

# COVID-19 : THE ROLE OF CPAP



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COVID-19 ... A HORRIBLE DISEASE,  
THE LIKES OF WHICH WE HAVE NOT SEEN BEFORE



- ~15% of hospitalized patients required admission to critical care units as facemask oxygen alone was insufficient to adequately raise blood PaO<sub>2</sub> levels
- Sudden rush of critically ill patients overwhelmed critical care and ventilator resources in China (in January) and Italy (in February)

**SO WHAT DID THEY DO?**

**... THEY TURNED TO CPAP AND  
HIGH-FLOW NASAL OXYGEN**

# PROS AND CONS OF CPAP

## PROS

- Well-established technique for improving oxygenation in patients with respiratory failure
- Protects scarce ventilator and critical care bed resource
- Much easier to manage with limited and inexperienced staff resource
- Protects patient from harm of ventilator-induced lung injury ("VILI") and other complications

## CONS

- Fears about increased risk of viral transmission to healthcare workers
- Delay in intubation + ventilation
- Theoretical risk of 'spontaneous breathing-induced lung injury' – "SILI" – from large tidal volumes + high transpulmonary pressures



- Franklin D. Roosevelt





American Society of  
**Anesthesiologists™**

## COVID-19

### Information for Health Care Professionals

*When considering a procedure for a patient with known or suspected COVID-19 infection:*

- In patient with acute respiratory failure, it may be prudent to proceed directly to endotracheal intubation, because non-invasive ventilation (e.g. CPAP or biPAP) may increase the risk of infectious transmission.

## Use of non-invasive ventilation for patients with COVID-19: a cause for concern?

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**Lancet Respir Med 2020**

**Vol 8 June 2020 e45**

## COVID-19 Infection

### Implications for Perioperative and Critical Care Physicians

John R. Greenland, M.D., Ph.D., Marilyn D. Michelow, M.D.,  
Linlin Wang, M.D., Ph.D., Martin J. London, M.D.

*ANESTHESIOLOGY 2020; 132:1346–61*

Thus, there is a risk that any method of oxygen delivery to a patient with COVID-19—associated respiratory distress can result in spread of virus-containing exhaled air, especially if the mask is poorly fitted or leaking, but the concern that use of noninvasive positive pressure ventilation or high flow nasal cannula specifically leads to worse environmental contamination is not substantiated by the current available evidence.

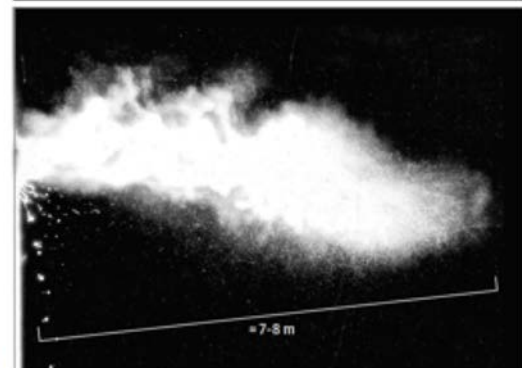
## Turbulent Gas Clouds and Respiratory Pathogen Emissions Potential Implications for Reducing Transmission of COVID-19

Lydia Bourouiba, PhD

Mask efficacy as source control depends on the ability of the mask to trap or alter the high-momentum gas cloud emission with its pathogenic payload. Peak exhalation speeds can reach up to 33 to 100 feet per second (10-30 m/s), creating a cloud that can span approximately 23 to 27 feet (7-8 m).

**JAMA** Published online March 26, 2020

Figure. Multiphase Turbulent Gas Cloud From a Human Sneeze





**From:** Du Bin <[dubin98@gmail.com](mailto:dubin98@gmail.com)>  
**Date:** Thursday, 5 March 2020 at 23:25  
**To:** "Singer, Mervyn" <[m.singer@ucl.ac.uk](mailto:m.singer@ucl.ac.uk)>  
**Subject:** Re: COVID-19 advice please

Dear Mervyn,

It is good to hear from you. As to your questions,

3. NIV and HFNC are everywhere.

I personally agree with WHO interim guidance that HFNC/NIV might have high failure rate, and delayed intubation might eventually lead to death.

However, you probably will understand that, when the surge of hundreds of patients with severe hypoxemia were admitted (it is not uncommon for us to see many patients with SpO<sub>2</sub> < 80%, even under oxygen therapy), you just do not have enough resources for invasive mechanical ventilation.

Bin Du, MD

Immediate Past President, Chinese Society of Critical Care Medicine (CSCCM)

President, Chinese Association of Critical Care Physicians (CACCP)

President, Chinese College of Intensive and Critical Care Medicine

Medical ICU, Peking Union Medical College Hospital



# VIRUS CRISIS

**When your child says, 'I've got a sore throat,' you freeze. There's no laughter, no car horns, no cheerful shouting. All you hear are sirens – and church bells tolling for the dead...**

**One Briton's apocalyptic despatch from Italy of what we pray is NOT our destiny**

Italian dying? Yes, Italy has a very elderly population, much of which smokes. The air in Lombardy and Emilia-Romagna, the worst-hit regions in the North, is notoriously polluted. There may be a high presence of hospital 'superbugs' or simply a lack of hospital capacity. But nobody knows for certain, and that is both terrifying and surely a wake-up call to Britain. The Italian government is so scared that it is considering extending the lockdown even further. Drones and helicopters circle overhead here in Parma, warning the public to stay at home or face fines. More than 40,000 people have already been fined (£15 (£120) for breaching the regulations. To leave your apartment, you have to fill in a form explaining the timing of, and reason for, your excursion. Police patrol the streets. My three children haven't been at school for four weeks and feel imprisoned. They get no exercise or fresh air. When your child says they have a sore throat, you freeze. There are none of the usual sounds of Italy: car horns, laughter, cheerful shouting or a volatile politician. All we hear are sirens – and church bells tolling for the dead. The country is nonetheless trying to debate. Every day at midday, we go on to our balconies to applaud the medical services. Many sing the national anthem, raising flags from the resistance, old folk sing and football chants. Yet in a country not known for respecting personal space, passers-by on pavements stare sidelongly away from you. Last week, I saw a man walking around town with a sign making to ensure others kept a metre away from him. Of course, the suspension of all retail and commercial life and the

# ITALY IN HELL ... BRITAIN IN WEEKS?

## THE ITALIAN TRAGEDY BY NUMBERS

- 4,032** Total deaths from coronavirus recorded in Italy so far
- 5,986** New cases in Italy yesterday
- 61%** Proportion of victims in Lombardy, the worst-hit region
- 627** Deaths in Italy yesterday
- 47%** One-day increase in deaths yesterday
- 784** Italy's fatalities exceed China
- 47,021** Confirmed coronavirus cases in Italy
- 36%** Number of world's coronavirus deaths that have been in Italy



### PATIENTS IN 'BUBBLE HELMETS' IN OVERWHELMED HOSPITAL

Shocking scenes in a crisis-hit area of Bergamo a week ago. Below: In full protective suits, medics deliver a coronavirus patient to hospital in Milan



### WORKING LIKE SAINTS



social isolation bring with them fears of a terrible economic slump. The worst-hit regions of Lombardy, the Veneto and Emilia-Romagna are powerhouses of the economy, exporting machinery, foodstuffs, furniture, clothing and engineering expertise all over the world. If the North grinds to a halt altogether, so will the whole country. This was supposed to have been a glorious year for Parma, famed for its air-cured ham. Elected Italian City of Culture for 2020, it had hoped to showcase its cultural and culinary grandeur. Now 90 per cent of hotel book-

ings for the event have been cancelled. The local hoteliers' association has estimated the loss of income to be a staggering £300,000 – or £275,000 – per day. Rob, manager of the city's best pub, the *Dubb Linn*, calls it 'the worst situation of my working life... I just don't know what I'm going to do'. Having lost a business over 25 years, he risks losing it if he can't find this month's rent. 'I don't know if I'll ever regret,' he says. As earnings dwindle, so costs are increasing. With all schools closed until at least April 3, many parents are being forced to finance child-

care or take time off work. The usual childcare providers – grandparents – are precisely those most at risk from Covid-19, and few want to expose the older generation. Though Italy is the EU's fourth-largest economy, even before this crisis its economy was on its knees. The growth forecast for 2020 was 0.2 per cent. It's now more likely to shrink in the next two quarters. That would put the country in its fourth recession in a decade. But no one can accuse the government of not taking the crisis seriously. There's an old joke that if you put two Italians in a room, you'll get

three opinions. On this occasion, however, there's almost unanimous agreement that the measures that have been taken against the virus are vital. Yes, the response has been drastic, but it has also been uncharacteristically decisive. And, contrary to cliché, Italians have, for the past fortnight, been disciplined and stoical. There was public buying early on but once people realised food supplies would hold, there has been little hysteria. Italians can look abroad and see the slow-motion tsunami of illness and death that is about to hit. To them, the preparations by Britain



and America seem lackadaisical to say the least. Yet Italy is a resilient place. Over the past 100 years, it has dealt with dictatorship, war, invasion, earthquakes, volcanic eruptions, avalanches, terrorism, organised crime and infrastructure disasters. It will, in time, overcome this pandemic, too. 'Boon,' the Prime Minister said recently, 'we'll be able to bag each other again.' But not for some time. **FRAN JONES** is author of *The Dark Heart of Italy and Other Underworlds of Italian Football*.

“I have no data but I’m absolutely sure CPAP is the answer”

Guido Bertolini,  
Lombardy Regional  
COVID Emergency  
Department Response Team

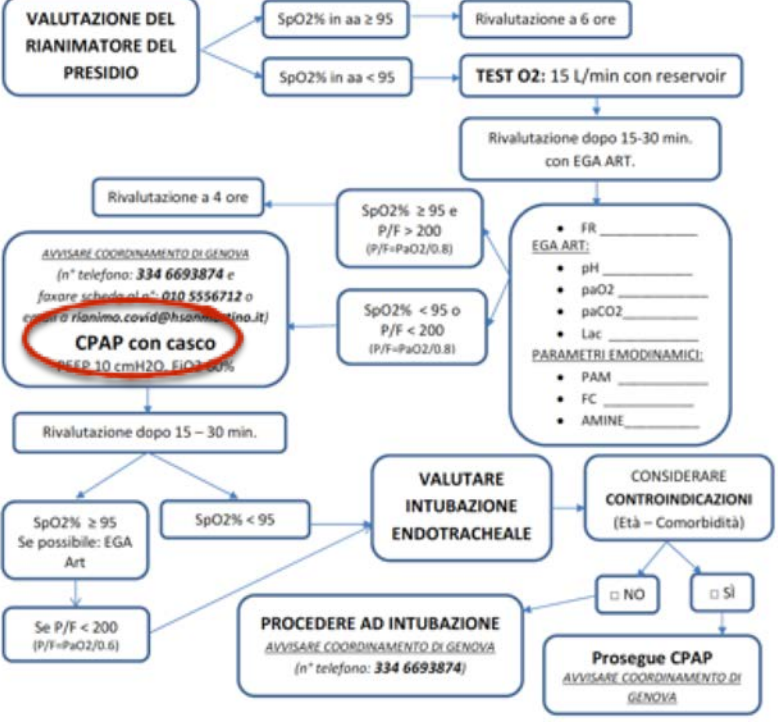
Personal communications

- 30-70% could be kept off ventilators
- No reports of serious HCW infection (wearing PPE)
- No issues with O<sub>2</sub> supply


**SCHEDA PAZIENTE COVID19 positivo  
CON INSUFFICIENZA RESPIRATORIA**


COGNOME	DATA DI NASCITA
NOME	OSPEDALE
N° RECAPITO DI UN FAMILIARE:	
<b>Dati anamnestici:</b> <ul style="list-style-type: none"> <li>• BPCO</li> <li>• Fumatore</li> <li>• Cardiopatia ischemica</li> <li>• Ipertensione</li> </ul>	<ul style="list-style-type: none"> <li>• Diabete</li> <li>• Neoplasia</li> <li>• Demenza</li> <li>• Malnutrizione</li> </ul>
<b>Terapia domiciliare:</b>	<b>Valutare altri criteri di intubazione indipendenti dalla Flow-chart:</b> <ul style="list-style-type: none"> <li>• Coscienza: Paziente confuso, agitato, soporoso, non contattabile</li> <li>• Emodinamica instabile (FC &gt;130 bpm o PAM &lt; 60 mmHg)</li> <li>• Lattati &gt;3 mEq/L (dopo adeguato riempimento)</li> <li>• Frequenza respiratoria (&gt;30 apm in CPAP o &gt;35 apm se in maschera con reservoir)</li> </ul>

**All'arrivo: RX torace ed esami ematochimici completi**







28 March 2020

## Use of Continuous Positive Airway Pressure (CPAP) for COVID-19 positive patients

There is a growing evidence base that there is a significant role for the use of CPAP in COVID-19 positive patients, more so than was initially understood. First reports from China suggested that early intubation and ventilation was preferable to introducing delay by the use of CPAP. However, it is now clearer that CPAP may be of benefit to patients earlier on in the disease process than first thought and may prevent deterioration of some patients to the extent of them not going on to need invasive ventilation.

There will obviously be patients who will require immediate intubation and invasive ventilation at the time of presentation but, in light of this additional information the recent NICE guidelines have been updated to include the use of CPAP in the early stages of the disease.

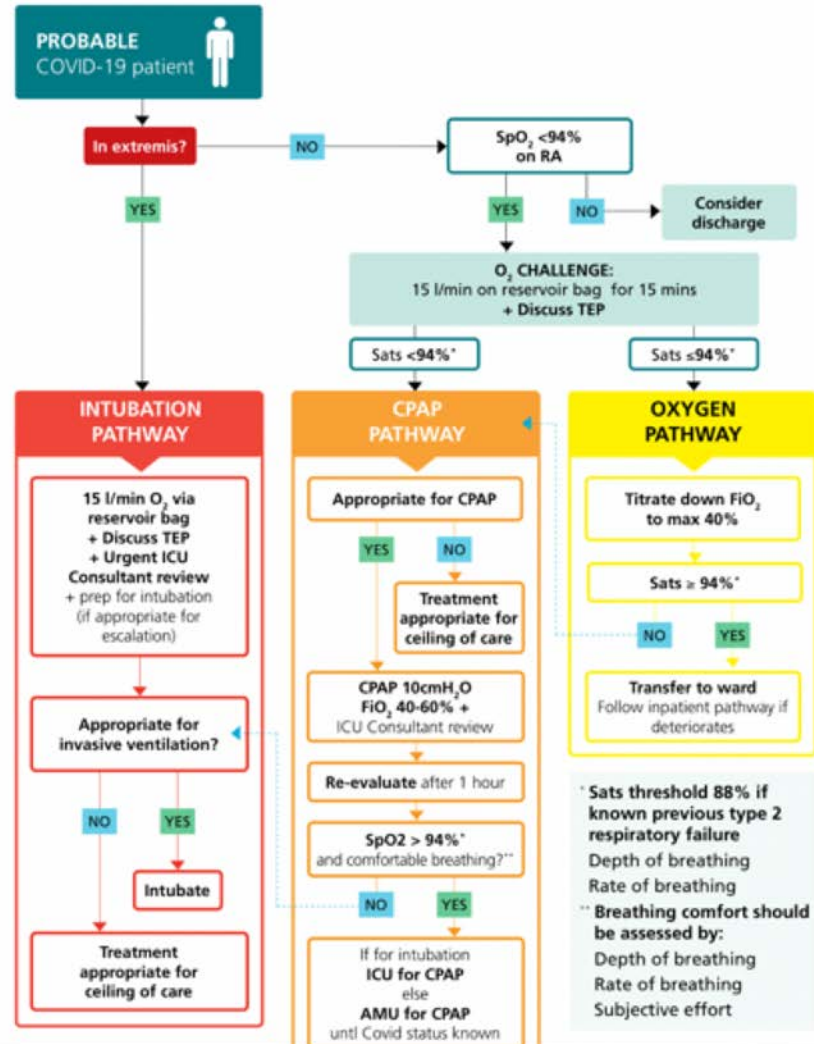
Learning from experiences in China and Italy, University College London Hospital started preparing - from early-mid March - to use CPAP to save ICU beds and ventilators for those in major need.



Strong buy-in from frontline doctors and nurses and hospital management

- Clinical management algorithm, commencing at the front door (ED)

COVID-19 respiratory pathway (ED)





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Strong buy-in from frontline doctors and nurses and hospital management

- Clinical management algorithm, commencing at the front door (ED)
- Training of doctors and nurses
- Sought to purchase more CPAP machines (only had 12 in whole hospital)
  - .. but none available
- .. So made the UCL Ventura!

## Whisperflow wall CPAP (1992)



UCL Ventura CPAP Mark I (2020)



UCL Ventura CPAP Mark II (2020)

.. with improvements to patient circuit,  
up to 70% reduction in oxygen use



## Coronavirus: Mercedes F1 to make breathing aid

By Fergus Walsh

Medical correspondent

🕒 29 March 2020 | Health



JAMES TYE/UCL

CPAP devices are less invasive than a ventilator

**A breathing aid that can help keep coronavirus patients out of intensive care has been created in under a week.**



4:34 a.m. ET, March 30, 2020

UK researchers develop breathing machine to help coronavirus patients



Coronavirus: Mercedes helps develop breathing machine

NEWS WEBSITE OF THE YEAR

Mercedes F1 team helps create breathing aid to keep coronavirus patients out of intensive care

BREAKTHROUGH Formula One engineers develop new coronavirus breathing mask to take pressure off NHS

Lucy Jones, Digital Health & Fitness Reporter  
30 Mar 2020, 11:04 | Updated: 30 Mar 2020, 16:14

3 Comments



The engineers hope the breathing aid will ease the pressure the NHS is facing

LOGIN

F1 Engineers Create Ventilator for Coronavirus Patients in Less Than 24 Hours

Mercedes Formula 1 engineers help develop coronavirus breathing aid

March 30, 2020 | 7:28am

CORONAVIRUS

Pub chat revved up Mercedes F1 team to create coronavirus breathing aid

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F1 team helps build new UK breathing aid for Covid-19 patients

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# HAS CPAP MADE A DIFFERENCE?

- No randomised controlled trial data
- UCLH experience:
  - 25% (117/468) hospital COVID-19 admissions received CPAP:
    - .. 45/117 (38%) of whom were not appropriate for invasive ventilation
    - .. 11 (24%) of these 45 'ceiling of care' patients survived
  - Of the 72 CPAP patients for full escalation:
    - 37 (51%) were eventually intubated
    - overall survival 51/72 (71%)



# PREDICTORS OF SUCCESS AND FAILURE

- 87 of 117 patients admitted for initial CPAP therapy to intensive care unit
- 16/87 patients had CPAP as 'ceiling of care'
- CPAP 'success' = hospital survival without invasive ventilation (n=30)
- CPAP 'failure' = death for CPAP ceiling of care **OR** need for invasive ventilation
- Initial resp'y parameters – moderate-to-severe resp'y failure – did not discriminate
- Inflammatory and ventricular dysfunction biomarkers predicted failure

