

Scientific Advisory Group

COVID-19 Scientific Advisory Group Rapid Evidence Report

Interim Update: Masking Guidance for Healthcare Workers

September 13, 2021



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Lay Summary

Background

- This review is focused on the practical question of whether healthcare workers (HCW) get infected with COVID-19 at work at different rates when they wear N95 respirators compared to medical/surgical-type masks.
- People with COVID-19 may generate both respiratory droplets and aerosols, depending on the circumstances (e.g. aerosol generating procedures). The evidence for the dominant mode of viral transmission is still under investigation and is beyond the scope of this review. The possibility of aerosol transmission alone is not sufficient to mandate the use of N95 respirators, instead the focus is on the clinically important outcome of HCW infection.
- The risk of COVID-19 infection for HCWs is influenced by many factors beyond mask type, including: immunization status, community prevalence and transmission, personal protective equipment (PPE) use practices (ie. PPE hygiene, donning and doffing), hand hygiene compliance, and adequacy of physical distancing measures.
- Existing masking guidance was developed based on respiratory illnesses other than COVID-19 and requires updating now that there is a broader COVID-19 evidence base and novel COVID-19 variants of concern (VOCs) to consider. Currently AHS advises continuous masking with a medical / surgical mask; N95 use is advised in the setting of aerosol generating medical procedures and readily available for HCW conducting point of care assessment.
- This review is intended to supplement a previous SAG report that examined the [evidence for PPE guidance and changes in acute and long-term care](#).

Summary of Key Messages

1. Is there a clinically important difference in occupational (workplace and patient care-related) acquisition of SARS-CoV-2 in healthcare workers using N95 vs. surgical/procedural/medical masks, based on published or local data?

- On balance, the evidence in this literature search does not show a difference in COVID-19 infection rates in HCWs who wear N95 respirators compared to medical/surgical masks, and high quality studies in the context of SARS-CoV-2 are needed.
- The current body of evidence is all observational, of very low to low quality, and has substantial limitations arising from multiple biases (such as recall and selection bias) and confounding factors (such as community prevalence, PPE donning/doffing practices, PPE reconditioning/reuse, hand hygiene, and physical distancing compliance). As more evidence becomes available, it is likely that one high quality study could change the conclusions from this review.
- Data from AHS suggests that the rate of occupationally-acquired COVID-19 remains very low compared to the risk of people acquiring COVID-19 in the community. Internal observations and reports highlight that infection risk tracks with overall PPE use practices and community outbreak status rather than the type of mask worn.

Lay Summary (Cont'd)

2. Is there any evidence that guidance for respiratory protection should be different for Variants of Concern, particularly the Delta variant?

- There is no current evidence to suggest that COVID-19 VOCs behave differently in the environment compared to the original strain of COVID-19.
- No published evidence regarding the Delta (B.1.617) was identified, although this information is rapidly evolving and the experience from other jurisdictions will need to be monitored.
- There is no evidence at this time to show that changes in mask PPE protocols would improve the protection of HCWs in Alberta against COVID-19.

3. Are there any jurisdictions that have changed their guidance around PPE use for HCW in response to increasing rates of highly transmissible COVID-19 Variants of Concern?

- Guidance from eight organizations was identified. Only national guidance from Australia did not explicitly recognize the rise of VOCs in HCW PPE documentation; European, American, and Canadian guidance recognized VOCs as an assessed factor in their HCW PPE guidance.
- In general, changes that were noted as specifically in response to VOCs were relatively minor and led to guidance concordant with existing AHS guidance (ie. recommendations were made to include eye protection and to empower HCWs to assess risk and select the appropriate PPE deemed necessary).
- Guidance that recommended changing practice did not offer specific clinical or epidemiological evidence to support the recommendations.

Summary of Recommendations

1. At this time, there is insufficient evidence to support changes to the overarching AHS policies that guide PPE for staff. Current measures (including current continuous masking recommendations) should be reinforced and supported regardless of HCW vaccination status, given the currently evolving understanding of VOC transmission.
2. Continue to encourage and empower staff to perform point-of-care risk assessments (PCRAs; AHS PCRAs are available for [inpatient, ED/UCC, surgery, obstetrics, inter-facility transfers, and direct admits](#) and [ambulatory](#) patients) and select the appropriate PPE required for safety while performing their duties. The PCRA should be updated as needed to reflect the current understanding of determinants of HCW risk including VOC transmission parameters and immunization status.
3. Ongoing PPE guidance updates should be based on scheduled intermittent review of emerging evidence in the literature through the Scientific Advisory Group, and scheduled Workplace Health and Safety and Infection Prevention and Control review of data including acute care outbreak reports, infections occurring after immunization in HCW, and HCW testing data.

Authorship and Committee Members

Name	Contribution
Rachael Erdmann	Writer – evidence screening, extraction, draft preparation
Rachel Zhao	Librarian – Database search and preliminary screening
Lynora Saxinger	Primary scientific reviewer, writer - draft revisions and content
Leyla Asadi, John Conly, Devika Dixit, Oscar Larios, Elizabeth MacKay, Stephanie Smith, Stephen Tsekrekos, Scott Klarenbach	Secondary scientific reviewers
Lynora Saxinger & Scott Klarenbach	Scientific Advisory Group chairs (oversight and leadership responsibility)
John Conly, Andre Corriveau, Alexander Doroshenko, Shelley Duggan, Grant Innes, Marcia Johnson, Elizabeth MacKay, Jeremy Slobodan, Brandie Walker, Nathan Zelyas	Discussion, revision, and approval of document

Questions or comments about this review can be sent to ScientificAdvisoryGroup@ahs.ca

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Topic: Updated Masking Guidance for Healthcare Workers

1. **Is there a clinically important difference in occupational (workplace and patient care-related) acquisition of SARS-CoV-2 in healthcare workers using particulate respirators (e.g. N95 masks) vs. surgical/procedural/medical masks, based on published or local data?**
2. **Is there any evidence that guidance for respiratory protection should be different for Variants of Concern, particularly Delta variant?**
3. **Are there any jurisdictions that have changed their guidance around PPE use for HCW in response to increasing rates of highly transmissible COVID-19 Variants of Concern?**

Context

- Protecting healthcare workers (HCW) from occupationally acquired COVID-19 infection is crucial. Against a background of evolving knowledge about the contribution of various modes of transmission of SARS-CoV-2 virus, this review focused on the practical question of whether there is a difference in observed rates of occupationally acquired COVID-19 in HCW based on the type of mask used (ie. N95 respirator compared to surgical masks).
- This review was commissioned to inform the Alberta Health Services (AHS) Personal Protective Equipment (PPE) taskforce of any signals of risk that would impact decisions in this interval, given anticipated larger studies and reviews of dominant modes of transmission and optimal PPE strategies.
- Individuals with SARS-CoV-2 infection can generate both respiratory droplets and aerosols depending on the circumstances (e.g. aerosol generating procedures). **The degree to which such aerosols contribute to transmission (compared to contact and droplet routes) is under active investigation and is beyond the scope of this review.** It is not presumed that the possibility of aerosol transmission should alone mandate the use of respirator N95 masks; this review focuses on clinically observable important outcomes (i.e. HCW infection) to inform guidance.
- [Current PPE guidance in AHS](#) as of July 2021 requires all staff to continuously wear a medical/surgical mask; recommendations for eye protection have changed in response to community transmission intensity between continuous eye protection and risk based (related to vaccination status and clinical circumstances). Staff working with suspected or confirmed COVID-19 patients are required to follow [regular contact-droplet precautions](#), and staff performing aerosol-generating medical procedures (AGMP) to wear an N95 respirator in addition to contact-droplet precautions (Alberta Health Services, 2021a). In addition, staff who conduct a point-of-care risk assessment (PCRA) and determine they require a higher level of PPE have access to surgical/procedure masks, fit-tested NIOSH-approved N95 respirators or approved equivalent,

gloves, face shields with side protection (or goggles), and impermeable fluid resistant gowns (Alberta Health Services, 2021b).

- Although this review was requested for evidence on respiratory protection, the risk of acquisition of COVID-19 in the healthcare workplace is also very highly influenced by HCW immunization status, the community prevalence and transmission patterns, the characteristics of circulating SARS-CoV-2 variants, PPE practices (donning and doffing), hand hygiene practices, and physical distancing measures. It is noted that the risk of acquisition of, and transmission of COVID-19 after vaccination is very significantly reduced (see [Scientific Advisory Group review](#)), and that the more recent local data included in this review encompasses an increasing proportion of vaccinated HCW.
- Initial pandemic masking guidance was based on prior meta-analyses of randomized trials and observational studies of masking for respiratory illnesses other than COVID-19. These data are varied in quality, but overall there is insufficient evidence to demonstrate a significant difference in documented healthcare worker infections when using N95 respirator versus medical / surgical (Barycka et al., 2020; Yin et al., 2021; Smith et al., 2016; Jefferson et al., 2020). During the pandemic additional studies on COVID19 transmission have been conducted, with some still underway. The prior references are detailed more extensively in the [previous SAG Review](#).
- This review is intended to reassess the evidence of potential benefit of N95 respirator use on clinically relevant outcomes. A previous SAG review of [PPE guidance for healthcare workers](#) identified potential harms that might result from long-term continuous masking using either N95 or medical masks. Evidence should also be interpreted in the context of modifications of absolute risk to HCW, including the substantial protection attained from vaccination of HCW, but also the risk of more transmissible COVID-19 Variants of Concern (VOCs).
- Variant SARS-CoV-2 strains have been shown to be more transmissible than the wild-type strain (World Health Organization, 2021a; Williams, Hutchinson & Stone, 2021); however, transmission routes are thought to be the same as the wild-type strain and evidence is currently insufficient to show that COVID-19 VOCs result in more severe disease (Curran et al., 2021). The VOC strains which have circulated in Alberta (with proportions of VOC screened samples from July 16th compared with August 13th) are:

	July 17, 2021	August 13, 2021
○ Alpha (B.1.1.7)	16.5%	0%
○ Beta (B.1.351)	1.6%	0%
○ Gamma (P.1)	3.6%	0%
○ Delta (B.1.617)	67.2%	91%
○ Unresolved / not screened	11.8%	9%

Key Messages and Synthesis (from the Evidence Summary and Grey Literature)

- New evidence retrieved from the literature databases was very limited and none was high quality, despite a broad search. Of 243 potentially relevant records, 28 were included in the final narrative synthesis (18 for questions 1 and 2; and 10

guidance documents pertaining to question 3). Seven additional records were identified *ad hoc*. The body of evidence is almost exclusively retrospective and observational, and all studies were evaluated as being at high risk of bias from confounding factors, recall bias, and selection bias.

- Notes on the terminology and abbreviations used in this review are available in Appendix A.

1. Is there a clinically important difference in occupational (workplace and patient care-related) acquisition of SARS-CoV-2 in healthcare workers using N95 vs. surgical/procedural/medical masks, based on published or local data?

Literature review for question 1:

The additional evidence identified in this review should be considered in the context of the [previous SAG review](#), which was a broader search and did not find evidence of a difference in effectiveness by mask type.

Identified studies in this targeted search suffered from numerous significant limitations that reduced confidence in reported results as follows:

- There was limited exploration of external factors such as community incidence of disease and PPE supply and of confounding factors such as appropriate donning/doffing procedures, mask fit, reuse & reconditioning practices, and hand hygiene practices.
- The level of intensity of exposures and assessment methods were not consistent between observational studies.
- Not all studies distinguished between AGMP and non-AGMP settings or other factors contributing to the level and intensity of exposure, and HCW vaccination status was not considered with most studies conducted prior to widespread vaccination.
- Eight articles of low quality (one case series (Chung et al., 2020), seven cross-sectional survey studies (Kingden-Milles et al., 2020; Mastan et al., 2021; Mariani et al., 2021; Schmitz et al., 2021; Akinbami et al., 2020; Haller et al., preprint) do not show a difference in the outcome of COVID-19 infection among HCW by type of mask. Notably, Haller (preprint) showed that despite no difference in COVID-19 infection rates, surgical masks were associated with increased risk of seropositivity but not RT-PCR test positivity.
- One article of low quality (pre-post quasi-experimental observational study (Ferris et al., preprint) suggests that N95 respirators may offer additional protection for HCWs working on units designated for confirmed COVID-19 cases
- Given the importance of the topic, studies of very low quality were included for review although their findings are regarded with caution:
- One article of very low quality (cross-sectional social media survey with self report of infection (Lentz et al., 2021) suggests that N95 respirators significantly reduce risk of HCW infection.
- Secondary analysis of two very low-quality studies suggest that N95 masks may be more protective than medical / surgical masks among HCW with greater exposure to COVID-19 patients. While these studies are of very low quality, it cannot be ruled out that N95 masks are more protective than medical / surgical masks to a small degree and this benefit may only be observed under conditions

of very high exposure risk. If clinical benefit in high-risk settings is substantiated in forthcoming higher quality evidence, an updated assessment of the impact of HCW vaccination on risk also will need to be incorporated in understanding effectiveness by mask type in the context of widespread HCW vaccination.

- The identified secondary literature sources (1 systematic review and 1 review of reviews) all conclude that the evidence is mixed and insufficient to declare a difference between N95 respirators and surgical masks in non-AGMP settings. We found no resources addressing N95 versus surgical masks in close contact or prolonged contact settings.
- On balance, the peer-reviewed literature in this review (in addition to evidence in the [previous SAG review](#) that included data on other respiratory viruses) does not show that N95 respirators are superior to medical/surgical masks for preventing SARS-CoV-2 infection in HCW who are not performing AGMPs; this evidence is very uncertain due to the consistently low to very low study quality; these conclusions could be altered by one high quality study.

Local Data Review:

These data in total do not address the question of mask type directly but are summarized to identify any noted themes or concerns regarding the relative risk of occupationally acquired COVID-19 in Alberta under current PPE guidance.

- The Alberta based data reviewed for this synthesis included a summary of acute care outbreak reports from population health, to identify any themes related to PPE in these outbreaks, Provlab testing data, AHS variant data, and the most recent (December-February) Workplace Health and Safety report on COVID-19 in AHS and APL HCW. These data in total are foundational in nature to help identify any themes or concerns regarding the relative risk of occupationally acquired COVID-19 in Alberta under current PPE guidance.
- Local data review from AHS Provlab datasets showed that Alberta HCW have a lower COVID-19 infection rate than the overall Alberta population, in the context of expected high case finding. Health care workers are more frequently tested for exposures and for symptoms than the general population (3X higher rates of testing with 3.6% positivity versus 6.0% positivity in non HCW supports the hypothesis of more accurate case finding). It is noted that the published literature, some of which is reviewed in a [previous SAG review](#), shows a significant range of HCW infection prevalence across settings, and for the purpose of local policy support, high quality local data is deemed most relevant as contextual information.
- Overall AHS and APL HCW infection rates (occupational, non-occupational, indeterminate and unknown) were 4.6% (compared with 5.2% of Albertans overall). Of these HCW cases, as assessed by WHS, 23% are under investigation, 59% are non-occupational, 10% are occupational, and 8% are mixed or indeterminate.
- The Workplace Health and Safety report and reviewed outbreak reports both identified opportunities to improve the application of current procedures to further reduce risk, as the majority of occupationally acquired cases self identified modifiable risks related to risk assessment processes and PPE use. These interview findings have been confirmed by unaware anonymous PPE

audits on known outbreak wards, where multiple PPE breaches have been observed with the key issue identified of doffing errors which offer a potential of self contamination. There has been no identified increase in occupationally acquired cases without these identified risks. Therefore, strategies to improve adherence to existing PPE guidance is a key theme in healthcare worker protection.

- Therefore, experiential evidence accrued during the pandemic by AHS IPC and WHS currently support that HCW occupational infections map most closely with risk assessment and PPE issues, and close unprotected contacts. Notably, there has been no pattern of elevated or increasing occupational infection in workers without these identified risk factors, which would be expected if the current standards for PPE were no longer as effective.
- From population and public health outbreak data, comparing healthcare (acute, continuing care and supportive living) outbreaks in May-July 2020 to and May-July 2021, in spite of 8 fold higher community cases, and 5-8 fold higher hospital and ICU COVID case burden, there was 3 fold fewer ill staff per outbreak, 4.5 fold lower numbers of ill staff in outbreaks, and outbreak numbers were increased by only 20%, in the face of an 800% increase in community and hospital cases. Thirteen percent of identified healthcare outbreaks were in acute care in this period. Healthcare worker vaccination programs started with high risk areas in late December, 2020.
- To date, based on IPC communication, the Delta VOC outbreaks in AHS acute care facilities have been limited in number, have increased in parallel with community transmission increases, and have been controlled quickly with usual measures including contact tracing and interventions geared to reinforcing adherence to existing IPC protocols including donning, doffing, and hand hygiene without changing mask guidance. Transmission to HCW in the last wave (predominantly alpha VOC) was less than previous waves.
- A more detailed analysis of these data to investigate HCW risk compared at work compared to their community risk of COVID-19 has been requested from the AHS COVID Responsive Analytics Group and this report will be updated when it is available.

2. *Is there any evidence that guidance for respiratory protection should be different for Variants of Concern (VOCs), particularly Delta variant?*

- A [previous review on VOCs \(variants of concern\) by the COVID-END consortium](#) found no evidence relevant to hand hygiene or masking practices; this is reinforced by the grey literature included in this review (Curran et al., 2021). There is no clear evidence that the mutations in the variant strains have impacted the stability or inactivation profile of the virus, and the mechanisms of increased transmissibility are under investigation (although there is some emerging evidence based on RNA copy numbers to suggest higher viral loads may be a factor but this data must be interpreted with caution, given the lack of timing information in the studies, and correlation with infectious virus titers).
- Two case series of reinfection or infection by VOC after vaccination were identified in the literature search, (each n<5) from Europe that may not be

representative of the Alberta HCW population. No evidence regarding the Delta (B.1.617) variant was identified given the very recent nature of it becoming a dominant VOC. This review will need to be updated.

- Infections post vaccination is being tracked in real time by Population and Public Health in Alberta.
- It is notable that local data demonstrates very few Delta outbreaks in Albertan healthcare facilities, which are increasing in number with increasing community rates of infection. All outbreaks thus far have been controlled by contact tracing, and enhanced adherence to PPE measures without changing mask or other guidance (source: AHS IPC), as well as increasing the proportion of vaccinated HCW.
- N95 masks may be variably tolerated by HCW (see [SAG review](#)) and currently HCW in Alberta may adjust their PPE mask choice based on their own risk assessment with no restriction to access for N95 masks.
- Taken together, there is no evidence at this time to support that mandating N95 masks (in comparison to the current risk based approach) would result in any improvement in protection of HCWs in Alberta from COVID-19 VOCs; however, information in this area is rapidly evolving.

3. Are there any jurisdictions that have changed their guidance around PPE use for HCW in response to increasing rates of highly transmissible COVID-19 Variants of Concern (VOCs)?

- Guidelines from Australia (federal), Ontario, British Columbia, the World Health Organization, the European Center for Disease Prevention and Control, Public Health England, and the Public Health Agency of Canada (PHAC) were identified initially and reviewers suggested additional publications and links that described changed practices in Victoria (Australia), Quebec, and the Cambridge NHS Trust in the UK.
- World Health Organization guidance published since this literature search on July 12, 2021 (World Health Organization, 2021c) does not recommend specific changes for VOCs, but advises current IPC measures (concordant with current AHS guidance) be reinforced and stringently implemented and HCW prioritization for COVID-19 vaccination.
- Only PHAC changed national guidelines in response to VOCs: references to PPE reuse/extended use by HCWs were removed and eye protection was recommended for the duration of a shift. Guidance regarding mask/respirator use did not change.
- WHO, Ontario and BC guidelines recognized VOCs but made no changes; European guidelines made no changes but recommended that jurisdictions consider universal masking for HCWs.
- Australian national guidelines were the only guideline identified that did not discuss VOCs. Local PPE Guidelines from Victoria, Australia recommend N95/respirator use and eye protection for all confirmed or highly suspect COVID-19 patients and for all AGMPs, although this change was not made in response to the COVID-19 VOCs.

- Given that the UK experienced a significant Alpha VOC driven surge over December 2020-March 2021, with a peak of >4000 hospital admissions daily in January 2021, an *ad hoc* search of grey literature from the UK revealed additional documents that describe confirmation of the findings of the UK Scientific Advisory Group on Emergencies (2021) and reinforced that the PPE policies for HCW do not need to be changed, but adherence to existing guidelines and COVID-19 testing should be emphasized. A [PHE update](#) published since this search is consistent, noting Delta comprises 99% of sequenced cases in the UK and that secondary attack rate within households of Delta cases is falling (at 10.3%) but is still higher than for Alpha.
- Guidelines from other jurisdictions that recommend changing practice due to the emergence of variants of concern did not offer any clinical or epidemiological evidence to support those recommendations.
- When comparing AHS guidance with guidance from other jurisdictions, including guidance recently updated to consider VOCs, AHS guidance is concordant with the majority of guidelines.

Key messages for additional considerations (see Evidence Synthesis for details and references)

- There is evidence that continuous masking policies (using medical masks) are associated with a decrease in the incidence of occupationally-acquired SARS-CoV-2 infection among HCW. The current AHS policy reflects this data.
- Masks, particularly N95 masks can be difficult to tolerate, and be associated with harms such as skin breakdown, headache, respiratory difficulties, thermal stress, dizziness, irritability, and memory loss (see [previous SAG review](#)) and mask recommendations should be based on updated risk benefit assessments as the situation evolves.
- The proportion of transmission from airborne vs. contact, droplet, fomite routes is still under active inquiry and risk mitigation practices for HCWs should continue to address contact & droplet spread with hand and environmental protection as well as optimized respiratory protection measures.

Comments on secondary review, stakeholder feedback, and committee discussion

This review was sent for additional comment from a broader than usual group of secondary reviewers to ensure a range of viewpoints was captured. The subsequent draft was then sent to stakeholder groups within AHS (Emergency, Anesthesiology, Surgery, Medicine, Nursing, Allied Health). Briefly, responding stakeholders agreed with the conclusions and recommendations of the review, with some suggestions that support maintaining status quo. Detailed comments were provided by some respondents which informed evolution of the draft. The response rate was 16%, influenced possibly by the timing (summer) of the review. The full commentary from this engagement is in Appendix E.

The SAG committee agreed with the content of the review and the conclusions; however, there was concern about how the report would be received by the broader healthcare community due to the narrow scope of the question posed, given the

substantial overlap between the topic of PPE adequacy and the current uncertainty and significant public, social media, and non evidence based activism regarding dominant modes of viral transmission in which official IPC and Public Health voices have not been highly represented.

Further complicating the interpretation of this review is the very low to low quality of the evidence – although a full quality appraisal was not conducted, all included studies are observational and given the poor quality of the body of evidence it is likely that a single high-quality study could change the conclusions of this review. It was therefore agreed that recommendations need to support formal iterative data review (both through updated external data review and structured internal data review) to assure appropriate evolution of policy in the context of changing risk assessments due to both VOCs and vaccination.

Recommendations

1. At this time, there is insufficient evidence to support changes to the overarching AHS policies that guide PPE for staff. Current IPC measures including current continuous masking recommendations should be reinforced and stringently implemented, regardless of HCW vaccination status, given an evolving understanding of VOC related reinfection risk and transmission.
Rationale: The evidence is insufficient to show that N95 respirators are superior to medical/surgical masks, or that Albertan HCWs have elevated risk of occupational acquisition of COVID-19, or that VOC transmission in current healthcare contexts is substantially different from the wild-type SARS-CoV-2.
2. Continue to encourage staff to perform point-of-care risk assessments (AHS PCRAs are available for [inpatient, ED/UCC, surgery, obstetrics, inter-facility transfers, and direct admits](#) and [ambulatory](#) patients) and select the appropriate PPE required for their safety while performing their duties. The point-of-care risk assessment should be updated as needed to reflect the current understanding of determinants of HCW risk including transmissibility and immunization status.
Rationale: Jurisdictional guidance updated after the signing of the February 2021 joint agreement between AHS and the unions identified the importance of PCRAs, and empowering staff to determine their own level of risk tolerance. Allowing staff to select the level of PPE required allows for both an evidence informed baseline standard, and individual customization by HCW personal risk assessment.
3. Ongoing PPE Guidance updates should be based on scheduled intermittent review of emerging evidence in the literature through the Scientific Advisory Group including evolving information on vaccination protection, and ongoing coordinated WHC and IPC review of data including acute care outbreak reports, infections occurring after immunization in HCW, and HCW testing data.
Rationale: These relevant data and acute care outbreak reports should be collated by WHS and IPC for review by the PPE taskforce on a minimum 12 weekly basis and as needed if earlier concerning trends are identified. The SAG literature review should be assessed for completeness at the same interval, with review of the needed frequency of these assessments in 1 year, in addition to a

planned review after the results of an ongoing multi-centre Canadian trial comparing N95 to surgical masks in HCWs are available.

Practical Considerations

- Measures supporting a goal of universal COVID-19 vaccination for HCW are strongly suggested for protection of patients, other staff, and health system resiliency. Vaccinated HCW should continue to isolate and seek testing upon development of possible COVID-19 symptoms to reduce the risk of post immunization spread.
Rationale: Vaccination confers a very high protective benefit against significant illness and reduces the likelihood of transmission (see [SAG review](#)). Information from that review and the current review should be directly shared with staff, with a commitment to sharing results of future PPE reviews and ongoing assessment of current practices.
- PPE optimization stands to be the current priority in staff safety, by optimizing the effectiveness of current PPE protocols. These include but are not limited to: improving adherence to proper PPE donning/doffing protocols with supportive anonymous audit and feedback, point of care risk assessments to determine PPE choice, and emphasizing the importance of mask fit and hand hygiene
Rationale: Ongoing attention to optimal PPE use is crucial even for vaccinated HCW given the potential impact of VOCs and the possibility of cocirculating respiratory pathogens in upcoming months.
- Resources for HCWs that assist them to accurately identify the factors that raise or lower their risk for SARS-CoV-2 infection (ie. point of care risk assessment, personal vaccination status, duration of care episode, AGMP/non-AGMP, mask fit, built environment considerations and duration of exposure, appropriate donning and doffing, etc.) may be developed as a useful adjunct for staff training and ongoing education.
- PPE guidance documents should be updated to reflect the findings of this review to assure readers that COVID-19 VOCs have been considered and the policies did not require change after this review, and that close monitoring of VOC data transmission, and the impact of vaccination is ongoing.

Research Gaps

- Higher quality studies addressing protection differences between medical/surgical masks and N95 respirators in HCW protection are required. The current data is exclusively retrospective and observational, with high risk of bias. No controlled trials were identified that were suitable for inclusion. This review should be considered for an update when [the randomized controlled trial underway by Loeb et al.](#) of use of continuous N95 versus usual practice/risk based N95 has published their results. It is noted that this study has an independent safety monitoring board that has identified no safety signal between the N95 and usual practice arms at the 50% enrollment level (personal communication).
- There is limited exploration of the relationship between mask type, donning/doffing procedures, and mask fit to determine the most important

elements in protecting HCW from COVID-19 infection. Within AHS, considering the use of unaware anonymous audits to inform staff education and support for PPE use, and optimization of PPE across sectors may be of benefit.

- The cause of increased transmissibility in COVID-19 variants of concern is under investigation, and this understanding may impact optimal PPE guidance.

Strength of Evidence

The primary evidence comparing the clinical differences between medical/surgical masks and N95 respirators (question 1) is of low quality. No randomized trials were identified that investigate COVID-19 incidence in the context of use of different types of masks. The observational studies were case-control and cross-sectional designs based on survey responses, which are at high risk of recall and selection bias. In many cases, there was insufficient exploration of possible confounders including donning/doffing procedures, infectiousness of the exposure cases, and possible community transmission. The evidence is also limited by small sample sizes and poor detail on exposures and PPE.

The primary evidence for added respiratory protections against the COVID-19 VOCs (questions 2 & 3) was very weak. Only two small case series were identified; both had very limited detail on exposures and PPE considerations. Only grey literature evidence syntheses were identified that applied to this research question, all concluding that there is no evidence for adjusting HCW PPE protocols.

The primary observational evidence, although low quality, is generally applicable to Alberta – evidence arises from Germany, the UK, Italy, Netherlands, and international surveys. The guidelines identified for research question 3 offer a useful glimpse into the policies from other jurisdictions; however, for most the changes made to the PPE guidance brought the jurisdictions into alignment with existing Albertan policy to allow HCWs to select appropriate PPE based on their point-of-care risk assessment.

Overall the identified body of evidence on the differences between medical/surgical masks and N95 respirators is of insufficient quality to draw any conclusions, with higher quality studies underway. There is no current evidence addressing whether PPE should be altered in the setting of COVID-19 VOCs, and monitoring is required.

Limitations of this review

This review is subject to limitations. As with all evidence reviews for COVID-19, the evidence is limited and is likely to change quickly. For PPE in particular, the evidence is heavily skewed towards meeting the challenge of PPE shortages early in the pandemic, rather than identifying the appropriate level of PPE to protect HCW while balancing harm considerations. Accordingly, the body of evidence for this review is relatively weak. The evidence is exclusively retrospective and observational and is subject to high risk of bias due to confounding, recall bias, and selection bias.

Second, this is a rapid review – the search was thorough but not systematic, with a very narrow time frame for inclusion and narrow languages for inclusion. It is possible that relevant articles in other languages were not identified in this report. As this is a rapid review, no formal quality assessment was performed on the included studies. Their

quality has been estimated based on the author’s experience and should be considered an estimate only.

This review does not consider mechanism of transmission directly, but rather considers evidence on clinical effectiveness of masking guidance to protect HCW (rather than surrogate or lab based outcomes), and does not include or review data pertaining strictly to modes of SARS-CoV-2 transmission.

Summary of Evidence

The evidence retrieved from the literature databases was very limited, despite a relatively broad search. Notably, the evidence base for masks reflects the PPE shortages faced by many jurisdictions early in the COVID-19 pandemic. Most of the articles excluded in the title and abstract screening step described the effectiveness of improvised PPE (such as using snorkel masks), the effect of reprocessing and reuse on commercial PPE, and particle/aerosol filtration studies describing the effectiveness of different materials.

A PRISMA diagram of the evidence screening is available in the appendix (Figure 1); briefly, 243 relevant records were identified from database searching (239) and *ad hoc* (6) after deduplication; 120 records were excluded on title and abstract screening, and 93 articles were excluded after full text review. 27 articles (17 articles for research questions 1 & 2; 10 guidance documents for question 3) were kept for the final narrative synthesis. Seven *ad hoc* guidance documents were included that pertain to question 3, and one *ad hoc* study was added during secondary review. Table 1 below shows the breakdown of article types. The extracted evidence from the included literature for research questions 1 & 2 is shown in detail in Table 3 in Appendix B.

Table 1. Summary of included articles for research questions 1 & 2

Article Type	Peer-reviewed	Preprint
Umbrella review	Griswold et al., 2021 (includes 17 systematic reviews and 1 qualitative synthesis)	-
Systematic review ± meta-analysis	Li et al., 2021 (includes six case-control studies)	-
Observational study (Cross-sectional; case-control)	Akinbami et al., 2020 Kingden-Milles et al., 2021 Lentz et al., 2021 Mariani et al., 2021 Mastan et al., 2021 Schmitz et al., 2021	-
Case series	Chung et al., 2020 Loconsole et al., 2021 Staub et al., 2021	-
Other	Ramaraj et al., 2020 (includes 3 RCTs*, 1 case report, 1 cohort study, 1 retrospective report)	-
Reputable grey literature	Curran et al., 2021 Evidence Synthesis Network, 2021 O’Keefe, 2021 Public Health Ontario, 2021a Scientific Advisory Group on Emergencies, 2021	

* The RCTs included in Ramaraj (2020) examine mask effectiveness against influenza

Research Question 1: Is there a clinically important difference in occupational (patient care-related) acquisition of SARS-CoV-2 in healthcare workers using N95 vs. surgical/procedural/medical masks, based on published or local data?

Evidence from secondary and grey literature

A good quality rapid review by Ramaraj et al. (2020) found that while *in vitro* studies using lab-based outcomes to examine mask effectiveness consistently show that N95 respirators are 16-17X more protective than surgical masks, clinical studies (three RCT [non-COVID-19], 1 cohort, one case report, one retrospective) that examined clinically important outcomes were difficult to compare due to inconsistent methodologies and heterogeneous findings; on balance, the review concluded that there is no convincing evidence of clinically important differences between mask types for SARS-CoV-2 protection.

There is evidence that any type of mask will reduce the risk of SARS-CoV-2 transmission when compared to not wearing a mask (Griswold et al., 2021; Li et al., 2021). A review of systematic reviews suggests that the evidence is mixed regarding the superiority of one type of mask over another (Griswold et al., 2021). Two of the included systematic reviews found no difference between surgical masks and N95 respirators, and two of the systematic reviews found that N95 respirators had a significant reduction of infection risk (Griswold et al., 2021), noting the evidence was of low quality in moderate-high risk settings (included studies did not consistently separate AGP vs. non-AGP settings).

Evidence from the primary literature

A case series reporting on an outpatient setting visited by eight COVID-19 positive patients, none of 317 “close contact” HCW were infected, despite wearing only surgical masks at the time of exposure (Chung et al., 2020). In this setting, five asymptomatic patients (62.5%) and 3 pauci-symptomatic patients (37.5%) were in the hospital from 1.5-3 hours; close contact was defined as: “1) being within approximately 6 feet of a patient with confirmed COVID-19 for at least 15 minutes or 2) direct contact without the use of appropriate PPE (N95 or FFP2 equivalent respirator, face shield/goggles, gown, and gloves)” (Chung et al., 2020). Five of the patients were continuously masked, and the other three were masked except for brief (< 20 minutes) periods to eat or receive dental treatment (Chung et al., 2020). This case series identified that a large number of close contacts in a healthcare setting without identified transmission suggests that surgical masks combined with hand hygiene is sufficient to protect HCW who are in casual contact with COVID-19 positive individuals of uncertain contagiousness (Chung et al., 2020).

Data from the Cambridge University Hospitals NHS Foundation Trust (CUHNFT) in the UK formed a natural pre/post observational study after a policy was implemented that required staff working on “red” wards (where patients had confirmed COVID-19) to wear N95/FFP3 respirators instead of medical/surgical-type masks (Ferris et al., preprint). Although this report was uncontrolled, staff infection rates on the “red” wards decreased to the level of staff working on “green” wards (where the patients were COVID-19

negative and had no clinical features). Staff on green wards who wore medical/surgical masks had an occupational risk consistently lower than the community exposure risk, while staff on red wards had a higher infection rate than could be explained by community exposure alone. Following the policy change to FFP3 respirators, the weekly staff infection rate on red wards declined to be the same as staff on green wards, with the authors concluding the infections were arising from community exposure (Ferris et al., preprint).

Survey data:

A cross-sectional survey and serology study of adults working in a hospital or public safety setting found that self reported consistent use of an N95 respirator or surgical facemask (both compared with using them less than “all the time”) lowered the likelihood of being seropositive (aOR 0.83, 95% CI 0.72–0.95 and aOR 0.86, 95% CI 0.75–0.98 respectively for N95 and surgical facemask) (Akinbami et al., 2020). This study does not directly compare N95 with surgical face masks, only that they both reduce the odds of SARS-CoV-2 infection by a similar amount.

A survey of critical care and emergency physicians with access to surgical masks, FFP2 masks, and FFP3 masks found no difference between physicians with and without SARS-CoV-2 infection, and no significant correlation between the availability of FFP2/FFP3 and SARS-CoV-2 infection ($p=0.99$) (Kingden-Milles et al., 2021). For care providers in orthopedic units/hospitals, there was likewise no significant difference in risk of outbreaks in units that used surgical masks compared with those that used FFP2/3 masks (Mastan et al, 2021).

A survey of endoscopy centres (not individual providers) showed that the type of mask worn by HCW (FFP2/3 vs. medical/surgical mask) was not significantly associated with infection risk (Mariani et al., 2021). Increased risk of infection was associated with lack of training in PPE donning/doffing (OR; 95% CI: 2.65; 1.07–6.53) and working on a COVID-19 team (OR; 95% CI: 4.96; 1.97–12.51) (Mariani et al., 2021).

A survey of permanent emergency care providers in the Netherlands found that the level of PPE worn, whether full coverage with FFP2 mask or lower-level medical/surgical mask, was not associated with the primary endpoint of PCR-confirmed COVID-19 (Schmitz et al., 2021). The combined number of confirmed and suspected ED staff infections was not significantly different between hospitals in which high-level PPE was used for all patient contacts compared to the other hospitals, and the initial finding of higher confirmed staff infections was confounded by a policy of increased staff testing (Schmitz et al., 2021).

One lower quality survey-based case-control study was identified for this research question (Lentz et al., 2021). This was a broadly disseminated survey very early in the pandemic, of 1130 self-identified HCWs from 67 countries, distributed via social media and snowballing, thus encouraging self-selection. This survey is at high risk of recall and selection bias for individuals who self-identify as having had COVID-19, and the assignment of “control” status was based on incomplete information. Community exposures were not assessed, and there was limited exploration of confounding factors, which would be wide-ranging in an international survey (including mask fit,

donning/doffing, PPE shortages/reuse/reconditioning, hand hygiene, and community incidence). This study has notable shortcomings in their presentation and analysis of results.

This study reported very high use of respirators in the responding group (94% of respondents during aerosol-generating procedures (AGMPs) and 72% during non-AGMPs), which may reflect selection bias towards individuals who prefer N95 masks. The study results suggest that N95 use in both AGMPs and non-AGMPs was associated with being a control (that is, no HCW infection) (aOR, 0.4; 95% CI, 0.2–0.8; $P = .005$), while wearing medical masks during both AGMPs and non-AGMPs was associated with HCW infection (adjusted OR, 7.4; 95% CI, 2.8–20.0; $P < .001$) (Lentz et al., 2021) but this was not consistent with multivariate analysis where there was no difference between use of medical masks vs respirator for non-AGMP. Prolonged continuous COVID-19 patient contact without a respirator (ie. with a medical mask) was an identified risk (adjusted OR, 2.3; 95% CI, 1.1–4.9; $P = .04$). HCWs working in settings with policies recommending N95 use during both AGMP and non-AGMP patient was associated with a 40-60% lower odds of SARS-CoV-2 infection, respectively (Lentz et al., 2021) although other bundled interventions were not reported. The results are compromised by the lack of adjustment for identified out of hospital exposures, which were associated with strongly increased risk, and respondents were from a wide range of community settings, some with extremely high community transmission.

A preprint prospective cohort study from Switzerland, performed in June-August 2020, compared self-reported positive SARS-CoV-2 test results or seroconversion with use of a medical/surgical mask or FFP2 respirator (Haller et al., preprint). This study found that FFP2 respirator masks were not significantly associated with a positive SARS-CoV-2 test (HR 0.8; 95% CI 0.6-1.0; $p=0.06$), or associated with a decreased risk of infection (aHR 0.8, 95% CI 0.7-1.0, $P=0.052$) (Haller et al., preprint). Using an FFP2 mask “most of the time” was possibly associated with a reduced hazard of seroconversion, as seroprevalence was 12.9% (85/658) for FFP2 users compared to 18.9% (429/2258) for users of surgical masks although other protective behaviours and exposures were not examined (OR 0.6, 95% CI 0.5-0.8, $p<0.001$). Exposure to a positive household member was the most significant risk factor for both a positive test and for seroconversion (aOR 5.0, 95% CI 3.9-6.5, $p<0.001$); in sensitivity analysis when household member positivity was accounted for, the association of mask use and positive SARS-CoV-2 test was no longer significant (aOR 0.8, $p=0.31$) (Haller et al., preprint).

Synthesis of the Information Relating to Question 1

The body of evidence for this topic is overall of low quality, largely because the study methodologies (primarily surveys and observational studies) are insufficient to conclusively show that one type of mask is superior to the other. *In vitro*, N95 respirators are more effective at blocking viral particles than surgical masks (Kim et al, 2020; Ueki et al., 2020), although neither mask type was able to completely block transmission even when completely sealed (Ueki et al., 2020), however, lab-based studies by definition do not consider the human and real-world factors involved in mask use, or clinically important outcomes. Ramaraj (2021) suggests a similar observation to the findings in the current review – that studies are difficult to compare due to

methodology differences, are often underpowered, and suffer from confounding. There is inadequate exploration of external factors such as community incidence of disease and PPE supply, or confounding factors such as donning/doffing procedures, mask fit, reuse and reconditioning practices, and hand hygiene practices.

On balance, the peer-reviewed evidence presented here is insufficient to conclude that N95 respirators are superior to medical/surgical masks for preventing SARS-CoV-2 infection in the general HCW setting. Some self reported survey data support that N95 respirators may be more protective for HCW with prolonged continuous contact of patients with COVID-19 infection although other risk exposures and behaviours are not fully assessed. Mariani (2021) observed that working on a COVID-19 team and lack of training in donning/doffing protocols is associated with HCW infections and suggested that infections may occur due to breaches in PPE donning/doffing protocol, rather than masking policies.

Summary and Analysis of Alberta data

These data in total do not address the question of mask type directly but are summarized to identify any noted themes or concerns regarding the relative risk of occupationally acquired COVID-19 in healthcare settings.

1. Epidemiologic Summary of Acute Care Outbreak Transmission, June 25, 2021

This report outlined common themes and qualitative factors in transmission in acute care outbreaks in AHS. In this report, it was noted that it is often difficult to definitively determine sources of exposure or transmission; in addition to patient care-based work exposures, cases have interactions with patients, community/family members, and other staff throughout the day.

Improper PPE use was commonly noted as an outbreak contributing factor, which may be a consequence of PPE fatigue. This is particularly true for units on outbreak status whereby donning and doffing consume disproportionate time. Some common PPE and IPC related comments were:

- Staff not masking around areas such as nurse desk or break room (other than eating)
- Hand sanitizer/ABHR not readily available at point of care
- Improper donning and doffing steps or missed steps (e.g. removing PPE in room, improper hand hygiene prior to donning, improper sequence)
- Float staff that fill the need for more coverage (particularly when more beds are added to a unit) have variable experience training, especially on an outbreak unit. This may contribute to errors or lack of awareness of IPC requirements. In one significant outbreak, it was noted that many of the HCW cases were float staff. Floats may also subsequently work on other units during communicability and incubation phase, increasing the risk of multi-unit outbreaks.

HCW interviews highlighted themes around PPE as follows: Relaxed PPE use and hand hygiene around coworkers or other areas of the facility compared with home unit (e.g. in office not masked or distanced); HCWs intermittently removed masks to sip drink on decanted units where there was more time without active patient care; exposure to symptomatic patients prior to COVID-19 diagnosis without proper PPE/suboptimal hand hygiene,

Audits, and environmental assessments in outbreak settings (not all sites):

Lapses in PPE donning/doffing and hand hygiene have been identified in WHS interviews and unaware audits, including in a setting of high environmental contamination with SARS-CoV-2, as follows:

- Main concerns: removal of PPE within the patient room, improper hand hygiene prior to donning, improper PPE sequence of donning and removal, and PPE supply issue with gowns not readily available. Errors may increase with fatigue due to long work hours.
- Such lapses are considered potentially significant given that high concentrations of cultivatable virus have been found in patient care environments in this outbreak, including samples from a Delta acute care outbreak setting (examples): whiteboard, bathroom commode chair, call bell, window ledge, bathroom toilet paper dispenser, curtains, bed side table, bathroom sink taps, fridge handle, SPO2 probe, and thermometer.
- Anonymous unaware audits of PPE practices have been completed within AHS and reinforce the suggestion that doffing errors may increase self contamination risk and are an area of focus in risk reduction.

HCW audits and questionnaires have been done to assess concerns with PPE

usage: Some HCWs identify discomfort using PPE (e.g. goggles were a new requirement and many were not used to it), time requirements for donning/doffing was a strain for HCWs (which may lead to further COVID fatigue), there was no PPE at the nurse desk where people would often remove their masks in this location, laundry carts missing for doffing, missed N95 seal check, risks with pulling mask down, issues with staff moving between units without changing PPE, and lack of awareness of room precautions.

Summary of these reports: It is noted that many of the current observations on HCW occupational risk were drawn from wave 1 and 2 HCW data and outbreak reports, and there are fewer delta cases and outbreaks to draw experience from as yet. IPC measures have remained largely the same for this duration and HCW vaccination has been the main change noted in the last wave.

The identified themes were mostly related to ward processes; the type of masks in use were not highlighted in this overview, as OR and AGMP settings were not a focus in the outbreak reports available. A number of challenges in patient and visitor assessment processes, as well as the ongoing challenges of implementing consistent PPE use in a strained workforce are described, many of which are amenable to quality improvement approaches with appropriate support.

Thus, the report identified a number of potential HCW transmission risks (as identified in many existing studies) that are relevant to Alberta acute care sites. However, this does not inform the question of evidence of potential incremental benefit of N95 over surgical masks in the conditions and challenges described, although type of mask used did not emerge as a specific theme in prior reports. Any change to PPE would have to be considered in the context of optimizing PPE training and process support as a first step

Data precis: Anonymous Unaware Audits and Delta outbreak report:

In addition to this report, data from some of the audits described was provided by Infection Prevention and Control. Between 11/21/2020 and 7/20/2021, 1111 audits were summarized, and across facilities, the range of audit finding revealed high variability in PPE practices between units, with doffing errors felt to be the highest risk for staff exposure.

Audit element	Range (Only included sites with >25 observations)
Perfect Donning	51-70%
Correct Donning Order	88-100%
Perfect Doffing	54-100%
Correct Doffing Order	73-96%
Perfect environment	90-95%

A preliminary AHS acute care Delta outbreak analysis was also reviewed:

Twelve HCW and 17 patients were affected in this outbreak, three on one ward where there was close contact with an unmasked coughing patient in a holding area and 14 on another mixed medical ward in another building with introduction considered likely from HCWs who were affected and working between the two units. On the unit with 14 patient cases, 13 patient cases occurred in multibedded rooms, and there was a trend towards risk of infection associated with use of a mobile vital signs cart which was only used in multibedded rooms. All the cases except one occurred within a relatively short period of about 3 days.

Extensive environmental contamination with SARS-CoV-2 was found, with 7/16 high touch surfaces PCR positive.

Prior to the outbreak, the main affected unit had significantly lower scores on doffing and hand hygiene than designated COVID units where no outbreak occurred ($p=0.007$), which suggests there was an opportunity for transmission events related to PPE breaches.

There was no difference in the type of PPE used between dedicated COVID units and general wards.

Ventilation on the outbreak unit was measured and exceeded standards, with 6.9-9.5 AEH, and the bathrooms were correctly negative with respect to the main patient rooms and the patient rooms were positive with respect to the hallway. This would argue against long range airborne transmission as a major factor in this outbreak.

Resolution of the outbreak within approximately 3 weeks, with no new cases in the patients remaining on the ward, was seen with the application of strict adherence/compliance to PPE donning and doffing and hand hygiene without any changes to standard PPE measures.

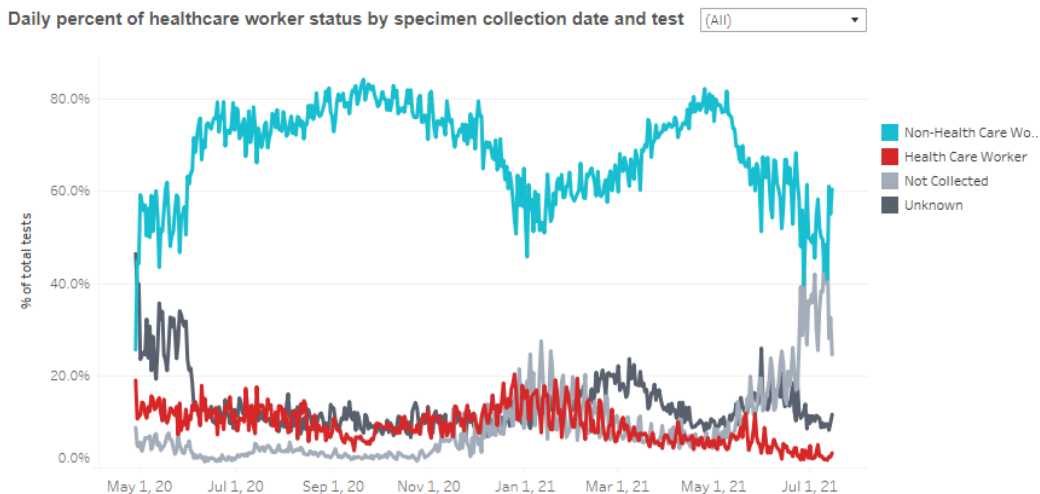
Review of Alberta HCW COVID-19 incidence and risk

Data were reviewed from three sources:

- *Precis of document: AHS Healthcare Worker COVID-19 Testing Dashboard Summary Report: December 1, 2020—February 28, 2021 (accessed in draft format)*
- AHS Healthcare Worker COVID-19 Testing Dashboard
- COVID-19 ProvLab dashboard

At the time of access of the detailed Workplace Health and safety dashboard: 5860 non physician healthcare employees (AHS and APL only) have tested positive for COVID-19. HCW tests comprise 9.4% of tests, but HCW are 2.9% of the population so high case ascertainment with this high testing is expected. The percent positivity of HCW tests is much lower than non-HCW at 3.6% versus 6.0% respectively, from ProvLab data.

Health care worker- proportion of positive tests over time



Overview: There have been 230,457 (July 21) Albertans documented to have COVID-19 since the start of the pandemic, which is 5.23% of the population. By comparison, HCW have a lower proportion (4.6%, (5860 of 127377 nonphysician AHS and APL employees) documented positive despite 3x higher increased testing, which would be expected to increase the case numbers through higher case finding. Within the major healthcare employee groupings identified by Workplace Health and Safety the percent of individuals testing positive are:

- Clinical 4.8% (84% of infections assessed as occupational are in this large group)
- Clinical Support 5.1% (10% of occupational cases)
- Nonclinical 3.5%
- Physicians 2.8%

The last full WHS data is reported as of May 17, 2021:

The probable source of transmission for 1400 (58%) HCW infections had been determined with the rest still under investigation.

- 23% likely arose from workplace transmission (classified as occupational).

- 58% likely arose from community transmission (classified as non-occupational).
- 19% were classified as indeterminate.

Fifty three percent of these occurred in tertiary care, 20% in community hospitals (and very few, 4% in continuing care as these data are post vaccination program in LTC). The number of HCW infections was higher than the September-November report, in parallel with increased community cases (a similar proportion of HCW and the overall Alberta population was infected during this reporting period: 1.9% of HCW and 1.7% of the general population with higher testing and case ascertainment in HCW).

In this report, of the 314 cases felt occupationally acquired, the source for 62% was felt to be an infected patient, with coworkers the next largest group. Although 32% of AHS staff are in Edmonton and 36% of staff are in Calgary, in the last full quarter of data 56% of occupational infection cases were in Edmonton versus 22% in Calgary, likely related to large outbreaks in that quarter.

Situations requiring AGMP precautions: 27% of total, all in a cluster, outbreak or COVID unit. Of these, 63% did not have proper PPE, 59% has a PPE breach or hand hygiene lapse, and 63% a missed point of care risk assessment (PCRA) was noted.

Contact and droplet precaution interactions: 52% of cases, proper IPC precautions were not in place for 19% of these, 32% had missed PCRA, 35% did not use proper PPE, 36% had a PPE breach or HH lapse, and in 5% (8 cases) no transmission factors were identified on interview. Eighty five percent of these interactions were on outbreak, cluster or COVID units.

Routine precaution interactions: 40% of cases, and involved coworkers in 93% with 41% of possible sources were said to be symptomatic. Twenty three percent involved a presymptomatic source, in 49% proper PPE was not used (e.g. no continuous masking/eye protection), a PPE breach or HH lapse was noted in 17% and no transmission factors were identified in 3%.

Opportunities to reduce risk identified in the WHS report (paraphrased) include:

- Risk assessment optimization, reinforce eye protection
- Ensure PCRA done with a low threshold for C and D precautions
- High risk patients should not be taken off precautions on the basis of a negative test alone
- Low threshold to test for COVID-19 and use AGMP precautions where needed in higher risk situations in respiratory conditions even with alternate explanations (e.g. CHF)
- Donning and doffing and hand hygiene lapses are still occurring potentially related to complexities in multiple systems of PPE – recommunicate importance with example scenarios
- Presymptomatic spread from coworkers may be reduced if HCW are instructed to identify as exposed (eg within the household or community) and WHS applying quarantine and testing.

- Visitor risk assessments are required (it is noted that visitor sources are very low in this report however). Visitors require support for proper masking and HH.
- HCW recognition of symptoms and fit for work screening need to be optimized: barriers such as stigma and loss of income may require additional attention. Immunization does reduce risk significantly and this need to be communicated. Fast track HCW testing to minimize excessive time away from work.
- The dominant issue in coworker and visitor interaction was a lack of continuous masking, as well as PPE and HH breaches and shared object concerns.

2. Current epidemiology:

The Delta variant of concern (VOC B.1.617) has risen proportionally (7 day rolling average) from 1.1% (June 8 2021) to 38.8% (July 1 2021) of screened samples, and as of July 17 is down to 4.8%. Total incident cases had remained < 75 daily over July with a percent positivity of 1.14%. However, cases have risen over August with Delta VOC now comprising 100% of VOC screened cases, with 400-500 daily cases since August 10 and percent positivity of 7-9% compared to the wave 3 peak of 2446 cases, and 12% positivity April 30th, 2021. Weekly hospitalization in the last wave peaked at 528 (71% VOC) and as of August 8th (last complete data) was 120 (85% VOC).

Given the increases in VOCs, current data on outbreaks in healthcare was accessed: this is not a formal analysis and should be viewed as preliminary as the data is directly from the tableau interface and incomplete data and errors are possible.

Health care outbreaks: Comparison of May-Mid July period in 2020 and 2021: Acute, Continuing Care and Supportive Living

	May 1-July 14 2021	May 1-July 14 2020
Outbreaks	195 (13% acute care)	160 (6.7% acute care)
# Cases (documented)	268 (136 VOC, mostly alpha)	547
Number of staff cases/outbreak	1.5	7.7
Number of client cases/outbreak	1.7	12
Total ill, staff ill	620 ill (82% LTC), 283 staff	2013 ill (96% LTC), 851 staff
Deaths associated with outbreak (not listed by staff/client)	7	58
HCW staff case range and average number ill in outbreaks >10 cases	Range 10-14 staff ill in large outbreaks (average of 13 staff ill in 3 large outbreaks)	Range 10-104 ill staff in large outbreaks (average of 26 staff ill in 24 large outbreaks, mostly LTC)
Mean number of community cases/day (average over period)	520 cases/day (percent positivity range 0.68-13.56%)	74 cases/day (percent positivity range 0.46-3.6%)

Interpretation: Local Data

Comparing the same time period a year apart was not predicated on encompassing specific “wave” periods and is meant to be illustrative. However, these time periods do reflect the decline of Wave 1 (in which restricted testing resulted in some undercounting, with peak percent positive April 23 with a modest number of daily cases) and the decline of Wave 3 (when documented case rates were 7-fold higher on average, peaking at the start of May with significant undercounting based on a high percent positivity). Health care worker potential exposures would be expected to be much more intense in acute care in the latter COVID-19 wave with COVID-19 occupancy on May 1, 2020 at 81, with 22 in ICU and on May 1 2021 at 636 (7.8 fold higher) with 153 in ICU (6.9 fold higher). As of August 31 2021 there are 431 hospitalized COVID-19 cases, 106 in ICU.

Therefore, in spite of the very high community transmission in the Wave 3 where the alpha VOC was dominant, and increased number of hospitalized COVID-19 cases, HCW symptomatic illness in outbreaks in the latter period was 3-fold lower, the number of staff ill per outbreak was 4.5 fold lower, and outbreak sizes were lower. This would suggest that in current measures, in combination with staff immunization and outbreak management, are reducing staff exposure risk appropriately. However, the number of VOC associated outbreaks will need to be monitored closely. HCW vaccination and optimizing IPC strategies to reduce infection risk remains an important priority.

Research Question 2: Is there any evidence that guidance for respiratory protection should be different for Variants of Concern, particularly Delta Virus?

Evidence from secondary and grey literature

A broad rapid review by the COVID-END consortium did not identify any evidence that was relevant to hand hygiene or mask protocols related to the variants of concern (Curran et al., 2021). Evidence for changes to masking guidance has not been identified, despite the actions of some jurisdictions (Curran et al., 2021).

The Ontario Evidence Synthesis Network suggested recommending FFP masks based on improved filtration efficiency that may improve protection, but this is not based on clinical evidence (Evidence Synthesis Network, 2021).

A broad jurisdictional scan conducted by Public Health Ontario (2021a) revealed that Austria, Germany, and France have upgraded their guidance for community masking (recommending medical masks or FFP2 masks instead of scarves or cotton masks) but made no changes to their guidance for HCW. These changes are not based on clinical or epidemiological evidence, but rather on the precautionary principle (Public Health Ontario, 2021a). Ecologic observations remain noncontributory: some European countries mandated the use of FFP2 respirators in public spaces, for example, Austria mandate occurred in January 2021 (Federal Ministry for Social Affairs, Health, Care and

Consumer Protection (BMSGPK), 2021). Austria subsequently experienced a significant third wave peaking at the end of March, 2021 at >350 cases/ million population.

A rapid review by the UK Scientific Advisory Group on Emergencies (SAGE) (2021) notes that the reason for VOC increased transmissibility is unclear, but it is unlikely to be due to the physical properties of the virus (SAGE, 2021). The guidance recommends changing community masking advice to improve source control, but not necessarily to change the guidance for HCW as a protective measure (SAGE, 2021).

Evidence from the primary literature

One lab-based study has shown that the Alpha (B.1.1.7) and Beta (B.1.351) variants have the same susceptibility to heat, soap, and ethanol as the original wild-type strain (Meister et al., 2021). There was also no difference between the wild-type and variant strains in their stability on mask surfaces (Meister et al., 2021). Taken together, these data suggest that the overall structure of the variant viruses are the same as the wild-type, and the authors conclude that current hygiene recommendations are appropriate against COVID-19 VOCs (Meister et al., 2021).

One small case series reports reinfections of four HCW with the B.1.351 (Beta) variant despite following the recommended guidance of wearing surgical masks at work (Staub et al., 2021). However, this study does not provide sufficient detail to determine if the infection was acquired at work or in the community and does not discuss PPE type and procedure or provide an assessment potential breaches or inadequacy of PPE (Staub et al., 2021).

A second small case series reported that one COVID-19 patient, infected with the B.1.1.7 (Alpha) variant, resulted in three infections in two vaccinated physicians and one unvaccinated nurse; all three of the HCW used a full set of PPE (particulate filter respirators (P3), two pairs of gloves, face shields, and a single-use coverall) (Loconsole et al., 2021). The patient presented to emergency in respiratory distress and shortly passed away; the three care providers were likely exposed while intubating the patient (Loconsole et al., 2021).

The cause of increased transmissibility of the VOCs is still unclear; however, an initial report of a Delta variant outbreak from a Chinese quarantine facility suggests that viral loads may be up to 1000X higher, corresponding to a mean initial cycle threshold of 24 (19-29) in 62 Delta-infected individuals, compared to 34.3 (31-36) in wild-type-infected individuals (Li et al., preprint). However, in this study, cultivatable virus was not assessed.

Synthesis of the Information Relating to Question 2

The clinical evidence suggesting that respiratory protection for COVID-19 VOCs should be different from respiratory protection for wild-type COVID-19 is extremely limited. Only two reports of reinfection or infection by VOC after vaccination were identified in the literature search, and these are very small case series (n<5) that do not appear to be representative of the HCW population at large and preclude any estimation of risk of transmission (i.e. reporting number of cases among HCW exposed). In Alberta, infections after immunizations are tracked in real time and these data can be followed. In general, any grey literature recommending changes to PPE policy is not based on

clinical or epidemiological evidence, but on expert opinion of the filtering efficiency of N95 respirators, the precautionary principle, and advocacy efforts (Wise, 2021; Iacobucci, 2021; Torjesen, 2021; Curran et al, 2021). Taken together, there is no evidence at this time to suggest that current respiratory protections are insufficient to protect HCWs in Alberta from COVID-19 VOCs.

Research Question 3: Are there any jurisdictions that have changed their guidance around PPE use for HCW in response to increasing rates of highly transmissible Variants of Concern (VOCs)?

The evidence from the scan of the PPE guidance from other provincial and international jurisdictions is shown in detail in Table 4 in Appendix B. Guidelines from Australia (federal), Ontario, British Columbia, the World Health Organization, the European Center for Disease Prevention and Control, and the Public Health Agency of Canada were identified and included by the librarian for review. Guidelines or policy statements from three additional jurisdictions (Victoria, Australia; Quebec; and Cambridge, UK) were recommended by reviewers and stakeholders.

The UK experienced a significant Alpha (B.1.1.7) variant-driven surge over December 2020-March 2021, with a peak of >4000 hospital admissions daily in January 2021. An ad hoc search for literature related to this recent surge in the UK revealed two grey literature documents that were not identified in the search by the librarian. Public Health England Infection prevention and control guidance was updated in June 2021, and reinforced 1) the use of fluid resistant surgical masks unless AGMP exposure in non-low risk pathways is anticipated, and 2) the need for a risk assessment to include evaluation of ventilation in the area (Public Health England, 2021a). The current Delta driven surge in the UK started in late May, 2021.

Likewise, an undated review of mask use for HCW conducted by the UK IPC Cell (estimated 22 February 2021) included data showing that the percent positivity rate in the healthcare worker surveillance samples to be consistently significantly lower than that in community samples, with weekly surveillance testing, as well as a dedicated review of measures across the NHS and a literature review (UK Infection Prevention and Control Cell, 2021). This review was consistent with other grey literature from England and concluded that the variants of concern do not transmit differently from the wild-type SARS-CoV-2 strain; that the PPE guidance for HCW should be maintained (medical/surgical masks + eye protection for non-AGMP duties, N95/FFP3 respirator + eye protection for care duties requiring AGMPs); reinforced the need for adherence to existing guidance for inpatient masking and physical distancing; and highlighted the importance of rapid testing in regions of high prevalence (UK Infection Prevention and Control Cell, 2021). These findings were confirmed by a systematic review and background narrative review conducted by Public Health England (Public Health England, 2021b).

Reviewers suggested additional references not captured in original literature search strategy, which met criteria for inclusion. As included above, Ferris et al. (preprint) observed higher HCW infection rates in HCW on designated COVID wards, with

reduction after changing to N95 masks. They observed a strong positive correlation between the incidence of SARS-CoV-2 in the community and the number of cases per ward day on green ($R^2=0.88$) but not red wards ($R^2 = 0.01$) and risk on green wards was consistently lower than the risk of community-based exposure, and increased in proportion to rising levels of community incidence. By contrast, in this setting the risk of direct infection from working on a red ward before the change in PPE was considerably higher than the risk of community-based exposure. This contrasts with other literature suggesting a lower risk of HCW on designated COVID units and with observations in Alberta, perhaps related to more stringent PPE use and support.

The other publication from Victoria, Australia provides the data that prompted a change in PPE in Victoria, Australia, in which N95/P2 respirators were recommended at all times when providing care to high-risk suspected and confirmed COVID-19 patients, regardless of the amount of time in contact (Victoria State Government, 2021; Buising et al., 2021). This change was in response to a very large institutional outbreak with 262 staff infections observed at a single hospital site (acute tertiary care, geriatric and rehabilitation care) between July 1 and August 31 2020 (Buising et al., 2021). Initial measures included enhanced PPE support for staff on designated wards, ventilation assessment, and on July 21 respirator use (N95) on “hot wards” (which contributed 22% of staff infections), spotters to observe PPE, additional cleaning and enhanced testing were instituted (Buising et al., 2021). The outbreak peak occurred at the end of July. This very large staff outbreak was eventually controlled with a bundled intervention that included continuous N95 use on designated COVID wards however the rate of staff infection in that setting was relatively low and constant over the duration (pre and post intervention), suggesting superspreader events in the mental health and geriatric care areas were driving the staff infections; this makes the direct contribution of N95 masks to COVID-19 ward care difficult to ascertain. It is also important to note that these changes were not made in response to VOCs specifically; rather, this change aligns with Australia’s zero-tolerance policy towards COVID-19.

In Quebec, a statement from the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) was published in February 2021 calling for N95 respirators for all HCWs with risk of exposure to SARS-CoV-2 (IRSST, 2021). There is limited exploration of the evidence underpinning this statement, and it provides only a high-level acknowledgement of the factors that may also contribute to a HCWs risk of exposure and infection. Further, this document does not constitute official guidance. It is unclear if the recommendations were adopted by health authorities in Quebec.

Evidence from secondary and grey literature

An overview of the guidance and changes related to the emergence of VOCs, identified through the database search, is shown in Table 2 below. The first guidance was from the World Health Organization (WHO) (last updated July 2021 from December 2020); guidance from Europe was from February 2021; guidance from Canada and Australia has all been updated within the last three months (April-June 2021). Very few guidelines specifically noted changes or recommendations based on VOC transmissibility.

Table 2. Overview of guidance from other provincial and international jurisdictions.

Jurisdiction	Masking Guidance	Changes because of VOCs
International (WHO)	<ul style="list-style-type: none"> - HCWs should continuously wear a medical mask when not performing AGMPs - Respirator, N95 or FFP2 or FFP3 standards, or equivalent in care settings for COVID-19 patients where AGMPs are performed; these may be used by health workers when providing care to COVID-19 patients in other settings if they are widely available and if cost is not an issue - PPE should be selected based on transmission-based precautions 	<p>No changes; current recommended PPE measures should be stringently followed</p>
Europe	<ul style="list-style-type: none"> - The use of medical face masks by HCW for personal protection and source control should be strongly considered during all routine activities and in communal areas as a measure for reducing transmission within healthcare settings in areas with community transmission - HCW in contact with a possible or confirmed COVID-19 case should wear a well-fitted respirator and eye protection (i.e. visor or goggles) - For AGMPs, all those present should wear a well-fitted respirator as well as visor or goggles, long-sleeved impermeable protective gown, and gloves 	<p>Some discussion of VOCs. No changes made to the guidance, but universal masking for HCW was added as a consideration for policy makers.</p>
Australia	<ul style="list-style-type: none"> - A surgical mask should be worn when entering a patient-care environment to prevent droplet transmission - A correctly fitted P2/N95 respirator is worn when entering the patient-care area when an airborne-transmissible infectious agent is known or suspected to be present (not necessarily during an AGMP) - All HCW providing direct patient care or working within the patient/client/resident zone for individuals with suspected or confirmed COVID-19 should have access to P2/N95 respirators, and should be able to choose based on their own point-of-care risk assessment. 	<p>No discussion of VOCs</p>
Canada	<ul style="list-style-type: none"> - Medical masks are recommended for all HCWs, non-clinical staff, and visitors to acute healthcare facilities at all times - A minimum of Droplet and Contact Precautions (which includes wearing gloves, a gown, a medical mask and eye protection) should be implemented when caring for patients who are considered exposed to, or suspected or confirmed to have COVID-19; substitution of an N95 or equivalent respirator in place of a medical mask may occur based on a HCW's point-of-care risk assessment 	<ul style="list-style-type: none"> - Continue to adhere to, reinforce and monitor the full range of existing infection prevention and control measures and guidance - References to reuse or extended use of PPE have been removed from the guidance, except for extended use in the context of masks worn as source control, and eye protection worn for the duration of shifts
British Columbia	<ul style="list-style-type: none"> - Use a surgical/procedure mask along with eye protection (face shield, safety glasses or goggles), gloves and gown when taking nasopharyngeal and throat swabs 	<p>No changes – no evidence that modes of transmission differ from wild-type</p>

Jurisdiction	Masking Guidance	Changes because of VOCs
	<ul style="list-style-type: none"> - Use a N95 respirator or equivalent with gown, gloves and eye protection (face shield or goggles) when performing aerosol generating medical procedures (AGMP) on patients suspected (patients with COVID-19 risk) or confirmed to have COVID-19. - Performing point-of-care risk assessments (PCRAs) will help HCWs determine if additional measures are required (e.g., N95 respirators for aerosol generating medical procedures (AGMPs)) 	
Ontario	<ul style="list-style-type: none"> - Contact & Droplet precautions + N95 respirator during AGMPs - As part of universal masking, HCW and patients should wear an appropriately sized mask that covers both their nose, mouth and chin without gaps, and which remains in position without the need for repeated re-positioning 	No recommended practice changes - no indication that these variants of concern are transmitted in fundamentally different modes from other variants of the virus

World Health Organization, 2020
World Health Organization, 2021b
World Health Organization, 2021c
European Centre for Disease Prevention and Control, 2021
Public Health Agency of Canada, 2021
Australian National COVID-19 Clinical Evidence Taskforce, 2021
BC Centre for Disease Control, 2021a
BC Centre for Disease Control, 2021b
BC Centre for Disease Control, 2021c
Public Health Ontario, 2021b
Public Health Ontario, 2021c

Synthesis of the Information Relating to Question 3

The current AHS guidance for healthcare worker PPE requires continuous masking (with a medical/surgical mask) in all AHS facilities, contact and droplet precautions for staff working with patients with suspected or confirmed COVID-19, and contact and droplet precautions plus an N95 respirator when performing an AGMP (Alberta Health Services, 2021a). In February 2021, an agreement between AHS and the healthcare worker unions allowed any healthcare worker to access surgical/procedure masks, fit-tested NIOSH-approved N95 respirators or approved equivalent, gloves, face shields with side protection (or goggles), and impermeable or, at least, fluid resistant gowns based on their point-of-care risk assessment (Alberta Health Services, 2021b).

The various guidance documents identified in this review either was already in alignment with AHS policies, or changes made because of the VOCs were concordant with already existing AHS policies.

Additional Considerations for HCW Masking Guidance

Creating PPE guidance for HCW is a challenging task, as many different elements must be considered. Staff protection must be balanced with evidence of mask effectiveness, the potential monetary cost of mandating a higher level of protection than necessary, the potential physical and mental harms to the individual, and the potential harms to the cohesion and performance of the care team. Many of these considerations were

outlined in the [previous SAG review on PPE guidance](#); however, the literature search for this review also returned many results highlighting the effects of masking beyond respiratory protection. Although not a pre-specified research question, it was deemed prudent to include some of this evidence in this review. As this section was developed *post hoc*, the articles referenced here are not included in the evidence extraction tables.

Continuous Masking: There is a relatively robust body of evidence to show that universal or continuous masking policies can significantly decrease the incidence of occupationally-acquired SARS-CoV-2 infection among HCW (Seideman et al., 2020; Gras-Valenti et al., 2021; Wang, D. et al., 2021; Wang, X. et al., 2020; Adawee et al., 2021; Pan et al., 2021; Lan et al., preprint) and that any type of mask is better than no mask at all (Griswold et al., 2021; Li et al., 2021; Chan et al., 2021). In high-risk scenarios such as tracheotomies or other AGMPs, retrospective chart review found that N95 respirators were effective at preventing SARS-CoV-2 transmission, although this was not a comparative study (Thal et al., 2021).

Healthcare worker risk perception does appear to affect protective behaviors, although the evidence is currently very limited. One cross-sectional study showed that health workers who perceived that they would not be exposed to COVID 19 infection were nearly ten times more likely to be infected with COVID 19 compared to HCW who perceived they will be exposed to COVID 19 infection (AOR = 9.56, 95% CI = 3.51–26.06) (Atnafie et al., 2021). This observation will need further study with respect to the effects of HCW vaccination and the perception of risk from COVID-19 VOCs.

Other potential impacts of PPE on HCW health and work performance: In an overall assessment, where COVID-19 risks are lower because of community transmission patterns and HCW vaccination, considering other potential negative impacts of PPE use is necessary. Both medical/surgical masks and N95 respirators have been associated with headache, adverse skin reactions, breathing difficulties, rhinitis and nasal symptoms, eye and ear discomfort, and thermal stress (Alberta Health Services, 2020; Khalid et al., 2021; Gelardi et al., 2020; Burns et al., 2021; Unoki et al., 2020). Both N95 respirators and surgical masks have been associated with complaints of dizziness, blurred vision, irritability, and memory loss (Gelardi et al., 2020; Khalid et al., 2021). Skin breakdown can be limited with thin dressings and improved skin care (Moore et al., 2021; Guschel, Chmiel & Rosenstein, 2020), but respiratory and physiological symptoms are not easily mitigated. Overall, more severe physical effects (such as headaches, breathing problems, impaired cognition) are seen from N95 respirators, while more minor effects (such as ear discomfort and skin reactions) were seen from procedural masks (Alberta Health Services, 2020).

Risks to care team performance due to the impact of PPE on communication as well as aspects of physical care may impact patient safety as well. Continuous masking and PPE have a detrimental effect on team communication, social cohesion, and therapeutic relationships (Hayirli et al., 2021; Alberta Health Services, 2020) and N95 respirators in particular have been shown to reduce CPR performance (Serin & Caglar, 2021; Tian et al., 2020) and may have long-term effects on physician procedure capacity in procedure based specialties (Khalid et al., 2021).

Modes of transmission of COVID-19 in healthcare settings: A full review of transmission modes is outside the scope of this document. The relative proportion of transmission from airborne routes versus from contact and droplet transmission (including from fomites) is an area of active inquiry with significant attendant controversy. Health care settings have both ventilation standards that are more clearly delineated and assessed than in many other settings (although not across all areas of possible risk) and risks associated with contact with patients and coworkers with transmissible COVID-19 infection. HCW risk associated with fomite spread has not been well assessed, and the role of “deep cleaning” of surfaces is under study. In addition, a recent preprint study with extensive sampling of surfaces and exhalations showed that high concentrations of cultivatable SARS-CoV-2 can be shed from infectious individuals, generally for up to 7 days post-symptom onset. In this study, virus was easily recovered from surfaces (such as medical devices and mask surfaces), in personal interactions (such as hand surfaces and kisses) and in cough/sputum samples, but not from casual speech or breathing samples, suggesting that fomites can be a major route for SARS-CoV-2 transmission in healthcare settings (Lin et al., preprint). Therefore, risk mitigation in HCW should continue to address contact and droplet spread with hand and environmental hygiene measures in addition to respiratory protection.

Potentially relevant studies and Observations in Community Settings:

There is increasing interest and advocacy around expanded N95 respirator use in the community and in healthcare, however particle science findings do not always correlate with observed transmission patterns. Mask studies on COVID-19 in community settings are just being reported (see [SAG review on community masking](#)) and have varied conclusions. These studies have used non respirator masks. In practice, large scale use of mandatory public use of respirator masks in Austria from January 25, 2021 through July 1, 2021 started before and continued through a third COVID wave in Europe. Austria experienced 40% more cases per capita than seen in neighbouring Germany and Switzerland which would suggest that a single intervention of mandating respirator masks is not effective in controlling transmission ([Our World in Data](#)).

Evolving Evidence

The body of evidence on masks for protecting HCW against SARS-CoV-2 is exclusively observational and there for is graded as of low quality. This has been identified in secondary literature as well (Bartoszko et al., 2020).

A large Canadian multi-center randomized controlled trial is underway to generate evidence to determine if medical masks are non-inferior to N95 respirators for non-aerosol generating procedures. In this trial, an estimated 576 HCW (nurses and physicians) who are working on COVID care units are randomized to use an N95 or medical/surgical mask unless AGMP are performed in which case precautions would be in accordance with local guidance on N95 respirator use. The primary outcome is PCR-confirmed COVID-19 infection, and secondary outcomes are acute respiratory illness, absenteeism, lower respiratory infection, pneumonia, critical care admission, mechanical ventilation, and death (all to be measured at 6 months). Outcomes will be

measured by a blinded assessor. Interim review by a data safety monitoring board has occurred and the trial is ongoing. This RCT is registered to [Clinicaltrials.gov with the identifier NCT04296643](https://clinicaltrials.gov/ct2/show/study/NCT04296643).

Appendices

A. Terminology Notes and Abbreviations

Terminology Notes

Continuous masking of HCW: refers to the continuous use of medical / surgical / procedural masks among healthcare workers (HCW) (i.e., always except for when eating or drinking). Medical/surgical/procedural are used interchangeably throughout the report. N95 respirator (N95) /Filtering Facepiece 2 (FFP2)/Filtering Facepiece 3 (FFP3) masks are used interchangeably throughout the report.

Universal masking of HCW: Synonymous with continuous masking of HCW

Continuous masking of patients: refers to the continuous use of medical / surgical / procedural masks or cloth masks among patients. The type of mask (i.e., cloth vs medical) is captured verbatim from the individual studies or guidelines in the report.

Eye protection: refers to face shields, goggles or visors and will be used interchangeably within the report. Personal prescription eyewear is not considered sufficient eye protection unless it meets applicable standards for protection as outlined in <https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-ppe-bring-my-own-guidance.pdf>

Probable, Suspected or Confirmed COVID-19: [Alberta-based definitions](#) for probable, suspected or confirmed are assumed; except for the evidence summaries where terminology is captured verbatim from the literature.

Abbreviations

AGMP: Aerosol Generating Medical Procedure

AHS: Alberta Health Services

BC: British Columbia

BCCDC: British Columbia Centre for Disease Control

COVID-19: Coronavirus disease 2019

ECDC: European Centre for Disease Prevention and Control

ED: Emergency department

FFP2/3: Filtering Facepiece 2/3

HCW: healthcare worker

HR: Hazard ratio

OR: Odds ratio

PPE: Personal Protective Equipment

RCT: randomized controlled trial

RT-PCR: Reverse transcriptase polymerase chain reaction

SAGE: Scientific Advisory Group on Emergencies

SARS-CoV-2: Severe Acute Respiratory Syndrome-Coronavirus-2

UK: United Kingdom

VOC: COVID-19 Variants of Concern

B. Evidence Extraction Tables

Table 3. Evidence extracted from included studies for research questions 1 and 2. 17 articles were included in the narrative synthesis. Evidence was extracted verbatim from included articles.

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
<p>Akinbami et al., 2020</p> <p>United States</p> <p>- COVID-19 - Study does not separate AGMPs and non-AGMPs - No direct comparison of N95 and surgical masks, but both are included</p>	Retrospective cross-sectional survey & serology study	<p>Adults who worked onsite in a first response, hospital, or public safety setting</p> <p>N= 16,397</p>	<p>- Exposure to persons with confirmed COVID-19 (co-worker, household member, patient, and other person) was defined as contact within 6 feet for >10 minutes</p> <p>- PE use was dichotomized for each piece of equipment into “use all the time” (the recommended, or optimal, frequency when PPE is required) versus all other choices.</p>	Positive serology test for SARS-CoV-2	<p>- 6.9% (95% CI 6.5%–7.3%) were positive for SARS-CoV-2 IgG, indicating previous infection. In contrast, 2.7% (95% CI 2.5%–3.0%) reported having previously tested positive by RT-PCR using a nasal, throat, or saliva sample.</p> <p>- Consistently wearing an N95 respirator (aOR 0.83, 95% CI 0.72–0.95) or surgical facemask (aOR 0.86, 95% CI 0.75–0.98) (vs. using them less than “all the time”) lowered the likelihood of being seropositive</p>	<p>- Estimated low quality study</p> <p>- Risk of recall bias and selection bias (convenience sample)</p> <p>- Effectiveness of PPE could be confounded by shortages/reuse protocols in place at the time or donning/doffing procedures</p>
<p>Chung et al., 2020</p> <p>Korea</p> <p>- COVID-19 - Study considers AGMP vs. non-AGMP - No direct comparison of N95 and surgical masks</p>	Case series	<p>HCWs in outpatient clinic</p> <p>N=317</p>	<p>- 8 outpatients with a confirmed COVID-19 diagnosis</p> <p>- median time spent in the hospital and the median examination time for the confirmed patients was 164 minutes (interquartile range [IQR], 92-179 min) and 6 minutes (IQR, 3-10 min), respectively.</p> <p>- 5 patients (62.5%) were asymptomatic, and 3 patients (37.5%) were pauci-symptomatic</p> <p>- Five patients were continuously masked, three patients were briefly (<20 minutes) unmasked to eat or receive treatment.</p> <p>- Close contact was defined as 1) being within approximately 6 feet of a patient with confirmed COVID-19 for at least 15 minutes or 2) direct</p>	- Lab-confirmed COVID-19	<p>- 16 HCWs with close contact were placed under self-isolation for 2 weeks and subsequently underwent a PCR test on the 14th day before returning to work</p> <p>- 0 of 317 HCWs who came in any contact had a confirmed COVID-19 diagnosis (0.00%; 95% confidence interval, 0.00%–0.01%)</p> <p>- During the study period, 3 of 8,800 HCWs were confirmed COVID-19 in our hospital. According to the interview and the closed-circuit television footage, none had contact with confirmed patients in the hospital</p> <p>- Our findings support the low risk of infection among HCWs with the use of standard precautions such as wearing surgical masks and maintaining hand hygiene</p>	<p>- Estimated low quality</p> <p>- Relatively small sample size, low-prevalence country limits generalizability</p> <p>- COVID+ patients may not have been contagious when visiting hospital</p>

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
			contact without the use of appropriate PPE (N95 or FFP2 equivalent respirator, face shield/goggles, gown, and gloves) - in our study, most HCWs wore only surgical masks at the time of exposure and even during aerosol-generating procedures; they did not wear goggles or face shields or gloves.			
Curran et al., 2021 - VOC focus only - No direct comparison of N95 and surgical masks	Rapid scoping review	Any	Any	Any	- No published or preprint studies were identified that were relevant to modifying hand washing or mask protocols related to the variants of concern	- COVID-END report
Evidence Synthesis Network, 2021 - COVID VOCs	Briefing Note	Any	- COVID-19 variants of concern - Any type of PPE		- Wearing a face covering with a filtering face piece (FFP) that is electrospun with composite air filter membranes may improve protection against more transmissible VOCs. Due to their better filtration efficiency and the emergence of VOCs, respirators may be considered for community use	- Recommendations not based on clinical or epidemiological evidence
Griswold et al., 2021 - Not specific to COVID-19 - Included SRs directly compare N95 and surgical masks - No comparison of AGMP and non-AGMP	Umbrella review ("review of reviews")	HCWs in emergency trauma surgery N= 17 SRs + 1 qualitative synthesis	- Different types of PPE compared to no PPE	Risk of infection to health personnel	Reviews that examine N95 and Surgical Masks (not COVID-19 specific) Chu (2020) - The use of a surgical mask compared with no face mask was associated with reduced infection risk (OR, 0.33; 95% CI, 0.17–0.61). - Strong risk reduction when comparing N95 and N95 equivalent respirators to no mask (OR, 0.04; 95% CI, 0.004–0.30) Macintyre (2020)	- Included reviews had low overall risk of bias - Evidence appears to be mixed; superiority of N95s has low-quality evidence in moderate-high risk settings - High certainty that masks are better than no masks - No meta-analysis

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
					<ul style="list-style-type: none"> - Respirators were found to be more protective than surgical masks, and surgical masks more protective than cloth masks for influenza Bartoszko (2020); Tom (2020) - There appears to be no difference between respirators and medical masks when used in non-aerosol-generating procedures low-risk environments Iannone (2020) - The reduction in contagion risk (influenza only; COVID-19 not examined) calculated from 2 RCTs was estimated to be as follows: RR, 0.43; 95% CI, 0.29 to 0.64; and I2 = 0%, from pooled analysis, with an absolute effect of preventing 73 (95% CI, 91–46) more infections per 1000 HCWs wearing N95 respirators compared with surgical masks. Chou (2020) - Reduction of risk of transmission associated with the use of masks in general. - Greater magnitude of risk reduction for respiratory illness (not COVID-19) associated with N95 respirators compared with surgical masks in the hospital setting (an effect seen for COVID-19 independently, as well as with the other coronaviruses outbreaks). Does not separate AGMPs and non-AGMPs. 	
Haller et al., preprint Switzerland - COVID-19 - Direct comparison of surgical masks and respirators	Prospective cohort study	HCW at seven acute care institutions N= 3259	<ul style="list-style-type: none"> - Continuous masking with surgical mask; respirator recommended for AGMP. - HCWs free to choose medical mask or respirator based on risk assessment - other PPE including gowns, gloves and goggles while caring for COVID-19 patients 	<ul style="list-style-type: none"> - Time to first self-reported positive NP swab - SARS-CoV-2 seroconversion 	<ul style="list-style-type: none"> - The number of self-reported positive SARS-CoV-2 tests was 81/716 (11%) for FFP2 users compared to 352/2543 (14%) in users of surgical masks (HR 0.8; 95% CI 0.6-1.0; p=0.06; no significant difference. - Use of FFP2 while caring for COVID-19 patients was associated with not statistically significant aHR of 0.8, 95% CI 0.7-1.0 - removing participants with a positive household member (aHR 0.8, p=0.31) and treating 	<ul style="list-style-type: none"> - Estimated low quality - moderate risk of bias and confounding - Study takes place June-August 2020

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
- Considers AGMPs and non-AGMPs			<ul style="list-style-type: none"> - Participants had the choice among “Use of surgical mask only”; “Mostly use of surgical mask”; “Equal use of both mask types”; “Mostly use of FFP2”; “Use of FFP2 only”. For the purpose of this analysis, the two latter categories were classified as “Mostly FFP2”, whereas the first three categories were merged into the group “Not mostly FFP2” (for better comprehensibility termed “Mostly surgical masks”) - Number of COVID-19 patients and of positive co-workers HCW had been knowingly exposed since March 2020 - AGMPs defined as bronchoscopies, in-/extubation, gastroscopy, transesophageal echocardiography, reanimation, non-invasive ventilation, and suction of tracheal secretions 		<ul style="list-style-type: none"> institutions/cantons as fixed effect (aHR 0.9, p=0.43) resulted in non-significant associations - Seroprevalence was 12.9% (85/658) for FFP2 users compared to 18.9% (429/2258) for users of surgical masks (OR 0.6, 95% CI 0.5-0.8, p<0.001) - In sensitivity analyses, removal of variable on household exposure (aOR 0.7, p=0.046) and including cantons/institutions as fixed effects (aOR 0.8, p=0.088) did not significantly change the point estimates for FFP2 use nor the significance levels for seroconversion in sensitivity analysis when household member positivity was accounted for, the association of mask use and infection was no longer significant (aOR 0.8, p=0.31) for positive test - Exposure to a positive household member was the most significant risk factor for a positive test and for seroconversion (aOR 5.0 (95% CI 3.9-6.5, p<0.001)) 	
Kingden-Milles et al., 2021 Germany - COVID-19 - Study does not separate AGMPs and non-AGMPs - No direct comparison of N95 and surgical masks	Cross-sectional survey	Critical care or Emergency physicians (n= 516)	<ul style="list-style-type: none"> - 454/516 (88%) worked in high risk areas including intensive care units, operating theatres, emergency departments and out-of-hospital physician-based emergency services - 379/516 (73%) treated patients with proven SARS-CoV-2 infection - 173/498 (35%) had stayed abroad after January 1st 2020 for a mean of 14 ± 24 days -22/502 (4.4%) reported household exposure - FFP2 masks available to 363/516 (70%) and FFP3 to 176/516 (34%). 	SARS-CoV-2 Seropositivity	<ul style="list-style-type: none"> - No difference detected between physicians with SARS-CoV-2 infection, i.e. 2/18 (11%), and those without SARS-SoV-2 infection, i.e. 67/498 (13%) - No statistically significant correlation between the availability of FFP2/FFP3 masks and SARS-CoV-2 infection (Fisher’s exact test; p = 0.99) - Significant correlation between contact to SARS-CoV-2 positive family members and SARS-CoV-2 infection in our participants (Fisher’s exact test; p = 0.0005). - no significant correlation between stays abroad and risk of SARS-CoV-2 infection in this study (Fisher’s exact test; p = 0.193) 	<ul style="list-style-type: none"> - Estimated low quality - Risk of recall bias & selection bias - Application of solutions in the absence of FFP2/3 masks (such as double masking) was not explored in this study

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
			- 69/516 (13%) participants neither FFP2 nor FFP3 masks were available at some point in time.			
Lentz et al., 2021 United States (International) - COVID-19 - Study does not compare mask types in non-AGMP settings alone - Direct comparison of N95s and surgical masks	Case-Control Online social media survey distributed in April-May 2020)	HCWs from 67 countries (n=1130) 244 cases 886 controls	- Aerosol-generating procedures (AGMP) (Intubation, extubation, open respiratory suctioning, bronchoscopy, nebulizer use, noninvasive positive pressure ventilation (NIPPV), tracheotomy, and CPR) - Occupational non-AGMP exposure - Community exposure - Disposable N95, FFP2, and FFP3 respirators (new or reused), powered air-purifying respirators (PAPRs), and reusable elastomeric respirators were considered respirator-level protection	- Self report of lab-confirmed COVID - Healthy and continued to work	- In this self-selected cohort, respirators were used by 94% of respondents during AGMPs and 72% during non-AGMPs - The odds of self-reported HCW infection were greater in those reporting prolonged continuous COVID-19 patient contact without a respirator (adjusted OR, 2.3; 95% CI, 1.1–4.9; P = .04) versus those who wore respirators in this context (adjusted OR, 0.8, 95% CI, 0.5–1.5; P = .60) Respirator use in both AGMPs and non-AGMPs was associated with being a control (aOR, 0.4; 95% CI, 0.2–0.8; P = .005) - The use of medical masks in AGMPs and non-AGMP was associated with self-reported HCW infection (adjusted OR, 7.4; 95% CI, 2.8–20.0; P < .001) - Working at facilities with policies recommending respirator use during AGMPs (adjusted OR, 0.4; 95% CI, 0.3–0.7; P < .001) and non-AGMP contact (adjusted OR, 0.6; 95% CI, 0.5–0.9; P = .008) were associated with being a control - HCW at institutions they identified as having policies advocating extended use or reuse of disposable respirators did not associate with being a case or control - Exposure to ill household members, gatherings of ≥10 people (aOR 4.6; 3.0-7.1; p<0.001), patronizing restaurants or bars (aOR 16.2; 8.6-30.5; p<0.001), and public transportation (aOR 4.4; 2.8-6.9; p<0.01) was associated with HCP infection - Our results suggest that medical masks are likely adequate during most non-AGMP contact with COVID-19 patients, but respirators might be	- Estimated low- quality - Risk of recall bias and high risk of selection bias towards people who have had COVID and possibly for HCW who select N95 masks - Possible overlap between cases and controls - Adjusted for age, gender, smoking status, presence of a baseline comorbidity, healthcare role, and world region - Unclear if infections were due to occupational or community exposure - Study design problematic – self identified HCW, self identified COVID-19 infection and assignation of control group by missing data. Concerns of recall bias, unclear results reporting, and statistical analysis irregularities.

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
					considered if very prolonged close contact is anticipated.	
Loconsole et al., 2021 Italy - VOCs only - Not a comparative study	Case series	HCW N=3	<ul style="list-style-type: none"> - 50-year-old male patient with a confirmed diagnosis of SARS-CoV-2 infection who presented at the emergency department with respiratory failure and pulmonary oedema; the severity of his condition required endotracheal intubation - All procedures were carried out using a full set of personal protective equipment (PPE): particulate filter respirators (P3), two pairs of gloves, face shields, and a single-use coverall. No eye glasses were used under the face shields. - The two physicians had been fully vaccinated with the BNT162b2 COVID-19 mRNA vaccine; the nurse refused vaccination 	PCR-positive COVID-19	<ul style="list-style-type: none"> - Breakthrough infection could be hypothesized since the clinical presentation was mild, and no biomarkers suggestive of VAED were identified. 	<ul style="list-style-type: none"> - very small sample size - no discussion of PPE breaches or effectiveness
Li et al., 2021- - COVID-19 - Does not directly compare N95 and surgical masks, although both are included - Does not differentiate between AGMP and non-AGMP	Systematic review and meta-analysis	Any population N= 6 included studies; 1233 subjects (all case-control)	<ul style="list-style-type: none"> - Any exposure - PPE including masks 	Lab-confirmed COVID-19 infection	<ul style="list-style-type: none"> - After wearing a mask (type not specified), the risk of contracting COVID-19 was significantly reduced, with the pooled OR of 0.38 and 95% CI: 0.21-0.69 (I2 = 54.1%, M-H Random-effect model) - In HCWs only, the protective effect was more obvious, with the pooled OR of 0.29 (95% CI: 0.18-0.44, I2 = 11%) - Face mask could significantly reduce the risk of SARS-CoV-2 infection compared to no mask (OR = 0.44, 95% CI: 0.21-0.93, I2 = 52.0%). - No significant protective effect was shown in the N95 respirator group (OR = 0.17, 95% CI: 0.02-1.69, I2 = 94.6%) in unadjusted subgroup analysis. - Significant protective effect of N95 respirator compared to no mask was shown in the adjusted 	Estimated low quality - Adjusted for sex, age, contact place, the shortest distance of contact, duration of contact, sharing dishes, or cigarettes and handwashing

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
					estimation subgroup analysis (OR = 0.19, 95% CI: 0.09-0.38, I2 = 0.0%)	
<p>Mariani et al., 2021</p> <p>Italy</p> <p>- COVID-19</p> <p>- Does not distinguish between AGMP and non-AGMP settings</p> <p>- Directly compares N95 and surgical masks</p>	Cross-sectional survey	<p>HCWs in endoscopy centres (not differentiated)</p> <p>N= 201</p>	<p>- FFP2-3 masks were used for all patients in 96 (47.8%) of centers and only for those with suspected or confirmed COVID-19 in 83 (41.3%) centers</p> <p>- FFP2 or FFP3 were not available in 10.9% of endoscopic centers</p> <p>- In 95.5% of centers, patients were interrogated about respiratory symptoms or fever occurring during the two weeks before endoscopy and in 90.1% about COVID-19 positive partners or close contacts or high-risk travel</p> <p>- A surgical mask was provided to patients undergoing endoscopy in 79.1% of centers</p>	Lab-confirmed SARS-CoV-2 infection, regardless of symptoms	<p>- Mask type not significantly associated with HCW infection risk.</p> <p>No FFP2/3 for all patients (comparator FFP2/3 used for all patients): OR 0.52 (0.21–1.30)</p> <p>- Involvement of HCWs in a COVID-19 care team (OR; 95% CI: 4.96; 1.97–12.51) and lack of training courses for PPE donning and doffing (OR; 95% CI: 2.65; 1.07–6.53) were the only factors associated with an increased risk of contagion at the logistic regression analysis.</p>	<p>- Estimated low quality</p> <p>- Risk of recall bias</p> <p>- Some selection bias risk due to relatively low endoscopist participation</p>
<p>Mastan et al., 2021</p> <p>UK</p> <p>- COVID-19</p> <p>- Directly compares N95 and surgical masks</p> <p>- non-AGMP only</p>	Cross-sectional survey	<p>Orthopedic specialist trainees</p> <p>N= 19 hospitals</p>	<p>- Acute orthopaedic units in the NW of England caring for elderly patients with hip fracture who are particularly vulnerable to infection and mortality from COVID-19.</p> <p>- Minimal PPE (surgical mask, apron and gloves), with eye protection if bodily fluid secretion is anticipated</p> <p>- Full PPE (filtering face piece 3 (FFP3) respirator or equivalent, eye protection, long-sleeved gown and gloves) reserved for when undertaking an aerosol generating procedure (AGMP)</p>	COVID-19 outbreak: 2 or more test-confirmed cases amongst individuals associated with illness in a non-residential setting, sharing onset dates within 14 days of each other, with the absence of another source of infection or an episode of direct	<p>- A COVID-19 outbreak was reported in 11/13 (85%) orthopaedic units where staff wore fluid resistant surgical masks compared to only 3/6 (50%) units using an FFP3 respirator mask (RR 1.69, 95% CI 0.74–3.89, Fisher's exact test P = 0.26)</p> <p>- COVID-19 outbreak was reported in 12/14 (86%) orthopaedic units where staff wore fluid resistant surgical masks compared to only 2/5 (40%) units using an FFP3 respirator mask (RR 2.14, 95% CI 0.72–6.4, Fisher's exact test P = 0.084)</p>	<p>- Study is underpowered to detect a difference in COVID-19 outbreaks due to masking practice</p> <p>- Estimated low quality</p> <p>- Risk of recall bias and selection bias</p>

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
				exposure between cases.		
Public Health Ontario, 2021a - COVID-19 - Guidelines	Jurisdictional scan	n/a	- COVID-19 variants of concern - Any type of PPE		Community masking changes: - Austria: recommendation for cotton masks or scarves upgraded to FFP2 (N95) masks - France: recommendation for homemade masks upgraded to medical masks - Germany: recommendation for fabric masks, visors, or scarves upgraded to medical masks or FFP2 respirators	- No clinical or epidemiological evidence identified to support recommended changes
Ramaraj et al., 2020 - Not COVID-specific - Does not differentiate AGMP and non-AGMPs - Directly compares N95 and surgical masks	Rapid review	Patient-facing HCW in secondary inpatient care N= 9 included studies (3 RCT, 1 cohort, 1 case report, 1 retrospective)	Surgical masks compared to N95 respirators	SARS-CoV-2 protection	- In lab-based studies, N95 respirators are 16-17X more protective than surgical masks - In clinical studies, evidence is mixed but on balance suggests that there is no difference between the two mask types - It was difficult to compare clinical studies as different methodologies and parameters were used to define the protective ability of each form of RPE. Studies were often underpowered and might suffer from confounding variables. - Unclear evidence on SARS-CoV-2 transmission complicates PPE guidance; PPE guidance should take a cautious approach rather than risk underprotecting staff	- Good quality rapid review - Included RCTs are for influenza
Schmitz et al., 2021 Netherlands - COVID-19 - Includes AGMP and non-AGMPs - Directly compares N95 and surgical masks ("high	Cross-sectional survey	Permanent HCWs in emergency departments N= 43 EDs represented	- For non-AGMP patient contacts, considerable variation was present in the type of face masks used. In between the start- and end of the study period, PPE-policy for non-AGMP changed in 27/43 hospitals, with more hospitals starting to use lower-level FFP face masks for non-AGMP patient contacts. - For AGMP, FFP2 or equivalent level face masks were worn in all but three hospitals for AGMP, and in all	PCR-confirmed SARS-CoV-2 infection	- Level of PPE use was not associated with the primary endpoint ($R^2 = 0.039$, $P = 0.40$) after multivariate analysis as a more active staff testing policy was present in the hospitals where a higher level of PPE was used, resulting in more confirmed SARS-Cov-2 staff infections (collinearity statistic 0.95). - the combined number of confirmed and suspected ED staff infections was not significantly different between hospitals in which high-level PPE was used for all patient contacts compared to the other hospitals	- Risk of recall bias - True number of COVID+ patients in EDs is unknown - Hospital staff testing policy was identified as a potential confounder of the relation between PPE use and the primary outcome (confirmed SARS-CoV-2 infections among ED staff)

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
<i>level PPE” vs. “low-level PPE”</i>			<p>but two hospitals, eye protection was worn, with additional face protection in the form of a welding mask in 13 hospitals</p> <ul style="list-style-type: none"> - Most EDs (n = 39, 90.7%) had dedicated areas or rooms where patients suspected of a SARS-CoV-2 infection were seen, either of fixed- (n = 14) or flexible (n = 25) size <p>Reference group: In 13 hospitals, representing 41 938 (32.8 %) of the patient contacts and 944 (30.8%) ED staff members, FFP-2 masks (or equivalent) and eye protection were worn during all patient contacts (irrespective of AGMP) throughout the whole study period.</p>		<ul style="list-style-type: none"> - The use of high-level PPE (FFP2 or equivalent and eye protection) by ED personnel during all contacts with patients with suspected or confirmed SARS-CoV-2 does not seem to be associated with a lower infection rate of ED staff compared to lower-level PPE use 	
<p>Scientific Advisory Group on Emergencies, 2021</p> <ul style="list-style-type: none"> - COVID VOCs - guidance 	Rapid review	n/a	<ul style="list-style-type: none"> - COVID-19 variants of concern - Any PPE type 		<ul style="list-style-type: none"> - Although there are uncertainties in the reasons why the B117 virus variant is more transmissible, the behaviour of respiratory particles is not likely to have changed (high confidence) - It is possible that transmission can happen with a reduced duration of exposure to someone who is infectious (medium confidence) - There is no specific evidence relating to the effectiveness of face coverings or face visors in the context of the B117 variant. <ul style="list-style-type: none"> - Advice on the correct wearing of face coverings should be strengthened to more effectively promote: wearing of face coverings in ways that improve their effectiveness as source controls; good hygiene practices including hand hygiene following removal of the face covering; as regular washing or disposal of face coverings. 	<ul style="list-style-type: none"> - Recommendations based on precautionary principle - No clinical or epidemiological evidence for increased PPE recommendations

Reference & Relevance	Study Type	Population	Exposures / PPE Use	Outcome	Conclusions	Notes
					- There is no specific evidence relating to the effectiveness of distancing in the context of the B117 variant, however the way respiratory particles behave in the air does not change. It is possible that the risk of transmission at all distances and from all particle sizes may be higher than with previous variants	
Staub et al., 2021 Luxembourg - COVID VOC - Not a comparative study	Case series	HCW with COVID-19 infection prior to Dec 2020 N=4	- Occupational outbreak of B.1.351 - Before the cluster onset, HCWs used surgical masks, as per recommendations.	- PCR-positive COVID-19 - Sequenced B.1.531 strain	- After the beginning of the cluster, the use of filtering facepiece (FFP2) masks was recommended.	- very small sample size - Very limited detail

Table 4. Extraction table for guidelines obtained in the literature search. 10 guidelines were included in this review.

Reference	Jurisdiction	Last Updated	Target Population	Guidance	Notes
Australian National COVID-19 Clinical Evidence Taskforce, 2021	Australia	9 June 2021	HCW	<p>The Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019)[40] include two specific recommendations for surgical masks and P2/N95 respirators:</p> <p>24. It is suggested that a surgical mask should be worn when entering a patient-care environment to prevent droplet transmission.</p> <p>27. It is suggested that a correctly fitted P2/N95 respirator is worn when entering the patient-care area when an airborne-transmissible infectious agent is known or suspected to be present.</p> <ul style="list-style-type: none"> - All HCW providing direct patient care or working within the patient/client/resident zone for individuals with suspected or confirmed COVID-19 should have access to P2/N95 respirators. - For HCW providing direct patient care or working within the patient/client/resident zone for individuals with suspected or confirmed COVID-19, the choice between P2/N95 respirator or surgical mask should be based on an assessment of risk of transmission. - HCW providing direct care or working within the patient/client/resident zone for individuals where assessment suggests a high-risk of transmission, should use P2/N95 respirators rather than surgical masks, along with the other PPE required. - HCW providing direct patient care or working within the patient/client /resident zone for individuals where assessment suggests a low risk of transmission, should use PPE in accord with existing guidance 	<ul style="list-style-type: none"> - All recommendations listed are based on expert consensus - No specific guidance developed for VOC
BC Centre for Disease Control, 2021a	British Columbia	21 June 2021	Healthcare settings	<ul style="list-style-type: none"> - Use a surgical/procedure mask along with eye protection (face shield, safety glasses or goggles), gloves and gown when taking nasopharyngeal and throat swabs. An N95 respirator is NOT required. - Use a N95 respirator or equivalent with gown, gloves and eye protection (face shield or goggles) when performing aerosol generating medical procedures (AGMP) on patients suspected (patients with COVID-19 risk) or confirmed to have COVID-19. - Double masking is not recommended 	<ul style="list-style-type: none"> - No specific guidance for VOCs

Reference	Jurisdiction	Last Updated	Target Population	Guidance	Notes
BC Centre for Disease Control, 2021b	British Columbia	16 April 2021	Healthcare settings	<ul style="list-style-type: none"> - Based on recent reviews of literature, at this time there is no evidence that the modes of transmission of VOC differ from the original (non-variant) SARS-CoV-2. - Recommendations for IPC measures in health-care settings remain unchanged; however, due to the increased potential of transmission and adverse outcomes, IPC measures must be strictly followed and reinforced <ul style="list-style-type: none"> - Health-care workers (HCWs) are required to wear medical masks in health-care settings as outlined in the provincial policy on Mask Use in Health-Care Facilities During the COVID-19 Pandemic. - HCWs should wear eye protection for all patient interactions when they are within two metres of patients. - Performing point-of-care risk assessments (PCRAs) will help HCWs determine if additional measures are required (e.g., N95 respirators for aerosol generating medical procedures(AGMPs)) 	
BC Centre for Disease Control, 2021c	British Columbia	2 June 2021	Home and Community Healthcare	<ul style="list-style-type: none"> - Implement droplet and contact precautions if there is COVID-19 risk in the home (e.g., the client or household member has suspected or confirmed COVID-19) - Wear a fit-tested N95 respirator, eye protection, gown and gloves when performing an AGMP on a client with suspected or confirmed COVID-19. 	- No discussion of VOCs
European Centre for Disease Prevention and Control, 2021	Europe	9 February 2021	Healthcare settings	<ul style="list-style-type: none"> - The use of medical face masks by HCW for personal protection and source control should be strongly considered during all routine activities and in communal areas as a measure for reducing transmission within healthcare settings in areas with community transmission. - Standard precautions, and in particular meticulous hand hygiene and respiratory hygiene, should be emphasized - HCW in contact with a possible or confirmed COVID-19 case should wear a well-fitted respirator and eye protection (i.e. visor or goggles) - For AGMPs, all those present should wear a well-fitted respirator as well as visor or goggles, long-sleeved impermeable protective gown, and gloves - There is no evidence that the modes of transmission of COVID-19 have changed for the SARS-CoV-2 VOCs, therefore current IPC measures in healthcare facilities remain unchanged. However, the increased transmissibility of the VOCs emphasizes the need for strict compliance with and possibly strengthening of these IPC measures <ul style="list-style-type: none"> - Consider universal masking for HCW at all times, not only during routine clinical activities. For example, this includes wearing a medical mask in 	

Reference	Jurisdiction	Last Updated	Target Population	Guidance	Notes
				communal areas such as nurses' or doctors' rooms or any other communal room (e.g. during breaks).	
Public Health Agency of Canada, 2021	Canada	16 June 2021	Acute healthcare settings	<ul style="list-style-type: none"> - Medical masks are recommended for all HCWs, non-clinical staff, and visitors to acute healthcare facilities at all times - A minimum of Droplet and Contact Precautions (which includes wearing gloves, a gown, a medical mask and eye protection) should be implemented when caring for patients who are considered exposed to, or suspected or confirmed to have COVID-19; substitution of an N95 or equivalent respirator in place of a medical mask may occur based on a HCW's point-of-care risk assessment (PCRA) - Updates due to VOCs: <ul style="list-style-type: none"> - Continue to adhere to, reinforce and monitor the full range of existing infection prevention and control measures and guidance - References to reuse or extended use of PPE have been removed from the guidance, except for extended use in the context of masks worn as source control, and eye protection worn for the duration of shifts - HCWs should be fit-tested for an N95 or equivalent respirator, and monitored for proper wearing, seal checking and removal of their assigned size and type of N95 or equivalent respirators, according to the facility's RPP 	
Public Health Ontario, 2021b	Ontario	May 2021	Healthcare settings	<ul style="list-style-type: none"> - Current evidence points to overall increased transmissibility to varying degrees, but shows no indication that these variants of concern are transmitted in fundamentally different modes from other variants of the virus. At this time there are no changes to current IPAC measures for variants of concern - Current measures: Contact & Droplet precautions + N95 respirator during AGMPs - Higher transmissibility suggests that for a given exposure there is a greater likelihood of infection, and hence the utmost importance for adherence to current IPAC measures. 	
Public Health Ontario, 2021c	Ontario	April 2021	Healthcare settings	<p>There is no recommended change in PPE practices related to the emergence of the B.1.1.7 VOC or other VOCs in Ontario.</p> <p>As part of universal masking, HCW and patients should wear an appropriately sized mask that covers both their nose, mouth and chin without gaps, and which remains in position without the need for repeated re-positioning.</p>	
World Health Organization, 2020	n/a	December 2020	Healthcare	- Health workers providing care to suspected or confirmed COVID-19 patients wear the following types of mask/respirator in addition to other personal protective equipment that are part of standard, droplet and contact precautions:	- Guidance not updated with respect to VOCs

Reference	Jurisdiction	Last Updated	Target Population	Guidance	Notes
				<ul style="list-style-type: none"> - medical mask in the absence of aerosol generating procedures (AGMPs) - Respirator, N95 or FFP2 or FFP3 standards, or equivalent in care settings for COVID-19 patients where AGMPs are performed; these may be used by health workers when providing care to COVID-19 patients in other settings if they are widely available and if costs is not an issue. - In areas of known or suspected sporadic SARS-CoV-2 transmission, health workers working in clinical areas where patients are present should continuously wear a medical mask. 	
World Health Organization, 2021b	n/a	21 Feb 2021	HCW	<p>Low risk:</p> <ul style="list-style-type: none"> - stay home if unwell; - observe hand and respiratory hygiene; - use fabric masks in common areas and face-to-face meetings. <p>Medium risk (workers)</p> <ul style="list-style-type: none"> - stay home if unwell; - observe hand and respiratory hygiene; - wear medical masks and other PPE according to their tasks and apply standard precautions in providing patient care. <p>High risk (workers and caregivers)</p> <ul style="list-style-type: none"> - use PPE based on transmission-based precautions (medical mask, gown, gloves, eye protection) and apply standard precautions in providing patient care; - stay home if unwell; - observe hand and respiratory hygiene. <p>Very high risk (workers)</p> <ul style="list-style-type: none"> - stay home if unwell; - observe hand and respiratory hygiene; <p>use PPE (respirator N95 or FFP2 or FFP3, gown, gloves, eye protection, apron) and apply standard precautions in providing patient care.</p>	- No comment on VOCs relating to risk levels
World Health Organization, 2021c	n/a	12 July 2021	HCW	<ul style="list-style-type: none"> - In the context of SARS-CoV-2 variants of concern, based on the available evidence and expert consensus, WHO advises that the current recommended IPC measures be reinforced and continue to be stringently implemented - Optimal compliance with appropriate use of personal protective equipment and hand hygiene by health workers is associated with decreased risk of SARS-CoV-2 transmission. 	No change to recommendations due to VOCs

Reference	Jurisdiction	Last Updated	Target Population	Guidance	Notes
				<ul style="list-style-type: none"> - All health workers, including community health workers and caregivers, should wear a medical mask at all times, for any activity (care of COVID-19 or non-COVID-19 patients) and in any common area (e.g., cafeteria, staff rooms) - Other staff, visitors, outpatients and service providers should also wear a mask (medical or non-medical) at all times when in the health facility. - A particulate respirator at least as protective as an N95 respirator should be worn instead of a medical mask in settings for COVID-19 patients where aerosol generating procedures are performed. In these settings, this includes continuous use of respirators by health workers throughout the entire shift. - All individuals should use contact and droplet precautions before entering a room where there is a patient with suspected or confirmed COVID-19. <ul style="list-style-type: none"> - In areas with community or cluster transmission of SARS-CoV-2, health workers assigned to intensive care units where AGMPs are performed should wear a particulate respirator throughout their shift 	

C. Methods

Literature Search

A literature search was conducted by Rachel Zhao from Knowledge Resources Services (KRS) within the Knowledge Management Department of Alberta Health Services. KRS searched databases for articles published from 2020-2021 and included: OVID MEDLINE, EMBASE, Australian National COVID-19 Clinical Evidence Taskforce Living Guidelines, WHO Publications, WHO COVID-19 database, CADTH, CPG Infobase, US Centers for Disease Control and Prevention, COVID-19 Primer, medRxiv & bioRxiv, National Collaborating Centre for Methods and Tools (NCCMT), NICE, Penn Medicine COVID-19 Guidance Summaries, Public Health England COVID-19 Rapid Reviews, Google and Google Scholar.

The full search strategy is available below; briefly, it was divided into two searches that were based on the following concepts:

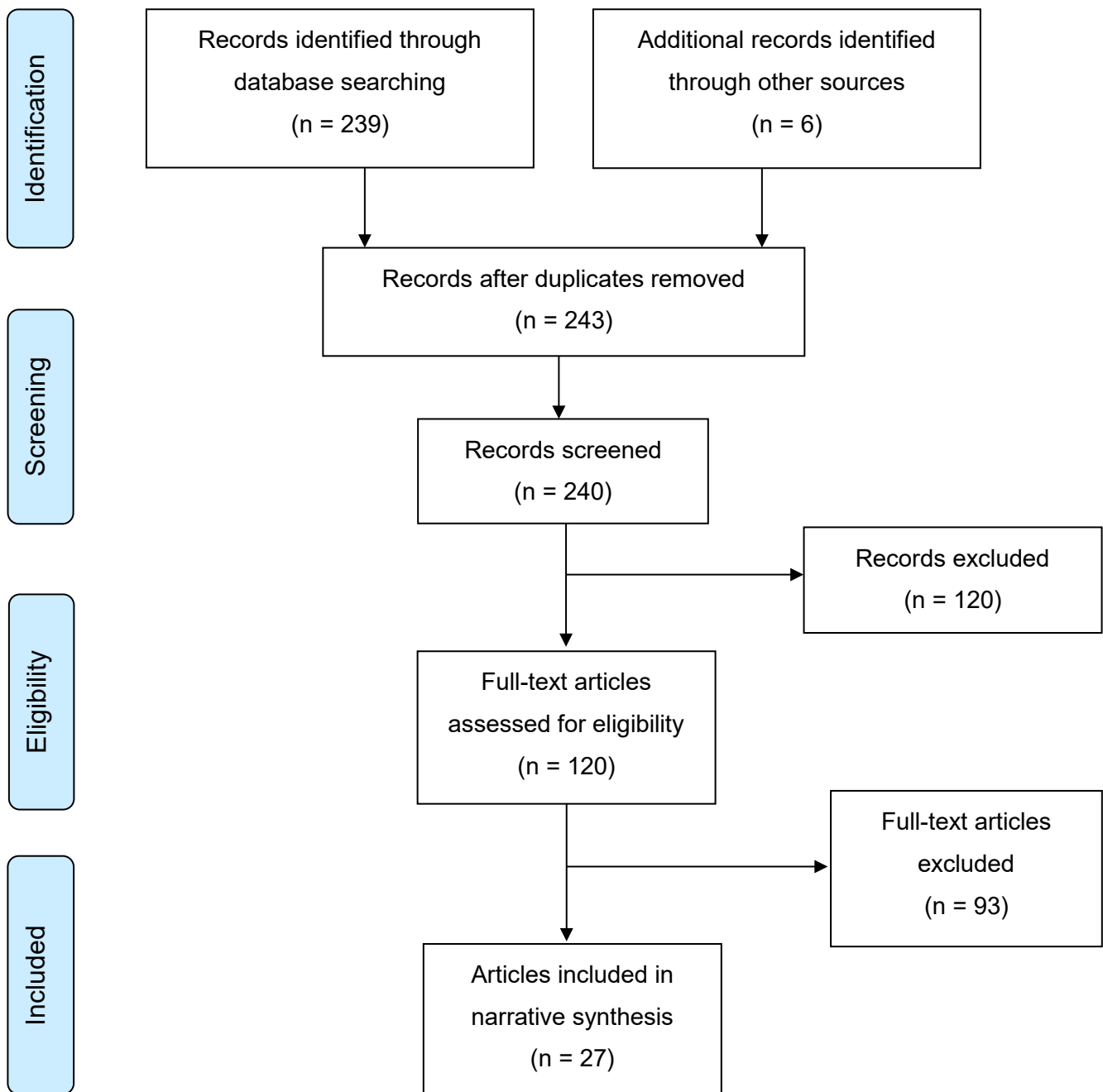
- SARS-CoV-2 / COVID-19 and variants (*note: the variant search string was only included in the searches for research questions 2 & 3*)
- Healthcare workers and acute care
- Masks / respiratory protection

Articles identified by KRS in their search were initially pre-screened by the librarian for obvious irrelevance. 239 articles were identified as potentially relevant with references and abstracts provided for further review. Six articles were identified *ad hoc* as useful and potentially includable. Articles were then screened by title and abstract, and full texts were read to determine eligibility in accordance with the inclusion and exclusion criteria in table 5 below. The number of articles excluded at each step are shown in the PRISMA diagram in Figure 1 (Moher et al., 2009). Seven additional records were identified by the primary and secondary reviewers following evidence synthesis.

Table 5. Inclusion and exclusion criteria for results of the literature search

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none">- COVID-19- Any COVID variant- Any type of healthcare worker- Article specifically describes PPE used- PPE includes masks- Describes COVID-19 infection or positivity as an outcome- Study is comparative- Meta-analysis, systematic review, RCT, observational study, case series- Published 2020-2021- English- Any jurisdiction	<ul style="list-style-type: none">- Article is not from a credible source- Article does not have a clear research question or issue- Presented data/evidence is not sufficient to address the research questions- Virus other than SARS-CoV-2- Masks in the community / general population- Description of PPE is not specific- PPE does not include masks- Article does not describe incidence of SARS-CoV-2 in healthcare workers- Article is descriptive only- Non-epidemiological outcomes- in vitro, non-human, Narrative review, commentary, editorial, case report, anecdotal report, abstract only, protocol- Published before 2020- Languages other than English

Figure 1. PRISMA Flow diagram of the identified studies. 27 articles were included in this rapid review.



Critical Evaluation of the Evidence

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

Table 6 below is a narrative summary of the body of evidence included in this review. The categories, format, and suggested information for inclusion were adapted from the Oxford Centre for Evidence-Based Medicine, the Cochrane Library, and the AGREE Trust (Urwin, Gavinder & Graziadio, 2020; Viswanathan et al, 2012; Wynants et al., 2020; Brouwers et al., 2010).

Table 6. Narrative overview of the literature included in this review.

	Description
Volume	1 umbrella review was included; 1 systematic reviews were included (0 were pre-review); 5 cross-sectional studies were included (0 were pre-review), 1 case-control study was included, 3 case series were included (0 were pre-review), 5 pieces of grey literature (rapid reviews; briefing notes; etc.) were included; 10 guidelines from reputable sources were included.”
Quality	In general, the primary evidence comparing the clinical differences between medical/surgical masks and N95 respirators is estimated to be low quality (referring to the GRADE convention). The data are observation and often gathered by survey, increasing the risk of bias. No randomized trials were identified that investigate COVID-19 incidence from different types of masks. The observational studies were case-control and cross-sectional designs based on survey responses, which are at high risk of recall and selection bias. In many cases, there is an insufficient exploration of possible confounders like donning/doffing procedures, infectiousness of the exposure cases, and possible community transmission. The primary evidence is also plagued by small sample sizes and limited detail on exposures and PPE. The primary evidence for added respiratory protections against the COVID-19 VOCs was very weak. Only two small case series were identified; both had very limited detail on exposures and PPE considerations. Only grey literature evidence syntheses were identified that applied to this research question, all stating that there is no evidence.
Applicability	The primary observational evidence is generally applicable to Alberta – evidence arises from the United States, Germany, the UK, Italy, Netherlands, and international surveys. There is no reason to believe that the evidence would not be applicable to Alberta. The guidelines identified for research question 3 offer a useful glimpse into the policies from other jurisdictions; however, the changes made to the PPE guidance often brought the jurisdictions into alignment with Alberta policy to allow HCWs to select appropriate PPE based on their point-of-care risk assessment.
Consistency	The body of evidence on the differences between medical/surgical masks is mixed and is insufficient to make strong recommendations. Likewise, the current evidence on COVID-19 VOCs is extremely limited, and there appears to be no virological

reason that the variant virus would behave differently on surfaces or in air than the wild-type strain. This will need to be updated as the VOC transmission evidence base evolves.

D. Search Strategy

Search was conducted in OVID MEDLINE, EMBASE, Australian National COVID-19 Clinical Evidence Taskforce Living Guidelines, WHO Publications, WHO COVID-19 database, CADTH, CPG Infobase, US Centers for Disease Control and Prevention, COVID-19 Primer, medRxiv & bioRxiv, National Collaborating Centre for Methods and Tools (NCCMT), NICE, Penn Medicine COVID-19 Guidance Summaries, Public Health England COVID-19 Rapid Reviews, Google and Google Scholar.

The librarian performed the preliminary screening.

- 217 results were kept for Question 1:
 - From MEDLINE: 1508 results were retrieved and 203 were kept
 - From EMBASE: 273 results were retrieved and 15 were kept
 - Additional 43 results were identified from other resources
- 22 results were kept for Question 2&3:
 - From MEDLINE: 23 results were retrieved and 2 were kept
 - From EMBASE: 3 were retrieved and none were kept
 - Additional 20 results were identified from other sources

174 results after deduplication

Ovid MEDLINE(R) ALL 1946 to June 28, 2021

#	Searches	Results
1	exp Coronavirus/ or Coronavirus Infections/ or COVID-19/ or (covid or coronaviru* or corona viru* or ncov* or n-cov* or novel cov* or COVID-19 or COVID19 or COVID-2019 or COVID2019 or SARS-CoV-2 or SARSCoV-2 or SARSCoV2 or SARSCoV19 or SARS-Cov-19 or SARSCov-19 or SARSCoV2019 or SARS-Cov-2019 or SARSCov-2019 or severe acute respiratory syndrome coronaviru* or severe acute respiratory syndrome cov 2 or 2019 ncov or 2019ncov).kf,tw.	167378
2	exp academic medical centers/ or exp ambulatory care facilities/ or exp hospitals/ or Inpatients/ or exp residential facilities/	445384
3	exp Hospital Units/	119587
4	Emergency Service, Hospital/	75096
5	(hospital or hospitals or long term care or nursing home* or acute care or hospital unit* or inpatient* or clinical observation unit* or delivery room* or h?emodialysis unit* or intensive care unit* or burn units* or coronary care unit* or intensive care unit* or recovery room* or respiratory care unit* or nursing station* or operating room* or self-care unit* or ER or ED or emergency department*).kf,tw.	1621997
6	exp Health Personnel/ or (health practitioner* or health professional* or healthcare worker* or health care worker* or health-care worker* or healthcare personnel or health care worker* or health-care personnel or healthcare practitioner* or health care practitioner* or health-care practitioner* or healthcare professional* or health care professional* or health-care professional* or health worker* or health personnel or emergency medical technician* or health aide* or psychiatric aide* or operating room technician* or pharmacist* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or endodontist* or doula* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or physical therapist* or physician* or doctor or doctors or an?esthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).kf,tw.	1869044

7	or/2-6	3327522
8	masks/ or n95 respirators/ or respiratory protective devices/	7710
9	(mask or masks or respiratory protective device* or KN95 or FFP2 or FFP3 or N95 or P2 or "enhanced respiratory and contact precautions" or E-RCP or respiratory protection* or filtering face piece* or filtering facepiece* or goggle* or visor or safety glass* or safety spectacles*).kf,tw.	78895
10	8 or 9	81571
11	1 and 7 and 10	1616
12	limit 11 to (english language and yr="2020 -Current")	1508
13	Protective Devices/ or Ear Protective Devices/ or Eye Protective Devices/ or exp Gloves, Protective/ or Masks/ or Personal Protective Equipment/ or Protective Clothing/ or Respiratory Protective Devices/	29754
14	(gown* or coverall* or protective layer* or surgical toga or apron* or smock or smocks or hazmat suit* or glove* or mask or masks or respiratory protective device* or KN95 or FFP2 or FFP3 or N95 or P2 or "enhanced respiratory and contact precautions" or E-RCP or respiratory protection* or transparent panel* or filtering face piece* or filtering facepiece* or goggle* or visor or safety glass* or safety spectacles* or PPE or protect* equipment* or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or hood*).kf,tw.	107724
15	13 or 14	124873
16	((Alpha or "B.1.1.7" or Beta or "B.1.351" or Gamma or "P.1" or Delta or "B.1.617.2" or Epsilon or "B.1.427/B.1.429" or Zeta or "P.2" or Eta or "B.1.525" or Theta or "P.3" or Iota or "B.1.526" or Kappa or "B.1.617.1" or Lambda or "C.37") and variant*).kf,tw.	112588
17	1 and 15 and 16	23
18	limit 17 to (english language and yr="2020 -Current")	20

Search date: June 29, 2021.

- 1508 results were retrieved for Question 1. 203 were kept after librarian's screening.
- 23 results were retrieved for Question 2 and 3. 2 were kept after librarians' screening.

Embase 1996 to 2021 Week 25

#	Searches	Results
1	COVID-19/ or SARS-CoV-2/ or coronavirinae/ or betacoronavirus/ or Coronavirus infection/ or (covid or coronavirus* or corona viru* or coronavirinae* or covid2019 or covid19 or covid-19 or nCoV* or n-CoV* or novel CoV* or 2019-nCoV* or 2019nCoV or 19nCov or hCoV* or h-Cov* or 2019-hCoV* or 2019hCoV* or 19 hCoV* or SARS-CoV-2 or SARSCoV2 or SARSCov-2 or SARS-CoV-19 or SARSCoV19 or SARSCoV-19 or SARS-Cov-2019 or SARSCoV2019 or SARSCoV-2019 or "severe acute respiratory syndrome CoV 2" or "severe acute respiratory syndrome coronavirus 2").kw,tw.	159492
2	exp *health care facility/	319079
3	exp *hospital patient/	31410
4	exp *emergency health service/	38727
5	(hospital or hospitals or long term care or nursing home* or acute care or hospital unit* or inpatient* or clinical observation unit* or delivery room* or h?emodialysis unit* or intensive care unit* or burn units* or coronary care unit* or intensive care unit* or recovery room* or respiratory care unit* or nursing station* or operating room* or self-care unit* or ER or ED or emergency department*).tw.	2145999
6	exp *health care personnel/ or (health practitioner* or health professional* or healthcare worker* or health care worker* or health-care worker* or healthcare personnel or health care personnel or health-care personnel or healthcare practitioner* or health care practitioner* or health-care practitioner* or healthcare professional* or health care professional* or health-care professional* or health worker* or health personnel or emergency medical technician* or health aide* or psychiatric aide* or operating room technician* or pharmacist* or physical therapist* or anatomist* or an?esthetist* or audiologist* or case manager* or endodontist* or doula* or health facility administrator* or hospital administrator* or hospital chief executive officer* infection control practitioner* or medical chaperone* or medical staff or hospitalist* or nursing or nurse or nurses or nutritionist* or occupational therapist* or physical therapist* or physician* or doctor or doctors or an?esthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or	2060835

	geriatrician* or nephrologist* or neurologist* or oncologist* or otolaryngologist* or pathologist* or neonatologist* or physiatrist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or neurosurgeon* or ophthalm* or urologist*).tw.	
7	or/2-6	3834737
8	exp *mask/	8650
9	(mask or masks or respiratory protective device* or KN95 or FFP2 or FFP3 or N95 or P2 or "enhanced respiratory and contact precautions" or E-RCP or respiratory protection* or filtering face piece* or filtering facepiece* or goggle* or visor or safety glass* or safety spectacles*).tw.	81770
10	8 or 9	83497
11	1 and 7 and 10	1569
12	limit 11 to (english language and yr="2020 -Current")	1476
13	limit 12 to exclude medline journals	273
14	protective equipment/ or ear protective device/ or eye protective device/ or exp respiratory protection/ or protection/ or protective clothing/ or coveralls/ or exp protective glove/ or shoe cover/	85281
15	(gown* or coverall* or protective layer* or surgical toga or apron* or smock or smocks or hazmat suit* or glove* or mask or masks or respiratory protective device* or KN95 or FFP2 or FFP3 or N95 or P2 or "enhanced respiratory and contact precautions" or E-RCP or respiratory protection* or transparent panel* or filtering face piece* or filtering facepiece* or goggle* or visor or safety glass* or safety spectacles* or PPE or protect* equipment* or overshoe* or shoe cover* or rubber boot* or head cover* or face shield* or hood*).tw.	112386
16	14 or 15	184875
17	((Alpha or "B.1.1.7" or Beta or "B.1.351" or Gamma or "P.1" or Delta or "B.1.617.2" or Epsilon or "B.1.427/B.1.429" or Zeta or "P.2" or Eta or "B.1.525" or Theta or "P.3" or Iota or "B.1.526" or Kappa or "B.1.617.1" or Lambda or "C.37") and variant*).tw.	50502
18	1 and 16 and 17	16
19	limit 18 to (english language and yr="2020 -Current")	14
20	limit 19 to exclude medline journals	3

Search date: June 29, 2021.

- 273 results were retrieved for Question 1. 15 were kept after librarian's screening.
- 3 results were retrieved for Question 2 and 3. None was kept after librarians' screening.

medRxiv & bioRxiv

Question 1:

- Search string: COVID-19 masks N95 health care workers. The first 50 were screened. 7 were kept.

Question 2&3:

- Search string 1: COVID-19 variants of concern ppe health care workers. The first 50 results were screened. 1 kept.
- Search string 2: COVID-19 variants of concern masks health care workers. The first 50 results were screened. Zero kept.

WHO COVID-19 Database

Question 1:

- Search string: mask* N95 health care workers. 129 results were retrieved and screened. 26 kept.

Question 2&3:

- Search string: variant* ppe. 13 results were retrieved. 5 kept.

Google / Google Scholar:

Question 1:

- Search string: COVID-19 masks N95 health care workers
- Google: the first 50 results were screened. 3 were kept.
- Google Scholar: the first 50 results were screened. 12 were kept.

Question 2&3:

- Search string: COVID-19 variants PPE health care workers
- Google: the first 50 results were screened. 9 were kept.
- Google Scholar: the first 50 results were screened. 2 were kept.

E. Compiled stakeholder feedback

Emergency

<p>Are there additional contextual issues relevant to your stakeholder group that you feel are missed and merit attention in this evidence review?</p>	<p>I think that there are two areas that may provide additional support to the recommendations. Emergency care providers while annoyed by PPE may feel safer with continued ongoing use and a change to N95 may actually be more difficult and increase annoyance. Secondly is the "we are now used to it" factor. With several months of PPE use under our belts and the appreciation that COVID measures have dampened non-COVID respiratory illness there may be more willingness to continue PPE than is noted in the SAG report.</p>
<p>Do you expect any issues related to implementation of the recommendations / practical considerations relevant in your stakeholder group?</p>	<p>One of our physicians is very vocal and visible about the aerosolized nature of COVID-19 and the lack of AHS transparency about this but is an outlier in these views and may actually be inadvertently creating support for the status quo and these recommendations.</p>
<p>Do you agree with recommendations and practical considerations? (Note that these are formulated based on a focused evidence review and synthesis, so we appreciate if you can highlight the evidence or interpretation of evidence that supports your comments.)</p>	<p>I agree with the recommendations and practical considerations. I am however somewhat less certain about the value of efforts directed towards PPE optimization. Is that evidence-based or just a cautious approach.</p>
<p>Please enter any additional comments on the review</p>	<p>The report seems biased towards maintaining the status quo and underlying the potential risks of aerosolized COVID. I think more could be included to address balance and provide transparency around why N95 has been raised as an improved protective strategy.</p>

<p>Are there additional contextual issues relevant to your stakeholder group that you feel are missed and merit attention in this evidence review?</p>	<p>A challenge that adds to this complex discussion is the apparent contradiction between there being significant evidence of COVID being transmitted through airborne means (along with other transmission modes):</p> <ul style="list-style-type: none"> - Ten scientific reasons in support of airborne transmission of SARS-CoV-2 - The Lancet https://www.thelancet.com/article/S0140-6736(21)00869-2/fulltext - Covid-19 has redefined airborne transmission The BMJ https://www.bmj.com/content/373/bmj.n913
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	<p>and the very strict IP&C standards has for other airborne agents: AHS precautions for agents with airborne transmission - https://www.albertahealthservices.ca/assets/healthinfo/ipc/hi-ipc-airborne-precautions-info.pdf On Page 28 "Modes of transmission of COVID-19 in healthcare settings:" - despite full review of modes of transmission being out of scope, perhaps the review should more explicitly acknowledge and reference evolving recognition that airborne transmission can be a risk with COVID</p>
<p>Do you expect any issues related to implementation of the recommendations / practical considerations relevant in your stakeholder group?</p>	<p>The very polar positions re airborne transmission of COVID complicates this SAG review. The SAG document might acknowledge the conflicting messages facing healthcare workers re N95 mask use in the COVID pandemic: This US CDC document comparing surgical masks to N95 respirators states that a surgical mask "Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection". https://www.cdc.gov/niosh/npptl/pdfs/UnderstandDifferenceInfographic-508.pdf</p>
<p>Do you agree with recommendations and practical considerations? (Note that these are formulated based on a focused evidence review and synthesis, so we appreciate if you can highlight the evidence or interpretation of evidence that supports your comments.)</p>	<p>Overall I'm supportive of the recommendations. Re the rationale for Recommendation 1 - "The evidence is insufficient to show that N95 respirators are superior to medical/surgical masks, or that Albertan HCWs have elevated risk of occupational acquisition of COVID-19, or that VOC transmission in current health care contexts is substantially different from the wild-type SARS-CoV-2." Lack of evidence is not the same does not constitute evidence that N95 respirators are not superior to surgical masks.... Perhaps the recommendation can build on why, with the lack of evidence, the recommendation is falling on the side against use of N95 mask rather than in favor of use of N95 masks (ie highlight downsides / risks). Recommendation 2 does allow staff to increase PPE level if their risk assessment suggests that is the best course to take. I'm not disagreeing with these recommendations however - I think the recommendations might be strengthened with more explicit discussion of these factors.</p>
<p>Please enter any additional comments on the review</p>	<p>Should the review consider these papers: 2013 paper - A randomized clinical trial of three options for N95 respirators and medical masks in health workers - PubMed https://pubmed.ncbi.nlm.nih.gov/23413265/ SARS-CoV-2 Infection Among Health Care Workers Despite the Use of Surgical Masks and Physical Distancing—the Role of Airborne Transmission Open Forum Infectious Diseases Oxford Academic https://academic.oup.com/ofid/article/8/3/ofab036/6121257 Risk factors and protective measures for healthcare worker infection during highly infectious viral respiratory epidemics: a systematic review and meta-analysis - PubMed https://pubmed.ncbi.nlm.nih.gov/33487203/ Face masks effectively limit the probability of SARS-CoV-2 transmission Science https://science.sciencemag.org/content/372/6549/1439 Sources of healthcare workers' COVID-19 infections and related safety guidelines - PubMed https://pubmed.ncbi.nlm.nih.gov/33847307/ Covid-19: Wider use of FFP3 masks may be needed because of airborne transmission, say scientific advisers The BMJ (letter with</p>

	<p>referenced articles) https://www.bmj.com/content/373/bmj.n1089 Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff - Verbeek, JH - 2020 - Cochrane Library https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD011621.pub4/full This collection of resources may have additional literature useful for the review - Resources on transmission & prevention of COVID-19 - Google Sheets https://docs.google.com/spreadsheets/d/1-l78z-rSodmSfsfChv7d_tubb6d1Zxst-d7YI4HZp4g/edit#gid=0 Should the document address Quebec directives re N95 mask use?: Questions and answers – COVID-19 Commission des normes de l'équité de la santé et de la sécurité du travail - CNESST (see Q36&37) https://www.cnesst.gouv.qc.ca/en/prevention-and-safety/covid-19/questions-and-answers-covid-19 Should Table 4 include IDSA guidelines?: IDSA Guidelines on Infection Prevention in Patients with Suspected or Known COVID-19 https://www.idsociety.org/practice-guideline/covid-19-guideline-infection-prevention/ How did the review address comparisons of N95 & surgical masks in other respiratory viral infections? If these studies are excluded, that should be explicitly stated. Examples: • Y. Long et al Effectiveness of N95 respirators versus surgical masks against influenza: A systematic review and meta-analysis. J. Evid. Base Med. 13, 93–101 (2020).Google Scholar • L. J. Radonovich et al N95 respirators vs medical masks for preventing influenza among health care personnel: A randomized clinical trial. J. Am. Med. Assoc. 322, 824–833 (2019).</p>
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<p>Are there additional contextual issues relevant to your stakeholder group that you feel are missed and merit attention in this evidence review?</p>	<p>No</p>
<p>Do you expect any issues related to implementation of the recommendations / practical considerations relevant in your stakeholder group?</p>	<p>Not regarding the recommendations per se. I think people will be happy that such a thorough review of evidence for prevention of transmission has been undertaken. I am.</p> <p>That said, there remains grumbling discontent among my ED physician colleagues that failure to recognize airborne as a contributory if not primary mode of transmission is intellectually dishonest and could lead to inappropriate bedside risk assessments and IP&C practices.</p> <p>The notion of AGMPs is very problematic given that it simultaneously acknowledges aerosol transmission and the need for N95 but limits this risk to the procedure itself. A stark example: a 60 second</p>

	<p>intubation on a non-coughing, paralyzed patient in a neg pressure room = N95, but doing a 5 minute slit-lamp examination in our tiny eye room on a coughing patient with conjunctivitis = surgical mask.</p> <p>A solution to the above is to simply acknowledge airborne clearly and openly, and then update the point of care risk assessment to include proximity, duration, ventilation, coughing, nature of illness, etc. in addition to the current droplet/fomite-based recommendations.</p> <p>***The impression on the ground is that airborne is not being acknowledged because AHS would have to admit we were wrong in not declaring it airborne in the first place. I feel this issue alone requires a clear and separate response. ***</p>
<p>Do you agree with recommendations and practical considerations? (Note that these are formulated based on a focused evidence review and synthesis, so we appreciate if you can highlight the evidence or interpretation of evidence that supports your comments.)</p>	<p>I support the use of continuous masking with surgical masks as evidence based.</p> <p>I support not making N95 routine practice based only on the peer reviewed evidence cited.</p> <p>I highly question the conclusions on risk to HCW based on testing % and outbreak tracking within AHS. Please refer to Otto 2020, Barrett 2020, Nguyen 2020, Pouwels 2020, Pollán 2020, Iversen 2020; Quigley 2020 for contradictory evidence of HCW risk. I would prefer to see this removed from the summary.</p> <p>I highly question the assertion that compliance with contact and droplet PPE protocols is alone sufficient to prevent future outbreaks. For example, how do we know that not properly hand-sanitizing while doffing resulted in infection but the 4-5 breaths without a mask or with a poorly fitted surgical mask did not. I would prefer to see these recommendations muted (but not removed) in the summary section.</p> <p>Of course proper doffing is important, but we are exposed (literally and figuratively) if we fail to acknowledge even seemingly innocuous airborne exposures as a plausible/likely risk.</p>
<p>Please enter any additional comments on the review</p>	<p>Thanks to all those to carried out this review. I had actually asked for just this a while back through my [redacted]. I know it is a lot of work and the evidence is often confounded. I am happy to discuss at anytime with the SAG or its members.</p>

Anesthesiology

<p>Are there additional contextual issues relevant to your stakeholder group that you feel are missed and merit attention in this evidence review?</p>	<p>As identified on Page 16, the identified themes mostly relate to ward processes; OR and AGMP settings were not a focus in the outbreak reports available. As always, our group (and the rest of the perioperative HCWs) would likely be interested in outbreak-specific data in relation to the OR given the nature of the interaction (that is, AGMPs with nearly every patient contact). It is unclear from the wording whether the focus did not include the OR/AGMP settings because the numbers did not show significant elevation in risk</p>
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	despite AGMP with primarily surgical masks (or N95 if suspected/confirmed COVID), or if there was another issue (not recorded, difficult to audit or obtain data, etc).
Do you expect any issues related to implementation of the recommendations / practical considerations relevant in your stakeholder group?	No. The recommendations have remained unchanged, which also includes the individual's choice to elevate PPE requirement based on PCRA / personal risk assessment. Practical considerations are interesting though, as on top of the expected practical considerations of continuous masking and no change / not requiring N95, we have witnessed similar "COVID Fatigue" and "PPE Slips" throughout the perioperative environment as well. Many of these likely relate to presumed efficacy of the vaccination of much of the staff, but if numbers on the ward that were traced back to occupational exposure show the primary concern related to PPE insufficiency or suboptimal donning / doffing (especially the latter), we likely still have ongoing concern despite vaccination status.
Do you agree with recommendations and practical considerations? (Note that these are formulated based on a focused evidence review and synthesis, so we appreciate if you can highlight the evidence or interpretation of evidence that supports your comments.)	Yes. This is much of the same data that has been reviewed with the Surgical Services IP+C working group, and ongoing recommendations have been identical. Although already stated within the document and even in the Key Messages in the second bullet point on Question 1 (page 7), perhaps highlighting the answer to the question / reinforcing further in the last sentence - such as "This indicates strategies to improve adherence to existing PPE guidance is a key theme." into something along the lines of "This indicates improving adherence to already existing PPE guidance is a key theme, rather than elevating PPE requirements such as N95 use."
Please enter any additional comments on the review	Having reviewed much of the literature for previous Surgical Services IPC recommendations, I am very happy to see the thoroughness of the evidence review (despite being "rapid") and confirmation that what we are doing is working and effective. It is also great to see upcoming studies and personal communications linked in, as it is another source that I, myself, don't have access to as readily.

- Medicine**
- No replies
- Surgery**
- No replies
- Nursing**
- No replies
- Allied Health**
- No replies

F. References

Adawee, M. O., Brum, R. E., & Ellsworth, L. J. (2021). Examining Common Characteristics Among Healthcare Personnel Positive for COVID-19 and the Effectiveness of Healthcare Personnel Mask Use in Preventing COVID-19 in a Large Health System in Central Michigan. *Journal of Occupational and Environmental Medicine*, 63(3), 226. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7934333/>

Alberta Health Services. (2020). What criteria should AHS use to inform changes to COVID-19 Personal Protective Equipment (PPE) guidelines in acute and long-term care? 15 December 2020. Retrieved from: <https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-criteria-ppe-guidelines-rapid-review.pdf>. Accessed 13 July 2021.

Alberta Health Services. (2021a). Interim IPC Recommendations during COVID-19. Updated 17 June 2021. Retrieved from: <https://www.albertahealthservices.ca/assets/healthinfo/ipc/hi-ipc-emerging-issues-ncov.pdf>. Accessed 13 July 2021.

Alberta Health Services. (2021b). Joint Statement: COVID-19 and Personal Protective Equipment. 25 February 2021. Retrieved from: <https://www.albertahealthservices.ca/assets/news/nr/ne-nr-2020-03-27-joint-statement-covid-ppe.pdf>. Accessed 13 July 2021.

Akinbami, L. J., Vuong, N., Petersen, L. R., Sami, S., Patel, A., Lukacs, S. L., Mackey, L., Grohskopf, L. A., Shehu, A., & Atas, J. (2020). SARS-CoV-2 seroprevalence among healthcare, first response, and public safety personnel, detroit metropolitan area, michigan, USA, may-june 2020. *Emerging Infectious Diseases*, 26(12), 2863-2871. <https://doi.org/10.3201/eid2612.203764>

Atnafie, S. A., Anteneh, D. A., Yimenu, D. K., & Kifle, Z. D. (2021). Assessment of exposure risks to COVID-19 among frontline health care workers in amhara region, ethiopia: A cross-sectional survey. *PloS One*, 16(4), e0251000-e0251000. <https://doi.org/10.1371/journal.pone.0251000>

Australian National COVID-19 Clinical Evidence Taskforce. (2021). Australian guidelines for SARS-CoV-2 infection prevention and control of COVID-19 in healthcare workers. Updated June 2021. Retrieved from: https://files.magicapp.org/guideline/b49fdd52-b141-49b5-83cc-664110b07210/published_guideline_4826-1_0.pdf Accessed 12 July 2021

Barycka, K., Szarpak, L., Filipiak, K. J., Jaguszewski, M., Smereka, J., Ladny, J. R., & Turan, O. (2020). Comparative effectiveness of N95 respirators and surgical/face masks in preventing airborne infections in the era of SARS-CoV2 pandemic: A meta-analysis of randomized trials. *PloS One*, 15(12), e0242901. <https://doi.org/10.1371/journal.pone.0242901>

British Columbia Centre for Disease Control. (2021a). Personal Protective Equipment. Updated 21 June 2021. Retrieved from: <http://www.bccdc.ca/health->

[professionals/clinical-resources/covid-19-care/infection-control/personal-protective-equipment](#). Accessed 12 July 2021.

British Columbia Centre for Disease Control. (2021b). Infection Prevention and Control Guidance on SARS-CoV-2 Variants of Concern. Updated 21 April 2021. Retrieved from: http://www.bccdc.ca/Health-Professionals-Site/Documents/IPC_Guidance_SARS-CoV-2_VoC.pdf. Accessed 12 July 2021.

British Columbia Centre for Disease Control. (2021c). COVID-19 Infection Prevention and Control: Guidance for Home and Community Health-Care. Updated 2 June 2021. Retrieved from: http://www.bccdc.ca/Health-Professionals-Site/Documents/COVID19_HomeCommunityCareIPCGuidance.pdf. Accessed 12 July 2021.

Brouwers, M. C., Kho, M. E., Browman, G. P., Burgers, J. S., Cluzeau, F., Feder, G., Fervers, B., Graham, I. D., Grimshaw, J., Hanna, S. E., Littlejohns, P., Makarski, J., Zitzelsberger, L., & AGREE Next Steps Consortium (2010). AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 182(18), E839–E842. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3001530/>

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. *Mental health*, 7, 2-7. Retrieved from: https://www.mja.com.au/system/files/issues/214_03/mja250850.pdf. Accessed 11 August 2021

Burns, E. S., Pathmarajah, P., & Muralidharan, V. (2021). Physical and psychological impacts of handwashing and personal protective equipment usage in the COVID-19 pandemic: A UK based cross-sectional analysis of healthcare workers. *Dermatologic Therapy*, 34(3), e14885-n/a. <https://doi.org/10.1111/dth.14885>

Chan, V. W., Ng, H. H., Rahman, L., Tang, A., Tang, K. P., Mok, A., Liu, J. P. H., Ho, K. S. C., Chan, S. M., Wong, S., Teoh, A. Y., Chan, A., Wong, M., Yuan, Y., & Teoh, J. Y. (2021). Transmission of severe acute respiratory syndrome coronavirus 1 and severe acute respiratory syndrome coronavirus 2 during aerosol-generating procedures in critical care: A systematic review and meta-analysis of observational studies. *Critical Care Medicine*, Publish Ahead of Print(7), 1159-1168. <https://doi.org/10.1097/CCM.0000000000004965>

Chung, H., Kim, E. O., Kim, S. H., & Jung, J. (2020). Risk of COVID-19 Transmission from Infected Outpatients to Healthcare Workers in an Outpatient Clinic. *Journal of Korean medical science*, 35(50), e431. <https://doi.org/10.3346/jkms.2020.35.e431>

Curran, J. A., Dol, J., Boulos, L., Somerville, M., Reynolds, B., Gallant, A., ... & McCulloch, H. (2021). Public Health and Health Systems Impacts of SARS-CoV-2 Variants of Concern: A Rapid Scoping Review. COVID-END; Ottawa, ON. Retrieved from: https://sporevidencealliance.ca/wp-content/uploads/2021/06/Public-Health-and-Health-Systems-Impacts-of-COVID-19-VOC_2021.06.04.pdf

European Centre for Disease Prevention and Control. (2021). Infection prevention and control and preparedness for COVID-19 in healthcare settings. Updated 9 Feb 2021. Retrieved from: https://www.ecdc.europa.eu/sites/default/files/documents/Infection-prevention-and-control-in-healthcare-settings-COVID-19_6th_update_9_Feb_2021.pdf. Accessed 12 July 2021

Evidence Synthesis Network. (2021). Briefing note: Best Practices for Limiting the Transmission of COVID-19 Variants of Concern. Updated 24 Feb 2021. Retrieved from: <https://esnetwork.ca/briefings/best-practices-for-limiting-the-transmission-of-covid-19-variants-of-concern/>. Accessed 12 July 2021.

Federal Ministry for Social Affairs, Health, Care and Consumer Protection (BMSGPK). (2021). Anschober: Ab Mitternacht sind FFP2-Masken und 2-Meter-Mindestabstand als präzise Antwort auf die Ausbreitung der Mutationen verpflichtend. Retrieved from: https://www.ots.at/presseaussendung/OTS_20210124_OTS0029/anschober-ab-mitternacht-sind-ffp2-masken-und-2-meter-mindestabstand-als-praezise-antwort-auf-die-ausbreitung-der-mutationen-verpflichtend. Accessed 11 August 2021.

Ferris, M., Ferris, R., Workman, C., O'Connor, E., Enoch, D. A., Goldesgeyme, E., ... & Weekes, M. P. (Preprint). FFP3 respirators protect healthcare workers against infection with SARS-CoV-2. Authorea Preprints. Retrieved from: <https://www.authorea.com/users/421653/articles/527590-ffp3-respirators-protect-healthcare-workers-against-infection-with-sars-cov-2>. Accessed 11 August 2021.

Gras-Valentí, P., Mora-Muriel, J. G., Chico-Sánchez, P., Algado-Sellés, N., Soler-Molina, V. M., Hernández-Maldonado, M., Lameiras-Azevedo, A. S., Jiménez Sepúlveda, N. J., Gómez Sotero, I. L., Villanueva-Ruiz, C. O., Barrenengoa-Sañudo, J., Fuster-Pérez, M., Cánovas-Jávega, S., Cerezo-Milan, P., Moneris-Palmer, M., Llorens-Soriano, P., Merino-Lucas, E., Rodríguez-Díaz, J. C., Gil-Carbonell, J., . . . Sánchez-Payá, J. (2021). Effectivity of a program for the control and prevention of COVID-19 healthcare-associated infections in a spanish academic hospital. *Journal of Patient Safety*, 17(4), 323-330. <https://doi.org/10.1097/PTS.0000000000000852>

Gelardi, M., Fiore, V., Giancaspro, R., La Gatta, E., Fortunato, F., Resta, O., Carpagnano, G. E., Santomasi, C., Dimitri, M., Foschino Barbaro, M. P., Lacedonia, D., Scioscia, G., Antonio, L., & Cassano, M. (2020). Surgical mask and N95 in healthcare workers of Covid-19 departments: clinical and social aspects. *Acta bio-medica : Atenei Parmensis*, 91(4), e2020171. <https://doi.org/10.23750/abm.v91i4.10660>

Griswold, D. P., Gempeler, A., Koliass, A., Hutchinson, P. J., & Rubiano, A. M. (2021). Personal protective equipment for reducing the risk of COVID-19 infection among health care workers involved in emergency trauma surgery during the pandemic: An umbrella review. *The Journal of Trauma and Acute Care Surgery*, 90(4), e72-e80. <https://doi.org/10.1097/TA.0000000000003073>

Guschel, S., Chmiel, K., & Rosenstein, J. (2020). Use of thin dressings under N95 respirators: Exploring their effect on quantitative fit testing results to guide hospital practice during the COVID-19 pandemic. *Wound Management & Prevention*, 66(11), 13.

Haller, S., Guesewell, S., Egger, T., Scanferla, G., Thoma, R., Leal-Neto, O. B., ... & Kohler, P. (Preprint). Use of respirator vs. surgical masks in healthcare personnel and its impact on SARS-CoV-2 acquisition: a prospective multicentre cohort study. *medRxiv*. Retrieved from: <https://www.medrxiv.org/content/10.1101/2021.05.30.21258080v1.full-text>

Hayirli, T. C., Stark, N., Bhanja, A., Hardy, J., Peabody, C. R., & Kerrissey, M. J. (2021). Masked and distanced: A qualitative study of how personal protective equipment and distancing affect teamwork in emergency care. *International Journal for Quality in Health Care*, 33(2). Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8083305/>

Hong, Quan Nha et al. (2018). The Mixed Methods Appraisal Tool (MMAT) Version 2018 for Information Professionals and Researchers'. 1 Jan. 2018 : 285 – 291. Retrieved from: http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/attach/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

Iacobucci, G. (2021). Covid-19: Doctors' leaders call for revised PPE guidance to reflect new variants. *BMJ (Online)*, 372, n146-n146. <https://doi.org/10.1136/bmj.n146>

IRSST. (2021). Respiratory Protection for Healthcare Workers in the Context of SARS-CoV-2 Transmission Through Inhalation. Retrieved from: <https://www.irsst.qc.ca/covid-19/avis-irsst/id/2795/respiratory-protection-for-healthcare-workers-in-the-context-of-sars-cov-2-transmission-through-inhalation>. Accessed 11 August 2021.

Jefferson, T., Mar, C. B. D., Dooley, L., Ferroni, E., Al-Ansary, L. A., Bawazeer, G. A., Driel, M. L., Jones, M. A., Thorning, S., Beller, E. M., Clark, J., Hoffmann, T. C., Glasziou, P. P., & Conly, J. M. (2020). Physical interventions to interrupt or reduce the spread of respiratory viruses. *Cochrane Database of Systematic Reviews*, 11. <https://doi.org/10.1002/14651858.CD006207.pub5>

Khalid, A., Romutis, S., Ibinson, J., Thomas, C., Myint, A., Dueker, J., Johnston, E., Kreiss, C., Kingsley, M., Skef, W., Vippera, K., McGrath, K., Phillips, A. E., Das, R., Fasanella, K., & Ibinson, J. (2021). Acute physiologic effects of N95 respirator use on gastroenterologists performing simulated colonoscopy. *Gastrointestinal Endoscopy*, 94(1), 160-168.e3. <https://doi.org/10.1016/j.gie.2021.01.017>

Kim, H., Hegde, S., LaFiura, C., Raghavan, M., Sun, N., Cheng, S., Rebholz, C. M., & Seidelmann, S. B. (2021). Access to personal protective equipment in exposed healthcare workers and COVID-19 illness, severity, symptoms and duration: A population-based case-control study in six countries. *BMJ Global Health*, 6(1), e004611. <https://doi.org/10.1136/bmjgh-2020-004611>

Kim, M., Bae, S., Kim, J. Y., Park, S. Y., Lim, J. S., Sung, M., & Kim, S. (2020). Effectiveness of surgical, KF94, and N95 respirator masks in blocking SARS-CoV-2: A controlled comparison in 7 patients. *Infectious Diseases (London, England)*, 52(12), 908. Retrieved from: <https://www.tandfonline.com/doi/full/10.1080/23744235.2020.1810858>

Kindgen-Milles, D., Brandenburger, T., Braun, J. F. W., Cleff, C., Moussazadeh, K., Mrosewski, I., Timm, J., & Wetzchewald, D. (2021). Prevalence of SARS-CoV-2 positivity in 516 German intensive care and emergency physicians studied by seroprevalence of antibodies national covid survey Germany (NAT-COV-SURV). *PLoS One*, 16(4), e0248813-e0248813. <https://doi.org/10.1371/journal.pone.0248813>

Lan, F., Christophi, C. A., Buley, J., Iliaki, E., Bruno-Murtha, L. A., Sayah, A. J., & Kales, S. N. (Preprint). Effects of universal masking on massachusetts healthcare workers' COVID-19 incidence. *Occupational Medicine (Oxford)*, 70(8), 606. Retrieved from: <https://www.ncbi-nlm-nih-gov.ahs.idm.oclc.org/pmc/articles/PMC7665621/>

Lentz, R. J., Colt, H., Chen, H., Cordovilla, R., Popevic, S., Tahura, S., Candoli, P., Tomassetti, S., Meachery, G. J., Cohen, B. P., Harris, B. D., Talbot, T. R., & Maldonado, F. (2021). Assessing coronavirus disease 2019 (COVID-19) transmission to healthcare personnel: The global ACT-HCP case-control study. *Infection Control and Hospital Epidemiology*, 42(4), 381. Retrieved from: <https://www.cambridge.org/core/services/aop-cambridge-core/content/view/DA2AE0D09CF425D4D045A4C9ABC19E35/S0899823X20004559a.pdf/div-class-title-assessing-coronavirus-disease-2019-covid-19-transmission-to-healthcare-personnel-the-global-act-hcp-case-control-study-div.pdf>

Li, Y., Liang, M., Gao, L., Ayaz Ahmed, M., Uy, J. P., Cheng, C., Zhou, Q., & Sun, C. (2021). Face masks to prevent transmission of COVID-19: A systematic review and meta-analysis. *American Journal of Infection Control*, 49(7), 900-906. <https://doi.org/10.1016/j.ajic.2020.12.007>

Li, B., Deng, A., Li, K., Hu, Y., Li, Z., Xiong, Q., ... Lu, J. (Preprint). Viral infection and transmission in a large well-traced outbreak caused by the Delta SARS-CoV-2 variant. *MedRxiv*, 2021.07.07.21260122. <https://doi.org/10.1101/2021.07.07.21260122>

Lin, Y.-C., Malott, R. J., Ward, L., Kiplagat, L., Pabbaraju, K., Gill, K., ... Conly, J. M. (preprint). Detection and Quantification of Infectious Severe Acute Respiratory Coronavirus-2 in Diverse Clinical and Environmental Samples from Infected Patients: Evidence to Support Respiratory Droplet, and Direct and Indirect Contact as Significant Modes of Transmission. *MedRxiv*, 2021.07.08.21259744. <https://doi.org/10.1101/2021.07.08.21259744>

Loconsole, D., Sallustio, A., Accogli, M., Leaci, A., Sanguedolce, A., Parisi, A., & Chironna, M. (2021). Investigation of an outbreak of symptomatic SARS-CoV-2 VOC 202012/01-lineage B.1.1.7 infection in healthcare workers, Italy. *Clinical Microbiology and Infection*, <https://doi.org/10.1016/j.cmi.2021.05.007>

Mariani, A., Capurso, G., Marasco, G., Bertani, H., Crinò, S. F., Magarotto, A., Tringali, A., Pasquale, L., Arcidiacono, P. G., & Zagari, R. M. (2021). Factors associated with risk of COVID-19 contagion for endoscopy healthcare workers: A survey from the Italian society of digestive endoscopy. *Digestive and Liver Disease*, 53(5), 534. Retrieved from: [https://www.dldjournalonline.com/article/S1590-8658\(21\)00129-8/fulltext#seccesectitle0009](https://www.dldjournalonline.com/article/S1590-8658(21)00129-8/fulltext#seccesectitle0009)

Mastan, S., Malik, R. A., Charalambous, C. P., Abdulla, M., Alonge, J., Chelva, R., Collins, T., Dupley, L., Din, A., Ferns, J., Hodhody, G., Hughes, I., Jamalfar, A., Jump, C., Koo, K., Qureshi, A., Qureshi, M., Patel, D., Patel, N., . . . on behalf of the COVID Hip Fracture study group. (2021). COVID-19 infection is related to differences in the use of personal protective equipment by orthopaedic specialist trainees caring for hip fracture patients during the second surge of COVID-19 in the North West of England. *European Journal of Orthopaedic Surgery & Traumatology*, 31(5), 989-993. <https://doi.org/10.1007/s00590-021-03006-z>

Meister, T. L., Fortmann, J., Todt, D., Heinen, N., Ludwig, A., Brüggemann, Y., Elsner, C., Dittmer, U., Steinmann, J., Pfaender, S., & Steinmann, E. (2021). Comparable environmental stability and disinfection profiles of the currently circulating SARS-CoV-2 variants of concern B.1.1.7 and B.1.351. *The Journal of Infectious Diseases*, <https://doi.org/10.1093/infdis/jiab260>

Ming, X., Ray, C., & Bandari, M. (2020). Beyond the PPE shortage: Improperly fitting personal protective equipment and COVID-19 transmission among health care professionals. *Hospital Practice* (1995), 48(5), 246. Retrieved from: <https://www.tandfonline.com/doi/pdf/10.1080/21548331.2020.1802172>

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

Moore, Z., McEvoy, N. L., Avsar, P., McEvoy, L., Curley, G., O'Connor, T., Budri, A., Nugent, L., Walsh, S., Bourke, F., & Patton, D. (2021). Facial pressure injuries and the COVID-19 pandemic: Skin protection care to enhance staff safety in an acute hospital setting. *Journal of Wound Care*, 30(3), 162. Retrieved from: <https://www-magonlinelibrary-com.ahs.idm.oclc.org/doi/pdfplus/10.12968/jowc.2021.30.3.162>

O'Keeffe, J. (2021). Masking during the COVID-19 pandemic - an update of the evidence. Vancouver, BC: National Collaborating Centre for Environmental Health. Updated May 2021. Retrieved from: https://ncceh.ca/sites/default/files/Masking%20during%20the%20pandemic_NCCEH%20UPDATE%20JUN2021_EN.pdf. Accessed 12 July 2021

Pan, Z., Zhang, H., Yang, J., Tang, S., Cheng, Z., Wu, K., & Liu, B. (2021). Surgical masks for protection of health care personnel against covid-19: Results from an observational study. *Clinical and Investigative Medicine*, 44(2), E48-54. <https://doi.org/10.25011/cim.v44i2.36355>

Public Health Agency of Canada. (2021). Infection prevention and control for COVID-19: Interim guidance for acute healthcare settings. Updated 16 June 2021. Retrieved from: <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/infection-prevention-control-covid-19-second-interim-guidance.html>. Accessed 12 July 2021

Public Health England. (2021a). COVID-19: Guidance for maintaining services within health and care settings. Updated 1 June 2021. Retrieved from: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachmen>

[t_data/file/990923/20210602_Infection_Prevention_and_Control_Guidance_for_maintaining_services_with_H_and_C_settings_1_.pdf](#). Accessed 14 July 2021.

Public Health England. (2021b). Independent High Risk AGP Panel systematic review: background paper. Retrieved from: <https://www.gov.uk/government/publications/independent-high-risk-agp-panel-summary-of-recommendations>. Accessed 11 August 2021.

Public Health Ontario. (2021a). Environmental Scan: Type of Mask Required or Recommended for the Public to Control Transmission of SARS-CoV-2 with Consideration of Variants of Concern: Rapid Environmental Scan. 18 Feb 2021. Retrieved from: <https://www.publichealthontario.ca/-/media/documents/ncov/voc/2021/03/covid-19-types-of-masks-public-variant-of-concern.pdf>. Accessed 12 July 2021

Public Health Ontario. (2021b). Technical Brief: IPAC Recommendations for Use of Personal Protective Equipment for Care of Individuals with Suspect or Confirmed COVID-19. Updated May 2021. Retrieved from: <https://www.publichealthontario.ca/-/media/documents/ncov/updated-ipac-measures-covid-19.pdf>. Accessed 12 July 2021

Public Health Ontario. (2021c). Interim Guidance for Infection Prevention and Control of SARS-CoV-2 Variants of Concern for Health Care Settings. Updated April 2021. Retrieved from: <https://www.publichealthontario.ca/-/media/documents/ncov/voc/2021/02/pidac-interim-guidance-sars-cov-2-variants.pdf>. Accessed 12 July 2021

Ramaraj, P., Super, J., Doyle, R., Aylwin, C., & Hettiaratchy, S. (2020). Triaging of respiratory protective equipment on the assumed risk of SARS-CoV-2 aerosol exposure in patient-facing healthcare workers delivering secondary care: A rapid review. *BMJ Open*, 10(10), e040321. <https://doi.org/10.1136/bmjopen-2020-040321>

Schmitz, D., Vos, M., Stolmeijer, R., Lameijer, H., Schonberger, T., Gaakeer, M., de Groot, B., Eikendal, T., Wansink, L., & Avest, E. t. (2021). Association between personal protective equipment and SARS-CoV-2 infection risk in emergency department healthcare workers. *European Journal of Emergency Medicine*, 28(3), 202-209. <https://doi.org/10.1097/MEJ.0000000000000766>

Scientific Advisory Group on Emergencies. (2021). EMG: Application of physical distancing and fabric face coverings in mitigating the B117 variant SARS-CoV-2 virus in public, workplace and community, 13 January 2021. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_t_data/file/957010/s1029-emg-face-coverings-distancing.pdf. Accessed 12 July 2021

Seidelman, J. L., Lewis, S. S., Advani, S. D., Akinboyo, I. C., Epling, C., Case, M., Said, K., Yancey, W., Stiegel, M., Schwartz, A., Stout, J., Sexton, D. J., & Smith, B. A. (2020). Universal masking is an effective strategy to flatten the severe acute respiratory coronavirus virus 2 (SARS-CoV-2) healthcare worker epidemiologic curve. *Infection Control and Hospital Epidemiology*, 41(12), 1466.

Serin, S., & Caglar, B. (2021). The Effect of Different Personal Protective Equipment Masks on Health Care Workers' Cardiopulmonary Resuscitation Performance During the Covid-19 Pandemic. *The Journal of emergency medicine*, 60(3), 292–298.

<https://doi.org/10.1016/j.jemermed.2020.11.005>

Smith, J. D., MacDougall, C. C., Johnstone, J., Copes, R. A., Schwartz, B., & Garber, G. E. (2016). Effectiveness of N95 respirators versus surgical masks in protecting health care workers from acute respiratory infection: a systematic review and meta-analysis. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 188(8), 567–574. <https://doi.org/10.1503/cmaj.150835>

Staub, T., Arendt, V., Lasso de la Vega, E. C., Braquet, P., Michaux, C., Kohnen, M., Tsobo, C., Abdelrahman, T., Wienecke-Baldacchino, A., & Francois, J. H. (2021). Case series of four re-infections with a SARS-CoV-2 B.1.351 variant, Luxembourg, February 2021. *Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin*, 26(18), 2100423. <https://doi.org/10.2807/1560-7917.ES.2021.26.18.2100423>

Thal, A. G., Schiff, B. A., Ahmed, Y., Cao, A., Mo, A., Mehta, V., Smith, R. V., Cohen, H. W., & Ow, T. J. (2021). Tracheotomy in a high-volume center during the COVID-19 pandemic: Evaluating the Surgeon's risk. *Otolaryngology-Head and Neck Surgery*, 164(3), 522-527. <https://doi.org/10.1177/0194599820955174>

Tian, Y., Tu, X., Zhou, X., Yu, J., Luo, S., Ma, L., Liu, C., Zhao, Y., & Jin, X. (2021). Wearing a N95 respirator increases rescuer's fatigue and decreases chest compression quality in simulated cardiopulmonary resuscitation. *The American journal of emergency medicine*, 44, 434–438. <https://doi.org/10.1016/j.ajem.2020.05.065>

Torjesen, I. (2021). Covid-19: PPE guidance is upgraded as evidence of airborne transmission grows. *BMJ (Online)*, 373, n1422-n1422. <https://doi.org/10.1136/bmj.n1422>

Ueki, H., Furusawa, Y., Iwatsuki-Horimoto, K., Imai, M., Kabata, H., Nishimura, H., & Kawaoka, Y. (2020). Effectiveness of face masks in preventing airborne transmission of SARS-CoV-2. *Msphere*, 5(5)<https://doi.org/10.1128/mSphere.00637-20>

UK Infection Prevention and Control Cell. 2021. Masks for healthcare workers to mitigate airborne transmission of SARS-CoV-2. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/979441/S1169_Facemasks_for_health_care_workers.pdf. Accessed 14 July 2021.

Unoki, T., Tamoto, M., Ouchi, A., Sakuramoto, H., Nakayama, A., Katayama, Y., Miyazaki, S., Yamada, T., Fujitani, S., Nishida, O., Tabah, A., & PPE-SAFE in Japan Project, International Exchange Committee, the Japan Society of Intensive Care Medicine. (2020). Personal protective equipment use by healthcare workers in intensive care unit during the COVID-19 pandemic in japan: Comparative analysis with the PPE-SAFE survey. *Acute Medicine & Surgery*, <https://doi.org/10.1002/ams2.584>

Urwin, S; Gavinder K, Graziadio S. (2020). What prognostic clinical risk prediction scores for COVID-19 are currently available for use in the community setting? Centre for Evidence-Based Medicine. Retrieved from: <https://www.cebm.net/covid-19/what-prognostic-clinical-risk-prediction-scores-for-covid-19-are-currently-available-for-use-in-the-community-setting/>

Victoria State Government. (2021). COVID-19 – A guide to the conventional use of personal protective equipment (PPE) (Updated 29 July 2021). Retrieved from: <https://www.dhhs.vic.gov.au/guide-conventional-use-ppe-covid-19-doc>. Accessed 10 August 2021.

Viswanathan, M., Ansari, M. T., Berkman, N. D., Chang, S., Hartling, L., McPheeters, M., ... & Treadwell, J. R. (2012). Assessing the risk of bias of individual studies in systematic reviews of health care interventions. In *Methods guide for effectiveness and comparative effectiveness reviews [Internet]*. Agency for Healthcare Research and Quality (US). Retrieved from: <https://www.ncbi.nlm.nih.gov/books/NBK91433/>

Wang, D. D., O'Neill, W. W., Zervos, M. J., McKinnon, J. E., Allard, D., Alangaden, G. J., Schultz, L. R., Poisson, L. M., Chu, B. S., Kalkanis, S. N., & Suleyman, G. (2021). Association between implementation of a universal face mask policy for healthcare workers in a health care system & SARS-CoV-2 positivity testing rate in healthcare workers. *Journal of Occupational and Environmental Medicine*, 63(6), 476-481. <https://doi.org/10.1097/JOM.0000000000002174>

Wang, X., Ferro, E. G., Zhou, G., Hashimoto, D., & Bhatt, D. L. (2020). Association between universal masking in a health care system and SARS-CoV-2 positivity among health care workers. *JAMA : The Journal of the American Medical Association*, 324(7), 703-704. <https://doi.org/10.1001/jama.2020.12897>

Williams, H., Hutchinson, D., & Stone, H. (2021). Watching brief: The evolution and impact of COVID-19 variants B.1.1.7, B.1.351, P.1 and B.1.617. *Global Biosecurity*, 3(1)<https://doi.org/10.31646/gbio.112>

Wise, J. (2021). Covid-19: Doctors and nurses demand better PPE for wider range of procedures. *BMJ (Online)*, 372, n30-n30. <https://doi.org/10.1136/bmj.n30>

World Health Organization. (2020). Mask use in the context of COVID-19. Retrieved from: [https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-\(2019-ncov\)-outbreak](https://www.who.int/publications/i/item/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak). Accessed 12 July 2021

World Health Organization. (2021a). Tracking SARS-CoV-2 variants. Retrieved from: <https://www.who.int/en/activities/tracking-SARS-CoV-2-variants/>. Accessed 11 July 2021.

World Health Organization. (2021b). COVID-19: Occupational health and safety for health workers. Retrieved from: https://www.who.int/publications/i/item/WHO-2019-nCoV-HCW_advice-2021.1. Accessed 12 July 2021.

World Health Organization. (2021c). Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed. Updated 12 July

2021. Retrieved from: <https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-2021.1>. Accessed 16 July 2021.

Wynants, L., Van Calster, B., Bonten, M. M., Collins, G. S., Debray, T. P., De Vos, M., ... & Schuit, E. (2020). Prediction models for diagnosis and prognosis of covid-19 infection: systematic review and critical appraisal. *BMJ*, 369. Retrieved from <https://www.bmj.com/content/369/bmj.m1328.long>

Yin, X., Wang, X., Xu, S., & He, C. (2021). Comparative efficacy of respiratory personal protective equipment against viral respiratory infectious diseases in healthcare workers: A network meta-analysis. *Public Health (London)*, 190, 82. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7755580/>