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Knowledge translation tools to guide care of non-intubated patients with acute respiratoryillness during the COVID-19 Pandemic and medication

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ABSTRACT

The COVID-19 pandemic has brought unprecedented challenges to healthcare systems worldwide. As the number of patients with acute respiratory illness continues to rise, healthcare professionals need to have a thorough understanding of non-intubated care for COVID-19 patients. To provide the best possible care for these patients, it is crucial to have access to knowledge translation tools that can guide clinical decision-making and optimize patient outcomes. This paper will discuss the importance of knowledge translation tools in patient care and medication management for non-intubated COVID-19 patients, with a focus on understanding non-intubated care for COVID-19 patients. Following these principles will minimize the risk of spreading the virus.

Key words : COVID-19, Non-invasive ventilation, High flow nasal oxygen, Prone positioning, ROX index

1. INTRODUCTION

The COVID-19 pandemic has presented unprecedented challenges to healthcare providers worldwide. As the number of cases continues to rise, healthcare providers need to explore alternative methods of treatment to manage the surge of patients. One such alternative is the non-intubated care of COVID-19 patients, which refers to the use of non-invasive ventilation (NIV) and high-flow nasal cannula (HFNC) as a means of respiratory support. According to Ng et al. (2020), non-intubated care has been shown to be effective in improving oxygenation and reducing the need for invasive mechanical ventilation (IMV) in COVID-19 patients. Additionally, non-intubated care has been associated with a lower risk of complications such as ventilator-associated pneumonia (VAP) and barotrauma compared to IMV. However, non-intubated care requires close monitoring and careful selection of patients who are suitable for this method of treatment. Ng et al. (2020) highlight the importance of identifying patients who have the potential to benefit from non-intubated care and also ensuring that healthcare providers are adequately trained to manage these patients. In conclusion, non-intubated care has emerged as a viable alternative for the management of COVID-19 patients, and its success depends on careful patient selection and close monitoring by healthcare providers.

Knowledge translation (KT) is a crucial component in healthcare as it aims to bridge the gap between research and patient care. The process of KT involves disseminating and implementing research evidence into practice, and this can be achieved through the use of knowledge translation tools. According to Bowen and Graham (2013), KT tools are defined as “any intervention, strategy, or tool that facilitates the transfer of knowledge into practice.” KT tools play a vital role in patient care as they provide healthcare professionals with evidence-based information to improve patient outcomes. For instance, clinical practice guidelines (CPGs) are one of the most commonly used KT tools in patient care. CPGs provide healthcare professionals with a summary of evidence-based recommendations for specific clinical conditions, which can help improve patient outcomes and reduce healthcare costs. Additionally, decision aids are another KT tool that can help patients make informed decisions about their care. Decision aids provide patients with evidence-based information about treatment options, benefits, and risks, which can help them make informed decisions about their care. In conclusion, KT tools are essential in patient care as they provide healthcare professionals with evidence-based information to improve patient outcomes and help patients make informed decisions about their care.

The management of medication for non-intubated COVID-19 patients is critical to manage the symptoms and prevent the progression of the disease. According to Goldberg et al. (2021), several medications have been used to manage COVID-19 symptoms in non-intubated patients. Antivirals such as remdesivir and monoclonal antibodies like casirivimab and imdevimab have been used to reduce viral replication and prevent the progression of the disease. Additionally, anti-inflammatory drugs like dexamethasone have been used to reduce inflammation and cytokine storm, which can lead to acute respiratory distress syndrome (ARDS). It is important to note that the use of corticosteroids must be balanced with the risk of immunosuppression in COVID-19 patients. Other medications, such as anticoagulants and bronchodilators, may also be used to manage the symptoms of COVID-19 patients. However, it is important to individualize the treatment plan based on the patient's clinical condition, comorbidities, and risk factors. The timing of medication administration is also crucial, as early intervention can prevent the progression of the disease and improve clinical outcomes. Therefore, medication management for non-intubated COVID-19 patients must be tailored to each patient to achieve the optimal therapeutic effect.

2. METHODS USED TO DEVELOP THE KNOWLEDGETRANSLATION TOOLS

The multidisciplinary Ventilation Strategy for COVID-19 Working Group held its first virtual meeting 25 March 2020. Our aim was to minimize the risk of viral transmission with NRS strategies among various subgroups of patients and provide clear guidance to our front-line HCP on early management of patients with suspected or confirmed COVID-19.

Our methodology included virtual discussion groups using Microsoft Teams® and Zoom® meeting software, evaluation of emerging published scientific literature, grey literature, Society (e.Key articles were retrieved using OMNI Academic Search Tool (https://ocul.ca/omni/) which includes PubMed, Google Scholar, Scopus, MEDLINE and others, using search terms COVID-19; SARS-CoV-2; hypoxemic respiratory failure; and treatment.

3. DEFINING THE RISK OF HOSPITAL TRANSMISSIONVERSUS THE RISK OF EARLY INTUBATION

The novel coronavirus SARS-CoV-2 has so far infected more than 50 million people worldwide [7]. Based on data from China, Europe and the United States, approximately 20% of infected people require hospitalization and 3-7% require assistance due to acute respiratory failure [8-12]. Current data indicate that 9–17% of novel coronavirus disease (COVID-19) cases are infected health care workers [13–15]. In northern Italy, 11.4% of healthcare workers working in respiratory wards caring for patients undergoing AGMP tested positive for COVID-19 during a follow-up period of 2.5 months [12]. The risks to HCP cannot be ignored. Therefore, their safety is paramount when he treats ARIs throughout the pandemic. The

SARS-CoV-2 virus is primarily transmitted by droplet transmission [10]. These droplets (particles >5–10 μm in diameter) are affected by gravity and can cause direct transmission through close contact or contribute to contamination of surfaces within 1.5–2.0 m of where the virus is present. and may remain active for up to several days [16], [17]. However, some events can produce aerosols consisting of smaller virus-laden particles (<5–10 μm) suspended in the air. Until further data become available, it should be assumed that NRS measures may be AGMP. The propagation distances for different treatments have been described using human patient simulator techniques that mimic different devices and lung disease severity [18-22]. However, careful attention to risk mitigation strategies can reduce the maximum expiratory distance compared to conventional oxygen therapy.

Early intervention in patients with suspected/confirmed COVID-19 is recommended because first-line therapy carries risks of patient mortality such as immobilization, non-use diaphragmatic atrophy, ventilator-associated infection, and respiratory-associated infection. Opt for endotracheal intubation (ETI) and avoid NRS. There is a risk of long-term physical and neurocognitive dysfunction [23], overloading intensive care unit and ventilation capacity. Strategies are therefore needed to identify and safely treat patients likely to benefit from NRS while protecting healthcare workers from the risk of AGMP contamination. Strategies are also needed to identify and de-risk patients who are likely to require early ETI. Increased mortality associated with inevitable delayed intubation [24].

4. CLINICAL MAMAGEMENT OF ARI DURING THE PANDEMIC

Patients with acute on chronic respiratory failure may or may not have concomitant COVID-19 infection, but appropriate precautions should be taken until confirmed negative by testing.

The algorithm is based on upholding best- evidence guidelines for non-COVID patients, and emerging evidence and worldwide clinical experience with COVID-19 during the pandemic.

The purpose of this tool is to identify and categorize patients into three groups based on their likelihood of requiring non-AGMP sup- port, AGMP or high-risk AGMP (intubation) as first-line therapy, so that patients can be admitted to the appropriate area within the hospital with the necessary level of expertise and appropriate precautions taken by HCPs.

Work of breathing should decrease with NRS measures and may be assessed by palpation of the sternomastoid muscle, detection of phasic contraction [27] and/or a reduction in an elevated serum lactate produced by fatiguing respiratory muscles [28]. HFNO and CPAP can sup- port both oxygenation and ventilation by reducing work of breathing for patients with hypoxemia and dyspnea with presumed COVID-19 pneumonia [29, 30].

In Lombardy Italy, where numbers of COVID-19 patients surpassed ICU capacity, necessitating NRS in specially developed Respira tory COVID Units, ETI was avoided in approximately 2/3 of patients without increasing the relative risk of death [12].

However, available best practice guidelines [29–31] suggest NRS should not be used for severe hypoxemic respiratory failure with high respiratory rate/high work of breathing not relieved with support [32], or a trajectory that suggests that invasive ventilation is inevitable.

Patients with high respiratory rate or effort in the setting of acute lung inflammation are at risk of exacerbating the acute lung injury by means of hyperventilation or high transpulmonary pressures, termed “patient self-inflicted lung injury” (P-SILI) [33, 34].

After HFNO or CPAP initiation, patients may be encouraged to assume the prone position, particularly if the PaO2/FiO2 ratio is below 200. The suggestion for a trial of awake prone positioning during NRS is based on physiologic benefit [35] and extrapolation from non-COVID studies rather than proven clinical outcomes in COVID-19 patients. Ventilation in prone position reduces mortality in patients with ARDS receiving invasive mechanical ventilation [36, 37] and improves oxygenation in awake, spontaneously breathing patients with moderate to severe ARDS receiving oxygen therapy by HFNO or NIV [38, 39].

Although small case series of spontaneously breathing and NIV-assisted COVID- 19 patients have recently described feasibility, tolerance and safety with improvement in oxygenation, larger randomized controlled trials are needed to determine if it improves outcomes [40–43].

In our experience, patients are able to pronate themselves but may need assistance adjusting their HFNO or NIV interface with turns. Although less complicated and labor-intensive than prone positioning in unconscious patients, potential risks and barriers include patient discomfort, nausea, increased leak from the interface, and nurse and respiratory therapist time to assist.

The ROX index is calculated as:

ROX index = SpO2/FiO2 / Respiratory Rate

Previously healthy patients with normal pulmonary compliance and cardiac output may tolerate lower SpO2 values without significant distress. A ROX index ≥ 4.88 is reassuring and such patients can continue to be monitored. Figure 1a shows her ROX index thresholds at different time points leading to consideration of change of management and intubation. The trend of the ROX index over time can be as important as the absolute value, as the ROX index should improve over time. Although the ROX index has been validated for his use with HFNO [46], it has not been specifically evaluated for its predictive value in COVID-19 and is not a substitute for clinical examination or clinical judgment. Additionally, patients who develop acidosis, confusion, mental changes, or who are unable to control secretions should be intubated using lung-protective strategies and subjected to invasive ventilation. Finally, patients undergoing NRS should be cared for in a monitored environment by well-trained staff familiar with the use and dose adjustment of these therapies (Figure 1b). At our facility, we have a pulmonary service (led by a resident pulmonologist) or a critical care team (with specially trained ICU nurses and registered respiratory therapists) to care for all patients. A rapid response team led by an intensivist) should be consulted. Patient NRS. Patients are admitted to ventilator units, wards, or intensive care units where bedside staff are appropriately trained. Both pre- and post-COVID-19 experiences support the association between participation in an appropriate environment with team competence and better outcomes in her NRS [3, 12].

5. PREVENTING HOSPITAL TRANSMISSION OF COVID-19 THROUGH ISOLATION AND PPE

Environmental controls and appropriate PPE should be considered during patient care to reduce nosocomial infections. Patients with suspected or confirmed COVID-19 who require hospitalization and are undergoing AGMP should be placed in a negative pressure room if available, or in a separate room (door closed) if not available. should be accommodated in An ED or ICU negative pressure room may be reserved on arrival for patients requiring ETI, as intubation is her AGMP of high risk. Rapid intubation should be performed by the most experienced personnel with a limited number of medical personnel in the room [1,2,47]. When available, a dedicated “intubation team” of experienced medical professionals can perform all intubations for suspected/confirmed cases of COVID-19 [47, 48]. A hydrophobic filter should be placed between the facemask and the breathing circuit. Once the intubation procedure is complete, patients on invasive ventilation via a closed circuit may be transferred from the negative pressure room and cohorted according to their COVID-19 status. Her number of air changes per hour in the room determines how long it takes for the air to be cleared of aerosolized particles after completion of her AGMP in the room. If a patient develops symptoms indicative of her COVID-19 within the hospital, the patient should be transferred to an AGMP single patient room or negative pressure room using her appropriate PPE. CT scans can improve diagnostic sensitivity, especially in the early stages of infection when PCR with nasopharyngeal swabs can be false-negative [49]. If the test results confirm that the patient is COVID-19 negative, no further action is required. Viruses can survive up to 48 hours on stainless steel and plastic, so the area should be thoroughly cleaned [16]. Detailed guidelines for his PPE required by AGMP and his recommendations for optimizing the supply of PPE during the COVID-19 pandemic are available [17, 50-52]. As reported by Lockhart et al. [17] recommends his three-step approach to PSA, as shown in Fig. 1b. Care when donning and donning PPE is essential and should be practiced under the supervision of instructional videos [53] and practiced under supervision.

6. TECHNICAL ASPECTS; MITIGATION TECHNIQUE TO REDUCE EXHALED DROPLET DISPERSION

During respiratory care, healthcare workers are exposed to respiratory droplets. Damage control techniques can significantly reduce droplet deposition during NRS. Figure 2 is an illustrated guide to modifying devices for NIV [54-56] and Figure 2 is an infographic summarizing risk mitigation techniques used in AGMP

7.HIGH FLOW NASAL OXYGEN

HFNO is a high-flow, open-loop oxygen delivery system that may be better tolerated than nasogastric or mask oxygen in the treatment of hypoxemia due to COVID-19 pneumonia there is. Attenuation of droplet infections associated with HFNO can be achieved using a surgical face mask that fits properly over the HFNO cannula, which can reduce lateral droplet spread [57] (Figure 1a). When using HFNO, provide a gas flow of 40-60 L/min and the lowest possible FiO2 to maintain SpO2 in the 92-96% range [6].

8. BOUSSIGNAC CPAP SYSTEM

The Bouchignac CPAP system is a simple method that works according to the venturi principle with wall oxygen flow. No ventilator/CPAP device is required [58, 59]. In the Bouchignac system, air or oxygen is injected through microchannels in the walls of plastic tubes. As gas molecules are accelerated through the channel into the cylinder, a virtual valve is created, resulting in continuous positive airway pressure (Figure 3A). An oxygen flow of 8 L/min produces a CPAP pressure of 3 cmH2O. 15 L/min yields 5 cmH2O. 23 L/min (or flush) provides a pressure of 10 cmH2O. A bacterial/viral filter should be placed between the mask and the Bouchignac valve.

9. HELMET CPAP SYSTEM

CPAP can be administered via a helmet interface with the inspiratory limb connected to a free-flow oxygen system and the expiratory limb connected to a PEEP (positive end-expiratory pressure) valve (Fig. 1a) [60]. Adjust the oxygen flow to 50-60 L/min to ensure carbon dioxide (CO2) is expelled from the helmet. FiO2 can be adjusted, but do not set the flow below 50 L/min to avoid CO2 rebreathing [60]. Alternatively, the helmet can be connected to a ventilator to provide CPAP or two levels of pressure.

10. NON-INVASIVE VENTILATION

With experience, administration of NIV via a helmet interface may lead to reduced droplet spread [61], improved patient tolerability [61] and efficacy [62] compared to oronasal masks.

The helmet is connected to her ICU ventilator via a conventional breathing circuit connecting two ports that allow inspiratory and expiratory flow.

A high flow rate and short inspiratory time are required to pressurize the helmet quickly.

If a helmet and/or expertise in its use are not available, an unvented oronasal mask should be used (instead of a nasal interface).

Proper fit and seal are important for non-vented face masks to minimize droplet spread and maximize effectiveness.

If possible, use a ventilator with an HME filter (heat and moisture exchanger) with a dual-limb circuit and a non-vented mask (no anti-asphyxiation valve required) (see Figure 2a).

Turn off the ventilator before removing the NIV interface.

If the patient has severe coughing discharges or is expected to require NIV for an extended period of time, humidification of the device may be required and can be used in a two-limb circuit.

In this case, we use a non-ventilated adaptive oronasal mask and an anti-asphyxiation valve that combines an HME viral/bacterial filter and an exhalation port.

An anti-asphyxia valve is mandatory when using a non-vented mask.

An antimicrobial/viral filter should be placed in the circuit between the mask and the exhalation port (see Figure 1b).

Antimicrobial/viral filters can increase flow resistance and should be replaced every 24 hours or sooner if dirty.

Initial prescription of single-circuit bilevel ventilation for de novo ARI: fast rise time (~200 ms).

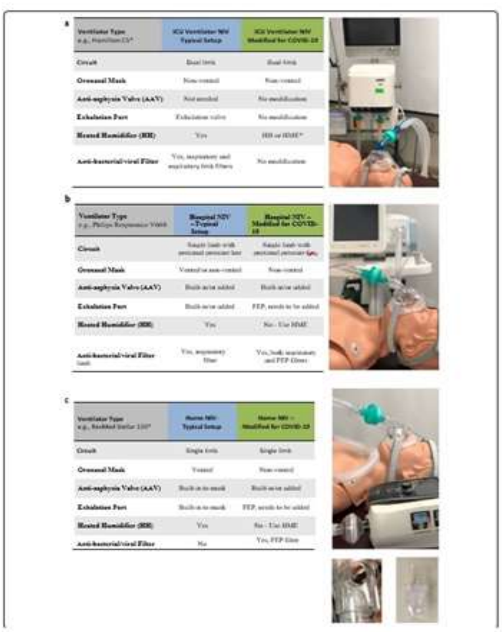

Figure 1: Show three types of ventilation.

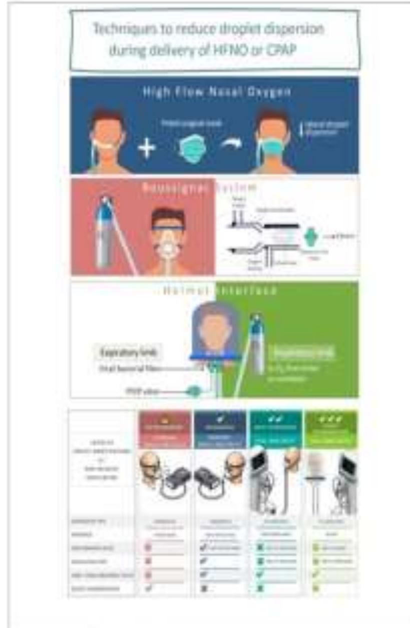

Figure. 2 a Infographic. Techniques to reduce droplet dispersion during HFNO and CPAP. Pictorial representation of techniques to reduce droplet dispersion during aerosol-generating medical procedures. **b** Infographic. COVID-19 Circuit Modifications for Non-Invasive Ventilation. Pictorial representation of circuit modifications for NIV use during the COVID-19 pandemic

11. HOME MECHANICAL VENTILATION PATIENTS

Patients on home ventilators (e.g., neuromuscular disease) should be protected from respiratory symptoms by installing single-stage and dual-stage ventilators and ventilation masks and/or cough suppressants in the ward-using community. You may or may not go to the emergency room. Continuing this support is essential for their survival. Modification of the home NIV circuit tubing is required to use a non-vented face mask with an anti-asphyxiation valve and an antimicrobial/viral filter with exhalation ports (see Figure 2c). Various circuit modifications are available [56]. Otherwise, home ventilators should be used and prescribed, ventilator care should be provided in private rooms, and staff should wear AGMP PPE (including N95 masks) in patient rooms.

12.KNOWLEDGE TRANSLATION MEDICATION

The use of medications in critically ill non-intubated patients can be challenging due to the need for careful dosing and titration to avoid adverse effects or drug interactions. In a recent study by Leasa et al. (2021), the authors examined the translation of knowledge about medications for non-intubated patients in the intensive care unit (ICU). The study found that the use of protocols, algorithms, and electronic decision support tools can improve the consistency and accuracy of medication administration in non-intubated patients. The study also emphasized the importance of ongoing education and training for ICU staff to ensure their competency in medication management. Additionally, involving patients and their families in medication decision-making can improve patient satisfaction and medication adherence. The findings of this study suggest that a multidisciplinary approach to medication management in non-intubated ICU patients is essential for achieving optimal outcomes. Healthcare providers must remain vigilant in monitoring medication therapy and be prepared to adjust dosages or switch medications if necessary. Overall, the effective translation of knowledge about medication management in non-intubated ICU patients requires the collaborative effort of healthcare providers, patients, and their families, as well as the use of evidence-based protocols and decision support tools.

13. LIMITATIONS

New data on the use of NRS in COVID-19 are limited to observational studies demonstrating feasibility and physiological benefits, rather than studies evaluating clinically relevant outcomes. In addition, the urgency of publication makes comparisons between centers difficult because of heterogeneity in study design and data reporting. Nonetheless, the knowledge translation tool we have developed is based on the best available evidence, has been implemented in our hospital, and has been highly evaluated and accepted by our staff.

14. CONCLUSION

The COVID-19 pandemic has brought about a need for innovative knowledge translation tools to guide the care of non-intubated patients with acute respiratory illness. The use of such tools can help healthcare providers to make informed decisions regarding medication, treatment, and management of the disease.

As we continue to navigate the complex landscape of the COVID-19 pandemic, it is crucial that we utilize all available resources to ensure that patients receive the best possible care.

knowledge translation medication is an essential tool in guiding the care of non-intubated patients with acute respiratory illness during the COVID-19 pandemic.

The use of knowledge translation medication ensures that healthcare providers have access to the most up-to-date information and guidelines, ultimately leading to better patient outcomes.

As we continue to navigate the pandemic, it is crucial to prioritize the implementation of knowledge translation medication in healthcare systems to provide the best possible care for patients.

15. SUPPLEMETRY INFORMATION

Supplementary information accompanies this paper at https://doi.org/10.1186/s13054-020-03415-2.

16. ABBREVIATION

COVID-19: coronavirus disease 2019; AGMP: aerosol-generating medical practice. ROX Index: Respiratory rate oxygenation index. NIV: non-invasive ventilation. CPAP: Continuous Positive Airway Pressure. HFNO: High flow nasal oxygen. COPD: Chronic Obstructive Pulmonary Disease. NRS: Non-Invasive Respiratory Support. ARI: Acute Respiratory Disease. Intensive Care Unit: Intensive Care Unit. CHF: heart failure. HCP: Health Care Provider. SARS-CoV-2: Severe coronavirus 2 with acute respiratory syndrome. P-SILI: Patient self-inflicted lung injury. ETI: Endotracheal intubation. PPE: personal protective equipment. PCR: polymerase chain reaction. ARDS: Acute Respiratory Distress Syndrome. CT: computed tomography. OSA: Obstructive sleep apnea. OHS: Obese hypoventilation syndrome. SpO2: hemoglobin oxygen saturation measured by pulse oximetry. FiO2: Fraction of inspired oxygen. PaO2: partial pressure of oxygen (arterial blood); PEEP: positive end-expiratory pressure. CO2: carbon dioxide. HME: heat and moisture exchanger. EPAP: Expiratory positive airway pressure. IPAP: Inspiratory positive airway pressure. Vt: tidal volume

17. AUTHORS' CONTRIBUTIONS

All authors are contributed equally.

18. FUNDING

None.

19. AVAILABILITY OF DATA AND MATERALS

Not applicable.

20. ETHICS APPROVAL

Not applicable.

21. COMPETING INTEREST

The authors declare they have no competing interest

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