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A Historical Review of the Influenza Outbreaks Within Military Settings and Understanding the Viral Spread of the 1918 Influenza Pandemic

Naomi Ngadiman
Georgia State University

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A Historical Review of the Influenza Outbreaks Within Military Settings and Understanding the Viral Spread of the 1918 Influenza Pandemic

By

Naomi Ngadiman

May 21, 2018

ABSTRACT

The influenza pandemic of 1918 was a tragic event that affected every part of the world and killed more people than compared to any other disease outbreak in history. During this epidemic, the United States was the most affected with a total of 675,000 American deaths with majority of them being around the ages of 20 to 40 years old in military training camps. By examining the history of the 1918 influenza pandemic, it will help us to better understand how the outbreak occurred particularly within the confined settings of military camps. The intended research will involve a systematic review of various literatures pertaining to the 1918 influenza pandemic and influenza outbreaks within the U.S. military camps. Examination of these literatures will provide a better understanding of how the virus spreads within the military population, how were the first cases identified, and how was the virus handled during that time. This historical reflection will also allow us to further evaluate current prevention strategies and what we can do to help improve these countermeasures for possible future outbreaks.

Keywords: 1918 influenza pandemic, 1918 influenza pandemic in military settings, influenza in U.S. military camps, influenza pandemic in U.S. military

**A Historical Review of the Influenza Outbreaks Within
Military Settings and Understanding the Viral Spread of the
1918 Influenza Pandemic**

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Naomi Ngadiman

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APPROVAL PAGE

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by

Naomi Ngadiman

Approved:

Gerardo Chowell-Puente, PhD
Committee Chair

Anu Laxmi, MPH
Committee Member

May 21, 2018
Date

Author's Statement Page

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Naomi Ngadiman

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Introduction

The influenza pandemic of 1918 or also commonly known as the “Spanish Flu of 1918”, was a significant part of our history that helped shaped medicine in many different ways.

Although it was a traumatic event that lead to a high mortality count throughout the world, it also lead to a new viral discovery and helped to foreshadow how public health would progress to the present. It took several research and back-tracking to better understand what had happened during the 1918 pandemic, but it is still not fully understood to its entirety.

During this historical time, not only were public health officials making several medical advancements but were also frequently being introduced to new contagions; Influenza being one of them. Because influenza presented similar characteristics like the common cold or pneumonia-in early stages-it was difficult for physicians to distinguish that a new viral infection was going to have a huge impact across all nations. It was not until 1933 that the influenza virus was first isolated (Wever and Bergen, 2014) and identified in 1997 as the Human influenza type A subtype H1N1 (Chertow et al., 2015). This highly contagious virus is mainly spread from person to person by means of inhalation of the viral respiratory droplets (CDC, 2017). When a susceptible individual comes within a 6 ft radius of an infected individual who has talked, coughed, or sneezed the virus into the environment around them, they are most susceptible to inhaling these viral droplets into their lungs (CDC, 2017). A person can also pick up the influenza virus from touching infected surfaces or objects and then touching their own nose or mouth areas (CDC, 2017). Normally, an infected individual is contagious within 24 to 48 hours-peaking at 72 hours-prior to any symptom shown and can continue to be contagious for up to a week after symptoms have resolved (Sanchez and Cooper, 2016). The most common symptoms that are presented with this infection are the onset of a fever, cough, malaise, and headaches that

usually can last up to 5 days (Sanchez and Cooper, 2016). Although influenza can cause serious complications, it is also very common to see influenza patients suffer from secondary infections. During the 1918 pandemic, pneumonia was the major secondary infection in conjunction with influenza that had a huge role in the increased mortality rates. According to George A. Soper (1918), influenza paved a path for pneumonia to follow. In other words, after every influenza outbreak there was a high prevalence of pneumonia that followed, which significantly contributed to the high death rates (Soper, 1918).

When influenza hit the countries, it came in different waves and during one of the most significant milestones of the world: World War I (WWI). Many historians have stated that this influenza pandemic caused more deaths worldwide than the actual war itself. According to Encyclopedia Britannica, the total casualties from WWI, without considering the unreported cases, were approximately 38 million people (2018). There were over 18 million deaths with roughly 10 million of them being military personnel (History of the Net, 2000; WW1 Facts, 2017). During 1918 to early 1919, it was estimated that 500 million people, or a third of the world's population, at that time were infected with influenza (Taubenberger & Morens, 2006). According to Taubenberger & Morens, it was estimated that approximately up to 50 million people died from this deadly infection worldwide. One of the most notable characteristic that was portrayed through this horrific pandemic was how the influenza virus came in waves of varying lethality (Wever and van Bergen, 2014). Each lethal wave had the greatest impact on men residing in military camps, especially those within the United States (U.S.) military. These particular settings were the most vulnerable to be affected by this virus. In order to help better understand how and why the outbreak occurred particularly within the military camps, this study will comprehensively examine and analyze the history of the 1918 influenza pandemic. We can

then reflect on how this virus spreads within such a confined setting and the social impacts it has had on the rest of the community.

Methods

A systematic review of various literature(s) relating to the 1918 influenza pandemic and influenza outbreaks within U.S. military camps were conducted. Information was gathered through an extensive literature search using various engines provided by Georgia State University's database access such as ScienceDirect, PubMed, JAMA, ProQuest central (Public Health database), Google Scholar, Ulrichsweb and others. Ulrichsweb was used to determine if the selected journal articles of interest were peer-reviewed for reliability purposes. All secondary data information were gathered from scholarly journals, peer-reviewed journal articles, and credible online sources. The key terms used in the literature search were: 1918 influenza pandemic, 1918 pandemic influenza, influenza in U.S. military camps, influenza pandemic in U.S. military camps, influenza outbreaks in U.S. military camps, influenza in U.S., world war I total casualties, world war I total deaths in U.S., influenza in camp Devens 1918, camp Grant 1918, camp Fort Dix 1918, camp Funston 1918, camp Dodge 1918, Camp Lee 1918, camp Upton 1918, and camp Custer 1918. Both US and U.S. were used with each key term specifying the United States. The search year from 1918 to present was the one main search parameter that was used to include all related literature from back to 1918. Because most of the research found were more current, a Georgia State Librarian was consulted with to help gain access to older articles. A few articles were not retrieved using key terms, but through the reference page of chosen articles. The articles of choosing were determined based on the detailed recollection of the entire 1918 influenza pandemic. This includes, but not limited to, the discussion of when and where possible cases were found, which camps were highly affected, how the influenza traveled around the camps, how influenza cases were determined and handled, risk factors, prevention strategies taken, public health response, total and per military camp incidence rates, mortality

and morbidity rates, and case-fatality rates. By analyzing the available data gathered through the literature review, the top 8 military camps with significant incidence and mortality rates were examined.

The tables listing all statistical information gathered by the literature were generated through Microsoft Word 2016. The outline of the U.S.A map was taken from google images and the military camp sites were traced using Microsoft Paint 3D.

Literature Review

When the 1918 pandemic struck, it had the greatest impact within the United States military. It was estimated that approximately more than 675,000 Americans, both civilian and military, died of the flu and pneumonia (Crosby, 2003) and 117,000 Americans died from the war itself (Encyclopedia Britannica, 2018).

The First Wave of the 1918 Pandemic

With influenza affecting various parts of the world, it was difficult to determine where the first true origin of the virus occurred. A main obstacle that also made it challenging to trace back its source, was the issue with misclassification of influenza amongst other common respiratory diseases (Chertow et al., 2015) and having cases that were never officially reported. Many physicians at the time were not aware of what influenza was and consequently continued to miscategorize cases until it was too late. Through long and extensive investigation, researchers were finally able to determine that the first pandemic wave appeared in the spring of 1918 (Taubenberger and Morens, 2006). Many argued on where this viral outbreak may have occurred, but after examining considerable evidence from other parts of the world, it was concluded that the “United States was the main site of origin” (Barry, 2004). The worldwide analysis took into account the timing of when the outbreaks took place, the type viral strain, and the duration it had. The first instance of influenza that was recorded was suggested to have occurred on January of 1918 in Haskell County, Kansas, which was known to be a small and isolated county (Barry, 2004). It affected many of the residents there, but it was not taken into serious account because of the short cycle it had and the distraction of the war. Although the virus came and left this town fairly quick, it was then suggested that this strain was somehow

carried over to the nearby military training camp in Ft. Riley, Kansas called Camp Funston. It was at this camp where the first major influenza outbreak was to occur (Wever and van Bergen, 2014). On March 4th, 1918, the first military documented influenza case was reported (Krieser, 2006) and marked what would be reflected as the ‘beginning phase of the 1918 influenza pandemic’. After the first case was recognized, Camp Funston, which supposedly contained 29,000 men, had already roughly over 1,100 men hospitalized with the disease between March 4th to March 29th (Opie et al., 1919).

During this spring pandemic wave from early March to summer of 1918, it was also observed that influenza would attack in 5 subsequent waves (Wever and van Bergen, 2014; Barry et al., 2008) according to susceptibility. The outbreak in the month of March was the first subsequent wave to hit the troops within the military training camp. According to the article by Opie et al. (1919), the 164th Depot Brigade (consisted of all white soldiers) was the first unit within this camp to have been attacked by the outbreak. This influenza epidemic in March, first attacked all organizations that had been in Camp Funston for at least 6 months or more (Opie et al., 1919). Although the virus affected almost all the units within the camp, the units that had suffered the most from influenza were the “164th Depot Brigade, the Medical Department and the 317th Headquarters Trains of the 92nd Division, and the 314th Trains (white troops)” (Opie et al., 1919). By the end of the month, all the susceptible individuals were infected leaving the virus spent out (Opie et al., 1919). In the next subsequent waves of influenza, the virus redirected its targets to infecting newly drafted men being brought into the camp (Opie et al., 1919). It took no more than a few days after their arrival for them to inevitably succumb to the infection.

As the virus continued to spread, physicians began to realize that with every influenza outbreak there also followed a secondary bacterial infection of pneumonia amongst the same

influenza infected troops (Opie et al., 1919). Pneumonia was a more severe infection that led to several deaths even with the available therapy at that time. Although there were a small number of pneumonia infections trailing behind during this spring epidemic (Soper, 1918), it did not have a large effect on the nation until later on in the year. According to Wever and van Bergen (2014), this initial wave was “relatively mild and caused few deaths” then what was seen in the more virulent wave occurring towards the autumn season. Approximately over “144,000 out of 1.2 million military men within the U.S. Army training camps were admitted to hospitals for respiratory illnesses during the spring wave of March to May of 1918” (Wever and van Bergen, 2014). By mid-May the influenza virus began to dissipate from the United States Army leaving the nation to believe that the epidemic was over. On the other hand, the U.S. Naval military camps located on the coastal regions, were unfortunately still experiencing the outbreak. The naval ships that transported military troops to other countries were the key connection to how the epidemic turned into a worldwide pandemic (Crosby, 2003). So although it was quiet within the U.S. grounds during the summer, the influenza outbreak was actually attacking other countries.

The Second and Third Waves of the 1918 Pandemic

By late summer of 1918, an emergence of a lethal influenza virus re-surfaced back onto the United States territory creating a second pandemic wave. This viral strain was responsible for most of the tens of millions of deaths worldwide from September to November 1918 (Wever and van Bergen, 2014). Although it had already emerged earlier amongst the military troops stationed in Europe, it did not hit the United States till late August of 1918 (Wever and van Bergen, 2014). It was on August 27, 1918 when the virus first surfaced at the Commonwealth Pier in Boston, Massachusetts (Byerly, 2010). Three sailors from the receiving ship, which was not a ship but a rest area for soldiers to sleep and eat during their travel from one assignment to

another, reported sick (Crosby, 2003). Because the Commonwealth Pier was already overcrowded at that time, it did not take long for other men within this location to fall ill to the disease. By the next day, “there were 8 new cases and 58 new reported cases on August 29” (Crosby, 2003). The virus struck so quick that it overwhelmed the medical facilities at the Commonwealth Pier causing many of the cases to be transferred to the nearby Chelsea Naval Hospital (Crosby, 2003).

Unfortunately, on September 8, 1918, the first case of influenza appeared at Camp Devens in Ayer, Massachusetts (Sanford, 1983). The first unit within this camp to be affected and also where the first case was located was within the Company B, 42nd Infantry (Woolley, 1919). Camp Devens, which was located about 30 miles west of Boston (Crosby, 2003), was experiencing severe overcrowding issues. It was supposedly built to house 35,000 soldiers but at the time contained more than 45,000 soldiers (Crosby, 2003). This overcrowding dilemma helped to create a perfect environment for the influenza virus to flourish. As soldiers in the camps and trenches became sick and sent to infirmaries, new healthy recruit soldiers were constantly being brought in as replacements while risking exposure to the virus (Byerly, 2010). This continuous cycle of viral exposure among the new recruits, along with the quick infection rate, is what made it difficult to contain and reduce the number of infections during this outbreak. “Within 10 days from the first infection, the base hospital and regimental infirmaries were overwhelmed with thousands of sick soldiers” (Byerly, 2010). As the number of influenza cases increased each day, Camp Devens experienced its maximum intensity on September 20th with approximately 1,543 cases on a single day (Soper, 1918; Woolley, 1919) <Table 2>. According to Wever and van Bergen (2014), by the end of September, Camp Devens was hit the hardest and alone had over 14,000 influenza cases and a case-fatality rate exceeding 5% with around 787

deaths (Bombardt, Jr. and Brown, 2003). <Refer to Table 1 & Table 2 for list of top 8 U.S military camp statistics>

“Before any travel ban was imposed, a contingent of replacement troops departed Camp Devens and brought influenza with them to Camp Upton in Long Island, New York on September 13, 1918” (Byerly, 2010; Wever and van Bergen, 2014). When the virus arrived, it abruptly resulted in 38 hospital admissions the first day and reaching its highest admissions of 483 cases on October 4th (Lyon et al., 1919; Byerly, 2010) <Table 2>. By October 22nd, the strongest portion of the fall epidemic at Camp Upton was at an end with a rough total of over 6,131 admissions and 404 deaths (Lyon et al., 1919; US Army Surgeon General’s office, 1928) <Table 1>.

Not too long after it hit Camp Upton, other “U.S. army training camps were also swept by the influenza outbreak from the northeastern coast, south and west following the wartime transportation routes” (Wever and van Bergen, 2014) <Figure 1>. For instance, Camp Lee in Petersburg, Virginia also reportedly admitted their first case on September 13th, 1918. By early morning of September 17th, there were already 500 cases and over 1,000 cases by September 19th (University of Michigan Center for the History of Medicine, n.d; Barker, 2002). From the first reported case to November 10, 1918, Camp Lee experienced a total of approximately 13,597 influenza cases and 674 overall deaths (Sanford, 1983) <Table 1>.

On September 15, 1918, the influenza epidemic reached Camp Dix, New Jersey (Synnott and Clark, 1918). According to the Office of the Surgeon General (1918e), the “34th Division, which was stationed at this camp, was the first and the hardest hit during this epidemic”. The outbreak reached its maximum number of cases on September 26th with 806 admissions (Synnott and Clark, 1918) <Table 2>. By October 6th, the number of daily admissions began to decrease

(Synnott and Clark, 1918) and eventually on November 10th the influenza epidemic was at its minimal (Office of the Surgeon General, 1918e). From September 9th to November 1st, there were approximately 13,733 admissions and 808 total deaths (Sanford, 1983) <Table 1>.

On September 16, 1918, Camp Funston sent 47 influenza cases to the base hospital and experienced their highest admissions between September 28th to October 5th (Office of Medical History, 2009). Within the 10th division of Camp Funston, the maximum admission of 708 cases were admitted on October 2nd (Office of Medical History, 2009). According to the report from the Office of Medical History (2009), the highest total number of influenza and pneumonia patients that were admitted to a hospital in a single day from all units was on September 30, 1918 with 785 cases <Table 2>. By November 7th, Camp Funston had witness approximately 17,000 admissions and 841 deaths (Sanford, 1983)<Table 1>.

Camp Dodge in Iowa had officially admitted its first case of the fall epidemic on September 18, 1918 (US Army Surgeon General Office, 1928). In a report from the Office of the Surgeon General (1918b), it stated that the possible carrier to have induced the epidemic at Camp Dodge was from the arrival of a soldier on September 14th from North-Hampton, Massachusetts. This individual entered the camp presenting influenza-like symptoms but was never admitted into the hospital (Office of the Surgeon General, 1918b). Because Company 64, which was where he was assigned to, was the first to become affected, it reinforced the speculation that this particular soldier was the source of origin (Office of the Surgeon General, 1918b). The outbreak in this camp lasted from September 20th to October 20th, yielding a total of 10,008 influenza cases, 1,923 pneumonia cases, and 702 total deaths (Office of the Surgeon General, 1918b) <Table 1>.

Camp Grant, which was located in the north central part of Illinois and housed approximately 43,000 men (Carter, 2015), had their first influenza case on September 21, 1918 (Byerly, 2010; Office of medical history, 2009). According to the US Army Surgeon General's Office (1928), from September 21st to October 31st approximately 10,700 men were attacked with 8,000 of these within the first 10 days of the outbreak. The highest number of cases reported in a single day were 984 cases on September 27th (Office of the Surgeon General, 1918a) <Table 2> and by November 3rd there were a total death of 1,060 men (Byerly, 2010; Sanford, 1983) <Table 1>.

The influenza epidemic in Camp Custer, Michigan made its first appearance on September 23, 1918 within the 78th Infantry (Vaughan, 1919; Office of the Surgeon General, 1918c). The epidemic soon reached its maximum admissions on October 2nd with 1,227 cases (Vaughan, 1919) <Table 2>. With the epidemic coming to an end on November 3, 1918, Camp Custer had a total of approximately 10,220 cases admitted into the hospital (Office of the Surgeon General, 1918d) <Table 1>. Approximately 2,374 out of the 10,220 cases went on to develop pneumonia and out of the 2,374 cases, there were 674 deaths (Office of the Surgeon General, 1918d).

Between September 12th to September 30th, approximately 31 camps were already struck with the influenza virus (Soper, 1918). Many of these camps saw more than 500 influenza cases being reported in a single day (Soper, 1918). According to Soper (1918), influenza attacked more military men within the Southwestern and North Central region compared to other geographical regions within the U.S. and with a minimum of 20% attack rate. The regions that had the greatest case fatality by pneumonia were the Southeastern, North Central, and Southwestern groups (Soper, 1918). <Refer to Figure 1 for list of main U.S. training camps affected>

Along with the influenza virus, a secondary bacterial infection of pneumonia was also at its most virulent stage during this fall pandemic. It was also believed that the strain causing the spring pandemic was an attenuated or avirulent form of influenza which later mutated to become a more virulent form in the fall (Woolley, 1919; Chertow et al., 2015). With this new lethal form of influenza causing serious outbreaks throughout military camps, it was seen to have paved a way for the virulent pneumonia to also invade (Sanford, 1983; Soper, 1918). One of the main reasons to why the 1918 influenza virus was so lethal was because of the increased proportion of influenza patients becoming susceptible to pneumonia (Shanks, 2015; Sanford, 1983). The timing of the onset of pneumonia was observed to be usually within a week after the incidence of influenza cases (Soper, 1918). With influenza attacking the upper respiratory system, the secondary bacterial infection of pneumonia was able to induce further pulmonary complications which consisted of extensive fluid buildup within the lungs (CDC, 2017; Shanks, 2015). With the lack of oxygen allowed to circulate in the body, patients suffered extreme coughs, chest pains, fever, and eventually suffocate due to difficulty breathing (CDC, 2017; Wever and van Bergen, 2014). Sadly, many of those who became infected with influenza and pneumonia had a low probability of surviving because of how quick both infections spread within the body and the lack of available treatment therapy. According to Chertow et al. (2015), “the odds of admission for influenza complicated by pneumonia was approximately 10 times higher during September to October 1918 relative to the spring pandemic”. The highest mark and deadliest month observed for morbidity and mortality rates in the United States army came in the first week of October 1918 (Byerly, 2010). Although the month of October was the peak of the epidemic, all attack and mortality rates began to slowly decline by mid-November. During the fall pandemic, approximately “1 in every 5 soldiers had influenza where of these 1 in 6 would go on to develop

pneumonia, and out of these pneumonia patients about 2 out of the 5 would not survive” (Soper, 1918). This deadly wave of the epidemic ran its course in about eight weeks from roughly September 15 to November 15, 1918 and took millions of lives with it (Byerly, 2010; Wever and van Bergen, 2014).

By the end of November, majority of the influenza and pneumonia cases began to slowly disappear. It was not until late December that these cases started to slowly present itself again. In many nations, a third wave occurred in the early winter months of 1919 (Taubenberger and Morens, 2006; Wever and van Bergen, 2014). The number of deaths and infections during this wave were significantly less than the second pandemic wave, but it still consisted of the same virulent strain. When examining Figure 2a generated by Chertow et al. (2015), the slightest increase in “deaths from all influenza illnesses” were found in the month of January 1919 followed by a steady decrease thereafter. Although this third wave of influenza in early 1919 did not last long, it still had a significant amount of deaths from the outbreak. Overall, the pandemic waves from 1918 to early 1919 resulted in millions of deaths worldwide with the largest impact amongst the military soldiers in the United States.

Risk Factors of the 1918 Pandemic

While investigating the 1918 influenza pandemic, researchers were able to determine various determinants that influenced the morbidity and mortality rates. For starters, there was a distinct preference in the type of individuals the virus infected. As we have observed in the recent recounts above, many of the soldiers that were affected were amongst newly drafted men from major training camp sites or those with less than three months in service (Wever and van Bergen, 2014) <Refer to Figure 1>. The case fatality and mortality rates were the highest among soldiers found in mobilization army camps than compared to naval camps (Shanks et al., 2016).

The most significant difference in the epidemiology of the 1918 pandemic was the extremely high mortality rates amongst young adults between the ages of 20 and 40 years (Hsieh et al., 2006; Shanks, 2015). Generally with outbreaks regarding respiratory infections, it was more commonly observed to have higher excess mortality rates among the very young and the very old populations (Crosby, 2003). These two groups are most susceptible to infections because of their immunocompromised systems. When examining the data collected from different sources, the age-specific death rates were exhibited in a distinct W-shaped mortality curve (Taubenberger and Morens, 2006; Wever and van Bergen, 2014; Shanks et al., 2016). This curve displayed the unique phenomenon of the pandemic where young adults between 20 to 40 years of age as well as the very young and elderly were affected (Shanks, 2015). It is still fully unknown to why the healthy young adults were the most affected, but there are few speculations that assume those >65 years of age had acquired protective immunity from a previous exposure to influenza in the late-1800's (Taubenberger and Morens, 2006; Shanks, 2015; Barry et al., 2008). There are no known research to prove the relationship between the 1890 and 1918 pandemics and therefore holding this speculation to remain hypothetical (Shanks, 2015).

Another risk factor that may have contributed to the 1918 pandemic was the issue of overcrowded facilities. During this time, many of the military camps and hospital settings accommodated more soldiers than what it was initially meant to house. These conditions allowed the aggressive virus to gain more host access in spreading the epidemic. According to Wever and van Bergen (2014), one regiment that had higher square feet per soldier had a lower disease rate than compared to a regiment that had lower square feet per soldier. Overcrowded facilities also lacked adequate isolation creating a sustainable environment for the virus. While it was challenging to control overcrowding within training camps, it was also difficult to manage it in

the battlefields of the war (Byerly, 2010). “As soldiers in the trenches became sick, the military evacuated them from the front lines and replaced them with healthy men” (Byerly, 2010).

Because of this frequent recycling of soldiers, the virus were continuously in contact with new, healthy and young hosts (Byerly, 2010).

Weather conditions during each of the outbreaks in 1918 was also noticed to be another contributor to the viral spread (Soper, 1918). It was observed that each epidemic occurred during colder periods of time. The increased case-fatality rates during the fall-winter pandemic also demonstrated another thriving condition that the virus preferred. Although the first pandemic wave did not yield a high fatality rate, the virus did initially appear during the colder months of March to April and diminishing towards the warmer summer period.

Racial segregation may have also played a minor role in the epidemic of influenza. According to the data analyzed by Byerly (2010), African American soldiers were observed to have “lower morbidity but higher mortality rates than compared to white soldiers”. Opie et al. (1919), also yielded data results that showed higher incidence rate among drafted colored men than drafted white men. The rationale to these observations, was due to the inferior living conditions and the medical care provided for the African American soldiers then compared to what the white soldiers were provided with (Byerly, 2010).

Prevention Strategies Performed During the Pandemic

Along with trying to understand the pathology of the novel influenza virus, there were also a diverse range of strategies and prevention measures taken to help mitigate the outbreak. With each approach varying across camps, public health and medical officials tried to generally

implement these countermeasures with the same medical objective of quarantine and possible viral elimination.

One key strategy that was important but difficult to achieve, was the action of effectively isolating influenza patients from each other and from the susceptible population. Many of the medical officials collaborated to generate different approaches to control the spread of the virus. By isolating those that were sick, it would minimize the exposure to the influenza virus and to other secondary bacterial infections such as pneumonia (Shanks, 2015). Unfortunately, during this pandemic it was extremely difficult to achieve this process due to the concentration of World War I. The war brought about the complication of overcrowding within training camps and on the battlefields. Since there were always a constant demand for soldiers, it kept exposure to the virus at a constant. By the time many of those who showed the initial symptoms, the virus was already in reach of the susceptible individuals. Within the camps and hospital facilities, those that were sick were arranged in alternating head to foot sleeping arrangements in order to increase the distance between the heads and the respiratory droplets as much as possible (Soper, 1918). Some barracks even adapted a cubicle system in which each bed was separated by hanging sheets to act as a barrier (Byerly, 2010; Soper, 1918). The most common recommendation that was suggested was to provide an ideal 100 square feet of space per man (Soper, 1918; Byerly, 2010), but this was never achieved because of the large ratio of soldiers entering the camps. With many camps and sick housing facilities following quarantine procedures, visitors were not allowed to travel in or out of the camps to see sick ones except for close friends and relatives (Soper, 1918). Because isolating the infected patients was challenging to accomplish, it created an optimal environment for influenza and pneumonia to flourish.

Sanitation was also an important preventative measure that was practiced by all camp and hospital settings. It was crucial that in order to help prevent the spread of the epidemic, each housing unit was kept clean and provided with adequate ventilation. Some techniques that were commonly found in practice were: oiling all floors to keep down the dust, boiling all the medical kits and linens, airing out bed and beddings outdoors, keeping equipment and spacing as clean as possible, furling tents for ventilation during favorable weather conditions, and providing fresh water (Byerly, 2010; Soper, 1918; Woolley, 1919; Sanford, 1983). Facial masks were also provided to sick ones and medical providers to aide in both sanitation and isolation purposes. It was used to further reduce the spread of respiratory droplets from coughs and sneezes from those that were sick (Byerly, 2010; Soper, 1918).

In order to help carry out these specific preventative measures, educating each individual on how to accomplish them was fundamental in reducing the epidemic spread. Medical officers and healthcare providers were taught on “what to expect in the way of symptoms and what principles of prevention to put into effect” (Soper, 1918). Lectures and instructions were provided for those within the military and for the rest of the community to better understand the principles of disease transmission, personal hygiene, and how to participate in the act of prevention (Soper, 1918).

Discussion

Future Prevention Strategies

Several of the prevention strategies that were practiced during the 1918 pandemic are methods that are still carried out today. By understanding and retracing the steps of what happened during the pandemic period in military camps, public health and medical providers can fine-tune and better implement preventative measures for the possibility of other future outbreaks. Military troops who travel abroad are constantly susceptible to coming into contact with various contagions. Since military troops are also stationed in confined settings and vulnerable to viral epidemics, it is especially important to understand how to regulate and prevent unwanted transmissions.

With viral evolution at a steady rise, education plays an important key in aiding how the community will respond and perform during medical emergencies. Although there are informational programs implemented within military training, there needs to be an increase in the exposure frequency to these modules. Rather than having just a one-time introduction or annual summarization to the information, all military soldiers and officers needs to be required to go through preventative programs on a quarterly basis. The presented information should continue to include general details and descriptions of what to expect during an outbreak, what to look out for, what can you do to help, what proper prevention and response techniques should be executed, who you should seek out to, and how to act in these circumstances. Reiteration of key strategies such as, but not limited to, early detection, sanitation, and isolation, are also concepts that should continually be demonstrated so that if military settings are affected by a contagion, there is a reduced risk of it disseminating to the general population. The increased prevention

awareness among military personnel can better prepare each individual's role in keeping unwanted exposure and mortality to its minimum.

Limitations

While reporting this analysis of the 1918 influenza pandemic, several limitations were observed. Due to the narrow amount of research performed to investigate the 1918 pandemic, this analysis was limited to the number of reliable and relevant published articles used for examination. There were a few considerable articles that did examine specific army camps at interest, but may not have been peer-reviewed for reliability. Data extrapolated from archives or other documentations that were used in primary reports and analyzed in this report, had indications of misclassification and missing data from unreported cases. Since influenza was a novel virus in 1918 and viral culture tests were unavailable, there were no standardized criteria for diagnosis or diagnostic categorization (Chertow et al., 2015; Crosby, 2003) established for medical providers to utilize. Many of the influenza reported cases were initially categorized with other common respiratory illnesses (Chertow et al., 2015) or meningitis (Soper, 1918). A few speculations that may have caused cases to not be reported, but are not limited to, are: individuals who were infected with influenza but recovered well, those who passed away from the infection due to the lack of access to medical care, or those who were infected but never sought out medical treatment.

Conclusion

The 1918 influenza pandemic had a profound effect on every civilian around the world, but especially among the men serving within the United States military. This study was performed to analyze and understand how the influenza virus in 1918 had such a huge impact within the vulnerable military population. By retracing and examining the number of incidence and mortality cases occurring within various U.S. military camps, we were able to generate a better understanding of what had happened and what was done to control this novel virus. Out of the approximately 17 months that the pandemic was polluting this nation, it displayed its extreme prominence within the short months of September to November and inhabiting almost every location. During this fall season, the soldiers within the training camps had an overall 28% attack rate with a 1.37% influenza-associated mortality rate (Shanks et al., 2016). With all the preventative measures and medical technology available at that time, it was still difficult for public health officials to successfully isolate and contain the epidemic. Overcrowded hospitals and military camp sites was a major factor that made it especially challenging to properly isolate the sick soldiers from the rest of the susceptible individuals. The data gathered from various articles displays significant amount of military men falling ill from the swiftness of the influenza virus despite the late implementation of prevention strategies.

Attempts to understanding the epidemiology of the past pandemic is extremely important for us so that we can best prepare for the possibility of another unexpected outbreak. It allows formulation of new prevention strategies, improvements to current medical and public health interventions, vaccine development, and better educational awareness for the community.

Although surveillance for influenza in 1918 was not the best, there is still a substantial amount of data information that can help researchers understand the nature of the epidemic. It also reminds

current researchers, epidemiologists, and all other public health officials, how important it is to report all cases despite how mild or severe the viral symptoms are presented. Continuous surveillance among the U.S. military personnel must be maintained since they are at an increased risk of being exposed and potentially contributing to the transmission of unwanted contagions to the susceptible populations. Combining increased surveillance and awareness programs among the military soldiers can help with early detection and decrease the likelihood of another outbreak. Since the influenza virus is continually evolving and becoming resistant to current vaccines, it is especially important to make sure we protect these group of individuals and the world. In order for us to keep up with this viral evolution, we need to ensure that medical research studies are regularly performed.

Tables and Figures

Table 1: List of the top 8 U.S. military camps that were affected the most during the 1918 fall pandemic wave with the total admissions and deaths (includes influenza and pneumonia cases)

Camp	Epidemic period	Total Admissions	Total Deaths
Devens (Massachusetts)	9/08 – 10/29	17,400	787
Upton (New York)	9/13 – 10/22	6,131	404
Lee (Virginia)	9/13 – 11/10	13,597	674
Dix (New Jersey)	9/09 – 11/01	13,733	808
Funston (Kansas)	9/16 – 11/07	16,983	841
Dodge (Iowa)	9/20 – 10/20	11,931	702
Grant (Illinois)	9/21 – 11/03	10,739	1,060
Custer (Michigan)	9/23 – 11/03	10,220	674

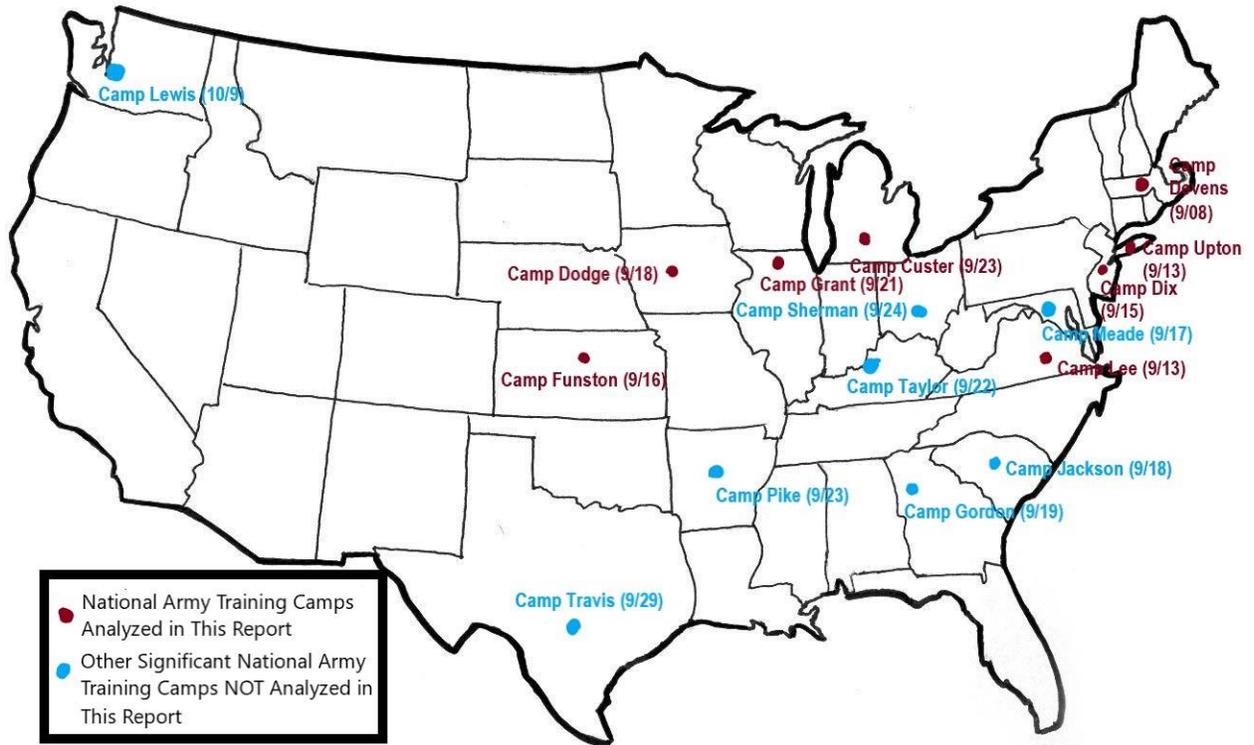
*Data for each camp was retrieved from the following authors: Sanford, 1983-Camp Devens, Camp Lee, Camp Dix, Camp Funston; Lyon et al, 1919-Camp Lee; Office of the Surgeon General, 1918-Camp Dodge, Camp Grant, Camp Custer.

Table 2: List of the top 8 U.S. military camps that were affected the most during the 1918 fall pandemic wave with dates indicating when the highest peak of cases occurred and total cases of that date

Camp	Date of 1 st reported case within the camp	Date of when single day high admissions occurred	# of cases (highest # of admission)
Devens (Massachusetts)	Sept 8	Sept 20	1,543
Upton (New York)	Sept 13	Oct 4	483
Lee (Virginia)	Sept 13	-	-
Dix (New Jersey)	Sept 15	Sept 26	806
Funston (Kansas)	Sept 16	Sept 30	785
Dodge (Iowa)	Sept 18	-	-
Grant (Illinois)	Sept 21	Sept 27	984
Custer (Michigan)	Sept 23	Oct 2	1,227

*Data for each camp was retrieved from the following authors: Soper, 1918 & Woolley, 1919-Camp Devens; Lyon et al, 1919-Camp Upton; Synnott and Clark, 1918-Camp Dix; Office of medical history, 2009-Camp Funston; Office of the Surgeon General, 1918- Camp Grant; Vaughan, 1919-Camp Custer.

Figure 1: Map depicting the main locations of the 1918 U.S. military training camps most affected



**Information gathered from Sanford, 1983 and The Official Home Page of the United States Army*

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