
NKAL
Netherlands Expertise Centre for Occupational Respiratory Disorders
Arbeidshygiëne in een pandemie:
Voorkomen van Covid-19
Rol van mondmaskers en ventilatie
in het Covid-19 maatregelenpakket
Nederlandse Vereniging
voor Arbeidshygiëne
NVvA Landelijke Contact Bijeenkomst
Digitale bijeenkomst 10 december 2020
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Introduction

- Covid-19 working group

Nederlandse Vereniging voor Arbeidshygiëne

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- Algemene bronnen
- Arbowet, Arbobesluit en biologische agentia
- Adembescherming
- Transmissieroute, Blootstellingsroute
- Virulentie op oppervlaktes
- Oogbescherming
- Huidbescherming
- Klimaatbeheersing en ventilatie
- Kwetsbare groepen
- Desinfectie
- AVG - Privacy en gegevens
- Branches
- Meldingsplicht
- Terug naar het werk

Info over het coronavirus voor Arboprofessionals

Het coronavirus leidt tot veel vragen bij arboprofessionals. Essentieel is nu dat wij allen samenwerken om de kennis die nodig is voor arbeidshygiënisten, zo snel mogelijk beschikbaar te stellen.

Op deze pagina's bieden wij de bronnen gerangschikt naar enkele thema's. Het doel is dat hiermee de arboprofessionals achtergrond info beschikbaar hebben, waarmee zij hun adviezen kunnen vormgeven. Dit betekent dat iedereen zelf verantwoordelijk blijft voor de opgestelde adviezen.

Let er ook op dat er constant voortschrijdend inzicht is. Check daarom de meest actuele versie van de informatie waarnaar in deze webpagina's verwezen wordt.

Graag ontvangen wij aan- en opmerkingen bij deze informatie. Ook indien je nieuwe informatie hebt dan ontvangen wij die graag, opdat we dit voor iedereen beschikbaar kunnen stellen. Stuur je reactie aan nvva@arbeidshygiene.nl

Elements in this presentation

- Covid-19 (general aspects)
- Respiratory Protective Equipment (general aspects)
- Respiratory protection in hospital settings
- Respiratory protection in the general community
- Potential role of aerosol transmission
- Thoughts on the role of ventilation

Covid-19: some general aspects

Transmission routes of respiratory viruses:

1. Contact transmission
   - Direct contact with an infectious person (e.g. handshake)
   - Contact a contaminated surface (hand to mouth, nose, eyes)
2. Droplet transmission
   - Respiratory droplets by infectious person (e.g. sneezing, coughing)
   - Close to an infected person
3. Airborne transmission
   - Smaller droplets and particles
     - Greater distance
     - Remain suspended in the air for longer time

CDC, 2020a

Covid-19: some general aspects

Consensus on relevant routes of transmission:

1. Contact transmission — YES
2. Droplet transmission — YES
3. Airborne transmission
   - Aerosol generating procedures in hospitals — YES
   - Aerosols in the general (indoor) environment — Under debate

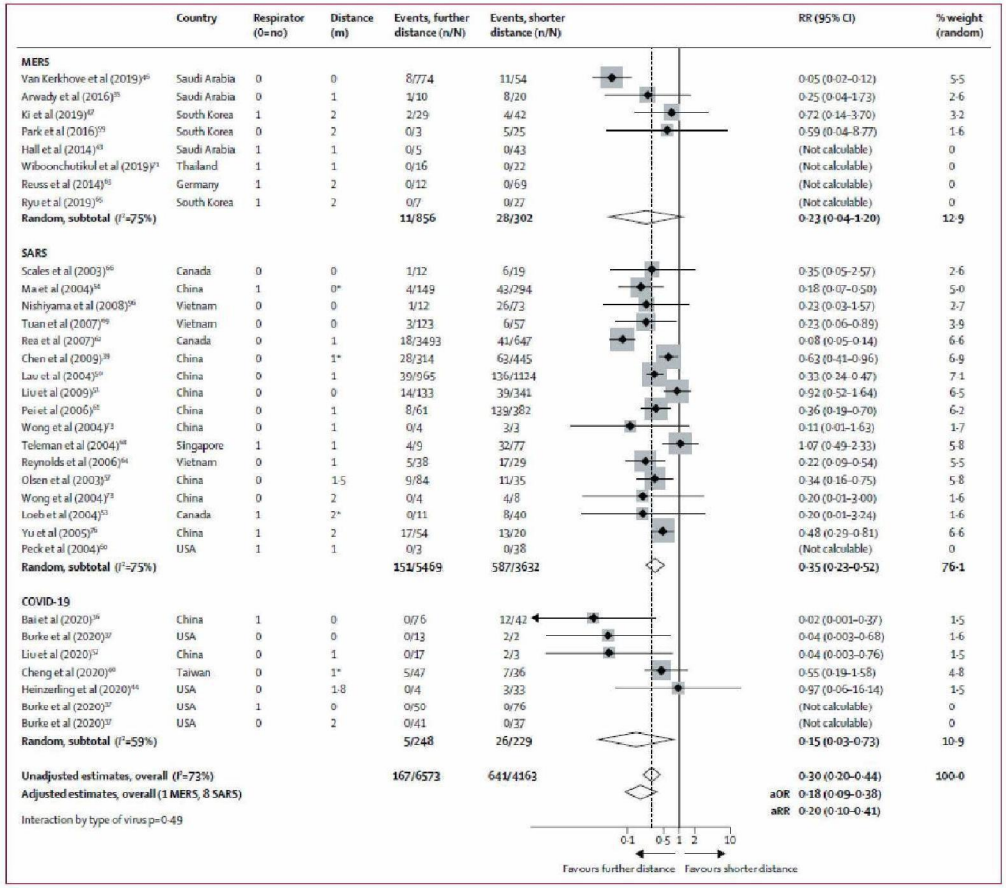
CDC, 2020a; WHO, 2020

Covid-19: some general aspects

General preventive measures

1. Stay home when complaints or tested positive
2. Physical distancing (1-2 meters)
3. Frequent hand hygiene
4. Sneeze and cough in your elbow
5. Try not to touch your face

CDC, 2020a; WHO, 2020



	Country	Respirator (0=no)	Distance (m)	Events, further distance (n/N)	Events, shorter distance (n/N)	RR (95% CI)	% weight (random)
MERS							
Van Kerkhove et al (2019)[45]	Saudi Arabia	0	0	8/774	11/54	0·05 (0·02–0·12)	5·5
Arwady et al (2016)[35]	Saudi Arabia	0	1	1/10	8/20	0·25 (0·04–1·73)	2·6
Ki et al (2019)[47]	South Korea	1	2	2/29	4/42	0·72 (0·14–3·70)	3·2
Park et al (2016)[53]	South Korea	0	2	0/3	5/25	0·59 (0·04–8·77)	1·6
Hall et al (2014)[43]	Saudi Arabia	1	1	0/5	0/43	(Not calculable)	0
Wiboonchutikul et al (2019)[51]	Thailand	1	1	0/16	0/22	(Not calculable)	0
Reuss et al (2014)[55]	Germany	1	2	0/12	0/69	(Not calculable)	0
Ryu et al (2019)[55]	South Korea	1	2	0/7	0/27	(Not calculable)	0
Random, subtotal (I^2=75%)				**11/856**	**28/302**	**0·23 (0·04–1·20)**	**12·9**
SARS							
Scales et al (2003)[56]	Canada	0	0	1/12	6/19	0·35 (0·05–2·57)	2·6
Ma et al (2004)[54]	China	1	0*	4/149	43/794	0·18 (0·07–0·50)	5·0
Nishiyama et al (2008)[56]	Vietnam	0	0	1/12	26/73	0·23 (0·03–1·57)	2·7
Tuan et al (2007)[46]	Vietnam	0	0	3/123	6/57	0·23 (0·06–0·89)	3·9
Rea et al (2007)[62]	Canada	0	1	18/3493	41/647	0·08 (0·05–0·14)	6·6
Chen et al (2009)[39]	China	0	1*	28/314	62/445	0·63 (0·41–0·96)	6·9
Lau et al (2004)[50]	China	0	1	39/965	136/1124	0·33 (0·24–0·47)	7·1
Liu et al (2009)[51]	China	0	0	14/133	39/341	0·92 (0·52–1·64)	6·5
Pei et al (2006)[52]	China	0	1	8/61	139/382	0·36 (0·19–0·70)	6·2
Wong et al (2004)[73]	China	0	1	0/4	3/3	0·11 (0·01–1·63)	1·7
Teleman et al (2004)[48]	Singapore	1	1	4/9	32/77	1·07 (0·49–2·33)	5·8
Reynolds et al (2006)[64]	Vietnam	0	1	5/38	17/29	0·22 (0·09–0·54)	5·5
Olsen et al (2003)[57]	China	0	1·5	9/84	11/35	0·34 (0·16–0·75)	5·8
Wong et al (2004)[73]	China	0	2	0/4	4/8	0·20 (0·01–3·00)	1·6
Loeb et al (2004)[53]	Canada	1	2*	0/11	8/40	0·20 (0·01–3·24)	1·6
Yu et al (2005)[76]	China	1	2	17/54	13/20	0·48 (0·29–0·81)	6·6
Peck et al (2004)[60]	USA	1	1	0/3	0/38	(Not calculable)	0
Random, subtotal (I^2=75%)				**151/5469**	**587/3632**	**0·35 (0·23–0·52)**	**76·1**
COVID-19							
Bai et al (2020)[36]	China	1	0	0/76	12/42	0·02 (0·001–0·37)	1·5
Burke et al (2020)[37]	USA	0	0	0/13	2/2	0·04 (0·003–0·68)	1·6
Liu et al (2020)[52]	China	0	1	0/17	2/3	0·04 (0·003–0·76)	1·5
Cheng et al (2020)[40]	Taiwan	0	1*	5/47	7/36	0·55 (0·19–1·58)	4·8
Heinzerling et al (2020)[44]	USA	0	1·8	0/4	3/33	0·97 (0·06–16·14)	1·5
Burke et al (2020)[37]	USA	1	0	0/50	0/76	(Not calculable)	0
Burke et al (2020)[37]	USA	0	2	0/41	0/37	(Not calculable)	0
Random, subtotal (I^2=59%)				**5/248**	**26/229**	**0·15 (0·03–0·73)**	**10·9**
Unadjusted estimates, overall (I^2=73%)				**167/6573**	**641/4163**	**0·30 (0·20–0·44)**	**100·0**
Adjusted estimates, overall (1 MERS, 8 SARS)						**aOR 0·18 (0·09–0·38)**	
						aRR 0·20 (0·10–0·41)	

Interaction by type of virus p=0·49

0·1 0·5 1 2 10

Favours further distance Favours shorter distance

Physical distancing: the evidence

- Systematic review and meta-analysis
- 1 meter or more compared with < 1m:
- Pooled adjusted odds ratio 0.18 (95% CI 0.09-0.38)
- Strength of association larger with increasing distance

Chu et al, 2020

Covid-19: some general aspects

General preventive measures

1. Stay home when complaints or tested positive
2. Physical distancing (1-2 meters)
3. Frequent hand hygiene
4. Sneeze and cough in your elbow
5. Try not to touch your face

What about respiratory protection?

Covid-19: some general aspects

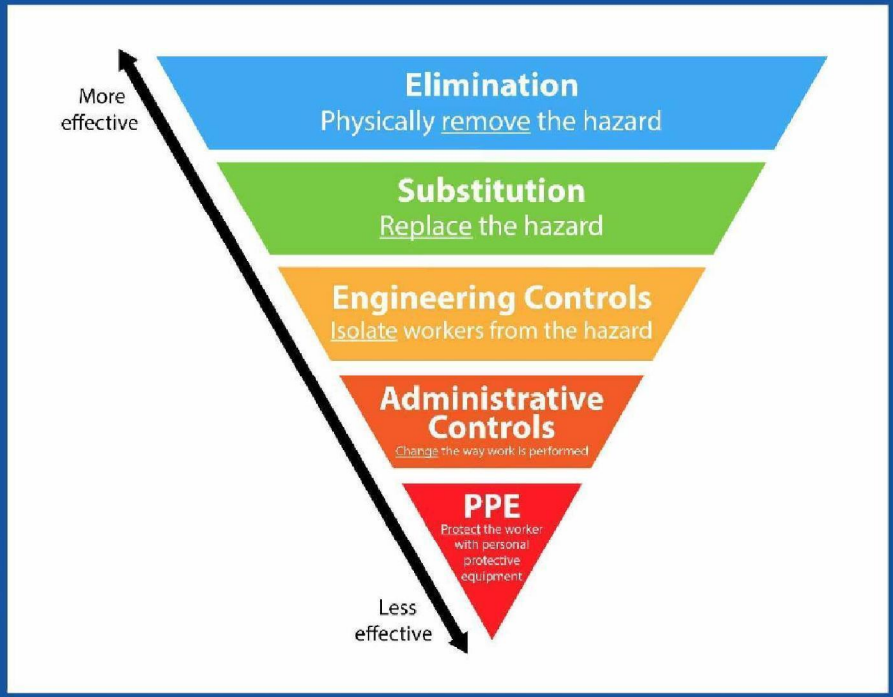
General preventive measures

1. Stay home when complaints or tested positive
2. Physical distancing (1-2 meters)
3. Frequent hand hygiene
4. Sneeze and cough in your elbow
5. Try not to touch your face
6. Respiratory protection:
   - Health worker with care for Covid-19 patients
   - In hospital settings with aerosol generating procedures
   - In settings where a physical distancing cannot be achieved

Further specifications and nuancing in next slides

CDC, 2020a; WHO, 2020

Respiratory protection (general aspects)

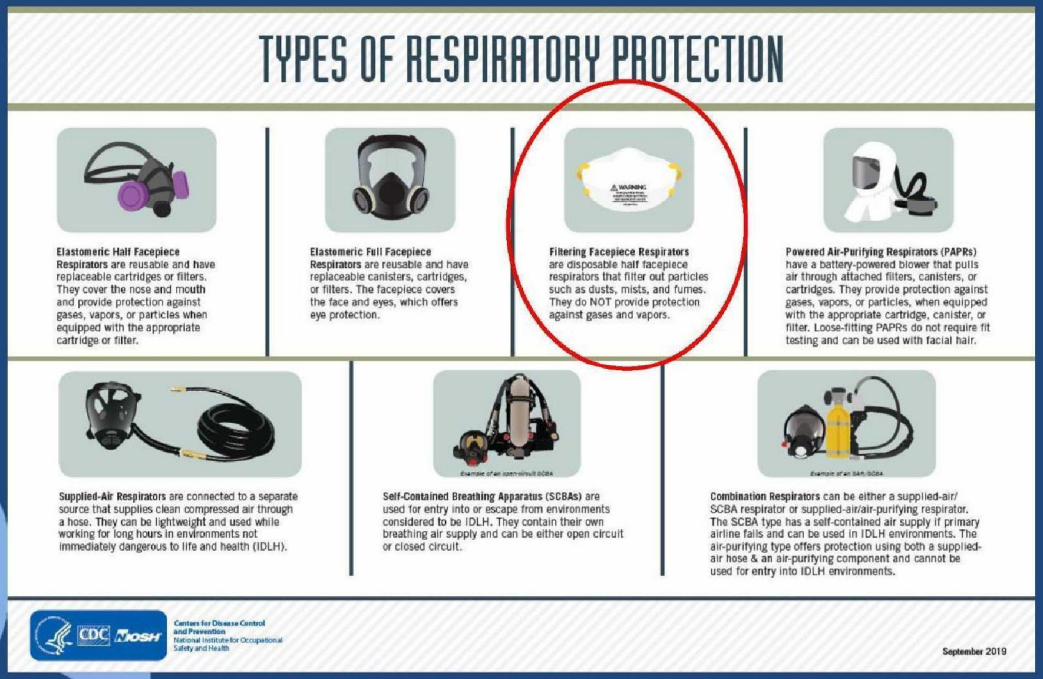


I need to say it…

- Personal protective equipment the last step in the occupational hygiene strategy
- Respiratory protection only in combination with other control measures!!!

!!!

Respiratory protection (general aspects)



For Covid-19 disposable respirator masks seems to be the most logical choice

Most tight-fit respirators: a good fit to the face skin is needed

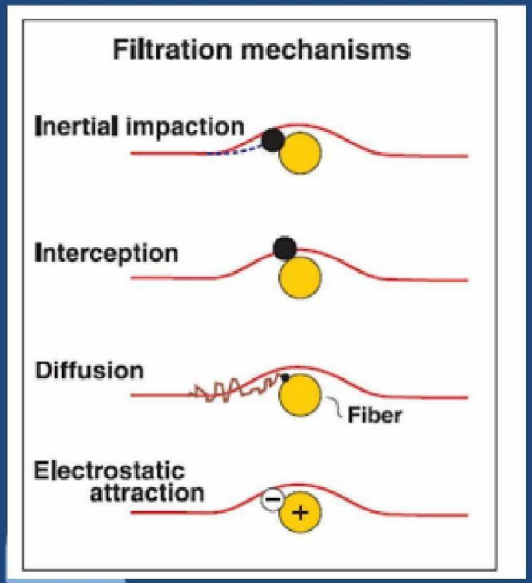
Respiratory protection (general aspects)

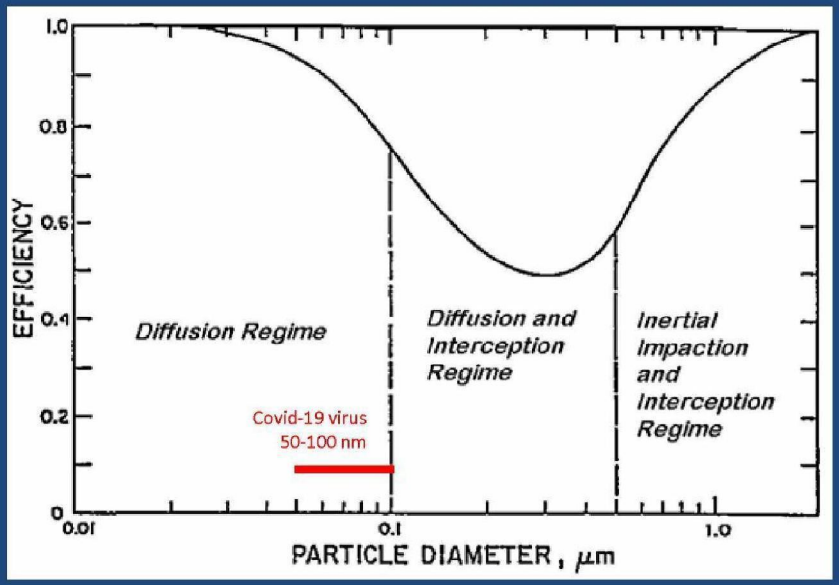
- Respiratory Protection Progamme including fit-testing

Qualitative fit test
(smell)

Quantitative fit test
(sampling inside & outside)

Filter efficiency





Covid-19 virus will be transported as part of a droplet/aerosol

NIOSH, 2009

Protection factor of filtering facepieces

Table 1. Efficiency requirement for filtering facepieces and their assigned protection factors

Class	Max permitted total inward leakage	Max permitted filter penetration	Min filter efficiency[□□]	Nominal Protection Factor [††]	Assigned Protection Factor
FFP1	22%	20	80%	4.5	4
FFP2	8%	6	94%	12.5	10
FFP3	2%	1	99%	50	20

□□ Figure derived from the maximum filter penetration allowed by BS EN 149:2001
□□□ Figure derived from the maximum total inward leakage allowed by BS EN 149:2001

HSE, 2008

Outside Europe

Table 1 Comparison of key requirements of N95, FFP2 and FFP3 respirators.

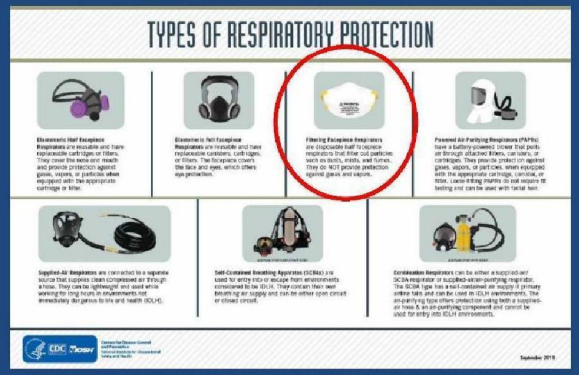
Requirement	N95 (NIOSH-42CFR84)	FFP2 (EN149:2001+A1:2009)	FFP3 (EN149:2001+A1:2009)
Assigned Protection factor (APF)	10	10	20
Filter efficiency	≥95% (85 l/min)	≥94% (95 l/min)	≥99% (95 l/min)
Test agent used	NaCl	NaCl and Paraffin oil	NaCl and Paraffin oil
Total inward leakage (TIL)	N/A	≤8%	≤2%
Inhalation resistance	≤343 Pa (85 l/min)	≤240 Pa (95 l/min)	≤300 Pa (95 l/min)
Exhalation resistance	≤245 Pa (85 l/min)	≤300 Pa (160 l/min)	≤300 Pa (160 l/min)

Not exactly the same (slightly different test protocols, but FFP2 ≈ N95 (US) ≈ P2 (down under) ≈ KN95 (China)

HSE, 2020

Respiratory protection (general aspects)

Mostly tight-fit



Intended to protect the wearer from particles in the environment

Respiratory protection equipment (with an assigned protection factor)

Loose-fit

Fluid-resistant medical mask (type IIR)

Test protocols (EN-14683)

Non-medical masks or cloth masks

No test protocols

Intended to protect the environment (patients) from particles expelled by the wearer

No respiratory protection equipment (no protection factor assigned)

Question: what protection do they offer?

Valved versus non-valved

Provides the same level of protection to the wearer

Exhalation valves reduces the exhalation resistance

But: exhaled air is released unfiltered: no protection for patients

Advice on the use of masks in the context of COVID-19

Interim guidance

5 June 2020

Health care settings
- By voting of Guidance Development Group
- Taking into account practical considerations (disadvantages of full-time use of respirators)

World Health Organization

Respirator (FFP2, FFP3, N95)

- In care settings where aerosol generating procedures (AGPs) are performed (e.g. Covid-19 intensive and semi-intensive care units)

Fluid-resistant medical mask

- Direct care to Covid-19 patients in the absence of AGPs

WHO, 2020

Advice on the use of masks in the context of COVID-19

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World Health Organization

Respirator (FFP2, FFP3, N95)

- In care settings where aerosol generating procedures (AGPs) are performed (e.g. Covid-19 intensive and semi-intensive care units)
  - Defined AGP list in most countries (WHO: tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy, sputum induction induced by using nebulized hypertonic saline, and autopsy procedures)
  - Potential of release of small particles that range > 1-2 meters and stay in the air longer
  - Potential of airborne transmission

WHO, 2020

Advice on the use of masks in the context of COVID-19

Interim guidance

5 June 2020

Health care settings

- By voting of Guidance Development Group
- Taking into account practical considerations (disadvantages of full-time use of respirators)

World Health Organization

If not a respirator….

Is it protective for the health worker?

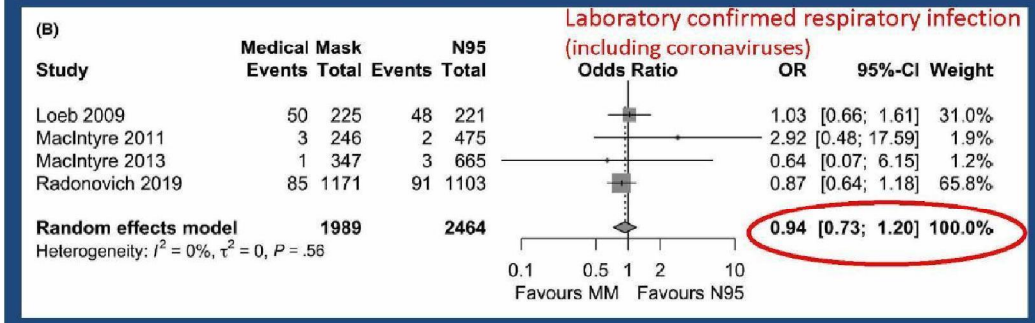
Yes: based on randomised clinical trials

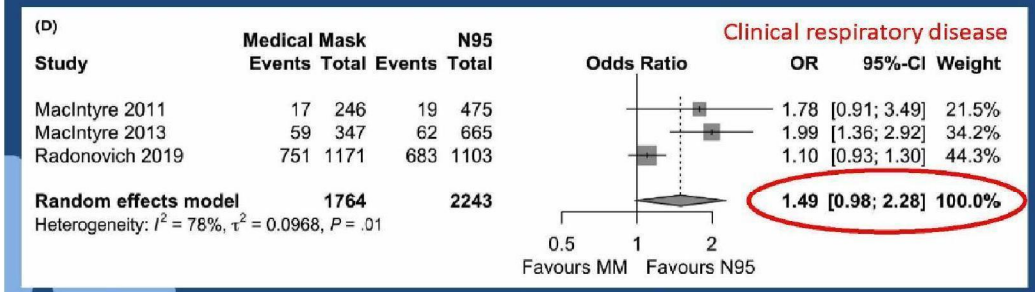
Fluid-resistant medical mask

- Direct care to Covid-19 patients in the absence of AGPs

WHO, 2020

Systematic review and meta-analysis of randomized controlled trials (RCTs)

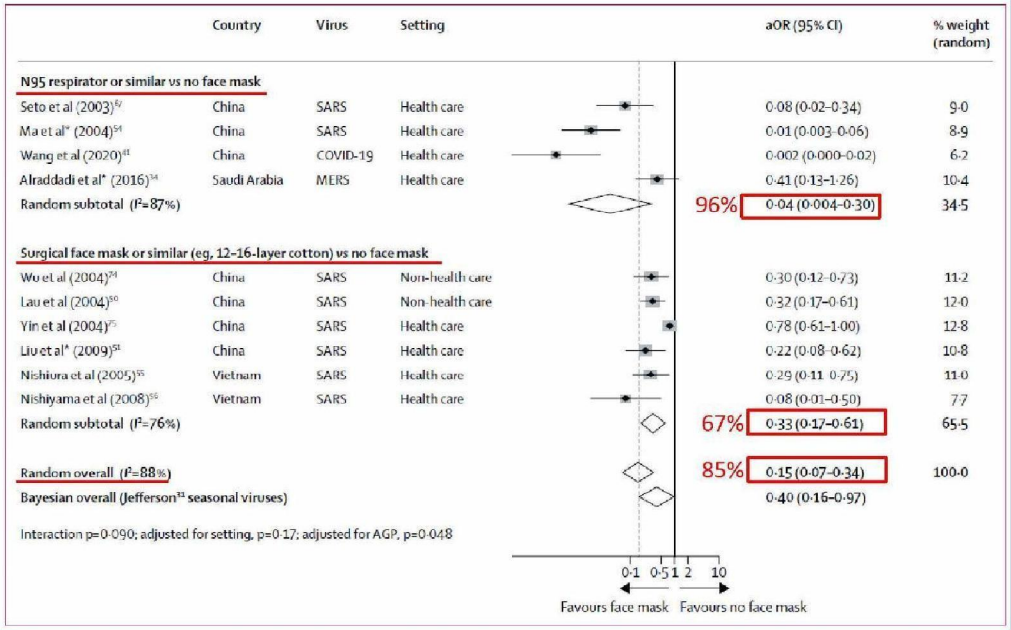




- Not statistically different
- Medical masks and N95 respirators offer similar protection during non-aerosol-generating care

Similar results for laboratory confirmed influenza infection and influenza like illness

Bartoszko et al, 2020 (& Long et al, 2020)



	Country	Virus	Setting	aOR (95% CI)	% weight (random)
N95 respirator or similar vs no face mask					
Seto et al (2003)[52]	China	SARS	Health care	0·08 (0·02–0·34)	9·0
Ma et al* (2004)[54]	China	SARS	Health care	0·01 (0·003–0·06)	8·9
Wang et al (2020)[41]	China	COVID-19	Health care	0·002 (0·000–0·02)	6·2
Alraddadi et al* (2016)[34]	Saudi Arabia	MERS	Health care	0·41 (0·13–1·26)	10·4
Random subtotal (I^2=87%)				96% 0·04 (0·004–0·30)	34·5
Surgical face mask or similar (eg, 12–16-layer cotton) vs no face mask					
Wu et al (2004)[74]	China	SARS	Non-health care	0·30 (0·12–0·73)	11·2
Lau et al (2004)[50]	China	SARS	Non-health care	0·32 (0·17–0·61)	12·0
Yin et al (2004)[75]	China	SARS	Health care	0·78 (0·61–1·00)	12·8
Liu et al* (2009)[51]	China	SARS	Health care	0·22 (0·08–0·62)	10·8
Nishiura et al (2005)[55]	Vietnam	SARS	Health care	0·29 (0·11 0·75)	11·0
Nishiyama et al (2008)[56]	Vietnam	SARS	Health care	0·08 (0·01–0·50)	7·7
Random subtotal (I^2=76%)				67% 0·33 (0·17–0·61)	65·5
Random overall (I^2=88%)				85% 0·15 (0·07–0·34)	100·0
Bayesian overall (Jefferson[33] seasonal viruses)				0·40 (0·16–0·97)	

Interaction p=0·090; adjusted for setting, p=0·17; adjusted for AGP, p=0·048

0·1 0·5 1 2 10

Favours face mask Favours no face mask

Face mask use: the evidence

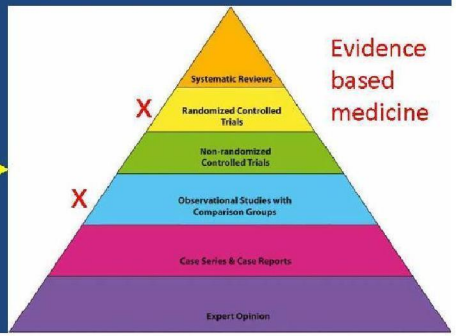
- Systematic review and meta-analysis
- Any face mask versus no face mask:
- Pooled adjusted odds ratio 0.15 (95% CI 0.07-0.34)

Study suggests better performance for N95 vs medical masks

However:

1. Mix of surgical mask and cotton masks
2. Observational studies only (no randomised controlled trials)

Chu et al, 2020



Evidence based medicine

Recent study suggests community transmission is more important than hospital transmission

COVID-19 in health-care workers in three hospitals in the south of the Netherlands: a cross-sectional study

Reina S Sikkema, Suzan D Pas*, David F Nieuwenhuijse, Áine O'Toole, Jaco J Verweij, Anne van der Linden, Irina Chestakova, Claudia Schapendonk, Mark Pronk, Pascal Lexmond, Theo Bestebroer, Ronald J Overmars, Stefan van Nieuwkoop, Wouter van den Bijllaardt, Robbert G Bentvelsen, Miranda M L van Rijen, Anton G M Buiting, Anne J G van Oudheusden, Bram M Diederen, Anneke M C Bergmans, Annemiek van der Eijk, Richard Molenkamp, Andrew Rambaut, Aura Timen, Jan A J W Kluytmans, Bas B Oude Munnink, Marjolein F Q Kluytmans van den Bergh*, Marion P G Koopmans**

Lancet, Vol 20, Nov 2020

- Research among 95 SARS-CoV-2 positive health-care workers in 3 hospitals in the early phase of the epidemic (feb/march 2020)
- Combination of epidemiologic data with whole-genome sequencing (determining the source of each infection)
- Consistent with multiple introductions through community-acquired infections
- Does not support nosocomial infections
- In hospitals use of medical mask (except for AGPs)

Sikkema et al, 2020

Non-medical masks for the general public

Advice on the use of masks in the context of COVID-19

Interim guidance

5 June 2020

Note:
Only in addition to the general measures for Covid-19 prevention!!

World Health Organization

No direct evidence of effectiveness but risk-based approach:

Use masks in geographical areas with known or widespread transmission (high prevalence)

- in public settings (e.g. grocery stores, churches)
- In situations with high population density
- Settings where physical distancing cannot be achieved (e.g. public transportation)

WHO, 2020

Filtration efficiency of non-medical masks

- Highly varies between cloth fabrics and masks (0-99%)
- Efficiency increases with multiple layers
- Expected: Reduction in infection rate and/or severity of infection

REVIEW

MAYO CLINIC

Studies between 1978-2020

Check for updates

Forgotten Technology in the COVID-19 Pandemic: Filtration Properties of Cloth and Cloth Masks—A Narrative Review

Catherine M. Clase, MB; Edouard L. Fu, BSc; Aumeen Ashur;

General conclusion: cloth masks may prevent transmission of Covid-19

- Cloth can block droplets and aerosols, and layers add efficiency
- Many materials tested, e.g.:
  - Cotton cloth: 43-94% filter efficiency
  - T-shirts/touwels: 10-40% filter efficiency

WHO, 2020; Clase et al 2020a&b); Peeples, 2020, NEN, 2020

However: no standardised testing so uncertainty in effectiveness

Some guidance in recent NEN-spec (nov 2020)

Community use of masks effective?

- CDC Scientific Brief November 2020
  - Multi-layer cloth mask can:
    - Block up to 70% of fine droplets and aerosol particles
    - Limit the spread of those particles that do penetrate the mask
  - Prevention benefit of masking is derived from the ***combination*** of source control and personal protection for the mask wearer

CDC, 2020b

Community use of masks effective?

Citing a number of studies that are strongly in support of reduced spread of Covid-19 when wearing masks:

- 2 hair stylist with symptoms and confirmed Covid-19: none of the 67 clients developed infection
- 124 households with ≥1 Covid-19 positive person: further household spread was reduced by 79%
- Military personell working in aircraft carrier: masking was associated with 70% reduced risk of infection
- Investigations of airline flights >10 hours that had covid-19 infected passengers: none of the other passengers and crew developed infections < 14 days
- 7 other studies: new infections declined significantly after introduction of rule to use masks on a community level

CDC, 2020b; Mitze et al 2020

Covid-19: some general aspects

Consensus on relevant routes of transmission:

1. Contact transmission — YES
2. Droplet transmission — YES
3. Airborne transmission
   - Aerosol generating procedures in hospitals — YES
   - Aerosols in the general (indoor) environment — Under debate

> 5 µm

< 5 µm

CDC, 2020a; WHO, 2020

Emission of small aerosols in the absence of aerosol generating procedures (AGPs)

Small aerosols

Reach longer distances

Stay in the air longer

Do they play a significant role in the Covid-19 epidemic?

Large droplets

Deposit close to the person

Arguments in favour of a significant role

- It has been shown that sneezing, coughing, talking, singing,…. also emit smaller aerosols
- It has been shown that such particles can travel far and stay in the air long
- Air sampling in clinical settings in the absence of AGPs found Covid-19 virus RNA in some settings (but not in others)
- Some disease clusters have been presented that suggest a possible role of small aerosols (e.g. choirs)

CDC, 2020a; WHO, 2020; Klompas et al 2020, RIVM 2020

Arguments not in favour of a significant role

- The estimated reproduction number of around 2,5 is not in favour of airborne transmission (diseases that spread through airborne transmission tend to have higher attack rates like measles)
- Also, the secundary attack rate is low both in the general public and among health care workers (only about 5% of contacts of patients with confirmed Covid-19 become infected)
- If aerosol transmission would be dominant, respirators would be more protective than medical masks
- If aerosol transmission would be dominant, the protective effect of distancing would be limited
- There is no evidence of efficient spread to people far way or who enter a space hours after an infectious person was there
- Air sampling in clinical settings in the absence of AGPs dit not found virus RNA in some settings (but did in others)
- Most studies that did found virus RNA have not shown viable infectous virus (the presence of viral RNA does not prove aerosol-based transmission)

CDC, 2020a; WHO, 2020; Klompas et al 2020, RIVM 2020

Overall considerations

- It cannot be concluded that aerosol-based transmission never occurs
- Available data indicate that SARS-CoV-2 spread like most other common respiratory viruses, primarily through respiratory droplets
- The balance of currently available evidence suggest that long-range aerosol-based transmission is not the dominant mode of transmission (like measles)
- However, airborne transmission can be relevant in special circumstances (as exception to the general rule)
  - Enclosed spaces
  - Prolonged exposure to respiratory particles generated with expiratory exertion (e.g. shouting, singing, exercising)
  - Inadequate ventilation (accumulation in time)

CDC, 2020a; WHO, 2020; Klompas et al 2020, RIVM 2020

What does this mean?

General preventive measures

1. Stay home when complaints or tested positive
2. Physical distancing (1-2 meters)
3. Frequent hand hygiene
4. Sneeze and cough in your elbow
5. Try not to touch your face
6. Respiratory protection
7. Ventilation →

- Only in addition to the general control measures (less important than 1-6)
- Ventilation will have little or no impact on droplet or contact transmission
- Follow the existing rules of room ventilation (e.g. ventilation rates)

Personal opinion:

- Proper ventilation is good from a general perspective and can also contribute to reduce covid-19 infections, but is not the most important action that needs to be taken.
- Ventilation is important but not more important since covid-19 (don't make ventilation the most important thing to do)

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In addition (in Dutch only): RIVM Medical guideline Covid-19 infection (including appendices)

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