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2009 H1N1 After Action Reports: Lessons On Vaccine Distribution

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Abstract

The responses of individual states to the 2009 H1N1 Pandemic are documented in their After Action Reports (AARs), written in summer 2010. In an attempt to understand how these responses could improve for future pandemics, this paper reviews the AARs of fourteen states to determine how vaccine distribution methods and communication issues impacted the success of the states' responses to the 2009 H1N1 Pandemic. The results of this review reveal several trends to inform preparation for future pandemics. For instance, the best distribution method for times of low supply of vaccine and high demand is one based on county populations within a state, while an online ordering system for vaccine performs well in times of high supply and lower demand. Finally, this paper finds that the best preparedness plans are the ones for which components have been tested in some capacity prior to use.

Introduction

Two years ago, a novel virus made headlines in the United States: influenza infections were spreading rapidly across Mexico and proving deadlier than the typical seasonal flu. When similar cases began to appear within America's borders, the United States government, under the direction of the Centers for Disease Control and Prevention (CDC), reacted decisively to combat the impending pandemic.¹ The cause of the influenza, a novel H1N1 virus, was quickly identified, and in April 2009 four large pharmaceutical companies were contracted to begin producing a vaccine to combat this disease.² By that fall, the second wave of H1N1 had begun. Citizens looked to the pharmaceutical companies for the vaccine, but due to a lengthy production process, it was unavailable until early October (and even then only in limited quantities).³ The slow production time coupled with the high expectations of American communities made the vaccination process a national challenge. This paper seeks to understand the actions taken by individual states to meet this challenge.

As a result of the 2009 H1N1 Pandemic, several states published After Action Reports to examine their strategies and strengths during this public health crisis. These reports provide a unique insight into the individual states' impressions of how their particular healthcare system performed during outbreaks of H1N1. In order to improve the healthcare response for future pandemics, a review of these reports is necessary to learn as much as possible from those who

were heavily involved in the management of the pandemic. This paper provides an overview and analysis of the After Action Reports of fourteen diverse states; the states range in size from Rhode Island to California, and in location from Massachusetts to Nevada. The reports reveal key themes and trends within the vaccine management strategies of each state; using these, we provide a clear explanation of why state health departments were ill-prepared for the events of the H1N1 Pandemic despite each having created a Preparedness Plan specifically for a pandemic scenario. In particular, miscommunication between all levels of health departments and gaps in the preparedness measures contributed to uncoordinated and frustrating state vaccination campaigns.

1. Centers for Disease Control and Prevention. The 2009 H1N1 Pandemic: Summary Highlights, April 2009-April 2010. Available at <http://www.cdc.gov/h1n1flu/cdcresponse.htm>. Accessed on August 16, 2010.
2. Morbidity and Mortality Weekly Report. (2009). Update on Influenza A (H1N1) 2009 Monovalent Vaccines. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5839a3.htm>.
3. Knox R. (2009). Swine Flu Vaccine Shortage: Why? *National Public Radio*. Available at <http://www.npr.org/templates/story/story.php?storyId=114156775>. Accessed on April 17, 2011.

Vaccine Preparedness

In 2005, the government mandated that each state create a preparedness plan to be used in the event of a pandemic. These plans were meant to aid the vaccine distribution within states by defining a logical structure of management and allocation for the next pandemic scenario. However, most of the preparedness plans were not realized during the actual H1N1 Pandemic and as a result many states did not have a premade plan for vaccine distribution.

The primary reason for this neglect was that the plans were not compatible with the specifics of the H1N1 2009 Pandemic. Each plan had been created in anticipation of an H5N1 Pandemic, an event which would likely have generated more cases and deaths. Each report was structured to deal with a pandemic that began in Asia, assuming a lag time of weeks between the initial cases in the world and the initial ones in the United States. This lag time would have been used to pull the healthcare system together, begin vaccine production, and in general get America ready for the pandemic to strike locally. When the H1N1 Pandemic appeared in Mexico, the time between reports of cases internationally and nationally was much less than expected. As a result, the preparedness plans each state had constructed were not easily scaled to the situation encountered with H1N1; states abandoned their plans in favor of meeting the more recent CDC recommendations and dealing with the cases within their jurisdictions as best they could.

It was those states which had practice holding mass vaccination clinics and which were aware of their risk group population composition that handled the H1N1 vaccine distribution and allocation the best. These advantages were primarily due to annual vaccine campaigns held

by the states for the seasonal flu vaccine. Thus in addition to analyzing vaccine distribution methods within states, this paper will show that the relative success of states with seasonal flu vaccine campaigns reveals the necessity of practicing a preparedness plan before it must be applied.

The 2009 H1N1 Vaccination Campaign

By January 2, 2010, only 20.3% of the United States population had been vaccinated against H1N1.¹ The pandemic that had generated enough fear to warrant large-scale production of a vaccine in the first place was barely mitigated by vaccination efforts at the end of the second wave. The most immediate reason for this low rate was the slow production of vaccines; vaccine providers, or those registered to administer the vaccine to the public, were frustrated when they did not receive enough from vaccine manufacturers to inoculate individuals seeking medical protection against H1N1 in the fall.² Vaccine production was clearly behind schedule, and the news media kept Americans well-aware of this fact.³ By the time the vaccine was being produced in sufficient quantities, the fall flu season had passed¹ and there was no longer an immediate incentive for the public to want to be vaccinated.

The slow production rate was a significant factor in the decision of 79.7% of Americans to not get vaccinated. However, a recent paper on the distribution of the vaccine during fall 2009 found that it was distributed uniformly to individual states as soon as it was produced regardless of a state's pandemic status. In fact, for several southern states, the majority of their population had already been infected by the time the vaccine was made available.⁴ The incentive for individuals in these states to be vaccinated was understandably lower, and since the peak in the state epidemic curve had already passed more inoculations were not likely to make a large difference in the overall number of H1N1 cases.

The findings of this recent paper suggest that the distribution of vaccines plays a large role in a vaccine's effectiveness. The paper looked at the distribution through a time lens: when is it best for a state to receive vaccine? Clearly, vaccinating before the peak in the epidemic curve is likely to have a larger impact on the number of people who are infected. We take this research one step further by examining the distribution of vaccine through a different lens: logistics. This focus allows for both a review of the vaccine distribution methods within a state and for an explanation of the delay in vaccine distribution versus administration observed in the 2009 H1N1 Pandemic.⁴

1. Morbidity and Mortality Weekly Report. (2010). Interim Results: Influenza A (H1N1) 2009 Monovalent Vaccination Coverage: United States, October-December 2009. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5902a4.htm>. Accessed on April 20, 2011.
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3. Maugh II TH & Ellingwood K. Swine flu vaccination production running behind by about 25%, officials say. *Los Angeles Times*. Available at <http://articles.latimes.com/2009/oct/17/science/sci-swine-flu17>. Accessed on April 20, 2011.
4. Finkelstein SN, Hedberg KJ, Hopkins JA, Hashmi S, & Larson RC. Vaccine availability in the United States during the 2009 H1N1 outbreak. *American Journal of Disaster Medicine*. 2011;6(1):23-30.

Vaccine Distribution: Conceptual Model

The purpose behind any vaccination campaign is to inoculate as many people as possible to prevent the spread of an infectious disease. Though the term “campaign” suggests a large-scale operation, the distribution of vaccine is best understood through a conceptual framework which builds up from the bottom of the supply chain: an individual receiving a single shot.

The vaccine is, to this individual, most likely a clear, unknown liquid substance that he or she believes will help ward off illness. A single dose of the vaccine is administered to this individual by a nurse or other trained healthcare personnel. This nurse (for example) received a set number of doses from the clinic or school where the vaccine is being given out before the individual came in for a shot. These doses, in turn, were sent to the clinic from an upper level of distribution: the local health department, for instance, or even the state health department. In order for this individual to be inoculated with the vaccine, therefore, the nurse needs to have a dose on hand when the individual walks into the clinic. This implies that there needs to be a sufficient number of doses with the nurse to administer to anyone who walks into the clinic looking for a vaccine.

Following this conceptual model farther up the chain of vaccine administration, it is clear that the individual looking for a vaccine will only get one if there is enough being produced by the vaccine manufacturers, and if the amount that is produced can be wisely distributed among the states and the counties within each state. A lack of coordination at any level connecting the individual to the manufacturers of the vaccine jeopardizes the overall goal of the vaccine campaign: to inoculate as many people as possible and prevent the spread of disease.

The After Action Reports touch on this chain of distribution for the 2009 H1N1 Pandemic and show that the ability of states to hold successful vaccine campaigns was severely impacted by communication throughout the chain linking vaccine providers to the decisions made on the federal level. In turn, the ways in which states adapted to federal decisions impacted local health departments and the inoculation of individuals on a day-to-day basis.

These After Action Reports generally collected data from a focus group of healthcare professionals at one of several conferences held by states after the 2009 H1N1 Pandemic. The reports often included a breakdown of who contributed: hospital professionals, managers, school nurses, healthcare workers and several other portions of the healthcare industry were typically present at a given conference. Though the numbers of each were usually small (on the order of ones to tens), for the purposes of reviewing a state’s response to a well-known pandemic their feedback was often sufficient to get a general idea of what had occurred within the healthcare system during the pandemic.

National to State Distribution

The state health departments who submitted AARs revealed several similar issues with the dissemination of information from the national level which impacted their ability to distribute vaccines. The most evident of these issues was miscommunication about when and how many vaccines were going to be available after the first production round. Massachusetts, for instance, reports that the communication of the date of vaccine release was misleading; “As required by MDPH, many [local health departments or providers] had scheduled and advertised H1N1 clinics during late October and early November that had to be cancelled.” The anticipation of the vaccine exceeded the reality; this naturally caused frustration among the public and health officials when promises of clinics were not able to be met due to late vaccine production. Virginia ran into the same problem; their AAR states that “The roll-out of the public communication campaign for vaccination before vaccine was available was problematic.” The communication between the CDC and the states was therefore too optimistic at times, causing providers within states to make promises to their populations that they could not keep.

Not all states reported having this problem, however; in fact, the AARs suggest that it was primarily larger states that ran into the issue of advertising the vaccine too early based on reports from the national level. Smaller states generally did not have to rely heavily on announcements and could more easily mobilize a vaccine campaign given their population sizes. They may not have needed to plan as far ahead as the more populous states.

Regardless, there was one significant communication issue which impacted all of the states that submitted AARs. The CDC published a list of risk groups that the states were supposed to attempt to vaccinate first. These groups included pregnant women, healthcare workers, and children between two age groups (very young to young adult). Providers within several states noted that the risk groups seemed to keep changing, and they were unclear as to which groups they should be prioritizing. Additionally, health departments were often fielding calls from senior citizens demanding to know why they had not been included in the risk groups. A lack of both a clear explanation of the logic behind these risk group choices and a consistent message of the composition of the risk groups made it difficult for states to follow the recommendations of the CDC when it came to vaccinating only certain portions of their population. In Wisconsin, for instance, some local health departments administered the vaccine based on risk groups, and others did not (either they did not see the point or were confused about who fit into what risk groups) and “Many health departments indicated frustration when other health departments did not follow the target groups and felt DPH should have enforced adherence to target groups, while a few health departments felt they should have been able to make their own decision regarding when to expand the target groups.” The local health departments of California ran into similar issues: what the risk groups were and why they were chosen was unclear, making the formulation of a vaccine campaign based on these groups difficult.

The confusion concerning the composition of risk groups was further compounded once the first batch of vaccines arrived in the states. The initial shipment was both much smaller than health departments had anticipated and consisted entirely of the nasal-spray version of the vaccine. This was the fastest type to produce, but it also contained LAIV (live attenuated

influenza virus) which posed a potential health hazard to certain demographics. In essence, the type of vaccine first shipped was incompatible with pregnant women and younger age groups—in fact, it was only recommended for healthy people between the ages of 2 and 49. Thus first batch of vaccine could not be used on most of the risk groups, prompting further confusion when states attempted to follow CDC instructions and vaccinate at-risk individuals before anyone else.

Additionally, since the initial shipment was smaller than anticipated the risk group criteria were refined by the CDC. The initial groups included pregnant women, healthcare workers, caregivers to infants, people between 6 months and 24 years of age, and people ages 25 to 64 with other medical issues. The revised groups still included pregnant women (who could not use the first batch of vaccine), healthcare workers and caregivers, and now children between the ages of 6 months and 4 years (those under 2 could not receive the first vaccine shipped) and children between the ages of 5-18 years with chronic health conditions (also incompatible with the first vaccine shipped).¹

Therefore, vaccine distribution within the states was confounded by communication at the national level. The production time of the vaccine was not something any level of healthcare could have improved. The messages concerning when the vaccine would first be shipped, however, could have been more accurate. In the same vein, the need to vaccinate the most at-risk people first was well-communicated, though exactly how this should be done was not as obvious. It would be best in the future to be consistent about who should be getting vaccinated first and to give directions for what states should do if the first batch of vaccines cannot be used on some of the most at-risk populations. Many states were paralyzed by their desire to follow the protocols and recommendations of the CDC; either more of both need to be created in anticipation of contingencies, or the states need to be explicitly given more autonomy when it comes to vaccinating their own populations. Overall, a review of the national to state communication reveals that some of the issues that resulted were unavoidable at the time, but with careful planning they could become avoidable. Delays in vaccines should be expected and risk groups should be kept consistent throughout, especially if the overall goal is to prevent as many infections as possible.

1. Centers for Disease Control and Prevention. CDC Advisors Make Recommendations for Use of Vaccine Against Novel H1N1. July 29, 2009. Available at <http://www.cdc.gov/media/pressrel/2009/r090729b.htm>. Accessed on April 22, 2011.

Vaccine Distribution within States

Despite the mixed messages in the national to state level communication, some AARs reported comparatively successful vaccine campaigns. Other states cited continued frustration and planning issues. One of the main factors in a well-executed state vaccine campaign, independent of communication with agencies such as the CDC, was the vaccine distribution method.

There were three main strategies reportedly used to distribute vaccine within states. The first and most common method was determining distribution based on an online ordering system analogous to an internet store. Those registered to administer the vaccine were given a

link to a website created and maintained by their state health departments; at these sites, they could electronically request a specific amount of vaccine from the state. Then the state health departments would receive vaccine directly from the manufacturers, and providers such as doctors' offices and local health departments would subsequently receive a certain amount of vaccine based on their orders. The vaccine would then be given out to the general public by the providers.

The second method was population based; with this plan, the state health departments would again receive vaccine directly from the manufacturers, but they would distribute the vaccine to their counties proportional to the population of each county. From there, the local health departments and providers in each county were responsible for getting the vaccine to the public. The third method was a modification of the second; population based, except this time the populations of concern were the risk groups. There were a scattering of other distribution methods as well, but those were used by one state at most.

The AARs indicate that the most popular method was also the least successful in terms of equitably and quickly getting the vaccine to the public. Additionally, states which had experience with seasonal flu vaccine campaigns generally fared better than those without regardless of the distribution method used during fall 2009.

For instance, Massachusetts used the online-ordering method to distribute vaccine within its state. From the accounts in its AAR, this method generated more confusion than vaccine in the first weeks of shipments. The report cites "the confusion experienced and lack of guidance on how to make the original vaccine request to MDPH" specifically when dealing with determining how much vaccine to order, for which "No direction of how to arrive at that number was given." As a result, regions either divided or meshed in an attempt to maximize the amount of vaccine they were likely to get based on the populations they served. Some ordered for their entire populations, others only for population subsets, creating "confusion and disharmony between local health departments." Finally, the AAR specifically states that "[providers] decided to store the small quantities of vaccine they received until enough was sent to the health department to hold clinics in schools," delaying the administration of the vaccine until days after the first shipment. The AAR reports that the first vaccine was present in Massachusetts on October 5, 2009, but ten days later many towns were still complaining about not having received the vaccine.

Massachusetts was not alone when it came to confusion generated by an online ordering system for vaccine. Wisconsin providers also experienced frustration with their online system. Comments in the AAR from healthcare workers labeled the process as "inequitable" and "cumbersome." This was due to the structure of the ordering system; for instance, "[m]any agencies thought when they pre-registered or registered that they had also placed an order for vaccine, which was not the case." Additionally, in order to receive vaccine, the policy was to place an order after scheduling a vaccine clinic. In fact, providers had to report the date of a clinic on their order form. However, many providers who scheduled clinics before ordering had to cancel them when less vaccine than requested (or no vaccine at all) arrived by the planned administration dates. Several refused to follow this protocol. One provider even stated "I do not believe in scheduling clinics until we have vaccine in our refrigerator," a belief which further complicated the task of ordering vaccine and, ultimately, getting enough people vaccinated.

California's online system was similarly difficult to navigate. Like Wisconsin, "many providers...believed their 'requests' were actually vaccine 'orders,'" a clear problem with regards to both the expectations of the providers and the logistics of distributing the vaccine within the state. The distribution of vaccine was also, in the end, deemed inequitable by the contributors to the AAR. Likewise, Delaware providers "were confused about pre-registration and enrollment to receive vaccine" as they also had to navigate a multi-step, unclear ordering system to acquire vaccines. In the same spirit, North Dakota reported it needed "improvements to the vaccine registration software to increase end-user capabilities."

In general, the system of ordering vaccines online made sense from a theoretical perspective. Providers could request only what they anticipated using based on their target populations. As a result, the vaccine would get where it needed to be with little excess. However, in practice this method would have worked better if the ordering system had been tested before the 2009 H1N1 Pandemic necessitated its use. Providers needed clearer directions and stricter guidelines when it came to using this system. Additionally, most states were working with over 500 providers which made coordinating between the sheer number of orders and the much smaller number of vaccines difficult. Oftentimes, states using the online ordering method would lose track of vaccine shipments. Providers had no way of judging when they would receive the vaccine from the state, or even if they would receive vaccine. The online interfaces used by states were not designed to solicit or incorporate feedback; thus confusion was compounded with uncertainty.

It is possible that the online ordering system could become feasible with practice, stricter guidelines, and enough vaccines to distribute during a given pandemic. However, given a scenario similar to the one which states encountered during the first weeks of October, when the interest in getting vaccinated was highest and the actual number of vaccines lowest, other distribution methods should be preferred. This will avoid confusion and uncertainty on the provider's part, hesitation on the part of the state health departments, and disinterest in the vaccine on the part of the target populations.

Other methods to consider for future vaccine distribution during times of high demand and low supply include population distribution: allocating vaccine to counties or local health departments based on the populations each serve. Vermont and Montana both reported using population as the measure for how much vaccine would be given to local health departments. Montana handled the vaccine shortage remarkably well according to their records, "allocating supplies according to packaging and population [since this] has been a part of the Montana Public Health Emergency Preparedness Strategic National Stockpile planning for several years." The state health department made sure that every jurisdiction in Montana received a small baseline amount of vaccine. From there, the AAR indicates that the Montana state health department may even have used epidemiological surveillance from jurisdictions to portion out the remaining vaccine. This tactic required time and manpower to repackage the vaccines into smaller shipments, but on the whole it appears to have been successful in minimizing confusion and getting at least some vaccine to every population group in the state.

Vermont also reports distributing on a population basis; however, there were more complaints about the distribution in the AAR than with Montana. Healthcare professionals considered it erratic; the vaccine still had to be ordered to some capacity and this step in the system often caused delays and general confusion. The difference between Montana's success

and Vermont's frustration appears to be the level of coordination present when using the population distribution method. Montana made sure to get a base amount to providers and invested resources in making the vaccine shipments received from the manufacturers more convenient for the state to distribute. Vermont, on the other hand, also used a population distribution method but ran into trouble with the associated vaccine request system.

A slightly more refined distribution method, risk population, was used by several states to varying degrees of success. New Mexico, for instance, only used this method initially but with promising results. The state health department had a structure for vaccine clinics already in place from annual seasonal flu clinics, which helped organize the administration of vaccine once they were acquired and also helped to inform which organizations (schools, offices, hospitals, clinics) could administer the vaccine to the public most efficiently. The state health department sent population-portioned amounts of vaccine to five regional public health offices which, in turn, allocated those vaccine shipments to the fifty local health offices. The state health department also independently narrowed the scope of the risks groups once the vaccine shortage was realized and, like Montana, organized the repackaging of vaccine into smaller shipments. These measures appear to have worked well in terms of minimizing confusion and maximizing efficiency when it came to getting the public access to the H1N1 vaccine. The AAR cites the "38% of those individuals residing in the State of New Mexico who fall within the five initial target groups" vaccinated in comparison to the national average of 24% as evidence of their success.

Alaska, on the other hand, had a more direct distribution pathway from state to citizens, but also initially allocated vaccine based on the population of risk groups. The state health department had a much larger hand in the vaccine distribution in Alaska than in New Mexico. State healthcare workers personally delivered vaccine to registered providers and made a significant effort to contact the local populations living in the wildernesses of Alaska and get vaccine to them. In general, distribution by risk group population worked well given the vaccine shortage the nation encountered during the fall wave of H1N1 because it focused on maximizing the amount of vaccine being received by the people who needed it the most. This strategy would likely work poorly in times of vaccine abundance due to comparatively lower vaccine demand, but for the initial stages of vaccine distribution it made sense.

There were other methods to allocate vaccine attempted by states, such as an algorithm used by Nevada based on population, patient load, target population, and other logistic parameters. This algorithm was labor intensive to maintain and update as the flu season progressed. Additionally, the algorithm did not function well when it attempted to incorporate the vaccine shortage into its calculations; instead, the health department of Nevada allocated the vaccine to providers who could use it the fastest. New Jersey distributed the vaccine through several routes, including directly to businesses. Goldman Sachs, for instance, got its employees inoculated as soon as possible after the manufacturers completed the vaccine. Though the feat of inoculating any significant population group was impressive, the fact that this group worked for a wealthy company caused a public relations mess for the New Jersey state health department.

In the end, the distribution methods of each state had an impact on the perceived success of their individual vaccine campaigns. The AARs of several of the states reveal that the best methods for vaccine distribution in times of shortage are based on population; ideally,

they are based on risk group populations. The online ordering method can work well with an abundance of vaccine, but only if the system has been thoroughly explained to the providers and, ideally, tested beforehand. The online ordering method appears best able to handle the allocation of large amounts of vaccine, while the population-based methods seem adept at making sure some vaccine is put to good use during times of scarcity.

Additionally, states improved the success of their vaccine campaigns by personalizing the campaigns to their populations. As illustrated by Montana and New Mexico, acting independently of the CDC, or going above and beyond national guidelines, was sometimes a good thing. Both states spent energy to repackage the vaccine into smaller shipments to accommodate their populations, a measure which worked to ensure that at least some vaccine was received by all providers. States that had run seasonal flu vaccine campaigns prior to 2009 were also more prepared for the distribution of vaccine necessitated by the H1N1 Pandemic.

Therefore, it is clear that the vaccine management for future pandemics could be improved by taking specific actions now: practicing vaccine distribution at a local scale during annual waves of seasonal flu and preferring population-based distribution during times of high demand, low supply and online ordering distribution otherwise.

Conclusion: Next Steps

Without the existence of pandemic preparedness plans which matched the vaccine supply scenario met during the 2009 H1N1 Pandemic, states struggled with distributing vaccine to their populations before interest in the vaccine waned. By surveying the After Action Reports of fourteen states, reasons for the inequitable and slow administration of the H1N1 vaccine during the fall influenza wave were readily identified as communication issues between the national and state healthcare systems and the lack of practice with vaccine distribution systems in several states. Despite these issues, the AARs of some states indicate these were more successful than others with their vaccine campaigns. Thus the AARs further show that the distribution system of vaccine within a state was an important factor in the ability of healthcare professionals to administer what little vaccine there was to target populations. Indeed, distribution by population appeared to be less frustrating and more productive than the most popular distribution method used by states: online ordering.

All of the aspects of vaccine distribution, however, reduce to the simple fact that pandemic preparedness needs to be better in the future. These reports suggest that the best method is not a written plan which may or may not turn out to be useful. The best method is a plan which includes the following:

- A vaccine distribution system based on population for periods of low vaccine supply
- Likewise, a vaccine distribution system based on an online ordering website for periods of sufficient vaccine supply
- Thorough testing of both systems

In any distribution network, it is important to test the nodes such as an ordering system. These nodes need to work efficiently in order for vaccine get where it is most needed, ideally equitably but at least using a system that can be readily explained to local healthcare departments and other providers. Testing a system for attributes such as ease-of-use and clarity would also not be too difficult; it would require a series of vaccine providers giving

feedback on a test run of the system. In short, paper plans like the ones made in 2005 are not sufficient; in order to be ready for the next pandemic of any scale, states need to make sure their systems work.

Though a single AAR supplies only the voice of a state and a sample size of the healthcare industry within that state, there is value in examining all of them to determine measures which can be taken now to avoid similar frustration in future pandemics. Since this paper analyzed fourteen such reports in parallel, the conclusions drawn about the common issues faced by states cannot be lightly dismissed, even if a single opinion in a single report might be debatable. In sum, these AARs provide a compelling picture of the significant frustration and inefficiencies confronting every healthcare professional on every level of vaccine distribution, beginning with the manufacturers and ending with the civilian attempting to get inoculated against the H1N1 virus.

Table 1: Summary of State Vaccine Distribution

State Name	Initial Distribution Method	Strategies for Distribution	Concerns of Vaccine Campaign
Alaska	Risk group population	Alaska’s Department of Health and Social Services coordinated the distribution from a central repository (warehouse). Initially shipped to providers based on population; switched to an online order system once levels of vaccine were high enough.	Nothing significant. Alaska had to manage some hotspots of influenza activity (a school with high rates of absenteeism, for instance) but dealt with these situations as they arose.
California	Online ordering	Local health departments and other providers were responsible for storing and dispensing vaccine once receiving it from the state health department.	Anticipated a slower spread of the pandemic and a more lethal virus; as a result, preparedness plan was not used. Confusion over the online ordering system’s “request” versus “order” of vaccine resulting in inequitable partitioning of vaccine to providers.
Delaware	Online ordering	Prioritized vaccination of schoolchildren to deal with initial supply of LAIV vaccine.	The vaccine ordering system was multi-step and difficult to navigate for several providers. Orders were not easy to track and “requesting” versus “ordering” vaccine was a point of confusion with several providers.

Massachusetts	Online ordering	Providers merged or divided to navigate vaccine ordering system; no direction as to how to determine order amount	Vaccine clinics had to be shut down due to a lack of vaccine. Providers stockpiled vaccine until they had enough to distribute.
Montana	Population	Repackaged vaccine from manufacturers into smaller aliquots for rural populations. Ensured a baseline amount of vaccine distributed to all population groups.	Labor intensive to repackage vaccine and track vaccine distribution.
New Jersey	Preconceived population plan as well as online ordering system	“H1N1 Vaccine System” responsible for tracking and allocating vaccine.	Lack of transparency in the distribution method and the ordering process for providers. Some vaccine doses bypassed local health departments and were distributed at companies such as Goldman Sachs. Providers perceived inequitable distribution of vaccine.
New Mexico	Risk group population	Repackaged vaccine into smaller aliquots to distribute to providers. Larger providers received vaccine directly from manufacturers, smaller providers from the state health department. Utilized seasonal flu distribution plans to help with coordination of vaccine campaign. Refined risk group designations independently of the CDC to better accommodate the vaccine shortage.	Cancellations of scheduled vaccine distribution clinics were common in the first few weeks of distribution.
Nevada	Algorithm for distribution	State Immunization Program shipped to small, private providers and local health departments. LHDs distributed among their county’s providers.	Algorithm did not handle the initial vaccine shortage well. The state health department decided to distribute vaccine based on speed of administration instead. The many levels of distribution and autonomy between the levels were causes of confusion and some communication failures

			regarding the status of vaccine administration across the state.
North Dakota	Online ordering	Distribution sites coordinated at the local level but the state health department was primary vaccine provider within the state.	Vaccine ordering system cited to be in need of improvement, though no further details are provided in the AAR.
Ohio	Online ordering	Distributed to local health departments, and from there to providers. Vaccine management was performed by a designated "Vaccine Group." Often understaffed.	"Vaccine Group" was often overwhelmed by need and lack of supply. "Pre-registration" versus "registration" of online ordering was a roadblock for providers ordering vaccine. Online system often incorrectly processed vaccine orders.
Rhode Island	Population	Utilized a preconceived "Medical Emergency Distribution System" to handle the logistics of distributing and administering vaccine. Deliveries were made daily from a central warehouse; unused vaccine was returned at the end of the day.	Nothing significant reported in the AAR. Highest vaccination rate (38.8%) in the country.
Vermont	Online ordering	Attempted to motivate distribution based on population, but still used an online ordering system to connect with providers.	Difficulties in scheduling clinics around vaccine arrivals due to erratic distribution from the state health department and the vaccine manufacturers. Online ordering system caused difficulties in ordering and tracking vaccine.
Virginia	Online ordering	State health department distributed vaccine to providers	Advertised vaccine administration clinics too early, before vaccine was received.
Wisconsin	Online ordering	Providers in the state received vaccine from a variety of sources, including local health departments, the vaccine manufacturers, and hospital pharmacies.	Confusion between the "request" for vaccines and the "order" of a vaccine shipment in the online system. Many providers believed distribution system to be inequitable.

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