COVID-19 Scientific Advisory Group Rapid Response Report

Key Research Questions: 1) Among countries who are past their initial peak of COVID-19 cases, what proportion of total cases were in healthcare workers (HCW), and what is the estimated proportion of the total number of HCWs who developed COVID-19 from presumed occupational exposure?

2) Is there any evidence that household members of HCWs are at elevated risk of COVID-19 disease, and if so, are there guidelines for mitigating that risk?

Context

- It is critical to understand the risk of transmission of COVID-19 virus (SARs-CoV-2) to HCWs, to develop evidence informed policies and practices to protect them while performing their work.
- **This update was issued to include data from a comprehensive Workplace Health and Safety dashboard**, as well as any accrued local data pertinent to Alberta, which will track COVID-19 infections and SARS-CoV2 testing in Alberta Health Services (AHS) and Covenant Health and Alberta Precision Laboratories (APL) staff (including clinical, clinical support, and non-clinical staff as well as physicians working within the facilities.
- An updated literature review, and partial re-analysis of data from high and low risk countries (using government surveillance data) is provided, and compared with current Alberta data.
- In the absence of reliable risk data, the perception of personal COVID19 risk in HCW is at risk of being driven by preferential media reporting of cases in HCWs. This risk perception is substantiated by a recent informal social media based poll of over 500 physicians across Canada which reportedly indicated that 86% felt they had a greater than 50% chance of acquiring COVID19 during the coming months(1).
- Detailed assessment and transparent reporting of HCW occupational risks will support HCWs and employers in ensuring appropriate risk reduction strategies are in place. The importance of this may be highlighted during a pandemic.

Key Messages from the Evidence Summary

- Alberta based data synthesized from the WHS dashboard indicated a current absolute occupational risk of documented COVID-19 infection in healthcare workers to be 0.01%, with an overall HCW risk of 0.14%, on the basis of detailed case investigation. This is compared with the overall current 0.1% risk in the community in Alberta. The elevated HCW non-occupational risk as compared with the general population may be explained in part by higher rates of testing in the HCW population (15% tested versus 2.9% of the general population tested), and by differences in travel patterns amongst HCWs compared with other populations prior to recognition of the pandemic and the implementation of travel restrictions.
- This new AHS surveillance is very valuable, because as yet there is no peer-reviewed published data, from any region within Alberta, reporting the proportion of healthcare workers infected and the mechanisms by which this occurred. The current Alberta data is notable for presenting the population denominators, as well as the outcomes of investigation of whether acquisition of COVID-19 was occupational. The data are also broken down by age and clinical versus non-clinical staffing categories.

- Current data in Alberta suggest that the majority of cases of COVID-19 infection in HCWs have arisen from non-occupational exposure, but it is acknowledged that this could change as the Alberta case counts and hospitalization rates increase.
- Our previous global analysis of 3 high risk and 3 low risk countries suggested that the overall incidence of COVID-19 infection in HCWs is higher than that of the general population. HCW risk (confined in this analysis to nurses and physicians) was 9-11 times higher than the general population, regardless of country/region risk status, although importantly the absolute risk of documented infection remained quite low (under 3% even in high risk countries, Table 4.) A much higher incidence of infection among HCWs was observed in regions with high population incidence and prevalence, with significantly strained health care systems (Italy, Spain, Hubei province), compared to regions with lower population incidence and prevalence (non-Hubei China, Indonesia, Philippines). The likelihood of increased testing amongst healthcare workers, and lower mortality rates of infection in HCW based on available data (Table 5) suggest higher case ascertainment among HCW versus the general population. It is important to note that evidence from 2003 SARS demonstrated that risk to HCWs could be mitigated by diligent hand hygiene and use of personal protective equipment (PPE) (Jefferson et al., 2008).
- The evidence for occupational exposure based excess risk is highly variable. Observations from Spain showed that the epidemic dynamics among HCW closely followed community dynamics, representing an argument against significant occupational transmission (no increased risk compared to community risk) (Folgueira, Munoz-Ruiperez, Alonso-Lopez, & Delgado, 2020). A case study from Switzerland in a primary care hospital found that when contact times were under 15 minutes there was no increased risk of infection (no transmission was detected among the 21 HCW who were exposed to the patient, despite minimal PPE) (Canova et al., 2020)
- A new pre-print study was identified that reported a 7.0% greater absolute risk (95% confidence interval for risk difference 4.7%-9.3%) of SARS-CoV-2 among HCW compared to non-HCW in a university and university hospital setting in New Jersey (Barrett et al., 2020). The highest infection rate was in nurses (11.1%), and ICU workers had lower infection rate (2.1%) compared to those on other units (4.9-9.7%).
- There are no reliable data on hospitalization and mortality risks for HCWs and most available data were from media reports. Within high-risk countries, these limited data suggested case fatality rate was substantially lower in HCWs than in the general population in Italy (0.01% vs. 13.9%) and Hubei (1.2% vs. 4.8%) possibly related to increased testing within HCW identifying a larger group of less severely ill cases (Table 5). Estimates of case fatality rates in low-risk countries were highly variable but were comparable between HCWs and the general population within a country. There were no reliable data on hospitalization rates for HCWs with COVID-19.
- There are still no available data on the transmission of COVID-19 from infected HCWs to household members outside case reports to address the second question. A recent publication suggested a household attack rate of 4.7%, with no documented asymptomatic transmission and lower transmission from presymptomatic cases, supporting prompt household self isolation with any symptoms to further reduce risk (Cheng et al., 2020)
- One case control publication suggested that, in the Chinese epidemic, HCW risk was highest in areas where aerosol generating procedures were carried out, including ICUs and respiratory wards. In this study, risk of occupational HCW infection was also increased substantially by self reported inadequate hand hygiene practices (Ran et al., 2020). However, a recent publication describing a staff screening program in the UK National Health Services (NHS) (Hunter et al., 2020) found the COVID-19 positivity rates among categories of symptomatic HCW not significantly different between “high-risk” HCW (high patient contact, high-risk aerosol generating procedures) to medium-risk HCW (moderate patient contact, no aerosol-generating procedures) to low-risk HCW (no patient contact) (Hunter et al., 2020).
- Two reports of nosocomial investigation of HCW exposures to severe COVID-19 cases are highlighted: in one, a patient was diagnosed with COVID-19 after being nursed on an open ward with 10 other patients for 35 hours, on high flow oxygen for 18.5h. No secondary nosocomial infection was detected to close contacts among staff or ward patients (Wong et al., 2020). In the other, 41 HCW were exposed to AGMP during the care of a retrospectively diagnosed COVID-19 patients in an ICU setting, 35/41 of whom used contact and droplet precautions rather than N95 precaution, with no transmission (Ng et al., 2020).

- Calgary has the preponderance of COVID-19 hospitalized cases within Alberta at this time. There has been no evidence of aerosol generating medical procedures as cause for COVID-19 infection on any of the four Calgary "Designated COVID-19" acute care wards (one at each of the four adult acute care hospitals in Calgary). On these wards, interim data reveals that there have been an estimated 5544 person hours of HCW exposure to 132 inpatients, using recommended PPE [gowns, gloves, medical masks, and face shield or goggles in routine care and the addition of N95 respirator for any aerosol generating medical procedures (AGMPs). These data support that the virus is not airborne in the setting described and that precision of execution of IPC precautions and PPE use protects HCWs. (Personal Communication, April 30, 2020. Conly J, Missaghi B, Kim J, Larios O, Harrison R, Lauzon M, Tsekrekos S.)

Updated Recommendations

1. Across jurisdictions, common metrics should be developed for reporting data on incidence and outcomes for occupational infections in HCWs, in different healthcare settings and to determine the rates of acquisition in the context of inappropriate vs. appropriate PPE use and hand hygiene. The current AHS WHS COVID-19 dashboard can be explored as a potential model to develop these metrics.
2. Within AHS, consideration to collecting data on rates of infection amongst the household contacts of healthcare workers should be made (with comparison to general community based risk, as risk of transmitting infection to household members is a concern amongst HCWs.)
3. AHS, Covenant Health and APL should continue to counsel and support HCWs to ensure best practices for infection prevention and control in both the healthcare and community settings:
    a. healthcare setting guidance: AHS-recommended hand hygiene and PPE and at work physical distancing practices to minimize the risk of COVID-19 infection in the hospital setting
    b. home guidance for self-isolation if infected and for general infection prevention in the home.
    c. community guidance for general infection prevention including physical distancing.

Committee Discussion:

The committee appreciated the pragmatic synthesis of literature and information in the assessment of HCW risk in jurisdictions with more mature epidemics, given the notable lack of verifiable HCW risk data available in this pandemic. It was noted that current media reports may bias toward perceptions of very high risk, increase morbidity, and maladaptive coping. The global estimates derived here were seen to suggest elevated relative risk but fairly modest absolute risk, which appears to be reassuringly lower than apparent self estimation, and the available data suggest that excess risk can be reduced by careful PPE doffing and hand hygiene, and potentially by enhanced distancing and cleaning within health care settings. For the update to this brief, the development of the AHS WHS dashboard reporting COVID-19 testing, documented cases, and their attribution among HCW addresses was greatly appreciated, and meets the recommendations around surveillance needs in the previous report. It was noted that this dashboard data reporting is potentially unique based on the current literature and available data and as such may serve as a valuable example for other jurisdictions.

Summary of Evidence

1) Updated Literature Review:

The body of evidence for these questions has become more robust over the past month as the local epidemics have progressed. Of the 16 articles included in this update, only 2 non-academic news articles were included, compared to the broad approach that was required for the initial modelling. Literature for this update was collected from a broad database and evidence service search. The search was limited by the publication time period and the article language – although language was not an exclusion criterion, articles published in languages other than English were not included. Correspondence and commentary articles in academic journals were included if they included data for HCW infection rates as a proportion of the COVID-19 case total.

Evidence from secondary and grey literature

The data for HCW infection is too new for any secondary evidence to be available. No guidelines or policies were identified that stated occupational risk of developing COVID-19 in HCW.

An investigative news story published by the Canadian Broadcasting Corporation (CBC) on April 2, 2020 collected HCW infection data directly from the Public Health departments of Ontario health regions. On average, HCWs make up 9.6% of Ontario's 2392 cases (Pelley, 2020). However, the regional rates of HCW infection vary widely, ranging from 3.7% (31/818) in Toronto to 43% (12/28) in Peterborough (Pelley, 2020).

One news article from a Spanish academic institution reported on COVID-19 incidence in HCW. As of April 24, 2020, the Spanish Health Ministry reported that 35,295 HCWs were infected – translating to 20% of all registered cases of COVID-19 in Spain (Güell, 2020).

Evidence from the primary literature

Among countries who are past their initial peak of COVID-19 cases, what proportion of total cases were in HCWs, and what is the estimated proportion of the total number of hospital-based HCWs who developed COVID-19 from presumed occupational exposure?

The evidence for this question is still variable, given the different epidemic intensities, health systems, and public health strategies of the affected countries.

Most of the data in the newly included studies was presented as incident COVID-19 in HCWs rather than risk. Four studies reported low incidence for HCWs (from the United States and China): 2.9% (CDC COVID-19 Response Team, 2020); 4.4% (Zhan, Qin, Xue, & Zhu, 2020); 8.2% (Bai et al., 2020); and 2.5% (Heinzerling et al., 2020). Four articles (all from Europe) described incidence rates for HCWs at or above 10%: 13.8% in Lombardy (Bellizzi, Fiamma, Arru, Farina, & Manca, 2020); 41% in Sardinia (Bellizzi et al., 2020); Italian average of 10% (Chirico, Nucera, & Magnavita, 2020); and 20% in Spain (Güell, 2020). Early evidence from Singapore shows that no HCWs developed COVID-19 after contact with 68 confirmed cases (Htun et al., 2020).

One pre-print study was identified that determined the absolute risk of COVID-19 for HCW. This was a prospective cohort study that tested 829 subjects for COVID-19 (546 HCW and 283 non-HCW, in a university hospital and university setting in New Jersey). 40 HCW (7.3%) and 1 non-HCW (0.4%) tested positive for SARS-CoV-2 infection, representing 7.0% greater absolute risk (95% confidence interval for risk difference 4.7%, 9.3%) of SARS-CoV-2 among HCW compared to non-HCW in hospital and university settings, in a setting of a significant community epidemic (Barrett et al., 2020). The highest infection rate was in nurses (11.1%), and ICU workers had a low rate of infection (2.1%) compared to those on other units (4.9-9.,7%). The comparison population may not be comparable to the general population in this study.

The evidence around occupational exposure risk is highly variable. Observations from Spain showed that the epidemic dynamics among HCW closely followed community dynamics, representing an argument against occupational transmission (no increased risk compared to community risk) (Folgueira et al., 2020). A case study from Switzerland in a primary care hospital found that when contact times were low (less than 15 minutes), there was no increased risk of infection (no transmission was detected among the 21 HCW who were exposed to the patient, despite minimal PPE) (Canova et al., 2020).

Observations from Folguiera (2020) are supported by the observations of the staff screening program developed by the National Health Services (NHS) in England (Hunter et al., 2020). Although the absolute risk of transmission to HCW was not calculated, the relative risk among categories of HCW was not significantly different (Hunter et al., 2020). These categories compared HCW by perceived risk as follows: high-risk HCW (high patient contact, high-risk aerosol generating procedures) to medium-risk HCW (moderate patient contact, no aerosol-generating procedures) to low-risk HCW (no patient contact) (Hunter et al., 2020).

In contrast, data from the United States suggests that 55% of 1423 infected HCWs who contacted a confirmed COVID-19 case were exposed through work (CDC COVID-19 Response Team, 2020), although these data are partial, and are felt to be subject to potential bias.

Finally, two HCW exposure investigations illustrate aspects of risk in hospital settings. In both, the case patients were severely ill requiring ETT, but were cared for by multiple HCW without N95 precautions. In one, a patient was diagnosed with COVID-19 after being nursed on an open ward with 10 other patients for 35 hours, on high flow oxygen for 18.5h. No secondary transmission was detected to close contacts among staff or ward patients (Wong et al., 2020). 'Staff close contact' was defined as staff who had contact within 2 m of the index case for a cumulative time of >15 min, or had performed AGPs, without 'appropriate' PPE. 'Appropriate' PPE in the above contact episodes referred to the use of N95 respirator, face shield/goggles, gown and gloves. Patients who shared the same cubicle with the index case were considered as 'patient close contact' (Wong et al., 2020). In the other, 41 HCW were exposed to AGMP (at least 10 minutes of exposure at a distance of less than 2 meters from the patient during endotracheal intubation, extubation, noninvasive ventilation, and exposure to aerosols in an open circuit) during the care of a retrospectively diagnosed COVID-19 patients in an ICU setting, 35/41 of whom used contact and droplet precautions rather than N95 precaution, with no transmission documented (Ng et al., 2020).

Is there any evidence that household members of HCWs are at elevated risk of COVID-19 disease, and if so, are there guidelines for mitigating that risk?

There is anecdotal reports that the majority of HCW infections in Wuhan occurred during the large and expanding community outbreak (Anonymous, 2020c). This brings into question the relative risk of HCW infection from community versus workplace exposure and is consistent with current Alberta data for HCW infections where most are currently from the community. There were no qualitative or quantitative data sources to address transmission from HCW back to members of their household in the broad search string employed. As a result, there are no estimates of risk of transmission of infection from HCWs to household members, and whether the attack rate in HCW household members is different from the general population.

One case study suggested that an infected HCW transmitted COVID-19 to all 5 of his household members (Luo et al., 2020), who were asymptomatic or mildly symptomatic at the time of testing. There was no specific grey literature search targeted to guidelines for prevention of transmission from HCW to other household members, and variability in the reported use of separate housing for HCW during peak epidemic work. No evidence was identified that could be used to determine HCW household members risk compared to the general population versus baseline risk in the community. In terms of overall household risk to case contacts, a recent report of 100 cases and their 2761 close contacts showed no transmission from 9 asymptomatic cases, but there was transmission documented from presymptomatic cases (0.7% attack rate) and a secondary attack rate of 4.6% to household contacts. The overall attack rate was 0.7% to all contacts including healthcare and non household family contacts (Cheng et al., 2020). Therefore, self isolation within the household, with testing immediately upon development of even minor symptoms is advisable (Cheng et al., 2020). Strategies to reduce self-contamination and viral transmission outside of the healthcare setting has already been addressed by multiple guidance documents including from Workplace Health and Safety and the COVID-19 Scientific Advisory Group (Available here) (Alberta Health Services, 2020).

2. Data Synthesis:

a) Information from Workplace Health and Safety Tableau Dashboard.

The Workplace Health and Safety team has created a dashboard of AHS Employee and Physician COVID-19 Test Surveillance, which provides local surveillance data within the province, including denominator data and case investigation determinations. See Table 1 for data current to April 27, 2020.

Methodology:
The source of this data comes from human resources data extracts as well as provincial laboratory data on SARSCoV-2 laboratory testing. Exposures are investigated, and non-occupational exposures include situations where there was no probable workplace exposure for the healthcare worker, and a community source for the

worker's infection was identified such as an infected household contact, participation in a gathering identified as a source of exposure, or recent international travel OR when it was probable that a community exposure was the most likely source of infection.

In this analysis, Clinical staff are designated as frontline staff (this include registered nurses (RNs), RPNs, paramedics, public health inspectors, dialysis technicians, LPNs, healthcare aides) and frontline support staff (this includes pharmacists, physical therapists, respiratory therapists, and psychologists.) Clinical support staff include food services workers, laundry workers, health records and housekeeping staff. Non-clinical staff include corporate support staff such as operations, education, and research services.

Results: (to April 27, 2020)

The current results indicate that, as is suspected in other jurisdictions, there is increased testing in healthcare worker populations. The reasons for this in Alberta are multifactorial including test prioritization algorithms as laboratory capacity was scaled up. These data show 3.8-5.5 fold higher testing rates in healthcare workers than in the general Albertan population. Overall, 15% of total Alberta Health Services employees have been tested (compared with 2.9% of the general Alberta population), with 0.13% documented to be SARS-CoV-2 positive, compared with 0.1% of the general population documented positive, and to date has been predominantly related to community transmission rather than occupational exposure.

Alberta Health Services physicians also have a higher number of tests per population at 12.6%, with 22 cases of 7408, or 0.3% positive in this population. Notably, there are no documented occupational transmissions in the physician group and an outbreak related to a physician social event accounts for a large proportion of cases. Physician data had to be removed from the total healthcare worker analysis because some physicians are counted in the AHS employee data, precluding an accurate denominator. Finally, there are currently a number of physician and AHS employee cases under review that are not included in the occupational transmission data. (It is noted that if all cases under investigation were deemed occupational, the proportion of cases due to occupational exposure would be at maximum 17%).

The clinical employee group had 1% test positivity overall, and 11% of cases were felt to represent occupational exposure, for 0.02% of the population documented to be SARS-CoV2 positive from an occupational source. There were no occupational exposure cases in the clinical support group, and 1 of 27 positives in the nonclinical group were felt to be occupational (3.7%).

The detailed AHS WHS investigations into the occupationally acquired infections to date have not revealed AGMPs as contributor to infection transmission. The occupational exposure events are reviewed and more detailed data are being collated.

Therefore, current data suggests that over 90% of the cases in healthcare workers in Alberta currently reflect community exposure and that the occupational risk is overall similar (and is currently lower) than the population based risk of documented COVID-19 in current conditions. These data are in keeping with the estimates of risk seen in some of the low risk countries evaluated in this review, reflecting both a relatively low exposure risk within healthcare settings currently, and potentially reflecting effectiveness of recommended PPE and other control measures such as symptom screening, visitor restrictions, dedicated care areas, continuous medical masking, physician distancing and other measures.

Table 1. Alberta SARS-CoV-2 testing and COVID-19 testing and case data broken down by Alberta Health Services employees, physicians and the general non-healthcare worker population.

Group	Number	# tested	% tested	# (%) of test results positive for SARS-CoV-2	# (%) of test positives from occupational exposure	Occupational risk % (PAR)	Overall risk % (PAR)
Total AHS Employees* (non-physician)	103,467	15,603	15.1%	137 (0.9%)	12 (8.8%)	0.01%	0.13%
AHS Physician	7,408	933	12.6%	22 (2.4%)	N/A **	N/A	0.30%
General Population (non-HCW) ***	4,287,068	122,386	2.9%	4,307 (3.5%)	N/A	N/A	0.10%
Total AB Population	4,397,816	138,922	3.2%	4,469 (3.2%)	N/A	N/A	0.10%

PAR - Population at risk

* Total AHS Employees includes some (but not all) AHS Physicians - AHS Physicians kept separate.

** 2 cases under investigation. 20 cases linked to a single community outbreak.

*** General population (non-HCW) has excluded the AHS Physician numbers because some are captured in AHS Employees and 20 cases are from a single outbreak.

b) Updated Global HCW Risk Comparison Analysis

Comparative data was generated from countries with later stage epidemics, prepared by a team from the University of Alberta School of Public Health, and updated using government surveillance data for Italy, on April 30, 2020.

Data were considered from countries where the death rate doubling time is greater than seven days according to the Our World in Data website (Roser & Ritchie, 2020) on April 3, 3030, based on the premise that these are later stage epidemics. These countries included: Italy, China, Spain, Singapore, South Korea, Indonesia and the Philippines. Raw data and formulas used to perform calculations are provided in the Appendix. National population estimates were based on the most current data (2018) from the World Bank (The World Bank, 2018). Current case and mortality numbers were taken from April 3, 2020 reporting from the EU CDC (European Centre for Disease Prevention and Control, 2020) (Italy/Spain) and Johns Hopkins University Medicine Coronavirus Resource Center (Dong, Du, & Gardner, 2020) (China, Philippines, Indonesia). Reports of HCW cases and mortalities/case fatality/hospitalization rates were taken from sources identified in the peer-reviewed and grey literature search (see reference citations and Table 5 in Appendix). These included media reports as complete epidemiologic analyses were not yet available at the time of the search. The proportion of HCWs infected (rather than proportion of infected who were HCWs) was not provided in existing reports. To estimate the HCW risk of infection, the number of HCW cases by country/region was divided by national HCW numbers, were estimated using the sum of doctors and nurses/midwives per 10,000 population for 2017/2018 from the WHO (World Health Organization, 2020c). HCW case numbers were not reported by healthcare work setting to account for differential risks in hospital versus community care and will require updated analysis if such data becomes available.

Comparisons were made between countries/regions considered to be “high risk” and “low-risk” for transmission – (Table 2) based on the number of total cases relative to population at risk, acuity of rise of cases and peak of their early epidemic curves. This distinction is supported by corresponding reports of severely compromised health care system capacity (Armocida, Formenti, Ussai, Palestra, & Missoni, 2020; Legido-Quigley et al., 2020).

Table 2. Risk definitions for countries/regions considered in the analysis for COVID-19 risk in frontline healthcare workers.

Category	Countries/Regions*	Definition
High-Risk	Italy, Hubei, Spain	High number of total cases relative to population (>1.0%) Rapid increase in case incidence Peak of epidemic curve Overwhelmed healthcare system/epidemic response
Low-Risk	Non-Hubei China, Indonesia, Philippines	Low number of total cases relative to population (<0.1%) Slower increase in case incidence Peak of epidemic curve Healthcare system/epidemic response not overwhelmed

* Based on countries that have mortality doubling times > 7 days that had available data for analysis.

Case numbers in South Korea and Singapore were too low to contribute to these comparisons owing to their aggressive testing and social distancing campaigns (Buchwald, 2020; Fisher & Sang-Hun, 2020). There was one report of HCW cases in South Korea in one of the original clusters at the Chungdo Daenam hospital where 9 of the 114 cases were medical staff (Shim, Tariq, Choi, Lee, & Chowell, 2020). On February 25, 2020, Singapore reported zero HCW infections (Young et al., 2020). Since then in Singapore there have been a handful of cases in HCWs, the source of which are thought to be from outside of the hospital (Xinghui, 2020).

Table 3. The numbers of healthcare workers, the general non-healthcare worker population and COVID-19 cases in each group and their estimated risks by country/region and risk category from synthesized formal and informal sources, including Alberta data.

Country/ Region	Total HCW Cases	Total HCWs	General Population Cases	2018 General Population	HCW risk % | risk/10,000 population (95% CI)	General population risk % | risk/10,000 population (95% CI)
Italy	15,314	587,211	124,063	59,844,069	2.61% | 260.7 (256.7-264.9)	0.21% | 20.7 (20.6-20.8)
China (Hubei)	1,809	75,075	65,993	7,480,925	2.41% | 241.0 (230.1-252.1)	0.88% | 88.2 (87.5-88.9)
Spain	15,433	448,641	94,805	46,275,109	3.44% | 344.0 (338.7-349.3)	0.21% | 20.5 (20.4-20.6)
Overall high-risk	25,600	1,110,927	284,861	113,600,103	2.93% | 293.1 (289.9-296.2)	0.25% | 25.1 (25.0-25.2)
China (non-Hubei)	246	6,389,978	14,463	1,378,784,022	0.004% | 0.39 (0.34-0.44)	0.001% | 0.105 (0.103-0.107)
Philippines	501	590,318	2,517	106,061,602	0.085% | 8.49 (7.76-9.26)	0.003% | 0.237 (0.228-0.247)
Indonesia	23	760,699	1,963	266,902,731	0.003% | 0.30 (0.19-0.45)	0.0007% | 0.074 (0.070-0.077)
Overall low-risk	770	7,740,996	18,943	1,751,748,354	0.010% | 1.00 (0.93-1.07)	0.001% | 0.108 (0.107-0.110)
Alberta*	137	103,467	4,307	4,287,068	0.13% | 13.2 (73.8-103.7) *(Occupational risk 0.01%)*	0.10% | 10.0 (9.7-10.4)

Table 3 Notes
***HCW** = in global analysis, WHO health workforce data on nurse and physician density per 10,000 population*
***Risk** = number of cases / population at risk. General population risk did not include HCW cases.*
***Relative Risk** (of HCW vs general population) = HCW Risk / General Population Risk*
***Risk Difference** = HCW attributable risk = the additional cases/10,000 population that occur from being a HCW. This is an absolute difference in risk and is low for the "Low-Risk" countries because the cases in China outside Hubei were so low relative to the total population-*
For global and Alberta data general population numbers have HCW numbers removed, CI - confidence interval.

General population and general population cases have excluded HCW population and cases.
* Alberta HCW cases and population do not include AHS Physician 22 cases and population (see text for explanation).

This analysis compares the incidence among HCWs compared to the general population in high-incidence compared to low-incidence regions. However, the absolute risk difference (additional cases/10,000 from being a HCW) is much higher in the “high-risk” countries/regions (293/10,000 population) compared to “low-risk” countries/regions (<1/10,000 population), suggesting an absolute additional risk of infection of 0.001 to 2.9% in the various settings. One potentially important confounder is the fact that case ascertainment may be higher in HCW than in the population, as most jurisdictions quarantine and test symptomatic HCW, to avoid transmission from infected HCW in occupational setting. This could increase the apparent relative risk of HCW.

Table 4. The relative risks and risk differences (attributable risks) for COVID-19 in healthcare workers compared to the general (non-healthcare worker) population by country/region and risk category from synthesized formal and informal sources, including Alberta data.

Country/Region	Healthcare worker Relative Risk (95% CI)	Risk Difference % | per 10,000 Population (95% CI)
Italy	12.6 (12.4-12.8)	2.4% | 240.1 (236.0-244.1)
China - Hubei province	2.7 (2.6-2.9)	1.5% | 153.7 (141.8-163.7)
Spain	16.8 (16.5-17.1)	3.2% | 323.5 (318.2-328.8)
Overall "high-risk"	11.7 (11.6-11.8)	2.7% | 268.0 (264.8-271.1)
Non-Hubei China	3.7 (3.2-4.2)	0.003% | 0.28 (0.23-0.33)
Philippines	35.8 (32.5-39.4)	0.08% | 8.25 (7.51-8.99)
Indonesia	4.1 (2.7-6.2)	0.002% | 0.23 (0.11-0.35)
Overall "low-risk"	9.2 (8.6-9.6)	0.009% | 0.89 (0.81-0.96)
Alberta* (p=0.001)	1.32 (1.11-1.56) **	0.03% | 3.2 (1.0-5.4) *(occupational risk difference -0.99%)*

All relative comparisons are healthcare workers compared to the general population for that country/region or risk group (all p<0.001 except AB p=0.001). CI confidence interval.
* Alberta HCW cases and population do not include AHS Physician 22 cases or population.
** healthcare worker attributable risk lower than general population risk as of April 27, 2020

The relative risk of documented COVID-19 for HCWs was elevated (9-11x) compared to the general population in both “high-risk” and “low-risk” countries in this analysis (Table 4). In contrast, in Alberta, the relative risk for HCW is 1.32 and the absolute risk increase is 0.03% over that of the general population including both occupational risk (0.01%) and nonoccupational risk (0.12%). Therefore, currently in Alberta, the occupational risk of documented COVID-19 in healthcare workers is lower than the overall risk observed in the general population.

Healthcare worker case fatality rates were also assessed considered to answer Question 1. It was not possible to obtain verified representative data on case fatalities in HCWs as most reporting was through the media (Table 4).

Using our search strategy, in “high risk” countries, the general population case fatality rate (death rate in cases excluding HCW cases) exceeded the ascertainable HCW case fatality rate in both Italy (11.9% vs 1.8%) and Hubei (4.8% vs 1.2%). It is possible that the demographics of physicians in Italy, with an older age distribution as documented in media reports and available data, may be partially responsible for this high mortality rate in Italian HCWs, in that HCW will carry inherent risk attributable to their age and medical condition (Vicarelli & Pavolini, 2015). There were no data on HCW mortalities in Spain, but the overall case reported fatality rate for all cases (general population and HCW) was 14.0%, higher than Italy or Hubei (Anonymous, 2020b; Benavides, 2020; Nugent, 2020). One media report from Spain, based on the report of one physician, reported a COVID-19 HCW hospitalization rate of 8.8% compared to 40% for the general population (Alfageme & Valdes, 2020). The general population case fatality rates in “low-risk” countries were comparable to that of HCWs, but were highly variable. The Indonesian rate was based on two sources: 6 HCW deaths (Andriyanto & Rikin, 2020) in 23 HCW cases reported separately (Anonymous, 2020f). Numbers in the Philippines were larger (33 deaths in 501 HCW cases) (CNN Philippines Staff, 2020). The reliability of these data is questionable presently. Non-Hubei HCW deaths in China were estimated to be 1 in 247 HCW cases. These data are at high risk of reporting and information bias as they largely come from media reports; an updated analysis will be required as more robust data is generated. There have been no reported fatalities among HCW in Alberta at the time of this update.

Table 5. The numbers of healthcare worker and general population COVID-19 cases, the attributable mortalities in each group and their estimated case fatality rates by country/region and risk category from synthesized formal and informal sources.

Risk Level	Country/Region	HCW cases	General Population Cases	HCW Deaths	General Population Deaths	HCW CFR (95% CI)	General Population CFR (95% CI)
High-risk	Italy	15,314	124,063	149	17,215	0.0097 (0.0082-0.0114)	0.139 (0.137-0.141)
	China (Hubei)	1,809	65,993	21	3,182	0.012 (0.007-0.018)	0.048 (0.047-0.050)
	Spain	15,433	94,805	1003*		N/A: (overall CFR 0.91)	
Low-risk	China (non-Hubei)	246	14,463	1	122	0.004 (0.0001-0.0224)	0.008 (0.007-0.010)
	Philippines	501	2,517	33	103	0.066 (0.046-0.091)	0.041 (0.034-0.049)
	Indonesia	23	1,963	6	175	0.261 (0.102-0.484)	0.089 (0.077-0.103)

HCW - healthcare worker, general population numbers have HCW numbers removed
CFR - case fatality rate, CI - confidence interval.

* The only number available for Spain was total deaths (not separated by HCW or general population).

Special Considerations/Limitations for the global analysis:

The overall population, case and death rate data came from reliable sources (government and academic) (The World Bank, 2018; World Health Organization, 2020c). However, most mortality data for HCWs came from news outlets (except for China).

The definition of a “healthcare worker” varies by country. These variations will likely affect the numbers of HCWs and reported number of cases in HCWs. National HCW numbers were estimated using the sum of WHO estimates for doctors and nurses/midwives per 10,000 population for 2017/2018 [**7**]. These results represent the estimate for the entire HCW population in a given region, not the subset of the HCWs that are more likely to be exposed in an acute hospital setting, where COVID-19 exposure would be anticipated to be elevated related to community based exposures. may be higher (Wu & McGoogan, 2020).

There is also concern about the possibility of increased risk of severe disease or death in HCW populations due to their increased level of stress and exhaustion (Bai et al., 2020). The age demographics of HCW populations may also vary between countries, with reports of an aging demographic for Italian physicians (Vicarelli & Pavolini, 2015). Further, a documented influx of HCWs coming out of retirement to work in acute hospital settings in most countries who could be at higher risk of infection, hospitalization and death because of their age (Hume, 2020). This suggests that the source of recruitment for additional HCWs should be informed by their baseline risk. These results likely do not include HCW deaths indirectly related to COVID-19, such as suicide, cardiac arrest and other conditions exacerbated by overwork, stress and fatigue (Anthanasios, 2020; Giuffrida & Tondo, 2020; Su, 2020)**.** It is also important to note that these are not age-specific case fatality rates, which may vary markedly between HCWs and the general population (and for which no data could be found).

It is crucial to note that these HCW case numbers do not account for whether the HCW was infected from occupational or non-occupational exposure. No external data sources separated likely occupational from likely non-occupational cases.

The last important limitation is that testing rates per capita, testing triage recommendations, and public health community interventions vary by country and region (Hasell et al., 2020). The relative proportions of HCW cases compared to the general population between countries must be considered with this in mind.

Evolving Evidence (if applicable)

Most of this evidence came from media reports, and both data reporting from official sources, and data standardization is a significant limitation. Regular updates will be required.

Date question received by advisory group: March 31, 2020
Date report submitted to committee: April 6, 2020
Date of first assessment: April 8 2020
(If applicable) Date of re-assessment: May 4, 2020

Authorship and Committee Members

The initial report was prepared by Dr. Simon Otto with global risk data synthesis performed with Amreen Babujee, Christine Neustaedter, and Dana Tschritter, from the University of Alberta School of Public Health, and Dr. Lynora Saxinger (co-chair) and scientifically reviewed by Drs. Andrew McRae, Uma Chandran, (external reviewer), and Joseph Kim (external reviewer). The update was prepared by Dr. Lynora Saxinger benefitted from additional review and input from Drs. Robyn Harrison and Stephen Tsekrekos of Workplace Health and Safety, and Dr John Conly and Braden Manns,. The full Scientific Advisory Group was involved in discussion and revision of the document: Alexander Doroshenko, Shelly Duggan, Nelson Lee, Elizabeth Mackay, Jeremy Slobodan, James Talbot, Brandie Walker, Andrew McCrea, and Nathan Zelyas.

COVID-19 Scientific Advisory Group Rapid Response Report

Appendix

List of Abbreviations

HCWs Healthcare Workers

PPE Personal Protective Equipment

UofA University of Alberta

Methods: Update April 30, 2020

Literature Search

A literature search was conducted by Rachel Zhao from Knowledge Resources Services (KRS) within the Knowledge Management Department of Alberta Health Services. KRS searched databases for articles published in April 2020 and included: OVID MEDLINE, LitCovid, CINAHL, TRIP PRO, BMJ Best Practice, WHO Covid-19 Database, CADTH and COVID-19, Cambridge Coronavirus Free Access Collection, CEBM, US CDC, Cochrane, COVID-19 Evidence Alerts from McMaster PLUS, medRxiv, bioRxiv, European Centre for Disease Prevention and Control, National Collaborating Centre for Methods and Tools, NICE, Twitter, Google and Google Scholar. Briefly, the search strategy involved combinations of keywords and subject headings including:

- SARS-CoV-2 or COVID-19 or novel coronavirus
- Healthcare workers (MeSH term and keyword search)

Articles identified by KRS in their search were pre-screened by the librarian to ensure relevance and that publication dates did not overlap with the previous search. Articles were then screened by title against the inclusion/exclusion criteria listed in Table 1 below. 61 articles were identified by KRS with references and abstracts provided for further review. 46 were excluded from the review in accordance with the inclusion/exclusion criteria stated below. Following full-text screening, 16 articles were included in the final narrative synthesis.

Figure 1. Modified PRISMA diagram of literature screening process (Moher, Liberati, Tetzlaff, & Altman, 2009). 46 articles were excluded according to the inclusion and exclusion criteria. 15 studies were included in the qualitative synthesis for this update.

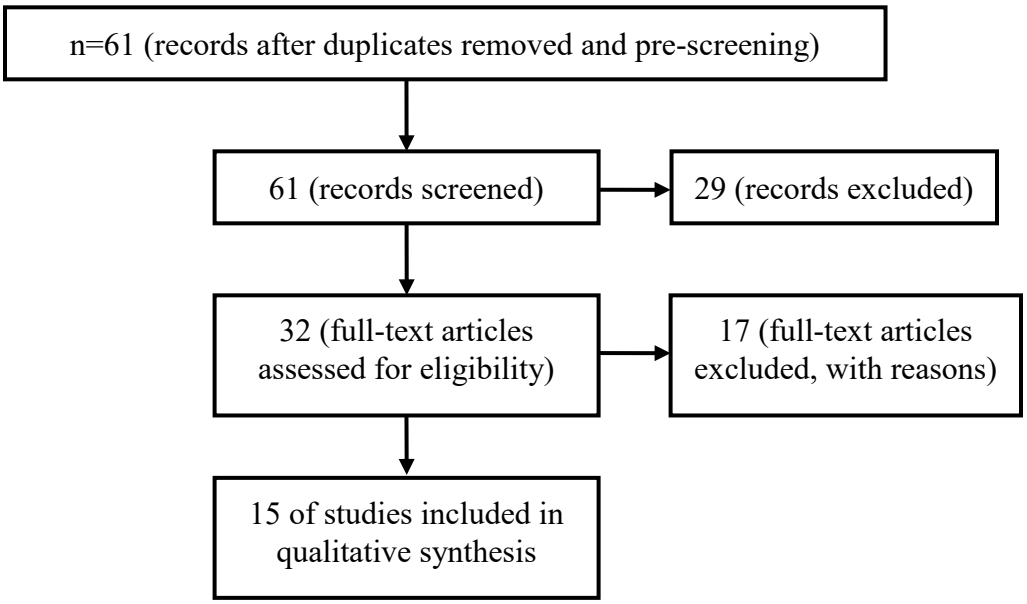

Table 1. Inclusion and exclusion criteria for results of the literature search

Inclusion Criteria	Exclusion Criteria
- Must mention COVID-19 (SARS-CoV-2) - Specifically mentions HCW of any specialty - Data from countries where the death rate doubling time is > 7 days (those not mentioned in the exclusion criteria) (Jefferson et al., 2008) - Data for Canada - Published in April 2020 - English language - Peer-reviewed research - Pre-print research - Reputable grey literature (eg. government reports) - Media articles - Blog posts - Academic institutions (eg. case count websites) - No restriction on research methods	1. Article is not from a credible source 2. Article does not have a clear research question or issue 3. Presented data/evidence is not sufficient to address the research questions 4. Does not mention COVID-19 (SARS-CoV-2) 5. Does not specifically mention HCW of any specialty 6. Only discusses patient treatment or outlines procedures or PPE recommendations 7. Languages other than English (peer-reviewed literature) or that could not be translated using Google Translate (grey literature) 8. Data from countries where the death rate doubling time is 7 days or less (Somalia, Haiti, Guatemala, Isle of Man, Tanzania, Kuwait, Latvia, Afghanistan, Sudan, Japan, Finland, Senegal, Russia) (Statista, 2020)

Critical Evaluation of the Evidence

Exclusion criteria for study quality were adapted from the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). Potential articles were evaluated on three criteria: 1) Peer reviewed or from a reputable source; 2) Clear research question or issue; 3) Whether the presented data/evidence is appropriate to address the research question. Preprints and non peer-reviewed literature (such as commentaries and letters from credible journals) are not excluded out of hand due to the novelty of COVID-19 and the speed with which new evidence is available.

Table 2 below is a narrative summary of the body of evidence included in this review. The categories, format, and suggested information for inclusion were adapted from the Oxford Centre for Evidence-Based Medicine, the Cochrane Library, and the AGREE Trust (Brouwers et al., 2010; Urwin, Graziadio, & Gavinder, 2020; Viswanathan et al., 2008; Wynants et al., 2020).

Table 2. Narrative overview of the literature included in this review.

	Description
Volume	- 4 pre-prints - 1 modelling study - 2 news articles - 3 letters to academic journals - 1 grey literature - 4 peer-reviewed articles
Quality	The evidence from this study was of variable quality. The majority was not peer-reviewed. Only one study was not observational (Barrett et al., 2020). Sources of bias in this body of evidence is related to data collection and the difficulties of determining the transmission exposure. In data collection, these could include variability in reporting structures across jurisdictions, variable rates of false negative (or false positive) test results and non-compliance with reporting instructions. When determining exposure and contacts, sources of bias could include recall ability and social desirability (when describing PPE use and hand hygiene). In news articles, data is often rounded to better serve the narrative and facilitate understanding, rather than presenting the true figures. These articles are also used to provoke a reaction in the reader, so the interpretation of the data is likely to include some bias.
Applicability	Each jurisdictions experience with COVID-19 has been different. This is a function of their epidemic dynamics, availability of PPE, the actions taken by decision-makers, and the public health strategies employed. The epidemic progression within a single country can be variable, as Alberta's experience is different from that of Ontario or Saskatchewan. Evidence presented here has limited applicability and should be used with caution.
Consistency	The evidence is somewhat consistent. It is still too early to determine the true risk to healthcare workers, and the incidence rates presented are reflective of each jurisdiction's experience with the pandemic.

Search Strategy

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) 1946 to April 24, 2020

#	Searches	Results
1	exp Health Personnel/ or (health practitioner* or health professional* or healthcare worker* or health care worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).kf,tw.	2691881
2	exp Coronavirus/ or exp Coronavirus Infections/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-COV-2.mp. or SARSCOV-2.mp. or SARSCOV2.mp. or SARSCOV19.mp. or Sars-Cov-19.mp. or SarsCov-19.mp. or SARSCOV2019.mp. or Sars-Cov-2019.mp. or SarsCov-2019.mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or "2019ncov".mp.	25857
3	1 and 2	2194
4	limit 3 to (english language and yr="2020 -Current")	905
5	limit 4 to ed="20200327-20200425"	120

CINAHL Plus with Full Text

#	Query	Limiters/Expanders	Last Run Via	Results
S4	S1 AND S2	Limiters - Published Date: 20200301-20200431; English Language Expanders - Apply equivalent subjects	Interface - EBSCOhost Research Databases Search Screen - Advanced	352

		Search modes - Boolean/Phrase	Search Database - CINAHL Complete	
S3	S1 AND S2	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	1,340
S2	(MH "Health Personnel+") OR (health practitioner* or health professional* or healthcare worker* or health care worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	2,039,675

	rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*)			
S1	(MH "Coronavirus+") OR (MH "Coronavirus Infections+") OR coronaviru* OR "corona virus" OR ncov* OR n-cov* OR COVID-19 OR COVID19 OR COVID-2019 OR COVID2019 OR SARS-COV-2 OR SARSCOV-2 OR SARSCOV2 OR SARSCOV19 OR SARS-COV-19 OR SARSCOV-19 OR SARSCOV2019 OR SARS-COV-2019 OR SARSCOV-2019 OR "severe acute respiratory syndrome cov 2" OR "severe acute respiratory syndrome coronavirus*" OR "2019 ncov" OR 2019ncov OR Hcov*	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	4,686

LitCovid

“healthcare workers” or “health care workers” or “health care professionals” or “healthcare professionals” or “health practitioners” or “health personnel” or pharmacists or nurses or physicians or doctors

TRIP PRO

(“healthcare workers” or “health care workers” or “health care professionals” or “healthcare professionals” or “health practitioners” or “health personnel” or “emergency medical technicians” or pharmacists or nurses or physicians or doctors) AND (coronaviru* OR "corona virus" OR ncov* OR n-cov* OR COVID-19 OR COVID19 OR COVID-2019 OR COVID2019 OR SARS-COV-2 OR SARSCOV-2 OR SARSCOV2 OR SARSCOV19 OR SARS-COV-19 OR SARSCOV-19 OR SARSCOV2019 OR SARS-COV-2019 OR SARSCOV-2019 OR "severe acute respiratory syndrome cov 2" OR "severe acute respiratory syndrome coronavirus*" OR "2019 ncov" OR 2019ncov OR Hcov*) from:2020

PubMed

("health personnel"[MeSH Terms] or health practitioner*[Title/Abstract] or health professional*[Title/Abstract] or healthcare worker*[Title/Abstract] or health care worker*[Title/Abstract] or health personnel[Title/Abstract] AND (english[Filter])) AND (((wuhan[tw] AND (coronavirus[tw] OR corona virus[tw])) OR coronavirus*[ti] OR COVID*[tw] OR nCov[tw] OR 2019 ncov[tw] OR novel coronavirus[tw] OR novel corona virus[tw] OR covid-19[tw] OR SARS-COV-2[tw] OR Severe Acute Respiratory Syndrome Coronavirus 2[tw] OR coronavirus disease 2019[tw] OR corona virus disease 2019[tw] OR new coronavirus[tw] OR new corona virus[tw] OR new coronaviruses[all] OR novel coronaviruses[all] OR "Severe Acute Respiratory Syndrome Coronavirus 2"[nm] OR 2019 ncov[tw] OR nCov 2019[tw] OR SARS Coronavirus 2[all]) AND (2019/12[dp]:2020[dp])) Filters: English Sort by: Most Recent

WHO

(tw:(“healthcare workers”)) OR (tw:(“health care workers”)) OR (tw:(“health care professionals”)) OR (tw:(“healthcare professionals”)) OR (tw:(“health personnel”)) OR (tw:("pharmacists")) OR (tw:("nurses")) OR (tw:("physicians")) OR (tw:("doctors"))

MEDRxiv
corona worker (posted between "27 Mar, 2020 and 28 Apr, 2020")
covid worker (posted between "27 Mar, 2020 and 28 Apr, 2020")
COVID-19 SARS-CoV-2 healthcare south korea (posted between "27 Mar, 2020 and 28 Apr, 2020")
COVID-19 SARS-CoV-2 healthcare singapore (posted between "27 Mar, 2020 and 28 Apr, 2020")
COVID-19 SARS-CoV-2 healthcare spain (posted between "27 Mar, 2020 and 28 Apr, 2020")
BIORxiv
corona worker (posted between "27 Mar, 2020 and 28 Apr, 2020")
covid worker (posted between "27 Mar, 2020 and 28 Apr, 2020")
Google
healthcare worker covid-19 infection rates south korea (Mar. 27, 2020 – Apr. 28, 2020)
healthcare worker coronavirus infection south korea (Mar. 27, 2020 – Apr. 28, 2020)
coronavirus infection demographic south korea (Mar. 27, 2020 – Apr. 28, 2020)
COVID-19 SARS-CoV-2 healthcare worker infections south korea (Mar. 27, 2020 – Apr. 28, 2020)
COVID-19 SARS-CoV-2 healthcare worker infections singapore (Mar. 27, 2020 – Apr. 28, 2020)
healthcare worker covid-19 infection rates singapore (Mar. 27, 2020 – Apr. 28, 2020)
healthcare worker coronavirus infection singapore (Mar. 27, 2020 – Apr. 28, 2020)
coronavirus infection demographic singapore (Mar. 27, 2020 – Apr. 28, 2020)
COVID-19 SARS-CoV-2 healthcare worker infections spain (Mar. 27, 2020 – Apr. 28, 2020)
healthcare worker covid-19 infection rates spain (Mar. 27, 2020 – Apr. 28, 2020)
healthcare worker coronavirus infection spain (Mar. 27, 2020 – Apr. 28, 2020)
coronavirus infection demographic spain (Mar. 27, 2020 – Apr. 28, 2020)
Coming out of retirement italy covid (Mar. 27, 2020 – Apr. 28, 2020)
Coming out of retirement pandemic (Mar. 27, 2020 – Apr. 28, 2020)
Increase in number of healthcare workers covid (Mar. 27, 2020 – Apr. 28, 2020)
Covid retirement (Mar. 27, 2020 – Apr. 28, 2020)
Healthcare worker suicide covid (Mar. 27, 2020 – Apr. 28, 2020)
Italy official data of healthcare worker covid infection (Mar. 27, 2020 – Apr. 28, 2020)
Italian ISS covid (Mar. 27, 2020 – Apr. 28, 2020)
Instituto sanitario de sante covid 19 (Mar. 27, 2020 – Apr. 28, 2020)
Italy covid raw data (Mar. 27, 2020 – Apr. 28, 2020)
Italy cdc (Mar. 27, 2020 – Apr. 28, 2020)
Italy health care worker covid (Mar. 27, 2020 – Apr. 28, 2020)
Google Scholar
healthcare worker covid-19 infection rates south korea
healthcare worker coronavirus infection south korea
coronavirus infection demographic south korea
COVID-19 SARS-CoV-2 healthcare worker infections south korea
healthcare worker covid-19 infection rates singapore
healthcare worker coronavirus infection singapore
COVID-19 SARS-CoV-2 healthcare worker infections singapore
coronavirus infection demographic singapore
COVID-19 SARS-CoV-2 healthcare worker infections spain
healthcare worker covid-19 infection rates spain

healthcare worker coronavirus infection spain
coronavirus infection demographic spain

Literature Search Details: Original Rapid Review

This rapid review was conducted according to the NCCMT Rapid Review Guidebook (Dobbins, 2017) and is similar to a recent published rapid review (Brooks et al., 2020).

PICO:

- **Population of interest:** frontline HCWs (doctors, nurses) – ideally in acute hospital settings with exposure to patients with COVID-19.
- **Interventions/Exposure:** HCW at risk of infection with COVID-19 resulting from occupational exposure (i.e., HCW are exposed to transmission of the virus from COVID-19-positive patients/co-workers).
- **Comparator:** cases of COVID-19 in the general population (i.e., non-HCW population)
- **Outcome:** infection with COVID-19 (SARS-CoV-2)

Table 3. Inclusion and exclusion criteria for sources to be considered in the rapid review.

Inclusion Criteria	Exclusion Criteria
1. Must mention COVID-19 (SARS-CoV-2) 2. Specifically mentions HCW of any specialty 3. Data from countries where the death rate doubling time is > 7 days (Jefferson et al., 2008) (Italy, China, Spain, South Korea, Singapore, Indonesia, the Philippines) 4. Data for Canada 5. 2019 to present due to the recent emerging nature of COVID-19 6. In English (peer-reviewed literature search) or ability to translate using Google Translate (grey literature) 7. Peer-review published research 8. Pre-print research 9. Government reports 10. Media articles (print or online) 11. Blog posts 12. Academic institutions (e.g., case count websites) 13. No restriction on research methods – due to the early global phase of this outbreak, it was anticipated that the majority of these data would not be published in peer-reviewed articles or even official government reports	1. Does not mention COVID-19 (SARS-CoV-2) 2. Does not specifically mention HCW of any specialty 3. Only discusses patient treatment or outlines procedures or PPE recommendations 4. Languages other than English (peer-reviewed literature) or that could not be translated using Google Translate (grey literature) 5. Date from countries where the death rate doubling is 7 days or less

- **Peer-reviewed literature:** The search strategy was developed by AHS librarians in Ovid Medline (shown below) and was completed on April 1, 2020 at 4:00MST. The search strategy was adapted and applied to the following databases: Ovid Medline, Ovid Embase, LitCovid, CINAHL, TRIP PRO, BMJ Best Practice, WHO Global research on coronavirus (database), Google and Google Scholar. Search results were exported in *.ris format and uploaded to DistillerSR. Reference lists of included articles were scanned for other references not found by the academic search. Due to the emerging nature COVID-19, the search results were limited to 2019-present, since the first documented case was November 2019. There were no restrictions on article type or country. The search was limited to English language articles only. The search strategies for the other databases are at the end of the Appendix.

Table 4. Example search strategy used in Ovid Medline for the in the rapid review.

#	Searches	Results
1	exp Health Personnel/ or (health practitioner* or health professional* or healthcare worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).mp.	6243193
2	exp Coronavirus/ or exp Coronavirus Infections/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-COV-2.mp. or SARSCOV-2.mp. or SARSCOV2.mp. or SARSCOV19.mp. or Sars-Cov-19.mp. or SarsCov-19.mp. or SARSCOV2019.mp. or Sars-Cov-2019.mp. or SarsCov-2019.mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or "2019ncov".mp.	20564
3	1 and 2	2742
4	limit 3 to (english language and yr="2019 -Current")	295

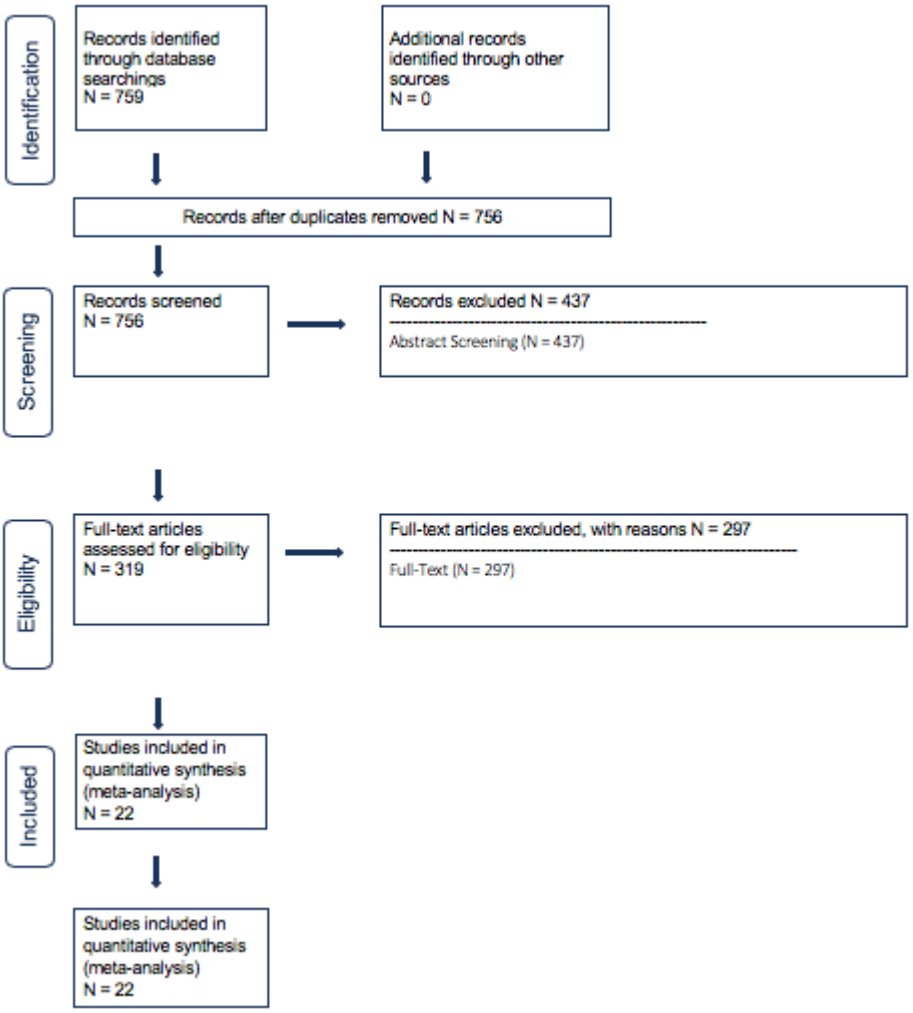

Figure 1. PRISMA diagram (Moher et al., 2009) for the peer-reviewed literature search to identify the HCW risk of COVID-19 infection from occupational exposure. Results are from the two-level screening conducted in DistillerSR.

Grey Literature sources/strategies included:

- All sources below were searched for COVID-19 information relating to HCW
- Snowball searching was employed where relevant (e.g., if an article referenced a primary data source of relevance to the review, it was reviewed wherever possible)
- Public Health Agencies of countries that meet our inclusion criteria:
    - China, Italy, South Korea, Singapore, Spain
- Twitter: 7 results - 1 duplicate with previous findings, 1 with expired case numbers
    - Searches:
    - #covid19 #healthcareworker
    - #COVID19 healthcare worker risk
    - #COVID19 #nurse risk
    - #COVID19 #doctor risk
- WHO
- MEDRxiv

    - Corona worker
    - Covid worker
    - COVID-19 SARS-CoV-2 healthcare south korea - 1 result
    - COVID-19 SARS-CoV-2 healthcare singapore - 0 results
    - COVID-19 SARS-CoV-2 healthcare spain - 0 results
- BIORxiv
    - Corona worker
    - Covid worker
- Google
    - healthcare worker covid-19 infection rates south korea - 0 results
    - healthcare worker coronavirus infection south korea - 0 results
    - coronavirus infection demographic south korea - 0 results
    - COVID-19 SARS-CoV-2 healthcare worker infections south korea - 1 result
    - COVID-19 SARS-CoV-2 healthcare worker infections singapore - 0 results
    - healthcare worker covid-19 infection rates singapore - 0 results
    - healthcare worker coronavirus infection singapore - 1 result
    - coronavirus infection demographic singapore - 0 results
    - COVID-19 SARS-CoV-2 healthcare worker infections spain - 3 results
    - healthcare worker covid-19 infection rates spain - 3 results
    - healthcare worker coronavirus infection spain - 0 results
    - coronavirus infection demographic spain - 0 results
    - Coming out of retirement italy covid
    - Coming out of retirement pandemic
    - Increase in number of healthcare workers covid
    - Covid retirement
    - Healthcare worker suicide covid
    - Italy official data of healthcare worker covid infection
    - Italian ISS covid
    - Instituto sanitario de sante covid 19
    - Italy covid raw data
    - Italy cdc
    - Italy health care worker covid
- Google Scholar
    - healthcare worker covid-19 infection rates south korea - 0 results
    - healthcare worker coronavirus infection south korea - 0 results
    - coronavirus infection demographic south korea - 0 results
    - COVID-19 SARS-CoV-2 healthcare worker infections south korea - 0 results
    - healthcare worker covid-19 infection rates singapore - 1 result
    - healthcare worker coronavirus infection singapore - 0 results
    - COVID-19 SARS-CoV-2 healthcare worker infections singapore - 0 results
    - coronavirus infection demographic singapore - 0 results
    - COVID-19 SARS-CoV-2 healthcare worker infections spain - 0 results
    - healthcare worker covid-19 infection rates spain - 0 results
    - healthcare worker coronavirus infection spain - 0 results
    - coronavirus infection demographic spain - 0 results

Evidence Synthesis

Research Question 1

Data were considered from countries where the death rate doubling time is greater than 7 days according to the Our World in Data website (Roser & Ritchie, 2020). These countries included: Italy, China, Spain, Singapore, South Korea, Indonesia and the Philippines. This was done to provide a more robust estimate of HCW cases compared to the general population numbers for the ascending, plateau and in China's case, descending case numbers. These numbers are more representative of the total population than, for example, the US or Canada where case numbers are still increases by the day (as of April 3, 2020). Raw data used to perform calculations are provided in the Table 5. National population estimates were based on the most current data (2018) from the World Bank (The World Bank, 2018). Current case and mortality numbers were taken from April 3, 2020 reporting from the EU CDC (European Centre for Disease Prevention and Control, 2020) (Italy/Spain) and Johns Hopkins University Medicine Coronavirus Resource Center (Dong et al., 2020) (China, Philippines, Indonesia). Reports of HCW cases and mortalities/case fatality/hospitalization rates were taken from sources identified in the peer-reviewed and grey literature search.

Table 5. Population, HCW, case and death numbers from various countries for COVID-19.

Country	2018 Population	# HCWs	Total # Cases	Total # HCW Cases	Total # Deaths	HCW # Deaths
Italy	60,431,280	587,211	97,686	8,358	10,781	149
China (Hubei)	7,556,000	35,266	67,802	1,808	3,203	21
Spain	46,723,750	448,641	110,238	15,433	1,003	N/A
China (all)	1,392,730,000	6,465,053	82,511	2,055	3,326	22
China (non-Hubei)	1,385,174,000	6,429,786	14,709	247	123	1
Philippines	106,651,920	590,318	3,018	501	136	33
Indonesia	267,663,430	760,699	1,986	23	181	6

Formulas and references:

1. # HCWs = 2017 or 2018 (Doctors + Nurses/Midwives)/10,000 * 2018 Population (The World Bank, 2018; World Health Organization, 2020c)
2. Total # Cases and Total # deaths
    a. Italy/Spain (European Centre for Disease Prevention and Control, 2020)
    b. All other countries/regions (Dong et al., 2020)
3. Total # HCW cases
    a. Italy (Filippo et al., 2020; Giordano, 2020; Heneghan, Brassey, & Jefferson, 2020; International Council of Nurses, 2020b, 2020a; Mitchell, 2020)
    b. All of China (World Health Organization, 2020b)
    c. Hubei = # China HCW cases * proportion from Hubei (World Health Organization, 2020b)
    d. Non-Hubei China = # China HCW cases * 1-proportion from Hubei (World Health Organization, 2020b)
    e. Philippines (CNN Philippines Staff, 2020)
    f. Indonesia (Anonymous, 2020f)
4. Total # HCW deaths
    a. Italy (Anonymous, 2020d; Giordano, 2020)
    b. All of China = national HCW mortality rate from COVID-16 (Wang, Wang, Chen, & Qin, 2020)* # HCW cases in China

   c. Hubei = national HCW mortality rate (Wang et al., 2020) * 3c
   d. Non-Hubei China = 3c – 4c
   e. Philippines (CNN Philippines Staff, 2020)
   f. Indonesia (Andriyanto & Rikin, 2020)
5. General Population Risk = (total cases – HCW cases) / (total population – HCW population)
6. HCW Attack Risk = HCW cases / # HCWs
7. Case Fatality Rate (Note: this is a risk measure, but is a commonly used term in outbreak analysis)
   a. General Population Case Fatality Rate = (total deaths – HCW deaths) / (total cases – HCW cases)
   b. HCW Case Fatality Rate = HCW deaths / HCW cases
8. Calculation of Relative Rates and Rate Differences, plus 95% confidence intervals and statistical tests:
   a. STATA 15 Intercooled (College Station, TX)
   b. csi (# cases HCW) (# cases general population) (# NCWs) (general population)

# HCW Cases (a)	**# General Population Cases (b)**
# HCW Non-cases (c)	**# General Population Non-cases (d)**

   c. Relative Rate = a/(a+c) / b/(b+c)
   d. Rate Difference per 10,000 = [a/(a+c)]*10,000 – [b/(b+c)]*10,000

Comparisons were made between countries/regions considered to be “high-risk” for transmission (Italy, Hubei Province and Spain) compared to “low-risk” non-Hubei China, the Philippines and Indonesia based on the patterns of their epidemic curves. There was only one report of HCW cases in South Korea in one of the original clusters at the Chungdo Daenam hospital where 9 of the 114 cases were medical staff (FGL 1). On February 25, 2020, Singapore reported zero HCW infections (Young et al., 2020). Since then, there have been a handful of cases in HCWs, the source of which are thought to be from outside of the hospital (Xinghui, 2020).

Table 1 shows the overall proportion of cases in HCW in “high-risk” countries/regions (Italy, Hubei, Spain) was 9.3% compared to 3.91% in “low-risk” countries (the rest of China, Indonesia, the Philippines). The relative attack rates in “high-risk” and “low-risk” countries/regions were significantly higher and similar (9-10x) for HCWs compared to the general population. However, the overall risk difference is much higher in the “high-risk” countries/regions; being a HCW increases the rate of COVID-19 cases by 217/10,000 population compared to <1 in “low-risk” countries.

It was difficult to obtain representative data case fatalities in HCWs (Table 2). In “high-risk” countries, the general population case fatality rate (death rate in cases excluding HCW cases) exceeded the HCW case fatality rate in both Italy (11.9% vs 1.8%) and Hubei (4.8% vs 1.2%). Spain did not report data on HCW mortalities, but the overall case fatality rate for all cases (general population and HCW) was 14.0%, higher than Italy or Hubei (Anonymous, 2020b; Benavides, 2020; Nugent, 2020). Spain reported a hospitalization rate (8.8%) for HCWs with COVID-19 infection (Alfageme & Valdes, 2020). The general population case fatality rate in “low-risk” countries is comparable to that of HCWs. However, these rates were highly variable, particularly the HCW case fatality rates.

For example, the Indonesia rate was based on two sources: 6 HCW deaths (Andriyanto & Rikin, 2020) in 23 HCW cases (Anonymous, 2020f). Data from the Philippines were based on larger numbers (33 HCW deaths in 501 HCW cases) (CNN Philippines Staff, 2020). Non-Hubei HCW deaths in China were estimated to be 1 in 247 HCW cases. In China, the same mortality rate was applied to Hubei and non-Hubei HCW cases (1.07%) because regional-specific data were not available (Wang et al., 2020; World Health Organization, 2020b). Overall, it seems that the HCW case numbers from non-Hubei China may be an underestimate given the size of the population.

Special Considerations/Limitations of global HCW risk analysis

The overall population, case and death rate data came from reliable sources (government and academic). However, most death rate data for HCWs came from news outlets (with the exception of China). The definition of a "healthcare worker" varies by country. These variations will likely affect the numbers of HCWs and reported number of cases in HCWs. National HCW numbers were estimated using the sum of WHO estimates for doctors and nurses/midwives per 10,000 population for 2017/2018 (World Health Organization, 2020c).There were no data available to estimate the proportion of healthcare workers that work in an acute hospital setting or further breakdown by medical specialty. As a result, these results represent the estimate for the entire HCW population in a given country, not the subset of the population that are more likely to be exposed in an acute hospital setting. The exposure risk for HCWs in acute, hospital-based settings is much likely higher than those in community-based settings (*Lynora Saxinger, Personal Communication*). There is also a documented influx of HCWs coming out of retirement to work in acute hospital settings in most countries who could be at higher risk of infection, hospitalization and death because of their age (Hume, 2020). There is also concern about increased death rates in HCW populations due to their increased level of stress and exhaustion (Bai et al., 2020). There have been two documented deaths by COVID-19 related suicide in Italian healthcare workers (Giuffrida & Tondo, 2020), while another source estimates that 6 healthcare workers have died by COVID-19 related suicide (Anthanasios, 2020). An additional 18 healthcare worker deaths have been reported from COVID-19 related cardiac arrest and other ailments due to overwork and fatigue (Su, 2020). It is also important to note that this case fatality rates have not been standardized by age. It may be that the age demographics of HCWs differ markedly from the general population, particularly age-specific case fatality rates. There were no data to estimate these age-specific case fatality rates by population of interest.

It is absolutely crucial to note that these HCW case numbers do not account for whether the HCW was infected from occupational or non-occupational exposure. No data separated occupational from non-occupational cases. The last important limitation is that testing rates per capita and testing triage recommendations vary by country and region (Hasell et al., 2020). As a result, the relative proportions of HCW cases compared to the general population between countries must be considered with this in mind.

Critical Appraisal

Given the early, emerging phase of the COVID-19 pandemic, there were few literature sources that fall into typical categories considered eligible for Rapid Reviews (eg. guidelines, systematic reviews, published primary studies, pre-print primary studies, etc.) (Dobbins, 2017). The critical appraisal methods from SAG was modified to fit the large volume of articles in this review that were media (mostly websites). It was too early to find much published and pre-print data, though 22 articles were considered for data extraction from full text. The review of these sources, using the modified critical appraisal table, is shown in Table 6.

Table 6. Modified critical appraisal of reviewed sources.

(International Council of Nurses, 2020b)	From Scoping Review? Yes	Peer reviewed? No	Type: Report (ICN)
(Bernstein, Boburg, Sacchetti, & Brown, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: News
(Heneghan et al., 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Report
(Oystein Kalsnes, Morten Carstens, Ketil, Goran, & Ragnheiur, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Temet et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Filippo et al., 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Anonymous, 2020c)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Chen & Bin, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Jiancong, Mouqing, & Fangfei, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Epidemiological Group of Emergency Response Mechanism of New Coronavirus Pneumonia in Chinese Center for Disease Control and Prevention, 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Liu et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Adams, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Chantal et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Wu & McGoogan, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Koh, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Joob, 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Yuanyuan et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Wang et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Ran et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(Zhang et al., 2020)	From Scoping Review? Yes	Peer reviewed? No	Type: Academic
(Elise et al., 2020)	From Scoping Review? Yes	Peer reviewed? Yes	Type: Academic
(International Council of Nurses, 2020b)	From Scoping Review? No	Peer reviewed? No	Type: Report (ICN)
(Belenky, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Gan, Thomas, & Culver, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Minder & Peltier, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Secon, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Grant, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Quigley, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Lee, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Stickings & Dyer, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Danmeng & Jia, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News

(Young et al., 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(World Health Organization, 2020b)	From Scoping Review? No	Peer reviewed? No	Type: Report (WHO)
(Xinghui, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Anonymous, 2020e)	From Scoping Review? No	Peer reviewed? No	Type: News
(Andriyanto & Rikin, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Bai et al., 2020)	From Scoping Review? No	Peer reviewed? No	Type: Academic
(Khera, Dhingra, Jain, & Krumholz, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Academic
(Pelley, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News (PHO)
(Benavides, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Anonymous, 2020a)	From Scoping Review? No	Peer reviewed? No	Type: News
(Anonymous, 2020b)	From Scoping Review? No	Peer reviewed? No	Type: News
(Nugent, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Jones, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Anonymous, 2020d)	From Scoping Review? No	Peer reviewed? No	Type: News
(Giuffrida & Tondo, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Anthanasios, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Opinion
(Xiantai, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(McMurty, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Epidemiological Group of Emergency Response Mechanism of New Coronavirus Pneumonia in Chinese Center for Disease Control and Prevention, 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(Wang et al., 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(Giordano, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Mitchell, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Gan et al., 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(World Health Organization, 2020a)	From Scoping Review? No	Peer reviewed? No	Type: Report (WHO)
(WHO Director General, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Report (WHO)
(Su, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Public Health Ontario, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Report (PHO)
(Buerhaus, Auerbach, & Staiger, 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(Dy & Rabajante, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Academic
(Pinedo & Faus, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Buchwald, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Fisher & Sang-Hun, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Shim et al., 2020)	From Scoping Review? No	Peer reviewed? No	Type: Academic

(Alfageme & Valdes, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Jiaojiao et al., 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(World Health Organization, 2020c)	From Scoping Review? No	Peer reviewed? No	Type: Dataset
(European Centre for Disease Prevention and Control, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Report
(The World Bank, 2018)	From Scoping Review? No	Peer reviewed? No	Type: Dataset
(Howlett, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(National Bureau of Statistics China, 2018)	From Scoping Review? No	Peer reviewed? No	Type: Dataset
(Québec, 2020)	From Scoping Review? No	Peer reviewed? No	Type: Report
(BCCDC, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News
(Brooks et al., 2020)	From Scoping Review? No	Peer reviewed? Yes	Type: Academic
(Hume, 2020)	From Scoping Review? No	Peer reviewed? No	Type: News

Literature Search Results

Topic: Is there an increased risk for hospital-based HCWs of infection with COVID-19?
Date: April 1, 2020
AHS Librarians

Search Strings from Other Databases

OVID MEDLINE, EMBASE, LitCovid, CINAHL, TRIP PRO, BMJ Best Practice, WHO Global research on coronavirus (database), Google and Google Scholar. The citation tracking method was also applied in Google Scholar.

Search Results

The search results to be sent in the ris format via email, for importing into a citation manager.

Search Strategies

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) 1946 to March 31, 2020

#	Searches	Results
1	exp Health Personnel/ or (health practitioner* or health professional* or healthcare worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or	6243193

	hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).mp.	
2	exp Coronavirus/ or exp Coronavirus Infections/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-COV-2.mp. or SARSCOV-2.mp. or SARSCOV2.mp. or SARSCOV19.mp. or Sars-Cov-19.mp. or SarsCov-19.mp. or SARSCOV2019.mp. or Sars-Cov-2019.mp. or SarsCov-2019.mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or "2019ncov".mp.	20564
3	1 and 2	2742
4	limit 3 to (english language and yr="2019 -Current")	295

CINAHL Plus with Full Text

#	Query	Limiters/Expanders	Last Run Via	Results
S6	S1 AND S4	Limiters - Published Date: 20191101-20200431; English Language Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	91
S5	S1 AND S4	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	977

S4	S2 OR S3	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	2,030,874
S3	health practitioner* or health professional* or healthcare worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,951,439
S2	(MH "Health Personnel+")	Expanders - Apply equivalent subjects	Interface - EBSCOhost	595,654

		Search modes - Boolean/Phrase	Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	
S1	(MH "Coronavirus+") OR (MH "Coronavirus Infections+") OR coronaviru* OR "corona virus" OR ncov* OR n-cov* OR COVID-19 OR COVID19 OR COVID-2019 OR COVID2019 OR SARS-COV-2 OR SARSCOV-2 OR SARSCOV2 OR SARSCOV19 OR SARS-COV-19 OR SARSCOV-19 OR SARSCOV2019 OR SARS-COV-2019 OR SARSCOV-2019 OR "severe acute respiratory syndrome cov 2" OR "severe acute respiratory syndrome coronavirus*" OR "2019 ncov" OR 2019ncov OR Hcov*	Expanders - Apply equivalent subjects Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	3,589

OVID EMBASE

Search #	Search Terms	Results
1	exp health care personnel/ or (health practitioner* or health professional* or healthcare worker* or health* personnel or community health worker* or dental* or dentist* or denturist* or emergency medical technician* or home health aide* or medical record administrator* or medical secretar* or medical receptionist* or psychiatric aide* or operating room technician* or pharmac* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or coroner* or medical examiner* or endodontist* or orthodontist* or doula* or epidemiologist* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical lab* personnel or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or optometrist* or hospital volunteer* or physical therapist* or physician* or doctor or doctors or allergist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or general practitioner* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).mp.	6500595
2	exp coronaviridae/ or exp coronaviridae infection/ or exp coronavirinae/ or exp coronavirus infection/ or coronaviru*.mp. or "corona virus*".mp. or ncov*.mp. or n-cov*.mp. or COVID-19.mp. or COVID19.mp. or COVID-2019.mp. or COVID2019.mp. or SARS-COV-2.mp. or SARSCOV-2.mp. or SARSCOV2.mp. or SARSCOV19.mp. or Sars-Cov-19.mp. or SarsCov-19.mp. or SARSCOV2019.mp. or Sars-Cov-2019.mp. or SarsCov-2019.mp. or "severe acute respiratory syndrome cov 2".mp. or "2019 ncov".mp. or "2019ncov".mp.	26766
3	1 and 2	4444

4	limit 3 to (english language and yr="2019 -Current")	434

LitCovid

“healthcare workers” or “health care workers” or “health care professionals” or “healthcare professionals” or “health practitioners” or “health personnel” or “emergency medical technicians” or pharmacists or nurses or physicians or doctors

TRIP PRO

(“healthcare workers” or “health care workers” or “health care professionals” or “healthcare professionals” or “health practitioners” or “health personnel” or “emergency medical technicians” or pharmacists or nurses or physicians or doctors) AND (coronaviru* OR "corona virus" OR ncov* OR n-cov* OR COVID-19 OR COVID19 OR COVID-2019 OR COVID2019 OR SARS-COV-2 OR SARSCOV-2 OR SARSCOV2 OR SARSCOV19 OR SARS-COV-19 OR SARSCOV-19 OR SARSCOV2019 OR SARS-COV-2019 OR SARSCOV-2019 OR "severe acute respiratory syndrome cov 2" OR "severe acute respiratory syndrome coronavirus*" OR "2019 ncov" OR 2019ncov OR Hcov*) from:2019

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