

Non-Pharmaceutical Interventions and Military Hygiene at the United States Military Academy between 1890 and 1910

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ABSTRACT

Introduction

Military installations are at increased risk for the transmission of infectious disease. Personnel who live and train on military installations live and train near one another facilitating disease transmission. An understanding of historical sanitation and hygiene can inform modern practices. This is especially pertinent considering the continuing rise of variants of infectious diseases, such as the recent pandemic of the 2019 severe acute respiratory syndrome coronavirus 2. In this article, we review the rise and decline of infectious disease at the United States Military Academy (USMA) during the period spanning 1890 through 1910, and the public health interventions used to combat disease spread.

Materials and Methods

Primary data regarding cadet illness were acquired from the historical archives of the USMA. These included annual reports, clinical admission records, casualty ledgers, and sanitation reports. Unpublished documents from the medical history of USMA provide periodic trends of health among cadets because of infectious disease.

Results

Between 1890 and 1910, the USMA at West Point was confronted with cases of influenza, measles, mumps, scarlet fever, smallpox, typhus, and malaria. In response, a series of non-pharmaceutical interventions (NPIs) were instituted to curb the spread of infectious disease. These interventions most likely proved effective in suppressing the transmission of communicable diseases. The most common and arguably the most effective NPI was the physical separation of the sick from the well.

Conclusions

The USMA experience mirrored what was occurring in the larger U.S. Army in the early 20th century and may serve as a model for the application of NPIs in response to modern infectious diseases resulting from novel or unknown etiologies.

INTRODUCTION

Historians have referred to the years spanning 1890 and 1917, as the age of the “bacteriological revolution”.^{1,2} During this period, the germ theory of disease was formulated and widely accepted and the first effective serum treatments for infectious disease were developed. This was also the period in which the precursors of modern sanitary systems were perfected, and the etiological agents of numerous diseases were identified. These developments had a profound impact upon the practice

of preventive medicine in the U.S. military in general and on the efforts to reduce the burden of infectious disease at the United States Military Academy at West Point (USMA), in particular.^{3,4} Because of rigid selection procedures, members of the USMA Corps of Cadets in the late 19th and early 20th centuries most likely represented a subset of the most well-fed and healthiest personnel available. However, there is an inherent risk in housing and training larger numbers of cadets together on an isolated military post.⁵ The faculty and staff of USMA were aware of the dangers of the military environment and they took numerous precautions to maintain the health of the Corps.

It is important to note that when the cadets of the late 19th and early 20th centuries arrived at USMA, they not only brought their luggage and uniforms but they also brought the unique collection of bacteria and viruses that were living on the surfaces of their skin, lining the tissues of their upper and lower respiratory tracts and thriving deep within their bodies. These potential pathogens may have represented the greatest danger that the cadets would face during their 4 years at the academy. In peacetime, infectious disease can have a negative impact on military readiness. In times of war and national emergency, the impact of infectious disease can be

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devastating. The impact of infectious disease on USMA can be particularly severe during situations in which there is an increased demand from the nation for the education, training, and commissioning of new officers. It was therefore necessary that incidence of infectious disease at USMA be controlled to the greatest extent possible.

Fortunately, the medical staff and faculty of USMA during the late 19th and early 20th centuries were composed of a select group of highly knowledgeable and skilled officers. Some of them had experience in the Spanish American War (1898) and they had seen first-hand the consequences of neglecting camp sanitation and military hygiene. They instituted a series of non-pharmaceutical interventions (NPIs) to prevent disease transmission at USMA and they took measures to ensure that all graduates were able to apply the concepts of military hygiene in the field.⁵ Specific interventions included the development of a mandatory military hygiene course that was taught by experienced medical officers and the development of the procedures and practices that would be used for responding to outbreaks of infectious disease in the community. Although it is difficult to directly determine whether these efforts resulted in an overall reduction in the numbers of cadets reporting to sick call or if they resulted in an overall reduction in disease transmission, they were most likely effective in instilling the concepts of military hygiene and preventive medicine into the members of the Corps of Cadets and they laid the foundations for the critical preventive medicine efforts that carried USMA through the First World War and the Influenza Pandemic of 1918. The history of preventive medicine and military hygiene at USMA is particularly relevant in this era of increased disease transmission because of international travel, climate change, and rapid urbanization. The late 19th and early 20th century was a time in which antibiotics were unavailable, vaccines were rarely given, and modern diagnostics did not exist. USMA was able to operate and succeed in its mission with minimal casualties in this environment. Understanding how they achieved this result may help to inform the policies and procedures that will be needed for preventing and responding to disease outbreaks in the military setting.

MATERIALS AND METHODS

Primary sources were acquired from the historical archives of the USMA library. These included the annual reports to the superintendent, clinical admission records, and the sanitation reports by the USMA Surgeon.⁵⁻⁸ An unpublished manuscript from 1950 documents the early history of the medical service at the USMA, annotating periodic trends within the Corps.⁹ Secondary sources were derived from peer-reviewed articles, news reports, and college newsletters. A qualitative analysis of all source materials was performed with the aim of identifying those factors that may have impacted the health of the USMA Corps of Cadets during the period spanning 1890 and 1910.

RESULTS

United States Military Academy Location and Geography

USMA is in the Hudson River Valley region of New York; the primary post is approximately 94 km north of New York City. The presence and location of the Hudson River was the cause of unique regional settlement patterns, the development of distinct cultural regions, and the positioning of the West Point garrison during the Revolutionary War.^{10, 11} The academic, administrative, and cadet areas are situated in the low-lying floodplain of the Hudson Valley. They are therefore subject to seasonal flooding and the continual presence of standing water reservoirs capable of supporting mosquito growth and malaria transmission.¹² Consequently, malaria was reported in each annual report of the Army Surgeon General from 1890 to 1910.⁵ In addition, enteric infections were common in the Hudson Valley area in the 19th and early 20th centuries but the rate of new infections declined in the latter half of 20th century, most likely because of advancements in bacteriology.^{11, 12}

Early Non-Pharmaceutical Interventions

During the 2 decades spanning 1890 and 1910, bacteriology was emerging as a newly developed discipline and viruses were just being discovered. Several key developments in the field of preventive medicine also took place during this time period.¹³ The typhoid vaccine was introduced 1896, the vector of yellow fever was discovered in 1901, and typhoid vaccination was made compulsory for all U.S. military members in 1909.^{14, 15} An examination of academy records indicates that each of these developments was followed by a period of overall decrease in the morbidity (sickness) and mortality (death) from infectious disease among the Corps of Cadets (Fig. 1). It is tempting to speculate that the diffusion of knowledge that took place during this period was at least partially responsible for improvements in the health of the Corps. Despite the remarkable advances that were taking place in diagnostic bacteriology, few vaccines were administered, antibiotics were yet to be discovered and the practice of clinical virology was lacking (the virus causing yellow fever was not isolated until 1927).^{16, 17} Therefore, interventions targeted against outbreaks of infectious disease based upon detailed knowledge of the etiological agent were not possible, and all rational interventions had to be non-pharmaceutical in nature.¹⁸

By the late 19th century, the concepts of disinfection and antiseptic use that had been developed in Europe reached United States. One of the first NPIs to be recorded at USMA was the filtration of the water exiting the sewage system in 1890. This was done in response to poor sanitary conditions, and it was conducted in combination with other preventive medicine efforts to include vaccination.⁵ The next NPI was the construction of a separate cadet hospital that took place between 1892 and 1893. This facility provided a dedicated

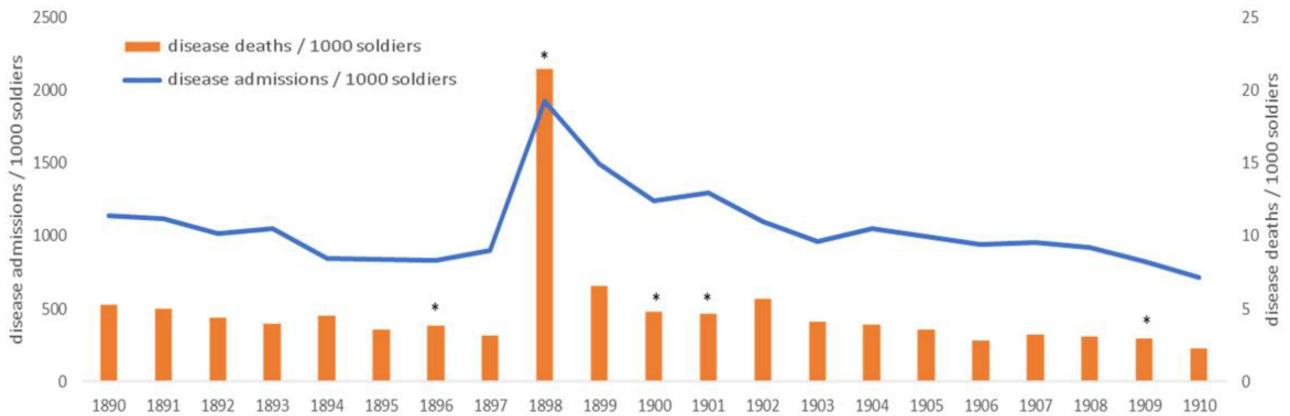


FIGURE 1. Morbidity and mortality rates because of infectious disease of all etiologies throughout the U.S. Army from 1890 to 1910. An overall reduction in rates of infectious disease and disease-associated death occurred during this period. The asterisks (*) represent a significant event in public health and preventive medicine, including, in chronological order, the development of the typhoid vaccine in 1896, the typhoid epidemic of 1898 during the Spanish–American War, the discovery of the vector of yellow fever in 1900, the last case of yellow fever in Havana in 1901, and the compulsory use of the typhoid vaccine by the U.S. military in 1909.^{12–15}

space for the identification, isolation, and monitoring of sick cadets. Further, this space allowed a separation of medical services in which ill cadets were no longer medically evaluated at the same facility as local family members or enlisted personnel. This resource most likely helped prevent the transmission of infectious disease between non-cadet members of the West Point community and the Corps of Cadets. The lessons learned during the development of these NPIs were continually communicated to the Corps of Cadet through the military hygiene course.¹⁹ This course was taught primarily by the medical staff and it most likely served as a vehicle for the exchange of ideas between the staff, the faculty, and the cadets.

With respect to personal hygiene, it is interesting to note that bathing was suggested as a weekly experience before the early 20th century. Widespread awareness of the benefits of personal hygiene resulting from an increased emphasis on military sanitation following the Spanish American War presents a possible explanation for the decline in infectious disease admissions within the cadet population. In addition to annual physical exams implemented in 1906, NPI initiatives by the medical staff improved the general health of the Corps and led to a continued yearly trend of decreasing sick call rates. Importantly, the USMA surgeon had requested that a separate isolation ward be provisioned in several annual reports with its final construction authorized in 1904, this contributed to the prompt removal of infectious cadets from the general population.⁵ Further, it was noted that such increased attention to hygiene and the development of preventive measures by the medical staff were associated with a general decline in infectious disease admissions to the hospital. These changes can be primarily attributed to the USMA surgeon’s efforts to prevent the transmission of respiratory pathogens.⁵

Although it is impossible to precisely determine the relative contributions of the multiple NPIs implemented between 1890 and 1910 because of a lack of a comparison group and fluctuations in the percentage of cadets reporting for sick call, declines were noted after some NPIs were introduced, indicating that these interventions may have had a positive effect.^{5–7}

Physical Separation as a Means of Infection Control

The construction of a medical treatment facility with a dedicated isolation ward provided USMA with the ability to physically separate sick cadets from well cadets. The term “isolation” refers to those practices that are designed to protect healthy people from those who are known to be sick by limiting the movements of the sick and treating and monitoring them in a separate location from the well. It differs from quarantine, in that quarantine refers to those practices that are designed to contain a pathogen by separating and limiting the movements of asymptomatic people and people who are suspected of being exposed.²⁰ Evidence for the use of both quarantine and isolation at USMA can be found in academy records. Knowledge of the benefits of physical separation can be found in practice of separating the diagnosis and treatment of cadets from the diagnosis and treatment of civilian spouses, children, and enlisted personnel.¹² Before the construction of a dedicated isolation ward, the isolation of sick cadets by restricting them to quarters appears to have been a routine practice at USMA and it is mentioned in reports from 1898 onward. This practice appears to have been particularly employed in preventing the transmission of enteric infections, such as typhoid fever, and respiratory infections, such as scarlet fever.⁵ Indeed, it can be argued that these methods were used to successfully contain an outbreak of scarlet fever

in 1899 by the quarantine of all potentially contaminated personnel in an empty barracks building.⁵ Physical separation appears to have worked well, and it has been noted that the few outbreaks that did occur after the introduction of this method were due largely to external influences (such as outside vendors and nonmilitary employees) that were beyond the direct control of the faculty and staff.⁵

Administrative Emphasis on Hygiene and Sanitation

Between 1890 and 1910, USMA staff continually reevaluated and updated hygiene and sanitation procedures. Each year, both the Superintendent's Annual Review and the Sanitation Reports included recommendations on how USMA leadership could improve the health of the Corps of Cadets. This dedication to preserve the health of the Corps and to avoid the public health concerns (malaria, scarlet fever, typhoid fever, influenza) of the surrounding communities set the conditions for a successful response.^{5, 8, 12} One result of this emphasis was the efforts of the USMA staff to understand and control the rate of malaria infection among the Corps of Cadets. Because of high rates of malaria being reported, an investigation was initiated in 1896 to identify the cause. It was incorrectly determined that contaminated water was responsible, and filtration of all potable water was ordered.⁵ Although it is now known that contaminated water does not transmit malaria, which is spread by *Anopheles* mosquitoes, this effort may have been effective in improving the health of the Corps by decreasing the number of standing water reservoirs that could be used by mosquitoes for laying eggs. Moreover, this action could have reduced the rate of infections associated with waterborne bacterial pathogens. Later, it was mandated that cadet encampment tents be permanently raised to allow for air circulation and that the encampment area be drained of standing water.⁵ Although these efforts likely reduced the rate of malaria infection indirectly, they may have also been effective in preventing the transmission of other vector-borne or waterborne infections.

The early members of the faculty and staff of the academy (1802–1832) were apparently not overly concerned with matters of hygiene. It has been recorded that a sanitary recommendation “had to be made many times before its wisdom was understood and appreciated”.¹² These recommendations were initially met with resistance leading up to the “sanitary crusade” in the 1850s and 1860s, with the post turning their attention to methods of improving heating, lighting, ventilation, sewage, water, and waste disposal systems”.¹² Aside from these structural initiatives, the War Department also instituted physical exams for the entering class in 1862, disqualifying personnel with chronic afflictions or severe injuries involving deafness, poor vision, or extremity incapacitation. An annual physical exam requirement was instituted in 1906.^{5, 12} Later, the USMA surgeon began to annotate “yearly cycles of respiratory disease during the winter months giving way to the insect-borne diseases in the summer months”.¹² The effec-

tiveness of NPI is best elucidated by the “epidemic diseases, which frequently appeared among civilians at this station, and were almost entirely absent” from the Corps of Cadets. This imbalance in disease transmission is attributable to the various sanitary initiatives involving sewage, water, and the maintenance of cadet health.¹² It is also important to note that although the genesis of military hygiene in the United States can be traced back to Friedrich Wilhelm von Steuben in 1779, the establishment of a Department of Military Hygiene at USMA did not occur until 1905 with a curriculum on the “Elements of Hygiene” and the publication of a foundational textbook on the subject.²¹

Another area of administrative focus was nutrition. Nutrition is often overlooked as an NPI, yet there is a positive correlation between nutrition and immune status.²² The Corps of Cadets at USMA were provided with 3 meals per day at government expense, making them arguably better fed than members of the neighboring communities.⁵ Providing consistent and quality meals to a large group of men can be logistically and financially challenging. However, this nutritional improvement may have improved the immune status of the Corps of Cadets, therein promoting their resistance to infection.

DISCUSSION

The current severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has led to a renewed interest in the topics of military hygiene and preventive medicine.^{26,27} This interest has been particularly strong at the USMA. The faculty and staff of USMA are charged with the year-round education and training of several thousand cadets and the graduation of nearly 1,000 new Second Lieutenants for the Army each year. Although the relative isolation of the academy environment may offer some degree of protection from the pandemic, it requires cadets to be housed, fed, and trained in close quarters. This is problematic since it has been established that SARS-CoV-2 is efficiently spread by the respiratory route and it appears to be easily transmitted in confined settings. This was dramatically demonstrated on a nuclear-powered aircraft carrier, the USS Theodore Roosevelt in early 2020, when this virus infected over 1,000 members of the crew in a relatively short time period.²⁸ To prevent similar events from occurring at USMA, it is necessary to briefly review the lessons that were learned during the pre-vaccine and pre-antibiotic era and to identify those practices that were most effective and determine if they can be applied in the modern military setting.

Interestingly, the Spanish American War (1898) was perhaps the first war in which extensive knowledge of bacteriology was available. However, this knowledge was not efficiently communicated and applied in the deployed setting.²⁹ This resulted in most of the casualties among members of the active Army being because of infectious disease. It has been estimated that over 60% of the war-related deaths that occurred during this conflict were because of infection.²⁹

The staff and faculty of USMA were aware of the failures of military hygiene and preventive medicine during this war and they took steps to ensure that these were not repeated at the academy. In fact, they produced the first two textbooks on military hygiene and field sanitation to be published in the United States. These were, *The Elements of Military Hygiene Especially Arranged for Officers and Men of the Line* by Percy Ashburn (1915) and *A Textbook of Military Hygiene and Sanitation* by Frank Keefer (1917).^{21,30} Both of these publications discuss the materials and methods that were considered necessary for the maintenance of the health of military members and both discuss the causes of infectious disease as they were understood at the time. These textbooks formed the basis for the instruction of the officers and staff of USMA and they were used in the courses on military hygiene that were delivered to the Corps of Cadets. They demonstrate a high degree of familiarity with the emerging fields of bacteriology and parasitology and an understanding of how to apply the information acquired from these fields to the issues of force health protection that were prevalent when they were written.

The establishment of a wide variety of NPIs between 1890 and 1910 appears to be correlated to an improvement in the aggregate health status of the Corps of Cadets and a corresponding decrease in the overall sick-call rate. The primary NPIs initiated were an increased administrative focus on hygiene and sanitation, physical separation established by treating cadets separately from other members of the facility, the use of isolation and quarantine as means of infection control, and the introduction of methods to prevent the airborne transmission of infection.

Numerous studies have shown that isolation and quarantine are important interventions in preventing the acquisition and spread of infectious disease, quarantine has been utilized as a method of epidemiological control since antiquity.¹⁸ Recently, empirical evidence has been acquired to indicate that the rapid isolation of symptomatic individuals, along with the quarantine and monitoring of potentially exposed asymptomatic individuals, can minimize the spread of a virus for which no vaccine or other pharmaceutical interventions are available.²³ Further, isolation, quarantine and strict patient monitoring have proven effective in reducing the transmission rates of coronavirus in immunocompromised populations, indicating that similar strategies might be at least partially effective in preventing disease transmission among young and healthy military-age personnel; these procedures should not be ruled-out when outbreak response protocols are being developed.²⁴ Efforts to control SARS-CoV-2 without an effective vaccine has brought NPI to national attention and non-pharmaceutical measures such as quarantine, hand hygiene, and social distancing are being employed to prevent the spread of this pathogen.²⁵

With the available data it is difficult to accurately gauge the effectiveness of the NPIs employed at USMA throughout the late 19th and early 20th centuries. However, it is important to note that there was a general trend toward a reduction in

the rates of infectious disease between 1890 and 1910. The experience with NPIs at USMA may serve as a historical model for determining how the burdens of infectious disease may be reduced in a close-quarters military environment when the etiologic agent is not known and there is no effective vaccine available.

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