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Recommendations and evidence: Physiotherapy in COVID-19 respiratory and heart disability

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PREFACE

Founded in 1998 in Fortaleza and having Dr. Vilalba Rita Colares Cruz Dourado as its first president, the Brazilian Physiotherapy Society (SBF) arose from the imperative will of a group of Brazilian Physiotherapists concerned with all the content of social, cultural and scientific demands of the profession .

SBF always in the forefront position SBF already in its embryonic phase debated themes such as Functional Kinesiological Diagnosis, Fee Reference, models of scientific development pertinent to the growth of Brazilian Physiotherapy, themes that would later become fundamental bases worldwide.

It is in this profile that the SBF has always raised two banners: clinical physiotherapy and full autonomy of the physiotherapist has supported all initiatives for the development of physiotherapy in Brazil. At this moment, as it could not be otherwise, we will propose in this paper a review based on evidence and recommendations from Physiotherapists specialized in the area of Respiratory Physiotherapy to propose recommendations on the Physiotherapist's performance in a hospital in the respiratory deficiencies caused by COVID-19.

We emphasize that this document should not be considered imperative, and adaptations must be made to the regional realities of Brazil associated with the contribution of the experience of other countries, in order to standardize decision making with a focus on mitigating preventable and treatable Acute Respiratory Deficiency events.

Considering the complexity and fragility of the affected patients, we recommend, whenever possible, consult Physiotherapists with experience and specialized training in Physiotherapy in highly complex patients and Respiratory Physiotherapy.

PRESENTATION

For the complexity and dimension of COVID 19 in the world since December 2019 and for the great commitment of the Unified Health System (SUS) in facing this new challenge. We physiotherapists professionals have gathered in this example some recommendations for the assessment, diagnosis and care of patients with Disabilities and or Limitation by COVID 19.

The term Disability and or Limitation was used extensively in this recommendation, as it is the Physiotherapeutic Diagnosis with a focus on changing a patient's function and activity respectively, based on the International Classification of Functionality, Disability and Health.

We incorporate and encourage the search for knowledge and evidence. This material contains science-based instruments for a better understanding of Brazilian and worldwide Physiotherapists in the construction of protocols and attention to the care of patients with COVID 19.

The pages of these recommendations were based on scientific evidence, expert opinion and peer-reviewed, in order to contribute in a simple way to the improvement of Physiotherapeutic care, mainly in its greatest aspect, which is the functional treatment of ventilation and oxygenation of patients.

1. Physiotherapeutic Assessment and Diagnosis in Adult Patients with Respiratory Disabilities caused by COVID-19

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Evidences: The epidemic of pneumonia due to infection with the new coronavirus (COVID-19) broke out in late December 2019, Wuhan, Hubei Province, China and spread rapidly across Brazil and the world. Discovered through entire genome sequencing, the pathogen was considered a new beta coronavirus genus, and the pathology was named new coronavirus pneumonia by the World Health Organization[1,2 3,4].

Evidences: Comorbidities and chronic diseases, such as hypertension, diabetes and other deficiencies in the respiratory, cardiovascular and metabolic systems, can be risk factors for severe acute respiratory syndrome (SARS-CoV-2). The patients seem to have an average age of 47 years, 5% of which require admission to the ICU, 2.3% are submitted to invasive mechanical pulmonary ventilation (VPMI), and mortality around 1.4%.[6,7].

PHYSIOTHERAPEUTIC EVALUATION

The evaluative aspects may be focused on the function changes caused by the clinical condition, so that, after this phase, provide the Physiotherapeutic Diagnosis as suggested in chart 1.

Chart 1: Main components for physiotherapeutic assessment and diagnosis in the context of COVID-19.

Function Change	Instrument \ Evaluation	Physiotherapeutic Diagnosis
Reduction in tidal volume (Vt)	Ventilometry - Vt	RD by Pulmonary Vt reduction
Compliance Reduction	Ventilometry * - CV Mechanical Fan - Cst	RD due to reduced pulmonary compliance
Ventilation imbalance	Ventilometry* - VM	RD due to reduced pulmonary ventilation
Alveolar and interstitial collapses	Image Examination - RT and TC Respiratory auscultation	RD due to pulmonary collapse
Gas exchange disorders	Arterial blood gas analysis. PaO_2 and $PaCo_2$ Pulse Oximetry * - $SatO_2$	RD by reducing gas exchange
Reduction of Respiratory Muscle Strength	Manovacuometry* - FMI	RD due to reduced respiratory muscle strength
Increased Airway Resistance	Peak Flow* - PFE	RD due to increased resistance of the proximal airway
Cough Disability	Peak Flow* - PFT	RD due to cough disability

Caption: RD: respiratory deficiency; Vt: Tidal Volume, CV: Vital Capacity, Cst: Static Compliance, MV: Minute Volume, RT: Chest X-ray, CT: Computed Tomography, PaO_2: Arterial Pressure of Oxygen, $PaCO_2$: Arterial Pressure of Carbon Gas, $SatO_2$: Peripheral Saturation Oxygen, PFE: Peak Expiratory Flow, IMF: Inspiratory Muscle Strength, PFT: Peak Cough Flow.

Recommendation 1: Ventilometry. CV, Vt and VE. CV is a variable that assesses the capacity to distend the thoracopulmonary system[8,9]. Values below 65 ml / kg indicate respiratory deficiency and less than 10 -15 ml / kg indicates severe respiratory deficiency. Vt is approximately 500ml or 7ml / kg of weight.[10,11]

Recommendation 2: Mechanical ventilator. Plateau pressure (Pplat) and Cst can be measured every 4 hours, after any change in Vt and positive end-expiratory pressure (PEEP), in the controlled volume mode[12]. Being Cst: 70-80 mL / cmH_2O[13] or 57-85 mL / cmH_2O[14].

Recommendation 3: In RT the structure presents consolidation, ground-glass lesion with peripheral distribution and lower zone bilaterally[15]. CT shows ground-glass opacity, interlobular septal consolidation and thickening[16].

Recommendation 4: Monitoring pulse oximetry and arterial blood gases.

PaO_2 \ FiO_2 ratio, Oxygenation Index (IO) and SpO_2 Saturation Index (IS) are preferred parameters for stratifying the severity of oxygenation in mechanically ventilated patients[17].

IO= (FiO_2 x Mean airway pressure x 100)/PaO_2. IO ≥ 4 and < 8 (DR mild hypoxemic), IO ≥ 8 and < 16 (DR moderate hypoxemic), IO ≥ 16 (DR severe hypoxemic).

IS = (FiO_2 x Mean airway pressure x 100) / SpO_2. IS ≥ 5 and <7.5 (mild hypoxemic DR), IS ≥ 7.5 and <12.3

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(moderate hypoxemic DR), IS ≥ 12.3 (severe hypoxemic DR).

PF = PaO_2 \ FiO_2. Mild hypoxemic DR 200 mmHg <PaO_2 / FiO_2 ≤ 300, Moderate 100 mmHg <PaO_2 / FiO_2 ≤200 mmHg and severe PaO_2 / FiO_2 ≤ 100 mmHg and PEEP 5 with PEEP 5 cmH_2O[18].

ROX index: Success indicator for high flow oxygen therapy, ROX index ≥ 9.2 is a predictor of success for high flow oxygen therapy[19]. ROX <3.85 received endotracheal intubation for invasive mechanical ventilation[20].

Recommendation 5: Manovacuometry. The assessment of inspiratory muscle strength. Equation for predicted values in MIP men (cmH_2O) = 155.3 - 0.80 (age) and MIP women (cmH_2O) = 110.4 - 0.49 (age)[21].

Recommendation 6: Peak Flow. Instrument for assessing proximal airway resistance and as an outcome for cough function. In normal cough, 2.3 ± 0.5 L of air are expelled at a flow rate of 360 to 1,200 L / min,[22] 160 L / min is the minimum required in adult patients to achieve effective cough[23].

(*) ATTENTION: All quantitative assessment instruments are essential for the best functional understanding and diagnosis of patients; however, the use of these instruments must respect:

1) Control of the spread of the virus - A dialogue with the hospital infection control service is suggested.

2) The use of a barrier and bacteriostatic filter between the mask or the mouthpiece and the evaluation device.

3) The protection of the evaluation device to not be contaminated externally with droplets and aerosols.

4) Proper disinfection of the evaluation device after use with a suspected or confirmed patient of COVID-19.

5) Prefer using a mask for the evaluation and get it well adapted to the patient to avoid contamination.

Respiratory Physiotherapeutic interventions are potentially aerosol producers, therefore, Physiotherapists must promote the highest protection with personal protective equipment.

All assessment procedures must be discussed with the head of Physiotherapy for a more appropriate, safe and common-sense approach.

Recommendation 7: Step test. Evaluates cardiorespiratory and metabolic function during exercise to provide deficiency to exercise tolerance in addition to identifying the evolution of functionality and response to treatment[24].

VO_2máx ml.-1kg-1.min-1 = 0.2 x (stepping rhythm) + 1.33 x 1.8 x (step height in meters) x (stepping rhythm) + 3.5[24].

Recommendation 8: FSS - Functional Status Scale. This assessment of the activity of hospitalized patients created based on the contexts of Activities of Daily Living (ADL) and the ability to adapt behavior[25]. Total score is 35, we recommend using the International Classification of Functionality qualifier to define the severity level.

REFERENCES

1. BogochII, WattsA, Thomas-BachliA, et al. Potential for global spread of a novel coronavirus from China[J]. J Travel Med, 2020, DOI: 10.1093/jtm/taaa011.
2. LuR, ZhaoX, LiJ, et al. Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding[J]. Lancet, 2020Jan 30. pii: S0140-6736(20)30251-8. [Epub ahead of print] DOI:10. 1016/s0140-6736(20)30251-8.
3. National Health Commission of the People's Republic of China. Notice from the National Health Commission on the temporary naming of new coronavirus pneumonia [EB/OL]. (2020-02-08) [2020-02-12]. Available in: http://www.nhc.gov.cn/mohwsbwstjxxzx/s2908/202002/f15dda000f6a46b2a1ea1377cd80434d.shtml.
4. World Health Organization. WHO Director - General's remarks at the media briefing on 2019-nCoV on 11 February 2020[EB/OL]. (2020-02-11)[2020-02-12]. Available in: https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020.
5. Ang J, Zheng Y, Gou X, et al. Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis [published online ahead of print, 2020 Mar 12]. Int J Infect Dis. 2020;S1201-9712(20)30136-3. DOI:10.1016/j.ijid.2020.03.017
6. World Health Organisation, Coronavirus disease 2019 (COVID-19) Situation Report 46, 2020.
7. Guan, W.-j., Z.-y. Ni, Y. Hu, W.-h. et al. Clinical Characteristics of Coronavirus Disease 2019 in China. New England Journal of Medicine, 2020. DOI: 10.1056/NEJMoa2002032.
8. Siqueira LTD. Impacto dos aspectos respiratórios e vocais na qualidade de vida do idoso. [Dissertação] Bauru (SP): USP; 2013. 26. DOI: 10.11606/D.25.2013.tde-05062013-153747
9. Fabron EMG, Sebastião LT, Oliveira GAG, Motonaga SM. Medidas da dinâmica respiratória em idosos participantes de grupos de terceira idade. Rev. Cefac. 2011;13(5):895-901. DOI: https://doi.org/10.1590/S1516-18462011005000034
10. Scalan CL, Wilkins RK, stoller. Fundamentos da terapia respiratória de Egan. São Paulo: Manole, 2000.

11. Iain Beardsell; et al. (2009). MCEM Part A:MCQs (em inglês). Londres: Royal Society of Medicine Press. p. 33. ISBN 9781853158049. OCLC 645632705. Available in: https://www.rsm.ac.uk/
12. C. Rajesh, T. Subhash. ICU Protocols. A Step-wise Approach. Vol I, Second Edition 3, 2020. DOI: https://doi.org/10.1007/978-981-15-0898-1.
13. Lu Q, Rouby JJ - Measurement of pressure-volume curves in patients on mechanical ventilation: methods and significance. Crit Care, 2000;4:91-100. DOI: 10.1186/cc662.
14. C. Rajesh, T. Subhash. ICU Protocols. A Step-wise Approach. Vol I, Second Edition 3, 2020. DOI: https://doi.org/10.1007/978-981-15-0898-1.
15. Wong HYF, Lam HYS, Fong AH.et al. Frequency and Distribution of Chest Radiographic Findings in COVID-19 Positive Patients. Radiology. 2019 Mar 27:201160. DOI: 10.1148/radiol.2020201160.
16. Wu J, Wu X, Zeng W. et al (2020) Chest CT findings in patients with corona virus disease 2019 and its relationship with clinical features. Invest Radiol. https://doi.org/10.1097/RLI.0000000000000670
17. Silva C, Silva-Pinto A, Santos L. et al. From the emergency of a novel human virus to the global spread of a new disease. 037.03.2020. Access: https://ispup.up.pt/news/internal-news/from-the-emergency-of-a-novel-human-virus-to-the-global-spread-of-a-new-disease/906.html/ em 28.03.2020.
18. Clinical management of severe acute respiratory infection when Novel coronavirus (2019-nCoV) infection is suspected: Interim Guidance. 28 January 2020. World Health Organization.
19. Maeva Rodriguez, Arnaud W. Thille, Florence Boissier. et al. Predictors of successful separation from high-fow nasal oxygen therapy in patients with acute respiratory failure: a retrospective monocenter study . Intensive Care (2019) 9:101 DOI: https://doi.org/10.1186/s13613-019-0578-8
20. RocaO, CaraltB, MessicaJ. et al. An index combining respiratory rate and oxygenation to predict outcome of nasal high flow therapy [J]. Am J Respir Care Med, 2019, 119(11): 1368-1376. DOI-10.1164/rccm.201803-0589OC.
21. Neder JA, Andreoni S, Lerario MC, Nery LE. Reference values for lung function tests. II. Maximal respiratory pressures and voluntary ventilation. Braz J Med Biol Res. 1999 Jun;32(6):71 DOI: https://doi.org/10.1590/S0100-879X1999000600007.
22. Paula, P. Correlação entre o pico do fluxo da tosse e os parâmetros clínicos e funcionais nas doenças neuromusculares. Dissertação de mestrado da Faculdade de medicina - UFMG, 2010.
23. Matos, L.; Rabahi, M. Manejo respiratório em doenças neuromusculares: revisão de literatura. Rev. Educ. Saúde 2017; 5 (2): 121-129. DOI:10.29237/2358-9868.2017v5i2.p121-129.
24. American College of Sports Medicine. Diretrizes do ACSM para os testes de esforço e sua prescrição. 7. ed. Rio de Janeiro: Guanabara Koogan; 2007. p. 216-7.
25. POLLACK M.M; et al. Relationship between the functional status scale and the pediatric overall performance category and pediatric cerebral performance category scales. JAMA Pediátrico; 168(7): p.671-676. 2014. DOI: 10.1001/jamapediatrics.2013.5316.

2. Physiotherapeutic Assessment and Diagnosis in Pediatric Patients with Respiratory Disabilities caused by COVID-19

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Evidences: Epidemiological data showed a lower proportion of severe expression of COVID-19 in neonates and children, with rare cases of mortality. However, children with chronic lung diseases are the most likely to develop severe acute respiratory syndrome (SARS-CoV-2)[1-3]. The newest individual with COVID-19 was only 1 month old and the possibility of vertical transmission remains uncertain[2-4].

PHYSIOTHERAPEUTIC EVALUATION

Recommendation 1: Evaluate the clinical and functional signs of COVID-19 Respiratory Deficiency: Temperature (common to fever), Cough (Common: Dry cough) and Respiratory rate with respiratory pattern (common to fatigue)[5].

Recommendation 2: Investigate symptoms of Respiratory Deficiency due to upper airway infection: nasal congestion and runny nose[5].

Recommendation 3: Investigate symptoms of Gastrointestinal Deficiency (uncommon), of which: nausea, vomiting, abdominal pain and diarrhea[5].

Recommendation 4: Laboratory tests should be evaluated. Normal or reduced white blood cell count, elevated liver and muscle enzyme changes; high level of C-reactive protein, reduction of lymphocytes in the blood and smears in the throat, sputum, lower respiratory tract, secretions, feces and blood, etc. Positive for COVID-19 nucleic acids.

Recommendation 5: Evaluate the pulmonary structure by means of an image, as these patients may present images with a ground-glass pattern and pulmonary consolidation (severe and critical cases)[6].

Evidences: Children with any of the symptoms listed below are considered a warning sign for hospitalization[6-9]:

- respiratory rate> 50 times / min for 2-12 months; > 40 times / min for 1-5 years; > 30 times / min in patients over 5 years (rule out the effects of fever and crying);
  · persistent high fever for 3-5 days;
  · lethargy or changes in the level of consciousness;
  · hepatic cardiac enzymes, altered lactate;
  · metabolic acidosis without a definite cause; chest image examination indicating infiltration, pleural effusion or rapid progression;
  · extrapulmonary complications;
  · infection associated with other viruses and / or bacteria.

Recommendation 6: If is suspected a COVID-19 contamination , both the child and his companion should receive a face mask and be placed in a separate area[10].

Observation: The use of PPE must be mandatory for the team (mask, glove, protective glasses, cape), in addition to washing hands or using alcohol gel. Stethoscopes and thermometers should not be shared between patients.

PHYSIOTHERAPEUTIC DIAGNOSIS

Recommendation 1: For the diagnosis, the professional must pay attention to the following markers:

- Respiratory frequency (consider severe respiratory deficiency) - disregard effects produced by fever and crying:
  · 50 ipm for 2-12 months;
  · 40 ipm for 1-5 years old;
  · 30 ipm for patients over 5 years.
  · Peripheral oxygen saturation - (SpO_2): between 92% to 97% - values below indicate hypoxia-like respiratory deficiency;
- Static and dynamic compliance, airway resistance - (indicate respiratory deficiency due to reduced compliance or impaired airway hygiene, respectively):
  · RN: 5 ml/cm H_2O ;
  · 1 year old: 15 ml/cm H_2O;
  · 7 years old: 50 ml/cm H_2O;
  · Dynamic compliance: 10-20% less than static.
  · Inspiratory and expiratory tidal volume - (Vt): 6 to 8ml / kg - values below indicate respiratory deficiency due to Vt reduction);
- Arterial blood gases: evaluation of PaO_2 and $PaCO_2$ (changes result in respiratory deficiency due to changes in gas exchange).
- Chest radiography and tomography (associate with pulmonary auscultation): respiratory failure due to alveolar collapse.
- Cough: It is not a parameter applicable to the entire population due to the wide variation in age and development of the respiratory muscular system, with greater assessable evidence of the inability to cough in neonates.
- Peak Flow: it is effort-dependent and therefore requires patient collaboration - not applicable to the entire population.

FINAL CONSIDERATIONS

There is a limitation of more accurate data on the pathophysiology of COVID-19 in children and neonates and researchers around the world are trying to understand the reasons that lead to relatively lower infection rates for

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this population, when compared to adult individuals.

Another important aspect to consider is that the variability of weight and age for this population limits the standardization of assessment, so the age of each patient must be respected and adjustments must be made for each age group.

Younger children who cannot wear masks and more specific isolation measures must be taken. It should be discussed with the team of the Hospital Infection Control Commission - CCIH.

The physiotherapist professional must be equipped with PPE's suitable for the evaluation of the child and, on average, their performance can produce the spread of droplets and aerosols, and therefore must also provide the companion, when necessary, with appropriate PPE during the process.

The evaluation of the specialist is essential, since, through the respiratory functional diagnosis, the anticipation of care and early rehabilitation can lead to more favorable outcomes for this population.

REFERENCES

1. Xia W, Shao J, Guo Y, Peng X, Li Z, Hu D. Clinical and CT features in pediatric patients with COVID-19 infection: different points from adults. Pediatric pulmonology 2020. Doi: 10.1002/ppul.24718.
2. Zhu H, Wang L, Fang C, Pang S, Zhang L, Chang G, et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. Translational Pediatrics 2020; 9(1):51.
3. Wei M, Yuan J, Liu Y, Fuo T, Yu X, Zhang Z-J. Novel coronavirus infection in hospitalized infants under 1 year of age in China. Jama 2020. Doi: 10.1001 / jama.2020.2131.
4. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020; 382:727-33. Doi: 10.1056.
5. Lu Q, Shi Y. Coronavirus disease (COVID-19) and neonate: What neonatologist need to know. J Med Virol 2020. Doi: 10.1002/jmv.25740.
6. Shen K, Yang Y, Wang T, Zhao D, Jiang Y, Jin R, et al. Diagnosis, treatment, and prevention of 2019 novel coronavirus infection in children: experts' consensus statement. World J Pediatr 2020; 1-9.
7. The subspecialty group of respiratory diseases of the Society of Pediatrics of Chinese Medical Association. Guidelines for management of community acquired pneumonia in children. Chin J Pediatr 2013; 51:145-52 .
8. Harris M, Clark J, Coote N, Fletcher P, Harnden Um, McKean M, et al. British Thoracic Society guidelines for themanagement of community acquired pneumonia in children: update 2011. Thorax 2011;66(suppl 2):ii1-ii23. Doi: 10.1136 / thoraxjnl-2011-200598.
9. Bradley J, Byington CL, Shah SS, Alverson B, Carter ER, Harrison C, et al. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin infect dis 2011;53(7):25-e76. Doi: 10.1093 / cid / cir531.
10. World Health Organization. WHO Statement Regarding Cluster of Pneumonia Cases in Wuhan, China. [access in 2020 mar 31]. Available in: https://www.who.int/health-topics/coronavirus.

3. Recommendations for Physiotherapeutic Management in Patients with Metabolic and Heart Disabilities caused by COVID-19

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Evidences: The coronavirus responsible for COVID-19 can have repercussions that go beyond lung involvement, damaging several systems, including the cardiovascular system[1]. COVID-19 can get the heart function decompensated, especially in those with previous impairments, such as heart failure and coronary artery disease. In addition, studies indicate the occurrence of acute myocarditis and severe acute respiratory syndrome (SARS-CoV-2), which favors systolic dysfunction and myocardial infarction[1,2].

Evidences: In a retrospective multicenter study, 33% of deaths from COVID-19 showed a joint association between heart failure and respiratory failure, with 7% of deaths being precipitated by isolated myocardial injury[3]. In this same study, the presence of myocardial infiltration by interstitial mononuclear inflammatory cells was observed at autopsy, demonstrating the direct impact of the coronavirus on the myocardium[4].

Evidences: In its severe presentation, COVID-19 can present several cardiovascular repercussions, making continuous monitoring and a multidisciplinary approach necessary in the care of this patient[5]. It is known that the integrity of aerobic physical performance is also associated with the integrity of the cardiovascular system. In addition, the physical weakness and the consequent disuse of the peripheral musculature means that the survivors of COVID-19 may present some impairment in physical performance. However, there is still no scientific data to support this scenario in COVID-19.

Recommendation 1: Among the various professionals involved in the physical recovery of patients with COVID-19, the role of the physiotherapist stands out, not for treating the disease but for preventing and rehabilitating the deficiencies and functional limitations caused by it[6].

Recommendation 2: The physiotherapist must follow the main global recommendations for physical exercise in heart failure, from the perspective of the impacts caused by COVID-19 / SARS-CoV-2.

Recommendation 3: Physical exercise is contraindicated in cardiac deficiencies caused by myocarditis, myocardial infarction (before 24 to 48 hours), acute systemic infection, dyspnoea at rest, hypotension and severe complex ventricular arrhythmias[7]. In these cases, continuous respiratory monitoring and bed rest with an elevated headboard, passive mobilizations and biomechanical positioning in the bed with controlled energy expenditure are recommended[7,8].

Recommendation 4: Before starting treatment, the physiotherapist must observe the reduction in serum levels of biochemical markers of cardiac injury such as CK-MB, myoglobin and troponins; in addition to certifying the absence of precordialgia and infra / supra unevenness of ST follow-up on the electrocardiogram[9].

It should also be noted whether there are signs of improvement in the thickness of the cardiac wall and in the ejection fraction seen on transthoracic echocardiography, especially in cases of acute myocarditis[1,7,10], as a form of cardiac functional evolution under the conditions described in recommendation[3]. The stability of the cardiovascular condition and beginning of exercises should always be discussed with the multiprofessional team.

Recommendation 5: The physiotherapist must pay attention to safety criteria[10] to be observed before performing physical exercises on the critical patient. It is essential to observe the signs and symptoms of intolerance to effort by the physiotherapist and the patient, observation of the security and mobilization instruments is recommended[11].

Recommendation 6: When performing exercises in patients with heart failure secondary to COVID-19, attention should be paid to the Frequency, Intensity, Type (or modality), Time (or duration) - Volume and Progression (FITT-VP) of the American College of Sports Medicine (ACMS), for post- infarction patients[12].

Recommendation 7: The FREQUENCY of mobilization can be between 2 to 4 times a day for the first 3 days of hospitalization, with INTENSITY guided by the BORG effort subjective perception scale, not exceeding 13 (in the 6 to 20 scale) and the frequency heart rate, which should not exceed 20 beats per minute in relation to rest. Another important criterion to be considered is the use of exercises that require energy expenditure < 3 MET´s[12]. The exercise time can vary between 3 to 5 minutes, progressing according to tolerability; in TYPE, bed exercises that should evolve to walk according to the

Suggested citation: Silva CMS, Andrade AN, Nepomuceno B, Xavier DS, Lima E, Gonzales I, et al. Evidence-based Physiotherapy and Functionality in Adult and Pediatric patients with COVID-19. *J Hum Growth Dev. 2020; 30(1):148-155.* DOI: http://doi.org/10.7322/jhgd.v30.10086

individuality of each patient. PROGRESSION must be performed when the duration reaches 10 to 15 minutes, as recommended by the heart rate and always taking into account the subjective perception of effort[12].

Recommendation 8: As there are no studies available on rehabilitation in individuals with COVID-19, we suggest taking into account the routine and consistent protocols reported in the literature.

REFERENCES

1. Inciardi RM, Lupi L, Zaccone G, et al. Cardiac Involvement in a Patient With Coronavirus Disease 2019 (COVID-19). 2020;2019:1–6. DOI:10.1001/jamacardio.2020.1096
2. Madjid M, Safavi-Naeini P, Solomon SD, Vardeny O. Potential Effects of Coronaviruses on the Cardiovascular System A Review. 2020;10:1–10. DOI:10.1001/jamacardio.2020.1286
3. Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. Intensive Care Med. 2020. DOI:10.1007/s00134-020-05991-x
4. Xu Z, Shi L, Wang Y, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med. 2020;2600(20):19–21. DOI:10.1016/S2213-2600(20)30076-X
5. Bouadma L, Lescure FX, Lucet JC, Yazdanpanah Y, Timsit JF. Severe SARS-CoV-2 infections: practical considerations and management strategy for intensivists. Intensive Care Med. 2020. DOI:10.1007/s00134-020-05967-x
6. Bispo Júnior JP. Fisioterapia e saúde coletiva: Desafios e novas responsabilidades profissionais. Cienc e Saude Coletiva. 2010;15(SUPPL. 1):1627–1636. DOI:10.1590/s1413-81232010000700074
7. Diretriz Sul-Americana de Prevenção e Reabilitação Cardiovascular. Soc Bras Cardiol. 2014;103(2). DOI:10.5935/abc.2014S003
8. Miranda Rocha AR, Martinez BP, Maldaner da Silva VZ, Forgiarini Junior LA. Early mobilization: Why, what for and how? Med Intensiva. 2017;41(7):429–436. DOI:10.1016/j.medin.2016.10.003
9. Bassan R, Pimenta L, Leães PE, Timerman A. Diretriz de Dor Torácica na Sala de Emergência. Arq Bras Cardiol. 2002;79(11):1–22
10. Stiller K. Safety Issues That Should Be Considered When Mobilizing Critically Ill Patients. Crit Care Clin. 2007;23(1):35–53. DOI:10.1016/j.ccc.2006.11.005
11. Stiller K, Phillips A. Safety aspects of mobilising acutely ill inpatients. Physiother Theory Pract. 2003;19(4):239–257. DOI:10.1080/09593980390246751
12. Diretrizes do ACMS para os testes de esforço e sua prescrição. 9o ed. Rio de Janeiro; 2016.

4. Recommendations for Physiotherapeutic Management in Patients with Respiratory Disabilities caused by COVID-19

Open acess

Evidences: Patients with suspected or confirmed COVID-19 may have exudative consolidation, mucous hypersecretion and / or difficulty in clearing secretions.[2], and also present:

· Wet voice/wet speech[2];

· SpO_2 <90% with supplemental oxygen therapy at 5l / min[2].

Recommendation 1: Secretion Removal Techniques (TRM) can be performed to ensure hygienic conditions and prevent contagion, and compliance with individual protection rules is essential.[1].

Recommendation 2: Directed cough[1,2] should be performed in an isolated room with negative pressure, if the service does not have this isolation, a surgical marker should be used. The aim is to prevent secretion build-up and reduce ventilatory discomfort[1,2].

Recommendation 3: Oscillating Positive Expiratory Pressure1 can be used in cooperative patients, with availability of the service and understanding of the tool by the patient[1]. The aim is to facilitate the removal of secretion and unblock the airways [3,4].

Note: Most of the patients affected with COVID-19 do not have a productive cough or radiological alteration and have the ability to expectorate without assistance.[1]

Early mobilization

Evidences: In the ICU, severe muscle weakness is independently associated with prolonged mechanical ventilation, increased ICU stay, hospital stay and increased mortality[5], with consequent decrease in quality of life and increase in mortality within 1 year after discharge from the ICU[6].

One of the factors favorable to the implementation of a systematic physical therapy intervention in patients with COVID -19, lies in the fact that intensive management, including prolonged mechanical ventilation, sedation and use of neuromuscular blockers, will significantly increase the risk of developing acquired muscle weakness in the ICU (FAUTI).

Recommendation 1: Exercises, mobilization and interventions for patients with Muscular Disabilities associated with COVID-19, in order to enable a functional return to the home. Therefore, it is essential to anticipate early physical therapy after the acute phase for rapid functional recovery[5].

Recommendation 2: The physiotherapist should consider the complexity of the condition and understand that with the appearance of generalized muscle weakness, functionality will certainly be compromised depending on the greater or lesser degree of this condition, which should be measured quantitatively using recognized and validated assessment methods.

Recommendation 3: Dynamometry measures isometric muscle strength and can be used as a quick diagnostic test. The cut-off scores are: less than 11kg (IQR 10 - 40) in men and less than 7kg (IQR zero to 7.3) in women, which were considered indicative of ICUAW[7].

Recommendation 4: Muscle strength assessed according to the Medical Research Council (MRC) criteria (table 1) a total score below 48/60 designates FAUTI or significant weakness, and a total MRC score below 36/48 indicates severe weakness (table 2)[8]. The evaluation by the MRC scale and dynamometry are indicated for the conscious, cooperative and motivated patient[9].

Table 1: Medical Research Council escore.

Evaluated movements	Degree of muscular strength
Shoulder adbuction	0 - no visible contraction
Elbow flexion	1- visible contraction without movement
Wrist extension	2-active movement without gravity
Hip flexion	3-active movement against gravity
Knee extension	4-active movement against gravity and resistance
Ankle dorsiflexion	5- normal strength

Source: De Jomghe, et al. 2005[11].

Table 2: Score values obtained by MRC and handgrip dynamometry

MRC < 48 Peripheral muscle weakness
MRC < 36 Severe peripheral muscle weakness
MRC < 27 Indication of failure in decannulation
Dinamometria < 11Kgf Peripheral muscle weakness in men
Dinamometria < 7Kgf Peripheral muscle weakness in women

Source: Adapted from Hermans G, et al. 2012[8].

Suggested citation: Silva CMS, Andrade AN, Nepomuceno B, Xavier DS, Lima E, Gonzales I, et al. Evidence-based Physiotherapy and Functionality in Adult and Pediatric patients with COVID-19. *J Hum Growth Dev. 2020; 30(1):148-155.* DOI: http://doi.org/10.7322/jhgd.v30.10086

Evidences: Functional assessment is the basic and first element of any Physiotherapy program aimed at optimizing therapeutic interventions[9]. Currently we have several scales that quantify and qualify the functional status, it is imperative to respect the specificity of each unit.

· Physical Function in Intensive care Test scored (PFIT-s);
· Functional Status Score for the ICU (FSS-ICU);
· Surgical Intensive Care Unit Optimal Mobilization Score (SOMS);
· Chelsea Critical Care Physical Assessment Tool (CPAx);
· Intensive Care Unit Mobility Scale (IMS);
· Perme Intensive Care Unit Mobility Score (Perme Score);
· Manchester Mobility Scale (MMS).

Recommendation 8: Avoid using more generic scales that do not meet the specificities of the patient admitted to the ICU with Functional Disability.

Recommendation 9: Transfer sitting to standing. With the patient in the armchair, the need for help by one or two people is evaluated for him to stand up, the scores are from 0 to 3 (where 0 = does not perform the task even with the help of two people and 3 = performs the task). task without help).

Recommendation 10: Walking cadence. Maximum number of steps possible without time limit. The cadence values are evaluated from 0 to 3 (0 = no steps and 3 = over 80 steps / min).

Recommendation 11: Strength of knee extensors and shoulder flexors. In this stage, the Oxford scale is used to measure the degree of strength that goes from 0 to 5 (with 0 = no strength and 5 = normal muscle strength).

Recomendação 12: After the evaluation, these values are added and there is a score of 0 to 12 or 0 to 10 (on the modified scale), where the lower the scores, the less function the patient has, or the more dependent he is and how much the greater the value of these scores, the greater the degree of functionality or independence.

We recommend using the International Classification of Functionality qualifier[12] to define the severity level.

Recommendation 13: All safety criteria and clinical status of the patient must be observed and the hemodynamic and respiratory organic reserves must be calculated before the prescription of the therapeutic intervention.

Recommendation 14: Use of FITT-VP as a reference for physical activity.

· F - Frequency in times per day, per week.
· I - Intensity between mild, moderate or severe activity, depending on some indicators, such as respiratory rate, heart rate and perceived effort.
· T - Duration time, as well as rest time between sets.
· T - Type or modality chosen: aerobic, muscular endurance, muscular strength or exclusively functional exercises.
· V - Volume: number of sessions or repetitions, intensity, type of exercise and time of rest between sets (total caloric expenditure in a given time).
· P - Progression, optimizing, in this way ,the gains obtained.

Recommendation 15: We recommend the use of Denehy[10] protocol (table 3). This protocol is based on the PFIT scale, serving as a basis for the prescription of the Physiotherapy session.

Note: *The use of this series of exercises scaled according to the patient's capacity can be used in any hospital environment. The formal indication is that the progression of this activity or protocol mentioned above reaches up to 60 minutes of execution, based on the criteria of FITT-VP. The therapeutic objective should always include the individual's functionality considering the DNPMN (functional neuropsychomotor development) in our therapy.*

Tabela 3: Denehy protocol for functional training.

1-3 series of 70% of the maximum stationary walking time with the cadence found during the PFIT scale evaluation;
2- it is not possible to remain in stationary gait, request training to sit and stand until 15 minutes of therapy are obtained
3 - In the impossibility of accomplishing the two previous tasks, shoulder flexion exercises were performed until 15 minutes were obtained.

Source: PFIT scale - Adapted from Denehy and cols (2013)[10].

Recommendation 16: Perform progressive activities (table 4) and aiming at functionality. Representing the main functional activities based on the DNPMN and which should be included in any protocol adopted for early mobilization in patients with COVID-19.

Table 4: Sequence of progression of activities for mobilization.

Decubitus change and functional positioning
Passive mobilization
Active-assisted and active exercises
Bed cycling
Sit on the edge of the bed
Orthostatism
Static walk
Transfer from bed to armchair
Walk

Source: Adapted from Franca e cols, 2012.

REFERENCES

1. Zhonghua Jie He He Hu Xi Za Zhi. Recommendations for respiratory rehabilitation of COVID-19 in adult .2020 Mar 3;43(0):E029. DOI: 10.3760/cma.j.cn112147-20200228-00206
2. Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, et al. Physiotherapy management for COVID-19 in the acute hospital setting. Recommendations to guide clinical practice. Version 1.0, published 23 March 2020. Journal of Physiotherapy. Available from: https://www.thoracic.org/about/ats-podcasts/physiotherapy-management-for-covid-19-in-the-acute-hospital-setting-a-conversation-with-dr-peter-thomas.php
3. Morsch ALBC, Amorim MM, Barbieri A, Santoro lL, Fernandes ALG. Influência da técnica de pressão expiratória positiva oscilante e da técnica de expiração forçada na contagem de células e quantidade do escarro induzido em portadores de asma ou doença pulmonar obstrutiva crônica. Bras Pneumol. 2008;34(12):1026-1032. DOI: https://doi.org/10.1590/S1806-37132008001200007
4. Tambascio J, de Souza LT, Lisboa RM, Passarelli Rde C, de Souza HC, Gastaldi AC. The influence of Flutter®VRP1 components on mucus transport of patients with bronchiectasis. Respir Med. 2011 Sep;105(9):1316-21. DOI: 10.1016/j.rmed.2011.04.017.
5. Latronico N, Bolton CF. Critical illness polyneuropathy and myopathy: a major cause of muscle weakness and paralysis. Lancet Neurol. 2011;10(10):931-41. DOI: 10.1016/S1474-4422(11)70178-8.
6. Needham DM, Wozniak AW, Hough CL, Morris PE, Dinglas VD, Jackson JC, et al. Risk factors for physical impairment after acute lung injury in a national, multicenter study. Am J Respir Crit Care Med. 2014;189(10):1214-24of Health NHLBI ARDS Network. DOI: 10.1164/rccm.201401-0158OC.
7. Parry SM, Berney S, Granger CL, Dunlop DL, Murphy L, El-Ansary D, et al. A new two-tier strength assessment approach to the diagnosis of weakness in intensive care: an observational study. Crit Care. 2015;19:52. DOI: 10.1186/s13054-015-0780-5.
8. Hermans G, Clerckx B, Vanhullebusch T, Segers J, Vanpee G, Robbeets C, et al. Interobserver agreement of Medical Research Council sumscore and handgrip strength in the intensive care unit. Muscle Nerve. 2012;45(1):18-25. DOI: 10.1002/mus.22219.
9. Vanpee G, Hermans G, Segers J, Gosselink R. Assessment of limb muscle strength in critically ill patients: a systematic review. Crit Care Med. 2014;42(3):701-11. Review. DOI: 10.1097/CCM.0000000000000030.
10. Denehy L, de Morton NA, Skinner EH, Edbrooke L, Haines K, Warrillow S, et al. A physical function test for use in the intensive care unit: validity, responsiveness, and predictive utility of the physical function ICU test (scored). Phys Ther. 2013 Dec;93(12):1636–45. DOI: 10.2522/ptj.20120310.
11. De Jonghe B, Sharshar T, Lefaucheur JP, Outin H. Critical illness neuromyopathy. Clin Pulm Med. 2005;12(2):90-6. DOI: 10.1097/01.cpm.0000156639.67261.19.
12. CIF: Classificação Internacional de Funcionalidade, Incapacidade e Saúde. São Paulo: Edusp; 2003.
13. Franca, Eduardo Ériko Tenório de et al . Fisioterapia em pacientes críticos adultos: recomendações do Departamento de Fisioterapia da Associação de Medicina Intensiva Brasileira. Rev. bras. ter. intensiva, São Paulo, 2012;24(1):6-22. DOI:https://doi.org/10.1590/S0103-507X2012000100003.

5. Recommendations for Physiotherapeutic Management in Pediatric Patients with Respiratory Disabilities caused by COVID-19

Open acess

Evidences: In children with COVID-19, symptoms are generally less severe than adults and are mainly with cough, fever, pharyngeal erythema and more rare, diarrhea, fatigue, rhinorrhea, vomiting and nasal congestion[1].

Evidences: Few cases have been reported of babies confirmed with COVID-19 and have experienced mild illness[2].

Evidences: 5% of children develop severe and critical symptoms that require hospitalization and intensive care[3-6].

Evidences: Children are classified as severe pneumonia when they have:

· Increased respiratory rate: ≥ 70 i.p.m. (<1 year) and ≥ 50 i.p.m. (≥ 1 year) (after discarding the effects of fever and crying);

· Drop in Oxygen Saturation <92%;

· Increased ventilatory work with cyanosis and intermittent apnea;

· Disorders of consciousness: drowsiness, coma;

· Refusal of food or feeding difficulties, with signs of dehydration[2].

Note: Respiratory failure that requires mechanical ventilation; shock; and / or failure of other organs fall into the Critical Cases class[2].

Recommendation 1: The physiotherapist must act in order to identify, elaborate and develop a physiotherapeutic diagnosis in the deficiencies of the cardiorespiratory and musculoskeletal system caused by viral infection, through anamnesis, physical evaluation and complementary exams.

POSSIBLE REPERCUSSIONS OF COVID-19 IN PEDIATRICS, FROM THE PERSPECTIVE OF CIF MULTIFACTORIAL CONTEXT·

COVID-19 is a disease that causes deficiency of respiratory tract structures, leading to impaired breathing functions[6], such as respiratory rate, respiratory rate and depth of breathing.

· Not only, depending on the clinical severity presented, there may be impaired respiratory muscle function and exercise tolerance.

· Limitations, which make it difficult to carry out basic activities that involve the ability to move, affecting even routine tasks such as walking and performing self transfers.

· The control of the spread of infection leads to the restriction of participation, interfering with tasks such as recreation and leisure activities[7].

Figure 1 shows some possible repercussions of COVID-19 in pediatrics, from the perspective of the ICF multifactorial context:

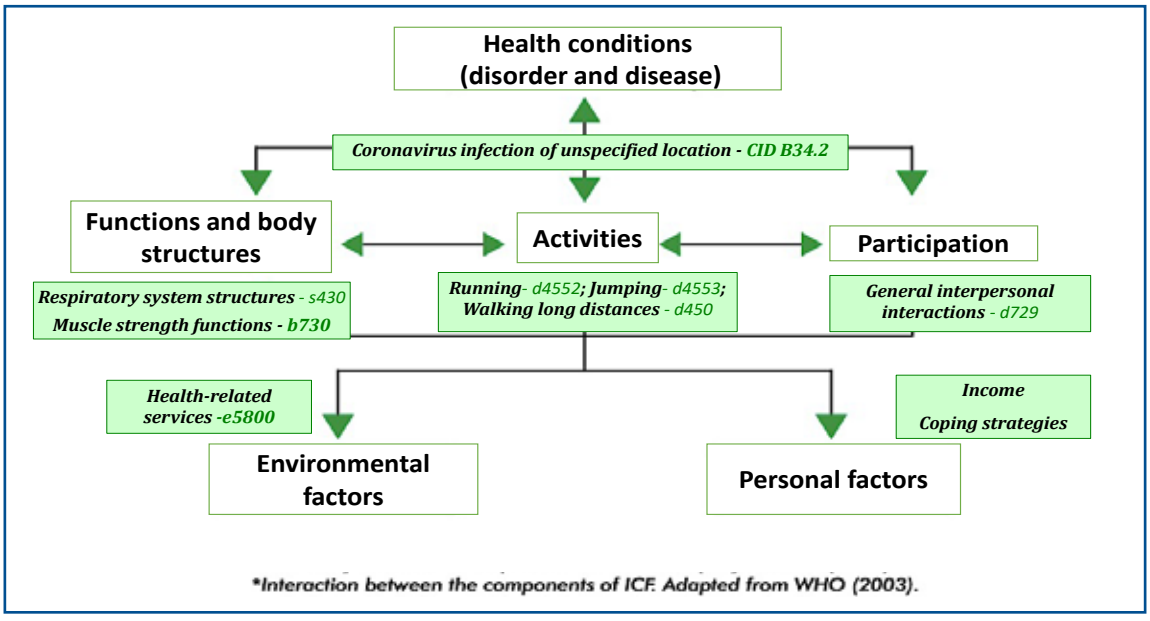

Figure 1: Possible repercussions of COVID-19 in pediatrics, from the perspective of the multifactorial context of the International Classification of Functionality, Disability and Health (CIF). Flowchart prepared by the authors based on the reference. CIF: International Classification of Functionality, Disability and Health. São Paulo: Edusp; 2003.

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COVID-19 INFECTION PREVENTION STRATEGIES

Evidences: Children with COVID-19, even if asymptomatic, must remain in social isolation, an essential measure to prevent the spread of the virus[8].

Recommendation 1: To prevent and control the spread of COVID-19, the following measures are recommended: wash your hands frequently with soap and water for at least 20 seconds; if there is no soap and water, use a hand sanitizer (which is 60% or more alcohol-based); keep children away from other sick people or keep them at home if they are sick; teach children to cough and sneeze on a tissue (make sure to throw it away after each use) or teach to cough and sneeze on the arm or elbow, not the hands; clean and disinfect the house as usual, using regular household sprays or cleaning cloths; avoid touching the face; teaching children to do the same; face masks only for people with COVID-19 symptoms, not for healthy people[8].

PHYSIOTHERAPEUTIC TREATMENT IN MUSCULOSKELETAL SYSTEM DEFICIENCIES CAUSED BY COVID-19

Evidences: Immobilization can lead to respiratory deficiencies such as hypoventilation and cardiorespiratory deconditioning[9].

Recommendation 1: Exercise and early mobilization are part of the Society of Critical Care Medicine Bundle, which aims to improve the quality of care provided to critically ill patients[10].

Evidences: Early mobilization can reduce the time of mechanical ventilation and hospitalization[9].

Recommendation 2: Motor physiotherapy can be performed with different protocols, even with the increase in exergaming[11] and virtual reality, promoting playful and attractive exercise for children, as long as attention is paid to dissemination prevention measures[5,8].

Recommendation 3: Progressive mobilization protocols can be adopted, based on conducts that encourage the maintenance of functionality[9].

PHYSIOTHERAPEUTIC TREATMENT OF THE IMPAIRED RESPIRATORY SYSTEM CAUSED BY COVID-19

Secretion Removal Therapy

Evidences: According to the clinical classification for pediatric COVID-19, children with upper airway infection have nasal congestion[2].

Evidences: It is known that the newborn, under physiological conditions, has predominantly nasal breathing[12]. Obstructions in the upper airways cause rapid and progressive respiratory discomfort, manifesting with nose wing beats (BAN), chest runs and chest retractions that increase energy demand.

Recommendation 1: In conditions of nasal congestion and upper airway obstruction, secretion removal techniques (TRM) should be applied. Attention should be paid to the specific indications and contraindications, to the different ways of performing the techniques according to the age group[13,14] and the use of PPE.

Recommendation 2: Retrograde rhinopharyngeal clearance (DRR) can be used to remove upper airway secretion.

Evidences: Children with COVID-19 with Severe Pneumonia (class 4) are suffering from Respiratory Deficiency, have hypoxemia and other symptoms[2].

Recommendation 3: For class 4, TEM which require less energy expenditure, priority should be given to this, the use of the Thoracoabdominal Rebalancing (RTA) method seems to be advantageous[13].

Evidences: The critical presentation (class 5) of the children's COVID-19 is characterized by respiratory failure with the need for ventilatory support[2].

Recommendation 4: In critical conditions it is advisable to opt for secretion mobilization techniques that do not require the disconnection of the artificial airway, such as techniques for increasing tidal volume without disconnecting the ventilator, avoiding the release of aerosols and depressurizing the system.

Recommendation 5: To prevent the spread of the virus, the use of a closed suction system is recommended,[15] you should choose this procedure only in case of the need to remove tracheobronchial secretion.

Evidences: It is important to highlight that most physical therapy interventions, especially with regard to MRI, have the potential to form aerosols[16] and risk of contamination at work.

Recommendation 6: The choice of TRM must be evaluated on the real need for application, the procedures must be carried out with the appropriate personal protective equipment, and preferably in an environment with negative pressure respiratory isolation (IRPN)[15,16]. If the environment does not have IRPN, TRM should be performed with a closed door with the least possible circulation of professionals[16].

Oxygen Therapy and Non-Invasive Pulmonary Mechanical Ventilation

Evidences: Children affected by Respiratory Deficiency may have low levels of oxygenation, in this sense the continuous monitoring of peripheral oxygen saturation (SpO_2) as a severity marker in this population is essential for the indication and administration of supplemental O_2[17,18].

Recommendation 1: SpO_2 should be maintained ≥ 90% in pediatric patients with Respiratory Deficiency due to previous Lung Diseases and ≥ 94% for those who do not have it.

Recommendation 2: The administration of supplemental oxygen should be offered preferably by a low-flow O_2 catheter or low-flow mask with a reservoir when the child shows signs of respiratory distress and a drop in arterial O_2 pressure (PaO_2)[19,20]. (see Table 1)

Table 1: Overview for indicating supplemental oxygen.

PaO_2	Oxygen therapy
> 75 mmHg	Nasal catheter up to 5 L/min
63 mmHg and 75 mmHg	Reservoir mask a 10 L/min
< 63 mmHg	Consider orotracheal intubation with medical staff

Evidences: Noninvasive mechanical pulmonary ventilation (NPMVP) is a resource frequently used in cases of hypoxemia and / or hypercapnia, and the subgroup of patients that seems to benefit most from NIPVM is that in which the PaO_2 / FiO_2 ratio (ratio between partial pressure of arterial blood oxygen and inspired oxygen fraction) is greater than 200 mmHg[21].

Recommendation 3: VPMNI can be applied to normalize breathing and reduces the need for intubation, but it also significantly reduces the need for high doses of oxygen to achieve a normal level of oxygenation[19,21].

Note: In order for VPMNI to be performed on children with COVID-19, it is necessary to guarantee the sealing of the interface during its application to avoid spraying the virus.

Invasive Mechanical Pulmonary Ventilation

Figure 2 shows signs for the recognition of respiratory distress that are some of the indicators of the need for endotracheal intubation and invasive mechanical pulmonary ventilation (VPMI) for children with severe acute respiratory syndrome (SARS-CoV-2), as well as a suggestion for adjustments initial ventilation.

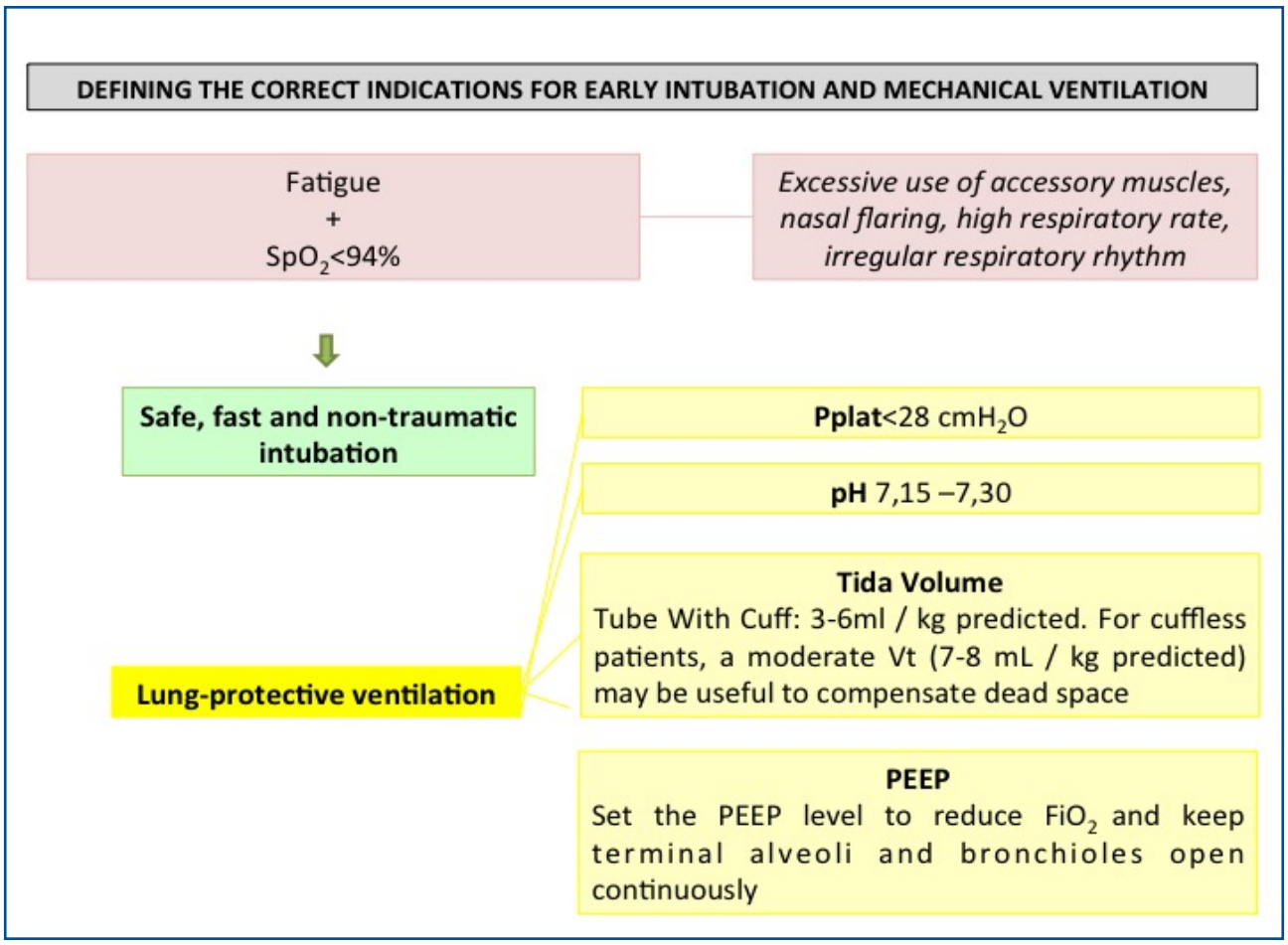

Figure 2: Illustrative panel to recognize the main signs of respiratory distress indicative of the need for endotracheal intubation, and parameters of protective ventilatory adjustments.

Source: Flowchart prepared by the authors based on the references: Pediatric Acute Lung Injury Consensus Conference Group. Pediatric acute respiratory distress syndrome: consensus recommendations from the Pediatric Acute Lung Injury Consensus Conference[J]. Pediatr Crit Care Med, 2015, 16(5): 428-439. Marraro GA, Spada C. Consideration of the Respiratory Support Strategy of Severe Acute Respiratory Failure Caused by SARS-CoV-2 Infection in Children. Zhongguo Dang Dai Er Ke Za Zhi. 2020 Mar;22(3):183-194.

Therapeutic positioning

Evidences: The prone position reduces the number of areas with Respiratory Deficiency due to Pulmonary Collapse in the dependent lung, promoting a homogenization of the pleural pressure gradient. This position can reduce the risk of barotrauma related to the need to apply manual recruitment maneuvers or increase the tidal volume to improve ventilation[22].

Recommendation 1: It is suggested that children be positioned no more than 1-2 hours, three or four times a day since the start of VPMI. While the 12-hour duration of the prone position is suggested for the consolidated dependent lung areas of the patient treated for several days with invasive ventilatory support[19].

Evidences: This intervention, according to the Pediatric Acute Lung Injury Consensus Conference (PALLIC), should not be used routinely, in all children with Respiratory Deficiency due to ARDS[23]. Thus, the prone position is perhaps a method of choice most suitable for the most serious cases of children with SARS-Cov-2.

Ventilatory weaning in children with SARS-CoV-2

Evidences: When consulting the main literary databases (PUBMED, PEdro, SciELO...), the authors found no evidence about specific procedures and protocols for the weaning of children and babies with SARS-CoV-2.

Recommendation 1: Extubation should be brought forward as soon as the patient returns to a stable state and the initial resolution of Respiratory Deficiency due to Lung Disease, to avoid the deleterious effects of IMPV[19].

Recommendation 2: If there is any doubt about the success of ventilatory weaning, it is suggested to keep the infant intubated to avoid the risk of reintubation.

Recommendation 3: Ventilatory weaning protocols should be strengthened, and include:

· Definition of weaning criteria;

· Reduction of ventilatory, sedative and control parameters;

· Interventions that favor weaning and extubation;

· Use of predictive indexes of weaning, including mechanics and lung volume according to the age group.

REFERENCES

1. Jiehao C, Jing X, Daojiong L, zhi Y, Lei X, Zhenghai Q, et al. A Case Series of children with 2019 novel coronavirus infection: clinical and epidemiological features. Clin Infect Dis, 2020 Feb;pii:ciaa198. DOI:https://doi.org/10.1093/cid/ciaa198
2. Shen K, Yang Y, Wang T, Zhao D, Jiang Y, Jin R, et al. Diagnosis, treatment, and prevention of 2019 novel coronavirus infection in children: experts' consensus statement. World J Pediatr. 2020 Feb. DOI: https://doi.org/10.1007/s12519-020-00343-7
3. China CDC Weekly. The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020. DOI: https://doi: 10.3760/cma.j.issn.0254-6450.2020.02.003.
4. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med. 2020 Feb;pii: S2213-2600(20)30079-5. DOI: https://doi.org/10.1016/S2213-2600(20)30079-5
5. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020 Feb 15;395(10223):497-506. DOI: https://doi.org/10.1016/S0140-6736(20)30183-5.
6. Xia W, Shao J, Guo Y, Peng X, Li Z, Hu D. Clinical and CT features in pediatric patients with COVID-19 infection: Different points from adults. Pediatr Pulmonol. Pediatr Pulmonol. 2020 Mar;395(10223):497-506, DOI: https://doi.org/10.1002/ppul.24718
7. Guanghai Wang YZ, Jin Zhao, Jun Zhang *Fan Jiang. Mitigate the effects of home confinement on children during the COVID-19 outbreak. Lancet. 2020 Mar;395(10228):945–947. https://doi.org/0.1016/S0140-6736(20)30547-X.
8. American Academy of Pediatrics (Copyright © 2020). 2019 Novel Coronavirus (COVID-19) [Internet]. Available from: https://www.healthychildren.org/English/health-issues/conditions/chest-lungs/Pages/2019-Novel-Coronavirus.aspx
9. Cameron S, Ball I, Cepinskas G, Choong K, Doherty TJ, Ellis CG, et al. Early mobilization in the critical care unit: A review of adult and pediatric literature. J Crit Care. 2015 Aug;30(4):664–72. DOI: https://doi.org/10.1016/j.jcrc.2015.03.032.
10. Stollings JL, Devlin JW, Lin JC, Pun BT, Byrum D, Barr J. Best Practices for Conducting Interprofessional Team Rounds to Facilitate Performance of the ICU Liberation (ABCDEF) Bundle. Crit Care Med. 2019 Apr;48(4):562–570. DOI: https://doi.org/10.1097/CCM.0000000000004197.

11. Abdulsatar F, Walker RG, Timmons BW, Choong K. “wii-Hab” in critically ill children: A pilot trial. J Pediatr Rehabil Med. 2013;6(4):193–204. DOI: https://doi.org/10.3233/PRM-130260.
12. Ministério da Saúde Secretaria de Atenção à Saúde Departamento de Ações Programáticas Estratégicas B. Atenção à Saúde do Recém-Nascido Guia para os Profissionais de Saúde Volume 2a edição [Internet]. 2. ed. 2012. 1–202 p. Available from: http://www.saude.gov.br/bvs
13. Carvalho De Oliveira M, Sobrinho CO, Orsini M. Comparação entre o método Reequilíbrio Toracoabdominal e a fisioterapia respiratória convencional em recém-nascidos com taquipneia transitória: um ensaio clínico randomizado Comparison between Thoracic-abdominal Rebalance Method and conventional respirato. Fisioter Bras. 2017;18(5):598–607. Available from: http://portalatlanticaeditora.com.br/index.php/fisioterapiabrasil/article/view/1289/pdf
14. Aparecida E, De Oliveira R, Leal De Freitas É, Gomes D. Evidência científica das técnicas atuais e convencionais de fisioterapia respiratória em pediatria Current and conventional scientific evidence of respiratory physical therapy in pediatrics. Fisioter Bras. 2016 Fev;17(1):88-97. Available from: http://docs.bvsalud.org/biblioref/2018/01/877606/evidencia-cientifica-das-tecnicas-atuais-e-convencionais.pdf
15. Zhi. ZJHHHXZ. Expert consensus on preventing nosocomial transmission during respiratory care for critically ill patients infected by 2019 novel coronavirus pneumonia. Respir care Comm Chinese Thorac Soc. 2020 Feb;17(0):E020. DOI: https://doi.org/10.3760/cma.j.issn.1001-0939.2020.0020
16. Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anesth. 2020 Feb;12:1–9. DOI: https://doi.org/10.1007/s12630-020-01591-x
17. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiological Characteristics of 2143 Pediatric Patients With 2019 Coronavirus Disease in China. Pediatrics. 2020 Mar;16:pii:e20200702. DOI: https://doi.org/10.1542/peds.2020-0702
18. Guan W-J, Ni Z-Y, Hu Y, Liang W-H, Ou C-Q, He J-X, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med [Internet]. 2020 Mar 28;395:945–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32109013
19. Marraro GA, Spada C. Consideration of the respiratory support strategy of severe acute respiratory failure caused by SARS-CoV-2 infection in children. Chin J Contemp Pediatr. 2020 Mar;22(3):183–94. DOI: https:// doi.org/10.7499/j.issn.1008-8830.2020.03.002
20. Yu IT, Xie ZH, Tsoi KK, Chiu YL, Lok SW, Tang XP, et al. Why Did Outbreaks of Severe Acute Respiratory Syndrome Occur in Some Hospital Wards but Not in Others? Clin Infect Dis. 2007 Apr;44(8):1017–25. DOI: https://doi.org/10.1086/512819
21. Zhan Q, Sun B, Wang C. Early Use of Noninvasive Positive Pressure Ventilation for Acute Lung Injury: A Multicenter Randomized Controlled Trial. Crit Care Med. 2012 Feb;40(2):455-460. DOI: https:/ /doi.org/10.1097/CCM.0b013e318232d75e
22. Curley MA, Thompson JE AJ. The effects of early and repeated prone positioning in pediatric patients with acute lung injury. Chest. 2000 Jul;118(1):156–63. DOI: https://doi.org/10.1378/chest.118.1.156
23. Jouvet P, Thomas NJ, Willson DF, Erickson S, Khemani R, Smith L, et al. Pediatric Acute Respiratory Distress Syndrome: Consensus Recommendations from the Pediatric Acute Lung Injury Consensus Conference. Pediatr Crit Care Med. 2015 Jun 21;16(5):428–39. DOI: https://doi.org/10.1097/PCC.0000000000000350
24. CIF: Classificação Internacional de Funcionalidade, Incapacidade e Saúde. São Paulo: Edusp; 2003.

6. Oxygen therapy in Adults with Respiratory Disabilities due to COVID-19

Open acess

Evidences: The use of oxygen therapy is an independent factor for increasing the chance of coronavirus spread[1].

Recommendation 1: Aerosol-generating procedures should be avoided whenever possible, given the risk of contamination of the environment and staff.

Evidences: Hypoxemia is a frequent sign in patients with symptomatic symptoms[2]. In a recent Chinese study, two scores related to SpO2 and supplemental oxygen were proposed, reinforcing the importance of these data in patients with COVID-19[3].

Recommendation 2: Patient on spontaneous ventilation with or without supplemental O_2, isolated analysis of arterial oxygen pressure (PaO_2), demands that the reference value be corrected for age. Corrected PaO_2 = 109 (age x 0.43)[4] with suggested use for this specific population[2].

Evidences: In VPM, monitoring the PaO_2 / FiO_2 ratio is a usual severity marker[5]. In conditions where the PaO_2 marker is not available, it is possible to use the SpO_2 / FiO_2 marker instead, with a cutoff ≤ 315, to suggest Respiratory Deficiency due to ARDS[2].

Recommendation 3: All hospital units that assist the patient with COVID-19 must be equipped with at least pulse oximetry. As well as, disposable oxygen therapy systems must be available, such as: nasal cannula, nasal catheters, simple face mask and mask with reservoir bag.

Evidences: About 41% of all patients hospitalized with COVID-19 use oxygen therapy in the course of their treatment, this number rises to 70% among cases with very severe evolution[6]. In the SARS-COVID pandemic in 2002, O_2 flow rates> 6L / min was a marker of increased outbreak risk. Adoption of high O_2 rates increased the chance of a viral outbreak by 2.42 times compared to low flow adoption[7,8].

Recommendation 4: The adoption of high oxygen flows should be discouraged in the absence of the respiratory isolation bed[7,8].

Evidences: Hypoxemia in acute conditions, SpO_2 ≤92%, may favor the dysfunction of organs and systems[9]. The excess supplemental oxygen causes complications such as respiratory system deficiency due to pulmonary absorption collapse and inflammatory cytokine production.

Recommendation 5: In patients with COVID-19, we suggest that supplemental oxygen be offered if SpO_2 is less than ≤ 92%. On the other hand, we advise against patients with acute hypoxemic respiratory failure being treated with oxygen support for SpO_2> 96%. The reasoning applies to the various O_2 delivery devices.

Recommendation 6: The high flow nasal catheter (CNAF) can be used in severe hypoxemic insufficiency as long as it presents a potential response in oxygenation in the first 30 minutes of therapy[7]. Should limit the CNAF flow rate to levels not exceeding 30L / min to reduce the potential for viral transmission[10].

Recommendation 7: The use of CNAF should preferably be used with patients in beds with a negative pressure room and with the use of individual protective equipment[9,10].

Evidences: To date, the literature does not provide a basis to support the routine use of CNAF for the treatment of patients with COVID-19. The potential risk of aerosol dispersion is not practicable in the current state of the art.

Recommendation 8: Adults in emergency conditions such as: severe hypoventilation or respiratory arrest; severe dyspnoea; central cyanosis; circulatory shock; coma; convulsions. They must receive maneuvers to release the airways and oxygen therapy, start flow with oxygen at 5 L / min and titrate flow rates to reach the target SpO_2 93%, during resuscitation. For children the target SpO_2 is ≥94% during such procedure[2].

Recommendation 9: The use of the mask-balloon resuscitator must have oxygen therapy guided by a SpO_2 target ≥94%, with a flow rate starting at 5L / min, with rational titration aiming at providing adequate oxygenation of the patient, as well as minimizing the formation of aerosol during emergency procedures.

Suggested citation: Silva CMS, Andrade AN, Nepomuceno B, Xavier DS, Lima E, Gonzales I, et al. Evidence-based Physiotherapy and Functionality in Adult and Pediatric patients with COVID-19. *J Hum Growth Dev. 2020; 30(1):148-155.* DOI: http://doi.org/10.7322/jhgd.v30.10086

REFERENCES

1. Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. PLoS One 2012; 7: e35797. DOI: 10.1371/journal.pone.0035797 Epub 2012 Apr 26.
2. WHO. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected. Interim guidance 13 March 2020. Available from: https://www.who.int/docs/default-source/coronaviruse/clinical-management-of-novel-cov.pdf.
3. Liao X, Wang B, et al. Novel coronavirus infection during the 2019-2020 epidemic: preparing intensive care units - the experience in Sichuan Province, China. Intensive Care Med. 2020 DOI: 10.1007/s00134-020-05954-2. Epub 2020 Feb 5.
4. Sorbini CA, Grassi V, Solinas E, Muiesan G. Arterial oxygen tension in relation to age in healthy subjects. Respiration. 1968;25(1):3-13. DOI: 10.1159/000192549
5. Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, Fan E, et al. Acute respiratory distress syndrome: the Berlin Definition. JAMA 2012;307:2526–33. DOI: 10.1001/jama.2012.5669.
6. Van den Boom W, Hoy M, Sankaran J, Liu M, Chahed H, Feng M, See KC, (2020) The Search for Optimal Oxygen Saturation Targets in Critically Ill Patients: Observational Data From Large ICU Databases. Chest 157: 566-573. DOI: 10.1016/j.chest.2019.09.015. Epub 2019 Oct 4.
7. Yu IT, Xie ZH, Tsoi KK, et al. Why did outbreaks of severe acute respiratory syndrome occur in some hospital wards but not in others? Clin Infect Dis 2007;44: 1017–25.DOI: 10.1086/512819.
8. Cheung JC, Ho LT, Cheng JV, Cham EYK, Lam KN. Staff safety during emergency airway management for COVID-19 in Hong Kong. Lancet Respir Med. 2020 Feb 24. pii: S2213-2600(20)30084-9. DOI: 10.1016/S2213-2600(20)30084-9. [Epub ahead of print].
9. Alhazzani W, Møller MH, Arabi YM, Loeb M, Gong MN, Fan E et al. Surviving Sepsis Campaign: Guidelines on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19). Crit Cara Med 2020. EPub of Print. Available from: https://www.sccm.org/getattachment/Disaster/SSC-COVID19-Critical-Care-Guidelines.pdf?lang=en-US .
10. Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, Hodgson C, Jones AYM, Kho ME, Moses R, Ntoumenopoulos G, Parry SM, Patman S, van der Lee L (2020): Physiotherapy management for COVID-19 in the acute hospital setting. Recommendations to guide clinical practice. Version 1.0, published 23 March 2020. Available from: https://www.journals.elsevier.com/journal-of-physiotherapy.

7. Noninvasive Mechanical Pulmonary Ventilation in Adults with Respiratory Disabilities caused by COVID-19

Open acess

Evidences: Non-Invasive Mechanical Pulmonary Ventilation (NPMV) can increase contamination of healthcare workers[5], even when applied by helmet(Helmet)[6] with double branch circuit, filters and good sealing at the neck-helmet interface, as the jet of exhaled air can reach 92cm[7] in distance. Additionally, the inappropriate application of PMNV may delay the intubation process, and contribute to increased mortality[8].

Evidences: PMVNN is associated with the absence of proven benefits in refractory hypoxemic respiratory deficiency[9], in previous epidemics (H1N1 e MERS-COV)[10,11], as well as in acute respiratory deficiencies secondary to acute respiratory distress syndrome (ARDS)[12].

Evidences: COVID-19 shows that 14% of patients developed dyspnea, tachypnea, peripheral oxygen desaturation (SpO_2) less than or equal to 93%, and deficient oxygenation index with a PaO_2 / FiO_2 ratio <300 mmHg and / or SaO_2 / FiO_2 lower or equal to 315, in 48hrs[13].

Evidences: PMVNN through an endotracheal tube is common in the midst of this outbreak, improving the clinical outcome[14].

Evidences: The risk of transmitting acute respiratory infections to healthcare professionals, in procedures that generate aerosol, are three times higher during the use of NIV[15].

Recommendation 1: Patients who benefit best from PMNV are those in which the PaO_2 / FiO_2 ratio is greater than 200 mmHg[16], despite the diagnosis of ARDS being associated with ineffective PMPM[17]. However, the risk of spreading COVID-19 is greater, and therefore PPE is needed.

Recommendation 2: MPVNM can be used in those places where access to VPMI is limited, or before patients have severe hypoxemic respiratory failure[19]. In this sense, the physiotherapist must ensure to perform any Physiotherapeutic conduct that:

1 - The procedures that generate aerosols are performed in a room with adequate ventilation (natural ventilation with an air flow of at least 160 L / s per patient)[20] or in negative pressure rooms[21];

2 - VPMNI procedures should be performed with PPE, such as professional mask PFF[2] (N95), goggles for protecting the eye mucosa, long-sleeved, fluid-resistant apron, and clean gloves for protection[22];

Recommendation 3: In specific situations, defined by the multiprofessional team, a response test to NPMVP, lasting “60 minutes” (we recommend up to 30 minutes), can be performed in patients with hypoxemic IRPA who have mild respiratory distress (with a higher PaO_2 / FiO_2 ratio or equal to 200), immunosuppression present or cardiovascular problems[23].

Recommendation 4: Avoid masks with ventilation holes, and add a filter between the mask and the ventilation valve to reduce viral transmission[24].

Recommendation 5: The best option is to combine VPMNI with a dual circuit with an expiratory valve, combining a single circuit face mask with an integrated exhalation port instead of using ventilated masks[25].

Recommendation 6: Antimicrobial and antiviral filters should always be installed[26]. Although some studies recommend changing filters every 48-72h, or before that, in cases of obstruction (water, blood or secretions), manufacturers recommend changing them every 24h to reduce infections[27,28,29].

Recommendation 7: The helmet interface must be used with a double limb circuit to reduce the risk of airborne transmission.[30]

Recommendation 8: Dialogue with the team for endotracheal intubation if there is no response to PMNV[31].

Recommendation 9: For patients with suspected COVID-19 infection who receive long-term respiratory support at home (for example, patients with respiratory impairment due to chronic airflow obstruction), they should stay in a single, well-ventilated room to avoid the possibility of infecting their relatives[32], and every care must be taken with respect to PPE.

Recommendation 10: In specific situations, in which there is an isolation room[33], mask without rebreathing, negative pressure room, double circuit and barrier filter in the exhalation branch, a quick test can be performed if SpO_2 <93% and / or RF> 24 ipm, already with oxygen therapy[34].

Recommendation 11: The NIV pressures should be as low as possible to provide and provides a reduction in RF and the use of accessory muscles, with an improvement in SpO_2[35], keeping it around 93%.

Suggested citation: Silva CMS, Andrade AN, Nepomuceno B, Xavier DS, Lima E, Gonzales I, et al. Evidence-based Physiotherapy and Functionality in Adult and Pediatric patients with COVID-19. *J Hum Growth Dev. 2020; 30(1):148-155.* DOI: http://doi.org/10.7322/jhgd.v30.10086

REFERENCES

1. Weng C-L, Zhao Y-T, Liu Q-H, et al. Meta-analysis: Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema. Annals of Internal Medicine. 2010;152(9):590-600. Available from: https://www.ncbi.nlm.nih.gov/pubmed/20439577. DOI:10.7326/0003-4819-152-9-201005040-.
2. Osadnik CR, Tee VS, Carson-Chahhoud KV, Picot J, Wedzicha JA, Smith BJ. Non-invasive ventilation for the management of acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2017;7:CD004104. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28702957. DOI: 10.1002/14651858.CD004104.pub4.
3. Zhonghua L, Xing B, Xue ZZ. Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. [The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China]. CMA.J. 2020; 17;41(2):145-151. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32064853 DOI:10.3760/cma.j.issn.0254-6450.2020.02.003.
4. Zhou F, Yu T, Du R, Fan G, Liu F, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet. 2020; 395, 10229: 1054-1062. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30566-3/fulltext. DOI: https://doi.org/10.1016/S0140-6736(20)30566-3.
5. Fowler RA, Guest CB, Lapinsky SE, et al. Transmission of Severe Acute Respiratory Syndrome during Intubation and Mechanical Ventilation. American Journal of Respiratory and Critical Care Medicine. 2004;169(11):1198-1202. Available from: https://www.ncbi.nlm.nih.gov/pubmed/14990393. DOI: 10.1164/rccm.200305715OC.
6. Xiao Z, Li Y, Chen R, Li S, Zhong S, Zhong N. A retrospective study of 78 patients with severe acute respiratory syndrome. Chin Med J (Engl). 2003;116(6):805-810. Available from: https://www.thelancet.com/journals/lanres/article/PIIS22132600(20)30079-5/fulltext. DOI: https://doi.org/10.1016/S2213-2600(20)30079-5.
7. Hui DS, Chow BK, Lo T, et al. Exhaled Air Dispersion During Noninvasive Ventilation via Helmets and a Total Facemask. Chest. 2015;147(5):1336-1343. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25392954. DOI: 10.1378/chest.14-1934.
8. Raiech S, Alingrin J, Dizier S, et al. Time to intubation is associated with outcome in patients with community-acquired pneumonia. PLoS One. 2013;8(9):e74937-e74937. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24069367. DOI:10.1371/journal.pone.0074937.
9. Chen C, Zhao B, Makeshift hospitals for COVID-19 patients: where health-care workers and patients need sufficientventilation for more protection, Journal of Hospital Infection. Available from: https://www.journalofhospitalinfection.com/article/S01956701(20)30107-9/fulltext. DOI: https://doi.org/10.1016/j.jhin.2020.03.008.
10. Xu X-P, Zhang X-C, Hu S-L, et al. Noninvasive Ventilation in Acute Hypoxemic Nonhypercapnic Respiratory Failure: A Systematic Review and Meta-Analysis. Critical care medicine. 2017;45(7):e727-e733. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28441237. DOI: 10.1097/CCM.0000000000002361.
11. Alraddadi BM, Qushmaq I, Al-Hameed FM,et al. Noninvasive ventilation in critically ill patients with the Middle East respiratory syndrome. Influenza Other Respir Viruses. 2019;13(4):382-390. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30884185. DOI: 10.1111/irv.12635.
12. Agarwal R, Aggarwal AN, Gupta D. Role of Noninvasive Ventilation in Acute Lung Injury/Acute Respiratory Distress Syndrome: A Proportion Meta-analysis. Respiratory Care. 2010;55(12):1653-1660. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21122173.
13. Lingzhong M, Haibo Q, Li W, Yuhang A, Zhanggang X, Qulian G, et al. Intubation and Ventilation amid the COVID-19 Outbreak: Wuhan's Experience. Anesthesiology 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/ 32195705. DOI: https://doi.org/10.1097/ALN. 0000000000003296.
14. Arabi YM, Arifi AA, Balkhy HH, et al. Clinical Course and Outcomes of Critically Ill Patients With Middle East Respiratory Syndrome Coronavirus Infection. Ann Intern Med. 2014;160:389–397. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24474051 DOI: https://doi.org/10.7326/M13-2486.
15. Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acuterespiratory infections to healthcare workers: a systematic review. PLoS One. 2012;7(4):e35797-e35797. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22563403. DOI: 10.1371/journal.pone.0035797.
16. Zhan Q, SunB, Liang L, et al. Early use of noninvasive positive pressure ventilation for acute lung injury: A multicenter randomized controlled trial. Read Online: Critical Care Medicine | Society of Critical Care Medicine. 2012;40(2):455-460. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22020236. DOI: 10.1097/CCM.0b013e318232d75e.
17. Antonelli M, Conti G, Moro M, et al. Predictors of failure of noninvasive positive pressure ventilation in patients with acute hypoxemic respiratory failure: a multi-center study. Intensive Care Medicine. 2001;27(11):1718-1728. Available from: https://link.springer.com/article/10.1007%2Fs00134-001-1114-4#citeas. DOI: https://doi.org/10.1007/s00134-001-1114-4.
18. Adda M, Coquet I, Darmon M, Thiery G, Schlemmer B, Azoulay É. Predictors of noninvasive ventilation failure in patients with hematologic malignancy and acute respiratory failure. Read Online: Critical Care Medicine | Society of Critical Care Medicine. 2008;36(10):2766-2772. Available from: https://www.ncbi.nlm. nih.gov/pubmed/18766110. DOI: 10.1097/CCM.0b013e31818699f6.

19. Murthy S, Gomersall CD, Fowler RA. Care for Critically Ill Patients With COVID-19. JAMA.Published online March 11, 2020. Available from: https://jamanetwork.com/journals/jama/fullarticle/2762996. DOI:10.1001/jama.2020.3633.
20. Atkinson J, Chartier Y, Pessoa-Silva CK, Jensen P, Li Y, Seto WH, editors. Natural ventilation for infection control in health-care settings. Geneva: World Health Organization; 2009 (https://apps.who.int/iris/handle/10665/44167, accessed 17 January 2020). Available from: https://www.ncbi.nlm.nih.gov/books/NBK143284/
21. World Health Organization. Infection Prevention and Control during Health Care when Novel Coronavirus (nCoV) Infection is Suspected. www.who.int/publications-detail/infection-prevention-and-control-during-health-care-whennovel-coronavirus-(ncov)-infection-is-suspected-20200125 Date last updated: 25 January, 2020. Date last accessed: 17 February, 2020
22. Cheung JC,Ho LT,Cheng JV,Cham EYK,Lam KN. Staff safety during emergency airway management for COVID-19 in Hong Kong. Lancet Respir Med.2020Feb 24. pii: S2213-2600(20)30084-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32105633. DOI: 10.1016/S2213-2600(20)30084-9
23. Hui DS . Influenza A/H5N1 infection: other treatment options and issues . Respirology . 2008 ; 13 (suppl 1): S22 – S26. Available from: https://www.ncbi.nlm.nih.gov/pubmed/18366525. DOI:10.1111/j.1440-1843.2008.01250.x
24. Conti G , Larrsson A , Nava S , Navalesi P. On the role of non-invasive ventilation (NIV) to treat patients during the H1N1 influenza pandemic. ERS & ESICM. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2887125/. DOI: 10.1186/cc8896
25. Hui DS , Hall SD , Chan MT , et al . Noninvasive positive-pressure ventilation: An experimental model to assess air and particle dispersion. Chest . 2006 ; 130 (3): 730 – 740. Available from: https://journal.chestnet.org/article/S0012-3692(15)52786-4/fulltext DOI: https://doi.org/10.1378/chest.130.3.730
26. Simonds AK, Hanak A, Chatwin M, et al. 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. Health Technol Assess 2010; 14: 131–172. Available from: https://www.ncbi.nlm.nih.gov/pubmed/20923611. DOI: 10.3310/hta14460-02.
27. Ricard JD, Markowicz P, Djedaini K, Mier L, Coste F, Dreyfuss D. Bedside evaluation of efficient airway humidification during mechanical ventilation of the critically ill. Chest 1999; 115:1646-52. Available from: https://europepmc.org/article/med/10378563. DOI: 10.1378/chest.115.6.1646
28. Davis K Jr, Evans SL, Campbell RS, et al. Prolonged use of heat and moisture exchangers does not affect device efficiency or frequency rate of nosocomial pneumonia. Crit Care Med 2000; 28:1412-8. Available from: https://www.crd.york.ac.uk/CRDWeb/ShowRecord.asp?AccessionNumber=22000000981&AccessionNumber=22000000981. DOI: 10.1097/00003246-200005000-00026
29. Boisson C, Viviand X, Arnaud S, Thomachot L, Miliani Y, Martin C. Changing a hydrophobic heat and moisture exchanger after 48 hours rather than 24 hours: a clinical and microbiological evaluation. Intensive Care Med 1999; 25:1237-43. Available from: https://link.springer.com/article/10.1007/s001340051051 DOI:10.1007/s001340051051
30. Hui DS , Ip M , Tang JW , et al . Airflows around oxygen masks: a potential source of infection? Chest . 2006 ; 130 (3): 822 – 826. Available from: https://europepmc.org/article/med/16963681. DOI: 10.1378/chest.130.3.822
31. Patel BK, Wolfe KS, Pohlman AS, Hall JB, Kress JP. Effect of Noninvasive Ventilation Delivered by Helmet vs Face Mask on the Rate of Endotracheal Intubation in Patients With Acute Respiratory Distress Syndrome: A Randomized Clinical Trial. JAMA. 2016;315(22):2435-2441. Available from: https://jamanetwork.com/journals/jama/fullarticle/2522693. DOI: 10.1001/jama.2016.6338
32. Chan JF et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating personto-person transmission: a study of a family cluster. Lancet 2020. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30154-9/fulltext. DOI: https://doi.org/10.1016/S0140-6736(20)30154-9.
33. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020. Available from: https://jamanetwork.com/journals/jama/fullarticle/2761044. DOI: doi:10.1001/jama.2020.1585.
34. Huang C,Wang Y, Li X, et al.Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China Lancet (2020) published online Jan 24. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30183-5/fulltext https://doi.org/10.1016/ S0140–6736(20)30183–5. DOI: 10.1016/S0140-6736(20)30183-5.
35. Guan L, Zhou L, Zhang J,et al. More awareness is needed for severe acute respiratory syndrome coronavirus 2019 transmission through exhaled air during non-invasive respiratory support:experience from China. Eur Respir J2020; 55: 2000352. Available from: https://erj.ersjournals.com/content/55/3/2000352. DOI:10.1183/13993003.00352-2020.

8. Invasive Mechanical Pulmonary Ventilation in Adults with Respiratory Disabilities caused by COVID-19: From Intubation to Weaning

Open acess

Evidences: Patients with COVID-19 may have Respiratory Deficiency (DR) due to severe pneumonia, acute respiratory distress syndrome (ARDS), sepsis and septic shock[1,2], and present hypoxemic acute respiratory failure or failure (SARS-CoV2 - severe acute respiratory syndrome caused by CoV2), requiring admission to the ICU in order to be addressed with ventilatory strategies[2,3,4]. Thus, the need for intubation and invasive mechanical pulmonary ventilation (VPMI) is common in the midst of this outbreak 5 mainly due to the variation of 2.3% to 4%[6,7], and even higher values like, 42% and 47%[2,4] in related studies.

Orotracheal Intubation (IOT)

Evidences: Intubation and invasive mechanical ventilation may have been delayed in some patients and this may have had a negative impact on mortality[5,8].

Recommendation 1: All patients in cardiopulmonary arrest (CRP) or with several non-pervious areas should be intubated. In other patients, the decision for IOT should be made based on the patient's functional assessment and clinical experience[5], considering early intervention.

Recommendation 2: Intubation should be performed as soon as the patient has tachypnea (> 30 ipm), hypoxemia, Spo_2 less than 93% in room air and a Pao_2 / $Wire_2$ ratio <300 mmHg[5]. Also consider OTI in cases of progressive worsening of the clinical picture with no prospect of acute recovery, with no clinical and functional improvement to conventional oxygen therapy or high flow oxygen therapy or NPMV in use within 1-2 hours[5,9,10,11].

Recommendation 3: You need to be aware of the physiological signs of asymptomatic hypoxic patients - referred to as silent hypoxemia[12], to consider the need for intubation, avoiding an emergency procedure, as this poses a risk of cross-infection.

Evidences: It should be noted that, until now, for COVID-19, there is no scientific evidence to recommend one method over the other with regard to pre-oxygenation, and that the clinical guidelines and consensus disagree on these aspects[13,14]. The use of a mask valve bag (AMBÚ, or similar brand) is still questioned before intubation for pre-oxygenation due to the risk of generating aerosols and suggest that this method be avoided[13].

Recommendation 4: Satisfactory pre-oxygenation must be performed before intubation, as already pointed out by guidelines and previous studies, in other health conditions[15,16,17]. A minimum of 5 minutes is recommended[14].

Recommendation 5: The reservoir mask is not recommended for patients diagnosed with COVID-19 due to the risk of contamination[14] should use an occlusive face mask (well adjusted to the patient's face) coupled to a mask valve bag (AMBÚ, or similar brand), connected to an oxygen source[13].

Recommendation 6: The filter must be connected to the mask valve bag (between the mask or the endotracheal tube and the AMBÚ)[14].

Recommendation 7: If the mask valve bag is used (most common in our country), a filter MUST be present. It is important to consider the use of AMBÚ if the pre-oxygenation method chosen by the team does not effectively improve the patient's oxygenation[5].

Recommendation 8: Personal protective equipment (PPE) can prevent auscultation to help confirm correct tube placement[14,18]. In this sense, it is recommended[18] a careful inspection of the bilateral movement of the chest, until the radiographic examination is performed (portable X-ray), since the use of PPE, at this moment, is essential[5].

Recommendation 9: Capnometry, SpO_2, skin color inspection, and clinical and functional assessment are useful for assessing successful intubation[5].

Recommendation 10: The cuff cuff pressure must be maintained between 25 to 30 cmH_2O (1 cmH_2O = 0.098 kPa)[19,10,11], and the cuffometer pressure gauge can be used routinely (every 6 to 8 hours)[19].

Ventilating the Patient

Evidences: With attention focused mainly on increasing the number of beds and ventilators, an approach to patients similar to that used in severe ARDS has been used, that is, high expiratory pressure (PEEP) and prone positioning[20]. However, patients with respiratory failure caused by 2019-nCOV2, who are diagnosed based on the Berlin criteria for ARDS, may have an atypical form of

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the syndrome[20]. In fact, the main characteristics observed are the dissociation between relatively well preserved pulmonary mechanics and the severity of hypoxemia[20].

Recommendation 11: Use the protective ventilatory strategy with a maximum tidal volume of 6ml / Kg of predicted weight, plateau pressure limited to 28 - 30cmH_2O, driving pressure limited to 15 cmH_2O, and target saturation of 88 to 93%. Hypercapnia must be tolerated (permissive hypercapnia), as well as acidosis (pH≥7,20)[3,7,19,21].

Recommendation 12: PEEP should be used in order to reduce driving pressure levels, as this parameter predicts mortality in ARD due to ARDS[22]. Elevated PEEP in a poorly recruitable lung tends to result in severe hemodynamic impairment and fluid retention[20]. It should be noted that this should be individualized and should be titled based on clinical and functional evaluation, considering that atypical ARDS can be observed[20].

Recommendation 13: The ventilatory modes most used in the studies are the conventional ones (PCV and VCV)[5]. The more contemporary modes, (such as double control), may be a possibility, but there is no scientific information about their use in COVID-19 patients.

Recommendation 14: AVOID disconnections of ventilator patients, as this results in air contamination (aerosols), loss of pressurization (PEEP) and can cause Respiratory System Deficiency due to collapse[1].

Recommendation 15: TOT clamping with straight Reynold or Kelly forceps should be performed when disconnection is necessary (for example to change the mechanical ventilator, change the HME / HEPA / HMEF, change the closed suction system)[1].

Recommendation 16: All gas exhaled from the ventilator must be filtered in order to avoid air contamination and the spread of COVID-19. Therefore, it is recommended that the heat and humidity exchanger, HME (Heat-moisture exchanger) be used between the orotracheal tube and the combined circuit with HEPA (High Efficiency Particulate Arrestance), which must be placed between the circuit and the fan , in the expiratory branch. HMEF (with filtration efficiency greater than 99.9%) can replace the HME + HEPA combination, and must be placed between the tube and the circuit[19]. Do not use a heated humidification system (HH - heated humidification)[19].

Recommendation 17: Regarding the use of VPMI equipment to ventilate two patients (Dual-Patient Ventilation), although there are already practical manuals for carrying out emergency cases, data on the effectiveness and / or losses of this strategy are not available.

Ventilatory weaning

Recommendation 17: PSV mode is recommended for the implementation of a spontaneous breathing test (TRE). It is not recommended to use the T-piece to do the TRE[19].

Recommendation 18: using a T-piece or tracheostomy mask[19].

Recommendation 19: Weaning protocols should be implemented, as well as, when possible, a sedation reduction protocol (daily awakening)[1].

Recommendation 20: For extubation, the same precautions as intubation must be considered. You should be thinking about using appropriate sedation to avoid coughing and agitation[5,23].

Special Situations

Evidences: In the patient infected with COVID-19, the need for resuscitation requires what the authors call ‘‘Protected Code Blue’’, a term created to distinguish the usual resuscitation from that which requires special procedures[13,24].

Recommendation 21: Resuscitation should take place in an air isolation room, given the need for aerosol-generating procedures, staff should be kept to a minimum, and PPE must be used[25].

Recommendation 22: It is suggested that the resuscitation cart be replaced by a cart containing the necessary devices, due to the difficulty of posterior cleaning[25]. Pay attention to the use of AMBU, it should be used with a filter[19].

Recommendation 23: Transport and transfers of patients diagnosed with COVID on VPMI should be avoided[19]. If essential, preparations must be made before the transfer is carried out, and it is recommended that the condensate in the respiratory circuit be cleaned, as well as the patient’s airway and oral cavity. The use of HMEF, must be maintained and sedation aims to promote comfort and prevent coughing[19].

REFERENCES

1. WHO. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance. 2020. Available from: https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected. (accessed March 27, 2020).
2. Xiaobo Ya, Yuan Yu, Jiqian Xu, Huaqing Shu, Prof Jia'an Xia, Prof Hong Liu. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. Lancet Respir Med. 2020. DOI: 10.1016/S2213-2600(20)30079-5 [Epub ahead of print].
3. Wax RS1,2,3, Christian MD4. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anaesth. 2020. DOI: 10.1007/s12630-020-01591-x [Epub ahead of print].
4. Wang D, Hu B, Hu C et al Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA 2020. DOI: 10.1001/jama.2020.1585 [Epub ahead of print].
5. Meng L, Qiu H, Wan L, Ai Y, Zhanggang X, Qulian Guo et al. Intubation and Ventilation amid the COVID-19 Outbreak Wuhan's Experience. Anesthesiology 2020. DOI: 10.1097/ALN.0000000000003296 [Epub ahead of print].
6. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020; 395: 497–506. DOI: 10.1016/S0140-6736(20)30183-5 [Epub ahead of print].
7. Guan W, Ni Z, Hu Y, Liang W, Ou C, He J et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020. DOI: 10.1056/NEJMoa2002032 [Epub ahead of print].
8. Zuo M, Huang Y, Ma W, Xue Z, Zhang J, Gong Y et al. Chinese Society of Anesthesiology Task Force on Airway Management: Expert recommendations for tracheal intubation in critically ill patients with noval coronavirus disease 2019. Chin Med Sci J 2020. DOI: 10.24920/003724. [Epub ahead of print]
9. Thomas P, Baldwin C, Bisset B, Boden I, Gosselink R, Granger C et al. Physiotherapy Management for COVID-19 In the Acute Hospital Setting: Recomendation to guide clinical pratice. WCPT 2020. Available from: https://www.wcpt.org/sites/wcpt.org/files/files/wcptnews/images/Physiotherapy_Guideline_COVID-19_FINAL.pdf.
10. Lazzerri M, Lanza A, Bellini R, Bellofiori A, Cecchetto S, Colombo A et al. Respiratory Physiotherapy in patients with COVID-19 infection in acute setting: a Position paper of the Italian Association of Respiratory Physiotherapists (ARIR). Monaldi Archives for Chest Disease. 2020. DOI: 10.4081/monaldi.2020.1285 [Epub ahead of print].
11. Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zh. Airway management of COVID-19 patients with severe pneumonia. i 2020. DOI: 10.3760/cma.j.issn.1673-0860.2020.04.001 [Epub ahead of print].
12. Xie J, Tong Z, Guan X, Du B, Qiu H, Slutsky A.Critical care crisis and some recommendations during the COVID-19 epidemic in China. Intensive Care Medicine 2020.DOI: 10.3760/cma.j.issn.1673-0860.2020.04.001 [Epub ahead of print].
13. Wax R, Christian M. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anaesth. 2020. DOI: 10.1007/s12630-020-01591-x [Epub ahead of print].
14. Brewster D, Chrimes N, Do T, Fraser K, Groombridge C, Higgs A et al. Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group. Med J Aust 2020 Available from: https://www.mja.com.au/journal/2020/consensus-statement-safe-airway-society-principles-airway-management-and-tracheal
15. Higgs A, McGrath B, Goddard C, Rangasami J, Suntharalingam G, Gale R et al. Guidelines for the management of tracheal intubation in critically ill adults. Br J Anaesth. 2018, 120:323:352 DOI: 10.1016/j.bja.2017.10.021.
16. Cabrini L, Pallanch O, Pieri M,Zangrillo A. Preoxygenation for tracheal intubation in critically ill patients: one technique does not fit all. J Thorac Dis. 2019; (Suppl 9):S1299-S1303 DOI: 10.21037/jtd.2019.04.67.
17. Frerk C, Mitchell V, McNarry A, Mendonca C, Bhagrath R, Patel et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. British Journal of Anaesthesia 2015; 115:827-48 DOI: 10.1093/bja/aev371.
18. Gottlieb M, Holladay D, Burns K, Nakitende D, Bailitz J. Ultrasound for airway management: an evidence-based review for the emergency clinician. Am J Emerg Med 2019; S0735-6757:30816-2 DOI: 10.1016/j.ajem.2019.12.019.

19. Respiratory care committee of Chinese Thoracic Society Expert consensus on preventing nosocomial transmission during respiratory care for critically ill patients infected by 2019 novel coronavirus pneumonia. Zhonghua Jie He He Hu Xi Za Zhi. 2020; 17:E020 DOI: 10.3760/cma.j.issn.1001-0939.2020.0020. [Epub ahead of print].
20. Gattinoni L, Coppola S, Cressooni M, Busana M, Chiumello D. Covid-19 Does Not Lead to a “Typical” Acute Respiratory Distress Syndrome. ATSJournal 2020 DOI: 10.1164/rccm.202003-0817LE [Epub ahead of print].
21. Fan E, Brodie D, Slutsky A. Acute respiratory distress syndrome: advances in diagnosis and treatment. JAMA 2018;319:698-710 DOI: 10.1001/jama.2017.21907.
22. Amato M, Meade M, Slutsky A, Brochard L, Costa E, Schoenfeld D et al. Driving pressure and survival in the acute respiratory distress syndrome. N Engl J Med. 2015; 372:747-55 DOI: 10.1056/NEJMsa1410639.
23. Venkatesan T, Korula G. A comparative study between the effects of 4% endotracheal tube cuff lignocaine and 1.5mg/kg intravenous lignocaine on coughing and hemodynamics during extubation in neurosurgical patients: A randomized controlled double-blind trial. J Neurosurg Anesthesiol 2006; 18:230–4 DOI: 10.1097/00008506-200610000-00002.
24. Abrahamson SD, Canzian S, Brunet F. Using simulation for training and to change protocol during the outbreak of severe acute respiratory syndrome. Crit Care 2005 DOI: 10.1186/cc3916.
25. Christian MD, Loutfy M, McDonald LC, et al. Possible SARS coronavirus transmission during cardiopulmonary resuscitation. Emerg Infect Dis 2004; 10:287-93 DOI: 10.3201/eid1002.030700.