

An Improved Immunization Record to Support Vaccination During the COVID-19 Pandemic at a University Hospital in Argentina

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Abstract

WHO and UNICEF highlight vaccination as the most cost-effective method of prevention of infectious diseases. An effective public health strategy requires efficient tracking of vaccination to assess coverage, safety, and efficacy of these vaccines. Paper-based immunization records are still being used in most low and middle-income countries. Adequate Electronic Logistic Management Information Systems, Immunization Registries and Records are crucial for proper data collection and analysis, and for making better decisions at an individual and at a population level. In this paper we share our experience in the redesign of an interoperable immunization record to track vaccination, including the recently developed vaccines for the novel coronavirus SARS-CoV-2 (COVID-19).

Keywords:

Public Health, COVID-19, Vaccines

Introduction

Vaccination is the most cost-effective method for the prevention of infectious diseases [1]. According to the World Health Organization (WHO), this method saves 2-3 million children's lives annually. An effective public health strategy requires efficient tracking of vaccination to assess coverage, safety, and efficacy of these vaccines [2]. Paper-based registries and immunization records are still being used in most low and middle-income countries (LMIC), with many disadvantages both for public health and patients [3]. The implementation of well designed electronic immunization records is crucial to improve this situation [4]. Electronic documentation allows for a nominal national registry that surpasses simple quantitative registries, and facilitates the creation of digital vaccination certificates for each patient. But the immunization digitalization has many challenges, like information security, updates and maintenance, user interface design, information authenticity, and standardization and data interoperability [5]. This functionality is key to support children vaccination schemes, the annual efforts against influenza and the need of mass vaccination against COVID-19.

This article shares our experience with the redesign and implementation of a new interoperable Immunization Record on the Electronic Medical Record (EMR) at the Hospital Italiano de Buenos Aires during the COVID-19 pandemic.

Methods

Setting

Hospital Italiano de Buenos Aires (HIBA) is a non-profit organization with a health services network in the Autonomous

City and the metropolitan area of Buenos Aires, Argentina. It has 2 tertiary teaching hospitals, 45 outpatient centers and almost 300 associated private practices. The hospital has developed a homegrown information system for the last 20 years. It integrates different administrative and clinical applications like the EMR, allowing the paperless operation of all hospital processes. It was certified as level 7 in the EMR adoption model by HIMSS (Healthcare Information and Management Systems Society). Even though the vaccine prescription is recorded through a clinical provider order entry (CPOE), the administration used to be registered in an independent section that built a certificate using just local data.

Materials and Methods

Therefore, a new Immunization Record was designed, developed and implemented with the aim of: enhancing data coverage and quality; standardizing electronic reports to public health authorities; and including the COVID-19 vaccine campaign requirement. The team followed an Agile project management and software development process, and a User Centered Design approach.

Results

We leveraged previous experiences regarding immunization applications and services from the Ministry of Health (MoH). The application used the HL7-FHIR API immunization resource [6] to comply with interoperability requirements from national authorities. The COVID-19 pandemic forced some changes to the initial project, including the provisional implementation of a "Coronavirus Campaign" EMR section. See Figure 1 to check the EMR registered data at the point of care,

Figure 1 – Screenshot of the implemented COVID-19 campaign record within the EMR.

The minimum dataset is recorded and automatically reported to the public health authorities through MoH RESTful APIs, updating the national vaccination database called NOMIVAC. This information is visible to the patient through Mi Argentina, the Citizen's Portal [7], issuing a secure national Smart Vaccination Certificate (SVC). See Figure 2 to analyze the resulting SVC issued by the MoH, including an encrypted bi dimensional code for verification.

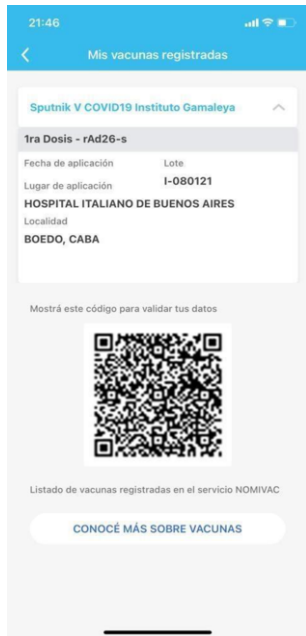


Figure 2 – Screenshot of the information displayed at the Smart Vaccination Certificate from the Ministry of Health.

In addition, the immunization process was fully mapped, surveying multiple user stories and use cases. We defined different states for vaccine records, as described in Figure 3. Every healthcare professional performs an action within the EMR to change states. A physician can prescribe any vaccine. A nurse can record the administration at the point of care. But taking into account that many vaccines are given without a medical prescription because they are mandatory by law, it should be possible to record such administered doses. On the other hand, some shots could have been administered outside the HIBA network and physicians would need to record those immunizations as medical history. It is noted that the electronic reporting to public health authorities involves just administered vaccines.

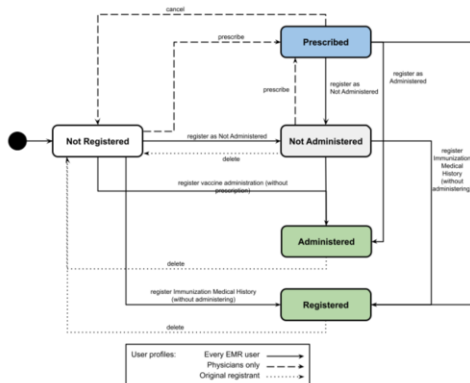


Figure 3 – State-machine that shows different possible states

The frontend redesign of the immunization module included a dual display that changes from a "calendar view" to a "vaccine list view", as seen in Figures 4 and 5. Both match the standard

API FHIR resources for immunization, using terminology services to code every vaccine. The development of this application continues to be iterated, implementing new improvements periodically.

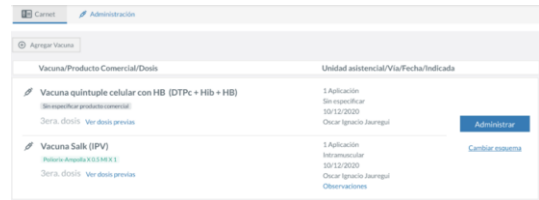


Figure 4 – Screenshot of the vaccine list to register every immunization through the patient EMR.

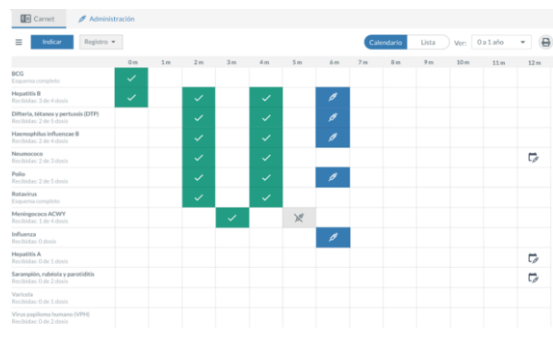


Figure 5 – Screenshot of the interactive calendar to register every immunization through the patient EMR.

Discussion

In LMIC, immunization is a domain where paper-based records prevails, both at a healthcare institution level, jurisdictional level and at patient level, with known limitations [3]. Electronic Immunization Records are the cornerstone of any efficient vaccination program [4]. The proper collection of quality data enhances critical analysis and enables a better decision-making process for healthcare on an individual [8, 9] and population-wide scale [10, 11]. Interoperable systems streamline the information exchange between healthcare providers and public health agencies who need updated data to support their operation, especially in health emergencies like the COVID-19 pandemic. The new vaccine section of the EMR enables a standardized ubiquitous registration and reporting to the MoH, updating the national database. In that way, it supports the generation of a SVC for each patient, allowing the continuity of care and being a proof of immunization. The Agile approach led to the design, development and implementation of minimum viable products along the way.

Future Directions

Further research projects include the implementation and assessment of a SMART on FHIR mobile application to record given shots at the point of care. Another future investigation should focus on the development of an Immunization Clinical Decision Support Systems (iCDSS). Also known as evaluation and forecasting, it is an automated process that recommends which vaccines are needed for a specific patient [12, 13]. This research should be faced jointly with the MoH, promoting the

digital transformation of the immunization guidelines development.

Limitations

Our research was done in a single academic center using in-house developed software and thus might not represent other institutions.

Conclusions

Developing and implementing an interoperable immunization registry is the cornerstone of any efficient vaccination program, including the COVID-19 campaign registry. Using an agile approach might help to focus on delivering value, based on changing priorities.

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