RESEARCH

Novel Influenza A (H1N1) Outbreak On Board a US Navy Vessel

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ABSTRACT

Background and Methods: Fleet Week New York 2009 was the latest installment of an annual celebration to honor US service personnel. It takes place during Memorial Day and this year's celebration coincided with the peak of novel influenza A (H1N1) virus (S-OIV) activity in New York City. Four service members from the USS Iwo Jima and USS Roosevelt contracted influenza while in New York City and were hospitalized in the Department of Veterans Affairs (VA)-New York Harbor Healthcare System to minimize the risk of widespread outbreak on board the naval vessels. No additional cases were identified on the USS Roosevelt. However, 135 service personnel on the USS Iwo Jima contracted influenza.

Results: Shipwide infection control measures including strict isolation and active case finding were instituted immediately with affected crew members and medical staff receiving oseltamivir. The new case rates remained high for 14 days, but the USS Iwo Jima was able to continue deployment. The secondary infectivity rate was 12.0%. The absolute end of the outbreak correlated with arrival at home port and the ability to move patients off board.

Conclusions: This outbreak not only reinforces the risk for rapid spread of novel strains of influenza A in confined populations but also demonstrates useful strategies to mitigate the severity of an outbreak, including isolation, infection control measures, and off board sick leave when feasible. (*Disaster Med Public Health Preparedness.* 2009;3(Suppl 2):S117–S120)

Influenza A (H1N1) virus (S-OIV) was first identified in the US on April 17, 2009 in 2 children,[1] and has since become a pandemic. It was first detected in New York City on April 24, 2009, and on May 21 the New York City Department of Health and Mental Hygiene determined that influenza was widespread in the city.[2] Fleet Week New York—a celebration to honor sailors, Marines, and Coast Guard personnel—takes place in New York City every year during Memorial Day week, this year running from May 20, 2009, through May 27, 2009. This year's celebration coincided with the peak of novel H1N1 (nH1N1) influenza activity in New York City.[3] On May 24, 2009, a US Marine from the USS Roosevelt contracted the flu. Subsequently, 3 crew members of the USS Iwo Jima tested positive for influenza A.

Thousand of sailors, Marines, and Guardsmen and 6 ships from the US Navy including the USS Iwo Jima and USS Roosevelt attended the celebration. The USS Iwo Jima, a multipurpose amphibious assault ship, houses 1100 sailors and can embark more than 1500 Marines. During Fleet Week there were approximately 2100 personnel on board the ship (1100 were permanent ship's company and 1000 temporarily "embarked" personnel, most of whom were US Marines). At the end of Fleet Week, the Marines disembarked the USS Iwo Jima and the company returned to the normal complement of 1100 onboard crew members.

The USS Roosevelt, a guided missile destroyer not to be confused with the USS Theodore Roosevelt, a nuclear powered aircraft carrier, has a crew of 280 sailors. The USS Roosevelt is deployed as part of the Iwo Jima Amphibious Ready Group supporting maritime security operations in the Navy's 5th Fleet area of operations. All of the members of both crews were vaccinated against seasonal influenza.

Given the logistical nature of shipboard living, the limited understanding of the virus' behavior at that point of the epidemic, and the threat of imminent widespread illness aboard the naval vessel, the VA-New York Harbor Healthcare System provided care and housing to the affected sailors and Marines until the outbreak was better characterized and brought under control. This assistance was provided as part of the Department of Veterans Affairs fourth statutory mission to support the Department of Defense during national emergency.[4] A total of 4 patients were housed at the VA facility.

On May 27, 2009, the ships departed New York City and continued their deployment, with the potential index cases off board at the VA Medical Center and with onboard infection control measures established

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to control the spread of influenza. Subsequently, no new cases occurred on the USS Roosevelt. Significant numbers of new cases emerged aboard the USS Iwo Jima, which nonetheless was able to continue its deployment until returning to home port 17 days later.

METHODS

On outbreak day 1, the only patient in this cohort detailed to the USS Roosevelt was identified. This patient was immediately identified as potentially ill and rapidly assessed clinically and with a rapid influenza A test. Once it was determined that he had influenza A, he was immediately treated with oseltamivir and put on offboard sick leave at the VA-New York Harbor Healthcare System NY campus. There were no additional cases of influenza-like illness (ILI) on board the USS Roosevelt and the affected Marine was able to rejoin his unit approximately 1 week later when the USS Roosevelt returned to homeport in Mayport, Florida.

On outbreak day 2, 2 service personnel assigned to the USS Iwo Jima were diagnosed with influenza A by rapid influenza testing, and on outbreak day 3 a third member of the crew of the USS Iwo Jima tested positive for influenza A. Each of these crew members was also transferred to the VA Medical Center.

Shipwide control measures were immediately deployed including Implementation of Respiratory Hygiene/Cough Etiquette, active case finding, strict isolation, and placing patients on sick leave. The USS Iwo Jima has a 46-bed medical unit and a 13-bed intensive care unit. All of the male patients diagnosed with ILI were placed on strict physical isolation in the medical unit. Because there were no severely ill crew members on board during this time, the intensive care unit was used to isolate and care for all ill female crew members. Isolation was continued until they were free from fever for 24 hours.[5]

RESULTS

Case Definition ILI and Admission to Shipboard Ward

1. One of the following: rhinorrhea or cough, and
2. One of the following: fever >100.4°F, or myalgia, general malaise, or chills.

Pharmacy

1. All admitted patients were prescribed oseltamivir 75 mg twice daily for 5 days. Acetaminophen, ibuprofen, and pseudoephedrine were offered for symptomatic relief.

Ward Procedure

1. All of the patients were assigned a specific bed.
2. Temperature assessed every morning and as indicated.
3. Discharged patients were released every morning.
4. Following discharge procedures the ward, bathrooms, and common areas were cleaned using hospital-grade disinfectant. Bed linens were changed daily.
5. All of the patients were required to take a full-body shower daily, enforced by the duty department head.
6. No visitors were allowed in the ward area while underway or in port.
7. All of the patients were required to wear a mask while transiting out of the immediate space or ward, especially during any transiting of the ship or passageways.

Discharge Criteria

1. Patients admitted with a fever >100.4°F may be discharged after 24 hours after fever is <100°F.
2. Patients admitted without fever may be discharged after 48 hours of isolation. If fever develops during admission period, criteria 1 applies.
3. Crew members detailed to food service were restricted from handling food for 4 days.

The case definitions defined ILI as cough, sore throat, or coryza and fever >38.0°C (>100.4°F). During the initial phase of the outbreak, oropharyngeal and nasopharyngeal specimens were tested in the field by using rapid influenza tests QuickVue Influenza A+B. Initial samples were subsequently forwarded for real-time reverse-transcriptase polymerase chain reaction performed at the Naval Research Center in San Diego, California.

Subsequently, given the sensitivity limitations of rapid influenza assays,[6] treatment decisions were made on an empiric clinical diagnosis of ILI. Active surveillance was continued until the new case finding returned to baseline level.

All of the patients with ILI as established by rapid testing or by clinical assessment were prescribed oseltamivir 75 mg twice daily for 5 days. The medical staff was given oseltamivir 75 mg once daily for 7 days as prophylaxis.

On outbreak day 4, the USS Iwo Jima left NYC and during the next 17 days 135 new patients met criteria for new ILI. By outbreak day 19, just preceding the USS Iwo Jima's arrival at home port in Norfolk, Virginia, the incidence of new cases seemed to be declining. Once at home port, all patients on sick leave could be kept off board at that time, and within 3 days no additional cases were identified.

We calculated the secondary infectivity rate using 3 index cases and a crew complement of 1100. The secondary infectivity rate is defined as (the number of new cases − primary cases/total on ship − primary cases) × 100%. In this cohort, the secondary infectivity rate equals 12.0%. Reports of adverse effects, although not specifically assessed or quantified, were limited to vivid dreams and some subjective difficulty with far-field visual accommodation during the first few days of therapy with oseltamivir. One patient manifested symptoms of transverse myelitis.

DISCUSSION

On May 24, 2009, there was limited information for making complex treatment decisions, and although most infections

with nH1N1 by that time seemed self-limited, a number of severe cases and deaths occurred in previously healthy young adults and children.[7] Even though the significance of the impending outbreak of nH1N1 was uncertain and guidance was inexact, using strict nonpharmaceutical interventions and offering antiviral therapy to symptomatic patients was consistent with existing recommendations.[8] No authority gave clear guidance for antiviral administration on a massive basis, however. Decisions needed to consider the relative benefit of treating a mostly self-limited disease versus the risk of mass treatment with oseltamivir including toxicity and the potential of cultivating antiviral resistance.[9]

Without specific controls, it is not possible to estimate the number of cases averted, but historical infection rates and local infectivity rates[10] were higher than those noted on the USS Iwo Jima. The secondary attack rate compares favorably with the outbreak of influenza A (H3N2) that occurred aboard the USS Arkansas in February 1996 and was related to antigenic drift distinct from the vaccination strain.[11] This favorable comparison is especially relevant given the higher attack rate of H1N1 relative to seasonal influenza and suggests that control measures provided a beneficial effect without significant adverse effects.[12]

It is also possible that an outbreak aboard the USS Roosevelt was completely aborted by immediately identifying an at-risk serviceman and housing him off board at the local VA Medical Center. Because VA Medical Centers are ubiquitous in the United States, they may serve as a useful asset to assist the military in emergencies such as this case. Two of the service members aboard the USS Iwo Jima were initially referred to a local nongovernment medical facility, which did not consider the logistical risk of shipboard living and discharged the patients back to their ships. The service personnel were subsequently sent to the VA facility where they were admitted and housed.

This outbreak also highlights the importance of rapid detection of influenza in naval vessels. The illness rate in the first few days was moderate, but implied a potentially consequential burden of occult infection and infection in the incubation phase. Decisions concerning which control measures to implement, including mass distribution of antiviral medications, were begun immediately and were fully implemented by outbreak day 3.

Within a few days it became clear that influenza A was thoroughly established in the environment and rapid testing was stopped. Because the rapid influenza kit performs with a sensitivity of approximately 70%, it is an inadequate tool for establishing a diagnosis of influenza in individual patients. Epidemiologically important information obtained was critical for the early identification of the presence of influenza A in the population, however. Confirmation of influenza A with immunofluorescence staining and viral culture requires at least several days, a timeframe in which an influenza outbreak may grow out of control.

Decision making regarding control measures should not be delayed until such confirmation is achieved. In this case, decisions on intervention measures were based on clinical and epidemiological characteristics and the results of the rapid influenza detection kit.

Recommended measures to control influenza include staying home, avoiding contact with others, and vaccination of those at risk for infection. Many recommendations are challenging to establish in an ideal fashion on a naval vessel, especially isolation and restriction of movement. Each ship has established isolation procedures to optimize control of infection without loss of readiness, however.

At the time of the outbreak, no vaccine was available for nH1N1, and even if it was available the development of antibodies for seasonal influenza takes up to 2 weeks. As with other outbreaks in confined settings, the threat of acceleration of the outbreak was consequential. Had a vaccination been available, it would have been strongly considered because it should ensure the termination of the outbreak within 14 days.[13]

Antiviral agents in sufficient quantities may not always be available uniformly, and even if they are, the benefit of treating self-limited relatively mild disease may be limited. Certainly, if illness was more severe or the transmission rate increased it would have been reasonable to initiate a mass prophylaxis regimen. Reserving treatment for those manifesting symptoms was a reasonable strategy in that no patients developed severe illness and treatment hazard was avoided in nearly 90% of the at-risk population. Nevertheless, despite the advances in shipboard infection control and isolation, a significant factor for ending the outbreak seemed to be the ability to move affected personnel off the ships.

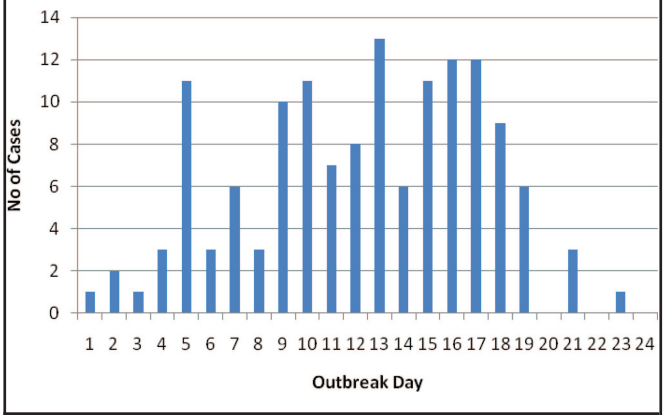
CONCLUSIONS

Military personnel are at risk for outbreaks of influenza and experience significant morbidity and mortality before widespread vaccination.[10,13–16] At the time of this outbreak, the trajectory of the nH1N1 pandemic was unknown, and although it seemed to be affecting otherwise young and healthy adults with a greater frequency than other influenza outbreaks, the severity of illness was similar to seasonal influenza.

Identification of an imminent influenza outbreak among sailors was made possible by routine onboard surveillance of acute respiratory illness including onsite laboratory confirmation of influenza A by rapid testing. A decision to treat only ill personnel was based on a risk-benefit analysis directed at containing the spread of illness, limiting complications, and minimizing potential treatment hazard. The use of shipwide control measures and treatment of affected personnel and prophylaxis of the medical staff likely limited the spread of influenza and reduced the magnitude of this outbreak. It is possible that broader

FIGURE 1

Novel influenza A (nH1N1) outbreak aboard the USS Iwo Jima, May–June 2009.



antiviral chemoprophylaxis may have further reduced the absolute number of cases, the relevance of which is unclear.

Nevertheless, the USS Iwo Jima was able to continue its deployment despite the presence of influenza on board with important strategic implications. Strict shipwide infection control appears to have limited the spread and impact of influenza on the crew. Even so, the absolute end of the outbreak coincided with the ability to get personnel off the ships for sick leave.

Finally, the widespread availability of VA Medical Centers may serve as a resource to support the military in secluding infected individuals from other sailors and Marines until other illness-containment procedures can be established, especially on vessels with smaller infirmaries. This intervention in our cohort may have completely aborted an influenza outbreak on the USS Roosevelt.

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Authors' Disclosures

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