Provision of ECMO During COVID-19 and Other Pandemics

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Discussion Points

Can we provide ECMO?

Should we provide ECMO?

Who should receive ECMO?

How to organise services?
Can we provide ECMO?
ECMO Provision

The ability to provide ECMO during a pandemic is determined by ICU capacity.
nCoV 2019

A highly transmissible virus infecting large numbers of people.
Rapid Spread

nCoV 2019 is spreading rapidly within and between populations.
Global Spread

Enormous numbers of people are being infected Worldwide.

Distribution of COVID-19 cases as of 18 March 2020

*Confirmed* cases reported between 13 and 19 February 2020 include both laboratory-confirmed and clinically diagnosed (only applicable to Hubei province); for all other dates, only laboratory-confirmed cases are shown.

*712 cases are identified on a cruise ship currently in Japanese territorial waters.*

Data Source: World Health Organization
Map Production: WHO Health Emergencies Programme

World Health Organisation
18 March 2020
Up to 60% of the population may be infected.
15-20% Who test positive will need hospitalisation
5-10% of those who test positive will need ICU admission.
Critical care beds are a finite resource.

No health system has enough beds to meet the expected demand.
Health Care Needs

Likelihood of hospitalization, need for critical care, and mortality rate increases with age

<table>
<thead>
<tr>
<th>Age-group (years)</th>
<th>% symptomatic cases requiring hospitalisation</th>
<th>% hospitalised cases requiring critical care</th>
<th>Infection Fatality Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9</td>
<td>0.1%</td>
<td>5.0%</td>
<td>0.002%</td>
</tr>
<tr>
<td>10 to 19</td>
<td>0.3%</td>
<td>5.0%</td>
<td>0.006%</td>
</tr>
<tr>
<td>20 to 29</td>
<td>1.2%</td>
<td>5.0%</td>
<td>0.03%</td>
</tr>
<tr>
<td>30 to 39</td>
<td>3.2%</td>
<td>5.0%</td>
<td>0.08%</td>
</tr>
<tr>
<td>40 to 49</td>
<td>4.9%</td>
<td>6.3%</td>
<td>0.15%</td>
</tr>
<tr>
<td>50 to 59</td>
<td>10.2%</td>
<td>12.2%</td>
<td>0.60%</td>
</tr>
<tr>
<td>60 to 69</td>
<td>16.6%</td>
<td>27.4%</td>
<td>2.2%</td>
</tr>
<tr>
<td>70 to 79</td>
<td>24.3%</td>
<td>43.2%</td>
<td>5.1%</td>
</tr>
<tr>
<td>80+</td>
<td>27.3%</td>
<td>70.9%</td>
<td>9.3%</td>
</tr>
</tbody>
</table>
Critical care resources will be exceeded by demand based on containment models.
Surge Pressure on ICU

China - 5% of patients who tested +ve admitted to ICU

Italy - 12% of patients who tested +ve admitted to ICU (16% of all hospitalized)

Survival time of non-survivors is 1-2 weeks.
Surge Pressure on ICU

Aim to have a critical care bed for all who need and might benefit from ICU care.

This may not always be possible.
Global ECMO Capacity - Finite
Flattening the Curve

No. of confirmed cases

Without intervention measures

Healthcare system capacity

With intervention measures

Time since first cases detected
Can we provide ECMO?

If the curve is flatter then resource-intensive therapies such as ECMO can be considered if indicated.
Should we provide ECMO?
What is the Role for ECMO?

ICU capacity may be exceeded by 5-15 fold.

COVID-19 2019 is not H1N1.

Do we really have the resources for ECMO?

Is there a reason to increase ECMO capacity?
ECMO Use and H1N1

ECMO use increased with H1N1

~20-30 run/year rise prior to 2009

Extra 603 runs 2009-2010
VV ECMO and H1N1

1175 patients with ARDS (1966-2015)

- Median Age 40y
- 42% received ECMO
- Mortality 37.1%
- Median ECMO duration 10d
- Median MV duration 19d
- Median ICU LOS 33d
H1N1 Mortality and Age

Majority (62%–85%) of the 2009 H1N1 deaths occurred among persons under 65y of age

“signature age shift”

Simonsen et al. PLoS Medicine 2013
COVID 19 Mortality

The majority of COVID 19 deaths are occurring in older patients.

The use of ECMO in this population is not our usual practice.
What should we provide?

High quality conventional ICU care on an large scale.

Compassionate, value-based care is equally important.
Outcomes with ECMO

- To date have been poor in patients with COVID 19
- Need for MCS
Should we provide ECMO?

We don’t need more ECMO runs, we need good ECMO runs.
Who should receive ECMO?
Patient Selection

Determined by patient characteristics

ECMO is only ever used for selected patients.

Should we use the usual selection criteria for COVID 19 patients?

What do we know about the patients and the pathophysiology?
Patient Characteristics

n=191
31 % ARDS (93% mortality)
23% HF (64% mortality)
20% septic shock (100% mortality)
Patient Characteristics

n=201

84 (41.8%) developed ARDS

44 (52.4%) died
Patient Characteristics

Clinical Characteristics of Coronavirus Disease 2019 in China

Characteristics and Outcomes of 21 Critically Ill Patients With COVID-19 in Washington State
The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the disease it causes, coronavirus disease 2019

Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China
Dawei Wang, MD; Bo Hu, MD; Chang Hu, MD; Fangfang Zhu, MD; Xing Liu, MD; Jing Zhang, MD; Binbin Wang, MD; Hui Xiang, MD; Zhenhun Cheng, MD; Yong Xiong, MD; Yan Zhao, MD; Yirong Li, MD; Xinghuan Wang, MD; Zhiyong Peng, MD

Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China
Qiuong Ruan1,2, Kun Yang1, Wensia Wang1, Lingyu Jiang1, and Jianxin Song1
Patient Characteristics

- Respiratory Failure: 36 (53%)
- Respiratory Failure with Myocardial Damage/Heart Failure: 5 (7%)
- Myocardial Damage/Heart Failure: 22 (33%)
- Unknown: 5 (7%)

LETTER

Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China

Qiu Ruan, Kun Yang, Wenxia Wang, Lingyu Jiang, and Jianxin Song
Mechanism of organ injury

Resemble those seen in SARS & MERS coronavirus infection

Pathological findings of COVID-19 associated with acute respiratory distress syndrome

Figure 2: Pathological manifestations of right (A) and left (B) lung tissue, liver tissue (C), and heart tissue (D) in a patient with severe pneumonia caused by SARS-CoV-2
Risk Factors for Death

- Increasing age
- Comorbidities
- Hyper inflammatory state
- Extrapulmonary organ failures
- Leucopenia

The pathophysiology of COVID19 is unclear.
200,000 cases and counting
Global Crisis needs Global Collaborations...

...join the other 120+ sites across the world!

www.ecmocard.org  @ecmocard  ecmocard@elso.org
Who should receive ECMO?

Carefully selected patients (need to develop COVID ECMO Scores)

Ethical dilemmas will arise

Bigger issue is: who should receive mechanical ventilation?
Who should receive ECMO?

A small number of highly selected patients.

If in doubt, don’t do it.
How to organise ECMO services?

Need for ECMO likely small
Planning and provision of extracorporeal membrane oxygenation services for severe acute respiratory distress syndrome during COVID-19 and other emerging infectious disease outbreaks

Kollengode Ramanathan, David Antognini, Alain Combes, Matthew Paden, Bishoy Zakheky, Mark Ogino, Graeme MacLaren, Daniel Brodie*, Kiran Seshan*

www.thelancet.com/respiratory  Published online March 19, 2020  https://doi.org/10.1016/S2213-2600(20)30121-1
An ECMO Action Plan

<table>
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<tr>
<th>ECMO Resource Planning and Allocation</th>
<th>ECMO Weaning, Decannulation and Rehab</th>
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<tbody>
<tr>
<td>Personnel Assignment</td>
<td>Staff Support</td>
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<tr>
<td>Personnel Training and ECMO use</td>
<td>Ethical Considerations</td>
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<tr>
<td>Infection Control Measures</td>
<td>Quality Assurance and Collaborative Research</td>
</tr>
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<td>Transport on ECMO</td>
<td>Post-mortem Care</td>
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</tbody>
</table>
Balancing Our Roles in Pandemics

We are here to do more than just ECMO.
Let us do well what we normally do in ICU.

Protect your staff