ECMO during the COVID-19 pandemic

(with preliminary results of the first pandemic wave with 6-month follow-up)

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Disclosure

- **Consultant for Medtronic, Getinge, LivaNova, CORCYM, and Abiomed***
- **Member of the Medical Advisory Board of Eurosets, Hemocue, and Fresenius***

Honoraria are paid to the Institution for research support

***Honoraria paid to the consultant**

Idea Born on February 28

Dataset Ready by March 10

Survey Started on March 15

First Report on March 21, 2020

Last Report on May 2, 2022

Total: 117 Weekly Reports

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Survey 20 June 2022

Principal Investigator: Prof. Dr. Roberto Lorusso
Collaborators: Dr. Maria Elena De Piero
Dr. Silvia Mariani
Dr. Valeria Lo Coco

On behalf of Prof. Jan Belohlavek and EuroELSO Committee

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Euro-ELSO ECMO-COVID Study

EuroECMO-COVID Survey
20 September 2021

EuroECMO COVID

532 ECMO
Royal Brompton & Harefield:157 Cambridge-Royal Papworth:119
Manchester - Wythenshawe Hospital:75
Guy's & St. Thomas Hospital: 153 Kings College Hospital: 8
Aberdeen -Royal Infirmary Hospital: 20
Edinburgh - Royal Infirmary Hospital: 0

754 ECMO
Dusseldorf - University Hospital: 81
Nuremberg - Medical University Hospital:32
Hannover - Medical School: 48
Leipzig Heart C.: 11 Hamburg Eppendorf :84
Regensburg - University Hospital: 118
Essen - University Hospital: 6
Berlin - Heart Center: 0 Langen-Asklepios K:11
Aachen - University Hospital: 41
Kassel – ECMO Center: 80
Freiburg – Univ Heart Center: 122
Koln – ECMO Center: 22
Tubingen – University Hospital: 17
Frankfurt – University Hospital: 80

72 ECMO
Maastricht - UMC: 24
Rotterdam - Erasmus UMC: 1
Leiden – UMC: 11
Utrecht – UMC: 10
Amsterdam – UMC: 17
Nieuwegein - St. Antonius Ziekenhuis: 7
Breda – Hospital: 0
Nijmegen – UMC: 1

410 ECMO
Leuven - University Hospital: 53
Aalst - OLV: 7- Jessa Hospital:23
Brussels - Erasmus Hospital: 39
Brussels – Chirec Hospital: 30
Brussels – University Hospital: 24
Antwerp - University Hospital: 29
Charleroi – CHU: 47
Ghent – University Hospital: 38
Brussels – CHU S. Pierre: 11
Bruges – Sint-Jan Hospital: 21
Liege – CHU:20
La Louviere – Jolimont Hospital: 36
Genk – Oost Limburg Hospital: 16
Roeselare - AZ Delta Hospital: 16

29 ECMO
Dublin - Mater Hospital:29

615 ECMO
Paris- Centers: 324
Montpellier – CHU: 58
Perpignan – CHU: 18
Jossigny - de Ma:rne-la-Vallée Hospital Center:13
Rennes – CHU: 19
Nimes – CHU: 32
Lyon - CHU: 68
Amiens – CHU:57
Dijon – CHU: 26

36 ECMO
Tallinn -North Regional Hospital: 18
Tartu - University Clinic: 17

97 ECMO
Zurich - University Hospital: 22
Zurich – Hirslanden Clinic: 2
Lugano – Cardiocentro Ticino: 3
Lausanne – CHUV: 19
Bern – University Hospital: 39
Basel – University Hospital: 12

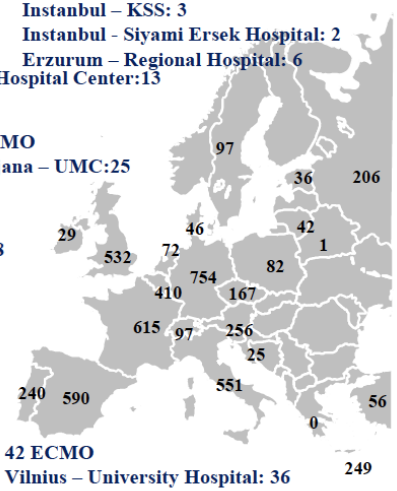
240 ECMO
Porto – San Joao Hospital: 73
Lisbon- Santa Maria Hospital: 78 Lisbon-Centro Hospitalar: 54
Coimbra – Hospital Center: 29 Madeira Island-Funchal Hospital:4
Vila Nova Gaia - Gaia/Espinho Hospital: 2

590 ECMO
Barcelona Vall d'Hebron University Hospital:90
Barcelona – Hospital Bellvitge: 71
Murcia - Virgen de la Arrixaca Hospital: 52
Madrid - University Hospital La Paz: 33
Valladolid – Rio Ortega Hospital: 32
Madrid - Hospital 12 de Octubre: 64
Madrid – Ramon y Cajal Hospital: 22
Bilbao - University Hospital Cruces Barakaldo: 23
Barcelona -University Hospital Germans Trias i Pujol:31
Madrid -University Hospital Gregorio Marañón:22
Madrid - Puerta de Hierro Hospital: 21
Madrid - Fundación Jiménez Díaz Hospital: 12

1 ECMO
Minsk -Republican Center Cardiology: 1

56 ECMO
Istanbul - Koşuyolu Hospital: 45
Instanbul – KSS: 3
Instanbul - Siyami Ersek Hospital: 2
Erzurum – Regional Hospital: 6

25 ECMO
Ljubljana – UMC:25



42 ECMO
Vilnius – University Hospital: 36
Kaunas- University Hospital: 6

0 ECMO
Greek Centers: 0

46 ECMO
Copenhagen - University Hospital: 35
Aarhus - University Hospital: 11

256 ECMO
Innsbruck - University Hospital: 30
St. Polten – Hospital: 38
Vienna – Medical University Hospital:115
Salzburg Hospital: 3
Graz Hospital: 2
Klagenfurt Hospital: 2
Linz University Hospital:64
Vienna Krankenhaus Nord: 2

249 ECMO
Sheba Hospital: 49 Poriya H: 10
Ichilov Hospital:32 Sh.TsedekH:14
Assaf Harofeh H: 19
Carmel Hospital: 19
Wolfson Hospital: 19
Beilinson Hospital: 20
Soroka Hospital: 23 Kaplan H:2
Hadassh H:17 Rambam H: 26

167 ECMO
Prague – University Hospital: 100
Třinec- Heart Centerl: 11
Ostrava:56

82 ECMO
Warsaw – Hospital: 80
Polish Centers: 2

206 ECMO
Syktyvkar City H: 1 St.Petersburg Military H: 2
Khabarovsk - City H: 1 Tyumen Regional H: 1
Moscow -Sklifosovsky Research Institute: 12
Moscow-City H: 61 Moscow Voronovskoe H:1
Maykop H: 1 Moscow Yudin H:1 Orenburg :1
Novosibirsk - National Medical Center: 10
Kemerovo H: 0 Chelyabinsk H:2 N.Chelny H: 2
Krasnoyarsk:11 Khanty Mansiysk:4 Ufa H:2
St. Petersburg City H: 7 NRCERM:2 Izhevsk:1
St. Petersburg – Botkin Infection Hospital: 3
St. Petersburg - Almazov Centre: 10
Ekaterinburg :0 Tver: 8 Salekhard: 4
Krasnodar H:54 Barnaul H #5:3 Petrozavodsk:1

97 ECMO
Stockholm- Karolinska University Hospital: 62
Lund – University Hospital: 20
Linkoping - University Hospital: 3
Orebro- University Hospital: 8
Gothenburg -Sahlgrenska University H: 3

551 ECMO
Bergamo – Papa Giovanni XXIII Hospital: 12
Bologna - S.Orsola Hospital: 17
Milan – Niguarda Hospital: 12
Milan – S. Donato Hospital:11
Milan – S. Raffaele Hospital: 21
Turin – S. Giovanni Bosco Hospital: 2
Turin – Molinette Hospital: 49
Pavia – S. Matteo Policlinic: 44
Palermo – ISMETT: 65 Bari- Policinic: 22
Brescia - Spedali Civili: 2 Vicenza Hospital: 4
Venezia/Mestre Hospital: 9 Pisa AOU:26
Udine – University Hospital: 0 Foggia H:0
Monza – S. Gerardo Hospital: 40
Ancona – Riuniti Hospital: 48 Perugia AO:1
Puglia – GVM & Research: 0
Alessandria – S. Giorgio Clinic Hospital: 0
Rome – S. Camillo Hospital: 1
Rome – Umberto I Hospital: 48
Rome – Gemelli Policlinic:50 Teramo H:3
Rome-Campus Biomedico:42
Cesena – Bufalini Hospital: 14

Barcelona - Hospital Clinic: 17
Zaragoza - Universitary Hospital Miguel Servet: 10
Valladolid – University Clinic Hospital: 5
Palma de Mallorca - Son Espases University Hospital: 9
Valencia – Politecnic La Fe: 18 Mostoles- Rey Juan Carlos:12
Madrid - Hospital Clinico San Carlos: 8
Vigo - Hospital Álvaro Cunqueiro: 10
Elche - Hospital de Vinalopó: 3
Sevilla – Virgen Macarena Hospital: 1
Sevilla – Virgen del Rocio: 1 Santander - Hospital de Valdecilla: 2
Cadiz - Hospital Universitario Puerta del Mar: 1
Cordoba -University Hospital Reina Sofia: 15
Santiago de Compostela Hospital: 4
A coruña - University Hospital: 0 Asturias University Hospital:2

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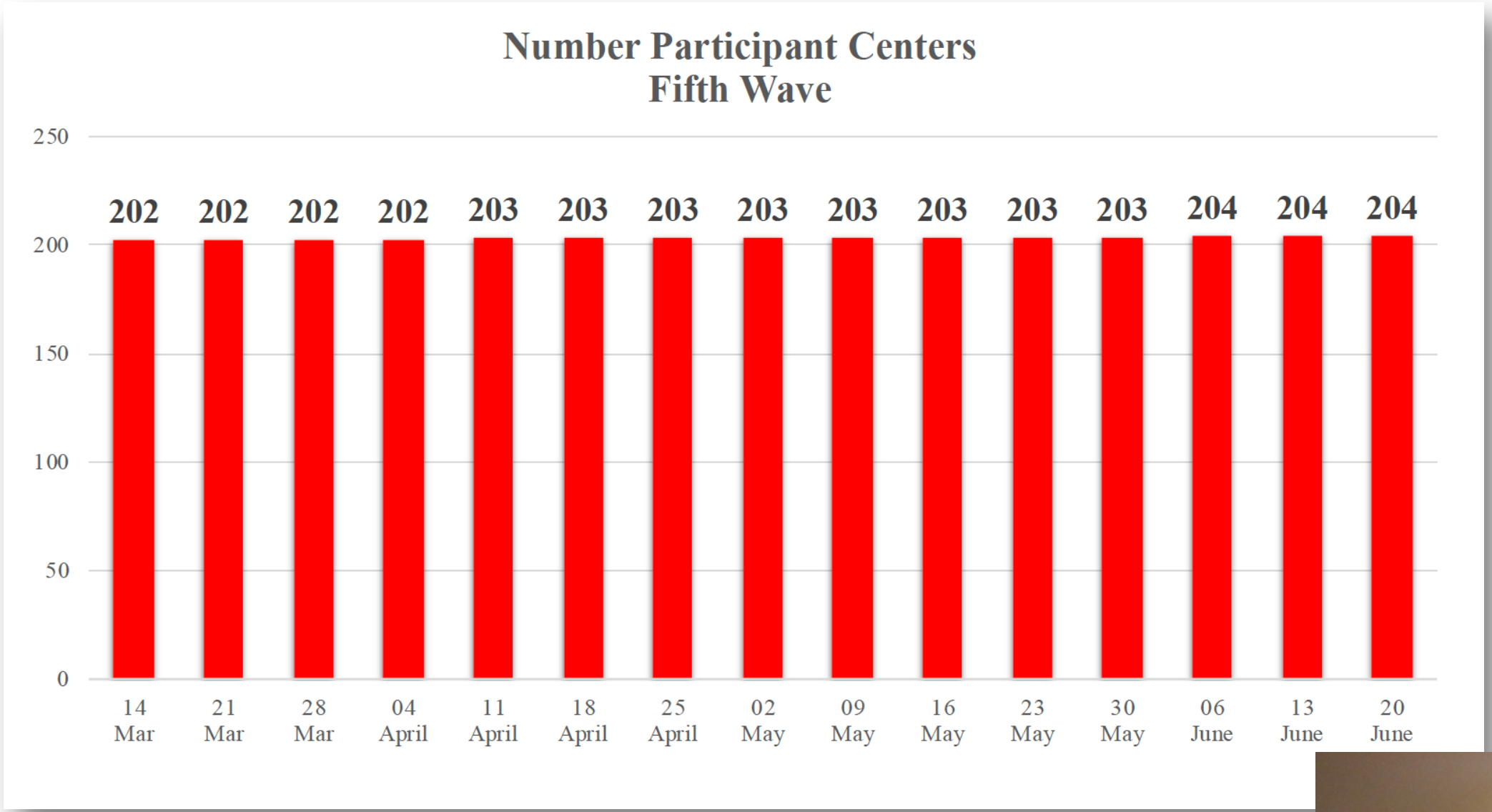

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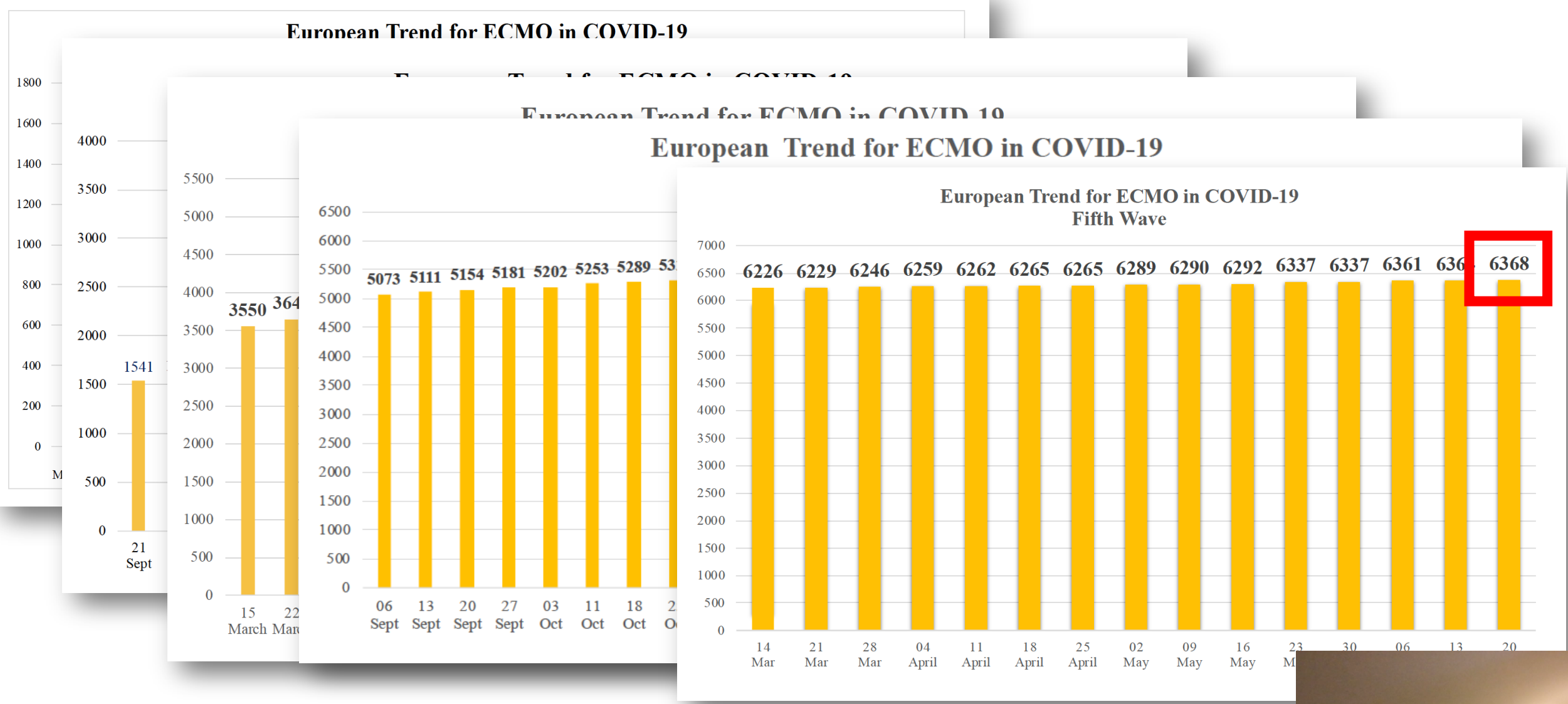

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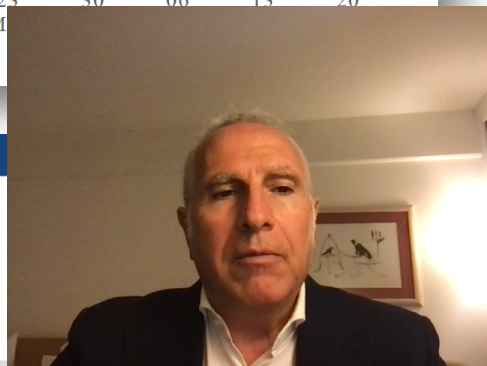

Age and Gender Distribution in ECMO – COVID-19: First Wave

	21 March	28 March	04 April
Mean Age	50.5	53.5	
Min Age	20	16	
Max Age	73	74	
% Male	90	80	
% Female	10	20	

	24 May	01 June	0
Mean Age	52.4	52.4	
Min Age	16	16	
Max Age	79	79	
% Male	78	78	
% Female	22	22	

	27 July	03 August	10
Mean Age	52,3	52,4	
Min Age	16	16	
Max Age	80	80	
% Male	78	78	
% Female	22	22	

Age and Gender Distribution in ECMO – COVID-19: Fifth Wave

	14 March	21 March	28 March	04 April	11 April	18 April	25 April	02 May
Mean Age	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,7
Min Age	16	16	16	16	16	16	16	16
Max Age	84	84	84	84	84	84	84	84
% Male	72,8	72,8	72,8	72,8	72,8	72,8	72,8	72,8
% Female	27,2	27,2	27,2	27,2	27,2	27,2	27,2	27,2

	09 May	16 May	23 May	30 May	06 June	13 June	20 June
Mean Age	51,7	51,7	51,6	51,6	51,6	51,6	51,6
Min Age	16	16	16	16	16	16	16
Max Age	84	84	84	84	84	84	84
% Male	72,8	72,8	72,8	72,8	72,7	72,7	72,7
% Female	27,2	27,2	27,2	27,2	27,3	27,3	

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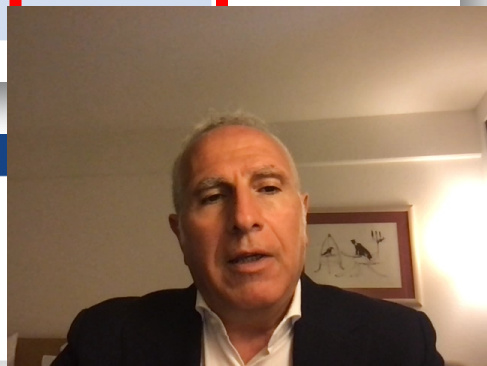

Trend Configuration ECMO in COVI
First Wave

Mean: 9.4%

	21 March	28 March	04 April	11 April	18 April	25 Apri
V-V ECMO	91%					
V-A ECMO	9%					
Others	-					

Trend Configuration ECMO in COVID-19
Second Wave

7.9%

	24 M
V-V ECMO	91%
V-A ECMO	6%
Others	3%

	27 J
V-V ECMO	90
V-A ECMO	5%
Others	5%

Trend Configuration ECMO in COVID-19
Third Wave

	06 September	13 S
V-V ECMO	92,3%	
V-A ECMO	4,5%	
Others	3,2%	

	08 November	15
V-V ECMO	92,4%	
V-A ECMO	4,4%	
Others	3,2%	

	10 January	17
V-V ECMO	92,5%	
V-A ECMO	4,4%	
Others	3,1%	

Trend Configuration ECMO in COVID-19
Fourth Wave

7.6%

Trend Configuration ECMO in COVID-19
Fifth Wave

7.4%

	14 March	21 March	28 March	04 April	11 April	18 April	25 April	02 May
V-V ECMO	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%
V-A ECMO	4,4%	4,5%	4,5%	4,5%	4,5%	4,5%	4,5%	4,5%
Others	3%	2,9%	2,9%	2,9%	2,9%	2,9%	2,9%	2,9%

	09 May	16 May	23 May	30 May	06 June	13 June	20 June
V-V ECMO	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%	92,6%
V-A ECMO	4,5%	4,5%	4,5%	4,5%	4,5%		
Others	2,9%	2,9%	2,9%	2,9%	2,9%		

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EuroECMO COVID First Pandemic Wave Results (in-hospital & 6-month follow-up)

- 1215 Patients
- 133 Centres
- 21 Countries

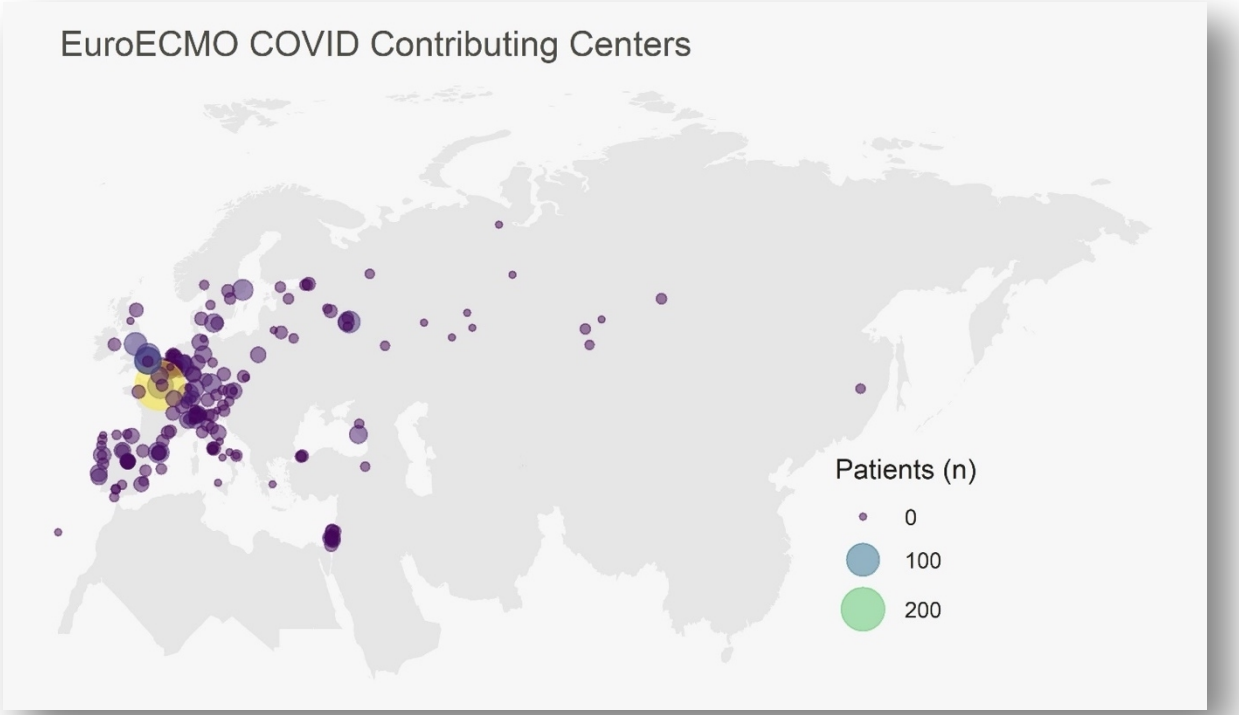

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Table 1- Baseline Characteristics

	Full Cohort (n=1215)		In-hospital Survivors (n=613)		In-hospital Non Survivors (n=602)		p-value
Age - years	53.0	(46.0-60.0)	50.0	(43.0-57.0)	57.0	(49.0-62.0)	<0.001
Age - categories							<0.001
< 59 years old	893	(73.5%)	536	(82.2%)	357	(63.4%)	
60-69 years old	271	(22.3%)	107	(16.4%)	164	(29.1%)	
≥ 70 years old	51	(4.2%)	9	(7.0%)	42	(7.5%)	
Time from Hospital Admission to ICU Admission - days	7.0	(4.0-10.0)	8.0	(5-11)	6.0	(3-10)	<0.001
Time from ICU Admission to Intubation - days	0.0	(0.0-2.0)	0.0	(0-1)	0.0	(0-1)	0.030
Time from Intubation to ECMO	4.0	(2.0-8.0)	4.0	(1-7)	4.0	(2-9)	0.032

Table 2- Extracorporeal Membrane Oxygenation Details.

	Full Cohort (n=1215)		In-hospital Survivors (n=613)		In-hospital Non Survivors (n=602)		p-value
Time on ECMO support - days	15.0	(8-27)	16.0	(9-27)	14.0	(6-27)	0.001
Type of ECMO							<0.001
VV ECMO	1105	(90.9%)	575	(93.8%)	530	(88.0%)	
VA ECMO	89	(7.3%)	36	(5.9%)	53	(8.8%)	
V-AV ECMO	10	(0.8%)	0	(0%)	10	(1.7%)	
VV-A ECMO	7	(0.6%)	2	(0.3%)	5	(0.8%)	
OxyRVAD	0	(0%)	0	(0%)	0	(0.0%)	
Other ECMO	4	(0.3%)	0	(0%)	4	(0.7%)	
Maximum ECMO Blood Flow - l/min	4.8	(4.2-5.3)	4.8	(4.2-5.2)	4.9	(4.2-5.5)	0.002
ECMO Configuration Change	109	(10.5%)	35	(6.8%)	74	(14.2%)	<0.001
Median Time to Configuration Change - days	4	(1-10)	4.0	(1-13)	4.0	(1-10)	0.577
Tracheostomy	590	(53.8%)	357	(64%)	233	(43.2%)	<0.001
Time from Intubation to Tracheostomy- days	16.0	(8-25)	19.0	(10-28)	12.0	(5-19)	

Table 3 - Complications and Outcomes

	Full Cohort (n=1215)		In-hospital Survivors (n=613)		In-hospital Non Survivors (n=602)		p-value
Any Complication	852	(74.2%)	380	(64.6%)	472	(84.1%)	<0.001
Renal Failure							<0.001
Renal Failure without RRT	388	(33.8%)	152	(25.8%)	236	(42.2%)	
Renal Failure with RRT	259	(22.6%)	111	(18.8%)	148	(26.5%)	
Major Bleeding	164	(20.7%)	65	(16.2%)	99	(25.3%)	0.002
Neurological complication							
Ischemic Stroke	61	(5.3%)	21	(3.6%)	40	(7.1%)	0.012
Hemorragic Stroke	54	(5.4%)	10	(1.9%)	44	(9.1%)	<0.001
Intracranial Bleeding	95	(9.6%)	27	(5.3%)	68	(14.2%)	<0.001
ICU length of stay- days	31	(18-49)	37	(23-58)	24	(14-39)	<0.001
ICU stay off ECMO - days	11	(5-23)	18	(8-32)	7	(3-13)	<0.001
Hospital length of stay- days	39	(25-63)	52	(34-81)	30	(19-45)	<0.001
Lung transplant	6	(1.1%)	6	(1.9%)	0	(0.0%)	n.a.
Heart transplant	3	(0.5%)	3	(1%)	0	(0.0%)	n.a.

Configuration changes

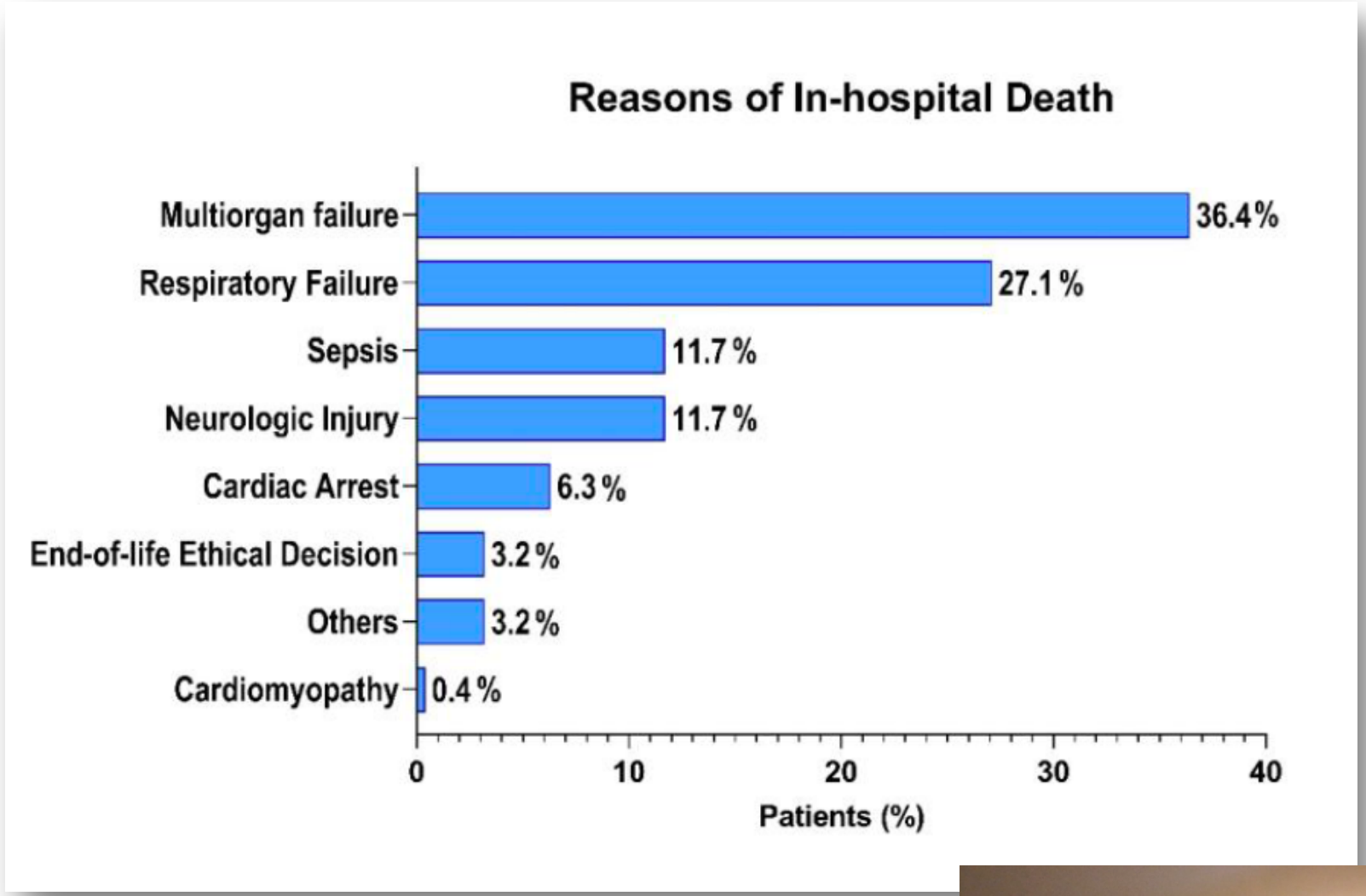
	Full Cohort (n=1215)	In-hospital Survivors (n=613)	In-hospital Non Survivors (n=602)	p-value
ECLS Configuration Change- n,%	109 (10.5%)	35 (6.8%)	74 (14.2%)	<0.001
Reason for Configuration Change- n,%				0.062
LV failure	5 (5.7%)	3 (10.7%)	2 (3.4%)	
RV failure	7 (8%)	4 (14.3%)	3 (5.1%)	
Biventricular failure	19 (21.8%)	1 (3.6%)	18 (30.5%)	
Refractory hypoxemia	23 (26.4%)	8 (28.6%)	15 (25.4%)	
Cannulation site bleeding	2 (2.3%)	0 (0%)	2 (3.4%)	
Leg ischemia	2 (2.3%)	0 (0%)	2 (3.4%)	
Drainage problems	6 (6.9%)	3 (10.7%)	3 (5.1%)	
Others	23 (26.4%)	9 (32.1%)	14 (23.7%)	
New ECLS configuration- n,%				0.002
V-V	48 (36.9%)	20 (40.8%)	28 (34.6%)	
V-A	20 (15.4%)	7 (14.3%)	13 (16.0%)	
V-AV ECLS	20 (15.4%)	2 (4.1%)	18 (22.2%)	
VV-A ECLS	23 (17.7%)	6 (12.2%)	17 (21.0%)	
OxyRVAD	7 (5.4%)	5 (10.2%)	2 (2.5%)	
Others	12 (9.2%)	9 (18.4%)	3 (3.7%)	
Median Time to Configuration Change - days	4 (1-10)	4 (1-13)	4 (1-10)	0.577

Data are reported as n (% of available data) or median (IQR, interequartile range).ECLS: Extracorporeal Membrane Oxygenation: V-V:veno-venous.V-A:veno-arterial.OxyRVAD:Oxygenator in right ventricular assist device.

In-Hospital Death: 49.5%

Death on ECMO: 81%

Death after ECMO: 19%



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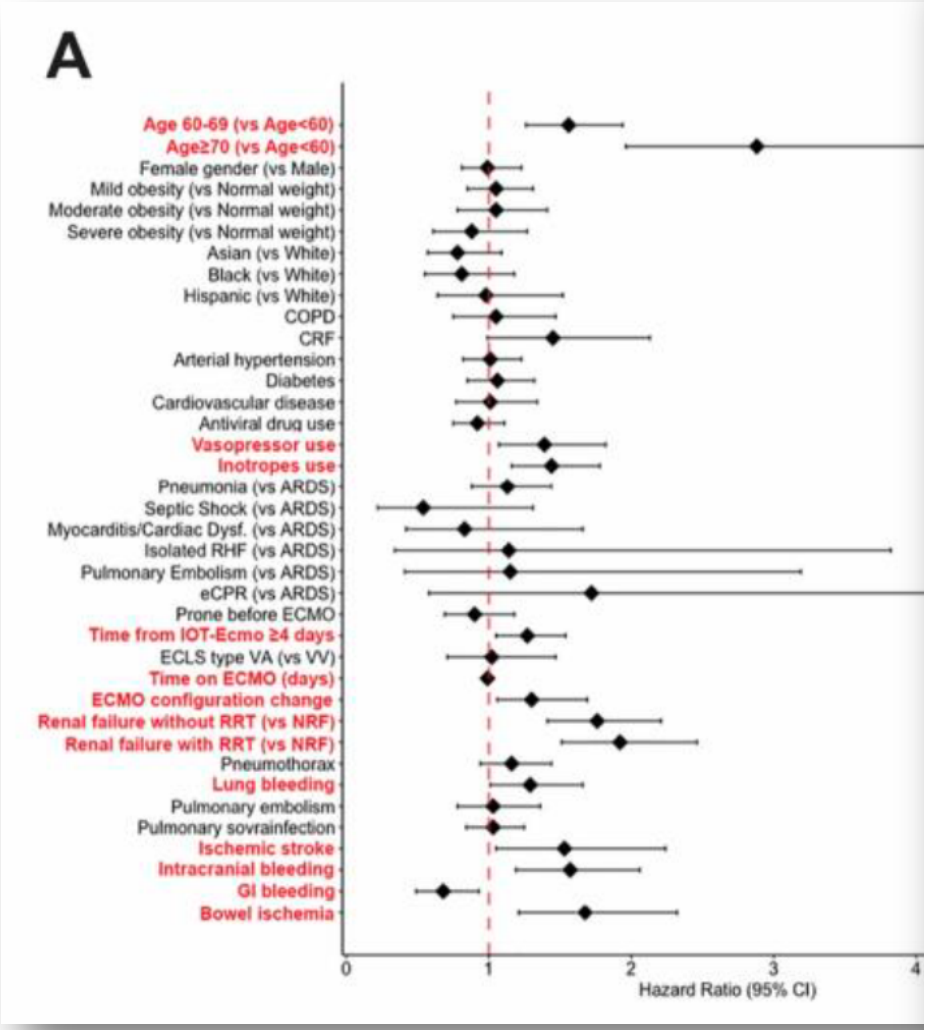

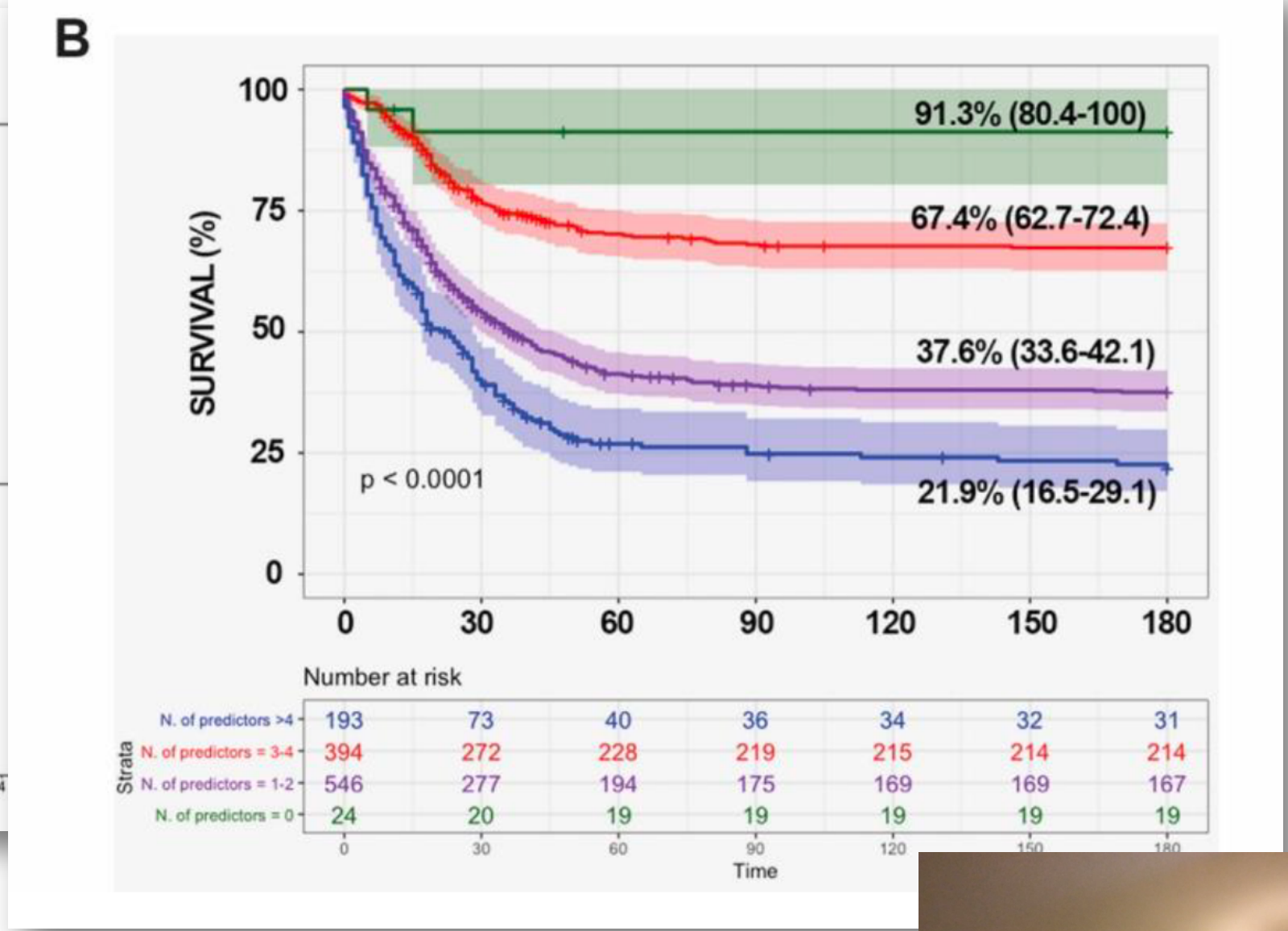

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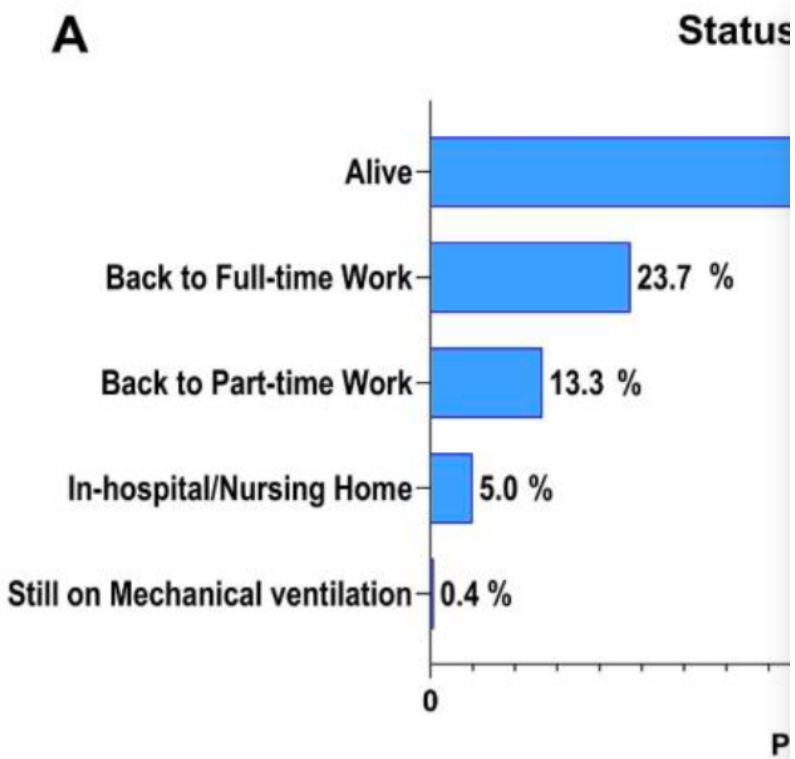
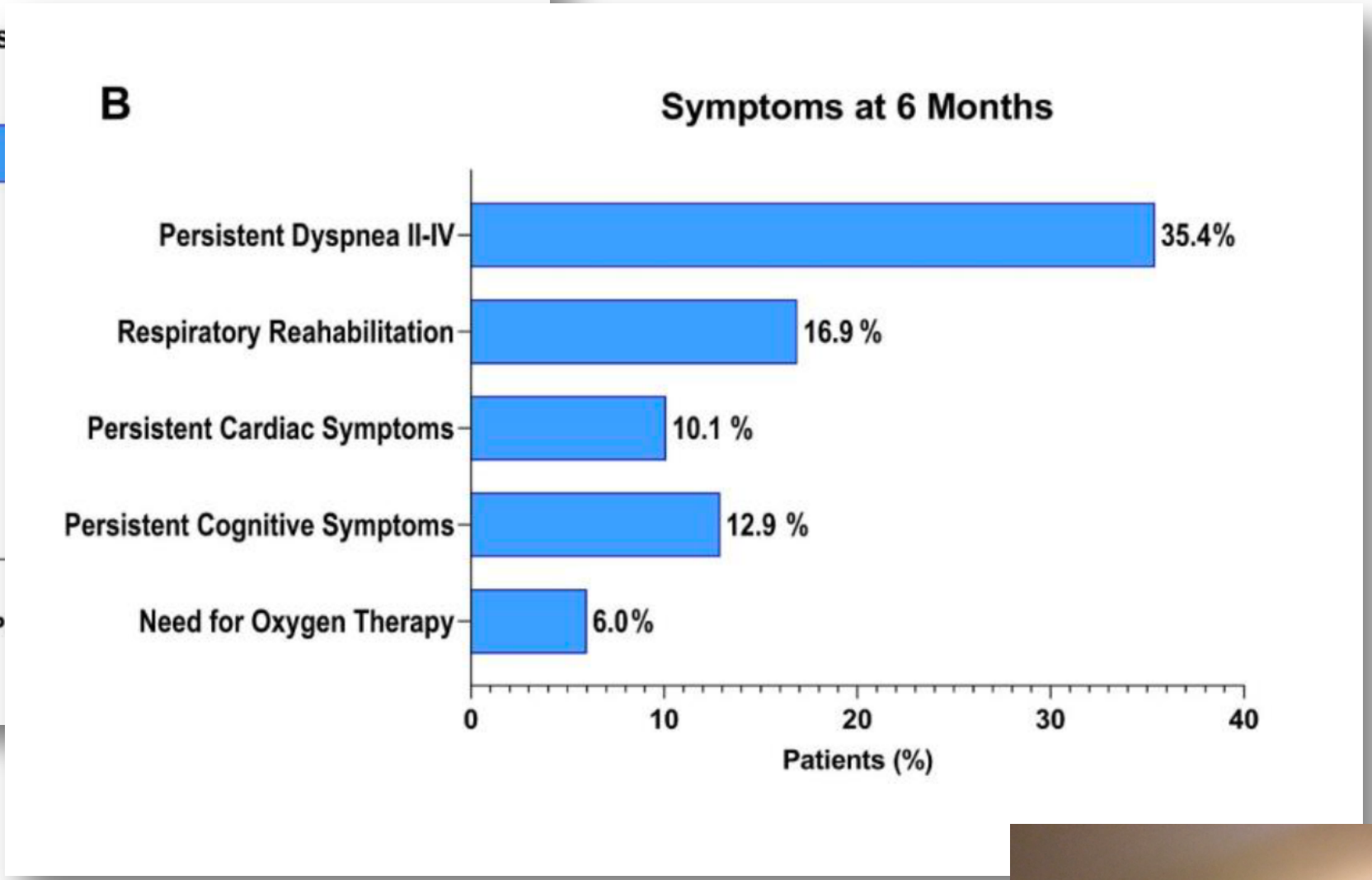
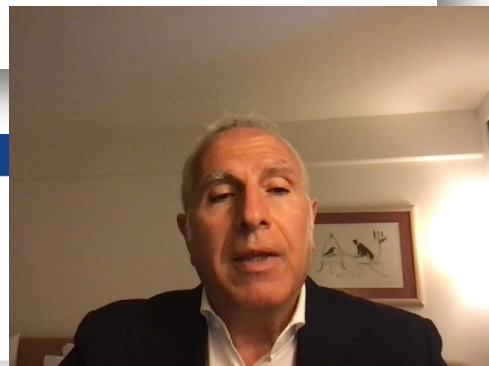

A
Status
Alive
Back to Full-time Work
23.7 %
Back to Part-time Work
13.3 %
In-hospital/Nursing Home
5.0 %
Still on Mechanical ventilation
0.4 %
0


B
Symptoms at 6 Months
Persistent Dyspnea II-IV
35.4%
Respiratory Reahabilitation
16.9 %
Persistent Cardiac Symptoms
10.1 %
Persistent Cognitive Symptoms
12.9 %
Need for Oxygen Therapy
6.0%
0
10
20
30
40
Patients (%)



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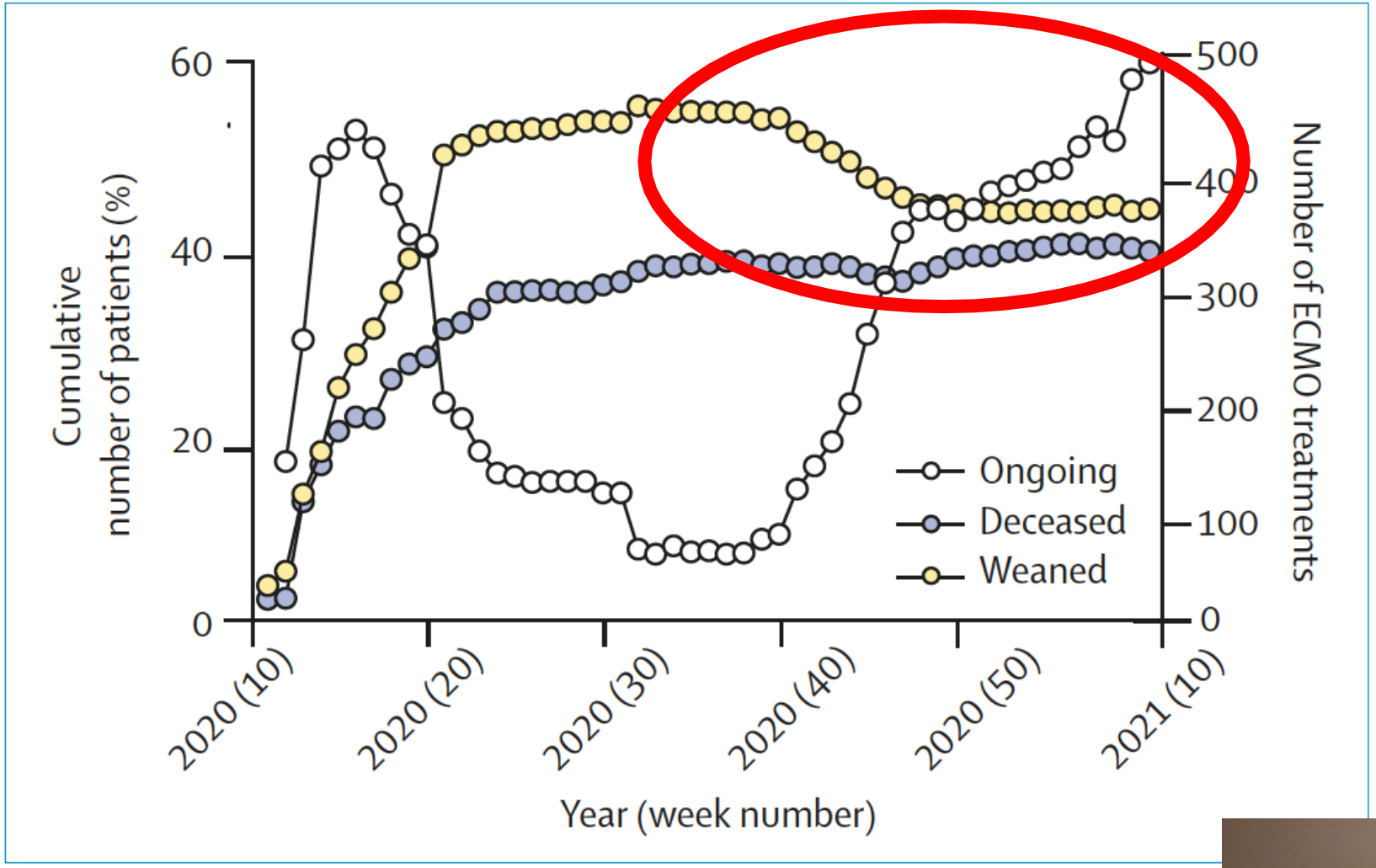
Preliminary Data of the Secc

Lancet Respir Med 2021



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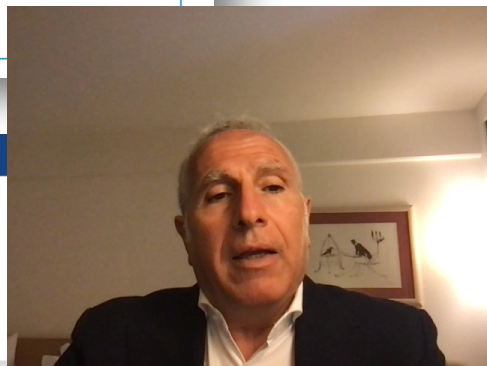

EuroECMO-COVID

- First-Wave Main Study Submitted for Publication
- First-Wave Sub-Study Analysis Ongoing – Submission for Publication Shortly
- 2-5 Waves Data Collection Ongoing

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Artificial Organs

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SYSTEMATIC REVIEW

Temporary mechanical circulatory support for COVID-19 patients: A systematic review of literature

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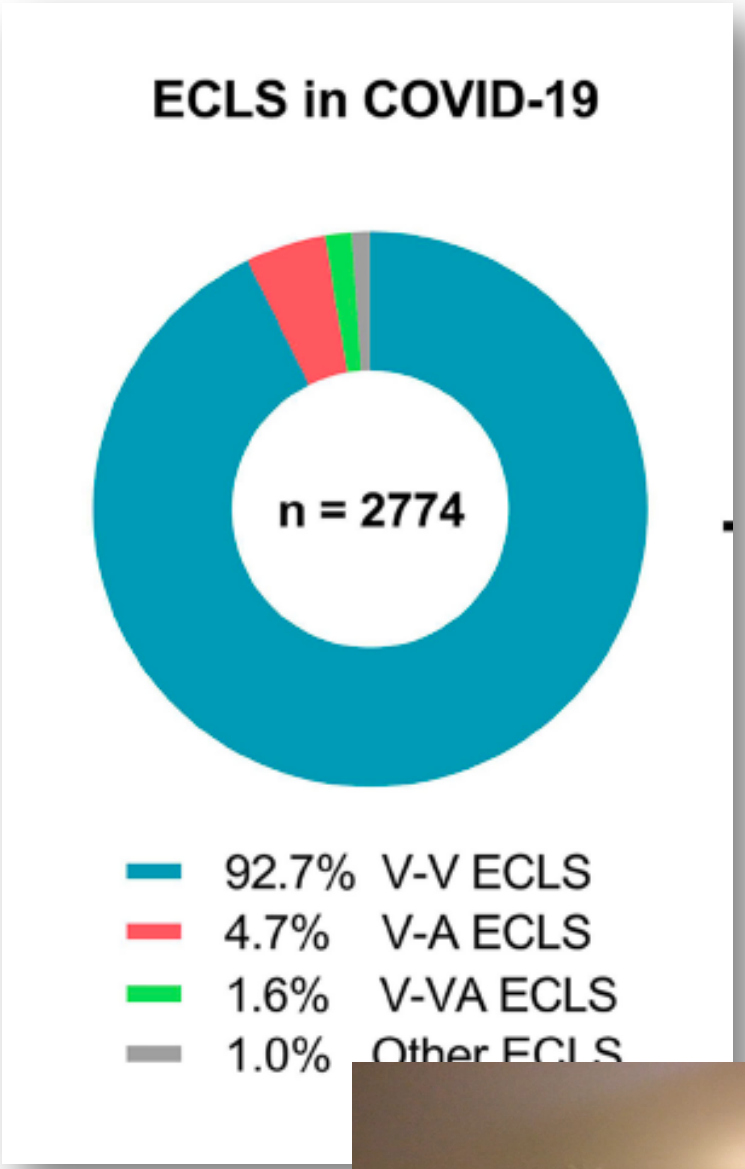

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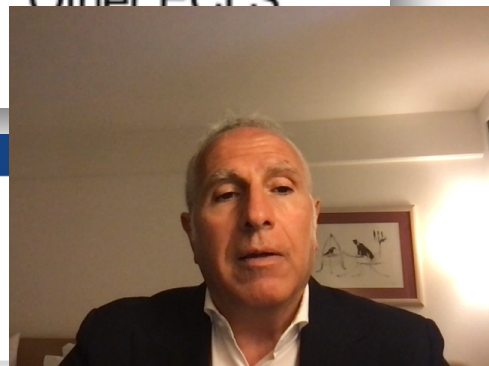

Editorial

and V-V ECMO + RV Support (OxyRVAD)

Has Venoarterial ECMO Been Underutilized in COVID-19 Patients?

Innovations
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Conclusions

EuroECMO COVID ECMO Study:
>200 centres and 110 Weekly Reports

6.300 Patients During
5 Pandemic Waves

First-Wave In-Hospital Mortality
50%

Second-Wave Outcome Worse

Age (>60 yrs), Vasopressors, AKI, Intubation-ECMO > 4 days, ECMO Riconfiguration, Time on ECMO, GI, Lung & Cerebral Injury, Negative Determinants for First-Wave In-Hospital Outcome

First-Wave Post-Discharge Outcome (6 months) Favorable, but Findings Consistent with Long-COVID Syndrome (particularly, persistent respiratory sympt

Thanks to All Participating Centres and Investigators

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