

Supplementary Material*

Chou R, Dana T, Buckley DI, et al. Update alert 4: epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med.* 11 September 2020. [Epub ahead of print]. doi:10.7326/L20-1134

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*This supplementary material was provided by the authors to give readers further details on their article. The material was reviewed but not copyedited.

Supplement Table 1. Burden of SARS-CoV-2 in HCWs

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Blairon et al, 2020 (5) Prospective cohort Belgium (Brussels); 4 hospitals; 25 May to 19 June 2020 Added for Update Alert #4	1499 asymptomatic HCWs • Median age 45 y • 72.4% female • 39% nurse or other HCW, 22% physician or dentist, 21% pharmacist or administrative staff, 9% maintenance or technical worker, 4% imaging or lab worker, 5% other/not specified • 37% known exposure to COVID-19-infected patient	SARS-CoV-2 seropositivity: 13.7% (206/1499); including initially equivocal tests that were retested: 14.5% (217/1499) • HCW with known exposure to COVID-19 patient: 13.5% (74/550) • HCW with no known exposure to COVID-19 patient: 12.6% (74/588)	48% participation rate; no information on clinical outcomes of SARS-CoV-2 infection
el-Boghdady et al, 2020 (22) Prospective cohort Multinational (17 countries); 503 hospitals; 23 March to 2 June 2020	1718 HCWs involved in tracheal intubation of patients • Mean age 42 y • 40.3% female • 91% physician, 9% non-physician • 83% anaesthesia, 15% intensive care medicine, 2% emergency medicine, < 1% other specialty	Incidence of laboratory-confirmed COVID-19: 3.1% (53/1718)	Criteria for COVID-19 diagnosis not reported
Grant et al, 2020 (7) Prospective cohort UK (London); multicenter health trust; March to May 2020 Added for Update Alert #4	2004 HCWs • Mean age 40 y • % female not reported • 67% clinical setting with prolonged direct patient contact, 9.8% clinical setting with less or no patient contact, 17.0% nonclinical setting and minimal/no patient contact, <1.0% working from home	Prevalence of SARS-CoV-2 seropositivity: 31.6% (634/2004) • Symptomatic for COVID-19-like illness: 77.3% (490/634) • Asymptomatic: 21.9% (139/634)	Limited information on demographic characteristics of HCWs; participation rate not reported; no information on clinical outcomes of SARS-CoV-2 infection
Houlihan et al, 2020 (8)	200 frontline HCWs • Median age 34 y	Prevalence of SARS-CoV-2 (seropositive or PCR), baseline plus follow-up: 43.5% (87/200)	Limited information on demographic characteristics of

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Prospective cohort UK (London); 1 acute care hospital; 26 March to 8 April 2020 Added for Update Alert #4	61% female 36% physician, 53% nurse or other front-line clinical staff, 11% other 17% ER, 18% acute medical admissions, 22% ICU, 21% hematology, 22% other setting	Prevalence of SARS-CoV-2 seropositivity at baseline: 25.4% (46/181) Incidence of SARS-CoV-2 seroconversion from baseline to 1 month: 19.9% (36/181) Prevalence of SARS-CoV-2 infection (PCR), baseline plus 1 month follow-up: 21.0% (42/200)	HCWs; selection of HCWs for testing unclear; no information on clinical outcomes of SARS-CoV-2 infection
Kassem et al, 2020 (11) Prospective cohort Egypt; gastroenterological unit of 1 hospital; 1 to 14 June 2020 Added for Update Alert #4	74 HCWs in gastroenterology service with no reported household contact with infected persons - Median age 42 y 59.5% female 40.5% physician, 37.8% nurses; 12.2% cleaning and transportation; 9.5% administration	Prevalence of SARS-CoV-2 infection (PCR and/or seropositive): 12.2% (9/74) Prevalence of SARS-CoV-2 (seropositive or PCR) during study period: 21.6% (16/74) Symptomatic: 50% (6/12) Asymptomatic: 16.1% (10/62)	59% participation rate; no information on clinical outcomes of SARS-CoV-2 infection
Maltezou et al, 2020 (23) Prospective cohort Greece; HCWs throughout Greece; 13 March to 3 May 2020	3,398 HCWs exposed to a patient or colleague with COVID-19 - Mean age 45 y 71% female 32% physician, 50% nurse, 18% other HCW role 47% low-risk setting, 23% moderate-risk setting, 30% high-risk setting	Incidence of SARS-CoV-2 infection (PCR): 2.2% (76/3,398) - Low-risk exposure: 1.0% (16/1,599) - Moderate-risk exposure: 1.0% (8/765) - High-risk exposure: 5.0% (52/1031) Incidence of COVID-19 diagnosis: 1.9% (66/3,398) - Low-risk exposure: 0.8% (13/1,599) - Moderate-risk exposure: 0.9% (7/765) - High-risk exposure: 4.5% (46/1031) Hospitalization due to COVID-19: 0.4% (13/3,398) - Low-risk exposure: 0.1% (2/1,599) - Moderate-risk exposure: 0.4% (3/765) - High-risk exposure: 0.8% (8/1031)	Unvalidated method used to categorize risk exposure (based on use of mask by patient and use of PPE by HCW)

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Martin et al, 2020 (24) Prospective cohort Belgium (Brussels); 1 hospital; 15 April to 18 May 2020	326 HCWs in high-risk units (COVID-19 unit, COVID-19 intensive care unit, or emergency department) • Mean age 37 y • 73% female • 29% physician, 51% nurse, healthcare assistant, 11% paramedical staff, 8% administrative, 2% cleaners or other role	Incidence of SARS-CoV-2 infection (PCR): 12.6% (41/326) • Pneumonia, not requiring hospitalization: 7.3% (3/41) • Hospitalization: 0% (0/41)	No major limitations noted
Mutambudzi et al, 2020 (25) Prospective cohort United Kingdom; HCWs throughout the United Kingdom; 16 March to 3 May 2020	11,353 HCWs participating in UK Biobank • Age, sex of HCWs not reported • 16% healthcare professionals, 12% medical support staff, 71% health associate professionals	Incidence of SARS-CoV-2 infection: 0.7% (76/10,718) Healthcare worker vs. non-essential worker: OR 7.59 (95% CI 5.43-10.62)	Not peer reviewed Selection for testing unclear; limited information on clinical and demographic characteristics of HCWs; no information on clinical outcomes of infections; 5.5% participation rate
Nguyen et al, 2020 (26) Prospective cohort United Kingdom and United States; start March 24 or 29, 2020, end date not reported	99,795 frontline HCWs • Mean age, 42 y • 83% female • HCW role/position not reported	30-day incidence of SARS-CoV-2 infection: 4.0% (1,922/1,454,701 person-days)	No information on clinical outcomes of SARS-CoV-2 infection; selection of HCWs for testing unclear; diagnosis based on self-report
Schmidt et al, 2020 (27) Prospective cohort	385 HCWs in a neurological center • Mean age not reported; 14% age 18-29 y, 40% age 30-49 y, 44% age 50-64 y, 2% age ≥65 y	Prevalence of SARS-CoV-2 seropositivity: 2.9% (11/385)	73% participation rate; limited information on clinical symptoms or outcomes

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Germany; 1 neurologic hospital; 20 to 30 March 2020	80% female 9% physician, 40% nurse, 21% therapist, 30% other healthcare role		
Villaneuva et al, 2020 (17) Prospective cohort The Philippines (Manilla); 1 hospital; 20 March to 20 April 2020 Added for Update Alert #4	324 HCWs with known exposure of signs or symptoms - Mean age, 36 y 67% female 11% physician, 63% nurse, 19% nursing aid, 2% radiology tech, 4% lab, 1% clerk and other	Incidence of SARS-CoV-2 infection (PCR): 2.5% (8/324) - High risk: 4.1% (4/97) - Low risk: 1.8% (4/227)	27% participation rate; no information on clinical outcomes of SARS-CoV-2 infection
Bai et al, 2020 (28) Retrospective cohort China (Wuhan); 1 hospital (neurosurgery department) prior to recognition of outbreak; December 25, 2019 to February 15, 2020	118 HCWs with potential exposure to COVID-19 patient - Mean age, 31 years 64% female 25% physician, 75% nurse	Incidence of COVID-19: 10.2% (12/118)	Not peer reviewed No information on clinical outcomes of COVID-19; criteria for COVID-19 diagnosis not reported; selection of HCWs for testing unclear
Baker et al, 2020 (29) Retrospective cohort United States (Boston); 1 hospital; dates not reported	44 HCWs with exposure (≥ 10 cumulative minutes of face-to-face contact within 6 feet) to a COVID-19 infected patient Age, sex, HCW role/position not reported	Incidence of COVID-19 (PCR): 6.8% (3/44) Incidence deemed related to workplace exposure: 4.7% (2/44)	No information on demographic or clinical characteristics; use of PPE not well-reported

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Blain et al, 2020 (4) Retrospective cohort Country not reported; 1 nursing home; 3 March to 20 April 2020 Added for Update Alert #4	34 HCWs in a facility with confirmed COVID-19 exposure Age, sex, HCW role/position not reported	Incidence of SARS-CoV-2 infection (PCR): 23.5% (8/34)	No information on demographic or clinical characteristics of HCWs; limited information on clinical outcomes of SARS-CoV-2 infection
Buchtele et al, 2020 (30) Retrospective cohort Austria (Vienna); stem cell transplant unit; 23 March to 17 April 2020	26 HCWs and staff with face-to-face exposure to a SARS-CoV-2 infected colleague - Age, sex not reported 19.2% physician, 69.2% nurse, 11.5% cleaning staff	Incidence of SARS-CoV-2 infection (PCR): 19.2% (5/26)	No information on demographic or clinical characteristics of HCWs
Figueira et al, 2020 (31) Retrospective cohort Spain (Madrid); 1 hospital; 1 to 29 March 2020	2085 HCWs tested for SARS-CoV-2 infection Age, sex, HCW role/position not reported	Incidence of SARS-CoV-2 infection: 37.9% (791/2,085) - Hospitalized: 2.7% (21/791) - Mechanical ventilation: 0.3% (2/791)	Not peer reviewed No information on demographic or clinical characteristics of HCWs; selection of HCWs for testing unclear
Heinzerling et al, 2020 (32) Retrospective cohort United States (California); 1 hospital with unsuspected	37 HCWs with exposure to COVID-19 patient and at least one aerosol-generating procedure - Median age, 39 years 84% female 7% physician, 51% nurse, 9% respiratory therapist, 9% phlebotomist, 7%	Incidence of COVID-19 (PCR): 5.4% (2/37)	No information on clinical outcomes of COVID-19; only 2 cases; 6 tested HCWs were not interviewed and excluded from analysis

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COVID-19 case; February 2020	- certified nursing assistant, 7% environmental services worker, 5% nutrition services worker, 2% pharmacist, 2% other - No use of N95 respirators, eye protection, gowns, or PAPR		
Khalil et al, 2020 (33) Retrospective cohort United Kingdom (London); 1 maternity hospital; testing end date 16 April 2020	266 HCWs Age, sex, HCW/role/position not reported	Incidence of SARS-CoV-2 infection (PCR): 17.7% (47/266) - Asymptomatic: 8.4% (16/190) - Symptomatic: 40.8% (31/76)	Selection of HCWs for testing unclear; no information demographic and clinical characteristics of HCWs; no information on clinical outcomes of infections
Lai et al, 2020 (34) Retrospective cohort China (Wuhan); 1 hospital; 1 January-9 February 2020	9,648 HCWs 12% ≥45 y, 88% <45 y 74% female 22% physician, 46% nurse, 32% health care assistant	Incidence of COVID-19: 1.1% (110/9658) Prevalence of asymptomatic SARS-CoV-2 infection: 0.9% (3/335) (random sample)	No information on clinical outcomes of COVID-19; criteria for COVID-19 diagnosis not reported; selection of HCWs for testing unclear
Liu J. et al, 2020 (35) Retrospective cohort China (Wuhan); 1 hospital; 16 January to 25 February 2020	101 HCWs with SARS-CoV-2 infection - Median age, 33 y 68% female 26% physician, 74% nurse	- Disease severity: 6% (6/101) severe, 94% (95/101) non-severe - Mortality: 0% (0/101) - Length of hospital stay (median, days): 17.0 (IQR 11.0-21.0)	Proportion meeting criteria for COVID-19 unclear; limited information on clinical outcomes of SARS-CoV-2 infection

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Luigi et al, 2020 (36) Retrospective cohort Italy (Bari); 1 hospital; 21 February to 22 March 2020	5,750 HCWs - Mean age, 49 y (HCWs) - Sex, HCW role/position not reported 70% physician, 22% nurse, 8.7% social health assistants	Prevalence of SARS-CoV-2 infection: 0.4% (23/5,750)	Clinical outcomes of infections not reported; limited information on demographic or clinical characteristics of HCWs
Moscola et al, 2020 (13) Retrospective cohort United States (New York); multicenter health system; 20 April to 23 June 2020 Added for Update Alert #4	40,329 HCWs - Median age, 42 y 73.7% female 16.0% Black, 14.0% Hispanic, 0.8% multiracial 9.3% physicians, 28.4% nurses	Prevalence of SARS-CoV-2 seropositivity: 13.7% (5523/40,329) 15.7% had previous PCR testing: 34.5% (2186/6341) positive	56% of all eligible HCWs; 7 different assays used; no information on clinical outcomes of SARS-CoV-2 infection
Murphy et al, 2020 (37) Retrospective cohort United States (Washington state); emergency medical services providers in King County; through 9 April 2020	700 emergency medical services providers with encounters with COVID-19 patients Age, sex not reported	Incidence of SARS-CoV-2 infection: 0.4% (3/700) Incidence among those with symptoms and tested: 7.0% (3/43)	Not peer reviewed No information on clinical outcomes of SARS-CoV-2 infection; only 40 symptomatic HCWs underwent testing; no information on demographic and clinical characteristics of HCWs

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Piapan et al, 2020 (15) Retrospective cohort Italy (Trieste); regional HCWs with known COVID-19 exposure; 1 March to 6 April 2020 Added for Update Alert #4	903 HCWs with exposure to COVID-19 infected patient • Mean age 45 y • 71% female • 28% physician, 43% nurse, 18% nurse's aide, 8% resident, 9% other role • 7% high-risk department, 13% moderate-risk department, 80% low-risk department	Prevalence of SARS-CoV-2 infection (PCR): 12.7% (115/903)	No information on clinical outcomes of SARS-CoV-2 infection
Ran et al, 2020 (38) Retrospective cohort China (Wuhan); 1 hospital serving outbreak; follow-up through 28 January 2020	72 HCWs with acute symptoms • Median age, 31 y • 69% female • 53% clinicians and 47% nurses	Incidence of COVID-19: 38.9% (28/72)	No information on clinical outcomes of COVID-19; selection of HCWs for testing unclear
Sotgiu et al. 2020 (16) Retrospective cohort Italy (Milan); 1 hospital; 2 to 16 April 2020 Added for Update Alert #4	202 apparently healthy HCWs • Median age 45 y • 65% female • 47% physician, 26% nurse, 10% resident, 6% socio-sanitary worker, 2% administrative staff, 4% technicians, 4% hospital staff, 1% non-hospital staff	Incidence of SARS-CoV-2 seropositivity • IgM: 14.4% (29/202) • IgG: 7.4% (15/202)	No information on clinical outcomes of SARS-CoV-2 infection

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Treibel et al, 2020 (39) Retrospective cohort United Kingdom (London); 1 hospital; recruitment 23 to 31 March 2020	400 asymptomatic HCWs Age, sex, HCW role/position not reported	Incidence of SARS-CoV-2 infection - Week 1: 7.1% (28/396) - Week 2: 4.9% (14/284) - Week 3: 1.5% (4/263) - Week 4: 1.5% (4/267) - Week 5: 1.1% (3/269) No symptoms in week before or after positivity: 27% (12/44)	No information on clinical outcomes of COVID-19; no information on HCW demographics or clinical characteristics
Wang Q. et al, 2020 (40) Retrospective cohort China (Hubei province); 107 hospital neurosurgery departments; January 20 to March 1, 2020	5,322 HCWs - Mean age, 34 years 50% female 45% surgeon, 55% nurse	Incidence of COVID-19: 2.2% (120/5442)	Not peer reviewed Selection of HCWs for testing unclear; limited information on clinical outcomes of COVID-19
Zhao et al, 2020 (19) Retrospective cohort China (Wuhan); 1 teaching hospital; 14 January to 21 February 2020 Added for Update Alert #4	1407 symptomatic HCWs or with close contact with COVID-19 patients who underwent PCR (n=1060) or CT imaging (n=1407)	Incidence of SARS-CoV-2: - Infection (PCR): 15.1% (106/1060) - Infection (CT imaging): 13.6% (191/1407) - Seropositive: 20.2% (215/1060) Mortality: 0.1% (2/1407)	Current applicability unclear (study conducted during early Wuhan outbreak)

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Amendola et al, 2020 (3) Cross-sectional Italy (Milan); 1 pediatric hospital; 15 April 2020 Added for Update Alert #4	663 asymptomatic HCWs (547 clinical and 116 nonclinical) in children's hospital • Mean age 44 y • 84% female • 83% clinical HCW, 17% nonclinical HCW ○ 32% physician, 32% nurse, 18% technician, 17% non-clinical hospital employee • 27% labor and delivery, 12% pediatric unit, 10% outpatient clinic, 4% surgical unit, 8% pediatric ER, 7% NICU, 6% PICU, 11% administrative / pharmacy / lab, 15% other • Among HCWs (n=547), 56% direct contact with COVID-19 patient, 44% no known direct contact	Prevalence of SARS-CoV-2 seropositivity: 5.1% (34/663)	No information on clinical outcomes of SARS-CoV-2 infection
Bays et al, 2020 (41) Cross-sectional United States; 2 hospitals; February to March 2020	421 HCWs with unsuspected exposure to patient with COVID-19 infection • Age, sex, and role/position of HCWs not reported	Incidence of COVID-19: 1.9% (8/421)	No information on clinical outcomes of COVID-19; no information on HCW demographics or clinical characteristics

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Clemency et al, 2020 (42) Cross-sectional United States (New York); regional health care system; 26 March to 16 April 2020	961 HCWs with symptoms of COVID-19, presenting for outpatient testing Age, sex, and role/position of HCWs not reported	Incidence of COVID-19: 23.3% (225/961)	No information on clinical outcomes of COVID-19; no information on HCW demographics or clinical characteristics
Dai et al, 2020 (43) Cross-sectional China (Hubei province); HCWs from throughout province; 3–11 February 2020	4357 HCWs - Mean age, 35 y 76.5% female 32.6% physicians, 53.8% nurses, 10.0% technicians, 3.6% support staff 0.9% diagnosed with COVID-19	Incidence of COVID-19: 0.9% (40/4357)	Not peer reviewed No control for baseline symptoms; no non-HCW controls; no control for work exposures
Felice, 2020 (44) Cross-sectional Italy; HCWs throughout country; 25 March to 4 April 2020	388 HCWs (98 underwent testing) 11% <30 y, 52% aged 30–39 y, 21% 40–49, 13% 50–59 y, 3.3% ≥60 y 61% female 74% physician, 26% other HCW	Prevalence of SARS-CoV-2 infection among HCWs who underwent testing: 18.4% (18/98) - Received medical therapy: 61.1% (11/18) - Hospital admission: 5.6% (1/18) - Asymptomatic: 33.3% (6/18)	Selection of HCWs for testing unclear
Gheysarzadeh et al, 2020 (45) Cross-sectional Iran (Ilam); single hospital; February to April 2020	125 nurses - Mean age not reported; range 33–39 y (cases) % female not reported 100% nurses - All reported to have been “equipped” with eye protection, masks (type not reported), face shield, gloves and shoe covers	Incidence of SARS-CoV-2 infection (PCR): 4.0% (5/125)	Limited information on clinical outcomes of COVID-19; limitation information on HCW demographics or clinical characteristics; selection of HCWs for testing unclear

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Hunter et al, 2020 (9) Cross-sectional United States (Indiana); 18 locations within one healthcare system; dates not reported Added for Update Alert #4	734 HCWs without active symptoms or previously confirmed COVID-19 • Mean age: 42.8 y • 70.1% female • 38.0% physicians, 43.2% nurses, 12.8% RTs, 6.0% Admin	Prevalence of SARS-CoV-2 seropositivity (IgG): 1.6% (12/734) • High risk: 1.3% (5/385) • Low risk: 2.0% (7/349)	Number of tests allocated according to assessed risk; testing protocol varied according to hospital risk (only offered to ED and COVID units in high risk hospitals); no information on clinical outcomes of SARS-CoV-2 infection
Jeremias et al, 2020 (10) Cross-sectional United States (New York); 1 hospital; 1 March to 30 April 2020 Added for Update Alert #4	1,958 HCWs (asymptomatic or symptom-free for at least 14 days) • Mean age 43 y • 70% female • 6.4% physician, 55.6% nurse, 10.0% technologist, 6.2% environmental worker, 21.7% ancillary worker	Prevalence of SARS-CoV-2 seropositivity: 9.8% (167/1699) Incidence of SARS-CoV-2 infection (PCR): 29.8% (184/617)	64% participation rate; demographic characteristics reported for the entire cohort rather than those who underwent testing
Kang, 2020 (46) Cross-sectional China (Wuhan); HCWs from hospitals in Wuhan; 29 January to 4 February 2020	994 HCWs • 63.4% aged 25–40 y • 85% female • 31.1% high-risk department • 18.4% physicians; 81.6% nurses	Incidence of SARS-CoV-2 infection: 1.9% (19/994)	Participation rate not reported; no control for baseline symptoms; no non-HCW controls

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Kluytmans-van den Berg et al, 2020 (47) Cross-sectional The Netherlands; 2 hospitals; 7 to 12 March 2020	1853 HCWs with fever or mild respiratory symptoms in past 10 d - Median age, 49 y (cases) 83% female (cases) - HCW role/position not reported	Prevalence of SARS-CoV-2 infection (PCR): 6.4% (86/1353) - Met case definition (fever and/or coughing and/or shortness of breath): 91.9% (79/86) - Recovery (by day of interview): 23.3% (20/86), median duration of illness 8 days - Admitted to hospital (not critical): 3.7% (2/86)	77% not recovered at time of interview
Korth et al, 2020 (48) Cross-sectional Germany (Essen); 1 hospital; 25 March to April 21 2020	317 HCWs - Mean age, 37 y in high-risk group, 42.3 y in low-risk group 100% female 25% physician, 66% nurse, 6% lab assistant, 3% other	Prevalence of SARS-CoV-2 IgG positivity: 1.6% (5/316) - High-risk (daily contact with COVID-19 patients on designated wards and intensive care units): 1.2% (3/244) - Intermediate-risk (daily non-COVID-19 patient contact): 5.4% (2/36) - Low-risk (no daily patient contact): 0% (0/35) - Hospitalization: 0% (0/5)	No major limitations noted
Lackermair et al, 2020 (12) Cross-sectional Germany (Dachau); 8 primary care clinics; 2 to 6 April Added for Update Alert #4	151 HCWs - Mean age 38 years 83% female 36% physician, 64% other HCW 28% known unprotected COVID-19 contact 72% symptomatic	Prevalence of SARS-CoV-2 seropositivity: 2.6% (4/151) - Symptomatic: 3.7% (4/108) - Asymptomatic: 0% (0/43) Hospitalized: 25.0% (1/4)	Potential recall bias
Lahner et al, 2020 (49) Cross-sectional Italy (Rome); 1 hospital; 18 March to 27 April 2020	2,115 HCWs in a COVID-19 regional hub - Median age 46 y 60.2% female 30% physician, 33% nurse, 37% other HCW role	Incidence of SARS-CoV-2 infection (PCR): 2.7% (58/2115) - Symptomatic: 67.3% (39/58) - Hospitalization: 1.7% (1/58) - Respiratory distress syndrome: 0% (0/58) - Mortality: 0% (0/58)	No non-HCW controls

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Liu C. et al, 2020 (50) Cross-sectional China; HCWs from multiple urban and rural hospitals; 10–20 February 2020	512 HCWs 75.4% aged 18–39 y 85% female 32.0% direct treatment contact of COVID-19–infected patient	Incidence of suspected COVID-19: 8.0% (41/512)	85% response rate; sample limited to HCWs utilizing WeChat app; no control for baseline symptoms
Lombardi et al, 2020 (51) Cross-sectional Italy (Milan); 1 hospital; 24 February to 31 March 31 2020	1,573 HCWs - Mean age, 44 y 64% female 37% physician, 33% nurse/midwife, 10% healthcare assistant, 11% health technician, 9% clerical workers/technician 30% at least 1 symptom	Prevalence of SARS-CoV-2 infection (PCR): 8.8% (138/1573) ≥1 symptom vs. no symptoms: 20.2% (97/480) vs. 3.7% (41/1093), OR 7.55 (95% CI 5.07–11.2)	Selection of HCWs for testing unclear; clinical outcomes of infections not reported
Maida et al, 2020 (52) Cross-sectional Italy; HCWs in gastroenterology departments throughout Italy; 30 March to 7 April 2020	266 HCWs in gastroenterology departments Age, sex, HCW role/position not reported	Prevalence of SARS-CoV-2 infection: 49.6% (132/266)	Participation rate 36%, selection of HCWs for testing unclear; diagnosis of SARS-CoV-2 infection based on self-report; clinical outcomes of infections not reported; no information on demographic or clinical characteristics of HCWs

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Manzoni et al, 2020 (53) Cross-sectional Italy; HCWs with data in national database; date not reported	291,500 HCWs (physicians or dentists) Age, sex, and other demographic data not reported	COVID-19 mortality rate: 0.046% (133/291500)	Data obtained from publicly accessible epidemiological databases and other websites (e.g., Medscape) with uncertain reliability; no information on demographic or clinical characteristics of HCWs
Olalla et al, 2020 (14) Cross-sectional Spain (Andalusia); 1 hospital; 15 to 24 April 2020 Added for Update Alert #4	498 HCWs, testing prioritized to those most exposed to direct patient care COVID-19 - Mean age 42 y 80% female 20% physician, 39% nurse, 26% nursing assistant, 7% security, 2% administrative, 5% housekeeping 26% ED, 13% ICU, 44% COVID-19 unit, 9% non-COVID-19 unit, 8% pediatric unit	Prevalence of SARS-CoV-2 infection (PCR): 0.4% (2/498) Prevalence of SARS-CoV-2 seropositivity (IgG): 1.8% (9/498)	Uncertain criteria for testing eligibility
Rivett et al, 2020 (54) Cross-sectional United Kingdom (Cambridge); 1 hospital; April 2020	1,268 HCWs - Median age, 34 y 71% female - HCW role/position: Not reported	Prevalence of SARS-CoV-2 infection (PCR): 4.8% (61/1,270) - Asymptomatic HCWs: 3.0% (31/1,032); 12 had experienced symptoms >7 days prior to testing - Symptomatic HCWs: 15.4% (26/169) - HCWs with symptomatic household contacts: 7.7% (4/52)	Limited information on demographic or clinical characteristics of HCWs; selection of HCWs for testing unclear
Romero et al, 2020 (55) Cross-sectional Spain; national survey; 9-19 2020 April	3,109 HCWs - Mean age 45 y % female not reported 56.6% medical staff; 26.5% nursing staff; 7.7% nurse assistants; 9.2% other staff (ancillary, administrative, laboratory technicians,	Incidence of SARS-CoV-2 seropositivity: 2.9% (90/3,109)	Participation rate unclear; no control for baseline symptoms; no non-HCW controls; no control for work exposures

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	research/faculty, management, hospital pharmacist) 25.2% anaesthesia and critical care; 10.5% pathology; 5.2% intensivist and critical care; other specialties (<5% each)		
Roxby et al, 2020 (56) Cross-sectional United States (Washington); single assisted-living facility; March 2020	62 HCWs (staff at independent and assisted living community) - Mean age 40 y 68% female 72% asymptomatic; 28% symptoms within 14 days	Prevalence of SARS-CoV-2 infection: 3.2% (2/62) (both symptomatic)	Limited information on clinical outcomes of SARS-CoV-2 infection
Shields et al, 2020 (57) Cross-sectional United Kingdom (Birmingham, England); four urban hospitals; 25 April 2020	554 asymptomatic HCWs Age, sex, HCW role/position not reported	Prevalence of SARS-CoV-2 (PCR): 2.4% (13/554) Prevalence of SARS-CoV-2 seroconversion (IgG, IgM, IgA): 24.4% (126/516)	Not peer reviewed No information on clinical characteristics of HCWs; no information on clinical outcomes of SARS-CoV-2 infection; participation rate not reported; 7% of patients who underwent PCR testing did not undergo antibody testing
Sikkema et al, 2020 (58) Cross-sectional The Netherlands; two teaching and one regional hospital; 2 to 12 March 2020	1796 HCWs with fever or mild respiratory symptoms - Mean age 49 (cases) 17% male 79% medical department, 21% staff without direct patient contact 32% close contact of individual with confirmed COVID-19 within 14 days	Prevalence of SARS-CoV-2 infection: 5.3% (96/1796)	Demographic information reported for cases only; participation rate among persons meeting inclusion criteria not reported; no information about clinical outcomes of infection

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Sikora et al, 2020 (59) Cross sectional United Kingdom (four cancer centers); 14 to 24 April 2020	161 HCWs • Mean age 43 • Other demographic data not reported	Prevalence of SARS-CoV-2 IgG or IgM: 7.5% (12/161)	<i>Not peer reviewed</i> No information on clinical outcomes of infection; limited information on demographic characteristics and no information on clinical characteristics of HCWs; participation rate not reported
Tang et al, 2020 (60) Cross-sectional United Kingdom (East Midlands); throughout region (tested in home: 3 March to 29 April 2020	523 HCWs who were self-isolating or performing non-patient-facing duties and called for testing due to symptoms of suspected COVID-19 • Age, sex, HCW role/position not reported	Prevalence of SARS-CoV-2 infection (PCR): 29.1% (152/523)	No information on clinical outcomes of infection; no information on demographic or clinical characteristics of HCWs
von Freyburg et al, 2020 (61) Cross-sectional Germany (Dachau); single hospital; 3-5 and April 2020	1170 HCWs in hospital with outbreak • Age, sex not reported • 17.8% physician, 35.3% nurse, 43.1% nonmedical staff; 3.8% other	Incidence of SARS-CoV-2 infection (PCR): 5.0% (58/1170)	No information on clinical outcomes of infection; limited information on demographic and no information on clinical characteristics of HCWs
Zhang G. et al, 2020 (18) Case series China (Wuhan); 1 university hospital; 25 December 2019 to 31 January 2020	237 HCWs with confirmed contact with a COVID-19 infected patient • Age, sex not reported • 28% physician, 72% nurse • 31% respiratory department, 31% hepatobiliary surgery, 38% neurology	Incidence of SARS-CoV-2 infection (PCR): 5.1% (12/237)	Limited information on demographic characteristics and clinical outcomes of SARS-CoV-2 infection

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Added for Update Alert #4			
Zhang S. et al, 2020 (62) Cross-sectional Iran; public and private hospitals (number not reported); 5-20 April 2020	304 HCWs • Mean age 35 y • 58.6% female • HCW role not reported	Incidence of COVID-19: 2.3% (7/304)	Recruitment method not reported; participation rate not reported; no control for baseline symptoms; no non- HCW controls; no control for work exposures
Zheng et al, 2020 (63) Cross-sectional China (Wuhan); throughout Wuhan area; from March 26, 2020	117,100 HCWs • Age not reported • 72% female • 37% physician, 49% nurse, 14% medical staff	Incidence of COVID-19: 2.1% (2,457/117,100) • HCW vs. non-HCW: 2.1% vs. 0.4%, $p<0.001$ Case fatality rate: 0.69% (17/2,440) • HCW vs. non-HCW: 0.69% vs. 5.30%, $p<0.001$	COVID-19 cases based on requests for financial assistance; denominators based on epidemiological data; limited information on clinical outcomes of COVID-19 infections
Zhu et al, 2020 (64) Cross-sectional Wuhan, China; tertiary hospital; 8–10 February 2020	5,062 HCWs • 96.5% aged 19–49 y • 85% female • 20% physicians, 68% nurses, and 13% medical technicians • 3.1% with suspected or confirmed COVID-19	Incidence of suspected or confirmed COVID-19: 3.1% (157/5,062)	Not peer reviewed Response rate 77%; did not control for baseline symptoms; no non-HCW controls

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Lapolla et al, 2020 (65) Case series (descriptive study) Italy (throughout); 21 February to 17 April 2020	16,991 HCWs with SARS-CoV-2 infection - Median age, 48 y 68% female	Incidence of SARS-CoV-2 in HCWs: 10.7% (16,991/168,941) - Nurse/midwife: 43.2% (6988/16,991) - Doctor: 22% (3574/16,911) Mortality in HCWs: 1.2% (206/16,991)	No denominator for the total number of exposed HCWs; proportion recovered unclear; estimates based on epidemiological data
Liu J. et al, 2020 (66) Case series China (Wuhan); single hospital; diagnosed 16 January–15 February 2020	64 HCWs with COVID-19 (PCR-positive) - Median age, 35 y 64% female 33% doctors; 67% nurses	- Mortality: 0% - ICU admission for mechanical ventilation: 0% - Severe illness: 1.6% (1/64) - Discharge (as of 24 February): 53% (34/64) - Discharge time (median): 20 days - Nondischarge: larger BMI (≥ 24 kg/m²) (HR, 0.14 [95% CI, 0.03–0.73]), fever (HR, 0.24, [95% CI, 0.09–0.60]), increased IL-6 (>2.9 pg/mL) (HR, 0.31 [95% CI, 0.11–0.87])	Small sample; 47% of patients still hospitalized at time outcomes reported
Liu M. et al, 2020 (67) Case series China (Wuhan); single hospital; diagnosed 10–31 January 2020	30 HCWs with COVID-19 (7 confirmed with PCR) - Mean age, 35 y 66.7% female 73.3% doctors; 26.7% nurses	- Mortality: 0% - Noninvasive ventilation or nasal high-flow oxygen: 13.3% (4/30) - Severe pneumonia (respiratory rate ≥ 30 breaths/min, resting oxygen saturation $\leq 93\%$; Pao₂/Fio₂ ≤ 300 mm Hg): 13.3% (4/30); severe pneumonia associated with higher BMI, greater number of exposures, and longer exposure times, and infections before use of PPE (10–20 January)	Small sample; 20% of patients still hospitalized at time outcomes reported; most cases not confirmed with PCR
McMichael et al, 2020 (68) Case series United States (Washington); 1 long-term care facility; initial resident case diagnosed 28 February 2020	50 HCWs with COVID-19 (PCR-positive) - Median age, 43.5 y 76% female - Various (numbers not reported)	29.9% (50/167) of cases were in HCWs - Hospitalized: 6.0% (3/50) - Mortality: 0% (0/50)	No denominator for the total number of exposed HCWs; proportion recovered at time of study not reported

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020 (69) Case series (descriptive study) China (throughout); through 11 February 2020	44 672 patients with COVID-19 (PCR-positive) Age, sex, and role/position of infected HCWs not reported (not restricted to physicians and nurses)	3.8% (1716/44 672) of cases were in HCWs - Before 31 December: 0% (0/104) 1–10 January: 3.1% (20/653) 11–20 January: 5.7% (310/5417) 21–31 January: 3.9% (1036/26 468) - Case-fatality rate: 0.3% (5/1716) - Mortality per 10 patient days: 0.002 - Proportion severe or critical: 14.6% (247/1608) 1–10 January: 45.0% (9/20) 11–20 January: 19.7% (61/310) 21–31 January: 14.4% (149/1,036) - After 1 February: 8.7% (28/322) - Wuhan: 17.7% (191/1,080) - Hubei (outside Wuhan): 10.4% (41/394) - Outside Hubei: 7.0% (15/214)	No denominator for the total number of exposed HCWs; proportion recovered unclear; estimates based on epidemiological data
Wang X. et al, 2020 (70) Case series China (Wuhan); through 18 February 2020	25 961 patients with COVID-19 (PCR-positive) Age, sex, and role/position of infected HCWs not reported	5.1% (1316/25,961) of cases were in HCWs - Estimated attack rate in HCWs vs. general population: 144.7 (95% CI, 137.0 to 152.8) vs. 41.7 (95% CI, 41.2 to 42.2) per 10⁶ people - Before 11 January: 6.1 vs. 2.2 per 10⁶ people 11–22 January: 275 vs. 44.9 per 10⁶ people 23 January–1 February: 507.4 vs. 150.9 per 10⁶ people 2–18 February: 116.6 vs. 54.1 per 10⁶ people	Not peer-reviewed Attack rate in general population and HCWs estimated using the Wuhan Statistical Yearbook 2018; denominator for potentially exposed HCWs not provided
Zhang et al, 2020 (18) Case series China (Wuhan); 1 university hospital; 25 December 2019 to 31 January 2020	237 HCWs with confirmed contact with a COVID-19 infected patient - Age, sex not reported 28% physician, 72% nurse 31% respiratory department, 31% hepatobiliary surgery, 38% neurology	Incidence of SARS-CoV-2 infection (PCR): 5.1% (12/237)	Limited information on demographic characteristics

CoV = coronavirus; COVID-19 = coronavirus disease 2019; ED = emergency department; EMT = emergency medical technician; HCW = health care worker; ICU = intensive care unit; OR = operating room; PPE = personal protective equipment; SARS = severe acute respiratory syndrome

*Here and throughout the tables, boldface and italics indicate a statistically significant difference between groups.

Supplement Table 2. Mental health and sleep outcomes associated with SARS-CoV-2 in HCWs

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Dai et al, 2020 (43) Cross-sectional China (Hubei province); HCWs from throughout province; 3–11 February 2020	4357 HCWs • Mean age, 35 y • 76.5% female • 32.6% physicians, 53.8% nurses, 10.0% technicians, 3.6% support staff • 0.9% diagnosed with COVID-19	GHQ-12 score ≥ 3 : 39.1% (1704/4357) Adjusted OR (95% CI) for GHQ-12 score ≥ 3 • Female vs. male: 1.53 (1.26–1.85) • Nurse vs. doctor: 0.97 (0.81–1.15) • Technician vs. doctor: 0.73 (0.57–0.94) • Support staff vs. doctor: 0.80 (0.55–1.18) • Hospital type (reference ministerial/provincial) ◦ Municipal: 1.45 (1.17–1.81) ◦ Country: 1.71 (1.30–2.23) ◦ Township/community: 1.46 (1.08–1.98)	Not peer reviewed No control for baseline symptoms; no non-HCW controls; no control for work exposures
Du et al, 2020 (71) Cross-sectional China (Wuhan); HCWs from 2 hospitals in Wuhan; 13-17 February 2020	134 frontline HCWs (60 local to Wuhan and 74 outreach workers relocated to Wuhan from other parts of China) • Mean age 36 years • 60.5% female • 35% physicians, 41% nurses, 23.9% support staff • Proportion diagnosed with COVID-19 not reported	Mean depression (BDI-II) score (score ≥ 14 =mild depression): 5.76 (SD 7.04) Mean anxiety (BAI) score (score ≥ 8 =mild anxiety): 4.96 (SD 8.13) Mean perceived stress (PSS) score (score ≥ 14 =moderate to severe stress): 13.81 (SD 6.34) Adjusted OR (95% CI): • Depression (BDI-II ≥ 14) ◦ Age 18-34 vs. age ≥ 35: 0.96 (0.90-1.03) ◦ Women vs. men: 2.76 (0.73-10.43) ◦ Physician or nurse vs. support staff: 2.45 (1.00-5.99) ◦ Family/friend with virus, yes vs. no: 2.51 (0.49-12.82) ◦ Low vs. high preparedness for material supplies: 1.18 (0.97-1.45) • Anxiety (BAI score ≥ 8): ◦ Age 18-34 vs. age ≥ 35: 1.00 (0.94-1.05) ◦ Women vs. men: 2.70 (0.99-7.37) ◦ Physician or nurse vs. support staff: 1.63 (0.86-3.10) ◦ Prior emergency response experience, yes vs. no: 2.13 (0.55-8.32) ◦ Family/friend with virus, yes vs. no: 4.66 (1.01-21.43)	Response rate 43%; no control for baseline symptoms; no non-HCW controls; no control for work exposures; proportion with COVID-19 infection not reported

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		Low vs. high preparedness for material supplies: 1.09 (0.91-1.30)	
Huang F. et al, 2020 (72) Cross-sectional China (29 provinces); 13-17 February 2020	2,970 HCWs in pediatric settings - Mean age not reported; 27.1% <30 y; 43% 30-39 y; 18.2% 40-49 y; 11.7% ≥50 y 89% female 52.4% physician; 47.6% nurses 61.8% internal medicine; 6.5% respiratory medicine; 2.7% infection medicine; 9.2% critical medicine; 19.8% other - Proportion diagnosed with COVID-19 not reported	HRQOL summary score (SD) (summary score includes physical function, emotional functioning, social functioning cognitive functioning and worry; scale 0-100; higher score=better QoL): 69.7 (15.9) - Male vs. female: 69.3 (16.7) vs 69.8 (15.8); p=0.60 <30 y vs. 30-39 y vs. 40-49 y vs. ≥50 y: 73.7 (15.6) vs. 69.0 (16.0) vs. 66.2 (15.0) vs. 68.7 (15.7); p<0.001 - Physician vs. nurse: 67.1 (15.4) vs. 72.6 (15.9); p<0.001 - Internal medicine vs. respiratory medicine vs. infection medicine vs. critical medicine: 69.6 (15.8) vs. 70.2 (16.8) vs. 71.8 (15.7) vs. 70.2 (16.2); p=0.73 - Independent fever/isolation clinic, no vs. yes: 67.4 (16.0) vs. 70.8 (15.7); p<0.001 - Previous treatment of COVID-19 patients, no vs. yes: 70.7 (15.7) vs. 64.6 (15.7); p<0.001 - Family or colleague with past or present COVID-19, no vs. yes: 63.8 (15.3) vs. 70.0 (SD 15.9); p<0.001 - Family or colleague contact with COVID-19, no vs. yes: 70.5 (16.0) vs. 65.6 (14.4); p<0.001 Adjusted OR (95% CI) for individual HRQOL domains or summary score (score converted to dichotomous outcome, ≤25 percentile vs. >25 th percentile): - Female vs. male, emotional functioning: 1.6 (1.2-2.1); cognitive functioning: 1.4 (1.1-1.8) 30-39 y vs. <30 y, summary score: 1.8 (1.4-2.2); 40-49 y vs. <30 y: 2.0 (1.5-2.6); ≥50 y vs. <30 y: 1.3 (0.9-1.8) - Nurse vs physician, physical functioning: 0.8 (0.6-0.9); emotional functioning: 0.8 (0.7-0.99); social functioning: 0.6 (0.5-0.7); cognitive functioning: 0.7 (0.6-0.9) - Independent fever/isolation clinic, no vs. yes, summary score: 1.5 (1.3-1.8) - Previous treatment of COVID-19 patients, yes vs. no, summary score: 1.7 (1.4-2.1)	Not peer reviewed Unclear recruitment method for participants; participation rate not reported; no control for baseline symptoms; no non-HCW controls; no control for work exposures; proportion diagnosed with COVID-19 not reported

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Huang, J. et al, 2020 (73) Cross-sectional China (Fuyang City); single hospital frontline-staff; 7-14 February 2020	230 HCWs • Mean age 32.6 y • 81.3% female • 30.4% physicians; 69.6% nurses • 35.7% internal medicine; 42.6% surgical system; 21.7% infectious disease • Proportion diagnosed with COVID-19 not reported	Anxiety, mean SAS score (SD) (score <50=normal; score 50-60=mild anxiety; score 61-70=moderate anxiety; score >70=severe anxiety): 42.9 (10.9) • Male vs. female: 39.1 (9.0) vs. 43.8 (11.1); p=0.01 • <30 y vs. 30-<40 y vs. ≥40 y: 44.2 (11.0) vs. 41.8 (11.0) vs. 44.3 (10.0); p=0.24 • Doctor vs. nurse: 38.5 (10.7) vs. 44.8 (10.4); p<0.001 • Internal medicine vs. surgical system vs. infectious disease: 42.3 (11.5) vs. 43.6 (10.2) vs. 42.4 (11.2); p=0.67 Proportion with mild, moderate or severe anxiety: • Male vs. female: 11.6% vs. 25.7%; p=0.045 • <30 y vs. 30-40 y vs. >40 y: 23.1% vs. 24.4% vs. 17.2%; p=0.76 • Physician vs. nurse: 14.3% vs. 26.9%; p=0.04 • Internal medicine vs. surgical system vs. infectious disease: 20.7% vs. 24.5% vs. 24.0%; p=0.86 Stress, mean PTSD-SS score (SD) (score ≥50=positive score for stress): 42.9 (17.9) • Male vs. female: 36.9 (14.0) vs. 44.3 (18.4); p=0.01 • <30 y vs 30-<40 y vs ≥40 y: 42.7 (18.0) vs. 43.8 (17.9) vs. 40.0 (17.8); p=0.38 • Physician vs. nurse: 41.5 (18.1) vs. 43.5 (18.3); p=0.42 • Internal medicine vs. surgical system vs. infectious disease: 43.1 (18.1) vs. 43.5 (17.2) vs. 41.6 (18.5); p=0.83 Proportion with score PTSD-SS score ≥50: • Male vs. female: 18.6% vs. 29.4%; p=0.15 • <30 y vs. 30-<40 y vs. ≥40 y: 24.3% vs. 30.1% vs. 24.1%; p=0.62 • Physician vs. nurse: 24.3% vs. 28.8%; p=0.48 Internal medicine vs. surgical system vs. infections disease: 28.0% vs. 29.6% vs. 22.0%; p=0.61	Participant selection method unclear; no control for baseline symptoms; no non-HCW controls; no control for work exposures; proportion diagnosed with COVID-19 not reported
Kang, 2020 (46)	994 HCWs • 63.4% aged 25–40 y	Proportion classified into moderate or severe mental health disturbance clusters:	Participation rate not reported; no control for baseline

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional China (Wuhan); HCWs from hospitals in Wuhan; 29 January to 4 February 2020	85% female 31.1% high-risk department 18.4% physicians; 81.6% nurses 1.9% (19/994) positive for SARS-CoV-2 infection	- Moderate: 22.4% (223/994) - Mean depression (PHQ-9) score: 9.0 (SD, 3.9) - Mean anxiety (GAD-7) score: 8.2 (SD, 3.6) - Mean insomnia (ISI) score: 10.4 (SD, 4.8) - Mean distress (IES-R) score: 39.9 (SD, 5.4) - Severe: 6.2% (62/994) - Mean depression (PHQ-9) score: 15.1 (SD, 5.2) - Mean anxiety (GAD-7) score: 15.1 (SD, 4.3) - Mean insomnia (ISI) score: 15.6 (SD, 5.2) - Mean distress (IES-R) score: 60.0 (SD, 9.8) No association between increased risk for moderate or severe mental health disturbance and age, sex, type of HCW or department	symptoms; no non-HCW controls
Lai et al, 2020 (74) Cross-sectional China; HCWs from hospitals with COVID-19 fever clinics or wards for COVID-19; 29 January–3 February 2020	1257 HCWs 65% aged 26–40 y 77% female 39% physicians and 61% nurses - Proportion diagnosed with COVID-19 not reported	Depression symptoms (PHQ-9), moderate or severe: 14.7% (186/1257) Anxiety symptoms (GAD-7), moderate or severe: 12.3% (154/1257) Insomnia symptoms (ISI), moderate or severe: 7.7% (97/1257) Distress symptoms (IES-R), moderate or severe: 35.0% (440/1257) Adjusted OR (95% CI): - Depression symptoms (PHQ-9) - Women vs. men: 1.94 (1.26–2.98) - Secondary vs. tertiary hospital: 1.65 (1.17–2.34) - Technical title: - Intermediate vs. junior: 1.77 (1.25–2.49) - Senior vs. junior: 1.21 (0.72–2.03) - Frontline vs. second-line HCW: 1.52 (1.11–2.09) - Anxiety symptoms (GAD-7) - Women vs. men: 1.69 (1.23–2.33) - Secondary vs. tertiary hospital: 1.43 (1.08–1.90) - Technical title: - Intermediate vs. junior: 1.82 (1.38–2.39) - Senior vs. junior: 1.01 (0.67–1.51) - Frontline vs. second-line HCW: 1.57 (1.22–2.02)	Response rate 69%; no control for baseline symptoms; no non-HCW controls; no control for work exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		- Insomnia symptoms (ISI) - Frontline vs. second-line: 2.97 (1.92–4.60) - Distress symptoms (IES-R) - Women vs. men: 1.45 (1.08–1.96) - Technical title: - Intermediate vs. junior: 1.94 (1.48–2.55) - Senior vs. junior: 1.03 (0.69–1.55) - Frontline vs. second-line HCW: 1.60 (1.25–2.04) - Location: Hubei outside Wuhan vs. Wuhan: 0.77 (0.57–1.06) - Outside Hubei vs. Wuhan: 0.62 (0.43–0.88)	
Li et al, 2020 (75) Prospective cohort China (Shanghai); 12 hospitals; August 2019 (Quarter 1, pre-COVID-19 outbreak)-March 2020 (Quarter 2, post-COVID-19 outbreak)	385 HCWs - Median age 25 y 64% female 100% physician intern - Proportion diagnosed with COVID-19 not reported	Anxiety score (GAD-7), Quarter 1 (2019) vs. Quarter 2 (2020): 4.33 vs. 5.43; mean change 0.64 (95% CI 0.17 to 1.12); p=0.008 Depression score (PHQ-9), Quarter 1 vs. Quarter 2: 5.17 vs. 5.77; mean change 0.61 (95% CI 0.08 to 1.14); p=0.02 Mood score (scale 1-10, higher score=better mood), Quarter 1 vs. Quarter 2: 7.07 vs. 6.80; mean change -0.50 (95% CI -0.80 to -0.20); p=0.002	53% response rate; no non-HCW controls; no control for work exposures
Liu C. et al, 2020 (50) Cross-sectional China; HCWs from multiple urban and rural hospitals; 10-20 February 2020	512 HCWs 75.4% aged 18–39 y 85% female 32.0% direct treatment contact of COVID-19–infected patient 8.0% suspected COVID-19 case	Anxiety score (scale 20–80; higher score = more anxiety), direct treatment contact vs. nondirect treatment contact: 38.8 (SD, 8.4) vs. 41.1 (SD, 9.8); P = 0.007 Adjusted beta (95% CI) for anxiety score: - Direct contact vs. nondirect contact: 2.33 (0.65–4.00) - Contact with suspect cases vs. no suspect cases: 4.44 (1.55–7.33) - Hubei province vs. other: 3.67 (1.44–5.89)	85% response rate; sample limited to HCWs utilizing WeChat app; no control for baseline symptoms
Liu Y. et al, 2020 (76) Cross-sectional	1,315 HCWs - Median age 37 y 76% female	Stress, proportion with moderate to severe stress (C-PSS-10 score ≥14): 49.1% (646/1315) - Male vs. female: 40.5% vs. 51.9%; p<0.01 ≤30 vs. 30~40 vs. 40~50 vs. ≥50: 54.5% vs. 51.7% vs. 41.0% vs. 46.7%; p<0.01	Recruitment methods and participation rate unclear; no control for baseline symptoms; no non-HCW controls; no control for work exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
China (excluding Wuhan and Hubei Province); setting not report, study focused on frontline workers; 11-14 February 2020	38.9% physician; 43.9% nurse; 9.1% technician; 8.1% hygiene 32.4% fever clinic; 12.8% ED; 16.6% isolation ward; 38.3% laboratory or radiology - Proportion diagnosed with COVID-19 not reported	- Physician vs. nurse vs. technician vs. hygiene: 44.7% vs. 51.1% vs. 51.7% vs. 54.7%; $p=0.03$ - Isolation ward vs. fever clinic vs. ED vs. laboratory or radiology: 46.3% vs. 45.3% vs. 56.0% vs. 51.3%; $p=0.10$ Anxiety, proportion with moderate to severe anxiety (GAD score ≥ 15): 10.7% (141/1315) - Male vs. female: 8.5% vs. 11.4%; $p=0.02$ ≤ 30 vs. 30~40 vs. 40~50 vs. ≥ 50: 6.8% vs. 12.3% vs. 11.8% vs. 15.1%; $p=0.003$ - Physician vs. nurse vs. technician vs. hygiene: 11.1% vs. 11.3% vs. 5.8% vs. 11.3%; $p=0.57$ - Isolation ward vs. fever clinic vs. ED vs. laboratory or radiology: 10.1% vs. 12.2% vs. 11.3% vs. 9.5%; $p=0.03$ Depression, proportion with major depression (PHQ-9 score ≥ 10): 12.5% (164/1315) - Male vs. female: 10.4% vs. 13.1%; $p=0.21$ ≤ 30 vs. 30~40 vs. 40~50 vs. ≥ 50: 10.8% vs. 13.9% vs. 12.4% vs. 13.8%; $p=0.04$ - Physician vs. nurse vs. technician vs. hygiene: 12.3% vs. 12.7% vs. 11.7% vs. 13.2%; $p=0.91$ - Isolation ward vs. fever clinic vs. ED vs. laboratory or radiology: 11.5% vs. 12.2% vs. 18.5% vs. 11.1%; $p=0.18$	
Lu et al, 2020 (77) Cross-sectional China (Fujian Province); single provincial hospital; 25–26 February 2020	2299 (2042 direct contact workers and 257 administrative staff) 78% aged <30-40 y 78% female 22% high-risk department (respiratory, emergency, ICU or infectious disease) - Proportion diagnosed with COVID-19 not reported	Medical staff vs. administrative staff - Anxiety symptoms (HAMA), mild/moderate: 22.6% (462/2042) vs. 17.1% (44/257) - Anxiety symptoms (HAMA), severe/extreme: 2.9% (59/2042) vs. 1.6% (4/257) - Depression symptoms (HAMD), mild/moderate: 11.8% (241/2042) vs. 8.2% (21/257) - Depression symptoms (HAMD), severe/extreme: 0.3% (6/2042) vs. 0% (0/257) - Fear scale (0 to 10 NRS), moderate: 43.9% (896/2042) vs. 38.9% (100/257) - Fear symptoms (0 to 10 NRS), severe/extreme: 26.7% (545/2042) vs. 19.5% (50/257)	Response rate not reported; no non-HCW control; no control for baseline symptoms

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		Adjusted hazard ratio (95% CI), direct contact worker vs. nonclinical: Fear, high-risk worker: 1.41 (1.02–1.93) ; low-risk worker: 1.30 (0.99–1.72) Anxiety (HAMA), high-risk worker: 2.06 (1.35–3.15) ; low-risk: 1.31 (0.89–2.93) Depression (HADA), high-risk worker: 2.02 (1.10–3.69) ; low-risk: 1.39 (0.80–2.43)	
Qi et al, 2020 (78) Cross-sectional China (Hubei Province); HCWs from hospitals throughout province; dates not reported	1306 HCWs (persons with sleep disturbances and treated for psychiatric conditions excluded) • Mean age, 33.1 y • 80% female • 61% frontline HCW and 39% non-frontline • Proportion diagnosed with COVID-19 not reported	Pittsburgh Sleep Quality Index >7: 59.6% (779/1306) overall • 67.2% (538/801) frontline medical workers vs. 47.7% (241/505) non-frontline medical workers, $P < 0.0001$ Athens Insomnia Index >6: 45.5% (594/1306) overall • 51.7% (414/801) frontline medical workers and 35.6% (180/505) non-frontline medical workers, $P < 0.0001$	Response rate not reported; no non-HCW control
Romero et al, 2020 (55) Cross-sectional Spain; national survey; 9-19 2020 April	3,109 HCWs • Mean age 45 y • % female not reported • 56.6% medical staff; 26.5% nursing staff; 7.7% nurse assistants; 9.2% other staff (ancillary, administrative, laboratory technicians, research/faculty, management, hospital pharmacist) • 25.2% anaesthesia and critical care; 10.5% pathology; 5.2% intensivist and critical care; other specialties (<5% each)	Psychological Stress and Adaptation at Work Score (SD) (scale not reported; higher score=more psychological impact/stress): • 20-29 y vs 30-39 y vs. 40-49 y vs. 50-59 y vs. 60-69 y: 46.7 (14.8) vs. 45.5 (15.9) vs. 42.1 (15.1) vs. 38.8 (14.5) vs. 37.6 (16); $p < 0.001$ • Work environment, ICU vs. surgery vs. hospital ward vs. consultation vs. ED vs. other: 44.3 (15.4) vs. 40.4 (15.3) vs. 43.3 (15.0) vs. 39.8 (15.6) vs. 45.1 (16.0) vs. 40.0 (15.2); $p = 0.12$ • Personal exposure, asymptomatic vs. symptomatic vs. in isolation vs. positive test vs. hospitalization: 41.3 (15.4) vs. 43.2 (15.5) vs. 44.3 (15.1) vs 43.7 (16.1) vs 45.9 (10.0); $p < 0.001$ No significant difference in scores when stratified according to medical profession or specialty	Participation rate unclear; no control for baseline symptoms; no non-HCW controls; no control for work exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	2.9% with SARS-CoV-2 seropositivity		
Wang B. et al, 2020 (79) Cross-sectional China (Shanghai); single medical center; 8-10 February 2020	694 HCWs - Mean age not reported; 36.5% 18-30 y, 36.5% 31-40 y, 21.6% 41-50 y, 5.5% ≥51 y 94.5% female 22.3% physician, 45.1% nurse, 14.6% technician/researcher, 10.1% administrator	Depression, severe depression (PQH-9 score ≥10) - Male vs. female: 5% (2/38) vs. 6% (37/656); p=0.92 31-40 y vs 18-30 y: 7% (18/253) vs. 7% (17/253); p=0.86 41-50 y vs 18-30 y: 3% (4/150) vs. 7% (17/253); p=0.09 ≥51 y vs. 18-30 y: 0% (0.38) vs 7% (17/253); p=0.998 - Nurse vs. physician: 10% (32/313) vs. 3% (5/155); p=0.01 - Technician/researcher vs. physician: 0% (0/101) vs. 3% (5/155); p=0.996 - Administrator vs. physician: 3% (2/70) vs. 3% (5/155); p=0.88 Anxiety, severe panic disorder (PDSS score ≥11) - Male vs. female: 3% (1/38) vs 7% (46/656); p=0.32 31-40 y vs 18-30 y: 7% (17/253) vs. 8% (20/253); p=0.61 41-50 y vs 18-30 y: 6% (9/150) vs. 8% (20/253); p=0.48 ≥51 y vs. 18-30 y: 3% (1/38) vs. 8% (20/253); p=0.27 - Nurse vs. physician: 12% (37/313) vs. 4% (6/155); p=0.008 - Technician/researcher vs. physician: 0% (0/101) vs 4% (6/155); p=0.996 - Administrator vs. physician: 4% (3/70) vs 4% (6/155); p=0.88	Not peer reviewed No control for baseline symptoms; no non-HCW controls; no control for work exposures; some data (adjusted ORs) appear to be missing
Ying et al, 2020 (80) Cross-sectional China (Ningbo); HCWs from 5 hospitals; February 2020	843 family members of HCWs - Mean age, 38 y 47.3% female - Relationship with HCW: 65.4% spouse, 4.7% child, 5.8% parent, 24.0% other - HCW had direct contact with confirmed or suspected COVID-19–infected patient: 48.0%	Prevalence of GAD score ≥5 in family members of HCWs: 33.7% Proportion with PHQ score ≥5 in family members of HCWs: 29.4% Adjusted OR (95% CI) for GAD score ≥5 in family members of HCWs (significant variables in model) - Hours/day focusing on COVID-19: 1.22 (1.06–1.39) - HCW in direct contact with confirmed or suspected COVID-19 patients: 1.48 (1.07–2.04)	Sample limited to family members using WeChat App; no control for baseline symptoms; no controls without HCW family members

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		- Family member's self-reported safety score for PPE of HCWs: 0.81 (0.70–0.93) Adjusted OR (95% CI) for PHQ-9 ≥5 in family members of HCWs (significant variables in model) - Occupation: - Enterprise worker vs. HCW: 1.75 (1.10–2.78) - Government employee vs. HCW: 0.53 (0.29–0.98) - Relationship: - Parent vs. spouse: 3.53 (1.61–7.73) - Other next of kin vs. spouse: 1.64 (1.10–2.45) - Hours/day focusing on COVID-19: 1.20 (1.04–1.38) - Average working time per week for HCWs: 1.02 (1.00–1.03)	
Zhang S. et al, 2020 (62) Cross-sectional Iran; public and private hospitals (number not reported); 5-20 April 2020	304 HCWs - Mean age 35 y 58.6% female - HCW role not reported 2.3% (7/304) infected with COVID-19	Mean mental health (SF-12) score (SD): 26.3 (7.5) Mean physical health (SF-12) score (SD) 40.7 (7.0) Proportion with depression (PHQ-2, cutoff not reported): 20.6% (63/304) Proportion with anxiety (GAD-2, cutoff not reported): 28.0% (85/304)	Not peer reviewed Recruitment method not reported; participation rate not reported; no control for baseline symptoms; no non-HCW controls; no control for work exposures
Zhou et al, 2020 (81) Cross-sectional China (Wuhan); single hospital 2 February-30 March 2020	1734 HCWs - Mean age 33 y 75.3% female 20.2% physicians, 79.8% nurses - Proportion diagnosed with COVID-19 not reported	ProQOL, mean burnout score (SD): 19.42 (5.73) - Proportion with low burnout score (≤22): 69.6% (1207/1734) - Proportion with average burnout score (23-41): 30.4% (527/1734) ProQOL, mean secondary traumatic stress score (SD): 24.8 (5.09) - Proportion with low traumatic stress score (≤22): 33.3% (578/1734) - Proportion with average traumatic stress score (23-41): 66.2% (1148/1734) - Proportion with high traumatic stress score (≥42): 0.46% (8/1734)	Not peer reviewed Participation rate not reported; no control for baseline symptoms; no non-HCW controls; no control for work exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		ProQOL, mean compassion satisfaction (SD): 41.4 (6.49) - Proportion with low compassion score (≤ 22): 0.63% (11/1734) - Proportion with average compassion score (23-41): 49.7% (861/1734) - Proportion with high compassion score (≥ 42): 49.7% (862/1734)	
Zhu et al, 2020 (64) Cross-sectional Wuhan, China; tertiary hospital; 8–10 February 2020	5062 HCWs 96.5% aged 19–49 y 85% female 20% physicians, 68% nurses, and 13% medical technicians 3.1% with suspected or confirmed COVID-19	Depression symptoms (PHQ-9 ≥ 10): 13.5% (681/5062) Anxiety symptoms (GAD-7 ≥ 8): 24.0% (1218/5062) Distress symptoms (IES-R > 33): 29.8% (1509/5062) Adjusted OR (95% CI) for psychological distress (selected factors) - Women vs. men: 1.31 (1.02–1.66) - Nurse vs. doctor: 2.24 (1.61–3.12) - Medical technician vs. doctor: 1.57 (1.12–2.21) - Working > 10 y vs. < 2 y: 2.02 (1.47–2.79) - Work in isolation ward vs. nonisolation: 1.32 (1.10–1.59) - Chronic noncommunicable disease vs. in good health: 1.51 (1.27–1.80); history of mental disorders vs. in good health: 3.27 (1.77–6.05) - Satisfied with coverage with protective measures vs. not satisfied: 0.69 (0.53–0.89) - Satisfied with work shift arrangement vs. not satisfied: 0.45 (0.33–0.63) - Satisfied with logistic support and accommodation arranged by hospital vs. not satisfied: not significant	Not peer reviewed Response rate 77%; did not control for baseline symptoms; no non-HCW controls

CoV = coronavirus; COVID-19 = coronavirus disease 2019; ED = emergency department; EMT = emergency medical technician; GAD = generalized anxiety disorder; GHQ = General Health Questionnaire; HADA = Hamilton Depression Scale; HAMA = Hamilton Anxiety Scale; HCW = health care worker; IES-R = Impact of Event Scale–Revised; PPE = personal protective equipment; Pro-QOL = SARS = severe acute respiratory syndrome

Supplement Table 3. Results of individual studies, risk factors for SARS-CoV-2 infection in HCWs

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Blairon et al, 2020 (5) Prospective cohort Belgium (Brussels); 4 hospitals; 25 May to 19 June 2020 Added for Update Alert #4	1499 asymptomatic HCWs - Median age 45 y 72.4% female 39% nurse or other HCW, 22% physician or dentist, 21% pharmacist or administrative staff, 9% maintenance or technical worker, 4% imaging or lab worker, 5% other/not specified 37% known exposure to COVID-19-infected patient	Incidence of SARS-CoV-2 infection - Nurse or other clinical HCW: 19.2% (113/588) - Physician or dentist: 11.8% (38/323) - Nurse vs. physician: OR 1.78 (1.20-2.65)* - Pharmacist or administrative staff: 9.1% (29/320) - Maintenance or technical worker: 16.4% (22/134) - Imaging or lab worker: 6.6% (2/31) - Inpatient unit: 24.3% (97/399) - Intensive care unit: 13.2% (31/234) - COVID emergency unit: 14.6% (30/205) - Non-COVID emergency unit: 18.5% (34/184) - Other non-COVID patient contact: 14.4% (159/1106) - Other services with no patient contact: 10.5% (33/317) - Performed bronchoscopies: 4.9% (3/61) - Performed intubations: 9.2% (11/119) - Performed other high-risk procedure: 17.4% (37/213)	48% participation rate; no control for confounders
el-Boghdadly et al, 2020 (22) Prospective cohort Multinational (17 countries); 503 hospitals; 23 March to 2 June 2020	1718 HCWs involved in tracheal intubation of patients - Mean age 41.5 years 40.3% female - Physician: 90.7%, non-physician 9.3% - Anaesthesia: 83.1%, intensive care medicine: 14.6%, emergency medicine: 1.6%, other specialty 0.6%	Laboratory-confirmed COVID-19 infection, self-isolation due to symptoms, or hospital admission with ≥1 symptom: - Physician: 10.7% (166/1558) - Non-physician: 11.2% (18/160) - Anaesthesia: 10.5% (150/1428) - Intensive care medicine: 12.4% (31/251) - Emergency medicine: 10.7% (3/28) - Other specialty: 0% (0/11) Unadjusted HR for laboratory-confirmed COVID-19 infection, self-isolation due to symptoms, or hospital admission with ≥1 symptom (95% CI) - Age (year): 0.99 (0.98-1.01) - Female vs. male: 1.44 (1.08-1.93) - PPE WHO standard (yes vs. no), analyzed by procedure: 0.97 (0.63-1.51) - Bag-mask ventilation (yes vs. no), analyzed by procedure: 0.81 (0.54-1.23) - Supraglottic airway device (yes vs. no), analyzed by procedure: 1.40 (0.66-2.97) Adjusted HR (95% CI) - Female vs. male: 1.36 (1.01-1.82)	Criteria for laboratory-confirmed COVID-19 diagnosis not reported; included outcomes based on symptoms without laboratory confirmation
Grant et al, 2020 (7)	2004 HCWs Mean age 40 y	Incidence of SARS-CoV-2 infection seropositivity Clinical setting with prolonged direct patient contact: 34.7% (467/1345)	Limited information on demographic

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Prospective cohort UK (London); multicenter health trust; March to May 2020 Added for Update Alert #4	• % female not reported • 67% clinical setting with prolonged direct patient contact, 9.8% clinical setting with less or no patient contact, 17.0% nonclinical setting and minimal/no patient contact, <1.0% working from home	• Clinical setting with less/no patient contact: 30.0% (59/197) • Nonclinical setting with prolonged direct patient contact: 25.0% (27/108) • Nonclinical setting with no/minimal patient contact: 22.6% (77/341) • Working from home: 30.8% (4/13) • COVID-19 ward with CPAP: 42.0% (84/200) • COVID-19 ward, without CPAP (excluding ER): 41.3% (175/424) • Operating theater: 33.6% (43/128) • Non-COVID-19 ward: 28.9% (82/284) • Any other non-ward environment: 26.0% (206/792) • ICU: 25.0% (44/176)	characteristics of HCWs; participation rate not reported
Houlihan et al, 2020 (8) UK (London); 1 acute care hospital; 26 March to 8 April 2020 Added for Update Alert #4	200 frontline HCWs • Median age 34.7 • 61% female • 36% physician, 53% nurse or other frontline clinical staff, 11% other • 17% ER, 18% acute medical admissions, 22% ICU, 21% hematology, 22% other	Incidence of SARS-CoV-2 infection (seropositive or PCR) • Age <30: 54% (31/57) • Age 30-39: 49% (34/70) • Age 40-49: 30% (12/30) • Age ≥50: 33% (10/30) • Female: 40% (49/122) • Male: 50% (38/76) ◦ Female vs. male: OR 0.67 (0.38-1.20)* • Physician: 44% (32/72) • Nurse or other frontline clinical staff: 43% (46/106) ◦ Nurse or other frontline clinical staff vs. physician: OR 0.96 (0.52-1.75)* • Other healthcare role: 41% (9/22) • ER: 38% (13/34) • Acute medical admissions: 51% (19/37) • ICU: 37% (16/43) • Hematology: 48% (19/40) • Other healthcare setting: 4% (18/43)	Limited information on demographic characteristics of HCWs; selection of HCWs for testing unclear; no control for confounders
Kassem et al, 2020 (11) Prospective cohort Egypt; gastroenterological	74 HCWs in gastroenterology service with no reported household contact with infected persons • Median age 42 y • 59.5% female	At least one positive test for SARS-CoV-2 infection (RT-PCR or RST) • Female: 18.2% (8/44) • Male: 26.7% (8/30) ◦ Female vs. male: OR 0.61 (0.20-1.86)* • Physicians: 13.3% (4/30) • Nurses: 21.4% (6/28) ◦ Nurse vs. physician: OR 91.77 (0.44-7.09)*	59% participation rate; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
unit of 1 hospital; 1 to 14 June 2020 Added for Update Alert #4	40.5% physician, 37.8% nurses; 12.2% cleaning and transportation; 9.5% administration	- Patient transporters/cleaners: 33.3% (3/9) - Administrative: 42.9% (3/7) - Comorbidities: 18.8% (3/16) - Exposure to suspected or confirmed COVID-19 during work in last 2 weeks: 75% (12/16) - Proper hand hygiene: 93.8% (15/16) - PPE when indicted: Always 93.8% (15/16) vs. occasionally 6.2% (1/16)	
Maltezou et al, 2020 (23) Prospective cohort Greece; HCWs throughout Greece; 13 March to 3 May 2020	3,398 HCWs exposed to a patient or colleague with COVID-19 - Mean age 45 y 71% female 32% physician, 50% nurse, 18% other HCW role 47% low-risk setting, 23% moderate-risk setting, 30% high-risk setting	Unadjusted OR (95% CI) for SARS-CoV-2 infection - High- vs. low-risk exposure: 5.26 (2.98-9.26)* - Medium- vs. low-risk exposure: 1.05 (0.45-2.45)* Adjusted OR (95% CI) for SARS-CoV-2 infection - Male vs female: 1.79 (1.03-3.13) - Administrative role vs other role: 3.34 (1.49-7.49) - High-risk exposure vs low or moderate risk exposure: 3.58 (1.94-6.58) Adjusted OR (95% CI) for COVID-19 diagnosis - Male vs female: 1.82 (1.04-3.20) - Administrative role vs other role: 3.06 (1.43-6.55) - High-risk exposure vs low or moderate risk exposure: 3.06 (1.43-6.55)	Unvalidated method used to categorize risk exposure (based on use of mask by patient and use of PPE by HCW); limited control for confounders
Martin et al, 2020 (24) Prospective cohort Belgium (Brussels); 1 hospital; 15 April to 18 May 2020	326 HCWs in high-risk units (COVID-19 unit, COVID-19 intensive care unit, or emergency department) - Mean age 37 y 73% female 29% physician, 51% nurse, healthcare assistant, 11% paramedical staff, 8% administrative,	Incidence of SARS-CoV-2 infection - Physician: 11.7% (10/85) - Nurse: 12.7% (19/150) - Care assistant: 14.8% (4/27) - Paramedical staff: 15.1% (5/33) - Administrative staff: 4.0% (1/25) - Cleaning staff and stretcher bearers: 33.3% (2/6) - COVID-19 units: 14.4% (31/215) - COVID-19 ICU units: 5.8% (3/52) - ED: 12.0% (7/58) Unadjusted OR (95% CI) for SARS-CoV-2 infection - Nurse vs. physician: 1.09 (0.48-2.46)*	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	2% cleaners or other role		
Mutambudzi et al, 2020 (25) Prospective cohort United Kingdom; HCWs throughout the United Kingdom; 16 March to 3 May 2020	11,353 HCWs participating in UK Biobank - Age, sex of HCWs not reported 16% healthcare professionals, 12% medical support staff, 71% health associate professionals 0.7% (76/10,718) diagnosed with SARS-CoV-2 infection	Incidence of SARS-CoV-2 infection - Healthcare professionals: 0.7% (12/1,779) - Medical support staff: 0.8% (10/1,286) - Health associate professionals: 0.7% (54/7,653)	Not peer reviewed No control for confounders; restricted to participants in UK Biobank study
Nguyen et al, 2020 (82) Prospective cohort United Kingdom and United States; Start March 24 or 29, 2020, end date not reported	99,795 frontline HCWs - Mean age, 42 years 83% female - HCW role/position not reported 4.0% 30-day incidence of SARS-CoV-2 infection	HR (95% CI) for SARS-CoV-2 infection Reported inadequate PPE availability vs. adequate: 1.24 (1.04-1.47) - No exposure to COVID-19 patients: 1.54 (1.12-2.11) - Exposure to suspected COVID-19 patients: 1.88 (1.25-2.84) - Exposure to documented COVID-19 patients: 5.98 (4.61-7.77) Adjusted hazard ratio (95% CI) for SARS-CoV-2 infection Reported inadequate PPE availability vs. adequate: 1.23 (1.03-1.46) - No exposure to COVID-19 patients: 1.53 (1.11-2.09) - Exposure to suspected COVID-19 patients: 1.84 (1.22-2.78) - Exposure to documented COVID-19 patients: 5.94 (4.57-7.72) Inpatient HCW (reference general population): 24.3 (21.8-27.1) - Nursing homes: 16.2 (13.4-19.7) - Outpatient clinics in hospital: 11.2 (8.44-14.9) - Home health sites: 7.86 (5.63-11.0) - Ambulatory clinics: 6.94 (5.12-9.41) - Other healthcare setting: 9.52 (7.49-12.1)	Potential selection bias, limited measurement of exposures/risk factors, SARS-CoV-2 infection status based on self-report
Schmidt et al, 2020 (27) Prospective cohort	385 HCWs in a neurological center Mean age not reported; 14% age	Prevalence of SARS-CoV-2 seropositivity 18-29 y: 1.9% (1/55) 30-49 y: 4.8% (7/154)	73% participation rate; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Germany; 1 neurologic hospital; 20 to 30 March 2020	18-29 y, 40% age 30-49 y, 44% age 50-64 y, 2% age ≥65 y 80% female 9% physician, 40% nurse, 21% therapist, 30% other healthcare role	50-64 y: 1.8% (3/170) ≥65 y: 0% (0/6) - Male: 5.2% (4/77) - Female: 2.3% (7/308) - Physician: 8.8% (3/34) - Nurse: 0% (0/154) - Therapist: 3.8% (3/80) - Other role: 4.3% (5/117) Unadjusted OR (95% CI) for SARS-CoV-2 seropositivity - Female vs. male: 0.42 (0.12-1.49)* - Nurse vs. physician: 0.03 (0.002-0.58)*	
Villaneuva et al, 2020 (17) Prospective cohort The Philippines (Manilla); 1 hospital; 20 March to 20 April 2020	324 HCWs with known exposure of signs or symptoms - Mean age, 36 y 67% female 11% physician, 63% nurse, 19% nursing aid, 2% radiology tech, 4% lab, 1% clerk and other	Positive (PCR) of HCWs screened 20-29 y: 2.3% (2/88) 30-39 y: 2.9% (4/140) 40-49 y: 2.9% (2/68) 50-59 y: 0% (0/24) 60-69 y: 0% (0/4) - Female: 2.8% (6/216) - Male: 1.9% (2/108) - Female vs. male: OR 1.51 (0.30-7.63)* - Physician: 2.7% (1/37) - Nurse: 2.0% (4/203) - Nurse vs. physician: OR 0.72 (0.08-6.66)* - Lab personnel: 25% (3/12) - Radiology tech, clerk, other: 0% - High risk: 4.1% (4/97) - Low risk: 1.8% (4/227) Of 8 positive tests - Care of COVID-19 patient: 12.5% (1/8) - Community/worker residence exposure: 87.5% (7/8) - At least one underlying disease: 100% (8/8)	27% participation rate; no control for confounders
Bai et al, 2020 (28) Retrospective cohort	118 HCWs with potential exposure to COVID-19 patient - Mean age, 31 years 64% female	COVID-19 vs. no COVID-19 Age (years): 36.6 vs. 30.5, $p=0.006$ BMI (kg/m ²): 22.4 vs. 22.0, $p=0.85$ Contact frequency (median, contacts/day): 3.0 vs. 5.0, $p=0.95$ Contact duration (median, minutes/contact): 4.0 vs. 4.0, $p=0.54$	Not peer reviewed ; potential recall bias; no control for confounders; criteria for COVID-19 diagnosis not

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
China (Wuhan); 1 hospital (neurosurgery department) prior to recognition of outbreak; December 25, 2019 to February 15, 2020	25% physician, 75% nurse 10.2% (12/118) diagnosed with COVID-19	OR (95% CI) for COVID-19 [†] - Female vs. male: 0.78 (0.23-2.64) - Current smoking (yes vs. no): 0.41 (0.02-7.49) - Current alcohol (yes vs. no): 0.37 (0.02-6.67) - Regular physical activity (yes vs. no): 2.12 (0.64-7.05) - Nurse vs. physician: 0.65 (0.18-2.34) - Working under pressure (yes vs. no): 4.24 (1.19-15.05) - Contact with index case (yes vs. no): 0.27 (0.08-0.94) - Air contact vs. no contact: 0.32 (0.07-1.50) - Direct contact vs. no contact: 0.22 (0.05-1.03) - Air or direct contact vs. no contact: 0.31 (0.03-3.01) - In same department as index case (yes vs. no): 62.70 (3.60-1092.46) - Chronic pulmonary disease (yes vs. no): 1.11 (0.13-9.76) - Chronic non-pulmonary disease (yes vs. no): 0.62 (0.03-11.65)	described; 4 infected HCWs without exposure data excluded
Buchtele et al, 2020 (30) Retrospective cohort Austria (Vienna); stem cell transplant unit; 23 March to 17 April 2020	26 HCWs and staff with face-to-face exposure to SARS-CoV-2 infected colleague - Age, sex not reported 19.2% physician, 69.2% nurse, 11.5% cleaning staff	Incidence of SARS-CoV-2 infection (PCR) - Physician: 0% (0/5) - Nurse: 27.8% (5/18) - Cleaning staff: 0% (0/3) Nurse vs. physician: OR 4.48 (0.21-95.60)*	No information on demographic or clinical characteristics of HCWs
Folgueira et al, 2020 (31) Retrospective cohort Spain (Madrid); 1 hospital; 1 to 29 March 2020	2085 HCWs tested for SARS-CoV-2 infection Age, sex, HCW role/position not reported	Incidence of SARS-CoV-2 infection, by department/hospital area - Intensive care unit: 52.3% (34/65) - Emergency department: 37.0% (50/135) - Surgery: 45.1% (79/175) - Oncology/hematology: 44.3% (31/70) - Medical areas without COVID-19: 37.4% (93/249) - Pediatrics/neonatal units: 48.6% (53/109) - Obstetrics/gynecology units: 39.5% (32/81) - Radiology: 38.0% (49/129) - Outpatient setting: 31.8% (14/44) - Administrative areas, clerical, informatics, communication, pharmacy: 55.2% (37/67)	Not peer reviewed ; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		- Laboratories: 33.3% (28/84) - Kitchen: 38.3% (18/47)	
Garcia et al, 2020 (83) Retrospective cohort Spain (Madrid); 1 hospital; 24 February to 30 April 2020	1911 symptomatic HCWs tested for SARS-CoV-1 - Median age 42 y 80% female 25.7% physician 64.4% nurse 1.3% nurse supervisor 2.0% department head 5.9% other role	Incidence of COVID-19 High-risk setting: 9.1% (52/572) - Medical COVID-19 department: 18.7% (9/48) - ICU: 5.7% (13/226) - ED: 10.1% (30/298) Moderate-risk setting: 12.3% (94/761) - Outpatient clinic: 14.1% (25/177) - Obstetrics/gynecology: 5.4% (4/74) - Day unit: 10.5% (4/38) - Medical non-COVID-19 department: 16.1% (37/229) - Surgical unit: 9.9% (24/243) Low-risk setting: 8.6% (9/105) - Pathology: 6.2% (1/16) - Pharmacy: 10.0% (3/30) - Administrative, management, preventive medicine and social work: 8.5% (5.59) HCW role: - Physician: 13.0% (64/491) - Nurse: 10.2% (126/1231) - Nurse supervisor: 37.5% (9/24) - Any nursing role: 10.7% (135/1255) - Department head: 23.1% (9/39) - Other role: 4.4% (5/113) OR (95% CI) for COVID-19 - Nurse vs. physician: 0.76 (0.55-1.05)*	No control for confounders
Heinzerling et al, 2020 (32) Retrospective cohort	37 HCWs with exposure to COVID-19 patient and at least one aerosol-generating procedure	Estimated time in patient room (median, minutes): 120 (IQR 120-420) vs. 25 (IQR 10-50), p=0.06 Estimated time in patient room during aerosol generating procedures (median, minutes): 95 (IQR 0-160) vs. 0 (IQR 0-3), p=0.13 OR (95% CI) for COVID-19 (PCR)*	Potential recall bias; no control for confounders; few cases and imprecise estimates; 6 tested HCWs were not

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
United States (California); 1 hospital with unsuspected COVID-19 case; February 2020	- Median age, 39 years 84% female 7% physician, 51% nurse, 9% respiratory therapist, 9% phlebotomist, 7% certified nursing assistant, 7% environmental services worker, 5% nutrition services worker, 2% pharmacist, 2% other 5.4% (2/37) diagnosed with COVID-19 - No use of N95 respirators, eye protection, gowns, or PAPR	- Taking vital sign (yes vs. no): 7.71 (0.61-97.85) - Taking medical history (yes vs. no): 1.93 (0.15-24.46) - Performing physical examination: 21.82 (1.02-466.52) - Providing medication: 1.20 (0.10-14.79) - Bathing or cleaning patient: 0.97 (0.04-22.02) - Lifting or positioning patient: 0.92 (0.08-11.18) - Emptying bedpan: 8.00 (0.49-13.70) - Changing linens: 0.77 (0.03-17.01) - Cleaning patient room: 0.97 (0.04-22.02) - Peripheral line insertion: 3.19 (0.11-94.15) - Central line insertion: 3.19 (0.11-94.15) - Drawing arterial blood gas: 16.50 (0.73-372.83) - Drawing blood: 0.77 (0.03-17.01) - Manipulation of oxygen mask or tubing: 11.60 (0.88-153.29) - Manipulation of ventilator or tubing: 0.53 (0.02-11.30) - In room while high-flow oxygen delivered: 1.39 (0.11-17.24) - Collecting respiratory specimen: 1.29 (0.05-30.38) - Airway suctioning: 0.52 (0.02-11.30) - Noninvasive ventilation (BiPAP, CPAP): 15.00 (1.09-205.50) - Manual (bag) ventilation: 8.00 (0.49-130.70) - Nebulizer treatments: 20.67 (1.42-300.55) - Breaking ventilation circuit: 0.77 (0.03-17.01) - Sputum induction: 3.19 (0.11-94.15) - Intubation: 8.00 (0.49-130.70) - Performed or assisted (vs. no involvement): 8.00 (0.49-130.70) - Present in room (vs. no involvement): 1.86 (0.07-46.97) - Bronchoscopy: 1.29 (0.05-30.38) - Performed or assisted (vs. no involvement): 1.29 (0.05-30.38) - Present in room (vs. no involvement): 3.19 (0.11-94.15) - Any aerosol generating procedure: 2.53 (0.21-30.68) - Always gloves during aerosol generating procedures: 3.10 (0.13-75.19) - Always facemask (non-N95) during aerosol generating procedures: 0.77 (0.03-20.02) - Always gloves during non-aerosol generating procedures: 4.40 (0.21-91.92) - Always facemask (non-N95) during non-aerosol generating procedures: 1.29 (0.05-30.38) - Longest single duration of time in room (reference <2 minutes): 2 to 30 minutes: 32.00 (1.96-522.78)	interviewed and excluded from analysis

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		○ 31 to 60 minutes: 1.86 (0.07-46.97) ○ >60 minutes: 8.00 (0.59-130.70) • Within 6 feet of index patient: 1.03 (0.05-23.49) • Direct skin-to-skin contact with index patient: 0.45 (0.02-9.52) • Index patient either masked or on closed system ventilator when contact occurred (reference never): Always: 0.20 (0.01-4.22) ○ Sometimes: 2.86 (0.24-34.66)	
Lai et al, 2020 (34) Retrospective cohort China (Wuhan); 1 hospital; 1 January-9 February 2020	9,648 HCWs • 12% ≥45 y, 88% <45 y • 74% female • 22% physician, 46% nurse, 32% health care assistant • 1.1% (110/9648) diagnosed with COVID-19	OR (95% CI) for COVID-19 (criteria not described)* • Age <45 y vs. ≥45 y: 0.32 (0.21-0.48) • Female vs. male: 0.91 (0.60-1.39) • Nurse vs. physician: 1.16 (0.73-1.84) ○ Health care assistant vs. physician: 0.59 (0.33-1.04) • Clinic department for patients presumed not to have COVID-19 vs. fever clinic or ward: 3.00 (1.76-5.09) Department with no patient contact vs. fever clinic or ward: 1.81 (0.95-3.46)	No control for confounders; incident rate ratios reported but unclear how duration of exposure estimated and results discrepant with data in study; criteria for COVID-19 not described
Moscola et al, 2020 (13) Retrospective cohort United States (New York); multicenter health system; 20 April to 23 June 2020 Added for Update Alert #4	40,329 HCWs • Median age, 42 y • 73.7% female • 16.0% Black, 14.0% Hispanic, 0.8% multiracial • 9.3% physicians, 28.4% nurses	Positive seroprevalence for COVID-19 IgG antibodies • 18-39 y: 15.0% (2723/18,193) • 40-49 y: 14.1% (1100/7829) • 50-59 y: 12.3% (1055/8550) • 60-69 y: 11.4% (597/5215) • ≥ 70 y: 8.9% (48/542) ○ Adjusted RR (95% CI) vs. age 18-39 years: ○ 40-49: 1.0 (0.97-1.02) ○ 50-59: 0.99 (0.97-1.02) ○ 60-69: 1.00 (0.98-1.03) • ≥70: 1.00 (0.94-1.07) • Female: 13.7% (4062/29,725) • Male: 13.8% (1461/10,604) ○ Female vs. male: adjusted RR, 1.05 (1.01-1.09) • American Indian: 17.0% (32/188) • Asian: 11.9% (722/6082) • Black: 23.5% (1513/6444) • Hispanic: 19.6% (1108/5653) • Pacific Islander: 17.2% (35/203) • White: 9.6% (2057/21 428)	56% of all eligible HCWs; 7 different assays used

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Other/multiracial: 16.9% (56/331) • Physicians: 8.7% (327/3746) • Nurses: 13.1% (1503/11,468) ◦ Nurse vs. physician: OR, 1.58 (1.39-1.79)* • Allied health: 11.6% (949/8156) ◦ Physician vs. allied health: adjusted RR, 0.98 (0.95-1.00) ◦ Nurse vs. allied health: adjusted RR, 1.00 (0.98-1.01) • Administrative: 12.6% (1217/9645) ◦ Administrative and clerical vs. allied health: adjusted RR, 1.01 (0.99-1.02) • Service/maintenance (included medical assistants): 20.9% (1527/7314) ◦ Service/ maintenance vs. allied health: adjusted RR, 1.03 (1.00-1.05) • ED: 17.3% (533/3089) • ICU: 9.9% (331/3355) • Other hospital units: 17.1% (1706/9976) • Other: 12.1% (2448/20) • Direct patient care, no: 12.2% (1562/12 803) • Direct patient care, yes: 14.4% (3437/23 852) • Work in COVID-19 unit, no: 16.0% (2519/15 779) • Work in COVID-19 unit, yes: 12.3% (2247/18 332) • Self-report suspicion of virus exposure, low: 5.3% (1177/22 155) • Self-report suspicion of virus exposure, medium: 11.3% (1180/10 410) • Self-report suspicion of virus exposure, high: 59.2% (2726/4604) • PCR test negative: 10.33% (403/3892) • PCR test positive: 93.5% (2044/2186)	
Ng et al, 2020 (84) Retrospective cohort Singapore; February 2020	41 HCWs with exposure to COVID-19 patient and aerosol-generating procedures for ≥10 min at ≤2 m • Age, sex, and HCW role/position not reported • 0% (0/41) diagnosed with SARS-CoV-2 infection	Incidence of SARS-CoV-2 infection in exposed HCWs: 0% (0/41); no HCWs developed symptoms • Aerosol-generating procedures: endotracheal intubation ($n = 10$), extubation ($n = 2$), noninvasive ventilation ($n = 25$), other ($n = 4$) • Mask type during exposures: surgical mask, 85%; N95, 15%	No cases of COVID-19 occurred

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Piapan et al, 2020 (15) Retrospective cohort Italy (Trieste); regional HCWs with known COVID-19 exposure; 1 March to 6 April 2020 Added for Update Alert #4	903 HCWs with known exposure to a COVID-19-infected patient • Mean age 45 y • 71% female • 28% physician, 43% nurse, 18% nurse's aide, 8% resident, 9% other role • 7% high-risk department, 13% moderate-risk department, 80% low-risk department	Adjusted OR (95% CI), prevalence of SARS-CoV-2 infection (PCR) • Female vs. male: 0.67 (0.45-1.02) • HCW role- ○ Nurse vs. physician: 0.9 (0.5-1.4) ○ Nurse's aide vs. physician: 1.4 (0.7-2.6) ○ Resident vs. physician: 1.3 (0.5-2.7) ○ Other role vs. physician: 0.9 (0.4-2.0) • Department- ○ High-risk vs. low-risk department: 67.9 (34.7-133) ○ Medium-risk vs. low-risk department: 9.6 (5.6-16.5) • Contact - ○ Contact with colleagues and patients vs. contact with patients: 7.0 (3.7-13.3) ○ Contact with colleagues vs contact with patients: 0.9 (0.54-1.5) • PPE - ○ Mask (FFP2-3 or surgical) vs. no mask: : 1.6 (0.9-2.9) ○ FFP2-3 mask vs. surgical mask: 7.1 (3.0-16.7) ○ Patient wearing mask: 7.1 (3.6-13.9)	Potential recall bias
Sotgiu et al. 2020 (16) Retrospective cohort Italy (Milan); 1 hospital; 2 to 16 April 2020 Added for Update Alert #4	202 HCWs • Median age 45 y • 65% female • 47% physician, 26% nurse, 10% resident, 6% socio-sanitary worker, 2% administrative staff, 4% technicians, 4% hospital staff, 1% non-hospital staff	Incidence of SARS-CoV-2 seropositivity • Female, IgG: 6.1% (8/132); IgM: 9.1% (12/132) • Male, IgG: 10.0% (7/70); IgM: 24.3% (17/70) ○ Female vs. male (IgG): OR 0.58 (0.20-1.67)* • Age ○ 20-29 y, IgG: 14.8% (4/27); IgM: 25.9% (7/27) ○ 30-39 y, IgG: 2.3% (1/44); IgM: 9.1% (4/44) ○ 40-49 y, IgG: 7.0% (4/57); IgM: 5.3% (3/57) ○ 50-59 y, IgG: 9.8% (5/51); IgM: 15.7% (8/51) ○ 60-69 y, IgG: 4.4% (1/23); IgM: 30.4% (7/23) • Contact with COVID-19 patient, IgG: 7.6% (12/158); IgM: 13.9% (22/158) • No contact with COVID-19 patient, IgG: 6.8% (9/44); IgM: 15.9% (7/44) • HCW, IgG: 7.6% (15/197); IgM: 14.7% (29/197) ○ Physician, IgG: 14.8% (7/115); IgM: 13.9% (16/115) ○ Nurse/OSS. IgG: 7.8% (5/64); IgM: 10.9% (7/64) ▪ Nurse vs. physician (IgG): OR 0.76 (0.23-2.52)* ○ Other role: IgG 13.0% (3/23); IgM: 26.1% (6/23) • Non-HCW, IgG: 0% (0/5); IgM: 0% (0/5)	No control for confounders
Ran et al, 2020 (38)	72 HCW with acute symptoms • Median age, 31 y • 69% female	RR (95% CI) for COVID-19 (PCR) • High-risk vs. general department: 2.13 (1.45–3.95) • High-exposure operation: 0.54 (0.19–1.53) • Tracheal tube removal: 0.63 (0.06–7.08)	Potential recall bias; unclear if most risk estimates adjusted; reference group

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Retrospective cohort China (Wuhan); 1 hospital serving outbreak; follow-up through 28 January 2020	53% clinicians and 47% nurses 38.9% (28/72) diagnosed with COVID-19	- CPR: 0.63 (0.06–7.08) - Fiberoptic bronchoscopy: 0.63 (0.06–7.08) - Sputum suction: 0.43 (0.12–1.55) - Unqualified handwashing: 2.64 (1.04–6.71) - Suboptimal handwashing before patient contact: 3.10 (1.43–6.73) - Suboptimal handwashing after patient contact: 2.43 (1.34–4.39) - Improper PPE (proper PPE defined as use of hospital masks, round caps, gloves, protective clothing, boot covers, and goggles or face shields): 2.82 (1.11–7.18) - Increase in work hours: log-rank P = 0.02 with interaction with high-risk department Contact history: - Diagnosed family member: 2.76 (2.02–3.77) - Suspected family member: 1.30 (0.31–5.35) Diagnosed patient: 0.36 (0.22–0.59) Suspected patient: 0.49 (0.27–0.89) Huanan seafood market: 0.63 (0.06–7.08)	unclear for some estimates; some estimates imprecise; 11 of 83 cases dropped for invalid surveys
Wang Q. et al, 2020 (40) Retrospective cohort China (Hubei province); 107 hospital neurosurgery departments; January 20 to March 1, 2020	5,322 HCWs - Mean age, 34 years 50% female 45% surgeon, 55% nurse 2.2% diagnosed with COVID-19 (120/5,442)	OR (95% CI) for COVID-19 (PCR) Level 2 protection (cap, N95 or higher, goggles/eye protection, gown, gloves, shoe covers) (yes vs. no): 0.03 (0.003–0.19)*	Not peer reviewed ; potential recall bias; no control for confounders
Wang X. et al, 2020 (70) Retrospective cohort	493 HCWs - Mean age, 32 y 87% female 27% doctor, 73% nurse	Incidence of COVID-19 - Respiratory department: 0% (0/70) - ICU: 0% (0/169) - Infectious disease department: 0% (0/39) - Hepatobiliary and pancreatic surgery department: 11% (8/74) - Trauma and microsurgery department: 2% (1/44) - Urology department: 1% (1/97)	Not peer reviewed ; mask and other PPE use based on department practice, not individual participant use;

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
China (Wuhan); 1 hospital; January 2020	2.0% (10/493) diagnosed with COVID-19	Unadjusted OR (95% CI) Nurse vs. doctor: 0.04 (95% CI 0.005 to 0.31)[†] - In department with N95 mask use (no vs. yes): 28.46 (1.65 to 488.48)* Adjusted OR (95% CI) for COVID-19 - In department with N95 mask use (no vs. yes): 464.82 (97.73– ∞)	estimate for mask very imprecise
Zhang G et al, 2020 (18) Retrospective cohort China (Wuhan); 1 university hospital; 25 December 2019 to 31 January 2020 Added for Update Alert #4	237 HCWs with confirmed contact with a COVID-19 infected patient - Age, sex not reported 28% physician, 72% nurse 31% respiratory department, 31% hepatobiliary surgery, 38% neurology	Incidence of SARS-CoV-2 infection (PCR) - Physician: 14.9% (10/67) - Nurse: 1.2% (2/170) - Nurse vs. physician: OR 0.07 (0.01-0.32)* - Respiratory department: 0% (0/73) - Hepatobiliary surgery: 14.9% (10/74) - Neurology: 2.2% (2/90)	Limited information on demographic characteristics; no control for confounders
Amendola et al, 2020 (3) Cross-sectional Italy (Milan); 1 pediatric hospital; 15 April 2020 Added for Update Alert #4	663 asymptomatic HCWs (547 clinical and 116 nonclinical) - Mean age 44 y 84% female 83% clinical HCW, 17% nonclinical HCW 32% physician, 32% nurse, 18% technician, 17% non-clinical hospital employee 27% labor and delivery, 12%	SARS-CoV-2 seropositivity - Female: 4.3% (24/555) - Male: 9.3% (10/108) - Female vs. male: OR 0.44 (0.21-0.96)* - Clinical HCW: 5.1% (28/547) - Physician: 4.7% (10/214) - Nurse: 6.0% (13/216) - Nurse vs. physician: OR 1.31 (0.56-3.05)* - Other health technicians: 4.2% (5/117) - Non-clinical HCW: 5.2% (6/116) - Outpatient services: 6.3% (4/63) - Surgery: 22.2% (6/27) - Pediatric: 1.2% (1/80) - Pediatric ER: 1.8% (1/55) - NICU: 2.1% (1/47) - PICU: 14.3% (6/42) - Labor and delivery: 3.3% (6/181) 6 (3.31)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	pediatric unit, 10% outpatient clinic, 4% surgical unit, 8% pediatric ER, 7% NICU, 6% PICU, 11% administrative / pharmacy / lab, 15% other Among HCWs (n=547), 56% direct contact with COVID- 19 patient, 44% no known direct contact	- Administration/pharmacy/laboratory: 8.6% (6/70) - Others: 3.1% (3/98) - Direct contact with COVID-19 patient: 6.6% (20/304) - No known direct contact: 3.3% (8/243) - Direct vs. no direct contact with COVID-19 patient: OR 2.07 (0.89-4.78)*	
Hunter et al, 2020 (9) Cross-sectional United States (Indiana); 18 locations within one healthcare system; dates not reported Added for Update Alert #4	734 HCWs without active symptoms or previously confirmed COVID-19 who volunteered and completed study - Mean age: 42.8 y 70.1% female 38.0% physicians, 43.2% nurses, 12.8% RTs, 6.0% Admin	Prevalence of SARS-CoV-2 IgG antibodies: - Physician/APP: 1.1% (3/279) - Nurses: 2.2% (7/317) - Nurse vs. physician: OR 2.08 (0.53-8.11)* - RTs: 0% (0/94) - Administrative : 4.5% (2/44) - High risk: 1.3% (5/385) - Low risk: 2.0% (7/349)	Number of tests allocated according to assessed risk; testing protocol varied according to hospital risk (only offered to ED and COVID units in high risk hospitals); no control for confounders
Jeremias et al, 2020 (10) Cross-sectional United States (New York); 1 hospital; 1 March to 30 April 2020 Added for Update Alert #4	3,046 HCWs (asymptomatic or symptom-free for at least 14 days), of whom 1958 underwent testing - Mean age 43 y 70% female 6.4% physician, 55.6% nurse, 10.0% technologist, 6.2% environmental	Prevalence of SARS-CoV-2 seropositivity - Female: 9.4% (118/1259) - Male: 11.1% (49/440) - Female vs. male: OR 0.83 (0.58-1.17)* - Physician: 11.4% (9/79) - Nurse: 9.5% (99/1043) - Nurse vs. physician: OR 0.82 (0.40-1.68)* - Technologist: 5.8% (9/155) - Environmental worker: 12.0% (12/100) - Ancillary worker: 12.1% (39/322) - ER: 10.2% (9/88) - Floor: 12.3% (60/489)	64% participation rate; demographic characteristics reported for the entire cohort rather than those who underwent testing

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	worker, 21.7% ancillary worker	- ICU: 6.9% (22/321) - Operational: 10.5% (42/400) - Procedural: 9.1% (22/243) - Other: 7.6% (12/158)	
Korth et al, 2020 (48) Cross-sectional German (Essen); 1 hospital; 25 March to April 21 2020	317 HCWs - Mean age, 37 y in high-risk group, 42.3 y in low-risk group 100% female 25% physician, 66% nurse, 6% lab assistant, 3% other 1.6% (5/316) diagnosed with SARS-CoV-2 IgG positivity	Prevalence of SARS-CoV-2 IgG positivity - High-risk (daily contact with COVID-19 patients on designated wards and intensive care units): 1.2% (3/244) - Intermediate-risk (daily non-COVID-19 patient contact): 5.4% (2/36) - Low-risk (no daily patient contact): 0% (0/35)	No control for confounders
Lackermair et al, 2020 (12) Cross-sectional Germany (Dachau); 8 primary care clinics; 2 to 6 April Added for Update Alert #4	151 HCWs - Mean age 38 years 83% female 36% physician, 64% other HCW 28% known unprotected COVID-19 contact 72% symptomatic	Prevalence of SARS-CoV-2 seropositivity - Female: 1.6% (2/126) - Male: 8.0% (2/25) - Female vs. male: OR 0.19 (0.02-1.38)* - Physician: 5.6% (3/54) - Other HCW role: 1.0% (1/97) - Direct contact with COVID-19 patient: 4.8% (2/42) - No direct contact with COVID-19 patient: 1.8% (2/109) - Direct contact with COVID-19 patient vs. no direct contact: 2.68 (0.36-19.64)*	Potential recall bias
Lahner et al, 2020 (49) Cross-sectional Italy (Rome); 1 hospital; 18 March to 27 April 2020	2,115 HCWs in a COVID-19 regional hub - Median age 46 y 60.2% female 30% physician, 33% nurse, 37% other HCW role	Incidence of SARS-CoV-2 infection (PCR) - Physician: 4.1% (26/632) - Nurse: 3.8% (27/705) - Other HCW role: 0.6% (5/778)	No non-HCW controls

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Lombardi et al, 2020 (51) Cross-sectional Italy (Milan); 1 hospital; 24 February to 31 March 31 2020	1,573 HCWs • Mean age, 44 y • 64% female • 37% physician, 33% nurse/midwife, 10% healthcare assistant, 11% health technician, 9% clerical workers/technician • 30% at least 1 symptom • 8.8% (138/1573) diagnosed with SARS-CoV-2 infection (PCR)	Odds ratio (95% CI) for SARS-CoV-2 infection (PCR) • Female vs. male: 0.83 (0.58-1.18) • Nurse vs. physician: 0.75 (0.50-1.13) Prevalence of SARS-CoV-2 infection (PCR) • <30 y: 11.7% (29/248) • 30-39 y: 8.8% (34/387) • 40-49 y: 8.0% (26/326) • 50-59 y: 7.9% (35/444) • ≥60 y: 8.3% (14/168) • Physician (including resident): 10.6% (62/582) • Nurses/midwife: 8.2% (43/522) • Healthcare assistant: 8.0% (13/162) • Health technician: 9.4% (16/170) • Clerical worker/technician: 2.9% (4/137)	No control for confounders
Olalla et al, 2020 (14) Cross-sectional Spain (Andalusia); 1 hospital; 15 to 24 April 2020 Added for Update Alert #4	498 HCWs • Mean age 42 y • 80% female • 20% physician, 39% nurse, 26% nursing assistant, 7% security, 2% administrative, 5% housekeeping • 26% ED, 13% ICU, 44% COVID-19 unit, 9% non-COVID-19 unit, 8% pediatric unit	Prevalence of SARS-CoV-2 IgG seropositivity, negative IgM and negative PCR • Physician: 1.9% (2/101) • Nurse: 0.5% (1/195) ◦ Nurse vs. physician: OR 0.26 (0.03-2.85)* • Nursing assistant: 2.3% (3/129) • Security: 2.9% (1/35) • ER: 1.6% (2/129) • ICU: 1.6% (1/63) • COVID-19 unit: 0.9% (2/219) • Non-COVID-19 unit: 4.5% (2/44) ◦ COVID-19 vs. non-COVID-19 unit: OR 0.19 (0.03-1.41)*	Uncertain criteria for testing eligibility; no control for confounders
Shields et al, 2020 (57) Cross-sectional United Kingdom (Birmingham,	554 asymptomatic HCWs • Age, sex, HCW role/position not reported	Prevalence of SARS-CoV-2 (PCR): 2.4% (13/554) Prevalence of SARS-CoV-2 seroconversion (IgG, IgM, IgA): 24.4% (126/516) • Housekeeping: 34.5% (10/29) • Acute medicine: 33.3% (10/30) • General internal medicine: 30.3% (30/99) • Intensive care: 14.8% (9/61) • Emergency medicine: 13.3% (2/15)	Not peer reviewed No information on clinical characteristics of HCWs; no information on clinical outcomes of SARS-CoV-2 infection;

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
England); four urban hospitals; 25 April 2020		- General surgery: 13.0% (3/23) - Female: 26.3% (102/388) - Male: 18.8% (24/128) OR (95% CI) for SARS-CoV-2 seroconversion - Female vs. male: 1.55 (0.94-2.54)*	participation rate not reported; 7% of patients who underwent PCR testing did not undergo antibody testing
Stubblefield et al, 2020 (85) Cross-sectional United States (Tennessee); 1 academic medical center; 3 to 13 April 2020	249 frontline HCWs - Mean age 34 y 57% female 37% nurse, 36% physician/provider, 8% radiology technician, 19% other healthcare role 59% ED, 22% medical ICU, 19% other setting	Prevalence of SARS-CoV-2 seropositivity - Female: 6.7% (11/163) - Male: 6.6% (8/122) - Nurse: 4.8% (5/105) - Physician/provider: 9.3% (8/86) - Radiology technician: 29.4% (5/17) - Other HCW role: 2.4% (1/41) - ED: 8.2% (12/147) - Medical ICU: 5.5% (3/55) - Other setting: 8.5% (4/47) - Did not use surgical or N95 mask or PAPR during all clinical encounters: 23.1% (3/13) OR (95% CI) for SARS-CoV-2 seropositivity - Female vs. male: 1.03 (0.40-2.65)* - Nurse vs. physician/provider: 0.49 (0.15-1.55)*	No control for confounders
von Freyburg et al, 2020 (61) Cross-sectional Germany (Dachau); single hospital; 3-5 and April 2020	1170 HCWs - Age, sex not reported 17.8% physician, 35.3% nurse, 43.1% nonmedical staff; 3.8% other	Incidence of SARS-CoV-2 seropositivity: - Physician: 3.8% (8/208) - Nurse: 9.7% (40/413) - Nonmedical: 1.6% (8/505) - Other: 4.5% (2/44) OR for SARS-CoV-2 seropositivity Nurse vs. physician: 2.68 (1.23-5.84)*	No information on clinical outcomes of infection; limited information on demographic and no information on clinical characteristics of HCWs
Zhang G et al, 2020 (18) Cross-sectional	237 HCWs with confirmed contact with a COVID-19 infected patient	Incidence of SARS-CoV-2 infection (PCR) - Physician: 14.9% (10/67) - Nurse: 1.2% (2/170) - Respiratory department: 0% (0/73) - Hepatobiliary surgery: 14.9% (10/74)	Limited information on demographic characteristics; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
China (Wuhan); 1 university hospital; 25 December 2019 to 31 January 2020 Added for Update Alert #4	- Age, sex not reported 28% physician, 72% nurse 31% respiratory department, 31% hepatobiliary surgery, 38% neurology	Neurology: 2.2% (2/90)	
Zheng et al, 2020 (63) Cross-sectional China (Wuhan); throughout Wuhan area; from March 26, 2020	117,100 HCWs - Age not reported 72% female 37% physician, 49% nurse, 14% medical staff 2.1% (2,457/117,100) diagnosed with COVID-19	OR (95% CI) for COVID-19 - Female vs. male: 1.02 (0.94-1.12) - Nurse vs. physician: 1.16 (1.07-1.27) - Nurse vs. medical staff: 1.03 (0.91-1.16) Prevalence of COVID-19 - General hospital: 2.9% (2,193/74,944) - Specialized hospital: 0.80% (140/17,565) - Community hospital: 0.50% (124/24,591)	COVID-19 cases based on requests for financial assistance; denominators based on epidemiological data; limited information on clinical outcomes of COVID-19 infections
Celebi et al, 2020 (6) Case-control Population subset of Celebi 2020 prospective cohort, see above Added for Update Alert #4	47 HCWs and 134 controls - Mean age 35 y (cases) 68% female (cases) 15% physician, 60% nurse, 25% cleaning personnel	Unadjusted OR (95% CI) for SARS-CoV-2 infection* - Female vs. male: 1.27 (0.63-2.57) - Nurse vs. physician: 2.45 (0.98-6.11) - Entered room with suspected or confirmed COVID-19 patient (yes vs. no): 0.58 (0.28-1.20) - Examined (touched) suspected or confirmed COVID-19 patient (yes vs. no): 0.42 (0.21-0.85) - Obtained a respiratory sample from a suspected or confirmed COVID-19 patient (yes vs. no): 0.50 (0.22-1.13) - Intubated a suspected or confirmed COVID-19 patient or present in the room during intubation (yes vs. no): 0.79 (0.30-2.09) - Resuscitated a suspected or confirmed COVID-19 patient or present in the room during resuscitation (yes vs. no): 1.25 (0.45-3.48) - Entered the ICU room of a suspected or confirmed patient with mechanical ventilation (yes vs. no): 0.72 (0.32-1.66) - Present in the operation room during a surgical procedure on suspected or confirmed COVID-19 patient (yes vs. no): 0.56 (0.03-11.83) - Improper use of PPE while caring for suspected or confirmed COVID-19 patient (yes vs. no): 5.29 (1.64-17.11)	Potential recall bias; imprecision in adjusted risk estimates

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		- Made mistake while implementing infection control precautions (yes vs. no): 2.98 (0.58-15.29) - Stayed in personnel break room with an HCW without wearing medical mask for more than 15 minutes (yes vs. no): 6.18 (2.98-12.83) - Consumed food within one meter of an HCW (yes vs. no): 2.91 (1.43-5.92) - Failed to keep a safe social distance from an HCW (yes vs. no): 2.54 (1.28-5.03) Adjusted OR (95% CI) for SARS-CoV-2 infection - Improper use of PPE while caring for suspected or confirmed COVID-19 patient (yes vs. no): 11.30 (2.18-59) - Stayed in same personnel break room as an HCW without wearing medical mask for more than 15 minutes (yes vs. no): 7.42 (1.90-29)	
Chatterjee et al, 2020 (86) Case-control India (throughout); 8 to 23 May 2020	378 HCW cases and 373 HCW controls - Mean age 35 y (cases) 42% female (cases) 29% physician, 44% nurse/nurse midwife, 4% housekeeping, 11% lab or operating room technician, 3% security guard, 9% other	Unadjusted OR (95%) for SARS-CoV-2 infection, - ICU with suspected or confirmed COVID-19 case on ventilator, yes vs. no: 1.36 (0.88-2.1) - Performing endotracheal intubation vs. not performing: 2.5 (1.13-5.5) - Respiratory tract suctioning (yes vs. no): 0.73 (0.37-1.45) - Handling clinical specimen (stool, blood, bronchoalveolar lavage) (yes vs. no): 0.89 (0.57-1.39) - Doctor vs. laboratory technician/operation theatre technician: 0.94 (0.57-1.57) - Nurse vs. laboratory technician/operation theatre technician: 1.2 (0.74-1.96) - No PPE use vs. PPE use all/most cases: 3.72 (2.12-6.52) - Any mask vs. no mask: 0.35 (0.22-0.57) - Cap vs. no cap: 0.70 (0.52-0.94) - Gown vs. no gown: 0.62 (0.46-0.83) - Shoe cover vs. no shoe cover: 1.05 (0.78-1.42) - Face shield or goggles vs. none: 0.81 (0.61-1.08) - Gloves vs. no gloves: 0.38 (0.26-0.55) Adjusted OR (95% CI) for SARS-CoV-2 infection - Male vs. female: 1.93 (1.21-3.07) - Never used PPE vs used PPE: 5.33 (2.27-12.48) - Performing endotracheal intubation vs. not performing: 4.33 (1.16-16.07)	Potential recall bias; 60% of eligible cases included

Abbreviations: ED = emergency department; HCW = healthcare worker; HR = hazard ratio; ICU = intensive care unit; NICO = neonatal intensive care unit; OR = odds ratio; PCR = polymerase chain reaction; PICU = pediatric intensive care unit; PPE = personal protective equipment; RR = relative risk

*Unadjusted OR calculated based on available data.

Supplement Table 4. Demographic characteristics and HCW role or position and risk for infection with SARS-CoV-2 in HCWs

Study, Year (Reference)	Age	Sex	Physician	Nurse	Other HCW Role
Amendola et al, 2020 (3) Added for Update Alert #4	--	Female: 4.2% (24/555) Male: 9.3% (10/108) Female vs. male: OR, 0.44 (0.21-0.96)	4.7% (10/214)	6.0% (13/216) Nurse vs. physician: OR, 1.31 (0.56-3.05)	- Other health technicians: 4.2% (5/117) - Non-clinical HCW: 5.2% (6/116)
Bai et al, 2020 (28)	Mean age: 36.6 y in cases vs. 30.5 in non-cases, P=0.006	Female vs. male: OR, 0.78 (0.23-2.64)	--	Nurse vs. physician: OR, 0.65 (0.18-2.34)	--
Blairon et al, 2020 (5) Added for Update Alert #4	--	--	11.8% (38/323)	19.2% (113/588) Nurse vs. physician: OR 1.78 (1.20-2.65)	Pharmacist or administrative staff: 9.1% (29/320) Maintenance or technical worker: 16.4% (22/134) Imaging or lab worker: 6.6% (2/31)
Buchtele et al, 2020 (30)	--	--	0% (0/5)	27.8% (5/18) Nurse vs. physician: OR, 4.48 (0.21-65.60)	Cleaning staff: 0% (0/3)
Celebi et al, 2020 (6) Added for Update Alert #4	--	-Female vs. male: OR, 1.27 (0.63-2.57)		Nurse vs. physician: OR, 2.45 (0.98-6.11)	
Chatterjee et al, 2020 (86)	Mean age: 34.7 y in cases vs. 33.5 y in non-cases	Male vs. female: adjusted OR, 1.93 (1.21-3.07)	--	--	--
el-Boghdadly et al, 2020 (22)	Age (y): HR, 0.99 (0.98-1.01)	Female vs. male: adjusted HR, 1.36 (1.01-1.82)	10.6% (166/1558) Physician vs. non-physician: OR, 0.94 (0.56-1.58)	--	Non-physician: 11.2% (18/160)

Study, Year (Reference)	Age	Sex	Physician	Nurse	Other HCW Role
Garcia et al, 2020 (83)	--	--	13.0% (64/491)	Nurse: 10.2% (126/1231) Nurse supervisor: 37.5% (9/24) Any nursing role: 10.7% (135/1255) Nurse vs. physician, COVID-19: OR, 0.76 (0.55-1.05)*	Department head: 23.1% (9/39) Other role: 4.4% (5/113)
Houlihan et al, 2020 (8) Added for Update Alert #4	Age <30: 54% (31/57) Age 30-39: 49% (34/70) Age 40-49: 30% (12/30) Age ≥50: 33% (10/30)	Female vs. male: OR, 0.67 (0.38-1.20)	44% (32/72)	Nurse or other frontline clinical staff: 43% (46/106) Nurse or other frontline worker vs. physician: OR, 0.96 (0.52-1.75)	Other healthcare role: 41% (9/22)
Hunter et al, 2020 (9) Added for Update Alert #4	--	--	1.1% (3/279)	2.2% (7/317) Nurse vs. physician: OR, 2.08 (0.53-8.11)	Administrative staff vs. all other employees: RR 3.1 (0.71-13.9)
Jeremias et al, 2020 (10) Added for Update Alert #4	--	Female vs. male: OR, 0.83 (0.58-1.17)	11.4% (9/79)	9.5% (99/1043) Nurse vs. physician: OR, 0.82 (0.40-1.68)	Technologist: 5.8% (9/155) Environmental worker: 12.0% (12/100) Ancillary worker: 12.1% (39/322)
Kassem et al, 2020 (11) Added for Update Alert #4	--	Female vs. male OR, 0.61 (0.20-1.86)	13.3% (4/30)	21.4% (6/28) Nurse vs. physician: OR, 0.56 (0.14-2.25)	Patient transporters/cleaners: 33.3% (3/9) Administrative: 42.9% (3/7)
Lackermair et al, 2020 (12) Added for Update Alert #4	--	Female vs. male: OR, 0.19 (0.02-1.38)	5.6% (3/54)	--	1.0% (1/97)

Study, Year (Reference)	Age	Sex	Physician	Nurse	Other HCW Role
Lai et al, 2020 (34)	<45 y vs. ≥45 y: OR, 0.32 (0.21- 0.48)	Female vs. male: OR, 0.91 (0.60-1.39)	--	Nurse vs. physician: OR, 1.16 (0.73-1.84)	Health care assistant vs. physician: OR, 0.59 (0.33- 1.04)
Lahner et al, 2020 (49)	--	--	4.1% (26/632)	3.8% (27/705) Nurse vs. physician: OR, 0.93 (0.54-1.61)*	Other HCW role: 0.6% (5/778)
Lombardi et al, 2020 (51)	<30 y: 11.7% (29/248) 30-39 y: 8.8% (34/387) 40-49 y: 8.0% (26/326) 50-59 y: 7.9% (35/444) ≥60 y: 8.3% (14/168)	Female vs. male: OR, 0.83 (0.58-1.18)	Physician (including residents): 10.6% (62/582)	Nurse/midwife: 8.2% (43/522) Nurse vs. physician: OR, 0.75 (0.50-1.13)	Healthcare assistant: 8.0% (13/162) Health technician: 9.4% (16/170) Clerical worker, technician: 2.9% (4/137)
Maltezou et al, 2020 (23)	--	Female vs. male: adjusted OR, 0.55 (0.31-0.96)	--	--	Administrative role vs other role: adjusted OR, 3.06 (1.43- 6.55)
Martin et al, 2020 (24)	--	--	11.7% (10/85)	12.6% (19/150) Nurse vs. physician: OR, 1.09 (0.48-2.46)*	Care assistant: 14.8% (4/27) Paramedical staff: 15.1% (5/33) Administrative staff: 4.0% (1/25) Cleaning staff and stretcher bearers: 33.3% (2/6)

Study, Year (Reference)	Age	Sex	Physician	Nurse	Other HCW Role
Moscola et al, 2020 (13) Added for Update Alert #4	Adjusted RR (95% CI) vs. age 18-39 years: 40-49: 1.0 (0.97-1.02) 50-59: 0.99 (0.97-1.02) 60-69: 1.00 (0.98-1.03) ≥70: 1.00 (0.94-1.07)	Female vs. male: adjusted RR, 1.05 (1.01-1.09)	Physician vs. allied health: adjusted RR, 0.98 (0.95-1.00)	Nurse vs. allied health: adjusted RR, 1.00 (0.98-1.01) Nurse vs. physician: OR, 1.58 (1.38-1.79)	Adjusted RR (95% CI) vs. allied health: Administrative and clerical: 1.01 (0.99-1.02) Service/ maintenance: 1.03 (1.00-1.05)
Mutambudzi et al, 2020 (25)	--	--	--	--	Healthcare professionals: 0.7% (12/1,779) Medical support staff: 0.8% (10/1,286) Health associate professionals: 0.7% (54/7,653)
Olalla et al, 2020 (14) Added for Update Alert #4	--	--	1.9% (2/101)	0.5% (1/195) Nurse vs. physician: OR, 0.26 (0.03-2.85)	Nursing assistant: 2.3% (3/129) Security: 2.9% (1/35)
Piapan et al, 2020 (15) Added for Update Alert #4	--	Female vs. male: adjusted OR, 0.67 (0.45-1.02)	12.7 (32/252)	Nurse vs. physician: adjusted OR, 0.9 (0.5-1.4)	Nurse's aide vs. physician: adjusted OR, 1.4 (0.7-2.6) Resident vs. physician: adjusted OR, 1.3 (0.5-2.7) Other role vs. physician: adjusted OR, 0.9 (0.4-2.0)
Schmidt et al, 2020 (27)	18-29 y: 1.9% (1/55) 30-49 y: 4.8% (7/154) 50-64 y: 1.8% (3/170) ≥65 y: 0% (0/6)	Female vs. male: OR, 0.42 (0.12-1.49)	8.8% (3/34)	0% (0/154) Nurse vs. physician: OR, 0.03 (0.002-0.58)	Therapist: 3.8% (3/80) Other role: 4.3% (5/117)
Shields et al, 2020 (57)	--	Female vs. male: OR, 1.55 (0.94-2.54)	--	--	--

Study, Year (Reference)	Age	Sex	Physician	Nurse	Other HCW Role
Sotgiu et al. 2020 (16) Added for Update Alert #4	IgG 20-29 y:14.8% (4/27) 30-39 y: 2.3% (1/44) 40-49 y: 7.0% (4/57) 50-59 y: 9.8% (5/51) 60-69 y: 4.4% (1/23)	Female vs. male (IgG): OR, 0.58 (0.20-1.67)	IgG: 14.8% (7/115)	IgG: 7.8% (5/64) Nurse vs. physician (IgG): OR, 0.76 (0.23-2.52)	Other role: IgG 13.0% (3/23)
Stubblefield et al, 2020 (85)	--	Female vs. male: OR, 1.03 (0.40-2.65)	9.3% (8/86)	4.8% (5/105) Nurse vs. physician: OR, 0.49 (0.15-1.55)	Radiology technician: 29.4% (5/17) Other HCW role: 2.4% (1/41)
Villaneuva et al, 2020 (17) Added for Update Alert #4	20-29 y: 2.3% (2/88) 30-39 y: 2.9% (4/140) 40-49 y: 2.9% (2/68) 50-59 y: 0% (0/24) 60-69 y: 0% (0/4)	Female vs. male: OR, 1.51 (0.30-7.63)	2.7% (1/37)	2.0% (4/203) Nurse vs. physician: OR, 0.72 (0.07-6.66)	Lab personnel: 25% (3/12) Radiology tech, clerk, other: 0%
von Freyburg et al, 2020 (61)	--	--	3.8% (8/208)	9.7% (40/413) Nurse vs. physician: OR, 2.68 (1.23-5.84)	4.5% (2/44)
Wang X. et al, 2020 (70)	--	--	--	Nurse vs. physician: OR 0.04 (0.005-0.31)	--
Zhang G, et al 2020 (18) Added for Update Alert #4	--	--	14.9% (10/67)	1.2% (2/170) Nurse vs. physician: OR, 0.07 (0.01-0.32)	--

Abbreviations: EMT = emergency medical technician; HCW = health care worker; OR = odds ratio; RR = relative risk.

Supplement Table 5. Exposure history and risk for infection with SARS-CoV-2 in HCWs

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Amendola et al, 2020 (3) Added for Update Alert #4	--	Direct contact with COVID-19 patient vs. no known direct contact: OR, 2.07 (0.89-4.78)	--	--	--
Bai et al, 2020 (28)	--	Contact with index case (yes or no): OR, 0.27 (0.08-0.94) Air contact vs. no contact: OR, 0.32 (0.07-1.50) Direct contact vs. no contact: OR, 0.22 (0.05-1.03) Air or direct contact vs. no contacts: OR, 0.31 (0.03-3.01)	--	Contact frequency (median, contacts/day): 3.0 in cases vs. 5.0 in non-cases, P=0.95 Contact duration (median, minutes/contact): 4.0 in cases vs. 4.0 in non-cases, P=0.54 In same department as index case: OR, 62.70 (3.60-1092.46)	--
Celebi et al, 2020 (6) Case-control study Added for Update Alert #4	Intubating a suspected or confirmed COVID-19 patient or being present in the room during intubation, yes vs. no: OR, 0.79 (0.30-2.09)		Obtaining a respiratory sample from a suspected or confirmed COVID-19 patient: OR, 0.59 (0.22-1.13)	--	Resuscitating a suspected or confirmed COVID-19 patient or being present in the room during resuscitation: OR, 1.25 (0.45-3.48) Entering a room in which a suspected or confirmed COVID-19 patient was hospitalized: OR, 0.58 (0.28-1.20) Examining (touching) a suspected or confirmed COVID-19 patient: OR, 0.42 (0.21-0.85)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					Entering the ICU room of a suspected or confirmed patient with mechanical ventilation: OR, 0.72 (0.32-1.66) Being present in the operation room during a surgical procedure on a suspected or confirmed COVID-19 patient: OR, 0.56 (0.03-11.83)
Chatterjee et al, 2020 (86)	Performing endotracheal intubation vs. not performing: adjusted OR, 4.33 (1.16-16.07)	--	--	--	In ICU with suspected or confirmed COVID-19 case on ventilator (yes vs. no): OR, 1.36 (0.88-2.1)* Respiratory tract suctioning (yes vs. no): OR, 0.73 (0.37-1.45)* Handling clinical specimen (yes vs. no): OR, 0.78 (0.57-1.39)*
el-Boghdady et al, 2020 (22)	Tracheal intubation: 8.97% (462/5148)	--	Apnoeic oxygenation: HR 0.84 (0.63-1.14) Bag-mask ventilation (yes vs. no): HR 0.81 (0.54-1.23) Supraglottic airway: device (yes vs. no): HR 1.40 (0.66-2.97)	--	--
Heinzerling et al, 2020 (32)	--	Direct skin-to-skin contact with index patient: OR 0.45 (0.02-9.52)	--	Estimated time in patient room (median, minutes): 120 vs. 25, P=0.06	Taking vital sign (yes vs. no): OR, 7.71 (0.61-97.85)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
				Estimated time in patient room during aerosol generating procedures (median, minutes): 95 vs. 0, P=0.13 Longest single duration of time in room (reference <2 minutes): 2 to 30 minutes: OR 32.00 (1.96-522.78) 31 to 60 minutes: OR 1.86 (0.07-46.97) >60 minutes: OR 8.00 (0.59-130.70) Within 6 feet of index patient: OR 1.03 (0.05-23.49)	Taking medical history (yes vs. no): OR, 1.93 (0.15-24.46) Performing physical examination: OR, 21.82 (1.02-466.52) Taking vital sign, taking medical history, providing medication, bathing or cleaning patient, lifting or positioning patient, emptying bedpan, changing linens, cleaning patient room, peripheral line insertion, central line insertion, drawing arterial blood bas, drawing blood: No statistically significant associations
Kassem et al, 2020 (11) Added for Update Alert #4	-	Exposure to suspected or confirmed COVID-19 during work in last 2 weeks vs. not: OR, 0.95 (0.27-3.44)	-	-	-
Moscola et al, 2020 (13) Added for Update Alert #4	--	--	--	Work in COVID-19 positive unit, yes vs. no: adjusted RR 1.00 (0.98-1.03)	Work location, ED ref RR multivariable ICU: 0.98 (0.93-1.02) Non ICU hospital units: 1.00 (0.96-1.04) Other: 0.99 (0.95-1.03)
Olalla et al, 2020 (14) Added for Update Alert #4	--	--	--	COVID-19 vs. non-COVID-19 unit: OR, 0.19 (0.03-1.41)	--
Ran et al, 2020 (38)	Endotracheal tube removal: RR, 0.63 (0.06-7.08)	--	--	--	CPR: RR, 0.63 (0.06-7.08)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					Fiberoptic bronchoscopy: RR, 0.63 (0.06-7.08) Sputum suction: RR, 0.43 (0.12-1.55)

Abbreviations: BiPAP = bilevel positive airway pressure; CPR = cardiopulmonary resuscitation; ECG = electrocardiography; HCW = health care worker; OR = odds ratio; RR = relative risk; SARS = severe acute respiratory syndrome.

* Variable not included in a multivariate model.

Supplement Table 6. Mask use and risk for infection with SARS-CoV-2 in HCWs

Author, Year (Reference)	Mask Use Versus Nonuse	Comparison of Mask Types	Consistency of Mask Use	Multiple Mask Layers Versus Single Layer
Chatterjee et al, 2020 (86)	Any mask vs. no mask: OR, 0.35 (0.22-0.57)*	--	--	--
Heinzerling et al, 2020 (32)	--	--	Always facemask (non-N95) during aerosol generating procedures: OR, 0.77 (0.03-20.02) Always facemask (non-N95) during non-aerosol generating procedures: OR, 1.29 (0.05-30.38)	--
Piapan et al, 2020 (15) Added for Update Alert #4	Mask (FFP2-3 or surgical) vs. no mask: adjusted OR, 1.6 (0.9-2.9)	FFP2 mask vs. surgical mask: adjusted OR, 7.1 (3.6-13.9)	--	--
Wang X. et al, 2020 (70)	In department with mask use (no vs. yes): adjusted OR, 464.82 (97.73– ∞)	--	--	--

Abbreviations: HCW = healthcare worker; OR = odds ratio; SARS = severe acute respiratory syndrome

* Variable not included in a multivariate model.

Supplement Table 7. Infection Prevention and Control Factors (Other Than Masks) and Risk for Infection With SARS-CoV-2 in HCWs

Study, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
Celebi et al, 2020 (6) Added for Update Alert #4	--	--	--	--	Making a mistake while implementing infection control precautions, yes vs. no: OR, 2.98 (0.58-15.29) Improper use of PPE while caring for a suspected or confirmed COVID-19 patient, yes vs. no: adjusted OR, 11.30 (2.18-59) Stayed in personnel break room with other HCW without wearing a medical mask for >15 minutes, yes vs. no: adjusted OR, 7.42 (1.90-29.02)
Chatterjee et al, 2020 (86)	Gown vs. no gown: OR, 0.62 (0.46-0.83)*	Gloves vs. no gloves: OR, 0.38 (0.26-0.55)*	--	Face shield or goggles vs. none: OR, 0.81 (0.61-1.08)*	No PPE vs PPE all/most of the time: adjusted OR, 5.33 (2.27-12.48) Shoe cover vs. no shoe cover: OR, 1.05 (0.78-1.42)* Cap vs. no cap: OR 0.70 (0.52-0.94)*
el-Boghdadly et al, 2020 (22)	--	--	--	--	PPE meeting WHO standard (yes vs. no): HR, 0.97 (0.63-1.51)*
Heinzerling et al, 2020 (32)	--	Always gloves during aerosol generating procedures: 3.10 (0.13-75.19) Always gloves during non-aerosol generating procedures: 4.40 (0.21-91.92)	--	--	--
Kassem et al, 2020 (11) Added for Update Alert #4	-	-	Proper hand hygiene: OR, 0.26 (0.02-4.46)	-	PPE when indicated, always vs. occasionally OR, 0.54 (0.05-6.32)

Study, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
Maltezou et al, 2020 (23)	--	--	--	--	High- vs. low- or moderate-risk exposure (based on mask use by patient and PPE use by HCW): adjusted OR, 3.06 (1.43-6.55)
Ran L et al, 2020 (38)	--	--	Unqualified hand washing: RR 2.64 (1.04-6.71) Suboptimal hand-washing before patient contact: RR 3.10 (1.43-6.73) Suboptimal hand-washing after patient contact: RR 2.43 (1.34-4.39)	--	Improper PPE: RR 2.82 (1.11-7.18)
Wang Q. et al, 2020 (40)	--	--	--	--	Level 2 protection (cap, N95 or higher, goggles/eye protection, gown, gloves, shoe covers) (yes vs. no): OR, 0.03 (0.003-0.19)[†]

Abbreviations: HCW = health care worker; OR = odds ratio; PPE = personal protective equipment; RR = relative risk; SARS = severe acute respiratory syndrome.

* Variable not included in a multivariate model

References

1. Chou R, Dana T, Buckley DI, et al. Epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med.* 2020;173(2):120-36. Epub 2020/05/06. doi: 10.7326/m20-1632. PubMed PMID: 32369541; PubMed Central PMCID: PMC7240841.
2. Chou R, Dana T, Buckley DI, et al. Update Alert 2: Epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med.* 2020. doi: 10.7326/M20-4806.
3. Amendola A, Tanzi E, Folgori L, et al. Low seroprevalence of SARS-CoV-2 infection among healthcare workers of the largest children hospital in Milan during the pandemic wave. *Infect Control Hosp Epidemiol.* 2020:1-6. Epub 2020/08/08. doi: 10.1017/ice.2020.401. PubMed PMID: 32758311.
4. Blain H, Rolland Y, Tuaillon E, et al. Efficacy of a test-retest strategy in residents and health care personnel of a nursing home facing a COVID-19 outbreak. *J Am Med Dir Assoc.* 2020;21(7):933-6. Epub 2020/07/18. doi: 10.1016/j.jamda.2020.06.013. PubMed PMID: 32674822; PubMed Central PMCID: PMC7287418.
5. Blairon L, Mokrane S, Wilmet A, et al. Large-scale, molecular and serological SARS-CoV-2 screening of healthcare workers in a 4-site public hospital in Belgium after COVID-19 outbreak. *J Infect.* 2020. Epub 2020/08/03. doi: 10.1016/j.jinf.2020.07.033. PubMed PMID: 32739485; PubMed Central PMCID: PMC7392848.
6. Çelebi G, Pişkin N, Bekleviç A, et al. Specific risk factors for SARS-CoV-2 transmission among health care workers in a university hospital. *Am J Infect Control.* 2020. Epub 2020/08/11. doi: 10.1016/j.ajic.2020.07.039. PubMed PMID: 32771498; PubMed Central PMCID: PMC7409872.
7. Grant J, Wilmore S, McCann N, et al. Seroprevalence of SARS-CoV-2 antibodies in healthcare workers at a London NHS Trust. *Infect Control Hosp Epidemiol.* 2020:1-12. Epub 2020/08/05. doi: 10.1017/ice.2020.402. PubMed PMID: 32746953.
8. Houlihan CF, Vora N, Byrne T, et al. Pandemic peak SARS-CoV-2 infection and seroconversion rates in London frontline health-care workers. *Lancet.* 2020;396(10246):e6-e7. Epub 2020/07/13. doi: 10.1016/s0140-6736(20)31484-7. PubMed PMID: 32653078; PubMed Central PMCID: PMC7347344.
9. Hunter BR, Dbeibo L, Weaver CS, et al. Seroprevalence of severe acute respiratory coronavirus virus 2 (SARS-CoV-2) antibodies among healthcare workers with differing levels of coronavirus disease 2019 (COVID-19) patient exposure. *Infect Control Hosp Epidemiol.* 2020:1-2. Epub 2020/08/04. doi: 10.1017/ice.2020.390. PubMed PMID: 32741406.
10. Jeremias A, Nguyen J, Levine J, et al. Prevalence of SARS-CoV-2 infection among health care workers in a tertiary community hospital. *JAMA Intern Med.* 2020. Epub 2020/08/12. doi: 10.1001/jamainternmed.2020.4214. PubMed PMID: 32780100.
11. Kassem AM, Talaat H, Shawky S, et al. SARS-CoV-2 infection among healthcare workers of a gastroenterological service in a tertiary care facility. *Arab J Gastroenterol.* 2020. Epub 2020/08/01. doi: 10.1016/j.ajg.2020.07.005. PubMed PMID: 32732168; PubMed Central PMCID: PMC7373030.
12. Lackermair K, William F, Grzanna N, et al. Infection with SARS-CoV-2 in primary care health care workers assessed by antibody testing. *Fam Pract.* 2020. Epub 2020/08/09. doi: 10.1093/fampra/cmaa078. PubMed PMID: 32766704.
13. Moscola J, Sembajwe G, Jarrett M, et al. Prevalence of SARS-CoV-2 antibodies in health care personnel in the New York City area. *JAMA.* 2020. Epub 2020/08/12. doi: 10.1001/jama.2020.14765. PubMed PMID: 32780804.
14. Olalla J, Correa AM, Martín-Escalante MD, et al. Search for asymptomatic carriers of SARS-CoV-2 in healthcare workers during the pandemic: a Spanish experience. *QJM.* 2020. Epub 2020/08/11. doi: 10.1093/qjmed/hcaa238. PubMed PMID: 32777050.
15. Piapan L, De Michieli P, Ronchese F, et al. COVID-19 outbreak in healthcare workers in Trieste hospitals (North-Eastern Italy). *J Hosp Infect.* 2020. Epub 2020/08/18. doi: 10.1016/j.jhin.2020.08.012. PubMed PMID: 32805309; PubMed Central PMCID: PMC7427613.
16. Sotgiu G, Barassi A, Miozzo M, et al. SARS-CoV-2 specific serological pattern in healthcare workers of an Italian COVID-19 forefront hospital. *BMC Pulm Med.* 2020;20(1):203. Epub 2020/07/31. doi: 10.1186/s12890-020-01237-0. PubMed PMID: 32727446; PubMed Central PMCID: PMC7388425.
17. Villanueva AMG, Lazaro J, Sayo AR, et al. COVID-19 screening for healthcare workers in a tertiary infectious diseases referral hospital in Manila, the Philippines. *Am J Trop Med Hyg.* 2020. Epub 2020/07/31. doi: 10.4269/ajtmh.20-0715. PubMed PMID: 32729461.
18. Zhang GQ, Pan HQ, Hu XX, et al. The role of isolation rooms, facemasks and intensified hand hygiene in the prevention of nosocomial COVID-19 transmission in a pulmonary clinical setting. *Infect Dis Poverty.* 2020;9(1):104. Epub 2020/07/25. doi: 10.1186/s40249-020-00725-z. PubMed PMID: 32703281; PubMed Central PMCID: PMC7376530.

19. Zhao D, Wang M, Wang M, et al. Asymptomatic infection by SARS-CoV-2 in healthcare workers: a study in a large teaching hospital in Wuhan, China. *Int J Infect Dis*. 2020. Epub 2020/08/08. doi: 10.1016/j.ijid.2020.07.082. PubMed PMID: 32758693.
20. Chou R, Dana T, Buckley DI, et al. Update Alert: epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med*. 2020;173(2):W46-w7. Epub 2020/06/10. doi: 10.7326/l20-0768. PubMed PMID: 32515983; PubMed Central PMCID: PMC7304657.
21. Chou R, Dana T, Buckley DI, et al. Update Alert 3: epidemiology of and risk factors for coronavirus infection in health care workers. *Ann Intern Med*. 2020. Epub 2020/08/04. doi: 10.7326/l20-1005. PubMed PMID: 32744870; PubMed Central PMCID: PMC7418491.
22. El-Boghdadly K, Wong DJN, Owen R, et al. Risks to healthcare workers following tracheal intubation of patients with COVID-19: a prospective international multicentre cohort study. *Anaesthesia*. 2020. Epub 2020/06/10. doi: 10.1111/anae.15170. PubMed PMID: 32516833.
23. Maltezou HC, Dedoukou X, Tseroni M, et al. SARS-CoV-2 infection in healthcare personnel with high-risk occupational exposure: evaluation of seven-day exclusion from work policy. *Clin Infect Dis*. 2020;29(5864498).
24. Martin C, Montesinos I, Dauby N, et al. Dynamic of SARS-CoV-2 RT-PCR positivity and seroprevalence among high-risk health care workers and hospital staff. *J Hosp Infect*. 2020;25(20):30313-3.
25. Mutambudzi M, Niedzwiedz CL, Macdonald EB, et al. Occupation and risk of COVID-19: prospective cohort study of 120,621 UK Biobank participants. *medRxiv*. 2020:2020.05.22.20109892. doi: 10.1101/2020.05.22.20109892.
26. Nguyen LH, Drew DA, Joshi AD, et al. Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study. *The Lancet*. 2020;July 25:2020.04.29.20084111. doi: 10.1101/2020.04.29.20084111.
27. Schmidt SB, Gruter L, Boltzmann M, et al. Prevalence of serum IgG antibodies against SARS-CoV-2 among clinic staff. *PLoS One*. 2020;15(6):e0235417. Epub 2020/06/26. doi: 10.1371/journal.pone.0235417. PubMed PMID: 32584894.
28. Bai Y, Wang X, Huang Q, et al. SARS-CoV-2 infection in health care workers: a retrospective analysis and a model study. *medRxiv*. 2020:2020.03.29.20047159. doi: 10.1101/2020.03.29.20047159.
29. Baker MA, Rhee C, Fiumara K, et al. COVID-19 infections among healthcare workers exposed to a patient with a delayed diagnosis of COVID-19. *Infect Control Hosp Epidemiol*. 2020:1-9. Epub 2020/05/28. doi: 10.1017/ice.2020.256. PubMed PMID: 32456720.
30. Buchtele N, Rabitsch W, Knaus HA, et al. Containment of a traceable COVID-19 outbreak among healthcare workers at a hematopoietic stem cell transplantation unit. *Bone Marrow Transplant*. 2020. Epub 2020/06/03. doi: 10.1038/s41409-020-0958-6. PubMed PMID: 32483288.
31. Folgosa MD, Munoz-Ruiperez C, Alonso-Lopez MA, et al. SARS-CoV-2 infection in health care workers in a large public hospital in Madrid, Spain, during March 2020. *medRxiv*. 2020:2020.04.07.20055723. doi: 10.1101/2020.04.07.20055723.
32. Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient - Solano County, California, February 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(15):472-6. Epub 2020/04/17. doi: 10.15585/mmwr.mm6915e5. PubMed PMID: 32298249.
33. Khalil A, Hill R, Ladhani S, et al. COVID-19 screening of health-care workers in a London maternity hospital. *Lancet Infect Dis*. 2020. Epub 2020/05/22. doi: 10.1016/s1473-3099(20)30403-5. PubMed PMID: 32437699.
34. Lai X, Wang M, Qin C, et al. Coronavirus Disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary hospital in Wuhan, China. *JAMA Netw Open*. 2020;3(5):e209666. Epub 2020/05/22. doi: 10.1001/jamanetworkopen.2020.9666. PubMed PMID: 32437575.
35. Liu J, Ouyang L, Guo P, et al. Epidemiological, clinical and radiological findings in medical staff with COVID-19 in Wuhan, China: a single-centered, retrospective cohort study 2020.
36. Luigi V, Alessandro D, Giovanni M, et al. Prevention and protection measures of healthcare workers exposed in health settings to severe acute respiratory infections from SARS-CoV-2 in a university hospital in Bari, Apulia Region, southern Italy. *J Hosp Infect*. 2020. Epub 2020/05/24. doi: 10.1016/j.jhin.2020.05.024. PubMed PMID: 32445776; PubMed Central PMCID: PMC7239006.
37. Murphy DL, Barnard LM, Drucker CJ, et al. Occupational exposures and programmatic response to COVID-19 pandemic: an emergency medical services experience. *medRxiv*. 2020:2020.05.22.20110718. doi: 10.1101/2020.05.22.20110718.

38. Ran L, Chen X, Wang Y, et al. Risk factors of healthcare workers with Corona Virus Disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. *Clin Infect Dis*. 2020. Epub 2020/03/18. doi: 10.1093/cid/ciaa287. PubMed PMID: 32179890.
39. Treibel TA, Manisty C, Burton M, et al. COVID-19: PCR screening of asymptomatic health-care workers at London hospital. *Lancet*. 2020. Epub 2020/05/14. doi: 10.1016/s0140-6736(20)31100-4. PubMed PMID: 32401714.
40. Wang Q, Huang X, Bai Y, et al. Epidemiological characteristics of COVID-19 in medical staff members of neurosurgery departments in Hubei province: A multicentre descriptive study. *medRxiv*. 2020:2020.04.20.20064899. doi: 10.1101/2020.04.20.20064899.
41. Bays DJ, Nguyen MH, Cohen SH, et al. Investigation of nosocomial SARS-CoV-2 transmission from two patients to health care workers identifies close contact but not airborne transmission events. *Infect Control Hosp Epidemiol*. 2020;1-22. Epub 2020/07/04. doi: 10.1017/ice.2020.321. PubMed PMID: 32618530.
42. Clemency BM, Varughese R, Scheafer DK, et al. Symptom criteria for COVID-19 testing of health care workers. *Acad Emerg Med*. 2020. Epub 2020/05/13. doi: 10.1111/acem.14009. PubMed PMID: 32396670.
43. Dai Y, Hu G, Xiong H, et al. Psychological impact of the coronavirus disease 2019 (COVID-19) outbreak on healthcare workers in China. *medRxiv*. 2020:2020.03.03.20030874. doi: 10.1101/2020.03.03.20030874.
44. Felice C, Di Tanna GL, Zanusi G, et al. Impact of COVID-19 outbreak on healthcare workers in Italy: results from a national e-survey. *J Community Health*. 2020. Epub 2020/05/23. doi: 10.1007/s10900-020-00845-5. PubMed PMID: 32440724; PubMed Central PMCID: PMC7242177.
45. Gheysarzadeh A, Sadeghifard N, Safari M, et al. Report of 5 nurses infecting COVID-19 during patient care: case Series. *New Microbes New Infect*. 2020:100694. Epub 2020/05/15. doi: 10.1016/j.nmni.2020.100694. PubMed PMID: 32405418; PubMed Central PMCID: PMC7219377.
46. Kang L, Ma S, Chen M, et al. Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 Novel Coronavirus Disease outbreak: a cross-sectional study. *Brain Behav Immun*. 2020. Epub 2020/04/03. doi: 10.1016/j.bbi.2020.03.028. PubMed PMID: 32240764.
47. Kluysmans M, Buiting A, Pas S, et al. Prevalence and clinical presentation of health care workers with symptoms of coronavirus disease 2019 in 2 Dutch hospitals during an early phase of the pandemic. *JAMA Netw Open*. 2020;3(5):e209673. doi: 10.1001/jamanetworkopen.2020.9673. PubMed Central PMCID: PMC7243090.
48. Korth J, Wilde B, Dolff S, et al. SARS-CoV-2-specific antibody detection in healthcare workers in Germany with direct contact to COVID-19 patients. *J Clin Virol*. 2020:104437. Epub 2020/05/15. doi: 10.1016/j.jcv.2020.104437. PubMed PMID: 32405256; PubMed Central PMCID: PMC7219425.
49. Lahner E, Dilaghi E, Prestigiacomo C, et al. Prevalence of SARS-CoV-2 infection in health workers (HWs) and diagnostic test performance: the experience of a teaching hospital in Central Italy. *Int J Environ Res Public Health*. 2020;17(12). Epub 2020/06/25. doi: 10.3390/ijerph17124417. PubMed PMID: 32575505.
50. Liu C, Yang Y-z, Zhang XM, et al. The prevalence and influencing factors for anxiety in medical workers fighting COVID-19 in China: A cross-sectional survey. *Epidemiol Infect*. 2020;May 20(148):e98. doi: 10.1101/2020.03.05.20032003. PubMed Central PMCID: PMC32430088.
51. Lombardi A, Consonni D, Carugno M, et al. Characteristics of 1,573 healthcare workers who underwent nasopharyngeal swab for SARS-CoV-2 in Milano, Lombardy, Italy. *Clin Microbiol Infect*. 2020;Jun 19:S1198-743X(20)30354-2. doi: 10.1101/2020.05.07.20094276. PubMed Central PMCID: PMC7305713.
52. Maida M, Sferrazza S, Savarino E, et al. Impact of the COVID-19 pandemic on Gastroenterology Divisions in Italy: a national survey. *Dig Liver Dis*. 2020. Epub 2020/05/20. doi: 10.1016/j.dld.2020.05.017. PubMed PMID: 32425733; PubMed Central PMCID: PMC7229963.
53. Manzoni P, Milillo C. COVID-19 mortality in Italian doctors. *J Infect*. 2020. Epub 2020/05/24. doi: 10.1016/j.jinf.2020.05.034. PubMed PMID: 32445726; PubMed Central PMCID: PMC7239786.
54. Rivett L, Sridhar S, Sparkes D, et al. Screening of healthcare workers for SARS-CoV-2 highlights the role of asymptomatic carriage in COVID-19 transmission. *Elife*. 2020;9. Epub 2020/05/12. doi: 10.7554/eLife.58728. PubMed PMID: 32392129.
55. Romero CS, Catala J, Delgado C, et al. COVID-19 Psychological impact in 3109 healthcare workers in Spain: The PSIMCOV Group. *Psychol Med*. 2020:1-14. Epub 2020/05/15. doi: 10.1017/s0033291720001671. PubMed PMID: 32404217.
56. Roxby AC, Greninger AL, Hatfield KM, et al. Outbreak investigation of COVID-19 among residents and staff of an independent and assisted living community for older adults in Seattle, Washington. *JAMA Intern Med*. 2020. Epub 2020/05/22. doi: 10.1001/jamainternmed.2020.2233. PubMed PMID: 32437547.
57. Shields AM, Faustini SE, Perez-Toledo M, et al. SARS-CoV-2 seroconversion in health care workers. *medRxiv*. 2020:2020.05.18.20105197. doi: 10.1101/2020.05.18.20105197.

58. Sikkema RS, Pas S, Nieuwenhuijse DF, et al. COVID-19 in healthcare workers in three hospitals in the South of the Netherlands, March 2020. *Lancet Infect Dis.* 2020:S1473-3099. doi: 10.1101/2020.04.26.20079418.
59. Sikora K, Barwick I, Hamilton C. Serological prevalence of antibodies to SARS CoV-2 amongst cancer centre staff. *medRxiv.* 2020:2020.05.16.20099408. doi: 10.1101/2020.05.16.20099408.
60. Tang JW, Young S, May S, et al. Comparing hospitalised, community and staff COVID-19 infection rates during the early phase of the evolving COVID-19 epidemic. *J Infect.* 2020. Epub 2020/05/23. doi: 10.1016/j.jinf.2020.05.029. PubMed PMID: 32442455; PubMed Central PMCID: PMC7236702.
61. von Freyburg A, Hagedorn H, Brucher B, et al. [COVID-19 cluster study at a teaching hospital]. *MMW Fortschr Med.* 2020;162(9):64-7. Epub 2020/05/15. doi: 10.1007/s15006-020-0482-z. PubMed PMID: 32405834.
62. Zhang SX, Liu J, Afshar Jahanshahi A, et al. At the height of the storm: Healthcare staff's health conditions and job satisfaction and their associated predictors during the epidemic peak of COVID-19. *Brain Behav Immun.* 2020. Epub 2020/05/11. doi: 10.1016/j.bbi.2020.05.010. PubMed PMID: 32387345.
63. Zheng L, Wang X, Zhou C, et al. Analysis of the infection status of the health care workers in Wuhan during the COVID-19 outbreak: A cross-sectional study. *Clin Infect Dis.* 2020. Epub 2020/05/16. doi: 10.1093/cid/ciaa588. PubMed PMID: 32409825.
64. Zhu Z, Xu S, Wang H, et al. COVID-19 in Wuhan: immediate psychological impact on 5062 health workers. *medRxiv.* 2020:2020.02.20.20025338. doi: 10.1101/2020.02.20.20025338.
65. Lapolla P, Mingoli A, Lee R. Deaths from COVID-19 in healthcare workers in Italy - what can we learn? *Infect Control Hosp Epidemiol.* 2020:1-4. Epub 2020/05/16. doi: 10.1017/ice.2020.241. PubMed PMID: 32408922.
66. Liu J, Ouyang L, Guo P, et al. Epidemiological, clinical characteristics and outcome of medical staff infected with COVID-19 in Wuhan, China: a retrospective case series analysis. *medRxiv.* 2020:2020.03.09.20033118. doi: 10.1101/2020.03.09.20033118.
67. Liu M, He P, Liu HG, et al. [Clinical characteristics of 30 medical workers infected with new coronavirus pneumonia]. *Zhonghua Jie He He Hu Xi Za Zhi.* 2020;43(3):209-14. Epub 2020/03/14. doi: 10.3760/cma.j.issn.1001-0939.2020.03.014. PubMed PMID: 32164090.
68. McMichael TM, Currie DW, Clark S, et al. Epidemiology of COVID-19 in a long-term care facility in King County, Washington. *N Engl J Med.* 2020. doi: 10.1056/NEJMoa2005412.
69. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. [The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China]. *Zhonghua Liu Xing Bing Xue Za Zhi.* 2020;41(2):145-51. Epub 2020/02/18. doi: 10.3760/cma.j.issn.0254-6450.2020.02.003. PubMed PMID: 32064853.
70. Wang X, Pan Z, Cheng Z. Association between 2019-nCoV transmission and N95 respirator use. *J Hosp Med.* 2020(March 3). Epub 2020/03/03. doi: 10.1016/j.jhin.2020.02.021.
71. Du J, Dong L, Wang T, et al. Psychological symptoms among frontline healthcare workers during COVID-19 outbreak in Wuhan. *Gen Hosp Psychiatry.* 2020. Epub 2020/05/10. doi: 10.1016/j.genhosppsych.2020.03.011. PubMed PMID: 32381270; PubMed Central PMCID: PMC7194721.
72. Huang F, Yang Z, Wang Y, et al. Study on health-related quality of life and influencing factors of pediatric medical staff during the COVID-19 outbreak. *Research Square preprint* 2020. doi: 10.21203/rs.3.rs-27641/v.
73. Huang JZ, Han MF, Luo TD, et al. [Mental health survey of medical staff in a tertiary infectious disease hospital for COVID-19]. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi.* 2020;38(3):192-5. Epub 2020/03/05. doi: 10.3760/cma.j.cn121094-20200219-00063. PubMed PMID: 32131151.
74. Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to Coronavirus Disease 2019. *JAMA Netw Open.* 2020;3(3):e203976. Epub 2020/03/24. doi: 10.1001/jamanetworkopen.2020.3976. PubMed PMID: 32202646.
75. Li W, Frank E, Zhao Z, et al. Mental Health of Young Physicians in China During the Novel Coronavirus Disease 2019 Outbreak. *JAMA Netw Open.* 2020;3(6):e2010705. Epub 2020/06/02. doi: 10.1001/jamanetworkopen.2020.10705. PubMed PMID: 32478846.
76. Liu Y, Liu X, Gao B, et al. Mental distress among frontline healthcare workers outside the central epidemic area during the novel coronavirus disease (COVID-19) outbreak in China: A cross-sectional study. 2020. doi: 10.21203/rs.3.rs-26633/v1.
77. Lu W, Wang H, Lin Y, et al. Psychological status of medical workforce during the COVID-19 pandemic: A cross-sectional study. *Psychiatry Res.* 2020;288:112936. Epub 2020/04/11. doi: 10.1016/j.psychres.2020.112936. PubMed PMID: 32276196.
78. Qi J, Xu J, Li B, et al. The evaluation of sleep disturbances for Chinese frontline medical workers under the outbreak of COVID-19. *Sleep Med.* 2020;May 23:2020.03.06.20031278. doi: 10.1101/2020.03.06.20031278. PubMed Central PMCID: PMC7244440.

79. Wang B, Sun J, Gao F, et al. A study on mental health status among the staff in a designated hospital for COVID-19 2020.
80. Ying Y, Kong F, Zhu B, et al. Mental health status among family members of health care workers in Ningbo, China during the Coronavirus Disease 2019 (COVID-19) outbreak: a Cross-sectional Study. *BMC Psychiatry*. 2020;20(1):379. doi: 10.1101/2020.03.13.20033290.
81. Zhou Q, Lai X, Wan C, et al. Prevalence and impact of burnout, secondary traumatic stress and compassion satisfaction on hand hygiene of healthcare workers in medical aid team during COVID-19 pandemic. 2020. doi: 10.21203/rs.3.rs-28820/v1.
82. Nguyen LH, Drew DA, Joshi AD, et al. Risk of symptomatic Covid-19 among frontline healthcare workers. *medRxiv*. 2020:2020.04.29.20084111. doi: 10.1101/2020.04.29.20084111.
83. García IS, López M, Vicente AS, et al. SARS-CoV-2 infection among healthcare workers in a hospital in Madrid, Spain. *J Hosp Infect*. 2020. Epub 2020/07/24. doi: 10.1016/j.jhin.2020.07.020. PubMed PMID: 32702465.
84. Ng K, Poon BH, Kiat Puar TH, et al. COVID-19 and the risk to health care workers: a case report. *Ann Intern Med*. 2020. Epub 2020/03/17. doi: 10.7326/120-0175. PubMed PMID: 32176257; PubMed Central PMCID: PMC7081171.
85. Stubblefield WB, Talbot HK, Feldstein L, et al. Seroprevalence of SARS-CoV-2 among frontline healthcare personnel during the first month of caring for COVID-19 patients - Nashville, Tennessee. *Clin Infect Dis*. 2020. Epub 2020/07/07. doi: 10.1093/cid/ciaa936. PubMed PMID: 32628750.
86. Chatterjee P, Anand T, Singh KJ, et al. Healthcare workers & SARS-CoV-2 infection in India: A case-control investigation in the time of COVID-19. *Indian J Med Res*. 2020;151(5):459-67. Epub 2020/07/03. doi: 10.4103/ijmr.IJMR_2234_20. PubMed PMID: 32611916.