# NIV behandling ved COVID-19 og aerosoldannelse

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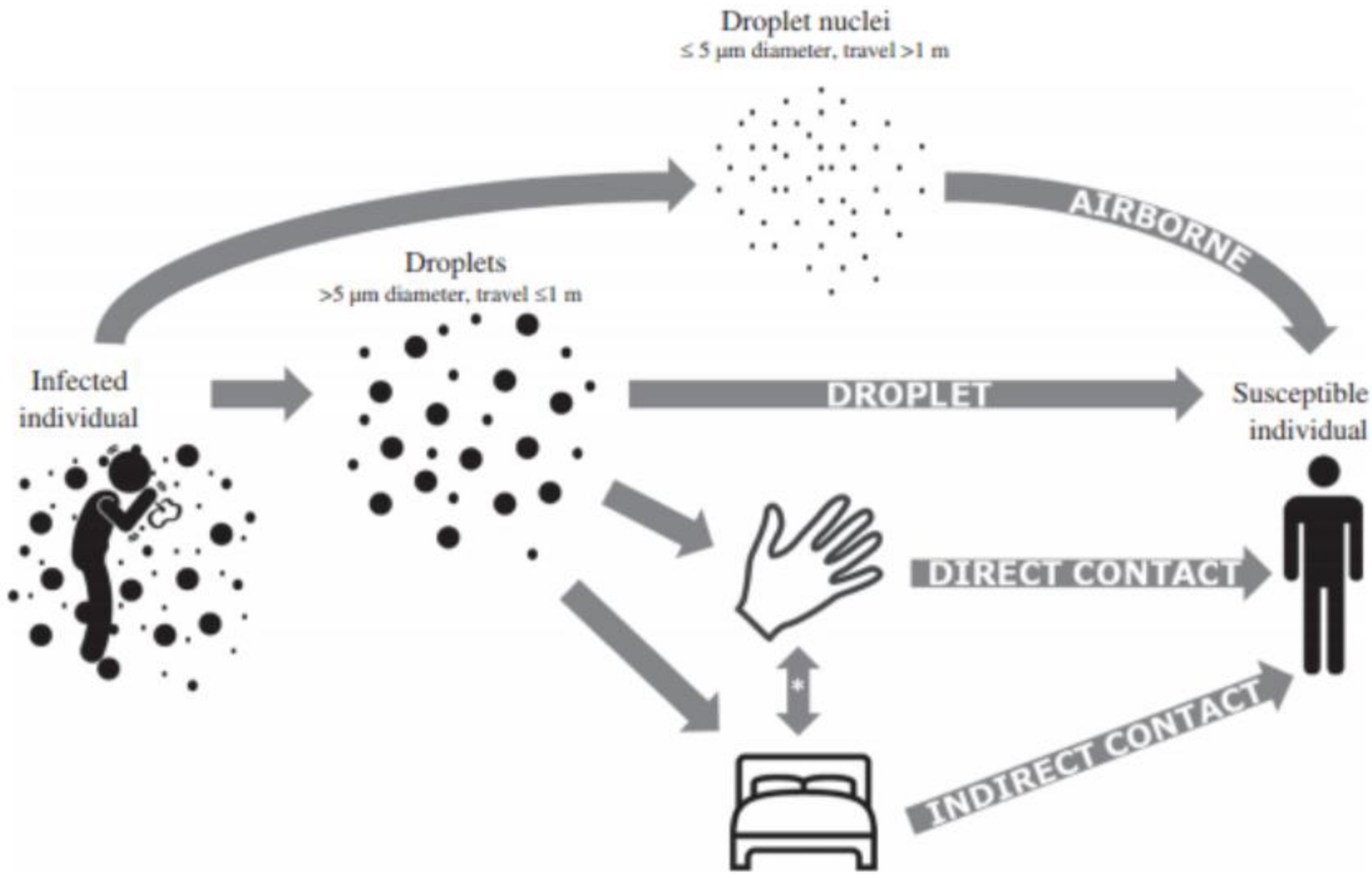

Droplet nuclei
≤ 5 µm diameter, travel >1 m
AIRBORNE
Droplets
>5 µm diameter, travel ≤1 m
Infected individual
DROPLET
Susceptible individual
DIRECT CONTACT
*
INDIRECT CONTACT

# Covid-19

- Kontakt og dråpesmitte

- SARS epidemien:
- Luftsmitte ved aerosol genererende prosedyrer

# Aerosolgenererende prosedyrer

- Luftsmittebeskyttelse
- Enerom med sluse
- Kontrollert undertrykkventilasjon
- Eget bad med WC/dusj
- Dekontaminator

# *Aerosol*

- "aero-solution"
- Aerosol er en gass med finfordelte partikler eller dråper som er så små at de holder seg svevende i gassen
- Kontinium: aerosol -> små dråper -> større dråper -> større ansamling
- Kan transporteres særlig ved høy luftstrøm som ved hoste eller medisinske gasser/prosedyrer

# Non-invasiv respirasjonsstøtte ved Covid-19

- Oksygen via nesekateter
- Oksygen via åpen maske
- Oksygen via maske med reservoar

- High-flow oksygen
- CPAP
- NIV

**Table 2** Respiratory non-invasive therapies for COVID-19: recommendations from scientific societies.

| Scientific society (country), ref nr | Non-invasive respiratory therapy first option |
|---|---|
| SEPAR (Spain)[56] | HFNC |
| AIPO (Italy)[57] | Helmet CPAP |
| ESICM/SCCM (EU/US)[58] | HFNC |
| SPP (Portugal)[51] | HFNC or CPAP |
| NHS (UK)[59] | CPAP |
| WHO[60] | HFNC or NIV |
| CTS (China)[61] | HFNC |
| ANZICS (Australia/New Zealand)[62] | HFNC |
| Multiple Societies (Germany)[63] | Helmet NIV |

*Abbreviations*: SEPAR-Sociedad Española de Patologia Respiratória; AIPO-Associazone Italiana Pneumologi Ospedalieri; ESICM-European Society of Intensive Care Medicine; SCCM-Society of Critical Care Medicine SPP-Sociedade Portuguesa de Pneumologia; CTS-Chinese Thoracic Society, ANZICS-Australian and New Zealand Intensive Care Society.

COVID-19 pandemic and non invasive respiratory management: Every Goliath needs a David. An evidence based evaluation of problems
J.C. Wincka,, N. Ambrosino
Pulmonology Volume 26, Issue 4, July–August 2020, Pages 213-220

# Aerosolgenererende prosedyrer Definisjoner

- Any medical and patient care procedure that results in the production of airborne particles (aerosols)
- Medical procedures that have been reported to be aerosol-generating <u>and</u> consistently associated with an increased risk of pathogen transmission

Evidens for aerosoldannelse

Evidens for øket smitterisiko

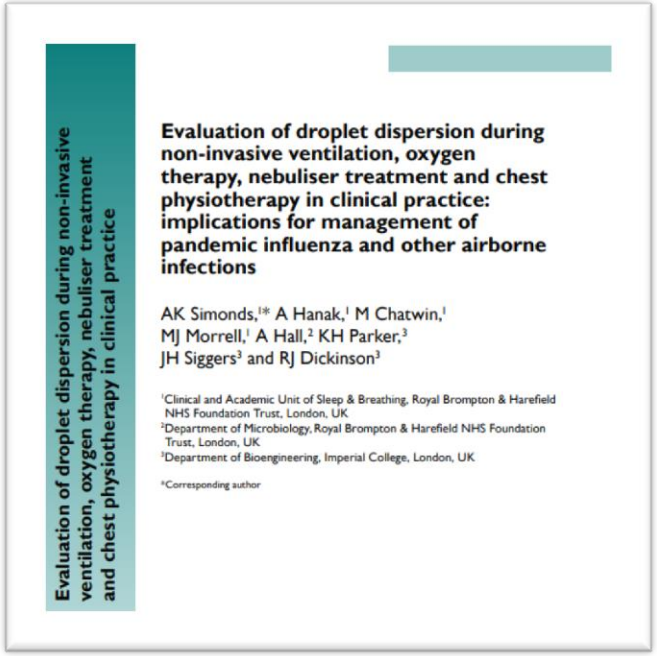
World Health Organization. Infection prevention and control of epidemic-and pandemic prone acute respiratory infections in health care. WHO guidelines. 2014.

# Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: Implications for management of pandemic influenza and other airborne infections

- 3 grupper: friske, luftveisinfeksjon, kronisk lungesyke med forverrelse
- NIV: med ventilert maske og med ikke-ventilert maske

- Dannelse av aerosoler og øket dråpedannelse
- Ved pasienten munn og 1 meter fra pasienten

- Konklusjon:
- NIV dannet ikke aerosoler
- Ventilert maske: Øket dråpedannelse
- Ikke ventilert maske: Ikke øket dråpedannelse



Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice

**Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: implications for management of pandemic influenza and other airborne infections**

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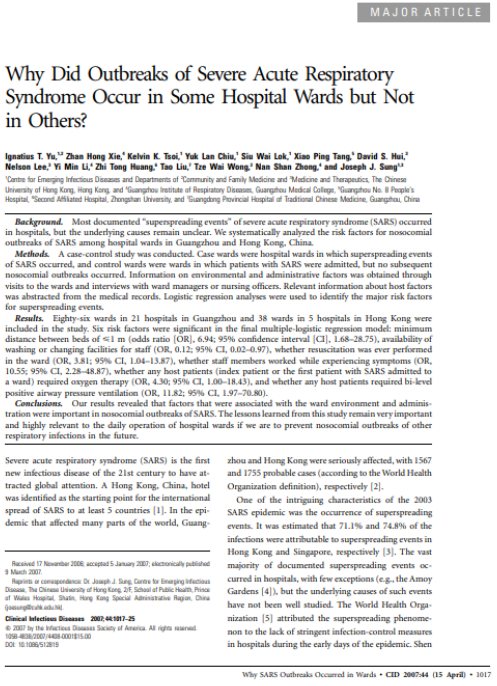
Simonds et al. October 2010 Health Technology Assessment 14(46):131-172

# Why Did Outbreaks of Severe Acute Respiratory Syndrome Occur in Some Hospital Wards but Not in Others?

- Superspreder hendelser av SARS i avdelinger
- 127 poster i KINA og Hong Kong 1 års periode 2004

- Høydose oksygen ( >6L/min)
- BIPAP



MAJOR ARTICLE

Why Did Outbreaks of Severe Acute Respiratory Syndrome Occur in Some Hospital Wards but Not in Others?

**Ignatius T. Yu,[1,2] Zhan Hong Xin,[4] Kelvin K. Tsoi,[1] Yuk Lan Chiu,[1] Siu Wai Lok,[1] Xiao Ping Tang,[5] David S. Hui,[3] Nelson Lee,[3] Yi Min Li,[6] Zhi Tong Huang,[6] Tao Liu,[7] Tze Wai Wong,[8] Nan Shan Zhong,[4] and Joseph J. Sung[1,2]**

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***Background.*** Most documented "superspreading events" of severe acute respiratory syndrome (SARS) occurred in hospitals, but the underlying causes remain unclear. We systematically analyzed the risk factors for nosocomial outbreaks of SARS among hospital wards in Guangzhou and Hong Kong, China.

***Methods.*** A case-control study was conducted. Case wards were hospital wards in which superspreading events of SARS occurred, and control wards were wards in which patients with SARS were admitted, but no subsequent nosocomial outbreaks occurred. Information on environmental and administrative factors was obtained through visits to the wards and interviews with ward managers or nursing officers. Relevant information about host factors was abstracted from the medical records. Logistic regression analyses were used to identify the major risk factors for superspreading events.

***Results.*** Eighty-six wards in 21 hospitals in Guangzhou and 38 wards in 5 hospitals in Hong Kong were included in the study. Six risk factors were significant in the final multiple-logistic regression model: minimum distance between beds of ≤1 m (odds ratio [OR], 6.94; 95% confidence interval [CI], 1.68–28.75), availability of washing or changing facilities for staff (OR, 0.12; 95% CI, 0.02–0.97), whether resuscitation was ever performed in the ward (OR, 3.81; 95% CI, 1.04–13.87), whether staff members worked while experiencing symptoms (OR, 10.55; 95% CI, 2.28–48.87), whether any host patients (index patient or the first patient with SARS admitted to a ward) required oxygen therapy (OR, 4.30; 95% CI, 1.00–18.43), and whether any host patients required bi-level positive airway pressure ventilation (OR, 11.82; 95% CI, 1.97–70.80).

***Conclusions.*** Our results revealed that factors that were associated with the ward environment and administration were important in nosocomial outbreaks of SARS. The lessons learned from this study remain very important and highly relevant to the daily operation of hospital wards if we are to prevent nosocomial outbreaks of other respiratory infections in the future.

Severe acute respiratory syndrome (SARS) is the first new infectious disease of the 21st century to have attracted global attention. A Hong Kong, China, hotel was identified as the starting point for the international spread of SARS to at least 5 countries [1]. In the epidemic that affected many parts of the world, Guangzhou and Hong Kong were seriously affected, with 1567 and 1755 probable cases (according to the World Health Organization definition), respectively [2].

One of the intriguing characteristics of the 2003 SARS epidemic was the occurrence of superspreading events. It was estimated that 71.1% and 74.8% of the infections were attributable to superspreading events in Hong Kong and Singapore, respectively [3]. The vast majority of documented superspreading events occurred in hospitals, with few exceptions (e.g., the Amoy Gardens [4]), but the underlying causes of such events have not been well studied. The World Health Organization [5] attributed the superspreading phenomenon to the lack of stringent infection-control measures in hospitals during the early days of the epidemic. Shen

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# Why Did Outbreaks of Severe Acute Respiratory Syndrome Occur in Some Hospital Wards but Not in Others?

**Table 7. Multivariate model for all risk factors with $P < .15$ in the separate models for environmental or administrative factors and for host factors.**

| | Guangzhou | | Hong Kong | | Overall | |
|---|---|---|---|---|---|---|
| Type of factor, factor | OR (95% CI) | *P* | OR (95% CI) | *P* | OR (95% CI) | *P* |
| Environmental or administrative factors | | | | | | |
| Minimum distance between beds of ≤1 m | **11.77 (1.54–90.13)** | .02 | 10.28 (0.58–182.10) | .11 | **6.94 (1.68–28.75)** | .008 |
| Washing or changing facilities for staff | … | >.15 | … | >.15 | 0.12 (0.02–0.97) | .05 |
| Never used exhaust fan | 4.16 (0.98–17.72) | .05 | … | >.15 | … | >.15 |
| Performance of resuscitation | … | >.15 | … | >.15 | **3.81 (1.04–13.87)** | .04 |
| Staff working while experiencing symptoms | **11.18 (1.99–62.81)** | .006 | **19.27 (1.12–332.48)** | .04 | **10.55 (2.28–48.87)** | .003 |
| Host factors | | | | | | |
| Requiring oxygen therapy | **10.14 (1.70–60.37)** | .01 | … | >.15 | **4.30 (1.00–18.43)** | .05 |
| Use of BIPAP ventilation | 6.67 (0.90–49.23) | .06 | … | >.15 | **11.82 (1.97–70.80)** | .007 |
| Systemic symptoms | 12.71 (0.70–232.03) | .09 | … | >.15 | … | >.15 |

Yu et al. Clin Infect Dis. 2007 Apr 15; 44(8): 1017–1025

ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

NHS National Services Scotland

# Assessing the evidence base for medical procedures which create a higher risk of respiratory infection transmission from patient to healthcare worker

Version 1.1, 16 October 2020.

| | |
|---|---|
| **Assessment of evidence for non-invasive ventilation** | **There is weak evidence to support the concept that non-invasive ventilation does not generate significant aerosols**<br><br>**There is weak evidence to support the increased ARI transmission risk associated with non-invasive ventilation** |

| | |
|---|---|
| **Assessment of evidence for pressurised, humidified oxygen administration** | **There is moderate evidence that oxygen therapy does not result in significant generation of aerosols.**<br><br>**There is weak evidence that manipulation of an oxygen mask does not pose a risk of ARI transmission.**<br><br>**There is weak evidence that administration of oxygen and high flow oxygen do not create an increased risk of ARI transmission but also very weak evidence that oxygen administration on a ward increases the chances of transmission events.** |

ELSEVIER

Annals of Emergency Medicine

Available online 10 August 2020

In Press, Corrected Proof

Infectious disease/systematic review/meta-analysis

# Oxygen Therapy and Risk of Infection for Health Care Workers Caring for Patients With Viral Severe Acute Respiratory Infection: A Systematic Review and Meta-analysis

| Study or Subgroup | log[Odds Ratio] | SE | Weight | Odds Ratio IV, Random, 95% CI | Year |
|---|---|---|---|---|---|
| **3.1.1 BiPAP** | | | | | |
| Fowler | 0.9555 | 1.3191 | 5.8% | 2.60 [0.20, 34.50] | 2004 |
| Ha | 0 | 0 | | Not estimable | 2004 |
| Yu | 2.4698 | 0.9133 | 12.2% | 11.82 [1.97, 70.80] | 2007 |
| Raboud | 1.1474 | 0.418 | 58.1% | 3.15 [1.39, 7.15] | 2010 |
| Cheng | 0 | 0 | | Not estimable | 2015 |
| **Subtotal (95% CI)** | | | **76.1%** | **3.83 [1.87, 7.85]** | |
| Heterogeneity: Tau² = 0.00; Chi² = 1.83, df = 2 (P = 0.40); I² = 0% | | | | | |
| Test for overall effect: Z = 3.68 (P = 0.0002) | | | | | |
| **3.1.2 NIV (undefined)** | | | | | |
| Scales | 0.5766 | 1.1955 | 7.1% | 1.78 [0.17, 18.54] | 2003 |
| Heinzerling | 2.7081 | 1.3354 | 5.7% | 15.00 [1.10, 205.50] | 2020 |
| Ng | 0 | 0 | | Not estimable | 2020 |
| **Subtotal (95% CI)** | | | **12.8%** | **4.76 [0.59, 38.16]** | |
| Heterogeneity: Tau² = 0.67; Chi² = 1.41, df = 1 (P = 0.23); I² = 29% | | | | | |
| Test for overall effect: Z = 1.47 (P = 0.14) | | | | | |
| **3.1.3 BiPAP mask manipulation** | | | | | |
| Loeb | 1.4351 | 0.9562 | 11.1% | 4.20 [0.64, 27.36] | 2004 |
| **Subtotal (95% CI)** | | | **11.1%** | **4.20 [0.64, 27.36]** | |
| Heterogeneity: Not applicable | | | | | |
| Test for overall effect: Z = 1.50 (P = 0.13) | | | | | |
| **Total (95% CI)** | | | **100.0%** | **3.96 [2.12, 7.40]** | |
| Heterogeneity: Tau² = 0.00; Chi² = 3.28, df = 5 (P = 0.66); I² = 0% | | | | | |
| Test for overall effect: Z = 4.32 (P < 0.0001) | | | | | |
| Test for subgroup differences: Chi² = 0.04, df = 2 (P = 0.98), I² = 0% | | | | | |

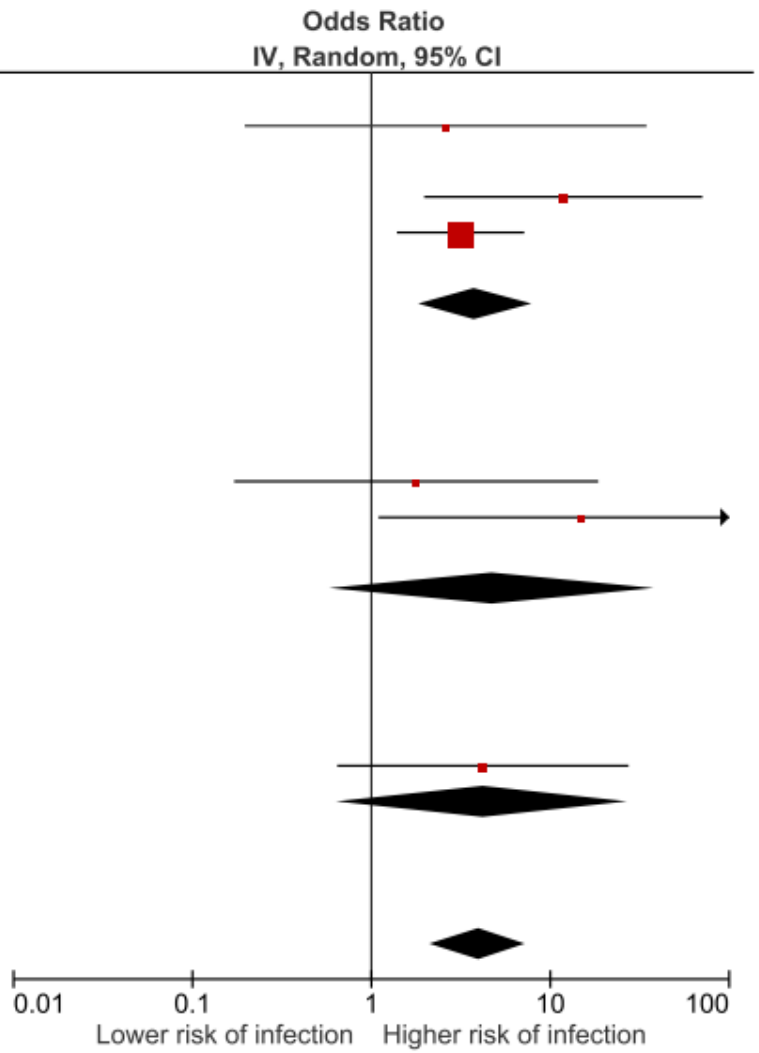


**Figure 4.** Forest plot describing the infection risk during noninvasive ventilation.

# Folkehelseinstituttet:
# Aerosolgenererende prosedyrer som er assosiert med smitterisiko for luftveisvirus

- Intubering/ekstubering
- åpent trakealsug og kortvarig frakopling
- Trakeotomi- og trakeostomiprosedyrer (innleggelse, bruk av åpent trakealsug, seponering)
- Bronkoskopi
- Øre-nese-hals luftveisprosedyrer som involverer bruk av sug
- Hjerte-lungeredning (HLR)*

- Non-invasiv ventilasjon (NIV)
- Høyhastighets oscillerende ventilasjon som HFOV (High-Frequency Oscillating Ventilation)
- High Flow Nasal Oxygenation (HFNO)**
- Indusert sputum
- Lungefysioterapi hvis utført rett etter indusert sputum, eller utført i områder hvor det regelmessig gjøres AGP, for eksempel på intensiv***
- Kirurgi og post-mortem prosedyrer i tilknytning til pasientens luftveier som innebærer bruk av høyhastighets roterende instrumenter/verktøy
- Gastroskopi som involverer bruk av åpent sug i øvre luftveier
- Tannbehandlingsprosedyrer

Kaur *et al. Critical Care* (2020) 24:571
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Critical Care

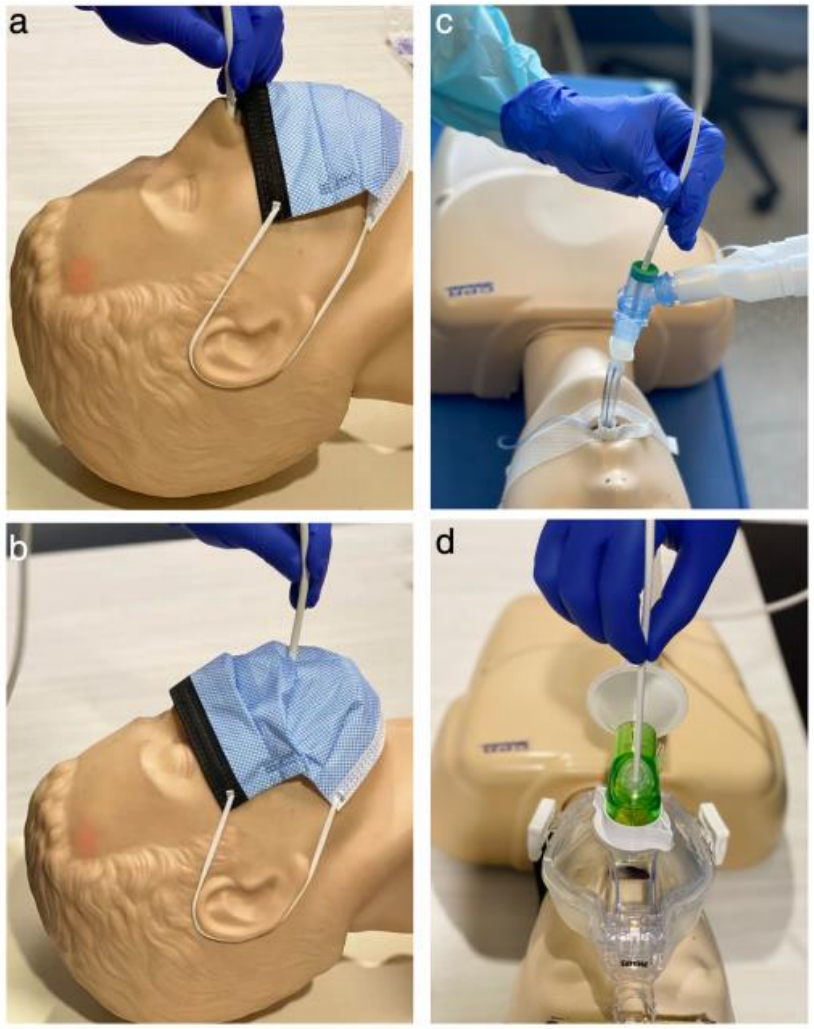
REVIEW

Open Access

# Practical strategies to reduce nosocomial transmission to healthcare professionals providing respiratory care to patients with COVID-19

Ramandeep Kaur[1], Tyler T. Weiss[1], Andrew Perez[1], James B. Fink[1], Rongchang Chen[2], Fengming Luo[3], Zongan Liang[3], Sara Mirza[1] and Jie Li[1*]

**Fig. 2** Wearing a surgical mask over high-flow high humidity nasal cannula



# NIV til pasienter innlagt på sykehus ved usikker eller påvist Covid-19.

## Anbefalinger om praktisk gjennomføring

*v/ Nasjonal kompetansetjeneste for hjemmerespirator (NKH) og regionale koordinatorer: S.Aarrestad, Ø.Rasch-Halvorsen, M.Wold, S.Indrekvam og O.Fondenes*

**Tre hovedtyper av maskiner kan brukes til non-invasiv ventilasjon (NIV):**

1. Intensivrespirator med NIV modus.
2. Spesialisert NIV maskin til akutt bruk.
3. NIV maskiner primært laget for langtids mekanisk ventilasjon (LTMV).
   a) Enkel NIV-maskin. (Ofte kalt BiPAP.)
   b) Avansert hjemmerespirator.

**To hovedtyper masker benyttes:**

1. Ventilert maske: Maske med lekkasjehull for ekspirasjonsluft. (Figur 1 A).
2. Ikke-ventilert maske (NV-maske). Tett maske uten lekkasjehull. (Figur 1 B og C).

**To hoved typer respiratorslanger benyttes**

1. Enkelt slangesett. (Figur 1 A og B).
2. Dobbelt slangesett. Ved dobbelt slangesett skilles inspirasjons- og ekspirasjonsgass. (Figur 1 C).

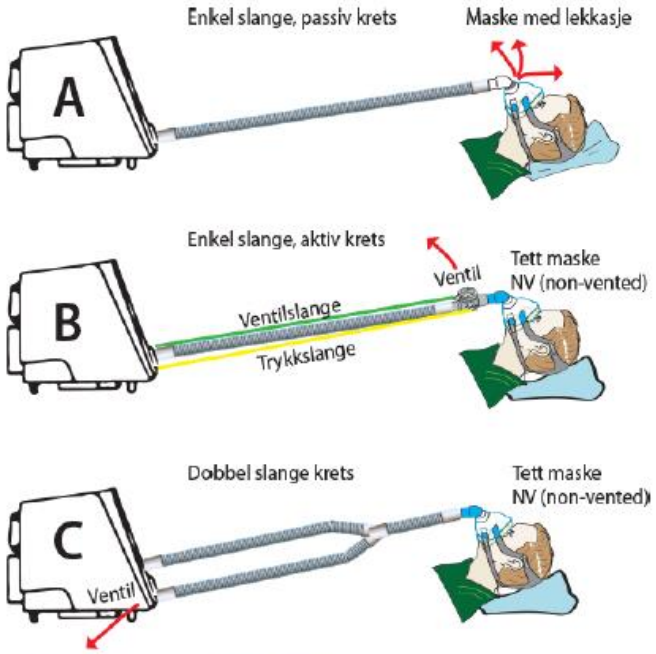



*Fig 1 Ulike slangekretser ved NIV behandling*