



A review of health worker vaccination programs in low, middle and upper middle-income countries[☆]

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ABSTRACT

Objectives: Health workers (HW) are at risk of contracting vaccine preventable diseases when caring for patients and communities. This study aims to evaluate the existing literature on the routine vaccination of health workers against a variety of antigens in low and middle income countries, focusing on facilitators, barriers, and considerations in the implementation of immunization programs and campaigns.

Study design: A PubMed Literature search.

Methods: A PubMed search was conducted to find articles that addressed vaccination programs and policies for HW in low-income countries (LIC), lower middle-income countries (LMIC), and upper middle-income countries (UMIC). Original articles, meta-analyses, and reviews published in English between January 2000 and July 2022 were included in the search. Inductive content analysis was used to identify themes that illustrate facilitators, barriers, and considerations in the implementation of immunization programs and campaigns.

Results: The search identified 4240 studies, 90 were used for analysis as they provided antigen specific details on immunization policies or programs. Hepatitis B was the most frequently discussed antigen, followed by Influenza, then Measles, Rubella and Mumps. With considerable variability by vaccine and country, in most cases the vaccination was not offered free to HW or included in a regular vaccination schedule. Utilizing existing immunization infrastructure such as the Expanded Programme on Immunization (EPI) and having effective management of vaccination programs were found to be key facilitators to vaccinate HW.

Conclusions: The low vaccination coverage of health workers in LMIC is of concern; attention towards the key considerations, barriers and facilitators of immunization implementation is central to the advancement of health worker vaccination coverage in LMIC's. The COVID-19 pandemic necessitated the swift vaccination of HW. Many LIC countries lacking established HW immunization infrastructure are now administering COVID-19 vaccines. As we move beyond the pandemic's acute phase, there is a chance for those countries to enhance their immunization initiatives and policies for HW concerning other antigens, even if it is not a standard practice currently.

[☆] 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.

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1. Introduction

Protecting people across the life course with appropriate vaccines is a priority to prevent unnecessary morbidity and mortality. This is even truer for the health workforce, who very often are at the front line in caring for patients and communities. Health workers (HW)¹ are at risk of contracting infectious diseases while performing their duties. Immunization against commonly encountered pathogens is an effective preventive strategy to protect them. Depending on country specific circumstances, the World Health Organization (WHO) recommends HW be vaccinated against Tuberculosis (BCG), Hepatitis B, Polio, Diphtheria, Measles, Rubella, Meningococcal, Influenza, Varicella, Pertussis and COVID-19 [1,2]. However, vaccination coverage amongst HW in low income, lower-middle-income, and upper-middle-income countries (LIC, LMIC and UMIC respectively) is notably low when compared to higher income countries [3]. For Hepatitis B for example, the WHO's most recent data estimated in 2005 that vaccination coverage amongst HW in LMIC was 18–39% compared to 67–79% in high-income countries [4].

While there may be several reasons for the lower rates of coverage, one could be the lack of programs and policies to vaccinate HW in LIC and LMIC. Many high-income countries have policies in place to vaccinate HW, especially against Influenza [5]. Previous literature reviews have examined policies for Influenza vaccination in LMIC, but no reviews are available for other antigens [6]. HW are an ideal group to target for vaccination programs and policies when compared to other groups across the life course. They are typically situated at healthcare facilities, and therefore easier to find and offer immunizations to. Vaccination of this group has the potential for a larger impact than in other groups, as it would protect the health workforce as well as patients, communities, and others HW they interact with. Additionally, HW who are vaccinated, are more likely to recommend vaccines to others [6,7]. The ongoing COVID-19 pandemic has reaffirmed the importance of HW immunization policies and programs, especially in LIC and LMIC where the burden of vaccine preventable disease is highest, and the risk of vaccine preventable disease resurgence is greater [8,9].

The purpose of this paper is to review the current published data referencing national vaccination policies and programs for low, lower-middle, and upper-middle income countries to understand the programs that are already in place, to review the enablers and barriers to HW vaccination programs and to inform policy makers as they plan for a post COVID-19 health system.

2. Methods

The study was designed as a literature search in PubMed examining articles dealing with vaccination programs and policies for HW in LIC, LMIC, UMIC using the following keywords: vaccination (“vaccination”, “vaccine”, “immunization”/“immunisation”, “immunization programs”/“immunisation programs”), health workers (“health personnel”,

¹ Health workers are all people engaged in work actions whose primary intent is to improve health. This includes health service providers, such as doctors, nurses, midwives, public health professionals, lab-, health- and medical and non-medical technicians, personal care workers, community health workers, healers, and some practitioners of traditional medicine. It also includes health management and support workers, such as cleaners, drivers, hospital administrators, district health managers and social workers, and other occupational groups in health-related activities. Health workers include not only those who work in acute care facilities but also those employed in long-term care, public health, community-based care, social care and home care and other occupations in the health and social work sectors as defined by the International Standard Industrial Classification of All Economic Activities (ISIC), revision 4, section Q: Human health and social work activities. https://unstats.un.org/unsd/publicati/on/seriesm/seriesm_4rev4e.pdf.

“health care workers”, “health providers”, “healthcare providers”, “health workers”, “physicians”, “doctors”, “nurses”). Original articles, meta-analyses and reviews published in English between January 2000 and July 2022 were included in the search. After title and abstract screening, full-text manuscripts of candidate papers were sought and reviewed by two independent researchers. Papers were excluded if they were unrelated to the topic of vaccination of health workers, or made no mention of policies or programs. For each included paper, relevant details about vaccination policies and programs for HW were extracted: namely whether a particular vaccine was recommended or required and provided free of charge or reimbursed. Lastly, the most recent mention of a policy or program for a specific antigen in a specific country was selected for comparison across countries (e.g., if multiple papers mentioned Hepatitis B for Pakistan, the latest paper with complete information was selected).

Subsequently articles selected were analyzed to identify facilitators, barriers, and considerations in the implementation of immunization programs and campaigns. Inductive content analysis was conducted. Inductive content analysis is a qualitative research method used to analyze textual data without pre-established categories or theoretical frameworks. Researchers identify themes and patterns from the data itself, allowing new insights to emerge from the bottom-up analysis. First, articles were reviewed and coded according to the main subject categories. Subsequently, similar categories were grouped into themes (Facilitator: Economic support; Effective management of vaccination programs. Barrier: Lack of awareness & inefficient communication; Lack of funds; Difficult access & lack of vaccines; Lack of data. Consideration: Increasing cost-effectiveness). The different themes are described in the Results section, reported as examples to the most relevant topics (shown in the Table 3).

3. Results

A total of 4240 studies were identified by the search, of which 187 met inclusion criteria using title and abstract screening. A total of 97 studies were excluded for the following reasons: they did not mention policies or programs related to HW vaccination (81), were not in English (7), were outdated (7), or full text was not available (2) (see Fig. 1). 90 studies in total were included for analysis as they provided details on immunization policies or programs for specific antigens. Most papers discussed attitudes towards vaccination by HW, and incidentally mentioned vaccine policies, programs, and access. Hepatitis B was the most frequently discussed antigen (56), followed by Influenza (30) and Measles (5), Rubella (4), and Mumps (3) (Table 1). The papers identified cited 12 country examples: Turkey (7), China (7), Nigeria (6), India (6), Brazil (5), Iran (4), Ethiopia (4), Cameroon (4), Pakistan (3), Mexico (3), Kenya (3), Uganda (3) most frequently (see Supplementary material). Most articles cited LIC and LMIC (26 countries in total) and mainly referred to the AFR region, followed by the Eastern Mediterranean and Western Pacific regions (Fig. 2 and Table 2).

3.1. Hepatitis B

Of the 31 countries for which papers cited the Hepatitis B vaccine for HW, 29% (9/31) provided free vaccine or reimbursed HW for the cost of the vaccine at least some of the time. This included Pakistan which was reported to provide Hepatitis B for free in public facilities only, and Egypt which makes Hepatitis B vaccine available to HW working in high-risk settings (dialysis, surgery, ICU). A total of 61% countries (19/31) were reported to have policies or programs recommending the Hepatitis B vaccine, including Georgia and Eswatini which had a one-time vaccine campaign. Only two countries, Mexico, and Uganda, despite required HW to be vaccinated against Hepatitis B. In Uganda, despite mandatory vaccination, HW completion rates vary between 57% and 81% across the country, with no repercussions for HW who do not receive the mandatory vaccination. A recent national Hepatitis B

vaccination campaign in Liberia has targeted more than 16,000 HW because of a baseline study that revealed a high testing prevalence of 6.12% amongst HW when conducting HBsAg antigen testing, specifically medical students and non-clinical staff which comprised 66.7% of the positive cases.

3.2. Influenza

Of the 14 countries for which papers discussed Influenza vaccines, 71% (10/14) provided free vaccine or reimbursed HW for the cost of the vaccine at least some of the time. This included Albania, which offered government subsidies for HW and other at-risk groups, and Vietnam, which in 2017 launched a seasonal immunization campaign. Seventy nine percent of countries (11/14) were reported to have policies or programs recommending annual Influenza vaccination, but only one country, China, required medical institutions to ensure HW in high-risk departments were vaccinated. Recent data from a study on WHO Member States showed that the number of new countries adopting influenza vaccination policies has had limited growth between 2014 and 2018. However, 5 countries expanded their influenza program to include health workers as a high-risk target group between this time.

3.3. Measles, mumps, rubella

Of the five countries for which papers referenced Measles, Mumps, or Rubella vaccination, 67% (4/6) recommended or required HW to be vaccinated. Only one country, Brazil, provides free vaccine for HW.

Table 1

Most frequently cited antigens (majority of the literature is focused on Hepatitis B and Influenza).

Immunization	Papers Citing	N Countries cited
Hepatitis B	56	31 (Brazil, Cameroon, China, Costa Rica, Egypt, Eswatini, Ethiopia, Georgia, Ghana, India, Iran, Kenya, Lao, Liberia, Libya, Malawi, Malaysia, Mauritius, Mexico, Morocco, Nepal, Nigeria, Pakistan, Peru, Rwanda, South Africa, South Sudan, Sri Lanka, Syria, Uganda, Zambia)
Influenza	30	14 (Albania, Algeria, China, India, Iran, Lao, Lebanon, Libya, Mexico, Morocco, Pakistan, Thailand, Tunisia, Turkey, Vietnam)
Measles	5	6 (Brazil, India, Lao, Mexico, Turkey, Uganda)
Rubella	4	5 (Brazil, Lao, Mexico, Turkey, Uganda)
Mumps	3	4 (Brazil, Lao, Mexico, Turkey)
BCG	3	4 (India, Lao, Mexico, South Africa)
Tdap	2	3 (Brazil, Lao, Mexico)
Varicella	1	2 (Lao, Turkey)
Tetanus	1	2 (Brazil, Lao)
Pertussis	1	2 (Brazil, Lao)
Multiple	1	1 (Turkey)
MCV	1	2 (China, Lao)
Hepatitis A	1	2 (India, Lao)
Diphtheria	1	2 (Brazil, Lao)
All vaccines	1	1 (Lao)

3.4. Considerations in implementing vaccine programs & campaigns

The studies were then analyzed to identify facilitators, barriers, and considerations in the implementation of immunization programs and

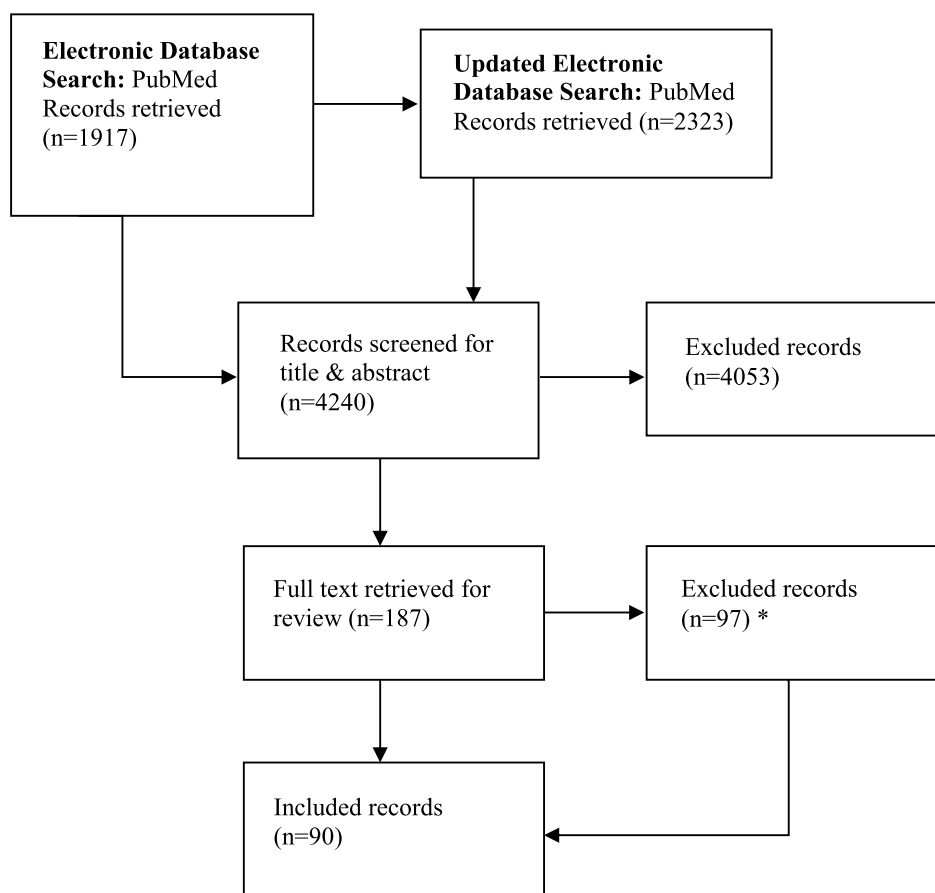


Fig. 1. Article selection process (PRISMA diagram).

*Reasons for exclusion: Did not mention policies or programs related to HW vaccination = 81, Were not available in English = 7, Were outdated (published before 2000) = 7, Full text was not available = 2.

campaigns (Table 3). Facilitators included economic support to vaccination such as free access to vaccines, vaccines and supplies donated by manufacturers or funded by public-private partnerships, as well as effective management of the vaccination programs such as using existing Expanded Programme on Immunization (EPI) infrastructure, and a robust institutional framework to offer vaccines to HW. Barriers included lack of awareness and inefficient communication such as lack of education on vaccines or awareness of availability, lack of funds, difficult access to (i.e., lack of time and/or opportunity to receive vaccine) and lack of vaccines itself, as well as a lack of baseline data on antigen prevalence rates among HW. Some policies included considering testing for Hepatitis B (serology) prior to initiating a vaccine program and targeting HW that may not have received vaccines through EPI.

4. Discussion

To our knowledge, this is the first review of published literature examining vaccination policies and programs for HW in LIC, LMIC and UMIC broadly. Vaccination of HW is an important step to protect HW, patients and communities in several ways. First, vaccines protect HW themselves and ensure a healthy and available workforce. Second, vaccinated HW are more likely to recommend vaccines to their patients [30]. Vaccinated health workers are also more likely to have accurate information on vaccines and serve as a trusted source within their community for vaccine related information. Lastly, infections can be transmitted from HW to their patients and communities, and vaccinating HW can prevent the spread of infections. The WHO recommends specific vaccines for HW (Tuberculosis (BCG), Hepatitis B, Polio, Diphtheria, Measles, Rubella, Meningococcal, Influenza, Varicella, Pertussis, and COVID-19), though recommendations vary based on circumstances within a country [1,2]. Of these vaccines, many are offered as a part of routine programs, while influenza is the only vaccine that is to be offered yearly. All antigens except Polio were represented at least once in the data we reviewed. The three most common antigens cited in our review were Hepatitis B, Influenza, and Measles. The high number of papers referencing Hepatitis B and Influenza likely reflects the increased risk of transmission of these pathogens in a healthcare setting. However, it was interesting that so few papers referenced Measles despite its high transmissibility in healthcare settings [31,32]. The Western Pacific region (WPR) bears the greatest incidence of Hepatitis B worldwide, with most countries in the region possessing a prevalence greater than 8% of their population [33]. Few papers (only from Malaysia and China) from

Table 2

Articles repartition according to income classification.

Income Level	Countries cited	Total # countries (according to World Bank classification)	% Represented
Upper middle income	13	54	24%
Lower middle income	18	54	33%
Low income	8	28	29%

this search focused on Hepatitis B in the region, despite its burden. These studies discussed the status of vaccination coverage among HW and called for a prioritization of the HBV for HW. Protecting HW against a bloodborne pathogen such as Hepatitis B could be an entry point for introducing other vaccines for HW in this region and beyond. Since measles has been a longstanding part of immunization programs of many countries, it may have been assumed that HW would have received this vaccine in childhood or would have had measles in childhood. \$

It should be noted that among the countries cited, several countries were over-represented in the literature. 12 countries (Turkey, China, Nigeria, India, Brazil, Iran, Ethiopia, Cameroon, Pakistan, Mexico, Kenya, Uganda) represented 63% of the papers we identified. A higher proportion of cited countries (57%) were from the African and Eastern Mediterranean WHO regions, though they represent only 45% of total LMIC. Further research in other regions that document their programs and lessons learned would be of interest to understand similarities and differences and provide additional examples for countries looking to introduce, strengthen, or expand existing programs.

A recent survey of Expanded Programmes on Immunization (EPI) managers on Influenza vaccination policies for HW in 68 LMIC found that 52% reported having a policy. Of those, 66% had voluntary vaccination, 11% had mandatory vaccination, and 23% had mixed policies [34]. The 2014 WHO/UNICEF Joint National Reporting Form sent to member states found that approximately 19% of LMIC surveyed had immunization policies targeting HW [35]. Our search found only 11 country experiences documented in the literature. Countries with known policies should document and share their learnings – including enablers and barriers to successful vaccination campaigns – so that other countries may benefit from these examples. Logistically, it may be easier to ensure that HW are up to date with vaccines that are a part of routine programs. When vaccines are not part of routine programs, specific

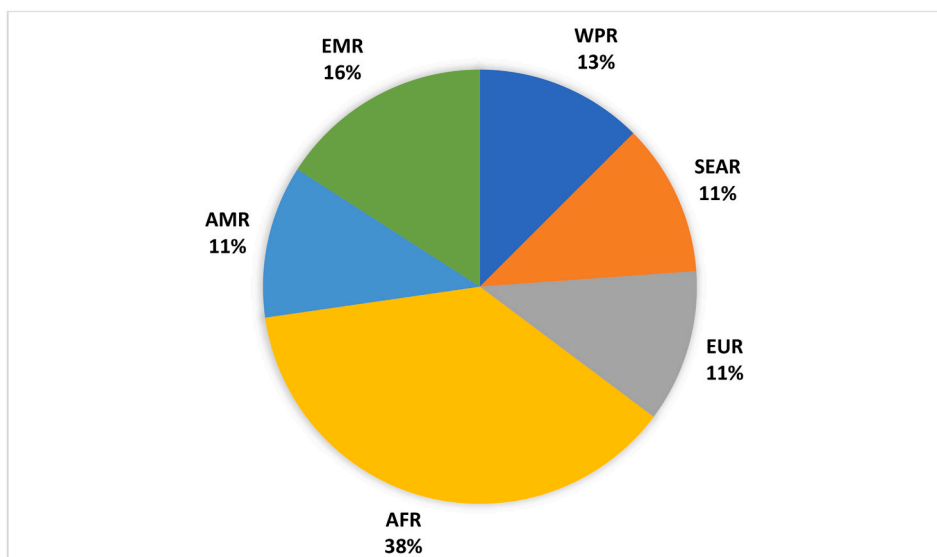


Fig. 2. Articles origin according to WHO regions (AFR: African region, AMR: region of the Americas, EMR: Eastern Mediterranean region, EUR: European region, SEAR: South-East Asian region, WPR: Western Pacific region).

Table 3
Facilitators, barriers, and considerations in implementing vaccine programs & campaigns.

Type	Themes	Description
Facilitator	●Economic support	<ul style="list-style-type: none"> ●Free vaccines [10,11] ●Vaccines & syringes donated by manufacturers [12] ●Funded, by non-profit public-private partnership [13,14]
	●Effective management of vaccination programs	<ul style="list-style-type: none"> ●Signups for vaccine to estimate demand [14] ●Reallocated unused vaccines to nearby sites [14] ●Close timing of sign up to vaccination session date [14] ●Support & encouragement from institution leaders [14] ●Use of existing EPI^a infrastructure [14,15]
Barrier	●Lack of awareness & inefficient communication	<ul style="list-style-type: none"> ●Lack of awareness of availability [16] ●Lack of education [16–18] ●Larger facilities had lower signups due to less face-to-face promotion [14]
	●Lack of funds	<ul style="list-style-type: none"> ●Lack of long-term funding [19] ●High costs [20–23]
	●Difficult access & lack of vaccines	<ul style="list-style-type: none"> ●Lack of time and/or opportunity [16,18]
	●Lack of data	<ul style="list-style-type: none"> ●Unavailability of vaccine doses [17, 19,24] ●Lack of accurate baseline data on antigen prevalence rates [25]
Consideration	●Increasing cost-effectiveness	<ul style="list-style-type: none"> ●Consider cost-effectiveness of screening for HBV antibodies prior to vaccinating those susceptible vs. universal vaccination [26,27] ●EPI (introduced 2005) does not cover older HW (program gap) [28, 29]

^a EPI: The WHO Expanded Programme on Immunization.

vaccines can be provided as a part of employment onboarding. Annual vaccines or vaccines that must be updated periodically require ongoing resources to deliver. Influenza vaccines are most often delivered in campaigns prior to the start of an influenza season. Creating or leveraging occupational health and safety programs may facilitate delivery of vaccines and can be integrated into services offered to HW. Additionally, providing funding for vaccine procurement and program development were found to enable HW vaccination programs.

The COVID-19 pandemic has required the rapid vaccination of HW. COVID-19 vaccines are being administered in many low-income countries that do not have existing routine HW immunization infrastructure. As we emerge from the acute phase of the pandemic, there is an opportunity for countries to strengthen their immunization programs and policies for HW for other antigens, especially in low- and middle-income settings where HW vaccination is not a standard of care but should be. The addition and strengthening of occupational health and safety programs with vaccination programs would be an outstanding contribution to rebuilding and preparing the HW for the possibility of future pandemics [36].

5. Limitations

There are some limitations to our findings. We relied on published studies in peer review journals without considering national guidelines. Given the extended time frame of our searches (2000–2022), some information may be outdated. The COVID-19 pandemic has also called attention to vaccine policies among HW given the effectiveness of currently available SARS-CoV-2 vaccines and the ongoing exposure experienced by HW. It is possible that there have been significant

changes in vaccine recommendations, availability, and provision not yet reflected in the published literature. Lastly, the studies we identified were from 36 countries, representing only 26% of LIC, LMIC, and UMIC worldwide, and a higher proportion were from the African and Eastern Mediterranean WHO regions, though they represent only half of LMIC.

6. Conclusion

Our study brought attention to the fact that the current literature concerning routine vaccination of health workers in low and middle-income countries predominantly emphasizes the Hepatitis B antigen, with Influenza, Measles, Rubella, and Mumps being the subsequent focus. In many instances, the vaccination was not provided for free to healthcare workers (HW) nor included in routine vaccination schedules, showing significant variability by vaccine and country. The study highlighted that utilizing existing immunization infrastructure like the Expanded Programme on Immunization (EPI) and effectively managing vaccination programs were crucial factors in successfully vaccinating HW. A review of published national guidelines and seroprevalence studies of vaccine preventable diseases among health workers are future analyses that could complement the information gathered in our literature review to inform policy makers and implement effective and sustainable immunization programs for HW in each country. Better optimization of available programs and structures developed during the COVID-19 pandemic may be a first step when complemented by effective communication to raise awareness and create a standard of care, whereby HW vaccination is seen as an integral part of employment safety and occupational health. Comprehensive coverage of HW against vaccine-preventable diseases is not only a right for workers, but also a key element in ensuring that their intervention in health facilities and communities is safe for all.

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Declaration of competing interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2023.100415>.

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