Supplementary Material*

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

Supplement Table 1. 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
Prospective cohort studies			

Abdelmoniem et al 2020 (31)
 	
Prospective cohort
 	
Egypt (Cairo); 1 university hospital; 1 to 14 June 2020
	203 asymptomatic ED HCWs
	• Mean age 32 y
	• 49% female
	• 37% physician, 44% nurse, 12% cleaning and transportation, 7% administration
	• 86% contact with confirmed or suspected COVID-19 patient
	• 13.9% SARS-CoV-2 infection (PCR)
		Age: Mean 31.7 (cases) vs 31.9 (non-cases) years, p=0.86
		Sex
		• Female: 16.1% (16/99)
		• Male: 12.5% (13/104)
		  o Female vs. male: OR 1.35 (0.61-2.97)*
		HCW role
		• Nurse: 16.8% (15/89)
		• Physician: 9.4% (7/74)
		  o Nurse vs. physician: OR 1.95 (0.75-5.05)*
		• Cleaner/transportation: 20.8% (5/24)
		• Radiology/lab: 0% (0/2)
		• Administration: 14.3% (2/14)
		Contact with COVID-19 infected patient (suspected or confirmed)
		• Contact: 12.5% (22/176)
		• No contact: 25.9% (7/27)
		  o Contact vs. no contact: OR 0.41 (0.15-1.08)*
		Proper hand hygiene practice
		• Yes: 14.1% (27/192)
		• No: 18.2% (2/11)
		  o Yes vs. no: OR 0.74 (0.15-3.59)*
		PPE use as recommended
		• Yes: 14.3% (27/189)
		• No: 14.3% (2/14)
		  o Yes vs. no: OR 1.00 (0.21-4.72)
		Comorbidities
		• Yes: 8.0% (2/25)
		• No: 15.2% (27/178)
		  o Yes vs. no: OR 0.49 (0.11-2.18)
			No control for confounders; potential recall bias; 37% participation rate

Bahrs et al., 2021 (32) Prospective cohort Germany (Jena); 1 academic hospital 19 May to 19 June 2020	660 HCWs • Median age 40 y • 73.6% female • 32.6% nurses, 27.3% administration, 15.6% physicians, 2.7%	Sex • Female: 2.7% (13/486) • Male: 2.9% (5/174) o Female vs. male: OR 0.93 (0.33-2.64)* HCW role • Physician: 4.8% (5/103); reference	20% participation rate; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	nursing assistants, 2.7% psychologists, 2.6% ergo therapists • 2.7% SARS-CoV-2 seropositive	• Nurse or care worker: 2.3% (5/215); adjusted OR 0.38 (0.10-1.34) • Cleaner: 16.7% (1/6); adjusted OR 2.75 (0.25-29.93) • Reception staff: 5.3% (1/19); adjusted OR 0.73 (0.07-7.32) • Administrative staff: 3.3% (6/180); adjusted OR 0.51 (0.13-1.93) • Other 0% (0/130) Work COVID-19 risk category • High-risk (patient contact with confirmed COVID-19 patients or high number of suspected cases): 1.5% (2/137); reference • Intermediate-risk (patient contact, no routine contact with confirmed or suspected COVID-19 patients): 2.9% (10/343); adjusted OR 1.97 (0.42-9.22) • Low-risk (no patient contact): 3.3% (6/180); adjusted OR 2.10 (0.40-11.06)	

Barrett et al 2020 (33)
 	
Prospective cohort
 	
United States (New Jersey); 2 hospitals; 24 March to 7 April 2020
	546 HCWs with increased risk of SARS-CoV-2 infection (≥20 hours work/week, regular patient exposure and regular direct patient contact)
	• Mean age not reported; 55% age 20-39 y, 37% age 40-59 y, 8% ≥60 y
	• 65% female
	• 38% physician, 41% nurse, 21% other HCW role
	• 14% COVID-19 symptoms in last week
	• 7.3% SARS-CoV-2 infection (PCR)
		HCW role
		• Nurse: 11.1% (25/225)
		• Physician (attending, resident or fellow): 2.4% (5/210)
		  ○ Nurse vs. physician: *OR 5.12 (1.92-13.65)**
		• Other HCW role: 9% (10/111)
		• Emergency department: 8.2% (20/245)
		• Medical floor: 4.9% (9/185)
		• Operating room: 9.7% (13/134)
		• ICU: 2.2% (4/192)
		• COVID-19 unit: 7.9% (5/63)
		• Other unit: 5.5% (14/255)
		PPE use (estimated proportion of patients for which PPE [gloves, gown and surgical or N95 mask] used)
		• <25%: 4.6% (4/87)
		• 25-49%: 3.5% (2/59)
		• 50-74%: 6.7% (4/61)
		• 75-99%: 9.8% (4/41)100%: 10.5% (25/238)
		  ○ <25% vs. 100%: OR 0.41 (0.14-1.22)*
		Average number of patients with suspected or confirmed COVID-19 per shift
		• 0: 4.1% (6/148)
		• >0-<5: 5.6% (9/162)
		• ≥5: 10.6% (24/226)
		• Missing data: 10% (1/10)
		  ○ 0 vs. ≥5 patients: *OR 0.36 (0.14-0.89)**
		Estimated percentage of work-time spent in patients' rooms
		• <25%: 5.2% (11/210)
		• 25-49%: 6.0% (7/117)
			No control for confounders; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• 50-74%: 9.5% (11/116) • ≥75%: 11.6% (11/95) ○ <25% vs. ≥75%: OR 0.42 (0.18-1.01)*	
Blairon et al, 2020 (34) Prospective cohort Belgium (Brussels); 4 hospitals; 25 May to 19 June 2020	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

Calcagno et al 2020 (35)
 	
Prospective cohort
 	
Italy (Turin); public hospitals and outpatient clinics; 17 April to 20 May 2020
	5,444 HCWs (4,306 with HCW role data)
	• Mean age 49 y
	• 75% female
	• 16% physician, 42% nurse, 11% nurse assistant, 10% healthcare personnel, 0.7% pharmacist, 12% administrative employee, 5% technical personnel, 4% laboratory personnel, 0.3% veterinarian
	• 6.9% SARS-CoV-2 seroprevalence
		HCW role
		• Nurse: 8.2% (150/1833)
		• Physician: 7.8% (55/700)
		   ○ Nurse vs. physician: OR 1.05 (0.76-1.44)*
		• Nurse assistant: 9.2% (44/476)
		   ○ Nurse or nurse assistant vs. physician: OR 1.08 (0.79-1.47)
		• Healthcare personnel: 6.7% (23/343)
		• Pharmacist: 3.4% (1/29)
		• Administrative employee: 3.3% (18/539)
		• Technical personnel: 6.9% (15/216)
		• Laboratory personnel: 11.5% (18/157)
		• Veterinarian: 0% (0/13)
			No control for founders; 73% participation rate; incomplete data for 21% of participants

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Damluji et al 2021 (36) Prospective cohort United States (Northern Virginia); April to November 2020 (specific dates not reported)	1323 asymptomatic HCWs with 6-month followup data • Mean age not reported; 19% 20-29 y, 29% 30-39 y, 24% 40-49 y, 18% 50-59 y, 10% ≥60 y • 81% female • 58% White, 11% Black, 8% Hispanic, 22% other race/ethnicity • Specific HCW role not reported; 79% direct patient care role, 21% non-direct role • 4.8% SARS-CoV-2 seropositive	Age • 20-29 y: 7.9% (20/253); reference • 30-39 y: 4.7% (18/381); *adjusted OR 0.48 (0.23-0.96)* • 40-49 y: 3.7% (12/321); *adjusted OR 0.44 (0.19-0.92)* • 50-59 y: 3.8% (9/238); *adjusted OR 0.41 (0.16-0.93)* • ≥60 y: 3.8% (5/130); adjusted OR 0.40 (0.11-1.05) Sex • Female: 4.6% (49/1070); reference • Male: 5.9% (15/253); adjusted OR 1.52 (0.77-2.77) Race/ethnicity • White: 4.0% (31/775); reference • Black: 8.8% (13/147); *adjusted OR 2.53 (1.20-5.05)* • Hispanic: 7.7% (8/104); adjusted OR 1.37 (0.50-3.09) • Other race/ethnicity: 4.0% (12/297); adjusted OR 1.07 (0.50-2.07) HCW role • Direct patient care role: 4.9% (51/1051); reference • Non-direct role: 4.8% (13/272); adjusted OR 0.93 (0.45-1.73)	27% dropout rate; potential selection bias; limited control of confounders
Dillner et al 2021 (37) Prospective cohort Sweden (Stockholm); university hospital; 23 April to 22 May 2020	12,928 HCWs • Mean age not reported; 12% <29 y, 25% 30-39 y, 25% 40-49 y, 24% 50-59 y, 15% ≥60 y • 79% female • HCW role not reported • 11.4% SARS-CoV-2 seropositivity	Age • < 29 y: 16.4% (249/1522); reference • 30-39 y: 12.1% (383/3172); *OR 0.70 (0.59-0.83)** • 40-49 y: 11.4% (370/3238); *OR 0.66 (0.55-0.78)** • 50-59 y: 10.2% (313/3066); *OR 0.58 (0.49-0.70)** • ≥60 y: 8.6% (166/1930); *OR 0.48 (0.39-0.59)**	84% participation rate; no data on HCW role; no control for confounders
Doernberg et al 2022 (20) Prospective cohort United States (San Francisco, CA); July 2020 to January 2021	2435 HCWs • Mean age 40 y • 79% female • 61% White, 23% Asian, 2% Black, 6% mixed race, 6% other race; 12% Latinx	*Incident cases* Age • Per year: adjusted HR 1.0 (1.0-1.0) Sex • Female: 2.9% (55/1923); adjusted HR 0.83 (0.45-1.67)* • Male: 2.9%(15/512); reference Race • White: 2.7% (38/1411); reference	Participation rate 62% among those screened (number eligible not reported); potential recall bias; some risk estimates imprecise

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Added for Update Alert #11	• 44% nurse, 22% clinician, 5% research or administration, 5% support service, 3% laboratory worker, 3% care coordinator, 2% clinic manager, 1% respiratory or speech therapist, <1% environmental or food services
	• 3.7% SARS-CoV-2 infection (PCR) or seropositive
		• Black: 5.4% (2/37); adjusted HR 2.6 (0.6-11.1)
		• Asian: 3.0% (16/530); adjusted HR 1.2 (0.7-2.2)
		• Mixed race: 2.2% (3/137); adjusted HR 0.8 (0.2-2.7)
		HCW role
		• Nurse: 3.2% (34/1077); adjusted HR 1.67 (0.91-3.33)*
		• Clinician: 2.0% (16/804); reference
		Exposure category
		• Low risk COVID-19 exposure (ever providing direct care, being within 6 feet, or being within the environment of a COVID-19 patient or being involved with laboratory processing of samples from COVID-19 patients): 1.9% (13/680); adjusted HR 0.8 (0.4-1.7)
		• High risk COVID-19 exposure (ever interacting with a COVID-19 patient without full PPE or having a breach in PPE [e.g., tears, accidental removal]): 3.9% (31/797); **adjusted HR 2.5 (1.3-4.8)**
		• No exposure: 2.8% (26/942); reference
		Time spent in the healthcare workplace
		• <10 hours/week: 3.3% (3/90); reference
		• 10-20 hours/week: 1.8% (3/169); adjusted HR 1.9 (0.5-7.9)
		• 21-30 hours/week: 3.0% (9/296); adjusted HR 2.5 (0.7-8.9)
		• 31-40 hours/week: 3.4% (39/1148); adjusted HR 2.2 (0.7-7.0)
		• >40 hours/week: 2.3% (16/688); adjusted HR 2.0 (0.6-6.6)
		Time spent providing direct patient-facing care:
		• <10 hours/week: 1.0% (3/305); adjusted HR 0.5 (0.2-0.9)
		• 10-20 hours/week: 2.5% (10/400); adjusted HR 0.6 (0.3-1.3)
		• 21-30 hours/week: 4.0% (16/397); adjusted HR 0.9 (0.5-1.7)
		• 31-40 hours/week: 3.5% (29/825); reference
		• >40 hours/week: 1.9% (5/258); adjusted HR 0.9 (0.4-2.0)
		Direct contact with a person with COVID-19 outside of work
		• Yes: 9.6% (17/176); **adjusted HR 8.1 (3.8-17.5)**
		• No: 2.3% (53/2259); reference
		Avoiding exposure others when not at work
		• All/most of the time: 2.5% (33/1312); adjusted HR 1.0 (0.6-1.6)
		• Some/none of the time: 3.3% (37/1107); reference
		PPE
		• Wearing a mask when not at work
		    o All of the time: 2.8% (49/1778); adjusted HR 0.8 (0.5-1.6)
		    o Most/some of the time or never: 3.3% (21/641); reference	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
El Abdellati et al, 2021 (38) Prospective cohort Belgium (Antwerp); 1 psychiatric hospital; 3 to 17 June 2020	431 asymptomatic clinical and nonclinical HCW • Age and sex not reported for entire cohort • 42.0% nurses, 31.3% non-clinical staff, 13.0% paramedical staff, 6.0% psychologists, 4.2% physicians, 3.5% other • 3.2% SARS-CoV-2 seropositivity	Age • Mean 46.8 (cases) vs. 43.7 (non-cases) years, p>0.05 Sex • Female: 2.8% (10/355) • Male: 5.3% (4/76) ○ Female vs. male: OR 0.52 (0.16 to 1.71)*	No control for confounders; 47% participation rate
el-Boghdadly et al, 2020 (39) 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
Ferreira et al 2021 (40) Prospective cohort	1669 asymptomatic HCWs *Infection (PCR; n=1669)* • Mean age 40 y	*Infection (PCR)* HCW role • Nurse: 1.2% (8/655)	Participation rate ~14%; no control for confounders; some

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Canada (Toronto); 1 multisite acute and long-term care system; 17 April to 29 May 2020	79% female 39% nurse, 9% physician, 27% allied health, 24% other role, 1% role not reported 0.5% SARS-CoV-2 infection *Seropositive (n=996)* - Mean age 41 y 78% female 36% nurse, 10% physician, 26% allied health, 27% other role, 0.1% role not reported 1.4% SARS-CoV-2 seropositive	- Physician: 0% (0/152) - Nurse vs. physician: OR 4.00 (0.23-69.75)* - Allied health: 2.2% (1/446) Exposure - Direct care of COVID patient: 0.6% (3/472) - No direct care of COVID patient: 0.6% (6/1083) - Direct care vs. no direct care: OR 1.15 (0.29 to 4.61)* *Seropositive* HCW role - Nurse: 1.9% (7/361) - Physician: 1.0% (1/101) - Nurse vs. physician: OR 1.98 (0.24-16.26)* - Allied health: 1.9% (5/261) Exposure: - Direct care of COVID patient: 0.4% (1/255) - No direct care of COVID patient: 1.9% (13/672) - Direct care vs. no direct care: OR 0.20 (0.03-1.53)*	missing data; imprecise estimates
Grant et al, 2020 (41) Prospective cohort UK (London); multicenter health trust; March to May 2020	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	Incidence of SARS-CoV-2 infection seropositivity - Clinical setting with prolonged direct patient contact: 34.7% (467/1345) - 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)	Limited information on demographic characteristics of HCWs; participation rate not reported
Hall et al 2021 (42) Prospective cohort	25,661 HCWs - Median age 46 y 84% female 87% white, 7% mixed race, 2% Asian, 2%	Sex - Female: 31.6% (6840/21617); ***OR 0.84 (0.78-0.90)**** - Male: 35.5% (1425/4010); reference - Other: 38.2% (13/34); OR 1.12 (0.56-2.25)* Race/ethnicity	Potential recall bias; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
United Kingdom (throughout England); NHS publicly funded hospitals; 18 June to 31 December 2020	Black, 1% Chinese, 0.6% other race/ethnicity, 0.2% declined • 42% nurse of healthcare assistant, 15% administration, 11% physician, 6% specialist, 4% healthcare scientist, 2% midwife, 2% pharmacist, 1% estates, porters or security • 32.3% SARS-CoV-2 infection (PCR), seropositivity or both	• White: 31.1% (6969/22404); reference • Mixed race: 40.8% (724/1773); *OR 1.53 (1.38-1.69)** • Asian: 45.0% (236/525); *OR 1.81 (1.52-2.15)** • Black: 32.5% (134/412); OR 1.07 (0.87-1.31)* • Chinese: 42.5% (147/346); *OR 1.64 (1.32-2.03)** • Other ethnic group: 33.8% (51/151); OR 1.13 (0.81-1.58)* • Not reported: 34.0% (17/50); OR 1.14 (0.64-2.05)* HCW role • Nurse or healthcare assistant: 34.4% (3751/10891); OR 0.94 (0.86-1.02)* • Physician: 35.9% (999/2783); reference • Administration: 27.9% (1090/3903); *OR 0.69 (0.62-0.77)** • Specialist: 31.6% (489/1548); *OR 0.82 (0.72-0.94)** • Scientist: 25.2% (225/894); *OR 0.60 (0.51-0.71)** • Midwife: 29.1% (189/649); *OR 0.73 (0.61-0.88)** • Pharmacist: 28.7% (112/390); *OR 0.72 (0.57-0.91)** • Estates, porters or security: 37.1% (95/256); OR 1.05 (0.81-1.37)* • Other role: 30.5% (1328/4347); *OR 0.79 (0.71-0.87)** Exposure • Direct patient contact: 32.9% (7280/22112); *OR 1.25 (1.16-1.36)** • No direct patient contact: 28.1% (998/3549); reference Medical conditions • None: 32.4% (6195/19,125); reference • Chronic respiratory conditions: 31.4% (1019/3248); OR 0.95 (0.88-1.03)* • Chronic non-respiratory conditions: 33.1% (909/2746); OR 1.03 (0.95-1.12)* • Immunosuppression: 28.6% (155/542); OR 0.84 (0.69-1.01)* Index of multiple deprivation • 5 (least deprived): 32.3% (1968/6094); reference • 4: 31.3% (1880/6005); OR 0.96 (0.89-1.03)* • 3: 31.2% (1823/5842); OR 0.95 (0.88-1.03)* • 2: 32.2% (1469/4563); OR 1.00 (0.92-1.08)* • 1 (most deprived): 36.1% (1054/2916); *OR 1.19 (1.08-1.30)** Antibody status (incidence [per 1000 participants] of reinfection [antibody positive cohort] vs. new infection [antibody negative cohort]) • Symptomatic: 6.0 vs. 64.8 • All events: 18.7 vs. 98.0	
Houlihan et al, 2020 (43)	200 frontline HCWs • Median age 34 7	Incidence of SARS-CoV-2 infection (seropositive or PCR) • Age <30: 54% (31/57)	Limited information on demographic

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Prospective cohort
 	
UK (London); 1 acute care hospital; 26 March to 8 April 2020
	• 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
		• 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)
			characteristics of HCWs; selection of HCWs for testing unclear; no control for confounders

Howard-Anderson et al 2022 (23)
 	
Prospective cohort
 	
United States (Atlanta, GA); academic health system comprised of 4 hospitals and associated clinics; May to December 2020
 	
Added for Update Alert #11
	301 HCWs
	• Mean age not reported; 57% <40 y
	• 77% female
	• 73% White, 11% Black, 10% Asian,7% other/no answer
	• 40% nurse, 26% physician, 24% other HCW, 10% administration
	• 9.5% SARS-CoV-2 seropositive
		Age
		• <40 y: 8.7% (15/172); adjusted OR 0.9 (0.3-2.5)
		• ≥40 y: 8.5% (11/129); reference
		Sex
		• Female vs. male: 9.1% (21/231) vs. 7.1% (5/70); OR 1.3 (0.5-0.4); not included in multivariate model
		Occupation (not included in multivariate model)
		• Administrator: 9.7% (3/31); reference
		• Nursing: 11.8% (11/119); OR 1.2 (0.4-5.7)
		• Other healthcare personnel: 8.3% (6/72); OR 0.8 (0.2-4.2)
		• Physician/advanced practice provider: 3.8% (3/79); OR 0.4 (0.1-2.1)
		Race
		• Asian: 3.4% (1/29); adjusted OR 0.8 (0.0-4.9)
		• Black: 21.1% (7/33); *adjusted OR 4.5 (1.3-14.2)*
		• Other race/ethnicity/not reported: 5.0% (1/20); adjusted OR 0.9 (0.0-5.2)
		• White: 7.8% (17/219); reference
		Directness of contact
		• Shifts in COVID-19 units
		   ○ At least some shifts in COVID-19 units: 10.1% (11/109); adjusted OR 1.1 (0.4-3.2)
		   ○ No shifts in COVID-19 units: 7.8% (15/192); reference
		• Time spent directly at bedside
		   ○ >50% of shift: 8.7% (12/138); adjusted OR 1.5 (0.5-5.0)
			Unclear participation rate; imprecise risk estimates; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		○ ≤50% of shift: 8.6% (14/163); reference
		• Close contact with a SARS-CoV-2 infected person
		    ○ Close contact in the community (yes vs. no): 13.3% (4/30) vs. 8.1% (22/271); adjusted OR 2.1 (0.5-6.9)
		    ○ Close contact with co-worker (yes vs. no): 4.8% (2/42) vs. 9.7% (24/259); adjusted OR 0.5 (0.1-1.8)
		PPE
		• Used a mask all/nearly all the time: (17/227); reference
		• Used a mask less than nearly all the time: (4/18); adjusted OR 4.0 (0.7-19.5)	

Kassem et al, 2020 (44)
Prospective cohort
 	
Egypt; gastroenterological unit of 1 hospital; 1 to 14 June 2020
	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
		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)*
		• 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)
			59% participation rate; no control for confounders

Leeds et al, 2020 (45) Prospective cohort UK (England); multicenter, including 2 main hospitals and 6 community hospitals; 1 to 28 April 2020	991 symptomatic HCWs • Mean age 43 y • 85% female 59% nurse, 7% allied health professional, 3% clinical support staff, 5% nonclinical staff (HCW role n=738)	Adjusted OR (95% CI) for SARS-CoV-2 infection (repeat PCR over 4 weeks): • Age: 1.01 (0.99-1.03) • Male: 1.03 (0.59-1.79) • Frontline worker: 0.79 (0.53-1.17) • Black, Asian, and minority ethnic: 1.08 (0.56-2.04)	Incomplete data on HCW role at baseline
Lepak et al 2021 (46) Prospective cohort	7015 HCWs with symptoms of SARS-CoV-2 infection • Mean age, sex not reported	HCW role • Physician: 4.0% (36/910); reference • Nurse, medical assistant or therapist: 8.5% (252/2968); **adjusted OR 1.79 (1.23-2.60)**	Participation rate not reported; potential recall bias; no control for PPE use

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
United States (Midwest); health system comprised of 4 hospitals and >80 outpatient clinics; 25 March to 11 November 2020	• 13% physician, 42% nurse, medical assistant or therapist, 5% medical or nursing student, 2% pharmacist, 12% other role with direct patient care, 25% other role with no direct patient care • 9% SARS-CoV-2 infection (PCR)	• Medical or nursing student: 9.1% (33/361); *adjusted OR 2.76 (1.63-4.67)* • Pharmacist: 12.6% (22/175); *adjusted OR 3.06 (1.69-5.52)* • Other HCW role with direct patient care: 10.0% (86/862); *adjusted OR 2.18 (1.41-3.35)* • Other HCW role with no direct patient care: 11.2% (195/1739); *adjusted OR 2.21 (1.49-3.29)* Exposure • Inpatient unit: 8.9% (278/3120); reference • Ambulatory unit: 8.2% (261/3196); adjusted OR 0.84 (0.69-1.04) • Work from home: 13.1% (67/511); adjusted OR 0.80 (0.56-1.15) • Affiliated health facility: 9.6% (18/188); adjusted OR 0.86 (0.47-1.57) • Reported contact with patients with respiratory illness (yes vs. no): adjusted OR 0.79 (0.58-1.06) • Reported contact with non-masked health care visitor (yes vs. no): adjusted OR 0.75 (0.53 to 1.04) • Reported contact with family/community member with known COVID-19 (yes vs. no): *adjusted OR 4.03 (3.13-5.18)* • Reported contact with family/community member with suspected COVID-19 (yes vs. no): adjusted OR 1.65 (1.24-2.19) Duration of contact • Unknown/no direct contact: 6.9% (245/3531); reference • <10 minutes: 5.2% (37/704); adjusted OR 0.79 (0.54-1.17) • 10-20 minutes: 5.5% (19/345); adjusted OR 0.62 (0.37-1.05) • >20 minutes: 13.3% (323/2435); adjusted OR 1.25 (0.97-1.59)	
Lumley et al, 2020 et al (47) Prospective cohort UK (Oxfordshire); 4 teaching hospitals; 27 March to 30 November 2020	12541 HCWs • Median age 38 y • 74% female; 0.2% other • 72% white, 16% Asian, 4% Black, 1% Chinese, 6 other race/ethnicity • 36% nurse, 15% physician, 12% administrative staff, 5% medical or nursing student, 4%	SARS-CoV-2 seropositivity at baseline Age • Median 38 years (positive at baseline) vs. 38-41 years (not positive at baseline) Sex • Female: 9.0% (835/9263) • Male: 10.4% (339/3259) ○ Female vs. male: *OR 0.85 (0.75-0.97)** Race/ethnicity • White: 7.7% (703/9074); reference • Asian: 14.2% (287/2026); *OR 1.97 (1.70-2.28)** • Black: 15.9% (81/510); *OR 2.25 (1.75-2.89)** • Chinese: 6.9% (9/130); OR 0.89 (0.45-1.75)*	No control for confounders (for baseline seropositivity); unclear participation rate

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	laboratory staff, 3% therapist, 3% porter or domestic worker, 2% security or catering, 20% other role • 9.4% SARS-CoV-2 seropositivity	• Other: 12.1% (97/801) HCW role • Nurse or health care assistant: 12.3% (555/4528) • Physician: 9.9% (184/1860) ○ Nurse or health care assistant vs. physician: **OR 1.27 (1.07-1.52)*** • Administrative staff: 6.1% (95/1557) • Medical or nursing student: 5.8% (36/620) • Laboratory staff: 8.0% (36/452) • Physical, occupational or speech therapist: 9.6% (37/386(• Porter or domestic worker: 15.4% (58/377) • Security, estates, or catering staff: 8.5% (23/271) • Other: 6.1% (153/2491) SARS-CoV-2 seroconversion incidence Sex • Male vs. female: adjusted IRR 1.03 (0.77-1.39) Baseline antibody status (vs. negative) • Anti-spike IgG positive: ***adjusted IRR 0.3 (0.03-0.44)*** • Anti-nucleocapsid IgG positive: ***adjusted IRR 0.11 (0.03-0.45)*** • Both anti-spike and anti-nucleocapsid IgG positive: ***adjusted IRR 0.06 (0.01-0.46)***	
Lumley et al 2022 (26) *Extension of Lumley 2020* (47) Prospective cohort UK (Oxfordshire); 4 teaching hospitals and associated clinics; 27 March 2020 to 28 February 2021 **Added for Update Alert #11**	13109 HCWs • Median age 39 y • 74% female • 27% nurse, 14% physician, 13% administration, 10% healthcare assistant • 5.4% SARS-CoV-2 infection (PCR)	Age • Per 10-year increase: adjusted IRR 0.99 (0.99-1.00) Sex • Female vs. male: 5.6% (544/9765) vs. 5.1% (169/3321); adjusted IRR 0.93 (0.75-1.11)* Race/ethnicity • White: 4.8% (455/9411); reference • Asian: 7.9% (170/2157); ***adjusted IRR 1.59 (1.32-1.91)*** • Black: 6.4% (34/532); adjusted IRR 1.25 (0.88-1.78) • Other race/ethnicity: 5.4% (55/1009); adjusted IRR 1.23 (0.93-1.62) HCW role • Nurse: 6.9% (248/3579); adjusted IRR 1.49 (1.21-1.83) • Junior physician: 4.4% (42/942); adjusted IRR 1.10 (0.78-1.54) • Senior physician (consultant): 2.5% (21/834); ***adjusted IRR 0.60 (0.38-0.95)*** • Healthcare assistant: 8.2% (103/1263); ***adjusted IRR 1.82 (1.42-2.34)*** • Physical, occupational or speech/language therapist: 4.7% (20/419); adjusted IRR 1.17 (0.73-1.88)	Unclear participation rate; limited control for exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Porter or domestic staff: 5.6% (19/338); adjusted IRR 1.37 (0.84-2.22) • Administration: 4.8% (82/1688); adjusted IRR 1.18 (0.89-1.57) • Other role: 4.4% (179/4046); reference Exposure • Working in a non-ICU COVID-19 ward: 3.4% (37/1090); **adjusted IRR 1.53 (1.21-1.94)** • Not working in a COVID-19 ward: 1.7% (290/12019); reference • Direct patient care: 5.7% (580/10221); adjusted IRR 1.13 (0.90-1.42) • No direct patient care: 4.6% (134/2888); reference Vaccination status • Unvaccinated, seronegative: 6.0% (635/10513); reference • Unvaccinated, seropositive: 0.9% (12/1273); **adjusted IRR 0.15 (0.08-0.26)** • Vaccinated once, previously seronegative: 0.6% (64/9711); **adjusted IRR 0.36 (0.25-0.50)** • Vaccinated twice, previously seronegative: 0.2% (2/940); **adjusted IRR 0.10 (0.02-0.38)** • Vaccinated, previously seropositive: 0.1% (1/974); **adjusted IRR 0.04 (0.01-0.27)**	
Maltezou et al, 2020 (48) 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
Milazzo et al 2021 (49) Prospective cohort Italy (Milan) University hospital; 21 February to 27 May 2020	679 HCWs • Median age 45 y • 76% female • 30% physician, 36% nurse, 11% other healthcare service worker; 13% health services assistants	Age • Per 1 year or more of increase: adjusted OR 0.99 (0.95-1.03) Sex • Female: 4.0% (18/452) • Male: 3.3% (5/153) ○ Female vs. male: adjusted OR 1.27 (0.41-3.85) HCW role • Nurse: 2.8% (6/214)	44% participation rate; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

	(including cleaning); 10% socio-administrative
	• 31% direct contact with infected patients
	• 7% direct contact with infected relatives
	• 62% trained in PPE use
	• 4.3% SARS-CoV-2 seropositive
		• Physician: 4.1% (8/194)
		  ○ Nurse vs. physician: adjusted OR 0.71 (0.22-2.27)
		• Healthcare service worker: 1.6% (1/63)
		• Health service assistant: 5.3% (4/76)
		• Socio-administrative staff: 6.9% (4/58)
		Exposure
		• Contact with infected relative: 14.9% (10/67)
		• No contact with infected relative: 2.4% (13/538)
		  ○ Contact vs. no contact with infected relative: ***adjusted OR 8.12 (2.95-22.34)***
		• Contact with infected patient (in previous 30 days): 3.5% (14/401)
		• No contact with infected patient: 4.4% (9/204)
		  ○ Contact vs. no contact with infected patient: adjusted OR 1.19 (0.37-3.79)
		PPE
		• Trained in PPE use: 3.4% (16/469)
		• Not trained in PPE use: 5.1% (7/136)
		  ○ Trained vs. not trained: adjusted OR 0.71 (0.25-2.13)
		• High/very high confidence with PPE use: 4.1% (18/434)
		• Low/medium confidence with PPE use: 2.9% (5/171)
		  ○ High/very high vs. low/medium confidence: adjusted OR 0.96 (0.31-2.98)	

Mutambudzi et al, 2020 (50) 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 (51) Prospective cohort	99,795 frontline HCWs • Mean age, 42 years	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)***	Potential selection bias, limited measurement of

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
United Kingdom and United States; Start March 24 or 29, 2020, end date not reported	• 83% female • HCW role/position not reported • 4.0% 30-day incidence of SARS-CoV-2 infection	• 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)*	exposures/risk factors, SARS-CoV-2 infection status based on self-report

Rashid-Abdi et al 2020 (52)
 	
Prospective cohort
 	
Sweden (Vasteras); 1 hospital; 4 May to 19 August 2020
	131 infectious disease HCWs
	• Mean age 39 y
	• 84% female
	• 36% nurse, 19% physician, 40% nurse assistant, 5% other role
	• 19.1% SARS-CoV-2 seropositivity
		Age: Mean 38 (cases) vs. 44 (non-cases) years, p not reported
		Sex
		• Female: 22.7% (25/110)
		• Male: 0% (0/21)
		  o Female vs. male: OR 12.82 (0.75-219.19)*
		HCW role
		• Nurse: 21.3% (10/47)
		• Nurse assistant: 24.5% (13/53)
		• Physician: 8.0% (2/25)
		  o Nurse vs. physician: OR 3.11 (0.62-15.47)*
		  o Nurse or nurse assistant vs. physician: OR 3.44 (0.75-15.68)*
		• Other role: 0% (0/6)
		Exposure to COVID-19
		• At work: 20.0% (25/125)
		• Outside of work: 10.5% (2/19)
		  o At work vs. outside of work: OR 16.88 (3.79-75.19)*
		• None: 0% (0/5)
			No control for confounders; potential recall bias; participation rate unclear

Rasmussen et al 2021 (53) Prospective cohort Denmark (Copenhagen); hospital otorhinolaryngology	347 HCWs • Mean age not reported • % female not reported • 30% nurse, 23% physician, 5% secretary, 23%	HCW role *Infection (PCR)* • Nurse: 1% (1/104) • Physician: 5% (4/80) o Nurse vs. physician: OR 0.18 (0.02-1.68)* • Secretary: 0% (0/18) • Theatre personnel: 0% (0/81) • Cleaner: 0% (0/8)	Some demographic data not reported; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
department; 27 March to 3 June 2020	theatre personnel, 2% cleaner, 9% porter, 7% other role • 2.0% SARS-CoV-2 infection (PCR); 4.3% SARS-CoV-2 seropositive	• Porter: 7% (2/31) • Other role: 0% (0/25) *Seropositive* • Nurse: 2% (2/104) • Physician: 4% (3/80) ○ Nurse vs. physician: OR 0.50 (0.08-3.09)* • Secretary: 6% (1/18) • Theatre personnel: 5% (4/81) • Cleaner: 0% (0/8) • Porter: 13% (4/31) • Other role: 4% (1/25)	
Schmidt et al, 2020 (54) Prospective cohort Germany; 1 neurologic hospital; 20 to 30 March 2020	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 • 80% female • 9% physician, 40% nurse, 21% therapist, 30% other healthcare role	Prevalence of SARS-CoV-2 seropositivity • 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) • 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)***	73% participation rate; no control for confounders
Science et al 2021 (55) Prospective cohort Canada (Ontario); 4 hospitals; 1 April to 13 November 2020	1062 HCWs • Median age 40 y • 78% female • 69% White, 16% Asian, 3% Middle Eastern, 2% Black, 1% Hispanic, 0.3% Inuit, First Nations or Metis, 5% other race/ethnicity, 4% unknown or	Age • Per year of increase: ***adjusted OR 0.98 (0.96-0.99)*** Sex • Female vs. male: adjusted OR 1.86 (0.72-4.78) Race/ethnicity • Non-White race vs. White race: adjusted OR 1.26 (0.46-3.52) Exposure • Direct care of patients with COVID-19 (yes vs. no): adjusted OR 1.33 (0.72-2.47) • Symptomatic household exposure (yes vs. no): ***adjusted OR 7.15 (5.42-9.41)***	Participation rate not reported; potential selection and recall bias; limited control of confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	unspecified race/ethnicity • 22% physician, 42% nurse, 1% nurse practitioner, 15% allied health worker, 5% respiratory therapist, 7% auxiliary health worker, 11% other role • 5.4% SARS-CoV-2 seropositive		

Sims et al 2020 (56)
 	
Prospective cohort
 	
United States (Michigan); health system including 8 hospitals; 13 April to 28 May 2020
	20,614 HCWs
	• Mean age 43 y
	• 77% female
	• 40% nurse/nursing support, 19% physician
	• 8.8% SARS-CoV-2 seropositivity
		Sex
		• Female: 8.8% (1,380/15,728)
		• Male: 9.0% (423/4,700)
		   ○ Female vs. male: OR 0.97 (0.87-1.09)*
		Age (mean, years): 41.3 (cases) vs. 43.3 (non-cases), p>0.05
		Race
		• White: 7.7% (1235/16141)
		• Asian/Pacific Islander: 11.4% (162/1419)
		• Black: 19.6% (236/1203)
		• Hispanic: 12% (47/388)
		• Other: 10.3% (64/619)
		   ○ Black vs. white: *OR 2.95 (2.54-3.44)*
		   ○ Hispanic vs. white: *OR 1.66 (1.22-2.27)*
		HCW role
		• Nurse/nursing support: 10.8% (902/8,352)
		• Physician: 7.0% (277/3,957)
		   ○ Nurse/nursing support vs. physician: *OR 1.62 (1.41-1.86)*
		• Respiratory therapy: 12.1% (37/306)
		• Phlebotomy: 14.6% (41/281)
		• Clinical support with patient contact: 8.0% (173/2162)
		• Facilities: 8.2% (41/500)
		• Administration: 6.8% (194/2,853)
		• Laboratory: 5.5% (44/800)
		• Security/safety: 6.6% (7/106)
		• Clinical support with no patient contact: 7.7% (102/1,325)
			Participation rate 48%; potential recall bias; limited control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• Direct patient contact: 9.5% (1,430/15,058)
		• No direct patient contact: 6.9% (388/5,584)
		  o Direct vs. no direct patient contact: *OR 1.41 (1.25-1.58)**
		Mask use
		• N95: 10.3% (532/5,165)
		• PAPR: 12.3% (8/65)
		• Surgical: 13.1% (171/1,305)
		• Other mask: 14.2% (11/77)
		• No mask: 17.5% (369/2,108)
		  o Any mask vs. no mask: *OR 0.58 (0.50-0.66)**
		  o N95 or surgical mask vs. no mask: *OR 0.57 (0.50-0.66)**
		  o N95 vs. no mask: *OR 0.54 (0.47-0.62)**
		  o Surgical mask vs. no mask: *OR 0.71 (0.58-0.86)**
		  o N95 vs. surgical mask: *OR 0.76 (0.63-0.92)**
		Diabetes
		• Yes: 5.8% (105/912)
		• No: 8.7% (1713/19,712)
		  o Diabetes (yes vs. no): *OR 1.37 (1.11-1.69)**
		Cardiovascular disease
		• Yes: 1.9% (33/395)
		• No: 8.8% (1785/20,219
		  o Cardiovascular disease (yes vs. no): OR 0.94 (0.66-1.35)*
		Chronic lung disease
		• Yes: 8.2% (58/710)
		• No: 8.8% (1760/19,904)
		  o Chronic lung disease (yes vs. no): OR 0.92 (0.70-1.20)*
		Chronic kidney disease
		• Yes: 6.4% (5/78)
		• No: 8.8% (1813/20,536)
		  o Chronic kidney disease (yes vs. no): OR 0.71 (0.29-1.75)*
		Hypertension
		• Yes: 9.3% (284/3064)
		• No: 8.7% (1534/17,550)
		  o Hypertension (yes vs. no): OR 1.07 (0.93-1.22)*
		Immunosuppressed
		• Yes: 6.5% (25/383)
		• No: 8.9% (1793/20,231)
		  o Immunosuppressed (yes vs. no): OR 0.72 (0.48-1.08)*	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Trieu et al, 2020 (57)
 	
Prospective cohort
 	
Norway (Bergen); 3 hospitals; testing began 6 March 2020
	607 HCWs
	• Median age 39 years
	• 77% female
	• 29% physician, 47% nurse; 24% other
	• 5.3% SARS-CoV-2 seroprevalence
		Age
		• Age 20-35 vs. 36-78 y: OR 1.5 (0.7-3.4)
		Sex
		• Female vs. male: OR 1.2 (0.6-2.2)
		HCW role
		• Physician vs. other: OR 0.9 (0.4-2.0)
		• Nurse vs. other: OR 1.3 (0.7-2.7)
		Exposure
		• High vs. low-exposure occupational risk group: OR 1.2 (0.5-2.9)
		• Patient contact vs. no patient contact: OR 1.7 (0.7-4.3)
		• Patient contact and PPE use (vs. no patient contact)
		  ○ Patient contact, full PPE: OR 1.1 (0.5-2.7)
		  ○ Patient contact, partial PPE: OR 2.5 (0.5-12.2)
			No control for confounders

Villanueva et al, 2020 (58)
 	
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

Vimercati et al 2021 (59) Prospective cohort	2407 asymptomatic HCWs with close contact with COVID-19-positive patients	*Infection (PCR)* Age • Mean age, positive vs. negative: 43.2 y vs. 45.7 y; OR 0.98 (0.95-1.02) Sex	Participation rate unclear; limited control for exposures and no control for PPE use

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Italy (Bari); 1 hospital; 8 April 2020 to 7 June 2020	- Mean age 46 y 56% female 34% nurse, 35% physician, 14% support operator, 2% healthcare professions, 15% other role 5% COVID units; 4% ER; 15% ICU/ anesthesiology; 3% ID; 57% other clinical units; 16% non-clinical units - Italian and CDC Biological Occupational Risk level: 27% high risk, 61% medium risk, 12% low risk 0.75% SARS-CoV-2 infection, PCR; 11.5% IgM seropositive; 2.4% IgG seropositive	- Female: 0.9% (12/1360) - Male: 0.6% (6/1047) - Female vs. male: OR 1.54 (0.58-4.13)* HCW role: - Nurse: 0.5% (4/809) - Physician: 1.6% (13/831) - Nurse vs. physician: ***OR 0.31 (0.10-0.96)**** - Support operator: 0.3% (1/347) - Healthcare professions: 0% (0/53) - Other role: 0% (0/367) Hospital unit: - COVID units: 0% (0/118) - ER: 0.9% (1/107) - ICU/anesthesiology: 1.1% (4/357) - ID: 0% (0/70) - Other clinical units: 0.9% (13/1373) - Non-clinical units: 0% (0/377) Risk level: - Low: 0% (0/281); reference - Medium: 0.8% (12/1452); OR 4.89 (0.29-82.76)* - High: 0.8% (5/653); OR 4.77 (0.26-86.6)* *Seropositive, IgM* Age - Mean age, positive vs. negative: 43.3 y vs. 46.0 y; ***OR 0.98 (0.97-0.99)*** Sex: - Female 11.9% (162/1360) - Male: 11.0% (115/1047) - Female vs. male: adjusted OR 0.97 (0.75-1.27) HCW role: - Nurse: 12.1% (98/809) - Physician: 13.6% (113/831) - Nurse vs. physician: OR 0.88 (0.66-1.17)* - Support operator: 10.1% (35/347) - Healthcare professions: 0.9% (5/53) - Other: 7.1% (26/367) Hospital unit: - COVID units: 15.3% (18/118)	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• ER: 3.7% (4/107)
		• ICU/anesthesiology: 14.6% (52/357)
		• ID: 2.9% (2/70)
		• Other clinical units: 13.3% (183/1373)
		• Non-clinical units: 4.2% (16/377)
		Risk level:
		• Low: 4.3% (12/281); reference
		• Medium: 12.3% (179/1452); adjusted OR 2.91 (1.57-5.39)
		• High: 11.6% (76/653); adjusted OR 2.84 (1.50-5.39)
		
		Seropositive, IgG
		Age
		• Mean age, positive vs. negative: 48.9 vs. 45.6; **OR 1.03 (1.00-1.059)**
		Sex:
		• Female 2.1% (29/1360)
		• Male: 2.7% (28/1047)
		   ○ Female vs. male: adjusted OR 0.73 (0.41-1.29)
		HCW role:
		• Nurse: 2.1% (17/809)
		• Physician: 2.2% (18/831)
		   ○ Nurse vs. physician: OR 0.97 (0.50-1.89)*
		• Support operator: 4.0% (14/347)
		• Healthcare professions: 1.9% (1/53)
		• Other: 1.9% (7/367)
		Hospital unit:
		• COVID units: 2.5% (3/118)
		• ER: 2.8% (3/107)
		• ICU/anesthesiology: 1.7% (6/357)
		• ID: 1.4% (1/70)
		• Other clinical units: 2.8% (39/1373)
		• Non-clinical units: 0.8% (3/377)
		Risk level:
		• Low: 1.1% (3/281); reference
		• Medium: 2.7% (39/1452); OR 3.03 (0.90-10.21)
		• High: 2.0% (13/653); OR 2.32 (0.62-8.62)	

Weinberger et al 2021 (60)	300 HCWs • Mean age 35 y • 67% female	Exposure • COVID-19 unit: 2.9% (4/140) • Non-COVID-19 unit: 11.1% (10/90)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Prospective cohort Germany (Munich); 1 university hospital; 24 March to 7 July 2020	• 49% nurse, 32% physician, 6% laboratory staff, 6% other frontline HCW, 8% administrative staff • 4.7% SARS-CoV-2 seropositivity	○ COVID-19 unit vs. non-COVID-19 unit: OR 0.24 (0.07-0.77)*	
Retrospective cohort studies			

Akinbami et al 2020 (61)
 	
Retrospective cohort
 	
United States (Detroit metropolitan area, Michigan); regional healthcare coalition; 18 May to 13 June 2020
	16,397 asymptomatic HCWs, first responders and public safety personnel
	• Mean age 42 y
	• 69% female
	• 86% HCW (39% nurse, 4% nurse assistant, 14% physician, 2% pharmacist, 1% physical therapist, 3% respiratory therapist, 6% administration/clerk, 2% clinical technician, 4% imaging technician, 2% laboratory technician, 4% midlevel clinician, 9% other role) 7% EMT, 2% firefighter, 5% police/ corrections officer
	• 6.9% SARS-CoV-2 seropositivity
		Age
		• 18-24 y: 7.9% (54/686); reference
		• 25-34 y: 6.9% (337/4,885); adjusted OR 0.89 (0.56-1.39)
		• 35-44 y: 7.0% (278/3,977); adjusted OR 0.93 (0.57-1.52)
		• 45-59 y: 6.9% (360/5,222); adjusted OR 0.86 (0.53-1.40)
		• 60-64 y: 7.5% (83/1,106); adjusted OR 0.97 (0.58-1.62)
		• ≥65 y: 3.5% (18/521); **adjusted OR 0.41 (0.23-0.72)**
		Sex
		• Female: 7.0% (787/11,251):
		• Male: 6.7% (345/5,146)
		  ○ Female vs. male: **adjusted OR 0.79 (0.65-0.95)**
		Race/ethnicity
		• Non-Hispanic white: 6.0% (771/12,858); reference
		• Non-Hispanic black: 16.3% (196/1200); **adjusted OR 1.92 (1.52-2.43)**
		• Non-Hispanic Asian: 7.3% (80/1097); adjusted OR 0.97 (0.74-1.26)
		• Hispanic: 6.8% (30/440); adjusted OR 1.06 (0.76-1.48)
		• Other: 7.2% (29/404); adjusted OR 0.95 (0.67-1.35)
		HCW
		• Nurse: 7.7% (495/6,426)
		  ○ Nurse vs. physician: **adjusted OR 1.52 (1.18-1.95)**
		• Nurse assistant: 12.8% (82/641)
		  ○ Nurse assistant vs. physician: **adjusted OR 1.88 (1.24-2.83)**
		• Physician: 6.1% (140/2,297)
		• Pharmacist: 4.4% (14/321)
		• Physical therapist: 10.6% (25/235)
		• Respiratory therapist: 8.3% (34/409)
		• Administration/clerk: 8.0% (77/964)
		• Clinical technician: 5.5% (20/365)
		• Imaging technician: 4.2% (30/719)
			Potential recall bias; ~7% of participants were firefighters or police/corrections officers

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Laboratory technician: 3.4% (10/293) • Midlevel clinician: 4.6% (26/566) • Other HCW role: 7.0% (62/888) • EMT: 5.2% (60/1,158) • Firefighter: 6.7% (22/330) • Police/corrections officer: 4.0% (31/785) Clinical setting (yes vs. no) • Hospital emergency department: Adjusted OR 1.16 (1.00-1.35) • Hospital ward: Adjusted OR 1.24 (0.97-1.58) • Hospital intensive care unit: Adjusted OR 0.78 (0.66-0.91) • Hospital operating room/surgical unit: Adjusted OR 0.63 (0.48-0.83) • Other hospital location: Adjusted OR 0.87 (0.74-1.03) • Emergency medical services: Adjusted OR 1.08 (0.70-1.66) Exposure to persons testing positive for COVID-19 (yes vs. no) • Co-worker: 10.0% (680/6799): *1.45 (1.21-1.73)* • Household member: 34.3% (178/519); *adjusted OR 6.18 (4.81-7.93)* • Patient: 7.8% (810/10,389); adjusted OR 1.03 (0.87-1.22) • Other person: 11.5% (312/2709); *adjusted OR 1.25 (1.08-1.45)* PPE use (all the time vs. less than all the time) • Gown: 6.9% (643/9,316); adjusted OR 1.14 (0.97-1.34) • Gloves: 7.0% (832/11,887); adjusted OR 1.09 (0.90-1.30) • N95: 6.9% (505/7,316); *adjusted OR 0.83 (0.72-0.95)* • PAPR: 7.6% (53/695); adjusted OR 1.10 (0.80-1.52) • Goggles/face shield: 6.5% (428/6,581); adjusted OR 1.12 (0.94-1.32) • Surgical mask: 6.6% (624/9,452); *adjusted OR 0.86 (0.75-0.98)* Aerosol generating procedure frequency • 0 times: reference • 1-5 times: adjusted OR 1.04 (0.85-1.28) • 6-10 times: adjusted OR 0.83 (0.66-1.04) • 11-25 times: adjusted OR 0.89 (0.69-1.16) • >25 times: adjusted OR 1.09 (0.89-1.34)	
Algado-Selles et al 2020 (62) Retrospective cohort Spain (Alicante); 1 hospital and 12 primary	784 symptomatic HCWs • Mean age not reported; 88% <age 60 y • 78% female • 27% physician, 34% nurse, 20% nursing	Age • <60 y: 19.5% (135/691) • ≥60 y: 22.6%% (21/93) o <60 vs ≥60: OR 1.2 (0.7-2.0); not included in multivariate model Sex • Female: 19.2% (118/615) • Male: 22.5% (38/169)	Potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

care clinics; 2 March to 16 April 2020	assistant or technician, 20% other role
	• 19.9% SARS-CoV-2 infection (PCR)
		o Female vs. male: OR 1.2 (0.8-1.8); not included in multivariate model
		HCW role
		• Nurse: 18.1% (49/270)
		• Physician: 28.2% (60/213)
		   o Nurse vs. physician: **_OR 0.57 (0.37-0.87)*_**
		• Nurse assistant/technician: 14.6% (27/185)
		• Other role: 17.2% (20/116)
		Department
		• ED: 16.2% (6/37)
		• Pediatric: 8.3% (4/48)
		• Critical care unit: 25.0% (30/120)
		• Adult ward: 14.9% (42/281)
		• Primary care: 23.7% (23/97)
		• Non-COVID-19 ward: 25.4% (51/201)
		   o ED vs. non-COVID-19 ward: adjusted OR 0.7 (0.2-1.9)
		   o Pediatric vs. non-COVID-19 unit: adjusted OR 0.4 (0.1-2.2)
		   o Critical care vs. non-COVID-19 unit: adjusted OR 0.8 (0.3-1.7)
		   o Adult ward vs. non-COVID-19 unit: adjusted OR 0.7 (0.4-1.4)
		   o Primary care vs. non-COVID-19 unit: adjusted OR 1.1 (0.5-2.2)
		Contact type
		• Close: 22.8% (119/523)
		• Occasional: 14.8% (27/182)
		• Unknown: 12.7% (10/79)
		   o Close vs. unknown: adjusted OR 2.1 (0.8-5.1)
		   o Occasional vs. unknown: adjusted OR 1.4 (0.5-3.9)
		   o Close vs. occasional: OR 1.69 (1.07-2.67)*
		PPE use (surgical mask or N95 [or equivalent] and eye protection for aerosol generating procedures)
		• Yes: 13.7% (40/293)
		• No: 22.8% (112/491)
		   o Yes vs. no: **_adjusted OR 0.45 (0.26-0.83)_**	

Bai et al, 2020 (63) Retrospective cohort China (Wuhan); 1 hospital (neurosurgery department) prior to recognition of outbreak;	118 HCWs with potential exposure to COVID-19 patient • Mean age, 31 years • 64% female • 25% physician, 75% nurse	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 OR (95% CI) for COVID-19[†] • Female vs. male: 0.78 (0.23-2.64)	**_Not peer reviewed_**; potential recall bias; no control for confounders; criteria for COVID-19 diagnosis not described; 4 infected HCWs without

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
December 25, 2019 to February 15, 2020	• 10.2% (12/118) diagnosed with COVID-19	• 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)	exposure data excluded
Banjeree et al 2020 (64) Retrospective cohort India (Kolkata); 1 hopsital; 1 June to 31 August 2020	274 symptomatic HCWs or HCWs who had direct contact with a COVID-19 patient • Mean age not reported • 40% female • HCW role not reported • 31% SARS-CoV-2 infection (PCR)	Sex • Female: 23.4% (32/109) • Male: 26.1% (43/165) o Female vs. male: OR 0.85 (0.49-1.45)*	No control for confounders; limited demographic information; participation rate unclear
Buchtele et al, 2020 (65) 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
Colaneri et al 2020 (66) Retrospective cohort	1,477 HCWs • Mean age 45 y • 70% female • 31% physician, 39% nurse, 18%	Age (mean, years): 46.3 (cases) vs. 44.9 (non-cases); p=0.43 Sex • Female: 10.3% (104/1007) • Male: 13.6% (60/440) o Female vs. male: OR 0.73 (0.52-1.02)*	Potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Italy (Lombardy); 1 hospital; 22 February to 8 May 2020	healthcare assistant, 12% administrative staff
	• 11.3% SARS-CoV-2 infection (PCR)
		HCW role
		• Nurse: 11.1% (63/568)
		• Physician: 12.1% (54/446)
		   o Nurse vs. physician: OR 0.91 (0.62-1.33)*; adjusted IRR 1.49 (0.97-2.30)
		• Healthcare assistant: 13.3% (34/255)
		• Administrative staff: 7.3% (13/178)
		Clinical setting; p<0.0001
		• COVID-19 ward: 20.9% (97/465)
		• Non-COVID-19 clinical ward: 7.3% (60/825)
		• No patient contact: 4.5% (7/157)
		Contact with CPAP helmets
		• Yes: 26.3% (73/278)
		• No: 7.8% (91/1169)
		   o Yes vs. no: **OR 4.22 (3.00-5.94)***
		BMI (mean, kg/m^2): 24.4 vs. 23.4; p=0.01
		Smoking; p<0.0001
		• Never: 15.7% (113/721)
		• Former: 23.9% (33/138)
		• Current: 7.3% (18/247)
		Hypertension
		• Yes: 16.2% (16/99)
		• No: 13.9% (148/1064)
		   o Yes vs. no: OR 1.19 (0.68-2.09)*
		Alcohol consumption; p=0.34
		• None: 10.0% (34/340)
		• Moderate: 12.3% (83/677)
		• Not moderate: 6.7% (3/45)
		• High: 0% (0/0)	

Comelli et al 2021 (67)
 	
Retrospective cohort
 	
Italy (Brescia); one hospital; May 2020
	1893 HCWs
	• Mean age 44 y
	• 77% female
	• 43% nurse, 22% physician, 14% support staff, 7% pharmacist, 1% technician, 1%
		Age (mean years), positive vs. negative: 45 vs. 44, p=0.01
		Sex
		• Female: 22.6% (330/1459)
		• Male: 23.7% (103/434)
		   o Female vs. male: OR 0.94 (0.73-1.21)*
		Exposure
		• Work in COVID-19 unit or ED: 23.2% (234/1008)
		• Did not work in COVID-19 unit or ED: 22.5% (199/885)
		   o Work vs. did not work in COVID-19 unit or ED: OR 1.04 (0.84-1.29)*
			48% participation rate among eligible HCWs; potential recall bias; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	psychologist, 11% other role • 22.9% SARS-CoV-2 seropositive	• Direct contact with confirmed COVID-19 case: 25.9% (284/1098) • No direct contact with confirmed COVID-19 case: 18.7% (149/795) ◦ Direct vs. no direct contact with confirmed COVID-19 case: **OR 1.51 (1.21-1.89)** Underlying immunosuppression: 26.7% (12/45) • Underlying immunosuppression (yes vs. no): OR 1.23 (0.63-2.41)	
Folgueira et al, 2020 (68) 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) • Laboratories: 33.3% (28/84) • Kitchen: 38.3% (18/47)	***Not peer reviewed***; no control for confounders
Garcia et al, 2020 (69) 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:	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• 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) o Nurse vs. physician: OR 0.76 (0.55-1.05)*	
Gras-Valenti et al 2020 (70) Retrospective cohort Spain (Alicante); 1 hospital and 12 primary care clinics; 24 April to 8 May 2020	4,179 HCWs • Mean age not reported; 2% ≤24 y, 9% 25-29 y, 10% 30-34 y, 12% 40-44 y, 12% 45-49 y, 13% 50-54 y, 15% 55-59 y, 16% 60-64 y, 2% ≥65 y • 73% female • 23% physician, 28% nurse • 6.6% SARS-CoV-2 infection (PCR)	Sex • Female: 6.4% (197/3,065) • Male: 6.9% (77/1,114) o Female vs. male: OR 0.93 (0.70-1.22)* Age • ≤24 years: 6.9% (5/72) • 25-29 years: 9.4% (36/383) • 30-34 years: 7.7% (29/375) • 35-39 years: 6.4% (26/408) • 40-44 years: 7.4% (36/487) • 45-49 years: 5.8% (29/503) • 50-54 years: 6.2% (34/553) • 55-59 years: 5.6% (36/645) • 60-64 years: 5.2% (36/688) • ≥65 years: 10.8% (7/65) HCW role • Nurse: 6.6% (78/1,186) • Physician: 8.7% (85/974) • Nurse vs. physician: OR 0.74 (0.53-1.01)*Caretaker: 6.8% (19/286) • Technician: 3.0% (4/127) • Administrative: 16.1% (/672) • Other housekeeping personnel: 3.8% (/158) • Other non-housekeeping personnel: 3.0% (/125) Clinical setting • Primary care: 18.1% (/757) • Urgent care: 7.6% (/318) • Critical care: 6.2% (/259) • Medical specialty: 13.0% (/545) • Surgical specialty: 20.2% (/846) • Other: 34.8% (1454)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Heinzerling et al, 2020 (71)
 	
Retrospective cohort
 	
United States (California); 1 hospital with unsuspected COVID-19 case; February 2020
	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% 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
		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)*
		• 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)
			Potential recall bias; no control for confounders; few cases and imprecise estimates; 6 tested HCWs were not interviewed and excluded from analysis

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• 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)**
		   o 31 to 60 minutes: 1.86 (0.07-46.97)
		   o >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)
		      o Sometimes: 2.86 (0.24-34.66)	

Lai et al, 2020 (72) 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) o 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
Larese Filon et al 2022(25) Retrospective cohort Italy (Trieste); 1 tertiary medical center; 1 March 2020 to 31 May 2021 **Added for Update Alert #11**	4251 HCWs • Mean age 47 y • 69% female • 40% nurse, 18% nurses' aide, 14% physician, 16% other HCW, 5% technician, 6% clerk • SARS-CoV-2 infection (PCR), before vaccine introduction: 13.6% (578/4251); after vaccine introduction: 1.4% (60/4251)	*Before vaccine introduction (1 March 2020 to 28 February 2021)* Age (per year): **adjusted IRR 0.99 (0.98-0.99)** Sex • Female vs. male: 13.4% (394/2944) vs. 14.1% (184/1307); adjusted IRR 1.06 (0.91-1.25)* HCW role • Nurse: 15.2% (261/1720); adjusted IRR 1.18 (0.94-1.49) • Nurses' aide: 16.9% (126/745); adjusted IRR 1.18 (0.91-1.52) • Physician: 12.6% (78/617); reference • Other HCW: 8.5% (57/673); adjusted IRR 0.70 (0.50 -0.98) • Technician: 9.0% (20/221); adjusted IRR 0.72 (0.43-1.22) • Clerk: 13.1% (36/275); adjusted IRR 1.18 (0.79-1.76) Hospital ward • Anaesthesia: 8.6% (17/198); adjusted IRR 1.10 (0.61-1.97)	No control for exposures other than hospital ward

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Other: 9.7% (126/1301); adjusted IRR 1.48 (0.98-2.23) • Surgery: 10.5% (95/909); adjusted IRR 1.37 (0.90-2.08) • Radiology and nuclear medicine: 11.8% (21/178); ***adjusted IRR 1.96 (1.14-3.36)*** • Administration: 11.9% (50/421); ***adjusted IRR 1.85 (1.13-3.04)*** • First aid: 18.8% (51/272); ***adjusted IRR 2.44 (1.56-3.83)*** • Pneumology (COVID ward): 21.8% (26/119); ***adjusted IRR 2.72 (1.65-4.48)*** • Rehabilitation (COVID ward): 22.2% (22/99); ***adjusted 3.59 (2.14-6.04)*** • Emergency medicine: 30.5% (18/59); ***adjusted IRR 3.70 (2.15-6.37)*** • Geriatrics: 46.5% (20/43); ***adjusted IRR 5.96 (3.64-9.76)*** • Infectious disease (COVID): 47.9% (23/48); ***adjusted IRR 5.75 (3.54-9.33)*** • Long term care (COVID): 57.8% (26/45); ***adjusted IRR 7.15 (4.59-11.14)*** • Other medical wards: 7.3% (26/355); reference	
Modenese et al 2021 (14) Retrospective cohort Italy (Modena); university hospital; 1 March 2020 to 21 January 2021 **Added for Update Alert #11**	5897 HCWs • Mean age 42 y • 71% female • 30% physician, 44% nurse or nurse's aide, 15% other HCW role, 11% non-HCW • 13.0% SARS-CoV-2 infection (PCR)	Sex • Female: 12.4% (518/4168); adjusted OR 0.97 (0.78-1.20) • Male: 14.3% (247/1729); reference Age • ≤30 y: 12.1% (159/1312); reference • 31-40 y: 13.2% (199/1512); adjusted OR 1.20 (0.92-1.56) • 41-50 y: 12.3% (188/1318); adjusted OR 1.06 (0.80-1.43) • 51-60 y: 13.5% (178/1329); adjusted OR 1.06 (0.77-1.46) • >60 y: 9.4% (41/426); adjusted OR 1.06 (0.65-1.72) Smoking • Non-smoker: 13.6% (389/2864); reference • Ex-smoker: 13.1% (36/274); adjusted OR 0.79 (0.54-1.16) • Current smoker: 12.0% (87/728); ***adjusted OR 0.70 (0.54-0.91)*** BMI • Underweight: 8.3% (19/228); adjusted OR 0.76 (0.45-1.26) • Normal weight: 12.2% (339/2784); reference • Overweight: 14.8% (151/1019); ***adjusted OR 1.28 (1.01-1.62)*** • Obese: 17.6% (70/398); ***adjusted OR 1.41 (1.01-1.95)*** HCW role • Nurse/nurse's aide: 18.2% (474/2603); ***adjusted OR 2.67 (1.63-4.37)*** • Physician: 11.3% (203/1790); ***adjusted OR 1.91 (1.16-3.14)*** • Other HCW: 5.6% (49/882); ***adjusted OR 0.50 (0.27-0.93)*** • Non-HCW: 6.3% (39/622); reference	Participation rate not reported; limited control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Moscola et al, 2020 (73)
 	
Retrospective cohort
 	
United States (New York); multicenter health system; 20 April to 23 June 2020
	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)
		   o Adjusted RR (95% CI) vs. age 18-39 years:
		   o 40-49: 1.0 (0.97-1.02)
		   o 50-59: 0.99 (0.97-1.02)
		   o 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)
		   o 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)
		• Other/multiracial: 16.9% (56/331)
		• Physicians: 8.7% (327/3746)
		• Nurses: 13.1% (1503/11,468)
		   o Nurse vs. physician: OR, 1.58 (1.39-1.79)*
		• Allied health: 11.6% (949/8156)
		   o Physician vs. allied health: adjusted RR,, 0.98 (0.95-1.00)
		   o Nurse vs. allied health: adjusted RR, 1.00 (0.98-1.01)
		• Administrative: 12.6% (1217/9645)
		   o Administrative and clerical vs. allied health: adjusted RR, 1.01 (0.99-1.02)
		• Service/maintenance (included medical assistants): 20.9% (1527/7314)
		   o 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)
			56% of all eligible HCWs; 7 different assays used

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• 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 (74) 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

Perez-Garcia et al 2020 (75)
 	
Retrospective cohort
 	
Spain (Alcalá de Henares); 1 hospital; 5 March to 30 May 2020
	2,963 HCWs
	• Mean age 43 y
	• 80% female
	• 9% physician, 29% nurse, 22% nurse technician, 15% medical staff, 5% technical specialist, 6% hospital porter, 2% other HCW, 12% non-healthcare hospital personnel
	• 37% symptomatic
	• 36.5% SARS-CoV-2 infection (PCR or seropositivity)
		HCW role
		• Nurse: 39.6% (340/859)
		• Physician: 33.1% (90/272)
		   o Nurse vs. physician: OR 1.32 (0.99-1.77)*
		• Nurse technician: 39% (250/641)
		   o Nurse or nurse technician vs. physician: *OR 1.31 (1.00-1.72)*
		• Medical staff: 34.7% (154/444)
		• Technical specialist: 29.1% (41/141)
		• Hospital porter: 44.9% (83/185)
		• Other HCW: 26.4% (19/72)
		• Non-healthcare hospital personnel: 29.8% (104/349)
		• Healthcare personnel vs. non-healthcare personnel: *OR 1.40 (1.10-1.79)*
		Exposure
		• Participation in aerosol-generating procedure vs. no participation: *OR 2.54 (1.71-3.77)^*
		• Contact with co-worker: *OR 3.18 (2.64-3.82)^*
		• Contact with relatives: *OR 2.16 (1.50-3.11)^*
		• Close contact with COVID-19 infected person vs. casual contact: adjusted OR 1.32 (0.97-1.80)
			Potential recall bias; some analyses did not control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• Contact with COVID-19 patients (yes vs. no): **adjusted OR 1.69 (1.28-2.24)**
		PPE use
		• Use of PPE (included cap, FFP2 mask [or FFP3 mask for aerosol generating procedures], disposable medical protective clothing, gloves, goggles/screens) vs. no use: **adjusted OR 0.56 (0.44-0.72)**
		Smoker
		• Yes: 25.7% (98/382)
		• No: 38.1% (983/2581)
		   o Yes vs. no: **OR 0.56 (0.44-0.72)***
		Hypertension
		• Yes: 49.5% (95/192)
		• No: 35.6% (986/2771)
		   o Yes vs. no: **OR 1.77 (1.32-2.38)***
		Cardiovascular disease
		• Yes: 43.9% (25/57)
		• No: 36.3% (1056/2906)
		   o Yes vs. no: OR 1.37 (0.81-2.32)*
		Chronic obstructive pulmonary disease
		• Yes: 49.6% (56/113)
		• No: 36.0% (1025/2850)
		   o Yes vs. no: **OR 1.75 (1.20-2.55)***
		Pregnancy
		• Yes: 53.8% (14/26)
		• No: 36.3% (1067/2937)
		   o Yes vs. no: OR 2.04 (0.94-4.44)*
		Immunosuppression
		• Yes: 50.0% (14/28)
		• No: 36.4% (1067/2935)
		   o Yes vs. no: OR 1.75 (0.83-3.69)*	

Piapan et al, 2020 (76)
 	
Retrospective cohort
 	
Italy (Trieste); regional HCWs with known COVID-19 exposure; 1 March to 6 April 2020
	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
		Adjusted OR (95% CI), prevalence of SARS-CoV-2 infection (PCR)
		• Female vs. male: 0.67 (0.45-1.02)
		• HCW role-
		   o Nurse vs. physician: 0.9 (0.5-1.4)
		   o Nurse's aide vs. physician: 1.4 (0.7-2.6)
		   o Resident vs. physician: 1.3 (0.5-2.7)
		   o Other role vs. physician: 0.9 (0.4-2.0)
		• Department-
		   o High-risk vs. low-risk department: **67.9 (34.7-133)**
		   o Medium-risk vs. low-risk department: 9.6 (5.6-16.5)
			Potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

	• 7% high-risk department, 13% moderate-risk department, 80% low-risk department	• Contact -
		  o Contact with colleagues and patients vs. contact with patients: **7.0 (3.7-13.3)**
		  o Contact with colleagues vs contact with patients: 0.9 (0.54-1.5)
		• PPE -
		  o Mask (FFP2-3 or surgical) vs. no mask: : 1.6 (0.9-2.9)
		  o FFP2-3 mask vs. surgical mask: **7.1 (3.0-16.7)**
		  o Patient wearing mask: **7.1 (3.6-13.9)**	

Piapan et al 2021 (16) *Extension of Piapan et al 2020 (76)* Retrospective cohort Italy (Trieste); regional HCWs with known COVID-19 exposure; 1 March to 31 May 2020 **Added for Update Alert #11**	963 HCWs with known exposure to a COVID-19-infected patient • Mean age 44 y • 71% female • 25% physician, 43% nurse, 13% nurse's aide, 6% resident, 13% other role • 20.0% SARS-CoV-2 infection (PCR)	Age • Per year: adjusted OR 0.98 (0.96-1.01) Sex • Female vs. male: adjusted OR 0.59 (0.31-1.11) HCW role (univariate estimates; not included in multivariate model) • Physician: 22.9% (54/236); reference • Resident: 23.7% (14/59); OR 1.35 (0.78-2.69) • Nurse: 20.5% (85/414); OR 1.12 (0.75-1.69) • Nurse aid: 23.6% (30/127); OR 1.39 (0.83-2.35) • Other: 15.7% (20/127); OR 1.01 (0.60-2.00) Exposure • High risk (infectious disease, geriatric or emergency medicine): **adjusted OR 13.4 (5.8-31.0)** • Medium risk (internal medicine): adjusted OR 1.88 (0.97-3.6) • Low risk (surgical and medical ward): reference Directness of contact • Contact with patients: reference • Contact with HCWs: adjusted OR 1.39 (0.64-3.0) • Contact with patients and HCWs: **adjusted OR 2.23 (1.01-4.9)** • Contact with contact of causal contacts: adjusted OR 1.40 (0.28-6.9) PPE use, yes vs. no: **adjusted OR 3.7 (1.6-8.2)** N95 use, yes vs. no: **OR 7.8 (4.0-15.2)** (not included in multivariate model)	Participation rate not reported; otential recall bias; limited control for confounders
Porru et al 2022 (29) Retrospective cohort Italy (Verona); one hospital; 27 December 2020 to 3 May 2021	9811 HCWs offered vaccination against SARS-CoV-2 • Mean age 36 y • 69% female • 25% nurse, 28% physician, 39% other	Age • Per 10-year increase: **adjusted HR 1.61 (1.27-2.04)** Sex • Female vs. male: 1.9% (132/6814) vs. 1.5% (45/2997); adjusted HR 1.15 (0.60-2.17)* HCW role • Nurse: 2.8% (70/2463); adjusted HR 2.13 (0.60-7.65) • Physician: 1.3% (36/2727); adjusted HR 1.62 (0.43-6.11)	Unclear participation rate; no control for exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Added for Update Alert #11	health professional, 8% administration • 82% vaccinated • 1.8% SARS-CoV-2 infection (PCR)	• Other health professional: 1.6% (59/3734); adjusted HR 2.46 (0.71-8.51) • Administration: 1.4% (12/828); reference Vaccination status • Fully vaccinated (2 doses): 0.7% (55/7659); ***adjusted HR 0.37 (0.29-0.69)*** • Not vaccinated: 4.5% (77/1718); reference	
Ran et al, 2020 (77) Retrospective cohort China (Wuhan); 1 hospital serving outbreak; follow-up through 28 January 2020	72 HCW with acute symptoms • Median age, 31 y • 69% female • 53% clinicians and 47% nurses • 38.9% (28/72) diagnosed with COVID-19	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) • 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)	Potential recall bias; unclear if most risk estimates adjusted; reference group unclear for some estimates; some estimates imprecise; 11 of 83 cases dropped for invalid surveys
Shorten et al 2021 (78) Retrospective cohort United Kingdom (northwest England); NHS trust; 29 May to 4 July 2020	4474 HCWs • Mean age 42 y • 78% female • 11% Asian/Asian British, 2% Black/Black British, 0.5% Chinese; 2% mixed race, 70% white (UK and Republic of Ireland),	Age, per 1-year change: adjusted OR 0.99 (0.98-0.994) Female vs. male: adjusted OR 1.06 (0.87-1.29) Race/ethnicity • White (UK or Republic of Ireland); reference • Asian/Asian British: ***adjusted OR 1.61 (1.27-2.04)*** • Other white: adjusted OR 1.28 (0.79-2.05) • Black/Black British: ***adjusted OR 2.08 (1.25-3.45)*** • Mixed race/ethnicity: adjusted OR 0.72 (0.35-1.49) • Chinese: adjusted OR 0.62 (0.18-2.14) • Unknown ethnicity: ***adjusted OR 1.44 (1.14-1.82)***	Limited adjustment for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	3% other white, 12% unknown race/ethnicity • 61% nonclinical staff, 7% ED, 5% critical care, 27% other clinical role • 17.4% SARS-CoV-2 seropositive	Exposure • Clinical vs. nonclinical location: **adjusted OR 2.68 (2.27-3.15)**	

Sotgiu et al. 2020 (79)
 	
Retrospective cohort
 	
Italy (Milan); 1 hospital; 2 to 16 April 2020
	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)
		  o Female vs. male (IgG): OR 0.58 (0.20-1.67)*
		• Age
		  o 20-29 y, IgG: 14.8% (4/27); IgM: 25.9% (7/27)
		  o 30-39 y, IgG: 2.3% (1/44); IgM: 9.1% (4/44)
		  o 40-49 y, IgG: 7.0% (4/57); IgM: 5.3% (3/57)
		  o 50-59 y, IgG: 9.8% (5/51); IgM: 15.7% (8/51)
		  o 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)
		  o Physician, IgG: 14.8% (7/115); IgM: 13.9% (16/115)
		  o Nurse/OSS. IgG: 7.8% (5/64); IgM: 10.9% (7/64)
		    ▪ Nurse vs. physician (IgG): OR 0.76 (0.23-2.52)*
		  o 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

Wang Q. et al, 2020 (80) 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

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Wang X. et al, 2020 (81) Retrospective cohort China (Wuhan); 1 hospital; January 2020	493 HCWs • Mean age, 32 y • 87% female • 27% doctor, 73% nurse • 2.0% (10/493) diagnosed with COVID-19	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) 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– ∞)**	Mask and other PPE use based on department practice, not individual participant use; estimate for mask very imprecise

Wang X. et al 2020b (82)
 	
Retrospective cohort
 	
China (Wuhan); hospital neurosurgery department; 25 December 2019 to 15 February 2020
	118 HCWs in neurosurgery unit
	• Mean age 31 y
	• 64% female
	• 75% nurse, 25% physician
	• 10% SARS-CoV-2 infection (PCR)
		Sex
		• Female: 9.3% (7/75)
		• Male: 11.6% (5/43)
		  ◦ Female vs. male: OR 0.78 (0.23-2.64)*
		Age (mean, years): 36.6 (cases) vs. 30.5 (non-cases), p=0.006
		BMI (mean, kg/m^2): 22.4 (cases) vs. 22.0 (non-cases), p=0.85
		HCW role
		• Nurse practitioners: 2.4% (1/42)
		• Nurse: 9.1% (8/88)
		• Physician: 13.3% (4/30)
		  ◦ Nurse vs. physician: OR 0.65 (0.18-2.34)*
		Exposure
		• Contact with COVID-19 index case: 7.3% (7/96)
		• No contact with index case: 22.7% (5/22)
		  ◦ Contact vs. no contact with index case: **OR 0.27 (0.08-0.94)***
		• Contact with infected co-worker: 28.6% (12/42)
		• No contact with infected co-worker: 0% (0/76)
		  ◦ Contact vs. no contact with infected co-worker: **OR 62.70 (3.60-1092.46)***
		Night shift work
		• Yes: 17.3% (9/52)
		• No: 4.5% (3/66)
		  ◦ Night shift work (yes vs. no): **OR 4.40 (1.12-17.18)***
		Working under pressure
			No control for confounders; potential recall bias; 2 infected HCWs not included in analysis

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• Yes: 19.0% (8/42)
		• No: 5.3% (4/76)
		   o Working under pressure (yes vs. no): **OR 4.24 (1.19-15.05)***
		Smoking
		• Current smoker: 0% (0/9)
		• Not current smoker: 11.0% (12/109)
		   o Current smoker (yes vs. no): OR 0.41 (0.02-7.49)*
		Alcohol
		• Current alcohol use: 0% (0/10)
		• No current alcohol use: 11.1% (12/108)
		   o Current alcohol use (yes vs. no): OR 0.37 (0.02-6.67)
		Chronic pulmonary disease
		• Yes: 11.1% (1/9)
		• No: 10.1% (11/109)
		   o Chronic pulmonary disease (yes vs. no): OR 1.11 (0.13-9.76)*
		Chronic non-pulmonary disease
		• Yes: 0% (0/6)
		• No: 10.7% (12/112)
		   o Chronic non-pulmonary disease (yes vs. no): OR 0.62 (0.03-11.65)*	

Zhang G et al, 2020 (83) Retrospective cohort 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) • Physician: 14.9% (10/67) • Nurse: 1.2% (2/170) o 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
Cross-sectional studies			
Abbas et al 2021 (84) Cross-sectional Pakistan (Lahore); 2 cancer hospitals; 29 to 31 July 2020	2162 HCWs • Mean age 34 y • 29% female • 48% clinical staff, 52% nonclinical staff • 39.6% SARS-CoV-2 seropositivity	Age (per year): adjusted OR 1.00 (0.99 to 1.01) Sex • Female: 32.3% (204/631); ***adjusted OR 0.60 (0.49-0.73)*** • Male: 42.6% (653/1531); reference HCW role • Clinical: 41.2% (470/1142); ***adjusted OR 1.27 (1.06-1.53)*** • Nonclinical: 37.9% (387/1020); reference	66% participation rate; limited data on HCW role; did not control for exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Akinbami et al 2021 (85) Cross-sectional *Hospital HCWs* US (Rhode Island); 15 hospitals; 17 July to 28 August	8,370 asymptomatic hospital HCWs • Mean age not reported; 3% 18-24 y, 24% 25-34 y, 22% 35-44 y, 35% 45-59 y, 11% 60-64 y, 5% ≥65 y • 81% female • 82% white, 4% Asian, 3% Black; 7% Hispanic; 5% other/decline • 33% nurse, 5% nurse assistant, 12% physician, 1% physician assistant; 2% administration • 3.1% SARS-CoV-2 seropositive	Age • 18-24 y: 7.6% (21/275); reference • 25-34 y: 3.6% (71/1987); *adjusted OR 0.53 (0.31-0.92)* • 35-44 y: 3.0% (56/1874); adjusted OR 0.46 (0.20-1.04) • 45-59 y: 2.8% (81/2890); *adjusted OR 0.50 (0.26-0.96)* • 60-64 y: 2.5% (22/896); *adjusted OR 0.48 (0.23-0.97)* • ≥65 y: 1.1% (5/448); *adjusted OR 0.26 (0.11-0.63)* Sex • Female: 3.1% (212/6788); adjusted OR 0.85 (0.59-1.21) • Male: 2.8% (44/1582); reference Race/Ethnicity • White: 2.7% (182/6829); reference • Black: 7.0% (20/284); *adjusted OR 2.83 (1.77-4.51)* • Asian: 3.2% (10/316); adjusted OR 1.16 (0.58-2.29) • Hispanic: 5.6% (31/554); *adjusted OR 1.70 (1.35-2.13)* • Other race/ethnicity: 5.8% (11/191); adjusted OR 1.94 (0.89-4.22) HCW role • Physician: 2.2% (22/1001); reference • Nurse: 4.2% (114/2733); *adjusted OR 1.66 (1.07-2.57)* • Nurse assistant: 5.9% (23/392); adjusted OR 1.44 (0.85-2.43) • Physician assistant: 1.0% (1/100); adjusted OR 0.68 (0.22-2.12) • Reception/medical assistant: 4.1% (12/296); *adjusted OR 2.04 (1.18-3.52)* Workplace (yes or no) • COVID-19 unit: 5.0% (72/1435); adjusted OR 1.29 (0.88-1.87) • General inpatient unit: 3.7% (138/3752); adjusted OR 1.04 (0.74-1.46) • ICU: 3.0% (37/1250); adjusted OR 0.78 (0.49-1.30) • Surgical unit: 2.5% (31/1234); adjusted OR 0.61 (0.41-0.91) • ED: 2.4% (7/288); adjusted OR 0.49 (0.18-1.29) • Administrative office: 1.9% (21/1132); adjusted OR 0.76 (0.48-1.21) • Ambulatory healthcare/dental office: 2.3% (48/2122); adjusted OR 0.80 (0.60-1.09) Coworker exposure • No/unknown exposure to COVID-19-positive coworker: 2.1% (134/6299); reference • Exposure to COVID-19-positive coworker: 5.9% (122/2070); *adjusted OR 1.87 (1.36-2.58)* Household member exposure	Participation rate not reported; potential recall bias; some imprecise estimates

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• No/unknown exposure to COVID-19-positive household member: 2.4% (198/8156); reference • Exposure to COVID-19-positive household member: 27.2% (58/213); ***adjusted OR 11.91 (8.43-16.83)*** Patient exposure • No/unknown exposure to COVID-19-positive patient: 2.0% (88/4422); reference • Exposed while not wearing PPE: 4.6% (60/1317); adjusted OR 1.28 (0.89-1.85) • Exposed while wearing PPE: 4.1% (108/2630); ***adjusted OR 1.41 (0.99-2.00)*** Other exposure to COVID-19-positive person • No/unknown exposure: 2.5% (189/7542); reference • Exposed: 8.1% (67/827); ***adjusted OR 1.63 (1.02-2.60)*** Frequency of aerosol-generating procedure (times/shift/week) • 0: 2.6% (108/4121); reference • 1-5: 3.7% (62/1679); adjusted OR 1.12 (0.76-1.62) • 6-10: 5.8% (22/380); adjusted OR 1.60 (0.87-2.92) • 11-25: 4.0% (11/277); adjusted OR 0.71 (0.36-1.40) • >25 times: 5.2% (19/366); adjusted OR 1.24 (0.70-2.20) Use of PPE shortage protocol (reference: never used PPE) • No shortage: 4.9% (25/511); 1.23 (0.67-2.25) • Reuse: 2.3% (21/934); adjusted OR 0.55 (0.28-1.05) • Extended use: 3.1% (42/1341); adjusted OR 0.66 (0.42-1.04) • Reuse and extended use: 3.9% (104/2644); adjusted OR 0.84 (0.56-1.26) Education/training • No PPE donning/doffing training: 2.5% (5/199); reference • PPE donning/doffing training: 3.6% (184/5140); OR 1.45 (0.59-3.55)*	
Akinbami et al 2021 (85) Cross-sectional *Nursing home HCWs* US (Rhode Island); 56 nursing homes; 17 July to 28 August	1,494 asymptomatic nursing home HCWs • Mean age not reported; 5% 18-24 y, 17% 25-34 y, 22% 35-44 y, 38% 45-59 y, 11% 60-64 y, 7% ≥65 y • 85% female	Age • 18-24 y: 10.3% (7/68); reference • 25-34 y: 14.6% (37/254); adjusted OR 1.27 (0.59-2.73) • 35-44 y: 13.7% (45/328); adjusted OR 1.21 (0.44-3.37) • 45-59 y: 13.7% (78/569); adjusted OR 1.61 (0.68-3.78) • 60-64 y: 11.8% (20/170); adjusted OR 1.94 (0.89-4.21) • ≥65 y: 8.6% (9/105); adjusted OR 1.75 (0.59-5.20) Sex • Female: 12.4% (157/1267); ***adjusted OR 0.66 (0.46-0.94)*** • Male: 17.2% (39/227); reference	Participation rate not reported; potential recall bias; some imprecise estimates

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	• 78% white, 6% Black, 2% Asian; 9% Hispanic; 7% other/decline • 28% nurse, 20% nursing assistant, 0.7% physician • 13.1% SARS-CoV-2 seropositive	Race/Ethnicity • White: 10.2% (119/1165); reference • Black: 27.6% (24/87); adjusted OR 1.60 (0.84-3.05) • Asian: 21.4% (6/28); adjusted OR 1.90 (0.99-3.66) • Hispanic: 21.5% (28/130); adjusted OR 1.90 (0.99-3.66) • Other race/ethnicity: 20.0% (8/40); **adjusted OR 2.57 (1.25-5.28)** HCW role • Occupational/physical/speech therapist: 9.8% (16/163); reference • Nurse: 15.3% (63/413); adjusted OR 1.78 (0.93-3.42) • Nurse assistant: 19.9% (59/296); adjusted OR 2.06 (1.06-4.00) Workplace (yes vs. no) • COVID-19 unit: 24.1% (136/565); **adjusted OR 2.86 (1.61-5.10)** • Non-COVID-19 unit: 10.2% (111/1088); adjusted OR 0.81 (0.51-1.28) • Administrative office: 5.5% (12/218); adjusted OR 0.77 (0.34-1.72) Coworker exposure • No/unknown exposure to COVID-19-positive coworker: 8.8% (83/944); reference • Exposure to COVID-19-positive coworker: 20.6% (113/550); adjusted OR 1.10 (0.71-1.72) Household member exposure • No/unknown exposure to COVID-19-positive household member: 10.9% (155/1418); reference • Exposure to COVID-19-positive household member: 54.0% (41/76); **adjusted OR 9.37 (4.75-18.50)** Patient exposure • No/unknown exposure to COVID-19-positive patient: 6.0% (49/823); reference • Exposed while not wearing PPE: 16.2% (28/173); adjusted OR 1.10 (0.54-2.07) • Exposed while wearing PPE: 23.9% (119/498); **adjusted OR 2.18 (1.26-3.80)** Other exposure to COVID-19-positive person • No/unknown exposure: 10.7% (142/1331); reference • Exposed: 33.1% (54/163); **adjusted OR 1.92 (1.26-2.91)** Frequency of aerosol-generating procedure (times/shift/week) • 0: 10.8% (93/858); reference • 1-5: 21.9% (25/114); adjusted OR 1.59 (0.87-2.92) • 6-10: 19.4% (7/36); adjusted OR 1.46 (0.66-3.24)	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• 11-25: 17.4% (4/23); adjusted OR 0.96 (0.25-3.71) • >25 times: 29.3% (12/41); adjusted OR 1.31 (0.63-2.74) Use of PPE shortage protocol (reference: never used PPE) • No shortage: 11.8% (28/238); adjusted OR 0.94 (0.46-1.94) • Reuse: 11.3% (21/186); adjusted OR 0.89 (0.42-1.87) • Extended use: 17.8% (45/253); adjusted OR 1.49 (0.77-2.87) • Reuse and extended use: 16.8% (83/495); adjusted OR 1.30 (0.66-2.58) Education/training • No PPE donning/doffing training: 20.0% (3/15); reference • PPE donning/doffing training: 15.0% (170/1135); OR 0.70 (0.20-2.52)*	
Al-Naamani et al 2021 (11) Cross-sectional Oman (Muscat); 1 military hospital; 9 to 24 December 2020 **Added for Update Alert #11**	1111 asymptomatic HCWs • Median age 37 y • 67% female • HCW role not reported • 33.6% SARS-CoV-2 seropositive	*n/N, 95% CI not reported* Age • >50: 2.6% • <50: 31%; adjusted OR 0.98 (p=0.19) Sex • Female: 26.4%; ***adjusted OR 2.27 (p<0.0001)*** • Male: 7.2% Exposure • High-risk environment: 5.5% (reference) • Low or intermediate-risk environment: 14.7%; adjusted OR 1.22 (p=0.29) Directness of contact • Unprotected contact with COVID-19 patients: 8.2%; adjusted OR 1.13 (p=0.72) • No contact with COVID-19 patients: 25.4%	Participation rate note reported; limited control for confounders; potential recall bias
Al Youha et al 2021 (86) Cross-sectional Kuwait (Kuwait City); 1 hospital; August to October 2020	847 HCWs • Mean age 36 y • 52% female • 56% physician, 18% nurse, 7% lab technician, 3% radiology technician, 2% pharmacist • 20.5% SARS-CoV-2 infection (seropositive or PCR)	Age, Sex • Narrative report of no association between age or sex and risk of infection (data not shown) HCW role • Nurse (yes vs. no): 27.6% (43/156); ***adjusted OR 1.77 (1.15-2.71)*** • Other medical staff (yes vs. no): 23.5% (44/186); adjusted OR 1.40 (0.93-2.12) PPE • Glove use vs. non-use: ***adjusted OR 2.93 (1.19-7.22)*** • Goggle use vs. non-use: adjusted OR 1.27 (0.72-2.27) • Gown use vs. non-use: adjusted OR 0.64 (0.31-1.32)	Participation rate not reported; potential recall bias; limited control of confounders
Alkurt et al 2021 (87) Cross-sectional	813 HCWs • Mean age 34 y • 65% female	Sex • Female: 13.3% (80/600) • Male: 11.7% (39/332)	Participation rate not reported; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

Turkey (Istanbul and Kocaeli); 3 hospitals; 30 May to 6 June 2020	• 27% nurse, 31% physician, 14% ward clerk and security, 12% lab and radiology technician, 10% cleaning staff, 5% administrative staff
	• 2.7% SARS-CoV-2 seropositive
		o Female vs. male: OR 1.16 (0.77-1.74)*
		HCW role
		• Nurse: 16.8% (45/268)
		• Physician: 10.8% (30/279)
		   o Nurse vs. physician: OR 1.67 (1.02-2.75)*
		• Ward clerk and security: 11.6% (15/129)
		• Lab and radiology technician: 6.5% (7/107)
		• Cleaning staff: 12.5% (12/96)
		• Administrative staff: 18.9% (10/53)
		Exposure
		• COVID-19 clinic: 15.2% (51/335)
		• Non-COVID-19 clinic: 27.8% (30/108)
		   o COVID-19 vs. non-COVID-19 clinic: **OR 0.46 (0.28-0.78)***
		• ICU: 12.7% (10/79)
		• ED: 14.5% (8/55)
		• Administrative office: 12.0% (15/125)
		Clinical factors
		• Hypertension: 17.0% (7/41)
		   o Yes vs. no: OR 1.43 (0.62-3.31)*
		• Diabetes mellitus: 20.7% (6/29)
		   o Yes vs. no: OR 1.82 (0.73-4.58)*
		• Smoking: 6.1% (14/228)
		   o Yes vs. no: **OR 0.37 (0.32-0.67)***
		• Immunosuppressive drug: 22.2% (2/9)
		   o Yes vs. no: OR 3.16 (0.61-16.48)*	

Allen et al 2021 (88) Cross-sectional Ireland (Dublin); 2 hospitals; 14 to 23 October 2020	5787 HCWs • Mean age 40 y • 77% female • 14% administration, 17% medical/dental staff, 36% nurse/midwife, 19% allied health, 5% healthcare assistant, 8% general support staff • 9.9% SARS-CoV-2 seropositivity	Age • 18-29 y: 13.0% (177/1350); **adjusted RR 1.40 (1.10-1.90)** • 30-39 y: 10.0% (168/1617); adjusted RR 1.20 (0.90-1.50) • 40-49 y: 8.2% (124/1515); adjusted RR 1.0 (0.80-1.30) • 50-59 y: 7.7% (77/1001); reference • >60 y: 9.9% (30/304); adjusted RR 1.40 (0.90-2.00) Sex • Female: 9.4% (422/4478); reference • Male: 12.0% (154/1308); **adjusted RR 1.2 (1.0-1.4)** Race/ethnicity • Irish: 8.6% (384/4444); reference • Other White: 11.0% (62/551); adjusted RR 1.3 (1.0-1.6) • African or other Black: 14.0% (16/113); adjusted RR 1.3 (0.8-2.0)	64% participation rate; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Asian: 19.0% (107/577); *adjusted RR 1.3 (1.0-1.6)* • Other race/ethnicity: 6.9% (7/101); adjusted RR 0.6 (0.2-1.3) HCW role • Administration: 6.0% (48/803); reference • Medical/dental: 10.0% (102/982); adjusted RR 1.2 (0.8-1.7) • Nurse/midwife: 13.0% (263/2064); *adjusted RR 1.6 (1.1-2.2)* • Allied health: 6.7% (73/1091); adjusted RR 0.9 (0.6-1.3) • General support staff: 7.6% (33/434); adjusted RR 0.9 (0.6-1.4) • Healthcare assistant: 18.0% (50/286); *adjusted RR 2.0 (1.4-3.0)* • Other role: 5.5% (7/127); adjusted RR 1.0 (0.5-2.1) Workplace exposure • Daily contact with COVID-19 patients: 15.0% (136/902); *adjusted RR 1.6 (1.2-2.1)* • Daily contact with non-COVID-19 patients: 11.0% (344/3245); *adjusted RR 1.4 (1.1-1.8)* • No patient contact: 5.9% (96/1635); reference	
Allen et al 2022 (18) Cross-sectional Ireland (Dublin and Galway); 19 to 28 April 2021 **Added for Update Alert #11**	5085 HCWs • Median age 40 y • 78% female • 84% White (Irish or other white background), 12% Asian, 2% African or Black, 2% other race/ethnicity • 37% nurse, 21% allied health, 14% medical or dental, 13% administration, 7% general support, 6% healthcare assistant, 2% other role • 17.7% SARS-CoV-2 seropositive	Age • 18-29 y: 22.5% (249/1108); *adjusted RR 1.3 (1.1-1.6)* • 30-39 y: 17.9% (238/1330); adjusted RR 1.1 (0.9-1.3) • 40-49 y: 14.7% (208/1414); adjusted RR 1.0 (0.7-1.1) • 50-59 y: 16.6% (158/951); reference • >60 y: 16.0% (45/282); adjusted RR 1.0 (0.7-1.3) Sex • Female: 16.9% (669/3959); reference • Male: 18.7% (229/1226); *adjusted RR 1.2 (1.0-1.4)* Race/Ethnicity • White (Irish): 15.7% (595/3798); reference • Other white: 19.7% (94/476); *adjusted RR 1.2 (1.0-1.4)* • Asian: 24.7% (148/599); adjusted RR 1.1 (0.9-1.3) • African or other Black: 33.3% (39/117); *adjusted RR 1.7 (1.3-2.2)* • Other race/ethnicity: 23.2% (22/95); adjusted RR 1.3 (0.9-1.9) HCW role • Administration: 12.6% (85/676); reference • Medical/dental: 16.3% (116/713); adjusted RR 1.0 (0.7-1.4) • Nurse/midwife: 20.9% (396/1891); *adjusted RR 1.4 (1.0-1.8)* • Allied health: 11.3% (118/1044); adjusted RR 0.8 (0.6-1.1) • General support: 22.2% (81/365); adjusted RR 1.2 (0.9-1.7) • Healthcare assistant: 32.0% (93/291); *adjusted RR 1.8 (1.3-2.3)*	56% participation rate

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Other role: 9.5% (10/105); adjusted RR 0.7 (0.3-1.2) Exposure • Contact with COVID-19 patients: 23.3% (265/1136); ***adjusted RR 1.4 (1.1-1.7)*** • Contact with patients without COVID-19: 18.5% (463/2500); ***adjusted RR 1.3 (1.1-1.5)*** • No patient contact: (170/1449); reference	

Al Maskari et al, 2020 (89)
 	
Cross-sectional
 	
Oman; 1 tertiary care hospital; 18 March to 11 July 2020
	4703 HCWs
	• Mean age not reported
	• 29% female
	• 12% physician, 40% nurse, 20% paramedic, 28% administrative/ support staff
		SARS-CoV-2 infection (PCR)
		• Male: 2.2% (74/3299)
		   o Female: 9.3% (130/1404
		• Female vs. male: OR 4.45 (3.32-5.96)*
		• Physician: 4.7% (26.556)
		   o Nurse: 4.1% (77/1870)
		• Nurse vs. physician: 0.88 (0.56-1.38)*
		• Paramedic: 2.8% (27/969)
		• Administrative/support staff: 5.6% (74/1308)
			No control for confounders

Amendola et al, 2020 (90)
 	
Cross-sectional
 	
Italy (Milan); 1 pediatric hospital; 15 April 2020
	663 asymptomatic HCWs (547 clinical and 116 nonclinical)
	• Mean age 44 y
	• 84% female
	• 83% clinical HCW, 17% nonclinical HCW
	   o 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 /
		SARS-CoV-2 seropositivity
		• Female: 4.3% (24/555)
		• Male: 9.3% (10/108)
		   o Female vs. male: OR 0.44 (0.21-0.96)*
		• Clinical HCW: 5.1% (28/547)
		   o Physician: 4.7% (10/214)
		   o Nurse: 6.0% (13/216)
		      ▪ Nurse vs. physician: OR 1.31 (0.56-3.05)*
		   o 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)
		• Administration/pharmacy/laboratory: 8.6% (6/70)
		• Others: 3.1% (3/98)
		• Direct contact with COVID-19 patient: 6.6% (20/304)
			No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	pharmacy / lab, 15% other • Among HCWs (n=547), 56% direct contact with COVID-19 patient, 44% no known direct contact	• No known direct contact: 3.3% (8/243) o Direct vs. no direct contact with COVID-19 patient: OR 2.07 (0.89-4.78)*	

Barallat et al 2020 (91)
 	
Cross-sectional
 	
Spain (Barcelona); HCWs in the Northern Metropolitan Area; 4 to 22 May 2020
	7563 HCWs
	• Mean age 43 y
	• 76% female
	• 24% physician, 30% nurse, 11% nursing assistant, 6% heathcare support services, 16% administration, 8% other role
	• 9.4% SARS-CoV-2 seropositivity
		Age
		• 18-34 y: 10.3% (209/2025); reference
		• 35-54 y: 9.0% (330/3664); OR 0.86 (0.72-1.03)*
		• ≥55 y: 10.1% (179/1771); OR 0.98 (0.79=-1.21)*
		Sex
		• Female: 9.2% (522/5673)
		• Male: 10.1% (181/1789)
		  o Female vs. male: OR 0.90 (0.75-1.08)*
		HCW role
		• Nurse: 9.6% (216/2243)
		• Nursing assistant: 11.9% (85/832)
		• Physician: 27.0% (192/1821)
		  o Nurse vs. physician: OR 0.90 (0.74-1.11)*
		  o Nurse or nursing assistant vs. physician: OR 0.92 (0.76-1.11)*
		• Heathcare support services: 4.6% (33/429)
		• Administration: 10.5% (75/1181)
		• Other role: 7.2% (51/616)
			No control for confounders; 81% participation rate

Baker et al 2021 (92) Cross-sectional US (Atlanta); 1 academic health care system including 11 hospitals and 250 locations;19 April 19 to 26 June 2020	10,275 HCWs • Mean age not reported; 16% <30 y, 31% 30-39 y, 22% 40-49 y, 19% 50-59 y, 12% ≥60 y • 78% female • 31% nurse, 18% physician, 19% other no patient contact; 15% other direct care; 7% advanced practice provider; 4% nurse tech; 3%	Age • ≥60: 4.9% (57/1153); reference • 50-59: 5.2% (93/1805); unweighted adjusted OR 0.8 (0.6-1.2) • 40-49: 5.9% (125/2118); unweighted adjusted OR 0.9 (0.7-1.4) • 30-39: 5.8 (171/2953); unweighted adjusted OR 1.0 (0.7-1.4) • <30: 6.9 (109/1581); unweighted adjusted OR 1.2 (0.8-1.7) Sex • Female: 5.7% (428/7456); reference • Male: 5.9% (127/2154); unweighted adjusted OR 1.3 (1.0-1.7) Race • White: 4.3% (226/5263); reference • Black: 8.3% (238/2860); unweighted adjusted OR 2.1 (1.7-2.6) • Asian: 5.3% (60/1133); unweighted adjusted OR 1.3 (0.9-1.7)	35% participation rate; potential recall bias; limited measurement of exposures and PPE

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	radiology tech; 1% respiratory therapist; 0.4% environmental services; 2% not specified • 30% Black, 55% white, 12% Asian, 1% multiracial, 0.3% American Indian/Alaska native, 0.2% Native Hawaiian/Pacific Islander, 2% not specified; 96% non-Hispanic • 5.7% SARS-CoV-2 seropositive	• Multiracial: 7.6% (10/132); unweighted adjusted OR 1.8 (0.8-3.5) HCW role • Nurse: 5.9% (177/2976); unweighted adjusted OR 1.0 (0.7-1.4) • Physician: 5.0% (87/1753); unweighted adjusted OR 0.9 (0.6-1.4) ○ Nurse vs. physician: OR 1.21 (0.93-1.58)* • Other no patient contact: 5.5% (100/1812); reference • Other direct care: 6.2% (88/1423); unweighted adjusted OR 1.1 (0.7-1.5) • Advanced practice provider: 5.2% (36/698); unweighted adjusted OR 0.9 (0.6-1.5) • Nurse tech:8.1% (28/346); unweighted adjusted OR 0.9 (0.5-1.5) • Radiology tech: 7.0% (21/302); unweighted adjusted OR 1.3 (0.7-2.2) • Respiratory therapist: not reported; unweighted adjusted OR 0.8 (0.3-1.7) • Environmental services: not reported; unweighted adjusted OR 1.3 (0.3-4.0) Exposure • No patient contact: 4.6% (43/941); reference • Home: 4.9% (13/267); unweighted adjusted OR 1.2 (0.6-2.2) • Other hospital area: 5.6% (52/926); unweighted adjusted OR 1.2 (0.8-2.0) • OR/procedure area: 5.7% (38/672); unweighted adjusted OR 1.2 (0.7-2.0) • Outpatient, clinical: 5.4% (90/1675; unweighted adjusted OR 1.4 (0.9-2.2) • Inpatient, not COVID-19 focused: 5.8% (93/1594); unweighted adjusted OR 1.4 (0.9-2.2) • COVID-19 focused: 6.7% (117/1750); unweighted adjusted OR 1.5 (1.0-2.4) • ED: 6.7% (67/1007); unweighted adjusted OR 1.5 (0.9-2.4) PPE use • As recommended: 5.9% (370/6320); reference • Not as recommended: 6.3% (14/221); unweighted adjusted OR 0.8 (0.4-1.4) • Unsure: 4.0% (22/546**); unweighted adjusted OR 0.6 (0.4-0.9)** • Not applicable: 5.9% (149/2523); unweighted adjusted OR 1.1 (0.8-1.3) Community contact with confirmed/suspected positive people • No/not sure: 5.4% (478/8862); reference • Yes: 10.3% (77/748); ***unweighted adjusted OR 1.7 (1.3-2.3)***	
Bayle et al 2021 (93) Cross-sectional France (Paris); 4 nursing homes; 16 to 29 April 2020	241 nursing home HCWs • Mean age 40 y • 84% female • 63% nurse and nursing assistant, 3% medical staff, 6% allied health, 8%	Sex • Female: 13.4% (27/202) • Male: 12.8% (5/39) ○ Female vs. male: OR 1.05 (0.38-2.92)* HCW role • Nurse and nursing assistant: 15.2% (23/151) • Medical staff: 0% (0/6)	Participation rate not reported; no control for confounders; imprecise estimates

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	clerical, 14% environmental staff, 5% food service • 13.3% SARS-CoV-2 infection (PCR)	o Nurse and nursing assistant vs. medical staff: OR 2.38 (0.13-43.64)* • Clerical staff: 0% (0/20) • Allied health: 13.3% (2/15) • Environmental staff: 12.1% (4/33) • Food service: 25.0% (3/12)	

Bouwman et al 2021(94)
 	
Cross-sectional
 	
The Netherlands (Northern Limburg); 1 teaching hospital; 22 June to 3 July 2020
	2507 HCWs
	• Median age 45 y
	• 82% female
	• 8% physician, 30% nurse, 18% paramedical staff, 44% other staff
	• 21.1% SARS-CoV-2 seropositive
		HCW role (reference no direct patient contact, 15.6% [137/877])
		• Physician: 17.8% (36/202); adjusted OR 0.60 (0.35-1.03)
		• Nurse: 30.2% (225/745); adjusted OR 1.21 (0.79-1.84)
		• Paramedical: 16.1% (74/459); adjusted OR 0.66 (0.45-0.98)
		• Other HCW with direct patient contact: 25.9% (58/224); adjusted OR 1.08 (0.69-1.70)
		Department (reference department with no direct patient contact, 15.4% [147/951])
		• Physician vs. role with no direct patient contact: adjusted OR 0.60 (0.35-1.03)
		• Nurse vs. role with no direct patient contact: adjusted OR 1.21 (0.79-1.84)
		• COVID-19 nursing ward: 29.2% (193/660); adjusted OR 1.86 (0.93-3.74)
		• ICU: 14.1% (28/199); adjusted OR 1.01 (0.43-2.33)
		• Pediatrics: 24.4% (11/45); adjusted OR 1.93 (0.67-5.55)
		• Emergency department: 26.1% (23/88); adjusted OR 1.41 (0.58-3.45)
		• Housekeeping: 18.0% (9/50); adjusted OR 1.05 (0.49-2.26)
		• General surgery: 37.9% (39/103); *adjusted OR 3.39 (1.32-8.71)*
		Exposure
		• COVID-19 contact
		  o No known COVID-19 contact: 11.7% (87/745); reference
		  o COVID-19 patient contact: 27.4% (299/1088); adjusted OR 1.62 (0.80-3.33)
		  o COVID-19 co-worker contact: 23.4% (215/919); *adjusted OR 1.83 (1.15-2.93)*
		  o COVID-19 household contact: 51.8% (44/85); *adjusted OR 6.09 (2.23-16.64)*
		• Hospital ward
		  o No direct patient contact: 15.4% (147/951); reference
		  o COVID-19 confirmed nursing ward: 29.2% (193/660); adjusted OR 1.05 (0.69-1.60)
		  o COVID-19 suspected nursing ward: 23.2% (93/400); adjusted OR 0.82 (0.53-1.25)
		  o Non-COVID-19 nursing ward: 24.1% (45/187); adjusted OR 0.95 (0.58-1.55)
			76% participation rate; potential recall bias; limited control of confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		o Outpatient department: 16.8% (52/309); adjusted OR 0.80 (0.53-1.19)	
Brousseau et al 2021 (12) Cross-sectional Canada (Quebec); 10 hospitals; 6 July to 24 September 2020 **Added for Update Alert #11**	2056 HCWs • Mean age not reported; 21% 18-29 y, 31% 30-39 y, 27% 40-49 y, 17% 50-59 y, 4% ≥60 y • 76% female • 77% White, 7% Black, 2% Hispanic, 13% other race/ethnicity • 21% physician, 58% nurse, 6% nursing assistant, 10% orderly, 5% cleaning staff • 11.7% SARS-CoV-2 seropositive	Race/Ethnicity • Black or Hispanic: 23.4% (45/192); ***adjusted RR 1.41 (1.13-1.76)*** • Other race/ethnicity: 12.2% (33/270); adjusted RR 0.89 (1.67-1.18) • White: 10.2% (163/1594); reference HCW role • Nurse/nursing assistant: 12.3% (163/1321); ***adjusted RR 1.34 (1.03-1.74)*** • Orderly: 17.9% (36/201); ***adjusted RR 1.49 (1.12-1.97)*** • Cleaning staff: 10.8% (11/102); adjusted RR 0.88 (0.50-1.54) • Physician: 7.2% (31/432); reference Department • ICU: 6.2% (29/469); ***adjusted RR 0.47 (0.30-0.71)*** • ED: 7.9% (46/580); ***adjusted RR 0.61 (0.39-0.98)*** • COVID-19 unit: 23.2% (101/436); adjusted RR 1.48 (0.93-2.36) • Other unit: 10.5% (14/133); adjusted RR 1.03 (0.70-1.50) • Non-COVID-19 unit: 11.6% (51/438); reference Exposure • ≥3 days/week working in SARS-CoV-2 unit: 14.0% (173/1233); adjusted RR 1.07 (0.74-1.56) • ≤2 days/week working in SARS-CoV-2 unit: 5.7% (5/87); reference	47% participation rate; limited control for confounders; potential recall bias

Clifton et al 2021 (95)
 	
Cross-sectional
 	
United States (New York City); COVID-19 government-administered treatment facility; 28 to 30 April 2020
	336 military HCWs
	• Median age 32 y
	• 40% female
	• 30% nurse, 7% physician or physician assistant, 28% medical support (LPN, medic, therapist or other specialty)
	• 1.8% SARS-CoV-2 infection (PCR)
		Sex
		• Female: 1.5% (2/135)
		• Male: 2.0% (4/201)
		  o Female vs. male: OR 0.74 (0.13-4.10)*
		HCW role
		• Nurse: 1.0% (1/100)
		• Physician or physician assistant: 0% (0/25)
		  o Nurse vs. physician or physician assistant: OR 0.77 (0.03-19.44)*
		• Medical support: 1.1% (1/94)
		• Other role: 3.4% (4/117)
		Exposure
		• Direct contact with COVID-19 patients: 0.9% (2/223)
		• No direct contact with COVID-19 patients: 3.5% (4/113)
		  o Direct contact vs. no direct contact: OR 0.25 (0.04-1.37)*
		• Performed aerosol-generating procedures: 0% (0/26)
		• Did not perform aerosol-generating procedures: 1.9% (6/310)
			57% participation rate; no control for confounders; imprecise estimates

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		o Performed vs. did not perform aerosol-generating procedures: OR 0.88 (0.05-16.12)* • Reported break in PPE: 2.8% (1/36) • Did not report break in PPE: 1.7% (5/300) o Reported vs. did not report break in PPE: OR 1.69 (0.19-14.84)*	
Cruz-Arenas et al 2021 (96) Cross-sectional Mexico (Mexico City); 1 hospital; 10 August to 9 September 2020	299 HCWs • Mean age not reported; 14% <30 y, 42% 30-44 y, 38% 45-49 y, 7% ≥60 y • 65% female • 19% medical personnel,19% nurse, 21% administration, 5% research, 5% orderly, 6% technician, 16% therapist, 4% janitor, 3% security, 2% food services • 13.0% SARS-CoV-2 seropositive	Sex • Female: 15.4% (30/195); reference • Male: 8.7% (9/104); *adjusted OR 0.31 (0.11-0.90)* HCW role • Nurse: 12.5% (7/56); adjusted OR 0.71 (0.18-2.78) • Medical personnel: 5.2% (3/58); adjusted OR 0.32 (0.06-1.66) • Research: 6.2% (1/16); adjusted OR 1.27 (0.13-12.23) • Orderly: 6.2% (1/16); adjusted OR 0.77 (0.07-8.41) • Technician: 11.1% (2/18); adjusted OR 0.73 (0.09-5.60) • Therapist: 12.8% (6/47); adjusted OR 1.81 (0.48-6.83) • Janitor: 45.4% (5/11); *adjusted OR 13.70 (2.85-65.77)* • Security: 62.5% (5/8); *adjusted OR 12.35 (1.32-115.01)* • Food service: 20.0% (1/5); adjusted OR 5.58 (0.47-66.31) • Administration: 12.5% (8/64); reference	Participation rate unclear; no control for exposures/PPE; some estimates very imprecise
Dacosta-Urbieta et al, 2020 (97) Cross-sectional Spain (Galacia); 1 pediatric hospital; 14 to 16 April 2020	175 HCWs • Mean age not reported; 18% ≥55 y • Gender not reported • 33% physician, 47% nurse/nurse's aide 47%, 13% resident, 7% other role	SARS-CoV-2 seropositivity • Nurse/nurse's aide: 4.8% (4/83) • Physician/resident: 3.8% (3/80) o Nurse/nurse's aide vs. physician/resident: OR 1.30 (0.28-6.00)*	No control for confounders
Dalla Volta et al, 2020 (98) Cross-sectional Italy (Brescia); 1 oncology unit; 24 February to 19 May 2020	76 HCWs • Median age 46 y • 75% female • 49% nurse, 22% oncologist, 16% resident, 1% psychologist, 7% data manager, 5% administrative	SARS-CoV-2 seropositivity • Physician/resident: 20.7% (6/29) o Nurse: 5.4% (2/37) • Nurse vs. physician/resident: OR 0.22 (0.04-1.18)* • Administrative: 50% (2/4)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	• 80% asymptomatic		
Davido et al 2021 (99) Cross-sectional France (Paris environs); 1 hospital; 5 March to 10 May 2020	99 HCWs (symptomatic or contact with COVID-19 patient) • Median age 44 y • 73% female • 47% nurse or nursing assistant, 18% physician, 21% support staff, 13% administration • 28.3% SARS-CoV-2 infection (PCR)	Age • <44: 18.4% (9/49); reference • >44: 38.0% (19/50); *adjusted OR 6.7 (1.7-37.7)* Sex • Female: 30.6% (22/72); adjusted OR 1.25 (0.42-5.00) • Male: 22.2% (6/27); reference HCW role (excluding administration; n=86) • Nurse or nursing assistant: 36.2% (17/47); OR 1.98 (0.56-7.00)* • Physician: 22.2% (4/18); reference • Support staff: 28.6% (6/21) Workplace exposure • COVID-19 unit: 26.9% (14/52); adjusted OR 0.7 (0.2-3.2) • Non-COVID-19 unit: 38.2% (13/34); reference Coworker exposure • No/unknown exposure to infected coworker: 26.5% (13/49); reference • Exposure to infected coworker: 37.5% (12/32); OR 1.66 (0.64-4.32)* Participated in procedure involving patient airway • Yes: 36.7% (11/30); adjusted OR 2.6 (0.6-12.5) • No: 23.4% (11/47); reference Mask use • Systematic use of mask: 22.2% (14/63); *adjusted OR 0.07 (0.003-0.56)* • No systematic use of mask: 85.7% (6/7); reference	50% participation rate; potential recall bias; some missing data
Davila-Conn et al 2022 (19) Cross-sectional Mexico (Mexico City); October 2020 to June 2021 **Added for Update Alert #11**	883 HCWs • Median age 36 y • 70% female • 24% physician, 28% nurse, 4% lab technician, 22% administration, 22 other role • 32.8% SARS-CoV-2 seropositive	*Prevalent cases* Sex • Female: 25.4% (158/620); adjusted OR 0.86 (0.58-1.29) • Male: 29.0% (76/262); reference HCW role • Physician: 22.2% (47/212); reference • Nurse: 31.1% (76/244); adjusted OR 1.02 (0.57-1.81) • Lab technician: 42.1% (16/38); *adjusted OR 4.38 (1.75-10.93)* • Administration: 22.6% (44/195); adjusted OR 1.18 (0.64-2.17) • Other role: 26.4% (50/189); adjusted OR 1.40 (0.79-2.50) Exposure • Frequent contact with COVID-19 patient: 30.7%% (113/367); • No or occasional contact with COVID-19 patient: 23.5% (121/514); reference PPE	Participation rate unclear; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Always or generally used PPE: 25.6% (208/812); adjusted OR 0.60 (0.32-1.13) • Sometimes or never used PPE: 37.7% (26/69); reference • Always or generally used a face mask: 26.4% (231/875); adjusted OR 0.44 (0.05-3.91) • Sometimes or never used a face mask: 50.0% (3/6); reference *Incident cases* Sex • Female vs. male: adjusted HR 1.54 (95% CI 0.81-2.94)* Age (comparison unclear): adjusted HR 0.80 (0.58-1.10) Occupation • Physician: Reference • Nurse: adjusted HR 0.94 (95% CI 0.40 to 2.19) • Administrative: adjusted HR 1.55 (95% CI 0.68-3.52) • Other: adjusted HR 0.23 (95% CI 0.06-81) Exposure • Contact with patient with COVID-19 (frequently vs. never/occasionally): adjusted HR 1.18 (95% CI 0.55 to 2.50) • Contact with any person with COVID-19 (yes vs. no/unknown): **adjusted HR 2.45 (95% CI 1.21-5.00)** PPE • Use of PPE (yes vs. no): adjusted HR 0.38 (95% CI 0.14 to 1.01)	
Ebinger et al 2021 (100) Cross-sectional USA (Los Angeles); health system; beginning 11 May 2020 (end date not reported)	6,062 HCWs • Mean age 41 y • 68% female • 50% white race, 31% Asian, 6% Black, 13% other • HCW role not reported • 3.5% SARS-CoV-2 seropositive	Age • Per decade increase: **adjusted OR 0.80 (0.68 to 0.94)** Sex • Female: 3.4% (139/4113) • Male: 3.7% (73/1949) ○ Female vs. male: adjusted OR 0.84 (0.63-1.12) Race/ethnicity • Asian: 3.1% (57/1866) • Black: 4.8% (18/372); **adjusted OR 2.02 (1.08-3.76)** • Hispanic/Latino: 5.3% (62/1159); **adjusted OR 1.98 (1.34-2.92)** • Other: 4.2% (33/782) • White: 3.4% (104/3042); reference Comorbidities • Asthma: 1.9% (14/747); adjusted OR 0.25 (0.13 to 0.51) • Autoimmune disease: 1.7% (4/232)^	Some data discrepancies; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Cancer: 1.5% (3/198)^ • Cardiovascular: 1.6% (2/129)^ • COPD: 0% (0/84)^ • Diabetes mellitus: 2.1% (8/378)^ • HTN: 2.6% (26/993)^ • BMI ≥30 kg/m^2: 3.1% (32/1030)^ Exposure • Regular contact with patients with COVID-19: 6.0% (86/1444)^ • Work in unit housing/caring for patients with COVID-19: 5.5% (93/1693); **_adjusted OR 1.61 (95% CI 1.18 to 2.18)_**	
Elfstrom et al 2021 (101) Cross-sectional Sweden (Stockholm); 1 hospital; 23 April to 24 June 2020	12,928 HCWs • Mean age not reported; 12% ≤29 y, 24% 30-29 y, 25% 40-49 y, 24% 50-59 y, 15% ≥60 y • 79% female • 18% physician, 31% nurse or midwife, 20% nursing assistant, 31% other role • 11.4% SARS-CoV-2 seropositive	Age • ≤29 y: 16.4% (249/1522); reference • 30-39 y: 12.0% (382/3172); **_adjusted OR 0.78 (0.65-0.93)_** • 40-49 y: 11.4% (370/3238); **_adjusted OR 0.76 (0.64-0.91)_** • 50-59 y: 10.2% (313/3066); **_adjusted OR 0.67 (0.56-0.80)_** • ≥60 y: 8.6% (166/1930); **_adjusted OR 0.57 (0.46-0.70)_** Sex • Female: 11.5% (1170/10203); reference • Male: 11.4% (310/2725); adjusted OR 1.14 (0.99-1.31) HCW role • Nurse or midwife: 12.1% (486/4027); adjusted OR 1.28 (1.11-1.49) • Nurse assistant: 15.4% (389/2532); adjusted OR 1.62 (1.38-1.90) • Physician: 9.5% (220/2326); adjusted OR 1.07 (0.89-1.28) • Other HCW role: 9.5% (385/4043); reference Exposure • COVID ward: 21.8% (2225/1031); **_adjusted OR 1.95 (1.65-2.32)_** • ICU: 9.9% (63/638); adjusted OR 0.86 (0.66-1.13) • Other hospital unit: 10.6% (1192/11259); reference	Limited control for exposures and no control for PPE use
Eyre et al 2020 (102) Cross-sectional UK (Oxfordshire); Oxford University hospitals; 23 April to 8 June 2020	10034 asymptomatic HCWs • Mean age not reported • 74% female; 0.05% transgender; 0.15% not reported • 72% white, 17% Asian, 4% Black, >1% Chinese, 2%	SARS-Cov-2 seropositivity or infection (PCR) Age, per 10 years: OR 0.95 (0.90-1.00) Sex • Female: 10.9% (812/7452) • Male: 12.2% (313/2562) ○ Female vs. male: OR 0.88 (0.76-1.01)^ • Transgender: 20.0% (1/5) Race/ethnicity • White: 9.5% (686/7237); reference • Asian: 16.8% (281/1673); **_adjusted OR 1.51 (1.28-1.77)_**	Potential recall bias; 73% participation rate; limited control of exposures and PPE

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	mixed race, 4% other/not reported • 40% nurse or healthcare assistant, 16% physician, 12% administration, 4% laboratory, 3% cleaning staff, 3% physical, occupational or speech/ language therapist, 2% security or catering, 21% other role • SARS-CoV-2 infection (seropositive or PCR): 11.2% (1128/10034)	• Black: 18.0% (71/394); ***adjusted OR 1.66 (1.25-2.21)*** • Chinese: 7.5% (7/93); adjusted OR 0.75 (0.34-1.67) • Mixed race/ethnicity: 11.6% (28/242); adjusted OR .23 (0.82-1.87) HCW role • Nurse/healthcare assistant: 14.2% (562/3971) • Physician: 10.9% (170/1557) o Nurse/healthcare assistant vs. physician: ***OR 1.35 (1.12-1.61)**** • Administration: 7.2% (88/1218) • Laboratory staff: 8.2% (29/354) • Cleaning staff: 18.6% (60/323) • Therapist: 14.9% (47/316) • Security or catering: 11.8% (26/221) Exposure • Do not work in COVID-19 unit: 8.6% (631/7369); reference • Work in COVID-19 unit: 22.6% (358/1586); ***adjusted OR 2.47 (1.99-3.08)*** • Work in any unit: 12.9% (139/1079); ***adjusted OR 1.39 (1.04-1.85)*** SARS-CoV-2 seropositivity (based on presence of IgG antibodies n=9956) Sex (vs. female) • Male: ***adjusted OR 1.19 (1.01-1.40)*** • Transgender: adjusted OR 3.32 (0.35-31.09) Race/ethnicity (vs. white) • Asian: ***adjusted OR 1.52 (1.29-1.80)*** • Black: ***adjusted OR 1.71 (1.28-2.28)*** • Chinese: adjusted OR 0.67 (0.29-1.59) • Mixed race/ethnicity: adjusted OR 1.30 (0.86-1.97) HCW role (vs. administration) • Nurse/healthcare assistant: adjusted OR 1.33 (0.94-1.87) • Senior physician: adjusted OR 0.84 (0.54-1.31) • Junior physician: adjusted OR 1.05 (0.70-1.58) • Laboratory staff: adjusted OR 0.96 (0.60-1.54) • Cleaning staff: ***adjusted OR 1.96 (1.26-3.04)*** Specialty (vs. other or none) • Anaesthetics: adjusted OR 0.70 (0.39-1.25) • ED: adjusted OR 1.06 (0.69-1.64) • General, urologic, plastic or cardiovascular surgery: adjusted OR 0.90 (0.61-1.33) • Hematology or oncology: adjusted OR 1.96 (1.32-2.92)	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Respiratory infectious disease: adjusted OR 0.76 (0.45-1.28) • ICU: **adjusted OR 0.47 (0.30-0.74)** • Medicine: **adjusted OR 1.47 (1.02-2.11)** • Ob/Gyn: adjusted OR 0.68 (0.38-1.23) • Ophthalmology, ENT surgery, or maxillofacial surgery: adjusted OR 0.73 (0.37-1.42) • Pediatrics: adjusted OR 0.82 (0.55-1.24) • Radiology: adjusted OR 0.90 (0.54-1.50) • Specialist medicine: adjusted OR 0.87 (0.63-1.21) • Trauma and orthopedics, rheumatology: **adjusted OR 1.83 (1.23 to 2.72)** Exposure (vs. no) • Exposure to known or suspected COVID-19 patient without PPE: **adjusted OR 1.47 (1.26-1.70)** • Work in COVID-19 patient area, yes: **adjusted OR 2.39 (1.91-3.00)** • Work in any area: **adjusted OR 1.38 (1.03-1.84)**	

Faico-Filho et al, 2020 (103)
Cross-sectional
 	
Brazil (Sao Paolo); 1 hospital; 22 March to 22 April 2020
	466 symptomatic HCWs
	• Median age 39 y
	• 72% female
	• 27% nurse technician, 11% nurse, 23% physician, 3% laboratory personnel, 19% administrative staff, 6% logistic worker, 10% other HCW role
		Incidence of SARS-CoV-2 infection (PCR): 36.2% (169/466)
		• Direct patient contact: 33.8% (109/322)
		  ○ Nurse or nurse technician: 40.1% (73/182)
		  ○ Physician: 24.2% (26/107)
		  ○ Laboratory personnel: 28.6% (4/14)
		    ○ Nurse or nurse technician vs. physician: OR 2.09 (95% CI 1.23-3.55)
		• No direct patient contact: 41.7% (60/144)
		  ○ Administrative staff: 31.1% (28/90)
		  ○ Logistic worker: 63.0% (17/27)
			Participation rate unclear; no control for confounders

Fitzpatrick et al 2021 (104) Cross-sectional United States (Illinois and Wisconsin); healthcare system that includes 26 hospitals and 500 clinical sites; 8 June to 10 July 2020	16,233 HCWs • Mean age 42 y • 86% female • 0.4% American Indian, 5% Asian, 4% Black, 6% Mixed, 85% White; 6% Hispanic • 14% COVID-19 clinical role, 57%	Age • 18-31 y: 5.5% (226/4073); reference • 32-40 y: 3.1% (126/4124); **adjusted OR 0.54 (0.43-0.68)** • 41-52 y: 3.6% (147/4122); **adjusted OR 0.66 (0.53-0.83)** • 53-82 y: 3.1% (123/3914); **adjusted OR 0.55 (0.44-0.69)** Race • American Indian: 3.6% (2/56); adjusted OR 0.85 (0.20-3.55) • Asian: 5.8% (46/787); **adjusted OR 1.87 (1.37-2.57)** • Black: 10.6% (62/587); **adjusted OR 3.86 (2.91-5.12)** • Mixed: 6.6% (60/912); **adjusted OR 1.99 (1.50-2.63)** • White: 3.1% (423/13500); reference	23% participation rate; potential selection bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	other clinical role, 28% nonclinical role	Ethnicity • Hispanic: 6.8% (66/968); adjusted OR 1.80 (1.34-2.42) • Non-Hispanic: 3.6% (556/15265); reference HCW role • COVID-19 clinical: 6.5% (153/2349); **adjusted OR 1.86 (1.45-2.40)** • Other clinical: 3.5% (330/9308); adjusted OR 1.09 (0.88-1.35) • Nonclinical: 3.0% (139/4576); reference	
Fletcher et al 2021 (105) Cross-sectional United States (Michigan); health system; 17 August to 4 September 2020 (Study Period 1)	Study Period 1 1385 HCWs • Mean age 40 y • 80% female • 92% white, 2% Hispanic, 1% Black, 2% Asian-Pacific Islander, 0.7% Arabic, 2% other race/ethnicity • 51% clinical provider, 10% interprofessional, 8% ancillary role, 32% nonclinical role • 1.9% SARS-CoV-2 seropositivity	Age (years): mean 36 (cases) vs. 40 (non-cases), p=0.08 Sex • Female: 1.6% (18/1104); OR 0.56 (0.24-1.30)* • Male: 2.9% (8/279); reference Race/ethnicity • White: 1.6% (20/1274); reference • Hispanic/Latino: 2.9% (1/34); OR 1.90 (0.25-14.58)* • Black: 4.8% (1/21); OR 3.14 (0.40-24.51)* • Asian/Pacific Islander: 0% (0/22); OR 1.36 (0.08-23.19)* • Arabic: 10.0% (1/10); OR 6.97 (0.84-57.62)* • Other race/ethnicity: 12.5% (3/24); **OR 8.96 (2.47-32.47)*** HCW role • Clinical provider: 2.4% (17/708); reference • Interprofessional: 0.8% (1/132); OR 0.31 (0.04-2.35)* • Ancillary: 1.0% (1/105); OR 0.39 (0.05-2.97)* • Nonclinical role: 1.6% (7/440); OR 0.66 (0.27-1.60)* Exposure • Exposed to COVID-19 outside of work but not in household: 5.7% (7/122); OR 0.54 (0.16-1.78)* • Exposed to COVID-19 in household: 10.2% (5/49); reference PPE use at work • Yes: 2.0% (26/1303); OR 0.98 (0.06-16.48)* • Sometimes: 0% (0/58) • No: 0% (0/23); reference Mask use • N95: 2.2% (10/453); OR 1.25 (0.55-2.85)* • Surgical mask: 1.8% (14/792); reference • CAPR: 0% (0/41); OR 0.65 (0.04-11.03)* • Mix of N95 or CAPR: 2.0% (2/99); OR 1.15 (0.26-5.12)*	Approximately 50% participation rate; potential recall bias; some imprecise estimates; no control for confounders
Fletcher et al 2021 (105)	Study Period 2 1445 HCWs	Age (years): mean 38.9 vs. 40.3, p=0.13 Sex	Approximately 50% participation rate;

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional United States (Michigan); health system; 2 to 23 December 2020 (Study Period 2)	• Mean age 40 y • 80% female • 90% white, 3% Hispanic, 2% Black, 2% Asian-Pacific Islander, 0.5% Arabic, 3% other race/ethnicity • 55% clinical provider, 15% interprofessional, 6% ancillary role, 23% nonclinical role • 13.7% SARS-CoV-2 seropositivity	• Female: 13.8% (159/1156); OR 1.05 (0.72-1.53)* • Male: 13.2% (38/288); reference Race/ethnicity • White: 13.5% (176/1303); reference • Hispanic/Latino: 20.5% (8/39); OR 1.65 (0.75-3.65)* • Black: 26.1% (6/23); OR 2.26 (0.88-5.81)* • Asian/Pacific Islander: 0% (4/33); OR 0.88 (0.31-2.54)* • Arabic: 12.5% (1/8); OR 0.91 (0.11-7.48)* • Other race/ethnicity: 7.7% (3/39); OR 0.53 (0.16-1.75)* HCW role • Clinical provider: 13.4% (107/800); reference • Interprofessional: 14.9% (33/222); OR 1.13 (0.74-1.72)* • Ancillary: 10.6% (10/94); OR 0.77 (0.39-1.53)* • Nonclinical role: 14.6% (48/329); OR 1.11 (0.77-1.60)* Exposure • Exposed to COVID-19 outside of work but not in household: 21.0% (48/229); ***OR 0.56 (0.34-0.90)**** • Exposed to COVID-19 in household: 32/3% (43/133); reference PPE use at work • Yes: 13.7% (189/1382); OR 0.36 (0.11-1.17)* • Sometimes: 10% (5/50); OR 0.25 (0.06-1.12)* • No: 30.8% (4/13); reference • Sometimes: 10% (5/50); OR 0.70 (0.27-1.79)* Mask use • N95: 14.5% (101/695); OR 1.18 (0.86-1.62)* • Surgical mask: 12.6% (80/635); reference • CAPR: 0% (7/31); OR 2.02 (0.84-4.85)* • N95 or CAPR: 11.8% (10/85); OR 0.93 (0.46-1.86)*	potential recall bias; some imprecise estimates; no control for confounders
Forrest et al 2021 (106) Cross-sectional United States; national registry of HCWs; 10 April to 31 July 2020	14,600 HCWs • Mean age 42 y • 76% female • 4% Black, 79% White, 6% Asian or Pacific Islander, 4% other race; 8% Hispanic/Latino • Clinical roles: 33% nurse, 18%	*n/N not reported for COVID-19 diagnosis* Age • 18-29 y: reference • 30-49 y: adjusted OR 1.26 (0.87-1.81) • 50-64 y: adjusted OR 1.38 (0.91-2.08) • ≥65 y: adjusted OR 1.13 (0.48-2.64) Sex • Female: adjusted OR 0.96 (0.72-1.29) • Male: reference Race/ethnicity	Participation rate not calculable; potential selection and recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	physician, 3% intern/resident, 3% physician's assistant, 5% nurse practitioner, 2% respiratory therapist, 2% physical therapist, 1% medical assistant; Nonclinical roles: 5% administration, 20% other nonclinical role • 3.8% SARS-CoV-2 infection (seropositive, PCR or physician diagnosis)	• Black: **adjusted OR 2.32 (1.45-3.70)** • Hispanic: **adjusted OR 2.19 (1.55-3.08)** • Asian/Pacific Islander: adjusted OR 1.39 (0.91-2.14) • Other race/ethnicity: adjusted OR 1.16 (0.62-2.17) • White: reference HCW role • Nurse: reference • Physician: adjusted OR 0.71 (0.49-1.02) • Intern/resident: adjusted OR 0.77 (0.40-1.48) • Paramedic/EMT: adjusted OR 0.67 (0.24-1.81) • Physician's assistant: adjusted OR 0.96 (0.48-1.90) • Nurse practitioner: adjusted OR 1.18 (0.69-2.01) • Respiratory therapist: adjusted OR 0.95 (0.36-2.51) • Physical therapist: adjusted OR 1.42 (0.67-2.99) • Medical assistant: adjusted OR 1.27 (0.46-3.45) • Administration: adjusted OR 1.10 (0.61-1.66) • Laboratory technician: adjusted OR 0.54 (0.16-1.79) • Pharmacist: **adjusted OR 0.29 (0.09-0.97)** • Dietary/food services: adjusted OR 0.71 (0.18-2.78) • Other role: adjusted OR 0.80 (0.58-1.11) Exposure • High-risk setting (ICU, ED, urgent care centers, COVID-19 therapeutic or diagnostic units, respiratory services, anaesthesia, EMS): adjusted OR 0.95 (0.72-1.25) • Low-risk setting (all other settings): reference	
Fukuda et al 2021 (107) Cross-sectional Japan (Tokyo); university hospital; 6 July to 21 August 2021	4147 HCWs • Mean age 37 y • 64% female • 32% nurse, 27% physician, 6% laboratory personnel, 8% paramedic, 12% administration, 15% researcher, 0.9% other • 0.3% SARS-CoV-2 seropositivity	Age • <40 y: 0.3% (9/2706); reference • ≥40 y: 0.3% (5/1,441); OR 1.04 (0.35-3.12)* Sex • Female: 0.4% (10/2649); OR 1.42 (0.44-4.52)* • Male: 0.3% (4/1498); reference HCW role • Nurse: 0.2% (3/1308); OR 0.51 (0.12-2.13)* • Physician: 0.4% (5/1111); reference • Laboratory personnel: 0% (0/236) • Paramedic: 0.6% (2/314) • Administrative staff: 0.6% (3/510) • Researcher: 0.2% (1/632)	Participation rate not reported; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Other role: 0% (0/36)	

Fusco et al, 2020 (108)
 	
Cross-sectional
 	
Italy; single hospital; 23 March to 2 April 2020
	115 HCWs in high-risk departments
	• Median age 43 y
	• 49% female
	• 23% physician, 50% nurse, 27% other HCW role
	92% direct patient care
		Incidence of COVID-19 (SARS-CoV-2 infection or IgG seropositivity): 3.5% (4/115)
		• Female: 1.8% (1/55)
		• Male: 5.1% (3/59)
		  ○ Female vs. male: OR 0.35 (0.03-3.43)
		• Physician: 3.8% (1/26)
		• Nurse: 3.5% (2/57)
		  ○ Nurse vs. physician: OR 0.91 (0.08-10.50)
		• Other HCW role: 3.1% (1/32)
		• ED: 3.4% (2/59)
		• Medical division: 1.8% (1/56)
		• Direct patient care: 3.7% (4/107)
		• No direct patient care: 0% (0/8)
		• >30 days exposure to patients with suspected or confirmed COVID-19: 4.3% (2/46)
		• <30 days exposure to patients with suspected or confirmed COVID-19: 2.9% (2/69)
		• Participation in a PPE training event: 4.1% (4/98)
		• No participation in a PPE training event: 0% (0/13)
		  ○ PPE training vs. no training: 1.27 (0.06-24.97)
			No control for confounders; estimates imprecise

Garralda Fernandez et al 2021 (109) Cross-sectional Spain (Fuenlabrada); 1 teaching hospital; 14 April to 13 May	2439 HCWs • Mean age 42 y • 78% female • HCW role not reported • 19.9% SARS-CoV-2 seropositivity or infection (PCR)	Sex • Female: 18.5% (353/1911) • Male: 25.0% (132/528) ○ Female vs. male: *OR 0.68 (0.54-0.85)** HCW role (n/N not reported; vs. administrative staff and management) • Doctor: 25.4%; OR 2.13 (1.53–2.96) • Nurse assistant: 22.0%; OR 1.77 (1.26–2.49) • Security: 21.1%; OR 1.68 (1.02–2.78) • Nurse: 19.4%; OR 1.51 (1.09–2.09) • Technician: 18.1%; OR 1.39 (0.87–2.21) • Cleaners: 16.9%; OR 1.27 (0.68–2.39)	No control for confounders; 81% participation rate
Gelanew et al 2022 (22) Cross-sectional	1997 HCWs • Mean age 34 y • 52% female • 28% nurse, 19% physician, 11%	Age • 19-24 y: adjusted OR 1.27 (0.9-1.9) • 25-34 y: adjusted OR 1.1 (0.9-1.5) • 35-49 y: reference • ≥50 y: adjusted OR 1.2 (0.8-1.8)	24% participation rate; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Ethiopia (countrywide); 5 hospitals; December 2020 to February 2021 **Added for Update Alert #11**	laboratory personnel, 17% administration, 24% role not reported • 39.8% SARS-CoV-2 seropositive	Sex • Female vs. male: adjusted OR 1.1 (0.92-1.4) HCW role • Nurse: adjusted OR 1.0 (0.8-1.4) • Physician: reference • Laboratory technician: adjusted OR 1.3 (0.9-1.9) • Administration: adjusted OR 1.01 (0.8-1.5) • Other role: adjusted OR 1.3 (0.9-1.7) Exposure • Close contact with a COVID-19-infected patient (yes vs. no): ***adjusted OR 1.4 (1.1-1.8)***	

Goenka et al 2020 (110)
 	
 Cross-sectional
 	
 India (region not described); 1 hospital; 12 July to 23 August 2020
	1,122 HCWs
	 • Mean age not reported; 59% age 30-50 y
	 • 34% female
	 • 23% physician, 20% nurse, 20% housekeeping, 9% technician, 7% administrative, 6% lab assistant/ pharmacist, 6% ward executive, 4% dietician, 4% other role
	 • 11.9% SARS-CoV-2 seropositivity
		HCW role
		 • Nurse: 9.4% (21/224)
		 • Physician: 3.9% (10/255)
		   o Nurse vs. physician: adjusted OR 1.61 (0.62-4.35)
		 • Housekeeping: 26.1% (59/226)
		 • Technician: 12.1% (12/99)
		 • Administration: 8.0% (6/75)
		 • Lab assistant/pharmacist: 15.3% (11/72)
		 • Dietician: 18.4% (9/49)
		 • Ward executive: 7.0% (5/71)
		 • Other role: 2.0% (1/51)
		 Exposure
		 • High-risk HCW (work in COVID-19 unit or ICU or regularly involved in testing or investigating of COVID-19 patients): 19.9% (27/136)
		 • Intermediate-risk HCW (workers not meeting high-risk or low-risk criteria): 11.1% (101/911)
		 • Low-risk HCW (no direct contact with patients or their belongings): 8.0% (6/75)
		   o High-risk vs. low-risk: adjusted OR 0.93 (0.13-6.79)
		   o Intermediate-risk vs. low-risk: adjusted OR 0.75 (0.11-5.15)
		 Time spent in hospital in a week
		 • <48 hours: 14.0% (102/731)
		 • 48 hours or more: 7.8% (29/373)
		   o <48 vs. 48 hours or more: ***OR 1.92 (1.25-2.97)****
		 Diabetes
		 • Yes: 9.2% (6/65)
			Potential recall bias; no control for confounders for some analyses; participation rate unclear

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• No: 12.1% (128/1057)
		   o Diabetes (yes vs. no): OR 0.74 (0.31-1.74)*
		Hypertension/coronary artery disease
		• Yes: 4.7% (5/107)
		• No: 12.7% (129/1015)
		   o Hypertension/coronary artery disease (yes vs. no): *OR 0.34 (0.13-0.84)**
		Lung disease
		• Yes: 9.7% (3/31)
		• No: 12.0% (131/1091)
		   o Lung disease (yes vs. no): OR 0.79 (0.24-2.62)*
		BCG vaccine
		• Yes: 7.3% (41/561)
		• No: 16.9% (13/77)
		   o BCG vaccine (yes vs. no): *OR 0.39 (0.20-0.76)**
		MMR vaccine
		• Yes: 8.6% (29/336)
		• No: 8.2% (25/303)
		   o MMR vaccine (yes vs. no): OR 1.05 (0.60-1.84)*
		Hydroxychloroquine prophylaxis
		• Adequate dose (400 mg/week for >6 weeks): 1.3% (1/77)
		• Inadequate dose: 11.2% (18/160)
		• Not received: 12.3% (115/885)
		   o Hydroxychloroquine prophylaxis with adequate dose vs. inadequate dose or no prophylaxis: *OR 0.09 (0.01-0.65)**	

Gohil et al 2021 (13) Cross-sectional United States (California); academic medical center; 1 January to 15 April 2020 **Added for Update Alert #11**	654 HCWs • Mean age 40 y • 72% female • 47% Asian, 27% White, 20% other race/ethnicity, 15% Latino. 2% Black • 15% physician, 58% nurse, 7% nurse aide, 2% physical or occupational therapist, 2% environmental service, 5% other	Age • <35 y: reference • 35 to <50: adjusted OR 1.53 (0.88-2.69) • 50 to <60: adjusted OR 1.68 (0.82-3.45) • >60: adjusted OR 1.42 (0.45-4.44) Sex • Female vs. male: *adjusted OR 0.56 (0.25-0.96)* Race/ethnicity • Latino (vs. not Latino): *adjusted OR 2.1 (1.12-3.96)* HCW role (reference registered nurse for roles other than registered nurse [unclear]) • Registered nurse: adjusted OR 1.29 (0.57-2.95) • Nurse aide: adjusted OR: adjusted OR 1.02 (0.20-5.74) • Physical/occupational therapist: adjusted OR 1.05 (0.12-9.36)	50% participation rate; limited control for confounders potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	patient care, 9% not direct patient care • 13.3% SARS-CoV-2 seropositive; analyses evaluated risk factors for SARS-CoV-2 infection (defined as sero- or PCR-positive)	• Respiratory therapist: adjusted OR 0.47 (0.20-1.13) • Physician: adjusted OR 0.32 (0.07-1.43) • Environmental services: adjusted OR 0.19 (0.02-1.69) • Other direct patient care: adjusted OR 0.95 (0.41-2.19) • Not direct patient care: adjusted OR 1.29 (0.57-2.95) • COVID patient care: adjusted OR 1.10 (0.64–1.88) Exposure • Direct COVID-19 patient care (yes vs. no): adjusted OR 1.10 (0.64-1.88) • ICU (yes vs no): adjusted OR 0.75 (0.41-1.37) • HCP COVID outbreak unit (yes vs. no): adjusted OR 2.21 (1.28-3.81) • Designated COVID care unit (yes vs. no): adjusted OR 0.53 (0.30-0.94)	

Gupta et al 2021 (111)
 	
Cross-sectional
 	
India (New Delhi); one hospital; 22 June to 24 July 2020
	3739 HCWs
	• Mean age 34 y
	• 41% female
	• 32% nurse, 18% physician, 20% paramedical staff, 11% technical staff, 14% administration
	• 13.0% SARS-CoV-2 seropositive
		Sex
		• Female: 11.7% (178/1519)
		• Male: 13.9% (309/2220)
		  o Female vs. male: OR 0.82 (0.67-1.00
		Age
		• 18-35 y: 13.1% (272/2073)
		• >35 y: 12.9% (215/1666)
		  o 18-35 vs. >35: OR 1.01 (0.86-1.18)
		HCW role
		• Nurse: 9.8% (117/1198)
		• Physicians: 5.4% (36/661)
		  o Nurse vs. physician: *OR 1.88 (1.28-2.77)**
		• Administration: 19.6% (105/537)
		• Technical staff: 17.9% (71/397)
		• Paramedical: 17.2% (128/743)
		• Research staff: 14.8% (30/203)
		Exposure
		• Active COVID duty: 11.7% (110/943)
		• Not active COVID duty: 13.5% (377/2796)
		  o Active vs. not active COVID duty: OR 0.84 (0.67-1.05)
		• Contact with COVID-19 positive individuals: 15.6% (196/1260)
		• No contact with COVID-19 positive individuals: 11.7% (291/2479)
		  o Contact vs. no contact: *OR 1.38 (1.14-1.68)*
		PPE (n=1773)
		• Reported PPE breach: 12.7% (38/300)
		• No report of PPE breach: 13.1% (193/1473)
		  o PPE breach vs. no breach: OR 0.96 (0.66-1.40)
			82% participation rate; potential recall bias; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Guerrero Torres et al 2021 (112) Cross-sectional Mexico (Mexico City); government database of SARS-CoV-2 infections; 27 February to 31 August 2020	1310 HCWs hospitalized due to SARS-CoV-2 infection • Mean age 46 y • 44% female • 38% nurse, 28% physician, 34% other role 24461 non-HCWs hospitalized with SARS-CoV-2 infection • Mean age 58 y • 36% female	*Non-HCWs vs. HCWs* Age • 30 y: reference • 50 y: *adjusted OR 2.31 (2.10-2.54)* • 60 y: *adjusted OR 3.65 (3.31-4.01)* Sex • Female: reference • Male: *adjusted OR 1.60 (1.51-1.69)* Role • Non-HCW: reference • Nurse: *adjusted OR 0.29 (0.20-0.42)* • Physician: *adjusted OR 0.60 (0.48-0.75)* • Other HCW role: *adjusted OR 0.61 (0.49-0.77)*	Potential selection bias due to database enrollment methods
Herzberg et al 2021 (113) Cross-sectional Germany (Schleswig-Holstein); single hospital; March to June 2020	871 asymptomatic HCWs • Mean age 40 y • 75% female • 17% physician, 34% nurse, 11% students or trainees • 2.6% SARS-CoV-2 seropositivity	Age • Age, per 10 years: adjusted OR 1.50 (1.19 to 1.90) Sex • Female vs. male: adjusted OR 0.91 (0.42-2.00) Other population characteristics • Body mass index, per increase of 5 kg/m^2: *adjusted OR 0.72 (0.56-0.94)* Exposure • Direct patient care, yes vs. no: adjusted OR 0.85 (0.41 to 1.74)	Details on multivariate analysis lacking; no control for PPE and limited control for exposures
Hunter et al, 2020 (114) Cross-sectional United States (Indiana); 18 locations within one healthcare system; dates not reported	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) o 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
Jacob et al 2021 (115) Cross-sectional	24749 HCWs • Mean age not reported; 18% <30 y,	Sex • Female: 4.3% (840/19361); adjusted OR 0.8 (0.7-1.0) • Male: 4.5% (240/5378); reference	Participation rate not reported; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
United States (Atlanta GA, Baltimore MD and Chicago IL); 4 healthcare systems; 19 April to 30 August 2020	30% 30-39 y, 21% 40-49 y, 18% 50-59 y, 12% ≥60 y • 78% female • 61% white, 21% Black, 10% Asian, 4% unknown race, 3% other race, 1% multiracial, 0.4% American Indian or Alaska Native; 4% Hispanic • 32% nurse, 18% physician, 21% nonclinical, 8% other direct care personnel, 6% nurse practitioner or physician's assistant, 5% nurse assistant or patient care technician, 2% radiology, 2% respiratory therapist, 2% physical, occupational or speech therapist, 2% other professional, 1% pharmacy, <1% environmental service, <1% unknown role • 4.4% SARS-CoV-2 seropositive	Age • <30 y: 5.3% (239/4545); *adjusted OR 1.3 (1.0-1.7)* • 30-39 y: 4.4% (328/7454); adjusted OR 1.1 (0.9-1.4) • 40-49 y: 4.4% (228/5234); adjusted OR 1.0 (0.8-1.3) • 50-59 y: 3.9% (178/4578); adjusted OR 0.9 (0.7-1.2) • ≥60 y: 3.6% (107/2938); reference Race • White: 3.3% (499/15157); reference • Black: 7.3% (376/5117); *adjusted OR 2.1 (1.8-2.4)* • Asian: 4.5% (107/2369); adjusted OR 1.2 (1.0-1.5) • Unknown: 5.2% (53/1012); *adjusted OR 1.8 (1.2-2.7)* • Other race: 3.6% (25/702); adjusted OR 1.3 (0.8-2.0) • Multiracial: 5.5% (14/253): adjusted OR 1.3 (0.8-2.3) • American Indian or Alaska Native: 4.8% (5/105); adjusted OR 1.4 (0.6-3.5) • Native Hawaiian or other Pacific Islander: 2.9% (1/34); adjusted OR 0.8 (0.1-6.2) Ethnicity • Hispanic: 5.2% (59/1126); adjusted OR 1.1 (0.8-1.5) • Non-Hispanic/Latino: 4.4% (975/22403); reference HCW role • Nonclinical: 3.9% (205/5289); reference • Nurse: 4.8% (374/7830); adjusted OR 1.1 (0.9-1.3) • Physician: 3.7% (166/4499); adjusted OR 0.9 (0.7-1.1) ○ Nurse vs. physician: *OR 1.13 (1.09-1.58)** • Nurse practitioner or physician's assistant: 3.5% (53/1535); adjusted OR 0.9 (0.6-1.2) • Environmental services: 7.4% (9/122); adjusted OR 1.5 (0.8-3.1) • Pharmacy: 3.1% (10/325); adjusted OR 0.8 (0.4-1.6) • Physical, occupational, or speech therapist: 3.5% (17/483); adjusted OR 1.3 (0.7-2.1) • Radiology technician: 4.8% (23/476); adjusted OR 1.0 (0.6-1.6) • Respiratory therapist: 4.5% (18/399); adjusted OR 0.9 (0.5-1.6) • Other direct care personnel: 5.5% (105/1914); adjusted OR 1.1 (0.9-1.4) • Other health care professional: 2.7% (10/367); adjusted OR 0.7 (0.4-1.3) • Unknown: 6.8% (11/162); adjusted OR 0.9 (0.4-1.8) Exposure - workplace • Inpatient unit (with or without COVID-19): 4.8% (425/8893); reference • ED: 5.3% (127/2409); adjusted OR 1.0 (0.8-1.3)	

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• Other: 3.7% (413/11257); adjusted OR 0.9 (0.7-1.0) • Unknown: 5.5% (115/2108); adjusted OR 0.9 (0.7-1.2) Exposure - patients • Any contact with COVID-19 patients: 4.7% (584/12413): adjusted OR 1.1 (0.9-1.3) • No contact with COVID-19 patients: 3.9% (448/11435); reference • Unknown contact: 5.3% (48/901); adjusted OR 1.3 (0.9-1.9)	

Jeremias et al, 2020 (116)
 	
Cross-sectional
 	
United States (New York); 1 hospital; 1 March to 30 April 2020
	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 worker, 21.7% ancillary worker
		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)
		• ICU: 6.9% (22/321)
		• Operational: 10.5% (42/400)
		• Procedural: 9.1% (22/243)
		• Other: 7.6% (12/158)
			64% participation rate; demographic characteristics reported for the entire cohort rather than those who underwent testing

Jespersen et al, 2020 (117)
 	
Cross-sectional
 	
Denmark (central region); all hospitals, prehospital and specialist practitioners; 18 May to 19 June 2020
	17,971 (17,280 with reported data) HCWs
	• Mean age not reported, 11% age <29 y, 22% age 30-39 y, 26% age 40-49 y, 26% age 50-59, 15% age ≥60 y
	• 86% female
	• 85% hospital worker (n=15,261)
	  ○ 13% physician, 46% nurse, 7% laboratory
		SARS-CoV-2 seropositivity
		• Age <29 y: 6.0% (116/1,916)
		• Age 30-39 y: 3.8% (144/3,794)
		• Age 40-49 y: 3.8% (175/4,560)
		• Age 50-59 y: 3.6% (161/4,505)
		• Age ≥60 y: 2.9% (72/2,505)
		• Male: 3.9% (94/2,430)
		• Female: 3.9% (574/14,850)
		  ○ Female vs. male: OR 1.00 (0.80-1.25)*
			69% overall response rate; discrepant results reported

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	scientist, 9% medical secretary, 25% other role		

Jones et al 2020 (118)
 	
Cross-sectional
 	
UK (Bristol); health service
	6858 HCWs (all invited for testing)
	• Mean age not reported
	• 78% female
	• 29% nurse/midwife, 12% medical/dental, 9% allied health, 18% administrative/ clerical, 21% other clinical services
	• 9.3% SARS-CoV-2 seroprevalence
		Age
		• ≤20 y: 12.3% (14/114); adjusted OR 1.47 (0.96-2.20)
		• 21-30 y: 10.9% (192/1757); *adjusted OR 1.64 (1.36-1.99)*
		• 31-40 y: 7.3% (118/1624); reference
		• 41-50 y: 10.3% (158/1536): *adjusted OR 1.36 (1.11-1.67)*
		• 51-60 y: 8.5% (120/1408): *adjusted OR 1.45 (1.17-1.80)*
		• 61-70 y: 8.7% (35/402): adjusted OR 1.28 (0.94 to 1.73)
		Sex
		• Female: 9.3% (498/5338)
		• Male: 9.2% (140/1520)
		   ○ Female vs. male: adjusted OR 1.04 (0.88-1.23)
		Race/Ethnicity
		• Black, Asian, and minority ethnic: 14.6% (160/1095
		• White: 8.2% (456/5578)
		   ○ BAME vs white: *adjusted OR 1.99 (1.69-2.34)*
		HCW role
		• Nurse/midwife: 10.2% (201/1962)
		• Medical/dental: 8.6% (74/856)
		   ○ Nurse/midwife vs. medical/dental: OR 1.21 (0.91-1.60)*
		• Allied health 7.5% (31/413)
		• Administrative/clerical: 5.9% (73/1233)
		• Other clinical services: 12.7% (180/1420)
			No control for exposures or PPE; 56% participation rate

Korona-Glowniak et al 2022 (24) Cross-sectional Poland (Lublin); 1 hospital and 1 medical center; 5 to 25 May 2020 and 4 to 15 December 2020 **Added for Update Alert #11**	387 HCWs • Mean age 46 y • 87% female • 32% nurse, 32% physician, 22% laboratory technician, 16% administration • 13.2% SARS-CoV-2 seropositive (IgG)	*IgG seropositive* Age (per year): adjusted OR 1.02 (0.98-1.08) Sex • Female vs. male: 11.6% (39/337) vs. 14.0% (7/50); adjusted OR 0.13 (0.02-0.71)* HCW role • Nurse: 13.1% (16/122); adjusted OR 5.0 (0.85-29.3) • Physician: 9.8% (11/112); reference • Laboratory technician: 10.5% (9/86); adjusted OR 2.87 (0.5-16.1) • Administration: 15.6% (10/64); adjusted OR 1.72 (0.35-8.4) Exposure • SARS-CoV-2 exposure at work: 23.5% (32/136); adjusted OR 1.54 (0.48-4.9)	Participation rate 26% in the May study and 22% in the December study; most risk estimates were imprecise

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• No SARS-CoV-2 exposure at work: 6.6% (14/211); reference	
Korth et al, 2020 (119) 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
Krastinova et al 2020 (120) Cross-sectional France (Creteil); 1 hospital; 17 March to 20 April 2020	314 symptomatic HCWs • Mean age 40 y • 81% female • HCW role not reported • 5.0% SARS-CoV-2 infection (PCR)	Age • >50 y vs. ≤50 y: adjusted OR 0.69 (0.36-1.32) Sex • Female: 34.5% (88/255) • Male: 37.2% (22/59) o Female vs. male: adjusted OR 1.20 (0.60-2.38) Comorbidities • BMI ≥30 vs. <30 kg/m^2: adjusted OR 0.92 (0.62-1.63) • Former vs. never smoker: adjusted OR 0.83 (0.40-1.74) • Current vs. never smoker: **adjusted OR 0.30 (0.15-0.62)** Exposure • Non-patient facing vs. non-clinical: adjusted OR 1.57 (0.5-5.31) • Direct patient facing vs. non-clinical: adjusted OR 3.08 (1.09-8.78)	No control for PPE and limited control for exposures

Lackermair et al, 2020 (121)
 	
Cross-sectional
 	
Germany (Dachau); 8 primary care clinics; 2 to 6 April
	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)
		   o 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)
		   o Direct contact with COVID-19 patient vs. no direct contact: 2.68 (0.36-19.64)*
			Potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Lahner et al, 2020 (122) 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
Lombardi et al, 2020 (123) 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
Madsen et al 2021 (124) Cross-sectional Denmark (Copenhagen); 1 medical school; 19 to 26 October 2020	1096 medical students • Median age 24 y • 71% female • 100% medical students • 35% SARS-CoV-2 seropositive	Age • Per year: adjusted OR 0.99 (0.94-1.04) Sex: • Female: adjusted OR 0.77 (0.56-1.05) Exposure • Working with COVID-19 (yes vs. no): **adjusted OR 1.40 (1.05-1.88)**	30% participation rate; potential recall bias; limited control for confounders
Martin et al, 2020 (125) Cross-sectional	326 HCWs • Mean age 37 y • 73% female	SARS-CoV-2 infection (PCR or seropositivity) • Male: 11.5% (10/87) o Female: 13.0% (31/239)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Belgium (Brussels); 1 tertiary hospital specializing in infectious disease; 15 April to 18 May 2020	• 29% physician, 51% nurse, 9% care assistant, 11% paramedical staff, 8% administrative staff, 2% cleaning staff • 82% asymptomatic • 11% COVID-19 diagnosis prior to study	• Female vs. male: OR 1.15 (0.54-2.45)* • Physician: 11.8% (10/85) ○ Nurse: 12.7% (19/150) • Nurse vs. physician: 1.09 (0.48-2.46)* • Care assistant: 14.8% (4/27) • Paramedical staff: 15.1% (5/33) • Administrative staff: 0.4% (1/25) • Cleaning staff: 33.3% (2/6) • COVID-19 unit: 14.4% (31/215) • COVID-19 ICU: 5.7% (3/53) • ED: 12.1% (7/58)	
Moncunill et al 2021 (126) Cross-sectional Spain (Barcelona); 1 hospital; 27 April to 6 May 2020	501 asymptomatic HCWs • Mean age 42 y • 72% female • 50% nurse/auxiliary services, 26% physician, 8% technician, 17% other role; 75% direct clinical care; 50% COVID-19 unit • 14.9% incident (4 weeks) SARS-CoV-2 seropositivity or infection (PCR)	Age • Per year: OR 0.98 (0.95-1.02) Sex • Female vs. male: OR 1.27 (0.50-3.24) HCW role (vs. other role) • Nurse/auxiliary services: OR 5.54 (0.72-42.55) • Physician: OR 2.77 (0.30-25.25) • Technician: *OR 13.03 (1.47-116)* Comorbidities (yes vs. no) • Heart and liver disease, diabetes, chronic respiratory and renal disease, cancer and autoimmune disease, or other immunological disorders: OR 0.70 (0.23-2.08) • Smoker: OR 1.58 (0.67-3.77) Exposure (vs. no) • Work in clinical care: 1.06 (0.41-2.70) • Involved with direct patient contact: OR 0.97 (0.38-2.50) • Work in COVID-19 unit: OR 1.07 (0.48-2.40)	No control for confounders; some estimates very imprecise
Mukhtar et al 2021 (127) Cross-sectional Egypt (Cairo); university hospital; 20 May to 11 June 2020	455 asymptomatic HCWs • Mean age 33 y • 48% female • HCW role not reported • 7.9% SARS-CoV-2 seropositivity	Age (years): mean 33.4 (cases) vs. 32.8 (non-cases), p=0.71 Sex • Female: 9.2% (20/216); OR 1.42 (0.72-2.82)* • Male: 6.7% (16/239); reference Exposure • Participation in an aerosol-generating procedure: 0.7% (1/143); *OR 0.06 (0.01-0.41)* *	75% participation rate; HCW role not reported; no control for confounders; some estimates very imprecise

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		• No participation in an aerosol-generating procedure: 11.2% (35/312); reference • Hypertension (yes vs. no): 8.0% (2/25) vs. 8.6% (34/396); OR 1.01 (0.23-4.48)* • Diabetes (yes vs. no): 0% (0/9) vs. 8.8% (36/410); OR 0.59 (0.03-10.38)* • Asthma (yes vs. no): 5.3% (1/19) vs. 8.7% (35/401); OR 0.64 (0.08-4.91)* • Current smoker vs. non-smoker: 8.3% (2/24) vs. 7.6% (28/369); OR 1.11 (0.25-4.95)* • Ex-smoker vs. non-smoker: 9.7% (6/62) vs. 7.6% (28/369); OR 1.30 (0.52-2.39)*	
Murongazvombo et al 2021(128) Cross-sectional United Kingdom (London); 2 hospitals; 4 May to 30 June 2020	615 HCWs • Mean age not reported; 59% <40 y, 41% ≥40 y • 71% female • 64% White, 19% Asian, 9% Black, 5% mixed race, 3% other, <1% missing data • 24% physician, 35% nurse, 16% allied health, 25% other role • 41% SARS-CoV-2 seropositive	Exposure • Not a frontline worker: reference • Frontline worker who carried out any activities more than 2 m away from a COVID-19 patient with or without appropriate PPE (FFP2/FFP3/N95, surgical mask, apron, gown, gloves): adjusted OR 1.48 (0.72-3.02) • Frontline worker who provided care within 2 m of a COVID-19 patient with appropriate PPE (surgical mask, apron, gown, gloves) for a non-aerosol-generating procedure: adjusted OR 1.15 (0.61-2.17) • Frontline worker who performed an aerosol-generating procedure on a COVID-19 patient with appropriate PPE (FFP2/FFP3/N95, apron, gown, gloves) for an aerosol-generating procedure: adjusted OR 1.06 (0.57-1.96) • Frontline worker who provided care within 2 m of a COVID-19 patient but without an aerosol-generating procedure and without appropriate PPE (surgical mask, apron, gown, gloves) for a non-aerosol-generating procedure: adjusted OR 1.82 (0.96-3.44) • Frontline worker who performed an aerosol-generating procedure on a COVID-19 patient without appropriate PPE (FFP2/FFP3/N95, apron, gown, gloves) for an aerosol-generating procedure: *adjusted OR 2.49 (1.00-6.18)*	25% participation rate; potential recall bias; limited control of confounders
Naesens et al 2021 (129) Cross-sectional Belgium (Antwerp region); public hospital system (3 acute care hospitals, 1 children's hospital, 5 chronic care	5233 HCWs • Mean age not reported, range 17-73 y • 80% female • 11% medical staff, 51% nursing staff, 13% paramedical staff, 12% administrative staff, 12%	Age • Unit of analysis not reported: *adjusted OR 0.99 (0.98–0.99)* Sex • Female: 7.7% (323/4174); reference • Male: 7.0% (74/1059); adjusted OR 0.86 (0.97-1.12) HCW role • Nursing staff: 10.0% (265/2660); reference • Medical staff: 6.4% (38/596); *adjusted OR 0.65 (0.43-0.94)* • Paramedical staff: 6.0% (40/671); *adjusted OR 0.74 (0.51-0.94)* • Administrative staff: 2.9% (19/654); *adjusted OR 0.40 (0.24-0.66)*	77% participation rate; potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

facilities); 9 to 29 June 2020	cleaning/technical staff
	• 8% SARS-CoV-2 seropositive
		• Cleaning and technical staff: 5.4% (35/652); *adjusted OR 0.63 (0.43-0.93)*
		Exposure
		• Not working on a COVID-19 ward: 5.2% (172/3289); reference
		• Working on a COVID-19 ward: 11.6% (225/1944); *adjusted OR 1.73 (1.36-2.20)*
		• No close colleague at work had confirmed COVID-19: 4.2% (123/2940); reference
		• Close colleague at work had confirmed COVID-19: 12.0% (274/2293); *adjusted OR 1.73 (1.36-2.20)*
		• No contact with confirmed/suspected COVID-19 cases in private setting: 6.8% (327/4783); reference
		• Contact with confirmed/suspected COVID-19 cases in private setting: 15.6% (70/450); *adjusted OR 2.56 (1.91-3.42)*
		• Contact with confirmed/suspected COVID-19 cases at work:
		  ○ No contact: 2.9% (42/1425); reference
		  ○ Only protected contact (PPE): 9.6% (188/1950); *adjusted OR 1.74 (1.19-2.54)*
		  ○ Only accidental and unprotected contact (no PPE): 8.2% (19/232); adjusted OR 1.44 (0.80-2.59)
		  ○ Any contact (intentional or accidental, protected or unprotected): 9.1% (148/1626); adjusted OR 1.17 (0.78-1.75)	

Newberry et al 2021 (130) Cross-sectional United States (California); 10 county fire departments; June to August 2020	983 firefighters cross-trained as paramedics or EMTs • Mean age not reported; 21% 18-34 y, 57% 35-49 y, 22% ≥50 y • 4% female • 60% white non-Hispanic, 20% Hispanic, 8% Asian/Pacific Islander, 3% Black non-Hispanic, 10% other • 2.5% SARS-CoV-2 seropositivity; 0.9%	*SARS-CoV-2 seropositivity* Age • 18-34 y: 1.0% (2/206); reference • 35-49 y: 3.1% (17/556); OR 3.22 (0.74-14.05)* • ≥50 y: 2.7% (6/221); OR 2.85 (0.57-14.27)* Race/ethnicity • White, non-Hispanic: 1.3% (8/594); reference • Hispanic: 4.7% (9/192); *OR 3.60 (1.37-9.47)* • Asian or Pacific Islander: 3.8% (3/78); OR 2.93 (0.76-11.29)* • Black, non-Hispanic: 3.8% (1/26); OR 2.93 (0.35-24.34)* • Other: 4.3% (4/93); OR 3.29 (0.97-11.16)* Exposure • Exposed to confirmed SARS-CoV-2 patient respiratory secretions (yes vs. no): 4.8% (13/271) vs. 1.7% (12/712); *OR 2.94 (1.32-6.53)* • Exposed to confirmed SARS-CoV-2 positive patient or colleague (yes vs. no): 3.0% (10/335) vs. 2.3% (15/648); OR 1.30 (0.58-2.92)* PPE	73% participation rate; potential recall bias; imprecise estimates; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	SARS-CoV-2 infection (PCR)	• Full use of PPE during exposure (yes vs. no): 1.3% (3/227) vs. 5.6% (5/90); **OR 0.23 (0.05-0.97)*** • PPE breach or failure (yes vs. no): 2.7% (1/38) vs. 2.3% (19/837); OR 1.20 (0.16-9.18) *SARS-CoV-2 infection (PCR)* Age • 18-34 y: 1.0% (2/206); reference • 35-49 y: 0.5% (3/556); OR 0.55 (0.09-3.34) • ≥50 y: 1.8% (4/221); OR 1.88 (0.34-10.38) Race/ethnicity • White, non-Hispanic: 1.0% (6/594); reference • Hispanic: 1.6% (3/192); OR 1.56 (0.39-6.28) • Asian or Pacific Islander: 0% (0/78); OR 0.58 (0.03-10.34) • Black, non-Hispanic: 0% (0/26); OR 1.71 (0.09-31.13) • Other: 0% (0/93); OR 0.48 (0.03-8.67) Exposure • Exposed to confirmed SARS-CoV-2 patient respiratory secretions (yes vs. no): 0.7% (2/271) vs. 1.0% (7/712); OR 0.75 (0.15-3.63)* • Exposed to confirmed SARS-CoV-2 positive patient or colleague (yes vs. no): 1.5% (5/335) vs. 0.6% (4/648); OR 2.44 (0.65-9.15)* PPE • Full use of PPE during exposure (yes vs. no): 1.3% (3/227) vs. 2.2% (2/90); OR 0.59 (0.10-3.59) • PPE breach or failure (yes vs. no):: 2.7% (0/37) vs. 1.1% (9/837); OR 1.16 (0.07-20.36)	
Nopsopon et al 2021 (131) Cross-sectional Thailand (Ranong province); public hospital; 17 April to 17 May 2020	844 HCWs in a low-risk hospital setting • Median age 42 y • 72% female • HCW role not reported • 0.8% SARS-CoV-2 seropositivity	Sex • Female: 1.0% (6/605); OR 2.10 (0.25-17.57)* • Male: 0.5% (1/211); reference Exposure • Close contact with a confirmed COVID-19 case: 0% (0/17); OR 3.13 (0.17-56.90)* • No close contact with a confirmed COVID-19 case: 0.8% (7/827); reference	No control for confounders; imprecise estimates
Nunes et al 2021 (27)	396 HCWs • Mean age 38 y • 83% female	Age • <38 y: 33.2% (71/214); reference • ≥38 y: 52.2% (95/182); adjusted OR 1.25 (0.75-2.10)	Unclear participation rate

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Population overlaps with Nunes et al 2022 Cross-sectional South Africa (Johannesburg); one tertiary care hospital; 22 April to 19 June 2020 **Added for Update Alert #11**	• 70% Black African, 14% Asian, 12% White, 3% other race • 49% nurse, 33% physician; 18% other role • 34.6% SARS-CoV-2 infection (PCR)	Female vs. male: 45.2% (148/327) vs. 26.1% (18/69); adjusted OR 1.15 (0.58-2.27)* Race/ethnicity • Black African: 49.8% (139/279); reference • Asian: 28.01% (16/57); OR 0.39 (0.21-0.73); not included in multivariate model • White: 20.4% (10/49); OR 0.26 (0.12-0.54); not included in multivariate model • Other race: adjusted OR 0.62 (0.30-1.26) HCW role • Nurse: 57.5% (111/193); reference • Other role: adjusted OR 0.72 (0.37-1.42) HCW department; not included in multivariate model • Internal medicine: 61.7% (103/167); reference • Pediatrics: 33.3% (31/93); OR 0.31 (0.18-0.53) • Intensive care: 22.4% (11/49); OR 0.18 (0.09-0.38) • Obstetrics: 13.0% (3/23); OR 0.09 (0.03-0.33) • Vaccines and immune disease analytics: 28.1% (18/64); OR 0.24 (0.13-0.46) Other demographic and clinical risk factors • Smoking (yes vs. no): adjusted OR 0.47 (0.17-1.19) • BMI >30: (yes vs. no): adjusted OR 0.97 (0.59-1.59) • ≥1 comorbid condition (yes vs. no): OR 1.41 (0.94-2.12); not included in multivariate model • Asthma (yes vs. no): OR 0.67 (0.30-1.467); not included in multivariate model • Diabetes (yes vs. no): OR 1.75 (0.46-6.61); not included in multivariate model	
Nunes et al 2022 (28) *Population overlaps with Nunes et al 2021* Cross-sectional South Africa (Johannesburg); initially one tertiary care hospital; two additional hospitals added in December 2021; 24 November to 31 December 2021	433 symptomatic HCWs • Mean age 38 y • 83% female • 90% Black African • HCW role not reported • 43.9% SARS-CoV-2 infection (PCR), Omicron variant	Previous infection status (PCR-confirmed) • Previous infection: ***adjusted OR 0.55 (0.36-0.84)*** • No previous infection: reference Vaccination status • Ad26.COV2 vaccine, single dose: adjusted OR 0.81 (0.46-1.43) • Ad26.COV.2 vaccine, booster dose: adjusted OR 0.94 (0.44-2.03) • BNT162b2 vaccine, two doses: adjusted OR 0.59 (0.23-1.57) • Never vaccinated: reference Previous infection status (PCR-confirmed) and vaccination status • No previous infection + no vaccination: reference o No previous infection + Ad26.COV.2 single dose: adjusted OR 0.89 (0.46-1.72) • Previous infection + no vaccination: reference	Unclear participation rate; no adjustment for exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Added for Update Alert #11		o Previous infection + Ad26.COV.2 single dose: adjusted OR 0.82 (0.28-2.44) o Previous infection + Ad26.COV.2 booster dose: adjusted OR 0.55 (0.14-2.09) Previous infection status (PCR-confirmed), vaccination status, and antibody level (spike IgG) • No previous infection + no vaccination + IgG<300: reference • No previous infection + Ad26.COV.2 single dose + IgG>1549: adjusted OR 0.42 (0.18-0.85)	
Nygren et al 2021 (132) Cross-sectional Sweden (Lund); university hospital; 8 September to 10 November 2020	271 HCWs • Mean age 37 y • 81% female • 40% nurse, 33% assistant nurse, 12% physician, 2% other HCW with patient contact, 12% other HCW without patient contact • 7.7% SARS-CoV-2 seropositive or infection (PCR)	Exposure • Working in COVID-19 unit: 21.6% (11/51); ***adjusted OR 5.6 (1.3-23.0)*** • Not working in a COVID-19 unit: 4.5% (10/220); reference • Increased risk (involvement in an aerosol-generating procedure or bedside surveillance for >3 hours/shift with a COVID-19 patient: 16.1% (9/56); ***OR 3.2 (1.1-8.7)^*** • No increased risk: 5.7% (12/211); reference • Caring for COVID-19 patient most days: 19.7% (12/61); ***adjusted OR 5.1 (1.3-19.0)*** • No caring for COVID-19 patient most days: 4.3% (9/210); reference • Worked shift with COVID-19-positive colleague; 11.3% (7/62); adjusted OR 1.4 (0.45-4.0) • Did not work shift with COVID-19-positive colleague: 6.7% (14/208); reference	Participation rate not reported; potential recall bias; limited adjustment for confounders

Olalla et al, 2020 (133)
 	
 Cross-sectional
 	
 Spain (Andalusia); 1 hospital; 15 to 24 April 2020
	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)
		    o 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)
		    o COVID-19 vs. non-COVID-19 unit: OR 0.19 (0.03-1.41)*
			Uncertain criteria for testing eligibility; no control for confounders

Paris et al 2021 (15)	3,234 HCWs	Exposure • Care of COVID-19 patient	Participation rate not reported; potential

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional France (Rennes); tertiary care hospital; 29 May to 10 July 2020 **Added for Update Alert #11**	• Mean age not reported; 26% <30 y, 28% 30-39 y, 25% 40-49 y, 21% ≥60 y • 80% female • 31% nurse/midwife, 21% auxiliary nurse, 10% medical staff, 7% administration, 6% cleaner, 4% student, 4% resident • 3.8% SARS-CoV-2 seropositive or infection (PCR)	○ Yes: 4.0% (75/1881); adjusted OR 1.30 (0.78-2.17) ○ No: 3.2% (3.2% (37/1151); reference • Contact with a COVID-19 infected co-worker ○ Yes: 4.9% (76/1564); ***adjusted OR 2.08 (1.33-3.24)*** ○ No: 2.4% (36/1477); reference • Contact with the family of a COVID-19 infected patient ○ Yes: 3.4% (6/178); adjusted OR 0.90 (0.38-2.10) ○ No: 3.6% (106/2905); reference • Contact with a COVID-19 infected patient at home ○ Yes: 6.9% (24/349); ***adjusted OR 2.00 (1.23-3.28)*** ○ No: 3.2% (86/2684); reference • Participated in nasopharyngeal sampling ○ With appropriate protective equipment: 3.8% (43/1140); ***adjusted OR 1.33 (1.15-10.40)*** ○ With suboptimal protective equipment: 9.1% (4.44); adjusted OR 3.46 (0.79-2.25) ○ No participation: 3.3% (82/2438); reference • Participated in central line insertion (n/N not reported) ○ With appropriate protective equipment: adjusted OR 0.72 (0.35-1.45) ○ With suboptimal protective equipment: adjusted OR 2.55 (0.57-12.38) ○ No participation: reference • Participated in upper respiratory tract actions ○ With appropriate protective equipment: 4.2% (38/914); adjusted OR 1.53 (0.92-2.55) ○ With suboptimal protective equipment: 7.1% (6/85); adjusted OR 1.85 (0.66-5.22) ○ No participation: 3.3% (68/2071); reference • Participated in washing and dressing patient (n/N not reported) ○ With appropriate protective equipment: ***adjusted OR 2.13 (1.05-4.30)*** ○ With suboptimal protective equipment: adjusted OR 0.38 (0.10-1.46) ○ No participation: reference • Participated in patient mobilization ○ With appropriate protective equipment: 3.3% (56/1692); adjusted OR 0.93 (0.49-1.79) ○ With suboptimal protective equipment: 7.2% (17/237); ***adjusted OR 3.30 (1.51-7.25)*** ○ No participation: 3.4% (39/1147); reference • Participated in patient feeding	recall bias; "appropriate protective equipment" imprecisely defined; some estimates very imprecise; limited control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
		o With appropriate protective equipment: 3.4% (29/842); adjusted OR 1.00 (0.54-1.89) o With suboptimal protective equipment: 7.5% (8/107); adjusted OR 2.49 (0.92-6.72) o No participation: 3.4% (71/2109); reference • Participated in clinical exam o With appropriate protective equipment: 3.8% (43/1140); adjusted OR 1.50 (0.85-2.65) o With suboptimal protective equipment: 7.5% (13/173); *adjusted OR 2.51 (1.16-5.43)* o No participation: 3.1% (56/1765); reference • Participated in eye exam o With appropriate protective equipment: 6.2% (10/161); adjusted OR 1.86 (0.93-3.73) o With suboptimal protective equipment: 7.5% (4/53); *adjusted OR 2.90 (1.01-8.35)* o No participation: 3.4% (98/2859); reference	
Pereckaite et al 2021 (134) Cross-sectional Lithuania (Kaunas); hospital system; 15 June to 21 September 2020	432 HCWs • Mean age 43 y • 85% female • 41% nurse, 39% physician, 12% assistant, 7% other role • 1.2% SARS-CoV-2 seropositive	HCW role • Nurse: 1.1% (2/179) • Physician: 1.2% (2/169) o Nurse vs. physician: OR 0.94 (0.13-6.77)*	Participation rate unclear; no control for confounders; imprecise estimate
Pinarlik et al 2021 (135) Cross-sectional Turkey (Istanbul); 1 hospital; May to December 2020 (specific dates not reported)	1732 HCWs • Median age 28 y • 67% female • 12% physician, 48% nurse, 7% porter, 4% janitorial staff, 3% anesthesia technician, 3% laboratory technician, 3% medical secretary, 2% security staff, 2% radiology technician,	*Non-significant risk factors were eliminated in stepwise regression analysis* HCW role • Janitorial staff, yes vs. no: *adjusted OR 2.24 (1.21-4.14)* • Medical secretary, yes vs. no: *adjusted OR 4.17 (2.21-8.18)* Exposure • Patient diagnosed with SARS-CoV-2 in household (yes vs. no): *adjusted OR 8.98 (6.64-12.15)*	90% participation rate; potential recall bias; limited control of confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	2% pharmacist, <1% physiotherapist, 13% other role • 16% SARS-CoV-2 infection (seropositive or PCR)		
Robles-Perez et al 2021 (136) Cross-sectional Mexico; Mexican Social Security Institute database of workers; March to December 2020 (specific dates not reported)	542381 HCWs (500920 active HCWs + 41461 inactive HCWs) • Mean age 37 y • 57% female • *Among active HCWs:* 30% nurse, 21% physician, 6% cleaner, 13% medical assistant; 6% laboratory technician, 2% food handler, 2% patient transport, 1% pharmacy staff, 1% social worker, 1% radiologist, 0.7% stomatologist, 0.5% ambulance personnel, 0.3% respiratory therapist, 0.2% histologist, 11% other role, 15% administration • 14.1% SARS-CoV-2 infection (PCR)	HCW role* • Administration: 11.6% (8689/74525); reference • Nurse: 17.0% (25469/149040); *adjusted RR 1.13 (1.10-1.15)* • Physician: 13.4% (13968/104306); *adjusted RR 0.91 (0.89-0.94)* • Cleaner: 14.7% (4501/30568); *adjusted RR 1.13 (1.09-1.17)* • Medical assistant: 13.2% (3741/28220); *adjusted RR 1.08 (1.04-1.12)* • Laboratory technician: 14.6% (1849/12626); adjusted RR 1.02 (0.97-1.07) • Food handler: 13.9% (1290/9297); *adjusted RR 1.11 (1.05-1.18)* • Patient transport: 17.5% (1561/8919); *adjusted RR 1.15 (1.09-1.22)* • Pharmacy staff: 14.2% (961/6740); *adjusted RR 1.07 (1.00-1.15)* • Social worker: 15.9% (971/6094); *adjusted RR 1.16 (1.08-1.24)* • Radiologist: 14.6% (746/5106); *adjusted RR 1.08 (1.00-1.17)* • Stomatologist: 7.9% (287/3641); adjusted RR 0.91 (0.81-1.02) • Ambulance personnel: 15.9% (425/2677); *adjusted RR 1.20 (1.09-1.32)* • Respiratory therapist: 19.0% (254/1336); adjusted RR 1.10 (0.97-1.25) • Histologist: 9.9% (78/791); adjusted RR 1.03 (0.82-1.29) • Other role: 10.1% (5741/57034); *adjusted RR 1.06 (1.03-1.10)*	Limited adjustment for confounders
Rodriguez et al 2021 (137) Cross-sectional	2210 HCWs • Mean age 44 y • 74% female • 56% nurse or nursing assistant, 17% physician, 5% other HCW, 10% other non	Age (mean, years), cases vs. non-cases: 42 vs. 44, p>0.05 Sex • Female: 2.6% (42/1637) • Male: 1.6% (19/1168) ○ Female vs. male: OR 1.59 (0.92-2.75)* HCW role • Nurse or nursing assistant: 3.0% (37/1240)	79% participation rate; no adjustment for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Spain (Mallorca); university hospital; 28 April to 11 June 2020	HCW, 3% registrar, 0.8% warden • 2.8% SARS-CoV-2 seropositive	• Physician: 2.6% (10/380) o Nurse or nursing assistant vs. physician: OR 1.14 (0.56-2.31)* • Registrar: 3.9% (3/77) • Warden: 3.4% (6/176) • Other HCW: 0% (0/108) • Other non-HCW: 2.2% (5/229)	
Sandri et al 2021 (138) Cross-sectional Italy (Lombardy); 7 healthcare facilities; 28 April to 16 May 2020	3985 HCWs • Median age 42 y • 67% female • 25% nurse, 16% physician, 7% surgeon, 3% anesthesiologist, 2% physiotherapist, 4% technician, 3% researcher, 8% administration, 1% biologist, 0.7% student • 11.2% SARS-CoV-2 seropositivity (confirmed positive result, defined as IgG >15.0 AU/mL)	n/N not reported for SARS-CoV-2 seropositivity Age • Age >60 vs. ≤60: **adjusted OR 0.35 (0.15-0.83)** Sex • Male vs. female: adjusted OR 0.73 (0.57-0.94) HCW role • Nurse: adjusted OR 1.16 (0.87-1.55) • Physician: adjusted OR 1.10 (0.79-1.53) • Anesthesiologist: adjusted OR 0.49 (0.22-1.08) • Physiotherapist: adjusted OR 1.17 (0.56-2.46) • Researcher: adjusted OR 0.94 *0.47-1.90) • Biologist: adjusted OR 0.69 (0.20-2.37) • Student: adjusted OR 1.07 (0.29-3.95) • Radiology technician: adjusted OR 0.53 (0.25-1.13) • Laboratory technician: adjusted OR 0.75 (0.31-1.86) • Staff: adjusted OR 1.04 (0.67-1.61) • Other role: reference	~65% participation rate

Schmitz et al 2020 (139)
 	
Cross-sectional
 	
The Netherlands (countrywide); 43 hospitals; 1 March to 1 May 2020
	3,064 ED HCWs
	• Mean age, % female not reported
	• 14% resident physician, 70% nurse, 16% consultant
	• 5.4% SARS-CoV-2 infection (PCR)
		HCW role
		• Nurse: 5.6% (121/2153)
		• Resident physician: 6.3% (27/431)
		• Consultant: 3.5% (16/459)
		  o Nurse vs. physician: OR 1.17 (0.82-1.68)*
		PPE use
		• High-level PPE hospital (FFP2 mask and eye protection for all patient contact) hospital: (73/944)
		• Other hospital: (91/2099)
		  o High-level PPE hospital vs. other hospital: **OR 1.85 (1.35-2.54)***^
			SARS-CoV-2 infection status based on self-report; potential recall bias; no control for confounders; participation rate 70%; PPE used based on hospital policy, not individual HW use

Scohy et al 2021 (140) Cross-sectional	3255 hospital HCWs • Mean age 42 y • 78% female	Age • <30 y: 7.7% (50/662); adjusted OR 1.25 (0.92-1.70) • 30-49 y: 9.0% (139/1539); adjusted OR not reported	Potential recall and selection bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Belgium (Brussels); one teaching hospital; 19 June to 30 June 2020	46% nursing role, 33% medical role, 2% pharmacy role, 19% administrative or other role 7.8% SARS-CoV-2 seropositivity	50-65 y: 6.1% (64/1049); reference Sex - Female: 8.4% (211/2513); *adjusted OR 1.61 (1.11-2.32)* - Male: 5.5% (39/712); reference HCW role - Nursing: 9.7% (145/1490); adjusted OR 1.04 (0.66-1.63) - Medical: 5.6% (60/1067); adjusted OR 0.79 (0.51-1.24) - Pharmacy: 10.4% (8/77); adjusted OR 1.49 (0.65-3.40) - Administration or other: 6.4% (40/621); reference Exposure - Work in COVID-19 unit: 11.2% (127/1130); *adjusted OR 1.64 (1.21-2.23)* - Did not work in COVID-19 unit: 5.9% (126/2125); reference - Exposed to a COVID-19 patient: 10.6% (115/1088); adjusted OR 1.30 (0.97-1.74) - Not exposed to a COVID-19 patient: 6.4% (138/2167); reference - Exposed to a COVID-19 colleague: 10.5% (135/1291); *adjusted OR 1.41 (1.06-1.87)* - Not exposed to a COVID-19 colleague: 6.0% (118/1964); reference - Cohabitant infected with SARS-CoV-2: 17.0% (46/271); *adjusted OR 2.55 (1.78-3.66)* - Cohabitant not infected with SARS-CoV-2: 4.8% (130/2727); reference	
Scozzari et al 2021 (141) Cross-sectional Italy (Turin); one teaching hospital; 4 May to 31 July 2020	8769 hospital HCWs - Median age 49 y 74% female 39% nurse, 29% physician, 2% biologist, 2% radiology technician, 4% laboratory technician, 2% obstetrician, 2% physiotherapist, 15% healthcare assistant, 4% other healthcare worker, 9% administration, 4% IT/maintenance,1% role not reported	Age - Per year increase: adjusted OR 1.00 (0.99-1.01) Sex - Female:7.2% (464/6450); reference - Male: 8.9% (206/2319); adjusted OR 1.15 (0.94-1.40) HCW role - Physician: 8.3% (181/2182); adjusted OR 1.00 (0.77-1.30) - Healthcare assistant: 8.6% (96/1123); adjusted OR 1.27 (0.97-1.66) - Other clinical role: 5.1% (16/315); adjusted OR 1.02 (0.78-1.35) - Administration: 7.3% (59/807); adjusted OR 1.30 (0.94-1.81) - IT/maintenance staff: 6.2% (20/325); adjusted OR 1.00 (0.61-1.66) - Nurse: 7.5% (223/2981); reference Exposure - Working in COVID-19 unit: *adjusted OR 1.24 (1.01-1.52)* - Not working in COVID-19 unit: ; reference - Household contact with COVID-19: *adjusted OR 5.31 (4.12-6.85)* - No household contact with COVID-19: reference	79% participation rate

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	• 7.6% SARS-CoV-2 seropositivity	• Other contact with COVID-19: adjusted OR 1.28 (0.86-1.92) • No other contact with COVID-19: reference	
Shields et al, 2020a (142) 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) • 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) • 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)*	***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
Shields et al 2020b (143) Cross-sectional UK (Birmingham); NHS hospital trust; 24 to 25 April 2020	516 HCWs • Mean age 42 y • 75% female • HCW role not reported • 24.4% SARS-CoV-2 seropositivity	Age • Per additional year: adjusted OR 0.98 (0.96-1.00) Sex • Female: (102/388) • Male: (24/128) ○ Female vs. male: adjusted OR 1.49 (0.81-2.83) Race/ethnicity • BAME vs. white: ***adjusted OR 1.92 (1.14-3.23)*** Department (working in the department vs. not working in the department) • Acute medicine: adjusted OR 0.99 (0.34-2.86) • ED: adjusted OR 0.36 (0.05-1.69) • Estates: adjusted OR 0.57 (0.11-2.29) • Internal medicine: adjusted OR 0.93 (0.42-2.12) • Surgery: adjusted OR 0.24 (0.03-1.05) • Facilities: adjusted OR 0.52 (0.15-1.60) • Housekeeping: adjusted OR 1.01 (0.31-3.09) • ICU: adjusted OR 0.28 (0.09-0.78) • Ob/gyn: adjusted OR 0.85 (0.30-2.39) • Research: adjusted OR 0.44 (0.15-1.22)	No control for HCW role, exposures, or PPE; participation rate unclear
Stubblefield et al, 2020 (144)	249 frontline HCWs • Mean age 34 y	Prevalence of SARS-CoV-2 seropositivity • Female: 6.7% (11/163)	No control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional United States (Tennessee); 1 academic medical center; 3 to 13 April 2020	57% female • 37% nurse, 36% physician/provider, 8% radiology technician, 19% other healthcare role • 59% ED, 22% medical ICU, 19% other setting	• 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)*	

Talbot et al 2021 (145)
 	
Cross-sectional
 	
United States (Suffolk County, NY); university hospital; 2 to 18 April 2020
	474 HCWs
	• Mean age 42 y
	• 62% female
	• 72% non-Hispanic white, 7% Hispanic or Latino, 3% African American/Black, 18% Asian, 0.5% other/unknown race/ethnicity
	• 28% nurse (RN), 21% frontline physician, 19% other physician, 28% other clinical staff, 2% administrative/other role
	• 16.9% SARS-CoV-2 seropositive
		Sex
		• Female: 18.5% (54/292)
		• Male: 14.3% (26/182)
		  ○ Female vs. male: OR 1.36 (0.82-2.27)*
		Race/Ethnicity
		• Non-Hispanic white: 15.6% (53/339); reference
		• Hispanic or Latino: 22.6% (7/31); OR 1.57 (0.65-3.84)*
		• African American/Black: 7.1% (1/14); OR 0.42 (0.05-3.24)*
		• Asian: 21.8% (19/87); OR 1.51 (0.84-2.71)*
		HCW role
		• Nurse (RN): 15.6% (21/135)
		• Frontline physician: 12.7% (13/102
		• Other physician: 16.5% (15/91)
		  ○ Nurse vs. (any) physician: OR 1.09 (0.59-2.01)*
		• Other clinical staff: 21.6% (29/134)
		• Administrative/other role: 16.7% (2/12)
		Exposure
		• High exposure (time exposed to COVID-19 patients at work): 14.2% (19/134); OR 0.71 (0.38-1.33)*
		• Moderate exposure: 17.0% (16/94); OR 0.88 (0.43-1.72)*
		• Some exposure: 17.1% (14/82); OR 0.89 (0.44-1.78)
		• Minimal to no exposure: 18.9% (30/159); reference
			Participation rate not reported; potential recall bias; no adjustment for confounders; imprecise estimates

Tomczyk et al 2022 (17)	*Second survey* 1223 HCWs	Age • 16-29 y: 6.8% (12/176); adjusted OR 1.6 (0.3-7.4)	Participation rate not reported; limited

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional Germany (Berlin); tertiary care hospital; 18 May to 10 June 2020 (first survey) and 8 to 20 December (second survey) **Added for Update Alert #11**	• Median age 40 y • 69% female • 27% nurse, 22% physician, 23% other allied health, 27% administration/other management role • SARS-CoV-2 seropositivity: 1.2% (18/1477) May-June 2020; 4.6% (56/1223) December 2020	• 30-39 y: 3.7% (15/405); adjusted OR 0.9 (0.2-3.9) • 40-49 y: 7.0% (20/284); adjusted OR 1.6 (0.3-7.1) • 50-59 y: 2.1% (6/281); adjusted OR 0.6 (0.1-3.1) • ≥60 y: 3.4% (2/58); reference Sex • Female: 3.7% (31/842); ***adjusted OR 0.5 (0.3-0.9)*** • Male: 6.3% (24/380); reference HCW role • Nurse: 6.7% (22/327); ***adjusted OR 2.7 (1.1-6.2)*** • Physician: 5.3% (14/264); adjusted OR 1.6 (0.6-4.2) • Other allied health: 3.6% (10/276); adjusted OR 1.2 (0.4-3.2) • Administration/other management: 2.8% (9/325); reference Exposure • High risk (working in a dedicated COVID-19 ward): 22.4% (13/58); ***adjusted OR 18.5 (6.0-57.2)*** • Moderate risk (ward with higher risk of transmission, e.g. anaesthesia, ENT, oral-maxillofacial surgery, non-COVID-19 ICU): 6.0% (12/200); ***adjusted OR 3.9 (1.3-11.6)*** • Low risk (direct patient contact outside of high- or moderate-risk categories): 4.2% (26/619); ***adjusted OR 2.9 (1.1-7.7)*** • Very low (no direct patient contact): 1.5% (5/332); reference	control for confounders; adjusted analyses only reported for second survey time period (December 2020); some imprecise estimates

Varona et al 2021 (146)
 	
Cross-sectional
 	
Spain (Madrid, Coruna, Barcelona, Other); hospital employees of the HM Group (GHM); 15 April to 30 June 2020
	6038 HCWs (1253 symptomatic in previous 2 mo)
	• Mean age 44 y
	• 71% female
	• 62.7 % high-risk (clinical environment; prolonged/ direct contact with patients); 16.8% moderate risk (clinical environment with non-intense/no patient contact); 20.5% low-risk (non-clinical environment)
		Age
		• <30: 12.3% (112/909); reference
		• 30-45: 10.2% (273/2679); adjusted OR 0.84 (0.67 to 1.06)
		• 46-60: 11.1% (209/1881); adjusted OR 0.96 (0.76 to 1.23)
		• >60: 11.9% (68/569); adjusted OR 1.07 (0.77 to 1.48)
		Sex
		• Male: 11.2% (195/1744)
		• Female: 10.9% (467/4294)
		   ○ Female vs. male: adjusted OR 0.98 (0.83 to 1.18)
		• Exposure risk category High (prolonged direct contact): 12.1% (457/3786)
		• Moderate (clinical or non-clinical with non-intense patient contact): 11.4% (116/1014)
		• Low (non-clinical and minimal/no patient contact): 7.2% (89/1238)
		   ○ High vs. low risk: ***adjusted OR 2.06 (1.63 to 2.62)***
		   ○ Moderate vs. low risk: ***adjusted OR 1.77 (1.32 to 2.37)***
			Potential recall bias; limited control for potential exposures and no control for PPE

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	• 11.0% SARS-CoV-2 seroprevalence		

Venugopal et al 2021 (147)
 	
Cross-sectional
 	
USA (South Bronx, NY); Level 1 trauma center; 1 March to 1 May 2020
	500 HCWs
	• Mean age not reported; 48% 20-39 y; 41% 40-59 y; 11% >60 y
	• 69% female
	• 28% Hispanic; 24% White; 24% Asian; 18% Black; 6% Other race/ethnicity
	• 33% physician; 30% nurse; 15% ancillary service; 22% other role
	• 14% high and moderate risk of healthcare exposure; 86% low risk of healthcare exposure 25% community exposure
	• 27.4% SARS-CoV-2 seropositivity
		Age^
		• 20-39 y: 25% (58/230); reference
		• 40-59 y: 30% (60/196); OR 1.31 (0.86-2.00)*
		• ≥60 y: 23% (12/52); OR 0.89 (0.44-1.81)*
		Sex^
		• Female: 26% (87/329)
		• Male: 29% (43/149)
		  o Female vs. male: OR 0.89 (0.58-1.36)* 0.90 (0.67-1.24)
		Race/ethnicity:
		• Caucasian: 15% (18/115); reference
		• Hispanic: 31% (41/132); adjusted OR 1.32 (0.60-2.89)
		• Black: 32% (28/87); adjusted OR 1.50 (0.62-3.58)
		• Asian: 26% (30/114); adjusted OR 0.90 (0.39-2.07)
		• Other race/ethnicity: 43% (13/30); adjusted OR 2.59 (0.86-7.73)
		HCW role^
		• Nurse: 28% (40/142)
		• Physician: 25% (39/157)
		  o Nurse vs. physician: OR 1.19 (0.71-1.98)*
		• Ancillary service: 28% (20/72)
		• Other role: 29% (31/107)
		PPE^
		• N95 only (yes vs. no): 25% (19/76); OR 0.87 (0.50-1.54)
		• Surgical mask only (yes vs. no): 36% (39/109); OR 1.70 (1.08-2.69)
		• N95 and surgical mask (yes vs. no): 25% (90/361); OR 0.64 (0.41-1.00)
		• Face shield and goggles (yes vs. no): 23% (77/329); OR 0.55 (0.36-0.84)
		• No PPE: 50% (1/2)
		• N95 only vs. surgical mask only: OR 0.60 (0.31-1.15)*
		Exposure
		• High/moderate risk (prolonged close contact with patient with COVID-19 with HCW or patient not wearing face mask or aerosol-generating procedure without eye, nose or mouth protection): 38% (25/65)
		• Low risk: 25% (105/413)
		  o High/moderate vs. low risk: adjusted OR 2.00 (0.99 to 4.25)
			Potential recall bias; limited control for exposures; potential data discrepancies between reported OR and data (unadjusted OR re-calculated using data provided in Table 1)

von Freyburg et al, 2020 (148)	1170 HCWs • Age, sex not reported	Incidence of SARS-CoV-2 seropositivity: • Physician: 3.8% (8/208) • Nurse: 9.7% (40/413)	No information on clinical outcomes of infection; limited

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional Germany (Dachau); single hospital; 3-5 and April 2020	• 17.8% physician, 35.3% nurse, 43.1% nonmedical staff; 3.8% other	• 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)*	information on demographic and no information on clinical characteristics of HCWs
Wan et al 2021 (149) Cross-sectional Malaysia; university medical center; 6 March to 20 August 2020	1174 HCWs with work-related COVID-19 exposure • Median age 30 y • 72% female • 47% nurse, 28% physician, 22% allied health, 3% ancillary personnel • 1.0% SARS-CoV-2 infection (PCR)	Age • ≤24 y: 0.6% (1/157); reference • 25-34 y: 1.1% (8/759); OR 1.66 (0.21-13.38)* • 35-44 y: 1.5% (3/204); OR 2.33 (0.24-22.60)* • 45-54 y: 0% (0/48); OR 1.08 (0.04-26.84)* • ≥55 y: 0% (0/6); OR 8.03 (0.30-216.60)* Sex • Female: 1.0% (8/841); OR 0.79 (0.24-2.64)* • Male: 1.2% (4/333); reference HCW role • Nurse: 1.1% (6/551); OR 1.78 (0.36-8.86)* • Physician: 0.6% (2/325); reference • Allied health: 1.2% (3/259); OR 1.89 (0.31-11.41)* • Ancillary personnel: 2.6% (1/39); OR 4.25 (0.38-47.98)* Exposure • High or moderate risk (exposed to respiratory secretions without PPE or prolonged contact with COVID-19 patient without proper PPE): 3.5% (12/342); **OR 62.97 (3.72-1066.70)* • Low risk (close contact with COVID-19 patient while using PPE): 0% (0/832); reference	No control for confounders; imprecise estimates
West et al 2022 (30) Cross-sectional Switzerland (Zurich area); six nursing homes and six home healthcare organizations; 21 September to 23 October 2020	427 HCWs • Mean age 44 y • 85% female • 58% nurse, 20% housekeeping, kitchen or technical services, 9% administration, 6% other role • 11.5% SARS-CoV-2 seropositive	HCW role • Nurse (yes vs. no)e: **adjusted OR 2.61 (1.09-6.19)** Exposure • Per increase in number of SARS-CoV-2 positive people in immediate environment: adjusted OR 1.22 (0.92-1.61) • Per increase in number of persons met outside household during the pandemic: **adjusted OR 0.92 (0.87-0.97)** Current smoker (yes vs. no): **adjusted OR 0.26 (0.10-0.70)**	Unclear participation rate; potential recall bias; limited control for exposures

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Added for Update Alert #11			
Yogo et al 2020 (150) Cross-sectional USA (San Diego); 4 acute care hospitals, 1 inpatient behavioral health hospital, 3 skilled nursing facilities; 20 May to 8 June 2020	1770 HCWs in high-risk settings • Mean age not reported; 45% 18-35 y, 26% 36-45 y, 18% 46-55 y, 8% 56-65 y, 2% >65 y • 75% female • 64% nurse, 9% nursing assistant, <1% nurse practitioner, 6% physician, 6% phlebotomist, 7% respiratory therapist, 2% social worker, 4% technician, 1% therapist, 1% other role • 2.3% SARS-CoV-2 seropositivity or infection (PCR)	Age • 18-35 y: reference • 36-45 y: adjusted OR 0.47 (0.17-1.33) • 46-55 y: adjusted OR 0.50 (0.16-1.59) • 56-65 y: adjusted OR 0.32 (0.04-2.50) • >65 y: adjusted OR 1.93 (0.25-14.80) Sex • Female vs. male: adjusted OR 1.00 (0.40-2.51) Race/ethnicity • Caucasian: reference • African American/Black: adjusted OR 1.32 (0.15-11.47) • Asian: adjusted OR 1.16 (0.41-3.31) • Hispanic/Latino: ***adjusted OR 2.79 (1.02-7.65)*** • Other: adjusted OR 2.85 (0.62-13.15) HCW role • Nurse: reference • Nursing assistant: adjusted OR 0.65 (0.17-2.45) • Physician: adjusted OR 1.19 (0.19-7.38) • Technician: adjusted OR 1.65 (0.38-7.15) • Therapist: adjusted OR 0.78 (0.01-70.94) PPE (exposure without PPE) • No: reference • Yes: adjusted OR 1.17 (0.42-3.26)	Potential recall bias; participation rate 45%
Zhang G et al, 2020 (83) Cross-sectional 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) • Physician: 14.9% (10/67) • Nurse: 1.2% (2/170) • 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
Zheng et al, 2020 (151)	117,100 HCWs • Age not reported	OR (95% CI) for COVID-19 • Female vs. male: 1.02 (0.94-1.12)	COVID-19 cases based on requests for

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Cross-sectional China (Wuhan); throughout Wuhan area; from March 26, 2020	• 72% female • 37% physician, 49% nurse, 14% medical staff • 2.1% (2,457/117,100) diagnosed with COVID-19	• 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)	financial assistance; denominators based on epidemiological data; limited information on clinical outcomes of COVID-19 infections
Zhou F et al, 2020 (152) Cross-sectional China (Wuhan); single hospital; 16 to 25 March 2020	3674 HCWs • Mean age not reported; 38% age 18-30 y, 45% age 31-50 y; 17% age >50 y • 68% female • 65% healthcare role, 14% administrative staff, 21% clinical support staff	Incidence of SARS-CoV-2 infection (PCR, seropositivity, or CT scan suggesting infection) • Female: 3.3% (81/2486) • Male: 3.8% (45/1188) ○ Female vs. male: OR 0.86 (0.59.1.24) • Age 18-30: 2.5% (35/1378) • Age 31-50: 3.3% (55/1656) • Age >50: (36/640) • Healthcare role: 3.0% (73/2406) • Administrative staff: 2.4% (12/505) • Clinical staff: 5.4% (41/763) • High risk vs. low-risk setting: p=0.39 • Attended vs. did not attend training early in the COVID-19 outbreak: *p<0.01*	No control for confounders
Case-control studies			
Alishaq et al 2021 (153) Case control Qatar (countrywide); national medical system; 20 December 2020 to 18 May 2021	164 fully vaccinated HCWs with breakthrough infection (cases) • Median age 39 y • 49% female • 16% physician, 42% nurse, 21% allied health professional, 4% clinical support services, 9% non-clinical support services, 8% administration • 0.7% SARS-CoV-2 infection (PCR)	Age • Per 10 years increase: adjusted HR 1.02 (0.61-1.68) Sex (reference female) • Male: adjusted HR 1.26 (0.51-3.16) HCW role (nurse/midwife reference) • Physician: *adjusted HR 6.27 (1.20-32.82)* • Allied health professional: adjusted HR 2.99 (0.94-9.50) • Clinical support service: *adjusted HR 9.15 (1.32-63.64)* • Non-clinical support service: *adjusted HR 4.95 (1.00-23.45)* Exposure (reference non-exposed) • Contact with confirmed COVID-19 case: *adjusted HR 9.25 (3.67-23.28)*	Potential recall bias; some estimates very imprecise; limited control of confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
	among total cohort (n=22247)		
Celebi et al, 2020 (154) Case-control Population subset of Celebi 2020 prospective cohort, see above	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): 00.50 (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)* • 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)*	Potential recall bias; imprecision in adjusted risk estimates
Chatterjee et al, 2020 (155) Case-control	378 HCW cases and 373 HCW controls	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)	Potential recall bias; 60% of eligible cases included

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

India (throughout); 8 to 23 May 2020	• 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
		• 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)**	

Dusefante et al 2022 (21) Case-control Italy (Trieste); 2 hospitals (1 outpatient only); 1 September 2020 to 31 January 2021 **Added for Update Alert #11**	120 HCWs (29 cases; 91 controls) • Median age 40 y • 58% female • 71% nurse or assistant nurse, 11% clinical or other medical professional, 12% patient transport	Age • Per year: adjusted OR 0.98 (0.93-1.03) Sex • Female: adjusted OR 0.66 (0.21-2.03) • Male: reference Education/training • <2 hours COVID-19 training: reference • ≥2 hours COVID-19 training: adjusted OR 0.36 (0.11-1.12) HCW role • Registered nurse vs. medical doctor: OR 0.49 (0.14-7.29); not included in multivariate model Exposure • Exposure to aerosol-generating procedures (yes vs. no): OR 0.50 (0.21-1.19); not included in multivariate model • Exposure to COVID-19 patient' body fluids (yes vs. no): OR 0.60 (0.24-1.48); not included in multivariate model • COVID-19 vs. non-COVID-19 ward: OR 1.32 (0.56-3.10); not included in multivariate model • COVID-19 wards dedicated days: OR 0.96 (0.82-1.12); not included in multivariate model	Potential recall bias

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations
Haller et all 2021 (156)[†] Prospective cohort Switzerland (northern and eastern regions); 18 institutions (14 acute care, 1 rehabilitation, and 3 psychiatric clinics); 22 June 2020 to 9 March 2021	*Total cohort* 3,259 HCWs • Median age 39 y • 81% female • 53% nurse, 21% physician, other HCW role not reported • 13.3% SARS-CoV-2 infection (self-report) *Seroconverted subgroup with negative serum testing at baseline and repeat testing in January or February 2021* 2916 HCWs • Age, sex, HCW role not reported • 17.6% SARS-CoV-2 seropositivity	*Total cohort* Mask use • Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.80 (0.64-1.00) o Restricted to data collected after 1 December 2020: adjusted HR 0.73 (0.55-0.97) *Seroconverted subgroup* Mask use • Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.73 (0.53-1.00)	***Not peer reviewed*** Potential recall bias

Khalil et al, 2020 (157)
 	
Case-control
 	
Bangladesh; multiple hospitals (number not reported); May to June 2020
	98 COVID-19 positive HCWs and 92 COVID-19 negative controls
	• Mean age 33 y (cases)
	• 22% female (cases)
	• 100% physicians
		Risk of COVID-19 (defined as positive PCR), unadjusted OR (95% CI):
		• Age ≥35 years vs. <35 years: 0.67 (0.35-1.28)
		• Female vs. male: 0.66 (0.44-1.69)
		• Workplace setting (reference inpatient)
		   o Outpatient: 0.64 (0.31-1.29)
		   o ED: 0.94 (0.41-2.15)
		   o ICU: 1.24 (0.40-3.85)
		   o Tertiary care: 0.95 (0.31-2.88)
		• Received formal training on PPE (yes vs. no): 1.67 (0.89-3.12)
		• Place of contact with COVID-19 (reference hospital environment)
		   o Suspected contact with COVID-19 patient or health worker: 1.51 (0.67-3.42)
		   o Confirmed contact with COVID-19 patient or health worker: 0.82 (0.39-1.69)
		   o Community contact: 1.14 (0.24-5.43)
		   o Unknown contact: 0.35 (0.13-0.94)
		• Participated in direct COVID-19 patient care (yes vs. no): 0.94 (0.50-1.77)
			Proportion of eligible HCW cases included not reported; method of identifying controls unclear; imprecise estimates; potential recall bias; no control for confounders

Study, Year (Reference) Study Design Setting and Study Dates	Population Characteristics	Outcomes	Limitations

		• Performed aerosol-generating procedure on COVID-19 patient (yes vs. no): 1.30 (0.64-2.37)
		• Direct contact with contaminated fomite (yes vs. no): 1.74 (0.90-3.35)
		• Wore PPE (yes vs. no): 0.15 (0.02-1.21)
		• Single-use gloves (yes vs. no): 1.01 (0.38-2.68)
		• Medical/surgical mask (yes vs. no): 1.40 (0.30-6.42)
		• Face shield/goggles (yes vs. no): **0.44 (0.23-0.84)**
		• Disposable gown (yes vs. no): 1.08 (0.53-2.20)
		• Proper donning and doffing of PPE (yes vs. no): 0.57 (0.29-1.14)
		• Followed hand hygiene –
		  ○ During patient care (yes vs. no): 0.78 (0.23-2.67)
		  ○ During procedure (yes vs. no): 3.28 (0.66-12.30)
		  ○ After body fluid exposure (yes vs. no): 0.28 (0.06-1.45)
		  ○ After touching fomites (yes vs. no): 1.58 (0.49-5.04)
		• Decontaminated surroundings (yes vs. no): **0.39 (0.18-0.87)**	

Not peer reviewed			
Haller et all 2021 (156)[†] Prospective cohort Switzerland (northern and eastern regions); 18 institutions (14 acute care, 1 rehabilitation, and 3 psychiatric clinics); 22 June 2020 to 9 March 2021	*Total cohort* 3,259 HCWs • Median age 39 y • 81% female • 53% nurse, 21% physician, other HCW role not reported • 13.3% SARS-CoV-2 infection (self-report) *Seroconverted subgroup with negative serum testing at baseline and repeat testing in January or February 2021* 2916 HCWs • Age, sex, HCW role not reported • 17.6% SARS-CoV-2 seropositivity	*Total cohort* Mask use • Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.80 (0.64-1.00) ○ Restricted to data collected after 1 December 2020: adjusted HR 0.73 (0.55-0.97) *Seroconverted subgroup* Mask use • Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.73 (0.53-1.00)	***Not peer reviewed*** Potential recall bias

Abbreviations: BAME = Black, Asian and minority ethnic; BCG = bacille Calmette-Guerin; CPR = cardiopulmonary resuscitation ; ED = emergency department; HCW = healthcare worker; HR = hazard ratio; ICU = intensive care unit; IRR = incidence rate ratio; MMR = measles, mumps and rubella; NICU = neonatal intensive care unit; ob/gyn =

obstetrics and gynecology; OR = odds ratio; PAPR = powered air purifying respirator; PCR = polymerase chain reaction; PICU = pediatric intensive care unit; PPE = personal protective equipment; RR = relative risk; VHA = Veterans Health Administration; y=years

*Unadjusted OR calculated based on available data.

^Variable was not retained in the multivariate model

†Preprint included for risk associated with mask use only

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

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Abbas et al 2021 (84)	Age (per year): adjusted OR 1.00 (0.99-1.01)	Female vs. male: *adjusted OR 0.60 (0.49-0.73)*	--	--	--	Clinical vs. nonclinical: *adjusted OR 1.27 (1.06-1.53)*
Abdelmonim et al 2020 (31)	Mean 31.7 (cases) vs. 31.9 years (non-cases), p=0.86	Female vs. male: OR 1.35 (0.61-2.97)	--	9.4% (7/74)	16.8% (15/89) Nurse vs. physician: OR 1.95 (0.75-5.05)	Cleaner/transportation: 20.8% (5/24) Radiology/lab: 0% (0/2) Administration: 14.3% (2/14)
Akinbami et al 2020 (61)	18-24 y: 7.9% (54/686) 25-34 y: 6.9% (337/4,885) 35-44 y: 7.0% (278/3,977) 45-59 y: 6.9% (360/5,222) 60-64 y: 7.5% (83/1,106) ≥65 y: 3.5% (18/521); *vs. 18-24 y, adjusted OR 0.41 (0.23-0.72)*	Female vs. male: *adjusted OR 0.79 (0.65-0.95)*	--	6.1% (140/2,297)	Nurse: 7.7% (495/6,426) Nurse vs. physician; *adjusted OR 1.52 (1.18-1.95)* Nurse assistant: 12.8% (82/641) Nurse assistant vs. physician: *adjusted OR 1.88 (1.24-2.83)*	Pharmacist: 4.4% (14/321) Physical therapist: 10.6% (25/235) Respiratory therapist: 8.3% (34/409) Administration/clerk: 8.0% (77/964) Clinical technician: 5.5% (20/365) Imaging technician: 4.2% (30/719) Laboratory technician: 3.4% (10/293) Midlevel clinician: 4.6% (26/566) Other HCW role: 7.0% (62/888)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Akinbami et al 2021 (85) *Hospital HCWs*	18-24 y: reference 25-34 y: ***adjusted OR 0.53 (0.31-0.92)*** 35-44 y: adjusted OR 0.46 (0.20-1.04) 45-59 y: ***adjusted OR 0.50 (0.26-0.96)*** 60-64 y: ***adjusted OR 0.48 (0.23-0.97)*** ≥65 y: ***adjusted OR 0.26 (0.11-0.63)***	Female: 3.1% (212/6788); adjusted OR 0.85 (0.59-1.21) Male: 2.8% (44/1582); reference	White: 2.7% (182/6829); reference Black: 7.0% (20/284); ***adjusted OR 2.83 (1.77-4.51)*** Asian: 3.2% (10/316); adjusted OR 1.16 (0.58-2.29) Hispanic: 5.6% (31/554); ***adjusted OR 1.70 (1.35-2.13)*** Other race/ethnicity: 5.8% (11/191); adjusted OR 1.94 (0.89-4.22)	2.2% (22/1001)	Nurse: 4.2% (114/2733) Nurse vs. physician: ***adjusted OR 1.66 (1.07-2.57)*** Nurse assistant: 5.9% (23/392) Nurse assistant vs. physician: adjusted OR 1.44 (0.85-2.43)	Physician assistant: 1.0% (1/100) vs. physician; adjusted OR 0.68 (0.22-2.12) Reception/medical assistant: 4.1% (12/296) vs. physician; adjusted OR 2.04 (1.18-3.52)
Akinbami et al 2021 (85) *Nursing home HCWs*	18-24 y: reference 25-34 y: adjusted OR 1.27 (0.59-2.73) 35-44 y: adjusted OR 1.21 (0.44-3.37) 45-59 y: adjusted OR 1.61 (0.68-3.78) 60-64 y: adjusted OR 1.94 (0.89-4.21) ≥65 y: adjusted OR 1.75 (0.59-5.20)	Female: 12.4% (157/1267); ***adjusted OR 0.66 (0.46-0.94)*** Male: 17.2% (39/227); reference	White: 10.2% (119/1165); reference Black: 27.6% (24/87); adjusted OR 1.60 (0.84-3.05) Asian: 21.4% (6/28); adjusted OR 1.90 (0.99-3.66) Hispanic: 21.5% (28/130); adjusted OR 1.90 (0.99-3.66) Other race/ethnicity: 20.0% (8/40); ***adjusted OR 2.57 (1.25-5.28)***	--	Nurse: 15.3% (63/413); adjusted OR 1.78 (0.93-3.42) Nurse assistant: 19.9% (59/296); adjusted OR 2.06 (1.06-4.00)	Occupational/physical/ speech therapist: 9.8% (16/163); reference

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Al Maskari et al, 2020 (89)	--	Female vs. male: **OR 4.45 (3.32-5.96)**	--	4.7% (26556)	4.1% (77/1870) Nurse vs. physician: OR 0.88 (0.56-1.38)	Paramedic: 2.8% (27/969) Administrative/support staff: 5.6% (74/1308)
Al-Naamani et al 2021 (11) **Added for Update Alert #11**	>50 vs. <50: adjusted OR 0.98 (p=0.19)	Female vs. male: **adjusted OR 2.27 (p<0.0001)**	--	--	--	--
Al Youha et al 2021 (86)	No association between age and risk of infection (data not shown)	No association between sex and risk of infection (data not shown)	--	--	*Nurse (yes vs. no):* **adjusted OR 1.77 (1.15-2.71)**	Other medical staff (yes vs. no): adjusted OR 1.40 (0.93-2.12)
Algado-Selles et al 2020 (62)	<60 y vs. ≥60 y: OR 1.2 (0.7-2.0)	Female vs. male: OR 1.2 (0.8-1.8)	--	28.2% (60/213)	18.1% (49/270) Nurse vs. physician: **OR 0.57 (0.37-0.87)**	Nurse assistant/technician: 14.6% (27/185) Other role: 17.2% (20/116)
Alishaq et al 2021 (153)	Per 10 years increase: adjusted HR 1.02 (0.61-1.68)	Female vs. male: adjusted HR 0.79 (0.32-1.96)	--	Physician vs. nurse/midwife: **adjusted HR 6.27 (1.20-32.82)**	--	*Reference nurse/midwife* Allied health professional: adjusted HR 2.99 (0.94-9.50) Clinical support service: **adjusted HR 9.15 (1.32-63.64)** Non-clinical support service: **adjusted HR 4.95 (1.00-23.45)**
Alkurt et al 2021 (87)	--	OR 1.16 (0.77-1.74)	--	10.8% (30/279)	16.8% (45/268) Nurse vs. physician: **OR 1.67 (1.02-2.75)**	Ward clerk and security: 11.6% (15/129)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Lab and radiology technician: 6.5% (7/107) Cleaning staff: 12.5% (12/96) Administrative staff: 18.9% (10/53)
Allen et al 2021 (88)	18-29 y: **adjusted RR 1.40 (1.10-1.90)** 30-39 y: adjusted RR 1.20 (0.90-1.50) 40-49 y: adjusted RR 1.0 (0.80-1.30) 50-59 y: reference >60 y: adjusted RR 1.40 (0.90-2.00)	Female vs. male: **adjusted RR 0.83 (0.71-1.0)**	Irish: reference Other White: **adjusted RR 1.3 (1.0-1.6)** African or other Black: adjusted RR 1.3 (0.8-2.0) Asian: **adjusted RR 1.3 (1.0-1.6)** Other race/ethnicity: adjusted RR 0.6 (0.2-1.3)	Medical/dental vs. administration: adjusted RR 1.2 (0.8-1.7)	Nurse vs. administration: **adjusted RR 1.6 (1.1-2.2)**	Administration: reference Allied health: adjusted RR 0.9 (0.6-1.3) General support staff: adjusted RR 0.9 (0.6-1.4) Healthcare assistant: **adjusted RR 2.0 (1.4-3.0)** Other role: adjusted RR 1.0 (0.5-2.1)
Allen et al 2022 (18) **Added for Update Alert #11**	18-29 y: 22.5% (249/1108); **adjusted RR 1.3 (1.1-1.6)** 30-39 y: 17.9% (238/1330); adjusted RR 1.1 (0.9-1.3) 40-49 y: 14.7% (208/1414); adjusted RR 1.0 (0.7-1.1)	Female: 16.9% (669/3959); reference Male: 18.7% (229/1226); **adjusted RR 1.2 (1.0-1.4)**	White (Irish): 15.7% (595/3798); reference Other white: 19.7% (94/476); **adjusted RR 1.2 (1.0-1.4)** Asian: 24.7% (148/599); adjusted RR 1.1 (0.9-1.3) African or other Black: 33.3% (39/117); **adjusted RR 1.7 (1.3-2.2)**	Medical/dental vs administration: 16.3% (116/713); adjusted RR 1.0 (0.7-1.4)	Nurse/midwife vs administration: 20.9% (396/1891); **adjusted RR 1.4 (1.0-1.8)**	Administration: 12.6% (85/676); reference Allied health: 11.3% (118/1044); adjusted RR 0.8 (0.6-1.1) General support: 22.2% (81/365); adjusted RR 1.2 (0.9-1.7) Healthcare assistant: 32.0% (93/291); **adjusted RR 1.8 (1.3-2.3)**

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
	50-59 y: 16.6% (158/951); reference >60 y: 16.0% (45/282); adjusted RR 1.0 (0.7-1.3)		Other race/ethnicity: 23.2% (22/95); adjusted RR 1.3 (0.9-1.9)			Other role: 9.5% (10/105); adjusted RR 0.7 (0.3-1.2)
Amendola et al, 2020 (90)	--	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)
Bahrs et al., 2021 (32)	--	Female vs. male: OR 0.93 (0.33-2.64)	--	4.8% (5/103)	Nurse or care worker: 2.3% (5/215) Nurse or care worker vs. physician: adjusted OR 0.38 (0.10-1.34)	Cleaner: 16.7% (1/6) Reception staff: 5.3% (1/19) Administrative staff: 3.3% (6/180) Other role: 0% (0/130)
Bai et al, 2020 (63)	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)	--
Baker et al 2021 (92)	≥60: reference 50-59: adjusted OR 0.8 (0.6-1.2) 40-49: adjusted OR 0.9 (0.7-1.4) 30-39: adjusted OR 1.0 (0.7-1.4) <30: adjusted OR 1.2 (0.8-1.7)	Female vs. male: adjusted OR 0.77 (0.59-1.00)	White: 4.3% (226/5263); reference Black: 8.3% (238/2860); *adjusted OR 2.1 (1.7-2.6)* Asian: 5.3% (60/1133); adjusted OR 1.3 (0.9-1.7)	5.0% (87/1753)	5.9% (177/2976) Nurse vs. physician: OR 1.21 (0.93-1.58)	Other HCW role with no patient contact: 5.5% (100/1812) Other direct care: 6.2% (88/1423) Advanced practice provider: 5.2% (36/698) Nurse tech:8.1% (28/346) Radiology tech: 7.0% (21/302)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			Multiracial: 7.6% (10/132); adjusted OR 1.8 (0.8-3.5)			
Banjeree et al 2020 (64)	--	Female vs. male: OR 0.85 (0.49-1.45)	--	--	--	--
Barallat et al 2020 (91)	35-54 vs. 18-34 y: OR 0.86 (0.72-1.03) ≥55 vs. 18-34 y: OR 0.98 (0.79-1.21)	Female vs. male: OR 0.90 (0.75-1.08)	--	27.0% (192/1821)	Nurse: 9.6% (216/2243) Nursing assistant: 11.9% (85/832) Nurse vs. physician: OR 0.90 (0.74-1.11) Nurse or nursing assistant vs. physician: OR 0.92 (0.76-1.11)	Heathcare support services: 4.6% (33/429) Administration: 10.5% (75/1181) Other role: 7.2% (51/616)
Barrett et al 2020 (33)	--	--	--	2.4% (5/210)	11.1% (25/225) Nurse vs. physician: *OR 5.12 (1.92-13.65)*	Other HCW role: 9% (10/111)
Bayle et al 2021 (93)	--	Female vs. male: OR 1.05 (0.38-2.92)	--	--	Nurse and nursing assistant: 15.2% (23/151) Nurse and nursing assistant vs. medical staff: OR 2.38 (0.13-43.64)*	Medical staff: 0% (0/6) Clerical staff: 0% (0/20) Allied health: 13.3% (2/15) Environmental staff: 12.1% (4/33) Food service: 25.0% (3/12)
Blairon et al, 2020 (34)	--	--	--	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)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Imaging or lab worker: 6.6% (2/31)
Bouwman et al 2021 (94)	--	--	--	Physician vs. role with no direct patient contact: adjusted OR 0.60 (0.35-1.03)	Nurse vs. role with no direct patient contact: adjusted OR 1.21 (0.79-1.84)	Paramedical vs. role with no direct patient contact: adjusted OR 0.66 (0.45-0.98) Other HCW with direct patient contact vs. role with no direct patient contact: adjusted OR 1.08 (0.69-1.70) *Reference department with no direct patient contact* COVID-19 nursing ward: adjusted OR 1.86 (0.93-3.74) ICU: adjusted OR 1.01 (0.43-2.33) Pediatrics: adjusted OR 1.93 (0.67-5.55) Emergency department: adjusted OR 1.41 (0.58-3.45) Housekeeping: adjusted OR 1.05 (0.49-2.26) General surgery: ***adjusted OR 3.39 (1.32-8.71)***
Brousseau et al 2021 (12)	--	--	Black or Hispanic: 23.4% (45/192);	7.2% (31/432)	Nurse/nursing assistant: 12.3% (163/1321)	Orderly: 17.9% (36/201) vs. physician;

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Added for Update Alert #11			*adjusted RR 1.41 (1.13-1.76)* Other race/ethnicity: 12.2% (33/270); adjusted RR 0.89 (1.67-1.18) White: 10.2% (163/1594); reference		Nurse/nursing assistant vs. physician: *adjusted RR 1.34 (1.03-1.74)*	*adjusted RR 1.49 (1.12-1.97)* Cleaning staff: 10.8% (11/102) vs. physician; adjusted RR 0.88 (0.50-1.54)
Buchtele et al, 2020 (65)	--	--	--	0% (0/5)	27.8% (5/18) Nurse vs. physician: OR 4.48 (0.21-65.60)	Cleaning staff: 0% (0/3)
Calcagno et al 2020 (35)	--	--	--	7.8% (55/700)	Nurse: 8.2% (150/1833) Nurse vs. physician: OR 1.05 (0.76-1.44) Nurse assistant: 9.2% (44/476) Nurse or nurse assistant vs. physician: OR 1.08 (0.79-1.47)	Healthcare personnel: 6.7% (23/343) Pharmacist: 3.4% (1/29) Administrative employee: 3.3% (18/539) Technical personnel: 6.9% (15/216) Laboratory personnel: 11.5% (18/157)
Celebi et al, 2020 (154)	--	Female vs. male: OR 1.27 (0.63-2.57)	--	--	Nurse vs. physician: OR 2.45 (0.98-6.11)	--
Chatterjee et al, 2020 (155)	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)*	--	--	--	--
Clifton et al 2021 (95)	--	Female vs. male: OR 0.74 (0.13-4.10)		Physician or physician assistant: 0% (0/25)	Nurse: 1.0% (1/100) Nurse vs. physician or physician assistant: OR 0.77 (0.03-19.44)	Medical support: 1.1% (1/94) Other role: 3.4% (4/117)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Colaneri et al 2020 (66)	Mean age: 46.3 y in cases vs. 44.9 in non-cases, p=0.43	Female vs. male: OR 0.73 (0.52-1.02)	--	12.1% (54/446)	11.1% (63/568) Nurse vs. physician: OR 0.91 (0.62-1.33); adjusted IRR 1.49 (0.97-2.30)	Healthcare assistant: 13.3% (34/255) Administrative staff: 7.3% (13/178)
Comelli et al 2021 (67)	Mean age: 45 y in cases vs. 44 y in non-cases, p=0.01	Female vs. male: 0.94 (0.73-1.21)	--	--	--	--
Cruz-Arenas et al 2021 (96)	--	Female vs. male: **adjusted OR 3.22 (1.11-9.09)**	--	--	Nurse vs. administration: adjusted OR 0.71 (0.18-2.78)	*Reference administration* Medical personnel: adjusted OR 0.32 (0.06-1.66) Research: adjusted OR 1.27 (0.13-12.23) Orderly: adjusted OR 0.77 (0.07-8.41) Technician: adjusted OR 0.73 (0.09-5.60) Therapist: adjusted OR 1.81 (0.48-6.83) Janitor: **adjusted OR 13.70 (2.85-65.77)** Security: **adjusted OR 12.35 (1.32-115.01)** Food service: adjusted OR 5.58 (0.47-66.31)
Dacosta-Urbieta et al, 2020 (97)	--	--	--	Physician/resident: 3.8% (3/80)	Nurse/nurse's aide: 4.8% (4/83)	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
					Nurse/nurse's aide vs. physician/resident: OR 1.30 (0.28-6.00)	
Dalla Volta et al, 2020 (98)	--	--	--	Physician/resident: 20.7% (6/29)	5.4% (2/37) Nurse vs. physician/resident: OR 0.22 (0.04-1.18)	Administrative: 50% (2/4)
Damluji et al 2021 (36)	*Reference 20-29 y* 30-39 y: ***adjusted OR 0.48 (0.23-0.96)*** 40-49 y: ***adjusted OR 0.44 (0.19-0.92)*** 50-59 y: ***adjusted OR 0.41 (0.16-0.93)*** ≥60 y: adjusted OR 0.40 (0.11-1.05)	Female vs. male: adjusted OR 0.66 (0.36-1.30)	*Reference White race* Black: ***adjusted OR 2.53 (1.20-5.05)*** Hispanic: adjusted OR 1.37 (0.50-3.09) Other race/ethnicity: adjusted OR 1.07 (0.50-2.07)	--	--	--
Davido et al 2021 (99)	>44 vs. <44: ***adjusted OR 6.7 (1.7-37.7)***	Female vs. male: adjusted OR 1.25 (0.42-5.00)	--	Physician: 22.2% (4/18)	Nurse or nursing assistant: 36.2% (17/47); vs. physician: OR 1.98 (0.56-7.00)	Support staff: 28.6% (6/21)
Davila-Conn et al 2022 (19) *Prevalent cases* **Added for Update Alert #11**	--	Female: 25.4% (158/620); adjusted OR 0.86 (0.58-1.29) Male: 29.0% (76/262); reference	--	Physician: 22.2% (47/212); reference	Nurse: 31.1% (76/244); adjusted OR 1.02 (0.57-1.81)	Lab technician: 42.1% (16/38); ***adjusted OR 4.38 (1.75-10.93)*** Administration: 22.6% (44/195); adjusted OR 1.18 (0.64-2.17) Other role: 26.4% (50/189); adjusted OR 1.40 (0.79-2.50)
Davila-Conn et al 2022 (19)	Adjusted HR 0.80 (0.58-1.10)	Female vs. male: adjusted HR 1.54 (95% CI 0.81-2.94)*				

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Incident cases **Added for Update Alert #11**						
Dillner et al 2021 (37)	< 29 y: 16.4% (249/1522); reference 30-39 y: 12.1% (383/3172); ***OR 0.70 (0.59-0.83)*** 40-49 y: 11.4% (370/3238); ***OR 0.66 (0.55-0.78)*** 50-59 y: 10.2% (313/3066); ***OR 0.58 (0.49-0.70)*** ≥60 y: 8.6% (166/1930); ***OR 0.48 (0.39-0.59)***	--	--	--	--	--
Doernberg et al 2022 (20) **Added for Update Alert #11**	Per year: adjusted HR 1.0 (1.0-1.0)	Female: 2.9% (55/1923); adjusted HR 0.83 (0.45-1.67)* Male: 2.9%(15/512); reference	White: 2.7% (38/1411); reference Black: 5.4% (2/37); adjusted HR 2.6 (0.6-11.1) Asian: 3.0% (16/530); adjusted HR 1.2 (0.7-2.2) Mixed race: 2.2% (3/137); adjusted HR 0.8 (0.2-2.7)	2.0% (16/804); reference	3.2% (34/1077); adjusted HR 1.67 (0.91-3.33)*	--
Dusefante et al 2022 (21)	Per year: adjusted OR 0.98 (0.93-1.03)	Female vs. male: adjusted OR 0.66 (0.21-2.03)	--	--	Registered nurse vs. medical doctor: OR 0.49 (0.14-7.29); not included	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Added for Update Alert #11					in multivariate model	
Ebinger et al 2021 (100)	Per decade increase: ***adjusted OR 0.80 (0.68 to 0.94)***	Female vs. male: adjusted OR 0.84 (0.63-1.12)	Asian: 3.1% (57/1866) Black: 4.8% (18/372); ***adjusted OR 2.02 (1.08-3.76)*** Hispanic/Latino: 5.3% (62/1159); ***adjusted OR 1.98 (1.34-2.92)*** Other: 4.2% (33/782) White: 3.4% (104/3042); reference	--	--	--
El Abdellati et al, 2021 (38)	Mean 46.8 (cases) vs. 43.7 (non-cases) years	Female vs. male: OR 0.52 (0.16-1.71)	--	--	--	--
el-Boghdadly et al, 2020 (39)	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)
Elfstrom et al 2021 (101)	*Reference ≤29 y* 30-39 y: ***adjusted OR 0.78 (0.65-0.93)*** 40-49 y: ***adjusted OR 0.76 (0.64-0.91)*** 50-59 y: ***adjusted OR 0.67 (0.56-0.80)*** ≥60 y: ***adjusted OR 0.57 (0.46-0.70)***	Female vs. male: adjusted OR 0.88 (0.76-1.01*	--	Physician vs. other HCW role: adjusted OR 1.07 (0.89-1.28)	Nurse/midwife vs. other HCW role: ***adjusted OR 1.28 (1.11-1.49)*** Nurse assistant vs. other HCW role: ***adjusted OR 1.62 (1.38-1.90)***	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Eyre et al 2020 (102) *Seropositive or PCR*	Per 10 years: OR 0.95 (0.90-1.00)	Female vs. male: OR 0.88 (0.76-1.01)	White: 9.5% (686/7237); reference Asian: 16.8% (281/1673); *adjusted OR 1.51 (1.28-1.77)* Black: 18.0% (71/394); *adjusted OR 1.66 (1.25-2.21)* Chinese: 7.5% (7/93); adjusted OR 0.75 (0.34-1.67) Mixed race/ethnicity: 11.6% (28/242); adjusted OR .23 (0.82-1.87)	10.9% (170/1557)	Nurse/healthcare assistant: 14.2% (562/3971) Nurse/healthcare assistant vs. physician: *OR 1.35 (1.12-1.61)**	Administration: 7.2% (88/1218) Laboratory staff: 8.2% (29/354) Cleaning staff: 18.6% (60/323) Therapist: 14.9% (47/316) Security or catering: 11.8% (26/221)
Eyre et al 2020 (102) *Seropositive*	--	Male vs. female: *adjusted OR 1.19 (1.01-1.40)*	*vs. White* Asian: *adjusted OR 1.52 (1.29-1.80)* Black: *adjusted OR 1.71 (1.28-2.28)* Chinese: adjusted OR 0.67 (0.29-1.59) Mixed race/ethnicity: adjusted OR 1.30 (0.86-1.97)	*vs. administration* Senior physician: adjusted OR 0.84 (0.54-1.31) Junior physician: adjusted OR 1.05 (0.70-1.58)	*vs. administration* Nurse/healthcare assistant: adjusted OR 1.33 (0.94-1.87)	*vs. administration* Laboratory staff: adjusted OR 0.96 (0.60-1.54) Cleaning staff: *adjusted OR 1.96 (1.26-3.04)*
Faico-Filho et al, 2020 (103)	--	--	--	24.2% (26/107)	Nurse or nurse technician: 40.1% (73/182)	Laboratory personnel: 28.6% (4/14)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
					Nurse or nurse technician vs. physician: **OR 2.09 (1.23-3.55)**	Administrative staff: 31.1% (28/90) Logistic worker: 63.0% (17/27)
Ferreira et al 2021 (40)	--	--	--	*PCR* 0% (0/152) *Seropositive* 1.0% (1/101)	*PCR* 1.2% (8/655) Nurse vs. physician: OR 4.00 (0.23-69.75) *Seropositive* 1.9% (7/361) Nurse vs. physician: OR 1.98 (0.24-16.26)	*PCR* Allied health: 2.2% (1/446) *Seropositive* Allied health: 1.9% (5/261)
Fitzpatrick et al 2021 (104)	18-31 y: reference 32-40 y: **adjusted OR 0.54 (0.43-0.68)** 41-52 y: **adjusted OR 0.66 (0.53-0.83)** 53-82 y: **adjusted OR 0.55 (0.44-0.69)**	--	*Race* American Indian: adjusted OR 0.85 (0.20-3.55) Asian: **adjusted OR 1.87 (1.37-2.57)** Black: **adjusted OR 3.86 (2.91-5.12)** Mixed: **adjusted OR 1.99 (1.50-2.63)** White: reference *Ethnicity* Hispanic vs. non-Hispanic: **adjusted OR 1.80 (1.34-2.42)**	--	--	COVID-19 clinical: **adjusted OR 1.86 (1.45-2.40)** Other clinical: OR 1.09 (0.88-1.35) Nonclinical: reference
Fletcher et al 2021 (105) *Study Period 1*	Study 1: Mean 36 (cases) vs. 40 (non-cases) years, p=0.08	Female vs. male: OR 0.56 (0.24-1.30)	White: 1.6% (20/1274); reference	--	--	Clinical provider: 2.4% (17/708); reference

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			Hispanic/Latino: 2.9% (1/34); OR 1.90 (0.25-14.58) Black: 4.8% (1/21); OR 3.13 (0.40-24.51) Asian/Pacific Islander: 0% (0/22); OR 1.36 (0.08-23.19) Arabic: 10.0% (1/10); OR 6.97 (0.84-57.62) Other race/ethnicity: 12.5% (3/24); **OR 8.96 (2.47-32.47)**			Interprofessional: 0.8% (1/132); OR 0.31 (0.04-2.35) Ancillary: 1.0% (1/105); OR 0.39 (0.05-2.97) Nonclinical role: 1.6% (7/440); OR 0.66 (0.27-1.60)
Fletcher et al 2021 (105) *Study Period 2*	Study 2: Mean 38.9 (cases) vs. 40.3 years, p=0.13	Female vs. male: OR 1.05 (0.72-1.53)	White: 13.5% (176/1303); reference Hispanic/Latino: 20.5% (8/39); OR 1.65 (0.75-3.65) Black: 26.1% (6/23); OR 2.26 (0.88-5.81) Asian/Pacific Islander: 0% (4/33); OR 0.88 (0.31-2.54) Arabic: 12.5% (1/8); OR 0.91 (0.11-7.48) Other race/ethnicity: 7.7% (3/39); OR 0.53 (0.16-1.75)	--	--	Clinical provider: 13.4% (107/800); reference Interprofessional: 17.5% (33/189); OR 1.37 (0.89-2.10) Ancillary: 10.6% (10/94); OR 0.77 (0.39-1.53) Nonclinical role: 14.6% (48/329); OR 1.11 (0.77-1.60)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Forrest 2021 et al (106)	18-29 y: reference 30-49 y: adjusted OR 1.26 (0.87-1.81) 50-64 y: adjusted OR 1.38 (0.91-2.08) ≥65 y: adjusted OR 1.13 (0.48-2.64)	Female vs. male: adjusted OR 0.96 (0.72-1.29)	Black: **_adjusted OR 2.32 (1.45-3.70)_** Hispanic: **_adjusted OR 2.19 (1.55-3.08)_** Asian/Pacific Islander: adjusted OR 1.39 (0.91-2.14) Other race/ethnicity: adjusted OR 1.16 (0.62-2.17) White: reference	Physician vs. nurse: adjusted OR 0.71 (0.49-1.02)	--	Nurse: reference Physician: adjusted OR 0.71 (0.49-1.02) Intern/resident: adjusted OR 0.77 (0.40-1.48) Paramedic/EMT: adjusted OR 0.67 (0.24-1.81) Physician's assistant: adjusted OR 0.96 (0.48-1.90) Nurse practitioner: adjusted OR 1.18 (0.69-2.01) Respiratory therapist: adjusted OR 0.95 (0.36-2.51) Physical therapist: adjusted OR 1.42 (0.67-2.99) Medical assistant: adjusted OR 1.27 (0.46-3.45) Administration: adjusted OR 1.10 (0.61-1.66) Laboratory technician: adjusted OR 0.54 (0.16-1.79) Pharmacist: **_adjusted OR 0.29 (0.09-0.97)_**

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Dietary/food services: adjusted OR 0.71 (0.18-2.78) Other role: adjusted OR 0.80 (0.58-1.11)
Fukuda et al 2021 (107)	≥40 vs. <40 y: OR 1.04 (0.35-3.12)	Female vs. male: OR 1.42 (0.44-4.52)		0.4% (5/1111)	0.2% (3/1308) Nurse vs. physician: OR 1.42 (0.44-4.52)	*Physician reference* Laboratory personnel: 0% (0/236); OR 0.43 (0.02-7.72) Paramedic: 0.6% (2/314); OR 1.42 (0.27-7.34) Administrative staff: 0.6% (3/510); OR 1.31 (0.31-5.50) Researcher: 0.2% (1/632); OR 0.35 (0.04-3.01) Other role: 0% (0/36); OR 2.76 (0.15-50.78)*
Fusco et al, 2020 (108)	--	Female vs. male: OR 0.35 (0.03-3.43)	--	3.8% (1/26)	3.5% (2/57) Nurse vs. physician: OR 1.10 (0.10-12.70)	Other HCW role: 3.1% (1/32)
Ganz-Lord et al 2021 (158)	--	--	--	17.5% (119/679)	38.9% (296/760) Nurse vs. physician: **OR 3.00 (2.35-3.84)**	*Physician reference* Nurse practitioner or physician assistant: 33.0% (34/103); **OR 2.32 (1.47-3.66)*** Clerk: 32.7% (135/413); **OR 2.29 (1.72-3.04)***

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Environmental service: 53.3% (32/60); **OR 5.38 (3.12-9.27)*** Respiratory service: 30.6% (11/36); OR 2.07 (0.99-4.32)* Security guard: 32.4% (11/34); **OR 2.25 (1.07-4.74)*** Social worker: 28.4% (23/81); **OR 9.84 (4.67-20.73)*** Other clinical staff: 39.2% (408/1040); **OR 3.04 (2.40-3.84)***
Garcia et al, 2020 (69)	--	--	--	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)
Garralda Fernandez et al 2021 (109)	--	Female vs. male: **OR 0.68 (0.54-0.85)**	--	25.4% (n/N not reported) Physician vs. administrator: OR 2.13 (1.53-2.96)	Nurse: 19.4% (n/N not reported) Nursing assistant: 22.0% (n/N not reported) Nurse vs. administrator: OR 1.51 (1.09-2.09)	Security: 21.1% (n/N not reported) Technician: 18.1% (n/N not reported) Cleaning staff: 16.9% (n/N not reported)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Gelanew et al 2022 (22) **Added for Update Alert #11**	19-24 y: adjusted OR 1.27 (0.9-1.9) 25-34 y: adjusted OR 1.1 (0.9-1.5) 35-49 y: reference ≥50 y: adjusted OR 1.2 (0.8-1.8)	Female vs. male: adjusted OR 1.1 (0.92-1.4)			Nurse vs. physician: adjusted OR 1.0 (0.8-1.4)	Laboratory technician: adjusted OR 1.3 (0.9-1.9) Administration: adjusted OR 1.01 (0.8-1.5) Other role: adjusted OR 1.3 (0.9-1.7)
Goenka et al 2020 (110)	--	--	--	3.9% (10/255)	9.4% (21/224) Nurse vs. physician: adjusted OR 1.61 (0.62-4.35)	Housekeeping: 26.1% (59/226) Technician: 12.1% (12/99) Administration: 8.0% (6/75) Lab assistant/pharmacist: 15.3% (11/72) Dietician: 18.4% (9/49) Ward executive: 7.0% (5/71) Other role: 2.0% (1/51)
Gohil et al 2021 (13) **Added for Update Alert #11**	<35 y: reference 35 to <50: adjusted OR 1.53 (0.88-2.69) 50 to <60: adjusted OR 1.68 (0.82-3.45) >60: adjusted OR 1.42 (0.45-4.44)	Female vs. male: *adjusted OR 0.56 (0.25-0.96*	Latino (yes vs. no) *adjusted OR 2.1 (1.12-3.96)*	Physician: adjusted OR 0.32 (0.07-1.43)	Registered nurse (yes vs. no): adjusted OR 1.29 (0.57-2.95); reference for other HCW role comparisons Nurse aide: adjusted OR 1.02 (0.20-5.74)	Physical/occupational therapist: adjusted OR 1.05 (0.12-9.36) Respiratory therapist: adjusted OR 0.47 (0.20-1.13) Environmental services: adjusted OR 0.19 (0.02-1.69)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Other direct patient care: adjusted OR 0.95 (0.41-2.19) Not direct patient care: adjusted OR 1.29 (0.57-2.95) COVID patient care: adjusted OR 1.10 (0.64–1.88)
Gras-Valenti et al 2020 (70)	--	Female vs. male: OR 0.93 (0.70-1.22)	--	8.7% (85/974)	6.6% (78/1,186) Nurse vs. physician: OR 0.74 (0.53-1.01)	--
Guerrero Torres et al 2021 (112)	*Non-HCWs vs. HCWs* 30 y: reference 50 y: *adjusted OR 2.31 (2.10-2.54)* 60 y: *adjusted OR 3.65 (3.31-4.01)*	*Non-HCWs vs. HCWs* Female vs. male: *adjusted OR 0.62 (0.59-0.66)*	--	Physician vs. non-HCW: *adjusted OR 0.60 (0.48-0.75)*	Nurse vs. non-HCW: *adjusted OR 0.29 (0.20-0.42)*	Other HCW role vs. non-HCW: *adjusted OR 0.61 (0.49-0.77)*
Gupta et al 2021 (111)	18-35 vs. >35: OR 1.01 (0.86-1.18)	Female vs. male: OR 0.82 (0.67-1.00)		5.4% (36/661)	9.8% (117/1198) Nurse vs. physician: *OR 1.88 (1.28-2.77)*	Administration: 19.6% (105/537) Technical staff: 17.9% (71/397) Paramedical: 17.2% (128/743) Research staff: 14.8% (30/203)
Hall et al 2021 (42)	--	Female vs. male: *OR 0.84 (0.78-0.90)*	White: 31.1% (6969/22404); reference	35.9% (999/2783)	34.4% (3751/10891) Nurse or healthcare assistant vs. physician: OR 0.94 (0.86-1.02	*Physician reference* Administration: 27.9% (1090/3903)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			Mixed race: 40.8% (724/1773); ***OR 1.53 (1.38-1.69)*** Asian: 45.0% (236/525); ***OR 1.81 (1.52-2.15)*** Black: 32.5% (134/412); OR 1.07 (0.87-1.31) Chinese: 42.5% (147/346); ***OR 1.64 (1.32-2.03)***			Specialist: 31.6% (489/1548) Scientist: 25.2% (225/894) Midwife: 29.1% (189/649) Pharmacist: 28.7% (112/390) Estates, porters or security: 37.1% (95/256) Other role: 30.5% (1328/4347)
Herzberg et al 2021 (113)	Per 10 years: adjusted OR 1.50 (1.19 to 1.90)	Female vs. male: adjusted OR 0.91 (0.42-2.00)	--	--	--	--
Houlihan et al, 2020 (43)	<30 y: 54% (31/57) 30-39 y: 49% (34/70) 40-49 y: 30% (12/30) ≥50 y: 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)
Howard-Anderson et al 2022 (23) **Added for Update Alert #11**	<40 y: 8.7% (15/172); adjusted OR 0.9 (0.3-2.5) ≥40 y: 8.5% (11/129); reference	Female vs. male: 9.1% (21/231) vs. 7.1% (5/70); OR 1.3 (0.5-0.4); not included in multivariate model	Asian: 3.4% (1/29); adjusted OR 0.8 (0.0-4.9) Black: 21.1% (7/33); ***adjusted OR 4.5 (1.3-14.2)*** Other race/ ethnicity/not	Physician/ advanced practice provider: 3.8% (3/79); OR 0.4 (0.1-2.1)	11.8% (11/119); OR 1.2 (0.4-5.7)	Administrator: 9.7% (3/31); reference Other healthcare personnel: 8.3% (6/72); OR 0.8 (0.2-4.2)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			reported: 5.0% (1/20); adjusted OR 0.9 (0.0-5.2) White: 7.8% (17/219); reference			
Hunter et al, 2020 (114)	--	--	--	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)
Jacob et al 2021 (115)	<30 y: 5.3% (239/4545); *adjusted OR 1.3 (1.0-1.7)* 30-39 y: 4.4% (328/7454); adjusted OR 1.1 (0.9-1.4) 40-49 y: 4.4% (228/5234); adjusted OR 1.0 (0.8-1.3) 50-59 y: 3.9% (178/4578); adjusted OR 0.9 (0.7-1.2) ≥60 y: 3.6% (107/2938); reference	Female vs. male: adjusted OR 0.8 (0.7-1.0)	Race White: 3.3% (499/15157); reference Black: 7.3% (376/5117); *adjusted OR 2.1 (1.8-2.4)* Asian: 4.5% (107/2369); adjusted OR 1.2 (1.0-1.5) Unknown: 5.2% (53/1012); *adjusted OR 1.8 (1.2-2.7)* Other race: 3.6% (25/702); adjusted OR 1.3 (0.8-2.0) Multiracial: 5.5% (14/253): adjusted OR 1.3 (0.8-2.3) American Indian or Alaska Native: 4.8% (5/105); adjusted OR 1.4 (0.6-3.5)	3.7% (166/4499)	Nurse: 4.8% (374/7830) Nurse vs. physician: *OR 1.13 (1.09-1.58)*	Nonclinical: 3.9% (205/5289); reference Nurse practitioner or physician's assistant: 3.5% (53/1535); adjusted OR 0.9 (0.6-1.2) Environmental services: 7.4% (9/122); adjusted OR 1.5 (0.8-3.1) Pharmacy: 3.1% (10/325); adjusted OR 0.8 (0.4-1.6) Physical, occupational, or speech therapist: 3.5% (17/483); adjusted OR 1.3 (0.7-2.1) Radiology technician: 4.8% (23/476); adjusted OR 1.0 (0.6-1.6) Respiratory therapist: 4.5% (18/399);

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			Native Hawaiian or other Pacific Islander: 2.9% (1/34); adjusted OR 0.8 (0.1-6.2) Ethnicity Hispanic: 5.2% (59/1126); adjusted OR 1.1 (0.8-1.5) Non-Hispanic/Latino: 4.4% (975/22403); reference			adjusted OR 0.9 (0.5-1.6) Other direct care personnel: 5.5% (105/1914); adjusted OR 1.1 (0.9-1.4) Other health care professional: 2.7% (10/367); adjusted OR 0.7 (0.4-1.3) Unknown: 6.8% (11/162); adjusted OR 0.9 (0.4-1.8)
Jeremias et al, 2020 (116)	--	Female vs. male: OR 0.83 (0.58-117)	--	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)
Jespersen et al, 2020 (117)	<29 y: 6.0% (116/1,916) 30-39 y: 3.8% (144/3,794) 40-49 y: 3.8% (175/4,560) 50-59 y: 3.6% (161/4,505) ≥60 y: 2.9% (72/2,505)	Female vs. male: OR 1.00 (0.80-1.25)	--	Range (according to study site): 1.9%-12.8%	Range (according to study site): 1.24%-18.2%	Range (according to study site): Laboratory scientist: 1.43%-12.9% Medical secretary: 1.09%-2.52% Other role: 0.80%-5.77%
Jones et al 2020 (118)	≤20 y: adjusted OR 1.47 (0.96-2.20)	Female vs. male: adjusted OR 1.04 (0.88-1.23)	BAME: 14.6% (160/1095	Medical/dental: 8.6% (74/856)	Nurse/midwife: 10.2% (201/1962)	Allied health 7.5% (31/413)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
	21-30 y: *adjusted OR 1.64 (1.36-1.99)* 31-40 y: reference 41-50 y: *adjusted OR 1.36 (1.11-1.67)* 51-60 y: *adjusted OR 1.45 (1.17-1.80)* 61-70 y: adjusted OR 1.28 (0.94 to 1.73)		White: 8.2% (456/5578) BAME vs white: *adjusted OR 1.99 (1.69-2.34)*		Nurse/midwife vs. medical/dental: OR 1.21 (0.91-1.60)	Administrative/clerical: 5.9% (73/1233) Other clinical services: 12.7% (180/1420)
Kassem et al, 2020 (44)	--	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)
Khalil et al, 2020 (157)	≥35 years vs. <35 years: OR 0.67 (0.35-1.28)	Female vs. male: OR 0.66 (0.44-1.69)	--	--	--	--
Korona-Glowniak et al 2022 (24) **Added for Update Alert #11**	Per year: adjusted OR 1.02 (0.98-1.08)	Female vs. male: 11.6% (39/337) vs. 14.0% (7/50); adjusted OR 0.13 (0.02-0.71)*	--	9.8% (11/112); reference	13.1% (16/122); adjusted OR 5.0 (0.85-29.3)	Laboratory technician: 10.5% (9/86); adjusted OR 2.87 (0.5-16.1) Administration: 15.6% (10/64); adjusted OR 1.72 (0.35-8.4)
Krastinova et al 2020 (120)	>50 y vs. ≤50 y: adjusted OR 0.69 (0.36-1.32)	Female vs. male: adjusted OR 1.20 (0.60-2.38)	--	--	--	--
Lackermair et al, 2020 (121)	--	Female vs. male: OR 0.19 (0.02-1.38)	--	5.6% (3/54)	--	1.0% (1/97)
Lahner et al, 2020 (122)	--	--	--	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)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Lai et al, 2020 (72)	<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)
Larese Filon et al 2022 (25) **Added for Update Alert #11**	Per year: *adjusted IRR 0.99 (0.98-0.99)*	Female vs. male: 13.4% (394/2944) vs. 14.1% (184/1307); adjusted IRR 1.06 (0.91-1.25)		12.6% (78/617); reference	Nurse: 15.2% (261/1720); adjusted IRR 1.18 (0.94-1.49) Nurses' aide: 16.9% (126/745); adjusted IRR 1.18 (0.91-1.52)	Other HCW: 8.5% (57/673); adjusted IRR 0.70 (0.50 -0.98) Technician: 9.0% (20/221); adjusted IRR 0.72 (0.43-1.22) Clerk: 13.1% (36/275); adjusted IRR 1.18 (0.79-1.76)
Leeds et al, 2020 (45)	Age: adjusted 1.01 (0.99-1.03)	Female vs. male: adjusted 0.97 (0.56-1.69)	--	--	--	Frontline worker vs. other worker: adjusted 0.79 (0.53-1.17)
Lepak et al 2021 (46)	--	--	--	--	--	*Reference physician* Nurse, medical assistant or therapist: *adjusted OR 1.79 (1.23-2.60)* Medical or nursing student: *adjusted OR 2.76 (1.63-4.67)* Pharmacist: *adjusted OR 3.06 (1.69-5.52)* Other HCW role with direct patient care: *adjusted OR 2.18 (1.41-3.35)* Other HCW role with no direct patient care: *adjusted OR 2.21 (1.49-3.29)*

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Lombardi et al, 2020 (123)	<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)
Lumley et al, 2020 et al (47)	Median 38 vs. 38-41 y (positive at baseline vs. not positive at baseline)	Female vs. male: *OR 0.85 (0.75-0.97)*	Asian vs. white: *OR 1.97 (1.70-2.28)* Black vs. white: *OR 2.25 (1.75-2.89)* Chinese vs. white: *OR 0.89 (0.45-1.75)*	9.9% (184/1860)	Nurse or health care assistant: 12.3% (555/4528) Nurse or health care assistant vs. physician: *OR 1.27 (1.07-1.52)*	Administrative staff: 6.1% (95/1557) Medical or nursing student: 5.8% (36/620) Laboratory staff: 8.0% (36/452) Physical, occupational or speech therapist: 9.6% (37/386) Porter or domestic worker: 15.4% (58/377) Security, estates, or catering staff: 8.5% (23/271)
Lumley et al 2022 (26), Lumley et al 2020 (47), (102) *Extension of Lumley et al 2020*	Per 10-year increase: adjusted IRR 0.99 (0.99-1.00)	Female vs. male: 5.6% (544/9765) vs. 5.1% (169/3321); adjusted IRR 0.93 (0.75-1.11)*	White: 4.8% (455/9411); reference Asian: 7.9% (170/2157); *adjusted IRR 1.59 (1.32-1.91)*	Junior physician: 4.4% (42/942); adjusted IRR 1.10 (0.78-1.54) Senior physician (consultant): 2.5%	6.9% (248/3579); adjusted IRR 1.49 (1.21-1.83)	Healthcare assistant: 8.2% (103/1263); *adjusted IRR 1.82 (1.42-2.34)* Physical, occupational or speech/language therapist: 4.7%

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Added for Update Alert #11			Black: 6.4% (34/532); adjusted IRR 1.25 (0.88-1.78) Other race/ethnicity: 5.4% (55/1009); adjusted IRR 1.23 (0.93-1.62)	(21/834); *adjusted IRR 0.60 (0.38-0.95)*		(20/419); adjusted IRR 1.17 (0.73-1.88) Porter or domestic staff: 5.6% (19/338); adjusted IRR 1.37 (0.84-2.22) Administration: 4.8% (82/1688); adjusted IRR 1.18 (0.89-1.57) Other role: 4.4% (179/4046); reference
Madsen et al 2021 (124)	Per year: adjusted OR 0.99 (0.94-1.04)	Female vs. male: adjusted OR 0.77 (0.56-1.05)	--	--	--	--
Maltezou et al, 2020 (48)	--	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 (125)	--	Female: 13.0% (31/239) Male: 11.5% (10/87) Female vs. male: OR 1.15 (0.54-2.45)	--	11.8% (10/85)	12.7% (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: 0.4% (1/25) Cleaning staff: 33.3% (2/6) COVID-19 unit: 14.4% (31/215) COVID-19 ICU: 5.7% (3/53) ED: 12.1% (7/58)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Milazzo et al 2021 (49)	Per 1 year or more of increase: adjusted OR 0.99 (0.95-1.03)	Female vs. male: adjusted OR 1.26 (0.41-3.85)	--	4.1% (8/194)	2.8% (6/214) Nurse vs. physician: adjusted OR 0.71 (0.22-2.27)	Healthcare service worker: 1.6% (1/63) Health service assistant: 5.3% (4/76) Socio-administrative staff: 6.9% (4/58)
Modenese et al 2021 (14)	≤30 y: 12.1% (159/1312); reference 31-40 y: 13.2% (199/1512); adjusted OR 1.20 (0.92-1.56) 41-50 y: 12.3% (188/1318); adjusted OR 1.06 (0.80-1.43) 51-60 y: 13.5% (178/1329); adjusted OR 1.06 (0.77-1.46) >60 y: 9.4% (41/426); adjusted OR 1.06 (0.65-1.72)	Female: 12.4% (518/4168); reference Male: 14.3% (247/1729); adjusted OR 1.03 (0.83-1.29)	--	Physician vs. non-HCW: *adjusted OR 1.91 (1.16-3.14)*	Nurse/nurse's aide vs. non-HCW: *adjusted OR 2.67 (1.63-4.37)*	Other HCW vs. non-HCW: *adjusted OR 0.50 (0.27-0.93)*
Moncunill et al 2021 (126)	Per year: OR 0.98 (0.95-1.02)	Female vs. male: OR 1.27 (0.50-3.24)	--	Physician vs. other HCW role: OR 2.77 (0.30-25.25)	Nurse/auxiliary services vs. other HCW role: OR 5.54 (0.72-42.55)	Technician vs. other HCW role: *OR 13.03 (1.47-116)*
Moscola et al, 2020 (73)	Adjusted RR (95% CI) vs. age 18-39 years: 40-49: 1.0 (0.97-1.02)	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)	Adjusted RR (95% CI) vs. allied health:

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
	50-59: 0.99 (0.97-1.02) 60-69: 1.00 (0.98-1.03) ≥70: 1.00 (0.94-1.07)				Nurse vs. physician: OR 1.58 (1.38-1.79)	Administrative and clerical: 1.01 (0.99-1.02) Service/ maintenance: 1.03 (1.00-1.05)
Mukhtar et al 2021 (127)	Mean 33.4 (cases) vs. 32.8 (non-cases) years, p=0.71	Female vs. male: OR 1.42 (0.72-2.82)	--	--	--	--
Mutambudzi et al, 2020 (50)	--	--	--	--	--	Healthcare professionals: 0.7% (12/1,779) Medical support staff: 0.8% (10/1,286) Health associate professionals: 0.7% (54/7,653)
Naesens et al 2021 (129)	Unit of analysis not reported: *adjusted OR 0.99 (0.98–0.99)*	Female vs. male: 1.16 (0.89-1.03)	--	--	--	*Reference nursing staff* Medical staff: *adjusted OR 0.65 (0.43-0.94)* Paramedical staff: *adjusted OR 0.74 (0.51-0.94)* Administrative staff: *adjusted OR 0.40 (0.24-0.66)* Cleaning and technical staff: *adjusted OR 0.63 (0.43-0.93)*

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Newberry et al 2021 (130) *SARS-CoV-2 seropositivity*	18-34 y: 1.0% (2/206); reference 35-49 y: 3.1% (17/556); OR 3.22 (0.74-14.05) ≥50 y: 2.7% (6/221); OR 2.85 (0.57-14.27)	--	White, non-Hispanic: 1.3% (8/594); reference Hispanic: 4.7% (9/192); ***OR 3.60 (1.37-9.47)*** Asian or Pacific Islander: 3.8% (3/78); OR 2.93 (0.76-11.29) Black, non-Hispanic: 3.8% (1/26); OR 2.93 (0.35-24.34) Other: 4.3% (4/93); OR 3.29 (0.97-11.16)	--	--	--
Newberry et al 2021 (130) *SARS-CoV-2 infection (PCR)*	18-34 y: 1.0% (2/206); reference 35-49 y: 0.5% (3/556); OR 0.55 (0.09-3.34) ≥50 y: 1.8% (4/221); OR 1.88 (0.34-10.38)	--	White, non-Hispanic: 1.0% (6/594); reference Hispanic: 1.6% (3/192); OR 1.56 (0.39-6.28) Asian or Pacific Islander: 0% (0/78); OR 0.58 (0.03-10.34) Black, non-Hispanic: 0% (0/26); OR 1.71 (0.09-31.13) Other: 0% (0/93); OR 0.48 (0.03-8.67)	--	--	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Nopsopon et al 2021 (131)	--	Female vs. male: OR 2.10 (0.25-17.57)	--	--	--	--
Nunes et al 2021 (27) *Population overlaps with Nunes et al 2022* **Added for Update Alert #11**	<38 y: 33.2% (71/214); reference ≥38 y: 52.2% (95/182); adjusted OR 1.25 (0.75-2.10)	Female vs. male: 45.2% (148/327) vs. 26.1% (18/69); adjusted OR 1.15 (0.58-2.27)	Black African: 49.8% (139/279); reference Asian: 28.01% (16/57); OR 0.39 (0.21-0.73); not included in multivariate model White: 20.4% (10/49); OR 0.26 (0.12-0.54); not included in multivariate model Other race: adjusted OR 0.62 (0.30-1.26)	--	57.5% (111/193); reference	Other role: adjusted OR 0.72 (0.37-1.42)
Olalla et al, 2020 (133)	--	--	--	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)
Pereckaite et al 2021 (134)	--	--	--	1.2% (2/169)	1.1% (2/179) OR 0.94 (0.13-6.77)	--
Perez-Garcia et al 2020 (75)	--	--	--	33.1% (90/272)	39.6% (340/859) Nurse vs. physician: OR 1.32 (0.99-1.77)	Medical staff: 34.7% (154/444) Technical specialist: 29.1% (41/141) Hospital porter: 44.9% (83/185) Other HCW: 26.4% (19/72)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Non-healthcare hospital personnel: 29.8% (104/349)
Piapan et al 2021 (16)	Per year: adjusted OR 0.98 (0.96-1.01)	Female vs. male: adjusted OR 0.59 (0.31-1.11)	--	Physician: 22.9% (54/236); reference Resident: 23.7% (14/59); OR 1.35 (0.78-2.69) HCW role not included in multivariate model	Nurse: 20.5% (85/414); OR 1.12 (0.75-1.69) Nurse aid: 23.6% (30/127); OR 1.39 (0.83-2.35) HCW role not included in multivariate model	Other HCW: 15.7% (20/127); OR 1.01 (0.60-2.00) HCW role not included in multivariate model
Pinarlik et al 2021 (135)	--	--	--	--	--	*Non-significant risk factors were eliminated in stepwise regression analysis* Janitorial staff (yes vs. no): *adjusted OR 2.24 (1.21-4.14)* Medical secretary (yes vs. no): *adjusted OR 4.17 (2.21-8.18)*
Porru et al 2022 (29) **Added for Update Alert #11**	Per 10-year increase: *adjusted HR 1.61 (1.27-2.04)*	Female vs. male: 1.9% (132/6814) vs. 1.5% (45/2997); adjusted HR 1.15 (0.60-2.17)*	--	1.3% (36/2727); adjusted HR 1.62 (0.43-6.11)	2.8% (70/2463); adjusted HR 2.13 (0.60-7.65)	Other health professional: 1.6% (59/3734); adjusted HR 2.46 (0.71-8.51) Administration: 1.4% (12/828); reference
Rashid-Abdi et al 2020 (52)	Mean 38 (cases) vs. 44 (non-cases) years, p not reported	Female vs. male: OR 12.82 (0.75-219.19)	--	8.0% (2/25)	Nurse vs. physician: OR 3.11 (0.62-15.47) Nurse or nurse assistant vs. physician: OR 3.44 (0.75-15.68)	Other HCW role: 0% (0/6)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Rasmussen et al 2021 (53)	--	--	--	*Infection (PCR)* 5% (4/80) *Seropositive* 4% (3/80)	*Infection (PCR)* 1% (1/104) Nurse vs. physician: OR 0.18 (0.02-1.68) *Seropositive* 2% (2/104) Nurse vs. physician: OR 0.50 (0.08-3.09)	*Infection (PCR)* Secretary: 0% (0/18) Theatre personnel: 0% (0/81) Cleaner: 0% (0/8) Porter: 7% (2/31) Other role: 0% (0/25) *Seropositive* Secretary: 6% (1/18) Theatre personnel: 5% (4/81) Cleaner: 0% (0/8) Porter: 13% (4/31) Other role: 4% (1/25)
Robles-Perez et al 2021 (136)	--	--	--	Physician vs. administration: **adjusted RR 0.91 (0.89-0.94)**	Nurse vs. administration: **adjusted RR 1.13 (1.10-1.15)**	Administration: reference Cleaner: **adjusted RR 1.13 (1.09-1.17)** Medical assistant: **adjusted RR 1.08 (1.04-1.12)** Laboratory technician: adjusted RR 1.02 (0.97-1.07) Food handler: **adjusted RR 1.11 (1.05-1.18)**

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Patient transport: ***adjusted RR 1.15 (1.09-1.22)***
						Pharmacy staff: ***adjusted RR 1.07 (1.00-1.15)***
						Social worker: ***adjusted RR 1.16 (1.08-1.24)***
						Radiologist: ***adjusted RR 1.08 (1.00-1.17)***
						Stomatologist: adjusted RR 0.91 (0.81-1.02)
						Ambulance personnel: ***adjusted RR 1.20 (1.09-1.32)***
						Respiratory therapist: adjusted RR 1.10 (0.97-1.25)
						Histologist: adjusted RR 1.03 (0.82-1.29)
						Other role: ***adjusted RR 1.06 (1.03-1.10)***
Rodriguez et al 2021 (137)	Mean 42 y (cases) vs. 44 y (non-cases), p>0.05	Female vs. male: OR 1.59 (0.92-2.75)	--	2.6% (10/380)	Nurse or nursing assistant: 3.0% (37/1240) Nurse or nursing assistant vs. physician: OR 1.14 (0.56-2.31)*	Registrar: 3.9% (3/77) Warden: 3.4% (6/176) Other HCW: 0% (0/108) Other non-HCW: 2.2% (5/229)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Sandri et al 2021 (138)	Age >60 vs. ≤60: *adjusted OR 0.35 (0.15-0.83)*	Female vs. male: *adjusted OR 1.37 (1.06-1.75)*	--	Physician vs. other role: adjusted OR 1.10 (0.79-1.53)	Nurse vs. other role: adjusted OR 1.16 (0.87-1.55)	Anesthesiologist: adjusted OR 0.49 (0.22-1.08) Physiotherapist: adjusted OR 1.17 (0.56-2.46) Researcher: adjusted OR 0.94 *0.47-1.90) Biologist: adjusted OR 0.69 (0.20-2.37) Student: adjusted OR 1.07 (0.29-3.95) Radiology technician: adjusted OR 0.53 (0.25-1.13) Laboratory technician: adjusted OR 0.75 (0.31-1.86) Staff: adjusted OR 1.04 (0.67-1.61) Other role: reference
Schmidt et al, 2020 (54)	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)
Schmitz et al 2020 (139)	--	--	--	4.8% (43/890)	5.6% (121/2153) Nurse vs. physician: OR 1.17 (0.82-1.68)	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Science et al 2021 (55)	Per year: *adjusted OR 0.98 (0.96-0.99)*	Female vs. male: adjusted OR 1.86 (0.72-4.78)	Non-White vs. White race: adjusted OR 1.26 (0.46-3.52)	--	--	--
Scohy et al 2021 (140)	<30 y vs. 50-65 y: adjusted OR 1.25 (0.92-1.70)	Female vs. male: *adjusted OR 1.61 (1.11-2.32)*	--	--	Nurse vs. administration: adjusted OR 1.04 (0.66-1.63)	Medical: adjusted OR 0.79 (0.51-1.24) Pharmacy: adjusted OR 1.49 (0.65-3.40) Administration or other: reference
Scozzari et al 2021 (141)	Per year increase: adjusted OR 1.00 (0.99-1.01)	Female vs. male: adjusted OR 0.87 (0.71-1.06)	--	Physician vs. nurse: adjusted OR 1.00 (0.77-1.30)	7.5% (223/2981)	Healthcare assistant: adjusted OR 1.27 (0.97-1.66) Other clinical role: adjusted OR 1.02 (0.78-1.35) Administration: adjusted OR 1.30 (0.94-1.81) IT/maintenance staff: adjusted OR 1.00 (0.61-1.66) Nurse: reference
Shields et al 2020b (143)	Per additional year: adjusted OR 0.98 (0.96-1.00)	Female vs. male: adjusted OR 1.49 (0.81-2.83)	--	--	--	--
Shields et al, 2020a (143)	--	Female vs. male: OR 1.55 (0.94-2.54)	BAME vs. white: *adjusted OR 1.92 (1.14-3.23)*	--	--	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Shorten et al 2021 (78)	Age, per 1 year change: adjusted OR 0.99 (0.98-0.994)	Female vs. male: adjusted OR 1.06 (0.87-1.29)	White (UK or Republic of Ireland); reference Asian/Asian British: *adjusted OR 1.61 (1.27-2.04)* Other white: adjusted OR 1.28 (0.79-2.05) Black/Black British: *adjusted OR 2.08 (1.25-3.45)* Mixed race/ethnicity: adjusted OR 0.72 (0.35-1.49) Chinese: adjusted OR 0.62 (0.18-2.14) Unknown ethnicity: *adjusted OR 1.44 (1.14-1.82)*	--	--	--
Sims et al 2020 (56)	Mean 41.3 y (cases) vs. 43.3 y (non-cases), p>0.05	Female vs. male: OR 0.97 (0.87-1.09)	--	7.0% (277/3,957)	Nurse/nursing support: 10.8% (902/8,352) Nurse/nursing support vs. physician: *OR 1.62 (1.41-1.86)**	Respiratory therapy: 12.1% (37/306) Phlebotomy: 14.6% (41/281) Clinical support with patient contact: 8.0% (173/2162) Facilities: 8.2% (41/500) Administration: 6.8% (194/2,853)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
						Laboratory: 5.5% (44/800) Security/safety: 6.6% (7/106) Clinical support with no patient contact: 7.7% (102/1,325)
Sotgiu et al. 2020 (79)	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 (144)	--	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)
Talbot et al 2021 (145)	Mean age 42.4 y (cases) vs. 41.9 y (non-cases)	Female vs. male: OR 1.36 (0.82-2.27)	Non-Hispanic white: 15.6% (53/339); reference Hispanic or Latino: 22.6% (7/31); **OR 1.57 (0.65-3.84)** African American/Black: 7.1% (1/14); OR 0.42 (0.05-3.24)	Frontline physician: 12.7% (13/102) Other physician: 16.5% (15/91)	15.6% (21/135) Nurse vs. physician: OR 1.09 (0.59-2.01)	Other clinical staff: 21.6% (29/134) Administrative/other role: 16.7% (2/12)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
			Asian: 21.8% (19/87); OR 1.51 (0.84-2.71)			
Tomczyk et al 2022 (17) **Added for Update Alert #11**	16-29 y: 6.8% (12/176); adjusted OR 1.6 (0.3-7.4) 30-39 y: 3.7% (15/405); adjusted OR 0.9 (0.2-3.9) 40-49 y: 7.0% (20/284); adjusted OR 1.6 (0.3-7.1) 50-59 y: 2.1% (6/281); adjusted OR 0.6 (0.1-3.1) ≥60 y: 3.4% (2/58); reference	Female vs. male: *adjusted OR 0.5 (0.3-0.9)*	--	Physician vs. administration/ management: adjusted OR 1.6 (0.6-4.2)	Nurse vs. administration/ management: *adjusted OR 2.7 (1.1-6.2)*	Other allied health vs. administration/ management: adjusted OR 1.2 (0.4-3.2)
Trieu et al, 2020 (57)	20-35 vs. 36-78 y: OR 1.2 (0.6-2.2)	Female vs. male: OR 1.2 (0.6-2.2)	--	Physician vs. other HCW role: OR 0.9 (0.4-2.0)	Nurse vs. other HCW role: OR 1.3 (0.7-2.7)	--
Varona et al 2021 (146)	30-45 vs. <30 y: adjusted OR 0.84 (0.67 to 1.06) 46-60 vs. <30 y: adjusted OR 0.96 (0.76 to 1.23) >60 vs. <30 y: adjusted OR 1.07 (0.77 to 1.48)	Female vs. male: adjusted OR 0.98 (0.83 to 1.18)	--	--	--	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
Venugopal et al 2021(147)	40-59 vs. 20-39 y: OR 1.31 (0.86-2.00)* ≥60 vs. 20-39 y: OR 0.89 (0.44-1.81)*	Female vs. male: OR 0.89 (0.58 to 1.36)*	Hispanic vs. white: adjusted OR 1.32 (0.60 to 2.89)* Black vs. white: adjusted OR 1.50 (0.62 to 3.58)* Asian vs. white: adjusted OR 0.90 (0.39 to 2.07)* Other race/ethnicity vs. white: adjusted OR 2.59 (0.86 to 7.73)*	25% (39/157)	28% (40/142) Nurse vs. physician: OR 1.19 (0.71-1.98)*	Ancillary service: 28% (20/72) Other role: 29% (31/107)
Villaneuva et al, 2020 (58)	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%
Vimercati et al 2021 (59)	*Infection* Mean age, positive vs. negative: 43.2 y vs. 45.7 y; OR 0.98 (0.95-1.02) *Seropositive, IgM* Mean age, positive vs. negative: 43.3 y vs. 46.0 y; **OR 0.98 (0.97-0.99)** *Seropositive, IgG*	*Infection (PCR)* Female vs. male: OR OR 1.54 (0.58-4.13) *Seropositive, IgM* Female vs. male: adjusted OR 0.97 (0.75-1.27) *Seropositive, IgG*	--	*Infection (PCR)* 1.6% (13/831) *Seropositive, IgM* 13.6% (113/831) *Seropositive, IgG* 2.2% (18/831)	*Infection (PCR)* 0.5% (4/809) Nurse vs. physician: **OR 0.31 (0.10-0.96)** *Seropositive, IgM* 12.1% (98/809) Nurse vs. physician: OR 0.88 (0.66-1.17) *Seropositive, IgG* 2.1% (17/809)	*Infection (PCR)* Support operator: 0.3% (1/347) Healthcare professions: 0% (0/53) Other role: 0% (0/367) *Seropositive, IgM* Support operator: 10.1% (35/347)

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
	Mean age, positive vs. negative: 48.9 vs. 45.6; **OR 1.03 (1.00-1.06)**	Female vs. male: adjusted OR 0.73 (0.41-1.29)			Nurse vs. physician: OR 0.97 (0.50-1.89)	Healthcare professions: 0.9% (5/53) Other: 7.1% (26/367) *Seropositive, IgG* Support operator: 4.0% (14/347) Healthcare professions: 1.9% (1/53) Other: 1.9% (7/367)
von Freyburg et al, 2020 (148)	--	--	--	3.8% (8/208)	9.7% (40/413) Nurse vs. physician: OR 2.68 (1.23-5.84)	4.5% (2/44)
Wan et al 2021 (149)	≤24 y: reference 25-34 y: OR 1.66 (0.21-13.38) 35-44 y: 1.5% (3/204); OR 2.33 (0.24-22.60) 45-54 y: OR 1.08 (0.04-26.84) ≥55 y: OR 8.03 (0.30-216.60)	Female vs. male: OR 0.79 (0.24-2.64)	--	0.6% (2/325)	1.1% (6/551) Nurse vs. physician: OR 1.78 (0.36-8.86)	*Physician reference* Allied health: 1.2% (3/259); OR 1.89 (0.31-11.41) Ancillary personnel: 2.6% (1/39); OR 4.25 (0.38-47.98)
Wang X. et al 2020b (82)	Mean 36.6 y (cases) vs. 30.5 y (non-cases), p=0.006	Female vs. male: OR 0.78 (0.23-2.64)	--	13.3% (4/30)	9.1% (8/88) Nurse vs. physician: OR 0.65 (0.18-2.34)	--
Wang X. et al, 2020a (81)	--	--	--	--	Nurse vs. physician: OR 0.04 (0.005-0.31)	--

Author, Year (Reference)	Age	Sex	Race/ethnicity	Physician	Nurse	Other HCW Role
West et al 2022 (30) **Added for Update Alert #11**	--	--	--	--	Nurse (yes vs. no)e: *adjusted OR 2.61 (1.09-6.19)*	--
Yogo et al 2020 (150)	18-35 y: reference 36-45 y: adjusted OR 0.47 (0.17-1.33 46-55 y: adjusted OR 0.50 (0.16-1.59) 56-65 y: adjusted OR 0.32 (0.04-2.50) >65 y: adjusted OR 1.93 (0.25-14.80)	Female vs. male: adjusted OR 1.00 (0.40-2.51)	*vs. Caucasian* African American/Black: adjusted OR 1.32 (0.15-11.47) Asian: adjusted OR 1.16 (0.41-3.31) Hispanic/Latino: *adjusted OR 2.79 (1.02-7.65)* Other: adjusted OR 2.85 (0.62-13.15)	--	Nurse vs. physician: adjusted OR 1.19 (0.19-7.38)	Nursing assistant: adjusted OR 0.65 (0.17-2.45) Technician: adjusted OR 1.65 (0.38-7.15) Therapist: adjusted OR 0.78 (0.01-70.94)
Zhang G, et al 2020 (83)	--	--	--	14.9% (10/67)	1.2% (2/170) Nurse vs. physician: OR *0.07 (0.01-0.32)*	--
Zhou et al, 2020 (152)	Age 18-30: 2.5% (35/1378) Age 31-50: 3.3% (55/1656) Age >50: (36/640)	Female vs. male: OR 0.86 (0.59-1.24)	--	--	--	Healthcare role: 3.0% (73/2406) Administrative staff: 2.4% (12/505) Clinical staff: 5.4% (41/763)

Abbreviations: BAME = Black, Asian and minority ethnic; EMT = emergency medical technician; HCW = health care worker; OR = odds ratio; RR = rate ratio.

*Results based on risk of seropositivity at baseline

Supplement Table 3. Clinical characteristics and risk for infection with SARS-CoV-2 in HCWs

Author, Year (Reference)	Antibody status	Previous Infection Status	Vaccination Status	Other Clinical Characteristics
Hall et al 2021 (42)	Incidence of infection within 14 days (reinfection or new infection) per 1000 participants 18.7 vs. 98.0	--	--	--
Lumley et al, 2020 et al (47)	*vs. negative* Anti-spike IgG positive: ***adjusted IRR 0.3 (0.03-0.44)*** Anti-nucleocapsid IgG positive: ***adjusted IRR 0.11 (0.03-0.45)*** Both anti-spike and anti-nucleocapsid IgG positive: ***adjusted IRR 0.06 (0.01-0.46)*** Either anti-spike or anti-nucleocapsid positive: adjusted IRR 0.42 (0.10-1.69)	--	--	--
Lumley et al 2022 (26), Lumley et al 2020 (47), (102) *Extension of Lumley 2020* **Added for Update Alert #11**	--	--	Unvaccinated, seronegative: 6.0% (635/10513); reference Unvaccinated, seropositive: 0.9% (12/1273); ***adjusted IRR 0.15 (0.08-0.26)*** Vaccinated once, previously seronegative: 0.6% (64/9711); ***adjusted IRR 0.36 (0.25-0.50)*** Vaccinated twice, previously seronegative: 0.2% (2/940); ***adjusted IRR 0.10 (0.02-0.38)*** Vaccinated, previously seropositive: 0.1% (1/974);	--

Author, Year (Reference)	Antibody status	Previous Infection Status	Vaccination Status	Other Clinical Characteristics
			adjusted IRR 0.04 (0.01-0.27)	
Nunes et al 2021 (27) *Population overlaps with Nunes et al 2022* **Added for Update Alert #11**	--	--	--	Asthma, yes vs. no: OR 0.67 (0.30-1.467); not included in multivariate model Diabetes, yes vs. no: OR 1.75 (0.46-6.61); not included in multivariate model

Nunes et al 2022 (28)
 	
Population overlaps with Nunes et al 2021
 	
Added for Update Alert #11
	--	PCR-confirmed previous infection vs. no previous infection: **adjusted OR 0.55 (0.36-0.84)**	Ad26.COV2 vaccine, single dose: adjusted OR 0.81 (0.46-1.43)
			
			Ad26.COV.2 vaccine, booster dose: adjusted OR 0.94 (0.44-2.03)
			
			BNT162b2 vaccine, two doses: adjusted OR 0.59 (0.23-1.57)
			
			Never vaccinated: reference
				Previous infection status (PCR-confirmed) and vaccination status:
				• No previous infection + no vaccination: reference
				  o No previous infection + Ad26.COV.2 single dose: adjusted OR 0.89 (0.46-1.72)
				• Previous infection + no vaccination: reference
				  o Previous infection + Ad26.COV.2 single dose: adjusted OR 0.82 (0.28-2.44)
				  o Previous infection + Ad26.COV.2 booster dose: adjusted OR 0.55 (0.14-2.09)
				
				Previous infection status (PCR-confirmed), vaccination status, and antibody level (spike IgG)
				• No previous infection + no vaccination + IgG<300: reference
				• No previous infection + Ad26.COV.2 single dose + IgG>1549: adjusted OR 0.42 (0.18-0.85)

Porru et al 2022 (29) **Added for Update Alert #11**	--	--	Fully vaccinated (2 doses) vs. not vaccinated: 0.7% (55/7659) vs. 4.5% (77/1718); **adjusted HR 0.37 (0.29-0.69)**	--

Supplement Table 4. 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
Abdelmoniem et al 2020 (31)	--	Contact with patient with known or suspected SARS-CoV-2 infection (yes vs. no): OR 0.41 (0.15-1.08)	--	--	--
Akinbami et al 2020 (61)	--	Exposure to patient with COVID-19 (yes vs. no): adjusted OR 1.03 (0.87-1.22)	--	--	Aerosol generating procedure frequency 0 times: reference 1-5 times: adjusted OR 1.04 (0.85-1.28) 6-10 times: adjusted OR 0.83 (0.66-1.04) 11-25 times: adjusted OR 0.78 (0.69-1.16) >25 times: adjusted OR 1.09 (0.89-1.34)
Akinbami et al 2021 (85) *Hospital HCWs*	--	No/unknown exposure to COVID-19-positive coworker: 2.1% (134/6299); reference Exposure to COVID-19-positive coworker: 5.9% (122/2070); ***adjusted OR 1.87 (1.36-2.58)***	--	--	Frequency of aerosol-generating procedure (times/shift/week) 0: 2.6% (108/4121); reference 1-5: 3.7% (62/1679); adjusted OR 1.12 (0.76-1.62) 6-10: 5.8% (22/380); adjusted OR 1.60 (0.87-2.92) 11-25: 4.0% (11/277); adjusted OR 0.71 (0.36-1.40) >25 times: 5.2% (19/366); adjusted OR 1.24 (0.70-2.20)
Akinbami et al 2021 (85) *Nursing home HCWs*	--	No/unknown exposure to COVID-19-positive coworker: 8.8% (83/944); reference Exposure to COVID-19-positive coworker: 20.6%	--	--	Frequency of aerosol-generating procedure (times/shift/week) 0: 10.8% (93/858); reference

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		(113/550); adjusted OR 1.10 (0.71-1.72)			1-5: 21.9% (25/114); adjusted OR 1.59 (0.87-2.92) 6-10: 19.4% (7/36); adjusted OR 1.46 (0.66-3.24) 11-25: 17.4% (4/23); adjusted OR 0.96 (0.25-3.71) >25 times: 29.3% (12/41); adjusted OR 1.31 (0.63-2.74)
Al-Naamani et al 2021 (11)	--	Unprotected contact with COVID-19 patients vs. no contact with COVID-19 patients: adjusted OR 1.13 (p=0.72)	--	--	High- vs. intermediate risk environment: adjusted OR 1.22 (p=0.29)
Algado-Selles et al 2020 (62)	--	Close vs. occasional contact: OR 1.69 (1.07-2.67)	--	--	--
Alishaq et al 2021 (153)	--	Contact with confirmed COVID-19 case vs. non-exposed: *adjusted HR 9.25 (3.67-23.28)*	--	--	--
Alkurt et al 2021 (87)	--	COVID-19 vs. non-COVID-19 clinic: *OR 0.46 (0.28-0.78)*	--	--	--
Allen et al 2021 (88)	--	Daily contact with COVID-19 patients: *adjusted RR 1.6 (1.2-2.1)* Daily contact with non-COVID-19 patients: *adjusted RR 1.4 (1.1-1.8)* No patient contact: reference	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Allen et al 2022 (18) **Added for Update Alert #11**	--	Contact with COVID-19 patients: 23.3% (265/1136); *adjusted RR 1.4 (1.1-1.7)* Contact with patients without COVID-19: 18.5% (463/2500); *adjusted RR 1.3 (1.1-1.5)* No patient contact: (170/1449); reference	--	--	--
Amendola et al, 2020 (90)	--	Direct contact with COVID-19 patient vs. no known direct contact: OR 2.07 (0.89-4.78)	--	--	--
Bahrs et al., 2021 (32)	--	Work COVID-19 risk category High-risk (patient contact with confirmed COVID-19 patients or high number of suspected cases): 1.5% (2/137); reference Intermediate-risk (patient contact, no routine contact with confirmed or suspected COVID-19 patients): 2.9% (10/343); adjusted OR 1.97 (0.42-9.22) Low-risk (no patient contact): 3.3% (6/180); adjusted OR 2.10 (0.40-11.06)	--	--	--
Bai et al, 2020 (63)	--	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)	--	Contact frequency (median, contacts/day): 3.0 in cases vs. 5.0 in non-cases, P=0.95	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		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 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)	
Baker et al 2021 (92)	--	COVID-19 unit vs. no patient contact: adjusted OR 1.5 (1.0-2.4)	--	--	--
Barrett et al 2020 (33)	--	--	--	Average number of patients with suspected or confirmed COVID-19 per shift, 0 vs. ≥5 patients: *OR 0.36 (0.14-0.89)** Estimated percentage of work-time spent in patients' rooms, <25% vs. ≥75%: OR 0.42 (0.18-1.01)	--
Brousseau et al 2021 (12)	--	--	--	≥3 vs. ≤2 days/week working in SARS-CoV-2 unit: adjusted RR 1.07 (0.74-1.56)	--
Bouwman et al 2021 (94)	--	*Reference no known contact* COVID-19 patient contact: adjusted OR 1.62 (0.80-3.33) COVID-19 co-worker contact: **adjusted OR 1.83 (1.15-2.93)** COVID-19 household contact: **adjusted OR 6.09 (2.23-16.64)**	--	--	*Reference hospital ward with no direct patient contact* COVID-19 confirmed nursing ward: adjusted OR 1.05 (0.69-1.60) COVID-19 suspected nursing ward: adjusted OR 0.82 (0.53-1.25)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					Non-COVID-19 nursing ward: adjusted OR 0.95 (0.58-1.55) Outpatient department: adjusted OR 0.80 (0.53-1.19)
Calcagno et al 2020 (35)	--	Direct patient contact vs. indirect/no patient contact: **OR 1.51 (1.11-2.05)***	--	--	--
Celebi et al, 2020 (154)	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)** 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

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					COVID-19 patient: OR 0.56 (0.03-11.83)
Chatterjee et al, 2020 (155)	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)*
Clifton et al 2021 (95)	--	Direct contact vs. no direct contact with COVID-19 patients: OR 0.25 (0.04-1.37)	--	--	Performed vs. did not perform aerosol-generating procedures: OR 0.88 (0.05-16.12)
Colaneri et al 2020 (66)	--	--	Contact with CPAP helmets (yes vs. no): *OR 4.22 (3.00-5.94)*	--	--
Comelli et al 2021 (67)	--	Direct vs. no direct contact with confirmed COVID-19 case: *OR 1.51 (1.21-1.89)* Work vs. did not work in COVID-19 unit or ED: OR 1.04 (0.84-1.29)	--	--	--
Damluji et al 2021 (36)	--	Direct patient care role vs. non-direct patient care role: adjusted OR 0.93 (0.45-1.73)	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Davido et al 2021 (99)	--	COVID-19 unit vs. non-COVID-19 unit: adjusted OR 0.7 (0.2-3.2) Exposure to COVID-19 infected coworker vs. no/unknown exposure: OR 1.66 (0.64-4.32)	--	--	Participated in procedure involving patient airway, yes vs. no: adjusted OR 2.6 (0.6-12.5)
Davila-Conn et al 2022 (19) **Added for Update Alert #11**	--	Contact with patient with COVID-19 (frequently vs. never/occasionally): adjusted HR 1.18 (95% CI 0.55 to 2.50) Contact with any person with COVID-19 (yes vs. no/unknown): ***adjusted HR 2.45 (95% CI 1.21-5.00)***	--	--	--
Doernberg et al 2022 (20) **Added for Update Alert #11**	--	Low risk COVID-19 exposure (ever providing direct care, being within 6 feet, or being within the environment of a COVID-19 patient or being involved with laboratory processing of samples from COVID-19 patients): 1.9% (13/680); adjusted HR 0.8 (0.4-1.7) High risk COVID-19 exposure (ever interacting with a COVID-19 patient without full PPE or having a breach in PPE [e.g., tears, accidental removal]): 3.9% (31/797); ***adjusted HR 2.5 (1.3-4.8)***	--	Time spent in the healthcare workplace: <10 hours/week: 3.3% (3/90); reference 10-20 hours/week: 1.8% (3/169); adjusted HR 1.9 (0.5-7.9) 21-30 hours/week: 3.0% (9/296); adjusted HR 2.5 (0.7-8.9) 31-40 hours/week: 3.4% (39/1148); adjusted HR 2.2 (0.7-7.0) >40 hours/week: 2.3% (16/688); adjusted HR 2.0 (0.6-6.6)	Direct contact with a person with COVID-19 outside of work Yes: 9.6% (17/176); ***adjusted HR 8.1 (3.8-17.5)*** No: 2.3% (53/2259); reference Avoiding exposure others when not at work All/most of the time: 2.5% (33/1312); adjusted HR 1.0 (0.6-1.6) Some/none of the time: 3.3% (37/1107); reference

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		No exposure: 2.8% (26/942); reference		Time spent providing direct patient-facing care: <10 hours/week: 1.0% (3/305); adjusted HR 0.5 (0.2-0.9) 10-20 hours/week: 2.5% (10/400); adjusted HR 0.6 (0.3-1.3) 21-30 hours/week: 4.0% (16/397); adjusted HR 0.9 (0.5-1.7) 31-40 hours/week: 3.5% (29/825); reference >40 hours/week: 1.9% (5/258); adjusted HR 0.9 (0.4-2.0)	
Dusefante et al 2022 (21) **Added for Update Alert #11**	--	COVID-19 vs. non-COVID-19 ward: OR 1.32 (0.56-3.10); not included in multivariate model	--	COVID-19 wards dedicated days: OR 0.96 (0.82-1.12); not included in multivariate model	Exposure to aerosol-generating procedures (yes vs. no): OR 0.50 (0.21-1.19); not included in multivariate model Exposure to COVID-19 patient' body fluids (yes vs. no): OR 0.60 (0.24-1.48); not included in multivariate model

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Ebinger et al 2021 (100)		Regular contact with patients with COVID-19: 6.0% (86/1444)* Work in unit housing/caring for patients with COVID-19 (yes vs. no): **adjusted OR 1.61 (1.18 to 2.18)**			
el-Boghdadly et al, 2020 (39)	Tracheal intubation: 8.97% (462/5148)	--	Apneic 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)	--	--
Elfstrom et al 2021 (101)	--	--	--	--	*Reference other hospital unit* COVID ward: **adjusted OR 1.95 (1.65-2.32)** ICU: adjusted OR 0.86 (0.66-1.13)
Eyre et al 2020 (102) *Seroprevalence or PCR*	--	Do not work in COVID-19 unit: 8.6% (631/7369); reference Work in COVID-19 unit: 22.6% (358/1586); **adjusted OR 2.47 (1.99-3.08)** Work in any unit: 12.9% (139/1079); **adjusted OR 1.39 (1.04-1.85)**	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Eyre et al 2020 (102) *Seroprevalence only*	--	*vs. no work in a COVID-19 patient area* Work in COVID-19 patient area: **adjusted OR 2.39 (1.91-3.00)** Work in any area: **adjusted OR 1.38 (1.03-1.84)**	--	--	--
Faico-Filho et al, 2020 (103)	--	Direct patient contact vs. no direct patient contact: OR 0.72 (0.48-1.07)	--	--	--
Ferreira et al 2021 (40)	--	*PCR* Direct care of COVID patient vs. no direct care: OR 1.15 (0.29 to 4.61) *Seropositive* Direct care of COVID patient vs. no direct care: OR 0.20 (0.03-1.53)	--	--	--
Fletcher et al 2021 (105)	--	--	--	--	<u>Study Period 1</u> Exposed to COVID-19 outside of work but not in household vs. exposed to COVID-19 in household: OR 0.54 (0.16-1.78) <u>Study Period 2</u> Exposed to COVID-19 outside of work but not in household vs. exposed to COVID-19 in household: **OR 0.56 (0.34-0.90)**
Forrest 2021 et al (106)	--	High-risk setting (ICU, ED, urgent care centers, COVID-19 therapeutic or diagnostic units, respiratory services, anaesthesia, EMS) vs.	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		low-risk setting (all other clinical settings): adjusted OR 0.95 (0.72-1.25)			
Fukuda et al 2021 (107)	--	--	--	-	High-risk exposure: 0.3% (8/2419); reference Medium-risk exposure: 0.4% (2/550); OR 1.10 (0.23-5.19)* Low-risk exposure: 0.3% (4/1178); OR 1.03 (0.31-3.42)*
Fusco et al, 2020 (108)	--	Direct patient care vs. no direct patient care: OR 0.74 (0.04-14.91)	--	>30 days vs. <30 days exposure to patients with suspected or confirmed COVID-19: OR 1.52 (0.21-11.21)	--
Gelanew et al 2022 (22) **Added for Update Alert #11**	--	Close contact with a COVID-19-infected patient (yes vs. no): ***adjusted OR 1.4 (1.1-1.8)***	--	--	--
Goenka et al 2020 (110)	--	High-risk (work in COVID-19 unit or ICU or regularly involved in testing or investigating of COVID-19 patients) vs. low-risk (no direct contact with patients or their belongings): adjusted OR 0.93 (0.13-6.79)	--	--	Time spent in hospital in a week <48 vs. 48 hours or more: ***OR 1.92 (1.25-2.97)***
Gohil et al 2021 (13) **Added for Update Alert #11**	--	Direct COVID-19 patient care (yes vs. no): adjusted OR 1.10 (0.64-1.88) COVID outbreak unit (yes vs. no): adjusted 2.21 (1.28-3.81)	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		Designated COVID care unit (yes vs. no): adjusted 0.53 (0.30-0.94)			
Gupta et al 2021 (111)	--	Contact vs. no contact with COVID-19 positive individual: **OR 1.38 (1.14-1.68)** Active vs. not active COVID duty: OR 0.84 (0.67-1.05)	--	--	--
Hall et al 2021 (42)	--	--	--	--	Direct patient contact vs. no direct patient contact: **OR 1.25 (1.15-1.35)**
Heinzerling et al, 2020 (71)	--	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 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 vital sign (yes vs. no): OR 7.71 (0.61-97.85) 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

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Herzberg et al 2021 (113)	--	Direct patient care, yes vs. no: OR 0.85 (0.41 to 1.7)	--	--	--
Howard-Anderson et al 2022 (23) **Added for Update Alert #11**		Shifts in COVID-19 units: At least some shifts in COVID-19 units: 10.1% (11/109); adjusted OR 1.1 (0.4-3.2) No shifts in COVID-19 units: 7.8% (15/192); reference Time spent directly at bedside: >50% of shift: 8.7% (12/138); adjusted OR 1.5 (0.5-5.0) ≤50% of shift: 8.6% (14/163); reference Close contact with a SARS-CoV-2 infected person: Close contact in the community (yes vs. no): 13.3% (4/30) vs. 8.1% (22/271); adjusted OR 2.1 (0.5-6.9) Close contact with co-worker (yes vs. no): 4.8% (2/42) vs. 9.7% (24/259); adjusted OR 0.5 (0.1-1.8)			
Jacob et al 2021 (115)	--	Any contact with COVID-19 patients: 4.7%	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		(584/12413): adjusted OR 1.1 (0.9-1.3) No contact with COVID-19 patients: 3.9% (448/11435); reference Unknown contact: 5.3% (48/901); adjusted OR 1.3 (0.9-1.9)			
Kassem et al, 2020 (44)	-	Exposure to suspected or confirmed COVID-19 during work in last 2 weeks vs. not: OR 0.95 (0.27-3.44)	-	-	-
Khalil et al, 2020 (157)	--	Participated in direct COVID-19 patient care vs. no participation (yes vs. no): 0.94 (0.50-1.77)	--	--	Performed aerosol-generating procedure on COVID-19 patient (yes vs. no): OR 1.30 (0.64-2.37)
Korona-Glowniak et al 2022 (24) **Added for Update Alert #11**		SARS-CoV-2 exposure at work: 23.5% (32/136); adjusted OR 1.54 (0.48-4.9) No SARS-CoV-2 exposure at work: 6.6% (14/211); reference			
Krastinova et al, 2020 (120)	--	Non-patient facing vs. non-clinical: adjusted OR 1.57 (0.5-5.31) Direct patient facing vs. non-clinical: adjusted OR 3.08 (1.09-8.78)	--	--	--
Lepak et al 2021 (46)	--	--	--	*Reference unknown or no direct contact* <10 minutes: adjusted OR 0.79 (0.54-1.17)	*Reference inpatient unit* Ambulatory unit: adjusted OR 0.84 (0.69-1.04)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
				10-20 minutes: adjusted OR 0.62 (0.37-1.05) >20 minutes: adjusted OR 1.25 (0.97-1.59)	Work from home: adjusted OR 0.80 (0.56-1.15) Affiliated health facility: adjusted OR 0.86 (0.47-1.57) Reported contact with patient with respiratory illness (yes vs. no): adjusted OR 0.79 (0.58-1.06) Reported contact with nonmasked health care visitor (yes vs. no): adjusted OR 0.75 (0.53-1.04) Reported contact with family/community member with known COVID-19 (yes vs. no): *adjusted OR 4.03 (3.13-5.18)* Reported contact with family/community member with suspected COVID-19 (yes vs. no): adjusted OR 1.65 (1.24-2.19)
Lumley et al 2022 (26), Lumley et al 2020 (47), (102) **Added for Update Alert #11**		Working in a non-ICU COVID-19 ward: 3.4% (37/1090); *adjusted IRR 1.53 (1.21-1.94)* Not working in a COVID-19 ward: 1.7% (290/12019); reference			

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		Direct patient care: 5.7% (580/10221); adjusted IRR 1.13 (0.90-1.42) No direct patient care: 4.6% (134/2888); reference			
Madsen et al 2021 (124)	--	Working with COVID-19 (yes vs. no): **adjusted OR 1.40 (1.05-1.88)**	--	--	--
Milazzo et al 2021 (49)	--	Contact vs. no contact with infected patient: adjusted OR 1.19 (0.37-3.79)	--	--	--
Moncunill et al 2021 (126)	--	Direct patient contact (yes vs. no): OR 0.97 (0.38-2.50) Work in COVID-19 unit (yes vs. no): OR 1.07 (0.48-2.40)	--	--	--
Moscola et al, 2020 (73)	--	--	--	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)
Mukhtar et al 2021 (127)	--	--	--	--	Participated vs. did not participate in an aerosol-generating procedure: **OR 0.06 (0.01-0.41)**
Naesens et al 2021 (129)	--	Working on a COVID-19 ward (yes vs. no): **adjusted OR 1.73 (1.36-2.20)**	--	--	Close colleague at work had confirmed COVID-19 (yes vs. no): **adjusted OR 1.73 (1.36-2.20)**

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					Contact with confirmed/ suspected COVID-19 cases in private setting (yes vs. no): *adjusted OR 2.56 (1.91-3.42)*
Newberry et al 2021 (130)	--	--	--	--	*Seropositivity* Exposed to confirmed SARS-CoV-2 patient respiratory secretions vs. no exposure: *OR 2.94 (1.32-6.53)* Exposed to confirmed SARS-CoV-2 positive patient or colleague vs. not exposed: OR 1.30 (0.58-2.92) *Infection (PCR)* Exposed to confirmed SARS-CoV-2 patient respiratory secretions vs. no exposure: OR 0.75 (0.15-3.63) Exposed to confirmed SARS-CoV-2 positive patient or colleague vs. not exposed: OR 2.44 (0.65-9.15)
Nopsopon et al 2021 (131)	--	--	--	--	Close contact with a confirmed COVID-19 case vs. no close contact: OR 3.13 (0.17-56.90)
Nygren et al 2021 (132)	--	Caring for COVID-19 patient most days: 19.7% (12/61); *adjusted OR 5.1 (1.3-19.0)*	--	--	Working in COVID-19 unit: 21.6% (11/51); *adjusted OR 5.6 (1.3-23.0)*

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		No caring for COVID-19 patient most days: 4.3% (9/210); reference			Not working in a COVID-19 unit: 4.5% (10/220); reference Increased risk (involvement in an aerosol-generating procedure or bedside surveillance for >3 hours/shift with a COVID-19 patient: 16.1% (9/56); *OR 3.2 (1.1-8.7)^* No increased risk: 5.7% (12/211); reference
Olalla et al, 2020 (133)	--	--	--	COVID-19 vs. non-COVID-19 unit: OR 0.19 (0.03-1.41)	--
Paris et al 2021 (15)	--	Care of COVID-19 patient, yes vs. no: adjusted OR 1.30 (0.78-2.17) Contact with a COVID-19 infected co-worker, yes vs. no: *adjusted OR 2.08 (1.33-3.24)* Contact with the family of a COVID-19 infected patient, yes, vs. no: adjusted OR 0.90 (0.38-2.10) Contact with a COVID-19 infected patient at home, yes vs. no: *adjusted OR 2.00 (1.23-3.28)*	--	--	Participated in nasopharyngeal sampling (reference no participation) • With appropriate protective equipment: *adjusted OR 1.33 (1.15-10.40)* • With suboptimal protective equipment: adjusted OR 3.46 (0.79-2.25) Participated in central line insertion (reference no participation) • With appropriate protective equipment: adjusted OR 0.72 (0.35-1.45) • With suboptimal protective equipment:

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					adjusted OR 2.55 (0.57-12.38) Participated in upper respiratory tract actions (reference no participation) • With appropriate protective equipment: adjusted OR 1.53 (0.92-2.55) • With suboptimal protective equipment: adjusted OR 1.85 (0.66-5.22) Participated in central line insertion (reference no participation) • With appropriate protective equipment: adjusted OR 0.72 (0.35-1.45) • With suboptimal protective equipment: adjusted OR 2.55 (0.57-12.38) Participated in washing and dressing patient (reference no participation) • With appropriate protective equipment: **_adjusted OR 2.13 (1.05-4.30)_** • With suboptimal protective equipment: adjusted OR 0.38 (0.10-1.46)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					Participated in patient mobilization (reference no participation)
					• With appropriate protective equipment: adjusted OR 0.93 (0.49-1.79)
					• With suboptimal protective equipment: *adjusted OR 3.30 (1.51-7.25)*
					Participated in patient feeding (reference no participation)
					• With appropriate protective equipment: adjusted OR 1.00 (0.54-1.89)
					• With suboptimal protective equipment: adjusted OR 2.49 (0.92-6.72)
					Participated in clinical exam (reference no participation)
					• With appropriate protective equipment: adjusted OR 1.50 (0.85-2.65)
					• With suboptimal protective equipment: *adjusted OR 2.51 (1.16-5.43)*
					Participated in eye exam (reference no participation)
					• With appropriate protective equipment:

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
					adjusted OR 1.86 (0.93-3.73) With suboptimal protective equipment: *adjusted OR 2.90 (1.01-8.35)*
Perez-Garcia et al 2020 (75)	--	Direct patient contact vs. no direct patient contact: *OR 1.40 (1.10-1.79)* Contact with COVID-19 patients (yes vs. no): *adjusted OR 1.69 (1.28-2.24)*	--	Close contact with COVID-19 infected person vs. casual contact: adjusted OR 1.32 (0.97-1.80)	Participation in aerosol-generating procedure vs. no participation: *OR 2.54 (1.71-3.77)* Contact with co-worker (yes vs. no): *OR 3.18 (2.64-3.82)**
Piapan et al 2021 (16)	--	Contact with patients: reference Contact with HCWs: adjusted OR 1.39 (0.64-3.0) Contact with patients and HCWs: *adjusted OR 2.23 (1.01-4.9)* Contact with contact of causal contacts: adjusted OR 1.40 (0.28-6.9)	--	--	High risk (infectious disease, geriatric or emergency medicine): *adjusted OR 13.4 (5.8-31.0)* Medium risk (internal medicine): adjusted OR 1.88 (0.97-3.6) Low risk (surgical and medical ward): reference
Pinarlik et al 2021 (135)	--	--	--	--	Person diagnosed with SARS-CoV-2 in household (yes vs. no): *adjusted OR 8.98 (6.64-12.15)*
Ran et al, 2020 (77)	Endotracheal tube removal: RR, 0.63 (0.06-7.08)	--	--	--	CPR: RR, 0.63 (0.06-7.08) Fiberoptic bronchoscopy: RR, 0.63 (0.06-7.08) Sputum suction: RR, 0.43 (0.12-1.55)

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Rashid-Abdi et al, 2020 (52)	--	--	--	--	Exposure at work vs. outside of work: OR 16.88 (3.79-75.19)
Science et al 2021 (55)	--	Direct care of patients with COVID-19 vs. no direct care: adjusted OR 1.33 (0.72-2.47)	--	--	Symptomatic household exposure (yes vs. no): *adjusted OR 7.15 (5.42-9.41)*
Scohy et al 2021 (140)	--	Worked in a COVID-19 unit vs. did not work in a COVID-19 unit: *adjusted OR 1.64 (1.21-2.23)* Exposed to a COVID-19 patient vs. not exposed: adjusted OR 1.30 (0.97-1.74) Exposed to a COVID-19 colleague vs. not exposed: *adjusted OR 1.41 (1.06-1.87)*	--	--	Cohabitant infected with SARS-CoV-2 vs. not infected: *adjusted OR 2.55 (1.78-3.66)*
Scozzari et al 2021 (141)	--	Working in COVID-19 unit vs. no working in COVID-19 unit: *adjusted OR 1.24 (1.01-1.52)*	--	--	Household contact with COVID-19 vs. no household contact: *adjusted OR 5.31 (4.12-6.85)* Other contact with COVID-19 vs. no other contact: adjusted OR 1.28 (0.86-1.92)
Sims et al 2020 (56)	--	Direct vs. no direct patient contact: *OR 1.41 (1.25-1.58)*	--	--	--
Talbot et al 2021 (145)	--	--	---	High exposure (time exposed to COVID-19 patients at work): 14.2% (19/134); OR 0.71 (0.38-1.33)	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
				Moderate exposure: 17.0% (16/94); OR 0.88 (0.43-1.72) Some exposure: 17.1% (14/82); OR 0.89 (0.44-1.78) Minimal to no exposure: 18.9% (30/159); reference	
Tomczyk et al 2022 (17)	--	--	--	--	High risk (working in a dedicated COVID-19 ward): 22.4% (13/58); *adjusted OR 18.5 (6.0-57.2)* Moderate risk (ward with higher risk of transmission, e.g. anaesthesia, ENT, oral-maxillofacial surgery, non-COVID-19 ICU): 6.0% (12/200); *adjusted OR 3.9 (1.3-11.6)* Low risk (direct patient contact outside of high- or moderate-risk categories): 4.2% (26/619); *adjusted OR 2.9 (1.1-7.7)* Very low (no direct patient contact): 1.5% (5/332); reference
Trieu et al, 2020 (57)	--	Patient contact vs. no patient contact: OR 1.7 (0.7-4.3)	--	--	--
Varona et al 2021 (146)	--	Prolonged direct contact vs. non-clinical and	--	--	--

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
		minimal/no patient contact: *adjusted OR 2.06 (1.63-2.62)* Clinical or non-clinical with non-intense patient contact vs. non-clinical and minimal/no patient contact: *adjusted OR 1.77 (1.32-2.37)*			
Venugopal et al 2021 (147)	--	--	--	--	High/moderate (prolonged close contact with patient with COVID-19 with HCW or patient not wearing face mask or aerosol-generating procedure without eye, nose, or mouth protection) vs. low risk: adjusted OR 2.00 (0.99 to 4.25)
Wan et al 2021 (149)	--	--	--	--	High/moderate risk (prolonged contact with COVID-19 patient without proper PPE use or exposed to respiratory secretions without PPE) vs. low risk (close contact with COVID-19 patient while using PPE): *OR 62.97 (3.72-1066.70)*
Wang X. et al 2020b (82)	--	Contact vs. no contact with index case: *OR 0.27 (0.08-0.94)* Contact vs. no contact with infected co-worker: *OR 62.70 (3.60-1092.46)*	--	--	--
West et al 2022 (30)	--	--	--	--	Per increase in number of SARS-CoV-2 positive people in immediate

Author, Year (Reference)	Intubation	Directness of Contact	Oxygen Administration and Related Exposures	Number or Duration of Contacts and Proximity to Patient	Other Exposures
Added for Update Alert #11					environment: adjusted OR 1.22 (0.92-1.61) Per increase in number of persons met outside household during the pandemic: ***adjusted OR 0.92 (0.87-0.97)***

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 5. Education or training, environmental and physical factors, and infection control policies and risk for infection with SARS-CoV-2

Author, Year (Reference)	Education or Training on Infection Control	Ventilation or Negative Pressure Isolation Room	Environment and Physical Layout	Infection Control Policies
Akinbami et al 2021 (85) *Hospital HCWs*	No PPE donning/doffing training: 2.5% (5/199); reference PPE donning/doffing training: 3.6% (184/5140); OR 1.45 (0.59-3.55)	--	--	Use of PPE shortage protocol (reference: never used PPE) No shortage: 4.9% (25/511); 1.23 (0.67-2.25) Reuse: 2.3% (21/934); adjusted OR 0.55 (0.28-1.05) Extended use: 3.1% (42/1341); adjusted OR 0.66 (0.42-1.04) Reuse and extended use: 3.9% (104/2644); adjusted OR 0.84 (0.56-1.26)
Akinbami et al 2021 (85) *Nursing home HCWs*	No PPE donning/doffing training: 20.0% (3/15); reference PPE donning/doffing training: 15.0% (170/1135); OR 0.70 (0.20-2.52)	--	--	Use of PPE shortage protocol (reference: never used PPE) No shortage: 11.8% (28/238); adjusted OR 0.94 (0.46-1.94) Reuse: 11.3% (21/186); adjusted OR 0.89 (0.42-1.87) Extended use: 17.8% (45/253); adjusted OR 1.49 (0.77-2.87) Reuse and extended use: 16.8% (83/495); adjusted OR 1.30 (0.66-2.58)
Fusco et al, 2020 (108)	Participation in a PPE training vs. no participation: OR 2.86 (0.14-56.58)	--	--	--
Milazzo et al 2021 (49)	Trained vs. not trained in PPE use: adjusted OR 0.71 (0.25-2.13)	--	--	--
Zhou F et al, 2020 (152)	Attended vs. did not attend training early in the COVID-19 outbreak: *p<0.01*	--	--	--

Abbreviations: PPE = personal protective equipment; SARS = severe acute respiratory syndrome

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
Akinbami et al 2020 (61)	--	--	Always use N95 vs. less than always: **adjusted OR 0.83 (0.72-0.95)** Always use surgical mask vs. less than always: **adjusted OR 0.86 (0.75-0.98)**	--
Chatterjee et al, 2020 (155)	Any mask vs. no mask: **OR 0.35 (0.22-0.57)***	--	--	--
Davido et al 2021 (99)	--	--	Systematic use of facemask vs. no systematic use: **adjusted OR 0.07 (0.003-0.56)**	--
Doernberg et al 2022 (20) **Added for Update Alert #11**	--	--	Wearing a mask when not at work: All of the time: 2.8% (49/1778); adjusted HR 0.8 (0.5-1.6) Most/some of the time or never: 3.3% (21/641); reference	--

Author, Year (Reference)	Mask Use Versus Nonuse	Comparison of Mask Types	Consistency of Mask Use	Multiple Mask Layers Versus Single Layer
Fletcher et al 2021 (105)	--	Study Period 1 N95 vs. surgical mask: OR 1.25 (0.55-2.85) Study Period 2 N95 vs. surgical mask: OR 1.18 (0.86-1.62)	--	--
Heinzerling et al, 2020 (71)	--	--	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)	--
Howard-Anderson et al 2022 (23) **Added for Update Alert #11**	--	--	Used a mask all/nearly all the time: (17/227); reference Used a mask less than nearly all the time: (4/18); adjusted OR 4.0 (0.7-19.5)	--
Khalil et al, 2020 (157)	Medical/surgical mask (yes vs. no): 1.40 (0.30-6.42)	--	--	--

Author, Year (Reference)	Mask Use Versus Nonuse	Comparison of Mask Types	Consistency of Mask Use	Multiple Mask Layers Versus Single Layer
Piapan et al, 2020 (76)	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)*	--	--
Piapan et al 2021 (16)	N95 use (yes vs. no): *OR 7.8 (4.0-15.2)*; not included in multivariate model	--	--	--
Sims et al 2020 (56)	Any mask vs. no mask: *OR 0.58 (0.50-0.66)* N95 or surgical mask vs. no mask: *OR 0.57 (0.50-0.66)* N95 vs. no mask: *OR 0.54 (0.47-0.62)* Surgical mask vs. no mask: *OR 0.71 (0.58-0.86)*	N95 vs. surgical mask: *OR 0.76 (0.63-0.92)*	--	--
Venugopal et al 2021 (147)	N95 only (yes vs. no): OR 0.87 (0.50-1.54)* Surgical mask only (yes vs. no): OR 1.70 (1.08-2.69)* N95 and surgical mask (yes vs. no): OR 0.64 (0.41-1.00)*	N95 only vs. surgical mask only: OR 0.60 (0.31-1.15)	--	--
Wang X. et al, 2020 (81)	In department with mask use (no vs. yes): *adjusted OR 464.82 (97.73– ∞)*	--	--	--

Author, Year (Reference)	Mask Use Versus Nonuse	Comparison of Mask Types	Consistency of Mask Use	Multiple Mask Layers Versus Single Layer
Haller et all 2021 (156)	--	*Total cohort* Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.80 (0.64-1.00) Restricted to data collected after 1 December 2020: adjusted HR 0.73 (0.55-0.97) *Seroconverted subgroup* Mostly FFP2 use vs. mostly surgical mask use: adjusted HR 0.73 (0.53-1.00)	--	--

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

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
Abdelmoniem et al 2020 (31)	--	--	Proper hand hygiene (yes vs. no): OR 0.74 (0.15-3.59)	--	PPE use as recommended (yes vs. no): OR 1.00 (0.21-4.72)
Akinbami et al 2020 (61)	Use all the time vs less than all the time: 6.9% (643/9,316); adjusted OR 1.14 (0.97-1.34)	Use all the time vs less than all the time: adjusted OR 1.09 (0.90-1.30)	--	Face shield or goggles, use all the time vs less than all the time: adjusted OR 1.09 (0.90-1.30)	PAPR, use all the time vs. less than all the time: adjusted OR 1.10 (0.80-1.52)
Akinbami et al 2021 (85) *Hospital HCWs*	--	--	--	--	No/unknown exposure to COVID-19-positive patient: 2.0% (88/4422); reference Exposed while not wearing PPE: 4.6% (60/1317); adjusted OR 1.28 (0.89-1.85) Exposed while wearing PPE: 4.1% (108/2630); ***adjusted OR 1.41 (0.99-2.00)***
Akinbami et al 2021 (85) *Nursing home HCWs*	--	--	--	--	No/unknown exposure to COVID-19-positive patient: 6.0% (49/823); reference Exposed while not wearing PPE: 16.2% (28/173); adjusted OR 1.10 (0.54-2.07) Exposed while wearing PPE: 23.9% (119/498); ***adjusted OR 2.18 (1.26-3.80)***
Al Youha et al 2021 (86)	Gown use vs. non-use: adjusted OR 0.64 (0.31-1.32)	Glove use vs. non-use: ***adjusted OR 2.93 (1.19-7.22)***	--	Goggle use vs. non-use: adjusted OR 1.27 (0.72-2.27)	--
Algado-Selles et al 2020 (62)	--	--	--	--	PPE use (surgical mask or N95 [or equivalent] and eye protection for aerosol generating procedures; yes

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
					vs. no): *adjusted OR 0.45 (0.26-0.83)*
Baker et al 2021 (92)	--	--	--	--	PPE use as recommended vs. not as recommended: adjusted OR 0.8 (0.4-1.4) PPE use as recommended vs. unsure use: *adjusted OR 0.6 (0.4-0.9)*
Barrett et al 2020 (33)	--	--	--	--	Estimated proportion of patients for which PPE (gloves, gown and surgical or N95 mask) was used, <25% vs. 100%: OR 0.41 (0.14-1.22)*
Celebi et al, 2020 (154)	--	--	--	--	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 (155)	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)**
Clifton et al 2021 (95)	--	--	--	--	Reported vs. did not report break in PPE: OR 1.69 (0.19-14.84)

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
el-Boghdadly et al, 2020 (39)	--	--	--	--	PPE meeting WHO standard, yes vs. no: HR, 0.97 (0.63-1.51)*
Eyre et al 2020 (102) *Seroprevalence*	--	--	--	--	Exposure to known or suspected COVID-19 patient without PPE, yes vs. no: *adjusted OR 1.47 (1.26-1.70)*
Fletcher et al 2021 (105)	--	--	--	--	Study Period 1 PPE use at work (yes vs. no): OR 0.98 (0.06-16.48) PPE use at work (sometimes vs. no): 0% (0/58) vs. 0% (0/23) Study Period 2 PPE use at work (yes vs. no): OR 2.81 (0.86-9.20) PPE use at work (sometimes vs. no): 10% (5/50); OR 0.70 (0.27-1.79)
Gupta et al 2021 (111)	--	--	--	--	PPE breach vs. no breach: OR 0.96 (0.66-1.40)
Heinzerling et al, 2020 (71)	--	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 (44)	-	-	Proper hand hygiene: OR 0.26 (0.02-4.46)	-	PPE when indicted, always vs. occasionally OR 0.54 (0.05-6.32)
Khalil et al, 2020 (157)	Disposable gown (yes vs. no): OR 1.08 (0.53-2.20)	Single-use gloves (yes vs. no): OR 1.01 (0.38-2.68)	Followed hand hygiene During patient care (yes vs. no): OR 0.78 (0.23-2.67)	Face shield/goggles (yes vs. no): *0.44 (0.23-0.84)*	Wore PPE (yes vs. no): OR 0.15 (0.02-1.21) Proper donning and doffing of PPE (yes vs. no): OR 0.57 (0.29-1.14)

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
			During procedure (yes vs. no): OR 3.28 (0.66-12.30) After body fluid exposure (yes vs. no): OR 0.28 (0.06-1.45) After touching fomites (yes vs. no): OR 1.58 (0.49-5.04)		
Maltezou et al, 2020 (48)	--	--	--	--	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)*
Murongazvombo et al 2021 (128)	--	--	--	--	*Reference not a frontline worker* Frontline worker who carried out any activities more than 2 m away from a COVID-19 patient with or without appropriate PPE (FFP2/FFP3/N95, surgical mask, apron, gown, gloves): adjusted OR 1.48 (0.72-3.02) Frontline worker who provided care within 2 m of a COVID-19 patient with appropriate PPE (surgical mask, apron, gown, gloves) for a non-aerosol-generating procedure: adjusted OR 1.15 (0.61-2.17) Frontline worker who performed an aerosol-generating procedure on a COVID-19 patient with appropriate PPE (FFP2/FFP3/N95, apron, gown, gloves) for an aerosol-generating procedure: adjusted OR 1.06 (0.57-1.96) Frontline worker who provided care within 2 m of a COVID-19 patient but without an aerosol-generating procedure and without appropriate PPE (surgical mask, apron, gown, gloves) for a non-aerosol-generating

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
					procedure: adjusted OR 1.82 (0.96-3.44) Frontline worker who performed and aerosol-generating procedure on a COVID-19 patient without appropriate PPE (FFP2/FFP3/N95, apron, gown, gloves) for an aerosol-generating procedure: **adjusted OR 2.49 (1.00-6.18)**
Naesens et al 2021 (129)					*Reference no contact with confirmed/ suspected COVID-19 cases at work* Only protected contact (PPE): **adjusted OR 1.74 (1.19-2.54)** Only accidental and unprotected contact (no PPE): adjusted OR 1.44 (0.80-2.59) Any contact (intentional or accidental, protected or unprotected [with or without PPE]): adjusted OR 1.17 (0.78-1.75)
Newberry et al 2021 (130)	--	--	--	--	*Seropositivity* Full use of PPE during exposure (yes vs. no): **OR 0.23 (0.05-0.97)** PPE breach or failure (yes vs. no): OR 1.20 (0.16-9.18) *Infection (PCR)* Full use of PPE during exposure (yes vs. no): OR 0.59 (0.10-3.59) PPE breach or failure (yes vs. no): OR 1.16 (0.07-20.36)
Paris et al 2021 (15)	--	--	--	--	Participated in nasopharyngeal sampling (reference no participation) With appropriate protective equipment: **adjusted OR 1.33 (1.15-10.40)**

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
					With suboptimal protective equipment: adjusted OR 3.46 (0.79-2.25)
					Participated in central line insertion (reference no participation)
					• With appropriate protective equipment: adjusted OR 0.72 (0.35-1.45)
					• With suboptimal protective equipment: adjusted OR 2.55 (0.57-12.38)
					Participated in upper respiratory tract actions (reference no participation)
					• With appropriate protective equipment: adjusted OR 1.53 (0.92-2.55)
					• With suboptimal protective equipment: adjusted OR 1.85 (0.66-5.22)
					Participated in central line insertion (reference no participation)
					• With appropriate protective equipment: adjusted OR 0.72 (0.35-1.45)
					• With suboptimal protective equipment: adjusted OR 2.55 (0.57-12.38)
					Participated in washing and dressing patient (reference no participation)
					• With appropriate protective equipment: *adjusted OR 2.13 (1.05-4.30)*
					• With suboptimal protective equipment: adjusted OR 0.38 (0.10-1.46)
					Participated in patient mobilization (reference no participation)

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
					• With appropriate protective equipment: adjusted OR 0.93 (0.49-1.79) • With suboptimal protective equipment: **adjusted OR 3.30 (1.51-7.25)** Participated in patient feeding (reference no participation) • With appropriate protective equipment: adjusted OR 1.00 (0.54-1.89) • With suboptimal protective equipment: adjusted OR 2.49 (0.92-6.72) Participated in clinical exam (reference no participation) • With appropriate protective equipment: adjusted OR 1.50 (0.85-2.65) • With suboptimal protective equipment: **adjusted OR 2.51 (1.16-5.43)** Participated in eye exam (reference no participation) • With appropriate protective equipment: adjusted OR 1.86 (0.93-3.73) • With suboptimal protective equipment: **adjusted OR 2.90 (1.01-8.35)**
Perez-Garcia et al 2020 (75)	--	--	--	--	Use of PPE (included cap, FFP2 mask [or FFP3 mask for aerosol generating procedures], disposable medical protective clothing, gloves, goggles/screens) vs. no use: **adjusted OR 0.56 (0.44-0.72)**
Piapan et al 2021 (16)	--	--	--	--	PPE use (yes vs. no): **adjusted OR 3.7 (1.6-8.2)**

Author, Year (Reference)	Gown	Glove	Handwashing	Eye Protection	PPE
Ran L et al, 2020 (77)	--	--	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)
Schmitz et al 2020 (139)	--	--	--	--	High-level PPE (FFP2 mask and eye protection for all patient contact) hospital vs. other hospital: **OR 1.85 (1.35-2.54)***
Trieu et al 2020 (57)	--	--	--	--	Patient contact with full PPE vs. no patient contact: OR 1.1 (0.5-2.7) Patient contact with partial PPE vs. no patient contact: OR 2.5 (0.5-12.2)
Venugopal et al 2021 (147)	--	--	--	Face shield and goggles (yes vs. no): OR 0.55 (0.36-0.84)*	--
Wang Q. et al, 2020 (159)	--	--	--	--	Level 2 protection (cap, N95 or higher, goggles/eye protection, gown, gloves, shoe covers) (yes vs. no): **OR 0.03 (0.003-0.19)**†
Yogo et al 2020 (150)	--	--	--	--	Exposure to SARS-CoV-2 infected patient without PPE, yes vs. no: adjusted OR 1.17 (0.42-3.26)

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

Supplement Table 8. Risk factors for SARS-CoV-2 infection in HCWs evidence map

Risk factor	Size of evidence	Strength of Evidence and Effect
Age	++++	●
Sex	++++	●
Race/ethnicity (Black or Hispanic vs. White)	+++	●
Prior SARS-CoV-2 infection	+	◆
Positive vaccination status	+	◆
Positive antibody status	+	◆
HCW role (nurse vs. physician)	++++	●
Greater directness or intensity of contact	++++	◆
Participation in high-risk procedure	+++	◆
Education/training in infection control measures	+	◆
Mask use	++	◆
PPE use	+++	●

Size of evidence
++++ >50 studies; >200,000 HCWs
+++ 20-50 studies; >100,000 HCWs
++ 10-20 studies; >50,000 HCWs
+ <10 studies; <20,000 HCWs

Strength of evidence
● Moderate
◆ Low
■ Insufficient
- No evidence

Effect
■ (dark gray) Positive association
■ (light gray) Negative association
□ No association

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