What Explains the Socioeconomic Status-Health Gradient? Evidence from Workplace COVID-19 Infections

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Abstract

This paper studies the contribution of the workplace to the SES-health gradient. Our analysis is based on a unique dataset that tracks various health outcomes and workplace risks among healthcare workers during the first four months of the coronavirus 2019 (COVID-19) pandemic. The setting provides an exceptional opportunity to test for work-related disparities in health, while controlling for confounding determinants of the SES-health gradient. We find that low-SES nurses were systematically more likely to contract COVID-19 as a result of workplace exposure. These differentials existed in all healthcare institutions, but were particularly large in non-hospital settings. In contrast, we find no relationship between SES and non work-related infection rates. The differences in workplace infection rates are substantially larger than those implied by standard 'task-based' indices of transmission risk, and cannot be attributable to easily identifiable metrics of workplace risk. Together, our results show how subtle differences in work conditions or job duties can substantially contribute to the SES-health gradient.

1   Introduction

The positive relationship between socioeconomic status (SES) and health is one of the most well-established findings in social science (see Marmot and Wilkinson, 1999, for a review).[1] Yet the sources of the gradient remain poorly understood. In economics, the empirical literature has documented a number of mediating factors in this relationship including differences in health knowledge and risky behavior (Kenkel, 1999; Grimard and Parent, 2007; de Walque, 2007; Cutler et al., 2011), access to healthcare (Currie and Gruber, 1996; Goodman-Bacon, 2018), and environmental conditions both at home and in the workplace (Evans and Kantrowitz, 1996; Currie and Stabile, 2003).[2] Nevertheless, it has proven difficult to disentangle their respective contribution to the SES-health gradient, in part, because these various mediators often move in tandem (Cutler, Lleras-Muney and Vogl, 2008; Elo, 2009).

We assess the role of the workplace for the SES-health gradient among a specific population: frontline healthcare workers during the Coronavirus 2019 (COVID-19) pandemic. Our analysis draws on a dataset with information on workplace risks from COVID-19 exposure and worker health outcomes. This setting provides a unique opportunity to test for work-related disparities in health, *holding constant* all other potential determinants of the SES-health gradient.

Our analysis is based on an administrative dataset of healthcare workers in Montreal, Quebec, during the first four months of the pandemic. Montreal was a major COVID-19 hotspot during the first wave. The city had the highest rates COVID-19 cases in Canada, and had similar case rates to several major northeastern U.S. cities.[3] The cross-sectional dataset covers health-

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[1]The relationship holds across numerous health outcomes and risk factors, and has been observed in many countries and time periods (Link and Phelan, 1995; Cutler and Lleras-Muney, 2010).

[2]Social scientists have also sought to understand the relative influence of various components of social class for health (Elo, 2009). While much of the literature has focused on the importance of education for health (Schnittker, 2004; Ross and Mirowksky, 2010; Cutler and Lleras-Muney, 2010), some scholars have argued that differences in income (Wilkinson, 1990; McDonough et al., 1999) and occupational standing (Marmot, Kogevinas and Elston, 1987; Marmot et al., 1991; Marmot, 2004) are key determinants of the SES-gradient. See Section 2.2. for a discussion.

[3]By July 1, the total number of diagnosed COVID-19 cases per 1,000 residents was 16 in Montreal, comparable to the rates in Baltimore (13), Washington D.C. (15), Philadelphia (17), and Boston (20), although lower than those in New York City (27) (Santé Montréal, 2020; Maryland Dept. of Health, 2020; Government of the District

care workers in three different healthcare institutions: hospitals, long-term elder care facilities, and local community health centers. There is detailed information on a range of health-related outcomes, including whether individuals had a COVID-19 contact at work, self-assessed symptoms, and diagnostic test results. There is also detailed information on occupation, age, gender, location of work, and location of residence.

We focus on three narrowly defined occupation categories: Licensed Nurse Practitioners, Registered Nurses, and Nurse Clinicians. These occupations each have similar daily workplace tasks – they are all nurses – but have distinct educational requirements and widely varying pay scales.[4] For the sake of clarity, we refer to these three occupations as Low-SES, Mid-SES and High-SES nurses.

We estimate the relative probability of infection across different SES nurses who were or were not exposed to COVID-19 in the workplace. These comparisons are based on workers with similar characteristics (age, gender, and residence ZIP code) who worked in the same 3-digit ZIP code location. The resulting estimates capture how heterogeneity in the SES-health risk gradient varies with underlying workplace conditions, holding constant all non-work drivers of COVID-19 infection. Thus, we are able to isolate the impact of the workplace on the relative risk of COVID-19 infection across different SES workers.

We find that Low-SES nurses were significantly more likely to test positive for COVID-19. This gradient is driven entirely by workplace exposure, and we find no significant difference in infection rates across nurses who were not exposed to COVID-19 in the workplace. The patterns are stable across a number of different specifications including models that control for workplace location fixed effects, suggesting that the observed SES gradient cannot be attributed to differences in underlying infection risk or safety protocols across healthcare facilities.

What explains the SES gradient in workplace-related COVID-19 infection rates? We find no significant differences in testing rates by SES group, suggesting that the results cannot be at-

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of Columbia, 2020; Philadelphia Dept. of Public Health, 2020; Massachusetts Dept. of Public Health, 2020; NY State Dept. of Health, 2020).

[4]For example, among nurses with at least 14 years of experience, the hourly wage gap between Nurse Clinicians and Licensed Nurse Practitioners is 80 percent (FIQ, 2020).

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tributed to different workplace testing policies across the three occupational groups.[5] Similarly, we find no clear differences in the levels of workplace risk across SES groups, as measured by either the duration of exposure or the probability of facing a high-risk contact. Finally, we find systematic differences in the magnitude of the SES-infection gradient across different healthcare institutions, with effect sizes that are three times larger in non-hospital settings. These patterns align with documented shortages of personal protective equipment (PPE) and lack of infection control measures in Quebec's non-hospital institutions during the first wave of the pandemic (Rinfret, 2020). Taken together, our results suggest that the observed SES-infection gradient was most likely driven by a combination of inadequate pandemic preparedness and worker training, as well as subtle differences in specific job responsibilities and work conditions across occupational groups.

Our results complement a number of recent studies that use occupation-based measures of viral transmission risk during the COVID-19 pandemic. These measures have been used to measure the size and characteristics of at-risk populations (Baylis et al., 2020b; Baker, Peckman and Seixas, 2020), to evaluate differential economic effects across workers (Beland et al., 2020; Beland, Brodeur and Wright, 2020), and to guide the policy response (Aum, Lee and Shin, 2020; Chopra, Devereux and Lahiri, 2020). To measure viral transmission risk, researchers typically combine O*NET data that provide detailed information on a range of specific job requirements (such as physical proximity, frequency of face-to-face interactions, etc.) with assessments from health experts on the role of these factors for viral transmission risk (see Baylis et al., 2020a; Beauregard, Connolly and Haeck, 2020). Although the ordering of the O*NET 'task-based' measure of infection risk aligns with our estimates of observed workplace infection risk, it drastically understates the disparities in infection risk across occupations and does not account for the large differences in infection risk across healthcare institutions. Our results show how large disparities in workplace infection risk can arise, even across workers in similar occupations

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[5]The decision to test an employee was made at the institutional level following guidelines provided by the Institut National de Santé Publique du Québec (INSPQ). Occupation did not factor directly into this determination.

with similar tasks. The findings provide a cautionary note for subjective task-based measures of infection risk, and highlight the critical need for data on incidence of workplace COVID-19 infections across a variety of occupations and industries.

More broadly, our research provides new insights into the drivers of the socioeconomic health gradient. These health disparities have only intensified during the COVID-19 pandemic (Kim, Marrast and Conigliaro, 2020; Golestaneh et al., 2020; Chowkwanyun and Reed, 2020; Baena-Diez et al., 2020). Previous research has documented how differences in underlying health conditions (Clay, Lewis and Severnini, 2019; Clark et al., 2020; CDC COVID-19 Response Team, 2020; Guan et al., 2020), exposure to air pollution (Clay, Lewis and Severnini, 2018; Wu et al., 2020), reliance on public transportation (Adda, 2016; McLaren, 2020; Medlock, Temzedlides and Hung, 2021), and access to healthcare (Clay et al., 2020; Ji et al., 2020), can all exacerbate socioeconomic health disparities during periods of pandemic. There is also a growing literature showing significant differences across sociodemographic groups in the knowledge about the sources of COVID-19 transmission, trust in public health officials, and behaviors regarding its spread (Alsan et al., 2020; Simonov et al., 2020). Finally, lower SES workers are disproportionately concentrated in occupations with fewer opportunities for remote work (Chandra et al., 2020; Dingel and Neiman, 2020; Bartik et al., 2020), although without direct measures of COVID-19 infection rates across occupations it is impossible to assess how these differences contributed to workplace-related exposure to COVID-19. Our paper provides the first direct evidence on workplace-related COVID-19 infections across occupations. Our results demonstrate how large SES-based health disparities can emerge even in a common workplace environment amongst a subset of healthcare workers who were all trained about the sources of disease transmission.

2 Context

2.1 Nursing in Quebec

In Quebec, the vast majority of nurses are employed in three types of healthcare facilities: hospitals, local community health centers, and long term elder care facilities. Employment in nursing can be broadly classified into three distinct occupations: Licensed Nurses Practitioner (LNP), Registered Nurses (RN), and Nurse Clinicians (NC). These three occupations are all regulated by the provincial government.

The three occupations each have specific educational requirements. LNPs must complete a high school degree and an 1800-hour training program. RNs must complete an additional year of education beyond high school and a 2100-hour job training program. Meanwhile, NCs must complete a three year bachelor degree in Nursing Science.

The salary profile also differs widely across the three occupations. Figure 1 reports the hourly wage scale for the nurses each occupation. This scale is standard for all Quebec nurses who work in the public sector and set by a collective agreement negotiated by the main nurses union.[6] The hourly wages vary according to years of work experience as well as the specific occupation (LNP, RN, or NC).[7] For every level of experience, hourly wages are higher for NPs than RNs than LNPs. These wage differentials are smaller early at lower levels of experience. For example, among workers with less than 5 years of experience, all three occupations earn hourly wages within \$10 of each other. The pay gaps increase with experience, so that an NP with at least 14 years of experience earns an hourly wage that is \$25 higher than that of an LNP. For reference, the median employment income in Montreal was roughly \$36,000 in 2016 (Statistics Canada, 2016), which is less than the annual salary of a full time worker in each of

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[6]In Quebec, 95 percent of nurses are unionized, and almost all are represented by the Fédération Interprofessionnelle de la Santé de Québec (FIQ). Roughly 85 percent work in the public sector. The salaries for nurses in the private sector may differ depending on the individual employer.

[7]The wage may also vary depending on an individual's license status (candidate for license, full license, or refresher period) as well as any additional job responsibility (i.e., team leader, assistant to team leader, or instructor).

the nursing occupations at any level of experience.[8]

Despite the wide differences in educational requirements and wages, all three occupations have overlapping job descriptions and responsibilities. Workers in each occupation are directly involved in patient care and common daily tasks include monitoring patient vital signs, administering treatments, providing comfort and hygiene to patients, and interacting with patient family members and friends (Avenir Santé Québec, 2020).

In March, 2020, the provincial government declared a public health emergency and modified several provisions of healthcare workers' collective agreements.[9] The government also authorized an 8 percent pay raise for all frontline healthcare workers. There were widespread accounts of inadequate pandemic preparation, particularly in senior living centers. Indeed, subsequent reporting documented inadequate worker training, an initial lack of PPE in many facilities, and healthcare staff that were heavily psychologically affected by the burden of the crisis (Rinfret, 2020). Frontline healthcare workers were disproportionately likely to contract COVID-19 during the first wave, accounting for 25 percent of all report COVID-19 cases between March 1 and June 15.

2.2 Potential Influences of SES on Workplace COVID-19 Infections

There are a number of potential channels through which occupational status differences across nurses may have influenced the likelihood of a workplace-related COVID-19 infection. First, educational differences across the three nursing occupations may have directly affected workplace infection risk. Educational differences may have influenced workplace COVID-19 infections through tolerance towards risk (Cutler and Lleras-Muney, 2010), adoption of health-promoting behaviors (Link and Phelan, 1995; Phelan, Link and Tehranifar, 2010) or the abil-

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[8]The demographics of the nursing workforce also differ from the general population. In particular, women are far more likely to be employed in nursing (in our sample 85 percent of nurses are women). It has been documented that the share of minorities among nurses in Canada is larger than the share in the general population (Turcotte and Savage, 2020).

[9]Modifications included the cancellation of vacations, allowances for extensions in work hours, and restrictions placed on job transfers.

ity to effectively cope with stressful environments (Ross and Mirowksky, 2010). In contrast, whereas previous research has documented a link between education and the level of knowledge about disease and the sources of transmission (Lange, 2011), this mechanism is unlikely to play a central role in our context, since all three groups of nurses received extensive medical training.

Second, the wide income disparities across nurses may have contributed to differences in workplace infection risk. There is a large literature documenting the relationship between income and health (see Smith, 1999, for a review).[10] In our context, lower SES nurses may have been induced to work longer hours out of financial necessity, placing themselves at greater risk of a workplace COVID-19 contact. It is also possible that higher underlying stress levels among lower income workers may have contributed to infection risk, both directly through a depressed immune system response (e.g., McEwen, 1998a,b), or indirectly through stress-induced behavioural changes in the workplace (e.g., Goldberger and Breznitz, 1993; Cooper, 2005).

Third, differences in job control across occupations may have contributed to workplace infection risk. Researchers have argued that individuals in lower status occupations may experience psychosocial stress due to feelings of subordination and lack of control, which may contribute to a compromised immune system and poor health (Wilkinson, 1999; Marmot, 2004). In addition, workers in lower status occupations often have less control over their hours of work (Schneider and Harknett, 2019). Thus, lower-SES nurses may have been required to take on higher risk shifts. Alternatively, irregular scheduling or frequent overnight shifting may have led this group to be more susceptible to a COVID-19 infection due to workplace error stemming from fatigue.[11]

Finally, workplace infection rates may have differed across nurses in the three occupational

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[10]A key challenge in establishing this link stems from the fact that low-income individuals may have other attributes that contribute to poor health. Nevertheless, evidence from large increases in the Earned Income Tax Credit shows positive effects on health as well as reduced stress among mothers (Evans and Garthwaite, 2014; Hoynes, Miller and Simon, 2015). The positive relationship between household income and health has also been documented in Canada, despite the existence of universal health insurance coverage for doctor and hospital services (Curtis et al., 2001).

[11]Importantly, because our empirical analysis is based on comparisons across nurses who all experienced a workplace COVID-19 exposure, we are able to control for this type of difference in underlying workplace.

groups as a result of distinct job responsibility and tasks. Although all three occupations share similar daily routines and job duties, it is possible that particular tasks required of lower SES nurses may have placed them at greater risk of infection. For example, they may have spent more time in direct contact with patients or worked in closer proximity to patients.

3 Data

We obtained an administrative dataset from the Human Resources department for nurses who worked in a subset of healthcare facilities in Montreal, Quebec from March 15 to July 1, 2020. These data provide information on all nurses who worked in healthcare facilities located in a particular area in Montreal that spans 16 3-digit ZIP codes. The cross-sectional dataset provides detailed health information on healthcare workers in the three nursing occupations: Licensed Nurses Practitioner (Low-SES), Registered Nurses (Mid-SES), and Nurse Clinicians (High-SES).[12] For each worker, we observe whether she had a contact with a COVID-19 positive person in the workplace (either patient or coworker). For workers with a COVID-19 contact, there is information about whether exposure lasted more than 10 minutes and whether the exposure was deemed to be high-risk.[13]

We also have information on diagnostic testing of employees. For each worker, we observe whether or not a diagnostic test was conducted and, if so, the results of the test. We use this information to construct various measures of testing: indicators for whether a worker was ever tested and whether the worker ever tested positive. The dataset also provides information on self-assessed COVID-19 symptoms, which were reported by all nurses regardless of testing. We use this information to construct an indicator for whether a worker ever had COVID-19 symptoms.

The dataset contains information on worker demographics and workplace characteristics. We

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[12]The dataset also information on orderlies. There is some information on doctors in these institutions, although most are classified as self-employed and not administered by the same Human Resources department.

[13]The 'high-risk' classification was made at the discretion of hospital administrators based on a variety of factors including proximity to the COVID-19 positive individual, the use of PPE, and duration of contact.

observe the age, gender, and 3-digit ZIP code of home residence for employees. The data also identify 16 distinct 3-digit ZIP code of the primary work location.[14] We use the information on workplace ZIP code to construct an indicator variable 'works in hospital' that identifies whether a nurse worked in hospital versus non-hospital settings.[15]

In Table 1, we report summary statistics across the the three categories of nurses: Low-SES, Mid-SES and High-SES. Overall, there are 4,250 individuals in the sample. 24 percent are Low-SES, 39 percent are Mid-SES, and 37 percent are High-SES. The composition of the nursing workforce across occupations in our sample is reflective of the province-wide distribution.[16]

Panel A shows a large and statistically significant SES gradient in workplace exposure, with the highest rates among Low-SES nurses. Conditional on workplace contact, however, the three groups appear to have faced similar levels of risk, as measured by both duration of exposure and whether the contact was deemed high-risk.

Panel B shows that 10 percent of nurses tested positive for COVID-19, substantially higher than the 1 percent city-wide diagnosis rate (Santé Montréal, 2020).[17] The high rates of COVID-19 infection are driven by work-related risks. Indeed, the COVID-19 diagnosis rate jumps to 27 percent for nurses with a workplace contact. We also find systematically higher rates of COVID-19 diagnosis among Low-SES workers, particularly among nurses with a workplace contact. Low-SES nurses were 6 percentage points more likely to be diagnosed for COVID-19 and were significantly more likely to report COVID-19 symptoms. The gap in the positive case rate doubles when we restrict attention to nurses with a workplace contact. For nurses without a workplace contact, COVID-19 diagnosis rates were much lower and similar across SES groups.

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[14]The dataset does not report information on the specific institution of employment. On average there are four healthcare facilities by ZIP code.

[15]All hospitals are located within a single ZIP code. Based on independent information on the workforce of these hospitals, we know that more than 95 percent of nurses associated with that ZIP code worked in a hospital. The indicator 'works in hospital' takes a value of one for nurses in that ZIP code and zero for nurses employed in the other 15 workplace ZIP codes.

[16]Data on the total number of Licensed Nurse Practitioners (Low-SES) and Registered Nurses (Mid-SES) across Quebec align exactly with their relative shares in our sample (CIHI, 2021).

[17]These disparities may reflect a combination of both the higher risk of infection among healthcare workers (Wu and McGoogan, 2020), and the high rates of testing that lowered the probability of undiagnosed infection (Benatia, Godefroy and Lewis, 2020a,b).

Panel C shows that 37 percent of nurses were tested for COVID-19 during the sample period.[18] COVID-19 tests appear to have been directed to higher risk workers: 84 percent of nurses with a workplace contact received a test. There is a monotonically decreasing relationship between COVID-19 testing rates and occupational ranking: 43 percent of Low-SES workers were tested, 37 percent of Mid-SES workers were tested, and 34 percent of High-SES workers were tested. Nevertheless, these differences appear to be driven by the differing rates of workplace exposure to COVID-19 (reported in Panel A). Among workers who faced a workplace contact, we find no significant differences in testing rates across the three SES groups. Similarly, for nurses who did not face workplace contact, the testing rates are virtually the same across the three occupations.

Panel D shows that the three groups also differed across several socioeconomic outcomes. Low-SES nurses were somewhat older and more likely to work in non-hospital settings. Importantly, in our estimation strategy, we control for both individual characteristics and workplace conditions.

4 Empirical strategy

Our estimation strategy compares health outcomes across nurses of different SES that did or did not have contact with a COVID-19 positive case in the workplace, controlling for demographic characteristics. We estimate the following equation:

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y_{ijk} = \sum_{\substack{j \in \\ Low,High}} \alpha_j SES_{ijk} + \beta Contact\ at\ Work_{ijk} + \sum_{\substack{j \in \\ Low,High}} \gamma_j SES_{ijk} \times Contact\ at\ Work_{ijk}
$$
$$
+ \lambda_k + \delta X_i + u_i \tag{1}
$$

where y_{ijk} denotes the outcome for nurse i, who belongs to one of three groups: Low-SES,

[18]In comparison, just 7 percent of the general population in the population had been tested by the end of the sample period (INSPQ, 2020).

Mid-SES, or High-SES (corresponding to the three occupations: Licensed Nurse Practitioner, Registered Nurse, and Nurse Clinician), at the workplace ZIP code, k. The main dependent variable is an indicator for whether or not the worker tested positive for COVID-19. We estimate equation (1) by OLS.[19] Standard errors are clustered at the 3-digit ZIP code of the workplace to allow for within-group correlation in outcomes.[20]

The variables SES_{ji} are indicators for Low-SES or High-SES (with Mid-SES left as the omitted reference group).[21] $Contact\ at\ Work_i$ is an indicator for whether worker i experienced a workplace COVID-19 contact. The term λ_k denotes a vector of 16 workplace 3-digit ZIP code fixed effects to allow for differences in workplace risks that might vary across worksites throughout the city. Because these ZIP code fixed effects subsume the indicator for 'works in hospital', they should also control for differences in infection risk across hospital versus non-hospital settings.[22]

The term X_i represents a set of individual covariates. These include an indicator for gender as well as a full vector of age fixed effects to control flexibly for age-based differences in infection risk. We also include a vector of fixed effects for 3-digit ZIP code of residence to allow for differences in infection risk according to non-workplace environmental conditions.

The coefficients α_{Low} and α_{High} capture SES-based differentials in outcomes among nurses who did not experience a workplace COVID-19 contact. Specifically, α_{Low} identifies the difference in outcomes for non-contact Low-SES workers relative to non-contact Mid-SES workers (the omitted reference group), while α_{High} captures the difference between non-contact High-SES workers and non-contact Mid-SES workers. Thus, these effects capture the underlying differences in health outcomes across SES groups that were unrelated to workplace risk.

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[19]In comparison to other models for limited dependent variables (i.e., probit or logit), the linear probability model does not impose any functional form assumption on the error terms, and the regression coefficient can be directly interpreted as marginal impacts without requiring any adjustments to the point estimates (Angrist and Pischke, 2009). In additional robustness analysis, we also report results from logit models.

[20]We also estimate two-way clustered standard errors that allow for correlation within both workplace and home ZIP code addresses, following the approach of Cameron, Gelbach and Miller (2011).

[21]In many specifications, we partition the sample into two groups: Low-SES versus Mid/High-SES nurses, in which case the omitted reference group are Mid/High-SES nurses.

[22]Because we lack information on specific institution of employment, we also cannot control for differences in workplace risks across long term elder care facilities and community-health centers.

Meanwhile, the coefficient β identifies the impact of a workplace COVID-19 contact on health outcomes for Mid-SES workers.

The main coefficients of interest, γ_{Low} and γ_{High}, identify the extent to which workplace COVID-19 exposure differentially affected outcomes for different SES workers. Specifically, γ_{Low} captures the differential impact of workplace exposure on outcomes for Low-SES workers relative to Mid-SES workers (the reference group). Similarly, γ_{High} captures the differential impact of workplace exposure on High-SES workers relative to Mid-SES workers. In many specifications, we partition the sample into just two groups: Low-SES workers versus Mid/High-SES workers, in which case the omitted reference group is Mid- and High-SES nurses. In these models, the coefficient γ_{Low} captures the differential impact of workplace exposure for Low-SES workers relative to the impact of workplace exposure on Mid/High-SES workers. In all cases, the estimates are based on relative differences across exposed versus non-exposed nurses of different SES status. Thus, the analysis holds constant all non work sources of COVID-19 risk, thereby isolating the contribution of the workplace to the health gradient. These differential estimates across nurses with and without a workplace contact control for any cross-occupation differences in underlying susceptibility to COVID-19 infection.[23]

5   Results

5.1   Differences in Workplace COVID-19 Infection by SES

Table 2 reports the results from equation (1) for our main estimation, where the dependent variable is an indicator equal to 1 if and only if the person tested positive.[24] Columns (1) - (4) report estimates of overall differences in diagnosis rates across SES groups. Columns (1) - (2)

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[23]For example, if individuals with underlying health conditions were more likely to select into the lowest tier occupations, we might expect them to experience higher overall rates of COVID-19 infection. Nevertheless, these health conditions should similarly impact the likelihood of COVID-19 infection in *both* workplace and non-workplace settings, so that we would not expect any systematic differences in the workplace-related infection gradient.

[24]In subsequent analysis, we explore what drives these baseline findings (see Tables 3 -5).

report the results when partition the sample into two groups to compare outcomes for Low-SES workers relative to the omitted category of Mid/High-SES workers. Columns (3) - (4) report the results when we partition the sample into all three occupations, so that we compare both Low- and High-SES workers relative to the omitted category of Mid-SES workers. Across the four specifications, we find that consistently higher rates of COVID-19 diagnosis among Low-SES nurses. Because these models control for workplace ZIP code fixed effects, these differences cannot be attributable to cross institution differences in workplace risk. The findings must reflect either within workplace differences in COVID-19 infection risk or various non-work risks or behavioral differences that are not captured by the demographic covariates.

Columns (5) - (8) report the results from our main specification that interact occupational status with workplace contact. Columns (5) - (6) report the estimates when we partition into two groups (Low- vs. Mid/High-SES workers), while columns (7) - (8) report the results when we partition into all three occupations. The results demonstrate that the underlying differences in positive test rates across groups were driven entirely by workplace contact. The interaction effects for Low-SES are positive and statistically significant across the various specification, implying that workplace contact differentially increased the probability of testing positive among Low-SES nurses. In contrast, the main effects for Low-SES workers are all small and statistically insignificant, indicating no systematic differences in infection rates among individuals who were not exposed in the workplace. Similarly, we find no significant effects for High-SES nurses regardless of workplace exposure.[25]

The interaction effects reported in columns (5) - (8) are large in magnitude. Our preferred estimates (col. 6) imply that workplace-related infection rates were 53% (= 0.123/0.23) higher for Low-SES nurses relative to the other two groups. The findings are consistent with the underlying differences in workplace-related COVID-19 diagnoses reported in Table 1. Notably, the regression results establish that these differentials persist, even after we account for cross-

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[25]Table A.1 reports the corresponding estimates to Table 2, in which we report the coefficients for the demographic covariates. For ease of presentation, we have replaced the full vector of age fixed effects with 10-year age group fixed effects. The main estimates are unaffected by this change.

institution differences in infection risk and individual demographic factors.

One potential explanation for the observed patterns in Table 2 is differential testing rates across SES workers. For example, if Low-SES nurses were more likely to be tested following a workplace contact, the previous estimates could partly reflect lower rates of undiagnosed infection among this group of workers. In practice, decisions over employee testing were made at the institutional level, following the guidelines established by the provincial health authorities. These guidelines made no mention of nurses' occupational standing, so it is unlikely that testing rates should differ across groups, *conditional* on underlying workplace risk. Nevertheless, we assess the extent to which group-specific testing policies may be driving the baseline findings.

Table 3 (cols. 1-2) shows no significant difference in the testing rates for Low-SES workers, regardless of workplace contact. The main interaction effects are positive, but small in magnitude, and statistically insignificant. The main results for COVID-19 diagnosis are similar to the baseline findings when we restrict the sample to individuals who received a COVID-19 tests (cols. 3-4). Similarly, we estimate a significant workplace-related SES gradient in the probably of reporting COVID-19 symptoms, *regardless* of whether a diagnostic test was conducted (cols. 5-6). Taken together, these results strongly suggest that the observed differentials in positive COVID-19 cases across nurses reflect actual differences in the likelihood of workplace-related infections and were not driven by SES-based differences in testing.

The absence of SES-based testing differentials is unsurprising, since employee occupational standing did not directly factor into the provincial testing guidelines. Nevertheless, these patterns are striking, given that a primary goal of workplace testing was to identify the maximum number of COVID-19 cases among workforce. According to this objective, tests should be allocated disproportionately to all identifiable group with higher underlying risk of COVID-19 infection. Instead, we find that Low-SES workers had significantly higher rates of workplace-related infection but were no more likely to be tested, suggesting that a reallocation of tests to Low-SES workers may have reduced the rates of undiagnosed infection.

The estimated differences in work-related COVID-19 infections reported in Table 2 are

robust to a range of alternative specifications and controls. In Table A.2 we report results from models with two-way clustered standard errors to allow for correlation in outcomes within both workplace and home ZIP code address, following the approach of Cameron, Gelbach and Miller (2011). Statistical inference is unaffected. In Table A.3, we report estimations from a logit model. The estimated odds ratios are similar in sign and significance to our baseline estimates.[26] In Table A.4, we assess the sensitivity of the results to different covariates. For reference, column (1) reports the original coefficient estimates (corresponding to Table 2, col. 6), estimated with 10-year age group fixed effects. In columns (2) and (3), we control for a series of week of diagnosis fixed effects to capture potential changes in underlying COVID-19 prevalence over the sample period. We estimate these models for both the full sample (col. 2) and the restricted sample of tested workers (col. 3).[27] Controlling for the week of testing does not affect the main estimates of interest.

Finally, in Table A.5, we explore whether Low-SES workers were more likely to test positive for COVID-19 following a *non-work* contact.[28] In columns (1) and (2), the estimates on 'Low-SES × Contact outside of work' are both statistically insignificant, while the main estimates for 'Low-SES Nurse' are both positive and significant. Taken together these findings suggest that workplace as opposed to non-work exposure was the key driver of the higher COVID-19 infection rates among Low-SES nurses.

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[26]The magnitude of the log-odds estimates are not directly comparable to the marginal impacts reported in Table 2. We report the marginal effects from the logit model at the bottom of Table A.3. For the full sample, the logit marginal effects are smaller than the OLS estimates, as often occurs when the mean of the dependent variable is small (Angrist and Pischke, 2009). Indeed, if we restrict the sample to people who are tested, as reported in the last two columns of Table A.3, the logit marginal effects are similar to the corresponding OLS estimates (columns 3-4 of Table 3).

[27]In column 2, we add an additional covariate for whether the individual was ever tested, so that nurses who were never tested (and thus cannot be assigned a testing date) are also included in the sample.

[28]Nurses were required to disclose all known COVID-19 contacts, although there was likely considerable measurement error in non-work contact.

5.2 Determinants of SES Differentials in Workplace COVID-19 Infection

What explains the higher rates of COVID-19 infection among Low-SES workers? One possibility is that these nurses were given tasks that placed them at higher risk of infection. For example, they may have been more likely to spend longer periods of time caring for COVID-19 positive patients or may have been assigned to patients that posed higher risks to caregivers.

In Table 4, we assess whether different SES workers faced different levels of risk in the workplace. In columns 1-3 we explore whether there were systematic differences in the duration of workplace COVID-19 contact. Overall, Low-SES workers were more likely to experience an extended COVID-19 contact (col. 1). Conditional on contact, however, we find no significant differences in the length of time spent with COVID-positive patients (col. 2). Moreover, the inclusion of a control for contact duration has almost no impact on the main interaction estimates (col. 3). Similarly, we find no evidence that Low-SES had higher rates of high-risk workplace contact, and controlling for high-risk contact does not alter the main estimates (cols. 4-6).[29]

In the final column of Table 4, we assess whether the SES gradient can be attributed to the workplace hierarchy. We estimate a generalized version of equation (1), allowing the effect of workplace exposure to vary according to whether a nurse was the team leader. This framework allows us to test whether team leaders, who were more likely to be Mid- or High-SES nurses, assigned themselves less risky tasks. We estimate a positive (albeit statistically insignificant) interaction effect for team leaders, suggesting that head nurses were somewhat more likely to assign *themselves* to higher-risk patients. The inclusion of these covariates has little effect on the main interaction terms. These patterns suggest that differences occupational status or

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[29]The negative direct effect of 'High-risk Contact' is likely a result of differential testing rates among workers whose exposure was deemed 'high-risk' (results available upon request). Differences in COVID-19 diagnosis rates across workers with high- and low-risk contacts reflect *both* average COVID-19 infection rates and differences in testing rates across each group. To the extent that the positivity rate decreases with the fraction of the population tested, this second selection effect may dominate.

control at work are unlikely to be the drivers of the COVID-19 infection gradient.

Taken together, the results in Tables 4 show no evidence that Low-SES nurses spent more time with COVID-19 patients, or were assigned to patients at higher risk of transmitting the virus. Instead, the results must reflect more subtle differences in the daily tasks performed by each group that placed some groups at systematically higher risk of infection.

To conclude the analysis, we explore heterogeneity in effects across different healthcare institutions. In Quebec, like many other jurisdictions, there were substantial differences in the effectiveness of the COVID-19 response across different healthcare institutions.[30] The outbreak was particularly acute in long term elder living facilities, which accounted for more than 60 percent of province-wide deaths during the first wave. A widely publicized report by the Quebec ombudsman noted that "[long term elder care facilities] were a blind spot in preparing for the pandemic, with efforts massively concentrated on hospitals (Rinfret, 2020)." The report documented that there was a "lack of infection prevention and control culture in [long term elder care facilities]" and that "personal protective equipment was insufficient and unequally distributed." Motivated by this evidence, we assess the extent to which the SES workplace infection gradient differed across hospital and non-hospital settings.

Table 5 reports the results from regressions that allow the Low-SES interaction effect to differ across hospital and non-hospital healthcare institutions. The estimates for COVID-19 diagnosis are positive and statistically significant in both hospital and non-hospital settings (cols. 1-2), suggesting that the SES gradient existed in both workplace settings. The estimates are more than twice as large in non-hospital institutions. These findings do not appear to have been driven by differential testing policies (cols. 5-6) and the differential effects remain even when we restrict the sample to tested workers (cols. 3-4).[31]

The fact that the SES-infection gradient is substantially larger in non-hospital settings suggest that something about particular workplaces (as opposed to workers) contributed to the

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[30]For details on PPE shortages in U.S. elder care facilities see Murray (2020); Holroyd-Leduc and Laupacis (2020).

[31]In these regressions, we are unable to identify the main effect of workplace exposure on COVID-19 diagnosis, since *overall* testing rates differed across hospital and non-hospital institutions.

gradient. In contrast, if the SES-gradient reflected pure behavioral differences or risk tolerance across groups (i.e., Cutler and Lleras-Muney, 2010), we would expect the infection risk gradient to be similar across both types of healthcare institutions. Taken together, these findings suggest that the costs of PPE shortages, poor preparedness, and inadequate worker training in many non-hospital healthcare facilities were disproportionately borne by Low-SES workers.

6   Assessing the Risks of COVID-19 Transmission in the Workplace

Policymakers in many countries have implemented partial lockdowns in which many businesses have been required to shutdown or transition to home-based work to reduce the spread of the COVID-19 pandemic. These decisions have been highly controversial, and there has been considerable debate on both the scope of workplace shutdowns and which industries should be targeted. One reason for the controversy is the large uncertainty regarding the actual risks of workplace infection and how these risks vary across occupations.

In an effort to address these concerns, researchers have developed tools to assess the relative risk of workplace infection as a function of the specific daily tasks involved with various jobs. These models combine detailed data on specific job characteristics and tasks from the O*NET dataset with assessments from health experts on the associated risks of viral transmission. For example, a job that requires daily face-to-face discussions would be classified as higher risk than one that requires only weekly interactions. The vector of these various job attributes can then be combined to construct an index of viral transmission risk at the industry/occupation level. These tools have gained influence and have been applied in a number of studies.

A challenge for the 'task-based' approach to measuring workplace transmission risk is that the various indices have not been validated with *actual* COVID-19 infection rates. As a result, we do not know the extent to which the risks of transmission identified by public health experts align with actual rates of transmission. This concern is particularly relevant for the current

pandemic, in which knowledge of sources of transmission continues to evolve.

We compare our estimates of relative transmission risk across licensed practitioner nurses and registered nurses to those implied by a standard occupational 'task-based' index (Baylis et al., 2020a).[32] We corroborate the ranking of these occupational groups: licensed practical nurses face higher risk of COVID-19 infection according to the 'task-based' index. Nevertheless, the magnitude of the differences in risk do not align. Our preferred estimates imply that the former group had a 50 percent higher risk of workplace-related infection. In contrast, the gap in infection risk on the 100 point 'task-based' index is 4 points, less than one third of the cross-occupation standard deviation in risk. Combining our estimated differences in infection risk with the occupation/industry risk index, we calculate that an implausible 98 percent of jobs carry zero risk of transmission risk.[33] We also found that the occupational differences in workplace infection risk were three times higher in non-hospital settings that were not identifiable in occupational-based indices.

These findings demonstrate the need to interpret with caution 'task-based' occupational measures of transmission risk. There may be subtle differences across occupations that are not easily quantified but that may importantly impact transmission risk. Moreover, our finding that the SES gradient differs substantially across different institutions highlights the crucial role of specific worksite conditions for disease spread. Our results demonstrate the critical need for data on *actual* COVID-19 infection rates across a broader set of workers to better understand how workplace conditions contribute to disease transmission.

7 Conclusion

The positive relationship between socioeconomic status and health has been extensively documented. Many national governments have set ambitious targets to reduce these "health

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[32]Nurse clinicians were not separately identified in the O*NET data.

[33]This large share is due to the implied steep decline in COVID-19 infection rates for jobs that had lower rankings on the index.

inequalities" (WHO, 2008; U.S. DHHS, 2010), although the effectiveness of government efforts will hinge on successfully identifying and addressing the underlying causes of the gradient.

Our study provides new evidence on the sources of health disparities among frontline healthcare workers during the COVID-19 pandemic. We find that large SES-based differences in COVID-19 infection rates. This gradient was driven entirely by work-related contact, and we find no differences infection rates among individuals who were not exposed to COVID-19 in the workplace.

We uncover wide differences in work-related COVID-19 infections, even among individuals within narrowly defined occupational categories who worked in the same healthcare institution. These differences are not easily captured by standard measures of workplace risk or 'task-based' indices of disease transmission. Instead, our results show how subtle differences in workplace conditions and job tasks can interact to generate large SES health disparities.

A defining feature of the coronavirus pandemic is its unequal burden across different socioeconomic groups. Our analysis highlights the critical role that the workplace can play for these health disparities. Future research might explore more deeply the underlying drivers of these workplace health disparities, and the extent to which they can be counteracted through targeted policy interventions. From a policy perspective, this analysis could shed light on how best to mitigate the pandemic's impact among lower status workers, and also offer potentially valuable insights into the drivers of "health inequalities" in normal times.

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8 Figures and Tables

Figure 1: **Hourly Wages of Low-SES, Mid-SES, and High-SES Nurses**
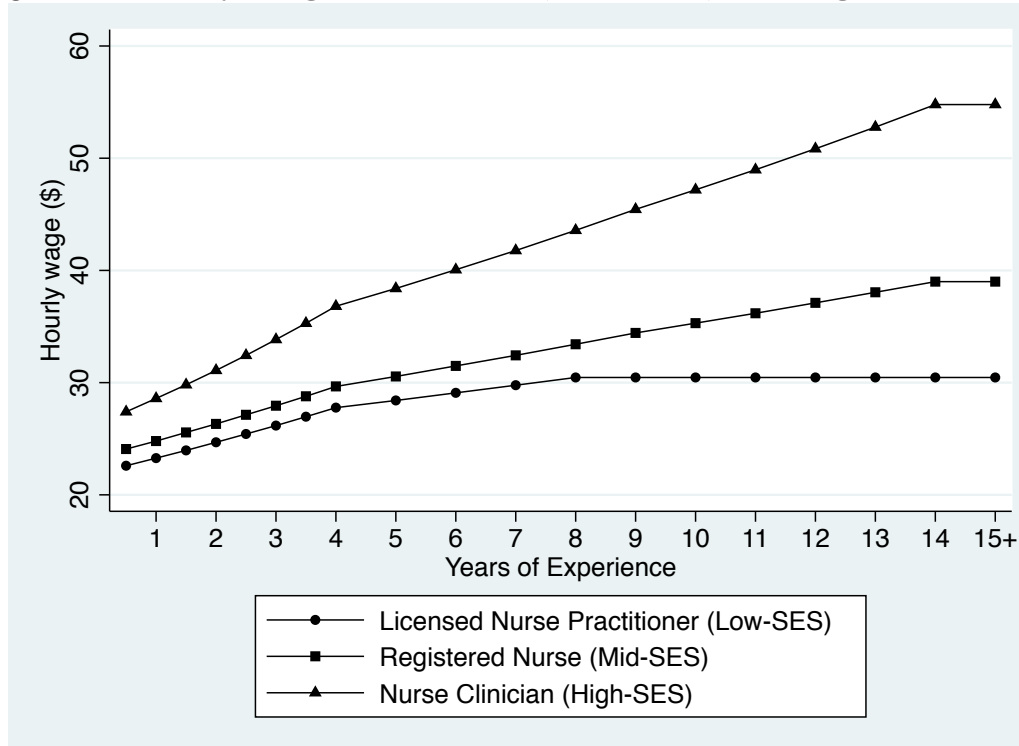
Notes: This figure reports the wage profiles for public sector nurses set by the 2016 FIQ collective agreement. In 2020, roughly 85 percent of Quebec nurses worked in the public sector. The wage profile is based on an 18-level pay scale, that changes every six months during the first four years of employment, and every year thereafter. The reported hourly wages are based on base pay rates that do not account for additional job responsibilities (i.e., team leader, assistant team leader, or instructor).
Source: http://www.fiqsante.qc.ca/wp-content/uploads/2016/10/Echelles_salariales_Web_2016-2020_ANG.pdf

Table 1: **Summary Statistics**

Outcome		Mean by Occupational Category		
	All	Low-SES	Mid-SES	High-SES
Panel A: *Workplace Exposure to COVID-19*				
Contact at work	0.30	0.35***	0.29	0.26*
Contact >10 mins, if contact at work	0.74	0.75	0.72	0.76
High-risk contact, if contact at work	0.29	0.28	0.29	0.28
Panel B: *COVID-19 Cases and Reported Symptoms*				
Tested positive for COVID-19	0.10	0.15**	0.09	0.08
Tested positive for COVID-19, if contact at work	0.27	0.37***	0.23	0.23
Tested positive for COVID-19, if no contact at work	0.030	0.038*	0.031	0.024**
Had COVID-19 symptoms	0.32	0.37***	0.31	0.29
Panel C: *Testing for COVID-19*				
Tested for COVID-19	0.37	0.43***	0.37	0.34*
Tested for COVID-19, if contact at work	0.84	0.86	0.85	0.81
Tested for COVID-19, if no contact at work	0.18	0.19	0.17	0.18
Panel D: *Demographic Outcomes*				
Works in hospital	0.60	0.42***	0.70	0.60**
Age	42.0	45.1***	41.1	40.8
Female	0.85	0.87	0.85	0.86
Observations	4,250	1,028	1,654	1,568

NOTES. This table presents sample means across Low-SES Mid-SES and High-SES workers. We report asterisks for statistically significant differences in means relative to the Mid-SES group. These differences are calculated by pooling all observations and estimating the following regressions: $outcome_i = \beta_0 + \beta_1 \text{Low-SES}_i + \beta_2 \text{High-SES}_i + u_i$, with standard errors clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

Table 2: **SES Differences in COVID-19 Infections and Workplace Exposure**

Dependent Variable: *Tested Positive for COVID-19*

	Differences in COVID-19 Infection Rates by SES				Differences in COVID-19 Infection Rates by SES and Workplace Exposure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low-SES	0.063** (0.029)	0.063** (0.029)	0.059** (0.025)	0.058** (0.027)	0.008 (0.005)	0.005 (0.007)	0.006 (0.005)	0.003 (0.008)
Low-SES × Contact at Work					0.122** (0.052)	0.123** (0.053)	0.124*** (0.041)	0.121** (0.043)
High-SES			-0.008 (0.008)	-0.011* (0.005)			-0.003 (0.004)	-0.004 (0.005)
High-SES × Contact at Work							0.003 (0.029)	-0.004 (0.025)
Contact at Work					0.204*** (0.011)	0.207*** (0.013)	0.203*** (0.006)	0.208*** (0.005)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
R2	0.014	0.070	0.014	0.070	0.148	0.198	0.148	0.198
# Clusters	16	16	16	16	16	16	16	16
# Observations	4250	4250	4250	4250	4250	4250	4250	4250
Mean Dependent Var.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive, on binary variables of interest. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses in columns 1, 2, 5 and 6, and Mid-SES in columns 3, 4, 7 and 8. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). "Demographic controls" are indicator variables for age, sex, and ZIP code of residency. Observations are clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

Table 3: **SES Differences in COVID-19 Testing**

Dependent Variable:	Tested for COVID-19		COVID-19 positive, if tested =1		Reported COVID-19 symptoms	
	(1)	(2)	(3)	(4)	(5)	(6)
Low-SES	0.009	0.006	0.042	0.045	-0.001	-0.006
	(0.019)	(0.026)	(0.034)	(0.041)	(0.018)	(0.025)
Low-SES × Contact at Work	0.014	0.019	0.100**	0.097**	0.061*	0.068**
	(0.039)	(0.038)	(0.034)	(0.033)	(0.029)	(0.031)
Contact at Work	0.657***	0.653***	0.122***	0.113***	0.542***	0.543***
	(0.017)	(0.015)	(0.016)	(0.015)	(0.017)	(0.020)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes	No	Yes
Restrict sample to tested workers			Yes	Yes		
R2	0.393	0.429	0.051	0.193	0.308	0.351
# Clusters	16	16	16	16	16	16
# Observations	4250	4250	1587	1587	4250	4250
Mean Dependent Var.	0.37	0.37	0.27	0.27	0.32	0.32

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested (columns 1 and 2), or if and only if the person is tested and positive (columns 3 and 4), or if and only if the person reported COVID-19 symptoms (columns 5 and 6). In columns 3 and 4, the sample is restricted to nurses who were tested. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). "Demographic controls" are indicator variables for age, sex, and ZIP code of residency. Observations are clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

Table 4: **SES Differences in Workplace COVID-19 Infection Risk**

Dependent Variable:	Duration of Workplace Contact			High-risk Workplace Contact			Team Hierarchy
	Contact >10 minutes		COVID-19 positive	High-risk contact		COVID-19 positive	COVID-19 positive
	All	If contact =1	Include contact duration controls	All	If contact =1	Include high-risk contact controls	Include team leader controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low-SES	0.050*** (0.014)	-0.019 (0.033)	0.006 (0.006)	0.018 (0.011)	0.001 (0.026)	0.005 (0.007)	0.006 (0.007)
Low-SES × Contact at Work			0.122** (0.056)			0.122** (0.052)	0.123** (0.053)
Contact > 10 mins			0.180*** (0.021)				
High-risk Contact						-0.089*** (0.020)	
Team Leader × Contact at Work							0.014 (0.013)
Contact at Work			0.072** (0.029)			0.232*** (0.009)	0.206*** (0.013)
Full controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.069	0.195	0.217	0.075	0.180	0.203	0.198
# Clusters	16	14	16	16	14	16	16
# Observations	4250	1252	4250	4250	1252	4250	4250
Mean Dependent Var.	0.22	0.74	0.10	0.08	0.29	0.10	0.10

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person was in contact for more than 10 minutes with a COVID-19 positive person at work (columns 1 and 2) or if and only if the person is tested and positive (columns 3, 6 and 7) or if and only if the person had a contact classified as high-risk by its workplace (columns 4 and 5). In columns 2 and 5, the sample is restricted to nurses who were in contact with a COVID-19 positive person at work. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). Full controls include workplace ZIP code and demographic controls reported in Table 2. The regression in column 7 also includes Team Leader fixed effects. Observations are clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

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Table 5: **SES Differences in Workplace COVID-19 Infection Risk Across Healthcare Institutions**

Dependent Variable:	COVID-19 positive		COVID-19 positive, if tested = 1		Tested for COVID-19	
	(1)	(2)	(3)	(4)	(5)	(6)
Low-SES × Contact at Work × Hospital	0.062***	0.068***	0.030*	0.044*	0.012	0.011
	(0.011)	(0.013)	(0.016)	(0.023)	(0.017)	(0.016)
Low-SES × Contact at Work × Non-hospital	0.155***	0.151**	0.137***	0.120**	0.022	0.031
	(0.051)	(0.054)	(0.043)	(0.050)	(0.051)	(0.048)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes	No	Yes
Restrict sample to tested workers			Yes	Yes		
R2	0.150	0.200	0.055	0.197	0.393	0.430
# Clusters	16	16	16	16	16	16
# Observations	4250	4250	1587	1587	4250	4250
Mean Dependent Var.	0.10	0.10	0.27	0.27	0.37	0.37

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive (columns 1 to 4) or if and only if the person is tested (columns 5 and 6). In columns 3 and 4, the sample is restricted to nurses who were tested. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). "Demographic controls" are indicator variables for age, sex, and ZIP code of residency. All models include double-interactions between Low-SES, hospital and non-hospital dummies as well as the direct effect of Contact at Work. Observations are clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

A Appendix (For Online Publication)

Table A.1: **SES Differences in COVID-19 Infections and Workplace Exposure**

	Dependent Variable: *Tested Positive for COVID-19*							
	Differences in COVID-19 Infection Rates by SES				Differences in COVID-19 Infection Rates by SES and Workplace Exposure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low-SES Nurse	0.066** (0.027)	0.062** (0.028)	0.062** (0.024)	0.056** (0.025)	0.010 (0.005)	0.004 (0.006)	0.008 (0.005)	0.001 (0.006)
Low-SES × Contact at Work					0.123** (0.051)	0.125** (0.055)	0.124*** (0.040)	0.123** (0.046)
High-SES Nurse			-0.008 (0.008)	-0.012* (0.006)			-0.003 (0.004)	-0.005 (0.005)
High-SES × Contact at Work							0.003 (0.029)	-0.004 (0.024)
Contact at Work					0.203*** (0.010)	0.207*** (0.013)	0.202*** (0.006)	0.209*** (0.006)
Female	-0.034*** (0.009)	-0.036*** (0.007)	-0.034*** (0.009)	-0.035*** (0.007)	-0.022** (0.008)	-0.022*** (0.006)	-0.022*** (0.008)	-0.022*** (0.006)
30-39 years old	-0.026*** (0.005)	-0.028*** (0.007)	-0.026*** (0.005)	-0.028*** (0.007)	-0.018*** (0.005)	-0.018** (0.007)	-0.018*** (0.005)	-0.018** (0.007)
40-49 years old	-0.014 (0.012)	-0.016* (0.009)	-0.015 (0.012)	-0.016* (0.009)	-0.010 (0.010)	-0.011 (0.008)	-0.010 (0.010)	-0.011 (0.008)
50-59 years old	-0.019 (0.021)	-0.021 (0.015)	-0.019 (0.020)	-0.022 (0.015)	-0.011 (0.015)	-0.012 (0.011)	-0.011 (0.014)	-0.012 (0.011)
60 or older	-0.046*** (0.010)	-0.042*** (0.009)	-0.046*** (0.010)	-0.042*** (0.009)	-0.013 (0.009)	-0.006 (0.011)	-0.013 (0.009)	-0.006 (0.011)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Residence ZIP code FEs	No	Yes	No	Yes	No	Yes	No	Yes
R2	0.017	0.055	0.017	0.056	0.149	0.187	0.149	0.187
# Clusters	16	16	16	16	16	16	16	16
# Observations	4250	4250	4250	4250	4250	4250	4250	4250
Mean Dependent Var.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES. The omitted reference group is Mid/High-SES nurses in columns 1, 2, 5 and 6, and Mid-SES in columns 3, 4, 7 and 8. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). Observations are clustered at the workplace ZIP code level. ***, **, * denote significance at the 1%, 5%, and 10% level.

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Table A.2: **SES Differences in COVID-19 Infections and Workplace Exposure**

Dependent Variable: *Tested Positive for COVID-19*

	Differences in COVID-19 Infection Rates by SES				Differences in COVID-19 Infection Rates by SES and Workplace Exposure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low-SES Nurse	0.063**	0.063*	0.059**	0.058*	0.008	0.005	0.006	0.003
	(0.028)	(0.030)	(0.024)	(0.029)	(0.005)	(0.008)	(0.006)	(0.009)
Low-SES × Contact at Work					0.122**	0.123**	0.124***	0.121**
					(0.050)	(0.054)	(0.039)	(0.045)
High-SES Nurse			-0.008	-0.011			-0.003	-0.004
			(0.008)	(0.008)			(0.004)	(0.008)
High-SES × Contact at Work							0.003	-0.004
							(0.029)	(0.028)
Contact at Work					0.204***	0.207***	0.203***	0.208***
					(0.011)	(0.016)	(0.005)	(0.011)
Workplace zipcode FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
R2	0.014	0.070	0.014	0.070	0.148	0.198	0.148	0.198
# Observations	4247	4247	4247	4247	4247	4247	4247	4247
Mean Dependent Var.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses in columns 1, 2, 5 and 6, and Mid-SES in columns 3, 4, 7 and 8. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). "Demographic controls" are indicator variables for age, sex, and ZIP code of residency. Observations are two-way clustered at the workplace and residency ZIP code level, following the approach of Cameron, Gelbach and Miller (2011). ***, **, * denote significance at the 1%, 5%, and 10% level.

Table A.3: **SES Differences in COVID-19 Infections and Workplace Exposure - Logit Odds Ratios**

Dependent Variable:	COVID-19 positive		Tested for COVID-19		COVID-19 positive, if tested =1	
	(1)	(2)	(3)	(4)	(5)	(6)
Low-SES Nurse	1.358**	1.361*	1.059	1.038	1.339	1.378
	(0.206)	(0.231)	(0.140)	(0.182)	(0.338)	(0.424)
Low-SES × Contact at Work	1.370*	1.459**	1.140	1.155	1.410***	1.517***
	(0.232)	(0.257)	(0.349)	(0.331)	(0.168)	(0.215)
Contact at Work	10.732***	12.542***	23.489***	28.026***	2.085***	2.127***
	(0.892)	(1.074)	(2.763)	(3.146)	(0.328)	(0.279)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes	No	Yes
Restrict sample to tested workers	No	No	No	No	Yes	Yes
# Observations	4210	3770	4247	4121	1574	1431
Mean Dependent Var.	0.10	0.10	0.37	0.37	0.27	0.27
Marginal Effect						
Low-SES × Contact at Work=1	0.026*	0.032**	0.019	0.020	0.068***	0.077***
	(0.015)	(0.015)	(0.046)	(0.041)	(0.024)	(0.027)

NOTES. This table reports the odds-ratios computed from the logit regression of a dichotomous variable equal to 1 if and only if the person is tested and positive (columns 1, 2, 5 and 6) or if and only if the person is tested (columns 3 and 4). In columns 5 and 6, the sample is restricted to nurses who were tested. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). Observations in columns "Demographic controls" are indicator variables for sex, and ZIP code of residency and age. Observations are clustered at the workplace ZIP code level. Columns ***, **, * denote significance at the 1%, 5%, and 10% level.

Table A.4:   **SES Differences in COVID-19 Infections and Workplace Exposure - Controlling for age categories and week of test**

Dependent Variable:	Tested Positive for COVID-19		
	(1)	(2)	(3)
Low-SES Nurse	0.004	0.000	0.043
	(0.006)	(0.007)	(0.027)
Low-SES × Contact at Work	0.125**	0.117**	0.098**
	(0.055)	(0.045)	(0.044)
Contact at Work	0.207***	0.039***	0.076***
	(0.013)	(0.010)	(0.011)
Female	-0.022***	-0.028***	-0.094***
	(0.006)	(0.006)	(0.013)
30-39 years old	-0.018**	-0.013	-0.026
	(0.007)	(0.008)	(0.025)
40-49 years old	-0.011	-0.010	-0.037**
	(0.008)	(0.007)	(0.016)
50-59 years old	-0.012	-0.003	-0.003
	(0.011)	(0.008)	(0.020)
60 or older	-0.006	0.014	0.064
	(0.011)	(0.011)	(0.037)
Tested		0.020	
		(0.017)	
Full controls	Yes	Yes	Yes
Week of test FEs	No	Yes	Yes
Restrict sample to tested workers	No	No	Yes
R2	0.187	0.276	0.187
# Clusters	16	16	16
# Observations	4250	4250	1587
Mean Dependent Var.	0.10	0.10	0.27

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive. Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact at Work" is a binary variable equal to 1 if and only if the person was in contact with an infected person at work (patient or coworker). "Full controls" are indicator variables for workplace ZIP code, and ZIP code of residency. Observations are clustered at the workplace ZIP code level. Columns ***, **, * denote significance at the 1%, 5%, and 10% level.

Table A.5: **SES Differences in COVID-19 Infections and Exposure Outside Workplace**

	Tested Positive for COVID-19		Tested for COVID-19	
	(1)	(2)	(3)	(4)
Low-SES Nurse	0.062**	0.061**	0.054**	0.058**
	(0.027)	(0.027)	(0.020)	(0.023)
Low SES x Contact outside of work	0.066	0.065	-0.045	-0.059
	(0.084)	(0.094)	(0.101)	(0.110)
Contact outside of work	0.049**	0.048*	0.461***	0.485***
	(0.023)	(0.023)	(0.068)	(0.068)
Workplace ZIP code FEs	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	No	Yes
R2	0.015	0.071	0.025	0.090
# Clusters	16	16	16	16
# Observations	4250	4250	4250	4250
Mean Dependent Var.	0.10	0.10	0.37	0.37

NOTES. This table reports the results of the OLS regression of a binary variable equal to 1 if and only if the person is tested and positive (columns 1 and 2) or if and only if the person is tested (columns 3 and 4). Nurses are partitioned into three categories: Low-, Mid- or High-SES. The omitted reference group is Mid/High-SES nurses. "Contact outside of work" is a binary variable equal to 1 if and only if the person was in contact with an infected person outside work. Observations in columns "Full controls" are indicator variables for workplace ZIP code, sex, and ZIP code of residency and age. Observations are clustered at the workplace ZIP code level. Columns ***, **, * denote significance at the 1%, 5%, and 10% level.