



Published in final edited form as:

*Vaccine*. 2020 January 29; 38(5): 1152–1159. doi:10.1016/j.vaccine.2019.11.025.

## Does having a seasonal influenza program facilitate pandemic preparedness? An analysis of vaccine deployment during the 2009 pandemic

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### Abstract

**Background:** National seasonal influenza programs have been recommended as a foundation for pandemic preparedness. During the 2009 pandemic, WHO aimed to increase Member States' equitable access to influenza vaccines through pandemic vaccine donation.

**Methods:** This analysis explores whether the presence of a seasonal influenza program contributed to more rapid national submission of requirements to receive vaccine during the 2009 influenza pandemic. Data from 2009 influenza vaccine donation, deployment, and surveillance initiatives were collected during May–September 2018 from WHO archival material. Data about the presence of seasonal influenza vaccine programs prior to 2009 were gathered from the WHO–UNICEF Joint Reporting Form. Cox proportional hazards models were used to assess the relationship between presence of a seasonal influenza program and time to submission of a national deployment and vaccination plan and to vaccine delivery.

**Finding:** Of 97 countries eligible to receive WHO-donated vaccine, 83 (86%) submitted national deployment and vaccination plans and 77 (79%) received vaccine. Countries with a seasonal

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#### 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.

#### Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2019.11.025>.

influenza vaccine program were more likely to submit a national deployment and vaccination plan (hazards ratio [HR] 2.1; 95% confidence interval [CI]. Countries with regulatory delays were less likely to receive vaccine than those without these delays (HR 0.4, 95% CI: 0.2–0.6).

**Interpretation:** During the 2009 pandemic, eligible countries with a seasonal influenza vaccine program were more ready to receive and use donated vaccines than those without a program. Our findings suggest that robust seasonal influenza vaccine programs increase national familiarity with the management of influenza vaccines and therefore enhance pandemic preparedness.

## Keywords

Influenza; Pandemic; Vaccination; Preparedness; Program; Deployment plan

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## 1. Introduction

Seasonal influenza affects all Member States and causes an estimated global burden of 290,000–650,000 respiratory deaths each year [1,2]. Influenza viruses caused four global pandemics (1918–19, 1957, 1968, and 2009) in the last century [3]. Influenza vaccines have been recommended and used for decades as the best option to prevent both seasonal and pandemic influenza morbidity and mortality [4]. In 2003, the World Health Assembly Resolution 56.19 urged all Member States to achieve 75% seasonal influenza vaccination coverage of the elderly. The Global Action Plan for Influenza Vaccines (2006–2016) increased seasonal influenza vaccine use, enhanced production capacity for pandemic influenza vaccines, and improved vaccine technology [5]. During the 2009 pandemic, monovalent pandemic vaccines were produced and distributed globally, using systems strengthened through the Global Action Plan for Influenza Vaccines [6].

Seasonal influenza programs are considered cornerstones to pandemic preparedness and response [5,7]. For seasonal influenza programs, countries develop and conduct activities that might be useful during pandemic vaccination programs, including: (1) conducting routine surveillance of influenza disease and viruses, and reporting to the global WHO influenza surveillance systems (FluNet and FluID); (2) conducting severity assessments using the Pandemic Influenza Severity Assessment (PISA); (3) identifying and accessing vaccine target risk groups; (4) building capacity of national regulatory agencies' to approve vaccines; (5) developing and using communications tools to increase public awareness of the burden and risks of influenza, and benefits of seasonal influenza vaccine; (6) developing national influenza vaccine distribution plans; (7) ensuring adequate cold chain and deployment logistics; (8) ensuring vaccine acceptance by target populations; and (9) establishing Adverse Event Following Immunization (AEFI) surveillance systems. Despite the assertion that seasonal influenza programs are critical for pandemic preparedness, little available research has evaluated the link between seasonal influenza programs and influenza pandemic readiness and response.

During the pandemic response, WHO's mandate was to: (a) support all Member States to mitigate the impact of the 2009 A(H1N1) on human populations, particularly in the world's most vulnerable regions, (b) increase equitable access to pandemic influenza vaccines and ancillary supplies, and (c) support countries' preparedness, readiness, and response to

pandemic influenza [8]. WHO established the Vaccine Deployment Initiative to increase equitable access to donated pandemic influenza vaccine and ancillary supplies in low and middle-income countries. Due to the technology available to produce pandemic vaccines and WHO's dependence on voluntary donations of vaccines in 2009, WHO did not have pandemic influenza vaccine available for deployment to Member States until over seven months after the pandemic was declared.

Once vaccine was available, WHO deployed pandemic influenza vaccine to countries that successfully completed and submitted: (1) a Letter of Intent that formally requested the vaccine donation, (2) a comprehensive national deployment and vaccination plan, and (3) a signed country recipient agreement with WHO. From January to November 2010, the WHO's Vaccine Deployment Initiative deployed 78 million pandemic influenza vaccine doses to 77 countries [6].

Eligibility to receive pandemic influenza vaccines through the Vaccine Deployment Initiative was determined based on information collected through the WHO Regional Offices. Early considerations for the 2009 vaccine deployment included anticipated severity of public health impact, timing of anticipated influenza spread in country, and ability to access vaccines through procurement, production, or other commercial means. Three additional countries were included based on concurrent natural catastrophes and/or preparation for the World Cup [6]. Initially, vaccines were in short supply, leading the WHO Vaccine Deployment Initiative to develop a prioritization matrix to allocate partial quantities from the earliest available doses to those eligible countries most likely to be impacted by the earliest wave of disease. The matrix was useful in early allocations of scarce supply to an initial group of countries, but country readiness to receive vaccine ultimately had more impact on the timing of when vaccines were received by each country [6]. Due to the limited availability of donated vaccines, WHO initially approved sufficient vaccine doses to cover typically 2% of each country's total population. Countries could request a second or third shipment of pandemic influenza vaccine doses to cover an additional 8% of their population following the government's confirmation that the country would allocate sufficient financial resources to deploy the additional vaccines. In addition to vaccine, WHO provided financial support totaling US \$19.2 million to 57 countries requiring assistance with vaccine deployment.

The 2009 pandemic provided a unique opportunity to evaluate the relationship between seasonal influenza programs and country capability to receive and use monovalent pandemic influenza vaccines. We hypothesized that the presence of a seasonal influenza program, or of specific components that comprise a seasonal influenza program, contributed to the increased likelihood of being able to submit the necessary requirements to receive donated influenza vaccine during the 2009 influenza pandemic.

## 2. Methods

We conducted a retrospective review that evaluated factors associated with the receipt of WHO donated pandemic influenza vaccines among eligible countries during the 2009 A(H1N1) pandemic. The primary data source was the WHO archives from the 2009

pandemic. These archives were collected during external and internal reviews of the pandemic response and provide explanations of the processes and operations of WHO's Vaccine Deployment Initiative. Country-level data about seasonal influenza vaccination activities prior to 2009 and pandemic vaccine deployment were collected from multiple sources. These sources include published manuscripts and reports, a global 2007 WHO survey on seasonal influenza vaccine use, a global 2010 WHO survey on pandemic influenza vaccine deployment, and the WHO-UNICEF Joint Reporting Form (JRF) [8–10]. The JRF is a self-reporting tool that Ministries of Health complete and submit to WHO and UNICEF annually. It contains information about national immunization coverage, policies, schedules, and other indicators about vaccine-preventable diseases, including influenza.

This analysis evaluated whether the presence of a seasonal influenza program at the onset of the 2009 pandemic, defined as the inclusion of seasonal influenza vaccines in the national immunization schedule, was associated with early receipt of pandemic influenza vaccine from WHO [9,11]. The WHO-UNICEF JRF was the primary source of data for presence of a national policy about influenza vaccination, which we used as a proxy for presence of a seasonal program. Data from the 2008 JRF were accessed in May 2018. The “Evaluation of seasonal influenza vaccination policies and coverage in the WHO European Region: Results from the 2008/2009 and 2009/2010 influenza seasons based on a joint VENICE-ECDC-WHO survey” publication was a secondary source of data [12].

This analysis also considered the role of the following factors: (1) regular reporting to WHO's influenza surveillance network FluNet, evaluated by the WHO's Global Influenza Programme as consistent weekly reporting during the national influenza season(s) [13]; (2) a designated National Influenza Centre (NIC) [8]; (3) a functional National Immunization Technical Advisory Group (NITAG) as evaluated by WHO [8,14]; (4) the presence of AEFI monitoring systems [8]; (5) seasonal influenza vaccine presence in the private sector prior to April 2009 [8]; and (6) identified regulatory delays to licensing and importation of influenza vaccine, as identified by each country and documented in the WHO archives [8]. These indicators were chosen as they encompass parts of a successful seasonal influenza program, and we believed them to be the most reliable indicators to assess readiness to receive donated pandemic influenza vaccination.

We considered one primary outcome, time from the notification of eligibility to participate in the Vaccine Deployment Initiative (22 September 2009) to submission of a national deployment and vaccination plan to WHO; and one secondary outcome, time from the notification of eligibility to participate in the Vaccine Deployment Initiative and delivery date of the first vaccine shipment in country. For the purpose of this analysis, delivery date was defined as the date that vaccine was arrived a country. Data on vaccine administration in each country were not consistently available and therefore were not considered in this analysis. We evaluated time to submission of a national deployment and vaccination plan as a proxy for readiness and included countries that ultimately did not receive the vaccine. By evaluating time to submission of a national deployment and vaccination plan as a primary outcome, this analysis accounted for factors that may have impacted vaccine delivery timing, such as the WHO's use of a prioritization matrix for country deployment and natural disasters (i.e. the 2010 volcanic eruption in Iceland that disrupted air traffic) [6,15]. Time to

delivery date of first vaccine was considered a secondary outcome due to several factors that could have also affected this timing, including: availability of vaccine, availability of a batch of the correct amount of vaccine, and availability of air carrier. Despite these factors we felt it important to assess this endpoint in our analysis. Multiple countries received more than one pandemic influenza vaccine shipment; for consistency, the date of the first WHO shipment was used in this analysis. In addition, 5 of the 97 eligible countries (5%) received pandemic influenza vaccine donations from other sources. The non-WHO donated pandemic influenza vaccines were not factored into the time to receipt for this analysis. Overall vaccine usage, among countries with available usage data, was evaluated as a tertiary outcome. A timeline of key dates is included in Fig. 1.

Descriptive statistics were used to summarize country characteristics. Chi-square tests and Fischer's exact test were used to compare country characteristics between those that received WHO donated pandemic vaccines and those that did not. A Kruskal-Wallis H test was conducted to determine if median usage of vaccine was different by WHO region, income classification, vaccine delivery category (January – April 2010, May-August 2010, or Post-Pandemic (after August 10, 2010) and presence of a seasonal influenza program. A Cox proportional hazards model was used to assess the relationship between each outcome and predictor separately. These models were then adjusted for World Bank income status (low, lower-middle, or upper-middle/high) as classified in 2008 and the initial WHO prioritization matrix [6,16]. The main assumption of the proportional hazards model, that the underlying hazard rates for each exposure subgroup are proportional over time, was assessed using graphical methods supported by goodness-of-fit testing. For each predictor, log (cumulative hazard) versus log (time) were plotted to visually assess if curves were parallel; parallel curves suggest baseline hazards between groups were constant over time. Schoenfeld residuals were then calculated for each predictor, and the correlation between the Schoenfeld residual and ordered failure time was calculated to test the proportional odds assumption. All analyses were conducted in SAS 9.4 (Cary, NC).

### 3. Results

Ninety-seven countries were eligible to receive WHO-donated pandemic influenza vaccine during the 2009 pandemic. Of these, forty countries (41%) were low-income, 41 (42%) lower-middle income, and 12 (12%) upper-middle or high income; four small island nations did not have World Bank Index classifications [16,17]. The 97 eligible countries represent 93% of all low-income countries, 73% of lower-middle income countries, and 10% of upper-middle income or high-income countries. Additionally, eligible countries spanned all WHO regions, with 45 of 46 (98%) countries from the African region, 11 of 35 (31%) in the Americas, 6 of 22 (27%) in the Eastern Mediterranean, 9 of 52 (17%) in Europe, 9 of 11 (81%) in South East Asia, and 17 of 27 (63%) in the Western Pacific region (Table 1). Twenty-three (24%) of the 97 countries eligible for the WHO Vaccine Deployment Initiative had influenza vaccines included in their national immunization schedule prior to the 2009 A(H1N1) influenza pandemic [9]. Of the 97 countries eligible to receive vaccine, 86 (88%) signed country recipient agreements to receive vaccine, 83 (86%) submitted a national deployment and vaccination plans, and 77 (79%) received vaccine between 7 January 2010 and 10 November 2010 (Fig. 2).

Of the 77 countries that received vaccine, 20 had an established influenza program (26%) and 57 did not have a program (74%) (Table 1). Low-income countries were less likely than other groups (3% vs. 39%,  $p < 0.001$ ) to have had an influenza program prior to 2009. Countries in the region of the Americas (AMR) were more likely than other regions (82% vs. 15%,  $p < 0.001$ ) to have had an influenza program prior to 2009.

Of the 77 countries that received WHO donated vaccine, 44 (57%) experienced regulatory delays related to the 2009 pandemic vaccine. Data were available about the cause of the regulatory delays for 23 of the 44 countries (52%). Common causes of regulatory delays included unfamiliarity with seasonal influenza vaccine or the lack of processes and/or experience related to emergency waivers, exemptions, or emergency authorization procedures (Table 1).

Countries with a seasonal program were more likely to submit a national deployment and vaccination plan than those without a program, after adjusting for World Bank income status and country prioritization ( $HR_{ADJ}$ : 1.9; 95% CI: 1.1, 3.7). Countries with a NIC and AEFI monitoring systems were also significantly more likely to submit a national deployment and vaccination plan than those without ( $HR_{ADJ}$ : 2.3; 95% CI: 1.4, 3.8 and  $HR_{ADJ}$ : 1.8; 95% CI: 1.1, 3.1, respective). Countries with regulatory delays were 50% less likely to submit a national deployment and vaccination plan than those without regulatory delays ( $HR_{ADJ}$ : 0.5; 95% CI: 0.3, 0.8). Due to their increased readiness, countries with a seasonal program were also 2.4 times more likely to receive donated vaccine than those without a program ( $HR_{ADJ}$ : 2.4, 95% CI: 1.4, 4.1). A country with a regulatory delay was 0.4 times less likely to successfully receive influenza vaccine compared to countries without indicated regulatory delays ( $HR_{ADJ}$  0.4, 95% CI: 0.2–0.7). Models were adjusted for World Bank income status and the initial WHO prioritization matrix, and we did not find any significant difference in estimates when comparing adjusted to unadjusted. All adjusted and unadjusted models are presented in tandem (Fig. 3).

As a secondary analysis, time of vaccine delivery was categorized into three periods: (1) January – April 2010, (2) May – August 2010, and (3) Post-Pandemic (After August 10, 2010). Fig. 4 depicts the global peaks of influenza activity compared with the monthly percentage of WHO Vaccine Deployment Initiative pandemic vaccine delivered for countries with and without a seasonal influenza program. All vaccine that was part of the Vaccine Deployment Initiative was delivered after the first peak of disease due to vaccine availability and WHO's access to pandemic influenza vaccine. However, due to quicker readiness, countries with a seasonal vaccine program received shipments earlier, and prior to the second wave of disease while countries without an influenza program received vaccine during the 'post-pandemic' period. Thirty-one percent (31%) of the total vaccine delivered to countries without a seasonal program was delivered during the second wave of disease as observed using global FluNet data (July-November), compared to 14% of the total vaccine delivered to countries with a seasonal program (Supplemental Table 1, Fig. 4).

Data on vaccine usage were available from 61 (79%) of the 77 countries that received vaccine. We examined aggregate usage and median usage of vaccine by country. The overall median usage of pandemic vaccine was 76%, with no significant difference by region,

income classification, and vaccine delivery category. When examining usage by delivery-time, 83% of vaccine delivered in the ‘first-wave’ was used, compared to 72% in the ‘second-wave’, and 48% after the pandemic. When examining usage by income classification, low-income countries used more vaccine than higher income countries, but this difference was not statistically significant (Supplemental Table 2).

#### 4. Discussion

We found that countries with a seasonal influenza program at the onset of the 2009 pandemic, defined as inclusion of seasonal influenza vaccines in the national immunization schedule, were twice as likely to provide the necessary documentation to receive donated pandemic influenza vaccine as countries without a seasonal influenza program. Countries with an existing seasonal influenza program were more likely to receive their shipments of vaccine during the active pandemic period, rather than the ‘post-pandemic’ period, and prior to the second wave of disease (Fig. 4). We hypothesize this was due to the fact that countries with a seasonal influenza program had experience with seasonal influenza vaccines, enabling them to complete the necessary documentation to receive pandemic vaccine faster than countries without experience gained from implementing a seasonal influenza program. Regardless of seasonal influenza program status, countries that received vaccine shipments early in the vaccine delivery process used significantly more vaccine than those that received vaccine during the ‘post-pandemic’ period. Finally, countries that indicated they had regulatory delays were less likely to submit a national deployment and vaccination plan, and less likely to successfully import vaccine, than countries without reported regulatory delays.

This analysis is the first to examine the relationship between seasonal influenza programs, pandemic preparedness, and pandemic vaccine deployment, using the 2009 WHO Vaccine Deployment Initiative as a case study. Our global findings are consistent with several regional studies of the 2009 influenza pandemic response. A 2012 report in Latin America and Caribbean countries highlighted regulatory issues as a key barrier to timely access to vaccine, among countries that were not a part of WHO’s Deployment Initiative [18]. A similar assessment was done in the WHO African Region, which also identified that in Africa, countries experienced barriers to importing vaccine that led to delays in vaccination [19]. These findings all underscore the need for strengthening of regulatory systems as an appropriate and necessary step to prepare for future pandemics. For future pandemics, WHO has developed the Collaborative Procedure for Accelerated Registration, which may reduce regulatory delay by offering participating countries a fast-track mechanism for authorization of prequalified antivirals and/or vaccines [20].

Our findings of country-level pandemic vaccine usage are complemented by other studies that were able to assess individual-level behaviors during the 2009 pandemic. A global review of the 2009 pandemic identified a link between willingness to be vaccinated against seasonal influenza and against pandemic influenza [21]. A global systematic review about factors associated with uptake of pandemic influenza vaccine also found that previous vaccination against seasonal influenza was associated with greater intention to vaccinate against pandemic influenza [22]. In the United States, regular recipients of seasonal influenza vaccines were (1) more likely to consider 2009 H1N1 influenza to be a serious

disease, and (2) twice as likely to hold positive attitudes about the safety and value of pandemic influenza vaccination, as compared to irregular and non-recipients of seasonal influenza vaccine [23]. These studies, coupled with our findings, further strengthen the argument that seasonal influenza programs play a key role in pandemic readiness and response.

While vaccines are the focus of this analysis, it is worth noting that prior to the declaration of the pandemic, WHO also deployed approximately 3 million antiviral treatment courses to 72 countries between 3–21 May 2009 [24]. Future studies could examine the relationship between countries' receipt of antivirals and their decision to request and/or deploy pandemic influenza vaccines, to garner additional insight into factors that affect national pandemic influenza response or relationship between other vaccine programs and preparedness.

A primary limitation of our analysis was the retrospective nature of data collection. Data were compiled from a variety of sources nine years after the start of the pandemic. Even though we compiled data retrospectively, the information in the data sources we used was collected immediately following the 2009–10 pandemic directly from in-country stakeholders, resulting in accurate recall and reporting. This analysis included all available WHO reports and data and consisted of an exhaustive search of publicly available information; however, it is still possible that other data sources on the 2009 pandemic exist and were not incorporated into these findings. These could include data on vaccine usage, coverage by target group, in-country vaccine distribution timing, and public and private vaccine use, which we were unable to collect for this report. As such, we were unable to evaluate the association between presence of an influenza program, and pandemic vaccine use or vaccine coverage. We report limited data on additional pandemic vaccine donations outside of WHO and country purchase of pandemic vaccine (Table 2) but due to substantial missingness of information on these variables (56% and 60%, respectively), we decided to exclude these variables from analysis. These variables could have had an impact on our findings if their full information were able to be included. A second limitation of this analysis was the requirement that countries sign the country recipient agreement prior to receiving pandemic influenza vaccine. Multiple countries were hesitant to sign this agreement and take on liability for the vaccine, particularly because of the rapid timeframe for production, testing, and licensing of the vaccines [25]. There may also have been other factors causing the delays in submitting this agreement (i.e. country determination of whether vaccine would be required, internal approval processes, etc.) [26]. Without data on the reasons for late submission of the country recipient agreement, we were unable to account for this hesitancy in our analysis. We attempted to collect data regarding introduction of other vaccines, including pneumococcal, rotavirus and Hib, but were only able to obtain limited data on the presence of a Hib vaccine prior to 2009. Preliminary analysis of these data did not indicate that presence of a Hib program was associated with either of our outcomes, but future analyses could focus on questions of whether additional vaccination programs outside of influenza are associated with a robust response to pandemic influenza.



## 5. Conclusion

The WHO's Vaccine Deployment Initiative, which offered donated pandemic influenza vaccine to eligible countries, provided a unique opportunity to assess the relationship between national seasonal influenza programs and pandemic preparedness. Our analysis identifies the benefits of seasonal influenza programs on facilitating pandemic response. These findings offer policy makers and global health champions' quantitative evidence of the value of national influenza programs for supporting preparedness. WHO, under the Pandemic Influenza Preparedness Framework, has signed standard material transfer agreements (SMTA2s) with manufacturers to provide up to 10% of their real time production of influenza vaccines, antivirals, and ancillary supplies as a donation or at an affordable price [27]. Through these SMTA2s, WHO has secured potentially more than 400 million pandemic influenza vaccine doses (more than 5 times the amount available for WHO deployment in 2009). By conducting national annual seasonal influenza programs, countries test crucial regulatory and delivery systems, strengthen their national response to influenza, and prepare for future pandemic vaccine deployments, while reducing the substantial burden of seasonal influenza.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

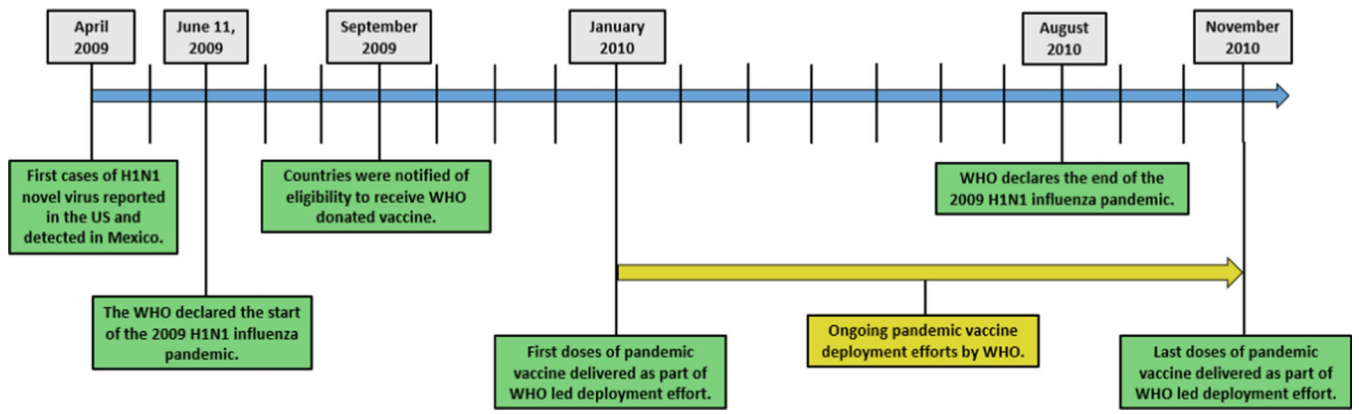
## Acknowledgements

The authors would like to thank the following from the World Health Organization (Reynald Erand, Laure Dumolard, Pernille Jorgensen, James Heffelfinger, Julia Fitzner, Nahoka Shindo, Martha Faith Mclellan) and the Centers for Disease Control Influenza Division (Lisa Grohskopf, Jerome Tokars, Alicia Fry) and Marie-Paule Kieny.

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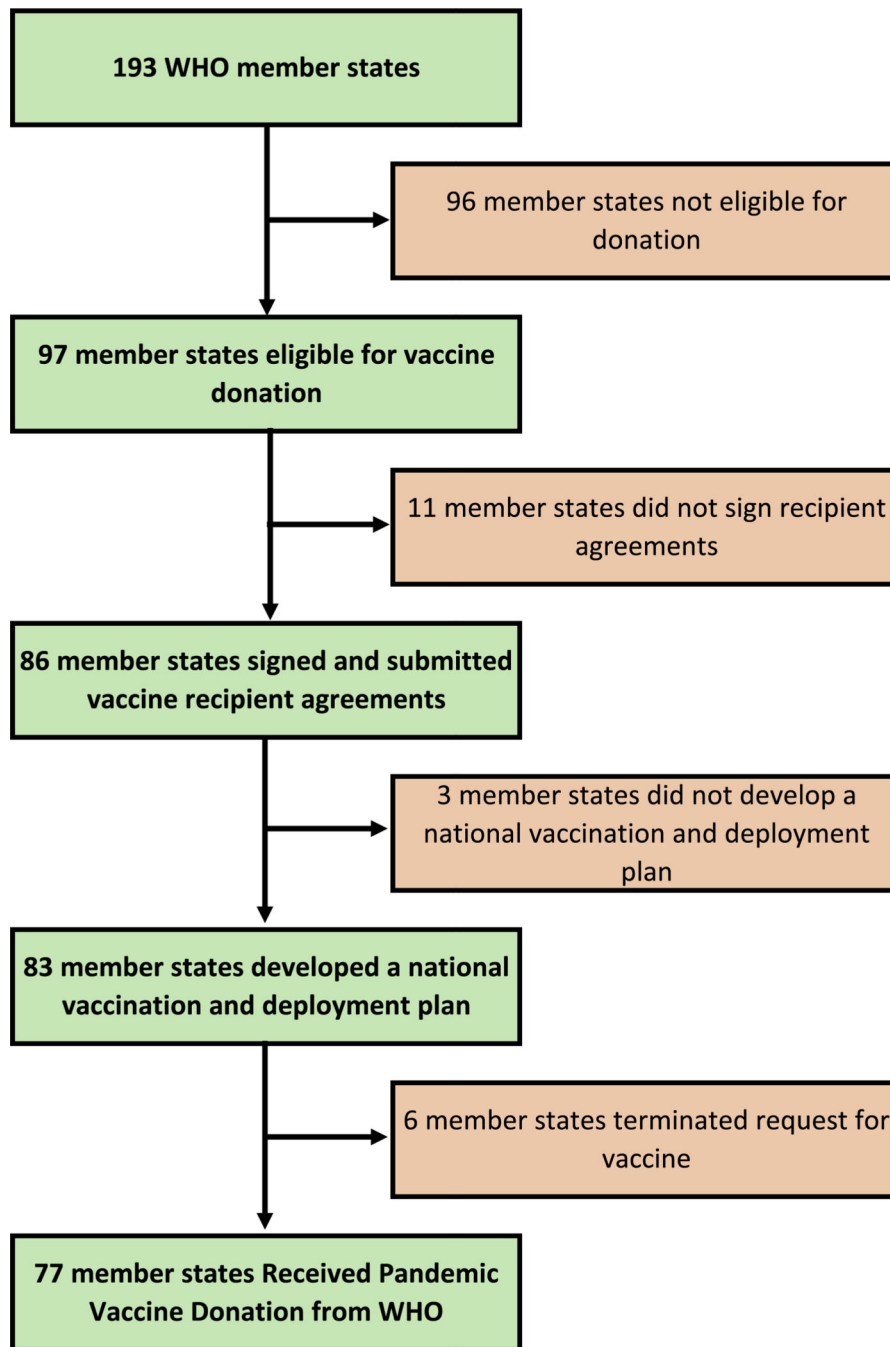
**Fig. 1.** Timeline of 2009 A(H1N1) influenza pandemic, including virus identification, and WHO response, April 2009-November 2010.

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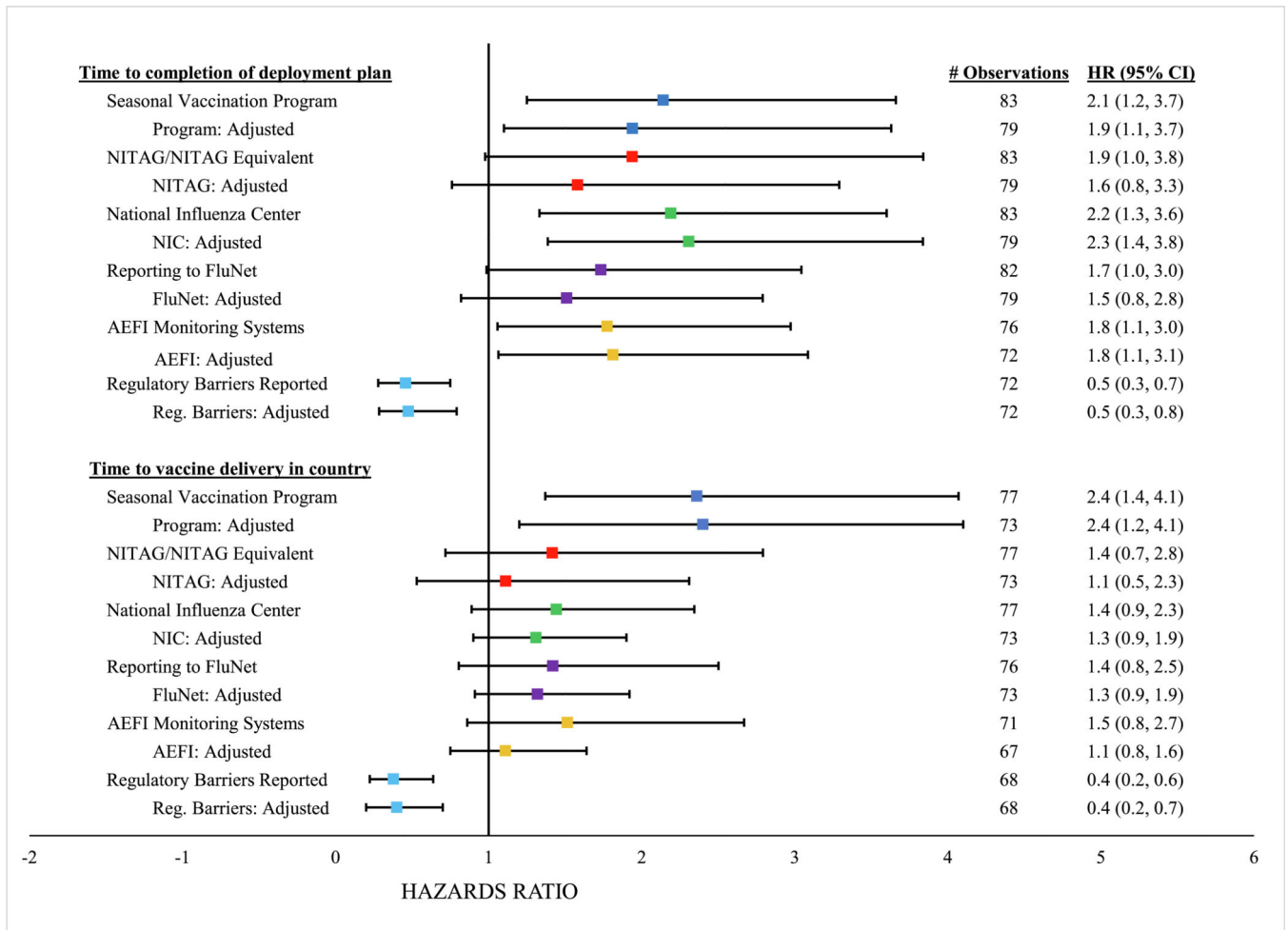
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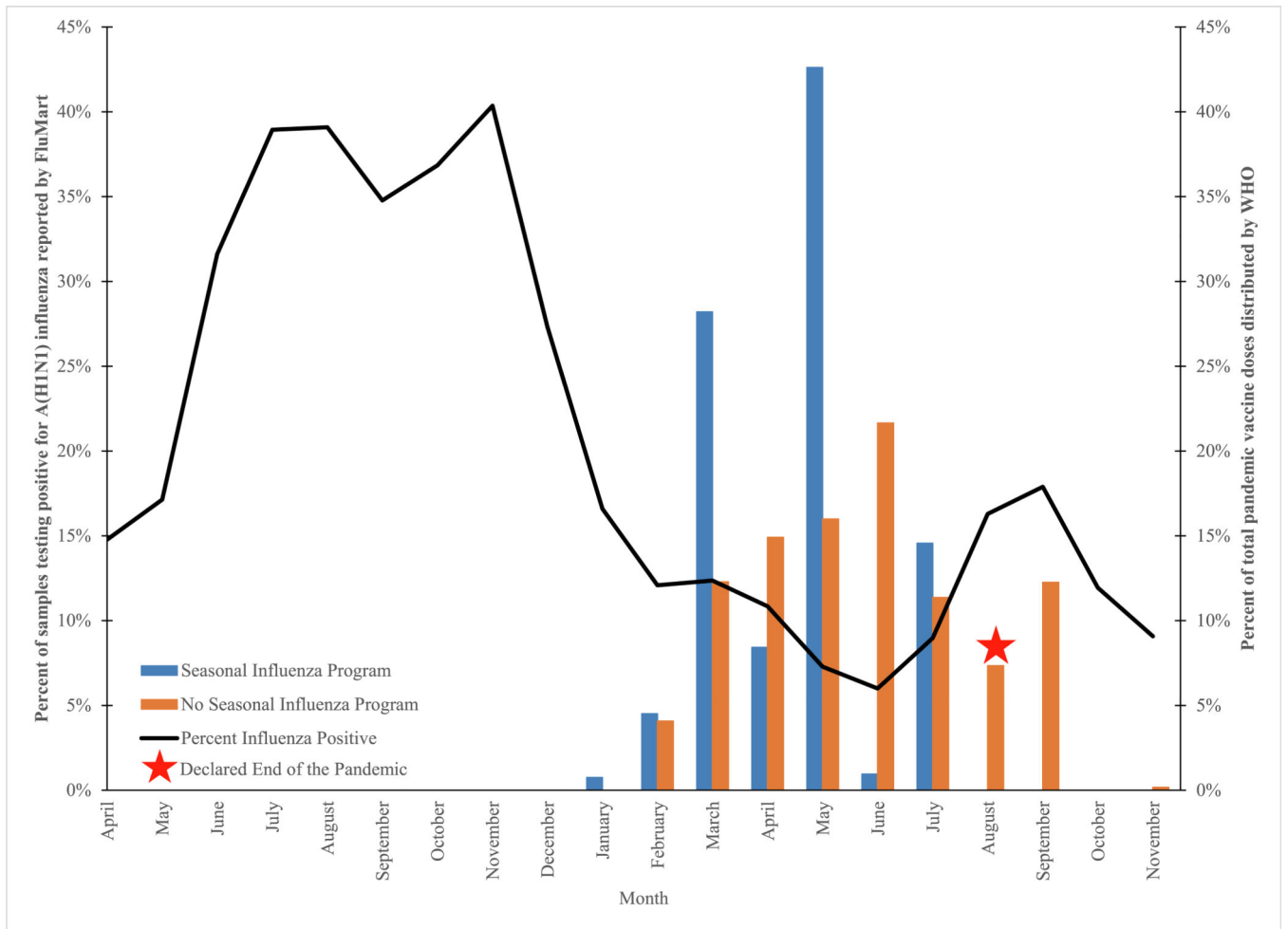
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**Fig. 2.** Flow chart of member states eligible for WHO deployed influenza vaccine during the 2009.



**Fig. 3.** Likelihood of completing a national deployment and vaccination plan and likelihood of receiving pandemic influenza vaccine donation through WHO deployment initiative by key predictors, adjusted for World Bank income status and WHO prioritization. \*All adjusted models were adjusted for the initial WHO prioritization matrix and World Bank Income classification (low, lower-middle, and upper-middle/high).



**Fig. 4.** Percent of specimens that tested influenza positive globally and percent of A(H1N1)pdm09 vaccine doses distributed by seasonal program and month, April 2009-November 2010.

Characteristics of countries eligible for WHO influenza pandemic vaccine donation during the 2009 A(H1N1) influenza pandemic, January - November 2010. (n = 97).

**Table 1**

	Eligible to Receive Donation		Received Donation		Row %	p-value <sup>†</sup>
	N	N	N	N		
<b>Entire Sample</b>	<b>97</b>	<b>77</b>	<b>77</b>	<b>79</b>		
<i>WHO Region</i>						
Africa	45	34	34	76		0.34
Americas	11	10	10	91		
Eastern Mediterranean	6	4	4	67		
Europe	9	6	6	67		
South-East Asian	9	7	7	78		
Western Pacific	17	16	16	94		
<i>Income Classification (World Bank)</i>						
Low	40	28	28	70		0.18
Lower Middle	41	34	34	83		
Upper Middle/High	12	11	11	92		
Missing	4	4	4	100		
<i>Program Description (prior to 2009)</i>						
Presence of a program	23	20	20	87		0.39
No program	74	57	57	77		
Presence of a NITAG	13	10	10	77		0.73
No NITAG	84	67	67	80		
National Influenza Center (NIC)	30	25	25	83		0.52
No NIC	67	52	52	78		
Experienced Regulatory Delay	47	44	44	94		0.003
No regulatory delay	37	25	25	68		
Missing	13	8	8	62		
AEFI Monitoring System	56	51	51	91		0.030
No AEFI monitoring system	28	20	20	71		

	Eligible to Receive Donation		Received Donation		Row %	p-value <sup>†</sup>
	N	%	N	%		
<b>Entire Sample</b>	<b>97</b>		<b>77</b>		<b>79</b>	
Missing	13		6		46	
Consistent Reporting to FluNet	20		16		80	0.92
No reporting to FluNet	76		60		79	
Missing	1		1		100	
Private Sector Vaccine	19		14		74	0.15
No private sector vaccine	29		26		90	
Missing	49		37		76	
Public Sector Vaccine	17		14		82	0.89
No public sector vaccine	31		26		84	
Missing	49		37		76	
National Regulatory Agency	9		6		67	0.73
No NRA	30		21		70	
Missing	58		50		86	

<sup>†</sup> Chi-square tests and Fisher's Exact Test used.



Demographics of countries eligible for pandemic influenza vaccine donation during the 2009 A(H1N1) influenza pandemic, by presence of a seasonal influenza program. (n = 97).

**Table 2**

	Seasonal Influenza Program <sup>1</sup>		Countries Eligible for Vaccine Donation		p-value <sup>2</sup>
	N	N	N	Row %	
<b>Entire Sample</b>	<b>23</b>	<b>97</b>			
<i>WHO Region</i>					
Africa	3	45	7		<0.0001
Americas	9	11	82		
Eastern Mediterranean	0	6	0		
Europe	5	9	56		
South-East Asian	1	9	11		
Western Pacific	5	17	29		
<i>Income Classification (World Bank)</i>					
Low	2	40	3		<0.0001
Lower Middle	14	41	34		
Upper Middle/High	6	12	50		
Missing (n = 4)	2	4	50		
<i>Experienced Regulatory Delays</i>					
Yes	6	47	13		0.004
No	15	37	41		
Missing (n = 13)	2	13	15		
<i>Additional Donations Outside of WHO</i>					
Yes	5	12	42		0.66
No	10	29	34		
Missing (n = 56)	8	56	14		
<i>Country Purchase of Pandemic Vaccine</i>					
Yes	9	12	75		0.03
No	7	25	28		
Missing (n = 60)	7	60	12		

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<sup>1</sup> Presence of a seasonal influenza program was obtained from data collected on the WHO-UNICEF Joint Reporting Form (JRF).

<sup>2</sup> Chi-square tests and Fisher's Exact Test used to compare proportions of countries with or without a seasonal influenza program.