PAN AMERICAN JOURNAL OF PUBLIC HEALTH 100 YEARS

Special report

Lessons learned from the implementation of integrated serosurveillance of communicable diseases in the Americas

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Suggested citation Saboyá-Díaz M-I, Castellanos LG, Morice A, Ade MP, Rey-Benito G et al. Lessons learned from the implementation of integrated serosurveillance of communicable diseases in the Americas. Rev Panam Salud Publica. 2023;47:e53. https://doi.org/10.26633/RPSP.2023.53

ABSTRACT

Objective. Systematize the experience and identify challenges and lessons learned in the implementation of an initiative for integrated serosurveillance of communicable diseases using a multiplex bead assay in countries of the Americas.

Methods. Documents produced in the initiative were compiled and reviewed. These included concept notes, internal working papers, regional meetings reports, and survey protocols from the three participating countries (Mexico, Paraguay, and Brazil) and two additional countries (Guyana and Guatemala) where serology for several communicable diseases was included in neglected tropical diseases surveys. Information was extracted and summarized to describe the experience and the most relevant challenges and lessons learned.

Results. Implementing integrated serosurveys requires interprogrammatic and interdisciplinary work teams for the design of survey protocols to respond to key programmatic questions aligned to the needs of the countries. Valid laboratory results are critical and rely on the standardized installment and roll-out of laboratory techniques. Field teams require adequate training and supervision to properly implement survey procedures. The analysis and interpretation of serosurveys results should be antigen-specific, contextualizing the responses for each disease, and triangulated with programmatic and epidemiological data for making decisions tailored to specific population socioeconomic and ecologic contexts.

Conclusions. Integrated serosurveillance as a complementary tool for functional epidemiological surveillance systems is feasible to use and key components should be considered: political engagement, technical engagement, and integrated planning. Aspects such as designing the protocol, selecting target populations and diseases, laboratory capacities, anticipating the capacities to analyze and interpret complex data, and how to use it are key.

Keywords Serology; surveillance; communicable diseases; Americas.

Understanding communicable diseases dynamics includes the need to define the immune profile of a population. Serosurveillance provides estimates of population-level immunity against pathogens using repeat cross-sectional studies of antibody prevalence (1). Integrated serosurveillance emerges as a practical and useful approach for monitoring population immunity and communicable disease transmission. It can accelerate efforts to identify populations with immunization gaps

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or waning immunity to vaccine-preventable diseases, monitor populations' exposure to diseases such as malaria, human immunodeficiency virus (HIV), enteric pathogens, neglected tropical diseases, and emerging pathogens such as SARS-CoV-2, and identify multilayered health disparities in communities living in different socioeconomic, environmental, and ecologic contexts (2).

Innovations in laboratory tests have advanced the potential of integrated serosurveillance as a platform via the ability to simultaneously measure antibody responses to multiple pathogens (3,4). Multiplex bead assays (MBA) such as those using Luminex xMAP technology (Luminex Corporation, Austin, TX, USA) can measure antibodies for 50-500 antigens, depending on the instrument used, with high reproducibility and correlation with traditional serological methods (5,6). MBA can be run using a very small quantity of a serum specimen (<1 µL) and can use dried blood specimens collected on filter paper, simplifying the logistics of sample collection, transportation, and testing across pathogens. MBA generates results with greater efficiency and reduced cost when compared to other assays, making its use feasible in a variety of contexts (7–10).

In 2016, a partnership was formed to launch a regional initiative to use integrated serosurveillance as a complementary tool to reinforce ongoing disease-specific programmatic activities. These partners included departments of epidemiology and communicable diseases control and elimination of the Ministries of Health and National Public Health Laboratories of three Latin American countries, the neglected, tropical, and vector-borne diseases and comprehensive family immunization units of the Pan American Health Organization (PAHO) and the Division of Parasitic Diseases and Malaria (including a team that became a PAHO/WHO Collaborating Center in 2018), Division of Viral Diseases, and the Global Immunization Division of the Centers for Disease Control and Prevention (CDC) of the United States of America.

A cornerstone of the initiative was to use the MBA adapted by the CDC for simultaneous serological analysis of pathogens related to neglected infectious diseases, vaccine-preventable diseases, vector, water, and food-borne diseases (11–13), hereinafter referred to as the Multiplex platform (14). It was envisioned as an initiative to contribute to the goals of the PAHO's plans of action to accelerate the control and elimination of these diseases in the Americas (15).

The aim of this report is to systematize the experience and identify the challenges and lessons learned from the integrated serosurveillance initiative using the Multiplex platform in the Region of the Americas.

METHODS

A retrospective qualitative analysis was conducted by reviewing documents produced in the implementation of the initiative between 2016 and 2021, including 1) PAHO and CDC project formulation documents, 2) PAHO concept notes developed between 2016 and 2017, 3) PAHO internal working documents with recommendations for formulation of serosurvey protocols, 4) PAHO formal communications with countries, 5) protocols of the serological surveys implemented in Brazil, Guatemala, Guyana, Mexico, and Paraguay, 6) serosurvey results available through December 2021, 7) reports from three meetings on the initiative held with delegates from countries, PAHO, and CDC in 2016, 2018, and 2020 (15–17), and 8) a toolkit developed by PAHO and CDC for conducting integrated serosurveys (18).

Information on the implementation of the initiative in Brazil, Mexico and Paraguay, and the integration of serology for multiple diseases within neglected tropical diseases (NTD) surveys in Guatemala and Guyana was organized chronologically and the most relevant information was extracted to describe the process and progress in the five countries. Challenges and lessons learned were identified, discussed, and agreed upon by consensus with advisors from PAHO and delegates from CDC.

RESULTS AND DISCUSSION

Process for implementation of the integrated serosurveillance of communicable diseases

The first step in the process was to select countries to participate in the initiative. Selection criteria included having public health laboratories with the capacity to carry out testing on the Multiplex platform, having functional epidemiological surveillance systems for communicable diseases, and having the potential to support an expansion of integrated serosurveillance to other countries in the Americas. As a result, Colombia, Mexico, and Paraguay were selected and invited to the first meeting in Bogota, Colombia in July 2016. Delegates from the CDC, selected countries (directors of national epidemiological surveillance systems and national public health laboratories), PAHO, and organizations interested in the topic, such as the Mundo Sano Foundation, the AbbVie Foundation, and the Sabin Vaccine Institute, participated. The conceptual and technical aspects of the initiative were presented and discussed, and the work plan was established (16).

Country delegates were asked to submit an official letter of interest to PAHO expressing its commitment to participating in the initiative. It included the designation of the national public health laboratory that would receive the transfer of capacities to use the Multiplex platform.

At the first meeting, epidemiological scenarios in which serosurveillance can be used to produce information to support public health decision-making (Table 1) were agreed upon. This helped countries to better understand its uses and to define the approach to formulate serosurvey protocols.

Following the meeting, two countries formally expressed their interest in participating in the initiative and designated the public health laboratory. Mexico designated the Institute for Epidemiological Diagnosis and Reference (InDRE, acronym in Spanish) which was chosen because it is the national reference laboratory with a variety of laboratory programs under its responsibility. InDRE is currently a PAHO/WHO Collaborating Center and reference laboratory in the Americas for several topics and communicable diseases (19). InDRE is funded by the Mexican government and has good laboratory infrastructure. The laboratory staff have experience running serology tests such as ELISA, confidence with complex equipment, and have worked with the Luminex platform.

Paraguay designated the Central Public Health Laboratory (LCSP, acronym in Spanish) because it is the diagnostic, reference, and research institution under the Ministry of Public Health and Social Welfare (20). LCSP is funded by the Paraguayan government and is the national leader in laboratory surveillance of communicable and other diseases. The

TABLE 1. Epidemiological scenarios for integrated serosurveillance of communicable diseases in the Region of the Americas

Epidemiological scenarios	Objectives	Utility
Areas where epidemiological surveillance systems are fragile, or there are no epidemiological data available	To provide complementary baseline information to support the design and implementation of interventions.	Identify high-risk groups for communicable diseases in hard-to-reach and resource-poor areas and conducting studies for individual diseases or interventions would be logistically complex and expensive.
Areas where interventions have been implemented and must be monitored to assess progress toward programmatic goals	To monitor changes in exposure over time and ascertain whether the frequency or quality of interventions needs to be modified or strengthened.	Provide information on the effect of these interventions to guide the decision-making in population groups and intervention areas.
Areas where diseases are close to elimination or have been eliminated and post-elimination surveillance is needed	To detect disease reintroduction or risk of reemergence toward monitoring achievement and sustainment of disease elimination.	In the post-elimination phase, provide information on the exposure of cohorts born after elimination and provide early warning of the risk of disease reemergence. Anticipate risks, support in-depth investigations, and support actions to prevent reintroduction or reemergence of one or more diseases

Source: Pan American Health Organization. Toolkit for implementing integrated serosurveys (18)

laboratory staff have experience running complex equipment needed for ELISA. Additionally, LCSP has good laboratory infrastructure and recently acquired the Luminex technology.

Colombia declined to participate in the initiative, and Brazil later requested to join in March 2017, designating the Molecular Biology Institute of Parana (IBMP, acronym in Portuguese) because of its work in applied research, technology development, innovation, and industrial production of inputs and diagnosis kits for health. The IBMP uses Luminex instruments regularly, has good infrastructure, well-trained staff, and the potential to contribute to expanding the use of the Multiplex platform in the country and to other countries of the Americas.

After confirming its interest in participating in the initiative, each country was supported to work on an implementing plan, including the development of a protocol to carry out an integrated serosurveillance survey, and a timeline to start transferring the Multiplex platform technology to the designated laboratory. Each country was recommended to establish a national interprogrammatic working group, including representatives responsible for communicable disease control and elimination programs, national immunization programs, the epidemiological surveillance system, and the designated laboratories. These groups, in collaboration with delegates from CDC and PAHO, participated in: 1) Scoping the research questions, the populations and geographical areas to be surveyed, and the selection of antigens to be included in the serosurvey, according to the epidemiological scenarios; 2) Developing and approving the survey protocol, using the PAHO recommendations described in an internal working document and supported by a facilitator. All protocols complied with ethics standards and included the request for authorization from surveyed participants to use the collected dried blood samples in future studies (21); 3) Preparing the supply lists, budget, and the field operation and logistics of the survey; 4) Training and supervising field teams to ensure that procedures were implemented following the survey protocol and to support troubleshooting when necessary; 5) Compiling, cleaning, and analyzing databases including laboratory results, demographic variables, and risk factors, as well as interpreting results and developing final reports.

Before starting the field operations, delegates from the CDC and PAHO visited the countries to introduce the Multiplex platform, and assess the existing capacity of the designated laboratory to identify equipment, supply, human resources, and training needs for performing the assay.

Once survey field operations began and at least 500 samples had been collected, a two-part reciprocal laboratory training took place. First, two professionals from each country's laboratory were trained for three weeks at CDC laboratories in Atlanta, United States of America, culminating with testing a subset of study samples to form the basis of an inter-laboratory comparison. One to two weeks afterward, the CDC delegate joined the trained professionals in their home laboratories to establish testing capacity. This included collection of control data to validate the proper functioning of the assay and identification of any issues needing to be addressed before the start of testing. The newly trained laboratory professionals performed an interlaboratory comparison with CDC using a sub-set of study samples analyzed during the training at CDC to assess the successful transfer of capacity. CDC provided participating laboratories with antigen-coupled beads for pathogens selected for the surveys, as well as reference standards and control sera for cutoffs and quality control.

Progress and challenges for participating countries

Table 2 summarizes the characteristics of the surveys in each participating country and the following text describes the progress and challenges.

Mexico

Progress. The interprogrammatic group was formed and worked with delegates from the Federal Secretariat of Health, the InDRE, the National Center for Child and Adolescent Health (CENSIA, acronym in Spanish), and the National Center for Preventive Programs and Disease Control (CENAPRECE, acronym in Spanish). Field implementation of a school-based serosurvey concluded in 2018, laboratory analysis of the samples took place in 2019, and analysis of the survey results was completed in February 2020. The study population was 1 012 school-age children (3-15 years old) and a subsample of 220 caregivers (18-30 years old) in six municipalities in the states of Chiapas, Sinaloa, and Morelos. Eleven antigens were analyzed to study six diseases: malaria, trachoma, taeniasis/cysticercosis, measles, rubella, and diphtheria (Table 2). In 2021, the interprogrammatic group with the support of the National Institute of Public Health (INSP, acronym in Spanish) of Mexico started the design of a protocol to carry out a second integrated serosurvey using samples of an existing serum bank of the Health

TABLE 2. Characteristics of the integrated serosurveys implemented in countries

Characteristics	Mexico	Paraguay	Guyana	Guatemala
Sample design	Schools selected by cluster sampling	Schools selected by cluster sampling	All schools in the selected areas	Schools selected by cluster sampling
Study population and sample size	1 012 children aged 3-15 randomly selected and 220 adults aged 18-30 selected by convenience. Sample size calculated to estimate the lowest expected prevalence of the studied diseases (cysticercosis) and the lowest vaccination coverage (measles and rubella)	1 200 children aged 6-15 randomly selected. Sample size calculated to estimate the lowest expected vaccination coverage (measles and rubella) and 50% expected prevalence for the other diseases.	7 200 children aged 6-14 randomly selected; in some schools, all children were included in the survey. Sample size calculated to estimate the prevalence of lymphatic filariasis	1 500 children aged 6-14 randomly selected. Sample size calculated to estimate the lowest expected prevalence of the studied diseases (onchocerciasis) and prevalence of soil-transmitted helminthiasis
Geographical areas	Six municipalities selected by convenience from 3 states (Chiapas, Morelos, and Sinaloa)	Paraguayan Chaco Region that included 3 States (Presidente Hayes, Boqueron, and Alto Paraguay).	Six regions (Regions 1, 2, 6, 7, 8, and 9)	National level
Criteria for selection of geographical areas	Areas with low vaccination coverage; former trachoma endemic areas; areas without reports of malaria cases in the last 20 years; and areas of interest for taeniasis/ cysticercosis surveillance	Hard-to-reach areas with large indigenous population; areas with weak epidemiological surveillance systems	Hinterland areas of the country where lymphatic filariasis could be endemic. Overlapping risks were considered to assess seroprevalence for other diseases.	Rural areas at risk of soil-transmitted helminthiasis. Other diseases were assessed based on the country's epidemiological situation.
Antigens included in the survey	11 antigens for malaria, trachoma, taeniasis/ cysticercosis, measles, rubella, and diphtheria	14 antigens for trachoma, taeniasis/cysticercosis, strongyloidiasis, giardiasis, cryptosporidiosis, toxoplasmosis, measles, rubella, diphtheria, and tetanus	18 antigens for lymphatic filariasis, malaria, strongyloidiasis, trachoma, yaws, taeniasis/cysticercosis, measles, rubella, diphtheria, and tetanus	20 antigens for malaria, onchocerciasis, lymphatic filariasis, strongyloidiasis, trachoma, giardiasis, taeniasis/ cysticercosis, measles, rubella, diphtheria, and tetanus

and Nutrition National Survey implemented in 2018 (ENSANUT-2018, acronym in Spanish). The purpose of the ENSANUT is to periodically collect information on the health and nutrition status of the Mexican population, and the last one was conducted from July 2018 to June 2019 (22).

Challenges. The consensus process among the interprogrammatic group members for the design of the first integrated serosurvey took longer than expected, given that this was the first time several communicable diseases control and elimination programs developed a serosurvey as an integrated effort. The group decided to implement a pilot study to learn to use the Multiplex platform in Mexico and selected municipalities based on convenience criteria, including areas where it was logistically feasible to meet the objectives. The fieldwork was delayed due to logistic and coordination challenges, primarily related to the lack of early communication with schools, causing some school principals to refuse to participate in the study. There were also social protests unrelated to the study that prevented entry to some schools. The study was not implemented as planned, the sample size was not reached as expected, and there were additional issues with the completion of informed consent forms and survey questionnaires. The latter was in part because the questionnaire was long and there were some questions for which information was not adequately captured such as the vaccination history of children. Children with incomplete informed consent forms were excluded from the analysis of results.

Paraguay

Progress. The interprogrammatic group consisted of delegates from the Ministry of Public Health and Social Welfare, the LCSP, the Expanded Program on Immunization, the child and adolescent health programs, and the indigenous health program, as well as delegates from the health regions where the survey was conducted. Field implementation of a school-based serosurvey concluded in February 2020, laboratory analysis of samples was completed in 2021, and the preliminary analysis of the survey results was completed in 2022. The study population included 1 200 children (6-15 years old) from schools in the Chaco region. Fourteen antigens were analyzed for the study to obtain data on ten diseases (Table 2).

Challenges. Fieldwork was prolonged due to flooding and difficulties in accessing the study areas. A total of 1 104 samples were collected. Regarding laboratory analysis of specimens at the LCSP, there were two issues identified. In the beginning, a buffer prepared at LCSP did not pass quality control, and the CDC sent the reagent from Atlanta to help overcome the problem, causing delays in the analysis of specimens. Then, when the LCSP completed the analysis of all specimens, the inter-laboratory comparison of results for the measles antigen showed significant differences between LCSP and CDC. Since LCSP ran out of reagents to repeat standard curves to establish new cutoffs, the decision was to retest the specimens at the CDC. The analysis of specimens took longer due to the impact of the COVID-19 pandemic limiting laboratory access for CDC staff, but it was completed by the end of 2021. The results of the survey are expected to be available in 2023.

Brazil

Progress. The first interprogrammatic group was established in 2018 with delegates from programs for neglected infectious diseases (NIDs), vaccine-preventable diseases (VPDs), malaria, the national laboratories directorate of the Ministry of Health,

and the IBMP. The group proposed to carry out an integrated serosurvey using specimens from a sera bank of a national dengue study to obtain serology data for selected communicable diseases of interest in rural populations of the country's northern region. Due to the limited ability to respond to the research questions using the proposed sera bank, the group decided in 2021 to develop a new protocol. This revised protocol will use specimens collected regularly for the epidemiological surveillance of communicable diseases in hard-to-reach populations to carry out a retrospective integrated serosurvey. This effort involves additional partners such as the Institute of Scientific and Technological Communication and Information in Health at Fiocruz, the Evandro Chagas Institute, the Tropical Medicine Foundation, and the University of São Paulo, among others. The protocol is expected to be completed and implemented in 2023, as well as laboratory training on the Multiplex platform.

In addition to the three countries participating in the initiative, integrated serosurveillance has been expanded to countries that have implemented surveys to assess the epidemiological status of NIDs. **Guatemala** conducted a national survey to estimate the prevalence of soil-transmitted helminth infections in school-age children and 20 antigens related to ten diseases were tested on the Multiplex platform (Table 2). **Guyana** conducted a survey of school-age children in six regions of the country to determine the level of transmission of lymphatic filariasis, and tested serology for 18 antigens related to ten diseases. In these two countries, samples were analyzed at the CDC (Table 2).

Approach to the analysis, interpretation, and use of results

Mexico was the only country in the initiative to complete the analysis of the integrated serosurvey results by the end of 2021. The laboratory group organized, cleaned, and validated the survey database. The laboratory team initially carried out a preliminary analysis of the raw laboratory results. Then, a database combining laboratory and survey results, including demographic data and risk factors of surveyed participants was compiled. This process took longer than expected since data entry from the paper-based questionnaires did not have adequate staff and time devoted to this task.

A statistician from CDC assisted in the analysis process for Mexico, including an in-person visit when the database was compiled. In 2019, the CDC and InDRE team worked together for several months to produce the first set of results. In February 2020, PAHO had an in-person visit to support the interpretation of results and to discuss them with the interprogrammatic team. Simple univariate and bivariate analysis of seroprevalence data, accounting for the cluster survey design, was produced for each group of diseases included in the survey. Serosurvey results were triangulated with program data to understand the results in the context of the surveyed populations. For instance, vaccine coverage by age cohorts and historic reports of cases and outbreaks of VPDs in the studied population were used to interpret seroprevalence for measles, rubella, and diphtheria.

Because of the survey design and nature of the survey as a pilot, the results were not robust enough to be used for programmatic decisions. However, the interprogrammatic team in Mexico understood the utility of serosurveillance as a complementary tool to characterize the transmission of communicable diseases and monitor the impact of interventions. The experience with the first integrated serosurvey in Mexico was used in 2021 to start developing a second serosurvey protocol.

In the meeting held in Mexico on March 2020 (15) with delegates of countries and institutions participating in the Multiplex initiative, the need to reinforce country capacities to analyze and interpret integrated serosurveillance data was highlighted. In April 2021, PAHO and CDC conducted a five half-day virtual workshop with delegates from interprogrammatic groups of Brazil, Guatemala, Guyana, Mexico, and Paraguay focused on reinforcing skills to effectively use integrated serosurvey data. Theory and practical sessions were completed to review the rationale, concepts, approach, laboratory aspects, survey data preparation, data analysis, and data triangulation and interpretation (23,24).

PAHO and CDC published a toolkit to help countries to plan, implement, analyze, and use the results of integrated serosurveillance to improve programmatic decisions. This toolkit was developed based on the experience of the initiative.

Paraguay, Guatemala, and Guyana will complete and publish the analysis of results in 2023.

Lessons learned

The following are the most important lessons learned from integrated serosurveillance in the Americas:

- The country coordinating team should be clearly defined from the beginning and include those responsible for the programs, experts in the subject matter and diseases under study, statisticians, experts with experience in survey design, epidemiologists, laboratory technicians, and professionals with other profiles according to the proposed protocol and the expected use of results.
- When monitoring several diseases at once, it is challenging to define the optimal age range and sample size to ensure the objectives of the study are met. Considering that, a household survey might be the best option, instead of a school-based survey. This would fulfill the needs of programs for diseases having significant transmission, or that require monitoring of routine immunization activities, in children below school age.
- Proper training, supervision, and monitoring of field teams are crucial to ensure adherence to the methods and procedures established in the protocol. Logistical situations and contingencies that could affect fieldwork should be, when possible, identified in advance to adjust the timeline, resource, and financing requirements.
- Disaggregated epidemiological data (e.g., cases and outbreaks) and historical data on interventions implemented (e.g., vaccination coverage, mass drug administration, etc.) are needed during the survey design phase to help define the research questions, and to interpret results using triangulation techniques.
- While the MBA is more complex than single target assays for serology, the assay is robust, the technique is easy to train, and data are generated for multiple antigens in a single sample. Technology transfer is an ongoing process; close and continuous communication and support are critical among participating laboratories to maintain and revalidate laboratory capacities in countries.

TABLE 3. Key aspects to consider when implementing integrated serosurveys

Planning
- The need and feasibility of carrying out an integrated serosurvey must be established and agreed upon by an interdisciplinary team.
- Interprogrammatic work aligning program needs and searching for common survey design elements, such as age ranges and geographic areas, is crucial.
- The survey design must be robust to address the objectives and obtain generalizable results for each disease.
- Use of banked serum samples and existing databases must identify the limitations of the survey design and clearly define the scope of the current study.
- Rapid testing for any other diseases (e.g., hepatitis B rapid tests or filarial test strips) might be added to dried blood sample collection which takes advantage of the field implementation to improve the cost-efficiency of the survey.
- The use of expanded informed consent to store and use collected samples for future studies is a best practice that facilitates future serological and other analyses of diseases relevant to public health.

Implementation
- Local and cross-sectoral coordination and involvement are needed during all phases of the survey to ensure that processes and interests are aligned.
- Training of field teams should include practical sessions according to the roles of the field team members.
- Piloting must be part of the training and any adjustments to procedures and questionnaires should be included immediately to ensure that data collection will run smoothly
- Transferring laboratory capacities for assays such as MBA requires sufficient planning and resources to guarantee proper training, provisioning of the recipient laboratory, fluid communication to solve problems, inter-laboratory comparisons, establish quality control procedures, and revalidating capacity skills to guarantee the quality of results.
- The use of mobile devices facilitates data collection and improves data quality (i.e., with proper validation checks) by avoiding omissions and preventing errors.
- Appropriate and timely supervision to track fieldwork progress is crucial to support protocol adherence and high-quality data.
- A timely response to unforeseen events is needed to solve problems or contingencies that could arise during the fieldwork.

Data analysis and decision making
- Data entry, validation, cleaning, and merging of datasets require appropriate training, resources, and management to ensure data quality.
- Integrated serosurveillance generates large and complex data sets that can be challenging to interpret. Proper training on data analysis of serosurveys results is critical to ensure generalizability to the study population.
- Data analysis can be disease-specific and multi-diseases. An analysis plan must be agreed upon and applying triangulation techniques to explain and interpret the serology results is needed.
- A report should be prepared and discussed as soon as possible after the completion of the survey to propose actionable interventions and identify synergies between the programs.

- In addition to improving laboratory capacities, it is crucial to ensure appropriate skills in survey design, statistical methods, data analysis, and interpretation to generate valid, reliable, and generalizable results to support actionable programmatic decisions. This process takes time and must integrate different disciplines, the programs´ responsible, and the support of partners such as academies and research groups.

Table 3 presents some of the key aspects in the planning, implementation, data analysis, and decision-making to consider when implementing integrated serosurveys.

Conclusion

The incorporation of integrated serosurveillance into epidemiological surveillance systems can contribute to identify immunity gaps, anticipate the reintroduction or risk of re-emergence of diseases including those in the post-elimination phase, monitor epidemics and emerging pathogens, and provide useful information for prediction models to understand transmission patterns, among others. It will also help share the costs since several programs or strategies will benefit from the same effort.

Using integrated serosurveillance as a complementary tool of functional epidemiological surveillance systems is feasible, but countries interested in using it should consider that regardless of the context in which this surveillance tool can be implemented, some key aspects should be considered: political engagement, technical engagement, and careful planning. Transferring the laboratory technology is only one aspect, but planning the integrated survey, designing the integrated protocol, carefully selecting the target populations and diseases to include, anticipating the capacities to analyze and interpret complex laboratory and epidemiological data, and using it to improve programmatic decisions are key components. The experience and lessons learned from serosurveillance in the Americas presented in our study will help expand its use as a tool to improve public health surveillance and programmatic actions to control and eliminate communicable diseases.

Acknowledgments. Special recognition to the delegates from the participating countries in the implementation of the integrated serological surveillance initiative using the Multiplex platform, for their commitment, hard work and, in particular, for supporting innovation opportunities and ways to improve public health programs' performance. Thanks to the technical teams from the participating PAHO country offices. The progress of this initiative and the learning achieved have been possible thanks to collaborating work across various disciplines and the extraordinary support of the CDC's teams.

Author contributions. Conceived and designed the study: MISD, AM, DLM, GC. Performed the study: MISD, AM, DLM. Organized and analyzed data: MISD, AM. Wrote the paper: AM, MISD, DLM, GC, HMS. Reviewed and edited the paper: MISD, AM, LGC, MPA, GRB, GC, HMS, REW, MMC, DLM. All authors reviewed and approved the final version.

Conflict of interest. None declared.

Funding. This work was developed by the Neglected, Tropical, and Vector-borne Diseases Unit of the Pan American Health Organization (PAHO) with the financial support of the Centers for Disease Control and Prevention of the United States of America as part of the joint initiative to implement integrated serosurveillance in the Region of the Americas.

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Manuscript submitted on 13 May 2022. Revised version accepted for publication on 21 December 2022.

Enseñanzas obtenidas en la aplicación de la serovigilancia integrada de las enfermedades transmisibles en la Región de las Américas

Resumen

Objetivo. Sistematizar la experiencia y determinar los desafíos y las enseñanzas obtenidas durante la aplicación de una iniciativa de serovigilancia integrada de enfermedades transmisibles mediante un ensayo de perlas múltiples en países de la Región de las Américas.

Métodos. Se recopilaron y revisaron los documentos generados en el marco de la iniciativa. Estos incluían notas conceptuales, documentos de trabajo internos, informes de reuniones regionales y protocolos de encuesta de los tres países participantes (Brasil, México y Paraguay) y otros dos países (Guatemala y Guyana) donde en las encuestas sobre enfermedades tropicales desatendidas también se incluía la serología para varias enfermedades transmisibles. Se recabó y resumió la información para describir tanto la experiencia como los desafíos y las enseñanzas de mayor relevancia.

Resultados. La realización de encuestas serológicas integradas requiere equipos de trabajo interprogramáticos e interdisciplinarios para la elaboración de protocolos de encuesta que permitan responder a cuestiones programáticas fundamentales y ajustadas a las necesidades de los países. Es imprescindible contar con resultados de laboratorio válidos, para lo que es preciso que sus técnicas e instalaciones estén estandarizadas. Para que los equipos de campo puedan ejecutar correctamente los procedimientos de la encuesta, deben contar con una formación y supervisión adecuadas. El análisis y la interpretación de los resultados de las encuestas serológicas deben ser específicos para cada antígeno, situar las respuestas en el contexto de cada enfermedad y triangularse con los datos programáticos y epidemiológicos para tomar decisiones adaptadas a los contextos socioeconómicos y ecológicos específicos de la población.

Conclusiones. Es uso de la vigilancia serológica integrada como una herramienta complementaria en los sistemas funcionales de vigilancia epidemiológica es algo posible; para esto deben tenerse en cuenta ciertos elementos fundamentales: el compromiso político, el compromiso técnico y la planificación integrada. A tal efecto, son fundamentales ciertos elementos como el diseño del protocolo, la selección de los grupos poblacionales y las enfermedades objetivo, la capacidad de los laboratorios, y la previsión de las capacidades de análisis e interpretación de datos complejos y la forma de utilizarlos.

Palabras claves Serología; vigilancia; enfermedades transmisibles; Américas.

Lições aprendidas com a implementação da vigilância sorológica integrada de doenças transmissíveis nas Américas

RESUMO

Objetivo. Sistematizar a experiência e identificar desafios e lições aprendidas na implementação de uma iniciativa de vigilância sorológica integrada de doenças transmissíveis, usando ensaio de micro-esferas multiplex em países das Américas.

Métodos. Os documentos produzidos na iniciativa foram compilados e examinados, e incluíram notas conceituais, documentos internos de trabalho, relatórios de reuniões regionais e protocolos de pesquisa dos três países participantes (México, Paraguai e Brasil) e de dois países adicionais (Guiana e Guatemala), onde a vigilância sorológica de várias doenças transmissíveis foi incluída em pesquisas sobre doenças tropicais negligenciadas. As informações foram extraídas e resumidas para descrever a experiência e os desafios e as lições aprendidas mais relevantes.

Resultados. A implementação de inquéritos sorológicos integrados requer equipes de trabalho interprogramáticas e interdisciplinares para o delineamento de protocolos que respondam a questões programáticas chave, alinhadas com as necessidades dos países. Resultados laboratoriais válidos são essenciais, e dependem da instalação e implantação padronizadas de técnicas laboratoriais. As equipes de campo precisam de treinamento e supervisão apropriados para implementar adequadamente os procedimentos de pesquisa. A análise e a interpretação dos resultados dos inquéritos sorológicos devem ser antígeno-específicas, contextualizando as respostas para cada doença, e trianguladas com dados programáticos e epidemiológicos para a tomada de decisões adaptadas aos contextos socioeconômicos e ecológicos específicos de cada população.

Conclusões. A vigilância sorológica integrada como ferramenta complementar para sistemas de vigilância epidemiológica funcionais é viável. Os componentes-chave a seguir devem ser considerados: engajamento político, engajamento técnico e planejamento integrado. Aspectos como o delineamento do protocolo, a seleção de populações-alvo e doenças-alvo, a capacidade laboratorial, a previsão das capacidades para análise e interpretação de dados complexos e como usá-los são fundamentais.

Palavras-chave Serologia; vigilancia; doenças transmissíveis; América.