National Collaborating Centre for Methods and Tools

Centre de collaboration nationale des méthodes et outils

School of Nursing | McMaster University

# Rapid Review: What is the evidence for COVID-19 transmission in acute care settings?

Prepared by: The National Collaborating Centre for Methods and Tools

Date: December 11, 2020

## Suggested Citation:

National Collaborating Centre for Methods and Tools. (2020, December 11). *Rapid Review: What is the evidence for COVID-19 transmission in acute care settings?* https://www.nccmt.ca/knowledge-repositories/covid-19-rapid-evidence-service.

Please Note: An update of this review may be available. Access the most current version of this review by visiting the National Collaborating Centre for Methods and Tools COVID-19 Rapid Evidence Service at the above link.

© 2020. National Collaborating Centre for Methods and Tools, McMaster University. All rights reserved.

The National Collaborating Centre for Methods and Tools (NCCMT) is hosted by McMaster University and funded by the Public Health Agency of Canada. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada.

This Rapid Review is for general information purposes only. The information provided in this Rapid Review is provided "as is" and McMaster University makes no warranties, promises and/or representations of any kind, expressed or implied, as to the nature, standard, accuracy, completeness, reliability or otherwise of the information provided in this Rapid Review, nor to the suitability or otherwise of the information to your particular circumstances. McMaster University does not accept any responsibility or liability for the accuracy, content, completeness, legality, reliability or use of the information contained in this Rapid Review. This review was supported by funding from nib Health. The funder had no role in collection or interpretation of data.

The authors declare they have no conflicts of interest to report.

# Executive Summary

## Background

Evidence related to COVID-19 transmission in acute care settings has implications for understanding risks for staff, patients and communities, infection prevention and control measures, and potential mitigation strategies.

This rapid review was produced to support public health decision makers' response to the coronavirus disease 2019 (COVID-19) pandemic. This review seeks to identify, appraise, and summarize emerging research evidence to support evidence-informed decision making.

This rapid review includes evidence available up to November 13, 2020 to answer the questions: What is known about how and by whom COVID-19 is introduced and transmitted within acute care settings? What factors influence the introduction and spread of COVID-19 in acute care settings? What control measures have been successful in acute care settings to prevent primary and secondary cases of COVID-19?

Abbreviations used in this report are:

- HCW: Health care worker(s)
- PPE: Personal protective equipment
- FFP1: Filtering face piece 1 – filters at least 80% airborne particles
- FFP2: Filtering face piece 2 – filters at least 94% of airborne particles
- FFP3: Filtering face piece 3 – Filters at least 99% of airborne particles

## Key Points

<u>Introduction and Transmission of COVID-19</u>

- Contact tracing in acute care settings is often unable to identify the source of infection (the index case), particularly for cases among health care workers (HCW). The nature of the work in acute care means that HCW cases have multiple contacts, with patients, staff and community/family members, making definitive contact tracing difficult. As a result, conclusions drawn from the available evidence about the transmission of COVID-19 in health care settings must be considered with caution.
- There are reports of transmission in acute care settings, but the frequency is not known and is dependent on factors in the setting including IPAC measures, levels of community transmission, among other variables.
- The available evidence related to transmission of COVID-19 in acute care settings shows a low risk of HCW transmitting infection to HCW or patients when PPE is used (e.g., masks, gloves, gowns, eye protection). When PPE is routinely in use in the setting, HCW are more likely to be infected by HCW than by patients, and patients are more likely to be infected by patients than by HCW. The overall certainty of this evidence is very low and findings are very likely to change as more evidence accumulates.

Risk Factors

- In studies that explored HCW with known exposures, close contact with an infected colleague or in a shared workplace appeared to increase risk of infection compared to exposure to an infected patient. The overall certainty of this evidence is very low, and findings are very likely to change as more evidence becomes available.
- Lack of access to or improper use of PPE is associated with increased risk of infection. The overall certainty of the evidence is moderate, so while the direction of effect is less likely to change as more evidence becomes available, the size, or magnitude, of effect may change.
- There is no clear association between demographic characteristics, a specific role in an acute care setting (e.g., physician, nurse, administrative staff, etc.) or work in a specific department or location in a hospital (e.g., emergency department, surgical ward, etc.) and risk of COVID-19 infection in HCW in acute care settings. The overall certainty of the evidence is low, and findings may change as more evidence accumulates.

Protective Strategies

- Demonstrated strategies to control the spread of infection include:
    - Use of PPE (masks, gloves, gowns, eye protection)
    - Universal workplace HCW testing
    - Distancing of 1m or more
    - Triaging areas are associated with low levels of infection, although no specific comparisons are available.

  The overall certainty of this evidence is very low and findings are very likely to change as more evidence accumulates.

## Overview of Evidence and Knowledge Gaps

- The designs of the included studies are observational (primarily cross-sectional and case-control designs which are high risk of bias) and do not control for the level of virus circulating in community settings. The majority of studies examined univariate relationships between transmission or risk factors and COVID-19 infection, without control for other confounding factors and other sources of exposure.
- The majority of identified studies include data collected in the early phases of the COVID-19 pandemic, during which lack of access to proper PPE was noted in some jurisdictions. As the understanding of the route of transmission and effective IPAC measures has evolved considerably, the applicability of these data to the current context may be limited. For example, several studies note that data were collected prior to widespread mask use in the hospital setting.
- There are few recent syntheses directly relevant to these questions and included studies were primarily completed during the first wave of the pandemic. Although not done as part of this review, it may be valuable to conduct a jurisdictional scan of current rates of COVID-19 among HCW, and patients in hospital, given that implementation of robust IPAC measures appears to coincide with reduced transmission within health care settings in comparison to community settings, where PPE is not generally worn.
- The majority of studies explore transmission to and spread among HCW. Fewer studies investigate transmission of COVID-19 to patients already in hospital for non-COVID-19 reasons.

- There are imprecise and variable definitions of “health care worker” and “staff” in the available studies. Included participants often hold roles without direct patient contact, but in which contact with other hospital personnel is frequent (e.g., cleaning, food service, administration). Greater specificity in the use of these terms would improve the ability to identify specific risk pathways in acute care settings.
- Prevalence of confirmed COVID-19 infection and seroprevalence using antibody tests was highly variable across included studies. This suggests that a number of contextual factors (such as what IPAC measures are in place within and outside of hospital settings, rates of community transmission, etc.) are likely very important. As these factors were not controlled for in analyses, it is very hard to compare findings from different jurisdictions, and findings from other countries may not be applicable to the Canadian context.

<u>Introduction and Transmission of COVID-19</u>

- In 6 studies of forward contact tracing (in which a case is identified and subsequent infections among their contacts are traced) of infected HCW, a total of 69 index HCW cases were linked to 18 HCW cases and 12 patient cases. Three of these studies identified no or inadequate use of PPE and accounted for 9 HCW infections and 2 patient infections. In the remaining 3 studies, a Canadian study reported 5 HCW cases with no forward transmission to staff or patients; a Chinese study reported 1 index HCW case linked to 4 HCW cases; a Polish study reported on an outbreak with 1 index HCW case linked to 5 HCW and 10 patient cases.
- In 1 study of forward contact tracing of infected patients, 28 infected patients in a respiratory ward were linked to no HCW infections and possibly to 1 patient infection in a patient with other exposures.
- Two studies of HCW infections identify the source of infection through viral sequencing studies of the strain of COVID-19, and both of these studies conclude that the HCW infections were community-acquired.
- In 12 studies reporting on backward contact tracing (in which a case is identified, and their prior exposures are examined) of HCW infections, 5 were in settings with no or inadequate PPE use. Of the remaining 7 studies, specific sources of infection were identified in 4. In these 4 studies, there were 291 HCW cases, 85 of which were traced to HCW sources and 94 of which were traced to patient sources, with 179 having no identified source.
- Transmission from patient to HCW is infrequent in settings in which PPE is used. In a review of secondary attack rates (SAR) of COVID-19 in health care settings where the index case was an infected patient, the pooled SAR was 0.7% (95% CI: 0.4%-1.0%), with most individual studies reporting a SAR of < 2%.
- In 2 studies reporting on backward contact tracing of a total of 111 patient infections, 5 infections were traced to HCW and 85 were traced to patients, with the remaining 21 cases having no identified source.
- HCW infections are frequently identified among staff working in roles with no patient contact. This finding suggests that transmission to these staff is happening through HCW or community contacts.
- Studies of HCW beliefs about the source of their infection show that they most often consider the source of their infection to be patients.

- A low quality review shows no clear evidence to date of transmission of COVID-19 associated with HVAC systems in health care facilities, based on 4 COVID-19-specific included studies with unknown risk of bias.

Risk Factors

- The risk factors for transmission explored within individual studies were highly variable, making cross-study comparisons difficult. Similarly, when the same variable was measured in different studies (e.g., type of HCW sometimes including staff not responsible for patient care such as administrative staff, laboratory workers, custodians, porters; physicians and nurses sometimes divided by department or specialty, etc.) the categories were quite different.
- Findings that inadequate access to and improper use of PPE are risk factors are in line with findings from studies on protective strategies, highlighting the importance of proper PPE in reducing transmission.

Protective Strategies

- Several reviews of protective strategies included studies of infections other than COVID-19 (e.g., SARS, MERS, H1N1). It was not always possible to separate out the findings from COVID-19-specific studies.
- Several studies of protective strategies do not include comparative data, so the specific effectiveness of the strategy relative to other measures is unknown.
- Demonstrated strategies to control the spread of infection include:
    - Use of PPE (masks, gloves, gowns, eye protection), although one moderate quality study found that FFP2 PPE was not superior to FFP1 PPE (e.g., surgical masks) at preventing COVID-19 infections.
    - Universal workplace HCW testing
    - Distancing of 1m or more
    - Triaging areas are associated with low levels of infection, although no specific comparisons are available.
    - Modelling studies show that:
        - Early testing of suspected cases (with results within 8 hours) and a quarantine unit for new patients were the most effective measures.
        - Front-door screening was moderately effective.
        - PPE (even less effective PPE) reduced infections, compared to no PPE.
        - Masking is superior to distancing.
        - Weekly testing of patients and HCW reduced infections. Weekly testing of HCW reduced transmission by 24%, and daily testing by 64%.
        - Smaller cohorts of suspected cases reduced infections, compared to larger cohorts.
        - Isolating suspected cases in single rooms reduced transmission compared to quarantine wards.
- Strategies with no evidence of control of the spread of infection include:
    - Aerosol boxes do not protect HCW from aerosolized particles.
    - Barrier enclosures may create additional risk.
    - Powered air purifying respirators (PAPRs) are not superior to other protective respiratory equipment when performing airway procedures.
    - Prophylactic hydroxychloroquine among HCW has no demonstrated effect.

# Methods

## Research Questions

1. What is known about how and by whom COVID-19 is introduced and transmitted within acute care settings?
2. What factors influence the introduction and spread of COVID-19 in acute care settings?
3. What control measures have been successful in acute care settings to prevent primary and secondary cases of COVID-19?

## Search

On November 13, 2020, the following databases were searched using key terms doctor, physician, clinician, nurse, nursing, practitioner, "healthcare worker", "health care worker", "primary care", "acute care", nosocomial:

- Pubmed's curated COVID-19 literature hub: LitCOVID
- World Health Organization's Global literature on coronavirus disease
- COVID-19 Living Overview of the Evidence (L·OVE)
- McMaster Health Forum
- Prospero Registry of Systematic Reviews
- NCCMT COVID-19 Rapid Evidence Reviews
- MedRxiv preprint server
- NCCEH Environmental Health Resources for the COVID-19 Pandemic
- NCCID Disease Debrief
- Uncover (USHER Network for COVID-19 Evidence Reviews)
- Alberta Health Services
- Oxford COVID-19 Evidence Service
- Centers for Disease Control and Prevention's Morbidity and Mortality Weekly Report
- Institut national de santé publique du Québec (INSPQ)

A copy of the full search strategy is available at this link.

## Study Selection Criteria

The search results were first screened for recent guidelines and syntheses. Single studies were included if no syntheses were available on the specific topic, or in the following instances: relevant single studies missing from included syntheses; single studies published after the search was conducted in the included syntheses. English-language, peer-reviewed sources and sources published ahead-of-print before peer review were included. Surveillance sources were excluded. When available, findings from syntheses and clinical practice guidelines are presented first, as these take into account the available body of evidence and, therefore, can be applied broadly to populations and settings.

**Question 1: What is known about how and by whom COVID-19 is introduced and transmitted within acute care settings?**

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Population | Staff, patients, visitors | |
| Intervention | Index case | |
| Comparisons | | |
| Outcomes | Secondary infection and/or outbreaks, clusters | Non-COVID -related |
| Setting | Acute care: hospitals, emergency rooms | Other health settings |

**Question 2: What factors influence the introduction and spread of COVID-19 in acute care settings?**

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Population | Staff, patients, visitors | |
| Intervention | Individual and organizational risk factors (including modifiable and non-modifiable) | |
| Comparisons | | |
| Outcomes | COVID-19 infection and/or secondary infection and/or outbreaks | Non-COVID -related |
| Setting | Acute care: hospitals, emergency rooms | Other health settings |

**Question 3: What control measures have been successful in acute care settings to prevent primary and secondary cases of COVID-19?**

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Population | Staff, patients, visitors | |
| Intervention | Strategies for spread & control | |
| Comparisons | | |
| Outcomes | COVID-19 infection and/or secondary infection and/or outbreaks | Non-COVID -related |
| Setting | Acute care: hospitals, emergency rooms | Other health settings |

## Data Extraction and Synthesis

Data relevant to the research question, such as study design, setting, location, population characteristics, interventions or exposure and outcomes were extracted when reported. We synthesized the results narratively due to the variation in methodology and outcomes for the included studies.

## Appraisal of Evidence Quality

We evaluated the quality of included evidence using critical appraisal tools as indicated by the study design below. Quality assessment was completed by one reviewer and verified by a second reviewer. Conflicts were resolved through discussion. For some of the included evidence a suitable quality appraisal tool was not found, or the review team did not have the expertise to assess methodological quality. Studies for which quality appraisal has not been conducted are noted within the data tables.

| Study Design | Critical Appraisal Tool |
|---|---|
| Synthesis | Assessing the Methodological Quality of Systematic Reviews (AMSTAR) AMSTAR 1 Tool |
| Case Control | Joanna Briggs Institute (JBI) Checklist for Case Control Studies |
| Case Series | Joanna Briggs Institute (JBI) Checklist for Case Series |
| Case Report | Joanna Briggs Institute (JBI) Checklist for Case Reports |
| Cohort | Joanna Briggs Institute (JBI) Checklist for Cohort Studies |
| Cross-sectional | Joanna Briggs Institute (JBI) Checklist for Analytical Cross Sectional Studies |
| Randomized Controlled Trial | Joanna Briggs Institute (JBI) Checklist for Randomized Controlled Trials |

Completed quality assessments for each included study are available on request.

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach was used to assess the certainty in the findings based on eight key domains.

In the GRADE approach to quality of evidence, **observational studies,** as included in this review, provide **low quality** evidence, and this assessment can be further reduced based on other domains:

- High risk of bias
- Inconsistency in effects
- Indirectness of interventions/outcomes
- Imprecision in effect estimate
- Publication bias

and can be upgraded based on:

- Large effect
- Dose-response relationship
- Accounting for confounding.

The overall certainty in the evidence for each outcome was determined taking into account the characteristics of the available evidence (observational studies, some not peer-reviewed, unaccounted-for potential confounding factors, different tests and testing protocols, lack of valid comparison groups). A judgement of 'overall certainty is very low' means that the findings are very likely to change as more evidence accumulates.

# Findings

## Summary of Evidence Quality

This document includes 11 completed syntheses and 52 single studies for a total of 63 publications included in this review. The quality of the evidence included in this review is as follows:

| Research Question | Evidence included | | Overall certainty in evidence based on completed evidence |
|---|---|---|---|
| What is known about how and by whom COVID-19 is introduced and transmitted within acute care settings? | Completed syntheses<br>Single studies | 2<br>25 | Very low |
| What factors influence the introduction and spread of COVID-19 in acute care settings? | Completed syntheses<br>Single studies | 4<br>17 | • Index case: Very low<br>• PPE: Moderate<br>• Role, clinical location, demographics: Very low |
| What control measures have been successful in acute care settings to prevent primary and secondary cases of COVID-19? | Completed syntheses<br>Single studies | 6<br>14 | Very low |

## Warning

Given the need to make emerging COVID-19 evidence quickly available, many emerging studies have not been peer reviewed. As such, we advise caution when using and interpreting the evidence included in this rapid review. We have provided a summary of overall certainty of the evidence to support the process of decision making. Where possible, make decisions using the highest quality evidence available.

A number of mathematical modelling studies are emerging related to COVID-19, including 5 cited in this review. We did not assess the methodological quality of modelling studies. Due to the highly technical nature of these studies, we highly recommend consulting a content-area expert to inform decision making. While these studies may provide important estimates, their ultimate usefulness depends on the quality of the data that is entered into the model. Given the constantly evolving nature and changing understanding of COVID-19 around the world, a high degree of caution is warranted when interpreting these studies, and the range of confidence intervals rather than single effect estimates should be considered.

## Question 1: What is known about how and by whom COVID-19 is introduced and transmitted within acute care settings?

### Table 1: Syntheses

| Reference | Date Released | Description of Included Studies | Summary of Findings | Quality Rating: Synthesis | Quality Rating: Included Studies |
|---|---|---|---|---|---|
| Koh, W. C., Naing, L., Chaw, L., Rosledzana, M. A., Alikhan, M. F., Jamaludin, S. A., . . . Wong, J. (2020). What do we know about SARS-CoV-2 transmission? A systematic review and meta-analysis of the secondary attack rate and associated risk factors. *PLoS One, 15*(10), e0240205-e0240205. | Oct 8, 2020 (Search completed Jul 25, 2020) | 18 studies examining transmission rates in health care settings | This review examined secondary attack rates (SAR) of COVID-19 in various settings, including health care.<br><br>18 studies were identified where the index case in health care was an infected patient.<br><br>Pooled SAR was 0.7% (95% Confidence Interval (CI): 0.4%-1.0%), with most individual studies reporting a SAR of < 2%.<br><br>There was some variation in who was tested between studies (only symptomatic vs all close contacts) and who was classified as a close contact (usually HCW and other patients). | High | High |
| Alberta Health Services. (2020, Jun 5). *Has there been documented transmission of SARS-CoV-2 virus (or similar viruses) through heating, ventilation, and air conditioning (HVAC) systems in hospitals or nonhospital settings?* | Jun 5, 2020 (Search completed May 11, 2020) | This review included:<br>• 12 studies<br>• 20 additional references (primary and grey literature)<br><br>4 studies specifically addressed COVID-19 | This rapid evidence report reviewed the transmission of COVID-19 in Heating, Ventilation and Air Conditioning (HVAC) systems in hospitals and non-hospital settings.<br><br>There is no clear evidence to date of transmission of COVID-19 associated with HVAC systems in hospitals or health care facilities, although there is a mechanistic possibility of this occurring.<br><br>Studies that have identified the presence of viral RNA in procedure-generated aerosols have not demonstrated viable virus that would be capable of infecting susceptible hosts. | Low | Not reported |

# Table 2: Single Studies

| Reference | Date Released | Study Design | Participants | Setting and Timing | Summary of findings | Quality Rating: |
|---|---|---|---|---|---|---|
| Studies of forward transmission by HCW | | | | | | |
| Cao, G., Tang, S., Yang, D., Shi, W., Wang, X., Wang, H., . . . Ma, L. (2020). The Potential transmission of SARS-CoV-2 from patients with negative RT-PCR swab tests to others: two related clusters of COVID-19 outbreak. *Japanese Journal of Infectious Diseases, 73*(6), 399-403. | Nov 30, 2020 | Case report | 4 HCW | Hospital, China<br><br>Jan 2020 | 4 cases of HCW COVID-19 were identified on a ward in a hospital in China. The index case was a HCW who was symptomatic but had repeatedly tested negative for COVID-19 infection. The index case worked while symptomatic. | Moderate |
| Baker, M. A., Fiumara, K., Rhee, C., Williams, S. A., Tucker, R., Wickner, P., . . . Klompas, M. (2020). Low risk of COVID-19 among patients exposed to infected healthcare workers. *Clinical Infectious Diseases*. Epub ahead of print. | Aug 28, 2020 | Cohort | Patients | Medical Centre, Boston<br><br>Mar 1 to Jun 10, 2020 | 238 patients were identified as having been exposed to COVID-19 infected HCW (n=60).<br><br>Among 92 patients tested, 2 tested positive:<br>• 1 was exposed to a pre-symptomatic physician for 30 minutes in an outpatient setting. Neither the physician nor patient were masked.<br>• 1 was exposed for >10 minutes to a nurse in a peri-operative setting. Only the nurse was masked. This patient also had close household contact with a case, which likely was exposure source.<br><br>Overall, 0.4% of infections were attributable to HCW exposure.<br><br>No infections were attributed to patient-to-patient transmission. A few patients had more than one exposure. | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mponponsuo, K., Kerkerian, G., Somayaji, R., Missaghi, B., Vayalumkal, J. V., Larios, O. E., . . . Conly, J. (2020). Lack of nosocomial transmission to exposed inpatients and coworkers in an investigation of five SARS-CoV-2-infected healthcare workers. *Infection Control & Hospital Epidemiology*. Epub ahead of print. | Aug 3, 2020 | Case series | HCW | Calgary, Alberta<br><br>Mar 1 and Apr 15, 2020 | Between epidemiologic investigation of 5 HCW cases with community-acquired COVID-19 was conducted to identify patient and colleague close contacts who had multiple high-risk exposures.<br><br>A total of 39 HCW and 20 patient close contacts were identified, of whom none developed infection (16 HCW and 22 patients were tested; the remainder did not report any symptoms and were considered not infected). | Moderate |
| Biernat, M. M., Zinczuk, A., Biernat, P., Bogucka-Fedorczuk, A., Kwiatkowski, J., Kalicinska, E., . . . Wrobel, T. (2020). Nosocomial outbreak of SARS-CoV-2 infection in a haematological unit - high mortality rate in infected patients with haematologic malignancies. *Journal of Clinical Virology*. Epub ahead of print. | Aug 1, 2020 | Cohort | Patients and HCW | Poland<br><br>Apr 7 to May 7, 2020 | During an outbreak of COVID-19 on a haematological unit after exposure to an index HCW case, among 20 HCW on the unit, 5 developed infection as confirmed through RT-PCR testing. Among 19 patients on the unit, 10 developed infection as confirmed through RT-PCR testing. | High |
| Knoll, R. L., Klopp, J., Bonewitz, G., Grondahl, B., Hilbert, K., Kohnen, W., . . . Gehring, S. (2020). Containment of a large SARS-CoV-2 outbreak among healthcare workers in a pediatric intensive care unit. *The Pediatric Infectious Disease Journal, 39*(11), e336-e339. | Jul 19, 2020 | Case report | HCW | Pediatric Intensive Care Unit (PICU), Germany<br><br>Mar 13 to Apr 27, 2020 | On March 13, 2020, a positive HCW case of COVID-19 was identified in the PICU. Point of care testing was performed on 91 HCW identified as contacts. A total of 8 additional HCW cases (19.5%) were identified by March 23, 2020.<br><br>All infected HCW were working at the PICU and had direct unprotected contact with each other prior to March 13, 2020. An infection rate of 16.3% was calculated.<br><br>Mass screening undertaken in the hospital from April 14 to 27, 2020 revealed only one additional case. This case had no connection to the PICU, and infection was attributed to community transmission. | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Prasitsirikul, W., Pongpirul, K., Pongpirul, W. A., Panitantum, N., Ratnarathon, A. C., & Hemachudha, T. (2020). Nurse infected with COVID-19 from a provisional dengue patient. *Emerging Microbes & Infections, 9*(1). | Jun 15, 2020 | Case report | HCW | Hospital, China<br><br>Jan 30, 2020 | A HCW was exposed to a symptomatic patient in hospital while performing venipuncture without appropriate PPE. The patient was later diagnosed with COVID-19 infection. The HCW subsequently became infected. No forward transmission of virus was documented among hospital or community close contacts. | High |
| Studies of forward transmission by patients | | | | | | |
| Wee, L. E. I., Sim, X. Y. J., Conceicao, E. P., Aung, M. K., Tan, K. Y., Ko, K. K. K., . . . Ling, M. L. (2020). Containing COVID-19 outside the isolation ward: The impact of an infection control bundle on environmental contamination and transmission in a cohorted general ward. *American Journal of Infection Control*, *48*(9), 1056-1061. | Sep 4, 2020 | Cohort | HCW<br><br>In-patients | Hospital, Singapore<br><br>Feb 7 to May 7, 2020, | A hospital in Singapore evaluated its experience with managing unsuspected COVID-19 infection in 28 patients admitted to respiratory surveillance wards instead of a COVID-19 ward.<br><br>There were no infections among staff close contacts; one exposed patient (who had other additional exposures) developed infection. | High |

| Studies of HCW Contact tracing with genome/RNA testing | | | | | | |
|---|---|---|---|---|---|---|
| Sikkema, R. S., Pas, S. D., Nieuwenhuijse, D. F., Toole, Á., Verweij, J., van der Linden, A., . . . Koopmans, M. P. G. (2020). COVID-19 in health-care workers in three hospitals in the south of the Netherlands: A cross-sectional study. *The Lancet Infectious Diseases*, *20*(11), 1273-1280. | Jul 2, 2020 | Cross-sectional | HCW<br><br>Patients | 3 hospitals, Netherlands<br><br>Mar 2 to Mar 12, 2020, | 1796 HCW (15% of the total number of staff) were voluntarily screened for COVID-19.<br><br>Genome sequences were completed on 60 samples. The noted patterns were consistent with multiple introductions into the hospitals through community-acquired infections and local amplification in the community.<br><br>856 patients were also screened and tested.<br>• 96 HCW (5%) tested positive.<br>• Of these, 20 HCW did not have direct contact with patients; however, 6 had contact with colleagues who had also tested positive.<br>• Many HCW had numerous potential exposures in the community.<br>• 32% reported close contact with a confirmed case in the 14 days prior to onset of symptoms including patients and colleagues in the hospital, household members or persons outside the hospital, including at a carnival which could have been a super-spreader event.<br>Of 856 patients tested, 23 (3%) were positive. | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Nasia, S., Gage, K. M., Katarina, M. B., Thomas, C. F., & David, H. O. C. (2020). Determining the source of transmission of SARS-CoV-2 infection in a healthcare worker. *Preprint*. | May 1, 2020 | Case report | HCW | Hospital, Wisconsin USA<br><br>Mar 21 to Apr 14, 2020 | A HCW case of COVID-19 was identified in hospital after developing symptoms and seeking out testing. This HCW case had hospital exposure to two COVID-19 positive patients while working in full PPE. No infection control breaches were identified. The worker also had community exposure to a symptomatic household member who was not tested for COVID-19.<br><br>As part of the epidemiologic investigation, samples were collected from the case, the two patient cases and the household member whose specimen resulted as positive. Based on viral RNA sequencing the likely source of infection was the family member, with transmission occurring outside the hospital, though other sources could not be ruled out. | High<br><br>**PREPRINT** |
| Studies of HCW Contact tracing | | | | | | |
| Buising, K. L., Williamson, D., Cowie, B. C., MacLachlan, J., Orr, E., MacIsaac, C., . . . Marshall, C. (2020). A hospital-wide response to multiple outbreaks of COVID-19 in health care workers: Lessons learned from the field. *The Medical Journal of Australia*. Epub ahead of print. | Nov 15, 2020 | Case report | HCW | Hospital, Melbourne, Australia<br><br>Jul 1 and Aug 31, 2020 | 262 cases of COVID-19 infection were identified among staff.<br>• 28.1% of affected staff worked in "hot wards" – designated COVID-19 wards.<br>• Clusters of infection occurred on three occasions on wards outside of designated "hot wards".<br>• There was anecdotal reporting by staff of transmission events being associated with various patient behaviours such as shouting and vigorous coughing.<br><br>HCW contact with COVID-19 cases outside the hospital was infrequent but did occur (i.e., HCW living together). | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Wee, L. E., Sim, X. Y. J., Conceicao, E. P., Aung, M. K., Goh, J. Q., Yeo, D. W. T., . . . Venkatachalam, I. (2020). Containment of COVID-19 cases among healthcare workers: The role of surveillance, early detection, and outbreak management. *Infection Control and Hospital Epidemiology*, 41(7), 765-771. | Nov 5, 2020 | Case report | HCW | Hospital, Singapore<br><br>Jan 1 and Apr 22, 2020 | Epidemiological investigation of 14 cases of COVID-19 among HCW determined that:<br>• 10 cases were acquired in the community<br>• 1 staff cluster occurred in a shared office in a non-clinical area of the hospital<br>• 1 staff cluster was family members<br>• 2 staff clusters were cases who shared a dormitory | High |
| Alajmi, J., Jeremijenko, A. M., Abraham, J. C., Alishaq, M., Concepcion, E. G., Butt, A. A., & Abou-Samra, A.-B. (2020). COVID-19 infection among healthcare workers in a national healthcare system: The Qatar experience. *International Journal of Infectious Diseases, 100*, 386-389. | Nov 1, 2020 | Cross-sectional | HCW | 14 hospitals with over 28,000 staff<br><br>Qatar<br><br>Mar 10 to Jun 24, 2020 | 16,912 staff across 14 hospitals were tested for COVID-19. Across all hospitals 1,799 (10.6%) staff tested positive.<br><br>Epidemiologic investigation of staff cases revealed:<br>• 9.5% of positive staff reported close contact with a case (family member or roommate).<br>• 5% reported acquiring infection while working at a COVID-19 designated facility; 95% reported working at a non-COVID-19 facility. Of these cases who were not working in a COVID-19 hospital, 45% reported exposure to an infected colleague and 29% reported exposure to an infected patient.<br>• Among HCW cases at designated COVID-19 facilities, 82% used full PPE, at all times.<br>• Among those HCW cases working at a non-designated facility, 68% reported using PPE as directed. | Low |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tubiana, S., Burdet, C., Houhou, N., Thy, M., Manchon, P., Blanquart, F., . . . Duval, X. (2020). High-risk exposure without personal protective equipment and infection with SARS-CoV-2 in healthcare workers: Results of the CoV-CONTACT prospective cohort. *Preprint*. | Sep 18, 2020 | Cohort | HCW | Hospital, Paris, France<br><br>Feb 5 to May 30, 2020 | 154 HCW had high-risk exposure(s) to 44 confirmed COVID-19 index cases (70 were exposed to in-patients and 95 were exposed to colleagues) without having worn appropriate PPE.<br><br>At day 30 following exposure, 43.9% had a confirmed or suspected infection. | High<br><br>**PREPRINT** |
| Kim, S. W., Jo, S. J., Lee, H., Oh, J. H., Lim, J., Lee, S. H., . . . Lee, J. (2020). Containment of a healthcare-associated COVID-19 outbreak in a university hospital in Seoul, Korea: A single-center experience. *PLoS One*. Epub ahead of print. | Aug 14, 2020 | Cross-sectional | Patients, Caregivers, and HCW | Hospital, Korea<br><br>Feb 21 to Feb 28, 2020 | After a hospital staff case was identified, 3,091 specimens were tested for COVID-19 among patients and staff in hospital.<br><br>2 in-patient and 1 caregiver hospital-associated cases were identified.<br><br>The 3 confirmed in-hospital cases were all linked to the same ward. There were no medical staff cases identified on this ward. | High |
| Contejean, A., Leporrier, J., Canoui, E., Alby-Laurent, F., Lafont, E., Beaudeau, L., . . . Kerneis, S. (2020). Comparing dynamics and determinants of SARS-CoV-2 transmissions among health care workers of adult and pediatric settings in central Paris. *Clinical Infectious Diseases*. Epub ahead of print. | Jul 15, 2020 | Cross-sectional | HCW | Hospital in Paris – 2 units (adult and pediatric)<br><br>Feb 24 to Apr 10, 2020 | 1344 symptomatic HCW were tested for COVID-19 and 373 (28%) were positive.<br><br>Unit specific attack rates were 3.2% and 2.3% for adult and pediatric units respectively, with an overall attack rate of 2.8%.<br><br>Epidemiologic investigations reported the following findings for 336 HCW participants:<br>• 70% had direct patient contact, 22% in dedicated COVID-19 units.<br>• In the adult setting, HCW reported multiple exposures to COVID-19 patients without PPE (25% vs 15% in the pediatric setting).<br><br>Some HCW reported having exposures to patients or colleagues without PPE, even after a masking policy was implemented | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Garzaro, G., Clari, M., Ciocan, C., Grillo, E., Mansour, I., Godono, A., . . . Pira, E. (2020). COVID-19 infection and diffusion among the healthcare workforce in a large university-hospital in northwest Italy. *La Medicina del lavoro*, *111*(3), 184-194. | Jun 26, 2020 | Case report | HCW | 4 hospitals in Italy<br>Mar 6 to Mar 21, 2020 | From 830 HCW with high risk or medium risk exposures to COVID-19 were tested. Of these, 80 tested positive (9.6%).<br><br>Investigations revealed the following:<br>• 57.6% reported exposure to a case, the majority were reported to be colleague cases.<br>• Social Network Analysis showed that HCW who had multiple contacts with other HCW were an important source of transmission.<br>• When patients were the source of infection, the cluster was limited to the area in which they were admitted, and spread was limited. | High |
| Lai, X., Wang, M., Qin, C., Tan, L., Ran, L., Chen, D., . . . Wang, W. (2020). Coronavirus disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary hospital in Wuhan, China. *JAMA Network Open, 3*(5), e209666 | May 21, 2020 | Case series | HCW | Hospital, China<br><br>Jan 1 to Feb 9, 2020 | 110 HCW tested positive for COVID-19. The infection rate was 1.1% among HCW.<br><br>Presumed sources of infection include:<br>• General clinics or wards (63.3%)<br>• Community (12.7%)<br>• Fever clinics or wards (6.4%)<br><br>Contact with positive patients (59.1%) and colleagues with infection (10.9%) as well as community-acquired infection (12.7%) were the main routes of exposure. | Moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| Guo, X., Wang, J., Hu, D., Wu, L., Gu, L., Wang, Y., . . . Wu, Y. (2020). Survey of COVID-19 disease among orthopaedic surgeons in Wuhan, People's Republic of China. *The Journal of Bone and Joint Surgery, American volume*, *102*(10), 847-854. | May 20, 2020 | Case control | HCW: Orthopaedic surgeons | 8 hospitals in Wuhan China<br><br>Dec 31, 2019 to Feb 24, 2020 | A total of 24 orthopaedic surgeons with COVID-19 were identified from 8 hospitals. 21 cases were lab-confirmed and 3 were clinically diagnosed.<br><br>The number of cases in each hospital varied from 1 to 8 and the incidence of infection ranged from 1.5% to 20.7%. 5 of 8 hospitals had only 1 case.<br><br>Epidemiologic investigation determined:<br>• Suspected sites of exposure were general wards (79.2%), public places at the hospital (20.8%), operating rooms (12.5%), intensive care units (4.2%) and outpatient clinics (4.2%).<br>• Forward transmission was demonstrated in 25% of cases including to colleagues (4.2%) and patients (4.2%) in addition to non-hospital contacts. | High |
| Jin, Y.H., Huang, Q., Wang, Y.Y., Zeng, X.T., Luo, L.S., Pan, Z.Y., . . . Wang, X.H. (2020). Perceived infection transmission routes, infection control practices, psychosocial changes, and management of COVID-19 infected healthcare workers in a tertiary acute care hospital in Wuhan: A cross-sectional survey. *Military Medical Research, 7*(24). | May 11, 2020 | Cross-sectional | HCW | Hospital in Wuhan China<br><br>Feb 15 to 29, 2020 | 105 HCW were confirmed with COVID-19 infection. Epidemiologic analysis was conducted for 103 of these HCW cases. Relevant findings included:<br>• 32 worked in high-risk departments such as respiratory medicine, infectious diseases, emergency, clinical laboratory, anesthesia surgery, operating room, and intensive care unit.<br>• 71 cases worked in low-risk departments (other than those listed as high risk).<br>• 84.5% were suspected of being infected in the working environment in hospital.<br>  ○ 73.6% reported close contact with confirmed patients<br>  ○ 17.2% had close contact with suspected cases<br>  ○ 41.4% were exposed to confirmed colleague cases<br>• 1.0% in the laboratory<br>• 4.9% through community exposure<br>• 41.8% related to inadequate PPE | Moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mandić-Rajčević, S., Masci, F., Crespi, E., Franchetti, S., Longo, A., Bollina, I., . . . Colosio, C. (2020). Contact tracing and isolation of asymptomatic spreaders to successfully control the COVID-19 epidemic among healthcare workers in Milan (Italy). *Preprint*. | May 8, 2020 | Cohort | HCW | 2 large hospitals and 40 territorial health care units in Italy<br><br>Feb 27 to Apr 8, 2020 | 185 HCW had positive test results for COVID-19. 12 of these samples were done at random. The positive rate in non-random samples was around 10% while the rate among randomly sampled HCW was 2.6%.<br><br>Epidemiologic investigation of 143 HCW cases determined:<br>• 49% had close contact with a positive colleague<br>• 28% had unknown contact<br>• 9.8% had positive household member<br>• 7.7% had close contact with positive patient | Moderate<br><br>**PREPRINT** |
| Wang, Q., Huang, X., Bai, Y., Wang, X., Wang, H., Hu, X., . . . Zhao, H. (2020). Epidemiological characteristics of COVID-19 in medical staff members of neurosurgery departments in Hubei province: A multicentre descriptive study. *Preprint*. | Apr 24, 2020 | Cross-sectional | HCW | Neurosurgery departments in 107 hospitals in Hubei province China<br><br>Jan 8 to Mar 1, 2020 | 120 HCW in neurosurgery departments of 26 hospitals had been infected with COVID-19. The overall incidence was 2.2%.<br><br>All 120 HCW had direct contact with COVID-19 patients. 119 did not use standard protective measures at work before infection.<br><br>Most common mode of transmission was contact with a positive patient (62.5%) or infected colleague (30.8%).<br><br>No confirmed transmission from medical staff to patients was noted. | High<br><br>**PREPRINT** |
| Studies of contact tracing of inpatients | | | | | | |
| Wake, R. M., Morgan, M., Choi, J., & Winn, S. (2020). Reducing nosocomial transmission of COVID-19: Implementation of a COVID-19 triage system. *Clinical Medicine Journal*. Epub ahead of print. | Oct 28, 2020 | Cohort | Patients | Hospital, London, England<br><br>Mar 11 and May 12, 2020, | Inpatients tested positive for COVID-19 more than 7 days after admission were labelled as probable hospital-acquired infections.<br><br>Analyzing date of symptom onset determined 45 cases were likely acquired in hospital.<br><br>Of hospital-acquired cases:<br>• 40 (88%) shared a ward with a known case, of which 13 (29%) had shared a bay with a known case.<br>• 5 (11%) cases may have been acquired from shared facilities or a HCW. | Moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rickman, H. M., Rampling, T., Shaw, K., Martinez-Garcia, G., Hail, L., Coen, P., . . . Houlihan, C. F. (2020). Nosocomial transmission of COVID-19: A retrospective study of 66 hospital-acquired cases in a London teaching hospital. *Clinical Infectious Diseases*. Epub ahead of print. | Jun 20, 2020 | Cross-sectional | Patients | London teaching hospital<br><br>Mar 2 and Apr 12, 2020 | 66 COVID-19 in-patients (15%) had infections that were determined to be "definitely" (11%) or "probably" (4%) hospital-acquired.<br>• 36 (55%) had been in the same bay as a patient with confirmed infection.<br>• 9 (14%) had no identified contacts in the same bay but had contacts on the same ward.<br>• 21 (32%) had no clear source of infection.<br>• Among the 36 cases with index case in the same bay, 22 (61%) of the index infections were also hospital-acquired with several possible chains of patient-to-patient in-hospital transmission.<br>  ○ 14 (39%) were linked to community-acquired index cases.<br>• 45 (68%) of hospital-acquired cases were not associated with any forward transmission; however, there were several community- and hospital-acquired cases associated with four or more likely secondary infections. | Low |

| Studies of HCW and patient contact tracing | | | | | | |
|---|---|---|---|---|---|---|
| Schwierzeck, V., König, J. C., Kühn, J., Mellmann, A., Correa-Martínez, C. L., Omran, H., . . . Kampmeier, S. (2020). First reported nosocomial outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in a pediatric dialysis unit. *Clinical Infectious Diseases*. Epub ahead of print. | Apr 27, 2020 | Cohort | Patients and HCW | Pediatric dialysis unit in Germany<br><br>Feb to Jul 2020 | 7760 inpatients, outpatients and HCW were tested for COVID-19. Of these, 357 were found to be positive.<br><br>The overall attack rate in the hospital was 1.3%<br>• 0.9% among inpatients<br>• 1.6% among HCW<br><br>In March, an outbreak occurred on the pediatric dialysis unit. Based on epidemiologic investigation, 27 cases (23 HCW and 4 patients) were identified. These individuals had contact with patients or HCW without the use of adequate PPE.<br><br>The overall attack rate in the outbreak was 25.5%<br>• 20% among inpatients<br>• 29.6% among HCW | Moderate |
| Luong-Nguyen, M., Hermand, H., Abdalla, S., Cabrit, N., Hobeika, C., Brouquet, A., . . . Sauvanet, A. (2020). Nosocomial infection with SARS-CoV-2 within departments of digestive surgery. *Journal of Visceral Surgery*, *157*(3S1), S13-S18. | Apr 23, 2020 | Case series | Patients and HCW | France<br><br>Mar 1 to Apr 5, 2020 | 15 patients (4.9%) admitted to digestive surgery departments developed hospital-acquired COIVD-19 infection.<br><br>Within 3 surgical services, 7 HCW were diagnosed with COVID-19 infection during the same time period.<br><br>A clear source of infection was not identified, though the possibility of community exposure for at least some of the cases exists. | High |

## Question 2: What factors influence the introduction and spread of COVID-19 in acute care settings?

## Table 3: Syntheses

| Reference | Date Released | Description of Included Studies | Summary of Findings | Quality Rating: Synthesis | Quality Rating: Included Studies |
|---|---|---|---|---|---|
| Galanis, P., Vraka, I., Fragkou, D., Bilali, A., & Kaitelidou, D. (2020). Seroprevalence of SARS-CoV-2 Antibodies and Associated Factors in Health Care Workers: A Systematic Review and Meta-Analysis. *The Journal of Hospital Infection*. Epub ahead of print. | Nov 16, 2020 (Search completed Aug 24, 2020) | This systematic review and meta-analysis included 49 studies, with 127,480 HCW to determine seroprevalence of SARS-CoV-2 antibodies and factors associated with seroprevalence.<br>• 26 cross-sectional<br>• 20 prevalence<br>• 3 cohort<br><br>27 analyzed risk factors for SARS-CoV-2 antibodies positivity.<br><br>The majority of studies were from Europe (n=31); the remaining were from North America (n=9), Asia (n=6), and Africa (n=3). | A number of risk factors associated with seropositivity were explored; no consistent risk factors were identified. Risk factors explored included:<br>• Sex: 3 studies found increased risk for males (OR range: 1.39 to 3.21), 23 found no relationship.<br>• Ethnicity: 2 studies found increased risk among African American HCW ($p<0.05$) and other ethnicities vs. white (OR: 2.30, 95% CI: 1.71, 3.10); 5 found no relationship.<br>• Age: 3 studies found conflicting results, with higher risk in those < 30 years (OR: 1.40, 95%CI 1.22, 1.60); ≥ 40 years old (OR: 1.36, 95%CI 1.09, 1.60) and ≥ 65 years old ($p<0.001$); 21 studies found no relationship.<br>• Role: 5 studies found relationships, including increased risk with work on COVID-19 unit (3 studies, OR range: 1.4 to 1.67); patient-facing work (3 studies, OR range: 1.22 to 2.9), frontline HCW (OR: 1.38, 95% CI: 1.22, 1.56); working in the surgery department (OR: 6.47, 95%CI 2.37, 17.63) or pediatric ICU (OR: 3.77, 95%CI 1.44, 9.89), or being an assistant (2 studies, OR: 1.39, 95%CI 1.05, 1.84 and 3.8, 95%CI 2.3, 6.1); 17 studies found no relationship.<br>• Lack of use or access to PPE, 2 studies found increased risk when not using a face covering for all clinical encounters ($p=0.012$) or working within a PPE shortage ($p=0.009$); 2 studies found no relationship.<br><br>Authors note poor reporting of testing validity and protocols, high heterogeneity amongst studies and few peer reviewed studies. | Moderate | Moderate |

| | | | | | |
|---|---|---|---|---|---|
| Chou, R., Dana, T., Buckley, D. I., Selph, S., Fu, R., & Totten, A. M. (2020). Update Alert 5: Epidemiology of and risk factors for coronavirus infection in health care workers: A living rapid review. *Annals of Internal Medicine*. Epub ahead of print. | Oct 20, 2020 (Search completed Sep 24, 2020) | The most recent version of this living review includes 34 studies about risk factors for COVID-19. | Inconsistent findings were reported across studies with respect to difference in risk of COVID-19 between males and females.<br><br>Some studies report increased risk in nurses vs. physicians, but this is inconsistent.<br><br>Proper PPE and handwashing, in particular face shields and goggles seem to have the strongest evidence for protection.<br><br>The authors note that the included studies are limited by methods of measuring exposures, recall bias, no control of confounders, and imprecise estimates. | Low | Not reported |
| Calò, F., Russo, A., Camaioni, C., De Pascalis, S., & Coppola, N. (2020). Burden, risk assessment, surveillance and management of SARS-CoV-2 infection in health workers: A scoping review. *Infectious diseases of poverty, 9*(1), 139. | Oct 7, 2020 (Search completed May 22, 2020) | This scoping review included 43 studies, 14 webpages and 5 ongoing trials assessing risk factors associated with COVID-19 in HCW.<br><br>5 of the sources considered adherence to infection control practices or other risk factors; 3 from China, 1 from Singapore and 1 unidentified. | Two studies found no difference in rate of infection with surgical mask or N95 respirators.<br><br>One study found increased risk with suboptimal adherence to IPAC measures (handwashing before (RR: 3.10, 95% CI: 1.43–6.73) and after (RR: 2.82, 95% CI: 1.11–7.18) patient contact; Improper PPE use, RR: 2.82, 95% CI: 1.11–7.18).<br><br>One study found increased risk in high risk versus general department (RR: 2.13,95% CI: 1.45–3.95), and with close direct contact (<1 m) with COVID-19 patients (OR not reported). | Low | Not reported |
| Gomez-Ochoa, S., Franco, O. H., Rojas, L. Z., … Muka, T. (2020). COVID-19 in Health-Care Workers: A Living Systematic Review and Meta-Analysis of Prevalence, Risk Factors, Clinical Characteristics, and Outcomes. *American Journal of Epidemiology*. Epub ahead of print. | Sep 1, 2020 (Search completed Jul 8, 2020) | This systematic review and meta-analysis included 97 studies, for a total of 230,398 HCW:<br>• 50 prevalence<br>• 31 cross-sectional<br>• 14 cohort<br><br>5 studies reported factors associated with COVID-19 infection in HCW. The majority were from Wuhan China. | Risk factors for COVID-19 infection included:<br>• Lack of adherence to IPAC measures including handwashing generally (OR: 2.64, 95%CI 1.04, 6.71), handwashing before patient contact (OR: 3.10, 95%CI 1.43, 6.73), inadequate PPE (OR: 2.82, 95%CI 1.11, 7.18), never using PPE vs. usual PPE use (OR: 3.72, 95%CI 2.12, 6.52).<br>• Wearing medical masks vs. N95 respirators (OR: 464.82, 95%CI 97.73, infinite).<br>• Having a larger household size was not associated with infection (p = 0.093). | Low | Low |

# Table 4: Single Studies

| Reference | Date Released | Study Design | Participants | Setting and timing | Summary of findings | Quality Rating: |
|---|---|---|---|---|---|---|
| COVID-19 prevalence studies | | | | | | |
| Mortgat, L., Barbezange, C., Fischer, N., Heyndrickx, L., Hutse, V., Thomas, I., . . . Duysburgh, E. (2020). SARS-CoV-2 prevalence and seroprevalence among HCW in Belgian hospitals: Baseline results of a prospective cohort study. *Preprint*. | Oct 6, 2020 | Cross-sectional | n=699 HCW | 14 hospitals, Belgium<br><br>Apr 22 to 26, 2020 | Prevalence of COVID-19 with RT-PCR was 1.1% (95% CI: 0.04, 3.0%) and seroprevalence was 7.7% (95% 4.7, 12.2%).<br><br>Only exposure to a COVID-19 patient without following precautions (vs. no contact) was associated with COVID-19 risk (adjusted RR=2.11, 95% CI: 1.36-3.28).<br><br>No other demographic or work-related factors were associated with positive serology. | High<br><br>**PREPRINT** |
| Zheng, C., Hafezi-Bakhtiari, N., Cooper, V., Davidson, H., Habibi, M., Riley, P., & Breathnach, A. (2020). Characteristics and transmission dynamics of COVID-19 in healthcare workers at a London teaching hospital. *The Journal of Hospital Infection*, *106*(2), 325-329. | Oct 1, 2020 | Cross-sectional | n=1045 symptomatic hospital staff | Hospital, London, UK<br><br>Mar to Apr 2020 | Frequency of staff testing, and percent positive are presented, but no statistical comparisons or denominators are provided<br>• A greater proportion of male staff were tested (13%) and positive (7%) than females (10%, 5% respectively).<br>• A higher proportion of clinical staff (7%) tested positive than non-clinical staff (3%).<br>• Doctors were most likely to test positive (11%) followed by nurses (7%) and health care assistants (6%).<br><br>Emergency (17.3%) and acute medicine, (10.4%) had the highest positivity rates followed by cardiothoracic (9.2%), cardiology (8.9%) renal, oncology and palliative (8.7%) and specialists (8.6%). | Moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tubiana, S., Burdet, C., Houhou, N., Thy, M., Manchon, P., Blanquart, F., . . . Duval, X. (2020). High-risk exposure without personal protective equipment and infection with SARS-CoV-2 in healthcare workers: Results of the CoV-CONTACT prospective cohort. *Preprint*. | Sep 18, 2020 | Cohort | n=154 HCW with exposure to patient or colleague with confirmed COVID-19 | Hospital, Paris, France<br><br>Feb to May 2020 | Prevalence of RT-PCR confirmed COVID-19 was 25% (95% CI: 18.4, 32.9). Including possible infections based on symptoms, the prevalence rose to 43.9% (95% CI: 35.9%, 52.3%).<br><br>Factors associated with infection include:<br>• Being a pharmacist or administrative assistant vs. medical staff (adjusted OR=3.8, 95% CI=1.3, 11.2)<br>• Exposure to infected patient vs. colleague (adjusted OR=2.6, 95% CI=1.2, 5.9)<br><br>Authors note 57% of exposures occurred prior to widespread use of masks. | High<br><br>**PREPRINT** |
| Wang, Y., Wu, W., Cheng, Z., Tan, X., Yang, Z., Zeng, X., . . . Wang, X. (2020). Super-factors associated with transmission of occupational COVID-19 infection among healthcare staff in Wuhan, China. *The Journal of Hospital Infection*, *106*(1), 25-34. | Sep 1, 2020 | Cross-sectional | n=92 hospital staff with >14 days patient contact | Hospital, Wuhan, China<br><br>Jan 1 to Feb 29, 2020 | Social Network Analysis was used to identify factors affecting transmission to medical staff. Overall, 33.7% were infected with COVID-19.<br><br>Odds of infection were higher amongst:<br>• Physicians (p = 0.045)<br>• Those with medical staff infected in the same department (p<0.001)<br>• Those with infected patients in the department (p < 0.001)<br>• Those reporting touching their check, nose and mouth during work (p = 0.045)<br>• Those who did not wear masks correctly (p = 0.045)<br>• Those who attended large parties or crowded places (p = 0.08)<br><br>Touching the check, nose or mouth during work was the factor most associated with infected participants, identified as a 'super-factor' in the social network analysis. | Moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| Garzaro, G., Clari, M., Ciocan, C., Grillo, E., Mansour, I., Godono, A., . . . Pira, E. (2020). COVID-19 infection and diffusion among the healthcare workforce in a large university-hospital in northwest Italy. *La Medicina del lavoro*, *111*(3), 184-194. | Jun 26, 2020 | Case report | n=2411 HCW with known COVID-19 contact | 4 Hospitals in Northwest Italy<br><br>Mar 6 to 21, 2020 | HCW with a positive test were more likely to be:<br>• Physicians (OR=2.03, 95%CI: 1.18-3.49) vs. nurses<br>• Administrative staff (OR=5.77, 95%CI: 1.47-19.55) vs. nurses<br>• Providing non-medical services (OR=4.23, 95%CI: 1.99-8.63) vs. inpatient services<br>• Working in the maternity hospital (OR=2.94, 95%CI: 1.72-4.95) vs. the general hospital<br>• Exposed through a shared working environment (OR=2.63, 95%CI: 1.34-5.32) vs. direct care | High |
| Guo, X., Wang, J., Hu, D., Wu, L., Gu, L., Wang, Y., . . . Wu, Y. (2020). Survey of COVID-19 disease among orthopaedic surgeons in Wuhan, People's Republic of China. *The Journal of Bone and Joint Surgery, American Version*, *102*(10), 847-854. | May 20, 2020 | Cross-sectional | n=24 orthopedic surgeons with COVID-19 and 48 matched controls. | 8 Hospitals, Wuhan, China<br><br>Dec 31, 2019 to Feb 24, 2020 | Surgeons with confirmed COVID-19 were more likely to:<br>• Report severe fatigue before infection (OR=4.0, 95%CI: 1.0-16.0)<br>• Not wear a N95 respirator (OR=5.20, 95%CI: 1.09-25.0)<br>• Report patients with suspected COVID-19 were not wearing masks (OR=6.05, 95%CI: 1.70-21.51)<br><br>The following factors decreased odds of infection:<br>• Participation in infection control training (OR=0.12, 95%CI: 0.03-0.57)<br>• Wearing respirators or masks all of the time (OR=0.15, 95%CI: 0.04-0.55) | High |
| Jiaqiang, Z., Mingyang, S., Weijia, Z., Ningtao, L., MingZhang, Z., Lei, Q., & Szu-Yuan, W. (2020). Predictive factors of transmission during endotracheal intubation for coronavirus disease 2019 (COVID-19). *Preprint*. | Apr 1, 2020 | Cross-sectional | n=98 anesthesiologists intubating COVID-19 patients | Hospitals, China<br><br>Feb 2020 | 20/98 were infected (20.41%).<br><br>Factors influencing risk for infection:<br>• Planned intubations were associated with a lower risk (adjusted OR=0.28, 95% CI: 0.14-0.68)<br>• Patient cough during intubation was associated with a higher risk (adjusted OR=1.70, 95% CI: 1.39-2.97) | High<br>**PREPRINT** |

| Seroprevalence surveys | | | | | | |
|---|---|---|---|---|---|---|
| Jones, C. R., Hamilton, F. W., Thompson, A., Morris, T. T., & Moran, E. (2020). Seroprevalence of SARS-CoV-2 IgG in healthcare workers and other staff at North Bristol NHS Trust: A sociodemographic analysis. *Preprint*. | Nov 16, 2020 | Case-control | n=6858 HCW and support staff | Hospital, England<br><br>Exposure Mar to May 2020, testing in May 2020 | Overall seroprevalence was 9.3%.<br><br>Factors associated with seropositivity include:<br>• Black, Asian and minority ethnic individuals were twice as likely to have antibodies for COVID-19 than white individuals (adjusted OR=1.99, 95% CI=1.69, 2.34).<br><br>Critical care and operating room staff were about one third as likely to have antibodies for COVID-19 than staff in other roles (adjusted OR=0.29, 95% CI=0.13, 0.57 for critical care, adjusted OR=0.29, 95% CI=0.15, 0.49 for operating room staff). | High<br>**PREPRINT** |
| Baker, J. M., Nelson, K. N., Overton, E., Lopman, B. A., Lash, T. L., Photakis, M., . . . Steinberg, J. P. (2020). Quantification of occupational and community risk factors for SARS-CoV-2 seropositivity among healthcare workers in a large U.S. Healthcare system. *Preprint*. | Nov 3, 2020 | Cross-sectional | n=10,275 HCW volunteers | Atlanta, USA<br><br>Exposure Mar to Jun 2020, testing from Apr to Jun 2020. | Overall seropositivity was 5.7% (95% CI: 5.2%,6.1%).<br><br>Occupational risk factors accounted for 27% (95% CI: 25%-30%) of risk in multivariable regression models.<br><br>Risk of infection was associated with:<br>• Community contact with a known or suspected case (adjusted OR=1.9, 95% CI:1.4, 2.5)<br>• Contact with a positive colleague (adjusted OR: 1.2, 95% CI: 1.0, 1.6)<br>• Community incidence (adjusted OR: 1.4, 95% CI: 1.0,2.0)<br>• Being Black (adjusted OR=2.0, 95% CI:1.6, 2.4)<br><br>The authors note that changing in understanding of and adherence to infection control measures in and out of the workplace was not accounted for in analysis. | High<br><br>**PREPRINT** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Erber, J., Kappler, V., Haller, B., Mijočević, H., Galhoz, A., da Costa, C. P., . . . Lingor, P. (2020). Strategies for infection control and prevalence of anti-SARS-CoV-2 IgG in 4,554 employees of a university hospital in Munich, Germany. *Preprint*. | Oct 6, 2020 | Cross-sectional | n=4554 hospital employees and medical students | Hospital, Munich, Germany<br><br>Exposure Mar to May 2020, testing Apr 14 to May 29, 2020 | Overall seroprevalence was 2.4% (95% CI: 1.9-2.9).<br><br>Risk factors for seropositivity include:<br>• Male sex (OR=1.54, 95% CI:1.03-2.27)<br>• Age 51-60 years (OR=1.75, 95% CI:1.06-2.85) vs </30 years<br>• Diabetes (OR=2.96, 95% CI:1.01-6.81)<br>• Administrative staff without direct patient contact (OR=2.36, 95% CI:1.19-4.80)<br>• Staff with exposure to COVID-19 co-workers (OR=1.74, 95% CI:1.11-2.65)<br>• Staff with exposure to private contacts with COVID-19 (OR=5.56, 95% CI:3.32-8.94)<br>• Unprotected contact with COVID-19 patients (OR=4.77, 95% CI:3.09-7.22)<br><br>Protective factors include:<br>• Smoking (OR=0.52, 95% CI:0.26-0.94)<br>• Performing aerosol generating procedures (OR=0.50, 95% CI:0.23-0.94).<br><br>The authors did not provide any explanation for the surprising protective factors. | Moderate<br><br>**PREPRINT** |
| Jespersen, S., Mikkelsen, S., Greve, T., Kaspersen, K. A., Tolstrup, M., Boldsen, J. K., . . . Erikstrup, C. (2020). SARS-CoV-2 seroprevalence survey among 18,000 healthcare and administrative personnel at hospitals, pre-hospital services, and specialist practitioners in the central Denmark region. *Clinical Infectious Diseases*. Epub ahead of print. | Oct 3, 2020 | Cross-sectional | n=17,971 HCW (69% of all in Central Denmark) | 7 hospitals, Central Denmark<br><br>Exposure Mar to Jun 2020, testing May 18 to Jun 19, 2020. | Adjusted seroprevalence was 3.4% (95% CI: 2.5%, 3.8%).<br>• Younger age, < 30 years vs. all others, was associated with higher seropositivity adjusted OR=1.9, 95% 1.4-2.6)<br>• Compared to medical secretaries, nurses (OR: 7.3, 95% CI: 3.5, 14.9), doctors (OR: 4.0, 95% CI: 1.8, 8.9) and laboratory staff (OR: 5.0, 95% CI: 2.1, 11.6) had higher seropositivity<br>• Emergency departments had the highest seropositivity (29.7%, vs departments with no or limited COVID-19patient contact (1.8%) | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| Wilkins, J., Gray, E. L., Wallia, A., Hirschhorn, L., Zembower, T., Ho, J., . . . Evans, C. (2020). Seroprevalence and correlates of SARS-CoV-2 antibodies in healthcare workers in Chicago. *Preprint*. | Sep 13, 2020 | Cross-sectional | n=6510 HCW | Hospitals, immediate care centres and outpatient practices in Chicago and suburbs, USA<br><br>Exposure Mar to Jul 2020, testing Jul 2020 | Weighted seroprevalence was 5.3% (95% CI: 4.8%, 5.9%).<br><br>The following demographic groups had higher seropositivity:<br>• Younger age (18-29), prevalence 7.4%, vs. older age groups ranging from 2.6 o 4.5% (p-value and OR not reported)<br>• Being Hispanic (9.6%) or non-Hispanic Black (8.5%) vs White (4.3) or Asian (4.6%) (p-value and OR not reported)<br><br>Other factors associated with seropositivity include:<br>• Known out of hospital exposure (adjusted OR=4.7, 95%CI: 3.5, 6.4)<br>• Family member with confirmed case (adjusted OR=26.8, 95%CI: 17.3, 41.8)<br>• Nurses (adjusted OR=1.9, 95%CI: 1.3, 2.9)<br>• Taking care of COVID-19 patients (adjusted OR=2.19, 95%CI: 1.61, 3.01)<br>• Exposure to patients receiving high flow oxygen (OR: 145, no 95% CI)<br>• Exposure to patients receiving hemodialysis (OR: 1.57, no 95% CI) | High<br><br>**PREPRINT** |
| Nishida, T., Iwahashi, H., Yamauchi, K., Kinoshita, N., Okauchi, Y., Suzuki, N., . . . Abe, K. (2020). Seroprevalence of SARS-CoV-2 antibodies among 925 staff members in an urban hospital accepting COVID-19 patients in Osaka prefecture, Japan. *Preprint*. | Sep 11, 2020 | Cross-sectional | n=925 HCW | Hospital, Japan<br><br>Exposure Feb to Jun 2020, testing Jun 2020.<br><br>Authors note only occasional PPE shortages | Overall seroprevalence was 0.43%, 95% CI: 0.17, 1.1% (4/925).<br><br>Those who were seropositive were significantly older (52.8+/- 6.8 vs 40.0+/-11.8, p = 0.03). There was insufficient statistical power to explore other risk factors. | Moderate<br><br>**PREPRINT** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Alkurt, G., Murt, A., Aydin, Z., Tatli, O., Agaoglu, N. B., Irvem, A., . . . Doganay, L. (2020). Seroprevalence of coronavirus disease 2019 (COVID-19) among health care workers from three pandemic hospitals of Turkey. *Preprint*. | Aug 22, 2020 | Case-control | n=932 HCW | 3 Hospitals, Turkey<br><br>Exposure Mar to Jun 2020, testing Jun 2020. | Overall seroprevalence was 2.7%.<br><br>Seroprevalence was higher in non-pandemic clinics (6.4%, p = 0.05). No differences were found between other settings or profession. | Moderate<br><br>**PREPRINT** |
| Morcuende, M., Guglielminotti, J., & Landau, R. (2020). Anesthesiologists' and intensive care providers' exposure to COVID-19 infection in a New York City academic center: A prospective cohort study assessing symptoms and COVID-19 antibody testing. *Anesthesia & Analgesia, 131*(3), 669-676. | Jun 9, 2020 | Cross-sectional | n=105 anesthesiologists and intensive care residents and staff | Hospital, New York, USA<br><br>Exposure Mar 1 to Apr 15, 2020, testing Apr 2020 | Overall seroprevalence was 12.1% (11/91).<br><br>Seropositive HCW were more likely to:<br>• Use the NYC subway (8.18 vs. 41.2%, p = 0.027)<br>• Have tested positive previously (p = 0.002)<br><br>There was a statistical difference in role type, with positive tests more common in staff than residents (p = 0.06).<br><br>There were no differences between groups for work-related exposure to COVID-19. | High |

| Modelling Studies | | | | | | |
|---|---|---|---|---|---|---|
| King, M.F., Wilson, A. M., Weir, M. H., Lopez-Garcia, M., Proctor, J., . . . Noakes, C. J. (2020). Modelling the risk of SARS-CoV-2 infection through PPE doffing in a hospital environment. *Preprint*. | Sep 23, 2020 | Modelling | N/A | Health care settings, not specified | This study constructed a Quantitative Microbial Risk Assessments (QMRA) model to predict the number of potential surface exposures and risk of COVID-19 infection for HCW over time. The model considered the following variables: number of patients on a ward, proportion of COVID-19 patients, length of HCW shift, probability of contact with contaminated PPE.<br><br>The model considered transmission within a health care setting and within the broader community. Interventions occurred in general health care settings by two actors (hospital HCW and patients). Measures included PPE, and periodic testing of patients and HCW.<br><br>Risk of COVID-19 infection was reported in terms of risk during a single HCW shift. The model found the following rates of risk:<br>• Single face-to-face contact: 0.18%<br>• Providing intravenous care: 1%<br>• Caring for 7 patients: 0.6%; caring for 14 patients: 1.3%<br>• Caring for exclusively COVID-19 patients: 1.6%<br>• Mistakes while doffing PPE: <1.0% | Not appraised<br><br>*Interpret with caution*<br><br>**PREPRINT** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Huang, Q., Mondal, A., Jiang, X., Horn, M. A., Fan, F., Fu, P., . . . Gurarie, D. (2020). SARS-CoV-2 transmission and control in a hospital setting: An individual-based modelling study. *Preprint*. | Aug 25, 2020 | Modelling | N/A | Wuhan, China | This study constructed an IBM (individual-based model) with a SEIR (susceptible-exposed-infectious-recovered) framework to predict transmission over time and the impact of different interventions in a tertiary hospital. Interventions occurred in a ward setting by two actors (hospital HCW and patients). Measures included social distancing, self-isolation, tracing and quarantining and PPE.<br><br>The model was calibrated to empirical data from a hospital department during the early pandemic in Wuhan, China.<br><br>The model found that high-risk pools of HCW were 52% more susceptible to COVID-19 infection. This was attributed to work-related stress. | Not appraised<br><br>*Interpret with caution*<br><br>**PREPRINT** |

## Question 3: What control measures have been successful in acute care settings to prevent primary and secondary cases of COVID-19?

### Table 5: Syntheses

| Reference | Date Released | Description of Included Studies | Summary of Findings | Quality Rating: Synthesis | Quality Rating: Included Studies |
|---|---|---|---|---|---|
| Calò, F., Russo, A., Camaioni, C., De Pascalis, S., & Coppola, N. (2020). Burden, risk assessment, surveillance and management of SARS-CoV-2 infection in health workers: A scoping review. *Infectious Diseases of Poverty, 9*. | Oct 7, 2020 (Search completed May 22, 2020) | 43 studies<br><br>5 ongoing trials<br><br>14 webpages | Inadequate or non-use of PPE is associated with increased infection risk. Strict infection prevention and control procedures, adequate training programs on the appropriate use of PPE and close monitoring of HCW with symptom surveillance and testing are recommended.<br><br>In a study of 41 HCW (35 wearing surgical masks, 6 wearing N95 masks) exposed to aerosol generating medical procedures with a COVID-19 patient, no cases of transmission were reported. | Low | Not reported |
| Sorbello, M., Rosenblatt, W., Hofmeyr, R., Greif, R., & Urdaneta, F. (2020). Aerosol boxes and barrier enclosures for airway management in COVID-19 patients: A scoping review and narrative synthesis. *British Journal of Anaesthesia*, *125*(6), 880-894. | Sep 3, 2020 (Search completed May 27, 2020) | 52 articles including:<br>• 19 correspondences<br>• 16 letters to the editor<br>• 10 original articles<br>• 3 research letters<br>• 1 guideline<br>• 1 short recommendation<br>• 1 case report<br>• 1 quality improvement study<br><br>6 websites | Aerosol boxes and other barrier-enclosure systems may reduce large droplet spread, but no evidence that they protect HCW from aerosolised viral particles.<br><br>Barrier type systems may create additional risk during airway emergencies, are not always ergonomically practical, may be associated with additional infection hazards and may damage or reduce use of PPE.<br><br>Much of this evidence is based on expert opinion or simulation studies – data with patients is lacking. | Moderate | Not reported |

| | | | | | |
|---|---|---|---|---|---|
| Licina, A., Silvers, A. J., & Stuart, R. (2020). Use of powered air-purifying respirator (PAPR) by healthcare workers for preventing highly infectious viral diseases - a systematic review of evidence. *Systematic Reviews, 9*(173). | Aug 8, 2020 (Search completed Jun 2020) | 10 studies, of which 2 included COVID-19 and 8 included other viruses (MERS, SARS, Ebola):<br>• 1 observational case series (COVID-19)<br>• 1 observational cohort study without a control group (COVID-19)<br>• 1 simulation RCT<br>• 3 observational simulation studies<br>• 4 randomized cross over simulation study | In HCW conducting airway procedures, powered air purifying respirators (PAPRs) were not associated with different rates of COVID-19 infection compared to other protective respiratory equipment. | Moderate | Low |
| Luqman Arafath, T. K., Jubbal, S. S., Gireesh, E. D., Margapuri, J., Jogu, H. R., . . . Penupolu, S. (2020). Risk of transmission of infection to healthcare workers delivering supportive care for coronavirus pneumonia; a rapid GRADE review. *Preprint*. | Jul 8, 2020 (Search completed Jun 28, 2020) | 22 studies:<br>• 11 mechanistic studies (7 on mannikins, 2 healthy volunteers, 2 others)<br>• 11 clinical studies (5 case-control, 6 cohort) | This review found across all studies (not specific to COVID-19) risk of transmission is:<br>• Lower when a mask is worn<br>• Lower when a gown is worn<br>• Lower when goggles are worn<br><br>The certainty of evidence for all the above factors was moderate according to GRADE. | Low<br><br>**PREPRINT** | Not reported |
| Alberta Health Services. (2020, Jun 12). *Topic: Effectiveness of screening programs for reducing the spread of COVID-19 in healthcare settings*. | Jun 12, 2020 (Search completed May 22, 2020) | 47 articles that included studies of screening for COVID-19 and other infections (MERS, influenza, TB):<br>• 4 modelling studies<br>• 3 systematic reviews on travel screening<br>• 1 systematic review on TB screening<br><br>Most studies observational.<br><br>Evidence related to COVID-19 was only found in grey literature, not primary research literature. | Evidence does not show that any single form of HCW screening program reduces transmission of infections, although specific studies related to COVID-19 were not identified.<br><br>There is some preliminary evidence (one modeling study and one observational study) that testing HCW for infection may reduce transmission in acute care settings. | Low | Quality of evidence related to travel screening, TB screening, MERS and H1N1 was relatively robust. |

| | | | | | |
|---|---|---|---|---|---|
| Chu, D.K., Akl, E.A., Duda, S., Solo, K., Yaacoub, S., & Schunemann, H.J. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: A systematic review and meta-analysis. *The Lancet*, *395*(10242), 1973-1987. | Jun 1, 2020 (Search completed May 3, 2020) | 172 observational studies, no RCTs. Includes 44 comparative studies included in meta-analysis.<br><br>Includes 7 studies focused on COVID-19 and other studies of MERS, SARS. | Absolute risk of infection was greater for shorter distance (<1m) vs longer distance (1metre or more), this association held for COVID-19 specific studies and those in health care settings.<br><br>Use of face masks was associated with lower risk of infection compared to no mask, with a stronger association in health care settings. This is possibly due to increased use of N95 type respirators in health care settings, which are associated with greater infection protection than other mask types.<br><br>Eye protection was also associated with a lower risk of infection (compared to no eye protection) although this finding was not specific to COVID-19. | High | Low-to-moderate |

# Table 6: Single Studies

| Reference | Date Released | Study Design | Population | Setting and Timing | Preventive Measure | Summary of findings | Quality Rating: |
|---|---|---|---|---|---|---|---|
| Schmitz, D., Vos, M., Stolmeijer, R., Lameijer, H., Schonberger, T., Gaakeer, M. I., . . . Ter Avest, E. (2020). Association between personal protective equipment and SARS-CoV-2 infection risk in emergency department healthcare workers. *European Journal of Emergency Medicine*. Epub ahead of print. | Nov 6, 2020 | Cross-sectional | Emergency physicians in 45 emergency departments, N not specified | Emergency department, Netherlands<br><br>Mar 1 to May 1, 2020 | High-level PPE | A survey of emergency departments between evaluated the association between COVID-19 infection and personal protective equipment used.<br><br>Use of high-level PPE (e.g., FFP2 mask, eye protection) was not associated with lower COVID-19 infections compared to lower-level PPE (e.g., FFP1 or surgical mask).<br><br>Contacts among physicians in contexts in which PPE was not in use were not controlled for. | Moderate |
| Ahmad, J., Anwar, S., Latif, A., Haq, N. U., Sharif, M., & Nauman, A. A. (2020). The Association of PPE Availability, Training and Practices with COVID-19 Sero-prevalence in Nurses and Paramedics in Tertiary Care Hospitals of Peshawar, Pakistan. *Disaster Medicine and Public Health Preparedness*. Epub ahead of print. | Nov 5, 2020 | Cross-sectional | n=133 nurses and paramedics | Hospital, Peshawar, Pakistan<br><br>Dates not specified | PPE | A survey and serological screen for COVID-19 antibodies evaluated the association between COVID-19 infection and personal protective equipment used.<br><br>There was no statistically significant difference in the seroprevalence of COVID-19 antibodies for staff who had received PPE immediately at the onset of the pandemic or who did not have interruptions in PPE supply, compared to those with delays or interruptions.<br><br>Most study participants (58.6%) did not report self-isolating during the pandemic. | Moderate |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Abella, B. S., Jolkovsky, E. L., Biney, B. T., Uspal, J. E., Hyman, M. C., Frank, I., . . . Treatment of, C.-W. H. I. (2020). Efficacy and safety of hydroxychloroquine vs placebo for pre-exposure SARS-CoV-2 prophylaxis among health care workers: A randomized clinical trial. *JAMA Internal Medicine*. Epub ahead of print. | Sep 30, 2020 | Randomized controlled trial | n=132 HCW (focus on those working in emergency or COVID-19 units) | 2 Hospitals, Philadelphia, USA<br><br>Apr 9 to Aug 4, 2020 | Prophylactic use of hydroxy-chloroquine | A double-blind, placebo controlled, RCT examined efficacy of Hydroxychloroquine for prevention of COVID-19 transmission in HCW.<br><br>There was no significant difference in COVID-19 infection rates between those receiving the Hydroxychloroquine (n=4, 6.3%) and those receiving the placebo (n=4, 6.6%) over the 8-week intervention period.<br><br>Study was terminated early due to futility. | Low |
| Schwartz, C., Oster, Y., Slama, C., Benenson, S., & Hadassah, C.-I. W. G. (2020). A dynamic response to exposures of health care workers to newly diagnosed COVID-19 patients or hospital personnel, in order to minimize cross-transmission and the need for suspension from work during the outbreak. *Open Forum Infectious Diseases*, *7*(9), ofaa384. | Sep 1, 2020 | Cohort | n=1095 HCW exposures to 51 index cases (n=23 HCW and n=28 patients) | Hospital, Jerusalem, Israel<br><br>Mar 8 to May 23, 2020 | Compulsory isolation based on level of contact and timing of symptomology of index case, PPE | The hospital revised guidelines for compulsory isolation of HCW based on close contact with index cases. Most HCW (251/400) were sent into isolation in the first 2 weeks of the study period.<br><br>Following this, isolation rules were changed and masks were made mandatory for all patient contact. The isolation rate of HCW after this measure was introduced dropped from 17.22 per index case to 2.79 per index case.<br><br>Of the 5 HCW who were diagnosed with COVID-19, none of these cases occurred after mandatory masks were introduced at 2 weeks. | Moderate |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Carretta, G., Contessa, C., Boemo, D. G., Bordignon, G., Bennici, S. E., Merigliano, S., . . . Donato, D. (2020). COVID-19 challenge: Proactive management of a tertiary university hospital in Veneto region, Italy. *Pathogens and Global Health*, *114*(6). | Aug 23, 2020 | Case report | n=7649 HCW | Hospital, Italy<br><br>Feb 21 to 1 May, 2020 | A number of hospital wide measures, but provision of FFP2/FFP3 respirators, goggles and protective suits as well as isolation protocols and testing via a swab were instituted for workers. | Low prevalence rate of COVID-19 (1.8%) among HCW compared to other regions of Italy was attributed to high staff testing rates, as well as timely and correct use of PPE. | Moderate |
| Hawkins, E. S., Fertel, B. S., Muir, M. R., Meldon, S. W., Delgado, F. J., & Smalley, C. M. (2020). Adding eye protection to universal masking reduces COVID-19 among frontline emergency clinicians to the level of community spread. *American Journal of Emergency Medicine*. Epub ahead of print. | Aug 20, 2020 | Cohort | n=352 frontline ED clinicians | 14 Midwest emergency departments, USA<br><br>Mar 18 to Jul 18, 2020 | Eye protection (goggles), plus universal masking of HCW and patients in ED | 1.14% (n=4) clinicians contracted COVID-19, which was not significantly different from the community prevalence rate of 0.85%.<br><br>Eye protection and universal masking brings the level of clinician prevalence of COVID-19 down to community levels (rather than ED patient population levels). | Moderate |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cattelan, A. M., Sasset, L., Di Meco, E., Cocchio, S., Barbaro, F., Cavinato, S., . . . Baldo, V. (2020). An integrated strategy for the prevention of SARS-CoV-2 infection in healthcare workers: A prospective observational study. *International Journal of Environmental Research and Public Health*. | Aug 10, 2020 | Cohort | n=60 HCW | Hospital, Italy<br><br>Feb 21 to Apr 16, 2020 | Advanced triage area, PPE protocols and testing | 361 swabs were taken from HCW, with no positive results for COVID-19 in this setting with triage, PPE and testing in place. | Moderate |
| Turcato, G., Zaboli, A., & Pfeifer, N. (2020). The COVID-19 epidemic and reorganisation of triage, an observational study. *Internal and Emergency Medicine*. Epub ahead of print. | Aug 9, 2020 | Diagnostic | Medical and nursing staff working in emergency department, n not specified | Emergency Department, Italy<br><br>Mar 4 to Apr 15, 2020 | Pre-triage area established in ED and PPE protocols implemented for infected and clean areas. | No medical or nursing staff working in the emergency department showed symptoms of COVID-19 in this setting with pre-triage and PPE in place. Of 63 swabs tested, none were positive. | Low |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Zhong, Q., Liu, Y. Y., Luo, Q., Zou, Y. F., Jiang, H. X., Li, H., . . . Zhang, Z. Z. (2020). Spinal anaesthesia for patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: Retrospective, single-centre, observational cohort study. *British Journal of Anaesthesia*, *124*(6), 670-675. | Mar 28, 2020 | Cohort | n=44 anesthetists | Hospital, Wuhan China<br><br>Jan 1 to Feb 14, 2020 | PPE | 49 patients with radiologically confirmed COVID-19 (but only 26% RT-PCR confirmed) received spinal anesthesia from 44 anesthetists. Anesthetists' only contact with presumed COVID-19 patients was during surgery.<br><br>37 anesthetists wore Level 3 PPE (positive pressure, full chemical protective suit and self-contained breathing apparatus) while the other 7 wore Level 1 PPE (gown, surgical mask, gloves, hat).<br><br>1 anesthetist wearing Level 3 PPE contracted COVID-19, 4 anesthetists wearing Level 1 PPE contracted COVID-19, suggesting the higher level of PPE reduces risk of transmission (relative risk reduction 95.3% (95% CI: 63.7-99.4%).<br><br>26 of the anesthetists (23/37 wearing PPE Level 3 and 3/7 wearing PPE Level 1) were also taking prophylactic antiviral therapy.<br><br>It is also possible that the infected anesthetists contracted COVID-19 through contact with a colleague or another source. | Low |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Huang, Z., Zhao, S., Li, Z., Chen, W., Zhao, L., Deng, L., & Song, B. (2020). The battle against coronavirus disease 2019 (COVID-19): Emergency management and infection control in a radiology department. *Journal of the American College of Radiology*, *17*(6), 710-716. | Mar 24, 2020 | Case report | n=65 diagnostic radiologists and 161 other staff members | Hospital, Chengdu, China<br>Jan 21 to Mar 9, 2020 | The radiology department reconfigured areas to reduce cross-contamination. Staff were provided with multiple forms of PPE, given regular breaks, monitored for symptoms and received additional training on infection control. | The radiology department screened 7203 people for COVID-19 and 24 were positive. 3083 of those screened received a CT. No radiology staff member contracted COVID-19 during this period, with PPE and protocols in place in the setting. | Moderate |

| Modelling Studies | | | | | | | |
|---|---|---|---|---|---|---|---|
| Baek, Y. J., Lee, T., Cho, Y., Hyun, J. H., Kim, M. H., Sohn, Y., . . . Choi, J. Y. (2020). A mathematical model of COVID-19 transmission in a tertiary hospital and assessment of the effects of different intervention strategies. *PLoS One*, *15*(10), e0241169 | Oct 26, 2020 | Modelling | N/A | Hospital, South Korea | Front door symptom screening, quarantine unit for new patients, early testing of suspected cases, PPE for staff and visitors | This study constructed a SEIR (susceptible-exposed-infectious-recovered) mathematical model to predict transmission over time and the impact of different interventions in a tertiary hospital. Interventions occurred in three categories (ward, outpatient clinics, emergency room) and by four actors (doctors, nurses, patients, caregivers). Measures included front door screening, triage clinics, access control, universal masking, increasing testing and isolation wards.<br><br>Effectiveness of simulated interventions was reported in terms of the proportion of decreased cases due to an intervention. The model found the following rates of effectiveness:<br>• All interventions combined: 80.7%<br>• Early testing of suspected cases with test results <8 hours: 80.7%<br>• Universal masking of HCW and visitors: 66.4%<br>• Quarantine of newly admitted patients: 65.7%<br>• Front door screening: 43.1% | Not appraised<br><br>*Interpret with caution* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Huang, Q., Mondal, A., Jiang, X., Horn, M. A., Fan, F., Fu, P., . . . Gurarie, D. (2020). SARS-CoV-2 transmission and control in a hospital setting: An individual-based modelling study. *Preprint*. | Aug 25, 2020 | Modelling | N/A | Hospital, Wuhan, China | Social distancing, HCW screening, PPE | This study constructed an IBM (individual-based model) with a SEIR (susceptible-exposed-infectious-recovered) framework to predict transmission over time and the impact of different interventions in a tertiary hospital. Interventions occurred in a ward setting by two actors (hospital HCW and patients). Measures included social distancing, self-isolation, tracing and quarantining and PPE.<br><br>The model was calibrated to empirical data from a hospital department during the early pandemic in Wuhan, China.<br><br>Effectiveness of simulated interventions was reported in terms of the proportion of decreased cases due to an intervention and decrease in workday loss. The model found the following rates of effectiveness:<br>• High efficacy face masks: 80% decrease in cases, 87% decrease in workday loss<br>• Health care worker screening: only marginal effects on number of cases and workday loss<br>• Social distancing: only marginal effects on number of cases and workday loss | Not appraised<br><br>*Interpret with caution*<br><br>**PREPRINT** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Miller, J.C., Qiu, X., MacFadden, D., & Hanage, W.P. (2020). Evaluating the contributions of strategies to prevent SARS-CoV-2 transmission in healthcare setting: a modelling study. *Preprint*. | Jul 14, 2020 | Modelling | N/A | Health care settings, not specified | PPE, periodic testing of patients and HCW, cohorting of suspected cases | This study constructed a SEIR (susceptible-exposed-infectious-recovered) model to predict transmission over time and the impact of different interventions in a tertiary hospital. The model considered transmission within a health care setting and within the broader community. Interventions occurred in general health care setting by two actors (hospital HCW and patients). Measures included PPE, and periodic testing of patients and HCW.<br><br>Effectiveness of simulated interventions was reported in terms of decreased cases of HCW infections due to an intervention. The model found:<br>• PPE use greatly reduces the number of health worker infections<br>• Use of less-effective PPE (improper use or low quality equipment) reduces infection rates in HCW to that of the general population<br>• Weekly testing of patients and HCW significantly reduced COVID-19 infections.<br>• Smaller cohorts of suspected cases reduced nosocomial infections, compared to larger cohorts.<br>• High efficacy face masks: 80% decrease in cases, 87% decrease in workday loss | Not appraised<br><br>*Interpret with caution*<br><br>**PREPRINT** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Evans, S., Agnew, E., Vynnycky, E., & Robotham, J. V. (2020). The impact of testing and infection prevention and control strategies on within-hospital transmission dynamics of COVID-19 in English hospitals. *Preprint*. | May 20, 2020 | Modelling | N/A | Hospital, United Kingdom | Periodic testing of HCW, single room isolation vs. cohorting of suspected cases | This study constructed a SEIR (susceptible-exposed-infectious-recovered) mathematical model to predict transmission over time and the impact of different interventions in a tertiary hospital. Interventions occurred in a ward setting by two actors (hospital HCW and patients). Measures included periodic testing of HCW and single room isolation vs. cohorting of suspected cases.<br><br>The model was calibrated to National Health Service data from two hospitals.<br><br>Effectiveness of simulated interventions was reported in terms of the proportion of decreased cases due to an intervention. The model found the following rates of effectiveness:<br>• Daily testing of HCW: 64% decrease in cases in HCW<br>• Weekly testing of HCW: 24% decrease in cases in HCW<br>• Single room isolation of suspected cases, instead of cohorting of suspected cases: significant reduction in nosocomial cases in patients | Not appraised<br><br>*Interpret with caution*<br><br>**PREPRINT** |

# References


Abella, B. S., Jolkovsky, E. L., Biney, B. T., Uspal, J. E., Hyman, M. C., Frank, I., . . . Treatment of, C.-W. H. I. (2020). Efficacy and safety of hydroxychloroquine vs placebo for pre-exposure SARS-CoV-2 prophylaxis among health care workers: A randomized clinical trial. *JAMA Internal Medicine*. Epub ahead of print.

Ahmad, J., Anwar, S., Latif, A., Haq, N. U., Sharif, M., & Nauman, A. A. (2020). The Association of PPE Availability, Training and Practices with COVID-19 Sero-prevalence in Nurses and Paramedics in Tertiary Care Hospitals of Peshawar, Pakistan. *Disaster Medicine and Public Health Preparedness*. Epub ahead of print.

Alajmi, J., Jeremijenko, A. M., Abraham, J. C., Alishaq, M., Concepcion, E. G., Butt, A. A., & Abou-Samra, A.-B. (2020). COVID-19 infection among healthcare workers in a national healthcare system: The Qatar experience. *International Journal of Infectious Diseases, 100*, 386-389.

Alberta Health Services. (2020, June 5). *Has there been documented transmission of SARS-Cov-2 virus (or similar viruses) through heating, ventilation, and air conditioning (HVAC) systems in hospitals or nonhospital settings?*

Alberta Health Services. (2020, June 12). *Topic: Effectiveness of screening programs for reducing the spread of COVID-19 in healthcare settings*.

Alkurt, G., Murt, A., Aydin, Z., Tatli, O., Agaoglu, N. B., Irvem, A., . . . Doganay, L. (2020). Seroprevalence of coronavirus disease 2019 (COVID-19) among health care workers from three pandemic hospitals of Turkey. *Preprint*.

Baek, Y. J., Lee, T., Cho, Y., Hyun, J. H., Kim, M. H., Sohn, Y., . . . Choi, J. Y. (2020). A mathematical model of covid-19 transmission in a tertiary hospital and assessment of the effects of different intervention strategies. *PLoS One,15(10), e0241169*

Baker, J. M., Nelson, K. N., Overton, E., Lopman, B. A., Lash, T. L., Photakis, M., . . . Steinberg, J. P. (2020). Quantification of occupational and community risk factors for SARS-CoV-2 seropositivity among healthcare workers in a large U.S. Healthcare system. *Preprint*.

Baker, M. A., Fiumara, K., Rhee, C., Williams, S. A., Tucker, R., Wickner, P., . . . Klompas, M. (2020). Low risk of covid-19 among patients exposed to infected healthcare workers. *Clinical Infectious Diseases*. Epub ahead of print.

Biernat, M. M., Zinczuk, A., Biernat, P., Bogucka-Fedorczuk, A., Kwiatkowski, J., Kalicinska, E., . . . Wrobel, T. (2020). Nosocomial outbreak of SARS-CoV-2 infection in a haematological unit - high mortality rate in infected patients with haematologic malignancies. *Journal of Clinical Virology*. Epub ahead of print.

Buising, K. L., Williamson, D., Cowie, B. C., MacLachlan, J., Orr, E., MacIsaac, C., . . . Marshall, C. (2020). A hospital-wide response to multiple outbreaks of covid-19 in health care workers: Lessons learned from the field. *The Medical Journal of Australia*. Epub ahead of print.

Calò, F., Russo, A., Camaioni, C., De Pascalis, S., & Coppola, N. (2020). Burden, risk assessment, surveillance and management of SARS-CoV-2 infection in health workers: A scoping review. *Infectious Diseases of Poverty, 9*.

Cao, G., Tang, S., Yang, D., Shi, W., Wang, X., Wang, H., . . . Ma, L. (2020). The Potential transmission of SARS-CoV-2 from patients with negative RT-PCR swab tests to others: two related clusters of COVID-19 outbreak. *Japanese Journal of Infectious Diseases, 73*(6), 399-403.

Carretta, G., Contessa, C., Boemo, D. G., Bordignon, G., Bennici, S. E., Merigliano, S., . . . Donato, D. (2020). COVID-19 challenge: Proactive management of a tertiary university hospital in Veneto region, Italy. *Pathogens and Global Health*, *114*(6).

Cattelan, A. M., Sasset, L., Di Meco, E., Cocchio, S., Barbaro, F., Cavinato, S., . . . Baldo, V. (2020). An integrated strategy for the prevention of SARS-CoV-2 infection in healthcare workers: A prospective observational study. *International Journal of Environmental Research and Public Health*.

Chou, R., Dana, T., Buckley, D. I., Selph, S., Fu, R., & Totten, A. M. (2020). Update Alert 5: Epidemiology of and risk factors for coronavirus infection in health care workers: A living rapid review. *Annals of Internal Medicine*. Epub ahead of print.

Chu, D.K., Akl, E.A., Duda, S., Solo, K., Yaacoub, S., & Schunemann, H.J. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: A systematic review and meta-analysis. *The Lancet*, *395*(10242), 1973-1987.

Contejean, A., Leporrier, J., Canoui, E., Alby-Laurent, F., Lafont, E., Beaudeau, L., . . . Kerneis, S. (2020). Comparing dynamics and determinants of SARS-CoV-2 transmissions among health care workers of adult and pediatric settings in central Paris. *Clinical Infectious Diseases*. Epub ahead of print.

Erber, J., Kappler, V., Haller, B., Mijočević, H., Galhoz, A., da Costa, C. P., . . . Lingor, P. (2020). Strategies for infection control and prevalence of anti-SARS-CoV-2 IgG in 4,554 employees of a university hospital in Munich, Germany. *Preprint*.

Evans, S., Agnew, E., Vynnycky, E., & Robotham, J. V. (2020). The impact of testing and infection prevention and control strategies on within-hospital transmission dynamics of covid-19 in English hospitals. *Preprint*.

Galanis, P., Vraka, I., Fragkou, D., Bilali, A., & Kaitelidou, D. (2020). Seroprevalence of SARS-CoV-2 Antibodies and Associated Factors in Health Care Workers: A Systematic Review and Meta-Analysis. *The Journal of Hospital Infection*. Epub ahead of print.

Garzaro, G., Clari, M., Ciocan, C., Grillo, E., Mansour, I., Godono, A., . . . Pira, E. (2020). COVID-19 infection and diffusion among the healthcare workforce in a large university-hospital in northwest Italy. *La Medicina del lavoro*, *111*(3), 184-194.

Gomez-Ochoa, S., Franco, O. H., Rojas, L. Z., ... Muka, T. (2020). COVID-19 in Health-Care Workers: A Living Systematic Review and Meta-Analysis of Prevalence, Risk Factors, Clinical Characteristics, and Outcomes. *American Journal of Epidemiology*. Epub ahead of print.

Guo, X., Wang, J., Hu, D., Wu, L., Gu, L., Wang, Y., . . . Wu, Y. (2020). Survey of COVID-19 disease among orthopaedic surgeons in Wuhan, People's Republic of China. *The Journal of Bone and Joint Surgery, American volume*, *102*(10), 847-854.

Hawkins, E. S., Fertel, B. S., Muir, M. R., Meldon, S. W., Delgado, F. J., & Smalley, C. M. (2020). Adding eye protection to universal masking reduces covid-19 among frontline emergency clinicians to the level of community spread. *American Journal of Emergency Medicine*. Epub ahead of print.

Huang, Q., Mondal, A., Jiang, X., Horn, M. A., Fan, F., Fu, P., . . . Gurarie, D. (2020). SARS-CoV-2 transmission and control in a hospital setting: An individual-based modelling study. *Preprint*.

Huang, Z., Zhao, S., Li, Z., Chen, W., Zhao, L., Deng, L., & Song, B. (2020). The battle against coronavirus disease 2019 (COVID-19): Emergency management and infection control in a radiology department. *Journal of the American College of Radiology*, *17*(6), 710-716.

Jespersen, S., Mikkelsen, S., Greve, T., Kaspersen, K. A., Tolstrup, M., Boldsen, J. K., . . . Erikstrup, C. (2020). SARS-CoV-2 seroprevalence survey among 18,000 healthcare and administrative personnel at hospitals, pre-hospital services, and specialist practitioners in the central Denmark region. *Clinical Infectious Diseases*. Epub ahead of print.

Jiaqiang, Z., Mingyang, S., Weijia, Z., Ningtao, L., MingZhang, Z., Lei, Q., & Szu-Yuan, W. (2020). Predictive factors of transmission during endotracheal intubation for coronavirus disease 2019 (COVID-19). *Preprint*.

Jin, Y.H., Huang, Q., Wang, Y.Y., Zeng, X.T., Luo, L.S., Pan, Z.Y., . . . Wang, X.-H. (2020). Perceived infection transmission routes, infection control practices, psychosocial changes, and management of COVID-19 infected healthcare workers in a tertiary acute care hospital in Wuhan: A cross-sectional survey. *Military Medical Research, 7*(24).

Jones, C. R., Hamilton, F. W., Thompson, A., Morris, T. T., & Moran, E. (2020). Seroprevalence of SARS-CoV-2 IgG in healthcare workers and other staff at North Bristol NHS Trust: A sociodemographic analysis. *Preprint*.

Kim, S. W., Jo, S. J., Lee, H., Oh, J. H., Lim, J., Lee, S. H., . . . Lee, J. (2020). Containment of a healthcare-associated covid-19 outbreak in a university hospital in Seoul, Korea: A single-center experience. *PLoS One*. Epub ahead of print.

King, M.F., Wilson, A. M., Weir, M. H., Lopez-Garcia, M., Proctor, J., . . . Noakes, C. J. (2020). Modelling the risk of SARS-CoV-2 infection through PPE doffing in a hospital environment. *Preprint*.

Knoll, R. L., Klopp, J., Bonewitz, G., Grondahl, B., Hilbert, K., Kohnen, W., . . . Gehring, S. (2020). Containment of a large SARS-CoV-2 outbreak among healthcare workers in a pediatric intensive care unit. *The Pediatric Infectious Disease Journal, 39*(11), e336-e339.

Koh, W. C., Naing, L., Chaw, L., Rosledzana, M. A., Alikhan, M. F., Jamaludin, S. A., . . . Wong, J. (2020). What do we know about SARS-CoV-2 transmission? A systematic review and meta-analysis of the secondary attack rate and associated risk factors. *PLoS One, 15*(10), e0240205-e0240205.

Lai, X., Wang, M., Qin, C., Tan, L., Ran, L., Chen, D., . . . Wang, W. (2020). Coronavirus disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary hospital in Wuhan, China. *JAMA Network Open, 3*(5), e209666

Licina, A., Silvers, A. J., & Stuart, R. (2020). Use of powered air-purifying respirator(papr) by healthcare workers for preventing highly infectious viral diseases -a systematic review of evidence. *Systematic Reviews, 9*(173).

Luong-Nguyen, M., Hermand, H., Abdalla, S., Cabrit, N., Hobeika, C., Brouquet, A., . . . Sauvanet, A. (2020). Nosocomial infection with SARS-CoV-2 within departments of digestive surgery. *Journal of Visceral Surgery*, *157*(3S1), S13-S18.

Luqman Arafath, T. K., Jubbal, S. S., Gireesh, E. D., Margapuri, J., Jogu, H. R., . . . Penupolu, S. (2020). Risk of transmission of infection to healthcare workers delivering supportive care for coronavirus pneumonia; a rapid GRADE review. *Preprint*.

Mandić-Rajčević, S., Masci, F., Crespi, E., Franchetti, S., Longo, A., Bollina, I., . . . Colosio, C. (2020). Contact tracing and isolation of asymptomatic spreaders to successfully control the COVID-19 epidemic among healthcare workers in Milan (Italy). *Preprint*.

Miller, J.C., Qiu, X., MacFadden, D., & Hanage, W.P. (2020). Evaluating the contributions of strategies to prevent SARS-CoV-2 transmission in healthcare setting: a modelling study. *Preprint*.

Morcuende, M., Guglielminotti, J., & Landau, R. (2020). Anesthesiologists' and intensive care providers' exposure to covid-19 infection in a new york city academic center: A prospective cohort study assessing symptoms and covid-19 antibody testing. *Anesthesia & Analgesia, 131*(3), 669-676.

Mortgat, L., Barbezange, C., Fischer, N., Heyndrickx, L., Hutse, V., Thomas, I., . . . Duysburgh, E. (2020). SARS-CoV-2 prevalence and seroprevalence among healthcare workers in Belgian hospitals: Baseline results of a prospective cohort study. *Preprint*.

Mponponsuo, K., Kerkerian, G., Somayaji, R., Missaghi, B., Vayalumkal, J. V., Larios, O. E., . . . Conly, J. (2020). Lack of nosocomial transmission to exposed inpatients and coworkers in an investigation of five SARS-CoV-2-infected healthcare workers. *Infection Control & Hospital Epidemiology*. Epub ahead of print.

Nasia, S., Gage, K. M., Katarina, M. B., Thomas, C. F., & David, H. O. C. (2020). Determining the source of transmission of SARS-CoV-2 infection in a healthcare worker. *Preprint*.

Nishida, T., Iwahashi, H., Yamauchi, K., Kinoshita, N., Okauchi, Y., Suzuki, N., . . . Abe, K. (2020). Seroprevalence of SARS-CoV-2 antibodies among 925 staff members in an urban hospital accepting COVID-19 patients in Osaka prefecture, Japan. *Preprint*.

Prasitsirikul, W., Pongpirul, K., Pongpirul, W. A., Panitantum, N., Ratnarathon, A. C., & Hemachudha, T. (2020). Nurse infected with COVID-19 from a provisional dengue patient. *Emerging Microbes & Infections, 9*(1).

Rickman, H. M., Rampling, T., Shaw, K., Martinez-Garcia, G., Hail, L., Coen, P., . . . Houlihan, C. F. (2020). Nosocomial transmission of COVID-19: A retrospective study of 66 hospital-acquired cases in a London teaching hospital. *Clinical Infectious Diseases*. Epub ahead of print.

Schmitz, D., Vos, M., Stolmeijer, R., Lameijer, H., Schonberger, T., Gaakeer, M. I., . . . Ter Avest, E. (2020). Association between personal protective equipment and SARS-CoV-2 infection risk in emergency department healthcare workers. *European Journal of Emergency Medicine*. Epub ahead of print.

Schünemann, H., Brożek, J., Guyatt, G., & Oxman, A. (2013). *Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach*.

Schwartz, C., Oster, Y., Slama, C., Benenson, S., & Hadassah, C.-I. W. G. (2020). A dynamic response to exposures of health care workers to newly diagnosed COVID-19 patients or hospital personnel, in order to minimize cross-transmission and the need for suspension from work during the outbreak. *Open Forum Infectious Diseases*, *7*(9), ofaa384.

Schwierzeck, V., König, J. C., Kühn, J., Mellmann, A., Correa-Martínez, C. L., Omran, H., . . . Kampmeier, S. (2020). First reported nosocomial outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in a pediatric dialysis unit. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. *Clinical Infectious Diseases*. Epub ahead of print.

Sikkema, R. S., Pas, S. D., Nieuwenhuijse, D. F., Toole, Á., Verweij, J., van der Linden, A., . . . Koopmans, M. P. G. (2020). COVID-19 in health-care workers in three hospitals in the south of the Netherlands: A cross-sectional study. *The Lancet Infectious Diseases*, *20*(11), 1273-1280.

Sorbello, M., Rosenblatt, W., Hofmeyr, R., Greif, R., & Urdaneta, F. (2020). Aerosol boxes and barrier enclosures for airway management in covid-19 patients: A scoping review and narrative synthesis. *British Journal of Anaesthesia*, *125*(6), 880-894.

Tubiana, S., Burdet, C., Houhou, N., Thy, M., Manchon, P., Blanquart, F., . . . Duval, X. (2020). High-risk exposure without personal protective equipment and infection with SARS-CoV-2 in healthcare workers: Results of the CoV-CONTACT prospective cohort. *Preprint*.

Turcato, G., Zaboli, A., & Pfeifer, N. (2020). The COVID-19 epidemic and reorganisation of triage, an observational study. *Internal and Emergency Medicine*. Epub ahead of print.

Wake, R. M., Morgan, M., Choi, J., & Winn, S. (2020). Reducing nosocomial transmission of covid-19: Implementation of a covid-19 triage system. *Clinical Medicine Journal*. Epub ahead of print.

Wang, Q., Huang, X., Bai, Y., Wang, X., Wang, H., Hu, X., . . . Zhao, H. (2020). Epidemiological characteristics of covid-19 in medical staff members of neurosurgery departments in Hubei province: A multicentre descriptive study. *Preprint*.

Wang, Y., Wu, W., Cheng, Z., Tan, X., Yang, Z., Zeng, X., . . . Wang, X. (2020). Super-factors associated with transmission of occupational covid-19 infection among healthcare staff in Wuhan, China. *The Journal of Hospital Infection*, *106*(1), 25-34.

Wee, L. E., Sim, X. Y. J., Conceicao, E. P., Aung, M. K., Goh, J. Q., Yeo, D. W. T., . . . Venkatachalam, I. (2020). Containment of covid-19 cases among healthcare workers: The role of surveillance, early detection, and outbreak management. *Infection Control and Hospital Epidemiology*, 41(7), 765-771.

Wee, L. E. I., Sim, X. Y. J., Conceicao, E. P., Aung, M. K., Tan, K. Y., Ko, K. K. K., . . . Ling, M. L. (2020). Containing covid-19 outside the isolation ward: The impact of an infection control bundle on environmental contamination and transmission in a cohorted general ward. *American Journal of Infection Control*, *48*(9), 1056-1061.

Wilkins, J., Gray, E. L., Wallia, A., Hirschhorn, L., Zembower, T., Ho, J., . . . Evans, C. (2020). Seroprevalence and correlates of SARS-CoV-2 antibodies in healthcare workers in Chicago. *Preprint*.

Zheng, C., Hafezi-Bakhtiari, N., Cooper, V., Davidson, H., Habibi, M., Riley, P., & Breathnach, A. (2020). Characteristics and transmission dynamics of COVID-19 in healthcare workers at a London teaching hospital. *The Journal of Hospital Infection*, *106*(2), 325-329.

Zhong, Q., Liu, Y. Y., Luo, Q., Zou, Y. F., Jiang, H. X., Li, H., . . . Zhang, Z. Z. (2020). Spinal anaesthesia for patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: Retrospective, single-centre, observational cohort study. *British Journal of Anaesthesia*, *124*(6), 670-675.