

OSHA Review of Peer-Reviewed Literature and Government Data on COVID-19 Across Health Care Facilities and Occupations (2022)

As noted in the health effects section, COVID-19 clearly results in significant adverse health outcomes, including death, to working age populations (*see Health Effects*, Section IV.B. of this preamble). The rulemaking record also contains numerous studies focused specifically on healthcare workers' risk of contracting COVID-19 in the workplace. Because the pandemic is ongoing and the evidence generated remains at the frontier of science, studies are not available for every type of employee in every type of healthcare setting. While the available data do not represent an exhaustive list of all of the places in which healthcare workers experience risk, it does provide ample evidence of the unique risk in healthcare settings. Peer-reviewed scientific journal articles, along with government reports and surveillance data that cover a wide range of healthcare workplaces, indicate that healthcare workers throughout the industry face a substantial risk of SARS-CoV-2 infection in various facilities and occupational roles.

OSHA's findings in this area are based primarily on the evidence from peer-reviewed scientific journal articles and government reports. However, the data collection, research, and peer review process for scientific journal articles takes a substantial amount of time; therefore, those sources do not always reflect the most up-to-date information (Document ID 0531). This is critical in the context of the COVID-19 pandemic, where new information is emerging regularly on new variants associated with enhanced transmissibility or virulence, reductions in neutralization by antibodies obtained through infection or vaccination, changes in the effectiveness of therapeutics, and the efficacy of vaccines and vaccine acceptance in preventing COVID-19 infections, serious illnesses, and deaths. However, studies throughout the entirety of the pandemic remain relevant, especially for healthcare workers: CDC and CMS data provide concrete evidence of continuing infections and deaths among healthcare workers and are

supported by state data demonstrating that workplace outbreaks continue to occur in healthcare facilities. Indeed, given the dynamic nature of the virus and the fact that it has maintained significant pathogenicity and transmissibility; changes in the efficacy of vaccination and treatments; and varying levels of workplace controls, it is difficult to forecast whether earlier or later studies will wind up being more predictive of the future course of the pandemic as it affects healthcare workers.

The peer-reviewed literature and government data, discussed below, reveal a significant number of SARS-CoV-2 infection outbreaks in healthcare settings.¹ Some of these studies involved serology tests, which determine if antibodies that respond to the SARS-CoV-2 virus are present in samples of blood serum. Seroprevalence is the percentage of individuals in a population who have antibodies. Terms such as seropositive or seroconversion are often used to describe persons who have tested positive for the SARS-CoV-2 antibody. Most of the serology tests conducted looked at a type of antibody known as Immunoglobulin G (IgG). Seroprevalence studies may provide a more complete picture of how many individuals in a population may have been infected as they identify all individuals with previous infections, not just those with symptomatic cases or access to COVID-19 testing.

The studies described below are offered for several reasons. First, the numerous examples of infections in hospitals, long-term care facilities, emergency medical services, and in-home services illustrate an industry-wide risk that exists across all healthcare settings. Second, the studies examine whether this risk is confined to particular job occupations or tasks within a healthcare setting. Within healthcare settings, some studies show more infections among staff dealing directly with COVID patients while other studies show that the risk is elevated across the

¹ OSHA uses the term “outbreak” in this section as it is defined by the pertinent studies’ authors, not as it is defined under this standard.

whole workplace or among specific occupations. These studies do not comprehensively take into consideration whether controls were fully and properly implemented and how transmission relates to infection rates in the greater community seeking care at these facilities.

A meta-analysis published in the American Journal of Epidemiologists compared data from 97 separate studies and found evidence that COVID-19 infections were both common among healthcare workers (11% of the tested cohort of healthcare employees) and spread throughout different healthcare worker occupations. In this study, nurses had the highest rate of seroprevalence, while most of the COVID-19-positive medical personnel were working in hospital nonemergency wards during screening (Document ID 1028). A 2021 cross-sectional study of 6,510 healthcare employees from the Northwestern HCW SARS-CoV-2 Serology Cohort Study (conducted May 28–June 30, 2020 in Illinois) similarly showed nurses had high levels of infection and were the only job classification with significantly higher infection risk than healthcare administrators. However, crude infection rates among medical assistants and support services, (including food services, environmental services, and patient transporters) were also higher than healthcare administrators (Document ID 0855).

A CDC Morbidity and Mortality Weekly Report (MMWR) reported on the occupational status of COVID-19 cases in Colorado. In the Colorado study, 1,600 randomly selected individuals with COVID-19 from nine counties were surveyed; these cases occurred before the state lockdown that began on March 26, 2020. Half of the individuals were exposed in a workplace setting, and of those with a known workplace exposure, 60% worked in healthcare (Document ID 0257).

Chen et al. analyzed records of deaths occurring between January 1, 2016 and November 30, 2020 in California and found that healthcare or emergency workers were one occupational

group that experienced excessive and statistically significant mortality compared to pre-pandemic periods (30 per capita excess). The study authors concluded that essential work conducted in person is a likely avenue of infection transmission, implying that the significant increase in healthcare worker deaths was likely related to COVID-19 (Document ID 1588).

Hawkins et al. examined death certificates of individuals who died in Massachusetts between March 1 and July 31, 2020. An age-adjusted mortality rate of 16.4 per 100,000 workers was determined from 555 death certificates that had useable occupation information. Employees in healthcare support had the highest age-adjusted mortality rates in this study, but personal care services and community and social services also had particularly high mortality rates. The study authors noted that occupation groups expected to have frequent contact with sick people, close contact with the public, and jobs that are not practical to do from home (all of which are true for many healthcare workers) had particularly elevated mortality rates (Document ID 0537).

Chea et al. conducted a case-control study involving U.S. healthcare personnel who had a positive SARS-CoV-2 PCR or antigen test result from May 19, 2020 through December 6, 2020 to determine risk factors for COVID-19. The study collected data on activities involving COVID-19 patient care and activities outside the workplace. Factors associated with positive SARS-CoV-2 infections (cases) included having close contact with COVID-19 patients in the workplace, assisting COVID-19 patients with activities of daily living (e.g., bathing, eating, toileting), and participating in restraint. (Document ID 1855).

Outside the United States, the impact of COVID-19 across industries and occupations is similar. The European Centre for Disease Prevention and Control investigated clusters in occupational settings throughout Europe. The Centre reviewed 1,376 occupational clusters throughout 16 European countries from March through July of 2020. Indoor settings contributed

to 95% of reported clusters, and hospitals and long-term care facilities accounted for many of the clusters (Document ID 0534). Similarly, Mutambudzi et al. investigated severe COVID-19 risk by occupational group in a study of 120,075 United Kingdom participants prior to vaccine availability. Researchers found that essential workers (including healthcare) had a more than seven-fold greater risk of severe COVID-19 than non-essential workers (Document ID 0896).

Hospitals and Healthcare Systems

OSHA reviewed a number of peer-reviewed studies related to COVID-19 infections among workers in hospitals and healthcare systems. Many hospitals provide short-term and/or long-term care for COVID-19 patients who have symptoms that are severe enough to require hospitalization. Frequent close contact with COVID-19 patients is expected in hospital settings, which puts hospital employees at risk of developing COVID-19.

Some employees who work in hospitals are healthcare practitioners, who generally have either licensure or credentialing requirements (e.g., doctors, nurses, pharmacists, physical therapists) for the purpose of promoting, maintaining, monitoring, or restoring health. Individuals who provide healthcare support services also work at hospitals and in healthcare systems. Examples of work performed by employees who provide healthcare support services and may have close contact with COVID-19 patients in some circumstances include patient intake/admission, patient food services, chaplain services, equipment and facility maintenance, housekeeping services, and medical waste handling services. Employees who provide healthcare support services usually have less direct contact with patients, but they can have close contact with COVID-19 patients or contaminated materials when performing tasks such as cleaning patient rooms, removing waste or dirty laundry from patient rooms, delivering food and picking up used food trays and utensils, or repairing equipment in the patient's room. In addition,

healthcare support employees can have close and prolonged contact with their healthcare co-workers while performing their duties.

Several studies used PCR tests of both healthcare workers and non-healthcare workers to evaluate risk of infection for healthcare workers. Mani et al. reported results from SARS-CoV-2 testing of 3,477 symptomatic employees in the University of Washington Medical system and its affiliated organizations in Seattle, WA, between March 12 and April 23, 2020. During that period, 185 (5.3%) employees tested positive, and rates were very similar between frontline healthcare workers and non-frontline staff. Of the 174 employees who tested positive and were followed, six (3.2%) reported COVID-related hospitalization, and one employee was admitted to the ICU. No deaths were reported. This study indicates that all healthcare workers in a variety of positions at workplaces where patients are seeking treatment for infections with SARS-CoV-2 face risk and that PPE is important in reducing that risk. In addition, authors noted that positive cases were likely underestimated due to the focus on testing symptomatic employees (Document ID 0416).

Vahidy et al., the authors of a study of Texas hospitals, concluded that healthcare workers are at higher risk of infection than those in the community and non-clinical settings, underscoring the need for surveillance, isolation, and consistent infection control throughout the healthcare organization. In addition, the study suggests that COVID-19 can be spread throughout staff in a hospital. Vahidy et al. studied asymptomatic infection rates among staff from a medical center consisting of seven hospitals in Texas and members of the surrounding community in March through April of 2020. Healthcare jobs with possible exposure to COVID-19 patients were classified into five categories, with varying levels of patient exposure: (1) nursing (e.g., nurses/nurses aids, emergency medical technicians), (2) clinicians (e.g., physicians, nurse

practitioners), (3) allied healthcare workers (e.g., therapists, social workers), (4) support staff (e.g., security, housekeeping), and (5) administrative or research staff (e.g., managers, research assistants). A total of 2,872 asymptomatic individuals, including 2,787 healthcare personnel and 85 community residents, were tested for SARS-CoV-2 infection. Among the healthcare personnel tested, the prevalence of SARS-CoV-2 infection was 5.4% among the 1,992 patient-facing staff treating COVID-19 patients and 0.6% among the 625 patient-facing staff not treating COVID-19 patients. No cases were seen among the 170 nonclinical healthcare staff that did not interact with patients or in the 85 community residents. The nonclinical healthcare staff worked in buildings with separate heating, ventilation, and air conditioning systems, and with lower population density because of remote work when compared to clinical healthcare staff. In the different healthcare categories that cared for COVID-19 patients, prevalence of infection ranged from 3.6% to 6.5%, with no significant differences in the different categories of healthcare workers. (Document ID 0848).

Misra-Hebert et al. conducted a retrospective cohort study to obtain data on rates of COVID-19 and risk factors for severe disease in healthcare and non-healthcare employees who were tested for SARS-CoV-2 and listed in a registry at the Cleveland Clinic Health System between March 8 and June 9, 2020 (it should be noted that the Cleveland Clinic Health System is an incredibly large system with a variety of roles, such as research and administrative jobs, that do not have any contact with patients). The authors compared patient-facing healthcare workers (those having direct contact with patients) with those who were not patient-facing. They found that patient-facing healthcare employees were 1.6 times more likely than non-patient-facing healthcare employees to test positive. The study authors suggested that the finding represents an increased risk of infection with work exposure, however they were not able to confirm if the

exposure occurred 14 days prior to testing or if PPE was worn during the exposure. Positive cases peaked in early-to-mid April for both healthcare employees and non-healthcare employees (16% positive and 12% positive, respectively, as estimated from figure 2 of the study), and then decreased concurrently with the implementation of preventive measures, such as masking and physical distancing, over the course of the study (Document ID 0295).

In addition to the PCR studies described above, several studies conducted serology testing to determine how many healthcare workers in hospitals and healthcare systems had been infected by the SARS-CoV-2 virus in the past. Venugopal et al. conducted a cross-sectional study of healthcare employees across all hospital services (including physicians, nurses, ancillary services, and “others”) at a level one trauma center in the South Bronx, New York, between March and May 2020. The period of analysis included the time when New York City experienced a surge of infections that resulted in strained resources and supplies such as PPE. This hospital was so highly impacted that it was considered in that paper “the epicenter of the epicenter.” Participants were tested for IgG antibodies. Of the 500 out of 659 healthcare employees who completed serology testing, 137 (27%) were positive for SARS-CoV-2 IgG antibodies. Seroprevalence was similar across the different job types of healthcare employees (25% to 29%). The study highlights the high rate of infection among all healthcare employees. Moreover, the study authors indicated that seroprevalence in healthcare employees was higher than in the community (Document ID 0302).

Sims et al. conducted a prospective cohort serology study at Beaumont Health, which includes eight hospitals across the Detroit metropolitan area. In April 2020, during the peak of the pandemic’s first wave, Michigan had the third highest number of cases in the U.S. and most cases were in the Detroit metropolitan area. All hospital employees (approximately 43,000

people) were invited to participate and seroprevalence was analyzed in 20,614 hospital employees between April 13 and May 28, 2020. A total of 1,818 (8.8%) of participants were seropositive. However, when separated according to employees working at home (n=1,868) versus those working in their normal, on-site manner, employees working at home were significantly less likely to be seropositive (5.6%) than those going into work (9.1%).

The Sims study also examined differences between exposure levels of employees in different roles at the hospital. Participants who were involved with direct patient care had a higher seropositive rate (9.5%) than those who were not (7%). Healthcare employees with frequent patient contact (phlebotomy, respiratory therapy, and nursing) had a significantly higher seropositive rate (11%) than those with intermittent patient contact (physicians or clinical roles such as physical therapists, radiology technicians, etc.), who on average had a seropositive rate of 7.4%. The study authors speculated that the differences in these two groups may have been based on differences in both duration and proximity of exposure to patients. Another notable observation is that support personnel such as facilities/security and administrative support employees had seropositivity rates of approximately 7% to 8%, which were similar to rates in physicians. Participants reporting frequent contact with either 1) non-COVID-19 patients, or 2) physicians or nurses but not patients, had higher rates of seropositivity (7.6%) than those reporting no significant contact with patients, physicians, or nurses, even if they handled patient samples (6.5%). Both healthcare support employees and physicians had seropositivity rates that were higher than the rates among employees working from home (Document ID 0417).

Wilkins et al. conducted a cross-sectional study to examine seropositivity rates in 6,510 healthcare workers from a Chicago healthcare system consisting of hospitals, immediate care centers, and outpatient practices. Blood samples were collected through July 8, 2020. The study

authors then compared the seropositivity rates of different occupational groups of workers, using administrators as the reference group to reflect exposure consistent with non-healthcare workers. Overall seropositivity for all study participants was 4.8%. Before adjusting for demographics and self-reported out-of-hospital exposure to COVID-19, the study found that a number of healthcare occupations had a higher crude prevalence rate than the administrator group, including: 10.4% for support service healthcare workers, 10.1% for medical assistants, 9.3% for respiratory technicians, and 7.6% for nurses, as compared to 3.8% for administrators. After adjustment for demographics and self-reported out-of-hospital exposure to COVID-19, the only type of healthcare workers that continued to be significantly more likely to be seropositive than administrators were nurses, who were 1.9 times more likely to be seropositive. The study authors concluded that the higher work-related risk in nurses likely occurred as a result of frequent and close contact with patients. The study also compared seropositivity rates for different occupational tasks and found that adjusted seropositivity rates were higher for workers participating in the care of COVID-19 patients when compared with those who did not report participating in the care of COVID-19 patients. Being exposed to COVID-19 patients receiving high-flow oxygen therapy and hemodialysis was significantly associated with 45% and 57% higher odds for seropositive status, respectively (Document ID 0855).

Barrett et al. conducted a prospective cohort study of healthcare employees and non-healthcare employees with no known previous SARS-CoV-2 infection who were recruited and tested for SARS-CoV-2 from March 24 through April 7, 2020 at Rutgers University and two of its affiliated university hospitals in New Jersey. As of July 2020, New Jersey was one of the hardest hit areas, with less than 3% of the U.S. population but 8.5% of all known U.S. cases. Healthcare employees were defined as individuals who worked at least 20 hours per week in a

hospital, had occupations with regular patient contact, and were expected to have contact with at least three patients per shift over the following three months. Occupations included residents, fellows, attending physicians, dentists, nurse practitioners, physician assistants, registered nurses, technicians, respiratory therapists, and physical therapists. Non-healthcare employees included faculty, staff, trainees, or students working at Rutgers for at least 20 hours a week and who had no patient contact (Document ID 0282).

Barrett et al. reported that 7.3% of healthcare employees (40 of 546) and 0.4% of non-healthcare employees (1 of 283) tested positive for SARS-CoV-2 infection. Even after the authors conducted sensitivity analyses to exclude individuals with symptoms at baseline and those who had exposure to someone with COVID-19 or COVID-19 symptoms outside of work, differences between infection rates in healthcare employees and non-healthcare employees continued to be observed. OSHA finds this suggests that, because these populations are likely similar in all aspects other than workplace conditions, healthcare employees were more likely than non-healthcare employees to have developed COVID-19 from a workplace exposure during the early months of the pandemic in the United States. The study authors concluded that the potential for workplace exposure among healthcare employees is further supported by the fact that only 8% of infected study subjects reported contact with someone having COVID-19 symptoms outside of work. In addition, higher rates of infection were observed in healthcare employees who worked in the hospital that had more COVID-19 patients and was located in the community that had higher rates of SARS-CoV-2 infections. The authors noted that because that hospital was overwhelmed, it was not always possible to separate COVID-19 patients from non-COVID-19 patients, which may have led to additional exposures among staff. Among healthcare employees, nurses had the highest rate of observed infections (11.1% tested positive), and

attending physicians had the lowest rate of observed infection (1.8% positive). Resident and fellow physicians had a 3.1% positivity rate and all other healthcare employees had a 9% positivity rate. Increased risk of infection was associated with spending greater proportions of work time in patients' rooms and higher reported exposures to patients with suspected or diagnosed COVID-19 (Document ID 0282).

Heinzerling et al. examined the development of COVID-19 in 120 healthcare employees who were unknowingly exposed to a patient with COVID-19. The patient was later identified as one of the first U.S. community cases of COVID-19, and the authors concluded that the “investigation presented a unique opportunity to analyze exposures associated with COVID-19 transmission in a healthcare setting without recognized community exposures.” Out of the 121 healthcare employees who were exposed, 43 developed symptoms within 14 days of exposure and were tested for COVID-19. Three of those employees (approximately 7% of those tested) were positive for COVID-19. Although those three employees represent 2.5% of the total exposed, it is possible that more employees might have developed COVID-19 because asymptomatic employees were not tested. The healthcare employees who became infected, when compared to those who were not infected, were more commonly present during two aerosol-generating procedures (nebulizer treatment (67% vs. 9%) and non-invasive ventilation (67% vs. 12%); more commonly performed physical examinations of the patient (100% vs. 24%); and were exposed to the patient for longer durations of time (median 120 minutes vs. 25 minutes). None of the exposed healthcare employees had been wearing the complete set of PPE recommended for contact with COVID-19 patients (Document ID 0290).

There have also been outbreaks reported among healthcare support services. For example, Hale and Dayot examined an outbreak of COVID-19 among food service employees

that occurred in an academic medical center before masking and physical distancing requirements were implemented. After an employee in the food and nutrition department tested positive, 280 asymptomatic staff were tested. The entire food and nutrition department that was actively working was considered exposed because employees shared a common locker room and break area. Therefore, testing was not limited to employees who worked near the index case as part of their duties. Ten staff members in the department (including the index case) tested positive during the investigation. At least seven of the cases were thought to result from transmission from the index case (Document ID 0269).

Studies of healthcare workers in hospitals in other countries further demonstrate the risk in these workplaces. Goldenfeld et al. investigated a summer 2020 COVID-19 outbreak among laundry workers in a large medical center in Israel; the study also included a genomic investigation of SARS-CoV-2 strains to determine the potential routes of transmission. Researchers identified 11 cases among the 49 laundry workers screened for SARS-CoV-2 and an additional two secondary cases of family members. The 11 positive cases worked as sorters, drivers, and general workers. The researchers determined that the most common source of transmission was direct person-to-person contact, likely with co-workers. Direct observations by the researchers revealed that most workers used surgical masks instead of N-95s, did not use face shields, and were unable to maintain a proper distance from one another (Document ID 1857).

Some studies indicated that workers treating COVID-19 patients could be at lower risk for becoming infected, but these studies nevertheless demonstrate the fact that all workers in hospitals are at risk and that when employers ensure there are sufficient protections for those workers while they are treating COVID-19 patients, those tasks can become relatively safe. For instance, Moscola et al. reported the prevalence of SARS-CoV-2 antibodies in healthcare

employees from the Northwell Health System in the greater New York City area. The healthcare employees were offered free, voluntary testing at each of the system's 52 sites between April 20 and June 23, 2020. The analysis included 40,329 of the system's 70,812 employees and found that 5,523 (13.7%) were seropositive. The prevalence of SARS-CoV-2 antibodies was similar to that found in randomly-tested adults in New York State at that time (14%). Analysis of seropositivity by job type reported the highest levels of seropositivity (20.9%) in service maintenance staff (including housekeepers, groundskeepers, medical assistants, and 21 others), followed by 13.1% in nurses, 12.6% in administrative and clerical staff (including non-clinical professionals such as employees in information technology, human resources, medical records, and billing); 11.6% in allied health professionals (including clinical professionals such as physician assistants, physical therapists/occupational therapists, social workers, mental health professionals, pharmacists, and laboratory technicians), and 8.7% in physicians. Seropositivity rates were highest in employees from the emergency department and non-ICU hospital units (approximately 17% each), followed by "other" non-specified areas (12.1%), and ICUs (9.9%) (Document ID 0296). This study illustrates that, even when a general healthcare worker population at a facility may be experiencing infection rates similar to the community, likely due to proper implementation of PPE protocols, there still may be some job activities or locations (e.g., service maintenance staff in this case) that have increased risks of infection. This may be due to insufficient protective measures for all healthcare workers who face exposures.

Similarly, Paris et al. conducted a seroprevalence survey among 3,234 healthcare workers at a hospital in France to identify risk factors related to patient care activities. The authors found that even in health care facilities that enjoyed fairly low levels of transmission during the first COVID-19 wave, contact with relatives or co-workers and aerosol-generating procedures were

risk factors for SARS-CoV-2 infections among healthcare workers. The authors found that contact with COVID-19 patients was not associated with increased risk of COVID-19, but that close or prolonged contact with patients generally was associated with an increased risk. The authors concluded that even while transmission may be low, some tasks that would be long in duration and require close contact with patients, such as patient handling, washing, and dressing, may carry high risk of transmission when PPE is not properly worn (Document ID 1865).

Erber et al. conducted a prospective, observational study involving 4,554 hospital staff and medical students at a university hospital in Munich, Germany. A total of 108 study participants were positive for SARS-CoV-2, resulting in a seroprevalence of 2.4% (95% CI 1.9%–2.9%). The authors found that seropositivity was particularly high for administrative staff who did not have any direct patient contact (odds ratio 2.36,² 95% CI 1.19–4.80), noting that nonclinical staff were not obliged to wear masks at work at the beginning of the pandemic. The authors conclude that patient-facing healthcare work during the SARS-CoV-2 pandemic might be safe as long as adequate PPE is used and infection prevention practices are followed, both inside and outside the hospital (Document ID 1598).

Some studies examined the timing of when healthcare workers were infected with COVID-19. Nagler et al. reported the results of SARS-CoV-2 testing in employees from the New York Langone Health system, an academic medical center encompassing four hospital campuses and over 250 ambulatory sites, with approximately 43,000 employees. Between March 25 and May 18, 2020, the health system tested employees who were symptomatic (4,150), employees who were asymptomatic but exposed to COVID-19 (4,362), and asymptomatic employees who

² An odds ratio is a measure of association between a condition and an outcome. It represents the odds that an outcome will occur given a particular condition, compared to the odds of the outcome occurring in the absence of that condition.

were returning to work after their services had been suspended during the peak of the epidemic (6,234). Among symptomatic employees, the COVID-19 positivity rate across the duration of the study was 33%. Among asymptomatic employees with self-reported exposure, the COVID-19 positivity rate was 8%. In asymptomatic employees returning to work, COVID-19 positivity rate was 3%. In all groups, the positivity rate in the first week of testing was substantially higher than in the last week of testing, which occurred more than a month after the first week. The study authors noted a temporal correlation of COVID-19 case declines in healthcare employees and the community, despite continued workplace exposure, and suggested that the rate of infections in healthcare employees may reflect the importance of “properly donned personal protective equipment” (Document ID 0297).

Other studies focused on the duration of exposure. Lentz et al. assessed COVID-19 transmission to healthcare workers in a case-control study of 1,130 healthcare workers from 67 countries using an online survey during a 2-week period between April 20, 2020 and May 5, 2020. The study objective was to characterize the associations of healthcare worker infections with exposure within and outside the medical workplace. The study found that prolonged contact with COVID-19 patients was associated with healthcare worker infection, and the odds of infection were greater in those reporting prolonged continuous COVID-19 patient contact without a respirator. The study further indicated that COVID-19 transmission to healthcare personnel was more likely during routine contact with COVID-19 patients than during aerosol-generating procedures, perhaps because of respirator use during aerosol-generating procedures. There was a significantly lower likelihood of healthcare personnel infection associated with working in ICUs and COVID-19 units, using respirators, and having PPE observers. The authors also indicated that appropriate use of PPE is likely highly protective within healthcare settings.

The authors, further, noted that factors external to the healthcare settings, such as having a household member ill with COVID or participating in mass gatherings, increased the risk of infection (Document ID 1860).

Long-term Care Facilities

In addition to the studies discussed above related to hospitals and healthcare systems, there are a number of studies of infections and outbreaks in long-term care facilities (CMS data on nursing home staff infections and deaths are discussed in the preamble to the final rule, in section IV.C., *Healthcare Workers Face a Significant Risk of Material Impairment of Health or Functional Capacity from COVID-19*). Long-term care facilities include nursing homes, skilled nursing facilities, and assisted living facilities. They provide both medical and personal care services to people unable to live independently. Because long-term care facilities are a congregate living situation where individuals are in indoor facilities and can be in close contact with each other all day long or share the same air, infections such as COVID-19 can spread rapidly between patients or residents and the healthcare staff who care for them (e.g., Document ID 1027). Therefore, employees who work at these facilities have an elevated risk of exposure and infection based on the biological factors of transmission identified in the preamble. Like employees who work at hospitals, employees who work at long-term care facilities include healthcare practitioners, who may have direct and close contact with patients and residents, as well as healthcare support staff, who could also be exposed to patients and residents.

McMichael et al. investigated a COVID-19 outbreak affecting patients, employees, and visitors at a long-term care facility in King County, Washington that began in February 2020. SARS-CoV-2 infections were identified in 167 people, including 101 residents, 50 of 170 staff (29%), and 16 visitors. None of the employees died, but 3 of the 50 infected employees (6%) had

symptoms severe enough to require hospitalization. The median age of the employees was 43.5 years (range 21-79 years). Job titles reported for the employees that were infected included physical therapist, occupational therapist assistant, environmental care worker, nurse, certified nursing assistant, health information officer, physician, and case manager. The study authors noted that infection prevention procedures at the facility were insufficient, and they concluded that introduction of SARS-CoV-2 into long-term care facilities will result in high attack rates among residents, staff, and visitors (Document ID 1027).

Weil et al. reported a cross-sectional study of skilled nursing facilities in the Seattle area between March 29 and May 13, 2020. Testing was performed by Public Health of Seattle and King County (testing of both nursing home residents and employees) or the Seattle Flu Study (testing of only employees). The authors described the period of the study to be at the peak of the pandemic, but the skilled nursing facilities were not experiencing outbreaks at the time of the study. Testing of employees for SARS-CoV-2 was voluntary, and 1,583 employees at 16 skilled nursing facilities were tested. Eleven of the 16 skilled nursing facilities had at least one resident or employee who tested positive. Forty-six employees (2.9%) had positive or inconclusive testing for SARS-CoV-2. Of 1,208 residents tested, 110 (9.1%) were positive. Study authors noted shortages in PPE and concluded that skilled nursing facilities are high-risk settings for the rapid spread of SARS-CoV-2 infection (Document ID 0303).

Studies outside of the U.S. show similar results. For example, Leão et al. examined data from 247 Portuguese public long-term care facilities, including 7,642 residents and 6,094 workers, from April to June 2020. A positive test was observed in 416 (3.0%) individuals representing 3.5% of residents and 2.4% of workers. Workers had twice the risk of being infected than expected according to the age incidence in the general population, but no COVID-

19 related deaths were observed among workers. The authors concluded that the excess risk of SARS-CoV-2 infection in long-term care facility workers and residents as compared to the general population may be linked to the high occupancy setting of long-term care facilities, lack of trained workers, shortage of PPE in the early months of the pandemic, and the higher probability of being tested (Document ID 1859).

Emergency Medical Services

There are also studies in the record examining the impact of COVID-19 on employees who provide emergency medical services (EMS) (e.g., EMTs, paramedics), who are considered healthcare personnel under this final rule. The studies that address EMS often address personnel such as EMTs along with other types of emergency responders such as firefighters, who are only considered healthcare personnel under this final rule if they are also providing healthcare services as EMTs. EMTs and similar occupations, such as paramedics, have close contact with patients who are or could be infected with SARS-CoV-2 when they provide medical care or transport those patients. The medical care they provide includes intubation and cardiopulmonary resuscitation, which could generate aerosols and put them at particularly high risk when performing those procedures on someone with confirmed or suspected COVID-19.

Prezant et al. reviewed paid medical leave data for EMS providers and firefighters using New York City fire department electronic medical records from October 1, 2017 through May 31, 2020. The study authors found that as of May 31, 2020, 1,792 of 4,408 EMS providers (40.7%) had been on leave for suspected or confirmed COVID-19. When compared with the medical leave data from before the pandemic—including months during influenza periods in prior years—the authors found that medical leave for EMS providers was 6.8% above baseline in March 2020 and peaked at 19.3% above baseline in April 2020. The authors determined that

COVID-19 was responsible for this increase. A total of 66 (1.2%) firefighters and EMS providers with COVID-19 were hospitalized and 4 died. Despite EMS providers having been given the same PPE (not further specified) as firefighters, EMS providers had higher rates of COVID-19. The study authors concluded that higher rates in EMS providers were attributable to greater exposure to COVID-19 patients while administering medical care (Document ID 0836).

Weiden et al. investigated risk factors for SARS-CoV-2 infection and severe disease (hospitalization or death) in New York City first responders (EMS and firefighters) from March 1 through May 31, 2020, based on medical records. The study had a total of 14,290 participants (3,501 EMS personnel and 10,789 firefighters). From March 1 to May 31, 2020, 5,175 (36.2%) were confirmed or suspected COVID-19 cases, and 62 (0.4%) were hospitalized. Three study participants died in a hospital, and one died at home. Researchers found that EMS responders had more cases of severe COVID-19 than firefighters (1.2% vs. 0.19%). The SARS-CoV-2 infection rate among New York City first responders overall was 15 times the New York City rate. EMS personnel had a more than four-fold greater risk of a severe case of COVID-19 and 26% increased risk of having a confirmed COVID-19 case when compared with firefighters. Both firefighters and EMS personnel responded to the pandemic-related emergency medical calls and followed the same PPE protocols. However, EMS personnel had greater COVID-19 exposure than firefighters due to greater COVID-19-related call volume and being solely responsible for patient transport, nebulization of bronchodilators, and intubation (Document ID 0305).

Tarabichi et al. recruited first responders (from EMS and fire departments) to participate in a study in the Cleveland, Ohio area. The authors conducted a first serologic survey and PCR test in the period between April 20 through May 19, 2020 and a second between May 18 and

June 2, 2020. A total of 296 respondents completed a first visit and 260 completed the second visit. Seventy-one percent of respondents reported exposure to SARS-CoV-2 and 16 (5.4%) had positive serological testing. Fifty percent (8/16) of those who tested positive were asymptomatic. Based on responses to questions about suspected contacts (it does not appear that the time period of exposure was considered), the study author concluded that likely sources of transmission in participants who tested positive were patients or co-workers (Document ID 0300).

In a study examining COVID-19 antibodies in employees from public service agencies in the New York City area from May through July of 2020, 22.5% of participants were found to have COVID-19 antibodies. The percentages of EMTs and paramedics found to have antibodies (38.3% and 31.1%) were among the highest levels observed in all the occupations. The study authors noted that risk of exposures may be increased for employees who provide emergency medical services because those services are provided in uncontrolled, unpredictable environments, where space is limited (such as ambulances), and quick decisions must often be made. Both EMTs and paramedics perform procedures, such as airway management, that involve a high risk of exposure. In fact, the proportions of employees who had antibodies were found to increase with increasing frequency of performing aerosol-generating procedures (Document ID 0299).

In-Home Healthcare Providers

In-home healthcare workers provide medical or personal care services, similar to those provided in long-term care facilities, inside the homes of people unable to live independently. Patients receiving in-home care may receive services from different types of healthcare providers (e.g., a nurse administering medical care, a physical therapist assisting with exercise, a personal care services provider assisting with daily functions such as bathing). In addition, a number of

workers may provide services to the same patient, while working in shifts over the course of the day. In-home healthcare providers have a high risk of infection from working close to COVID-19-positive patients and possibly their family members or other caregivers in enclosed spaces (e.g., performing a physical examination, helping the patient bathe or eat).

The impact of COVID-19 on in-home healthcare workers is not well studied. Reported surveillance data of COVID-19 cases and deaths in healthcare workers in the United States do not indicate if any of the affected healthcare workers provided home care. In a UK Office for National Statistics report of COVID-19-related deaths by occupation from March through December of 2020, it was reported that nearly three in four deaths involving COVID-19 in social care operations were in “care workers and home carers,” with 109.9 deaths per 100,000 men and 47.1 deaths per 100,000 women (Document ID 0849).

A qualitative study using semi-structured interviews of 33 home health care workers employed by 24 unique home care agencies in New York City was undertaken to understand the experience of home health care workers caring for patients during the COVID-19 pandemic. Home healthcare workers reported a heightened risk for virus transmission, received varying amounts of information, supplies, and training from their employers, and relied on nonagency alternatives for support, including information and supplies. The authors concluded that in-home health care workers providing frontline essential care during the pandemic experienced inequalities as a marginalized workforce and recommended interventions and policies to better support these frontline healthcare workers (Document ID 1641).