Article

Comparative effectiveness of N95, surgical or medical, and non-medical facemasks in protection against respiratory virus infection: a systematic review and network meta-analysis

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Research in context

Summary

The aim of this systematic review and network meta-analysis is to evaluate the comparative effectiveness of N95, surgical/medical, and non-medical facemasks as personal protective equipment (PPE) against respiratory virus infection.

The study incorporated 35 published and unpublished randomized controlled trials (RCTs) and observational studies investigating specific mask effectiveness against influenza virus, SARS-CoV, MERS-CoV, and SARS-CoV-2. We searched PubMed, Google Scholar, and medRxiv databases for studies published up to 5 February 2021 (PROSPERO registration: CRD42020214729). The primary outcome of interest was the rate of respiratory viral infection. The quality of evidence was estimated using the GRADE approach.

High compliance to mask-wearing conferred a significantly better protection (odds ratio [OR], 0.43; 95% confidence interval [CI], 0.23-0.82) than low compliance. N95 or equivalent masks were the most effective in providing protection against coronavirus infections (OR, 0.30; CI, 0.20–0.44) consistently across subgroup analyses of causative viruses and clinical settings. Evidence supporting the use of medical or surgical masks against influenza or coronavirus infections (SARS, MERS, and COVID-19) was weak.

Our study confirmed that the use of facemasks provides protection against respiratory viral infections in general; however, the effectiveness may vary according to the type of facemask used. Our findings encourage the use of N95 respirators or their equivalents (e.g., P2) for best personal protection in healthcare settings until more evidence on surgical and medical masks is accrued. This study highlights a substantial lack of evidence on the comparative effectiveness of mask types in community settings.

ABBREVIATIONS

AGP: aerosol generating procedure

CDC: Centers for Disease Control and Prevention

CI: confidence interval

CoV: coronavirus

GRADE: Grading of Recommendations Assessment, Development, and Evaluation

ILI: influenza-like illness

MERS: Middle East respiratory syndrome

NMA: network meta-analysis

OR: odds ratio

PICOS: population, intervention, comparator, outcomes, and setting

PPE: personal protective equipment

RCTs: randomized controlled trials

SARS: Severe acute respiratory syndrome

WHO: World Health Organization

INTRODUCTION

The coronavirus disease (COVID-19) pandemic has led to an unprecedented increase in the demand for facemasks globally. The types of facemasks currently in use include N95 respirators, surgical masks, medical masks, and non-medical masks (e.g. cloth or cotton masks)[1-4]. However, there is no established evidence or consensus on which type of facemask is superior in preventing respiratory viral infection either by the wearer or those they encounter. Different facemask guidelines recommend the use of different facemasks against COVID-19[1-4], and this is an area of concern as certain mask types may not be as capable as others in preventing respiratory viral infections. Previous systematic reviews exclusively performed pairwise comparisons of mask types[5-7], and did not evaluate the capacities of all existing mask types simultaneously, leading to the unconsolidated information on the comparative effectiveness of different facemask types.

Therefore, we conducted the first network meta-analysis (NMA) to evaluate the comparative prevention effectiveness of the most common types of facemasks (N95 respirators, surgical or medical masks, and non-medical masks) that have been used as personal protective equipment (PPE). NMA is an analytical tool that enables a single coherent ranking of multiple interventions; thus, it can provide information that helps policy makers and healthcare workers choose appropriate equipment from an array of protective equipment[8,9]. To inform optimised protective strategies for different causative viruses and clinical settings, we separately analysed comparative mask effects in various respiratory viral infections, including influenza, Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS), and COVID-19, in both community and healthcare settings.

METHODS

Search strategy and selection criteria

We conducted a meta-analysis following a pre-registered protocol in PROSPERO (CRD42020214729). Two researchers (MS Kim and D Seong) independently searched the PubMed, Google Scholar, and medRxiv databases from inception to 5 February 2021 using the search strategy detailed in the Supplementary Appendix (p. 2). The manual research and screening of reference lists of review articles were also conducted to include additional relevant studies that have not been retrieved through the primary search. Any conflicts were resolved by consensus, with the mediation of a third independent investigator (JI Shin).

Our research question could be summarized in PICOS (population, intervention, comparator, outcomes, and setting) as follows: people at risk of respiratory virus infection (P), adhered to facemask wearing (I), compared with either no mask-wearing or little mask-wearing (C), reduction in the risk of laboratory-confirmed viral infection (O), in health care or community settings (S). Eligible studies met the following criteria: (1) RCTs, cluster RCTs, prospective cohort studies, retrospective cohort studies, case-control studies, and cross-sectional studies; (2) studies comparing the effectiveness of N95 respirators or their equivalent (e.g., P2), surgical masks, medical masks, or non-medical (e.g., cloth or cotton) masks with each other or with not wearing masks/very low compliance to wearing masks. Studies were excluded if they did not specify the types of mask used, and did not present isolated outcomes for individual mask types. There was no limitation regarding the type of mask, compliance to wearing masks, and the fitting of the mask; however, we preferentially used results from high compliance and better mask fitting when stratified results were presented within a study. Pre-prints have been used relatively frequently in meta-analyses for the urgent topic of COVID-19[10-14] as a large amount of relevant data is still unpublished. We included pre-prints to reduce the risk of selection and publication bias and increase network density, as done elsewhere[15].

We included both RCTs and observational studies in our NMA; inclusion of real-world data from non-randomized studies has the potential to improve precision of findings from RCTs if appropriately integrated[16,17] and many previous NMAs have increased the density of network and enhanced the statistical power of findings using the approach[18-21].

Data extraction

Two investigators (D Seong and MS Kim) extracted data on the PICOS (Participants, Interventions, Comparisons, Outcomes, and Study design) for each study. Moreover, information on the following was collected: first author, publication year, study design, estimated effect sizes or number of events, population information, type of respiratory virus, details of interventions and comparisons (mask type and compliance, if applicable), and outcome of interest. The intervention group included participants wearing a specific type of mask for protection, and the control group consisted of participants not wearing a mask or those who had a very low compliance to wearing a mask. For studies involving facemask and other non-pharmaceutical interventions (i.e., hand hygiene), we extracted data from selective groups to make the facemask the only difference. The primary outcome of the current NMA was laboratory-confirmed infection of various respiratory viruses—influenza virus, SARS-CoV, MERS-CoV, and SARS-CoV-2. Disagreements were resolved by consensus, with any persistent conflict resolved by a third independent investigator (JI Shin).

Quality assessment

Two investigators (D Seong and MS Kim) evaluated the risk of bias for all included studies according to meta-analysis guidelines. The risk of bias of RCTs was assessed using the ROB2 tool[22]. The risk of bias of observational studies was assessed using the ROBINS-I tool[23]. The certainty of evidence for primary outcomes was evaluated using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach specifically

designed for NMA[24-27]. Using the GRADE approach, outcomes were classified as high, moderate, low, or very low certainty of evidence.

Data synthesis

This NMA assessed the effectiveness of facemasks in preventing respiratory viral infection by presenting binary outcomes as odds ratio (OR) with 95% confidence interval (CI). The frequentist framework was used to perform the NMA using STATA (Stata Corp, College Station, TX, US, version 15.0) and R software (version 3.6.0)[28]; self-programmed routines of STATA[29,30] and the 'netmeta' package in R[31] were used as described in the previous studies[15,32]. The 'netmeta' package utilises graph theoretical approach, which constructs the Moore-Penrose pseudoinverse matrix and calculates the fitted values of the network model using a weighted least squares approach[33]. Review Manager (REVMAN version 5.3; Nordic Cochrane Centre, Copenhagen, Denmark) was used for pairwise meta-analysis using inverse variance random-effects model. We applied random-effects model as we deemed that the expected heterogeneity between studies is likely to be due to real differences between studies rather than by chance.

In this NMA, the rank hierarchy for each mask type was investigated using the surface under the cumulative rank curve (SUCRA) of the P rank score of R[34]. We assessed the consistency of evidence between direct and indirect comparisons where $p < 0.05$ under the design-by-treatment interaction random-effects model or inconsistency factors with 95% credible intervals containing 0 was deemed a lack of consistency[35]. As consistency could be considered as statistical measure of transitivity[36], transitivity assumption was estimated along with consistency test. The net heat plot was constructed to visualise the inconsistency matrix[35]. Heterogeneity was measured using the I^2 value, with $I^2 > 50\%$ indicating moderate-to-high

heterogeneity. Publication bias was assessed using comparison-adjusted funnel plots and Egger's test[29]. A two-sided P-value of <0.05 was considered statistically significant.

Subgroup analysis

Subgroup analyses were performed for virus types (influenza virus, SARS-CoV, MERS-CoV, and SARS-CoV-2), clinical settings (health care setting and community setting), and study design (RCT and observational study) as planned in priori. Post hoc subgroup analysis for usual healthcare setting (patient contact) versus aerosol-generating procedure (AGP) was further conducted given that increasing evidence has supported the difference in the risk of infection in those settings[37,38].

RESULTS

Study characteristics

A total of 5,892 articles were identified through an initial search, and an additional 54 articles were identified from other sources after reviewing references (Figure 1). Duplicates and irrelevant studies were excluded; hence, a total of 185 articles were selected. After screening the full text of the articles to identify studies meeting the prespecified inclusion and exclusion criteria, 35 articles were included in the final meta-analysis. Among them, 8 studies were conducted in non-healthcare settings, and 27 studies investigated mask effectiveness in healthcare settings. Twelve studies were randomized or cluster-randomized controlled trials and 23 studies were observational studies. The PICOS data of individual studies and reference list of included studies are described in Supplementary Tables 1 and 2 (pp 4-14). The risk of bias in the included studies was generally low to moderate (Supplementary Appendix pp. 46–80).

In pairwise meta-analysis and NMA, heterogeneity (I^2) ranged from 0% to 53.7% (Supplementary Appendix pp. 15–45). Inconsistencies in NMA outcomes were evaluated to identify disagreement between direct and indirect assessments; global inconsistency was found in results of coronavirus (overall), coronavirus (healthcare setting), and COVID-19. Networks of eligible comparisons are shown in Figure 2. The certainty of evidence (GRADE) for the primary outcomes is depicted in Table 1.

Overall effect of wearing masks against respiratory viral infections

Wearing masks, regardless of the type, was associated with a reduced risk of infection from all respiratory viruses (OR, 0.50; 95% CI, 0.37–0.68; GRADE, low), SARS-CoV/MERS-CoV (OR, 0.30; 95% CI, 0.14–0.63; GRADE, low), and SARS-CoV-2 (OR, 0.49; 95% CI, 0.31–0.78; GRADE, low), but not with the risk of infection from influenza virus (OR, 0.71; 95% CI, 0.42–1.21; GRADE, moderate) (Figure 3). High adherence to wearing masks was associated with a lower risk of respiratory viral infection relative to low adherence (Figure 3).

Comparative effectiveness of facemasks against influenza

The use of facemask, including medical/surgical masks (OR, 0.75; 95% CI, 0.51–1.09; GRADE, moderate), N95 or equivalent masks (OR, 0.84; 95% CI, 0.56–1.28; GRADE, moderate), and non-medical masks (OR, 1.29; 95% CI, 0.24–6.94; GRADE, very low), was not associated with reduced infection from influenza virus, similar to the non-use of facemasks or a very low compliance to wearing masks in all studies (Figure 4A). The results were consistent in subgroup analyses of RCTs (Figure 4B) and observational studies (Figure 4C).

Comparative effectiveness of facemasks against coronaviruses

Only wearing N95 or equivalent masks (OR, 0.30; 95% CI, 0.20–0.44; GRADE, low) was associated with a decreased risk infection from all coronaviruses (SARS-CoV, MERS-

CoV, and SARS-CoV-2). The results were similar for assessment of the comparative effectiveness of masks against SARS and MERS (Figure 5B) and COVID-19 (Figure 5C).

Comparative effectiveness of facemasks in healthcare and community settings

No facemask type, was associated with a reduced influenza infection rate in healthcare settings (Figure 6A) and community settings (Figure 6B). For all coronavirus infections, including SARS, MERS, and COVID-19, in healthcare settings, the use of N95 or equivalent mask was associated with a lower infection rate (OR, 0.29; 95% CI, 0.19–0.44; GRADE, low), but not the use of medical/surgical masks (Figure 6C); the results were consistent in subgroup analysis particularly limited to mask effectiveness during AGP (Supplementary Figure 1). Insufficient data were collected on the effectiveness of N95 or equivalent masks against coronavirus infection in community settings (Figure 6D).

DISCUSSION

We conducted the first NMA to evaluate the comparative effectiveness of facemasks against various respiratory viral infections (influenza, MERS, SARS, and COVID-19) in both community and healthcare settings. This NMA mainly focused on using facemask as PPE (i.e., to protect the uninfected wearer) rather than as source control or transmission prevention, and as such, the interpretation of the results was confined to this regard. Our study revealed that the use of facemasks provides protection against respiratory viral infections in general, but the effectiveness may vary according to the type of facemask used. The N95 respirator or its equivalent was the most effective mask type, while evidence supporting the use of medical or surgical masks against influenza or coronavirus infections (SARS, MERS, and COVID-19) was weak.

The current facemask guidelines for COVID-19 vary from one organisation to another[6]. The World Health Organization (WHO) recommends non-medical masks for the general population; medical/surgical masks for individuals aged >60 years, those with underlying medical conditions, the frail, and/or those attending the ill; and respirator masks including N95 masks for healthcare workers in settings where procedures that may aerosolize the virus are performed[1]. While our findings agree with the use of N95 or equivalent in the healthcare setting for both usual patient contact and AGP, this study highlights insufficient evidence on the effectiveness of medical or surgical masks in community settings. The Centers for Disease Control and Prevention (CDC) advises the use of non-medical masks with multiple layers for community dwellers and advocates the reservation of medical/surgical masks or N95 respirators for healthcare workers[2]. Although we acknowledge that identifying the optimal mask distribution strategy based on mask effectiveness and supply is complicated, our finding raises the concern that non-medical masks may not provide sufficient protection against respiratory viral infections as our results show very large CIs and even an increased OR toward infection in community settings (Figure 6D), which leads to the belief that non-medical masks are less likely to be shown to be effective even after accumulation of more evidence. The findings of this study support that N95 or equivalent (e.g. P2) masks should be the primary choice, and further investigations on N95 or equivalent masks, including effects of reusing N95 masks or extending their use period[39-41], would be useful in mitigating the demand and supply imbalance and protecting the globe against current and future respiratory infection pandemics.

Although N95 or equivalent masks were effective against coronavirus infections (e.g. SARS, MERS, and COVID-19), they did not show effectiveness in preventing influenza virus infections (Figure 4). Four potential explanations are provided for this discrepancy. First, we investigated laboratory-confirmed influenza infection, rather than clinically diagnosed influenza

(i.e., standard CDC classification of fever ≥37.8 °C plus cough or sore throat) or influenza-like illness (ILI); this is because the clinical diagnosis cannot guarantee if the person was indeed infected by influenza virus given the numerous respiratory viruses (i.e., respiratory syncytial virus, adenovirus, and rhinovirus) can induce similar symptoms. This different focus of outcome may in part explain our counterintuitive results on mask effectiveness against influenza infection, considering previous studies have made conclusions for mask effectiveness in light of ILI[42,43]. Second, there was a consistent trend towards reduced influenza infection with facemasks (Figure 3 and 4); given the imprecision of the effect estimates for wearing masks against influenza according to GRADE (Table 1), we cannot yet discount facemasks' effectiveness in prevention of influenza infection. Third, the poor effectiveness of masks against influenza may be attributable to the higher aerosol transmission potency of influenza virus compared to that of coronaviruses[44,45]. The higher aerosol potency of influenza virus may allow more particles to be penetrated through unfitted masks. Lastly, the difference in the findings can be possibly explained by a higher adherence to wearing masks in pandemic settings than during the seasonal spread of influenza[6]. The global effect of SARS, MERS, and COVID-19 led to unprecedentedly high standards, regulations, and education regarding facemask usage, and this may have contributed to a significant reduction in the numbers of coronavirus infections. This is also supported by our result that higher compliance to masks significantly reduced respiratory viral infection (Figure 3).

This study does not claim the ineffectiveness of surgical or medical masks nor does it oppose their use. Their effect directions were consistently toward lower risk for infection but with substantial imprecision according to GRADE, which may reflect a lack of statistical power rather than absence of actual effectiveness. Moreover, facemasks can be used to block the spread of droplets by an infected person (source control), as well as PPE[46,47]. Since the present study

mainly focused on the protection of uninfected wearer but not the source control or transmission, the interpretation of the results on surgical and medical masks should be limited to protection. Wearing medical or surgical masks can still be meaningful in preventing transmissions of influenza virus and coronavirus as they can serve as shields to prevent the spreading of droplets carrying the infectious viruses from infected persons[48-50]. Laboratory findings insisted that wearing of surgical masks or KN95 respirators reduced the number of particles emitted from breath and coughing[51], even without proper fit testing[52].

This study has several limitations. First, in contrast to the wealth of RCTs investigating mask potencies for preventing influenza virus infection, there is one RCT investigating mask effectiveness against COVID-19. Thus, analysis of mask usage against coronaviruses was performed primarily based on observational studies, which may be prone to reporting, selection, and confounding biases. To account for such biases, we evaluated the certainty of evidence using the GRADE framework[24] and downgraded the evidence level for limited study design and any detection of bias. Second, individual studies were heterogeneous in terms of causative viruses, settings, protocols for wearing facemasks, and participants' compliance. We conducted various subgroup analyses to address these issues and reached relatively low heterogeneity, ranged from I^2 0% to 53.7%, compared to previous meta-analysis investigating facemask effectiveness (I^2 ranging from 48% to 87%)[5]. Lastly, it is observed in the GRADE framework that certainty of evidence for medical or surgical masks are generally lower than that for N95 or equivalent (Table 1). This may support the necessity for reappraisal of surgical/medical masks after more studies are published. Although the certainty of evidence is yet suboptimal, this study presents the highest level of evidence to date.

Coronaviruses are a serious public health threat, as demonstrated during the previous SARS and MERS epidemics and the current COVID-19 pandemic. Our study demonstrated that

the use of facemasks provides protection against respiratory viral infections in general. Among various types of facemasks**,** it is likely safer to use N95 or equivalent in healthcare settings as PPE for the moment until more evidence on other types of masks are realized.

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Author Contribution Statement

MS Kim, D Seong, and JI Shin contributed to the study concept and design. MS Kim and D Seong identified and acquired relevant trials and extracted data. MS Kim and D Seong drafted the protocol for this study. MS Kim analyzed the data. MS Kim, Han Li, and JH Kim wrote the first draft of the manuscript. MS Kim finalized the manuscript. SK Chung, Y Park, and M Lee contributed to evaluating the Risk of Biases. SW Lee, DK Yon, KH Lee, M Solmi, E Dragioti, A Koyanagi, L Jacob, A Kronbichler, K Tizaoui, S Cargnin, S Terrazzino, SH Hong, RA Ghayda, J Radua, H Oh, S Lee, K Kostev, S Ogino, I-M Lee, E Giovannucci, Y Barnett, L Butler, D McDermott, P-C Ilie, and JI Shin contributed to the interpretation of data and critical revision of the manuscript. JI Shin, E Dragioti, Ai Koyanagi, A Kronbichler, S Ogino, and I-M Lee provided statistical advice or supervised the statistical interpretations. All authors saw and approved the final submitted version.

Conflict of interest disclosure

No conflict of interest declared

Data Availability Statement

The data that supports the findings of this study are available in the supplementary material of this article

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TABLES

Table 1. Certainty of evidence evaluated with Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework for primary outcomes

Comparisons **(vs. Control)**	Comparison No.	OR (95% CI), p-value	Study design†	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	GRADE
Overall mask effect									
Preventive effect of wearing mask (any type) on respiratory viral infection									
Overall respiratory viral infection	22	0.50 (0.37, 0.68), **p<0.001**	Observational study	Not serious	Not serious	Not serious	Not serious	Not serious	Low
Influenza	8	0.71 (0.42, 1.21), p=0.208	RCT	Not serious	Not serious	Not serious	Serious	Not serious	Moderate
SARS/MERS	6	0.30 (0.14, 0.63), **p=0.001**	Observational study	Serious	Not serious	Not serious	Not serious	Not serious	Low‡
COVID-19	8	0.49 (0.31, 0.78), **p=0.003**	Observational study	Not serious	Not serious	Not serious	Not serious	Not serious	Low
Compliance (vs. low compliance)									
High adherence to mask behavior	6	0.43 (0.23, 0.82), **p=0.010**	Observational study	Not serious	Serious	Not serious	Not serious	Not serious	Very Low
Per specific mask type									
Influenza virus infection									
Medical and surgical mask	17	0.75 (0.51, 1.09), p=0.132	RCT	Not serious	Not serious	Not serious	Serious	Not serious	Moderate
N95 or equivalent	11	0.84 (0.56, 1.28), p=0.417	RCT	Not serious	Not serious	Not serious	Serious	Not serious	Moderate
Non-medical mask	1	1.29 (0.24, 6.94), p=0.767	Observational study	Not serious	Not serious	Not serious	Very serious	Not serious	Very Low
Coronavirus infection, overall (SARS, MERS, and COVID-19)									
N95 or equivalent	14	0.30 (0.20, 0.44), **p<0.001**	Observational study	Not serious	Not serious	Not serious	Not serious	Serious	Low‡
Medical or surgical mask	14	0.72 (0.51, 1.01), p=0.057	Observational study	Not serious	Not serious	Not serious	Serious	Serious	Very Low
Non-medical mask	2	0.77 (0.29, 2.07), p=0.605	Observational study	Not serious	Not serious	Not serious	Serious	Serious	Very Low
SARS/MERS infection									
N95 or equivalent	8	0.24 (0.13, 0.46), **p<0.001**	Observational study	Not serious	Not serious	Not serious	Not serious	Serious	Low‡
Medical and surgical mask	7	0.70 (0.38, 1.30), p=0.259	Observational study	Not serious	Not serious	Not serious	Serious	Serious	Very Low
COVID-19 infection									
N95 or equivalent	6	0.30 (0.17, 0.55), **p<0.001**	Observational study	Not serious	Not serious	Not serious	Not serious	Serious	Low‡
Medical or surgical mask	7	0.71 (0.44, 1.14), p=0.156	Observational study	Serious	Not serious	Not serious	Serious	Serious	Very Low
Non-medical mask	2	0.73 (0.25, 2.14), p=0.566	Observational study	Not serious	Not serious	Not serious	Serious	Serious	Very Low
Health care settings									
Influenza virus infection									
Medical or surgical mask	10	0.65 (0.28, 1.49), p=0.309	RCT	Not serious	Not serious	Not serious	Serious	Not serious	Moderate
N95 or equivalent	9	0.72 (0.31, 1.69), p=0.451	RCT	Not serious	Not serious	Not serious	Serious	Not serious	Moderate

Non-medical mask	1	1.29 (0.24, 6.94), p=0.767	Observational study	Not serious	Not serious	Not serious	Very serious	Not serious	Very Low
Coronavirus infection, overall (SARS, MERS, and COVID-19)									
N95 or equivalent	14	0.29 (0.19, 0.44), **p<0.001**	Observational study	Not serious	Not serious	Not serious	Not serious	Serious	Low‡
Medical or surgical mask	12	0.69 (0.44, 1.07), p=0.097	Observational study	Serious	Not serious	Not serious	Serious	Serious	Very Low
Community settings									
Influenza virus infection									
Medical or surgical mask	7	0.76 (0.47, 1.20), p=0.239	RCT	Serious	Not serious	Not serious	Serious	Not serious	Low
N95 or equivalent	2	3.50 (0.44, 27.97), p=0.237	RCT	Not serious	Not serious	Not serious	Very serious	Not serious	Low
Coronavirus infection, overall (SARS, MERS, and COVID-19)									
Medical or surgical mask	2	0.78 (0.53, 1.12), p=0.150	Observational study	Serious	Not serious	Not serious	Serious	Not serious	Very Low
Non-medical mask	1	1.29 (0.48, 3.45), p=0.612	Observational study	Not serious	Not serious	Not serious	Serious	Not serious	Very Low

†: dominant study design. ‡upgraded by one for a large magnitude of effect. RCT = randomized controlled trial.

Rationale:
Study design: If randomized trials form the majority of evidence base, the quality rating starts at “high”. If observational studies form the majority of evidence, base the quality rating starts at “low”.
Risk of bias: Downgraded for failure to conceal random allocation or blind participants in randomized controlled trials or failure to adequately control for confounding in observational studies.
Inconsistency: Downgraded if direct and indirect evidence are not coherence as demonstrated by the difference in point estimates and the lack of overlap in the 95% confidential intervals (CIs) between direct and indirect evidence (Global incoherence tests such as Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model were used as supplementary information for judgement).
Indirectness. Downgraded if there present substantial differences in study characteristics (PICO) that may modify treatment effect in the direct comparisons (such as A v C and B v C) that form the basis for the indirect estimate of effect of the comparison of interest (A v B), or the result is solely derived from indirect comparisons.
Imprecision: Downgraded when cases are small; or 95% CIs are wide and include or are close to null effect.
Publication bias: Downgraded when substantial asymmetry is observed in funnel plot or p<0.10 in egger’s test.

GRADE Definition (suggested by Puhan et al. in “A GRADE Working Group approach for rating the quality of treatment effect estimates from network meta-analysis”):
High quality: We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate quality: We are moderately confident in the effect estimate i.e. the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low quality: Our confidence in the effect estimate is limited i.e. the true effect may be substantially different from the estimate of the effect.
Very low quality: We have very little confidence in the effect estimate i.e. the true effect is likely to be substantially different from the estimate of effect.

Figure legend

Fig. 1 PRISMA diagram showing selection of articles for pairwise and network meta-analysis

Fig. 2 Network of eligible comparisons for respiratory viruses
(A) Influenza virus. (B) Coronavirus (including SARS, MERS, and COVID-19). (C) SARS (SARS-CoV) and MERS (MERS-CoV). (D) COVID-19 (SARS-CoV-2). Control includes no mask wearing, or mask wearing at very low frequencies. Non-medical masks include cloths or cotton masks. Lines indicate direct comparisons of agents, and the thickness of line corresponds to the number of trials in the comparison. The size of node corresponds to the number of studies that involve the intervention. SARS = Severe Acute Respiratory Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

Fig. 3 Pairwise meta-analysis for the impact of wearing masks and adhering to mask behavior on the risk of infection to respiratory viral diseases
Control includes no mask wearing, or mask wearing at very low frequencies. SARS = Severe Acute Respiratory Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

Fig. 4 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for influenza virus infections
Risk of laboratory-confirmed infection by influenza virus in (A) overall, (B) RCTs, and (C) observational studies. Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value. RCT = randomized controlled trial.

Fig. 5 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for coronavirus infections
Rate of diagnosed with coronavirus infection. (A) Risk of overall coronavirus infection (SARS, MERS, and COVID-19), (B) SARS (SARS-CoV) and MERS(MERS-CoV), and (C) COVID-19 (SARS-CoV-2). Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value. SARS = Severe Acute Respiratory Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

Fig. 6 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for respiratory viral infections in health care and non-health care settings
(A) Risk of influenza virus infection in health care setting, (B) risk of influenza virus infection in community setting, (C) risk of coronavirus infection (SARS, MERS, and COVID-19) in health care setting, and (D) risk of coronavirus infection (SARS, MERS, and COVID-19) in community setting. For studies that investigated mask effectiveness separately for usual care and aerosol-generating procedure (AGP) within the health care setting, results from usual care were preferentially used for the analysis. Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value.

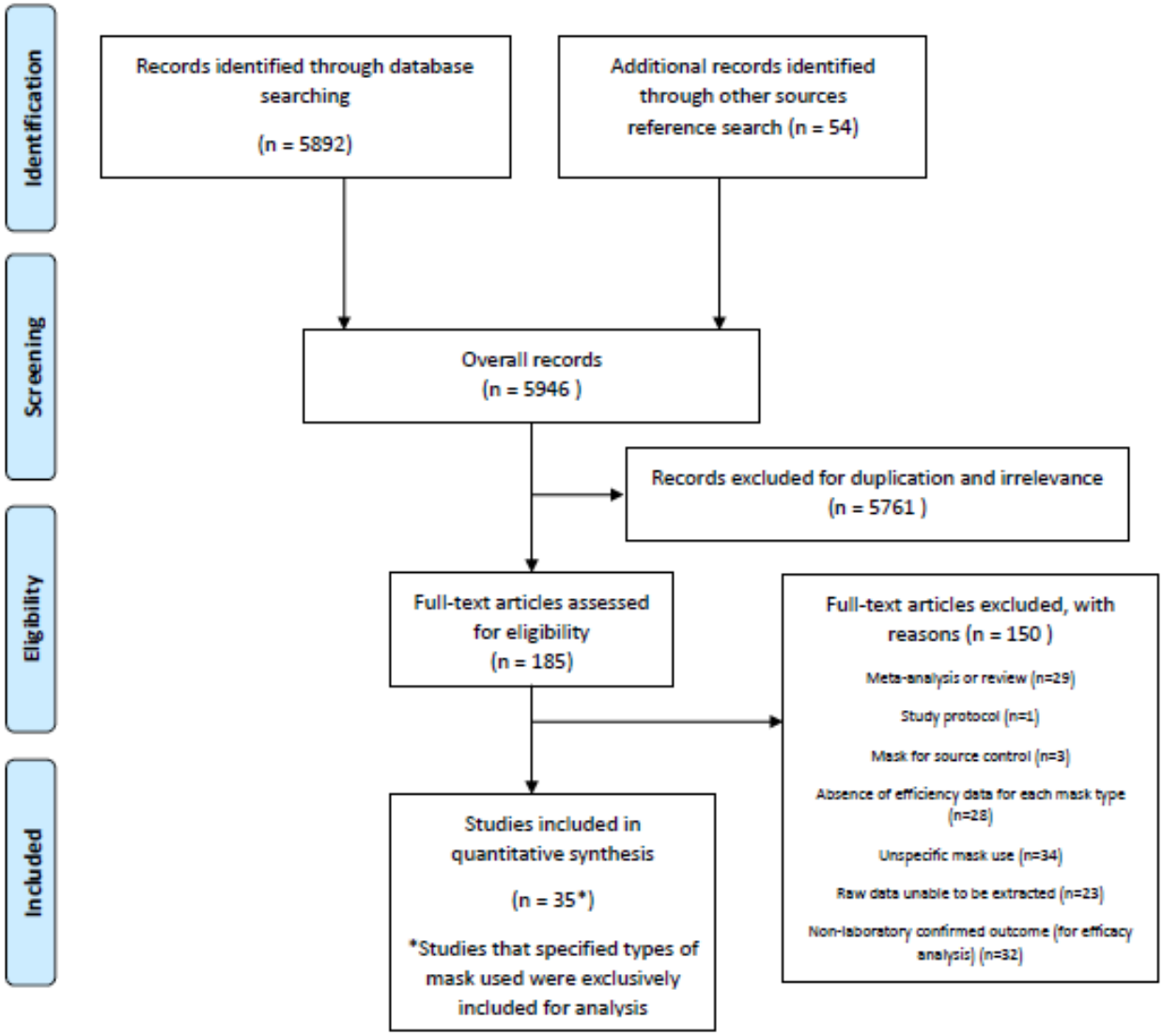
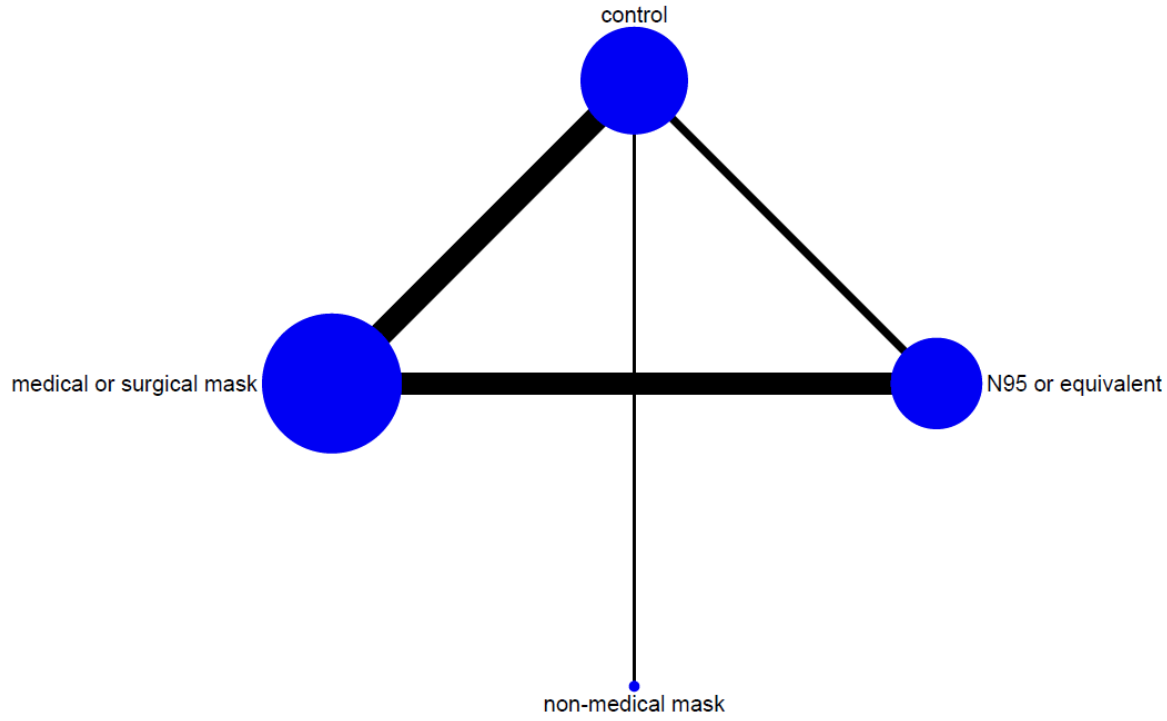
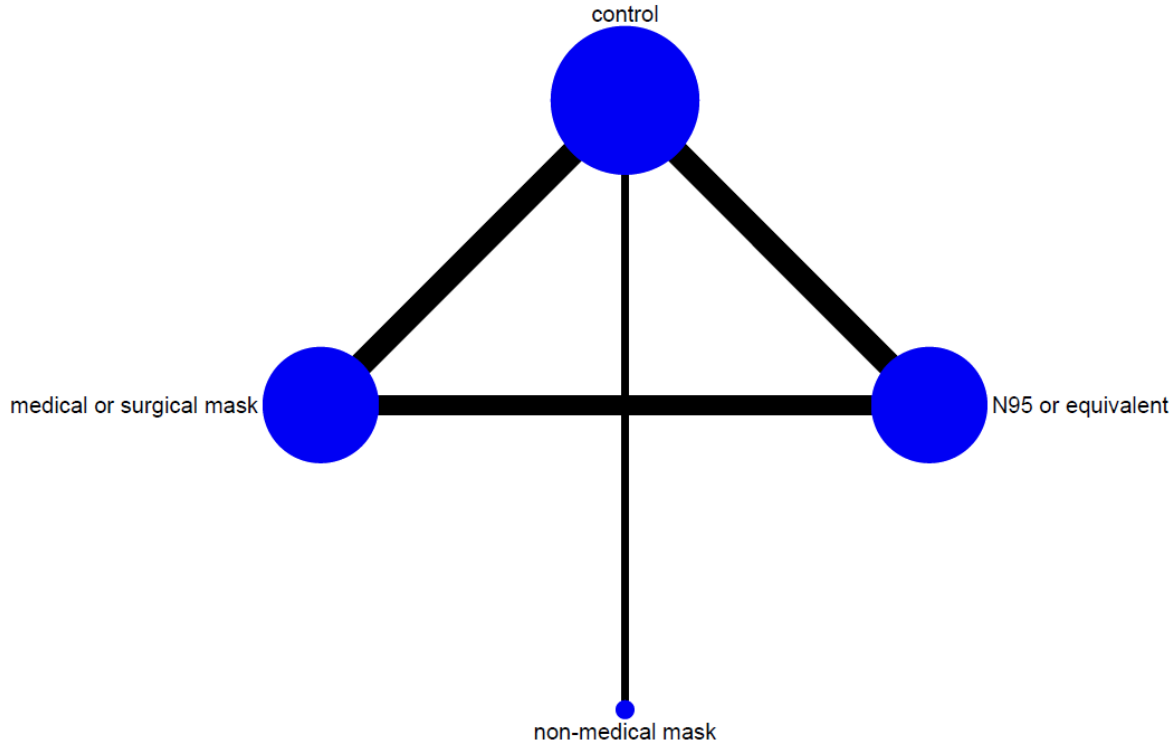


Fig. 1 PRISMA diagram showing selection of articles for pairwise and network meta-analysis

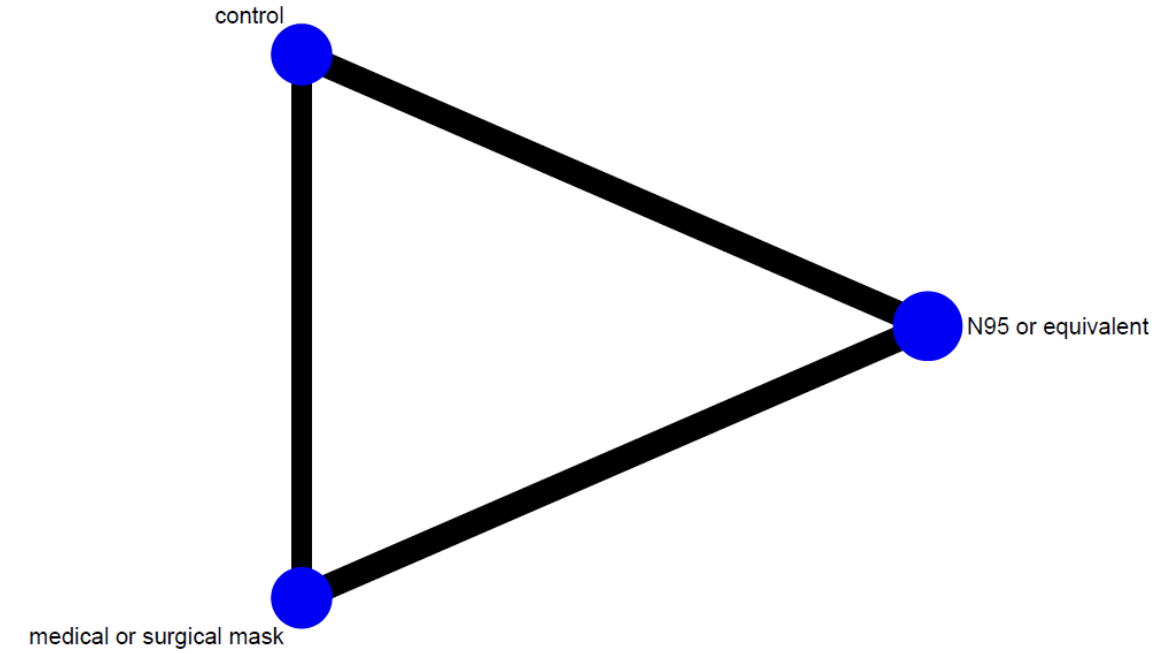
A Influenza virus



B Coronavirus (SARS, MERS, and COVID-19)



C SARS (SARS-CoV) and MERS(MERS-CoV)



D COVID-19 (SARS-CoV-2)

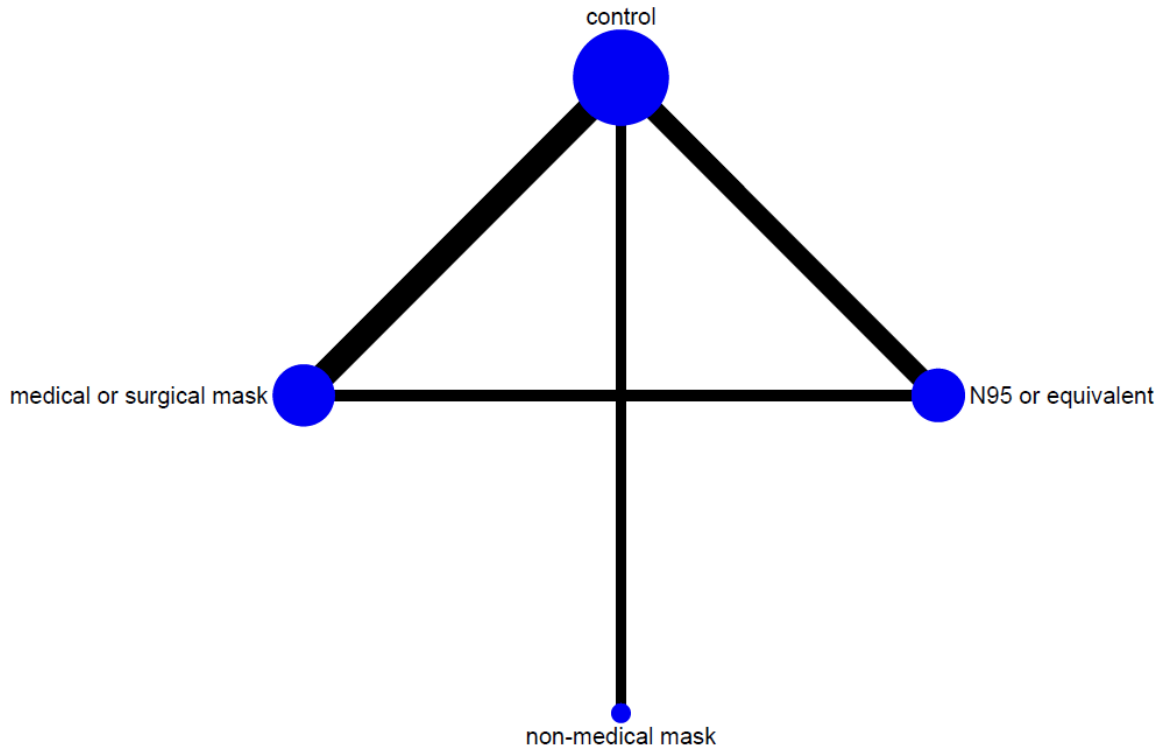


Fig. 2 Network of eligible comparisons for respiratory viruses
(A) Influenza virus. (B) Coronavirus (including SARS, MERS, and COVID-19). (C) SARS (SARS-CoV) and MERS (MERS-CoV). (D) COVID-19 (SARS-CoV-2). Control includes no mask wearing, or mask wearing at very low frequencies. Non-medical masks include cloths or cotton masks. Lines indicate direct comparisons of agents, and the thickness of line corresponds to the number of trials in the comparison. The size of node corresponds to the number of studies that involve the intervention. SARS = Severe Acute Respiratory

Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

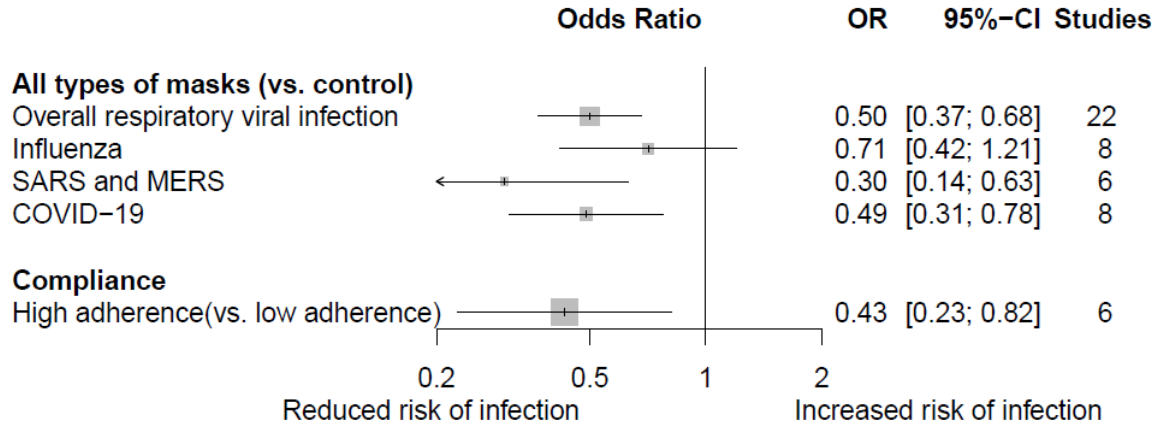
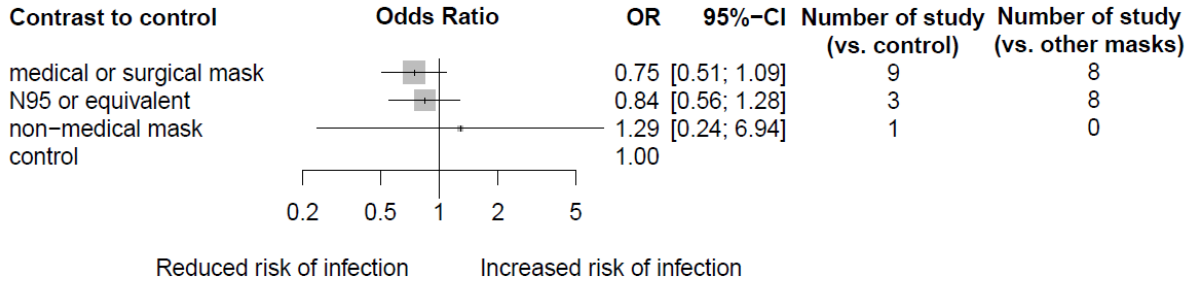
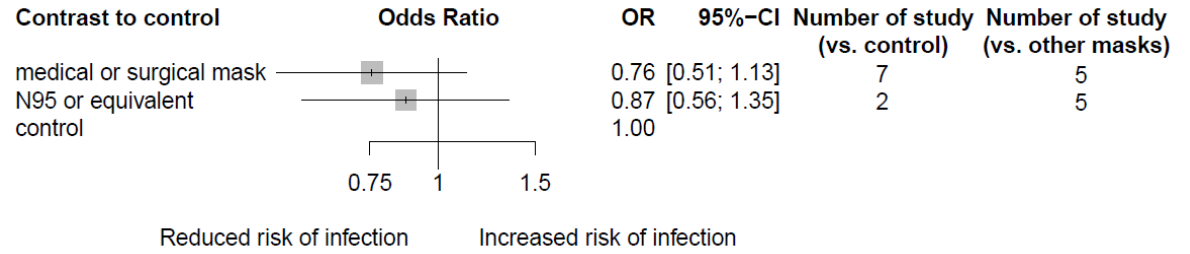


Fig. 3 Pairwise meta-analysis for the impact of wearing masks and adhering to mask behavior on the risk of infection to respiratory viral diseases
Control includes no mask wearing, or mask wearing at very low frequencies. SARS = Severe Acute Respiratory Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

A Influenza (overall)



B Influenza (RCTs)



C Influenza (observational studies)

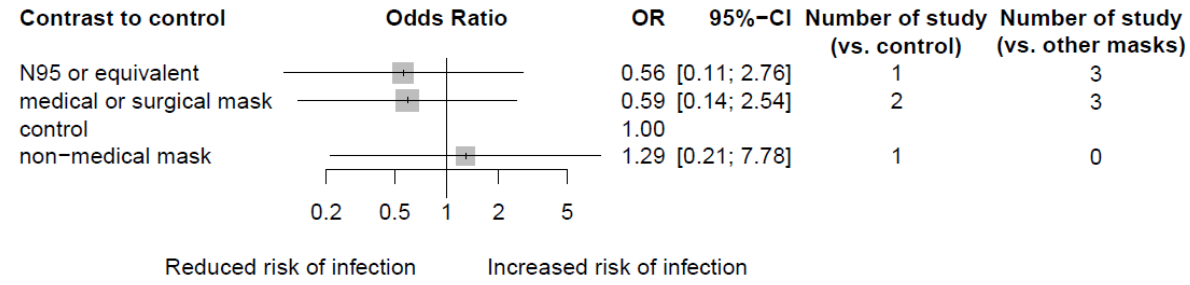
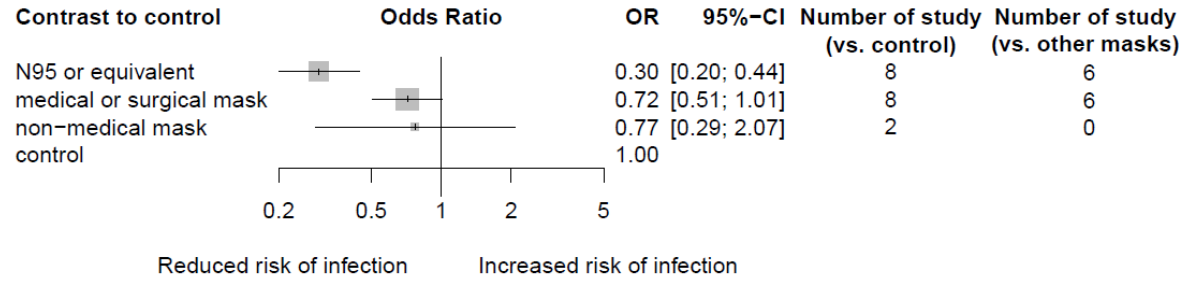
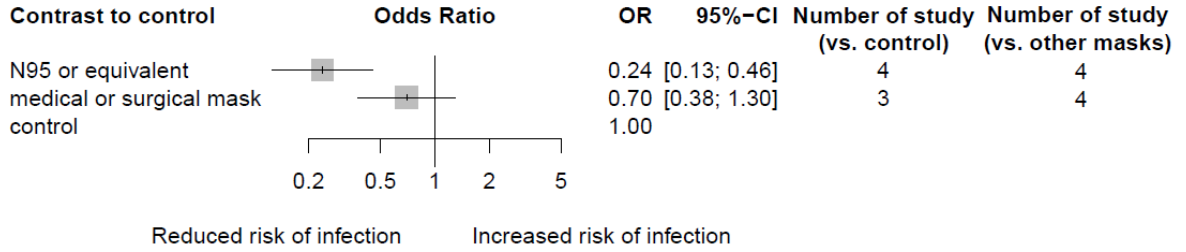


Fig. 4 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for influenza virus infections
Risk of laboratory-confirmed infection by influenza virus in (A) overall, (B) RCTs, and (C) observational studies. Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value. RCT = randomized controlled trial.

A Overall coronavirus (SARS, MERS, and COVID-19)



B SARS (SARS-CoV) and MERS(MERS-CoV)



C COVID-19 (SARS-CoV-2)

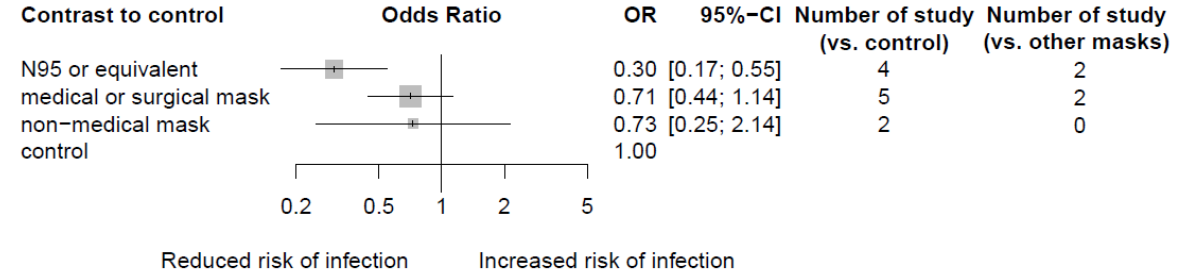
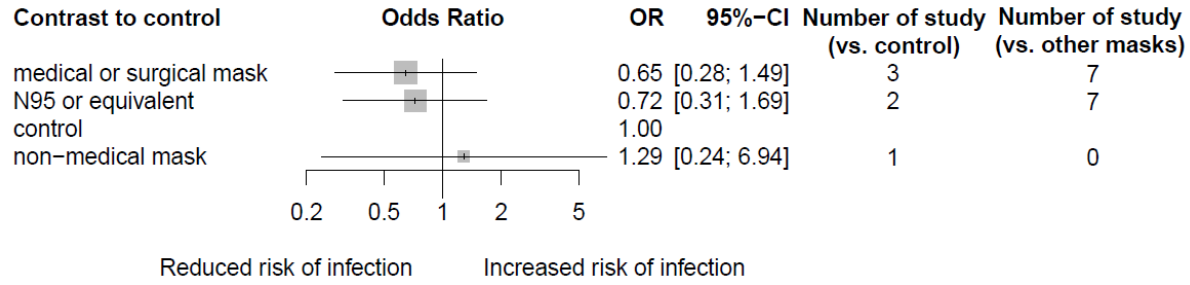
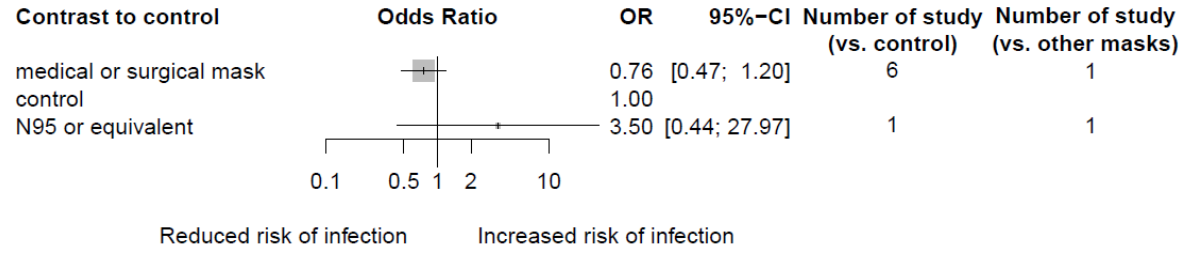


Fig. 5 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for coronavirus infections
Rate of diagnosed with coronavirus infection. (A) Risk of overall coronavirus infection (SARS, MERS, and COVID-19), (B) SARS (SARS-CoV and MERS(MERS-CoV), and (C) COVID-19 (SARS-CoV-2). Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value. SARS = Severe Acute Respiratory Syndrome. MERS = Middle East Respiratory Syndrome. COVID-19 = Coronavirus Disease-19.

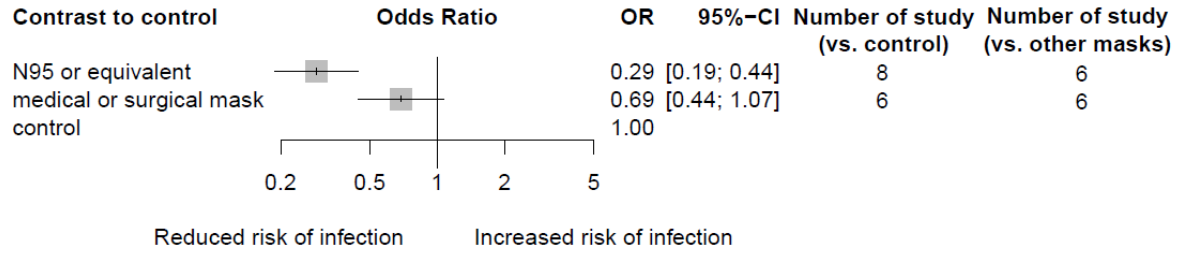
A Influenza virus infection in health care setting



B Influenza virus infection in community setting



C Coronavirus infection (SARS, MERS, and COVID-19) in health care setting



D Coronavirus infection (SARS, MERS, and COVID-19) in community setting

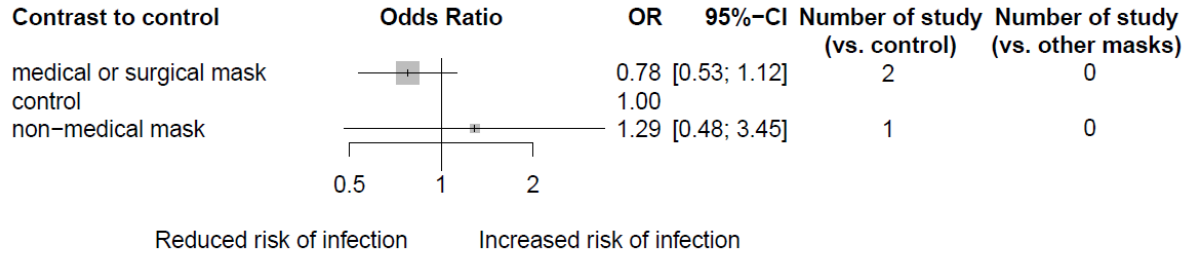


Fig. 6 Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for respiratory viral infections in health care and non-health care settings

(A) Risk of influenza virus infection in health care setting, (B) risk of influenza virus infection in community setting, (C) risk of coronavirus infection (SARS, MERS, and COVID-19) in health care setting, and (D) risk of coronavirus infection (SARS, MERS, and COVID-19) in community setting. For studies that investigated mask effectiveness separately for usual care and aerosol-generating procedure (AGP) within the health care setting, results from usual care were preferentially used for the analysis. Effect estimates are presented in odds ratios (ORs) with 95% CI. Facemasks are ranked by surface under the cumulative ranking curve (SUCRA) value.

Supplemental Appendix

Comparative effectiveness of N95, surgical or medical, and non-medical facemasks in protection of respiratory virus infection: a systematic review and network meta-analysis

Authors: Min Seo Kim, Dawon Seong, Han Li, Seo Kyoung Chung, Youngjoo Park, Minho Lee, Seung Won Lee, Dong Keon Yon, Jae Han Kim, Keum Hwa Lee, Marco Solmi, Elena Dragioti, Ai Koyanagi, Louis Jacob, Andreas Kronbichler, Kalthoum Tizaoui, Sarah Cargnin, Salvatore Terrazzino, Sung Hwi Hong, Ramy Abou Ghayda, Joaquim Radua, Hans Oh, Karel Kostev, Shuji Ogino, I-Min Lee, Edward Giovannucci, Yvonne Barnett, Laurie Butler, Daragh McDermott, Petre-Cristian Ilie, Jae Il Shin, Lee Smith

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Search strategy

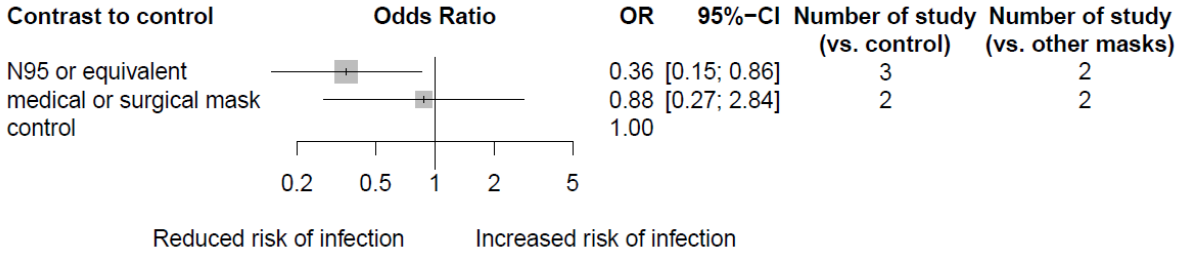
PubMed

(masks[MeSH] OR respirator*[tiab] OR facemask* OR N95[tiab] OR FFP2[tiab] OR P2[tiab] OR “medical mask*”[tiab] OR “surgical mask*”[tiab] OR fabric[tiab] OR cotton*[tiab] OR “cloth mask*”[tiab] OR “non-medical mask*”[tiab]) AND (Virus Diseases[MeSH] OR “respiratory infection*” OR “respiratory virus*” OR pneumonia[MeSH] OR influenza*[tiab] OR SARS[tiab] OR SARS-CoV-1[tiab] OR “severe acute respiratory syndrome”[tiab] OR MERS[tiab] OR MERS-CoV[tiab] OR “Middle East respiratory syndrome”[tiab] OR COVID-19[tiab] OR SARS-CoV-2[tiab] OR coronavirus[tiab]) NOT protocol*[ti] NOT comment*[tiab]

NOT autobiography[pt] NOT bibliography[pt] NOT biography[pt] NOT congresses[pt] NOT editorial[pt] NOT interview[pt] NOT lectures[pt] NOT animal[MeSH]

Search strategies used for other databases are fairly identical or slightly modified on the circumstance of each database.

Supplementary Figure 1. Network meta-analysis of different types of facemask compared with control (no mask or very low frequencies) for respiratory viral infections during aerosol-generating procedure (AGP).



Supplementary Table 1. Included studies in non-healthcare setting

Study	Design	Population	Intervention†	Outcome*
Non healthcare setting				
Maclyntre 2009[1]	RCT	Households with 2 or more healthy adults >=16 years of age, where the adults had known exposure within the household to a child with fever and respiratory symptoms (n=145) Sydney, Australia	Control=50 families, 100 adults Surgical mask intervention=47 families, 94 adults P2 mask intervention=46 families, 92 adults	Presence of ILI Laboratory confirmed viral-infection (influenza A and B and RSV, PIV types 1–3, picornaviruses (enteroviruses or rhinoviruses), adenoviruses, coronaviruses 229E and OC43, and hMPV)
Barasheed 2014[2]	RCT	Australian pilgrims at 2011 Hajj (n=164 in 22 tents, mask supervision randomized by tents)	Control=89 (unsupervised mask use, 36 were 'cases' with ILI, 53 were 'contact') Mask=75 (supervised mask use, 39 'cases' and 36 'contacts')	Syndromic ILI (less contacts became symptomatic in the 'mask' tents compared to the 'control' tents (31%(11/36) versus 53%(28/53), p= 0.04), however laboratory results did not show any difference between the two group) NAT-confirmed viral infection (surgical mask tent vs control tent)
Suess 2012[3]	Cluster randomized trial	84 households with an influenza positive index case in Berlin, Germany during 2009-2011	Control=30 households, 82 contacts Mask only=26 household, 69 contacts (Mask: surgical facemask)	qRT-PCR confirmed influenza infection Clinical ILI
Cowling 2008[4]	Cluster randomized	122 households with an ILI index subject (randomized by households)	Control (71 household, 205 contacts) Surgical face mask (21 households, 61 contacts)	Laboratory culture confirmed influenza in a household contact

	trial	Multivariate analysis		Clinically diagnosed influenza
Aiello 2012[5]	Cluster randomized trial	37 residence houses of the University of Michigan (1111 young adults) Randomized by residence house	Control (12 houses, 370 participants) Mask (13 houses, 392 participants)	Laboratory confirmed influenza Unadjusted model (RR as cumulative RR)
				Laboratory confirmed influenza Adjusted model (RR as cumulative RR)
Alfelali 2020[6]	Cluster-randomized trial	Hajj in Mina, Greater Makkah, Saudi Arabia among pilgrims from Saudi Arabia, Australia and Qatar over three Hajj seasons; From October 13 to 17 in 2013, October 2 to 6 in 2014, and September 22 to 26 in 2015, 7,687 adult participants(>=18 years old) from 318 tents were randomised to facemasks or no facemasks; 3,864 participants from 149 tents were assigned to the Facemask group and 3,823 participants from 169 tents to the Control group.	Surgical mask (Facemask group was provided with 50 surgical facemasks (3M™ Standard Tie-On surgical mask, Cat No: 1816) in addition to verbal and printed instructions about appropriate facemask usage. Pilgrims in the Control group were not provided with facemasks and instructions, but could use their own masks if they chose to do so)	Laboratory-confirmed viral respiratory tract illness
				Clinical respiratory illness
			Surgical mask use per protocol (including only participants allocated to the Facemask group who used facemasks daily, and participants allocated to the Control group who never used any facemasks)	Laboratory-confirmed viral respiratory tract illness
				Clinical respiratory illness
Doung-ngern 2020[7]	Case-control	1,050 asymptomatic participants who had contact with or were in the same location as a symptomatic COVID-19 patient from 1 through 31 March 2020 in Thailand (case=211, control=839) For mask use, control=834	Not wearing mask (102 in case, 500 in control) Wearing non-medical mask (25 in case, 77 in control) Wearing medical masks (72 in case, 209 in control)	SARS-CoV-2 infection (Individuals who had positive RT-PCR test results for SARS-CoV-2, officially confirmed and reported by Department of Disease Control, Ministry of Public Health, Thailand.)
Bundgaard 2020[8]	RCT	Community-dwelling adults (>=18 years old) without previous/current symptom or diagnosis of COVID-19, who reported being outside home more than 3 hours per day without occupational mask use in Denmark, April and May of 2020. (Recruitment through media advertisements and contacting private	Randomly assigned 1:1 to each group using computer algorithm Control group (n=2994) Surgical mask group(n=3030): instructed to wear mask when outside home during the next month, were provided with 50 surgical face masks (TYPE II EN 14683 [Abena]; filtration rate, 98%; made in China)	SARS-CoV-2 infection (positive result on oropharyngeal/nasal swab test, development of a positive SARS-CoV-2 IgM/IgG antibody test result, or a hospital-based diagnosis of

		companies and public organizations.)		SARS-CoV-2 infection)
†For observative studies, the compared groups (e.g. cases vs controls) are shown as intervention groups. * Detailed description given if needed. RCT: randomized controlled trial, ILI: influenza like illness, NAT: nucleic acid testing, qRT-PCR: quantitative reverse transcriptase-polymerase chain reaction				

Supplementary Table 2. Included studies in healthcare setting

Study	Design	Population	Intervention†	Outcome*
Health-care setting				
Radonovich 2019[9]	Cluster RCT (cluster randomized, multicenter, pragmatic effectiveness trial)	Health care workers in clinic or outpatient settings (n=4698) Study intervention sites included outpatient settings at: Children's Hospital Colorado (Aurora), Denver Health Medical Center (Denver, Colorado), Johns Hopkins Health System (Baltimore, Maryland), Michael E. DeBakey Veterans Affairs (VA) Medical Center (Houston, Texas), VA Eastern Colorado Healthcare System (Denver), Washington DC VA Medical Center, and VA New York Harbor Healthcare System (New York).	N95 respirators (n=2512) vs Medical masks (n=2668) N95 respirator models studied were the 3M Corporation 1860, 1860S, and 1870 (St Paul, Minnesota) and the Kimberly Clark Technol Fluidshield PFR95-270, PFR95-274 (Dallas, Texas); medical mask models were the Precept 15320 (Arden, North Carolina) and Kimberly Clark Technol luidshield 47107 (Dallas, Texas).	Incidence of laboratory confirmed influenza (primary outcome) : defined as detection of influenza A or B virus by RT-PCR 22 in an upper respiratory specimen collected within 7 days of symptom onset; detection of influenza from a randomly obtained swab from an asymptomatic participant; or influenza seroconversion (symptomatic or asymptomatic), defined as at least a 4-fold rise in hemagglutination inhibition antibody titers to influenza A or B virus between preseason and postseason serological samples deemed not attributable to vaccination. Acute respiratory illness events Laboratory-detected respiratory infection events : detection of a respiratory pathogen by PCR or serological evidence of infection with a respiratory pathogen during the study surveillance period (Respiratory pathogens assayed by PCR: Coxsackie/echoviruses, Coronavirus HKU1, Coronavirus NL63, Coronavirus OC43, Coronavirus 229E, Human metapneumovirus, Human rhinovirus, Influenza A, Influenza B, Parainfluenza virus type 1, Parainfluenza virus type 2, Parainfluenza virus type 3, Parainfluenza virus type 4a, Parainfluenza virus type 4b, Respiratory syncytial virus type A, Respiratory syncytial virus type B) Laboratory-confirmed respiratory illness : defined as self-reported acute respiratory illness plus the presence of at least 1 PCR–confirmed viral pathogen in a specimen collected from the upper respiratory tract within 7 days of the reported symptoms and/or at least a 4-fold rise from preintervention to postintervention serum antibody titers to influenza A or B virus Influenza-like illness : defined as temperature of at least 100°F (37.8°C) plus cough and/or a sore throat, with or without laboratory confirmation.

Loeb 2009[10]	RCT	Nurses from 8 centers in Ontario (n=446)	Surgical mask (n=225) vs N95 respiratory (n=221)	laboratory-confirmed influenza A or B infection (primary outcome) : detection of viral RNA using RT PCR from nasopharyngeal and flocked nasal specimens or at least a 4-fold rise in serum antibodies to circulating influenza strain antigens.
				Other laboratory confirmed respiratory illness (RT-PCR positive): parainfluenza virus types 1, 2, 3, and 4; respiratory syncytial virus types A and B; adenovirus; metapneumovirus; rhinovirus-enterovirus; and coronaviruses OC43, 229E, SARS, NL63, and HKU1.
				Influenza like illness : defined as the presence of cough and fever (temperature≥38°C)
				Physician visits for respiratory illness Work-related absenteeism
MacIntyre 2011↓[11]	RCT (randomized by hospital level)	HCWs in 15 Beijing hospitals (n-1441) during 2008-2009	All N95 (either fit-tested or non-fit tested) vs medical mask	Clinical respiratory illness : defined as two or more respiratory or one respiratory symptom and a systemic symptom
				Influenza like illness : defined as fever ≥38℃ plus one respiratory symptom (i.e. cough, runny nose, etc.)
				Laboratory-confirmed infection : detection of adenoviruses, human metapneumovirus, coronavirus 229E ⁄ NL63, parainfluenza viruses 1, 2 and 3, influenza viruses A and B, respiratory syncytial virus A and B, rhinovirus A⁄ B and coronavirus OC43⁄HKU1 by multiplex PCR
				Laboratory confirmed influenza A or B
	Not randomized control, convenience comparison	HCWs in 15 Beijing hospitals (n-1441) vs convenience group of no-mask (n=481)	All N95 Medical mask No mask	CRI
				ILI
				Laboratory-confirmed infection

				Laboratory confirmed influenza A or B
MacIntyre 2015[12]	Clustered RCT (randomized by hospital)	HCWs in 14 hospitals in Hanoi, Vietnam (n=1607)	Cloth mask (n=569) medical mask (n-580) Control (n=458)	CRI
				ILI
				Laboratory-confirmed viruses (RSVA/B, influenza A/H3N2, A(H1N1) and B viruses, hMPV; parainfluenza viruses 1–4 ; rhinoviruses, influenza C virus, SARS-CoV ; coronaviruses OC43, 229E, NL63 and HKU1 ; and adenoviruses and hBoV)
MacIntyre 2013[13]	Clustered RCT	HCWs in 19 Beijing hospitals (n=1669) during 2009-2010	Medical mask (n=572) All time N95 (n=581) Targeted (only use while aerosol generating procedures) N95(n=516)	CRI
				ILI
				Laboratory-confirmed viral respiratory infection in symptomatic subjects : defined as detection of adenoviruses; human metapneumovirus; coronaviruses 229E/NL63 and OC43/HKU1; parainfluenza viruses 1, 2, and 3; influenza viruses A and B; respiratory syncytial viruses A and B; or rhinoviruses A/B by NAT using a commercial multiplex PCR.
				Laboratory-confirmed influenza A or B in symptomatic subjects
				Laboratory-confirmed bacterial colonization in symptomatic subjects : defined as detection of Streptococcus pneumoniae, legionella, Bordetella pertussis, chlamydia, Mycoplasma pneumoniae, or Haemophilus influenzae type B by multiplex PCR.
Loeb 2004[14]	Cohort, retrospective	Critical care nurses in Hospital A, Toronto	N95 Surgical mask No mask	SARS cases (The case definitions are in accordance with the World Health Organization's case definitions)

Seto 2003[15]	Case-control	Hospital staffs in five Hong Kong hospitals (Case=13, infected staff Control=241, non-infected staff)	Masks (paper mask, surgical mask, N95)	SARS infection
Teleman 2004[16]	Case-control	HCWs in Tan Tock Seng Hospital, Singapore (Case=36: infected Control=50: non-infected)	Wearing N95 mask	SARS infection
Zhang 2012[17]	Case-control	HCWs in hospitals in Beijing, China (Case=51: infection Matched Control=204: non-infected)	Never wore a mask N95 mask Medical mask Cloth mask	H1N1 infection
Cheng 2010[18]	Case-control	Exposed persons(patients, and HCW) in hospital setting (n=836)	Exposed person wearing surgical mask during contact with the index case (n=836)	H1N1 infection
Chokephaibulkit 2012[19]	Cross-sectional	Healthcare professionals in Bangkok, Thailand (n=256)	Mask type used when caring for patients with suspected/confirmed 2009 H1N1 -N95 respirator -surgical mask Intervention by frequency	H1N1 Hemagglutination inhibition(HI) titer >=40

			of mask use (compliance) - All the time(>90-100%) - Most of the time(60-90%) - Sometimes (<60%)	
Wilder-Smith 2005[20]	Cohort	HCWs exposed to SARS patient in Singapore 45 positive with SARS serology	N95 Mask use	SARS-CoV-1 positive
Nishiura 2005[21]	Case-control	Healthcare staffs in Hanoi French Hospital (Case=38, Control=98)	Surgical mask use (N95 unavailable) Non-use	laboratory-confirmed SARS
Scales 2003[22]	Comparative NRS	31 healthcare workers who entered index patient's room (Mount Sinai Hospital, Toronto, Ontario, Canada)	-N95 -surgical mask Both mask groups wear gown and gloves.	SARS infection
Park 2016[23]	Case-control cohort	HCWs in a hospital isolation cohort and quarantine cohort (n=40; 5 case, 35 control)	Surgical mask (3 in case, 21 in control)	MERS (5 case, 23 control analysed in evaluating protection while contact)
Kim 2016[24]	Case-report	HCWs within 3-6 feet of the index MERS patient (n=9)	6 surgical mask, 1 N95 mask, 2 no mask	MERS
Alraddadi 2016[25]	cohort	HCWs in King Faisal Specialist Hospital and Research Center (Jeddah, Saudi Arabia) during May–	PPE use always vs sometimes/never in direct contact	MERS (MERS-CoV antibody seropositive)

		June 2014	- Medical mask - N95 respirator	
Wang 2020[26]	Retrospective-cohort	Medical staff worked during 2 to 22 January 2020 at six departments (Respiratory, Intensive Care Unit (ICU), Infectious Disease, Hepatobiliary Pancreatic Surgery, Trauma and Microsurgery and Urology) from Zhongnan Hospital of Wuhan University. (n=493)	N95 group(n=278) vs No mask group (n=215)	SARS-CoV-2 (confirmed cases)
Toyokawa 2011[27]	Cross-sectional	Healthcare workers in Kobe, Japan (n=269)	-Surgical masks -N95 respiratory	Laboratory confirmed influenza infection
Raboud 2010[28]	Retrospective cohort	HCWs who provided care to intubated SARS-1 patients in Canada (n=624, 26 was SARS-CoV-1 seropositive)	None (n=52) Surgical mask (n=30) N95 or equivalent (n=514)	SARS-CoV-1 seropositive
Chen Y 2020[29]	Cross-sectional cohort	105 HCWs exposed to 4 COVID-19 patients in Nanjing Drum Tower Hospital, China	Disposable non-surgical face mask wearing	SARS-CoV-2 seropositive (seropositive=18, seronegative=87)
Guo 2020[30]	Case control	Case=orthopedic surgeons and trainees who were infected with COVID-19 from December 31, 2019 to February 24, 2020 in the urban	Wearing N95 respirators	COVID-19 infection

		area of Wuhan (n=24) Control 1:2 matched control (n=48)		
Khalil 2020[31]	Cross-sectional comparative study	Physicians working at different health facilities in Bangladesh (98 COVID-19 positive physicians and 92 COVID-19 negative physicians enrolled)	N95 mask use while performing AGP (36 in case, 56 in control) Medical mask/surgical mask during usual care (89 in case, 85 in control)	COVID-19 infection
Khurana 2020[32]	Case-control	HCWs in a tertiary level hospital in Delhi (COVID positive=94 HCWs, matched control COVID negative=87 HCWs)	Minimum level of protection - N95 (29 in case, 50 in control) - 3-Ply mask (60 in case, 30 in control) - Bandana (5 in case, 7 in control)	COVID-19 infection
Akinbami 2020[33]	Cross-sectional	Adults (>=18yrs old) who worked onsite in a first response, hospital, or public safety setting (n=16397)	N95 respirator use all the time Surgical facemask use all the time	SARS-CoV-2 seroprevalence (SARS-CoV-2 antibody testing using Ortho Clinical Diagnostics VITROS Immunodiagnostic Products Anti-SARS-CoV-2 IgG Test)
Kumar 2020[34]	Cross-sectional	50 HCWs quarantined following exposure to confirmed or suspected COVID-19 cases or due to ILI development	No mask(n=10) N95(n=29) Surgical mask(n=11)	COVID-19 positive by RT-PCR
Sims 2020[35]	Prospective cohort	Employees of Beaumont Health (n=20614)	N95/PAPR	COVID-19 seropositivity

			Surgical mask/other Not wearing mask	(SARS-CoV-2 IgG assay EUROIMMUN)

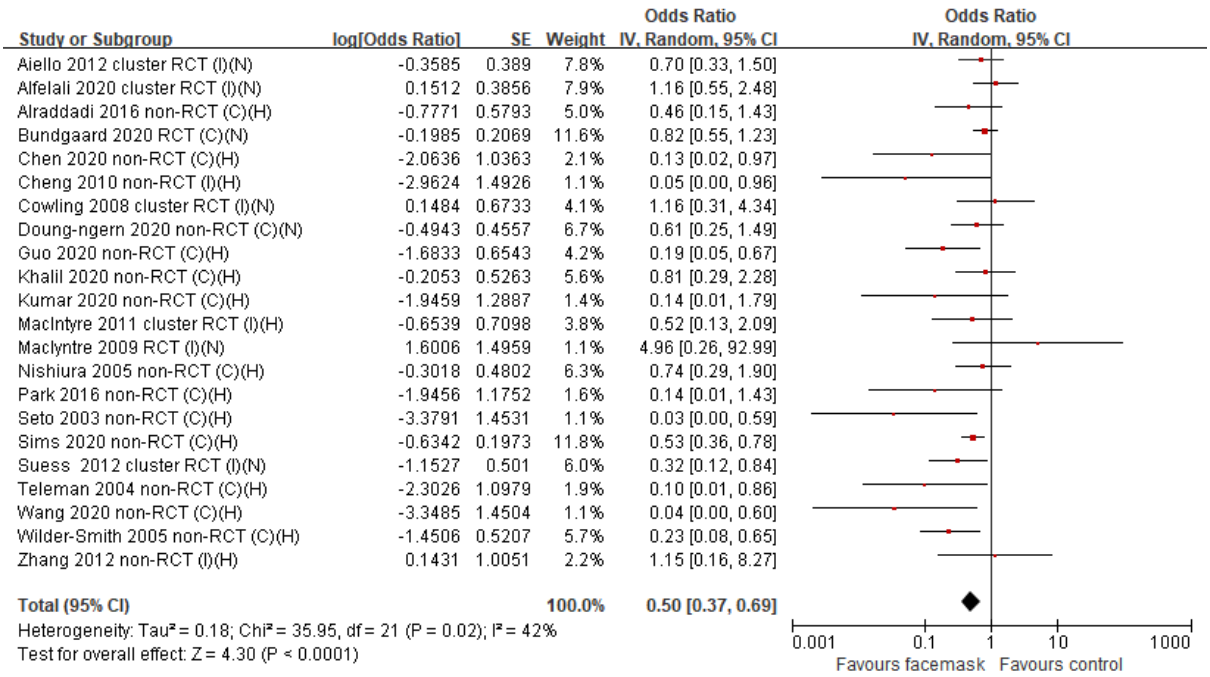
†For observative studies, the compared groups (e.g. cases vs controls) are shown as intervention groups. When more than two groups were compared, intervention is shown as list of intervention groups. When two groups were compared, intervention is shown as either comparison (A vs B) or single intervention (control not shown).*Detailed description given if needed. ⸸Two comparison was done with different study design.

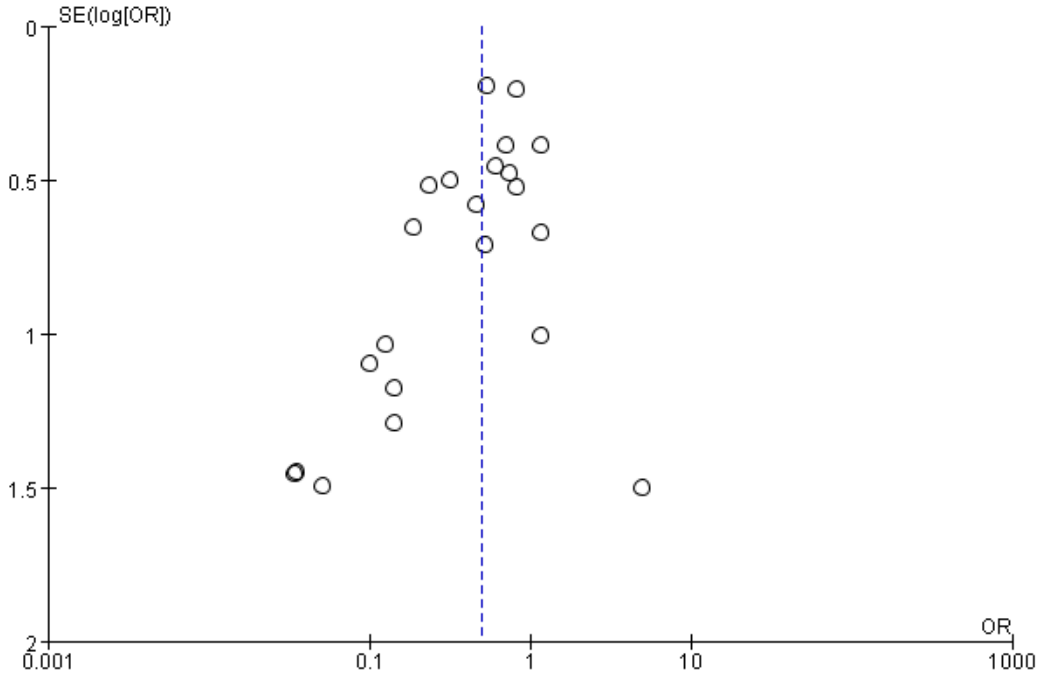
RCT: randomized controlled trial, CRI: clinical respiratory illness, ILI: influenza like illness, NAT: nucleic acid testing, qRT-PCR: quantitative reverse transcriptase-polymerase chain reaction, PCR: polymerase chain reaction, HCW: health care worker

1) All types of masks (vs. control) :

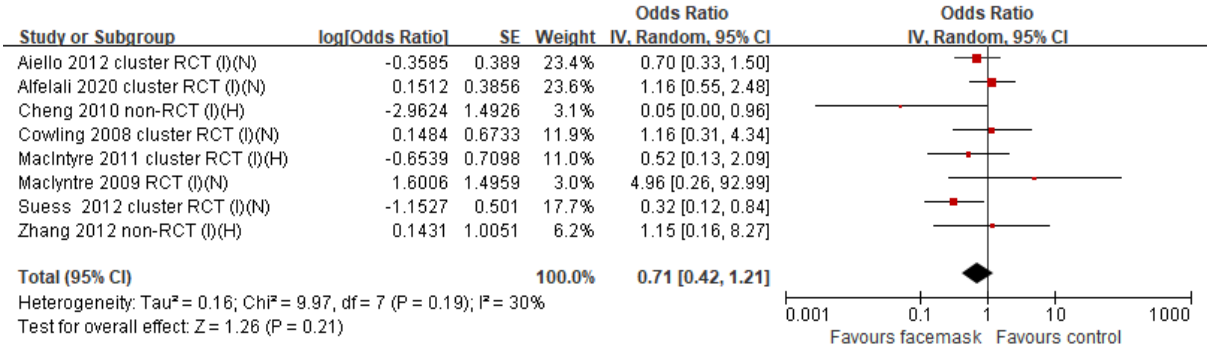
information next to the author name – RCT: randomized controlled trial, (I): influenza virus infection, (C): coronavirus infection (SARS, MERS, COVID-19), (H): healthcare settings, (N): non-healthcare settings.

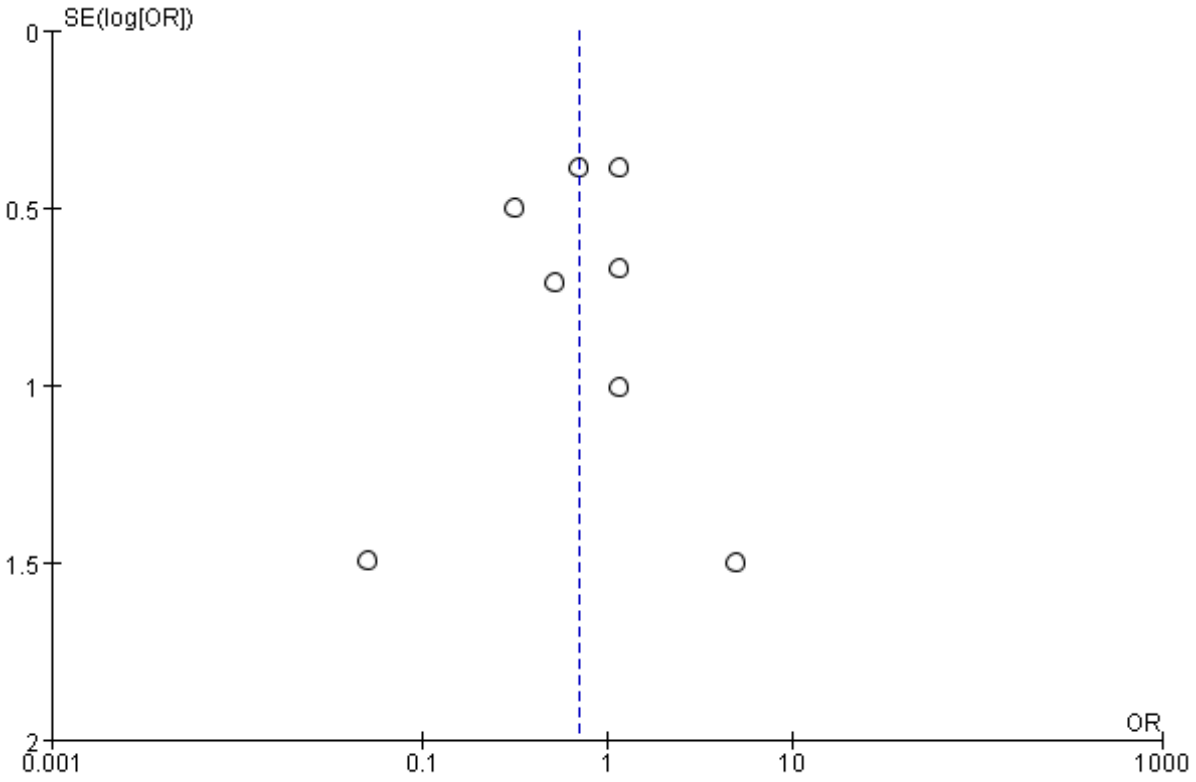
A. Overall respiratory viral infection



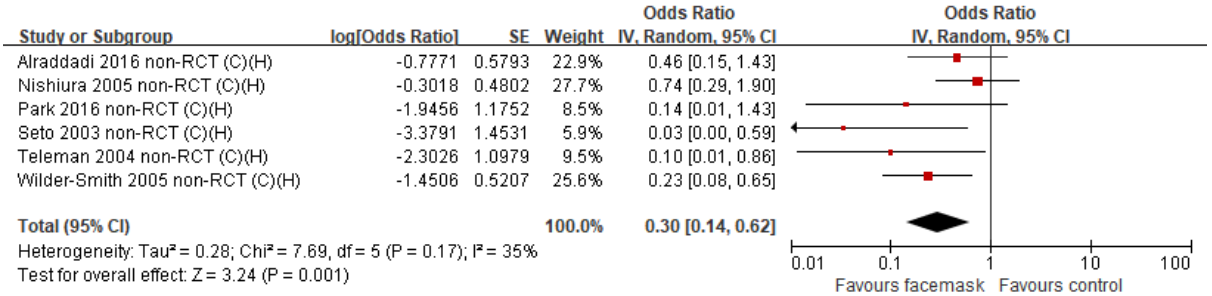


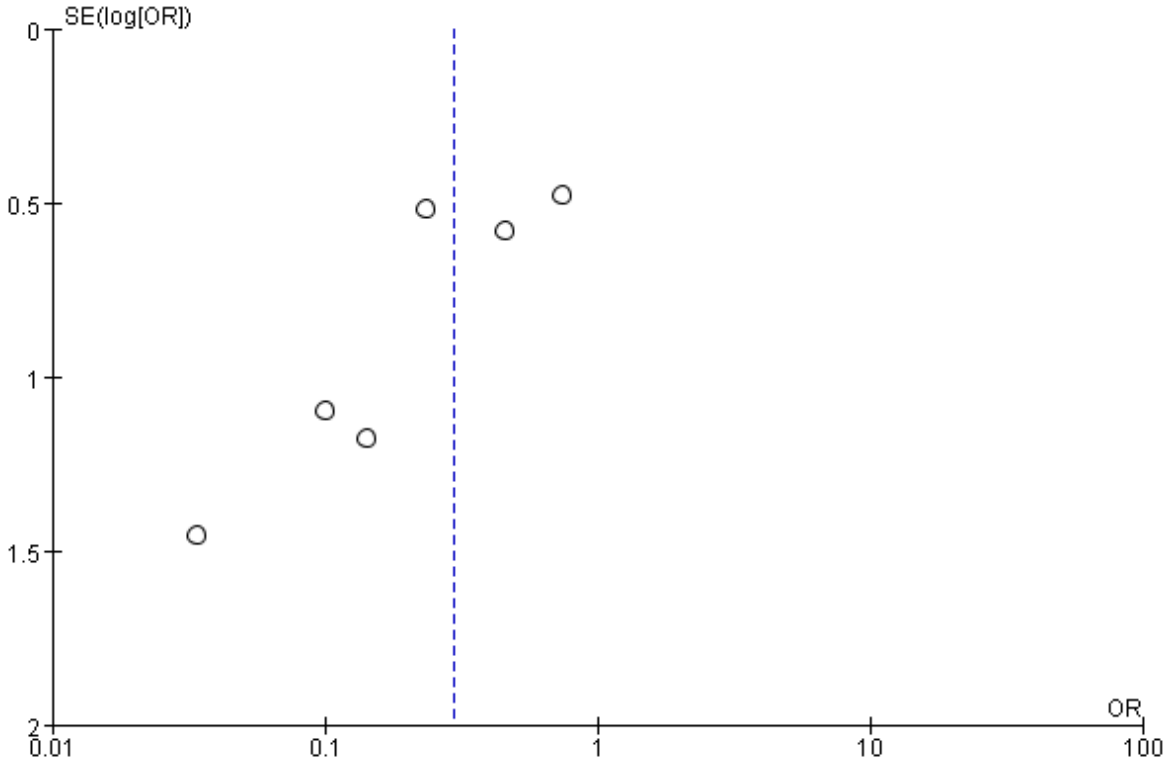
B. Influenza





C. SARS and MERS

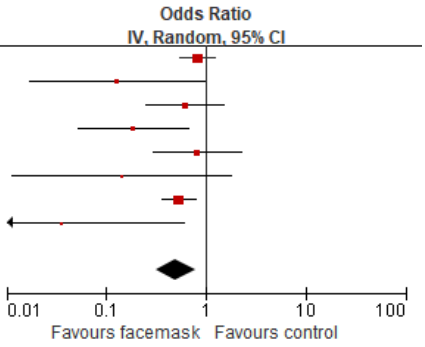


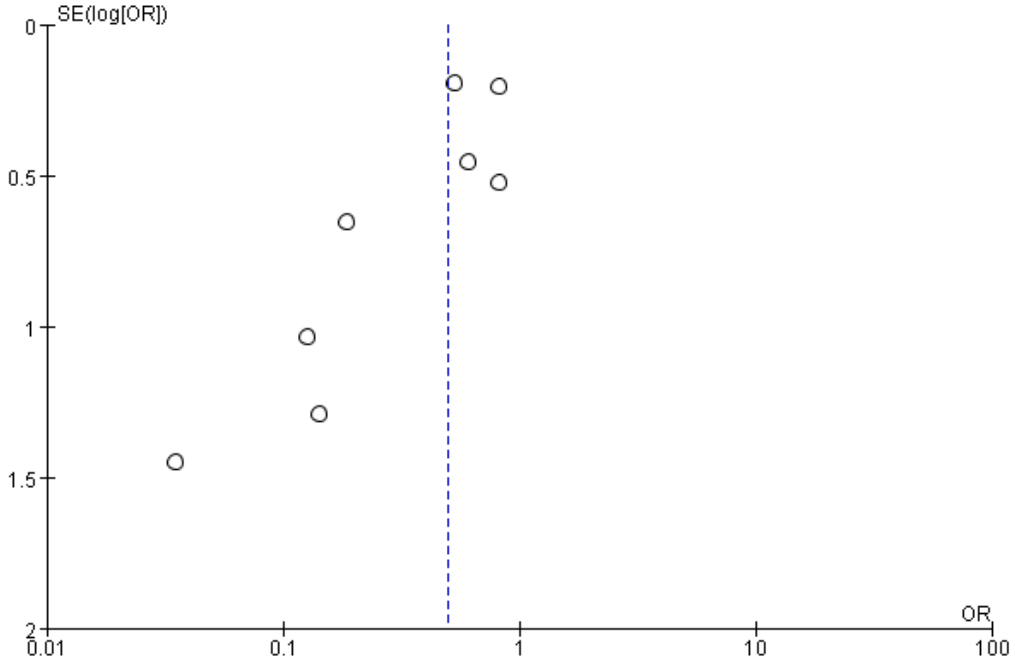


D. COVID-19

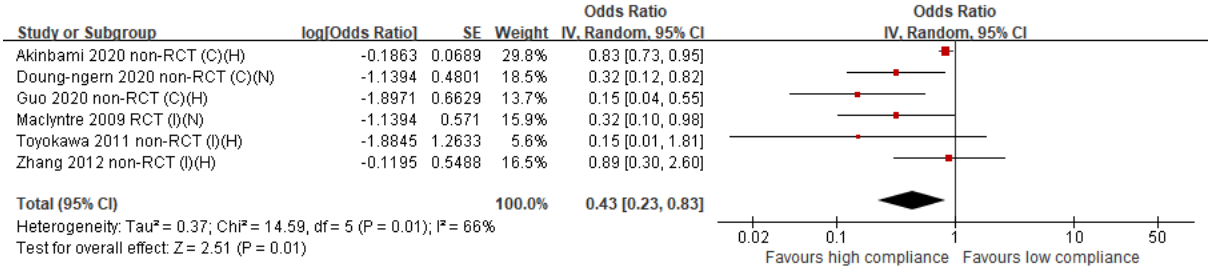
Study or Subgroup	log[Odds Ratio]	SE	Weight	Odds Ratio IV, Random, 95% CI
Bundgaard 2020 RCT (C)(N)	-0.1985	0.2069	26.8%	0.82 [0.55, 1.23]
Chen 2020 non-RCT (C)(H)	-2.0636	1.0363	4.3%	0.13 [0.02, 0.97]
Doung-ngern 2020 non-RCT (C)(N)	-0.4943	0.4557	14.7%	0.61 [0.25, 1.49]
Guo 2020 non-RCT (C)(H)	-1.6833	0.6543	9.1%	0.19 [0.05, 0.67]
Khalil 2020 non-RCT (C)(H)	-0.2053	0.5263	12.3%	0.81 [0.29, 2.28]
Kumar 2020 non-RCT (C)(H)	-1.9459	1.2887	2.9%	0.14 [0.01, 1.79]
Sims 2020 non-RCT (C)(H)	-0.6342	0.1973	27.4%	0.53 [0.36, 0.78]
Wang 2020 non-RCT (C)(H)	-3.3485	1.4504	2.4%	0.04 [0.00, 0.60]
Total (95% CI)			**100.0%**	**0.49 [0.31, 0.78]**

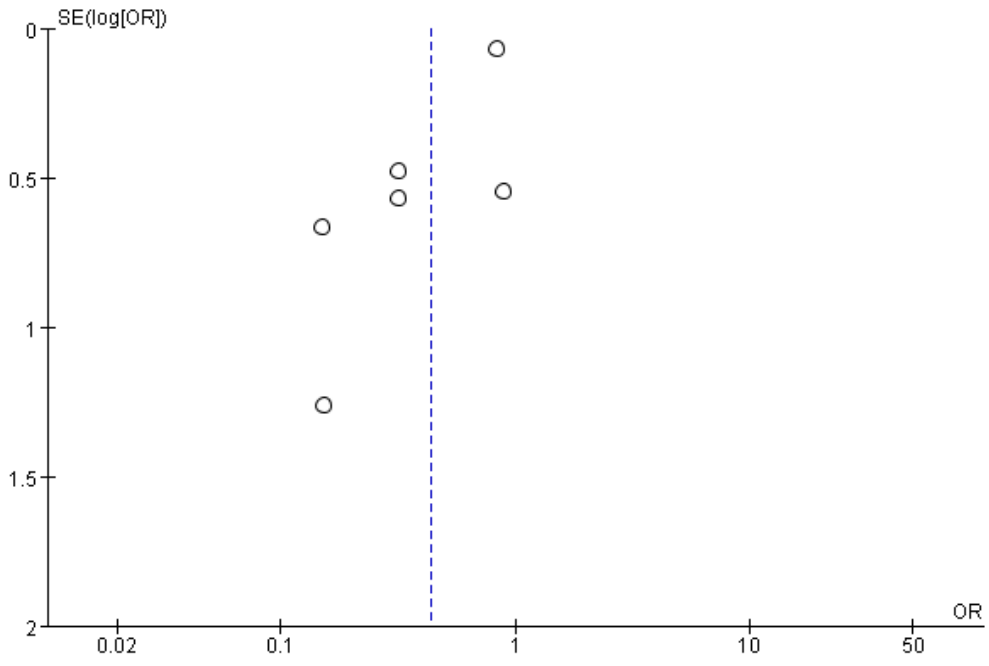
Heterogeneity: Tau² = 0.16; Chi² = 13.51, df = 7 (P = 0.06); I² = 48%
Test for overall effect: Z = 3.05 (P = 0.002)





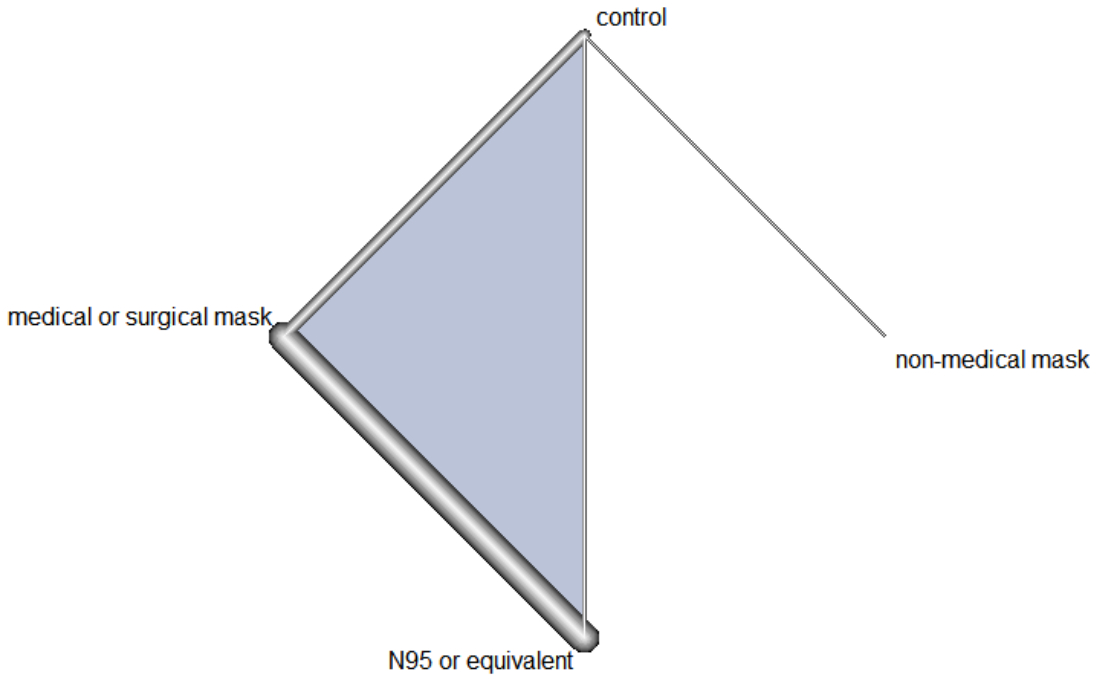
2) Compliance



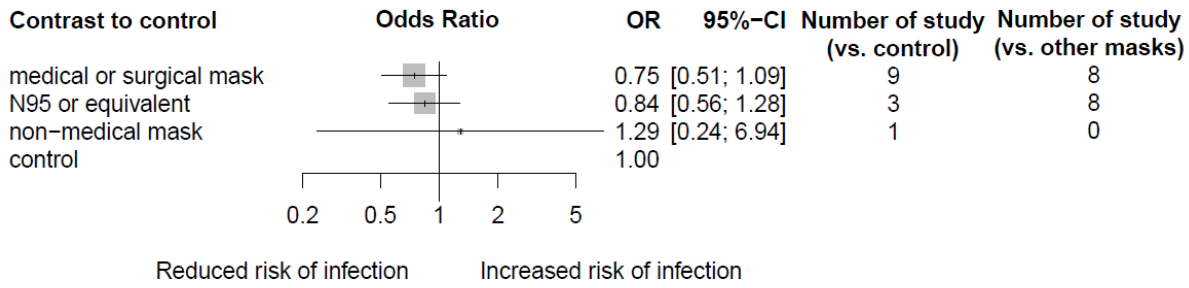


3) Overall Influenza (RCT + observational studies)

A. Network plot



B. Forest plot



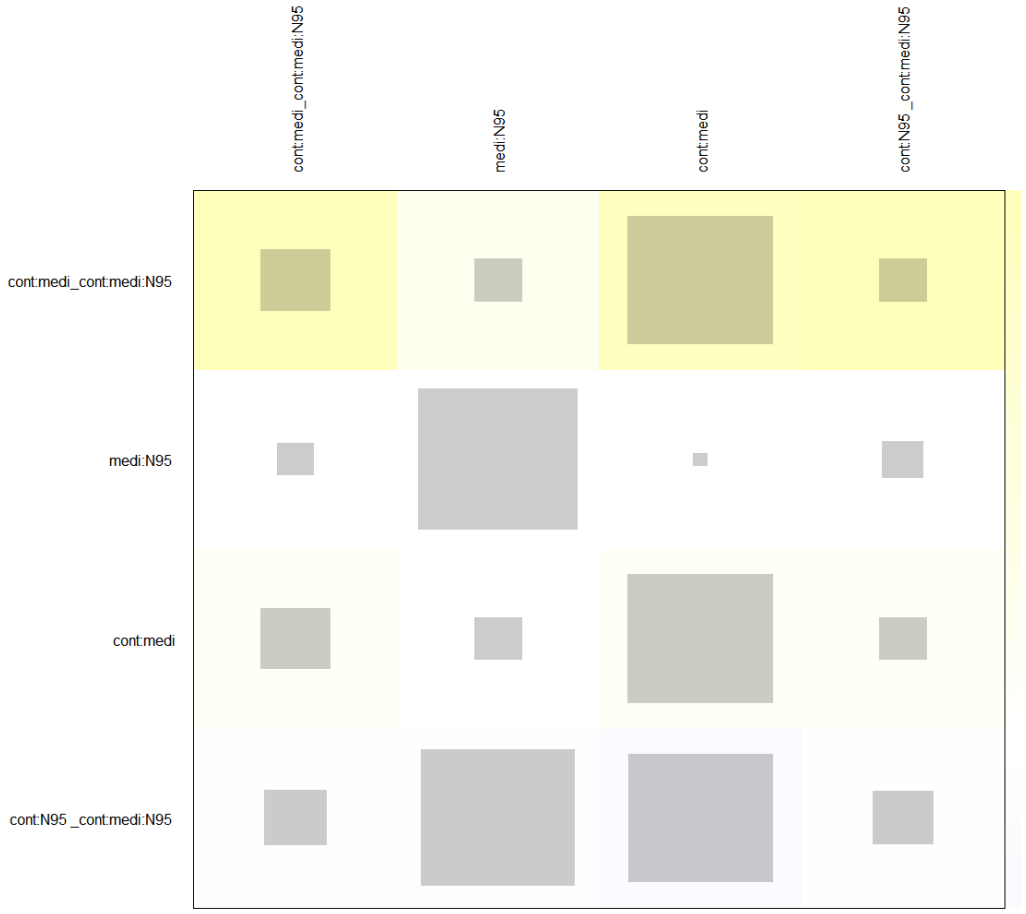
C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 0.56, p value = 0.7547

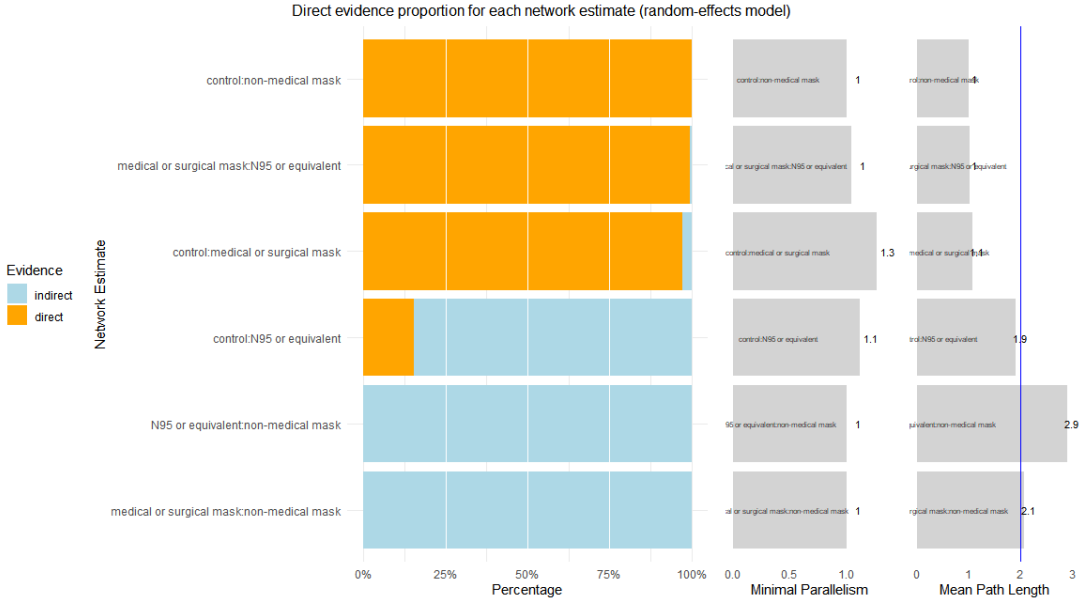
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0; tau = 0; I^2 = 0% [0.0%; 47.1%]

E. Net heat plot

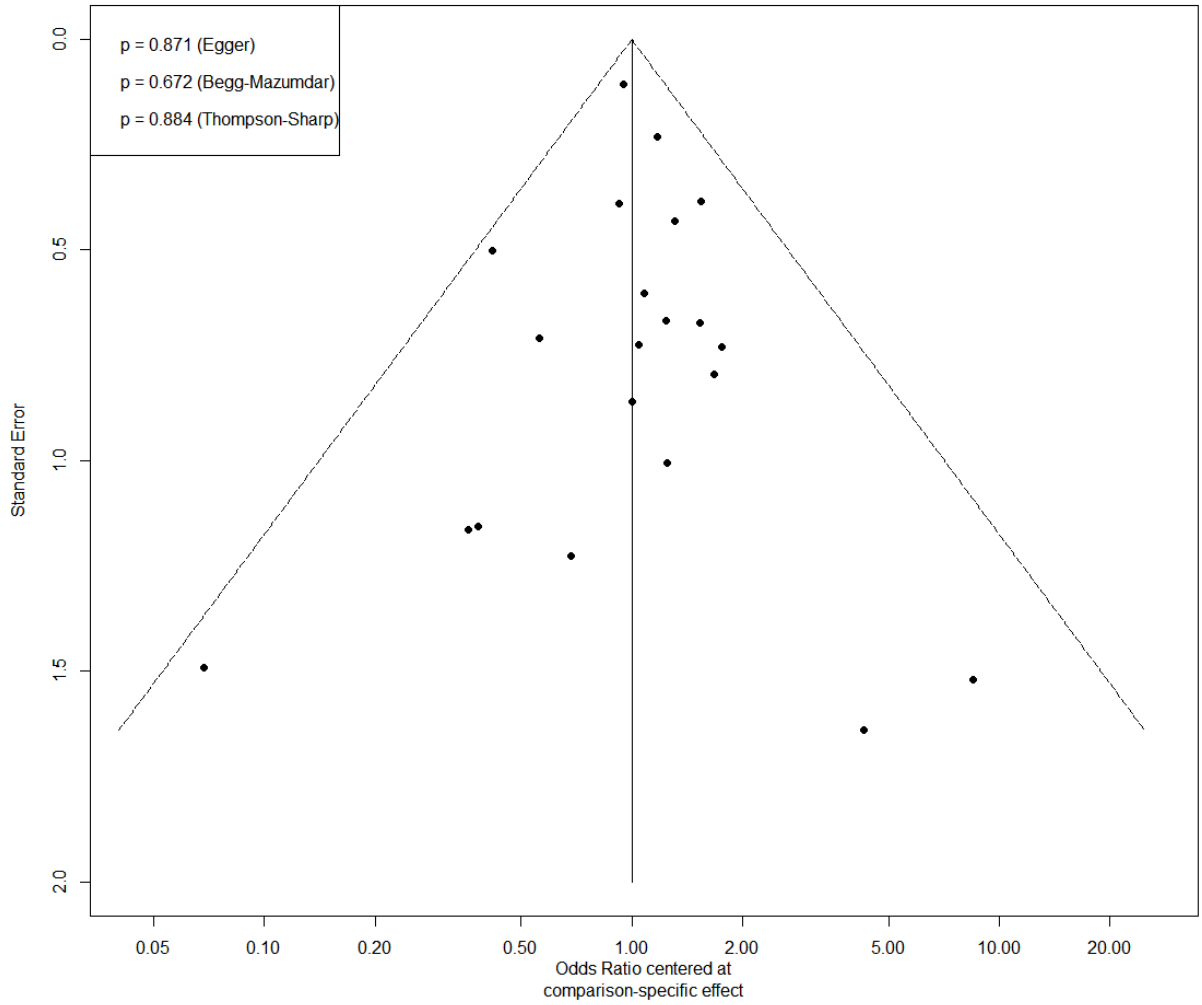


F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



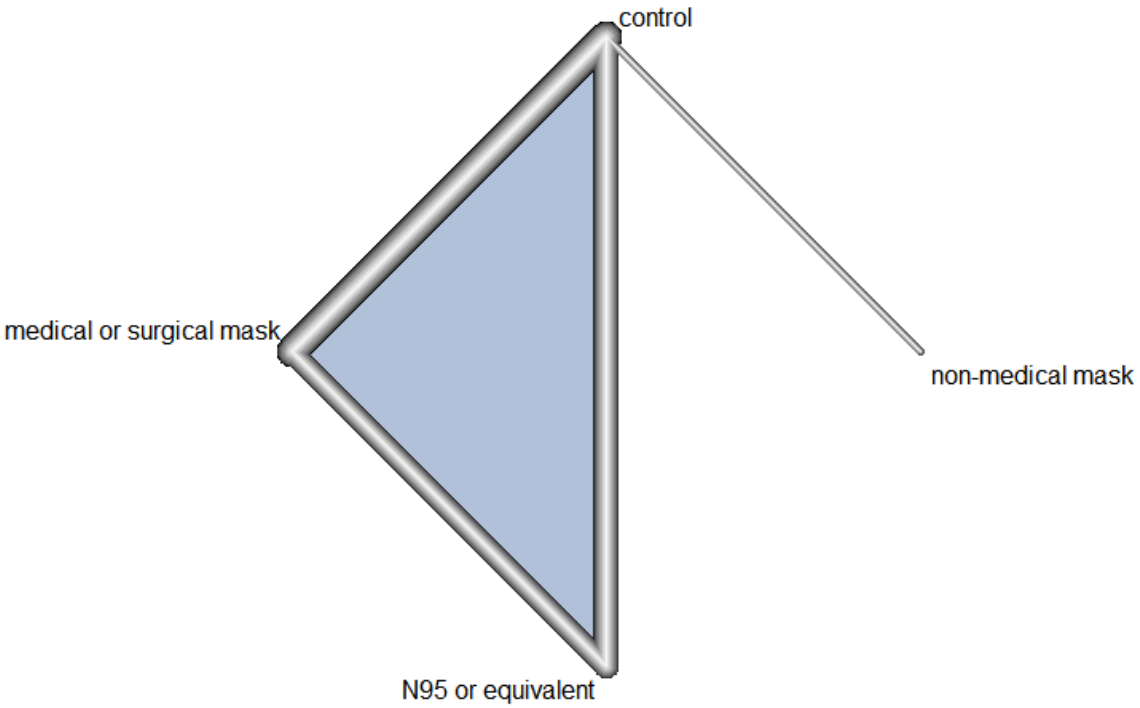
H. League table

medical or surgical mask	0.89 [0.74 ;1.06]	.	0.75 [0.51 ;1.11]
0.88 [0.74 ;1.05]	N95 or equivalent	.	0.93 [0.32 ;2.68]
0.58 [0.10 ;3.26]	0.66 [0.12 ;3.73]	non-medical mask	1.29 [0.24 ;6.94]
0.75 [0.51 ;1.09]	0.84 [0.56 ;1.28]	1.29 [0.24 ;6.94]	control

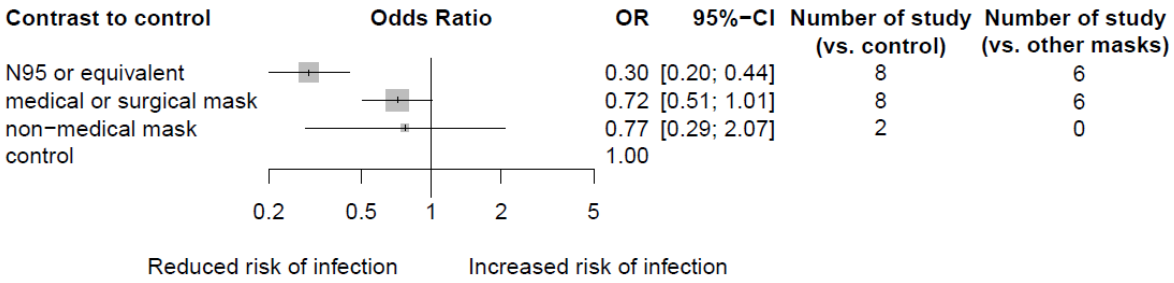
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

4) Overall coronavirus (SARS, MERS, COVID-19)

A. Network plot



B. Forest plot



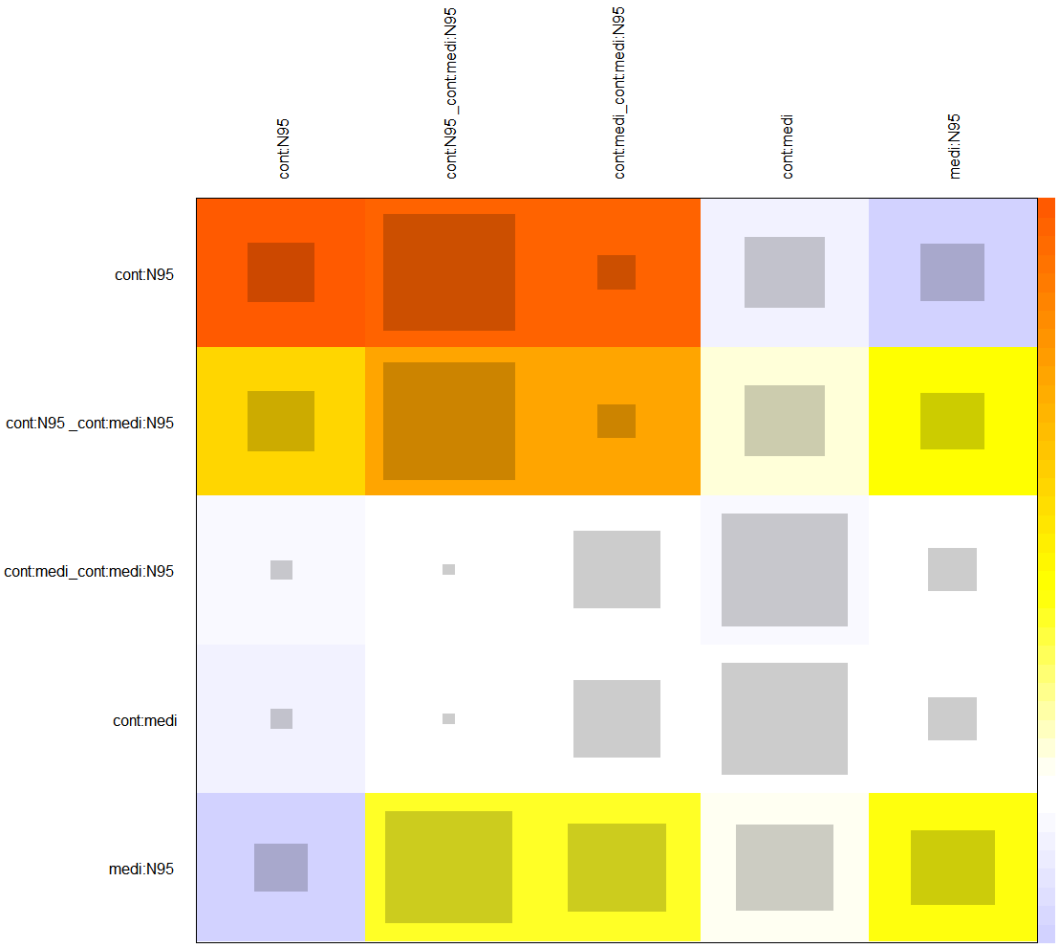
C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 12.11, p value = 0.007

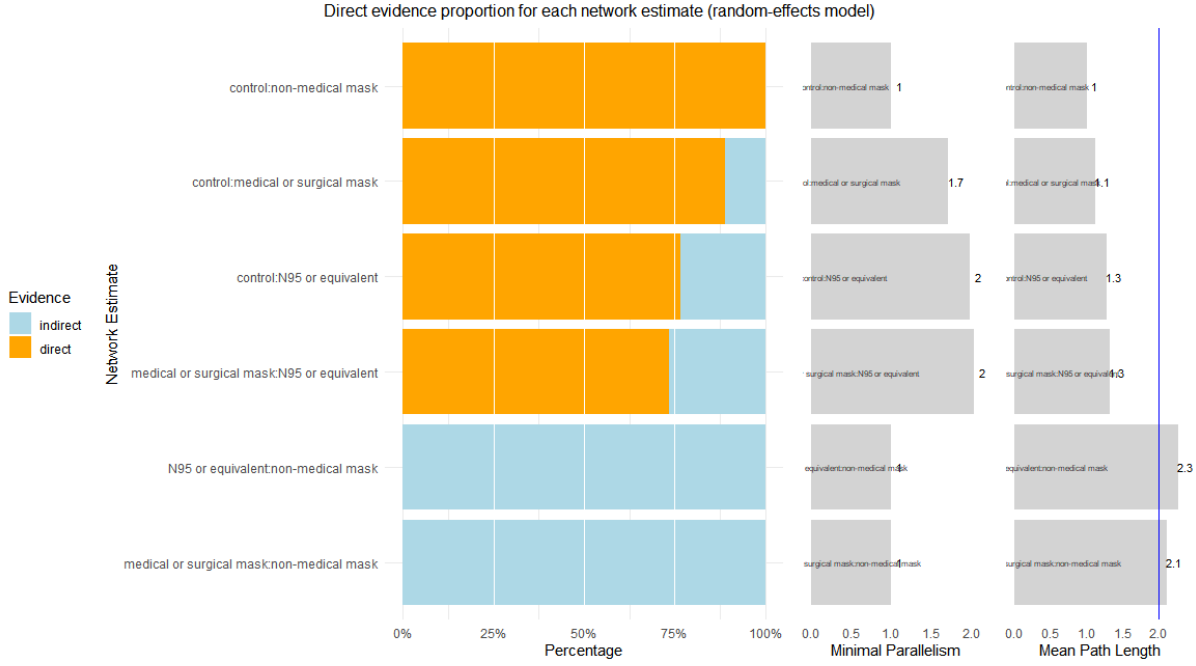
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0.0747; tau = 0.2732; I^2 = 22.3% [0.0%; 54.8%]

E. Net heat plot

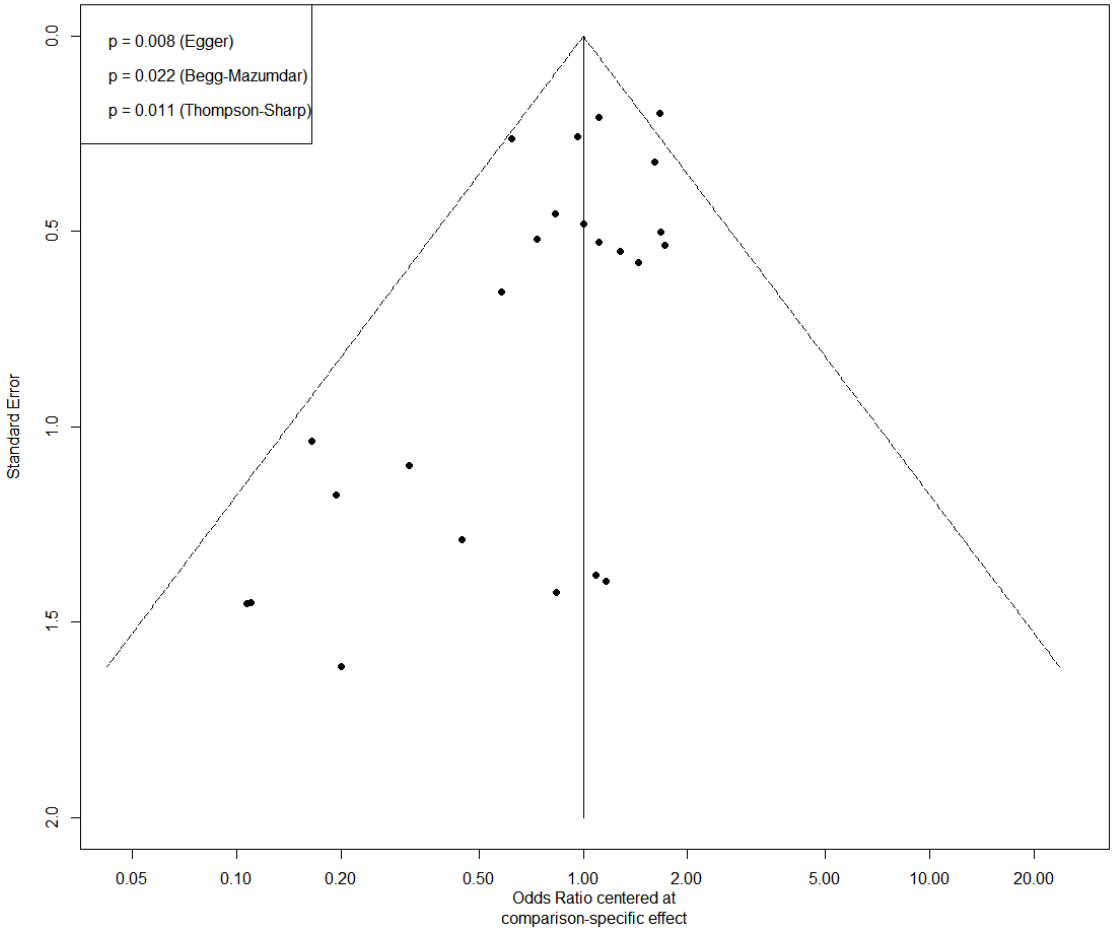


F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



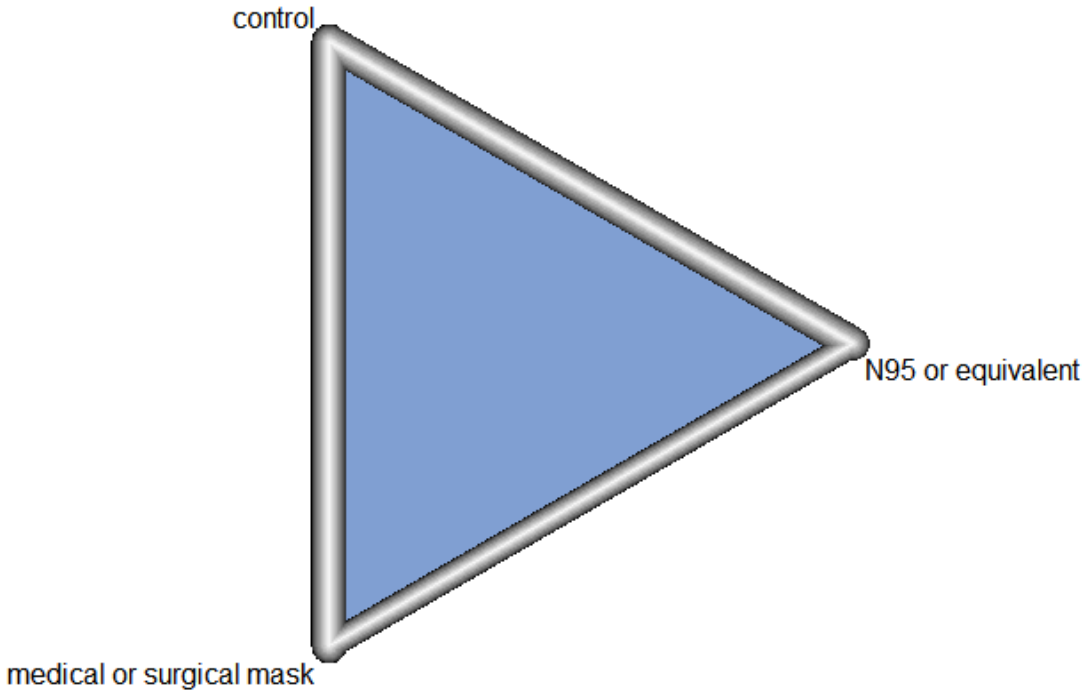
H. League table

N95 or equivalent	**0.46 [0.29 ;0.75]**	.	**0.32 [0.20 ;0.50]**
0.42 [0.28 ;0.63]	medical or surgical mask	.	0.74 [0.51 ;1.06]
0.39 [0.13 ;1.12]	0.93 [0.33 ;2.64]	non-medical mask	0.77 [0.29 ;2.07]
0.30 [0.20 ;0.44]	0.72 [0.51 ;1.01]	0.77 [0.29 ;2.07]	control

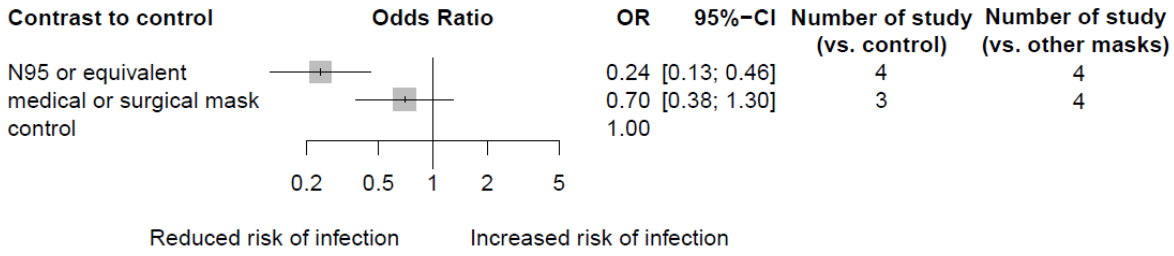
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

5) SARS and MERS

A. Network plot



B. Forest plot



C. Inconsistency

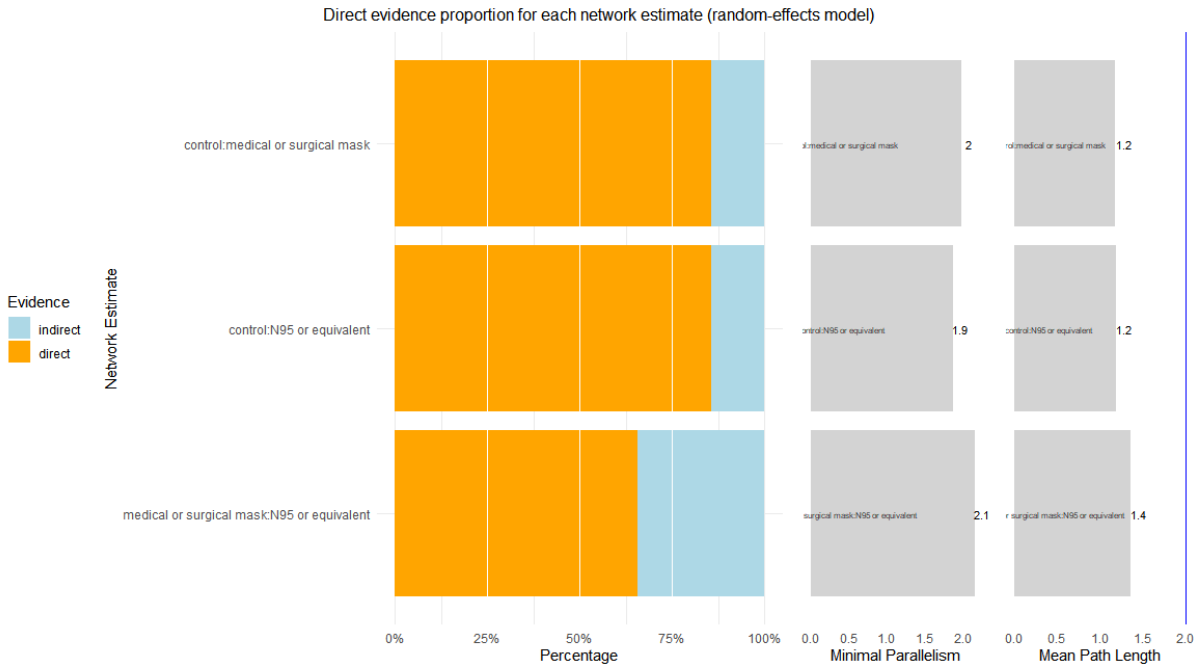
i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 2.53, p value = 0.4707

D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0; tau = 0; I^2 = 0% [0.0%; 53.6%]

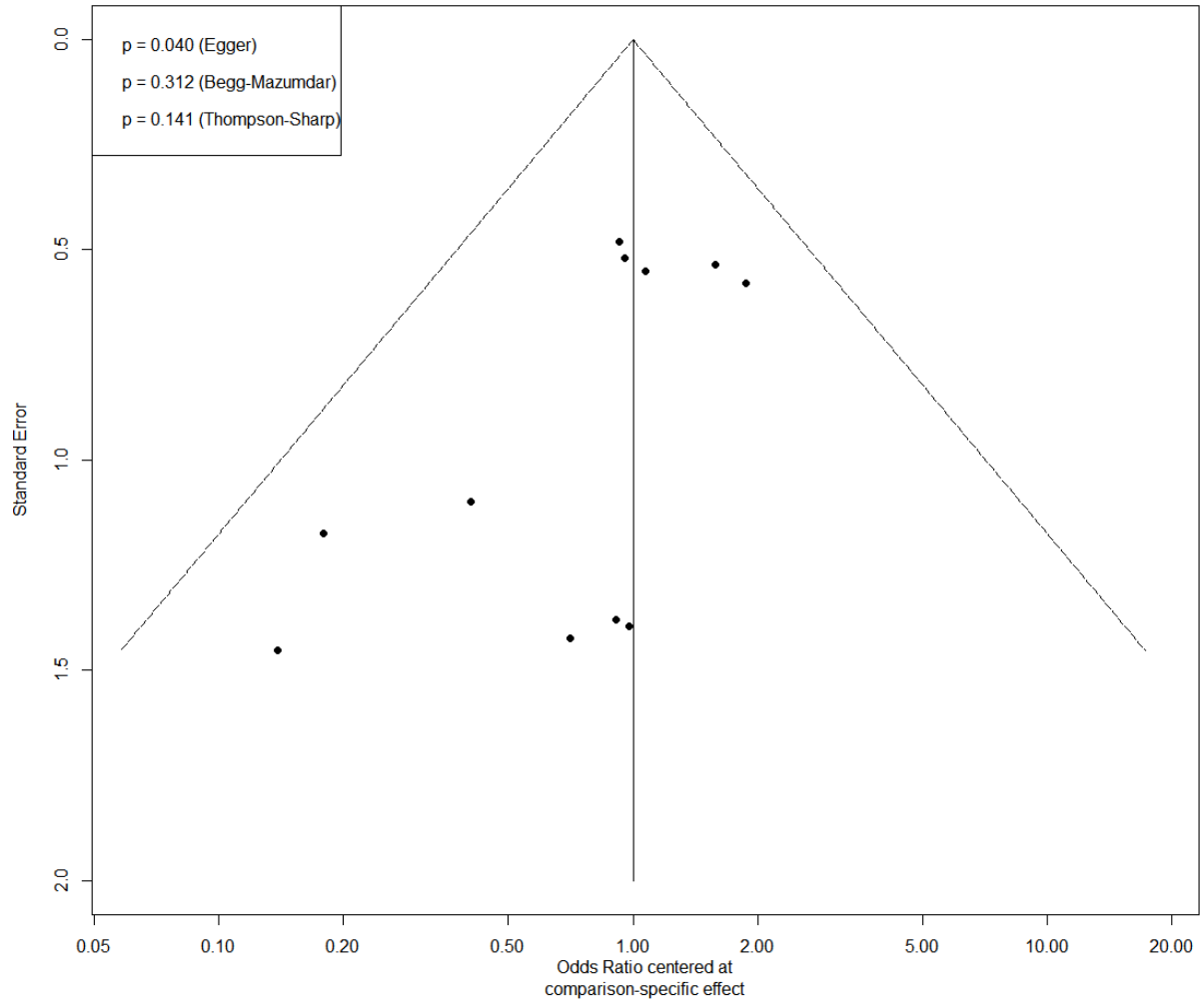
E. Net heat plot

F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



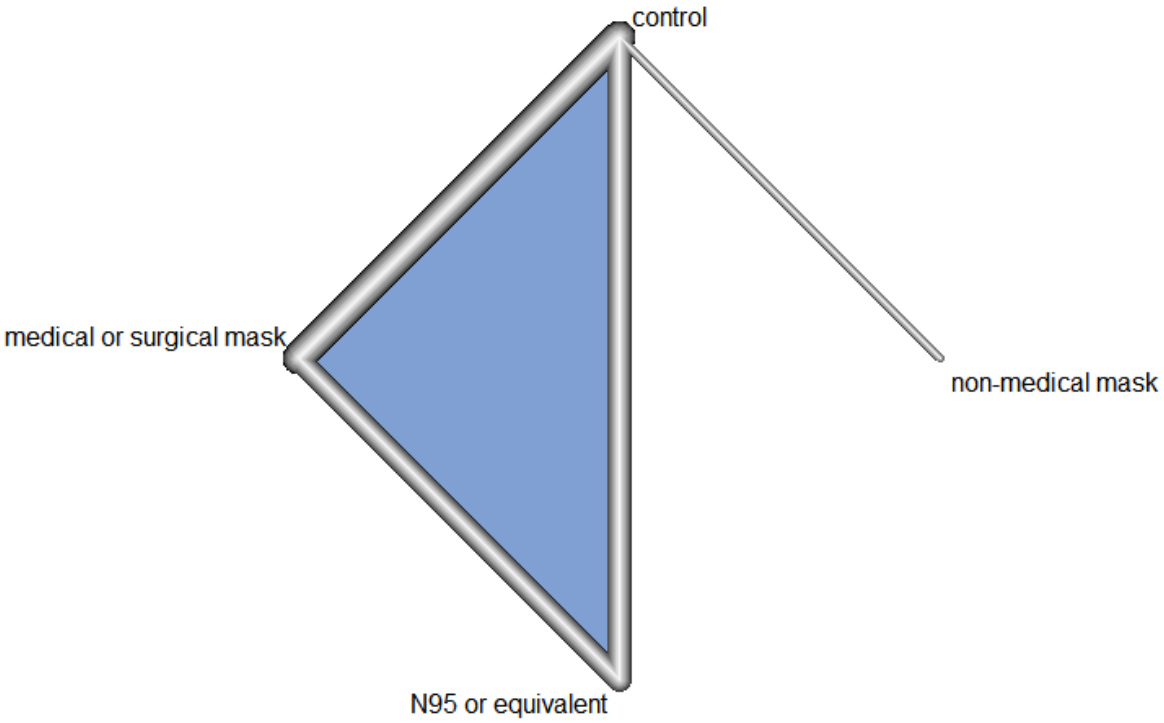
H. League table

N95 or equivalent	**0.39 [0.16 ;0.95]**	**0.25 [0.12 ;0.49]**
0.34 [0.17 ;0.71]	medical or surgical mask	0.80 [0.41 ;1.57]
0.24 [0.13 ;0.46]	0.70 [0.38 ;1.30]	control

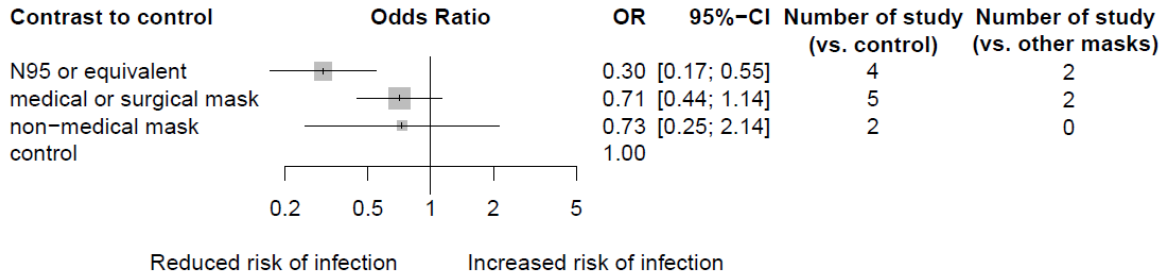
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

6) COVID-19 (SARS-CoV-2)

A. Network plot



B. Forest plot



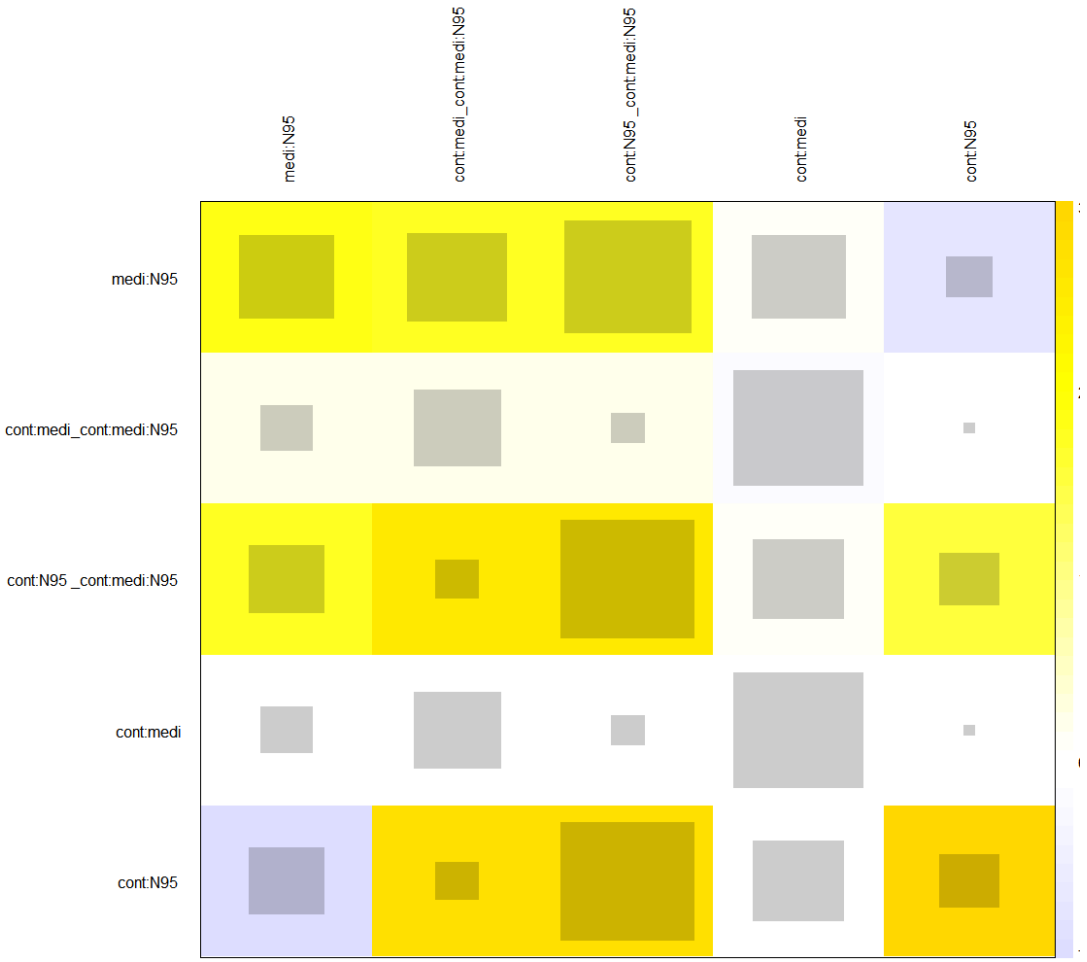
C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 7.64, p value = 0.054

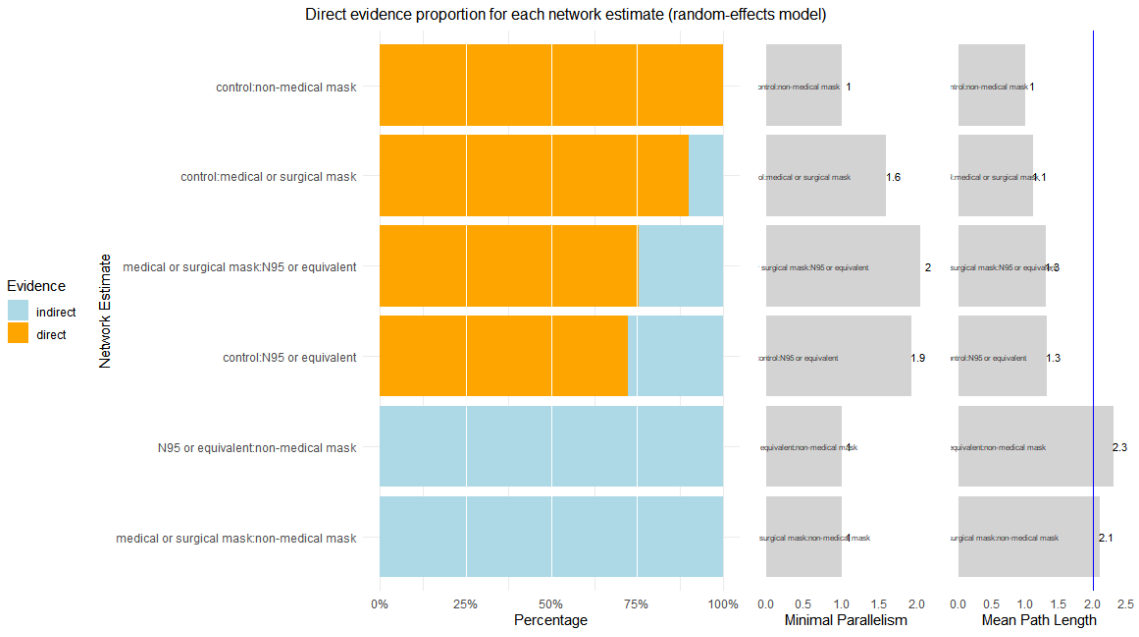
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0.1485; tau = 0.3853; I^2 = 44.9% [0.0%; 73.5%]

E. Net heat plot

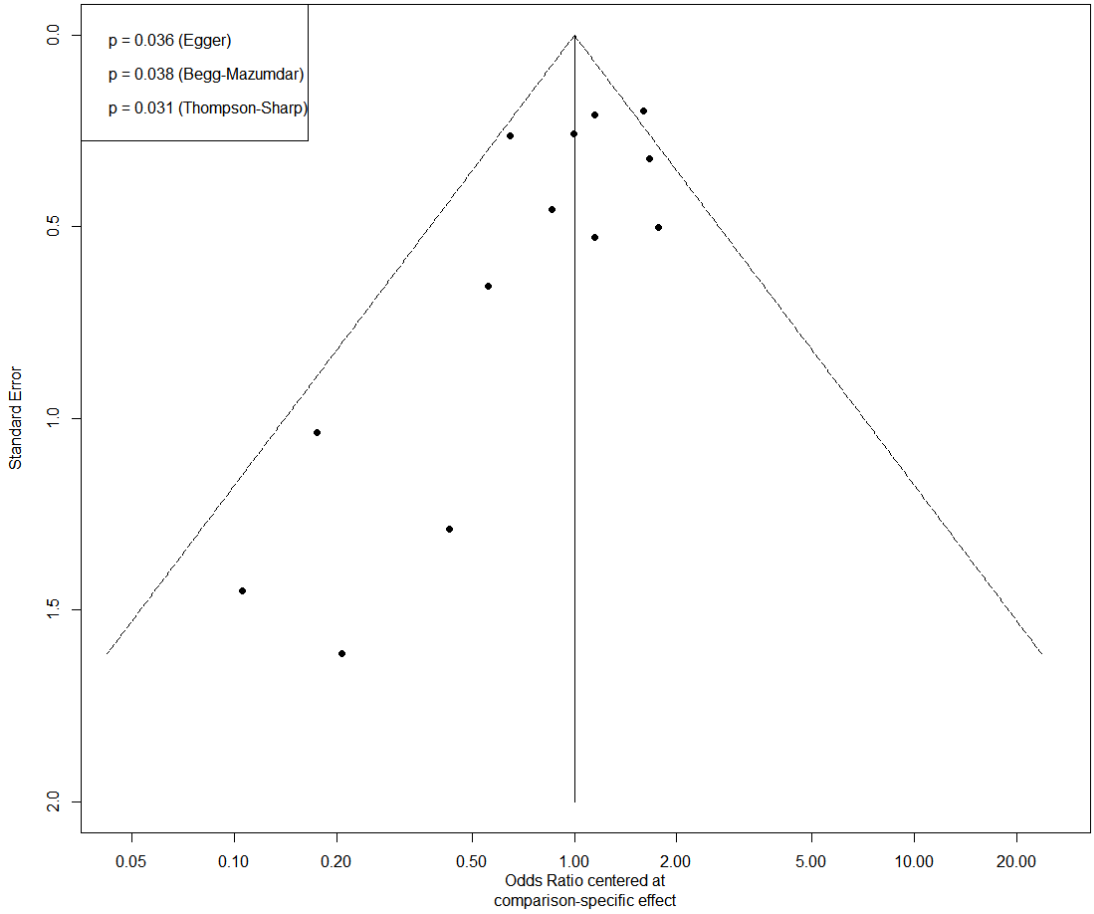


F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



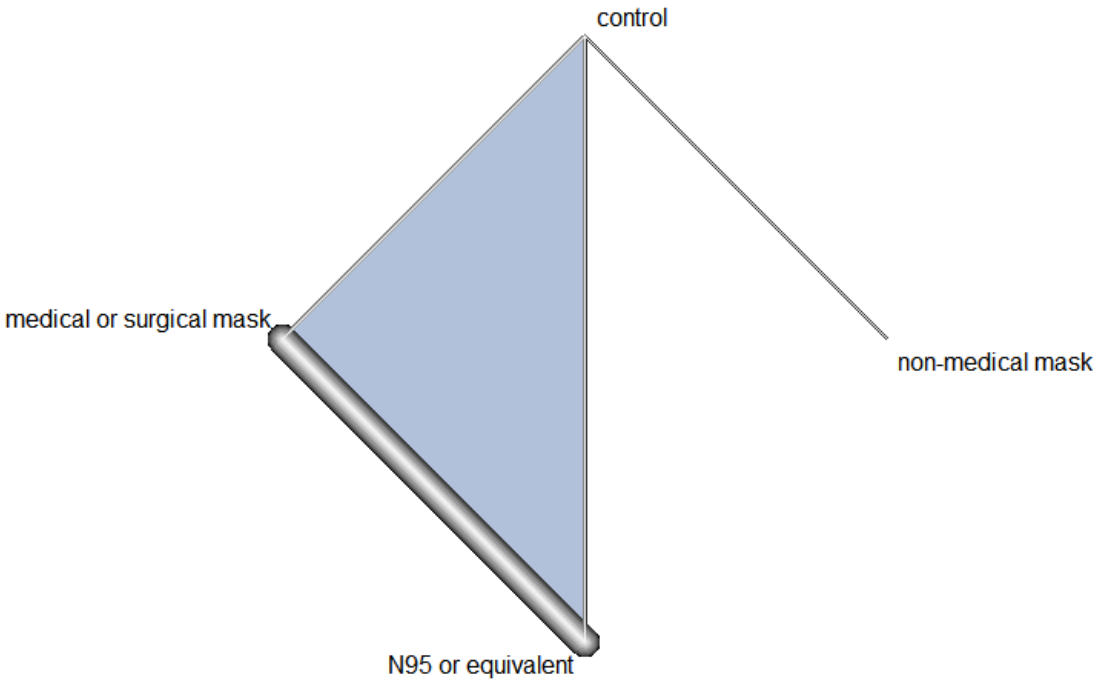
H. League table

N95 or equivalent	**0.48 [0.25 ;0.94]**	.	**0.33 [0.17 ;0.66]**
0.43 [0.24 ;0.77]	medical or surgical mask	.	0.71 [0.43 ;1.17]
0.42 [0.12 ;1.42]	0.97 [0.30 ;3.15]	non-medical mask	0.73 [0.25 ;2.14]
0.30 [0.17 ;0.55]	0.71 [0.44 ;1.14]	0.73 [0.25 ;2.14]	control

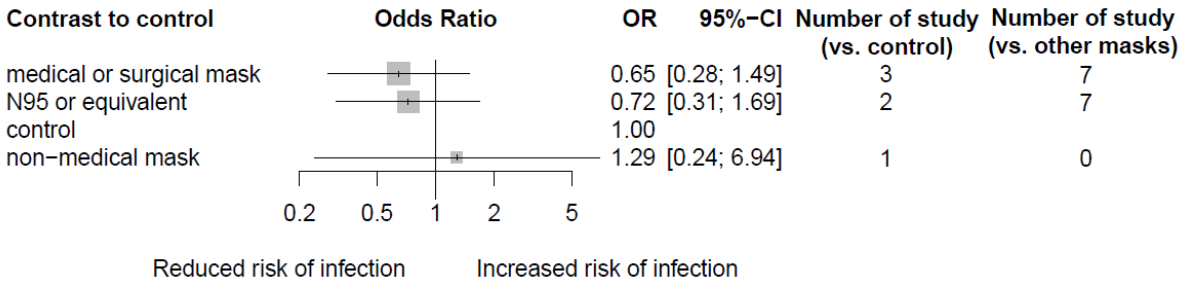
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

7) Influenza virus infection in health care setting

A. Network plot



B. Forest plot



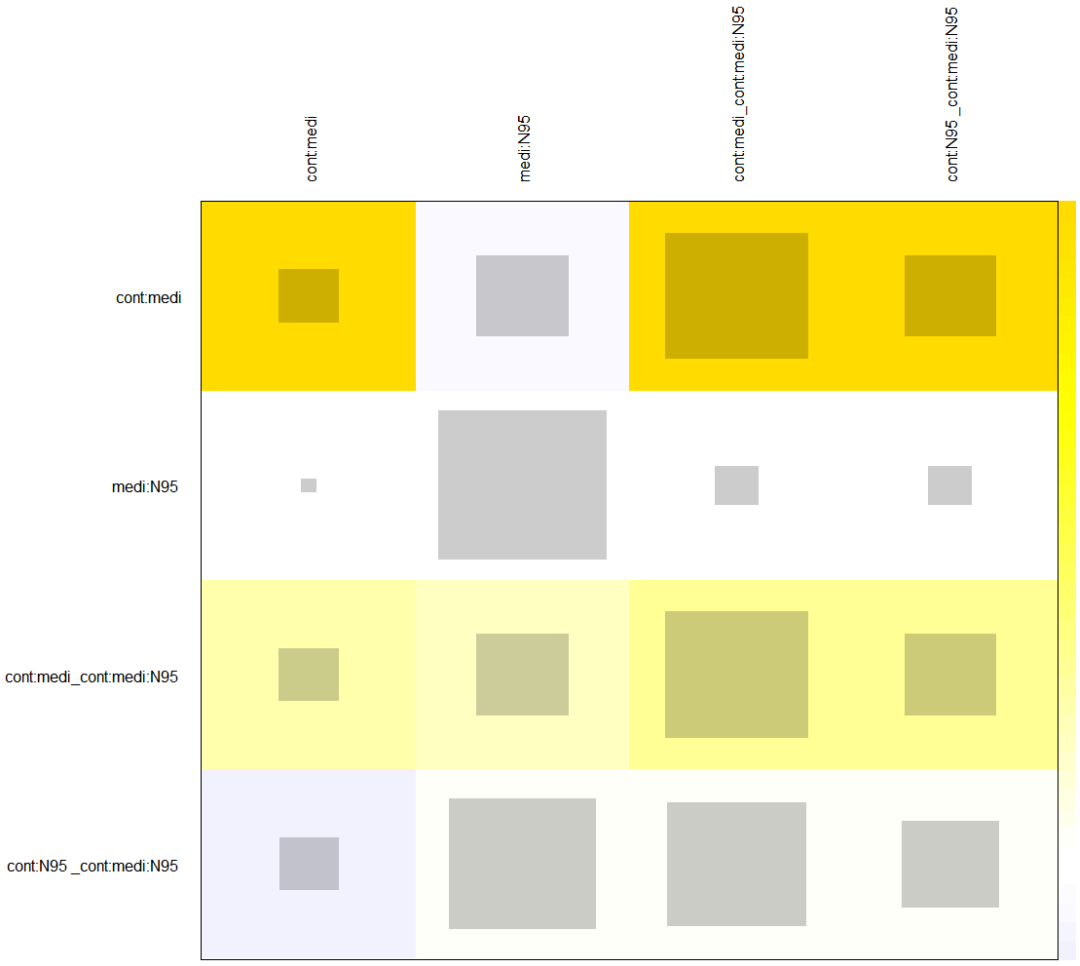
C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 3.84, p value = 0.1466

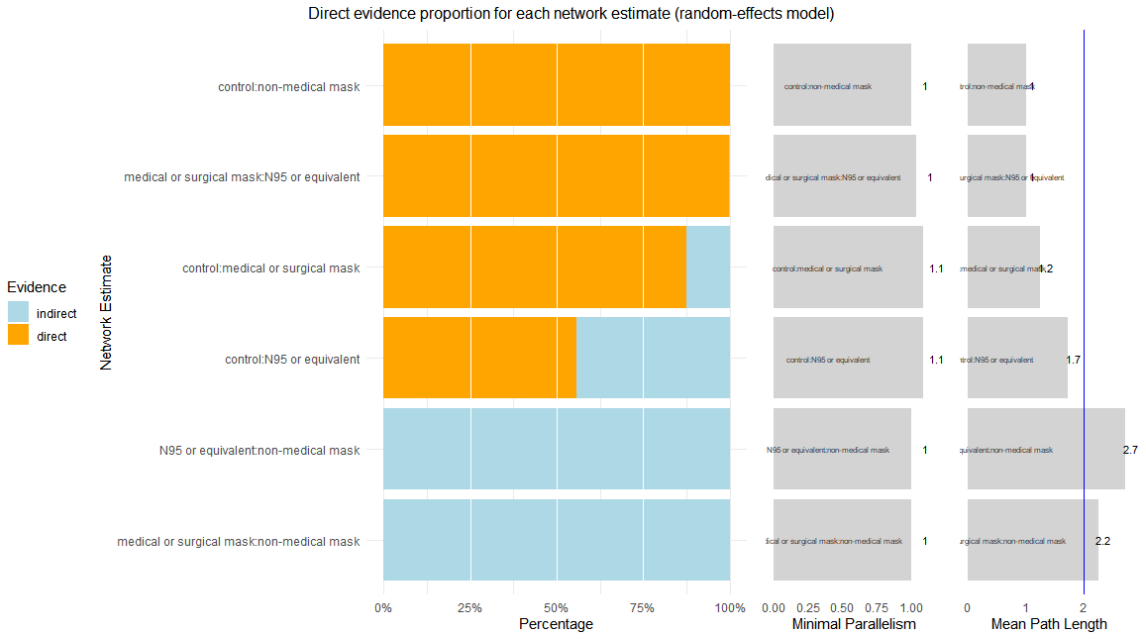
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0; tau = 0; I^2 = 0% [0.0%; 53.6%]

E. Net heat plot

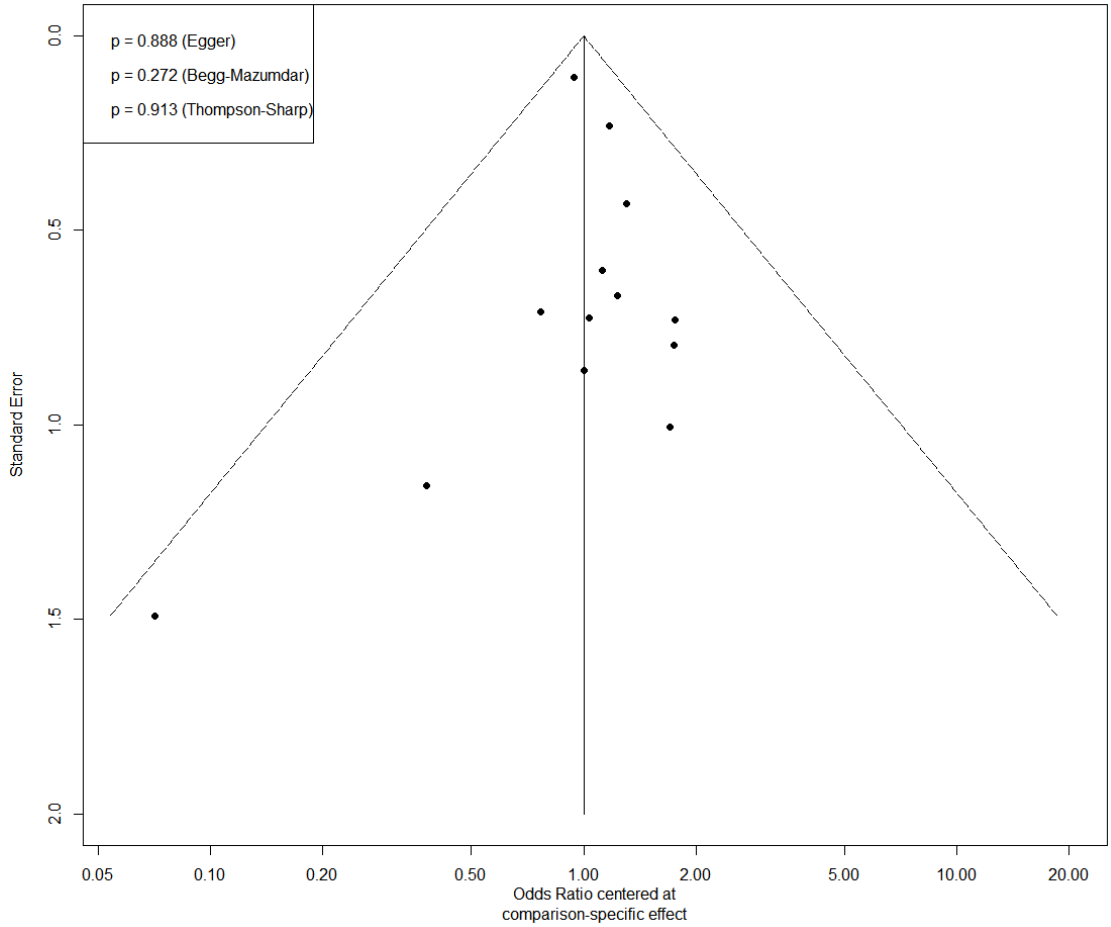


F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



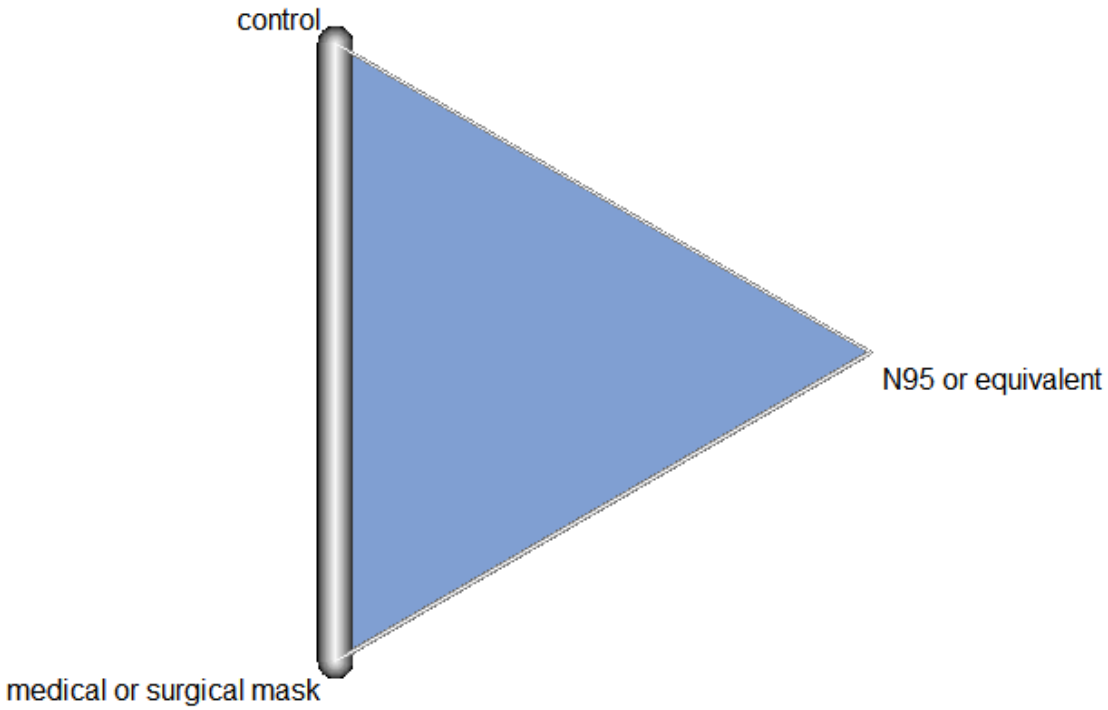
H. League table

medical or surgical mask	0.89 [0.75 ;1.07]	0.73 [0.30 ;1.78]	.
0.89 [0.75 ; 1.06]	N95 or equivalent	0.68 [0.22 ;2.11]	.
0.65 [0.28 ; 1.49]	0.72 [0.31 ; 1.69]	control	0.78 [0.14 ;4.20]
0.50 [0.08 ; 3.30]	0.56 [0.09 ; 3.72]	0.78 [0.14 ; 4.20]	non-medical mask

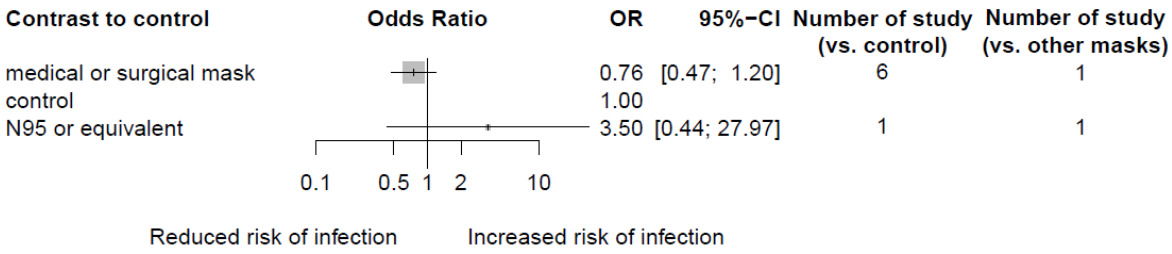
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

8) Influenza virus infection in community setting

A. Network plot



B. Forest plot



C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 0.78, p value = 0.3757

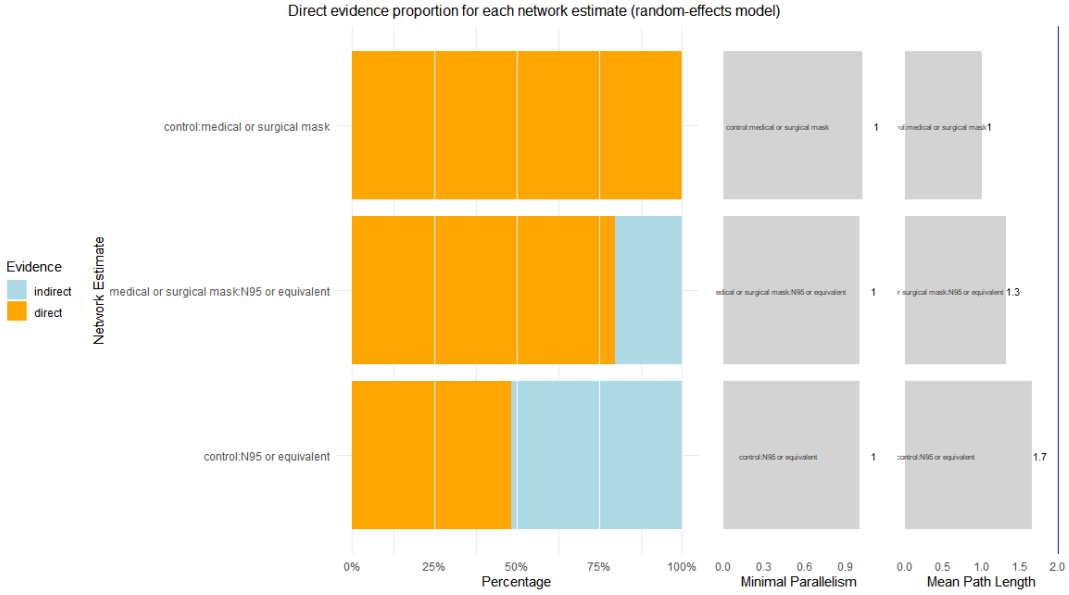
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0.0313; tau = 0.1768; I^2 = 8.7% [0.0%; 76.8%]]

E. Net heat plot

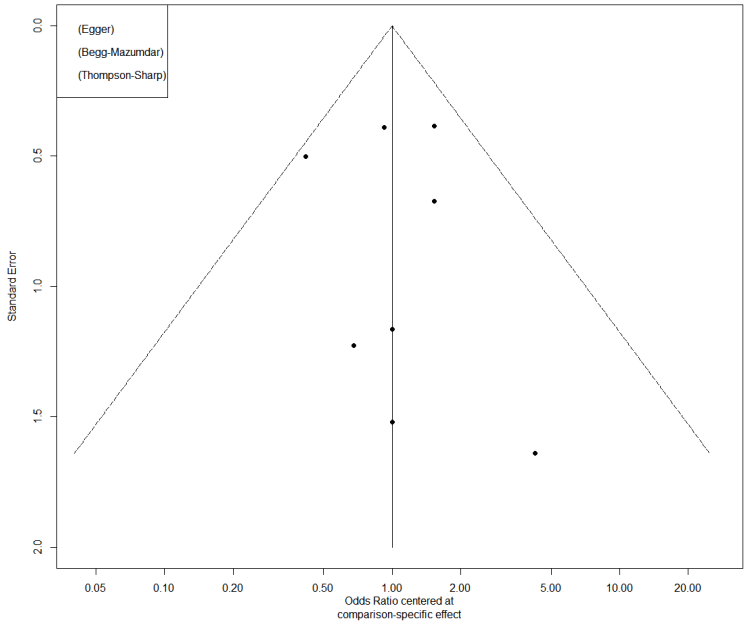
i. Net heat plot not available due to small number of informative designs.

F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



Egger's test: p-value = 0.8169

H. League table

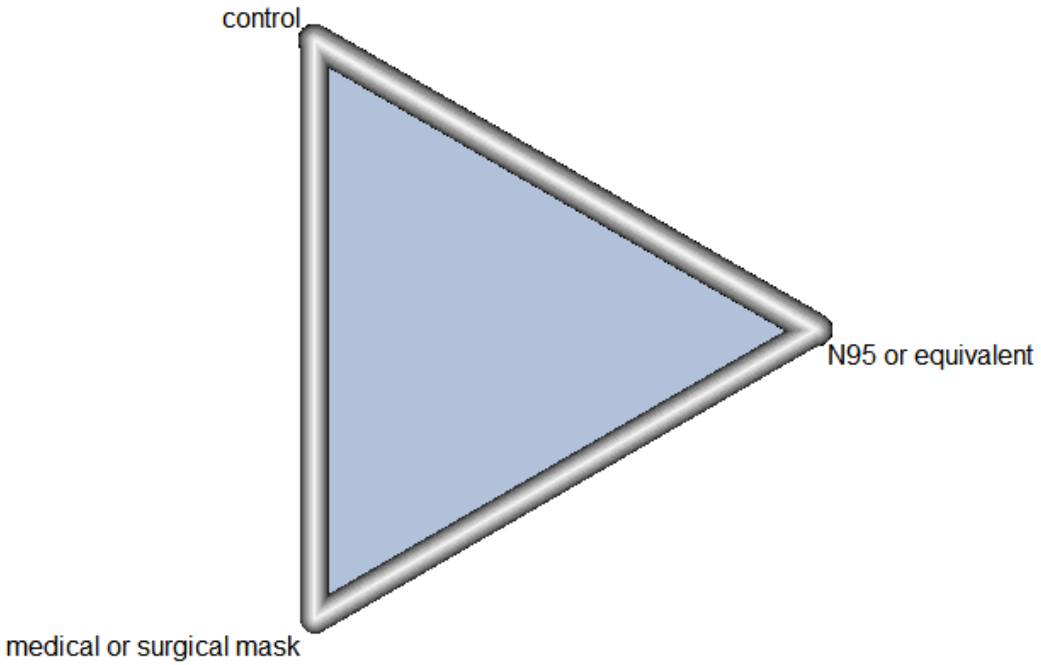
medical or surgical mask	0.76 [0.48 ; 1.21]	0.32 [0.03 ; 3.21]
0.76 [0.47 ; 1.20]	control	0.13 [0.01 ; 2.55]
0.22 [0.03 ; 1.70]	0.29 [0.04 ; 2.29]	N95 or equivalent

Pairwise (upper right portion) and network (lower left portion) meta-analysis results are

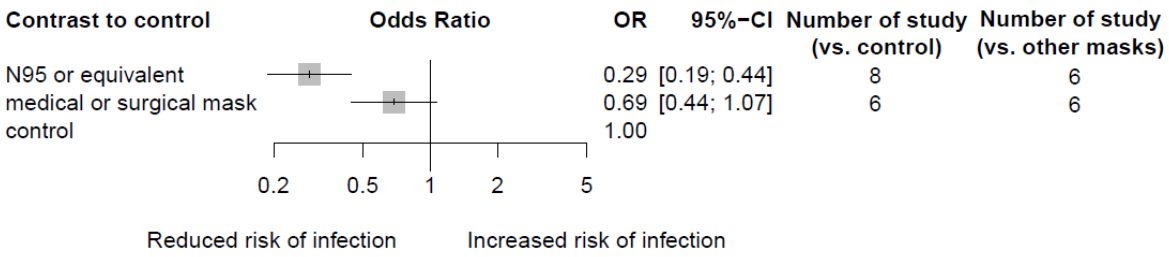
presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

9) Coronavirus infection (SARS, MERS, COVID-19) in health care setting – usual care

A. Network plot



B. Forest plot



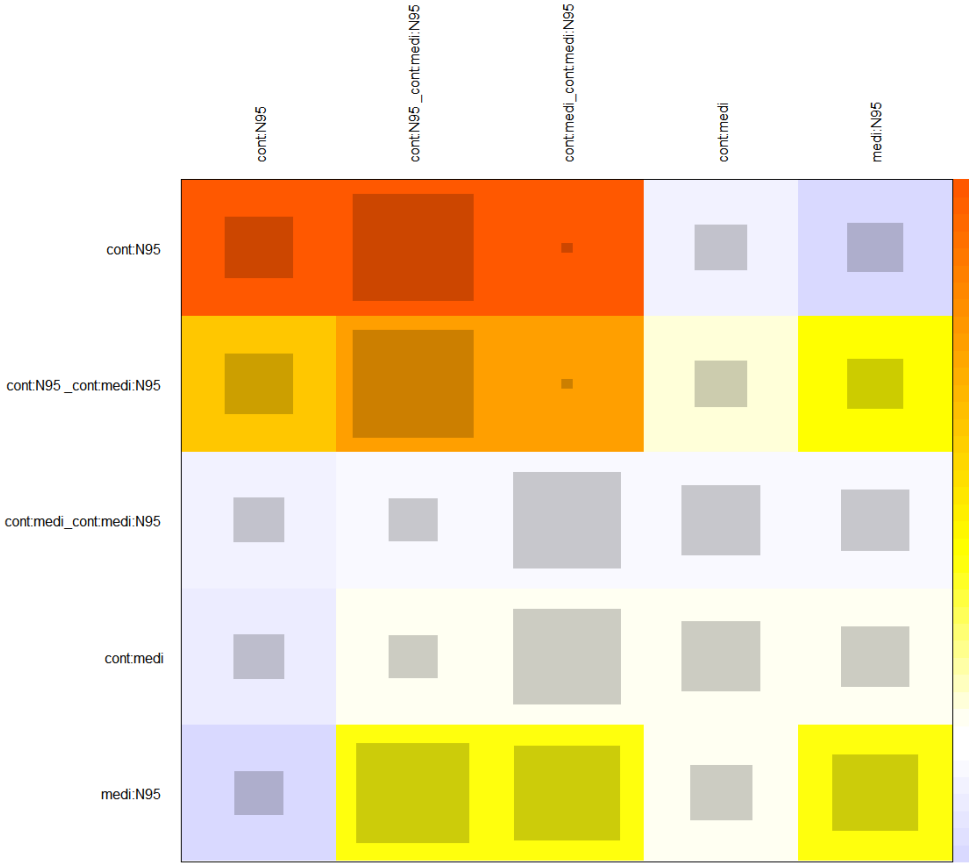
C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 12.41, p value = 0.0061

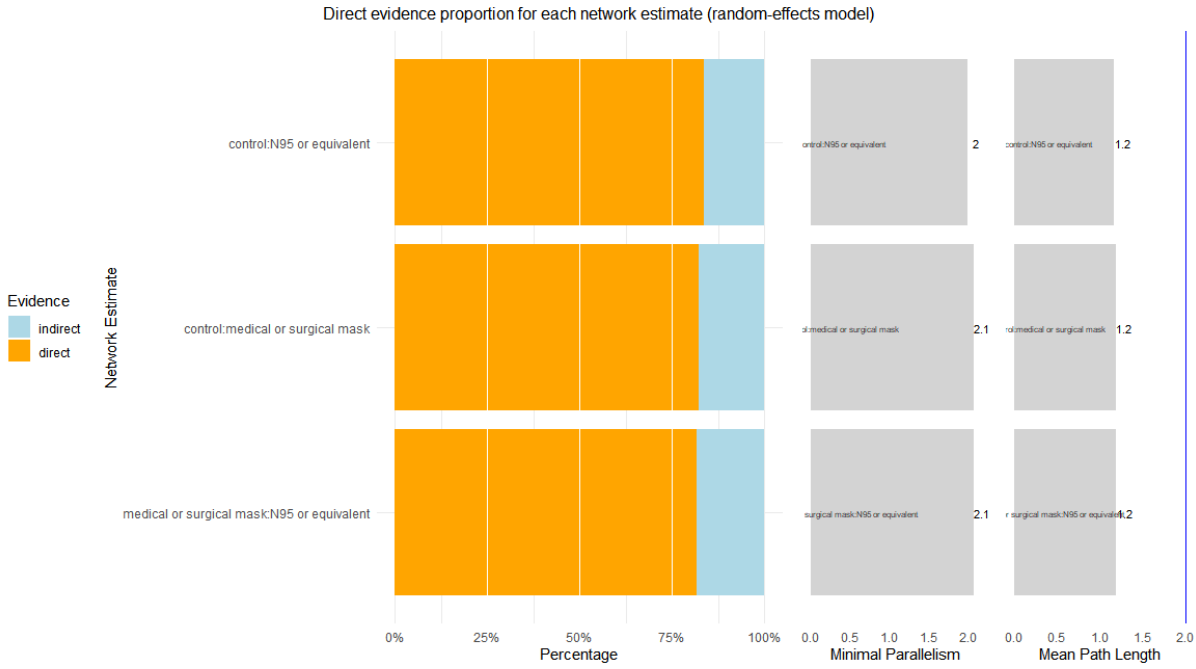
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0.0846; tau = 0.2908; I^2 = 20.2% [0.0%; 55.3%]

E. Net heat plot

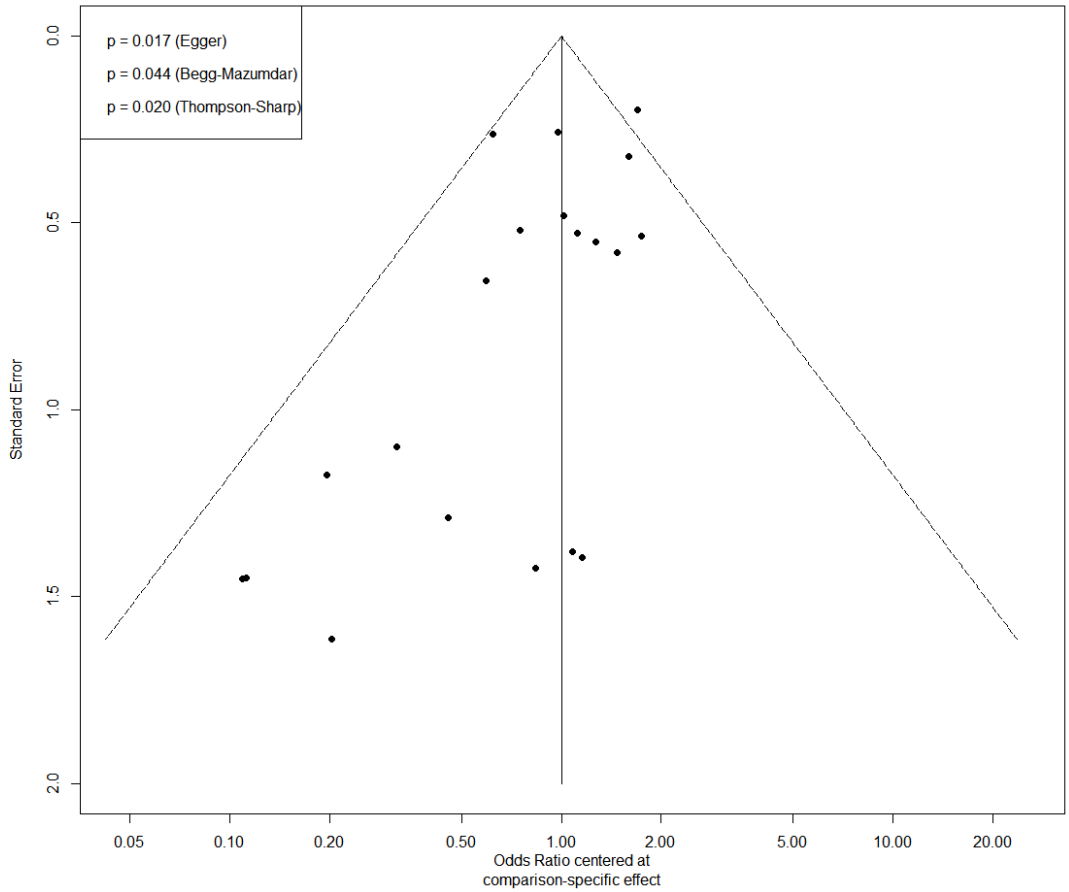


F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



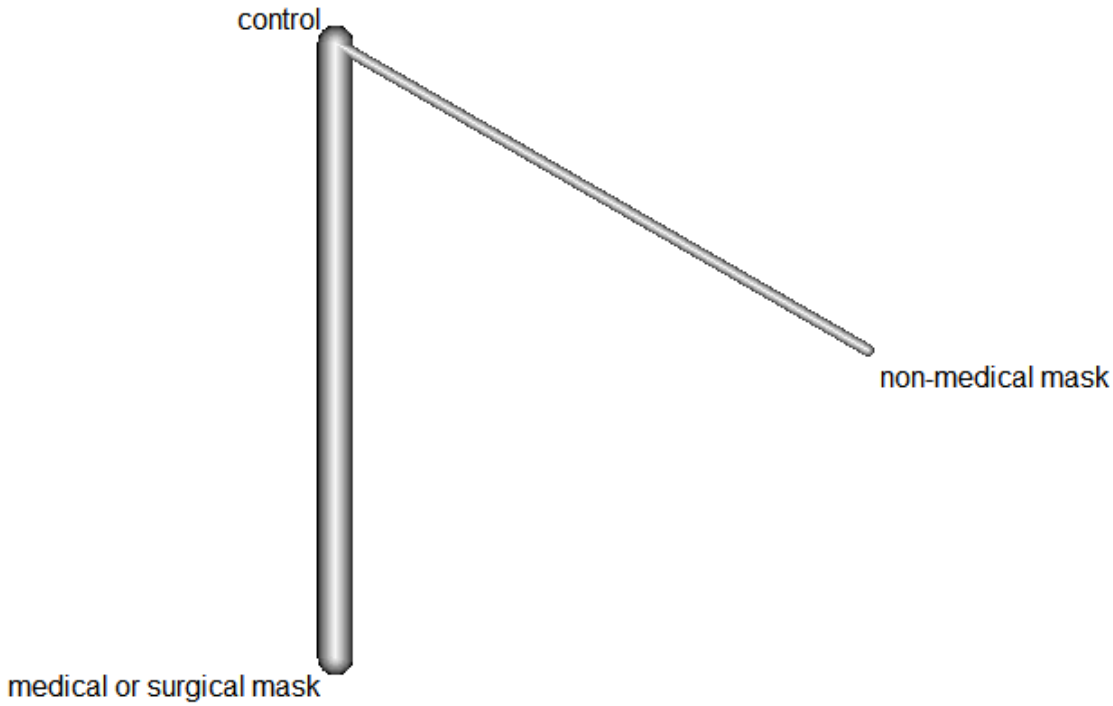
H. League table

N95 or equivalent	**0.46 [0.28 ;0.76]**	**0.31 [0.20 ;0.50]**
0.42 [0.27 ;0.65]	medical or surgical mask	0.73 [0.45 ;1.18]
0.29 [0.19 ;0.44]	0.69 [0.44 ;1.07]	control

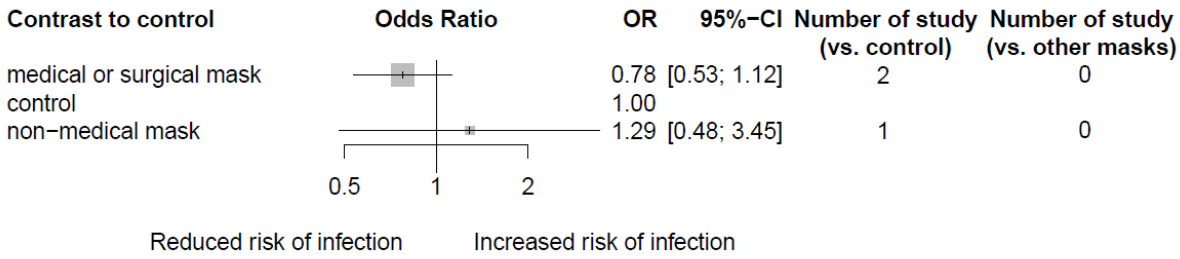
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

10) Coronavirus infection (SARS, MERS, COVID-19) in community setting

A. Network plot



B. Forest plot



C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 0.00

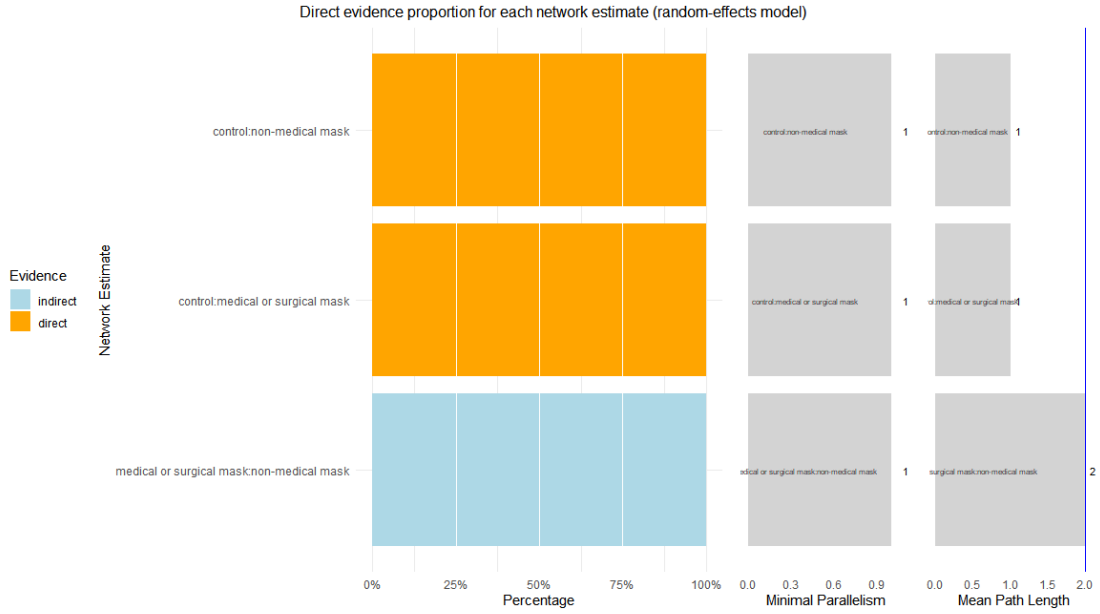
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0; tau = 0; I^2 = 0%

E. Net heat plot

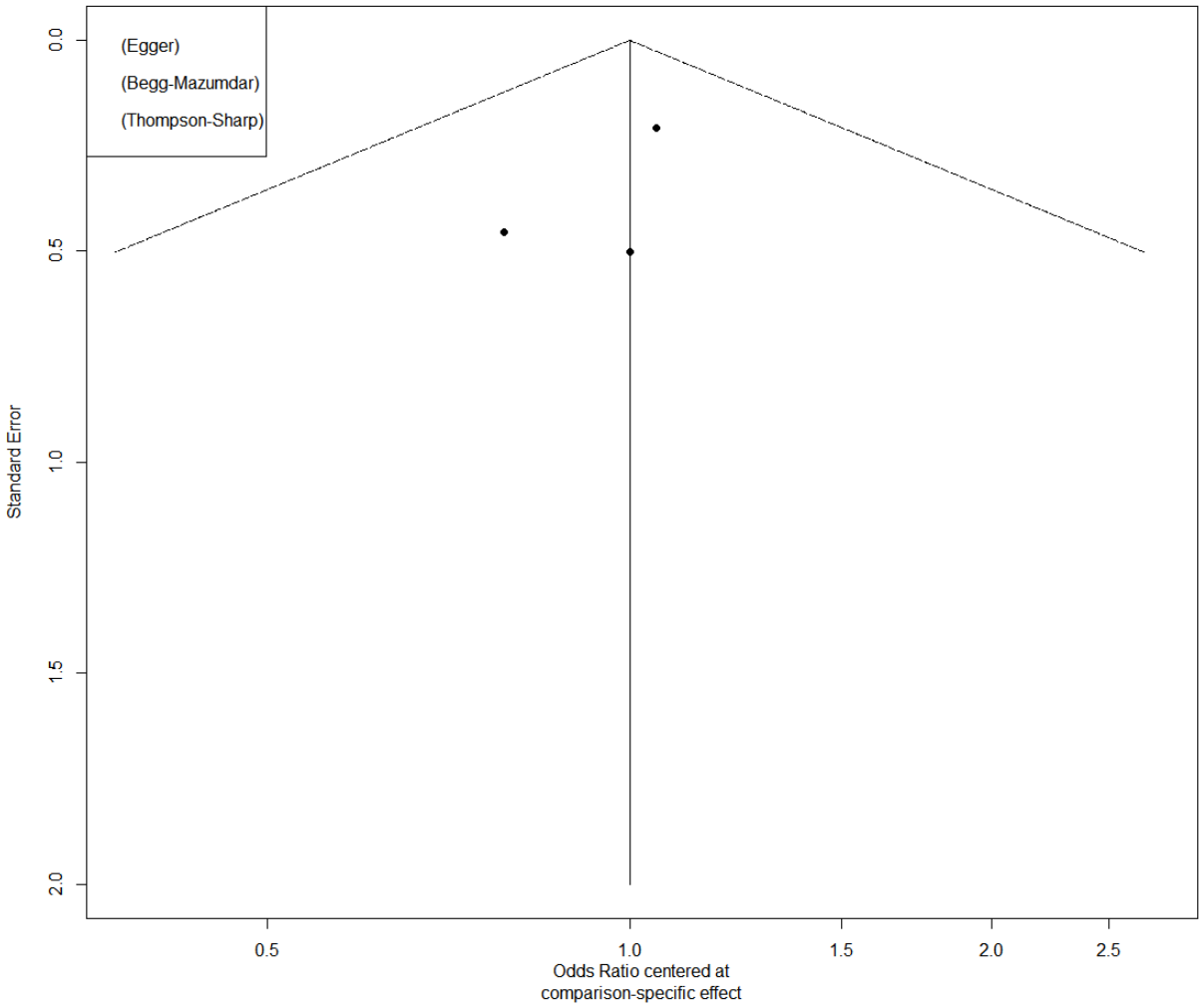
i. not available (too small number of studies)

F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot



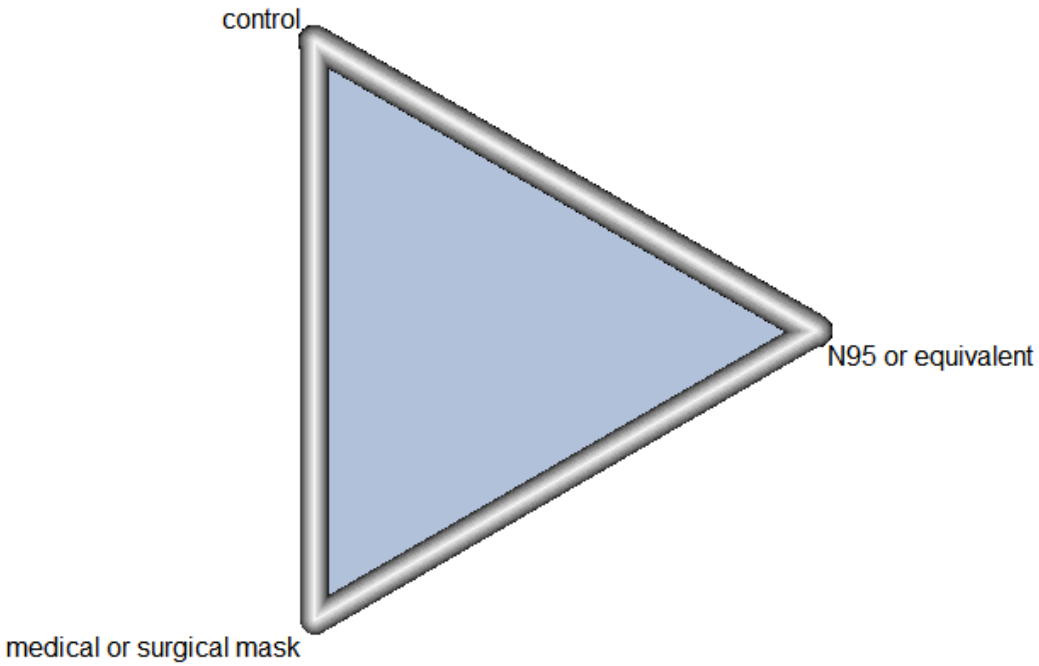
H. League table

medical or surgical mask	0.78 [0.53 ;1.12]	.
0.78 [0.53 ;1.12]	control	0.78 [0.29 ;2.07]
0.60 [0.21 ;1.72]	0.78 [0.29 ;2.07]	non-medical mask

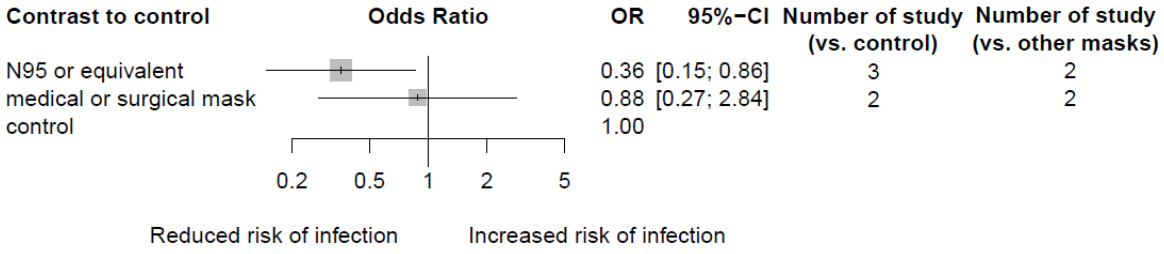
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

11) Coronavirus infection (SARS, MERS, COVID-19) in health care setting – Aerosol generating procedures (AGP)

A. Network plot



B. Forest plot



C. Inconsistency

i. Q statistic to assess consistency under the assumption of a full design-by-treatment interaction random effects model: Q = 0, p value = 0.9791

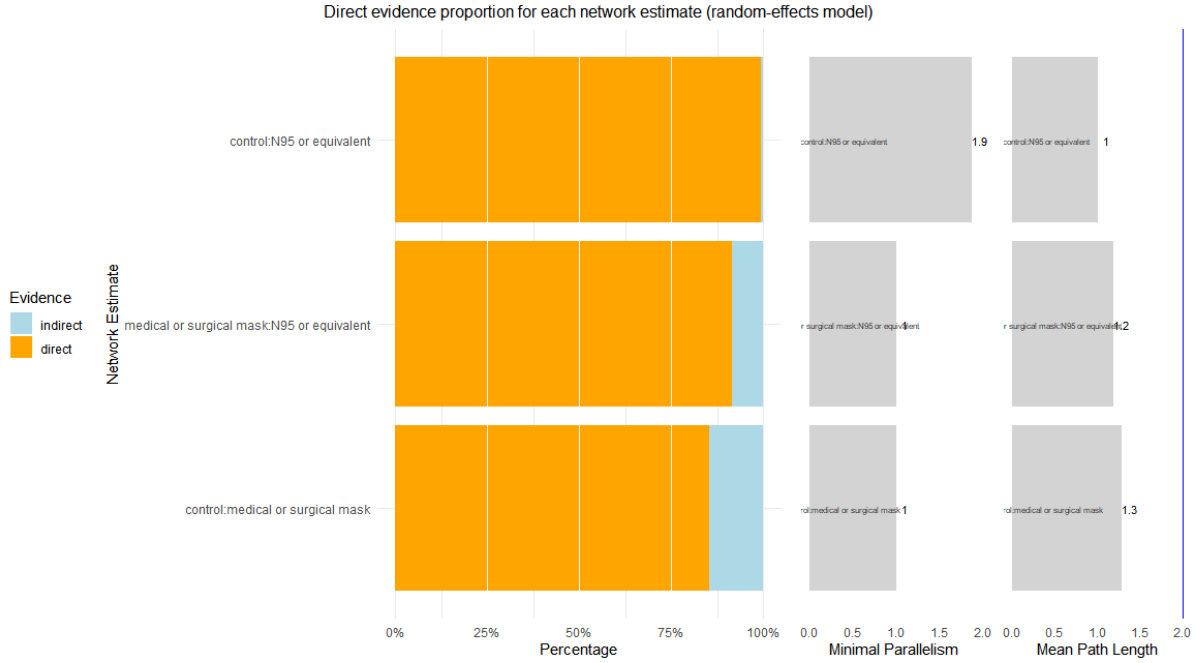
D. Heterogeneity

i. Quantifying heterogeneity: tau^2 = 0.3419; tau = 0.5847; I^2 = 53.7% [0.0%; 84.7%]

E. Net heat plot

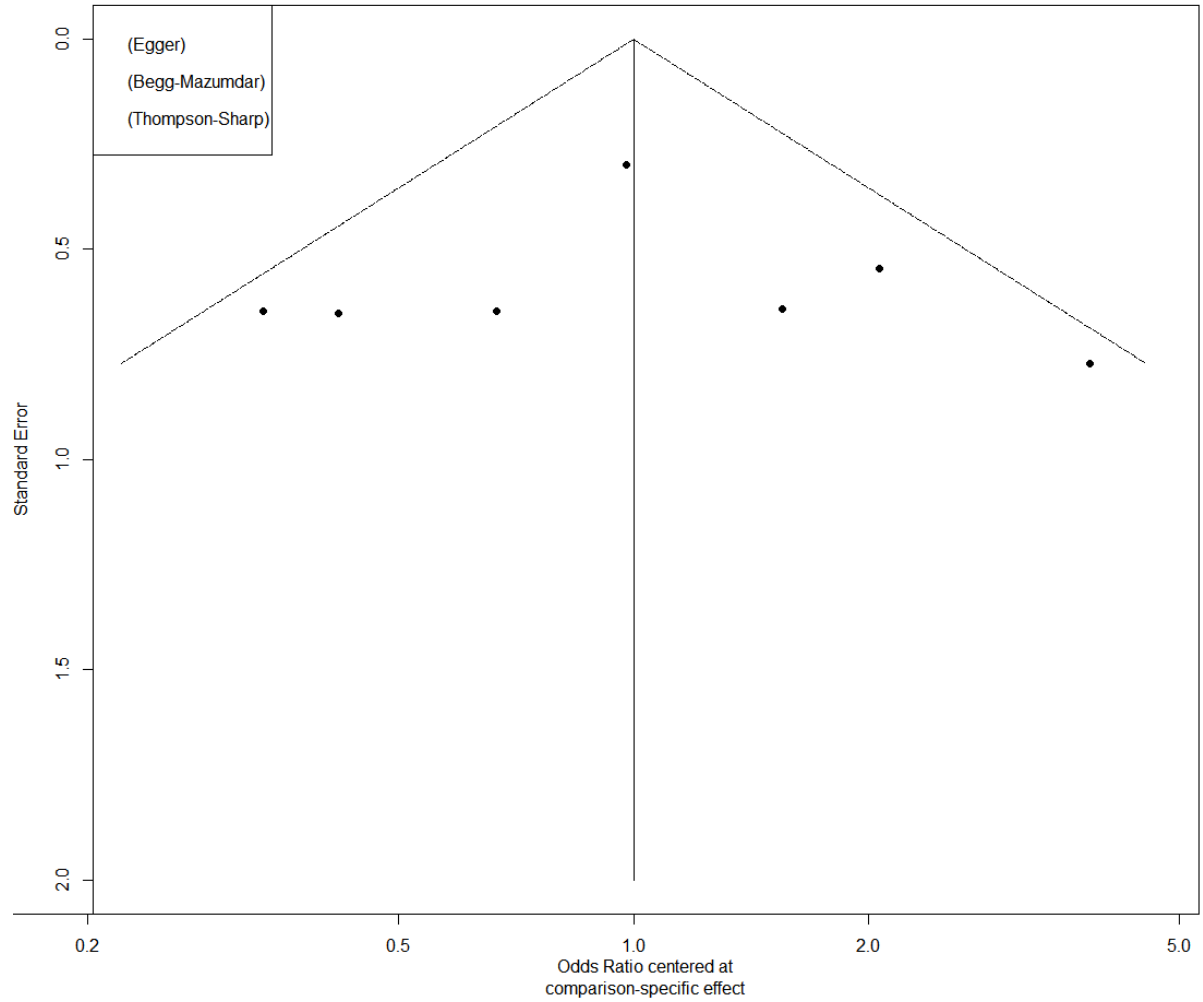
i. not available (too small number of studies)

F. Direct and indirect evidence proportion for each outcome



According to König, Krahn, and Binder (2013), lower values of minimal parallelism and Mean Path Length>2 means that results for a specific comparison should be interpreted with caution.

G. Funnel plot

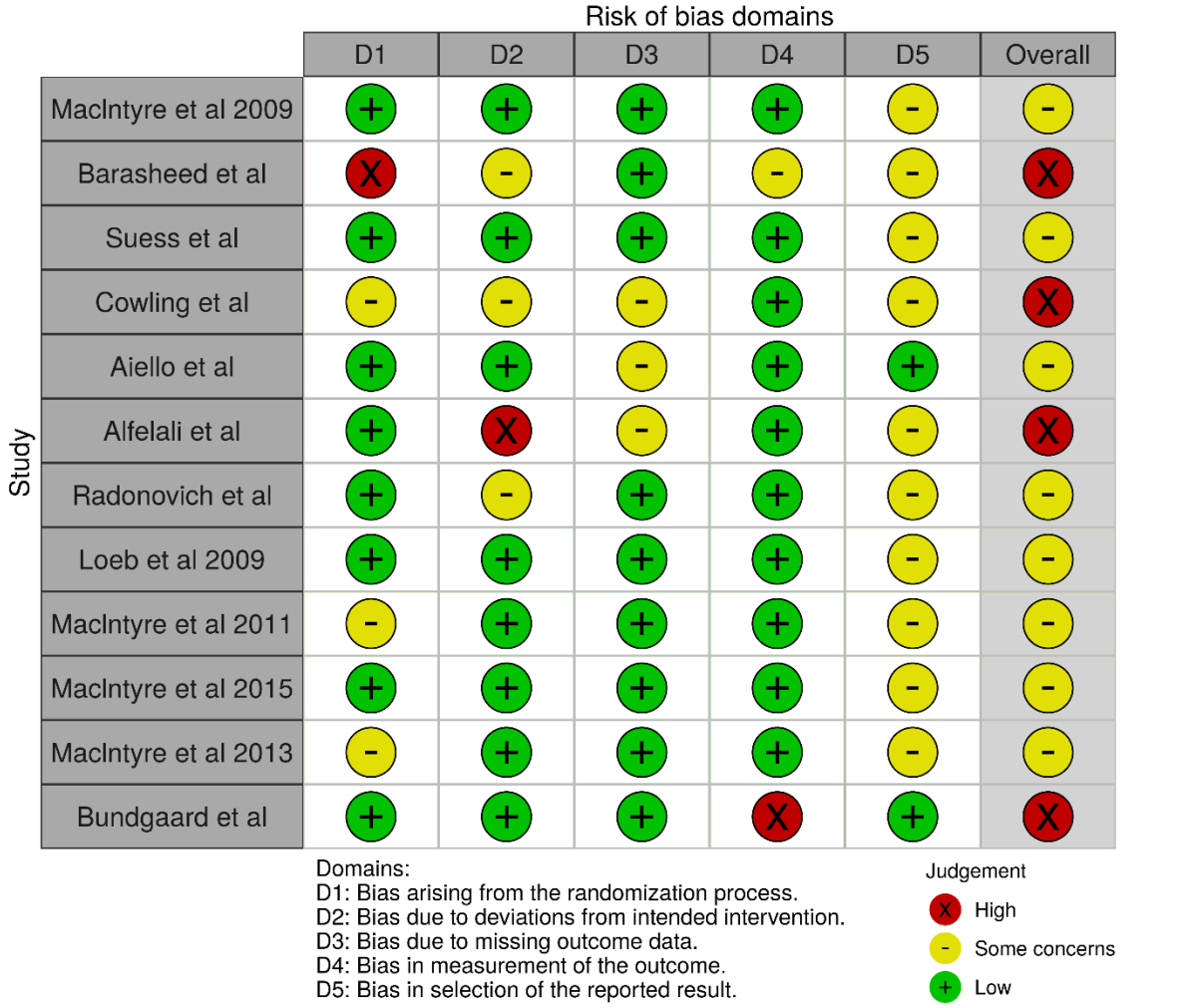


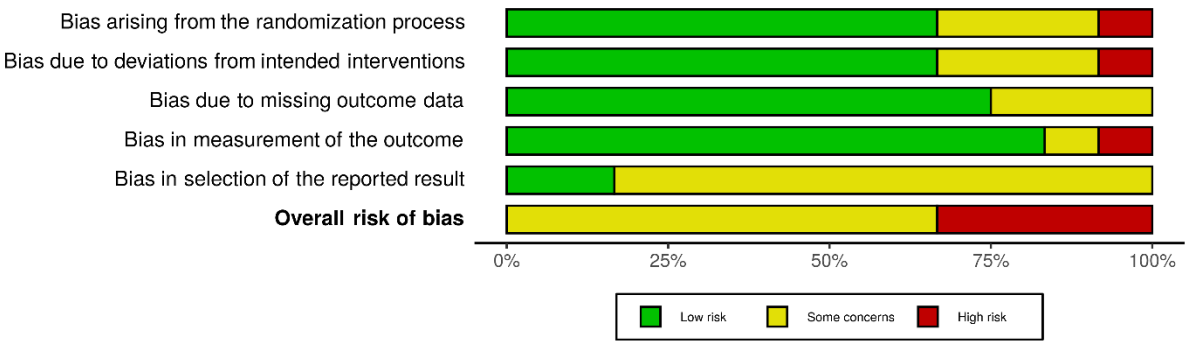
H. League table

N95 or equivalent	0.37 [0.12 ;1.19]	**0.38 [0.16 ;0.92]**
0.40 [0.13 ;1.22]	medical or surgical mask	0.85 [0.24 ;3.03]
0.36 [0.15 ;0.86]	0.88 [0.27 ;2.84]	control

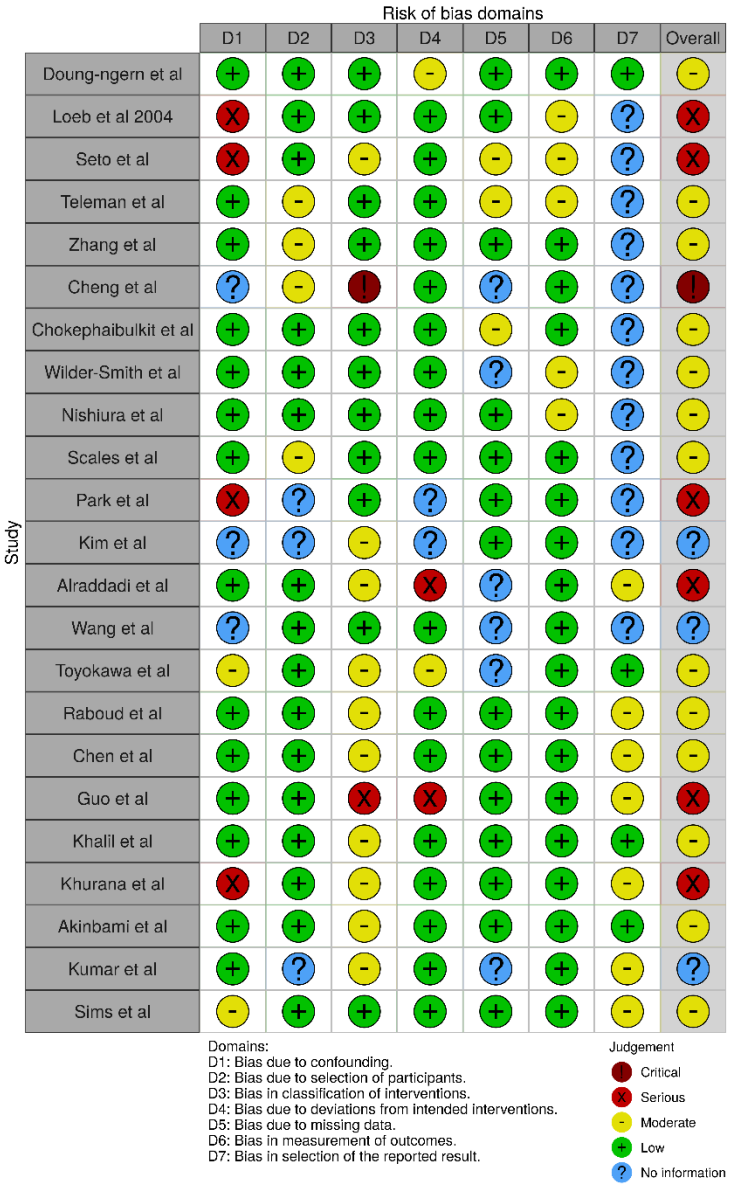
Pairwise (upper right portion) and network (lower left portion) meta-analysis results are presented. Masks are reported in order of prevention efficacy ranking according to SUCRAs. Comparison should be read from left to right. Effect estimation is presented in odds ratio (OR) with 95% CI and is located in intersection of two agents. OR less than 1 favours the column-defining treatment (lower infection rate). To obtain OR (95% CI) for comparison in the opposite direction, reciprocals should be taken.

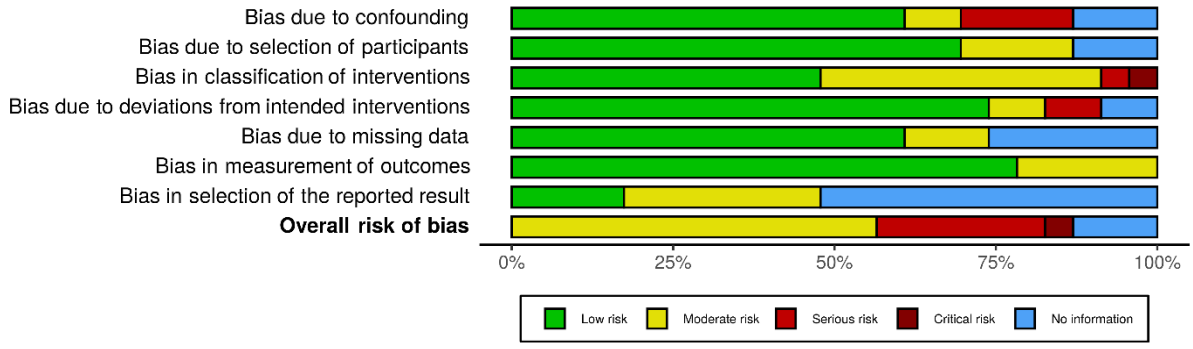
12) Risk of Bias summary and graph for RCTs





13) Risk of Bias summary and graph for observational studies





14) Risk of bias tables for included studies - Risk of Bias Tables

MacIntyre et al. “Face Mask Use and Control of Respiratory Virus Transmission in Households”.

RoB 2 tool

Bias	Author’s judgement	Support for judgement
Bias arising from the randomization process	Low risk	Allocation sequence was chosen by a secure computerized randomization process.
Bias due to deviations from intended interventions	Low risk	Not possible to blind participants and trial staff to intervention of mask type to which participants were assigned. Laboratory staff were blinded to the arm of randomization. No significant deviations from intended intervention.
Bias due to missing outcome data	Low risk	Outcome data available for all participants.
Bias in measurement of the outcome	Low risk	Laboratory staff were blinded to the arm of randomization.
Bias in selection of the reported result	Some concerns	No information.

Barasheed et al. “Pilot Randomised Controlled Trial to Testing Facemasks Effectiveness in Preventing Influenza-like Illness Transmission among Hajj Pilgrims”.

RoB 2 tool

Bias	Author’s judgement	Support for judgement
Bias arising from the randomization process	High risk	No information as to whether allocation sequence concealed. Allocation was not random; based on intervention availability and selected by independent study coordinator.
Bias due to deviations from intended	Some concerns	Participants may be aware of interventions since they were not blinded. No information available on deviations from intended interventions.

interventions		
Bias due to missing outcome data	Low risk	One participant did not return symptom diary but no one dropped out or was excluded.
Bias in measurement of the outcome	Some concerns	Delay in releasing testing kits resolved by revised documentation. No information as to whether outcome assessors were blinded to the intervention received by participants.
Bias in selection of the reported result	Some concerns	No information.

Suess et al. “The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011”.

RoB 2 tool

Bias	Author’s judgement	Support for judgement
Bias arising from the randomization process	Low risk	Allocation sequence concealed and random, baseline imbalances do not suggest a problem.
Bias due to deviations from intended interventions	Low risk	Participants blinded from intervention with closed boxes labeled with randomization number. No significant deviations from intended interventions.
Bias due to missing outcome data	Low risk	Outcome data available for all participants.
Bias in measurement of the outcome	Low risk	Physicians and laboratory staff were blinded to the intervention received by participants.
Bias in selection of the reported result	Some concerns	No information.

Cowling et al. “Preliminary Finding of a Randomized Trial of Non-Pharmaceutical Interventions to Prevent Influenza Transmission in Households”.

RoB 2 tool

Bias	Author’s judgement	Support for judgement
Bias arising from the randomization process	Some concerns	Patients were enrolled from 30 first-contact outpatient clinic; potential bias from recruiting symptomatic subjects. Randomization prepared by biostatistician and allocated by random number generator.
Bias due to deviations from intended interventions	Some concerns	Participants were not blinded but also not informed of interventions. In a protocol deviation, 9 subjects randomized and retained in analyses.
Bias due to missing outcome data	Some concerns	Dropout rate was higher than expected. Missing data on age, excluded for multivariable regression analysis.
Bias in measurement of the outcome	Low risk	No significant bias in measurement of outcome.
Bias in selection of the reported result	Some concerns	No information.

Aiello et al. “Facemasks, Hand Hygiene, and Influenza among Young Adults: A Randomized Intervention Trial”.

RoB 2 tool

Bias	Author’s judgement	Support for judgement
Bias arising from the randomization process	Low risk	Allocation sequence was chosen randomly, baseline imbalances do not suggest a problem.
Bias due to deviations from intended	Low risk	Patients aware of interventions but no significant deviations from the intended intervention. Patients not blinded but compliance with

interventions		interventions considered carefully.
Bias due to missing outcome data	Some concerns	Some participants moved/withdrew and were lost to follow up; there was a 94% retention rate for analysis.
Bias in measurement of the outcome	Low risk	PI's and statisticians were blinded to intervention status for analyses.
Bias in selection of the reported result	Low risk	Reliance on self-reported data may be susceptible to reporting and recall bias. Randomized assignment of interventions found similarity in reported behaviors across study groups at baseline, which argues against reporting biases.

Alfelali, Haworth, et al. " Facemask against viral respiratory infections among Hajj pilgrims: A challenging cluster randomized trial"

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Low risk	Cluster randomized by accommodation tents arranged by country and gender. Allocation sequence was random because an independent person outside of the study used coin tossing to allocate intervention.
Bias due to deviations from intended interventions	High risk	Participants and personnel both aware of study, and deviations arose due to low compliance of intervention, which affected outcome. Intention-to-treat analysis was done.
Bias due to missing outcome data	Some concerns	Number of participants with missing data reported for all variables. Comparisons between groups only included known values, except where otherwise specified.
Bias in measurement of the outcome	Low risk	Laboratory staff were blinded to the intervention received by participants.
Bias in selection of the reported result	Some concerns	No information.

Doung-ngern, Suphanchaimat, et al. "Case-Control Study of Use of Personal Protective Measures and Risk for SARS Coronavirus 2 Infection, Thailand."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Case control study. Multivariable logistic regression models used to estimate associations between diagnosis of COVID-19 and covariates. Multivariate analysis that adjusted for major variables.
Bias in selection of participants into the study (Selection bias)	Low risk	211 cases and 839 non-matched controls using all contact tracing records of Thailand's national Surveillance and Rapid Response Team. All patients in the enrolment period were screened for eligibility.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Patients were categorized as case group and control group. Cases were asymptomatic contacts of COVID-19 patients diagnosed with COVID-19 in a specified duration of time. Controls were asymptomatic contacts who were not diagnosed with COVID-19.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Moderate risk	This study did not evaluate the probability of contact with other infected people in the community setting. Cases with mild/no symptoms could have been missed. Also, impossible to identify every potential contact with and some may have had contact with more than one COVID-19 patient.
Bias due to missing data (Selection bias)	Low risk	Missing values for mark wearing not included in analyses. For other variables, missing values were random and were imputed by chained equations.
Bias in measurement of the outcome	Low risk	Assessment of outcome may be affected because findings subject to memory bias, observer bias and information bias. To reduce

(Information bias)		potential bias, structured interviews used where each participant was asked the same set of defined questions.
Bias in selection of the reported result (Reporting bias)	Low risk	A STROBE statement checklist provided that give evidence of transparent reporting.

H. Bundgaard, J. Bundgaard, et al. " Effectiveness of Adding a Mask Recommendation to Other Public Health Measures to Prevent SARS-CoV-2 Infection in Danish Mask Wearers"

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Low risk	Computerized randomization, no imbalances apparent between groups.
Bias due to deviations from intended interventions	Low risk	Participants were aware of study, but there were no deviations from the intended intervention. Intention-to-treat analysis was done.
Bias due to missing outcome data	Low risk	Missing data was 19%, but post hoc imputations was done using R package smcfcs to impute missing values of outcome.
Bias in measurement of the outcome	High risk	Participants tested for antibodies on their own and reported outcomes.
Bias in selection of the reported result	Low risk	Reason for inconsistency given, pre-planned analysis was done.

Radonovich et al. "N95 Respirators vs Medical Masks for Preventing Influenza Among Health Care Personnel".

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Low risk	Random allocation of clusters by constrained randomization. Independent individual used computer-generated random sequences to allocate groups.
Bias due to deviations from intended interventions	Some concerns	Participants were not blinded but also not informed of interventions. Criteria for PCR testing may have missed participants who were infected but had no symptoms.
Bias due to missing outcome data	Low risk	Missing data imputed to create multiple imputed data sets with no missing values for each analysis.
Bias in measurement of the outcome	Low risk	Investigators blinded to randomization and an independent data and safety monitoring board assessed the data.
Bias in selection of the reported result	Some concerns	No information.

Loeb, Mark, et al. "Surgical mask vs N95 respirator for preventing influenza among health care workers: a randomized trial."

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Low risk	Randomization was performed centrally by an independent clinical trials coordinating group such that investigators were blind to the randomization procedure. There were no baseline imbalance in two groups.
Bias due to deviations from intended interventions	Low risk	It was not possible to conceal the identity of the N95 respirator or the surgical mask since manipulating these devices would interfere with their function, but there was no deviation that arose because of trial context.

Bias due to missing outcome data	Low risk	Missing data were unlikely to have had a significant impact on the results
Bias in measurement of the outcome	Low risk	Assessment of outcome unlikely to be influenced by the assessors' knowledge of intervention received.
Bias in selection of the reported result	Some concerns	No information as to whether the reported data were selected based on the results of multiple outcome measurements or multiple analyses of data.

MacIntyre, Chandini Raina, et al. "A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers."

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Some concerns	Description of randomization process is unclear, and baseline imbalances were present.
Bias due to deviations from intended interventions	Low risk	Participants were aware that they were in a trial, but deviations from intended intervention were unlikely to affect the outcome in a major way.
Bias due to missing outcome data	Low risk	There was no missing data.
Bias in measurement of the outcome	Low risk	Outcome assessment was unlikely to be influenced by the knowledge of intervention received.
Bias in selection of the reported result	Some concerns	Not enough information to determine whether the reported data were selected based on the results of multiple outcome measurements or multiple analyses of data.

MacIntyre, C. Raina, et al. "A cluster randomised trial of cloth masks compared with medical masks in healthcare

workers."

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Low risk	Allocation sequence was subverted and random; there were no baseline imbalances.
Bias due to deviations from intended interventions	Low risk	Participants were aware that they were in a trial, but deviations from intended intervention were unlikely to affect the outcome in a major way.
Bias due to missing outcome data	Low risk	Data were complete.
Bias in measurement of the outcome	Low risk	Assessors were aware of intervention received by study participants, but three primary outcomes are unlikely to have been affected by the assessors' knowledge.
Bias in selection of the reported result	Some concerns	Not enough information to determine whether the reported data were selected based on the results of multiple outcome measurements or multiple analyses of data.

MacIntyre, C. Raina, et al. "A randomized clinical trial of three options for N95 respirators and medical masks in health workers."

RoB 2 tool

Bias	Author's judgement	Support for judgement
Bias arising from the randomization process	Some concerns	Randomization were done by a secure computerized randomization program, but age was significantly different between groups.
Bias due to deviations from intended	Low risk	Participants were aware of study, but there were no deviations from the

interventions		intended intervention
Bias due to missing outcome data	Low risk	No missing data.
Bias in measurement of the outcome	Low risk	Assessors were aware of interventions, but outcome assessment was unlikely to be influenced by the knowledge of intervention received.
Bias in selection of the reported result	Some concerns	Not enough information to determine selective reporting bias.

Loeb, Mark, et al. "SARS among critical care nurses, Toronto."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Serious risk	Retrospective cohort study. Baseline characteristics were generally comparable except age. Also, potential for unknown confounders remains.
Bias in selection of participants into the study (Selection bias)	Low risk	Forty-three nurses worked at least one shift in a critical care unit where there was a patient with SARS were enrolled. Start of intervention and follow-up coincide.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Intervention definition was clear and based solely on information collected at the time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and deviations that do occur are likely to reflect usual clinical practice.
Bias due to missing data (Selection bias)	Low risk	Data were complete.

Bias in measurement of the outcome (Information bias)	Moderate risk	They minimized bias using medical records. However, Certain outcome measures (e.g. personal protective equipment) may be influenced by knowledge of intervention received by patients.
Bias in selection of reported result (Reporting bias)	No information.	Unclear if authors selected this outcome measure a priori.

Seto, W. H., et al. "Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Serious risk	Case-control study; Baseline characteristics were not considered.
Bias in selection of participants into the study (Selection bias)	Low risk	Infected hospital staff were those who acquired SARS 2–7 days after exposure, with no exposure to cases outside the hospital. They tested sera taken from index patients and infected hospital staff during the acute phase of the infection and during convalescence for antibodies to the corona-like virus 4 associated with SARS using an indirect immunoflourescence test.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Interventions of interest are protective equipment during exposure to index patients, and were determined retrospectively.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention likely reflect usual clinical practice.
Bias due to missing data (Selection bias)	Moderate risk	356 completed questionnaires were returned, covering 85% of the staff on roster. The analysis is unlikely to have removed the risk of bias arising from the missing data.
Bias in measurement of the outcome (Information bias)	Moderate risk	Main outcome measure was infection with evidence of clinical manifestation and serology. Knowledge of intervention received may have minimally affected certain aspects of infection.

Bias in selection of reported result (Reporting bias)	No information	Unclear if authors selected the reported outcome measures a priori

Teleman, Monica D., et al. "Factors associated with transmission of severe acute respiratory syndrome among health-care workers in Singapore."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Case-control study; Multivariate analysis conducted.
Bias in selection of participants into the study (Selection bias)	Moderate risk	Start of intervention and start of follow-up did not necessarily coincide for cases
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Diagnosis of SARS with exposure by SARS patients was intervention. Intervention status well-defined and intervention definition is based solely on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention likely reflect usual clinical practice.
Bias due to missing data (Selection bias)	Moderate risk	Data on time of first and last exposure were missing for 78 (83%) and 65 (69%) out of 94 subjects
Bias in measurement of the outcome (Information bias)	Moderate risk	Main outcome measure was transmission of SARS. Outcome measures may be influenced by knowledge of intervention received by study participants
Bias in selection of reported result (Reporting bias)	No information	Unclear if authors selected the reported outcome measures a priori

Zhang, Yi, et al. "Factors associated with the transmission of pandemic (H1N1) 2009 among hospital healthcare workers in Beijing, China."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Case-control study. Multivariate conditional logistic regression analysis was conducted
Bias in selection of participants into the study (Selection bias)	Moderate risk	Start of intervention and start of follow-up did not necessarily coincide for cases
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Intervention of interest is diagnosis of pandemic (H1N1) 2009. Intervention status is well-defined, and intervention definition is based solely on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention likely reflect usual clinical practice.
Bias due to missing data (Selection bias)	Low risk	Data for main outcome were considered complete.
Bias in measurement of the outcome (Information bias)	Low risk	Main outcome measure consisted of seasonal influenza and pandemic (H1N1) 2009 vaccination, and conduct of high-risk procedures. Risk of measurement bias is inherently low, and assessment of outcome is unlikely to have been affected by knowledge of intervention received.
Bias in selection of reported result (Reporting bias)	No information	unclear if the outcome measure was selected a priori

Cheng, Vincent CC, et al. "Prevention of nosocomial transmission of swine-origin pandemic influenza virus A/H1N1 by infection control bundle."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	No information	Observational study; There were no information about the baseline characteristics of participants.
Bias in selection of participants into the study (Selection bias)	Moderate risk	Start of intervention and start of follow-up did not necessarily coincide for all patients.
At-intervention domain		
Bias in classification of interventions (Information bias)	Critical risk	Intervention was S-OIV infection, and was not well-defined.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and any deviations will reflect usual clinical practice
Bias due to missing data (Selection bias)	No information	No information is reported about missing data
Bias in measurement of the outcome (Information bias)	Low risk	The study design was based on the epidemiological analysis of clinical symptoms of the exposed persons without serological confirmation, and this might have underestimated the true incidence of nosocomial transmission.
Bias in selection of the reported result (Reporting bias)	No information	No information as to whether authors selected outcomes measure a priori.

Chokephaibulkit, Kulkanya, et al. "Seroprevalence of 2009 H1N1 virus infection and self-reported infection control practices among healthcare professionals following the first outbreak in bangkok, Thailand."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to	Low risk	Observational study; Multiple logistic regression analysis was used

confounding (Confounding)		for multivariate analysis of self-reported factors
Bias in selection of participants into the study (Selection bias)	Low risk	HCPs who worked during the peak of the 2009 H1N1 outbreak (June–August, 2009) on the wards that cared for patients with influenza and at emergency rooms of two large public tertiary care centers in Bangkok, were randomly invited to participate in the study. Start of follow-up and start of intervention coincided.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Intervention of interest was HI titer. Intervention is well-defined and based solely on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and any deviations will reflect usual clinical practice.
Bias due to missing data (Selection bias)	Moderate risk	There were missing data from some characteristics.
Bias in measurement of the outcome (Information bias)	Low risk	Main outcomes include self-reported IC and the factors associated with infection during the outbreak. Assessment of outcome is unlikely to have been affected by knowledge of intervention received.
Bias in selection of reported result (Reporting bias)	No Information	Unclear if authors selected the reported outcome measures a priori

Wilder-Smith, Annelies, et al. "Asymptomatic SARS coronavirus infection among healthcare workers, Singapore."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Cohort study. Baseline charateristics were comparable, and univariate analysis was used.
Bias in selection of participants into the	Low risk	Study population consisted of Only HCWs with exposure to any of these 3 patients were included. Start of follow-up and start of

study (Selection bias)		intervention coincided.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Patients were classified by symptom(fever, respiratory symptom), radiologic changes, and seropositivity. Intervention is well-defined and based solely on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and any deviations will reflect usual clinical practice.
Bias due to missing data (Selection bias)	No information	No information is reported about missing data or the potential for data to be missing
Bias in measurement of the outcome (Information bias)	Moderate risk	Main outcome was variables(e.g. no. who used masks, gloves, washed hands and were close to a SARS patient) between asymptomatic SARS-CoV infection and pneumonic SARS. Assessment of outcome is unlikely to have been affected by knowledge of intervention received.false-negative patients and those tests may not have been included.
Bias in selection of reported result (Reporting bias)	NI	Unclear if authors selected the reported outcome measures a priori

Nishiura, Hiroshi, et al. "Rapid awareness and transmission of severe acute respiratory syndrome in Hanoi French Hospital, Vietnam."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Case-control study; multiple logistic regression analysis was used to determine the protective effect and eliminate confounding variables.
Bias in selection of participants into the study (Selection bias)	Low risk	29 cases were confirmed to have symptomatic SARS infection through serological studies using ELISA, and 98 controls were included by several selection criteria such as contact with confirmed case, age. Start of intervention and start of follow-up coincide.
At-intervention domain		

Bias in classification of interventions (Information bias)	Low risk	Participants were classified by precautionary measures such as handwashing, masks, gloves and gowns. Intervention status well-defined and intervention definition based on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Any deviations from usual practice were unlikely to impact on the outcome..
Bias due to missing data (Selection bias)	Low risk	Data were considered complete.
Bias in measurement of the outcome (Information bias)	Moderate risk	Primary outcome was precautions against droplet contamination and contact, and measured by mathematical methods such as SEIR model. Certain outcome measures with unknown external cofounding factors may be influenced by knowledge of intervention received by patients.
Bias in selection of the reported result (Reporting bias)	No information	No information as to whether authors selected outcomes measure a priori.

Scales, Damon C., et al. "Illness in intensive care staff after brief exposure to severe acute respiratory syndrome."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low Risk	Observational study; For comparisons of characteristics of healthcare workers with SARS to those of healthcare workers without SARS, they used the two-sample t test.
Bias in selection of participants into the study (Selection bias)	Moderate risk	Start of intervention and follow-up did not necessiarily coincide.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Patients classified by predictors of developing SARS(e.g. entry into room, contact duration, nature of contact, infection control precautions). Intervention status well-

		defined and intervention definition based on information collected at time of intervention.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and any deviations will reflect usual clinical practice.
Bias due to missing data (Selection bias)	Low risk	Data was complete.
Bias in measurement of the outcome (Information bias)	Low risk	Primary outcome measure consist of proximity, duration of exposure and precautions. Assessment of outcome is unlikely to have been affected by knowledge of intervention received.
Bias in selection of reported result (Reporting bias)	No informaton	Not enough information.

Park, J. Y., et al. "Factors associated with transmission of Middle East respiratory syndrome among Korean healthcare workers: infection control via extended healthcare contact management in a secondary outbreak hospital."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Serious risk	Case-control cohort study; baseline characteristics were not considered.
Bias in selection of participants into the study (Selection bias)	No information.	40 inpatients and 26 HCWs in hospital isolation cohort and 14 HCWs who directly contacted the index case in home quarantine cohort were included. No information is reported about whether start of follow up and start of intervention coincide.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Participants in cases and controls classified by factors associated with transmission of MERS. Intervention is well-defined.
Post-intervention domains		

Bias due to deviations from intended interventions (Confounding)	No information	No information is reported on whether there is deviation from the intended intervention.
Bias due to missing data (Selection bias)	Low risk	There was no missing data
Bias in measurement of the outcome (Information bias)	Low risk	Assessment of outcome is unlikely to have been affected by knowledge of investigators.
Bias in selection of reported result (Reporting bias)	No information	Not enough information.

Kim, T., et al. "Transmission among healthcare worker contacts with a Middle East respiratory syndrome patient in a single Korean centre."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	No information	Case report.
Bias in selection of participants into the study (Selection bias)	No information.	31 HCWs in the emergency department during his 27-min stay the patient were included. No information is reported about whether start of follow up and start of intervention coincide.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Participants classified by personal protective equipment, and distance from the patient. Assignments of intervention status were determined retrospectively.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	No information	No information is reported on whether there is deviation from the intended intervention.

Bias due to missing data (Selection bias)	Low risk	There was no missing data
Bias in measurement of the outcome (Information bias)	Low risk	Assessment of outcome is unlikely to have been affected by knowledge of investigators.
Bias in selection of reported result (Reporting bias)	No information	Not enough information.

Alraddadi et al. " Risk Factors for Middle East Respiratory Syndrome Coronavirus Infection among Healthcare Personnel."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Retrospective cohort. Multivariable logistic regression performed.
Bias in selection of participants into the study (Selection bias)	Low risk	Two cohorts (MICU unit and ED unit) that housed MERS-CoV confirmed patient were included. In addition a neurology unit where there were no MERS-CoV patient was also included. For analysis of risk factors including PPE use, participants were limited to those who reported direct contact with MERS-CoV patients.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk.	Data collected retrospectively.
Post-intervention domains		
Bias due to deviations from intended	Serious risk	PPE use was investigated as either always, not always, never using. N95 use and medical mask use were not mutually exclusive (co-

interventions (Confounding)		intervention).
Bias due to missing data (Selection bias)	No information	No information on missing data
Bias in measurement of the outcome (Information bias)	Low risk	Infection was confirmed through laboratory findings. Method was comparable across all participants.
Bias in selection of reported result (Reporting bias)	Moderate risk	Outcome measurement clearly defined and no indication of selection of reported analysis.

X. Wang, et al. " Association between 2019-nCoV transmission and N95 respirator use."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	No information	Retrospective cohort. No information on whether confounding might be present
Bias in selection of participants into the study (Selection bias)	Low risk	Eligible participants of six departments were included.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Intervention well defined.

Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention are likely to reflect usual practice
Bias due to missing data (Selection bias)	No information	No information reported about missing data
Bias in measurement of the outcome (Information bias)	Low risk	Suspected cases of 2019-nCoV infection were investigated by chest computed tomography, and confirmed by molecular diagnosis.
Bias in selection of reported result (Reporting bias)	No information	Little information to make judgement.

Toyokawa, et al. " Seroprevalence of antibodies to pandemic (H1N1) 2009 influenza virus among health care workers in two general hospitals after first outbreak in Kobe, Japan."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Moderate risk	Cross-sectional study. Logistic regression model analysis performed to determine factors significantly associated with seropositivity. Confounding expected since no multiple regression were conducted.
Bias in selection of participants into the study (Selection bias)	Low risk	Participants recruited in voluntary basis from the HCWs who had worked in the emergency department and wards in which pH1N1 patients were hospitalized in two target hospitals.

At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Intervention status well defined. Data collected retrospectively through questionnaires.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Moderate risk	Degree of impletementation of was divided into a 4-point scale and was analyze into two groups (1 always implementation vs 2-4 partial or no implementation). Subjective self-assessment can lead to deviation but impact on outcome expected to be slight.
Bias due to missing data (Selection bias)	No information	No information is reported about missing data
Bias in measurement of the outcome (Information bias)	Low-risk	HI antibody against pandemic A/H1N1pdm virus were tested according to established protocols in the NESVPD.
Bias in selection of reported result (Reporting bias)	Low-risk	No indication of selection of reported analysis.

Raboud, et al. " Risk Factors for SARS Transmission from Patients Requiring Intubation: A Multicentre Investigation in Toronto, Canada."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low-risk	Retrospective cohort study. Generalized estimating equation logistic regression models and classification and regression trees were used to identify risk factors for SARS transmission.

Bias in selection of participants into the study (Selection bias)	Low-risk	Among all HCWs who were identified as having provided care to SARS patients, 624 (90%) who consented to participate were enrolled.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Intervention well defined. Data collected retrospectively through questionnaires.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention are likely to reflect usual practice
Bias due to missing data (Selection bias)	Low risk	Data reasonably complete
Bias in measurement of the outcome (Information bias)	Low risk	HCWs were classified as SARS if they had antibodies to SARS-CoV detected in their convalescent serum, or if they met the SARS outbreak case definition and did not have serology performed. They were classified as not having SARS if they had negative serology or if they did not have serology done and had no fever or respiratory symptoms.
Bias in selection of reported result (Reporting bias)	Moderate risk	Outcome measurement clearly defined and no indication of selection of reported analysis.

Chen, et al. " High SARS-CoV-2 antibody prevalence among healthcare workers exposed to COVID-19 patients."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment

Pre-intervention domains		
Bias due to confounding (Confounding)	Low risk	Cross-sectional cohort. Univariate and multivariate analysis of risk factors were done.
Bias in selection of participants into the study (Selection bias)	Low risk	All 105 HCWs with direct contact with 4 COVID-19 patients were investigated.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Intervention status (risk factors) well defined. Data collected retrospectively at the first day of quarantine.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low-risk	Any deviations from usual practice unlikely to impact on outcome.
Bias due to missing data (Selection bias)	Low-risk	Data reasonably complete
Bias in measurement of the outcome (Information bias)	Low-risk	COVID-19 seropositivity determined through laboratory assays. Measurement comparable across all participants.
Bias in selection of reported result (Reporting bias)	Moderate-risk	Outcome measurement clearly defined and no indication of selection of reported analysis.

Xiaodong Guo, et al. "Survey of COVID-19 Disease Among Orthopaedic Surgeons in Wuhan, People's Republic of China."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low-risk	Matched case-control study. No significant difference of demographic variables between infected and matched orthopaedic surgeons. Univariate conditional logistic regression model used to assess associations between potential exposures and COVID-19 morbidity.
Bias in selection of participants into the study (Selection bias)	Low-risk	All eligible patients were entered. 24 hospitals were investigated and 26 COVID-19 cases (as defined according to guidance of WHO) were identified. 2 were excluded since one assisted in fever clinic and 1 unable to finish questionnaire). Controls selected from uninfected surgeons who worked in the same department as the case at each hospital.
At-intervention domain		
Bias in classification of interventions (Information bias)	Serious risk	Intervention status not well defined. Questionnaire asked degree of protection (all the time, most of the time, occasionally) which had no further explanation of the options. Individual protective measure uses were not asked, rather they were asked as multiple choice questions. Data collected retrospectively.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Serious-risk	Degree of protection (similar to protective measure adherence) not well defined. N95 use can be affected by surgical mask use (co-intervention).
Bias due to missing data (Selection bias)	Low-risk	Data reasonably complete
Bias in measurement	Low-risk	Outcome unlikely to be influenced by knowledge of risk factors. COVID-19 cases were either confirmed with laboratory tests or

of the outcome (Information bias)		clinically diagnosed in guidance of WHO.
Bias in selection of reported result (Reporting bias)	Moderate-risk	Outcome measurement and analyses well-defined and no indication of selection of the reported analysis from among multiple analyses.

Khalil, et al. " Role of Personal Protective Measures in Prevention of COVID-19 Spread Among Physicians in Bangladesh: a Multicenter Cross-Sectional Comparative Study."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low-risk	Cross-sectional comparative study. No multiple regression study done to get rid of confounding effects of various protective measures.
Bias in selection of participants into the study (Selection bias)	Low risk	All COVID-19 positive physicians of different hospitals were approached. 98 physicians whose COVID-19 RT-PCR test was positive were enrolled. COVID-19 negative physicians who worked in the same hospitals were contacted and 92 were enrolled as controls. No significant difference in baseline information or exposure.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	The study used predesigned structured questionnaire type developed by WHO for risk assessment and management of exposure of healthcare workers in the context of COVID-19. Data collected retrospectively.
Post-intervention domains		
Bias due to deviations from intended interventions	Low risk	The WHO tool has four options to quantify the frequency of taking personal-protective measures. Among them, "always (>95% of the time)" and "most of the time (50-95% of the time)" were defined as

(Confounding)		taking proper protective measure for each item.
Bias due to missing data (Selection bias)	Low risk	Data were reasonably complete
Bias in measurement of the outcome (Information bias)	Low risk	Primary outcome was COVID-19 infection. COVID-19 infection was confirmed by RT-PCR. Outcome unlikely to be influenced by knowledge of intervention and any error unrelated to intervention status.
Bias in selection of reported result (Reporting bias)	Low risk	Although it is unclear if authors selected the reported outcome measures a priori, the objectively most important outcome is COVID-19 RT-PCR positive, and this is used as a main outcome measure.

Khurana, et al. "Prevalence and clinical correlates of COVID-19 outbreak among health care workers in a tertiary level hospital in Delhi."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Serious risk	Case-control study. No multivariable analysis done to eliminate possible confounding effects of each intervention on each other.
Bias in selection of participants into the study (Selection bias)	Low risk	COVID positive HCWs recruited as cases. Matched cohort who tested negative were recruited as control group. Baseline characteristics showed no difference between the two groups.
At-intervention domain		
Bias in classification of interventions	Moderate risk	Intervention well defined. Data collected retrospectively.

(Information bias)		
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations from intended intervention are likely to reflect usual practice.
Bias due to missing data (Selection bias)	Low risk	Data reasonably complete
Bias in measurement of the outcome (Information bias)	Low risk	Method of outcome assessment comparable across intervention groups.
Bias in selection of reported result (Reporting bias)	Moderate risk	No indication of selection of reported analysis.

Akinbami, Vuong, et al. "SARS-CoV-2 Seroprevalence among Healthcare, First Response, and Public Safety Personnel, Detroit Metropolitan Area, Michigan, USA, May–June 2020."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low-risk	Observational study; Baseline characteristics considered, and multivariable adjustment done for possible confounding factors
Bias in selection of participants into the study (Selection bias)	Low risk	All eligible participants included in the study (volunteers of ≥18 years working onsite in a first response, hospital or public safety setting and consented to phlebotomy and serum sample storage, were all included for analysis)
At-intervention domain		
Bias in classification of interventions	Moderate risk	Intervention was N95 respirator or surgical facemask use, which is well-defined. Information collected retrospectively.

(Information bias)		
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Deviations are unlikely, and any deviations will reflect usual clinical practice
Bias due to missing data (Selection bias)	Low risk	Data reasonably complete
Bias in measurement of the outcome (Information bias)	Low risk	Outcome assessment comparable for all participants. Seroprevalence was measured through antibody testing using a uniform product.
Bias in selection of the reported result (Reporting bias)	Low risk	A priori protocol reviewed by CDC human subjects research officials.

Kumar, et al. "Risk factors and outcome among COVID-19 exposed and quarantined healthcare workers: A study on the status of existing practices of standard precautions."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Low-risk	Observational study; Baseline characteristics considered, no statistically significant differences in the demographic characteristics between positive and negative groups
Bias in selection of participants into the study (Selection bias)	No information	50 HCWs quarantined in April and May 2020 following exposure to confirmed or suspected COVID-19 cases or due to development of ILI were included. No information given as to how participants were selected from all with eligible condition.
At-intervention domain		
Bias in classification of interventions (Information bias)	Moderate risk	Intervention was N95 respirator or surgical facemask use, which is well-defined. Information collected retrospectively.
Post-intervention domains		
Bias due to deviations from intended interventions	Low risk	Mask use compliance (e.g. always, sometimes, etc) was not defined. Deviations might exist from intended intervention (proper use of masks) but impact on the outcome expected to be slight.

(Confounding)		
Bias due to missing data (Selection bias)	No information	No information given about missing data.
Bias in measurement of the outcome (Information bias)	Low risk	Outcome assessment comparable for all participants. (RT-PCR of oropharyngeal and nasal/nasopharyngeal swabs between day 5 and 7 from the day of last exposure or development of symptoms, whichever was earlier.)
Bias in selection of the reported result (Reporting bias)	Moderate risk	Outcome measurement clearly defined and both internally and externally consistent. No protocol given a priori.

Sims, Maine, et al. "COVID-19 seropositivity and asymptomatic rates in healthcare workers are associated with job function and masking."

ROBINS-I (risk of bias assessment for nonrandomized studies)

Bias	Author's judgment	Support for judgment
Pre-intervention domains		
Bias due to confounding (Confounding)	Moderate risk	Baseline characteristics considered. No multivariate analysis done for evaluating effect of mask use on seroprevalence, confounding expected.
Bias in selection of participants into the study (Selection bias)	Low risk	Eligible participants included in the study.
At-intervention domain		
Bias in classification of interventions (Information bias)	Low risk	Intervention was mask use (N95 respirator, PAPR, surgical facemask, others) which is well-defined. Information collected prospectively.
Post-intervention domains		
Bias due to deviations from intended interventions (Confounding)	Low risk	Mask use compliance (e.g. always, sometimes, etc) was not defined. Deviations might exist from intended intervention (proper use of masks) but impact on the outcome expected to be slight.
Bias due to missing data (Selection bias)	Low risk	Data reasonably complete

Bias in measurement of the outcome (Information bias)	Low risk	Outcome assessment comparable for all participants. (Serum antibody tested using a uniform automated IgG assay)
Bias in selection of the reported result (Reporting bias)	Moderate risk	Outcome measurement clearly defined and both internally and externally consistent. No protocol given a priori.

Included studies

1. MacIntyre CR, Cauchemez S, Dwyer DE, Seale H, Cheung P, Browne G, Fasher M, Wood J, Gao Z, Booy R *et al*: **Face mask use and control of respiratory virus transmission in households**. *Emerg Infect Dis* 2009, **15**(2):233-241.

2. Barasheed O, Almasri N, Badahdah AM, Heron L, Taylor J, McPhee K, Ridda I, Haworth E, Dwyer DE, Rashid H *et al*: **Pilot Randomised Controlled Trial to Test Effectiveness of Facemasks in Preventing Influenza-like Illness Transmission among Australian Hajj Pilgrims in 2011**. *Infect Disord Drug Targets* 2014, **14**(2):110-116.

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11. MacIntyre CR, Wang Q, Cauchemez S, Seale H, Dwyer DE, Yang P, Shi W, Gao Z, Pang X,

Zhang Y *et al*: **A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers**. *Influenza Other Respir Viruses* 2011, **5**(3):170-179.

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