Running head: THE EFFICIENCIES OF MASS VACCINATION CLINICS

What are the Efficiencies of a Mass Vaccination Drive-Through Clinic compared to a Walk-In Clinic?

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Abstract

The problem is that the Stanwood Camano Fire Department (SCFD) made the first Regional attempt at facilitating a mass vaccination drive-through clinic; yet the efficiencies of this type of clinic compared to the coinciding walk-in mass vaccination clinics hosted by hospitals and medical clinics are still unknown. The purpose of the study is to compare SCFD's mass vaccination drive-through clinic to walk-in clinics to evaluate best practices for future clinics. To achieve this, four questions were answered: What are the efficiency elements of a mass vaccination clinic, what are the efficiency comparisons between SCFD's and the county's other mass vaccination clinics, what are the pros and cons of a drive-through mass vaccination clinic and what are the pros and cons of a walk-in mass vaccination clinic?

Data was collected by way of questionnaire from seven out of eight other Snohomish Health District's Strategic National Stockpile Point of Dispensing walk-in clinics held simultaneously with the SCFD clinic. An onsite survey was done by SCFD which was also used to evaluate and compare the efficiencies of its clinic. Literature review addressed the pros and cons of a walk-in and drive-through clinic and to identify their efficiencies. The research method chosen was descriptive.

Results from the questionnaire and SCFD's survey found that SCFD rated high in its ability to efficiently use staffing levels to vaccinate large numbers of the public quickly. SCFD's drive-through clinic was found to have several definitive advantages to vaccinating the public when it comes to biological events. SCFD's efficiencies were also found to be bolstered, in part, due to its operational procedures already being based on the *National Incident Management System (NIMS)*. It is recommended that SCFD update its Comprehensive Emergency

Management Plan to allow for a drive-through mass vaccination clinic to be part of its regular operational procedures.

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Introduction

The specific problem addressed in this Applied Research Project is that the Stanwood Camano Fire Department (SCFD) made the first Regional attempt at facilitating a drive-through mass vaccination clinic yet the efficiencies of this type of clinic compared to the coinciding walk-in mass vaccination clinics are still unknown. To date, none of the data collected from the other participating mass vaccination clinics hosted by hospitals and medical centers has been analyzed nor has any of the data been officially published. This has left SCFD questioning the efficiencies of the unique method it chose for assisting in the 2009 H1N1 pandemic vaccination efforts.

The purpose of this research is to compare SCFD's mass vaccination drive-through clinic efficiencies as they relate to the walk-in clinics held simultaneously and to select the best practices for future mass vaccination clinics. To achieve this, descriptive research was used to answer the four questions: what are the efficiency elements of a mass vaccination clinic, what are the efficiency comparisons between the other countywide mass vaccination clinics and SCFD's vaccination clinic, what are the pros and cons of a drive-through mass vaccination clinic and what are the pros and cons of a walk-in mass vaccination clinic.

Background and Significance

The Stanwood Camano Fire Department consists of 42 career firefighter/EMT’s and paramedic/firefighters, approximately 25 part-time and 38 volunteer firefighter/EMT’s, 10 support members to include chaplain response, 2 mechanics and 11 career administrative employees and one emergency manager. The response area covers an estimated population of

23,200 ("Washington State Fire Service Directory", 2008, p. 27, 68) where three of the six stations are staffed 24 hours a day. The Department covers a combined initial response area of 47 square miles with 57 miles of shoreline.

SCFD, also known as Island County Fire District #1 and Camano Island Fire & Rescue, serves the entire geographical region known as Camano Island in Washington State. Although located on an island, we are connected to the mainland by a bridge. Just over the bridge on the mainland is the City of Stanwood in Snohomish County. On January 1, 2006, the City of Stanwood signed an interlocal agreement with Camano Island Fire and Rescue to manage its fire department and to provide advanced life support response and transport to the residents of Stanwood City. Due to our partnership, both departments operate effectively as one and are referred to as Stanwood Camano Fire Department.

The department is not only committed to suppression, medical response and transport, but also to “all hazards”, which include but are not limited to, surface water rescue, marine-based firefighting, high-angle rescue, technical vehicle rescue and hazardous materials response. According to the department’s documented response statistics, between 1999 and 2008 our department responses grew from 1034 to 3545 responses for the year 2008 (Stanwood Camano Fire Department [SCFD], 2009, p. 3). The problem for SCFD is directly associated to the United States Fire Administration’s (USFA) strategic plan’s goal #2, “Improve local planning and preparedness” and goal #3, “To promote within communities a comprehensive, multi-hazard risk-reduction plan led by the fire service organization” (U.S Department of Homeland Security, 2009, p. 17). This research project has a direct relevance to the Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM) course (United States Fire Administration [USFA], 2006).

In 2005, under the direction of Stanwood City Mayor Dianne White, City of Stanwood officials, along with representatives from Skagit Valley and Providence Everett Hospitals, The Everett Clinic (TEC), the Skagit Camano Medical Center (SCMC), representatives from the Snohomish and Island County Health Districts and SCFD met to discuss how a pandemic might impact our area. The City of Stanwood's staff felt that, due to its rural location and distance from the urban County seat located in The City of Everett, that in the event of an actual pandemic, the City would more than likely have to "fend for itself." From these initial meetings, the City developed a Pandemic Flu Response Plan as Incident Annex F to the City's Comprehensive Emergency Management Plan (CEMP). The original Annex F and the ESF #8 Public Health and Emergency Services did well in addressing many of the concerns brought up in our original planning meetings, but it did not address the possible need for the City to take a more active role in assisting the Public Health Districts with mass vaccinations (The City of Stanwood, 2010).

Then, on June 11, 2009, the World Health Organization declared that the H1N1 flu virus had become a worldwide pandemic (World Health Organization [WHO], 2009, ¶ 1). The United States Department of Health and Human Services had also issued a nationwide public health emergency declaration in response to the rapid increases in infections from the unique H1N1 virus (U.S. Department of Health & Human Services [USDHHS], 2009, ¶ 1). The Snohomish Health District then began planning for widespread transmissions of the H1N1 flu virus which resulted in establishing a countywide Unified Command to mitigate, prepare for, respond to, and recover from this health crisis.

The City of Everett Office of Emergency Management activated the Everett Emergency Operations Center (EOC) September 2, 2009, through December 23, 2009, which supported the

Joint Information System in organizing a coordinated public information campaign (Snohomish County Unified Command for h1N1 response and mass vaccination clinic support, 2010, p. 2). On October 9, 2009, Snohomish County, located in Washington State, proclaimed a State of Emergency to prepare the county to receive and distribute the H1N1 vaccine. This was also done to meet Washington State Department of Health guidance for EMS administration of the vaccine so that the County would have an adequate number of qualified vaccinators to inoculate as much of the population as possible (Snohomish County Executive Office, 2009, p. 1). On October 24, 2009, President Barack Obama declared a National State of Emergency in order for health and medical facilities to better combat H1N1 flu (The White House, Office of Press Secretary, 2009, ¶ 2).

With the epidemic expanding aggressively and vaccination shipments from the being sporadic and unreliable, the Snohomish Health District decided to rapidly deliver the vaccine it had received through mass vaccination clinics to protect the most at-risk populations identified by the Centers for Disease Control (CDC). Initial reports to SCFD, although not confirmed at the time, were that only one site was being considered for Stanwood, to be located at and hosted by The Everett Clinic, Stanwood (TECS). Because of The Everett Clinic's commitment to host two other distant mass vaccination clinics, staffing for our local clinic was going to be an issue. Local TECS vaccination coordinator Kim Gangloff advised that she had only a handful of staff available for the TECS Clinic and that it would also have to be held at the TECS, which would also still be open to receiving patients for medical care (K. Gangloff, personal communication, September, 2009).

Concerns were also brought to light that, had TECS established a mass vaccination clinic at its Stanwood location, the City's two highways and downtown arterials would be unable to

handle the influx of people wanting to be vaccinated. Such a situation would have the potential to hamper public safety response to the area due to traffic congestion and create secondary events, such as traffic collisions. Another concern was that the City of Stanwood and Camano Island, which are tied together socially, economically and geographically, are in two different counties; each county with its own health jurisdiction and there was no ongoing coordination between the two counties for the dispersal of vaccinations. Camano Island also shared the disadvantage of being isolated by having its County seat located across the Puget Sound on Whidbey Island, an hour and a half away by land and lacking direct, water-based ferry services.

It was decided locally that the involvement of the Stanwood Camano Fire Department, which was the one entity responsible across the County borders for fire, EMS and emergency management, might be the most appropriate agency to have oversight over these issues in order to lessen the overall impact that the H1N1 pandemic would have on our community. SCFD initiated communications with the local health district jurisdictions and health care providers to begin coordinating facilitation of a local mass vaccination clinic.

During the period of September through October, 2009, the Stanwood Camano area emergency response community, which now consisted of the City of Stanwood (Fire, Police, Public Works), Snohomish Health District, Snohomish County DEM, Island County Health Department, The Everett Clinic located in Stanwood, The Stanwood Camano Medical Center in Stanwood, and health care providers from the local skilled nursing facilities who collaborated under the sponsorship of the Snohomish Health District and the Island County Health Department as key stakeholders to plan and execute a drive-through mass vaccination clinic for the H1N1 virus. While other mass vaccination clinics in the two counties focused on the traditional walk-in clinic format, it was decided that the situation in Stanwood necessitated a

different approach. In order to be effective, not add to the risk of contagion, address concerns of inadequate parking and the lack of suitable facilities available to host a walk-in clinic, that a drive-through format would be a better choice to meet planning and operational objectives.

Planning in Stanwood was coordinated by the Stanwood Camano Fire Department (SCFD) to hold an H1N1 POD (Point of Dispensing) vaccination clinic on October 31, 2009. The Incident Management Team (IMT) structure and planning philosophy was used both to enhance familiarity with this standard system and because most all clinic planning partners had a basic understanding of the National Incident Management System's(NIMS) Incident Command System (ICS). Two weeks prior to the scheduled date, a change in vaccination strategy by the Snohomish Health District determined that multiple clinics around the county should be held as soon as possible to get the available vaccine to the groups most at risk. To the Stanwood planners this meant the clinic date was advanced one week to October 24, 2009. The Incident Action Plan (IAP) primarily designed by SCFD with continual input from the key stakeholders, IMT documentation, and excellent teamwork by the major participants, made meeting this date possible.

This initial clinic held on October 24th, although hurried and hampered by high wind conditions the night before, was set-up and ready only 10 minutes later than planned. While over 1200 doses of vaccine were available, factors such as the restricted vaccination priority group, poor weather, a definitive lack of available advertising time, and some public fear of vaccine safety, made the client turn-out low with only 250 doses administered (K. Sylliaasen, personal communication, October 24, 2009). The positive out-come was that the drive-through clinic process worked well. At this time, the Snohomish Health District announced that another clinic with an expanded target group would be held on the 31st as originally planned.

The lessons learned from the October 24, 2009 clinics were applied to the clinic structure and process and changes were made in a number of areas, including: staffing, site set-up, supply-support, traffic and security. The Centers for Disease Control (CDC) priority groups eligible for this clinic were expanded and 1800 doses of vaccine were made available for the SCFD clinic. Although high winds again plagued the outdoor clinic site the night before, the clinic was able to open 15 minutes earlier than scheduled. At that time, there was in excess of 500 cars in-line waiting for the clinic start. The operational lessons learned the week before made for a more efficient operation.

Early-on, based on the rapid vaccination thru-put and the number of cars in line, more vaccine was transferred to SCFD from another clinic. The Stanwood clinic, originally scheduled to be operated from 0900 to 1300, stayed open for an additional hour and a half (until 16:30) to vaccinate those still in line waiting. Although the number of vaccinations during those additional 90 minutes was minimal compared to the activities earlier in the day, turning people away who had been waiting in line would have been a public relations disaster. The final count of vaccine doses administered was 2551 (T. Neumann, personal communication, April 30th, 2010).

This was a large and unprecedented undertaking by the SCFD since never before had it been considered that a local fire department would have such a major leadership role in this type of event. Considerable time by SCFD staff was committed to developing the clinic's incident action plan, attending health district and County EOC briefings, and in the logistics and planning for the operation. In order to address the real fear that there might be inadequate medical staffing, paramedics from SCFD were also used for dispensing vaccinations. The event had a definite impact on the department's normal, daily operations. The total benefit of hosting the

clinic for the Stanwood Camano residents and to the department at the time, and presumably for the future, was based on the expectation that it would be an efficient method of illness prevention and risk management. Until then, mass vaccination had not been an area that SCFD had originally intended to be part of its normal operations. Understanding the impact of the department's involvement would effect future considerations of hosting a clinic, and which method of dispensing, drive-through or walk-in, would invariably be selected.

Literature Review

One of the key issues that needed to be addressed through literature review was what a mass vaccination clinic is and what it is intended to accomplish, which would a basis for identifying the key efficiency elements for the clinic. We also need to identify all of the players needed to make a clinic successful. Starting at the top, the Office of Public Health Preparedness and Response (OPHPR), formerly known and referred to by current literature as the Coordinating Office for Terrorism Preparedness and Emergency Response (COTPER) "coordinates terrorism preparedness and emergency response activities across CDC and strategically distributes funds to other CDC centers and offices" (Centers for Disease Control and Prevention [CDC], 2008, p. 147). The Centers for Disease Control and Prevention (CDC) manages the Strategic National Stockpile (SNS) which is a national repository of antibiotics and other critical medications, along with medical supplies, that are intended to assist public health agencies respond to emergencies. The CDC releases or delivers the SNS to states when the need exists (Centers for Disease Control and Prevention [CDC], 2008, p. 22).

Once it is determined that a State(s) is in need of items from the SNS, the National Department of Health and Services (HHS) will deliver an initial "12 hour push package" of initial supplies and pharmaceuticals and then transfer authority for the material to the state and

local authorities. More supplies will then be forthcoming as SNS members remain onsite to assist and advise state and local officials in putting the SNS assets to prompt and effective use (Centers for Disease Control and Prevention [CDC], 2009, ¶ 14). In responses that require such, state and local authorities now have the task of distributing vaccinations to specific target groups as outlined by the CDC. In the case of the distribution plan for the joint Snohomish/Island County POD's, it was decided to be accomplished with the use of both walk-in and drive-through mass vaccination clinics.

Specific objectives of the SCFD's clinic were to first vaccinate public safety and health care providers, keep the patients who opted to receive vaccinations from clogging critical infrastructure, provide a safe POD that decreased the potential for exposure for both vaccinators and those receiving the vaccination, and to vaccinate as many as possible safely and quickly (Simmons & Reid, 2009, p. 2). For any type of biological outbreak, it is SCFD's intent to assist in vaccinating as many people as possible in hopes that we can avert an increase in related 911 calls from infected, exposed or simply concerned citizens. It was assumed that the potential for putting an unmanageable burden on our system due to poor or untimely vaccinations, resulting in increased illnesses and a need for EMS response, had greater probability than our system being burdened by assisting public health with timely mass vaccinations. Through SCFD's participation in the vaccination process, it was believed that our system would have a better chance of maintaining system wide homeostasis.

While mass vaccination clinics of SNS POD derive their origins from the Department of Health and Human Services (DHHS) and the Centers for Disease Control (CDC), in the State of Washington the POD concept had evolved to include the fire and EMS involvement as outlined in Washington State's *Pandemic Influenza Planning Overview* (Washington State Department of

Health [WSDOH], 2005, p. 1). Not citing specific details relating to fire and EMS's roles in this type of event but still having general codes relating to the topic is the National Fire Protection Association (NFPA). Listed in the NFPA's National Fire Codes can be found NFPA 1600, *Standards on Disaster/Emergency Management and Business Continuity Programs*. In Chapter 5, Program Management outlines how fire and EMS are to operate as a resource for a variety of emergency response hazards. This includes facilitating responses to natural, technological and environmental disasters (National Fire Protection Association, 2005).

For research question one; what are the efficiency elements of a mass vaccination clinic, literature review varied little. Universally, the objectives of a POD are to minimize bottlenecks for efficient patient flow, to design a floor plan that prioritizes the expected transit pattern of individuals that may have specialized needs, and to be easily accessible to the public to maximize vaccination effectiveness. Effective use of staff for a POD is essential, as is having enough staff to separate sick from non-sick individuals who have arrived together for vaccinations. An effective POD would have OSHA rated N95 masks to give individuals who are triaged as sick (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services [AHRQ], 2004, p. 39), and reiterating that social distancing is still a standard for decreasing a person's exposure to any biological agent.

It is recommended that large and small social gatherings should be discouraged or cancelled to decrease the transmission of disease (National Governors Association Center for Best Practices [NGA], 2006, p. 18), which is contradictory to a walk-in POD designed to bring the masses together for vaccinations. While the AHRQ advises that it is preferable to prevent infection when possible, for both the patients and health care workers, the AHRQ also states that patients becoming infected with a contagious disease inside the POD have a decreased chance of

that infection progressing to actual symptomatic illness since they received prophylactic medications (AHRQ, p. 39).

If the vaccination event was in response to a localized terrorist attack, public health agencies may be discouraged from implementing walk-in POD's in large facilities for fear that the large congregated masses may present itself as a prime target to terrorists, making the POD susceptible to a secondary attack. During the time span of April 4th through April 8th, 2005, an exercise called TOPOFF (Top Officials) 3 was held in the States of Connecticut and New Jersey to provide an opportunity for federal, state, and local agencies to carry out a coordinated response to a large-scale terrorist attack involving a biological agent. The exercise emphasized on implementing the POD strategy for dispensing antibiotics to asymptomatic individuals. The possibility of the POD being the subject of a secondary attack as they were attempting to treat victims of the first attack was outlined in a paper titled *TOPOFF 3 Comments and Recommendations by Members of New Jersey Universities Consortium for Homeland Security Research* (Lioy et al., 2005, p. 4).

It would also be a concern that if any type of natural or technological event prompted the necessity for POD's that they might become an appealing target for an initial terrorist attack. The paper further pointed out an observation that large, centralized POD's might not be able to handle the traffic congestion, decreasing the efficiencies of the POD. Decentralizing and using multiple PODS and bringing the pharmaceuticals to the affected areas with heavy support from fire, EMS and law enforcement was recommended. Structure for deployment and the ability to coordinate and control event activities through communications and command centers was found to be crucial in implementing a successful POD (Lioy et al., p. 8, 9).

Some locations that may seem to be natural locations for mass vaccinations have their own specific disadvantages. The CDC now recommends that hospitals or other established health care institutions such as medical clinics should not be considered as POD sites, and that they will more than likely be overwhelmed with the increased patient loads created by the event. Because of their limited inventory and staffing, small size of the buildings, floor plan design and security issues, commercial pharmacies are also not recommended (CDC, 2005).

For a mass vaccination POD to be efficient and successful, representatives from local, county, state and federal levels are needed to be involved at one point or another. For the Stanwood Clinic, the most significant partners were the Snohomish Health District, the Island County Department of Health, the Stanwood Fire and Police Departments, the medical staffs of The Everett Clinic-Stanwood, The Stanwood Camano Medical Center, individual medical professionals from the Josephine Sunset Center and the Warm Beach Senior Center and the Snohomish County Department of Emergency Management (SNODEM), who provided oversight of the Emergency Operations Center in conjunction with the Snohomish Health District (SHD). Their ties at the State and Federal level allowed them to take delivery of Snohomish County's portion of vaccines from the CDC and then distribute those supplies to the clinics. The involvement of the aforementioned type agencies has become a necessity when developing a planning guide for a Point of Dispensing site, as echoed in the draft version of New Mexico Point of Dispensing Planning Guide (Torok, 2008, p. 13).

The H1N1 vaccines that were dispensed by the October 31st 2009 mass vaccination clinics were allocated and released by the CDC, although a private company was used for the national distribution (G. Goldbaum, personal communication, June 4, 2010). While not part of the CDC's specific SNS inventory at the time, the H1N1 vaccines were an asset controlled by the

CDC and distributed by the Snohomish County Clinics similarly to how antibiotics, chemical antidotes, antitoxins, life-support medications, IV administration, airway maintenance supplies, and medical/surgical items normally stored by the SNS would be distributed. This method of combining SNS terrorism response strategies to pandemic response plans is part of the CDC's expanded focus on their dispensing plan (Department of Health and Human Services [DHHS], 2008, p. 356)

One type of mass vaccination program that was found in the literature review is what the Department of Health and Human Services (DHHS) refers to as the "push" approach. In a Memorandum of Agreement between the Department DHHS and the U.S. Postal Service (USPS), the USPS could be used to deliver medicine directly to individuals or homes in an affected region (AHRQ, 2004, p. 8). The "Push" approach also has an advantage of being faster and offering more widespread coverage. But where it is weak is in its ability to offer medical evaluations, dosage adjustments or allow for medications that need to be injected to be done so safely and with oversight. In the case of Snohomish County's mass vaccination clinics of October, 2009, the "Push" method was not an option since the H1N1 vaccines had both dosage adjustment or injection requirements.

The Texas Department of State Health Services advises that a clinic that can vaccinate the highest number of individuals with the least amount of staff necessary will be more efficient. A clinic that offers a warm, dry and stable environment with handicap access will also be most efficient. It should also offer the following: adequate bathrooms, water, electricity, a method of communicating with the clinic's staff and patients, equipment drop-off area, separate and secure parking for clinic staff and patients, as well as a break area for staff. Other elements for an efficient clinic would include items such as a staging zone for press, helicopter landing zone,

traffic control and site security, and a location for patients that may need medical attention (Texas Department of State Health Services, 2007, p. 4).

To assure a solid base of operations for a clinic, the operational aspects of an Emergency Operations Center or an Incident Management Team should be imbedded. This should include staffing for the following positions: Incident Commander or The POD manager; Operations; Logistics; Planning; Medical Branch, which is responsible for medical triage, medical evaluation and transport; Security; Public Information Officer (PIO) Safety; and other branches, groups or divisions as outlined by the National Incident Management Systems (NIMS), a companion document of the National Response Framework (NRF) (U.S. Department of Homeland Security [USDHS], 2008, p. 50).

Having addressed the efficiency elements of mass vaccination clinics, questions three and four, what are the pros and cons of a drive-through mass vaccination clinic and a walk-in mass vaccination clinic should now be addressed. Depending on the intended objectives of a mass vaccination clinic; the type of pharmaceutical that may need to be dispensed at the clinic, staffing capabilities and the issue of how many individuals need to be vaccinated in a specified time-line all have weight on which type of clinic should be implemented. This information will invariably influence the direction that SCFD takes in future clinic planning and response.

Drive-through mass vaccination pro's found through literature review included a decreased risk of exposure for health care workers and patients at the clinics. With individuals staying "encapsulated" in their own vehicles, they could decrease their chances of exposure through social distancing. Also, by staying in their vehicles, they would avoid further potential for exposure by removing the potential of touching viruses that might frequent an indoor walk-in clinic (Greene & Moline, 2006, p. 156).

Through a survey given to a group of emergency medical responders by Dr. Niklas Mackler, it was found that in a high risk event such as a smallpox outbreak, the medical workers willingness to show up to work was directly related to their own level of safety and protection from the virus (2007). As cited earlier, with a drive-thorough clinic health care providers could decrease their potential exposure to the patient, an advantage that may help address the issue of health care workers not showing up to work at a clinic for fear of exposure. The Occupational Safety and Health Administration (OSHA) even recommend using drive-through for isolation purposes; not necessarily for vaccination clinics, but also for things such as the distribution of food or supplies (U.S. Department of Labor Occupational Safety and Health Administration [OSHA], 2009, p. 9).

The primary issues of making sure people are warm or cool, comfortable and entertained can be solved in a drive-through setting with patients simply staying in their vehicles. Individuals with limited physical mobility have less of an issue if they can stay in their vehicles, which is also an easier method to keep families together (Torok, 2008, p. 11). Expanded drive-through clinics are less of an effective target for initial terrorism or a secondary attack (Lioy et al., 2005, p. 4) and static parking is not a problem for a drive-through clinic. Drive-through clinics still need to plan for long lines of vehicles, which could become a con.

The cons of drive-through mass vaccination would include people who are unable to drive, although the same would be true for walk-in clinics. Running out of gas and stalling a line would cause complications. Paying for gas after idling for hours would be a con. Carbon monoxide poisoning was also brought forward as a possible hazard for the drive-though by the SCFD planning staff. Weather is an issue; maybe not for the patients in their cars but for the medical staff at the outdoor clinic. Exposure to biological agents might be less of an issue, but

exposure to the environment is a definitive con. In extreme cold, it might slow down the vaccination process in a drive-through if people have to remove excess clothing (Torok, 2008, p. 11).

Getting information out to people in long lines of cars might be problematic. Traffic control issues and the need to spread security resources out over a vast area may prove to be difficult. The potential for impacting surrounding businesses or thoroughfares might exist if your clinic is near any critical infrastructure. Communications to patients in a long line of cars might also be a difficult task to accomplish. All of these issues were identified in the *Stanwood-Camano H1N1 mass vaccination clinics: After action report* (Simmons & Reid, 2009).

For research question four, what are the pros and cons of a walk-in mass vaccination clinic; pros found through literature review found that communication to patients in large facilities would be easier and therefore offer more options for educating the public in line for vaccination. All clinic staff and patients would have a better opportunity to be warm and dry in an indoor environment. Facility amenities such as electricity, storage capabilities, phone and internet connectivity, audio-visual equipment, break-rooms, restrooms, availability of coolers needed for pharmaceutical storage, and the ease of security control measures are all desired benefits available at facilities that would be considered for use as a walk-in clinic (AHRQ, 2004).

The cons of walk-in mass vaccination would include having potentially sick people congregate with healthy people (NGA, 2006, p. 18). A majority of the literature reviewed and cited stressed social distancing as being a priority to keep illnesses from spreading. For the patients, indoor clinics make it more difficult for family's walking in a long, slow line to keep younger members of the family entertained. Family members with limitations on mobility may

find standing in line difficult, especially when a clinic may be crowded and they are outdoors enroute to the dispensing point of a walk-in clinic.

If the indoor clinic is too small, you will have issues with patients standing outside, exposed to the elements (Snohomish County Unified Command for h1N1 response and mass vaccination clinic support, 2010, p. 8). Individuals with limited physical mobility are more prone to inconveniences by having to stand in line. A mass walk-in mass vaccination clinic has the logistical disadvantage of needing vast amounts of static parking space. If parking is needed at multiple locations because of the lack of parking spaces, then transportation by mass transit will also need to be considered. This has the disadvantage of needing extra staffing and vehicles to accomplish, and the need for clear thoroughfare. If there is access to a large stadium with ample parking, this disadvantage is overcome, but the risk of placing large populations of people together and exposing them as a terrorist target would then exist (Lioy et al., 2005, p. 4). It was also concluded in Dr. Lioy's paper that the stadium method would be in contrast to the benefits found of having several clinics spread out for easier access and attendance by the affected population.

While the intent of this paper was to compare and review SCFD's H1N1 pandemic mass vaccination drive-through clinic efficiencies to walk-in H1N1 pandemic mass vaccination clinics for the dispensing of vaccines, during literature review it was found that the same SNS POD template used by our clinics had significant value by the SCFD for use in other venues. This template could also be used for pharmaceutical distribution for a biological weapon of mass destruction attack, for the evaluations of numerous patients in need of medical triage from natural, technological or sociological disasters that might otherwise cripple a regions resources

("Ramping up for flu season", 2009, p. 8), and as a drive-through for the distribution of items such as food, water and other essentials (Ekici, 2009, p. 5).

In summary, literature review found both viable pros and cons to drive-through verses walk-in mass vaccination clinics. It is also realized that depending on the scenario, no one type of clinic is optimal for all events requiring mass vaccination. What were not found in the literature review were publications that pontificated against the philosophy of the value of mass vaccination clinics. Also found was that successful clinics keep both the clinic staff and patients safe, comfortable and informed and to do so takes planning and a willingness to identify and work with all stakeholders. The locations of mass vaccination clinics need to be carefully chosen for ease of set-up and access by public and staff. Clinics should not cause congestion for area infrastructure and should attempt to be ran as efficiently as possible with as limited resources and staffing as possible, while doing the most good, as was the intent of the SCFD clinic design.

Procedures

To address research question one; what are the efficiency elements of a mass vaccination clinic; research question three; what are the pros and cons of a drive-through mass vaccination clinic and research question four; what are the pros and cons of a walk-in mass vaccination clinic, a literature search was started on November 18th, 2009, at the Learning Resource Center (LRC) at the National Fire Academy (NFA) to locate any Executive Fire Officers' (EFO) Applied Research Papers (ARP) that may provide information on the topic. The key words used for the search were vaccinations, mass vaccinations, drive-through clinics, walk-through clinics, drive-through, walk-through, vaccinations, biological, Weapons of Mass Destruction, terrorism, bioterrorism, pandemic, H1N1, pandemic and several combinations of the words in Boolean searches.

An article search was later done with the following magazines: *Fire Chief, Fire Rescue,* and the *Journal of Emergency Medical Services (JEMS),* which were found to have little in the way of useful information on the topics. Also used were the same key words; vaccinations, mass vaccinations, drive-through clinics, walk-through clinics, drive-through, walk-through, vaccinations, biological, Weapons of Mass Destruction, terrorism, bioterrorism, pandemic, H1N1, pandemic and several combinations of the words in Boolean searches.

The same key words were used to search the Sno-Isle Public Library System, the National Fire Academy's Learning Resource Center online and the National Fire Protection Association (NFPA) National Fire Codes (NFC) with the results producing literature later referred to in this paper. Literature from private industry, County Health Districts both local and nationwide, the SCFD offices, federal government agencies and medical centers was also retrieved and referenced. Also searched with the same key words were the two web search engines Yahoo and Google Scholar, which did produce applicable results.

For research question three; what are the pros and cons of a drive-through mass vaccination clinic, the potential for carbon monoxide poisoning was brought forward by the SCFD's POD design team as a possible con for POD staff working at the drive-though. In response to this, a RAE Multi-detector was tested and placed on a 36" high table top in the middle of a six foot space between two lanes of cars being vaccinated; which was considered to be the most congested portion of the drive-through clinic. The tent that the detector was placed in measured 20 long and 20 feet wide with open walls on all four sides and a 14 foot peaked ceiling. According to wuderground.com, wind speed ranged from 0 mph to 14 mph from the North West averaging 1.3 mph with gusts up to 21 mph. Mean temperature was 53 degrees Fahrenheit with a dew point of 50 degrees Fahrenheit, a sea level pressure of 30.49 inches and an

average humidity of 88% (Weather Underground, 2009, ¶ 1). The RAE Multi-detector alarm and parameters were set to alarm and record at any readings of carbon monoxide (CO). After placement of the detector and approximately 15 minutes of visual monitoring showing negative for increased CO levels, it was left in place as a monitoring alarm.

Through the Snohomish Health District, all nine of the vaccination clinics had the same oversight, "just in time" training, public information releases and adhered to the same target groups for vaccinations as the other clinics. Representation from the Snohomish Health District was onsite and maintained that all clinics operated under the Point of Dispensing mass vaccination template. Adjustments for efficiency and from lessons learned were allowed and shared with the incident commanders of the other clinics through a live and constant communications network.

During the original planning to open all nine vaccination clinics simultaneously for the 31st of October, the Snohomish Health District adopted a new vaccination strategy based on an urgency to dispense any and all vaccines currently available. After reviewing the amount of vaccine on-hand and likely to be available by the 31st, the Snohomish Health District (SHD) determined that it would advance the initial clinics to October 24th in order to vaccinate the highest CDC priority group – pregnant women and children from 6 months to just under 5 years. All nine clinics were able to effectively staff and put into operation their POD clinics for that date. The clinics held on the 24th, while deemed a success, delivered a much smaller percentage of the vaccination that was later delivered on the 31st.

Comparatively, SCFD dispensed 250 doses of the H1N1 vaccine on the 24th and then 2551 doses on the 31st. The advantage gained was that the clinics held on the 24th allowed for a "dry run" of their operations before they were forced to address a wider range of public now

eligible for the vaccinations. In the following week after the 24th vaccinations, through countywide meetings, webinars and phone conferences, each clinic was able to share their individual strengths and weaknesses with the other clinics and be better prepared for the final and larger mass vaccination event to be held on the 31st.

With these lessons learned and shared, each clinic was able to adjust its operations to allow for increased efficiencies in its POD activities. Based on this, the data collected from the October 31st clinic activities, after having "practice" runs the week before, became a more accurate reflection of our efficiencies and comparables of the other walk-in clinics. To get an accurate comparison of clinic outcomes, with only local clinics that participated in the aforementioned vaccinations, meetings, webinars and phone conferences were cited in this research paper.

One method used to address research question two; what are the efficiency comparisons between other countywide mass vaccination clinics and SCFD's vaccination clinic, (Appendix A) was the Vaccination Questionnaire (Appendix A) designed by the author. A sample run of this questionnaire was sent out to the Snohomish Health District (SHD) for review. Since SHD had already sent out a similar but more in-depth survey that they were still awaiting responses for, confirmation was made that the SCFD questions accurately reflected the events that occurred.

The final Vaccination Questionnaire consisted of ten questions and was then sent out by electronic mail to eight of the other nine mass vaccination clinics (Appendix B) that participated in the countywide mass vaccination event on October 31st, 2009. Eight of the nine evaluated clinics returned their questionnaires and the results were compiled into Microsoft Excel in a raw data format (Appendix C), mined for data, and the analysis of such was used to address research question three. A tenth clinic was also set up at the Tulalip Pharmacy, although due to its limited

capabilities for mass vaccination, its data was not considered to be useful for comparison. Survey results were also never received from the Tulalip Pharmacy.

Vaccination Questionnaire questions number two; total hours of operation; numbers five and six; what was the total number of volunteer/paid staff positions onsite, and number seven; total number of injections and nasal vaccinations given at the sites on October 31st, were used in the statistical analysis of clinic efficiencies. Two different types of efficiency comparisons; Vaccinations Per Hour (VPR) and Hourly Vaccinations Per Staff (HVPS), were used to evaluate clinic throughputs.

One other efficiency evaluation tool, referred to as the SCFD POD Survey, was used only at the SCFD clinic site to help answer research question two; what are the efficiency comparisons between SCFD's and the county's other mass vaccination clinics. For two hours, during the SCFD clinic's peak hours of operations (1000 until 1200), two seniors from the Stanwood High School monitored one vaccination line of cars each out of the six that were operating, all six having equal volume and capacity. The evaluators staged at the point of dispensing where they timed from the moment the vaccinator approached the vehicle until the vehicle started to drive away. This information is listed in Appendix D and is referred to as the SCFD POD Study. Vehicles in the Extended Needs section of the POD were not included in the sampling, although the total number of cars that used the Extended Needs section was estimated to be fewer than 20, according to the clinic's Operations Chief (L. Yengoyan, personal communication, October 31, 2009).

Also documented was how many people per vehicle were vaccinated, whether they received a nasal or injectable vaccination and if they were a child or adult. Ages six months up to and including 17 years old were considered to be children. The evaluators recorded all

vehicles that went through vaccinations in the two hour period of time, how many adults or children received injections or nasal vaccinations in each car and how long it took. The rapid rates at which the vaccinations were being accomplished presented limitations to the evaluators overall abilities to record precise seconds, so vaccination times for each vehicle were instead rounded to the nearest whole minute. For example: 45 seconds would be recorded as one minute and one minute and 29 seconds would be recorded as one minute. To address these limitations, having two evaluators instead of one at each station; one to keep time and the other to record the number of vaccinations per vehicle, might allow for the recording of vaccination times to the exact second, potentially fine tuning the accuracy of future surveys.

The SCFD POD Survey sampled 375 cars containing 821 people who received vaccinations. To find the average number of people vaccinated per car, the VPH for the SCFD POD Survey was arrived at by dividing the average time it took to vaccinate the occupants of one vehicle into a period of one hour and multiply that number by the average number of vaccinations given per vehicle resulting in the VPH per vaccination lane.

The clinic administered 2551 vaccines which at the rate of people that were vaccinated per car, 1160 cars had been calculated as the clinics overall attendance (N = 1160, S = 375). With a sample size of only 289 cars needed (n = 289) for a confidence level of 95%, the actual sampling of 375 cars gave a confidence level of 98.1%. This resulted in only a 4.2% margin of error, giving solid validation to the survey's results. Appendix E shows all applicable calculation tables from the online calculator used in determining the sample size needed for the desired margins of error and confidence levels (Raosoft sample size calculator, n.d.). With a confidence level this high, the SCFD POD Survey would be able to give an accurate reflection of the

capabilities and efficiencies of a local clinic specific to the demographics of the local community.

The SCFD POD Study was originally done to document the clinic's efficiencies in respect to how long it was taking to vaccinate each vehicle once they made it to the dispensing section of the POD. The results could be used as a tool to calculate vaccination capacity potential of future clinics. It was noted in the *Stanwood-Camano H1N1 mass vaccination clinics: After action report* that the County's Unified Command Emergency Operations Center, using data from other clinics, issued a media statement at approximately noon stating that clinics were or would soon be out of vaccine. This resulted in an unknown number of people who were not yet at a clinic deciding not to get vaccinated. At the SCFD clinic, this resulted in a rapid decline in cars arriving at the waiting line (Simmons & Reid, 2009, p. 13).

What this meant to the SCFD clinic was that while SCFD could post and compare the hours of operations and total vaccinations with other clinics during that timeline, a completely accurate evaluation of the SFD clinic's specific capabilities, since the final two hours of the clinic had a rapid decline in attendance, could not be evaluated (Simmons & Reid, 2009, p. 13). By using the data collected from the SCFD POD Study (Appendix D), specific analysis of the SCFD clinic's efficiencies was made and modeled as a comparative to the statistics reported by the other county clinics to see be used to more effectively answer research question two.

Some limitations of the data collected through the questionnaire should be noted. Seven out of the eight clinics chosen to participate in the survey that operated countywide on the 31st responded to their questionnaires. Of the eight, the Community Health Center did not respond after repeated attempts by email and phone calls by the author and SHD. Stevens Hospital was unable to report on the number and types of staffing used for their clinic.

The original questionnaire asked for only the total number of vaccinations given by the clinic during their operational period on the 31st. Some clinics reported their nasal and injectable vaccinations separately, and while the author decided to record the clinics results separately, they were combined in order to conform to the studies parameters. Issues such as how long people waited in line before they were vaccinated were not officially documented; only the number of people that were processed during the day and how many Full Time Equivalents (FTE's) were used to staff the clinics. Aside from these limitations, the data collected was more than sufficient to compare the efficiency levels of the participating clinics.

Another factor that could be construed as a limitation of this research paper was that an overall cost of putting on the clinics was not factored in as an efficiency comparison. Only the data sets reported in this paper were of concern by the author for this analysis. It shall be noted that each clinic was given a set amount by the Snohomish Health District to meet their objectives and that SCFD did stay within that budget. The Island County Department of Health contributed to the clinic the amount of vaccinations allocated for Camano Island as well as a staffing level of two to help accomplish the overall objectives.

Results

For research question one; what are the efficiency elements of a mass vaccination clinic, the literature available for review on this topic is abundant and provided many efficiency elements. Staffing necessary for a clinic may be short in an event where there may be a threat to clinic participants and/or their families. That shortfall will more than likely be compounded by the severity of the event as it relates to their personal health and safety (Mackler, Wilkerson, & Cinti, 2007, p. 2). A clinic that can vaccinate the highest number of individuals with the least amount of staff necessary will be more efficient, as will a clinic that offers a warm, dry and

stable environment with handicap access. It should also offer the following: adequate bathrooms, water, electricity, a method of communicating with the clinic's staff and patients, equipment drop-off area, separate and secure parking for clinic staff and patients, as well as a break area for staff. Other elements for an efficient clinic would include items such as a staging zone for press, helicopter landing zone, traffic control and site security, and a location for patients that may need medical attention (Texas Department of State Health Services, 2007).

To assure a solid base of operations for a clinic, the operational aspects of an Emergency Operations Center or an Incident Management Team should be imbedded. This should include staffing for the following positions: Incident Commander or The POD manager; Operations; Logistics; Planning; Medical Branch, which is responsible for medical triage, medical evaluation and transport; Security; Public Information Officer (PIO) Safety; and other branches, groups or divisions as outlined by the National Incident Management Systems (NIMS), a companion document of the National Response Framework (NRF) (U.S. Department of Homeland Security [USDHS], 2008, p. 50).

To answer research question two, what are the efficiency comparisons between other countywide mass vaccination clinics and SCFD's vaccination clinic, it was important to process the results of the SCFD Vaccination Questionnaires. Based on the results of the ten original Vaccination Questionnaire questions, all eight responding clinics answered yes to question nine; was food available for staff? Question eight was: Could the clinic have set everything up the night before the vaccination date? For question eight all eight clinics reported yes which fell in line with the set up time of 12 hours, considered to be the standard by other counties (Torok, 2008, p. 3). All participating clinics were found to be equal in their ability to rapidly set up their

clinics and supply the essentials needed to maintain their onsite workforce in an acceptable timeline.

Throughput was the major factor in answering question two; what are the efficiency comparisons between other countywide mass vaccination clinics and SCFD's vaccination clinic. Based on the total reported hours of operation for each reporting clinic, their total vaccinations given and their total staff onsite as reported in the Vaccination Questionnaire (Appendix A) and outlined in Table One below.

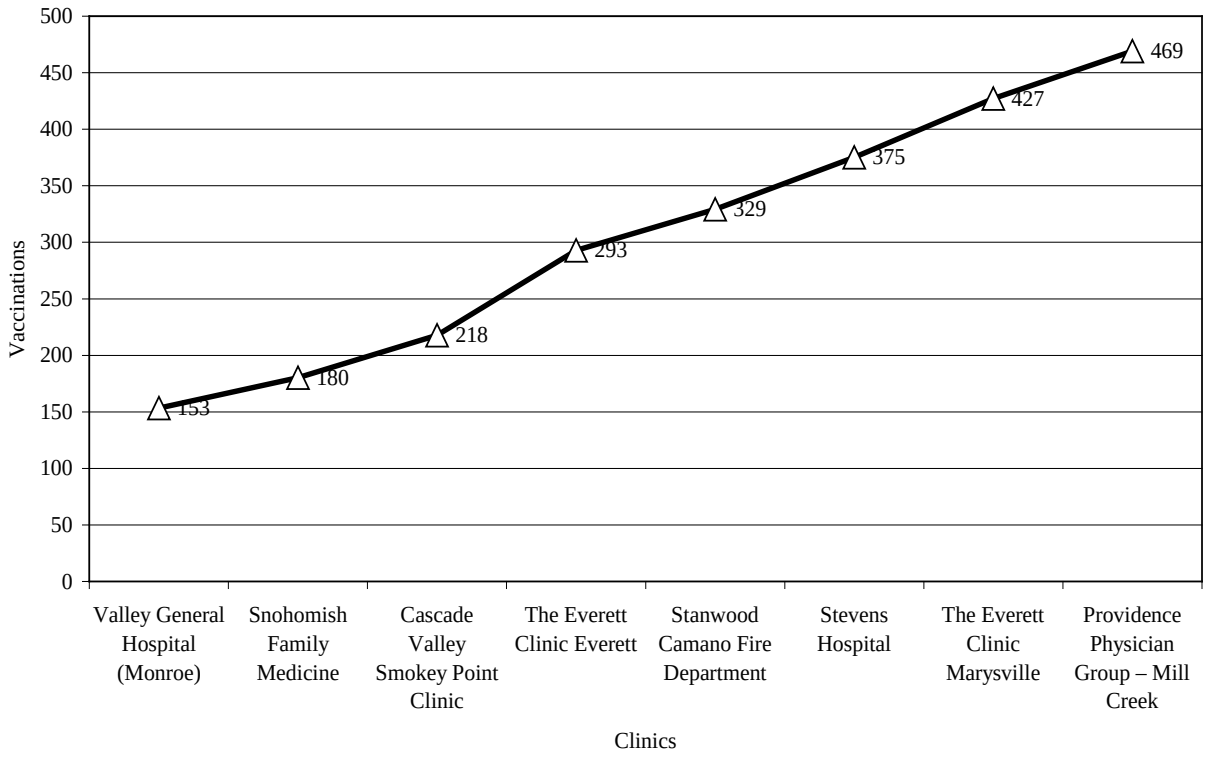
Table 1: Total hours of operation and vaccinations given at each clinic

As reported by each clinic for the October 31st vaccinations

Name of mass vaccination clinic	Hours of operation	Total vaccinations given	Total staff onsite
Stanwood Camano Fire Department (SCFD)	7.75	2551	39
Valley General Hospital (Monroe)	7	1074	18
Providence Physician Group (Mill Creek)	8	3753	55
Snohomish Family Medicine	6.5	1171	51
Cascade Valley Smokey Point Clinic	6.5	1416	15
The Everett Clinic (Everett)	7.5	2197	48
The Everett Clinic (Marysville)	6.5	2776	65
Stevens Hospital	6.5	2439	39
Community Health Center	Unk.	Unk.	18
Totals:	56.25	17,377	291
Averages:	7.1	2172	42

Figure One on page 34 below shows how many vaccinations were accomplished per hour by each of the clinics. In respect to SCFD's overall Vaccinations Per Hour (VPH) when compared to the other seven reporting clinics throughout the County, SCFD's VPH of 329 was above the 57th percentile (MS Excel Version 2003), with the lowest VPH being Valley General Hospital at 153 and the highest being Providence Physicians Group in Mill Creek at 469, with an eight clinic VPH average of 279.

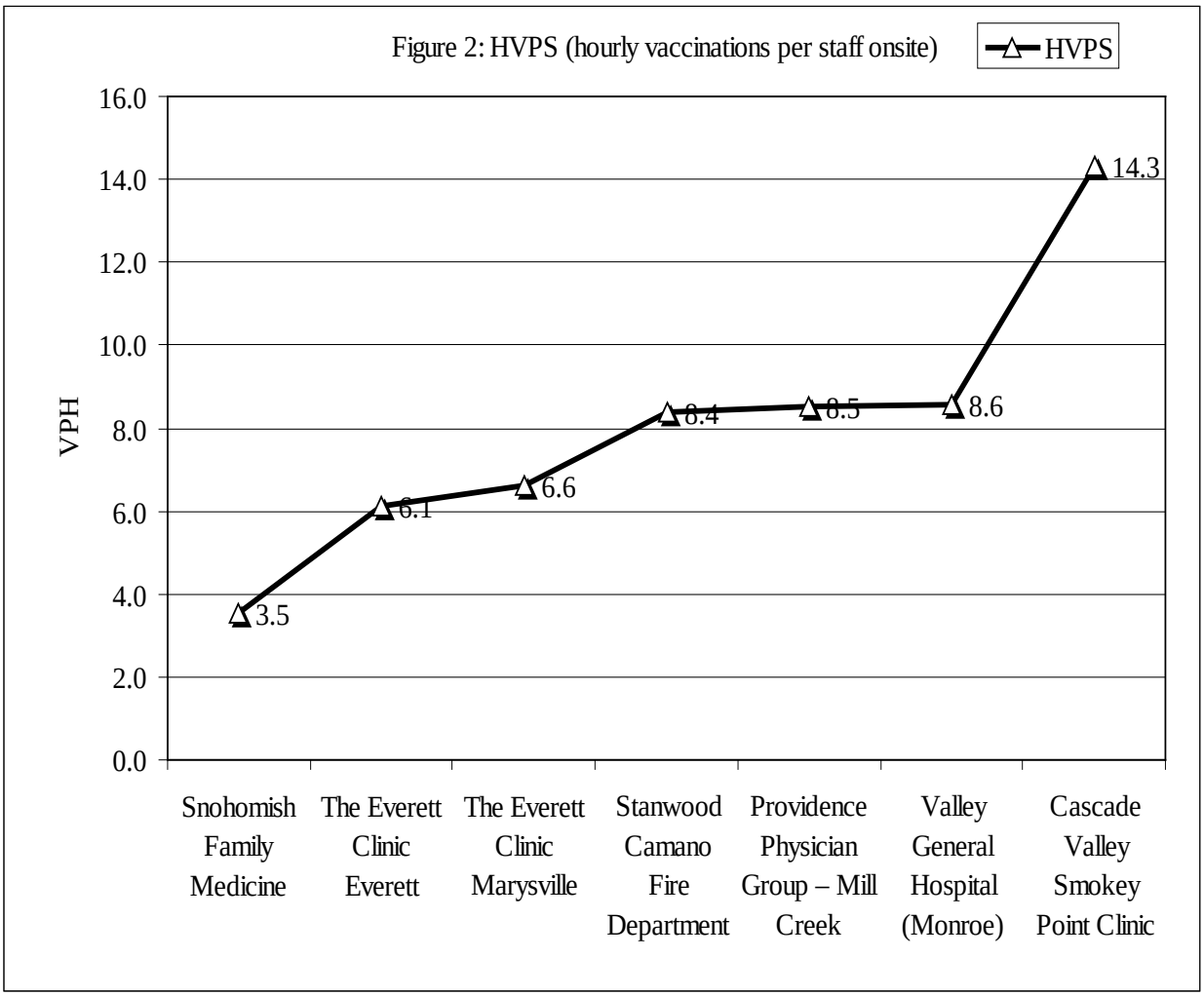
Figure 1: Vaccinations Per Hour



Note: Figure 1 is the comparison of vaccinations given per hour between eight of the reporting clinics for the mass vaccinations held on October 31st, 2009.

Looking at the efficiencies of staff utilization, Figure Two shows that the Cascade Valley Smokey Point Clinic was able to accomplish the highest efficiency level of Hourly Vaccinations Per Staff (HVPS) working at their site with 14.3 vaccinations being accomplished per hour for

every member of clinic staff onsite. In respect to SCFD's overall HVPS's of 8.4 when compared to the other seven reporting clinics throughout the county, SCFD's rated in the 50th percentile (MS Excel Version 2003) with the lowest HVPS being Snohomish Family Medicine at 3.5 and the highest again being Cascade Valley Smokey Point Clinic at 14.3, with an eight clinic average of 8.0 HVPS (MS Excel Version 2003).



Note: Figure 2 is the comparison of vaccinations given between the seven reporting clinics for the mass vaccinations held on October 31, 2009, per hour and per staff member onsite.

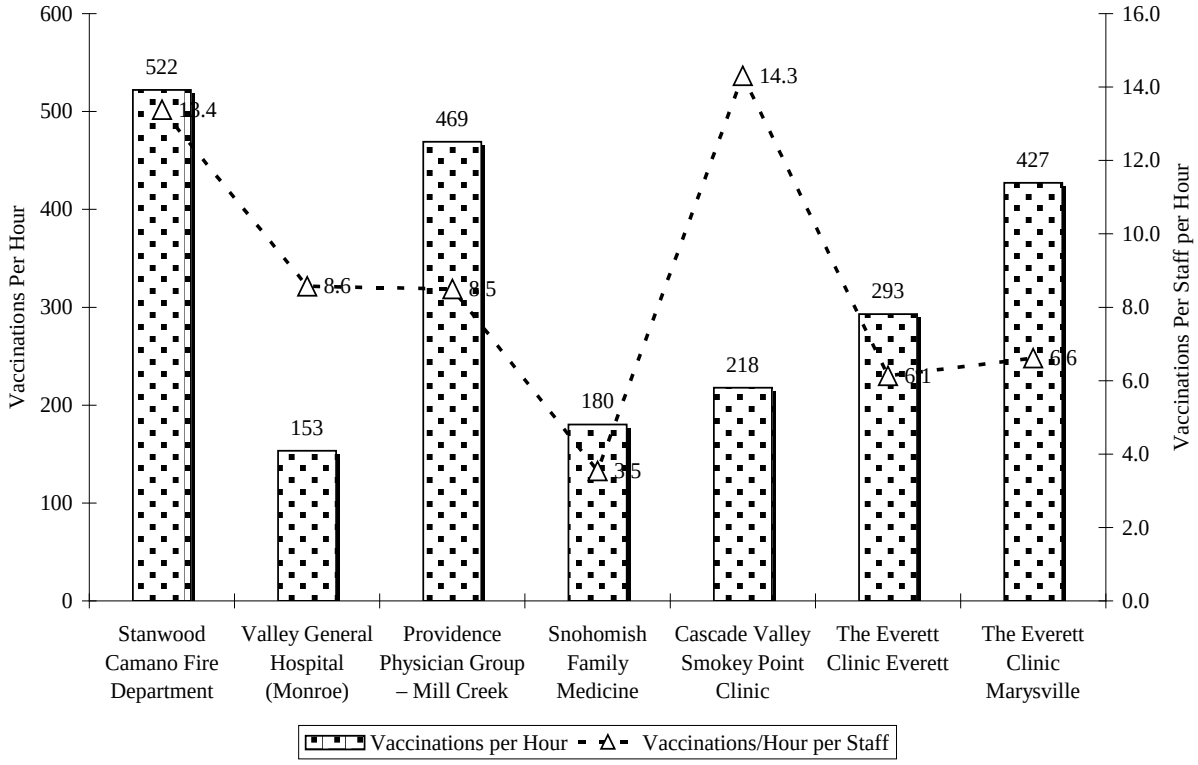
Based on the site specific SCFD POD Survey results presented in Table Two below, the estimated figure of 522 vaccinations per hour (VPH) was used in Figure Three in place of the 329 VPH used in Figure One showing SCFD with a much higher vaccination rate. This surveys estimate of 522 VPH is a 58.6% increase over the SCFD's documented vaccination capabilities found in the Vaccination Questionnaire. The overall demographics of the survey's participants showed that 49.3% of those sampled were children, with 50.7% being adults, showing diversity in the samplings data.

Table 2: SCFD POD Study Results

Results	Areas Evaluated
1 min. 31 sec.	Average time spent for each vehicle to have occupants vaccinated
2.2	Average number of vaccinations given per vehicle
87	Estimated number of people vaccinated per hour in one lane
6	Total Lanes Operating at the SCFD Clinic
465	Total Minutes of Clinic Operation
522	Total estimated SCFD 6 lane vaccination capabilities per hour
4046	Total estimated vaccination capabilities in the total SCFD clinic's operational period
329	Actual total vaccinated during the SCFD 31st POD per hour
2551	Actual Total Vaccinated during the SCFD 31st POD operational period
2	Total survey hours
7.75	Total clinic hours of operation
58.6%	% Increase in vaccination capabilities for the SCFD 31st operational period

Figure 3 below overlays the calculated SCFD POD Survey numbers estimating both the SCFD vaccinations per hour capabilities and the vaccination capabilities per staff member onsite. The figures shown are a more accurate depiction of the SCFD clinic's capabilities when comparing them to the walk-in clinic's statistics and it was found to be an effective and accurate tool for planning the department's future mass vaccination capabilities. Keeping all comparisons equal, the data projected in Figure One and Figure Two are valid representations of the comparables of the eight participating clinics based on the results of the SCFD POD Survey compared to the Vaccination Questionnaire's parameters as reported by the other participating clinics.

Figure 3: Total vaccinations given per hour compared to vaccinations given per hour for each staff member



N*ote:* Figure 3 shows the totals estimating the SCFD vaccinations per hour and per each onsite staff member per hour, based on the SCFD POD Study done calculating POD efficiency potential.

The results of both the Vaccination Questionnaire and the SCFD POS Survey clearly shows that the SCFD that the drive-through model had throughput at least as high as that for conventional clinics. At or above the 50th percentile in all comparisons, the drive-through clinic method used by the SCFD for mass-vaccinations showed comparable and effective results in both numbers vaccinated per hour and numbers vaccinated per hour per staff member.

For research question three; what are the pros and cons of a drive-through mass vaccination clinic, the SCFD drive-through was found to provide many of the pro's identified in the literature review and mitigated most of the cons. A summery of question three's literature review found that having potentially sick people not congregate with healthy people was a pro for drive-in clinics and also results in clinic workers decreasing their exposure to the patient (Greene & Moline, 2006, p. 156). The primary issues of making sure people are warm or cool, comfortable and entertained was taken care of by patients staying in their vehicles. During the SCFD clinic, many people were observed by the author watching movies, listening to music or reading books. Weather, as cited for the carbon monoxide monitoring procedures, was mild and there were no reports of exposure to the elements problems at SCFD's drive-through clinic (Simmons & Reid, 2009).

The traffic line of vehicles in line for the drive-through was kept expanded offering less of an effective target for initial terrorism or a secondary attack. Results of the carbon monoxide testing were shown to be negative. The RAE Multi-detector placed on a table top at the drive-through clinic when checked after four hours of constant monitoring showed that there were never any alarms or recordings of carbon monoxide presence during the event.

Traffic associated with the SCFD's drive-through clinic did pose a concern. At one point, the City's police chief was advising that there may be as many as 5000 cars in lines waiting to be

vaccinated (T. Trenary, personal communication, October 31st, 2009), which at the time was considered to be more than the traffic plan was designed to handle. Any initial problems were overcome and effects on area businesses ant thoroughfares were managed quickly with few problems (Simmons & Reid, 2009). Getting information out to people in lines of cars was problematic. Traffic control issues and the need to spread security resources out over a vast area proved difficult but not impossible. The SCFD drive-through resulted in providing for the pro's identified in the literature review and mitigated most of the cons.

A summary of the findings identified in the literature review for research question four; what are the pros and cons of a walk-in mass vaccination clinic, finds that a significant pro's for a walk-in clinic are directly related to the facility used and it's infrastructure. Facility amenities such as electricity, storage capabilities, phone and internet connectivity, audio-visual equipment, break-rooms, restrooms, availability of coolers for pharmaceuticals, ease of security control measures and protection from the environment are all positives listed by the guide *Community-based massprophylaxis: A planning guide for public health preparedness* (AHRQ, 2004).

The cons of a walk-in include difficulties in enforcing social distancing. For the patients, walking in a long, slow line to the dispensing center may prove to be tiresome and boring with little opportunity to keep children occupied, especially if they have to initially wait outdoors while enroute to the dispensing point. A mass walk-in mass vaccination clinic has the logistical disadvantage of needing vast amounts of static parking space. If there is access to a large stadium with ample parking, this disadvantage is overcome, but the risk would still exist by placing large populations of people together and exposing them as a terrorist target. The stadium method would also be in contrast to the benefits of having several clinics spread out for easier access and attendance by the affected population (Lioy et al., 2005, p. 4).

Discussion

In the course of comparing Stanwood Camano Fire Department's drive-through mass vaccination clinic to the other walk-in mass vaccination clinics, it was important to do so from several different angles and perspectives. While each clinic was used by the Snohomish Health District to disperse the county's allocation of H1N1 vaccinations, they each did so with some trace of independence. The Point of Dispensing template was used by all agencies involved and, in the end, found to be effective at different levels.

In this countywide vaccination effort, the SCFD was only a small branch of the entire operation. The months of mitigating, preparing, responding and recovery from the 2009 H1N1 pandemic mass-vaccination efforts has left the SCFD a far better understanding of emergency operations on a countywide level. It has also built relationships with agencies it had never worked with before it will undoubtedly have to work with again in the future. SCFD's own experience and concepts of emergency preparedness, Incident Management Teams and our Incident Command structure has been practiced and refined, better preparing our department for future large scale incidents. If a similar situation arises again, the department is now confident that it can, with efficient and well coordinated and unified effort; deliver these services again to the citizens of the Stanwood and Camano Island communities.

The rest of the original objectives of the SCFD's clinic to first vaccinate the public safety and health care providers was successfully accomplished as a coordinated effort between the Snohomish Health District and SCFD prior to the first public vaccination clinics being initiated on October 24th. By holding the clinic in a secluded area away from the City's business district, for the most part successfully kept individuals who opted to receive vaccinations from clogging critical infrastructure (Simmons & Reid, 2009). With the turnout that was experienced and

knowing the layout of the City and the businesses that surround the Everett Clinic's original walk-in POD location in Stanwood, gridlock would have ensued and emergency services would have been hampered. Since gridlock of the City's critical infrastructure and commercial areas did not occur, the drive-through plan implemented by SCFD showed to be a more efficient design.

Providing a safe POD that decreased the potential for exposure for both vaccinators and those receiving the vaccination was also accomplished. There was no report of injuries to staff, patients or of any local area traffic injuries related to the event reported to the SCFD's Incident Management Team onsite at the POD (Simmons & Reid, 2009, p. ii). Literature review supported the benefits of increased exposure protection for vaccinators in a drive-through environment as well as for the patients that are being vaccinated (AHRQ, 2004, p. 39). It is understandable that, if you make the response to an emergency as safe as possible, you increase your chances of having your workforce show up, as found by Dr. Niklas Mackler's survey of responders finding that in a high risk event such as a smallpox outbreak their willingness to show up to work was directly related to their own level of safety and protection from the virus (2007).

The effectiveness of vaccination clinics to be held at health care facilities should be reevaluated. In the case of a pandemic with a high mortality rate, hospitals and clinics may be inundated with the infected well before a vaccine has been perfected and ready for mass distribution; therefore, they should not be used as POD's (Torok, 2008, p. 4). The drive-through clinic hosted by SCFD, in conjunction with several of the other local health care facilities under the guidance of the Snohomish Health District, was held outside the commercial hub of the City and away from both of the medical clinics in town, which could have otherwise been inundated with patients and not been available for assisting in the vaccination process. In this case, with

low morbidity and illness percentages, the system worked. In future pandemics, it may be beneficial to public safety agencies such as SCFD to take the lead in countywide mass vaccinations as early as possible so that they might attempt to lessen the impact on their services from the lack of vaccinations being distributed in a timely manner.

As shown by the TOPOFF 3 large-scale terrorist attack drill involving a biological agent, the possibility of the POD being the subject of a secondary attack as they were attempting to treat victims of the first attack is a real issue to be concerned with (Lioy et al., 2005, p. 4). The report by Lioy further pointed out that a large, centralized POD might not be able to handle the traffic congestion, decreasing the efficiencies of the POD. Decentralizing and using multiple POD's, as did the Snohomish Health District, and bringing the pharmaceuticals to the affected areas with heavy support from fire, EMS and law enforcement was recommended (Lioy et al., p. 8, 9). This method of decentralizing and dispensing using smaller clinics over a wider area proved to be very effective for the Snohomish Health District (Snohomish County Unified Command for h1N1 response and mass vaccination clinic support, 2010, p. 6).

A pro for a drive-through may directly correlate as a con for a walk-in clinic, and vice-versa. The use of radio transmitters or reader boards might be used to mitigate the communications con of a drive-through (Snohomish County Unified Command for h1N1 response and mass vaccination clinic support, 2010, p. 19). Knowing what the pro's and con's are first, and then through planning, training and drills, most negative issues for either type of clinic might likely have an acceptable solution. Maintaining drive-through traffic control versus parking issues associated with a walk-in clinic was found to be a more efficient means to offer vaccinations in the City. An after action discussions lead to a modification of the traffic pattern that was used in the October 2009 clinics, which should allow future clinics to accommodate

increased traffic flow and line capacity while also decreasing the ratio needed of flaggers to cars in line (Simmons & Reid, 2009, p. 17).

For the Stanwood Camano Fire Department, the clinic was considered to be successful by safely and efficiently distributing the H1N1 vaccine as well as meeting the planning, operations, and training related objectives that had been established through federal guidelines (U.S. Department of Labor Occupational Safety and Health Administration [OSHA], 2009). Also accomplished with no reports of any logistical or territorial issues was the successful merger of both the Snohomish and Island County public health agencies in the efforts to distribute their allotments of H1N1 vaccinations across borders; a perfect example of the Incident Command System as outlined by NIMS (USDHS, 2008, p. 50). Since SCFD assisted in the planning and distribution efforts on a local level, it was obvious for SCFD to notice that the credit of interoperability between the two counties should go to each of the two public health agencies specifically.

As mentioned earlier, SCFD currently does not have a published planning guide in place for mass vaccination POD's, yet it has addressed many other pandemic related issues in its Comprehensive Emergency Management Plan (CEMP) Emergency Support Function (ESF) #8; Public Health and Emergency Services. In ESF #8 existed draft Incident Annex F; Pandemic Response Plan – Influenza (2010). Based on the successful outcome of this study, it is clear the Stanwood Camano Fire Department will need to develop a planning guide for the implementation of mass vaccination clinics. Also to be addressed by SCFD are training guidelines, objectives and training sessions on the set-up, use and demobilization of a vaccination clinic.

Comparisons of the SCFD drive-through clinic and the walk-in clinics found that the drive-through method was at least as efficient as the conventional walk-in clinics. In both comparisons of sheer volume of vaccinations and staffing levels used to deliver the vaccinations, the drive-through method was found to be as efficient as the POD walk-in set-up. This would not only apply to the SCFD, but for any other fire department wishing to facilitate a mass vaccination program. The primary area outlined as being troublesome were extreme weather issues affecting the set-up of the drive-through POD; although on the day of the vaccinations, while raining at times, it was found that the patients were kept warm, dry and entertained in their vehicles. With so many vehicles attending the drive-through, spare fuel and jumper cables were kept available as a precaution.

Direct statistical comparisons of the SCFD drive-through verses the walk-in clinics showed that high traffic flow could be easily accomplished. SCFD was in the 57th percentile in vaccinations per hour capabilities and in the 50th percentile for efficient use of staff when associated with vaccinations per hour per staff member onsite. When comparing the vaccination capabilities documented by the SCFD POD Survey to the results of the walk-in clinics responses to the questionnaire, the SCFD clinic's VPH ranked number one in VPH capabilities. The organizational implications of the study have solidified the departments initial theory that a fire department hosted, drive-through mass vaccination clinic was an efficient method of SNS POD delivery when compared to walk-in clinics.

While it would have also been beneficial to have been able to compare the results found in this paper with a similar applied research project, none could be found. A search on the National Fire Academy's Learning Resource Center online catalog did not find any papers related to the topic at hand.

Recommendation

Based on literature review, the results of the Vaccination Questionnaire and the SNS POD Study, the drive-through concept for dispensing vaccinations is an efficient method for delivering vaccinations to the masses quickly and safely.

The Stanwood Camano Fire Department, the City of Stanwood (Police and Public Works), Snohomish Health District, Snohomish County DEM, Island County Health Department, The Everett Clinic, The Stanwood Camano Medical Center and several health care providers from the local skilled nursing facilities are all key stakeholders necessary to plan and execute a drive-through mass vaccination clinic for future biological vaccinations. The following are recommendations to be made to the stakeholders:

A. When considering any future mass vaccination clinics, first look at the pros and cons of each type of clinic such as staffing requirements or availability of staff and their output capabilities before a decision is made on the type of clinic to be utilized. Smaller events such as a vaccination clinic for seasonal flu inoculation may not have as many logistical concerns.
B. Alternate locations of vaccination clinics should be considered in the event that hospitals and medical centers are inundated with patients. A plan with only one resource outlined can be limited and give way to impromptu vaccination methods that have a higher risk for failure.
C. The Stanwood Camano Fire Department's CEMP and ESF #8 should be reviewed by administration, and planning for future mass vaccination clinics for Points of Dispensing should be addressed.

D. Administrations need to proactively review any future studies, reports and/or trends from other agencies as they might relate to this issue. Constant literature review will help in perfecting the current plan during annual review.

E. Fire departments nationwide should research the topic and address the issue in order to realize any potential benefits for implementing this type of vaccination program for their area.

F. The *National Response Plan* should be reviewed and adhered to by all stakeholders. Lack of common terminology or organizational structure will have a negative impact on the overall objectives.

G. Local, countywide, regional and statewide meetings should be held regularly, not just for planning and training purposes, but for the benefit of staying familiar with all of the key players who may have a role in mass vaccinations.

H. Implement a SNS POD training program designed for fire, EMS and law enforcement's specific roles.

I. Identify solutions to applicable problems addressed in after action reports posted from all agencies involved in the H1N1 mass vaccination effort.

J. Develop an Incident Action Plan that may be used as a template to set up a mass vaccination clinic in a 12 hour or less time span.

K. Review staffing needs based on local resources and the population of the catchment areas in need of SNS PODs. By knowing what the capabilities are of each type of vaccination clinic, you will have the tools useful for planning local and regional mass vaccination capabilities.

L. Review National Fire Protection Association's National Fire Code1600, Chapter 5: *Standards on Disaster/Emergency Management and Business Continuity Programs*. This will serve as a good resource for advising on how fire and EMS are to operate as a resource for a variety of emergency response hazards. This should include facilitating response to natural, technological and environmental disasters.

Also, be aware of the possibility that a POD could be the subject of a secondary attack as you try to vaccinate victims of the first attack. Large PODs for non-terrorist, pandemic type vaccinations could also be targeted by terrorists for initial attacks. Identify and involve all stakeholders in preplanning for SNS POD implementation; a single agency alone is not enough. For some, it may not appear that planning for and hosting a mass vaccination clinic should be a primary objective for their department. By testing and now enforcing SCFD's abilities to manage a successful clinic and through the discovery of the connected benefits the department will receive by assuring that the clinic is successful, we will lessen the impacts of any disaster experienced by our region.

With the specific threat of the more deadly H5N1 virus becoming a pandemic, fire-based drive-through vaccinations should be considered as an efficient method for rapidly facilitating mass vaccinations, decreasing exposure potential for healthcare providers and patients, decreasing the spread of the virus; thus decreasing the need for response and recovery efforts. Other efficiencies include decreasing the potential for negative impact on an areas infrastructure, and increasing the likelihood of adequate staffing turning out to assist in facilitating the vaccination process.

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Appendix A

I am writing a research paper addressing the efficiencies of our October 31st, 2009, drive-through mass vaccination clinic compared to the walk-in mass vaccination clinics. I would like to respectfully request your help in answering the following ten questions. Please just hit reply to this email, fill in the blanks and send. I have also attached the questionnaire in Word in case the format did not come through legibly in this email. Thank you.

		Example	Your Clinic
1	**Clinic Name:**	**Stanwood Camano Fire Department**	
2	**Total Hours of Operation:**	**7.5**	
3	**Start Time:**	**9:00 AM**	
4	**Finish Time:**	**4:30 PM**	
5	**Total Number Only of Volunteer Staff Positions Onsite:**	**42**	
6	**Total Number Only of Paid Staff Positions Onsite:**	**23**	
7	**Total Number of Injections and Nasal Vaccinations given at the Sites on October 31st:**	**2551**	
8	**Was food Available for Staff?**	**Yes**	
9	**Could the Clinic have set everything up the night before the vaccination date?**	**Yes**	
10	**Were there other Challenges not Addressed? Please list the three most Important Challenges.**	* Methods to notify people in their cars of the wait times and vaccine availability * Portable toilets in the line * Capability to handle the large volume of traffic.	

Appendix B

Snohomish County
Executive Office
Aaron Reardon, County Executive

Cascade Valley Hospital

Community Health Center of Snohomish County

Emergency Services Coordinating Agency

The Everett Clinic

Everett Office of Emergency Management

Monroe Office of Emergency Management

Premera Blue Cross

Providence Physician Group

Providence Regional Medical Center Everett

Puget Sound Family Physicians

Snohomish County Department of Emergency Management

Snohomish County Public School Districts

Snohomish Health District

Stevens Hospital

Swedish Visiting Nurses Service

Tulalip Health Services

Tulalip Tribal Office of Emergency Management

Valley General Hospital

Media Advisory—Oct. 28, 2009
Contact: 425.388.3608

Free H1N1 vaccine for people in all CDC priority groups, Oct. 31

Ten locations will offer vaccine from 9 a.m. to 3 p.m.

SNOHOMISH COUNTY, Wash. – Health officials hope to vaccinate at least 12,000 people in eligible categories at 10 H1N1 vaccination clinics in Snohomish County on Saturday, Oct. 31, from 9 a.m. to 3 p.m.

Immunizations are free, but clinics could close earlier if they run out of vaccine. People need to arrive prepared to stand in line in inclement weather — please dress warmly and bring an umbrella or a hooded, waterproof jacket. Wait times will be posted at www.snocoflu.com.

H1N1 vaccine will be available only to people in the Centers for Disease Control and Prevention's (CDC) target groups, plus teachers and professional child care providers. The groups do not include people older than 65.

The target groups for the Oct. 31 clinics are:

- All pregnant women (Note: Thimerosal-free vaccine will *not* be available at the clinics. Vaccine that *is* thimerosal-free will be available from a pregnant patient's obstetrician or family practitioner.);
- All persons ages 6 months through 24 years;
- Household and caregiver contacts of children younger than 6 months (e.g. parents, siblings and daycare providers);
- Persons ages 25 through 64 years who have medical conditions such as asthma, diabetes or lung disease;
- Teachers and professional child care providers;
- Health care workers and emergency workers.

Only FluMist nasal spray will be offered to healthy people who are eligible to receive it. Injectable vaccine will be reserved expressly for pregnant women, children ages 6 months to 2 years, and people ages 6 months through 64 years who have asthma, cerebral palsy, congenital heart conditions or other chronic medical conditions for which FluMist is medically contraindicated.

Children ages 9 and younger require two doses of vaccine for full immunity, and generally should get the second dose through their own health-care providers four weeks after getting the first dose.

In addition to expanding the vaccine distribution to all CDC priority groups, Dr. Gary Goldbaum, Health Officer and Director of the Snohomish Health District, has issued guidelines to hospitals and schools to help prevent disease transmission.

Dr. ' ŽuEdA?w?? recommendations to hospitals are to greet and visually screen visitors for flu-like symptoms and to discourage symptomatic people from visiting inpatients; limit visitors to two per patient; and limit visitors to persons older than 12 years. Most hospitals in Snohomish County are following those recommendations.

The guidelines to Snohomish County schools urge schools to consider cancelling or postponing extramural events that involve overnight stays in close quarters. If such events continue, schools are asked to screen participants for flu-like symptoms and to exclude symptomatic people from participation. Should students become ill during an event, parents or guardians are responsible for getting their ill students home quickly.

Check www.snocoflu.,com for more H1N1 information, clinic wait times, and downloadable consent forms ? some materials are available there in multiple languages. The SnoCo Flu Line will be staffed and operational on vaccination clinic Saturdays from 8 a.m. to 4 p.m. Its weekday hours are 10 a.m. to 4 p.m., Monday through Friday.

Below is a list of clinic sites for Saturday, Oct. 31:

- Stanwood Camano Fire/The Everett Clinic ?*s* *-ISŽOS* *ĐsŸĐ*
  City of Stanwood Heritage Park
  9600 276th St. NW
  Stanwood, WA 98292

- Stevens Hospital
  21601 76th Ave. W (Enter via Hwy. 99 and 216th St. SW)
  Edmonds, WA 98026

- Valley General Hospital @ Sky Valley Education Center
  17072 Tye Street, Bldg. B
  Monroe, WA 98272-1527

- Providence Physician Group ? Mill Creek
  12800 Bothell-Everett Hwy.
  Everett, WA 98208

- Community Health Center
  1019 112th St. SW
  Everett, WA 98204

- Cascade Valley Smokey Point Clinic
  16410 Smokey Point Blvd. #101
  Arlington, WA 98223-8415

- The Everett Clinic @ Evergreen Middle School
  7621 Beverly Lane
  Everett, WA 98203

- The Everett Clinic @ Bethlehem Lutheran Church
  7215 51st Ave.
  Marysville, WA 98270

- Snohomish Family Medical Center
  629 Avenue D
  Snohomish WA 98290

- Tulalip Pharmacy
  8825 34th Ave NE, Suite A -- Marysville WA 98271
  Open to general public and Native Americans

###END###

Appendix C

		Clinic 1	Clinic 2
1	**Clinic Name:**	**Stanwood Camano Fire Department**	**Valley General Hospital (Monroe)**
2	**Total Hours of Operation:**	**7.75**	**7**
3	**Start Time:**	**8:45 AM**	**8:00 AM**
4	**Finish Time:**	**4:30 PM**	**3:00 PM**
5	**Total Number Only of Volunteer Staff Positions Onsite:**	**42**	**60**
6	**Total Number Only of Paid Staff Positions Onsite:**	**23**	**0**
	Total Number of Injections given at the Sites on October 31st:	**1412**	**0**
	Total Number of Nasal Vaccinations given at the Sites on October 31st:	**1139**	**0**
7	**Total Number of Vaccinations given at the Sites on October 31st:**	**2551**	**1074**
8	**Was food Available for Staff?**	**Yes**	**Yes**
9	**Could the Clinic have set everything up the night before the vaccination date?**	**Yes**	**Yes**
10	**Were there other Challenges not Addressed? Please list the three most Important Challenges.**	* Methods to notify people in their cars of the wait times and vaccine availability * Portable toilets in the line * Capability to handle the large volume of traffic.	Things went very well. I was inside dispensing the vaccine and keeping track of the numbers and, therefore, am not aware of any challenges outside. The Monroe police helped and handled the volume and traffic flow. We really had a

	lot of volunteers. The only real issue was that some of the patients did not fit the suggested criteria, but still "demanded" they get the vaccine. Luckily this was very few patients

Clinic 3	Clinic 4	Clinic 5	Clinic 6	Clinic 7
Stevens Hospital	**Providence Physician Group (Mill Creek)**	**Community Health Center**	**Snohomish Family Medicine**	**Cascade Valley Smokey Point Clinic**
6.5	**8**		**6.5**	**6.5**
9:00 AM	**8:00 AM**		**9:00 AM**	**9:00 AM**
3:30 PM	**4:00 PM**		**3:30 PM**	**3:30 PM**
Unk.	**39**		**4**	**77**
Unk.	**29**		**19**	**16**
0	**NA**		**0**	**NA**
0	**NA**		**0**	**NA**
2439	**3,753**	**0**	**1171**	**1416**
Yes	**Yes**		**Yes**	**Yes**
Yes	**Yes**		**Yes**	**Yes**

Inaccurate line counts - shutting down countywide too early due to inaccurate counts - inexperienced vaccinators.	Wait time verification - vaccine availability (being ordered to close and reopen) - and portable toilets.		Long Lines	Lack of sheltered areas for people waiting in line, it was raining -Triage runners in lines before patients made it up to the registration tables to find out they did not qualify for vaccine - Lack of immunization inventory. (i.e.: We didn't know who had the preservative free vaccine in which location. We had several vaccination rooms going.)

Clinic 8	Clinic 9
The Everett Clinic (Everett)	**The Everett Clinic (Marysville)**
7.5	**6.5**
8:30 AM	**8:30 AM**
4:00 PM	**3:00 PM**
21	**20**
25	**23**
1012	**1223**
1185	**1553**

2197	**2776**
Yes	**Yes**
Yes	**Yes**
Portable toilets for people in line - Separate flow for handicap pt (we had one but not visible to pts) - Not clear communication between emergency command and SHD	Portable toilets for people in line - Separate flow for handicap pt (we had one but not visible to pts) - Not clear communication between emergency command and SHD

Appendix D

H1N1 Vaccination Times

Individual Cars		Adult Shot	Child Shot	Adult Nasal	Child Nasal	Total Vacc.	Minutes in Dispensing Rounded
1		2	0	0	2	**4**	2
2		1	1	0	1	**3**	3
3		1	0	0	0	**1**	1
4		1	0	1	0	**2**	2
5		1	1	0	0	**2**	2
6		1	0	1	1	**3**	3
7		0	1	1	1	**3**	3
8		2	0	0	0	**2**	1
9		1	0	0	0	**1**	1
10		2	0	0	0	**2**	1
11		2	5	0	1	**8**	10
12		0	1	0	2	**3**	1
13		0	0	2	1	**3**	1
14		1	0	0	3	**4**	2
15		1	1	1	3	**6**	2
16		1	1	0	1	**3**	2
17		0	0	1	0	**1**	1
18		2	0	0	0	**2**	2
19		1	0	0	0	**1**	1
20		1	0	0	2	**3**	4
21		1	0	0	1	**2**	1
22		0	0	0	3	**3**	1
23		1	1	0	0	**2**	1
24		1	1	0	3	**5**	3
25		1	0	0	0	**1**	1
26		2	0	0	2	**4**	2
27		2	1	0	0	**3**	2
28		1	0	0	3	**4**	2
29		1	0	0	0	**1**	1
30		0	1	1	0	**2**	1
31		0	0	0	1	**1**	1
32		0	0	1	2	**3**	2
33		0	1	0	1	**2**	1

34		0	1	1	0	**2**	2
35		0	1	0	0	**1**	2
36		1	1	0	0	**2**	2
37		0	0	0	1	**1**	1
38		1	0	0	0	**1**	1
39		1	0	0	0	**1**	1
40		0	0	0	1	**1**	1
41		1	0	0	0	**1**	1
42		0	0	0	1	**1**	1
43		1	0	0	0	**1**	1
44		1	1	0	0	**2**	1
45		0	0	0	2	**2**	1
46		2	0	0	1	**3**	1
47		1	0	0	0	**1**	1
48		0	1	2	0	**3**	2
49		1	0	0	0	**1**	1
50		2	0	0	0	**2**	2
51		1	0	0	0	**1**	1
52		0	0	1	2	**3**	2
53		1	0	0	0	**1**	1
54		2	0	0	0	**2**	2
55		0	0	0	3	**3**	2
56		0	1	0	1	**2**	2
57		2	0	0	0	**2**	2
58		0	1	0	0	**1**	1
59		2	0	0	0	**2**	1
60		1	0	1	3	**5**	2
61		1	1	1	0	**3**	2
62		2	1	1	0	**4**	2
63		0	1	0	0	**1**	2
64		1	1	0	0	**2**	1
65		0	1	0	1	**2**	4
66		0	1	0	2	**3**	3
67		0	0	0	2	**2**	1
68		0	2	0	0	**2**	2
69		1	0	0	0	**1**	2
70		1	0	0	0	**1**	1
71		0	1	0	0	**1**	1
72		3	2	0	0	**5**	8

73		1	0	0	0	**1**	1
74		1	0	0	0	**1**	1
75		1	1	0	0	**2**	2
76		0	1	0	0	**1**	2
77		1	0	0	0	**1**	1
78		0	2	0	0	**2**	2
79		1	1	0	0	**2**	2
80		0	1	0	0	**1**	2
81		0	2	0	0	**2**	1
82		1	1	0	1	**3**	2
83		2	1	0	0	**3**	2
84		2	0	0	0	**2**	2
85		0	1	0	0	**1**	1
86		1	0	0	0	**1**	1
87		1	0	0	0	**1**	1
88		1	0	0	0	**1**	1
89		2	3	0	0	**5**	5
90		0	2	0	0	**2**	1
91		2	3	0	0	**5**	3
92		2	0	0	0	**2**	1
93		2	0	0	0	**2**	1
94		1	0	0	0	**1**	2
95		0	1	0	0	**1**	2
96		2	0	0	0	**2**	1
97		1	1	0	0	**2**	2
98		2	3	0	0	**5**	2
99		1	0	0	0	**1**	1
100		2	0	0	0	**2**	1
101		2	0	0	0	**2**	1
102		1	0	0	0	**1**	1
103		0	4	0	0	**4**	2
104		1	0	0	0	**1**	1
105		1	0	0	2	**3**	1
106		1	0	0	0	**1**	1
107		0	0	0	3	**3**	2
108		1	0	0	0	**1**	1
109		1	0	2	0	**3**	2
110		1	0	0	0	**1**	2
111		1	3	0	0	**4**	5

112		1	1	0	0	**2**	2
113		0	0	2	0	**2**	1
114		0	1	0	0	**1**	1
115		1	0	0	0	**1**	1
116		1	1	0	1	**3**	2
117		1	0	0	0	**1**	1
118		1	0	0	0	**1**	2
119		1	0	0	2	**3**	3
120		0	1	0	1	**2**	3
121		0	1	0	1	**2**	2
122		2	0	1	0	**3**	4
123		1	0	3	0	**4**	3
124		1	0	1	0	**2**	1
125		1	0	0	1	**2**	1
126		2	0	0	2	**4**	3
127		1	0	1	0	**2**	2
128		0	1	2	1	**4**	2
129		0	1	2	0	**3**	2
130		1	0	0	0	**1**	1
131		1	0	0	0	**1**	1
132		2	0	0	2	**4**	2
133		1	0	0	2	**3**	2
134		2	0	1	0	**3**	1
135		1	2	0	0	**3**	1
136		0	0	0	2	**2**	3
137		0	0	1	1	**2**	1
138		1	1	0	3	**5**	3
139		2	0	0	1	**3**	2
140		0	0	0	1	**1**	1
141		1	3	0	0	**4**	3
142		1	1	0	0	**2**	1
143		1	0	0	0	**1**	1
144		0	0	0	2	**2**	2
145		2	1	0	0	**3**	2
146		2	0	0	0	**2**	1
147		0	1	0	0	**1**	1
148		0	0	1	1	**2**	1
149		1	0	0	0	**1**	1
150		0	0	0	2	**2**	1

151		1	0	0	2	**3**	2
152		0	1	0	1	**2**	1
153		0	0	2	2	**4**	3
154		1	0	0	0	**1**	1
155		1	1	1	1	**4**	3
156		2	1	0	1	**4**	3
157		2	0	0	0	**2**	1
158		1	0	1	0	**2**	1
159		1	0	0	3	**4**	3
160		0	0	2	0	**2**	1
161		0	1	2	1	**4**	2
162		0	3	2	0	**5**	3
163		1	0	0	1	**2**	1
164		0	0	2	2	**4**	2
165		2	0	0	2	**4**	2
166		2	0	0	0	**2**	1
167		1	0	0	0	**1**	1
168		2	0	0	0	**2**	1
169		1	0	0	0	**1**	1
170		1	0	0	0	**1**	1
171		0	0	0	2	**2**	1
172		1	1	0	0	**2**	1
173		2	0	0	3	**5**	4
174		1	0	1	2	**4**	2
175		0	0	1	0	**1**	1
176		1	0	0	1	**2**	1
177		0	1	0	0	**1**	1
178		2	0	0	0	**2**	1
179		0	0	0	1	**1**	1
180		2	1	0	1	**4**	2
181		1	0	0	1	**2**	1
182		1	0	0	0	**1**	1
183		2	0	0	0	**2**	1
184		0	0	1	0	**1**	1
185		1	1	0	1	**3**	2
186		1	0	0	0	**1**	1
187		0	1	2	0	**3**	1
188		1	0	0	0	**1**	1
189		1	0	0	0	**1**	1

190		1	0	0	2	**3**	2
191		0	0	2	1	**3**	1
192		0	0	0	2	**2**	1
193		1	1	0	0	**2**	1
194		1	0	0	0	**1**	1
195		1	0	0	0	**1**	1
196		2	0	0	0	**2**	1
197		0	0	1	1	**2**	1
198		2	0	0	0	**2**	1
199		2	1	0	0	**3**	2
200		1	0	0	0	**1**	1
201		0	0	0	2	**2**	1
202		0	0	0	1	**1**	1
203		0	1	0	0	**1**	1
204		0	0	0	2	**2**	1
205		1	0	0	2	**3**	1
206		0	0	2	0	**2**	1
207		0	0	1	3	**4**	1
208		0	0	1	2	**3**	1
209		0	1	0	0	**1**	1
210		1	0	0	4	**5**	2
211		2	0	0	0	**2**	1
212		0	0	0	2	**2**	1
213		1	0	0	0	**1**	1
214		1	1	0	0	**2**	1
215		0	1	0	0	**1**	1
216		1	0	1	0	**2**	1
217		1	0	1	2	**4**	2
218		1	0	0	2	**3**	2
219		0	0	0	1	**1**	1
220		1	0	0	1	**2**	1
221		2	0	0	0	**2**	1
222		0	0	0	1	**1**	1
223		1	1	0	1	**3**	2
224		1	1	0	0	**2**	1
225		1	1	0	0	**2**	1
226		2	0	0	0	**2**	1
227		1	0	0	0	**1**	1
228		1	0	1	0	**2**	1

229		0	0	0	2	**2**	1
230		0	1	1	0	**2**	1
231		2	0	0	0	**2**	1
232		2	0	0	0	**2**	1
233		1	0	0	0	**1**	1
234		1	0	0	0	**1**	1
235		2	2	0	0	**4**	2
236		1	0	0	0	**1**	1
237		1	0	0	1	**2**	1
238		0	0	2	3	**5**	3
239		0	0	0	3	**3**	2
240		0	0	2	0	**2**	1
241		2	0	0	0	**2**	1
242		1	0	0	1	**2**	1
243		2	2	0	0	**4**	2
244		0	0	0	2	**2**	1
245		2	0	0	0	**2**	1
246		1	0	0	0	**1**	1
247		2	0	0	0	**2**	1
248		2	0	0	2	**4**	3
249		1	0	0	1	**2**	1
250		0	0	1	1	**2**	1
251		0	1	0	0	**1**	1
252		0	0	0	1	**1**	1
253		0	0	1	2	**3**	2
254		1	0	0	1	**2**	1
255		1	0	0	0	**1**	1
256		0	0	1	1	**2**	1
257		2	0	0	1	**3**	2
258		0	1	1	0	**2**	1
259		0	0	1	1	**2**	1
260		0	1	1	2	**4**	2
261		0	0	1	2	**3**	2
262		2	0	0	0	**2**	1
263		0	0	0	2	**2**	1
264		1	0	0	0	**1**	1
265		0	1	0	1	**2**	1
266		2	0	0	3	**5**	2
267		1	0	1	1	**3**	2

268		1	0	1	1	**3**	2
269		1	0	0	0	**1**	1
270		1	1	1	2	**5**	3
271		0	0	0	2	**2**	1
272		1	0	0	0	**1**	1
273		3	0	0	1	**4**	2
274		0	0	2	1	**3**	1
275		0	0	0	2	**2**	1
276		0	2	0	0	**2**	1
277		0	0	0	2	**2**	1
278		0	0	1	1	**2**	1
279		0	0	0	2	**2**	1
280		1	0	0	0	**1**	1
281		1	0	0	2	**3**	1
282		2	0	0	0	**2**	1
283		0	0	0	2	**2**	1
284		1	1	0	0	**2**	1
285		0	0	1	2	**3**	1
286		1	0	1	2	**4**	2
287		1	0	0	0	**1**	1
288		1	0	0	1	**2**	1
289		0	1	2	1	**4**	2
290		1	1	0	0	**2**	3
291		1	0	0	2	**3**	2
292		0	0	0	1	**1**	1
293		0	0	0	2	**2**	1
294		2	0	0	0	**2**	1
295		0	0	1	1	**2**	1
296		1	0	1	0	**2**	1
297		0	0	0	1	**1**	1
298		0	0	0	3	**3**	2
299		1	0	0	0	**1**	1
300		2	0	0	0	**2**	2
301		1	0	0	0	**1**	1
302		0	1	0	3	**4**	2
303		1	2	0	0	**3**	2
304		0	1	2	2	**5**	2
305		2	3	0	0	**5**	3
306		0	0	0	1	**1**	1

307		1	0	1	2	**4**	2
308		1	0	0	0	**1**	1
309		0	0	1	0	**1**	1
310		1	0	0	0	**1**	1
311		1	0	0	0	**1**	1
312		2	1	0	0	**3**	2
313		0	0	0	1	**1**	1
314		1	1	0	0	**2**	1
315		0	0	1	1	**2**	1
316		0	0	0	3	**3**	1
317		0	0	0	1	**1**	1
318		2	0	0	0	**2**	1
319		2	0	0	2	**4**	1
320		0	2	0	0	**2**	2
321		0	2	0	0	**2**	2
322		1	0	0	1	**2**	3
323		1	2	0	0	**3**	2
324		1	0	0	0	**1**	1
325		1	0	0	0	**1**	1
326		2	0	0	0	**2**	1
327		1	0	0	0	**1**	1
328		1	0	0	0	**1**	1
329		1	1	0	0	**2**	1
330		1	0	0	0	**1**	1
331		2	2	0	0	**4**	2
332		0	0	0	2	**2**	2
333		2	0	0	0	**2**	2
334		0	2	0	0	**2**	2
335		2	3	0	0	**5**	4
336		0	2	0	0	**2**	2
337		2	1	0	0	**3**	3
338		2	0	0	0	**2**	1
339		0	1	0	0	**1**	1
340		1	0	0	2	**3**	2
341		1	0	0	0	**1**	1
342		1	0	0	0	**1**	1
343		1	0	0	0	**1**	1
344		1	0	0	0	**1**	1
345		1	0	0	0	**1**	1

346		1	0	0	0	**1**	1
347		0	2	0	0	**2**	1
348		2	0	0	0	**2**	1
349		1	1	0	0	**2**	1
350		0	2	0	0	**2**	1
351		1	1	0	0	**2**	1
352		1	0	0	0	**1**	1
353		1	1	0	0	**2**	2
354		0	1	0	0	**1**	1
355		2	0	0	0	**2**	1
356		0	2	0	0	**2**	1
357		1	1	0	0	**2**	1
358		0	3	0	0	**3**	2
359		1	1	0	0	**2**	1
360		1	0	0	0	**1**	1
361		1	1	0	0	**2**	1
362		1	0	0	0	**1**	1
363		1	0	0	0	**1**	1
364		2	3	0	0	**5**	3
365		2	1	0	0	**3**	2
366		1	0	0	0	**1**	1
367		1	1	0	1	**3**	3
368		1	2	0	0	**3**	2
369		1	0	0	0	**1**	1
370		1	0	0	0	**1**	1
371		1	0	0	0	**1**	1
372		1	0	0	0	**1**	1
373		1	1	0	1	**3**	1
374		1	0	0	0	**1**	1
375		2	0	0	0	**2**	1
Totals:		249	121	68	143	**821**	168

Appendix E

Sample Size Calculator by Raosoft, Inc.

Raosoft®

Sample size calculator

What margin of error can you accept? 5% is a common choice	5	%	The margin of error is the amount of error that you can tolerate. If 90% of respondents answer *yes*, while 10% answer *no*, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55. Lower margin of error requires a larger sample size.
What confidence level do you need? Typical choices are 90%, 95%, or 99%	95	%	The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer *yes* would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone. Higher confidence level requires a larger sample size.
What is the population size? If you don't know, use 20000	1160		How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000.
What is the response distribution? Leave this as 50%	50	%	For each question, what do you expect the results will be? If the sample is skewed highly one way or the other,the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing.
Your recommended sample size is	**289**		This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey.

Alternate scenarios

With a sample size of	100	375	500	With a confidence level of	90	95	98.1
Your margin of error would be	**9.37%**	**4.16%**	**3.31%**	Your sample size would need to be	**220**	**289**	**374**

More information

If 50% of all the people in a population of 20000 people drink coffee in the morning, and if you were repeat the survey of 377 people ("Did you drink coffee this morning?") many times, then 95% of the time, your survey would find that between 45% and 55% of the people in your sample answered "Yes".

The remaining 5% of the time, or for 1 in 20 survey questions, you would expect the survey response to more than the margin of error away from the true answer.

When you survey a sample of the population, you don't know that you've found the correct answer, but you do know that there's a 95% chance that you're within the margin of error of the correct answer.

Try changing your sample size and watch what happens to the *alternate scenarios*. That tells you what happens if you don't use the recommended sample size, and how M.O.E and confidence level (that 95%) are related.

To learn more if you're a beginner, read **Basic Statistics: A Modern Approach** and **The Cartoon Guide to Statistics**. Otherwise, look at the **more advanced books**.

In terms of the numbers you selected above, the sample size n and margin of error E are given by

$$x = Z(^{c}/_{100})^{2}r(100\text{-}r)$$