Caring for patients with COPD and COVID-19: a viewpoint to spark discussion

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INTRODUCTION

Coronavirus SARS-CoV-2 is currently causing a pandemic of COVID-19, with more than 3 million confirmed cases around the globe identified as of June 2020. During these extraordinary times, caring for patients with COVID-19 and underlying COPD poses particular challenges. Certain treatments relevant to treating patients with COPD, such as nebulised bronchodilators and non-invasive ventilation (NIV), are thought to carry an increased risk of viral spread via aerosols. Uncertainties on whether to use systemic steroids have entered the minds of intensive care and respiratory communities. Moreover, questions regarding which life-sustaining treatments to start, when to start them and even *whether to start them* are faced by clinicians on a daily basis. Treating COPD effectively in the context of COVID-19 is important since patients with COPD are at an increased risk of poor outcomes. Here, we summarise current viewpoints from four European countries on how to care for patients with COPD and COVID-19.

We will address the following specific questions:

1. Are patients with COPD at an increased risk of COVID-19?
2. Should COVID-19 be considered a COPD exacerbation?
3. What is the optimal medical treatment for a patient with COPD and COVID-19?
4. Which ventilatory support should be provided to patients with COPD and COVID-19?
5. What other supportive treatments should be offered to patients with COPD and COVID-19?
6. How should end-of-life care be delivered in patients with COPD during the COVID-19 pandemic?

Are patients with COPD at an increased risk for COVID-19?

Since patients with COPD are vulnerable to viral respiratory tract infections, and COPD is generally a disease of the elderly, many had expected that patients with COPD would have a considerably increased risk of acquiring COVID-19. Studies so far, however, indicated only around 2% of patients admitted to hospital with COVID-19 infection in China had underlying COPD,[1 2] while the prevalence of COPD in China ranges from 5% to 13%.[3] Indeed, COPD was not the most commonly reported comorbidity seen in patients with COVID-19.[1] However, while the low percentage suggests COPD is not a risk factor for acquiring COVID-19, the size of the pandemic will still affect many patients with COPD. What's more, patients with COPD and COVID-19 have a worse clinical outcome compared with patients with other comorbidities[2]: patients with COPD and current smokers have an increased risk for severe disease.[2 4] Moreover, both patients with COPD and smokers have an increased risk of dying from COVID-19.[2 4]

Should a COVID-19 infection be considered a COPD exacerbation?

Coronaviruses are recognised seasonal causes of acute exacerbations of COPD (AECOPD). There remains controversy as to whether COVID-19 in a patient with underlying COPD should be considered a COPD exacerbation. This stems from our current definition of an exacerbation being a clinical diagnosis based on a change in symptoms needing a change in treatment.[5] Thus, a patient with COVID-19 and COPD presenting with increased cough and breathlessness requiring treatment would fulfil the current definition of exacerbation. However, it is clear from imaging and postmortem studies that the pathology of a typical AECOPD is very different from the viral pneumonia typical of COVID-19.[6] Thus, conceptually, COVID-19 in a patient with COPD is likely a very different pathophysiological process.

What is the medical treatment of a patient with COPD and COVID-19?

Though COVID-19 might not be a typical AECOPD, physicians must take the underlying COPD into consideration when treating COVID-19 in COPD. Also, diagnosing COVID-19 in a patient with COPD does not preclude a concomitant AECOPD and the need for treatment for this. Specific to treating patients with COPD is the necessity for bronchodilators, the beneficial effects of NIV and the frequent need for antibiotics. Concerns have been raised as to whether and how these therapies should be offered to patients with COPD during the pandemic.

Antibiotics

Outside the context of COVID-19, not all AECOPDs should be treated with antibiotics,[5] and current guidelines suggest reserving antibiotics for AECOPDs that require hospitalisation or ventilatory support.[7] Overall, bacterial coinfections are uncommon in COVID-19: recent meta-analysis has shown that only 8% of patients had a bacterial/fungal coinfection.[8] The risk of coinfections increases with the severity of COVID-19: a cohort study on risk factors for in-hospital death from COVID-19 found that 50% of non-survivors experienced secondary infections and that ventilatory-associated pneumonia was seen in 31%.[9] Since it may be difficult to distinguish SARS-CoV-2 infections from a bacterial pneumonia and because patients with COPD are at risk for bacterial (super)infections, we suggest treating hospitalised patients with COPD

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Table 1 Caring for patients with COPD and COVID-19

1	There are no data to suggest that COPD is a risk factor for acquiring SARS-CoV-2.
2	In patients with COVID-19, COPD is associated with an increased risk of poor outcome.
3	A COVID-19 chest infection in a person with underlying COPD is likely a very different process from an acute exacerbation of COPD. However, the diagnosis of COVID-19 does not exclude a coexisting AECOPD. Furthermore, treatment of COVID-19 should take the underlying COPD into account.
4	Antibiotics are advisable in patients with COPD requiring hospitalisation for SARS-CoV-2 chest infection, especially when ventilatory support is needed.
5	Bronchodilators administered by pMDI and spacer are preferred to nebuliser treatment in patients with COPD and COVID-19 and respiratory symptoms. We suggest using long-acting bronchodilators, if needed at twice the frequency of maintenance treatment.
6	Nebuliser treatment should be reserved for those patients with life-threatening disease or those unable to use a pMDI and a spacer. Attention should be paid to preventing airborne transmission in such cases.
7	A course of systemic corticosteroids is advisable in patients with COPD and an AECOPD who require hospitalisation for a SARS-CoV-2 chest infection.
8	Regarding the choice of ventilatory support, it is of utmost importance that patients' wishes and decisions made with regard to ventilatory support and/or ICU admission and intubation are clear.
9	NIV should be offered to patients with COPD and COVID-19 and acute (on chronic) hypercapnic respiratory acidosis. Care should be taken to limit viral spread by using non-vented masks with exhaled air passing a bacterial/viral filter before entering the room.
10	Chronic NIV should be continued in patients with COPD on home NIV when they present with COVID-19. Home treatment might be an option.
11	We suggest HFNC or CPAP with high FiO_2 in patients with COPD and COVID-19 and acute hypoxaemic respiratory failure, if oxygen therapy fails. Care should be taken to limit viral spread by using surgical masks over the nasal cannulas. With CPAP, exhalation can be filtered before entering the room.
12	Rapid intubation and invasive mechanical ventilation should be provided if patients do not respond adequately to non-invasive support, depending on prior discussions and decisions about escalation of treatment.
13	Hospitalised patients with COPD and COVID-19 should be monitored for unintentional weight loss and dietary support should be offered accordingly.
14	The use of airway clearance techniques in patients with COPD and COVID-19 should be provided prudently to reduce the risk of viral transmission.
15	Early mobilisation in patients with COPD and COVID-19 is very important.
16	It is important to offer psychological and spiritual support to patients with COPD and COVID-19 during hospital admission, as well as during follow-up.
17	Pulmonary rehabilitation should be offered to all patients with COPD and COVID-19 after discharge from the hospital, perhaps starting in an alternative form as long as social distancing is still required.
18	We suggest screening all patients with COVID-19, especially after ICU stay, for emotional and functional limitations and to offer rehabilitation when indicated.
19	Timely advance care planning in patients with COPD should be provided, including patient–physician communication about patients' values, goals and preferences regarding life-sustaining treatments, as well as addressing worries about the dying phase and palliative treatment options. Timeliness and diligence in this are even more important and challenging during this time of COVID-19 pandemic.
20	Appropriate management of symptoms at the end of life in patients with COPD and COVID-19 is crucial, including management of anxiety, dyspnoea and palliative sedation as needed.
21	We suggest considering bereavement care for loved ones of deceased patients with COPD and COVID-19, since they may be at an increased risk for complicated grief.

AECOPD, acute exacerbations of COPD; HFNC, high-flow nasal cannula; ICU, intensive care unit; NIV, non-invasive ventilation; pMDI, pressurised metered-dose inhaler.

and COVID-19 and respiratory symptoms with broad-spectrum antibiotics, guided by local/national guidelines for treating pneumonia. This is in line with the current WHO treatment guideline for severe COVID-19.[10] Microbiological analysis, such as sputum culture, should be performed on admission and it may then be reasonable to stop antibiotics in the absence of a coinfection.

Bronchodilators and nebulisation

Bronchodilators are frequently given via nebuliser in hospitalised patients with COPD. The British Thoracic Society (BTS) guideline on treating patients with COPD and COVID-19 supports the use of nebulisers, claiming there is no evidence supporting an increased risk of viral transmission and, second, that aerosols surrounding the nebuliser come from the nebuliser not from patients.[11] However, the meta-analysis suggesting nebulisers do not increase viral transmission has some methodological concerns.[12] It is based on one study with a very small sample size, a second study investigating a variety of interventions and on a third in which infections began before exposure to nebulisation. The BTS guideline was also based on a methodological study showing that nebulisers predominantly produce aerosols not droplets, also used to suggest that nebulisation was safe.[13] Viral transmission was not the subject of this investigation and since it remains open to debate whether droplets or aerosols can contain SARS-CoV-2, we do not think these results should be used as reassurance of no risk of transmission.

Alternative modes of inhalation are available, including pressurised metered-dose inhalers (pMDI) used with a spacer. In AECOPD pMDIs are not inferior to nebulisers.[14] Long-acting dual bronchodilators may be preferred; some also have a fast onset of action, and are more effective with a longer duration of action. There are currently two long-acting pMDI combinations available which can be used with a spacer.

No maximum dosing has been provided for nebulised short-acting bronchodilators and very high doses are often administered for AECOPD. We suggest doubling the maximum maintenance dose of long-acting bronchodilators, reflecting the high doses of short-acting bronchodilators often used in clinical practice. Since the safety of nebulisers is controversial and given that there is a suitable alternative, we recommend bronchodilators administered by pMDI and spacer over the use of nebuliser treatment in symptomatic patients with COPD and COVID-19. Nebulised treatment should be reserved for those

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situations in which pMDI with spacer is not possible, such as patients with severe, life-threatening disease or those unable to use a pMDI. For healthcare workers, respiratory masks (FFP-3 or equivalent) and other personnel protective equipment should be used during aerosol-generating procedures such as nebulisers.[15]

Systemic corticosteroids

It is recognised that not all AECOPDs need to be treated with systemic corticosteroids.[5] Eosinophil-based steroid treatment has been advocated for both stable COPD and AECOPD; however, the use of this strategy in patients with COPD and COVID-19 has not been tested. Until recently, the efficacy of corticosteroids in general for treating COVID-19 was inconclusive, though a cohort study suggested steroids might improve clinical outcome in patients with COVID-19.[16] Recent, preliminary results from the Randomized Evaluation of COVID-19 Therapy (RECOVERY) trial have shown that dexamethasone improves mortality in patients with COVID-19 requiring respiratory support.[17] The WHO recommended against the use of steroids previously,[10] but is now updating treatment guidelines to include dexamethasone or other corticosteroids.

Corticosteroids are beneficial to patients with severe AECOPD, especially in patients requiring ventilatory support, in whom steroids reduce ventilation days and NIV failure; therefore, it is reasonable to treat patients with COPD and severe COVID-19 with course of corticosteroids. The RECOVERY regimen of 6 mg once daily could be used until more evidence is provided to guide treatment in patients with COPD with COVID-19.

Which ventilatory support should be provided to patients with COPD with respiratory failure?

Approximately, 14% of patients with a SARS-CoV-2 infection will develop severe disease requiring oxygen therapy and 5% will require transfer to the intensive care unit (ICU) and ventilatory support.[5] In patients with COPD, several ventilatory support strategies can be considered, depending on the type of respiratory failure (ie, hypoxaemic or hypercapnic respiratory failure), and on local practice and availability of resources.[18]

Patients with hypoxaemic COPD and COVID-19 should be given controlled oxygen therapy as the first step.[18] If hypoxaemia is insufficiently controlled with maximum oxygen supplementation, high-flow nasal cannula (HFNC) or CPAP with high oxygen flow should be considered. HFNC has recently been suggested as a management option in patients with COVID-19 with acute hypoxaemic respiratory failure.[18] Reduction of hypercapnia and work of breathing might be additional benefits of HFNC in patients with COPD and COVID-19.[19 20] However, HFNC is an open system and expiration cannot be filtered. A surgical mask can be placed over the nasal cannula to limit aerosol spread.[15] Besides HFNC, CPAP with a high fraction of inspired oxygen (FiO_2) might be an option to treat hypoxaemic respiratory failure. CPAP provides a certain level of positive end-expiratory pressure, which might be a useful add-on to oxygen supplementation. Furthermore, it is possible to filter expiration with CPAP and thus limit viral spread.

In patients with COPD with acute (on chronic) hypercapnic respiratory failure, NIV should be considered.[21] There are no data showing that HFNC is equivalent and thus in this population we recommend using NIV first line. Transmission of virus can be reduced by using a non-vented mask with the exhaled air passing through a bacterial/viral filter before entering the room. Second, an expiration system with an active valve can be used and the oxygen supply can be connected close to the mask, so that a higher FiO_2 can be reached.[22] Before starting NIV, the patient's willingness to undergo invasive mechanical ventilation (IMV), if NIV fails, should be discussed. Previous studies have shown that IMV after NIV failure is associated with higher mortality in AECOPD,[23] though this association has not been shown in COVID-19.[24]

IMV should be instituted in patients with severe hypoxaemic respiratory failure or after NIV failure.[18] Particularly in COPD, this decision should be made carefully, as it is known that in-hospital mortality with IMV in AECOPD is high.[25] Mortality is even higher for patients with COPD with severe COVID-19,[2] and the prolonged duration of mechanical ventilation seen in patients with COVID-19 might be particularly detrimental to the future health status of patients with COPD. In communicating IMV with patients with COPD, the risks and benefits should be explained clearly, and patients' wishes and preferences regarding life-prolonging therapies should be explored such that known risk factors for poor outcomes of IMV in COPD[26] can be weighed in a process of shared decision-making.

Finally, clinicians might be faced with patients on home mechanical ventilation admitted to the hospital with COVID-19. Their ventilatory support should be continued in hospital, with precautions to limit viral spread. Home treatment, supported by telemonitoring, might be preferred. The value and goals of a hospital admission should be discussed in the low likelihood of surviving a long period of ICU admission.

Which other supportive treatments should be offered to patients with COPD and COVID-19?

SARS-CoV-2 infections may have wide-ranging detrimental effects on patients' well-being. The strict isolation required may amplify feelings of solitude and hopelessness. Also, patients with SARS-CoV-2 often complain of loss of taste and appetite, increasing the risk of unintentional weight loss. Regular exercise, let alone rehabilitation, is difficult during a hospital stay.

Hospital treatment should therefore include dietary, as well as emotional and spiritual support. Early mobilisation is encouraged in recent COVID-19-specific physiotherapy guidelines, while airway clearance techniques should be provided prudently as they carry the risk of aerosol spread.[27] After discharge, discharge bundles should be continued to ensure smooth transfer from hospital to home care and to reduce the risk of readmission.[5] Although pulmonary rehabilitation (PR) is recommended for people with COPD, rehabilitation in general should be offered to all patients with COVID-19 and certainly after ICU admission. The prolonged ICU stay is known to have significant impact on both physical and emotional well-being and patients may have accompanying symptoms of post-traumatic stress disorder.[28]

Social distancing and concerns about residual viral transmission may limit possibilities for centre-based PR and physiotherapy. Home-based, unsupervised PR might be a solution in these times of social distancing.[5] However, exercise-induced desaturation and cardiac arrhythmias associated with COVID-19 may make it difficult to guarantee the safety of unsupervised training. As soon as centre-based PR is possible, patients should again flow into such supervised programmes for optimal benefit.

How should end-of-life care be delivered in patients with COPD during the COVID-19 pandemic?

As described above, patients with COPD are at an increased risk for a poor outcome

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with COVID-19 and may choose to forego life-sustaining treatments. Ideally, identifying and discussing goals and preferences for future medical treatment and care, known as advance care planning (ACP), should have been undertaken before hospital admission. In practice, ACP is uncommon in COPD.[5] The challenge in the current SARS-CoV-2 pandemic is addressing palliative care needs in times of crisis, at a time when preventing unwanted life-sustaining treatments is paramount. We stress that discussions concerning triage for intensive care treatment under resource scarcity should not be included in this process of ACP.

ACP also includes communication about end-of-life care. We advise timely communication about end-of-life care.[29] Patients may have worries about suffocation and the process of dying. Fear is common in patients in respiratory distress and could be pharmacologically treated with anxiolytics, such as lorazepam.[30] Opioids such as morphine can be used to manage dyspnoea and should not be delayed to the dying phase.[30] In patients with suffering despite optimal symptom management, palliative sedation can be discussed with patients and their relatives. Care for relatives needs specific attention in the SARS-CoV-2 pandemic: social distancing limits hospital visits and the necessity of personal protective equipment imposes severe restraints on saying goodbye to loved ones, thereby increasing the risk for complicated grief. Therefore, bereavement care needs to be considered.

CONCLUSION

This article provides an overview on how to manage patients with COPD and COVID-19 during the SARS-CoV-2 pandemic. Key points have been summarised in table 1. Caring for patients with COPD and COVID-19 poses special challenges for healthcare workers. Not only are they faced with severely ill, often elderly, patients who can deteriorate rapidly and have a poor prognosis, they are working in an environment with increased risk of being infected themselves. The suggestions put forward in this article provide a framework for those working in such challenging conditions. We acknowledge that such a viewpoint provides a momentary snapshot of current clinical practice and evidence how to treat COVID-19 effectively in patients with COPD is limited. Knowledge of COVID-19 is rapidly accumulating; therefore, the discussion on how to best treat patients with COPD and COVID-19 should continue and we invite the respiratory community to share best practices online.

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REFERENCES

1 Guan W-J, Liang W-H, Zhao Y, *et al*. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. *Eur Respir J* 2020;55:2000547.
2 Alqahtani JS, Oyelade T, Aldhahir AM, *et al*. Prevalence, severity and mortality associated with COPD and smoking in patients with COVID-19: a rapid systematic review and meta-analysis. *PLoS One* 2020;15:e0233147.
3 Fang X, Wang X, Bai C. COPD in China: the burden and importance of proper management. *Chest* 2011;139:920–9.
4 Williamson A, Walker AJ, Bhaskaran KJ, *et al*. OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. *MedRxiv* 2020.
5 Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease, 2019 report. Available: https://goldcopd.org/wp-content/uploads/2018/11/GOLD-2019-v1.7-FINAL-14Nov2018-WMS.pdf [Accessed 19 Apr 2020].
6 Ackermann M, Verleden SE, Kuehnel M, *et al*. Pulmonary vascular endothelialitis, thrombosis, and angiogenesis in Covid-19. *N Engl J Med* 2020;383:120–8.
7 Hopkinson NS, Molyneux A, Pink J, *et al*. Chronic obstructive pulmonary disease: diagnosis and management: summary of updated NICE guidance. *BMJ* 2019;366:l4486.
8 Rawson TM, Moore LSP, Zhu N, *et al*. Bacterial and fungal co-infection in individuals with coronavirus: a rapid review to support COVID-19 antimicrobial prescribing. *Clin Infect Dis* 2020:ciaa530.
9 Zhou F, Yu T, Du R, *et al*. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020;395:1054–62.
10 WHO. *Clinical management of COVID-19: interim guidance*. World Health Organization, 2020.
11 British Thoracic Society. COPD and COVID-19 for healthcare professionals. Available: https://www.brit-thoracic.org.uk/about-us/covid-19-information-for-the-respiratory-community [Accessed 19 Apr 2020].
12 Tran K, Cimon K, Severn M, *et al*. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. *PLoS One* 2012;7:e35797.
13 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

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for management of pandemic influenza and other airborne infections. *Health Technol Assess* 2010;14:131–72.
14 van Geffen WH, Douma WR, Slebos DJ, *et al*. Bronchodilators delivered by nebuliser versus pMDI with spacer or DPI for exacerbations of COPD. *Cochrane Database Syst Rev* 2016;8:CD011826.
15 Ferioli M, Cisternino C, Leo V, *et al*. Protecting healthcare workers from SARS-CoV-2 infection: practical indications. *Eur Respir Rev* 2020;29:200068.
16 Wu C, Chen X, Cai Y, *et al*. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. *JAMA Intern Med* 2020:e200994.
17 RECOVERY Collaborative Group, Horby P, Lim WS, *et al*. Dexamethasone in hospitalized patients with covid-19 - preliminary report. *N Engl J Med* 2020. doi:10.1056/NEJMoa2021436. [Epub ahead of print: 17 Jul 2020].
18 Alhazzani W, Møller MH, Arabi YM, *et al*. Surviving sepsis campaign: guidelines on the management of critically ill adults with coronavirus disease 2019 (COVID-19). *Intensive Care Med* 2020;46:854–87.
19 Bräunlich J, Köhler M, Wirtz H. Nasal highflow improves ventilation in patients with COPD. *Int J Chron Obstruct Pulmon Dis* 2016;11:1077–85.
20 Pisani L, Astuto M, Prediletto I, *et al*. High flow through nasal cannula in exacerbated COPD patients: a systematic review. *Pulmonology* 2019;25:348–54.
21 Osadnik CR, Tee VS, Carson-Chahhoud KV, *et al*. 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.
22 Thys F, Liistro G, Dozin O, *et al*. Determinants of Fi,O2 with oxygen supplementation during noninvasive two-level positive pressure ventilation. *Eur Respir J* 2002;19:653–7.
23 Lindenauer PK, Stefan MS, Shieh M-S, *et al*. Outcomes associated with invasive and noninvasive ventilation among patients hospitalized with exacerbations of chronic obstructive pulmonary disease. *JAMA Intern Med* 2014;174:1982–93.
24 Yang X, Yu Y, Xu J, *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;8:475–81.
25 de Miguel-Diez J, Jiménez-García R, Hernández-Barrera V, *et al*. Trends in the use and outcomes of mechanical ventilation among patients hospitalized with acute exacerbations of COPD in Spain, 2001 to 2015. *J Clin Med* 2019;8:1621.
26 Connors AF, Dawson NV, Thomas C, *et al*. Outcomes following acute exacerbation of severe chronic obstructive lung disease. The support Investigators (study to understand prognoses and preferences for outcomes and risks of treatments). *Am J Respir Crit Care Med* 1996;154:959–67.
27 Thomas P, Baldwin C, Bissett B, *et al*. Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations. *J Physiother* 2020;66:73–82.
28 Dijkstra-Kersten SMA, Kok L, Kerckhoffs MC, *et al*. Neuropsychiatric outcome in subgroups of intensive care unit survivors: implications for after-care. *J Crit Care* 2020;55:171–6.
29 Patel K, Janssen DJA, Curtis JR. Advance care planning in COPD. *Respirology* 2012;17:72–8.
30 Lanken PN, Terry PB, Delisser HM, *et al*. An official American thoracic Society clinical policy statement: palliative care for patients with respiratory diseases and critical illnesses. *Am J Respir Crit Care Med* 2008;177:912–27.

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