

# The Role of Digital Identification for Healthcare:

## The Emerging Use Cases

Identification for Development (ID4D)

World Bank



© 2018 International Bank for Reconstitution and Development/The World Bank  
1818 H Street, NW, Washington, D.C., 20433  
Telephone: 202-473-1000; Internet: [www.worldbank.org](http://www.worldbank.org)

## Some Rights Reserved

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Nothing herein shall constitute or be considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, or of any participating organization to which such privileges and immunities may apply, all of which are specifically reserved.

## Rights and Permission



This work is available under the Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO) <http://creativecommons.org/licenses/by/3.0/igo>. Under the Creative Commons Attribution license, you are free to copy, distribute, transmit, and adapt this work, including for commercial purposes, under the following conditions:

**Attribution**—Please cite the work as follows: World Bank. 2018. *The Role of Digital Identification for Healthcare: The Emerging Use Cases*, Washington, DC: World Bank License: Creative Commons Attribution 3.0 IGO (CC BY 3.0 IGO)

**Translations**—If you create a translation of this work, please add the following disclaimer along with the attribution: *This translation was not created by The World Bank and should not be considered an official World Bank translation. The World Bank shall not be liable for any content or error in this translation.*

**Adaptations**—If you create an adaptation of this work, please add the following disclaimer along with the attribution: *This is an adaptation of an original work by The World Bank. Views and opinions expressed in the adaptation are the sole responsibility of the author or authors of the adaptation and are not endorsed by The World Bank.*

**Third Party Content**—The World Bank does not necessarily own each component of the content contained within the work. The World Bank therefore does not warrant that the use of any third-party-owned individual component or part contained in the work will not infringe on the rights of those third parties. The risk of claims resulting from such infringement rests solely with you. If you wish to reuse a component of the work, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright owner. Examples of components can include, but are not limited to, tables, figures, or images.

All queries on rights and licenses should be addressed to World Bank Publications, The World Bank, 1818 H Street, NW, Washington, DC, 20433; USA; email: [pubrights@worldbank.org](mailto:pubrights@worldbank.org).

Cover image by: Daniel Silva

# Contents

---

- About ID4D** **iii**
- Acknowledgments** **iv**
- Abbreviations** **v**
- 1. Introduction** **1**
  - Why ID for Health? 1
  - Role of Foundational ID 2
  - Goal of This Paper 3
  - Scope and Method 3
  - Organization of This Paper 4
- 2. The Role of Foundational Identification in Healthcare** **5**
  - Patient Management and Treatment 6
  - Insurance and Benefits Programs 7
  - Data Collection for Planning and Research 8
  - Reinforcing ID and CR Systems 9
- 3. Country Case Studies** **10**
  - ESTONIA: Digital Identity as a Health Services Platform 10
  - BOTSWANA: Improving HIV Treatment with the National ID Number 12
  - THAILAND: National ID as a Delivery System for Universal Health Coverage 14
  - REPUBLIC OF KOREA: Unique Identification for Health Insurance and Big Data 16
  - INDIA: Early Use of Aadhaar in Healthcare 18
- 4. Key Considerations** **21**
  - Robustness and Coverage 21
  - Data Privacy and Protection 21
  - System Design 22
- 5. Conclusion** **23**
- References** **24**

## Tables

<b>Table 1. Benefits of Foundational Identification in Healthcare</b>	<b>6</b>
---	----------

## Boxes

<b>Box 1. ID in Estonia</b>	<b>10</b>
<b>Box 2. ID in Botswana</b>	<b>12</b>
<b>Box 3. ID in Thailand</b>	<b>14</b>
<b>Box 4. ID in The Republic of Korea</b>	<b>16</b>
<b>Box 5. ID in India</b>	<b>18</b>

# About ID4D

---

The World Bank Group's Identification for Development (ID4D) initiative uses global knowledge and expertise across sectors to help countries realize the transformational potential of digital identification systems to achieve the Sustainable Development Goals. It operates across the World Bank Group with global practices and units working on digital development, social protection, health, financial inclusion, governance, gender, and legal, among others.

The mission of ID4D is to enable all people to access services and exercise their rights, by increasing the number of people who have an official form of identification. ID4D makes this happen through its three pillars of work: thought leadership and analytics to generate evidence and fill knowledge gaps; global platforms and convening to amplify good practices, collaborate, and raise awareness; and country and regional engagement to provide financial and technical assistance for the implementation of robust, inclusive, and responsible digital identification systems that are integrated with civil registration.

The work of ID4D is made possible with support from World Bank Group, Bill & Melinda Gates Foundation, and Omidyar Network.

To find out more about ID4D, visit [worldbank.org/id4d](http://worldbank.org/id4d).

# Acknowledgments

---

This paper was authored by the ID4D initiative to support progress toward identification systems using 21st century solutions. The final draft was prepared by Julia Clark with significant inputs from the World Bank team which included Anneke Schmider, Luda Bujoreanu, Jonathan Marskell, and Ana Milena Aguilar Rivera. Additional inputs on country case studies have been received from Vijay Madan (former Director General of UIDAI) and Dr. Minah Kang (Ewha Womans University).

The authors would like to thank Samuel Lantei Mills, Chiho Suzuki, and Dominic Haazen from the World Bank and Kate Wilson from the Digital Impact Alliance (DIAL) for additional comments and feedback, and Vyjayanti Desai (ID4D Manager) for her supervision. Funding and direction for this paper were also generously provided by DIAL.

# Abbreviations

---

APBS	Aadhaar Payment Bridge System ( <a href="#">India</a> )
ART	antiretroviral therapy
ASHA	Accredited Social Health Activist ( <a href="#">India</a> )
BHRIMS	Botswana HIV/AIDS Rapid Information Management System ( <a href="#">Botswana</a> )
BORA	Bureau of Registration ( <a href="#">Thailand</a> )
BRDS	Birth and Death Registration System ( <a href="#">Botswana</a> )
CR	civil registry/registration
CRVS	civil registration and vital statistics system ( <a href="#">Korea</a> )
CSMBS	Civil Servant Medical Benefit Scheme ( <a href="#">Thailand</a> )
DBTs	Direct Benefits Transfers ( <a href="#">India</a> )
EHIF	Estonian Health Insurance Fund ( <a href="#">Estonia</a> )
EHIS	Estonian Health System Information System ( <a href="#">Estonia</a> )
EHR	electronic health record
eID	electronic identity document
eKYC	electronic know-your-customer
EMBR	Estonian Medical Birth Registry ( <a href="#">Estonia</a> )
FRR	Family Relationship Registration ( <a href="#">Korea</a> )
HIE	National Health Information Exchange ( <a href="#">Estonia</a> )
HMIS	Hospital Management Information Systems ( <a href="#">India</a> )
HSD	Health Statistics Department ( <a href="#">Estonia</a> )
ID	identification or identity document
JSY	Janani Suraksha Yojana ( <a href="#">India</a> )
MWS	Medical Welfare Scheme ( <a href="#">Thailand</a> )
NHI	National Health Insurance ( <a href="#">Korea</a> )
NHM	National Health Mission ( <a href="#">India</a> )
NHSO	National Health Security Office ( <a href="#">Thailand</a> )
NID	national ID
OTP	one-time password
ORS	Online Registration System ( <a href="#">India</a> )
PCS	Population Change Survey ( <a href="#">Korea</a> )
PIC	Personal Identification Code ( <a href="#">Estonia</a> )
PID	Personal Identification Number ( <a href="#">Thailand</a> )
PIN	personal identification number
PKI	public-key infrastructure
PR	population register ( <a href="#">Estonia</a> )
RIN	Resident Identification Number ( <a href="#">Korea</a> )
RR	Resident Registration ( <a href="#">Korea</a> )
SSS	Social Security Scheme ( <a href="#">Thailand</a> )
UCS	Universal Coverage Scheme ( <a href="#">Thailand</a> )
UHID	Unique Health Identification ( <a href="#">India</a> )
UIDAI	Unique Identification Authority of India ( <a href="#">India</a> )
UIN	unique identification number
VCT	voluntary counselling and testing center ( <a href="#">Botswana</a> )
VHCS	Voluntary Health Card Scheme ( <a href="#">Thailand</a> )



# 1. Introduction

---

## Why ID for Health?

Identification is crucial for the efficient and effective delivery of health services and public health management and is therefore instrumental for achieving Sustainable Development Goal (SDG) 3.<sup>1</sup> Providers need to know a patient's identity to access relevant medical and treatment histories and ensure that they are giving consistent and appropriate care. Patients also need documentation to prove enrollment in insurance programs or other safety nets that cover medical expenses. Administrators and researchers need a unique patient identifier to be able to aggregate records and share data between separate health databases (e.g., health information systems) in order to generate statistics and other data for planning, evaluation, emergency response, and improved treatments and disease management. Health insurers need to be able to identify patients to ensure that those for whom claims are submitted are actually insured and to facilitate the adjudication of claims based on the patient's history. A secure, inclusive, and responsible method of uniquely identifying and authenticating healthcare users over time and across facilities is central to each of these needs and the goal of achieving universal healthcare.

In many countries, however, patient identification and information systems have historically been weak. Hospital and clinic records are often paper based, or (where digital) have stand-alone information systems that cannot communicate, transfer data or records, or aggregate data between or within facilities. This reduces monitoring and planning capacity and can lead to inferior care for existing patients. Other patients—including some of the estimated 1.1 billion globally who lack legal identity documents (World Bank 2017d)—are unable to prove their eligibility or coverage and thus receive no services at all. Governments also face challenges extending or rationalizing health insurance programs when it is difficult to establish the identity of existing or excluded beneficiaries. As a result, healthcare providers and officials in many countries have struggled to improve public health and reach the 3.5 billion people worldwide who do not have access to quality essential health services (World Bank 2017c).

Over the past few decades, we have begun to see important reforms in the healthcare sector that have allowed countries to overcome some of these inefficiencies. This includes, for example, the increased adoption of digital information systems such as electronic health records (EHRs) and “e-Health” platforms. According to the WHO, for example, some 47 percent of countries now have an EHR system, while some 83 percent have adopted at least one mobile health (“mHealth”) application (WHO 2016). These improvements are often enabled by the creation of stand-alone, or *functional*, identification systems in the health sector, such as a unique patient ID number and/or card created by the Ministry of Health or the national health insurer and used by all facilities in the country.<sup>2</sup> Such functional identification systems

---

1 To the extent that identification helps improve the quality of care, patient access, insurance coverage, and data collection, it may play an important role in achieving SDG targets 3.1 and 3.2 (reducing maternal and child mortality), 3.3 and 3.4 (reducing mortality from communicable and non-communicable diseases), 3.7 and 3.8 (universal access to sexual and reproductive health and universal health coverage), 3b (research to develop medicines and vaccines), and 3d (improving monitoring and response systems for health risks).

2 A *functional* identification system is created for a specific use or purpose, such as the identification and authentication of healthcare patients. It could be unique to each hospital or consortium (e.g., private health insurance and providers in the US), or used throughout the country (e.g., the UK's NHS system). In contrast, *foundational* systems, such as a National Population Register or eID, are designed to be a general form of identification for multiple purposes. For more on this distinction, see Gelb and Clark (2013).

offer a number of potential benefits to patients, healthcare providers, and various government ministries. By allowing for secure and accurate identification and authentication of patients and enabling information exchange, they can increase the efficiency of patient management, improve the quality of treatment, reduce administrative burdens for patients, facilitate access to insurance, reduce fraud, and improve data collection. However, functional identification systems, such as a health ID card, can be costly to operate and contribute to a proliferation of sector-specific IDs and databases that may be non-interoperable and burdensome to users.

## Role of Foundational ID

As an alternative to creating a health-specific functional identification system, some countries have instead opted to use existing foundational identification systems, such as population registers, unique identification numbers (UINs) or national ID (NID) cards, as the basis for patient identification, verification, and authentication. Leveraging a foundational system in this way may create additional benefits beyond those offered by a functional system.

First, by streamlining identity management overall and eliminating health-ID specific costs, integrating a foundational system into the health sector may improve patient management, insurance administration, and data collection even more than a functional system. In [Estonia](#), for example, adopting the country's national electronic identity document (eID) as a unique patient identifier has increased the efficiency and accuracy of health data, reduced the administrative burden of doctors, and facilitated new services such as an e-prescription system that leverages the eID's digital signature capability. In [Botswana](#), various programs to address the HIV/AIDS crisis have used the national ID to uniquely identify patients and enable an advanced monitoring system that has increased patient retention and facilitated evaluation and scale-up.

Second, by using a foundational identifier shared with other systems—e.g., civil registration and vital statistics, etc.—health systems will be interoperable with other government databases. This could facilitate, for example, easier compilation of aggregate data by vital statistics offices, which can be used for planning and research, as in [Korea](#). Similarly, in a country where multiple agencies use a common foundational identifier, it can be used to verify or cross-check patient attributes across systems for a variety of purposes. In [Thailand](#), the use of the national ID number by disparate insurance databases allowed for the rapid creation and de-duplication of a universal healthcare registry.

Third, these linkages can also help strengthen identification and civil registration systems by driving demand for the foundational system and creating more points of contact with individuals for updating information. For example, if a foundational ID card or number enables access to certain health services or insurance—as in [India](#)—individuals may have greater incentive to obtain it. In this way, foundational identification, civil registration, and health systems can be mutually reinforcing when integration between the three systems is high.

At the same time, there may also be potential drawbacks to the use of foundational identification systems in health. This might include, for example, risks related to privacy if sufficient legal protections and technical and administrative controls are not in place. Non-robust foundational systems or those with low coverage may also pose challenges for their integration into healthcare systems. These potential risks and benefits require careful consideration when determining how to best fulfill the identification needs of the health sector.

## Goal of This Paper

The trend of leveraging foundational identification in health and other sectors is likely to grow in the coming years and decades. This type of application embodies the principle<sup>3</sup> that such systems should create a platform that—rather than serving a single purpose—is interoperable and responsive to the needs of various service providers and end users, including patients, healthcare facilities, medical professionals, Health Ministries, and other government agencies. To date, however, there have been no systematic studies of the effectiveness of this integration in healthcare systems. In addition, more work is needed to understand the particular risks and challenges of integrating foundational identification into healthcare systems, such as the need to protect and ensure fair use of sensitive personal data.

The goal of this paper is therefore to synthesize selected examples of how foundational systems are used for healthcare in a variety of countries. We hope that this initial effort at framing the utility of foundational identification for healthcare and providing early lessons and key considerations will help guide future work in this area by practitioners, donors, and researchers.

## Scope and Method

There are a number of limitations to the scope of this paper. First, its focus is on the use of unique *foundational* identification for healthcare in a selected number of countries. Although there are many types of foundational identity systems and documents, all of the cases discussed below—including Botswana, Estonia, India, Republic of Korea, and Thailand—involve population registers, digital ID cards, and/or UINs. In some cases, the advantages of a foundational system over a functional are clear; in others, it is difficult to separate the benefits of a foundational system from those of adopting any unique patient identifier, given that we cannot know the counterfactual. A deeper analysis comparing the use and impact of foundational versus functional identification is beyond the scope of this paper. Rather, the goal is to highlight why strong identification is important for health and demonstrate how foundational systems have filled this role.

Second, the paper focuses on four areas in which foundational identification systems may offer particular benefits—or risks—to healthcare patients, providers, and government agencies, including: (1) patient management and treatment, (2) insurance and benefits programs, (3) data collection for planning and research, and (4) reinforcing ID and civil registration (CR) systems. Although there may be others, these areas cover the main channels through which the use of a foundational system is likely to provide the most positive impact in the health sector.

Finally, the country case studies included here were chosen to illustrate these potential benefits, and are not exhaustive. Each highlights the use of foundational identification in one or more of the four areas above, but there is significant scope for further research in each topic and in each country. We hope this initial work will serve as a starting point for more detailed work on these issues that can further understanding of global experiences and distill important lessons and good practices.

---

3 See the *Principles on Identification for Sustainably Development: Towards the Digital Age* (World Bank 2017a), available online at <http://documents.worldbank.org/curated/en/213581486378184357/pdf/112614-REVISED-English-ID4D-IdentificationPrinciples.pdf>.

## Organization of This Paper

The remainder of this paper is organized as follows. Section 2 provides an overview of the main areas in which using a foundational system is likely to impact healthcare. Section 3 then illustrates these impact areas using country cases from Botswana, Estonia, India, Korea, and Thailand. In light of these examples, Section 4 discusses the key issues for practitioners to consider when integrating foundational identification into health care systems, including high-level design issues and strategies for maintaining data privacy and security. Section 5 provides concluding thoughts.

## 2. The Role of Foundational Identification in Healthcare

---

Healthcare systems require the identification of users (patients) for a variety of purposes. This includes treating patients and managing their health records, verifying insurance or benefits coverage, and aggregating data to optimize performance, improve resource allocation, and facilitate research. By enabling accurate and continuous recordkeeping of patients' medical histories over time and across facilities, unique, digital identification systems offer large gains in efficiency and effectiveness over fragmented and paper-based health systems.

While some countries have opted to create stand-alone, *functional* identification systems for these purposes, others have instead chosen to integrate an existing *foundational* identification system—e.g., using national ID cards or unique ID numbers—into their healthcare systems. In addition to the general benefits of digital patient identification, using a foundational identification system to underpin EHRs, insurance benefits, and health data exchange offers three potential advantages over a typical, health-specific functional system:

1. **Increased efficiency in the identity ecosystem:** By leveraging a foundational identification system rather than developing a health-specific system, countries may be able to create economies of scale and avoid duplicate databases, systems, and data collection efforts. Patients and healthcare providers may also save time to the extent that using the foundational system eliminates the need to apply for or carry additional identity documents, fill out and process multiple enrollment forms, and more.<sup>4</sup>
2. **Opportunities for interoperability:** If health systems use a unique patient or beneficiary identifier that is common to other programs (e.g., for social protection, education, taxation, etc.), these databases will also be able to interoperate (i.e., to exchange information or respond to queries). For example, if a health insurance provider is attempting to determine eligibility, they could query a socioeconomic database to determine below poverty-line status, reducing the need for extra data collection or verification during enrollment. Interoperability across a wide array of systems will also improve the ability to quickly and seamlessly collect data for planning and research. Such linkages, however, should only be implemented after considering potential risks to privacy and developing a strong legal and operational framework that protects personal information and prevents misuse.
3. **Mutual reinforcement of identification systems:** Integration between foundational identification and healthcare systems has the potential to not only improve the delivery of health services and public health management, but also to strengthen identification systems themselves. This is particularly the case where there are strong linkages between identification and civil registration systems, the latter of which already relies on the health sector for birth and death registration. Incorporating foundational systems into healthcare can strengthen and streamline these processes and create further demand for identity documents and civil registration.

The way in which a foundational identification is integrated into the healthcare system will vary by country. The two main models demonstrated in the cases below include requiring individuals to present their ID

---

4 For a more detailed description of how linkages with foundational identification systems can create efficiencies and fiscal savings for governments, see World Bank (2018d).

numbers or cards when first seeking treatment or enrolling in a health insurance or benefits program (e.g., [Botswana](#), [India](#), [Korea](#)) and/or using existing foundational identification databases to generate or update lists of health program beneficiaries (e.g., [Estonia](#), [Thailand](#), [Korea](#)).

Both types of integration can create benefits for patients, hospitals, Ministries of Health, and other government agencies. As summarized in Table 1, these benefits can be categorized into four primary areas, including: (1) patient management and treatment, (2) health insurance and benefits programs, (3) collecting data for planning and research, and (4) reinforcing ID and CR systems. Many of these benefits could also be achieved by adopting a digital, nationwide functional identification system. In general, however, it is likely that using a foundational—rather than functional—identification system will serve to amplify or create additional benefits in Areas 1–3, while the benefits in Area 4 will likely require the use of a foundational system. The remainder of this section gives a brief overview of each area, and Section 3 then provides illustrative examples from a diverse set of country cases.

**Table 1. Benefits of Foundational Identification in Healthcare**

Area	Benefits	Examples
<b>1. Patient Management and Treatment</b>	<ul style="list-style-type: none"> <li>▪ <i>Patients:</i> Improved quality of care and experience; transferability of care regardless of physical location; potential reduction in duplicate diagnostic testing; potential to control personal information sharing</li> <li>▪ <i>Hospitals and Clinics:</i> Improved efficiency in care planning and management, records management and reporting; improved quality of care, including preventative healthcare</li> <li>▪ Indirect benefits for <i>Ministry of Health</i> and <i>other agencies</i> due to improved resource management and allocation</li> </ul>	Botswana Estonia India Korea
<b>2. Health Insurance and Benefits Programs</b>	<ul style="list-style-type: none"> <li>▪ <i>Patients:</i> Improved access and experience</li> <li>▪ <i>Hospitals and Clinics:</i> Streamlined billing and claims processing and improved management system</li> <li>▪ <i>Ministry of Health:</i> Less fraud in health benefits</li> </ul>	Estonia India Korea Thailand
<b>3. Data collection for Planning and Research</b>	<ul style="list-style-type: none"> <li>▪ <i>Ministry of Health:</i> More accurate targeting of resources; faster emergency response; data-driven planning and policymaking</li> <li>▪ <i>Multiple Agencies:</i> More complete and accurate vital statistics</li> <li>▪ Indirect benefits for <i>hospitals, clinics</i> and <i>patients</i></li> </ul>	Botswana Estonia Korea Thailand
<b>4. Reinforcing ID and CR Systems</b>	<ul style="list-style-type: none"> <li>▪ <i>ID Providers:</i> Higher coverage; more accurate data through cross verification; improved statistics</li> <li>▪ Indirect benefits for <i>other agencies, hospitals, clinics</i> and <i>patients</i></li> </ul>	Estonia India Thailand

## Patient Management and Treatment

One area in which foundational identification may impact the health sector is in *patient management and treatment* within healthcare facilities, including hospitals, clinics, and other providers. When a patient arrives at a facility, providers need to accurately and consistently identify the individual and their relevant medical history. Without a records system that uniquely identifies a patient, administration becomes

burdensome for providers and clients, requiring duplicate paperwork for each new visit that may be incomplete or inaccurate. This is particularly problematic for certain illnesses—such as HIV/AIDS and tuberculosis—and vaccinations that require multiple visits and adherence to established protocols (UNAIDS 2014). Furthermore, if patient ID systems exist but are not shared across facilities (e.g., if each hospital maintains its own, non-interoperable system), it may be difficult for individuals to seek care at multiple or new locations, decreasing access to and continuity of care.

The ability to uniquely identify patients *across* healthcare facilities can therefore improve administration, patient management, and the quality of care by ensuring that individuals can be repeatedly and correctly identified when accessing services throughout the country (UNAIDS 2014, WHO 2012, WHO 2017a). When combined with an EHR system, a unique identifier facilitates a longitudinal history for each patient, including health status, diagnoses, test results, treatments, and outcomes over time. This reduces administrative duplication, wasted resources, and potentially dangerous errors in medications, transfusions, and testing (WHO 2007). In particular, treatment and administrative-level benefits of using unique identifiers can include (WHO 2017a):

- Ensuring accurate and timely information from multiple sources for diagnosis and treatment
- Improving linkages between testing and treatment
- Continuity and transferability of care when people across different facilities
- Increasing patient retention and follow-up care
- Reducing duplication of health records for the same individual
- Reducing waste and errors in diagnostic testing, medication, and treatment

Beyond this, longitudinal patient data are needed to aggregate reliable statistics on health services and outcomes over time. Such data are vital for research on the effectiveness of facilities and treatments, timely responses to public health crises, and the efficient allocation of resources (OECD 2015a, WHO 2012). This has direct benefits for Ministries of Health and Planning, and indirect benefits for healthcare providers and individuals, including by improving health outcomes and the performance of healthcare systems (OECD 2015a).

While the above benefits can be achieved with the adoption of a unique identifier specific to a program or the broader healthcare system (i.e., a functional system), using an existing foundational identifier may offer additional benefits, including improved linkages between health and other services (e.g., social protection) that also rely on the foundational system, the technological sustainability of the system, further cost-savings and increased efficiency, and more accurate data and statistics (WHO 2017a). This is particularly the case when the foundational system in question is digital, rather than paper-based. In [Estonia](#), for example, integration between the national eID and healthcare system have limited the administrative burden on doctors, automated data collection efforts, facilitated easy identification of families for health insurance, and facilitated the adoption of an e-prescription system backed by the eID's digital signature capability. In [Botswana](#), using the national ID number as a unique patient identifier has improved patient follow-up and retention in HIV/AIDS treatment programs.

## Insurance and Benefits Programs

Unique identification, a method of verifying or authenticating individuals, and the ability to aggregate individual-level data are also important for insurance and benefits programs within the healthcare system. In order to access health facilities or treatments, individuals in many countries must be able to prove that they are covered by insurance or another entitlement; failure to provide appropriate documentation may

exclude them from services. Similarly, where identification of beneficiaries is weak, insurance and benefits providers may see higher instances of fraud. And where health information systems are fragmented and patients seek care at multiple facilities, there may be instances of double charging, double payment, or patients not being properly reimbursed (WHO 2017a, 2017b). Importantly, health financing and insurance schemes also need complete and accurate records on service usage and data on system performance in order to correctly bill patients and care providers and to inform budgeting and management decisions.

With many countries seeking to scale their health systems and achieve universal coverage, we have seen a proliferation of new insurance schemes. Integrating a foundational identifier into such insurance programs has the potential to improve their effectiveness and efficiency while increasing inclusion. In [Thailand](#), for example, the national population registry serves as the baseline list of beneficiaries for the universal healthcare scheme, allowing for rapid coverage and eliminating the need for a duplicative enrollment campaign. In [Estonia](#), the linkage between the country's health information system and population register—underpinned by its unique eID and X-Road integration layer—has enabled every child to be automatically listed as a beneficiary in the health insurance fund from birth (World Bank 2015a). Furthermore, Estonia's e-Services infrastructure allows patients and providers to instantly check insurance coverage online using their national eID.

## Data Collection for Planning and Research

Health is a knowledge-intensive sector; it depends on data and analytics to improve care and facilitate discovery and innovation (OECD 2015a, OECD 2015b, WHO 2016). Indeed, the ability of healthcare administrators, researchers, and development planners to improve facility performance, develop better treatments, create personalized therapies, respond to epidemics and public health crises, and efficiently distribute resources hinges on their access to a wide variety of reliable data. This includes both patient-level clinical information as well as statistics on health services delivery, provider performance, patient outcomes, mortality rates and causes, disease outbreaks, and public health trends that could be aggregated across facilities and individuals over time. With disease outbreaks, for example, up-to-date information can mean the difference between a local outbreak that is easily contained and a regional public health emergency (Dye et al. 2016). Treatment and research related to common diseases such as cancer also rely on longitudinal patient histories derived from a variety of sources (e.g., hospitals, pathology laboratories, radiotherapy, death registries, etc.).

In each of these cases, data collection is improved by the ability to access health data and records that link patient histories and outcomes over time and are frequently updated—i.e., through the use of a unique ID enabled EHR system. The adoption of such systems has facilitated the growth of “big health data,” expanding the range and frequency of information collected and possibilities for analysis and research that were not previously possible (OECD 2015a). The power of uniquely identified, linked data, therefore offers the potential to address a broad range of public health concerns and enables more efficient monitoring of patient treatments, disease progress, and outcomes.

Using a foundational ID number as the unique identifier in these cases creates additional efficiencies, particularly when linked with civil registration and vital statistics systems (CRVS).<sup>5</sup> In [Korea](#), [Thailand](#), and [Estonia](#), for example, integration with the foundational identification system allows national health insurance programs to easily add newborns and remove deceased beneficiaries from their registers. However, it is important to note that there are also significant risks and implications from the misuse or inadvertent release of health data based on individual records that may be augmented when a foundational identifier is used. For example, original patient identifiers should not be included in micro-level data used for administrative

---

5 See UN (2014) for more on vital statistics systems.

or research purposes and should instead be anonymized or pseudonymized.<sup>6</sup> The challenges of secure and confidential management are discussed in more depth in the *Key Considerations* section of this paper.

## Reinforcing ID and CR Systems

The above sections describe how using foundational identification in health applications can help strengthen the healthcare system, creating efficiencies and better health outcomes for patients, providers, and governments. Beyond this, however, it can also help to strengthen foundational systems themselves, including the unique ID card or number used and/or the civil register.

Linkages between each of these systems are mutually reinforcing. For example, integration between the health sector and CR has well-known benefits for each system. Timely birth and death notifications from health facilities and outreach from frontline health workers boosts the accuracy of the register and coverage of birth and death certificates (WHO 2014, UNICEF 2017). Stronger vital statistics generated by CR systems also benefit public health by improving the accuracy and timeliness of important indicators—e.g., mortality, morbidity, maternal and child health, etc.—used in health policy and planning and emergency response to disease outbreaks (UNICEF 2017).

When a foundational identifier, such as a unique number or card, is embedded into these systems, this also provides benefits for identity providers, civil registration, and the health sector. More accurate and complete birth and death recording by health and civil registration systems linked to the unique ID will improve the quality of data in foundational systems, such as national population registers and other identity databases. Furthermore, where a unique foundational identifier is required to enroll in or access health services, it may increase incentives to obtain the ID, as in [Estonia](#) and [India](#).

---

<sup>6</sup> In British Columbia, for example, a longitudinal database was established in 1998 and now contains over 30 years of data on all health services used by residents of the province, as well as vital statistics. However, the pseudonymized identifiers used to link these records over time cannot be traced back to the original identifier. See more at <https://www.popdata.bc.ca/aboutus>

## 3. Country Case Studies

---

This section uses case studies from five countries—Estonia, Botswana, Thailand, the Republic of Korea, and India—to illustrate the potential benefits of using foundational identification in healthcare enumerated above. These countries vary significantly in terms of region, size, and type of identification system. In some cases, (e.g., [Estonia](#), [Thailand](#), and [Korea](#)), foundational systems have been broadly integrated into the health sector as a whole. In others (e.g., [Botswana](#) and [India](#)), its use has been limited to particular schemes, locations, or pilot projects. Taken as a whole, these cases therefore illustrate a broad range of possible scenarios in which countries may be able to leverage foundational identification to improve health outcomes and strengthen the identification system as a whole.

### ESTONIA: Digital Identity as a Health Services Platform

#### Box 1. ID in Estonia

Estonia is a pioneer in digital development, which is enabled in part by the country's innovative foundational identification system. The Estonian digital ID system is based on a near universal, public-key infrastructure (PKI)-enabled eID card that allows users to securely authenticate themselves and provide digital signatures for numerous online services, including banking, tax filing, and voting in elections. The eID card is mandatory for all citizens and legal residents over the age of 15; as of 2015, over 1.2 million cards had been issued out of a population of 1.3 million. Each citizen is registered at birth in the comprehensive Population Register (PR) and issued with a unique Personal Identification Code (PIC). Facilitated by the PIC, Estonia's "X-Road" integration layer allows databases from over 900 organizations to share information while preserving the sovereignty of each database, facilitating user control, and reducing the collection of duplicate data (Vassil 2015, World Bank 2015a).

Among many other "e-Services," Estonia's eID system has enabled important innovations in healthcare that have had direct benefits for patients, service providers, and a variety of government agencies.<sup>7</sup> The government implemented the Estonian Health Information System (EHIS) beginning in 2005, and e-health applications have continued to develop over the past 10 years. These services are enabled by the adoption of electronic health records (EHRs) in 2008 and e-Prescriptions in 2010, both of which rely on the national eID and X-Road interoperability platform for integration. EHRs use the PIC and/or eID as a unique patient identifier, enabling patients and providers to access records and services via online authentication. The EHIS uses X-Road to exchange health information across a variety of providers and databases including the PR and the Estonian Health Insurance Fund (EHIF) register of national insurance beneficiaries.

---

<sup>7</sup> Unless otherwise cited, the information in this section on eID integration in the Estonian healthcare system draws heavily from World Bank (2015a).

## Patient management and treatment

The integration of the PR, eID, and X-Road systems into healthcare has numerous benefits for patient management and treatment in Estonia. For patients, having EHRs linked to their eID allows them to easily access and exercise control over their personal information. By logging into an online healthcare platform using their eID and personal identification number (PIN), patients can review past doctor visits, current prescriptions, and health insurance claims status. They also can determine who has access to their health record information<sup>8</sup> and receive answers to general health requests. For care providers, the EHIS system allows for the exchange of vital information in the case of accidents or emergencies and reduces duplication of treatments or tests.

A prime example of how the eID has enabled innovations in patient treatment is Estonia's digital prescriptions (e-Prescription) system. e-Prescriptions were launched by the EHIF in 2010 with the goal of streamlining the process of writing, filling, and collecting prescriptions for doctors, patients, and pharmacies. Before the system was implemented, patients were required to collect prescriptions at the doctor's office. Now, using X-Road and e-signature capabilities, medical practitioners submit the prescription to a central prescription center. This has improved convenience for patients, who can then collect medications at the location of their choice using their eID to authenticate their identity.

The e-Prescription system has also benefited care providers and pharmacists by reducing their administrative burden and improving the quality of care. With EHRs and the EHIS system, doctors can check a patient's medication history across all providers and access the automatically calculated reimbursement amount for medications compensated by the EHIF. By querying the PR, relevant personal information (e.g., age, gender, address, and parents' information for children) automatically populates the e-Prescription form, so doctors do not need to complete additional documents. Pharmacies simply retrieve the prescription information from the EHIS and record when the medication is collected by the patient. In addition to convenience, this service has contributed to a more transparent prescription process by promoting monitoring and better prescription habits and allowing patients to view prescription records when they log in to e-Services using their eID. After five years of implementation, 99 percent of all prescriptions were electronic and e-Prescription had become the country's most popular e-Service.

## Health Insurance and Benefits Programs

The online access and integration offered by the Estonian ID system have also made the compulsory national insurance program (EHIF) more inclusive,<sup>9</sup> improved the allocation of resources, reduced the administrative burden of doctors, and simplified invoicing. As with e-Prescriptions, the EHIF uses the eID to facilitate e-Services related to insurance and benefits coverage, such as allowing patients and doctors to conveniently check insurance information through online authentication. The EHIF also relies on X-Road to update its Health Insurance Registry of beneficiaries. The Registry is updated daily with information on new births, deaths, and other changes in the PR. Newborns that enter the PR through birth registration are linked to their mothers' eIDs and automatically entered as new beneficiaries. All children are thus guaranteed coverage from birth, regardless of their parents' work status or social contributions. In addition, up-to-date information on beneficiary characteristics and the use of services have allowed the EHIF to improve budget allocations, while paperless administration and a reduction in the collection of duplicate data have allowed for administrative cost savings and improved administrator and patient convenience. For example, because prescription information from doctors and pharmacies is linked to the EHIS system, the invoicing process for insurance claims is almost completely automated.

---

8 Access to health records is regulated by law, and enabled only for licensed attending medical professionals (Saluse et al. 2010).

9 The EHIF was created in 2002 and provides coverage to all citizens and legal residents, across both public and private healthcare providers.

## Data Collection for Planning and Research

Estonia's eID and X-Road interoperability platform have also facilitated the exchange and collection of individual- and aggregate-level data by a variety of institutions to facilitate research and planning. This includes important data users and contributors, such as the National Health Information Exchange (HIE) platform, the Health Statistics Department (HSD), the Estonian Medical Birth Registry (EMBR), the Estonian Cause of Death Registry, the EHIF, and other medical registries such as those for abortions, cancer, tuberculosis, and drug treatments. The data flow includes both anonymized individual-level information from EHRs as well as aggregate data from registries and healthcare providers that are obliged to file quarterly and annual reports on inputs and services provided.<sup>10</sup> As a result, providers are able to track the development and spread of various types of diseases across different regions of the country. The ability to aggregate data from patients and providers also helps with financial planning, as the government is able to target support based on current needs.

## Reinforcing ID and CR systems

Finally, the use of the digital ID platform to integrate health services with other systems has potentially helped to reinforce the identification system as a whole. In order to take advantage of EHR or e-Prescription services, for example, patients (or their parents, in the case of children) must have an eID. Although the eID is mandatory, its use and adoption has increased significantly as more services (such as e-health) have been linked to the system (Vassil 2015). In addition, the X-Road-enabled link between the PR and EHIF provides an incentive for parents to register their children soon after birth in order to immediately obtain coverage for pediatric care. Although there are other driving factors—e.g., mandatory registration and a strong link between hospitals and the PR system—this link may contribute to the fact that almost all births in Estonia are registered within the first month.

## BOTSWANA: Improving HIV Treatment with the National ID Number

### Box 2. ID in Botswana

Botswana has a relatively advanced foundational identification system that consists of the “Omang” national ID card (issued to citizens aged 16+) and the Birth and Death Registration System (BRDS). The NID and BRDS systems are interoperable through their use of a common unique ID number that is issued at birth and later becomes the Omang ID card number. This number is used across various government registries and programs to facilitate data exchange and identity verification, and will serve as the basis of a new population register. Citizens use the national ID card to access public services, entitlements, and benefits, including social assistance, social insurance, driver's licenses, voting, education, and health services (World Bank 2015b).

---

10 The Health Statistics Department compiles, processes, and analyses aggregated information on a regular basis from 1,400 health-care facilities, which provides reports via an internet-based system. This allows for the calculation of statistics on morbidity, service delivery, and inputs.

Among other health-related uses, Botswana’s national ID number has been integrated into the country’s flagship antiretroviral therapy (ART) program. This program, called *Masa* or “new dawn,” was launched in 2001/2002 to tackle the country’s HIV/AIDS epidemic by providing comprehensive and free treatment to all citizens in need (Farahani et al. 2014). When *Masa* began, patient records were handwritten, paper-based files, which made it difficult for providers to track patients’ adherence and adverse reactions to ART over time and across the country’s decentralized health facilities. In order to improve outcomes and reduce the administrative burden of the program, *Masa* was transitioned to a computer-based patient management system and the Omang number has been gradually adopted as a unique patient identifier throughout Botswana’s ART facilities and related testing and treatment programs (UNAIDS 2004, UNAIDS 2009). This integration with the national ID system has improved administration and treatment, and has also facilitated data collection necessary to strengthen the program and assess its impact.

## Patient Management and Treatment

Integrating the Omang ID number into patient health records has helped to improve the quality and continuity of care for citizens living with HIV/AIDS. For patients, having a unique identifier to link their health records has allowed for easier access to ART at multiple locations and also to related services, such as those for tuberculosis (TB) (WHO 2017a). For providers, uniquely identified patient data have enabled the Botswana HIV/AIDS Rapid Information Management System (BHRIMS) to aggregate data at the facility level, improving clinic management and care. For example, the BHRIMS automatically generates lists of patients that need home follow-up, which has improved treatment adherence and patient retention (Glassman and Temin 2016). These benefits have extended beyond ART centers to other providers in Botswana’s network of healthcare facilities and programs designed to tackle HIV/AIDS. For example, the country’s voluntary counselling and testing centers (VCTs) have used the unique national ID number to avoid double counting the number of patients who have been tested and to improve follow-up with patients referred to other services such as ART (UNAIDS 2009).

## Data Collection for Planning and Research

In addition to improving care at the individual and facility levels, the BHRIMS monitoring system—underpinned by unique patient identification—also helps aggregate and analyze outcome data, pharmaceutical usage, and other indicators needed to improve treatment protocols and track progress. These data have also helped with general planning and bringing the *Masa* program to scale. In 2002, some 3,500 patients were receiving treatment; by November 2012, that number had reached 201,822 patients (Farahani et al. 2014). De-identified data from this system have also been used by various research teams to assess the impact of the *Masa* program.<sup>11</sup> Because the database is nationally comprehensive and the unique ID links patient records over multiple years, this has provided a more complete dataset than those available to researchers in other countries (Farahani et al. 2014). Notably, the information system also includes important data security measures. For example, there are four categories of users—doctors, pharmacists, laboratory staff, and program administrators—who each have different levels of access to edit patient records and are only able to read data entered by other categories of users (UNAIDS 2004).

---

<sup>11</sup> See, for example, Farahani et al. (2014) and Stoneburner et al. (2014).

# THAILAND: National ID as a Delivery System for Universal Health Coverage

## Box 3. ID in Thailand

Established in 1984, Thailand’s foundational identification system includes a digitized national population register based on household and civil registration, which now covers over 99 percent of the resident population. The system is managed by the Bureau of Registration (BORA) under the Ministry of Interior. BORA registers Thai citizens and eligible migrants, stateless persons, and refugees, who each receive a 13-digit Personal Identification Number (PID) at the time of birth or first household registration. Thai citizens are issued national ID smart cards at age seven, while non-citizens receive a simple plastic card at age 16. The PID and national ID smart card have become ubiquitous and a part of daily life in Thailand as the primary means of authenticating the unique identity of individuals. Because they are also used as proof of address for a wide range of purposes (e.g., to establish voting constituency and an address for official correspondence), there are significant incentives for individuals and the government to keep this data up to date. All government agencies collect the PID, which facilitates interoperability between systems (World Bank, forthcoming).

Thailand’s foundational identification system has been leveraged to increase access to healthcare and enhance the efficiency of health systems in several ways. The most significant contribution is the instrumental role that the national population register and PID—a lifetime unique identifier—played in enabling the government to successfully implement its Universal Coverage Scheme (UCS) in 2001, guaranteeing subsidized healthcare to all citizens. Called “one of the most ambitious healthcare reforms ever undertaken in a developing country” (Glassman and Temin 2016), the UCS reduced the uninsured population from 29 to 5 percent in less than two years (Kijsanayotin 2017). The foundational identification system also plays several other roles, from tracking vaccinations, to producing vital statistics that guide public health policy, to monitoring health system performance. As Thailand’s health system moves from paper based to electronic health records, the Ministry of Public Health and the National Health Security Office (NHSO) are exploring how the PID could be used to facilitate access to those records anywhere across Thailand while maintaining privacy, data protection, and ethical standards.

## Health Insurance and Benefits Programs

Before 2001, approximately 71 percent of Thai citizens were covered by one of four public health insurance schemes: the Voluntary Health Card Scheme (VHCS), the Medical Welfare Scheme (MWS), the Civil Servant Medical Benefit Scheme (CSMBS), and the Social Security Scheme (SSS). Although coverage was intended to be universal, the VHCS and MWS suffered from adverse selection and a lack of coverage among the informal sector, respectively (Paek et al. 2016). In order to ensure subsidized healthcare for all Thai citizens, the new government created the UCS—which guaranteed a 30-baht (~US\$1) copayment for accessing healthcare at public hospitals—to replace the VHCS and MWS in 2001. However, ensuring true universal coverage required the ability to identify the 29 percent of the population that were uninsured while preventing duplication of beneficiaries between the new UCS and the remaining insurance programs for formal sector employees (SSS) and civil servants (CSMBS). Because the national population register had achieved near universal coverage and the SSS and CSBMS already collected the PIDs of their beneficiaries, the newly established NHSO worked with BORA to use a truncated version of the national population

register to serve as the “baseline” of eligible beneficiaries. In order to create the UCS registry, the NHSO simply excluded existing SSS and CSMBS beneficiaries on the basis of their PID. All other PIDs were automatically enrolled as beneficiaries of the UCS (Kijsanayotin 2017).<sup>12</sup>

In addition to rapidly increasing the initial coverage of the UCS, the dynamic relationship between the national population register, PID, and the NHSO has continued to increase access to healthcare while reducing fraud and increasing efficiency. Every Thai citizen must be a member of the UCS, SSS, or CSMBS, all of which are managed by the NHSO. If a civil servant loses their job or moves to the private sector, they are automatically moved from the CSMBS into either the UCS or SSS. At the end of each day, BORA sends updated data on new births and deaths to the NHSO; newborns are automatically added to the beneficiary registry while the deceased are automatically removed. When a beneficiary visits any public health facility and provides their PID, staff can use an online portal maintained by the NHSO or, in the case of a Thai citizen, read the data stored on the national ID smart card to verify the scheme in which the citizen is enrolled and, in the case of UCS beneficiaries, their eligibility to receive nonemergency care at that facility (Suchonwanich 2013). In addition, the NHSO relies on PID-enabled database interoperability for e-claims and payments (Hanvoravongchai 2013).

## Data Collection for Planning and Research

The UCS has an extensive information system for collecting data on beneficiaries and providers, which relies on the PID to link records across individuals and facilities.<sup>13</sup> After removing personally identifiable information, these data—including comprehensive information on medical procedures, treatments, pharmaceuticals, and socio-demographic characteristics of beneficiaries—are used for research, monitoring health system performance, improving services, and planning. The NHSO publishes beneficiary and utilization statistics and financial reports on its website, while an internal information system uses the data for monitoring, evaluation, and planning (Hanvoravongchai 2013). The Health Insurance System Research Office also uses the data to conduct research on health financing and health service system development, and to produce ad-hoc studies on health outcomes and other aspects of health system performance. Similar analyses are undertaken using various disease registries, for instance linking these with cause of death data to assess the survival curve of different diseases and intervention outcomes (Jongudomsuk et al. 2015).

Interoperability between the national population register and the NHSO also plays an important role in efficient resource allocation by the Ministry of Public Health and the NHSO. UCS beneficiaries can only access subsidized nonemergency healthcare at a nominated facility in their home district, which enables evidence-based monthly and annual planning of staff, drugs, and equipment. Similarly, because of the incentives for Thais to keep their address in the national ID system up to date, BORA can produce real-time population statistics and forecasts down to the village level.

## Reinforcing ID and CR systems

The application of the foundational identification system for healthcare in Thailand has provided an important incentive for timely birth registration and for people to keep their address in the national population register up to date. UCS beneficiaries can only access nonemergency healthcare at a hospital they nominate in the district where they reside, according to the national population register. Furthermore, because parents use their PID on a weekly—or even daily—basis to access government and other services

---

12 Importantly, Thailand’s Ministry of Public Health also provides subsidized health insurance to a large number of stateless persons and migrant workers who are registered and issued PIDs.

13 The development and maintenance of the shared database system relied heavily on cooperation and agreement to share data between agencies, especially between the Ministry of Interior and NHSO (ILO 2015).

such as healthcare, they appreciate the importance of obtaining a PID for a child, which is generated during the birth registration process and issued for the first time on the child's birth certificate (World Bank, forthcoming).

The health system also plays an important role in civil registration by automatically notifying BORA about births and deaths on a daily basis. In order to make birth registration universally accessible, the NHSO, Ministry of Public Health (MOPH) and BORA—with support from UNICEF—introduced an online birth notification system in 2011 that enables hospitals to send the data necessary to complete a birth registration directly to the nearest district office. As a result, birth registration forms are prefilled, and parents therefore spend minimal time in the district office to complete the process. If the parents do not visit the district office within 15 days of birth, officials actively follow up with the family. Today, this system is operational in over 900 public hospitals. BORA also posts staff in hospitals where large numbers of births take place, allowing parents to complete registration in the hospital itself, often within a few hours. In order to make birth registration accessible to the families of migrant workers—typically from neighboring Myanmar, Cambodia, or Lao PDR—BORA works with nongovernmental organizations (NGOs) to provide legal advice and translation in hospitals where the births of their children most often take place. These linkages between the health sector and BORA—combined with the fact that some 99 percent of births in Thailand occur in hospitals—have contributed to high birth registration rates for children under five (99 percent) and high death registration rates (approximately 95 percent) (NSO & UNICEF 2016, THIS 2012). As a result, the national population register is accurate in real time and thus serves a wide range of administrative purposes, such as proof of address, compiling population statistics by province, district, and village, and producing voter lists by constituency with relative ease.

## REPUBLIC OF KOREA: Unique Identification for Health Insurance and Big Data

### Box 4. ID in The Republic of Korea

Korea has an integrated identity and CRVS ecosystem that includes a population register (Resident Registration, or RR), a family register (Family Relationship Registration, or FRR), and the Population Change Survey (PCS) to generate vital statistics. Each individual in the RR is issued a unique, 13-digit Resident Identification Number (RIN), which is included on the national ID card issued to citizens at age 17 (the individual RR Certificate Card) and also on household RR record cards. Vital events and changes in residency are registered at local government offices, and this information is electronically transferred to and between the central RR, FRR, and PCS databases, managed respectively by the Ministry of Interior, Supreme Court, and Statistics Korea. Nearly all documents (e.g., birth, marriage, and death certificates) and other government services in Korea require individuals to present their RIN number, facilitating data exchange. A “Government for Citizens” project in 2002 first brought RR services online, and the 2013 launch of second-generation e-services portal (Minwon24) now allows individuals to conveniently report changes in address and access a variety of administrative services, including those related to voting, immigration, health, welfare, and employment (Joon Song et al. 2016).

National ID cards and RIN numbers are highly integrated into the healthcare system in Korea. Most Koreans access health services through the National Health Insurance (NHI) program, which relies on the RIN as a unique patient identifier for EHRs, and use their ID cards as proof of identity when interacting with healthcare

providers. This linkage has had concrete benefits by streamlining patient management and treatment and increasing the inclusivity and scale of the NHI program. In addition, the high level of integration between the RIN, health providers, and the vital statistics system has automated data collection by Statistics Korea and provided a rich base of information for research and planning (Joon Song et al. 2016).

## Patient Management and Treatment

Subscribers to the NHI scheme use their national IDs or RINs to prove their identity and insurance coverage and receive medical treatment and prescriptions at any facility in the country (Joon Song et al. 2016). This includes a variety of services, including monitoring and management of chronic illnesses, infant and child screening, national immunization support projects, and maternity care support projects. Patients can make appointments, access their medical records, and view utilization histories and immunization schedules using their RINs. Because of linkages between the NHI and broader CRVS systems through the national ID, hospitals are able to leverage up-to-date information from these systems—e.g., current address from the RR—to provide services such as notifications to schedule follow-up appointments for infant check-ups and immunizations. The identification system also helps track usage statistics to improve treatment. For example, real-time Drug Utilization Reviews rely on the RIN and RR to identify potential drug abuse and misuse and provide pop-up notices to prescribers (Kang et al. 2018).

Recently, local hospitals have implemented a number of pilot projects for chronic disease management that rely on mobile (“M health insurance”) and internet (“health iN”) platforms to collect data—e.g., blood pressure and glucose levels—and provide patients with health information, reminders, and a feedback mechanism. The national ID is required to enroll in these programs, preventing duplicate registration and facilitating mobile services for patients. The Ministry of Health and Welfare has also announced plans for a comprehensive chronic disease management program that integrates patient data from local clinics with EHRs and extends non-face-to-face monitoring and management using smart phones. Each of these programs will rely on the national ID and RR for registration and information exchange, facilitating database and patient management between clinics and allowing for integration with the NHI reimbursement system (Kang et al. 2018).

## Insurance and Benefits Programs

Korea’s NHI program provides universal healthcare services and covers approximately 97 percent of the population (MOWH and KIHASA 2017).<sup>14</sup> The NHI uses a single payer system, and all insured people have access to an identical benefits package. Subscribers pay a premium according to their ability to pay, and vouchers are available for limited benefits such as maternity care and funeral expenses (Kwon et al. 2015). The NHI system makes extensive use of administrative information sharing with the CRVS system to identify eligible beneficiaries and determine and collect insurance premiums. For example, determinations of health insurance premiums rely on the national ID number to verify subscriber’s personal income, tax, and pension information. In addition, linkages with the CRVS system are used to update the NHI beneficiary list. After birth, parents register their newborns at a local office, and the infant receives an RR number and is entered into the CRVS system. Parents must then apply for NHI coverage of the newborn within 14 days, including the infant’s RR number and the parent’s ID numbers. This information is used to link the child to the parents as a dependent in the NHI system for the purposes of billing. The NHI also automatically receives notifications of new deaths from the CRVS system, and these subscribers are removed from the system (Joon Song et al. 2016).

---

14 The remaining 3 percent are covered by a tax-funded program to ensure access to healthcare for low-income citizens (Soonman, Lee, and Kim 2015).

## Data Collection for Planning and Research

Because coverage is universal, data from the NHI represents the entire Korean population and is routinely used for a wide variety of research. These data include information on treatments, pharmaceuticals, procedures, and diagnoses, and other information for almost 50 million beneficiaries (Kim et al. 2017). The utility of the NHI data is increased by its linkages with the CRVS system that facilitate the collection and sharing of a broad range of data used for policymaking and business development (Joon Song 2016). They are used to calculate a range of public health indicators—such as medication adherence, prescribing patterns, adverse events, cost-effectiveness, disease incidence and prevalence, cause of death, healthcare service utilization, outcomes—that help improve planning and healthcare (Kim et al. 2017). For example, a recent study used a representative sample of records from one million people over the 2002–2010 period to assess utilization patterns, provision of customized health management services, and healthcare costs (Kwon et al. 2015). Importantly, Korea has taken steps to ensure the protection of personal data. Beneficiary and provider ID information is stored in an encrypted format, and access to linked, individual-level records by other agencies, researchers, and the private sector is regulated. In addition to data shared with most third parties, any public information available through the open data platform system must be de-identified (Kim et al. 2017).

## INDIA: Early Use of Aadhaar in Healthcare

### Box 5. ID in India

Launched in 2010, India's pioneering Aadhaar system is based on a 12-digit unique ID number issued to each resident of the country. As of the end of 2017, over 1.19 billion Aadhaar numbers have been issued, covering nearly 90 percent of the population. The Aadhaar database is maintained by the Unique Identification Authority of India (UIDAI) and captures minimal biographic and biometric data, including name, gender, date of birth, address, a digital photo, 10 digital fingerprints, and 2 iris scans. These biometrics are used to ensure uniqueness at the time of enrollment and for cloud-based authentication. Rather than relying on a card, individuals authenticate themselves using their Aadhaar number in combination with demographic data, a fingerprint, and iris, or a one-time password (OTP), which are checked against the central database. For general purposes, UIDAI provides a simple yes/no response to authentication queries, for e-Know-Your-Customer (eKYC) purposes, UIDAI will provide additional information with the user's consent, such as name, date of birth, address, gender, email, mobile number, and photograph (Abraham et al. 2017).

As of 2017, the Aadhaar number has been adopted as a method of uniquely identifying and authenticating beneficiaries and clients in a variety of sectors in India. For example, many of the country's social protection schemes—including food rations, wage payments, energy subsidies, and pensions—have seeded Aadhaar into their databases in order to rationalize beneficiary lists and facilitate Direct Benefits Transfers (DBTs) (Abraham et al. 2017). Although most early adopters of the Aadhaar platform have been outside the health sector, there are a number of emerging cases and pilots. This includes using Aadhaar to facilitate online appointment scheduling for patients, tracking the performance of health workers, and improving the identification of insurance beneficiaries. Although it is too early to fully assess the outcomes of these new initiatives, they still highlight some of the potential benefits of leveraging foundational identification systems for improved healthcare.

## Patient Management and Treatment

One of the Indian Government's flagship e-governance projects is its Online Registration System (ORS) for e-Health, piloted in Delhi and then launched nationwide in 2015. The ORS portal links the Hospital Management Information Systems (HMIS)<sup>15</sup> of various hospitals to an Aadhaar-based registration and appointment system for patients. After entering their Aadhaar-linked mobile numbers and choosing a hospital and appointment date, patients then authenticate their identities via their Aadhaar number and an OTP.<sup>16</sup> After the patient's consent, the hospital then receives their eKYC from UIDAI, and new patients are issued a Unique Health Identification (UHID) number used in the hospital's EHR system. After the appointment is booked, patients then receive a confirmation SMS. For patients, this system provides a more convenient option to the other alternative of booking appointments in person at the hospital, which may require long travel times and waiting in line. It also allows access to other services, such as viewing lab reports and checking the availability of blood in blood banks. For hospitals, this improves the accuracy of patients' data, strengthens EHR systems, and streamlines the appointment management system. Thus far, the ORS system has been adopted in over 1,100 departments in 131 hospitals throughout the country that have digitized their HMIS systems. As of January 2018, over 1.2 million appointments were booked through the ORS (ORS 2018).

In addition to the unique identification of patients, various programs in India have begun to use Aadhaar to uniquely identify healthcare workers for performance monitoring and incentives, with potential indirect benefits to patients in terms of quality of care. In March 2017, for example, the Ministry of Health and Family Welfare began requiring all Accredited Social Health Activists (ASHAs)<sup>17</sup> and other contractors with the National Health Mission (NHM) to register their Aadhaar numbers in the employee database. This will allow for performance-based incentives and other payments to be deposited directly into their bank accounts through the Aadhaar Payment Bridge System (APBS). Although details of Aadhaar seeding in the ASHA database and payments through APBS are not yet available in the public domain, this system is expected to improve the incentives and performance of healthcare workers (The Gazette of India 2017a).

## Health Insurance and Benefits Programs

A number of health insurance and benefits schemes have also begun using Aadhaar to register and authenticate beneficiaries with the goal of increasing coverage and access and reducing fraud. These projects are mostly in the early stages, but the use and potential benefits of Aadhaar are likely to increase in the coming years. For example, the Janani Suraksha Yojana (JSY) scheme—an all-India NHM program designed to reduce maternal and neonatal mortality—requires beneficiaries (10.4 million in 2016–17) to provide their Aadhaar number during enrollment (The Gazette of India 2017b). Similarly, the government of Maharashtra recently launched its Mahatma Jyotiba Phule Jan Arogya Yojana scheme to provide social health insurance, and plans to use Aadhaar numbers to deduplicate beneficiaries and authenticate patients at hospitals. The government of Tamil Nadu has also included the Aadhaar number on insurance cards

---

15 The HMIS or “e-Hospital” system relies on cloud-based, open source software that can be customized to manage major functions of multiple hospitals, including out- and in-patient services and clinical, administrative, billing, and insurance requirements.

16 Aadhaar authentication via the OTP requires that users have linked their mobile number with Aadhaar, which is optional during enrollment. If patients have not linked their mobile number with Aadhaar, the ORS system uses the patient's name for authentication. In this case, eKYC data are not automatically supplied, and the patient must enter additional information. Patients can also use the system without Aadhaar, but are then required to collect their appointment cards from the hospital after providing proof of identity. See <https://ors.gov.in/index.html> for more information.

17 ASHA workers are female community health activists hired and trained by the NHM. The goal is to provide every village with a first point of contact for health-related demands and concerns within the community, with a particular focus on women and children who may find it difficult to access health services.

issued to beneficiaries of its new Chief Ministers Comprehensive Health Insurance Scheme. Finally, the National Aids Control Organisation is piloting a program to seed its “People Living with HIV” database with Aadhaar numbers with the goal of helping eligible beneficiaries obtain access to various schemes, including health programs, financial assistance, and social sector schemes.<sup>18</sup>

## Reinforcing ID and CR Systems

One main goal of the Aadhaar program was to rapidly provide a secure, unique identity to the millions of Indians who lacked a reliable form of identification due in part to low birth registration. However, the now widespread coverage of Aadhaar and its integration into services, such as healthcare, provides the opportunity to strengthen civil registration through mutual reinforcement. For example, the government of Haryana and the Registrar General of India jointly launched an “Aadhaar linked Birth Registration” project in 2015, which allows newborn children in the State to be enrolled in Aadhaar and complete birth registration through a single process. From February 2016 to September 2017, more than 740,000 births were registered in Haryana. Of these, around 88 percent of all birth certificates contained the child’s Aadhaar number.<sup>19</sup> Because holding an Aadhaar number will facilitate access to a number of social and health-related programs—such as immunization campaigns and the Integrated Child Development Service scheme to provide primary healthcare, preschool education, and food to children under six and their mothers—it is anticipated that this linkage will simultaneously improve access to these services, incentivize registration in Aadhaar, and increase the coverage of birth registration and certificates.

---

18 See <https://www.jeevandayee.gov.in/>, <https://www.cmchistn.com/>, and <http://www.naco.gov.in/register-aadhaar-card> for more information on these programs.

19 Aadhaar-linked death registration are also being piloted, but numbers are not yet available. See <http://crsorgi.gov.in/> for more information.

## 4. Key Considerations

---

This paper highlights key areas where foundational identification can be leveraged to improve healthcare outcomes for patients, providers, and government agencies, and in doing so also reinforce the identification system as a whole. However, it is also important to recognize that there are risks and challenges in planning and implementing such integration. In particular, this includes ensuring (1) that foundational systems are robust and inclusive, and (2) that there are sufficient measures in place for the confidentiality and security of personal data. The particular design of identification systems will also dictate which integration models are most appropriate for any given country. While a full treatment of these issues is beyond the scope of this paper, a brief discussion of each is given below. Additional work is needed to fully explore best practices for the use of foundational identification in healthcare.

### Robustness and Coverage

All of the examples above involve countries with technically advanced foundational identification systems that have broad coverage throughout the population. These two qualities—coverage and robustness (i.e., data accuracy and integrity)—have been critical to their utility in the health sector.

In [Thailand](#), for example, universal health insurance coverage was made possible by a complete and up-to-date population register. The comprehensiveness of national ID and health databases in [Korea](#) and [Botswana](#) have facilitated population-wide data collection and research to monitor and improve service delivery. In [Estonia](#), the universality of the eID has enabled the adoption of a broad digital health system. Health-related applications that leverage [India's](#) Aadhaar have only been rolled out in the past few years, after the program had reached a large majority of the population.

Conversely, the benefits of using a foundational identification system for unique ID in healthcare are likely to be limited where foundational systems are non-robust or when a large portion of the population remains uncovered by the identification system. A national ID number that is only issued to adults, for example, will not have sufficient coverage to use as a unique patient identifier for children. This is a problem if those who need identification for health the most—e.g., children or poor beneficiaries of a social insurance program—are also the most likely to lack identification. In such cases, requiring a foundational system to enroll in or access health services may unintentionally exclude the most marginalized groups.

At the same time however, and as discussed above, there is also the potential that linking a foundational identifier to a high-demand service like healthcare will help improve the coverage of the identification system itself. This tradeoff between incentives and exclusion must be carefully weighed to ensure that requiring a particular ID number or card for healthcare drives—rather than depresses—demand for both.

### Data Privacy and Protection

Data privacy and protection are key to both well-managed health systems and to identification systems more broadly. In certain cases, the use of foundational identification systems within the health sector may enhance privacy. If patients are able to authenticate their identities with only their unique number, fingerprint, or PIN, this can avoid the unnecessary disclosure of other potentially sensitive information during the process of receiving treatment or collecting prescriptions (UNAIDS 2014). In the [Estonian](#) case, for example, the eID and X-Road system minimize the collection of duplicate data and allow users to view and manage access to their health data.<sup>20</sup>

---

20 For example, Estonia's Public Information Act prohibits the collection of data that is already contained in the PR.

However, such systems may also create risks related to data protection and privacy. Unauthorized access to or misuse of personal information can reduce trust, undermine individual rights to privacy and consent, and in some cases, put vulnerable groups at a serious risk of harm (World Bank 2017a, WHO 2017a).<sup>21</sup> While these concerns are present in any identification system, they may be pronounced in the health context, particularly if unique identifiers are linked to health records or other potentially sensitive data such as medical conditions and past treatments. These risks must therefore be mitigated and managed by strong data protection and privacy laws and regulations that privilege individual rights while ensuring adequate access to data to meet public health information needs (OECD 2017). For example, data used to detect and address disease outbreaks should be collected and aggregated in a way that does not compromise individual privacy or allow for anonymized patient data to be re-identified.

In addition to the *Principles on Identification* (World Bank 2017a), the WHO (2017c) and OECD (2017) offer a number of guidelines on managing data protection, privacy, and security in the context of unique ID and health systems. In particular, these guidelines emphasize the importance of allowing for the aggregation and sharing of data for monitoring, planning, and research while ensuring (1) the security of databases, data collection devices (e.g., mobile phones), and data transmission, (2) individual consent and control over the use of personal data, (3) de-identification or anonymization of shared data, (4) the certification or accreditation of any third parties who have access to data, and (5) periodic review and reevaluation of data use and sharing procedures as norms change and new types of data become available.

## System Design

The design of existing and planned identification and healthcare systems has important implications for integrating a foundational identifier into the health sector. This includes the technical architecture, governance models, policies and procedures, and legal frameworks related to identification systems, civil registration, and health services. For example, an integration model based on a national ID card and number (e.g., [Estonia](#), [Botswana](#), [Thailand](#), [Korea](#)) may look different from one based on a unique number only (e.g., [India](#)). Countries with paper-based or fragmented health information systems will have different options and utility from integrating a foundational identifier than those with national-level, digitized EHRs. Data protection and privacy laws also vary by country and may limit certain types or methods of data sharing. Countries with decentralized healthcare systems that involve multiple agencies, levels of government, donors, and NGOs may require different strategies for integration and higher levels of coordination than those with more centralized healthcare administration. In order to begin exploring these issues, practitioners are encouraged to begin with a detailed assessment of identification in health and the broader identity landscape within a country.<sup>22</sup>

Practitioners can also consult existing guidelines to ensure that foundational and health ID systems meet global standards. This includes, for example, the 10 *Principles on Identification for Sustainable Development* which provide broad standards for achieving universal coverage and accessibility, robust and sustainable system design, and trusted legal frameworks in ID systems (World Bank 2017a). The WHO's Guidance note on implementing unique identification in health also provides more detailed guidance on adopting unique IDs in health systems (WHO 2017c), while the UN's *Principles and Recommendations for a Vital Statistics System* provide basic standards for the collection of key health and other data (UN 2014).<sup>23</sup>

---

21 For example, revealing an individual's disease status may cause serious harm if it was acquired in a way which is illegal in a country's context (WHO 2017a).

22 The World Bank, for example, conducts detailed ID4D diagnostics of client countries as a first step toward further engagement on ID-related projects. These exercises provide a broad snapshot of identification systems as a whole, but can also be targeted to provide a deeper analysis of a specific sector, such as health. Additional ID4D assessments can also provide a targeted analysis of identity-related legal frameworks for privacy and data protection. See World Bank (2018a) for more information.

23 Readers are also encouraged to consult pieces from the World Bank on technical standards (World Bank 2018b) and emerging technologies (World Bank 2018c) for identification systems.

# 5. Conclusion

---

This paper provides an introduction to the importance of identification in healthcare and the areas in which foundational identification systems may be able to create benefits for patients, providers, and governments. By adopting a unique digital ID for patient identification and authentication, countries can improve the quality of care and user convenience, improve coverage and eliminate fraud in insurance, reduce administrative inefficiency, and create the infrastructure for data generation and collection. Although any health-specific digital ID system with national coverage may achieve these goals, the use of a foundational system can amplify them while also reinforcing existing identification and civil registration systems more broadly.

However, while summary examples from Botswana, Estonia, India, Korea, and Thailand included in this paper provide early evidence of these benefits, they are insufficient. More rigorous analysis is needed at the country and global level to provide a complete picture of the full impact and potential risks associated with using a foundational identifier in the health sector. Such work should build on emerging standards for technology and legal frameworks to help ensure that foundational identification systems used in health applications enhance—rather than infringe on—individual privacy. To the extent that countries meet these standards, foundational identification systems may play an important role in facilitating better quality healthcare for all.

# References

---

- Abraham, R., E. Bennett, N. Sen, and N.B. Shah. 2017. "State of Aadhaar Report, 2016-17." IDinsight. Available at: <http://stateofaadhaar.in/>
- Dye, C., Bartolomeos, K., Moorthy, V., and Kieny, M., (2016). Data sharing in public health emergencies: a call to researchers. *Bulletin of the World Health Organization* 94(158). Available at: <http://www.who.int/bulletin/volumes/94/3/16-170860.pdf>
- Farahani, et al. (2014). 'Outcomes of the Botswana national HIV/AIDS treatment programme from 2002 to 2010: a longitudinal analysis'. *The Lancet Global Health* 2(1).
- Gelb, A., and Clark, J. (2013). Identification for Development: The Biometrics Revolution. CGD Working Paper. Washington, DC: Center for Global Development.
- Glassman, A., and Temin, M. (2016). "Making the Impossible Real: Botswana's Mass Antiretroviral Therapy Program" in *Millions Saved: New Cases of Proven Success in Global Health*. Washington, DC: Center for Global Development. Online at: <http://millionsaved.cgdev.org/case-studies/botswanas-mass-antiretroviral-therapy-program>
- Hanvoravongchai, P. (2013). Health Financing Reform in Thailand: Toward Universal Coverage under Fiscal Constraints, World Bank UNICO Study Series, 20 January 2013.
- ILO. (2015). Thailand: A national health insurance beneficiary registry based on national identification numbers. ILO Social Protection Department. Available at: <http://www.social-protection.org/gimi/gess/RessourcePDF.action?ressource.ressourceId=53144>
- Jongudomsuk, P., et al. (2015). The Kingdom of Thailand Health System Review. *Health Systems in Transition* 5(5).
- Joon Song, Hee, Kang, Minah, Kim, Churin, and Kim, Yeonsoo. (2016). Korea: an integrated system of civil registration and vital statistics. Washington, DC: World Bank.
- Kang, M., Bae G., Kim H., and Hong S. (2018). Global Civil Registration and Vital Statistics Advisory Services Analytics: Korea Resident Registration and Universal Health Coverage Case Study. World Bank.
- Kijsanayotin, Boonchai. (2017). Thailand's national IDs as a foundation for universal health coverage and healthcare delivery. Third meeting of the Regional Steering Group on Civil Registration and Vital Statistics in Asia and the Pacific, 19 October 2017, Bangkok, Thailand. Available at <http://getinthepicture.org/system/files/event/documents/Session%205%20-%20Thailand%20-%20Thailand%E2%80%99s%20national%20IDs%20as%20a%20foundation%20for%20universal%20health%20coverage%20and%20healthcare%20delivery.pdf>
- Kim, J., et al. (2017). Towards Actualizing the Value Potential of Korea Health Insurance Review and Assessment (HIRA) Data as a Resource for Health Research: Strengths, Limitations, Applications, and Strategies for Optimal Use of HIRA Data. *Korean Journal of Medical Science* 32.

- Kwon S., Lee Tj., and Kim Cy. (2015). *Republic of Korea Health System Review 5(4)*. Manila: World Health Organization, Regional Office for the Western Pacific.
- MOHW and KIHASA. (2017). *Social Security Factbook 2016*. Korea Social Security Committee, Ministry of Health and Welfare.
- NSO and UNICEF. (2016). *Thailand Multiple Indicator Cluster Survey 2015–2016, Final Report*, Bangkok: National Statistical Office and United Nations Children’s Fund.
- OECD. (2015a). *Data-Driven Innovation: Big Data for Growth and Well-Being*. Paris: OECD Publishing.
- OECD. (2015b). *Health Data Governance: Privacy, Monitoring and Research*. Paris: OECD.
- OECD. (2017). *Recommendations of the OECD Council on Health Data Governance: the next generation of health reforms*.
- ORS. (2018). *ORS Patient Portal Dashboard*. Government of India. <https://ors.gov.in/copp/>
- Paek, S. C., Meemon, N., and Wan, T. T. H. (2016). Thailand’s universal coverage scheme and its impact on health-seeking behavior. *SpringerPlus*, 5(1): 1952.
- Saluse, J., et al. (2010). *Assessing the Economic Impact/Net Benefits of the Estonian Electronic Health Record System DIGIMPACT Final Report*. <http://www.praxis.ee/fileadmin/tarmo/Projektid/Tervishoid/Digimoju/Digimimpact.pdf>
- Soonman, K., Lee, T., and Kim, C. (2015). *Republic of Korea Health System Review. Health Systems in Transition 5(4)*. Asia Pacific Observatory on Public Health Systems and Policies.
- Stoneburner, R., et al. (2014). Using Health Surveillance Systems Data to Assess the Impact of AIDS and Antiretroviral Treatment on Adult Morbidity and Mortality in Botswana. *PLOS*.
- Suchonwanich, Netnapis. (2013). *Enrollment systems and eligibility checking mechanism in Thailand*. Presentation, 31 May 2013. National Health Security Office (NHSO).
- The Gazette of India. (2017a). Part II—Section 3, March 3, 2017. Government of India.
- The Gazette of India. (2017b). Part II—Section 3, February 10, 2017. Government of India.
- THIS. (2012). *Rapid Assessment of National Civil Registration and Vital Statistics Systems: A case study of Thailand*. Thai Health Information Standards Development Center (THIS), Health Systems Research Institute. Available at <http://www.this.or.th/files/6.pdf>
- UN. (2014). *Principles and Recommendations for a Vital Statistics System*. New York: United Nations. Available at: <https://unstats.un.org/unsd/demographic/standmeth/principles/default.htm>
- UNAIDS. (2004). *Stepping back from the edge: The pursuit of antiretroviral therapy in Botswana, South Africa and Uganda*. Geneva: UNAIDS.
- UNAIDS. (2009). *Developing and Using Individual Identifiers for the Provision of Health Services including HIV*. Proceedings from a Workshop, 24–26 February 2009, Montreux, Switzerland. Geneva: UNAIDS.
- UNAIDS. (2014). *Considerations and guidance for countries adopting national health identifiers*. Geneva: UNAIDS.

- UNICEF. (2017). Better Data for Women and Children: Strengthening CRVS across the Continuum of Care. Technical Meeting Report, 4th–6th October 2016, New York, USA. New York: UNICEF. Available at: [https://www.unicef.org/health/files/Better\\_Data\\_for\\_Women\\_and\\_Children\\_Final\\_Meeting\\_Report\\_\(Mar\\_2017\).pdf](https://www.unicef.org/health/files/Better_Data_for_Women_and_Children_Final_Meeting_Report_(Mar_2017).pdf)
- Vassil, Kristjan. 2015. *Estonian E-Government Ecosystem: Foundation, Applications, Outcomes*. Washington, DC: World Bank.
- World Bank. (2015a). Estonia: A successfully Integrated Population-Registration and Identity Management System Delivering Public Services Effectively. Washington, DC: World Bank.
- World Bank. (2015b). Identification for Development (ID4D) Identification Systems Analysis: Botswana Country Report. Washington, DC: World Bank.
- World Bank. (2017a). Principles on Identification for Sustainable Development: Towards the Digital Age. Washington, DC: World Bank.
- World Bank. (2017b). The State of Identification Systems in Africa: A Synthesis of Country Assessments. Washington, DC: World Bank.
- World Bank. (2017c). Tracking universal health coverage: 2017 global monitoring report. Washington, DC: World Bank.
- World Bank. (2017d). Identification for Development (ID4D) Global Dataset. Available at: <http://data.worldbank.org/data-catalog/id4d-dataset>.
- World Bank. (2018a). Identification for Development (ID4D) Diagnostic: Guidelines. Washington, DC: World Bank.
- World Bank. (2018b). Technical Standards for Digital Identity: Draft for Discussion. Washington, DC: World Bank.
- World Bank. (2018c). Technology Landscape for Digital Identification. Washington, DC: World Bank.
- World Bank. (2018d). Public-Sector Savings from Identification Systems: Opportunities and Limitations. ID4D Working Paper. Washington, DC: World Bank.
- World Bank. (forthcoming). Case study on Thailand’s civil registration and national ID system. Washington, DC: World Bank.
- WHO. (2007). Collaborating Centre for Patient Safety Solutions. Patient Identification: Aide Memoir. Patient Safety Solutions, volume 1, solution 2.
- WHO. (2012). Management of Patient Information: Trends and Challenges in Member States. Global Observatory for e-Health series. Vol 6.
- WHO. (2014). Strengthening Civil Registration and Vital Statistics Systems through Innovative Approaches in the Health Sector: Guiding Principles and Good Practices. Geneva: World Health Organization. Available online at: [http://www.who.int/healthinfo/civil\\_registration/crvs\\_meeting\\_dec2013\\_report.pdf?ua=1](http://www.who.int/healthinfo/civil_registration/crvs_meeting_dec2013_report.pdf?ua=1)
- WHO. (2016). Global diffusion of e-Health: making universal health coverage achievable. Report of the third global survey on e-Health. Geneva: World Health Organization.

- WHO. (2017a). Consolidated guidelines on person-centred HIV patient monitoring and case surveillance. Geneva: World Health Organization.
- WHO. (2017b). Strategic Purchasing for UHC: Unlocking the Potential. Report from a Global meeting, 25–27 April 2017. Geneva: World Health Organization.
- WHO. (2017c). Using Unique Identifiers for Person-Centred HIV Patient Monitoring and Case Surveillance. WHO Technical Brief. Geneva: World Health Organization

[worldbank.org/id4d](http://worldbank.org/id4d)

