The USS Theodore Roosevelt (CVN-71) is a Nimitz Class, nuclear-powered aircraft carrier 1092 feet long, weighing more than 100,000 tons and capable of handling 90 tactical high-performance aircraft and helicopters. The entire crew of 4800 sailors reside in exceedingly close sleeping and working quarters with linear fan forced flow mechanical ventilation. A coronavirus disease 2019 (COVID-19) outbreak among the crew was discovered in late March 2020 after a port visit to Vietnam. Approximately 1000 crew members were determined to be infected. A report noted, “The outbreak was characterized by widespread transmission with relatively mild symptoms and asymptomatic infection among this sample of mostly young, healthy adults with close, congregate exposures.”

The case series by Alvarado et al provides additional information on the Theodore Roosevelt outbreak. In this study, 736 sailors who were positive for severe acute respiratory syndrome coronavirus 2 according to nasal swab polymerase chain reaction testing were placed in separate room isolation facilities on US military bases in Guam. Test-negative asymptomatic individuals were quarantined in single rooms. Daily symptom monitoring was conducted; new symptomatic cases were confirmed by polymerase chain reaction testing and moved to separate room isolation areas.

Of 4800 (85%) sailors who disembarked (several hundred remained aboard to maintain essential services such as nuclear reactor operations and security), 736 had a diagnosis of severe acute respiratory syndrome coronavirus 2; 590 sailors were symptomatic (cough, 13.6%; coldlike symptoms, 9.7%; anosmia [ie, loss of smell], 9.3%; headache, 8.8%; ageusia [ie, loss of taste], 7.9%; and fever, 1.3%) for a median duration of 7 days. In this young (median age, 25 years; 77.77% male) population that is required to meet US Navy height, weight, and physical fitness standards, there were 6 hospitalizations and 1 death of a senior enlisted member in his 40s.

The shore-based isolation and quarantine interventions in the first 2 weeks of April resulted in control of the outbreak, as summarized by the epidemic curve from 218 crew members with a documented symptom onset date. Alvarado et al appropriately concluded that testing is required to differentiate COVID-19 from other acute respiratory illnesses in young healthy workers in confined-space congregate settings. Asymptomatic and presymptomatic spread were noted as major contributors to the outbreak. A rapid increase in case numbers as persons with incubating cases disembarked, followed by the precipitous decline in cases was observed. The authors also concluded that the shore-based nonpharmaceutical interventions of cohorting (isolation and quarantine) interrupted an acceleration of the outbreak.

A report by Payne et al on the April 2020 outbreak described a voluntary convenience sample of 382 Theodore Roosevelt crew members that included persons who were previously infected, currently infected, or never infected. Sixty percent had reactive antibodies and one-fifth of infected participants reported no symptoms. Face coverings (53.8% vs 67.5%) and social distancing (54.7% vs 70.0%) decreased the infection rate but did not halt spread in the closely confined spaces with a crew engaged in the high-paced operations of an aircraft carrier at sea. In their sample of 382 service members completing questionnaires, 267 (70%) provided a nasal pharyngeal swab for polymerase chain reaction testing. Of the 382 participants, 284 (74%) had symptoms; ageusia and anosmia were most strongly associated with previous or current infection, followed by fever, chills, and myalgias. The investigations by Payne et al and Alvarado et al were designed and led by different US Department of Defense organizations (US Army vs US Navy, respectively), so the potential exists that some crew members were sampled by both groups of investigators.
Closed, confined-space shipboard environments will continue to be a source of respiratory infection outbreaks. Past US Navy examples of shipboard respiratory disease outbreaks include tuberculosis on a 350-member destroyer in 1966 and H1N1 influenza on a 3000-member large amphibious assault ship in 2009. The 1966 tuberculosis (transmitted by droplet nuclei) outbreak highlighted the contribution of recirculated air through the ventilation system, whereas the amphibious assault ship had an influenza attack rate of 32% and a large proportion of asymptomatic infection (53%). More recently in 2014, an H3N2 outbreak with a 25% attack rate was reported in a small minesweeper with a previously vaccinated 100-member crew. The notion that COVID-19 transmission is airborne, especially in confined spaces, continues to gain support.

Shipboard COVID-19 outbreaks will continue; COVID-19 has resulted in near cessation of the cruise ship industry. Masks, hand hygiene, and social distancing when possible are beneficial but will not change the basic issues with closed, confined-space environments and forced linear air handling systems. To reduce the risk of introducing COVID-19 into US military operational units, premovement sequester (similar to a quarantine although individuals have not been exposed to COVID-19) with individual 14-day restriction of movement is used. Unfortunately, the COVID-19 outbreak on the USS Theodore Roosevelt will be remembered by the removal of the Commanding Officer and April 7, 2020, resignation of the Secretary of the Navy instead of the many lessons learned regarding a highly contagious respiratory virus in ships with closely confined spaces and linear airflow systems.