



# Electronic immunization registries in Latin America: progress and lessons learned

M. Carolina Danovaro-Holliday,<sup>1</sup> Claudia Ortiz,<sup>1</sup> Shea Cochi,<sup>1</sup>  
and Cuauhtémoc Ruiz-Matus<sup>1</sup>

## Suggested citation

Danovaro-Holliday MC, Ortiz C, Cochi S, Ruiz-Matus C. Electronic immunization registries in Latin America: progress and lessons learned. *Rev Panam Salud Publica*. 2014;35(5/6):453-7.

## ABSTRACT

*Most of the current vaccination coverage monitoring in Latin America relies on aggregated data. Improved monitoring has been shown to result in better coverage. Taking advantage of current information and communication technologies, the use of electronic immunization registries (EIRs) can facilitate coverage monitoring in terms of particularity (at the level of the individual), timeliness, and accuracy. Countries in Latin America are rapidly developing and implementing national EIRs to improve the monitoring of immunization coverage. These countries are using a variety of approaches toward system conception and development; integration with larger health information systems; different modalities for data collection, entry, and transmission; and other key features. Some countries are exploring linkages with mHealth (mobile health) for data collection and for automated recall/reminders. Evaluating EIRs and sharing experiences are important to streamlining and improving national EIR development, implementation, and use, and to ensuring its sustainability.*

## Key words

Immunization, statistics & numerical data; medical records systems, computerized; Latin America.

At the 2005 World Health Assembly, a Resolution on eHealth was passed that committed the World Health Organization (WHO) to “strengthen the ability of Member States to address health problems by integrating eHealth applications into health systems in order to improve performance, care delivery, and information mechanisms” and to “support capacity-building and to provide technical assistance and policy guidance on the implementation of eHealth applications” (1).

<sup>1</sup> Comprehensive Family Immunization Unit, Department of Family, Gender and Life Course, Pan American Health Organization, Washington, D.C., United States of America. Send correspondence to M. Carolina Danovaro-Holliday, danovarc@paho.org

The computerization of immunization registries is an important part of eHealth in the context of national immunization programs. Experiences from different settings suggest that improving the monitoring of immunization coverage results in better coverage (2). The use of electronic immunization registries (EIRs) can improve coverage monitoring in terms of particularity (individual follow-up of persons), timeliness, and accuracy. Currently, most countries in the world still rely on aggregated data on vaccine doses given. Nevertheless, countries in Latin America are rapidly progressing toward developing and implementing EIRs. This report summarizes the current progress on EIR implementation in Latin

America and the main lessons learned to date.

## Electronic immunization registries

Back in 1965, James L. Goddard, then Director of the United States Centers for Disease Control, said “...perhaps in the rather distant future, the capabilities of electronic computers for storing and retrieving information could greatly facilitate our immunization programs... A nationwide computer system could put us well on the road to efficient national follow-up of births for maintenance of immunization levels.”<sup>2</sup>

<sup>2</sup> Proceedings of the 2nd National Immunization Conference, 1965. Contact NIPNIC@cdc.gov for further information.

EIRs have been defined as computerized, confidential, population-based information systems that contain data on vaccine doses administered. They allow coverage monitoring by provider, vaccine, dose, age or other target group, and geographical area, and provide outputs to facilitate individualized follow-up (3–5). These registries can be part of an immunization information system that also has other capabilities, such as vaccine and supply stock management and adverse event reporting (6, 7).

The “ideal” EIR comprises: (i) enrollment at birth; (ii) a unique and unequivocal identifier (ID); (iii) vaccination provider, vaccine dose, and date; (iv) mechanisms for aggregating data at different geographical levels; and (v) automated individualized follow-up of vaccination schedules (3, 8). For the Americas, the Pan American Health Organization (PAHO) has included two additional characteristics: (vi) data security and protection of patient confidentiality and (vii) data entry as close to vaccination as possible, in terms of time and place. For the latter, the development of electronic health records systems, the adoption of standards for interoperability, and the increased availability of Internet connectivity shortens lag time between vaccine administration and data entry. EIRs can also help support decision-making on an individual-basis and at the population level, and provides a better understanding of coverage gaps, which enables more targeted vaccination delivery, social communication, and advocacy strategies.

While immunization registries need not be computerized to be effective at the local level, EIRs can facilitate data processing, especially when data entry is done at the point of delivery. This reduces the number of paper records (e.g., tally sheets, docket, vaccination/health card, and paper registry) and can streamline overall workflow. Also, EIRs can enhance proper utilization of mobile technologies, e.g., linking the registry to mobile data entry or automated reminder/recall messages sent via text message to users and/or their caregivers (2, 6).

Nationwide EIRs facilitate tracking of a country’s transient or nomadic populations, such as some indigenous communities and seasonal migrant workers, making it easier to retrieve their vaccination history, even when vaccination

cards have been lost. Only by using EIRs can countries monitor coverage in every community, a goal set forth by the Global Vaccine Action Plan, which was approved by World Health Assembly in 2012 (9).

The data available in an EIR can also be used to detect data quality issues; monitor the vaccination status of each birth cohort (by month of birth) and vaccination drop-outs; identify problems in following recommended schedules (vaccination timeliness and simultaneity); improve birth registration (10); facilitate the investigation of suspected adverse events following immunization; print new vaccination cards; and even, facilitate vaccination effectiveness studies (11).

### Progress in Latin America

Countries in Latin America consider coverage monitoring and follow-up of individual schedules as key components of immunization programs. In all countries, some form of paper-based registry exists. Mexico and Uruguay were the first countries in Latin America to begin using computerized national EIRs, in 1987 and 1991, respectively; Panama followed in 2006–2007 (3, 12, 13). All three of these countries are currently work-

ing on updated versions of their EIRs using newer technology platforms. For Chile, 2013 was the first year when the EIR was the source of coverage data for routine immunization. While still relying on traditional aggregated data collection systems to obtain coverage, Argentina, Belize, Brazil, Colombia, Costa Rica, Guatemala, and Paraguay are progressively implementing or piloting a national EIR. The Dominican Republic is advancing in the EIR development process. El Salvador is including vaccine doses given at birth in its electronic birth records and Venezuela is starting with a platform to follow yellow fever vaccination (Figure 1). This listing only includes nationwide EIRs. Several countries have EIRs in certain provinces/cities, or for certain providers (e.g., non-government organizations, Social Security) (14, 15).

EIR development has followed several modalities (Table 1), from in-house (within the Ministry of Health) to complete outsourcing, including system maintenance and hosting. Similarly, technology platforms range from proprietary software to open source, but more often use a mix. In most cases, the bulk of the EIR investment has been made by the countries themselves, though some have worked with support from international/bilateral development organiza-

**FIGURE 1. Status of electronic immunization registries (EIR) Latin America and the Caribbean, July 2013**



Source: Country reports to FGL-IM/PAHO.

<sup>a</sup> In blue also: Social Security in Costa Rica, the city of Bogotá and the Department of Antioquia (except Medellín) in Colombia, and some states/provinces in Argentina and Brazil.

**TABLE 1. Modalities used for electronic immunization registry (EIR) development by countries in Latin America, 1987–2013**

Modalities
Relation to national Health Information System (HIS) <ul style="list-style-type: none"> <li>• Module of a national HIS</li> <li>• Stand-alone</li> </ul>
Relation to other immunization systems <ul style="list-style-type: none"> <li>• Not related</li> <li>• Part of a larger immunization information system (stock management, epidemiological surveillance, and adverse event monitoring)</li> </ul>
Development and maintenance <ul style="list-style-type: none"> <li>• Ministry of Health itself</li> <li>• Outsourced (from development to even hosting)</li> <li>• Mix</li> </ul>
Financing <ul style="list-style-type: none"> <li>• Government resources</li> <li>• Partner support</li> </ul>
Software <ul style="list-style-type: none"> <li>• Open source</li> <li>• Proprietary</li> <li>• Mix</li> </ul>
Data entry (usually from paper) <ul style="list-style-type: none"> <li>• Vaccinator</li> <li>• Data clerk</li> </ul>
Data flow <ul style="list-style-type: none"> <li>• Web-based</li> <li>• Offline with database synchronization</li> </ul>

tions. The early computerized EIRs in Latin America were applications developed for exclusive use by the immunization program and could not interoperate or permit data exchanges with other systems, even within the Ministry of Health. Most of the new EIRs are conceived as modules of a larger health information system, but are often one of the first such modules. An example of the opposite is Belize where the immunization module is one of the most recent additions to the Belize Health Information System, the country's web-based nationwide health information system (16).

Even though most Latin American countries using EIRs still collect the vaccination data on paper, the utility of these computerized registries is likely maximized when data entry occurs close to vaccine delivery in time and place. For example, for years the Social Security Administration of Costa Rica has made its EIR available on computers in their health facilities where nurses administering the vaccines can also enter the data. Where computers are not widely available however, discussions still exist about whom the best person to record the vaccination is: vaccinator or data-entry clerk.

For an EIR to serve as a census of the population, it is important to ensure that

all people living in the area are in the registry and that duplicates are avoided. Regarding the ID, EIRs in Latin America have used the national identification number provided by the civil registry office, a birth registration number or a unique combination of names, parental names or IDs, and date and/or place of birth. Biometrics, such as fingerprints, are being tested in some African countries (17), but have not been used in EIRs in Latin America. Countries with high levels of timely birth registrations, such as Chile and Costa Rica, are linking or considering linking their EIR to the civil registration database. Most other countries rely on registration at the time of vaccination. Having comprehensive EIRs can change the way childhood vaccination coverage is monitored, from coverage rates based on annual fixed targets to coverage rates by birth cohort, as in Uruguay (13).

Early EIRs focused on childhood vaccination, however, newer ones are also aimed at including all groups targeted for vaccination. Though most electronic registries have been developed to monitor routine vaccination, uses of EIRs for vaccination campaigns have been explored. During its 2010 pandemic influenza campaign, Chile deployed an earlier version of its current EIR.

The coupling of EIRs with mHealth (mobile health) is being explored. For various health issues, data collection using mobile devices has resulted in improved collection time and data quality (18). Although the potential for using mobile devices for vaccination data collection remains largely unexplored in Latin America, a project using an open-source mobile application for immunization in Nicaragua (mVac) is worth noting (19). EIRs allow issuing automated reminder/recall messages. Mexico is working on vaccination SMS (i.e. "text") reminders, while others are discussing projects to assess the effectiveness and cost of such systems. These types of patient reminder/recall systems have been shown to be effective in improving immunization rates, at least in developed countries (20).

### Lessons learned

In Latin America, the documentation of experiences regarding EIR development and use, including failed system implementations, is limited. Only data

produced by the EIR in Uruguay has been externally evaluated (13). In spite of the limited data from formal evaluations, challenges with EIR development and implementation are being observed and several lessons learned are emerging from the Latin American experience (21). These have been mainly distilled in meetings and through sharing of information between countries and PAHO:

(i) EIR implementation should not be approached as a project, but rather as a process that will take time and must be closely monitored;

(ii) An EIR requires continuous human and financial resources for its maintenance and proper use; and

(iii) For an EIR to be accepted and the data entered to be of good quality, the EIR must be useful to vaccinators and should facilitate work at the local level.

Other lessons learned include:

- Before starting EIR development, objectives and scope should be clearly defined, and a collaborative and transparent decision-making process should be in place;
- Pros/cons of different options for system development should be weighed before commencing development;
- Data flow, beginning with where and by whom the data will be entered, what form will be used to capture the data, how duplicate records will be managed, and how to ensure correct and timely synchronization of databases for offline registries (where the Internet is not widely available) need to be defined beforehand;
- EIRs need to be flexible enough to accommodate new vaccines, new schedules, and special situations;
- The EIR should consider a unique identifier so as to have only one record per person and the system should allow capturing the entire target population;
- Data security and confidentiality, as well as legal considerations and eHealth or eGovernment standards need to be taken into account before designing an EIR;
- EIR implementation needs to be systematically monitored, including the satisfactions and problems faced by the users, in order to address problems as soon as possible; and
- Training, sometimes starting from how to use a computer, and support-

ive supervision must be ongoing to ensure data quality.

In addition to the need for systematic evaluation of EIR effectiveness and associated costs, the exploration of the relationship between EIRs and effective utilization of mHealth will be important. A recent study noted that in Latin America, nearly 70% of people have a mobile phone and the 3G mobile phone network is widening (22), making expanding the use of mHealth for immunization a real possibility.

PAHO has been working to support countries with EIR development and implementation as a component of their national immunization programs. The PAHO Technical Advisory Group on Vaccine-preventable Diseases (TAG) guides the Organization's work in this area. In the context of ongoing efforts to improve immunization data quality, in 2009, TAG recommended that "countries using national computerized EIRs...document their experiences, successes, and lessons learned in order to share them with other countries" (21). Following this recommendation, PAHO has been providing technical assistance to countries, with support from various partners, and is facilitating specific exchanges of experiences, where representatives from one country visit another to learn about EIR. In February 2011, PAHO held a workshop to share lessons learned on EIR development and implementation. The workshop included 81 participants from 20 Latin American countries and key

partners (23). PAHO continues to organize Web-based sessions where different EIRs are demonstrated; a session on the HL7<sup>3</sup> standards was also conducted.

In July 2011, the PAHO TAG welcomed the progress made on national EIRs, and added the following recommendations: (i) Countries and PAHO should continue documenting and exchanging experiences on EIR development and implementation; (ii) EIRs should aim to ensure interoperability with other information systems; and (iii) PAHO should work in coordination with other sectors and initiatives related to e-government, information and communication technologies, and birth registration, among others. Finally, in 2013, besides recognizing the progress made in EIR and reemphasizing its previous recommendations, TAG issued recommendations aimed at monitoring implementation to ensure proper performance and to validate that the needs of vaccinators at the local level are being met. TAG also asked PAHO to explore the use of innovative mobile technologies capable of linking to immunization registries, and to assess country experiences with EIRs in order to continue fostering the exchange of country experiences, lessons learned, and good practices at the Regional and global levels (21). PAHO will

<sup>3</sup> HL7, an abbreviation of Health Level Seven, is a standard for exchanging information between medical applications. HL7 defines a format for the transmission of health-related information and has been widely used in countries such as the United States.

continue working with Member States to follow TAG recommendations and to help countries of the Americas lead the way on EIR use.

## Conclusion

Countries in Latin America are moving towards developing and using EIRs as a better way to monitor immunization coverage; they are also exploring mHealth. Evaluating EIRs to define best practices, effectiveness and costs, and to systematize lessons learned for regional and global sharing are important to streamlining and improving development, implementation, and use, and to ensuring sustainability.

**Acknowledgments.** The authors wish to acknowledge all the people working to improve health standards in Latin America, particularly those working with immunization. The authors thank all those who participated in the workshop in Bogotá, Colombia, in February 2011, to share lessons learned on developing and implementing electronic immunization registries, and appreciate their openness and willingness to share their systems and their good and bad experiences. The authors also acknowledge their partners, who help them facilitate the work in and among countries. Finally, the authors thank Tony Burton, Department of Immunization, Vaccines, and Biologicals, WHO, for his critique of an earlier version of this manuscript.

**Conflicts of interest.** None.

## REFERENCES

1. World Health Organization. Fifty-eighth World Health Assembly Report, 16–25 May 2005. Geneva: WHO; 2005.
2. Papania M, Rodewald L. For better immunisation coverage, measure coverage better. *Lancet*. 2006;367(9515):965–6.
3. Danovaro-Holliday MC, Andrus JK, Ruiz-Matus C. The Australian Childhood Immunisation Register—a model for universal immunisation registers? [letter to the editor]. *Vaccine*. 2009;27(48):6652–3.
4. Freeman VA, DeFriese GH. The challenge and potential of childhood immunization registries. *Ann Rev Pub Health*. 2003;24:227–46.
5. Linkins, RW. Immunization registries: progress and challenges in reaching the 2010 national objective. *J of Public Health Manag Pract*. 2001;7(6):67–74.
6. Hull BP, Deeks SL, McIntyre PB. The Australian Childhood Immunisation Register—a model for universal immunization registers? *Vaccine*. 2009;27(37):5054–60.
7. Cardemil C, Pabst L, Gerlach K. Progress in immunization information systems—United States, 2011. *MMWR*. 2013;57(11):289–91. Available from: [www.cdc.gov/mmwr/preview/mmwrhtml/mm6203a2.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6203a2.htm) Accessed on 12 July 2013.
8. Gostin, LO, Lazzarini Z. Childhood immunization registries. A national review of public health information systems and the protection of privacy. *JAMA*. 1995;274(22):1793–9.
9. World Health Organization. Decade of vaccines collaboration. Available from: [www.dovcollaboration.org/action-plan/](http://www.dovcollaboration.org/action-plan/) Accessed on 12 July 2013.
10. Pan American Health Organization. Immunization and birth registration. *Immunization Newsletter*. 2012;33(6):1–2. Available from: [www.paho.org/immunization/newsletter](http://www.paho.org/immunization/newsletter) Accessed on 12 July 2013.
11. Picón T, Alonso L, García Gabarrot G, Speranza N, Casas M, Arrieta F, et al. Effectiveness of the 7-valent pneumococcal conjugate vaccine against vaccine-type invasive disease among children in Uruguay: an evaluation using existing data. *Vaccine*. 2013;31(suppl 3):C109–13.
12. Santos JI. El Programa Nacional de Vacunación: orgullo de México. *Rev Fac Med UNAM*. 2002;45(3):142–53. Available from: [www.revistas.unam.mx/index.php/rfm/article/view/12660](http://www.revistas.unam.mx/index.php/rfm/article/view/12660) Accessed on 12 July 2013.

13. Ronveaux O, Arrieta F, Curto S, Laurani H, Danovaro-Holliday MC. Assessment of the quality of immunization data produced by the national individual registration system in Uruguay. *Rev Panam Salud Publica*. 2009;6(2):153–60.
14. Pan American Health Organization. Immunization registries in Latin America. *Immunization Newsletter*. 2012;33(6):1–2. Available from: [www.paho.org/immunization/newsletter](http://www.paho.org/immunization/newsletter) Accessed on 12 July 2013.
15. Danovaro-Holliday MC, Ortiz C, Cochi S, Ruiz-Matus C. PAHO and IIS's in Latin America. Snapshots: Immunization Registry News from American Immunization Registry Association. Available from: [www.immregistries.org/resources/aira-snapshots](http://www.immregistries.org/resources/aira-snapshots) Accessed on 12 July 2013.
16. World Health Organization. Belize health information goes digital. *Bull World Health Organ*. 2009;87(2):87–88. Available from: [www.who.int/bulletin/volumes/87/2/09-020209.pdf](http://www.who.int/bulletin/volumes/87/2/09-020209.pdf) Accessed on 12 July 2013.
17. VaxTrac. Available from: <http://vaxtrac.com/mission> Accessed on 12 July 2013.
18. Blaya JA, Fraser HS, Holt B. E-Health technologies show promise in developing countries. *Health Aff (Millwood)*. 2010; 29(2):244–51.
19. Open X Data. Available from: [www.opendata.org/](http://www.opendata.org/) Accessed on 12 July 2013.
20. Jacobson Vann JC, Szilagyi P. Patient reminder and recall systems to improve immunization rates. *Cochrane Database of Systematic Reviews*. 2005. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003941.pub2/abstract> Accessed on 26 May 2014.
21. Pan American Health Organization. Technical Advisory Group on Vaccine-preventable Diseases—Final Reports, 2009, 2011, 2013. Available from: [http://new.paho.org/hq/index.php?option=com\\_content&view=article&id=1862&Itemid=2032&lang=en](http://new.paho.org/hq/index.php?option=com_content&view=article&id=1862&Itemid=2032&lang=en) Accessed on 12 July 2013.
22. Anta R, El-Wahab S, Giuffrida A. Mobile health: the potential of mobile telephone to bring health care to the majority. February, 2009. Washington, DC: Inter-American Development Bank. Available from: <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1861959> Accessed on 12 July 2013.
23. Pan American Health Organization. National computerized nominal immunization registries: workshop to share lessons learned. *Immunization Newsletter*. 2011;32(1):4. Available from: [www.paho.org/immunization/newsletter](http://www.paho.org/immunization/newsletter) Accessed on 12 July 2013.

Manuscript received on 14 July 2013. Revised version accepted for publication on 19 May 2014.

## RESUMEN

### Registros electrónicos de vacunación en América Latina: avances y enseñanzas

La mayor parte de la vigilancia actual de la cobertura vacunal en América Latina se basa en datos consolidados. Sin embargo, se ha demostrado que una mejor vigilancia puede llevar a una mayor cobertura. Si se aprovechan las tecnologías de la información y la comunicación que existen en la actualidad, el uso de registros electrónicos de vacunación puede facilitar la vigilancia de la cobertura en cuanto a aspectos particulares (a escala individual), pertinencia temporal y exactitud. Los países de América Latina están elaborando e implantando rápidamente este tipo de registros electrónicos a escala nacional con objeto de mejorar la vigilancia de la cobertura vacunal. Estos países están empleando diversos métodos para diseñar y crear el sistema; integrarlo con otros sistemas de información sanitaria más amplios; considerar las diferentes modalidades de recopilación, introducción y transmisión de datos, y otras características importantes. Algunos países están explorando posibles vínculos con la tecnología móvil en el ámbito de la salud (mHealth) para recopilar datos y generar recordatorios automatizados. La evaluación de los registros electrónicos de vacunación y el intercambio de experiencias son importantes para racionalizar y mejorar el desarrollo, la implantación y el empleo de estos registros a escala nacional, y garantizar su sostenibilidad.

## Palabras clave

Inmunización, estadística & datos numéricos; sistemas de registros médicos computarizados; América Latina.