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National immunization research agenda setting in a lower-middle-income country: a stakeholder-informed modified Delphi study in Honduras

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Title page

Title

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Abstract

Background

Strengthening immunization programs in low- and middle-income countries requires context-specific evidence to inform policy and programmatic decisions. Research efforts often remain fragmented and poorly aligned with national priorities. A coordinated, stakeholder-informed research agenda helps ensure that evidence generation addresses the gaps most relevant to program performance. This study aimed to define national research priorities for immunization in Honduras through a structured multi-stakeholder consensus process.

Methods

A modified Delphi study was conducted virtually and asynchronously between February and April 2026. A multisectoral panel from the Ministry of Health, international health organizations, clinical services, and academia evaluated a preliminary list of 24 research topics across six thematic domains over three rounds. In round one, participants indicated whether each topic was relevant to the national context and proposed additional topics through open-ended questions analyzed thematically. In round two, participants rated the consolidated research lines on a five-point Likert scale for national public health relevance and the applicability of the expected evidence to decision-making; lines needed at least 70% of responses in the two highest categories on both dimensions to advance. In round three, panelists reviewed the aggregated round two results and selected the eight highest-priority lines among those that had reached consensus, ranked by selection frequency.

Results

Twenty-six experts completed round one and constituted the panel; 24 (92.3%) and 25 (96.2%) completed rounds two and three. Round one produced 18 revised research lines from the initial 24 topics, of which 16 (88.9%) reached consensus in round two. The eight lines prioritized in round three addressed evaluation of immunization information systems, barriers to and facilitators of vaccine acceptability, missed opportunities for vaccination, access barriers among vulnerable populations, sociocultural and structural determinants of schedule completion, risk communication strategies, health worker competencies, and surveillance of vaccine-preventable diseases and vaccine effectiveness.

Conclusions

This study produced the first stakeholder-consensus national research agenda for immunization in Honduras. The prioritized lines center on strengthening program implementation rather than on vaccine technology development, offering a context-specific roadmap for research investment in a lower-middle-income setting.

Keywords: Delphi technique; consensus; research priority setting; health priorities; immunization programs; vaccination; evidence-informed policy; Honduras; developing countries

Background

Immunization is among the most cost-effective public health interventions available, preventing millions of deaths each year from vaccine-preventable diseases [1]. Sustaining these gains, however, depends not only on delivering vaccines but also on generating the evidence needed to guide improvements in immunization programs. The Immunization Agenda 2030 (IA2030), endorsed by the 73rd World Health Assembly in 2020, reflects this dual imperative by setting a global framework to ensure that everyone, everywhere, at every age benefits from vaccines, with particular emphasis on equity and reaching the unvaccinated and under-vaccinated [2].

Despite recent progress, immunization coverage in Honduras has remained below target for several consecutive years. According to the WHO and UNICEF Estimates of National Immunization Coverage (WUENIC) 2025 revision, coverage with three doses of the diphtheria-tetanus-pertussis-containing vaccine (DTP3), a widely used marker of program performance, was 86% in 2025, down from 90% in 2019 and below the 90% target set by IA2030. Over the same period, coverage with the first dose of measles-containing vaccine (MCV1) fell from 90% to 87% [3]. These endpoints, however, understate the instability of the intervening years: nationally reported coverage fell to around 75% in 2024 before recovering in 2025 [4]. Several years below the 90% threshold, together with year-to-year volatility, allow susceptible children to accumulate across birth cohorts, sustaining the immunity gaps that drive vaccine-preventable disease outbreaks.

These figures reflect deeper structural challenges in the country's Expanded Program on Immunization (EPI), including access barriers in geographically dispersed and socially marginalized communities and weaknesses in health information systems. They also point to a less visible but equally consequential

gap: the scarcity of locally generated evidence to inform programmatic decisions. Strengthening immunization in Honduras therefore requires not only improving service delivery and program management, but also building a systematic, context-grounded research capacity to identify why coverage gaps persist and which strategies are most likely to close them.

Against this backdrop, the Faculty of Health Sciences of the Universidad Tecnológica Centroamericana (UNITEC) established the Honduran Vaccine and Immunization Research Group in 2025, in collaboration with the Honduran Ministry of Health and with technical support from the country offices of The Global Health Network and the Pan American Health Organization (PAHO). The group was conceived to generate locally relevant evidence, build research capacity among students and faculty, and strengthen the linkage between research, program needs, and public health decision-making.

To translate this mandate into results, however, the group first required a clearly defined and collectively agreed research agenda. Without it, research efforts tend to fragment, resources are used inefficiently, and outputs may not align with the priorities most relevant to the health system, a limitation well documented in the priority-setting literature [5].

The Delphi technique is a structured, iterative consensus method designed to synthesize expert judgment on questions where evidence is sparse, contested, or highly context-specific [6]. It has been widely applied in the health sciences to set research priorities and inform policy, particularly where integrating academic, programmatic, and clinical perspectives is essential [7, 8]. A modified Delphi retains the core features of the Delphi method while adapting one or more of its traditional features [9, 10]. One such modification involves beginning with a set of carefully selected items or topics [11].
To our knowledge, this is the first study to apply a Delphi approach to define immunization research priorities in Honduras. It aimed to define, through a modified Delphi process, the priority research lines to guide the recently established Vaccine and Immunization Research Group, aligned with national

health priorities and the needs of the EPI. In doing so, it contributes to the still-limited literature on participatory research agenda setting for immunization in low- and middle-income settings.

Methods

Study design and setting

To build a nationally grounded and stakeholder-informed immunization research agenda, this study convened a multisectoral panel of experts through a structured consensus process using a modified Delphi technique. This approach was chosen because it enabled the systematic integration of diverse technical, programmatic, and academic perspectives in a context where locally generated evidence is limited and expert judgment is essential for orienting health system priorities. The modified Delphi process began with a preliminary list of research topics anchored in national and international strategic documents, while allowing participants to refine existing topics and propose new areas through open-ended contributions. This adaptation allowed the research agenda to be progressively refined, assessed, and prioritized across the three rounds.

Honduras is a lower-middle-income country of approximately 11 million inhabitants, 41% of them rural, with a gross national income per capita of US$ 3,270 in 2025 [12, 13]. This classification conceals widespread poverty: 61.1% of households were below the national poverty line in 2026 and 39.7% in extreme poverty [14]. The health system is segmented and fragmented, with the Ministry of Health acting as steward and main provider for approximately 60% of the population and an estimated 17% to 18% lacking regular access to services [15]. Out-of-pocket payments represented 51.1% of current health expenditure in 2022 and government health spending 3.5% of gross domestic product, below the region's 6% benchmark [16].

The study was conducted between February and April 2026, entirely in a virtual and asynchronous format, using KoboToolbox as the data collection platform. The Research Ethics Committee of the

Universidad Tecnológica Centroamericana approved the protocol (IRB 00012967; session of 14 January 2026, recorded in minutes 003-2026), and the study was registered prospectively in the Open Science Framework (OSF) before data collection (https://osf.io/bryfc/). The study is reported in accordance with the ACCORD (ACcurate COnsensus Reporting Document) reporting guideline for consensus methods in biomedicine [17].

Panel composition and selection

Participants were selected through purposive sampling based on relevant professional expertise and multisectoral representation, so that the resulting agenda would reflect the range of perspectives needed to inform national immunization policy and program decision-making. The panel comprised technical staff from the national and regional levels of the Honduran Ministry of Health, including the EPI; representatives of international health organizations; clinical specialists in infectious diseases and immunization; academic researchers; and medical students affiliated with the Vaccine and Immunization Research Group. This deliberate integration of programmatic and academic expertise is consistent with recommendations for panel composition in Delphi health research [18].

Response rates for Rounds 2 and 3 were calculated relative to the panel members who completed Round 1. Panel members who did not respond in Round 2 were not excluded from Round 3, a deliberate design decision intended to maximize panel retention and preserve diverse perspectives.

The exercise was directed by a four-member steering team from the Vaccine and Immunization Research Group, combining expertise in epidemiology, including implementation research, in infectious diseases and in health professions education. The team designed the study, compiled the preliminary list of topics, analyzed the responses, and took the final decisions on item retention after each round. Its members did not act as panelists: they did not complete the data collection forms or vote in any round.

This separation between the steering team and the panel was intended to minimize potential influence on participants' judgments.

Panel members who subsequently expressed a wish to be recognized as authors, and who met the authorship criteria of the International Committee of Medical Journal Editors (ICMJE), are listed as co-authors. Individual responses are not attributable to any named author.

Delphi process

The process was conducted in three rounds, each with a response window of approximately two weeks (range 10 to 17 days). Informed consent was obtained digitally at the beginning of Round 1 through a mandatory question allowing participants to accept or decline involvement before proceeding. At the outset, participants also provided demographic information on professional background, years of experience, primary role, institutional sector, and scope of work. Responses were confidential rather than anonymous at the point of collection: participants were asked to provide their email in each round solely to allow the steering team to track completion, send reminders and follow participation across rounds, and this was explained to them. Emails were removed before analysis, and responses were analyzed and reported only in aggregate form, so that no response is attributable to an identifiable individual. Panel members remained anonymous to one another throughout, and no aggregated result was ever presented with individual attribution, preserving the independence of judgment that the Delphi technique is designed to protect.

Before Round 2, participants received a narrative summary describing how their Round 1 responses had been processed, without aggregated data on individual topics. Participants received controlled feedback on aggregated results before Round 3, consistent with the methodological principles of the Delphi technique.

The steering team developed the preliminary list of 24 topics, organized across six thematic domains (coverage, access and equity; acceptance, confidence and communication; program management and quality of services; surveillance, information and decision-making; evaluation of interventions and new strategies; and governance, financing and sustainability), by reviewing national and international strategic documents, including the Honduras Health Research Agenda 2024-2030 and the programmatic priorities of the EPI and IA2030, and used it as the starting point for Round 1.

In Round 1, participants reviewed each topic and indicated, in a binary format, whether they considered it relevant to the Honduran context, with open-response fields to propose additional topics or research areas not captured in the preliminary list. Open-ended contributions were analyzed thematically by the steering team and used to reformulate, merge, or expand topics and derive new ones. Decisions on whether to retain, reformulate, merge, replace or remove each topic were reached by integrating the two analyses: the proportion of panelists endorsing the topic, for which 70% was taken as an indicative reference rather than a fixed cut-off, and the substance of the qualitative contributions, through iterative review and discussion within the steering team, with each decision documented for every topic (Table 2). Because Round 1 asked participants to identify relevant topics rather than to rate them, its quantitative results were used only for this consolidation and were not fed back to the panel.

In Round 2, participants rated the consolidated research lines on a 5-point Likert scale against two criteria, defined as follows. Relevance to national public health was defined as the extent to which a topic is important for guiding the national immunization research agenda, considering its pertinence to the national public health context and its alignment with country priorities, rated from 1 (no relevance) to 5 (very high relevance). Applicability of evidence for decision-making was defined as the extent to which the expected findings of a research line can be translated into concrete actions, including the design, adjustment or implementation of interventions, the strengthening of policies, training processes

across levels and sectors, and community participation in immunization efforts in Honduras, rated from 1 (no applicability of the evidence for action) to 5 (very high applicability).

A research line reached consensus when at least 70% of respondents rated it in the two highest categories (4 or 5) on both criteria; lines meeting this threshold advanced to the final round. The 70% threshold applied in Round 2 corresponds to a value commonly used in Delphi studies in the health sciences [10, 19]. The registered protocol did not prespecify a numerical consensus threshold; the steering team defined it before analyzing Round 2 responses.

In Round 3, participants were presented with the research lines that had reached consensus in Round 2, each accompanied by its aggregated results from that round: the median and interquartile range and the distribution of responses across the five categories, for both relevance and applicability. Lines were displayed in the order of the thematic domains, not ranked by their Round 2 scores. Participants were asked to select exactly eight lines, without ordering them, as those they considered most important for guiding the national immunization research agenda. No further open-ended input was requested at this stage. The number of times each line was selected was then used to rank the lines by priority, and the eight most frequently selected constituted the final agenda.

The instruments were not piloted with external respondents before distribution. One member of the steering team configured each data collection form in KoboToolbox, and the remaining three independently reviewed the forms, checking proper functioning, including mandatory fields, skip logic, and branching, before each round opened.

All study materials were administered in Spanish, the working language of all panel members. During each two-week window, a reminder with the closing date was sent at the midpoint to those who had not yet responded, and a further reminder was sent to the same group one day before closing. No

financial or material incentive was offered. No members of the public or service users took part in the panel.

The full instruments used in each round are available in the same repository and are provided as Supplementary material 1.

Data analysis

Data were analyzed using a mixed-methods approach, with quantitative analyses performed in Stata/IC 16.1 (StataCorp, College Station, TX, USA). Binary responses from Rounds 1 and 3 were summarized as frequencies and proportions. Round 2 ratings were summarized for each research line and each criterion as medians with interquartile ranges and as the distribution of responses across the five categories, from which the proportion of ratings in the two highest categories was derived. Open-ended responses from Round 1 were analyzed thematically.

A large language model (Claude, Anthropic, San Francisco, CA, USA) supported manuscript drafting and improved clarity of expression. It was not used for data collection, analysis, or interpretation, and it is not credited with authorship. All authors reviewed the manuscript and take full responsibility for its content.

Results

Of the 31 experts contacted, 27 confirmed their participation. Twenty-six participants completed Round 1 and constituted the expert panel. One participant who had confirmed participation did not respond to Round 1 and was therefore not included in the panel or invited to subsequent rounds. Twenty-four panel members completed Round 2 (92.3%) and 25 completed Round 3 (96.2%). One panel member did not respond to Round 2 but participated in Round 3. No new participants were incorporated during the process. Figure 1 presents the flow of participation throughout the Delphi process.

Invitations to participate were sent on 18 February 2026. Round 1 was open from 27 February to 12 March 2026, Round 2 from 23 March to 8 April 2026, and Round 3 from 15 to 24 April 2026, giving response windows of 14, 17, and 10 days, respectively. The length of each window was adjusted to account for public holidays falling within the data collection period. No extensions were granted once a round had closed. The registered protocol had anticipated a panel of 15 to 20 experts.

The panel included participants with diverse professional backgrounds related to immunization, including health management and administration, EPI technical staff, clinical care, teaching, and research. Thirteen participants (50.0%) reported more than 10 years of experience in vaccination, immunization, public health, or research. Sixteen participants (61.5%) worked primarily at the national level. Most participants (15; 57.7%) came from non-academic sectors, and 11 (42.3%) were affiliated with academia (Table 1).

Round 1: refinement and enrichment of the proposed research topics

Of the 24 topics evaluated, one was retained without modification, 15 were reformulated in response to participant contributions, two were merged with related topics, and five were removed after considering their comparatively low endorsement and the content of the open-ended contributions. One topic was replaced: although 80.8% of panelists endorsed it, all associated subtopics addressed missed opportunities for vaccination, so the line was reframed accordingly. Two emergent topics were also incorporated: one was merged with an existing topic, while the other was retained as a separate research line. Overall, experts proposed 92 additional subtopics through the open-ended responses, which were synthesized into the corresponding research lines. This process resulted in the 18 research lines that constituted the instrument used in Round 2. Table 2 presents detailed results by topic.

Round 2: assessment of relevance and applicability for decision-making

The panel reviewed the 18 revised research lines, and 24 members responded (92.3%).

Sixteen of the 18 research lines (88.9%) reached the consensus threshold on both criteria and advanced to Round 3 (Table 3). For the relevance criterion, the Likert scale median values were predominantly 5 (interquartile range 4-5), with the proportion of responses in categories 4 and 5 ranging from 75.0% to 100.0%. Scores for applicability for decision-making were generally lower, with medians ranging from 4 to 5 and proportions of responses in categories 4 and 5 ranging from 58.3% to 95.8%. Two lines did not reach consensus on applicability for decision-making and were excluded from Round 3: Line 5.3 (social and community participation in immunization efforts) and Line 6.2 (strengthening intersectoral and interinstitutional coordination for immunization interventions at national and local levels).

Round 3: prioritization of research lines

Round 3 presented the 16 research lines that achieved consensus in Round 2 for prioritization. Twenty-five panel members completed this round (96.2%), including one who had not responded in Round 2. Line 4.1 received the highest selection frequency (18 panelists; 72.0%), followed by 2.1, 5.2, 1.2, and 1.1 (17 panelists; 68.0% each). The eight most frequently selected lines were 4.1, 2.1, 5.2, 1.2, 1.1, 2.2, 3.3, and 4.3 (Table 4).

Discussion

Priority setting is a fundamental step in directing limited resources toward research questions that address health system needs and maximize potential health benefits [5, 20]. In immunization, this need has gained renewed importance as global frameworks increasingly recognize research and innovation as essential to strengthening programs and advancing equitable access to immunization [2, 21]. Against this background, this study established a national immunization research agenda for Honduras through a modified Delphi process, which, to the best of our knowledge, represents the first structured, consensus-based immunization research priority-setting exercise in the country.

The line ranked highest by the panel was the evaluation of the EPI information systems, selected by 18 of 25 panelists (72.0%), followed by four lines tied at 17 (68.0%), among them the sociocultural and structural determinants of vaccination schedule completion. These two lines, information systems and schedule completion, address distinct aspects of the immunization process: the capacity of information systems to identify gaps in vaccination schedule completion and the factors contributing to those gaps. Overall, the prioritized agenda points inward, toward program operations. This orientation may partly reflect the country's procurement of vaccines through the PAHO Revolving Fund, which largely secures product availability and shifts the operational challenge toward distribution and last-mile delivery [22]. The remaining prioritized lines reinforce this reading: access barriers in vulnerable populations, missed opportunities for vaccination, vaccine acceptability, health-worker competencies, risk communication, and surveillance of vaccine-preventable diseases and generation of evidence on real-world vaccine effectiveness all concern the delivery, uptake, and monitoring of immunization services.

This is consistent with the direction of international evidence on coverage gaps, which has concentrated on interventions to improve uptake and delivery in low- and middle-income countries [23] and on the behavioral and social determinants that shape immunization decisions [24], determinants that operate through linked pathways rather than in isolation [25]. The panel's concern with measurement follows the same logic: modeling studies indicate that unevenly distributed immunity and declining coverage can translate into renewed outbreaks of diseases previously under control [26, 27], and identifying where such gaps are accumulating requires timely and reliable information systems capable of detecting them.

This orientation toward implementation rather than discovery is not unique to Honduras; it is consistent with what the priority-setting literature has observed in settings where effective interventions are already available and the research challenge lies in their delivery and implementation. The Child Health

and Nutrition Research Initiative (CHNRI) method, a structured approach in which experts score candidate research questions against predefined criteria, has been widely applied to health research priority setting. A review of the first fifty applications of the CHNRI found that priorities shift toward implementation and translational research wherever effective interventions are already available and simply need to be delivered at scale, and toward discovery only when no such intervention exists [28]. The same pattern recurs across recent consensus exercises in comparable settings: a modified Delphi on COVID-19 vaccine delivery in low- and middle-income countries converged on structural and service-delivery barriers rather than on product innovation [7]; a national child-health priority-setting exercise in India ranked the development and implementation of cost-effective interventions and the improvement of data quality above basic discovery [29]; and a Delphi on cancer research priorities in resource-challenged regions similarly favored implementation, registries and prevention over fundamental research [30]. Taken together, these findings suggest that the Honduran agenda reflects a broader pattern in which priority-setting exercises in settings with established interventions tend to emphasize implementation, delivery, and system-level barriers. At the same time, the specific priorities identified here remain grounded in the Honduran immunization context. The contrast with global-level priority setting is equally instructive. Recent global exercises have concentrated on vaccine products rather than on delivery: a multi-criteria decision analysis identified priority endemic pathogens for vaccine research and development [31], and country-stakeholder consultations under the Vaccine Innovation Prioritisation Strategy ranked vaccine product innovations [32]. That a national panel in Honduras converged instead on schedule completion, information systems, and service delivery suggests that global and national exercises identify different problems because they start from different positions in the health system.

Limitations

These results should nonetheless be interpreted within the scope of consensus methods. First, the priorities reflect the collective judgment of a purposively selected group of experts and should be considered a basis for research planning within broader planning and resource-allocation processes [33]. Second, the steering team constructed the initial list of topics from strategic documents; although open-ended fields in Round 1 allowed participants to propose new areas, two of which were incorporated, this anchoring may have constrained the emergence of entirely novel priorities. Third, the panel included a substantial proportion of academic participants and participants working at the national level, while community members were not directly represented. Consequently, operational, local, and community perspectives relevant to program implementation, particularly lived experiences related to access and acceptability, may not have been fully captured. These perspectives are complementary to, rather than interchangeable with, the assessments provided by technical experts. Finally, the study did not assess the technical, financial, or political feasibility of the prioritized lines. Guidance on research priority setting recommends that implementation be planned from the outset rather than addressed once priorities have been established, since those who set priorities are often not those responsible for acting on them [5]. The panel included EPI and Ministry of Health staff, which partly addresses this concern, but the exercise did not include an explicit plan for translating the agenda into research activity. Doing so will require deliberate planning, capacity building, and resource mobilization.

Implications for implementation

Finally, defining an agenda is only the first step, and arguably the easier one. Priority-setting exercises are frequently published but seldom followed through with the funding, capacity, and institutional commitment implementation requires, and priorities that are not resourced or revisited quickly lose relevance as epidemiological and programmatic conditions change [20, 34]. For this agenda to shape research in Honduras rather than document a moment of consensus, it must be embedded in the planning of the research group and its partners, matched to funding calls and postgraduate training, and

reassessed periodically against national coverage and program priorities [35]. The value of the exercise will ultimately be judged not by the ranking it produced but by the research it enables and the programmatic decisions that research informs.

Conclusions

Defining research priorities is an essential step toward more robust, equitable, and evidence-informed immunization programs. This study provides the first consensus-based national research agenda for immunization in Honduras and establishes a roadmap to orient knowledge generation according to the current needs of the EPI. It also demonstrates that a modified Delphi process can support the development of national research agendas through a transparent, participatory, and methodologically rigorous approach. In settings with limited research resources, clearly defined priorities can align scientific investment with programmatic needs and strengthen the connection between research, policy, and practice [5]. Given the pace of epidemiological and programmatic change in immunization, this agenda should be considered a dynamic instrument and formally reassessed every three to five years, or earlier if substantial changes occur in national immunization coverage, program priorities, or the broader policy and governance context [34].

List of abbreviations

AEFI: adverse event following immunization
DTP3: third dose of diphtheria–tetanus–pertussis-containing vaccine
EPI: Expanded Program on Immunization
IA2030: Immunization Agenda 2030
ICMJE: International Committee of Medical Journal Editors
IQR: interquartile range
MCV1: first dose of measles-containing vaccine
OSF: Open Science Framework
PAHO: Pan American Health Organization
UNITEC: Universidad Tecnológica Centroamericana
WHO: World Health Organization
WUENIC: WHO and UNICEF Estimates of National Immunization Coverage

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Research Ethics Committee of the Universidad Tecnológica Centroamericana (Comité de Ética en Investigación, UNITEC; IRB 00012967) at its session of 14 January 2026, recorded in minutes 003-2026, with the corresponding certificate issued on 15 January 2026. All methods were carried out in accordance with relevant guidelines and regulations. The study consisted of a structured expert consultation; it involved no clinical interventions or patients, and no human tissue samples were collected or used. All participants provided informed consent electronically at the start of Round 1 through a mandatory question that allowed them to accept or decline participation before accessing the questionnaire. Participation was voluntary, and participants could withdraw at any time without consequence.

Consent for publication

Not applicable. The manuscript does not contain data from any identifiable individual participant.

Availability of data and materials

The study protocol and the instruments used in each Delphi round are available in the Open Science Framework repository (https://osf.io/bryfc/). The aggregated datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests. Panel members were asked to declare any competing interest at the time of consenting to be recognized in the manuscript.

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Authors' contributions

SERM, KLM, CA and JPB conceived and designed the study, coordinated the Delphi process, analyzed and interpreted the data, and drafted the manuscript. AAAT, HEA, EBV, DECM, XLEA, RALM, WM, GP, JLP, AGRS, RJS, DVB, CJVP, AY and KY participated as members of the expert panel: they contributed to the identification, reformulation and prioritization of the research lines across the three rounds, and they reviewed and interpreted the aggregated Round 2 results as the basis for the final prioritization. All authors critically revised the manuscript for important intellectual content, read and approved the final version, and agreed to be accountable for all aspects of the work.

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Authors' information

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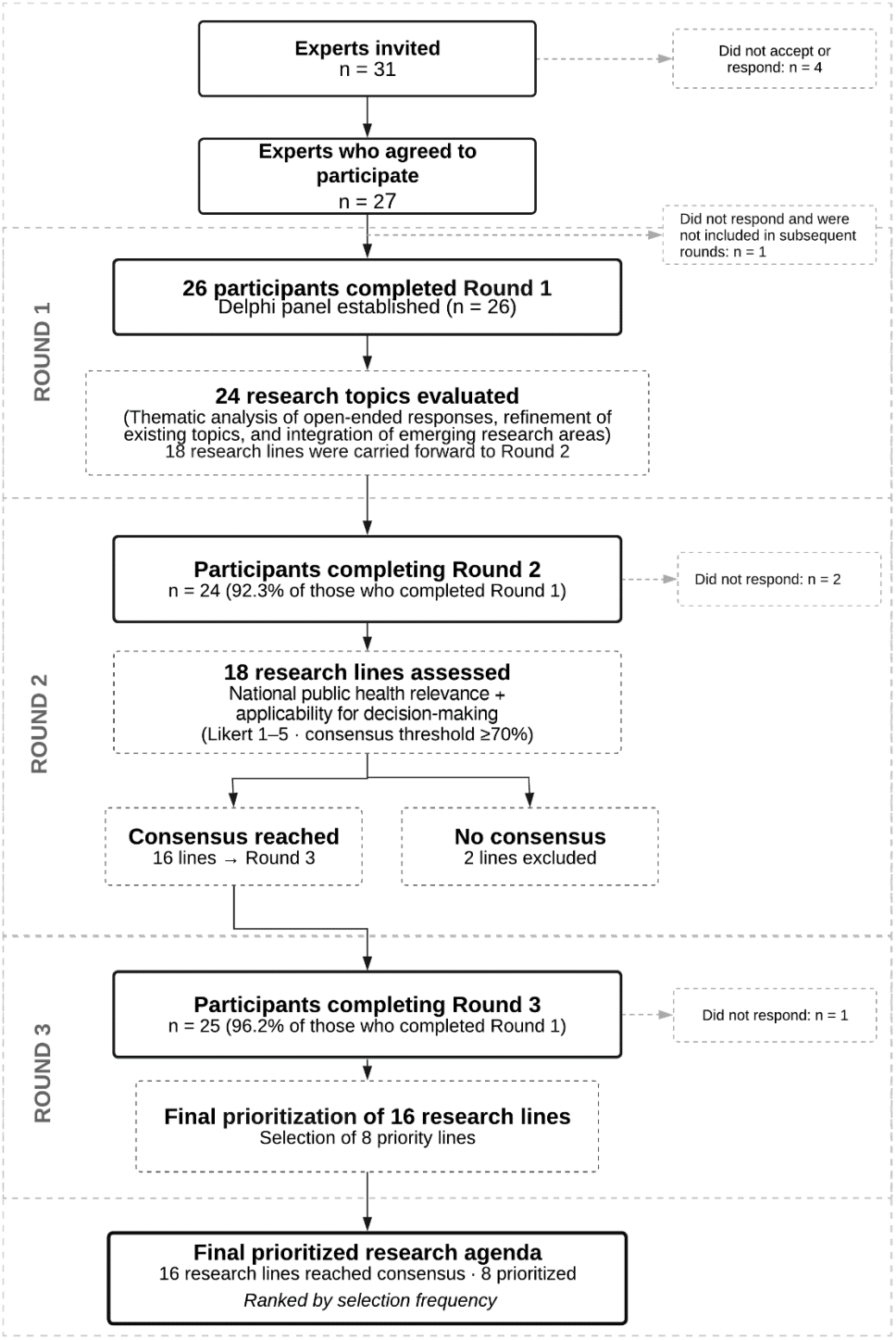
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Figure legend

Fig. 1 Flow of expert panel participation across the three Delphi rounds



Tables

Table 1 Characteristics of the expert panel, Round 1 (n = 26)

Characteristic	n	%
Years of experience in vaccination, immunization, public health or research		
Less than 5 years	3	11.5
5–10 years	10	38.5
11–20 years	6	23.1
More than 20 years	7	26.9
Primary role		
Health management or administration	5	19.2
EPI technical staff	3	11.5
Teaching or faculty	3	11.5
Clinical care	3	11.5
Research	3	11.5
Advanced medical students	2	7.7
Other[a]	7	26.9
Primary scope of work		
National	16	61.5
Regional	6	23.1
International	4	15.4
Institutional sector		
Academia	11	42.3
Ministry of Health / EPI	5	19.2
Independent consultant or non-governmental organization	3	11.5
Clinical or hospital services	3	11.5
International cooperation	2	7.7
Research center or research site	2	7.7

Notes: EPI: Expanded Program on Immunization. [a] Includes program advisors, independent consultants, data specialists, clinical advisors, and international cooperation professionals who did not identify with the predefined role categories.
Source: Prepared by the authors

583 **Table 2 Round 1 results: validation and refinement of the proposed research topics (n = 26)**

No.	Domain	Proposed research topic	Relevant, n (%)	Not relevant, n (%)	Decision
1	1	1.1 Geographic, economic and sociocultural barriers to vaccination in rural, Indigenous and urban marginalized populations	20 (76.9)	6 (23.1)	Reformulated
2	1	1.2 Social and structural determinants associated with incomplete vaccination schedules	20 (76.9)	6 (23.1)	Reformulated
3	1	1.3 Territorial inequities in vaccination coverage and EPI performance	17 (65.4)	9 (34.6)	Reformulated
4	1	1.4 Microplanning strategies to improve vaccination coverage in hard-to-reach areas	19 (73.1)	7 (26.9)	Retained
5	2	2.1 Impact of misinformation and social media on vaccine acceptance	18 (69.2)	8 (30.8)	Removed
6	2	2.2 Evidence-based risk communication and vaccination promotion strategies	21 (80.8)	5 (19.2)	Reformulated
7	2	2.3 Community perceptions regarding vaccine safety, effectiveness and AEFI	21 (80.8)	5 (19.2)	Reformulated[a]
—	2	Emergent topic: vaccine acceptability from the perspective of social and institutional actors	—	—	Added[b]
8	3	3.1 Cold chain performance and its impact on vaccine quality	19 (73.1)	7 (26.9)	Reformulated
9	3	3.2 Vaccine inventory management, losses and wastage	17 (65.4)	9 (34.6)	Removed
10	3	3.3 Organization and quality of vaccination services	20 (76.9)	6 (23.1)	Reformulated
11	3	3.4 Capacities and competencies of health personnel in immunization	22 (84.6)	4 (15.4)	Reformulated
12	4	4.1 Quality, timeliness and use of EPI information systems	18 (69.2)	8 (30.8)	Reformulated
13	4	4.2 Underreporting and data quality in vaccination coverage	14 (53.8)	12 (46.2)	Removed
14	4	4.3 Integration of information systems and use of data for microplanning	21 (80.8)	5 (19.2)	Reformulated
15	4	4.4 Evaluation and surveillance of vaccine effectiveness and impact	19 (73.1)	7 (26.9)	Reformulated
16	4	4.5 Surveillance of AEFI and serious adverse events following immunization	17 (65.4)	9 (34.6)	Removed
—	4	Emergent topic: vaccine research for emerging and vaccine-preventable diseases	—	—	Added[b]

No.	Domain	Proposed research topic	Relevant, n (%)	Not relevant, n (%)	Decision
17	5	5.1 Evaluation of the impact of vaccination campaigns and outreach activities	19 (73.1)	7 (26.9)	Merged
18	5	5.2 Innovative strategies for recovery of incomplete vaccination schedules and reduction of coverage gaps	21 (80.8)	5 (19.2)	Replaced[c]
19	5	5.3 Use of digital technologies for vaccination schedule tracking	22 (84.6)	4 (15.4)	Reformulated
20	5	5.4 Community-based interventions to increase vaccination demand	17 (65.4)	9 (34.6)	Reformulated
21	6	6.1 Financial sustainability of the EPI	17 (65.4)	9 (34.6)	Merged
22	6	6.2 Costs and economic evaluation of vaccination strategies	19 (73.1)	7 (26.9)	Reformulated
23	6	6.3 Intersectoral and interinstitutional coordination for strengthening the EPI	19 (73.1)	7 (26.9)	Reformulated
24	6	6.4 Dependence on international cooperation and transition to national financing	16 (61.5)	10 (38.5)	Removed

Notes: AEFI adverse event following immunization, EPI Expanded Program on Immunization. Thematic domains: 1, coverage, access and equity; 2, acceptance, confidence and communication; 3, program management and quality of services; 4, surveillance, information and decision-making; 5, evaluation of interventions and new strategies; 6, governance, financing and sustainability. [a] Topic 2.3 was reformulated and merged with the emergent topic on vaccine acceptability to create Round 2 line 2.1. [b] Topics added on the basis of recurrent qualitative contributions from the panel; the final content of these lines was developed through thematic synthesis of the comments and subtopics proposed by participants. [c] Topic 5.2 was replaced with new content (missed opportunities for vaccination) derived from panel comments.

Source: Prepared by the authors

Table 3 Round 2 results: relevance and applicability for decision-making of the 18 research lines (n = 24)

Line	Research line	Relevance, median (IQR)	Relevance, 4–5, n (%)[a]	Applicability, median (IQR)	Applicability, 4–5, n (%)[a]	Reached Consensus
1.1	Sociocultural and structural determinants associated with vaccination schedule completion	5 (4–5)	23 (95.8)	5 (4–5)	21 (87.5)	Yes
1.2	Geographic, economic and sociocultural barriers to vaccination in vulnerable populations	5 (4–5)	22 (91.7)	5 (4–5)	23 (95.8)	Yes
1.3	Territorial inequalities in vaccination coverage: geospatial analysis and impact of migration on schedule continuity	5 (4–5)	22 (91.7)	5 (4–5)	19 (79.2)	Yes
1.4	Microplanning strategies to improve vaccination coverage	5 (4–5)	22 (91.7)	5 (4–5)	20 (83.3)	Yes

Line	Research line	Relevance, median (IQR)	Relevance, 4–5, n (%)[a]	Applicability, median (IQR)	Applicability, 4–5, n (%)[a]	Reached Consensus
2.1	Sociocultural barriers to and facilitators of vaccine acceptability: perceptions of safety, trust in services and the role of social and institutional actors	5 (4–5)	24 (100.0)	5 (4–5)	22 (91.7)	Yes
2.2	Evidence-based risk communication and vaccination promotion strategies, with a focus on digital platforms and audience segmentation	5 (4–5)	23 (95.8)	5 (4–5)	19 (79.2)	Yes
3.1	Comprehensive management of the vaccine supply chain and cold chain	5 (4–5)	19 (79.2)	5 (4–5)	19 (79.2)	Yes
3.2	Installed capacity, quality and institutional safety in the provision of vaccination services	5 (4–5)	21 (87.5)	5 (4–5)	17 (70.8)	Yes
3.3	Health worker competencies in immunization: continuing education and operational conditions for service delivery	5 (4–5)	22 (91.7)	5 (4–5)	20 (83.3)	Yes
4.1	Evaluation of EPI information systems: data quality, system integration and use for decision-making	5 (4–5)	23 (95.8)	5 (4–5)	23 (95.8)	Yes
4.2	Data use for microplanning and identification of under-immunized populations: geospatial analysis and population segmentation	5 (4–5)	23 (95.8)	5 (4–5)	22 (91.7)	Yes
4.3	Surveillance of vaccine-preventable diseases and generation of evidence on real-world vaccine effectiveness	5 (4–5)	22 (91.7)	5 (4–5)	21 (87.5)	Yes
4.4	Evaluation of digital technologies for vaccination registration, tracking and management: effectiveness, implementation and scale-up	4.5 (4–5)	20 (83.3)	5 (3–5)	17 (70.8)	Yes
5.1	Evaluation of vaccination strategies across levels of the health system: implementation, effectiveness and local adaptation	4 (4–5)	20 (83.3)	5 (4–5)	20 (83.3)	Yes
5.2	Missed opportunities for vaccination in health services: determinants and strategies for reduction	5 (4–5)	23 (95.8)	5 (4–5)	22 (91.7)	Yes
5.3	Social and community participation in vaccination: engagement mechanisms and sustainability	4.5 (4–5)	19 (79.2)	5 (3–5)	16 (66.7)	No†
6.1	Economic evaluation of vaccines (health technologies), strategies and policies	5 (3.5–5)	18 (75.0)	4.5 (3.5–5)	18 (75.0)	Yes
6.2	Strengthening intersectoral and interinstitutional coordination for immunization interventions at national and local levels	4 (3.5–5)	18 (75.0)	4 (3–5)	14 (58.3)	No†

Notes: IQR: interquartile range, EPI: Expanded Program on Immunization. Research lines were rated on a five-point Likert scale (1 = lowest, 5 = highest) for relevance to national public health and for applicability of the expected evidence to decision-

making. [a] Consensus was defined as at least 70% of ratings in categories 4 and 5 on both criteria. †Lines that did not reach the consensus threshold on applicability for decision-making and were not carried forward to Round 3.

Source: Prepared by the authors

Table 4 Round 3 results: selection frequency of the research lines (n = 25)

Line	Research line	n (%)
4.1	Evaluation of EPI information systems: data quality, system integration and use for decision-making	18 (72.0)
2.1	Sociocultural barriers to and facilitators of vaccine acceptability: perceptions of safety, trust in services and the role of social and institutional actors	17 (68.0)
5.2	Missed opportunities for vaccination in health services: determinants and strategies for reduction	17 (68.0)
1.2	Geographic, economic and sociocultural barriers to vaccination in vulnerable populations	17 (68.0)
1.1	Sociocultural and structural determinants associated with vaccination schedule completion	17 (68.0)
2.2	Evidence-based risk communication and vaccination promotion strategies, with a focus on digital platforms and audience segmentation	16 (64.0)
3.3	Health worker competencies in immunization: continuing education and operational conditions for service delivery	15 (60.0)
4.3	Surveillance of vaccine-preventable diseases and generation of evidence on real-world vaccine effectiveness	13 (52.0)
3.1	Comprehensive management of the vaccine supply chain and cold chain	10 (40.0)
3.2	Installed capacity, quality and institutional safety in the provision of vaccination services	10 (40.0)
4.4	Evaluation of digital technologies for vaccination registration, tracking and management: effectiveness, implementation and scale-up	9 (36.0)
1.3	Territorial inequalities in vaccination coverage: geospatial analysis and impact of migration on schedule continuity	9 (36.0)
4.2	Data use for microplanning and identification of under-immunized populations: geospatial analysis and population segmentation	8 (32.0)
1.4	Microplanning strategies to improve vaccination coverage	8 (32.0)
6.1	Economic evaluation of vaccines (health technologies), strategies and policies	8 (32.0)
5.1	Evaluation of vaccination strategies across levels of the health system: implementation, effectiveness and local adaptation	8 (32.0)

Notes: Each panelist selected 8 of the 16 research lines that reached consensus in Round 2. Lines are ordered by descending selection frequency; the first eight constitute the prioritized national research agenda.

Source: Prepared by the authors

Additional files

Supplementary material 1: Instruments used in Rounds 1, 2 and 3 of the modified Delphi process

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