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Health workers vaccination: Experience and lessons learned from Costa Rica

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ABSTRACT

Objective: To describe the decision-making processes, enablers, challenges and lessons learned in Costa Rica for implementing a sustained and multi-pronged approach in health workers vaccination (HW).
Methods: A retrospective descriptive analysis was conducted by searching published and grey literature, including scientific publications, legislation, decrees, policies, manuals, technical reports, and platforms used for data register and coverage monitoring. Key informants from the Ministry of Health (MoH), the Costa Rican Social Security Fund (CCSS) were interviewed representing national, subnational and local levels; as well as members of the National Technical Advisory Group (NITAG) and the private sector. Collected data were transcribed and categorized by the following specific topics using a thematic content analysis approach: decision making process, pre-service screening, vaccination for current HWs and engagement with the private sector. Major findings were discussed and organized into enablers, challenges and lessons learned.
Results: Decision making processes to establish the vaccination strategies and schedules in Costa Rica were based on the epidemiological trends of vaccine-preventable diseases (VPDs) and cost analysis. Risk assessment and feasibility considerations determined that some vaccines such as hepatitis B, varicella and influenza, were first introduced in HWs and then were expanded to other target populations. These decisions were approved by the NITAG as the advisory technical advisory group of the MoH. Main enablers identified were: high level and sustained political will, decisions based on data analysis and feasibility considerations, HWs knowledge and high vaccine acceptance and demand. Challenges were related to effective coverage monitoring, and private sector engagement.
Conclusions: The Costa Rican experience provides lessons learned that can be leveraged by other countries to strengthen HWs vaccination strategies at regional and global levels.

Introduction

Health workers (HWs) are considered a priority target group for immunization programmes. Compared to the general population, HWs are at higher risk of exposure to infections due to vaccine preventable diseases (VPDs) because of their contact with patients, continuous exposure to potentially contaminated surfaces and materials, and environmental factors. HWs vaccination has the potential to reduce individual risk of contracting a VPD and can decrease the risk of workplace transmission of VPD. Protecting HWs will also protect their patients and families as well as vulnerable patients at higher risk of morbidities, complications and death if infected by a VPD (i.e., newborns, pregnant women, older adults, immunosuppressed persons, among others) [1].

The importance of HWs vaccination has been reinforced by global health strategies, including the WHO Global Health Sector Strategy on

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Viral hepatitis 2016–2021 [2], the Global Influenza Strategy 2019–2030 [3], the Measles & Rubella Strategic Framework 2021–2030 [4] and HWs have been globally targeted as one of the highest priority groups for COVID-19 vaccines. The COVID-19 pandemic reinforced the importance of vaccinating HWs as an essential strategy to reduce health services disruptions during seasonal epidemics or outbreaks [5]. WHO has issued specific recommendations for vaccines of particular importance to HWs and developed implementation guidance to summarize the current global recommendations for routine immunizations that all health workers should receive ideally prior to entering the workforce, as well as annual vaccinations and emergency and outbreak response vaccinations [6].

In addition, vaccinated HWs are also more likely to be knowledgeable about vaccination and be more effective in communicating messages to advocate for and improve vaccination acceptance [7]. They are considered one of the most trusted sources for vaccine uptake in specific groups such as pregnant women [8].

Despite these efforts, limited information is available about global, national and subnational policies and strategies implemented for HWs vaccination. In low and middle-income country settings in particular, there is currently a lack of understanding regarding platforms, schedules, coverage and resources assigned for HWs vaccination. This article provides a comprehensive review of the HWs vaccination experience in Costa Rica to understand the decision-making processes, enablers, challenges and lessons learned about the policies and practices to leverage learnings that could inform country, regional and global HW vaccination platforms.

Methods

A retrospective qualitative analysis was conducted by reviewing the published literature and interviewing key informants to describe the evolution of HWs vaccination policies and strategies from the seventies to 2022. This study period was defined considering that the National Health System was established in 1971 and the Law of Universalization of Social Security and the General Law of Health were approved in 1973 [9,10]. HW was defined in this paper as *"all people engaged in work actions whose primary intent is to improve health"*. It includes personnel who are in direct contact with patients but also workers supporting health care and persons employed in residential long-term care facilities and community-based care [11]. Published and grey literature was searched in English and Spanish. In addition to manuscripts published in peer review journals, the search included legislation, decrees, policies, immunization schedules, manuals and operational guidances, periodic technical reports, platforms used for data register and vaccine coverage reports. All documents provided by key informants and institutional websites were collected and reviewed.

The key informants were selected based on their roles from the Ministry of Health (MoH) and the Costa Rican Social Security Fund (CCSS) representing national, subnational and local levels and the private sector. It included Essential Programme on Immunization (EPI) managers of MoH and CCSS, epidemiology units, specialists in infectious diseases and immunology working in hospitals and members of the National Technical Advisory Group (NITAG). All informants provided verbal consent to participate. A total of 14 interviews were conducted virtually by one of the authors from November 2021 to January 2022 using a semi-structured interview guide to collect information about policies and decision making processes for vaccine introduction, milestones related to HW immunization strategies and schedules recommended to vaccinate students of health related careers and new workers, engagement of private providers, monitoring and evaluation of vaccine coverage and recommendations to improve HW vaccination in the country.

Data collected were transcribed while the informants were interviewed and organized by the main topics: decision making process, preservice screening, vaccination for current HWs and engagement with the private sector. Information was coded using a thematic content analysis approach in Microsoft Word. Major findings were discussed and organized into enablers, challenges and lessons learned. Due to the nature of this study, no approval was required by the Institutional Review Board of the NCH and an exception for a non-biomedical study was authorized by this board.

Results

Country context and immunization policies

Costa Rica is an upper middle-income country located in Central America with an estimated population of 5,163,038 inhabitants in 2021 (Fig. 1). The National Health System, established in the 1970 s, integrates the MoH and the CCSS to provide health care to all citizens. The Health Sector Reform implemented during the 1990 s redefined the role of the MoH and expanded primary health care through the Basic Comprehensive Health Care Teams (EBAISs), this is at the first level where vaccination is implemented and monitored. The MoH, no longer provides direct health services but rather is the institution in charge of defining health policies, strategic planning, sanitary regulation, epidemiologic surveillance, human environment protection, health promotion and research [12,13].

The national health service network is composed of 29 hospitals of varying levels of complexity and specialization, supported by primary care services including 105 health areas and 1,057 EBAIS. Social Security Health Coverage of the National Population was 91.1% in 2019 [14,15]. The private sector is relatively small in Costa Rica and is predominantly located in metropolitan areas. Private providers offer ambulatory and hospital care. Three out of every ten Costa Ricans use private health services at least once a year, according to the latest National Household Survey [16]. Private services are financed mostly out-of-pocket, but also through private insurance. All private hospitals, ambulatory clinics and long-stay homes must be authorized by MoH to provide specific health services.

In Costa Rica, the use of vaccines to prevent disease among children has been a cornerstone of social policies and health programs. The legal bases for vaccination in Costa Rica are given by the General Health Law N° 5395, enacted in 1973, which establishes in its article 150: *"Vaccination and revaccination against communicable diseases determined by the Ministry are mandatory. Exceptional cases, for medical reasons, will be authorized only by the corresponding health authority"*. In August 2001, the National Vaccination Law was approved and as a result, the National Advisory Technical Advisory Group (NITAG) to the MoH was created. Article 3 of this law establishes that: *"Vaccinations against diseases are mandatory when the National Vaccination and Epidemiology Commission deems it necessary. Vaccines must be provided and applied without economic reasons or lack of supply in health services offered by state institutions can be alleged"* [17]. Vaccines are provided by the public health services network at no additional cost to the population.

Epidemiology of VPD and decision-making processes

Costa Rica adopted a sustained strategy to control, eliminate and eradicate vaccine-preventable diseases since mid-fifties. Over time, vaccination strategies have broadened from the infant and child population to include other target groups. Based on risk assessment and feasibility considerations, some vaccines such as hepatitis B, varicella and influenza, were introduced in HWs before they were included in the national child immunization schedule. HWs vaccination policies and strategies are closely related to the evolution of the national immunization programme as shown in Table 1.

Diphtheria, pertussis and tetanus (DPT vaccine) was introduced in 1950 in the national child immunization schedule and reported cases declined progressively. Diphtheria was eliminated in 1976 and neonatal tetanus in 1988, but pertussis cases peaks occurred every 3–5 years. At

Territory	51,100 Km^2
Population 2021 *(inhabitants)*	5,163,038
Human Development Index	0.810
Life expectancy *(years)*	80 years
Infant Mortality Rate *(x 1000 births)*	7.8 x 1000
Maternal Mortality Ratio *(x 1000 births)*	0.34 x 1000
Health Care Coverage (%)	98%
Literacy Rate (%)	97%
GDP per capita (USD)	$12.140
Total expenditure on vaccines financed by Government (%)	100%
Health spending per capita (USD)	$922
Government health spending (%)	72.5%
Out of pocket spending (%)	22.3%

Sources: The World Bank Data https://data.worldbank.org/country/CR
Instituto Nacional de Estadísticas y Censos (INEC) de Costa Rica https://www.inec.cr
WHO, Global Expenditure Database https://apps.who.int/nha/database/country_profile/Index/en

Fig. 1. Map of Costa Rica and social and health indicators, 2020-21.

Table 1
Vaccination milestones in Costa Rica.

Vaccine	Year of introduction			Milestones
	Child	HWs	Other groups	
Diphtheriae, pertussis and tetanus (DPT)	1950	–	–	- Diphtheria was eliminated in 1976
BCG	1952	–	–	- Progressing towards 2035 Tuberculosis Elimination Goal
Polio	1959	–	–	- Last case of polio in 1973 - PAHO certified polio elimination in 1994
Measles	1967 *(Measles)* 1972 (*MR*) 1986 *(MMR)*	–	–	- PAHO certified measles elimination in 2011
Rubella	1972	–	–	- PAHO certified rubella and CRS elimination in 2011
Hepatitis B*	1997 *(Cohorts of newborns, 3 doses at birth, 2 and 6 months)*	1987	2001 *(Persons working in high-risk activities,* i.e., *municipalities*	- Hepatitis B virus elimination goal as a major public threat by 2030 is on progress - 100% AntiHBc screening in blood banks
Influenza	2004	2001 *(Some private and public health facilities)*	2004 *(Expanded to vaccinate high-risk groups: persons with chronic diseases and the elderly)*	- Flu surveillance network increased from 2 sentinel sites in 2004 to a national network all over the country - Laboratory capacity was improved for monitoring circulating flu virus to define the best time for vaccination and vaccine formulation
Varicella*	2007 *(1 dose in 1 year old children)*	1990 *(HWs of NCH)* 2017 *(HWs of all public health facilities)*		- After varicella vaccine introduction in 2007, a reduction of 73.8% of varicella cases and 85.9% of hospitalization was reported
Pertussis* *(Tetanus, diphtheria & acellular pertussis)*	2007 *(Cocoon strategy)* 2011 *(pregnant women)*	2011 *(HWs in maternity wards and newborn care)*		- Strengthening pertussis epidemiological and laboratory-based surveillance since 2001 - Introduction of cocoon and pregnant women vaccination reduced hospitalization and deaths due to pertussis in children
Pneumococcal*	2007 *(PCV7 introduction in children)* *2009 (PCV13 in child immunization schedule)*	2017 *(PCV13 in HWs)*	2011 *(PPSV23 in elderly and high-risk groups)*	- Strengthening laboratory-based surveillance of *Streptococcus Pneumoniae* - Impact evaluation of Pneumococcal conjugate vaccine introduction (2015)
COVID-19 *	2021 *(12 years and older)* 2022 *(5 to 11 years)*	2020	2020 *(elderly and high-risk groups)*	- Vaccination started in December 2020 using Pfizer-BioNTech vaccine

* In 2018, these vaccines were established as mandatory in the official HWs vaccination schedule of the CCSS [39]. COVID-19 primary series and first booster are also mandatory.

the end of 2000, the National Childreńs Hospital (NCH) warned of an increase in cases of whooping cough in newborns and infants. Data analysis showed that 90% of the hospitalized children were not old enough to complete a 3 doses schedule of DPT and 62% of the cases had a history of contact with a family member with persistent cough [18]. In 2007, Costa Rica introduced a cocoon strategy and maternal

immunization using pertussis acellular vaccine (Tdap) [19]. Since then, personnel working in maternity wards and newborn care must be vaccinated.

Poliomyelitis vaccine was introduced in 1952 and polio elimination was certified in 1994; the last case of wild-polio virus was reported in 1973. During 2006–2010, under the concept of Vaccines for Human Development, Costa Rica switch from oral to inactivated polio vaccine [20,21].

Measles vaccination began in 1967, rubella vaccine in 1972, measles and rubella (MR) vaccine in 1975 and measles, mumps and rubella (MMR) in 1986. In 1991, the MoH adopted the goal of eliminating endemic measles by maintaining high vaccine coverage through routine immunization, campaigns, and outreach activities. In 2000, a nationwide vaccination campaign targeting men and women aged 15–39, including personnel working at health facilities [22,23]. Measles and rubella elimination were certified in 2011 in Costa Rica. After the introduction of the MMR vaccine in 1998, rates of mumps declined, but reported cases show higher rates in adolescents and young adults and controlling some outbreaks of mumps in prisons have been challenging in Costa Rica [24]. To prevent cases of measles, rubella and mumps, all health personnel and students should demonstrate that they have been vaccinated against measles, mumps and rubella. If no evidence of vaccination is available, a 2 doses schedule must be administered.

Costa Rica is currently classified as a low endemic country for hepatitis B virus (HBV) considering that HBsAg prevalence is lower than 2% but, during the sixties, HBV was found endemic all over the country with some hyperendemic areas in the provinces of Alajuela and San José [25,26]. Reported outbreaks showed that person-to-person contact was the most likely mode of spread but HWs were also at risk of acquiring hepatitis B from infected patients as a result of sharp injuries or contact with HBV-contaminated surfaces [27]. HWs vaccination began in 1987 with the administration of three doses of hepatitis B vaccine and in newborn cohorts since 2011. In 2016, the estimated % HBsAg seroprevalence in Costa Rica was 0.2 (CI = 0.2–0.6) [28]. Costa Rica endorsed the resolution to eliminate viral hepatitis as a public health threat by 2030 and is progressing towards the elimination goal.

Influenza vaccination in HWs started in the NCH and Geriatric Hospital in the late nineties. It was progressively expanded to persons working in hospitals who were in direct contact with patients, but nowadays all staff working at public and private health services, including long-care term facilities are included as the target population. In 2004, following an analysis of the epidemiology of influenza, Costa Rica officially introduced a plan of action aimed at strengthening surveillance for influenza virus to characterize seasonal trends, and to provide the virological data needed to select the most effective vaccine composition [29]. The savings in costs and services that the Costa Rica would accrue following annual seasonal flu vaccination showed that the economic benefits increased when vaccinating high risk groups, including persons with chronic diseases, the elderly and HWs since direct protection would also reduce absenteeism in health facilities. Vaccination with quadrivalent inactivated vaccine is implemented annually over 6 weeks at the beginning of the flu season in each health facility. Vaccines are administered in fixed posts and by mobile teams during national vaccination campaigns. The goal is to vaccinate 100% of HWs working in public sector. The coverage increased from 68.7% in 2018 to 95.2% in 2020. In 2021, CCSS reported that the target population was 53,344 HWs and 87.5% of them were vaccinated [30]. To reach personnel working during all shifts, the vaccinators schedules are modified to provide vaccines not only during daytime but also at night. Private sector and organizations such as the College of Physicians and Surgeons of Costa Rica were actively involved and supported flu vaccination to HWs and their families.

In 1999, to prevent nosocomial varicella transmission to susceptible personnel, hospitalized patients and their families, the NCH started vaccination of HWs who didńt have history of varicella or previous vaccination [31,32]. In addition, a cost analysis of nosocomial interventions using varicella-zoster immune globulin and vaccine to prevent secondary cases when a varicella case is detected in the NCH was also developed in 2002. In 2007, varicella vaccine was introduced in the national child immunization and after 8-years post implementation of universal varicella vaccination, the incidence, hospitalizations and complicated cases of varicella declined in all age groups [33]. In 2017, considering the risks of hospital transmission of varicella zoster virus (VZV) and the costs associated to disruption of services and control measures when the virus is inadvertently introduced by staff, patients and visitors [35], vaccination of HWs against varicella was expanded to all public hospitals in the country.

Before pneumococcal conjugate vaccine (PCV7) was introduced in 2007, followed by PCV13 in 2009, non-invasive [34] and invasive diseases caused by *Streptococcus pneumoniae* was a major concern in Costa Rica [35,36]. After vaccine introduction, the burden of pneumococcal disease declined in children and indirectly, had a protective effect on the adult population by reducing the primary role of children as carriers, transmitting the pneumococcal strains to vulnerable population [37]. Currently, PCV13 is administered to children and pneumococcal polysaccharide vaccine 23 (PPSV23) in persons aged 65 year and above.

SARS CoV-2 infection (COVID-19) vaccination started in December 2020 in HWs and elderly population in Costa Rica. A first booster (third dose) is currently mandatory after COVID-19 primary series vaccines. The second booster (fourth dose) is voluntarily administered, regardless of the age and risk factors, at least 4 months after receiving the third dose.

Pre-service screening of HWs and students of health-related careers

HWs must provide evidence of primary vaccination against polio, measles, rubella and mumps, tetanus and diphtheria toxoid. If their electronic registries entries or vaccination card are not available, they must complete the vaccination schedule as described in Table 2 [38]. For hepatitis B vaccine, if unvaccinated, HWs and students must receive a 3-doses schedule and then, their anti-HBsAg level must be determined using a quantitative test [39]. A booster dose is recommended when AntiHBs titers fall below 10 IU/L [40]. Acellular pertussis (within Tdap), varicella and pneumococcal conjugate (PCV13) vaccines are administered to personnel and students working in direct and close contact with patients. The rationale and expected result achieved with PCV13 vaccination is to decrease pneumococcal carriage rates among HWs and the risk of transmitting to vulnerable patients.

Prior to their clinical training, all students within the faculty of health sciences (Nursing, Pharmacy, Medicine, Microbiology, Nutrition, Dentistry, Veterinary Medicine, and related technicians) in Costa Rica must provide proof of vaccination with the following vaccines: varicella, hepatitis B, seasonal influenza, Tdap and PCV13. Pre-service screening also applies to new personnel at all levels of health system. This decision was approved by the NITAG and endorsed by the MoH and CCSS in 2017 [41,42]. Before starting their in-hospital training, the academic coordinator at each health facility must check that each student has all required vaccines.

In the case of new HWs, the Occupational Health Area is required to review the vaccine registry to ensure new HWs are up to date. The nursing staff is responsible for administering and registering the vaccines in the Integrated Information System of Vaccines (SIVA) if not up to date. If evidence of vaccination is not available, students and newly hired HWs must use a catch-up immunization schedule. If they refuse vaccination, they are included on a list to be reviewed by the director of each health facility, who can then determine if an exemption is warranted.

Private sector engagement

The national recommendations for HWs vaccination include those working in private health facilities. However, unlike in public facilities,

Table 2
Immunization schedule for health workers and students of health-related careers.

Antigen	Target population	Recommendation
Polio	All HWs and students should have completed the primary vaccination against polio	- Review vaccination card if available.
Measles, rubella, mumps	All HWs and students should have 2 doses of MMR vaccine	- Review vaccination card or electronic registry - If no evidence of vaccination, a 2-dose schedule must be administered
Hepatitis B	All HWs and students should have 3 doses	- HW should have 3 doses: 0, 1 and 6 months. - If HW has 1 or 2 doses, a 3-dose scheme should be completed
Tetanus, diphtheria	All HWs and students	- One dose and a booster every 10 years
Influenza	All HWs and students	- One dose annually
Varicella	Staff working in direct patient care Students The vaccine is contraindicated in pregnant women and immunosuppressed personnel	- If unvaccinated or if HW doesńt have an electronic registry or vaccination card: 2 doses should be administered (4 weeks interval) - If HW has evidence of previous varicella disease or has 1 dose of varicella vaccine: 1 dose should be administered
Pertussis*	Staff working in maternity wards and neonatal care* Students	- One dose of Tdap - A booster should be administered every 10 years
Pneumococcal 13**	Staff working in direct patient care. Students	- One dose of PCV13 to reduce nasopharyngeal colonization and bacterial carriage.
COVID-19	All HWs and students	- Three dose schedule (primary series and first booster). A second booster (fourth dose) is recommended

* Each health facility assesses the risk of infection based on type of work to decide if additional vaccines should be administered. As an example, HWs who work in contact with patients with respiratory infections should be protected against pertussis by administering Tdap.
** Workers who demonstrate that they have applied the pneumococcal polysaccharide vaccine 23 (PPSV-23) must wait at least 1 year for the application between one pneumococcal vaccine and another.

HWs vaccination for private sector is not mandatory. Nevertheless, the major private hospitals have established procedures to ensure that their personnel are vaccinated according to the national recommendations. The director of the hospital approves the standard operating procedures, the chief of nosocomial infections is the coordinator, supported by infection prevention control (IPC) practitioners. In addition to nationally recommended antigens, some of these private hospitals also include hepatitis A vaccine in their HWs schedule. These vaccines are administered free of charge to the staff working in private hospitals.

To provide high-quality patient care and safety, some private specialized hospitals have adopted Joint Commission International Accreditation standards that include HWs vaccination recommendations. Ambulatory private clinics are not accredited but they require an operating permit granted by the MoH. The current national regulations doṅt include HWs vaccination as a requirement for providing health services. In this case, if HWs are vaccinated it is because they already completed their primary vaccination schedule or because some of them also work within the public sector. On the contrary, regulations for personnel in long-stay homes for the elderly only explicitly include the requirement for vaccination against hepatitis B and tetanus [43].

Vaccine coverage monitoring

The Integrated Health Registry System (EDUS) is the electronic platform developed by the CCSS to standardize health care registries in Costa Rica. It is a centralized programme and includes a vaccination data module, the SIVA. All vaccines administered by CCSS are registered in the SIVA, including HWs vaccination data. Vaccines administered at private sector are reported to MoH.

As the MoH does not provide direct vaccination services, they implemented a nominal information electronic system (SINOVAC) to capture the vaccines administered at public (CCSS) and private health facilities. All private hospitals, clinics, and pharmacies send their vaccination data to the local office of MoH on monthly basis. Once these data are captured, each area checks for missing entries and errors before sending the data to the national level. The CCSS sends the datasets directly to the national level of MoH to merge all data and calculate the official vaccine coverage. An important challenge is that SINOVAC is facing major constraints to ensure timely reporting and data quality and must be upgraded according to the current vaccination schedules and new technology.

As nominal electronic immunization registries were developed and evolved over the time, records of HWs vaccinations administered before the launch of SIVA are not necessarily included in the system. Currently, to estimate the target population of HWs, each health facility prepares a line list for each of the required vaccines and the total number of HWs to be vaccinated during the next year. The facilities monitor uptake based on the number of vaccines administered. The total number of HWs vaccinated for each one of the vaccines are reported monthly and in the case of influenza, the vaccine coverage is reported using two indicators: influenza coverage of personnel working at CCSS and national coverage, which includes the HWs vaccinated in private health facilities.

Lessons learned, enablers and challenges

As HWs vaccination strategies in Costa Rica evolved along with the introduction of new vaccines in the national immunization schedules, key lessons were learned that could be useful to other countries to accelerate their immunization programmes (Table 3). A summary of enablers and challenges of HWs vaccination are also described in Table 4.

Discussion

This study represents the first documented review of immunization of HWs from the beginning of the programme to the present. The HWs vaccination platform has expanded over time in Costa Rica. Through targeted measures that took into account country specific needs, different antigens and sectors are now included in the programme. Strong demand by HWs and political willingness to invest in HWs has led to a robust programme with many strengths.

Vaccination in Costa Rica has made great progress over the years to update immunization schedules administered for current HWs, ensuring pre-service screening and vaccination as a prerequisite for practicum training, and hiring process for new employees. These efforts reached and included all public health services, private sector health providers and long-term care facilities. The current schedules are aligned with the WHO global strategies targeting HWs as one of the key priority groups for life-course vaccination [44].

The case of Costa Rica reinforces that vaccinations for health workers should be based on local epidemiological situation and exposure risk, public health priorities and goals, feasibility, resources, logistics and infrastructure available to achieve sustainable and effective vaccination coverages. As an example, the decision-making process to introduce pertussis vaccination of personnel working in neonatal care units,

Table 3
Lessons learned to strengthen HW vaccination.

Vaccine introduction
o Some vaccines (i.e., varicella, hepatitis B, influenza) can be introduced in HWs before other target populations. This decision makes it feasible to start and progressively increase the access to vaccination because the costs are lower when compared to vaccinating general population.
o Iťs crucial to find opportunities for updating of HWs vaccination schedules when a new vaccine is introduced in the child official schedule of the country.
o Having policies, guidelines and experience on implementing HW vaccination was useful for implementing an effective COVID-19 pandemic preparedness and response.
Data analysis for decision-making
o High risk and specialized health facilities -such as the NCH in Costa Rica- can have a key role in alerting policy decision makers about changes in epidemiologic patterns of VPDs, developing cost-effectiveness analysis for introducing new vaccines in HWs, analyzing and providing information to health authorities for making decisions.
o Experts, research and academic institutions must be involved to support data analysis and advocate for decision-making.
Confidence and acceptability
o Mandatory and free of charge access improve HWs vaccination coverage, but iťs important to provide clear and reliable information to promote vaccine acceptance and demand.
o HWs must be confident of the benefits and risks of vaccination.
o HWs vaccination schedules should be flexible, facilitate access and must consider the local context and differences in occupational risks of exposure to VPDs to facilitate HWs vaccination even if they are not clearly included in the recommendations.
Monitoring and evaluation
o The rationale for HWs vaccination might be different to the rationale of vaccinating children. Therefore, messages should emphasize all benefits of vaccination and should be tailored depending on the protective mechanism of the vaccines.
o Monitoring HWs vaccination can be challenging, but there are feasible options. Iťs important to engage and empower each health facility in the process of identifying, preparing the list of workers that must be vaccinated, implementing vaccination and monitoring coverage.
o Political, government, and HẂs commitments are key contributors to success in order to achieve high coverage of HWs vaccination

emergency and intensive care units and services attending children with respiratory infections in Costa Rica was based on the epidemiologic situation of the country, safety, and cost-effectiveness considerations, ensuring sustainability of the immunization strategy [45–47].

HWs immunization schedules must consider the exposure risk of health workers, epidemiologists or vector control personnel exposed to infections when investigating and controlling outbreaks. They should be vaccinated not only to reduce their risk of infection, but also because they must be role models supporting vaccination. It is well documented that vaccinated HWs are more likely to be knowledgeable about vaccination and can influence vaccination demand and vaccine acceptance [48,49].

The Costa Rican experience shows that the implementation of sustainable HWs vaccination strategies must be based not only on technical and scientific information but also on political commitment. Effective training and communication have also been critical to increase vaccine confidence, acceptance, and uptake. These lessons learned can be tailored to different contexts for strengthening vaccination of health care workers in other countries.

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Disclaimer

The authors alone are responsible for the views expressed in this study, and they do not necessarily represent the views, decisions, or policies of the institutions with which they are affiliated.

Table 4
Enablers and challenges of HWs vaccination.

Key aspect	Enablers	Challenges
Policies and strategies	- High level and sustained political commitment - Immunization policies based on evidence and endorsed by legislation and decrees - HWs vaccination schedules approved by CCSS Directive Council and endorsed by NITAG - Mandatory vaccination for health personnel working at public health facilities if NITAG recommends it. - HWs vaccination is available free of charge in public and private institutions. - HWs are knowledgeable and engaged to support vaccine acceptance and demand - Private hospitals participating on accreditation processes including vaccination requirements	- HWs vaccination in private facilities should be mandatory in staff working in direct contact with patients - Operating permit for private health facilities granted by MoH should include HWs vaccination as a requirement - Specific recommendations for vaccinating staff working at the MoH in public health and epidemiological activities are missing and must be established - There are a few physicians known as anti-vaxxers. They have been accused and some were punished by the Costa Rican Medical College, but more actions are needed to undermine their credibility in specific groups
Decision making	- Introduction of new vaccines has been based on country specific data analysis as well as feasibility considerations - NITAG role has evolved and broadened, involving clinical specialists, epidemiologists and researchers in data analysis, monitoring and impact evaluation. - Demand for new vaccines sometimes have come from HWs - Prioritization of HWs is transparently determined and is based on exposure risk and financial feasibility - HWs vaccination scaled up over the time to cover 100% of public health facilities	- Online platforms to access epidemiologic and vaccination data should be improved to support data analysis and decision making.
Implementation	- Guides and manuals have been developed to support training and implementation of HWs vaccination programmes - Sustained funding for the immunization programme is provided through the national government - Operational and logistics capacity is available at all levels	- National immunization guidelines must be updated to develop a specific section about HWs vaccination
Monitoring and evaluation	- Electronic immunization registries (EIRs) evolved over time and COVID-19 pandemic was an opportunity to improve nominal records and health information systems - A mobile application of the EIR is available to be used by general population	- EIRs should be upgraded to provide timely and high-quality data of HWs vaccine coverage - Standardization and interoperability of immunization and health information systems must be encouraged and sustained.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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