Outbreaks in Dormitories: Literature Search as of November 4, 2020

Zachary Weber, Stephanie Schulte and Kenya Moyers on Behalf of the Safe Campus & Scientific Advisory Committee

Methods

A broad search of the literature was conducted and updated using Pubmed, preprint servers and Google Scholar. The search focused on outbreaks, disease, and infections in dormitory like settings such as college dormitories, residential halls, apartment complexes, barracks, and cruise ships. Relevant findings are summarized below.

Review

In general, the literature on disease outbreaks and infections in dormitories, apartments, cruises, etc. focuses mainly on the description of the epidemic and tracing to an index person/exposure. Very little has been done with possible interventions to decrease infection and transmission of disease within dormitories. Of the few studies that have been conducted, most are observational in nature, comparing the risk of disease after an outbreak versus implementing an intervention to stop the spread of a disease.

Also, of particular note, is that most studies look at multiple possible explanations for increased risk of transmission, ie: ventilation, building age, room density, cleanliness, all at once. This makes it difficult to assign actual values to the reduction in risk by performing a single change within a dormitory building. In general, the following have been found to be sufficient at reducing risk of infection or shortening a disease outbreak.

Ventilation and Air Filters[1-6]

Multiple studies have found that increasing ventilation has reduced the incidence of disease within buildings. When incidence of disease is compared between two buildings, generally the building with a higher ventilation rate has lower disease rates, on average. While most studies have focused on ventilation using HVAC systems, some have also explored natural ventilation via opening of windows, which seems to be almost as effective as increased ventilation from an HVAC system. That said, natural ventilation is thought to have intensified an outbreak of SARS during the 2003 pandemic at an apartment complex in China due to strong wind from infected persons towards uninfected. Additionally using appropriate air filters in HVAC systems could also reduce disease. Within multiple settings, such as hospitals, airplanes, and daycares, HEPA filters have been shown to best filter influenza droplets. While HEPA filters are expensive and can restrict air flow, less expensive filters such as MERV 13-16 have shown nearly the same efficacy. Notably, the CDC's guidance for shared housing recommends working with maintenance staff to increase outdoor air if possible, as well ensuring good ventilation in shared rooms.

Room/Floor Density[2,4, 7-12]

In investigations of outbreaks at dormitories where multiple people live in limited space, the rate of infection is much higher than those with more individual space. Studies that compared rates of disease among rooms with single, double, or triple or more occupancy rooms all found that those within single rooms had the least risk, and double occupancy rooms had less risk than triples or higher. Simulations also suggest that limiting the number of students in a room can help prevent the spread of disease. The total number of people living on a particular floor must also be considered. Fewer people living on one floor appears to be lower disease risk. Currently, there are no recommendations on how much reduction should occur nor minimum square footage per occupant, room furniture arrangement, or physical barriers between roommates. CDC guidance on shared living spaces recommends cleaning shared bathrooms twice per day if possible

Case Isolation[11-14]

Few studies have investigated isolating cases within living quarters when disease occurs. There is evidence to show that removing cases from barracks helped to shorten an outbreak of norovirus in a military base. Simulations have also confirmed that removing and isolating cases will shorten an outbreak. What is less clear is where cases or quarantined individuals should be moved, as simulations just remove cases from their modeling. Recommendations for this are not given in any of the studies. Simulation studies of the Diamond Princess cruise ship COVID-19 outbreak, though a significantly different population than a university dorm, showed isolation and quarantine reduced the number of total infections, but that isolation within rooms may have contributed to spread between rooms. Other studies of previous SARS outbreaks on campuses in Asia in 2003, found that isolating known cases was also effective at reducing incident cases.

Cleaning[5,14,16]

While not an intervention, there is evidence suggesting that those in rooms that are cleaner tend to have fewer reported flu-like symptoms. In studies where there were shared toilet facilities, more routine cleaning of the facilities was also related to lower rates of disease. CDC guidance suggests cleaning shared bathrooms twice daily.

Hand Hygiene[14, 17]

One trial found that dormitories that received the hand sanitizing stations had significantly decreased illness rates compared to those that did not receive the stations. A hand hygiene educational program significantly increased self-reported hand hygiene overall. Meta-analysis also suggests that paper towels may be more effective than hand dryers at reducing the amount of bacteria on hands after washing, although this may exacerbate other issues with fomite transmission.

-

Case Studies of COVID-19 in Dormitory-like Settings[18-27]

There have been some case studies on COVID-19 spread and containment in settings similar to dormitories. Some of these studies, such as those focusing on prisons in the United States and migrant worker housing in Singapore, have shown that COVID-19 can spread rapidly throughout the entire living area, even when some mitigation techniques are applied such as testing or quarantine. This may be due to asymptomatic spread and the delayed implementation of the previously described interventions. Other case studies, such as those on military bases, have shown that when proper transmission mitigation has been implemented, the incidence of COVID-19 is greatly reduced. This was specifically seen at the Joint Base San Antonio-Lackland in Texas. Over 10,000 new trainees reported between March and April 2020. Interventions included quarantining, social distancing, early screening, and isolation, and even though these trainees slept in barracks similar to dormitories, there were only 5 incident cases detected.

Numerous COVID-19 outbreaks at summer camps have been reported, where close living quarters are common. At a Georgia summer camp, testing found that 260 of 344 campers tested positive for COVID-19, equating to an attack rate of 44%. Other outbreaks at overnight camps in Michigan, Oregon, and Wisconsin have also been reported. Of note in these outbreaks is the high attack rates seen among young persons, which suggests that this rapid spread in a dorm like setting is possible even among the young adults.

1. Zhu S, Jenkins S, Addo K, et al. Ventilation and laboratory confirmed acute respiratory infection (ARI) rates in college residence halls in College Park, Maryland. *Environ Int*. 2020;137:105537. doi:10.1016/j.envint.2020.105537
2. Sun Y, Wang Z, Zhang Y, Sundell J. In China, students in crowded dormitories with a low ventilation rate have more common colds: evidence for airborne transmission. *PLoS One*. 2011;6(11):e27140. doi:10.1371/journal.pone.0027140
3. Li Y, Duan S, Yu IT, Wong TW. Multi-zone modeling of probable SARS virus transmission by airflow between flats in Block E, Amoy Gardens. *Indoor Air*. 2005;15(2):96-111. doi:10.1111/j.1600-0668.2004.00318.x
4. Li T, Liu Y, Di B, et al. Epidemiological investigation of an outbreak of pandemic influenza A (H1N1) 2009 in a boarding school: serological analysis of 1570 cases. *J Clin Virol*. 2011;50(3):235-239. doi:10.1016/j.jcv.2010.11.012
5. CDC. COVID-19 guidance for shared or congregate housing. Updated August 22, 2020. Accessed November 4, 2020.https://www.cdc.gov/coronavirus/2019-ncov/community/shared-congregate-house/guidance-shared-congregate-housing.html
6. Azimi P, Stephens B. HVAC filtration for controlling infectious airborne disease transmission in indoor environments: Predicting risk reductions and operational costs. *Build Environ*. 2013;70:150-160. doi:10.1016/j.buildenv.2013.08.025
7. Asiedu-Bekoe F, Adu DA, Offei A. Mass oseltamivir prophylaxis halts pandemic influenza A H1N1 2009 outbreak in a secondary school in Ashanti Region, Ghana. *Ghana Med J*. 2012;46(4):219-224.

8. D'Alessio DJ, Meschievitz CK, Peterson JA, Dick CR, Dick EC. Short-duration exposure and the transmission of rhinoviral colds. *J Infect Dis*. 1984;150(2):189-194. doi:10.1093/infdis/150.2.189
9. Haque F, Sturm-Ramirez K, Homaira N, et al. Influenza B virus outbreak at a religious residential school for boys in Northern Bangladesh, 2011. *Influenza Other Respir Viruses*. 2017;11(2):165-169. doi:10.1111/irv.12430
10. Poletti P, Visintainer R, Lepri B, Merler S. The interplay between individual social behavior and clinical symptoms in small clustered groups. *BMC Infect Dis*. 2017;17(1):521. Published 2017 Jul 26. doi:10.1186/s12879-017-2623-2
11. Araz OM, Lant T, Fowler JW, Jehn M. A simulation model for policy decision analysis: a case of pandemic influenza on a university campus. *J Simul*. 2011;5(2):89-100. doi:10.1057/jos.2010.6
12. Xu J, Wang G, Zhang Y, et al. An outbreak of tuberculosis in a middle school in Henan, China: Epidemiology and risk factors. *PLoS One*. 2019;14(11):e0225042. Published 2019 Nov 15. doi:10.1371/journal.pone.0225042
13. Chapman AS, Witkop CT, Escobar JD, et al. Norovirus outbreak associated with person-to-person transmission, U.S. Air Force Academy, July 2011. *MSMR*. 2011;18(11):2-5.
14. Liu HE. Severe acute respiratory syndrome (SARS) prevention in Taiwan. *J Sch Nurs*. 2004;20(2):76-80. doi:10.1177/10598405040200020401
15. Rocklöv J, Sjödin H, Wilder-Smith A. COVID-19 outbreak on the Diamond Princess cruise ship: estimating the epidemic potential and effectiveness of public health countermeasures. *J Travel Med*. 2020;27(3):taaa030. doi:10.1093/jtm/taaa030
16. Miko BA, Cohen B, Haxall K, et al. Personal and household hygiene, environmental contamination, and health in undergraduate residence halls in New York City, 2011. *PLoS One*. 2013;8(11):e81460. Published 2013 Nov 27. doi:10.1371/journal.pone.0081460
17. Huang C, Ma W, Stack S. The hygienic efficacy of different hand-drying methods: a review of the evidence. *Mayo Clin Proc*. 2012;87(8):791-798. doi:10.1016/j.mayocp.2012.02.019
18. Wallace M, Hagan L, Curran KG, et al. COVID-19 in Correctional and Detention Facilities - United States, February-April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(19):587-590. Published 2020 May 15. doi:10.15585/mmwr.mm6919e1
19. Njuguna H, Wallace M, Simonson S, et al. Serial Laboratory Testing for SARS-CoV-2 Infection Among Incarcerated and Detained Persons in a Correctional and Detention Facility - Louisiana, April-May 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(26):836-840. Published 2020 Jul 3. doi:10.15585/mmwr.mm6926e2
20. Chew MH, Koh FH, Wu JT, et al. Clinical assessment of COVID-19 outbreak among migrant workers residing in a large dormitory in Singapore. *J Hosp Infect*. 2020;106(1):202-203. doi:10.1016/j.jhin.2020.05.034
21. Payne DC, Smith-Jeffcoat SE, Nowak G, et al. SARS-CoV-2 Infections and Serologic Responses from a Sample of U.S. Navy Service Members - USS Theodore Roosevelt, April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(23):714-721. Published 2020 Jun 12. doi:10.15585/mmwr.mm6923e4

22. Marcus JE, Frankel DN, Pawlak MT, et al. COVID-19 Monitoring and Response Among U.S. Air Force Basic Military Trainees - Texas, March-April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(22):685-688. Published 2020 Jun 5. doi:10.15585/mmwr.mm6922e2
23. Szablewski CM, Chang KT, Brown MM, et al. SARS-CoV-2 Transmission and Infection Among Attendees of an Overnight Camp - Georgia, June 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(31):1023-1025. Published 2020 Aug 7. doi:10.15585/mmwr.mm6931e1
24. Krafcik M. 21 COVID-19 cases linked to overnight camp in Barry County. Updated August 10, 2020. Accessed November 4, 2020. https://wwmt.com/news/local/21-covid-19-cases-linked-to-overnight-camp-in-barry-county
25. Green A. 25 campers and staff test positive for COVID-19 in Oregon's first large summer camp outbreak. Updated August 04, 2020. Accessed November 4, 2020. https://www.oregonlive.com/coronavirus/2020/08/25-campers-and-staff-test-positive-for-covid-19-in-oregons-first-large-summer-camp-outbreak.html
26. Kaeding D. Ashland County Reports COVID-19 Outbreak At Northern Wisconsin Summer Camp. Updated August 03, 2020. Accessed November 4, 2020. https://www.wpr.org/ashland-county-reports-covid-19-outbreak-northern-wisconsin-summer-camp
27. Wilder D. Alexandria Camp Closed Early Due to COVID-19 Case, Parent Says. Updated August 07, 2020. Accessed November 4, 2020. https://www.nbcwashington.com/news/local/parent-says-alexandria-camp-closed-early-due-to-covid-19-case/2384970/