The use of ICT also contributes to the sustainability of health systems by improving their efficiency. This represents a fifth challenge, among many others that could be added, whose greater relevance can be observed in the mid-term, considering the increased occurrence of noncommunicable diseases, which already puts pressure on public spending in the countries in the region.

TYPES OF INDICATORS

The identification, definition and classification of indicators for measuring digital health were originally based on the need for information by decision makers. For this purpose, the OECD and European Union broke it down into three stages: *preparation, intensity, and impact*. These stages reflect the developmental process of implementing ICT in health systems and, consequently, give rise to indicators targeting equally different objectives (Meyer, Husing, Didero & Korte, 2009; OECD, 2010).

In the first stage, the emphasis of the measurement is to provide information about the level of preparation of each country (territories, organizations and health systems) for implementing digital health applications. This stage corresponds to indicators for measuring the availability of ICT infrastructure in healthcare facilities.

This first developmental stage is satisfied by the SCA-ECLAC proposal, through the use of indicators equivalent to those used by Brazil in its monitoring methodology. These include: "Number of facilities that have Intranet/Extranet," "Type of broadband connection," "Number of facilities that have computers," and "Number of facilities that have specialized ICT personnel."

5 In the region, they are also called electronic medical records. The authors suggest replacing the adjective "electronic" with "digital" in all the concepts used and for all meanings, since the information (text, audio or images) is encoded in bits. Digital electronics is actually a branch of electronics.

This proposal also includes indicators corresponding to the intensity stage, which seeks to compare levels of implementation of digital health tools. There are specific indicators for this level, such as "Number of facilities that have an Electronic Medical Record System" and "Number of facilities that provide telemedicine services." This stage also covers intensity of use of the available functionalities, a dimension partially included in the SCA-ECLAC proposal[6]. Its measurement requires directly consulting healthcare professionals about issues such as frequency of access to the clinical data of patients (available in digital format), lab results, clinical notes, and radiology reports, using the same methodology applied by Cetic.br/NIC.br.[7]

Deepening the study published in 2010, the OECD presented a new methodological proposal in 2015 aimed at measuring the use of digital health applications based on the functionalities that they target (OECD, 2010; OECD, 2015). According to this proposal, the use of digital medical records is measured based on questions about the types of clinical data available (demographic, diagnoses, allergies, etc.), the possibility of digital drug prescription, available also in drugstores, and patient health information management (list of patients according to type of diagnosis, for example), among others. An interesting innovation is the distinction between provider-centered functionalities and patient-centered functionalities, formulating differentiated indicators. In the case of telemedicine, this new OECD proposal classifies functionalities into synchronous activities (for example, simultaneous videos), asynchronous activities (such as information storage and subsequent analysis of radiological images), and remote monitoring of vital signs.

For the third stage, referred to as impact, the OECD and EU suggest distinguishing between two dimensions. One focuses on the measurement of perceptions, which is particularly useful for analysis and management of organizational change – although it is also used as an indirect quality measurement factor. The other is designed to measure impacts on the efficiency of health systems and on the health indicators of populations.

Methodological reflection on the impact stage is less developed, particularly with regard to its links with the preceding stages. Note that to perform an impact assessment, it is necessary to have indicators that interact theoretically and methodologically with the indicators from the previous stages, in order to determine their relationship with digital health investments and the organizational characteristics of healthcare facilities, especially those related to observable changes in production chains. As pointed out earlier, the only experience in the region that formally included an impact assessment was the Digital Health Program of Uruguay ("Salud.uy"), even though it has not yet been applied, awaiting for progress proper of the intensity stage.

To assist in the reflection process for moving toward the creation of an integrated M&E model, in accordance with the three aforementioned developmental stages, the authors of the present article differentiated between effects, results and impacts in referring to the different performance realms of health systems.

Effects refer to changes that are generated in production chains and health systems, in terms of inputs, processes and products. These changes start being observed in the preparation stage and, more strongly, in the intensity stage, particularly in intensity of use. The indicators available to date, despite delving into measurements of inputs, indicate little progress in relation to the other components (processes and products).

When going through the intensity stage, it will be possible to observe increases in the efficiency of systems, as well as improvements in healthcare access, quality and equality. Note that these results are only attributable to digital health if, prior to this, health provision processes were transformed through the incorporation of ICT. Finally, the impacts on the health status of populations and on reducing gaps among population segments in countries will be a consequence of the results achieved in the previous stages, as can be seen in Diagram 1.[8]

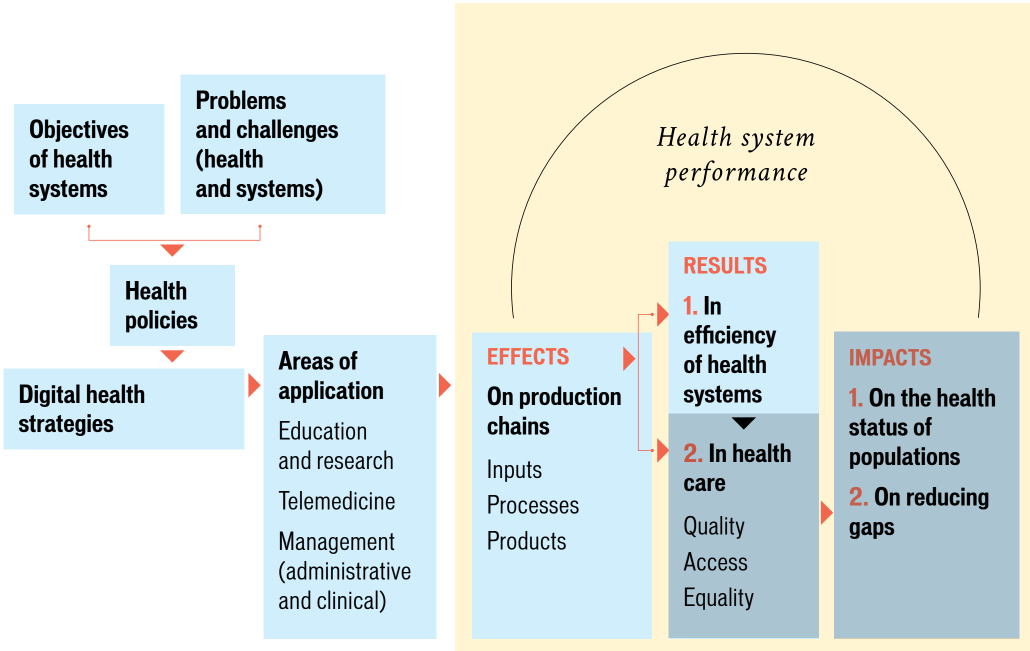
6 Consulting digital medical records enables knowing, through four ordinal categories, the coverage of patients in establishments whose data is digitalized, which is not equivalent to level of use.

7 In order to measure intensity of use, Cetic.br/NIC.br's methodology uses ordinal variables in three categories: always uses, sometimes uses and does not use.

8 For more information about these concepts, see Fernández & Carrasco (2016).

DIAGRAM 1.

CONCEPTUAL MODEL FOR MONITORING AND ASSESSING DIGITAL HEALTH STRATEGIES



SOURCE: CREATED BY THE AUTHORS, 2016.

PRELIMINARY IDENTIFICATION OF NEW VARIABLES AND INDICATORS

As mentioned earlier, it is necessary to continue progressing in terms of conceptual and methodological reflection, in order to provide additional indicators that will enable completion of the M&E model. In this section, some core ideas are proposed in order to move forward in this direction.

It must be pointed out that the three developmental stages are not perfectly correlated with the three performance dimensions. In fact, the intensity stage is found in the effects dimension and, partially, in the results dimension. Furthermore, the indicators for measuring results are distinct in nature, since the variables are also different.

It has been suggested that a substantial number of the indicators proposed by SCA-ECLAC focus on the preparation stage and, to a certain extent, the intensity stage. The challenge still remains to advance in the formulation of the intensity of use indicators and the requirements for measuring effects and results, i.e., monitor changes in production chains and measure healthcare improvements.

At the same time, there has also been insufficient progress in measuring the contributions of digital health to the reduction of social inequalities in health, even in relation to some of its previous factors, such as disparities in access and quality. It is true that there is still a long way to go for these impacts to be observable, but being proactive in methodological reflection has also been lacking.

EFFECT VARIABLES AND INDICATORS

During the preparation stage, it is possible to observe a gradual increase in hardware and software investments, which has at least two types of effects. First, there will be training needs, the creation of new job positions and the incorporation of qualified personnel in the area of human resources; and second, there must be changes in storage and data transfer procedures.

The relevant questions for monitoring, therefore, should be linked to these effects and, in general, they are addressed reasonably well in the SCA-ECLAC proposal and the instruments used by Brazil and Uruguay. However, an aspect that has not been studied is the relationship between these effects and the economic value of introducing ICT. Efforts to measure the amounts of investment have encountered various types of difficulties, as can be seen in the experience of Cetic.br/NIC.br. However, it is important to insist on the use of pilot tests to find alternatives that enable knowing at least an approximate percentage of these investments, to compare them with the investment and operating budgets of health units.

Another aspect that has not been considered, which is highly relevant for monitoring implementation oriented toward the interconnection of units, is the use of standards for the interoperability of information systems. This is a critical aspect of investment decisions to be managed during the preparation stage, without which the intensity stage will only be observable in islands of operation, i.e., in separate health units.

Equally important for the preparation and intensity stages is the monitoring of the quantity and quality of inputs. Although this is measurable based on the standards established in the investment plans, it is also useful to do it by recording perceptions, of both those in charge of managing the processes and direct users, at least those from the clinical environment. However, it is also recommended that administrative users and patients be included. In the case of Brazil, Cetic.br/NIC.br. addresses this measurement by consulting with healthcare professionals about their perceptions of existing barriers to ICT use.

The foregoing, as well as the available digital functionalities and the types of services provided via telemedicine, are the foundation that will support the desired improvements in access, quality and equality. For this reason, it is necessary to strive to progress more in the measurement of the intensity of use of these applications.

The challenge is to generate indicators that will make it possible to know, for example:

- the percentage of patients that have digital medical records;
- the percentage of organizations that can digitally exchange their clinical data;
- the volume of health care provided through telemedicine (in the distinct specialties); and
- the percentage of care given synchronously and asynchronously.

In so doing, it will be possible to build indicators for the preparation/intensity gap, which will enable effective monitoring of change management and technology adoption.

RESULT VARIABLES AND INDICATORS

With the exception of questions regarding the perceptions of safety improvements and satisfaction with care provided, which are included in the Cetic.br/NIC.br. surveys, this is the performance dimension with the lowest development of indicators, making it difficult to address with the already proposed instruments. Therefore, it will be necessary, not only to design new instruments, but also to develop complementary methodology. This way, the transition from monitoring to actual assessment will begin and shape the aforementioned integrated model. The main variables that make up the results dimension to be measured are: efficiency, quality, access and equality. It should be noted that each of these variables may require different indicators, according to the digital health functionality desired to be measured.

For this purpose, some examples of indicators are presented below. They will need continued work, in terms of their identification and operationalization. It should be added that, at times, it is not possible to avoid interactions between results variables. A functionality that enables quality improvement may, at the same time, generate cost reductions, increases in productivity, and improved efficiency. It should also be pointed out that the formulation of these indicators strongly depends on the characteristics of the digital health programs implemented by the countries in the region.

Efficiency is a measurement of a relative nature, calculated on the basis of time comparisons, such as before and after, or estimated optimums between what was programmed and what was implemented, or between similar units. In addition, differences can also be established between clinical and non-clinical services, for which it would also be necessary to generate different sets of indicators. It may also be necessary to adapt indicators for measuring improvements in efficiency in relation to certain pathologies.[9]

Examples of indicators for measuring efficiency improvements:

- Fewer requests for diagnostic tests through the use of data available in digital medical records.
- Fewer clinical personnel for administration of clinical medical records (paper vs. digital).
- Fewer medical consultations to renew prescriptions for prolonged treatments through the use of digital prescriptions.
- Decrease in hours/people in admission, discharge and referral processes through the use of digital hospital information systems.
- Reduced transportation costs through the use of telemedicine for providing health care.
- Lower mean unit cost per image, through the use of teleimaging.
- Decreased mean annual cost per patient with chronic pathologies through the use of telemonitoring.

Care quality is conceptualized on the basis of three components: effectiveness, safety, and receptivity. Effectiveness is related to treatment results, and also to achievement of the goals and objectives of health systems. Safety is understood as the prevention and reduction of adverse events in care processes. Receptivity refers to the ability of health systems to provide patient-focused care (Kelley and Hurst, 2006).

Examples of indicators for measuring quality improvements:

- Decrease in hospital discharges of chronic patients through the use of digital medical records and telemonitoring.
- Increased perception of safety expressed by attending physicians.
- Increased perception of quality of service expressed by patients.
- Higher percentage of informed images in relation to the total number of images processed.
- Decreased number of alerts for contraindications in drug prescriptions.
- Increased percentage of chronic patients adhering to treatment.

Access restrictions also encompass various components: availability of resources in systems (healthcare professionals, facilities, equipment and drugs); geographic distance from resources in relation to the populations needing them; and care costs and cultural gaps between health services and their target populations (Fernández and Oviedo, 2010b).

Examples of indicators for measuring access improvements:

- Decrease in mean waiting time to receive care.
- Decrease in the percentage of transfer of patients from primary care to the secondary level.
- Increased percentage of patients with chronic pathologies under treatment and control, in relation to prevalence.
- Increased number of synchronous or asynchronous teleconsultations performed in basic health centers in rural areas or urban peripheries.

Equality is closely linked to the access dimension. It refers to the way in which the benefits of health systems are distributed, taking into account the different health statuses of various populations (Veillard, Kadandale, Garcia-Arnesto & Klazinga, 2010). In other words, it is associated with the social determinants of health. For this reason, measurement of improvements in equality implies adaptation of the indicators already presented for access to the characteristics of the populations where it will be measured.

9 For example, in the case of the Salud.uy program, the measurement of efficiency and quality improvements has been proposed, in relation to the use of digital medical records with diabetic patients.

IMPACT VARIABLES AND INDICATORS

The identification of variables and the formulation of indicators are based, in this case, on the challenges faced by a country's health system. Several were mentioned in the second section; they obviously vary in their relevance and intensity among countries, as well as between geographical areas within countries.

Before obtaining information about the impact of digital health, it is necessary to know the capacity of a country (whether organizations or territories) to develop ICT in health projects. Likewise, the impact of applications that have not yet been implemented cannot be assessed. Therefore, the development of indicators in terms of products, effects and results must precede their evaluation. Because of this, it is vital that countries make progress in monitoring the preparation and intensity stages, so that afterwards the impacts of digital health can be assessed. For this reason, it is necessary to insist that plans to invest in ICT in health be formulated on the basis of their desired impacts.

As mentioned earlier, Uruguay is the only country in the region that included an impact assessment strategy when it designed its digital health program. However, it is necessary to confirm whether the investments have already reached sufficient intensity of use to justify the application of this strategy.

In contrast, the experience of Brazil's Telehealth Program has already reached a maturity and intensity of use that are more than sufficient to carry out an impact evaluation, both at the state and national levels. Moreover, given the evaluative experiences of the Minas Telehealth Program, in the state of Minas Gerais, it would be advisable to begin that endeavor right there.

The term "impact" refers to final results which are or should be formulated as objectives and goals of health systems. They are basically expressed in terms of reductions in morbidity and mortality rates, and the disparities in these rates between different segments of populations, that are attributable to social inequalities. Thus, the impact indicators are formulated based on the epidemiology, social inequalities and characteristics of the digital health investment programs of each country and are expressed, for example, in terms of reductions in morbidity and mortality and disparities between quintiles of income or areas of residence.

CONCLUSIONS

As countries develop and implement their digital health strategies, there is clearly a need to measure progress to ensure the effectiveness of the efforts made. This, in turn, helps governments identify barriers and understand the incentive mechanisms for using ICT, and thereby achieve long-range economic and social benefits from its applications. The measurement experiences underway in the region are moving in this direction, especially with respect to the creation of indicators to measure the actual progress of the preparation and intensity stages. However, there are important challenges in monitoring intensity of use and in measuring its results and impact.

An integrated monitoring and assessment model for digital health in the region must enable determining the progress made in reducing social inequalities in health. This will not be found in proposals developed for first-world nations, whose focus is the efficiency of health systems. Efficiency is also a very relevant factor for this region. The point here is that the region has been bearing a debt of inequality since the last century. The burden, therefore, is double.

It is only a matter of time until many more countries reach the intensity stage. Therefore, it is imperative that indicators enable analyzing effects on production chains and the results arising from them, and thus obtain information to provide feedback for investment decisions and correcting implementation errors. This is the aim of the present chapter. More work, however, is required to operationalize the indicators and expand the proposed list.

Another challenge is the need to create indicators geared toward the relevant agents in implementation processes, whose perceptions may be decisive for removing barriers and generating incentives, particularly in relation to patients. It should be borne in mind that given the advance of noncommunicable diseases, it will be increasingly important for patients to commit to the process of controlling and treating them.

There is not room here to address other relevant methodological issues, such as: the need for historical records to analyze some of the variables identified; recommendations for drawing conclusions from probable correlations between indicators; or suggestions of procedures for counterfactual constructions to verify impacts. It will also be necessary to work on creating instruments that consider modules of minimum indicators for their initial application in some countries, as well as to formulate extended modules for countries that have already accumulated a certain amount of experience in the area.

In view of all the above, and in order to continue progressing, the authors feel it is essential to develop even more spaces and opportunities for methodological reflection, with the support of institutions such as those participating in the present publication. To that end, it is suggested that a regional digital health observatory be created, one that not only proposes M&A methodology, but also provides technical assistance to countries for its application.

The focus of this observatory, however, should not be making comparisons, which requires a standardization process that removes flexibility from the measurements and hinders the observation of specificities. It is indispensable that countries have sufficient flexibility to avoid reducing their tasks to the mere collection of aggregate data, which is not very useful for decision making. Useful data is needed to guide these complex processes of social and technical change.

In addition, this type of entity should facilitate the adaptation of methodologies and instruments to the heterogeneous realities of Latin America and the Caribbean and to the needs of their populations.

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MEASUREMENT OF ACCESS TO AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGES IN THE HEALTH SECTOR

QUESTIONNAIRE SEPTEMBER 2014

→ *Working Group on Measurement of Information and Communication Technologies (ICT)*

→ *Statistical Conference of the Americas (SCA) of the Economic Commission for Latin America and the Caribbean (ECLAC)*

1

IDENTIFICATION OF HEALTH FACILITY

1.1 GEOGRAPHIC LOCATION OF HEALTH FACILITY

NAME OF HEALTH FACILITY

TAX REGISTRATION NUMBER

ADDRESS

Street *Number*

Municipality or district *Region*

TELEPHONE FAX

EMAIL WEB

NAME OF LEGAL REPRESENTATIVE

1.2 OPERATIONAL NATURE OF HEALTH FACILITY

→ Functioning
→ Partially functioning
→ Temporarily closed
→ Permanently closed

1.3 LEGAL STATUS OF HEALTH FACILITY

→ Public
→ Private

1.4 INAUGURAL DATE OF HEALTH FACILITY

→ Day
→ Month
→ Year

TYPE OF CARE PROVIDED (check one box only)

HEALTH FACILITY WITHOUT INPATIENT HOSPITALIZATION

→ **a)** Primary-care outpatient clinic: Health facility that provides general outpatient medical services and professional basic care.

→ **b)** Specialist outpatient clinic: Health facility that provides specialized medical services.

→ **c)** Emergency clinic: Health facility that provides specialized medical services and emergency care.

→ **d)** Diagnosis and therapeutic support services: Health facility that provides specialized diagnosis and/or therapy services

HEALTH FACILITY WITH INPATIENT HOSPITALIZATION

- → **a)** Low complexity facility: Health facility for inpatient care that possesses all services except intensive care units.
- → **b)** Medium complexity facility: Health facility that has all the services, including intensive care units, but with no facilities for cardiovascular and organ transplant surgery.
- → **c)** High complexity facility: Health facility that has all the services, including intensive care units and facilities for cardiovascular and organ transplant surgery.

1.6 NUMBER OF BEDS (only for health facilities with inpatient hospitalization)

1.7 THE FACILITY PROVIDES THE FOLLOWING TYPE OF CARE:

- → General
- → Specialized
- → Both general and specialized care

1.8 NUMBER OF PEOPLE EMPLOYED IN THE HEALTH FACILITY:

	Total	Men	Women
HEALTH PROFESSONALS			
Physicians			
Stomatologists/dentists			
Nursing staff			
PROFESSIONALS UNRELATED TO HEALTH			
HEALTH TECHNICAL PERSONNEL			
TECHNICAL PERSONNEL UNRELATED TO HEALTH			
OTHERS			

2

ICT INFRASTRUCTURE

2.1 DOES THE HEALTH FACILITY OWN THE FOLLOWING DEVICES?

	Yes	No	Quantity
DESKTOP COMPUTER			
LAPTOP COMPUTER			
TABLET			
OTHER PORTABLE DEVICES			

2.2 DOES THE HEALTH FACILITY HAVE INTERNET ACCESS?

☐ → Yes ☐ → No

2.3 CHECK THE TYPE OF INTERNET ACCESS AND THE CONTRACTED CONNECTION SPEED

Bandwidth	Type of access	
	Fixed	Cellular/mobile
UNDER 256 KBPS		
BETWEEN 256 KBPS AND UNDER 2 MBPS		
BETWEEN 2 MBPS AND UNDER10 MBPS		
10 MBPS OR OVER		

2.4 NUMBER OF EMPLOYEES (BY SEX) WHO USE ICT IN THE COURSE OF THEIR WORK IN THE HEALTH FACILITY AT LEAST ONCE A WEEK:

	Total	Men	Women
HEALTH PROFESSONALS			
Physicians			
Stomatologists/dentists			
Nursing staff			
PROFESSIONALS UNRELATED TO HEALTH			
HEALTH TECHNICAL PERSONNEL			
TECHNICAL PERSONNEL UNRELATED TO HEALTH			
OTHERS			

2.5 DOES THE HEALTH FACILITY HAVE A LAN NETWORK?

→ Yes   → No

2.6 DOES THE HEALTH FACILITY HAVE:

	Yes	No
INTRANET		
EXTRANET		

2.7 DOES THE HEALTH FACILITY HAVE A PERSON WHO IS SPECIALIZED IN ICT (or responsible for TIC)?

→ Yes   → No

2.8 HOW MANY PEOPLE ARE SPECIALIZED IN ICT (or responsible for ICT) IN THE HEALTH FACILITY?

	Total	Men	Women
HEALTH PROFESSONALS			
Physicians			
Stomatologists/dentists			
Nursing staff			
PROFESSIONALS UNRELATED TO HEALTH			
HEALTH TECHNICAL PERSONNEL			
TECHNICAL PERSONNEL UNRELATED TO HEALTH			
OTHERS			

3

SERVICES

3.1 INDICATE THE SITUATION REGARDING ELECTRONIC MEDICAL RECORDS IN THE HEALTH FACILITY (check one box only):

- → All the records are in electronic format.
- → The majority of the records are in electronic format yet some are paper-based.
- → The majority of the records are paper-based yet some electronic.
- → All the records are paper-based.

3.2 WITH REGARDS TO PATIENT RECORDS THAT ARE AVAILABLE ELECTRONICALLY, WHAT TYPES OF DATA ARE AVAILABLE IN THIS FORMAT?

	Yes	No
GENERAL PATIENT DATA (ADDRESS, TELEPHONE NUMBER, DATE OF BIRTH, ETC.)		
PATIENT'S MEDICAL HISTORY OR CLINICAL NOTES (INCLUDING OUTPATIENT, HOSPITAL AND SURGERY NOTES		
LABORATORY TEST RESULTS RADIOLOGY REPORTS		
RADIOLOGY REPORTS		
RADIOLOGY IMAGE		
VITAL SIGNS		
VACCINE RECORD		
LIST OF ALLERGIES		
LIST OF MEDICATION		
DIAGNOSIS, PROBLEMS, OR DATA ON PATIENT'S STATE OF HEALTH		

3.3 DOES THE HEALTH FACILITY PROVIDE THE FOLLOWING TELEMEDICINE SERVICES?

	Yes	No
RADIOLOGY		
PATHOLOGY		
DERMATOLOGY		
PSYCHIATRY		
CARDIOLOGY		
ULTRASONOGRAPHY		

Continues →

	Yes	No
MAMMOGRAPHY		
SURGERY		
CONSULTATIONS		
OPHTHALMOLOGY		
NEPHROLOGY		
OBSTETRICS/GYNECOLOGY		
DIABETES		
PATIENT MONITORING		
PEDIATRICS		
HOME CARE		
NEUROLOGY		
NEUROSURGERY		
TREATMENT FOR STROKE		
UROLOGY		
ONCOLOGY		
OTORHINOLARYNGOLOGY		

3.4 CHECK THE TYPE OF FUNCTIONALITIES AVAILABLE IN YOUR ELECTRONIC SYSTEM:

	Yes	No
LIST OF ALL PATIENTS BY DIAGNOSIS		
LIST OF ALL PATIENTS BY LABORATORY TEST RESULTS		
LIST OF ALL PATIENTS TAKING SPECIFIC MEDICATION		
PATIENT DISCHARGE SUMMARIES		
LIST OF ALL THE MEDICATION THAT A SPECIFIC PATIENT IS TAKING, THOSE PRESCRIBED BY OTHER PHYSICIANS		
LIST OF ALL THE LABORATORY TEST RESULTS OF A SPECIFIC PATIENT		
LIST OF ALL THE RESULTS OF RADIOLOGICAL TESTS, INCLUDING REPORTS RELATED TO SPECIFIC PATIENTS		
SCHEDULING CONSULTATIONS, TESTS OR SURGERY		
REQUEST IMAGE TESTS		

REQUESTS FOR MEDICATION/MEDICAL PRESCRIPTIONS		
ORDERING OF MATERIALS AND SUPPLIES		

3.5 CHECK THE TYPE OF DATA SENT TO OR RECEIVED FROM OTHER HEALTH FACILITIES ELECTRONICALLY:

	Yes	No
CLINICAL DATA SENT TO/ RECEIVED FROM PROFESSIONALS IN OTHER HEALTH FACILITIES		
PATIENT REFERRALS TO OTHER HEALTH FACILITIES SENT ELECTRONICALLY.		
CARE SUMMARY RECORDS SENT/ RECEIVED AT THE TIME PATIENT IS DISCHARGED OR TRANSFERRED TO ANOTHER HEALTH FACILITY		
A LIST OF ALL THE MEDICATION PRESCRIBED TO A PATIENT SENT TO/RECEIVED FROM OTHER HEALTH FACILITIES		
PATIENT'S LABORATORY TEST RESULTS SENT TO/RECEIVED FROM OTHER HEALTH FACILITIES		
PATIENT'S IMAGING TEST RESULTS SENT TO/RECEIVED FROM OTHER HEALTH FACILITIES.		
NURSING CARE PLAN SENT/RECEIVED .		

3.6 ELECTRONIC DATA SECURITY TOOLS USED BY HEALTH FACILITY:

	Yes	No
ANTISPAM AND ANTIMALWARE (MALWARE INCLUDES VIRUSES, WORMS, TROJANS, ROOTKITS, SPYWARE, INTRUSIVE ADWARE OR ANY OTHER MALICIOUS SOFTWARE)		
FIREWALL, IDS (INTRUDER DETECTION SYSTEM), IPS (INTRUDER PREVENTION SYSTEM), WAF (WEB APPLICATIONS FIREWALL)		
DATA PROTECTION TECHNOLOGY (DATABASE ENCRYPTION), DAM (DATA ACCESS MONITORING), DLP (DATA LOSS PREVENTION SYSTEM)		
AUTHENTICATION TECHNOLOGIES (PASSWORDS, BIOMETRICS, TOKENS, OTP, SMARTCARDS, DIGITAL CERTIFICATES)		
OTP, SMARTCARDS, DIGITAL CERTIFICATES) SECURE COMMUNICATION TECHNOLOGIES IN CLIENT-SERVER APPLICATIONS (HTTPS, VPN) WITH BLOCKING DEVICES FOR E.G. ONLINE STORES, ACCESS TO UNWANTEDSITES, MUSIC STREAMING, ETC.)		
RESTRICTED ACCESS TO INTERNET SITES (SECURITY POLICY WITH SOME BLOCKING DEVICES FOR E.G. ONLINE STORES, ACCESS TO UNWANTED SITES, MUSIC STREAMING, ETC.)		
SECURITY INFORMATION AND EVENT MANAGEMENT (SIEM)		

3.7 DOES THE HEALTH FACILITY HAVE A WEBSITE?

☐ → Yes ☐ → No

3.8 TYPE OF WEB HOSTING

☐ → Own

☐ → Hosted on the server of another entity

3.9 SOCIAL MEDIA USED BY THE HEALTH FACILITY:

	Yes	No
SOCIAL NETWORKS (FACEBOOK, GOOGLE +)	☐	☐
INSTANT MESSAGING NETWORKS (WHATSAPP, TELEGRAM OR OTHERS)	☐	☐
MICROBLOGGING NETWORKS (TWITTER, TUMBLR, FRIENDFEED OR OTHERS)	☐	☐
PROFESSIONAL NETWORKS (LINKEDIN, YAMMER)	☐	☐
IMAGE-SHARING NETWORKS (FLICKR, PICASA, PINTEREST, INSTAGRAM OR OTHERS)	☐	☐
VIDEO NETWORKS (YOUTUBE, VIMEO OR OTHERS)	☐	☐

3.10 WHICH SERVICES ARE AVAILABLE BY TELEPHONE?

	Yes	No
APPOINTMENT MANAGEMENT	☐	☐
APPOINTMENT REMINDERS	☐	☐
GENERAL PATIENT INFORMATION	☐	☐
GENERAL INFORMATION ABOUT THE SERVICES PROVIDED BY THE HEALTH FACILITY	☐	☐
FREE EMERGENCY TELEPHONE LINE	☐	☐
COMMUNITY MOBILIZATION AND HEALTH PROMOTION	☐	☐
AWARENESS RAISING	☐	☐

3.11 WHICH ONLINE SERVICES ARE PROVIDED TO USERS?

	Yes	No
BOOKING OF MEDICAL APPOINTMENTS (ELECTRONIC DIARY)	☐	☐
APPOINTMENTS FOR TESTS	☐	☐
VIEWING DIAGNOSTIC TEST RESULTS	☐	☐
VIEWING MEDICAL RECORD OR FILE	☐	☐
DATA INSERTION IN MEDICAL RECORD BY PATIENT	☐	☐

4

EDUCATION/TRAINING

4.1 DOES THE HEALTH FACILITY RUN ICT TRAINING PROGRAMS?
(if NO, go to Section 5)

☐ → Yes ☐ → No

(if YES, check one or both these boxes)

☐ → Remote

☐ → Classroom

4.2 INDICATE ALL THE TYPES OF ICT TRAINING PROGRAMS AVAILABLE:

	Yes	No
ELECTRONIC HEALTH RECORD (OR ELECTRONIC MEDICAL RECORD)	☐	☐
PHARMACOTHERAPY MANAGEMENT	☐	☐
CLINICAL-ADMINISTRATIVE MANAGEMENT	☐	☐
DIGITAL MEDICAL IMAGING	☐	☐
INFORMATION SYSTEMS	☐	☐
TELEMEDICINE SERVICES	☐	☐
PUBLIC OR OCCUPATIONAL HEALTH SURVEILLANCE SYSTEMS	☐	☐
HEALTH EDUCATION DISTANCE LEARNING PROGRAMS	☐	☐

4.3 INDICATE THE NUMBER OF EMPLOYEES WHO HAVE RECEIVED ICT TRAINING UNDER THE RESPONSIBILITY OF THE HEALTH FACILITY:

	Total	Men	Women
HEALTH PROFESSONALS			
Physicians			
Stomatologists/dentists			
Nursing staff			
PROFESSIONALS UNRELATED TO HEALTH			
HEALTH TECHNICAL PERSONNEL			
TECHNICAL PERSONNEL UNRELATED TO HEALTH			
OTHERS			

5

INFORMANT

5.1 NAME OF INFORMANT

5.2 JOB TITLE

5.3 TELEPHONE

EMAIL

COMMENTS

Pan American Health Organization

World Health Organization
REGIONAL OFFICE FOR THE Americas

United Nations
Educational, Scientific and
Cultural Organization

cetic.br
Regional Center for Studies on the
Development of the Information
Society under the auspices of UNESCO

nic.br
Brazilian Network
Information Center

cgi.br
Brazilian Internet
Steering Committee