Il Neuro-COVID in Italia

Alessandro Padovani

Clinica Neurologica, UNIBS

Unità Neurologia 2 e Unità COVID C

ASST Spedali Civili di Brescia

WHO Neurological Group
NEUROCOVID International Coalition

Approaches to Understanding COVID-19 and its Neurological Associations

Ettore Beghi, MD,[1] Benedict D. Michael, PhD, MRCP,[2,3,4]
Tom Solomon, PhD, MRCP, FRCP,[3,4,5] Erica Westenberg, MSc [ORCID],[6]
and Andrea S. Winkler, MD, PhD,[6,7] on behalf of
the Global COVID-19 Neuro Research Coalition

There is an accumulating volume of research into neurological manifestations of coronavirus disease 2019 (COVID-19). However, inconsistent study designs, inadequate controls, poorly validated tests, and differing settings, interventions, and cultural norms weaken study quality and comparability, hence the understanding of the spectrum, burden, and pathophysiology of these complications. Therefore, a global COVID-19 Neuro Research Coalition, together with the World Health Organization, has reviewed reports of COVID-19 neurological complications and harmonized clinical measures for future research. This will facilitate well-designed studies using precise, consistent case definitions of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and neurological complications, with standardized forms for pooled data analyses that nonspecialists can use, including those in low-income settings.

Symptom/ Disease	Minimum	Selection criteria	Maximum	Selection criteria
Headache	3.5%	Consecutive hospital patients aged ≥60 yr[32]	66%	Telephone questionnaire survey in COVID$^+$ patients[33]
Anosmia	5%	Search of neurological manifestations in a retrospective hospital series[1]	85.6%	COVID$^+$ patients seen in ENT consultation[34]
Ageusia	6%	Search of neurological manifestations in a retrospective hospital series[1]	88%	COVID$^+$ patients seen in ENT consultation[34]
Myalgia	2%	Consecutive hospital patients with brain/spine imaging[35]	61%	Population-based survey in COVID$^+$ patients[36]
Altered mentation	2%	Retrospective cohort study of hospitalized patients with chest CT examination[37]	21%	Hospitalized patients with categorized neurological manifestations[38]
Stroke	0.5%	Retrospective hospital cohort[39]	77%	Retrospective neurology hospital series[24]
Seizures/ epilepsy	1%	Consecutive hospitalized patients[40]	9%	Patients seen in a COVID-19 dedicated hospital[31]

COVID$^+$ = coronavirus disease 2019 confirmed cases; CT = computed tomography; ENT = ear, nose, and throat.

Major Critical Issues

- Regional Health Care Organisation heterogeneity
- Asymmetrical Distribution of Medical resources according to local rules
- Skewed distribution of cases across italian Regions and Provinces
- Identification of Hospital Hubs and Spokes
- Reorganization of Hospital and Neurology Services
- Lack of Clinical Standard of Care and Instruments
- Difficulties in case ascertainment due to different ethiopatogenetic mechanisms

Possible mechanisms underlying neurological manifestations in patients with SARS-CoV-2 infection

Lifting the mask on neurological manifestations of COVID-19
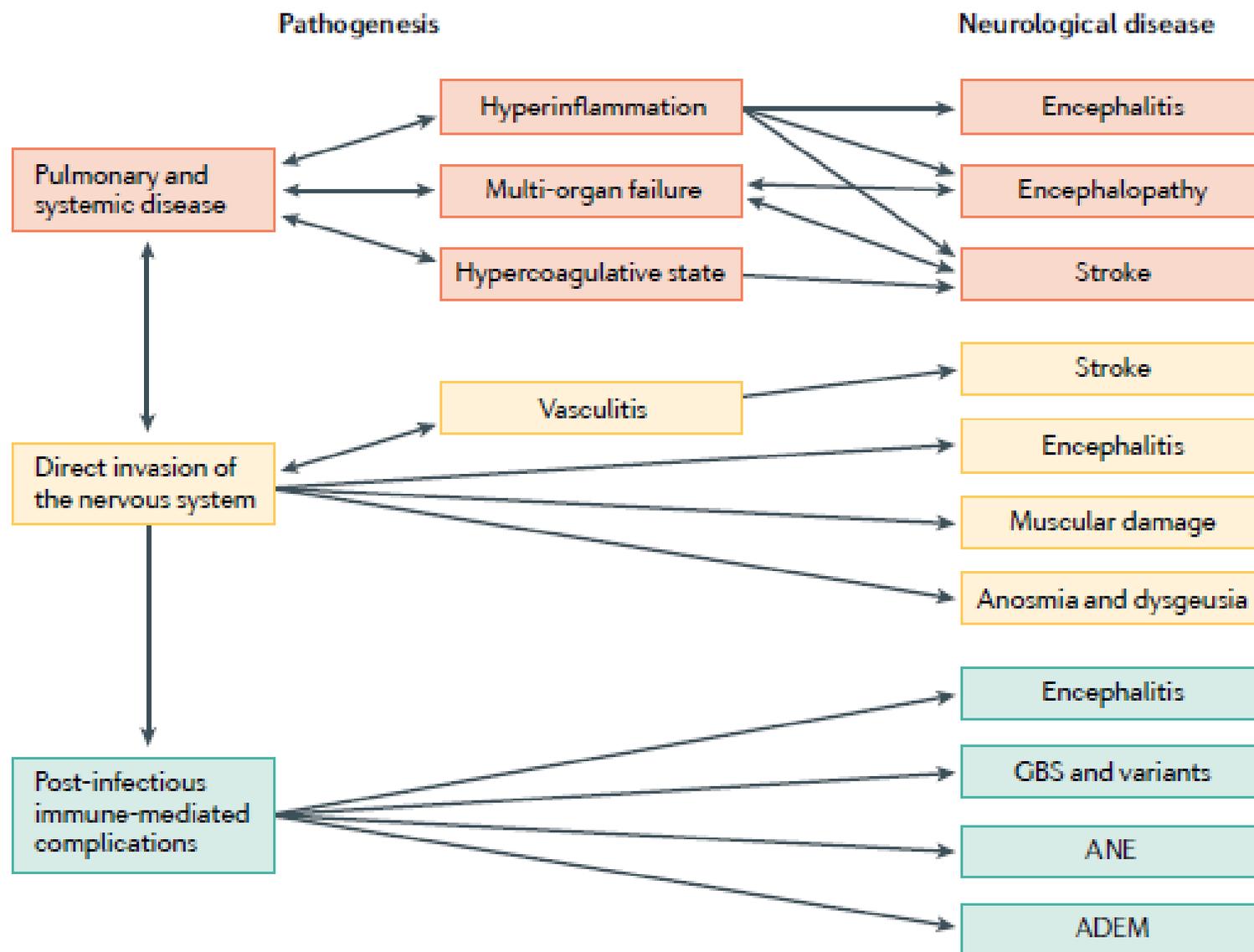
Neurology and COVID

The relationship between COVID infection and Neurological disease is doubleface. Infact, many hospitalised patients were old and carried both systemic and neurologic comorbidities, thus were intrinsically frail.

On the other hand, both ARDS and CRS increased the risk of CNS/PNS neurologic involvement and vascular complications

Finally, most patients were located in ICU or Internal Medicine wards and neurological symptoms disattended if not unrecognised

Neuro-COVID Study Steering Committee

Prof. Carlo Ferrarese
Prof. Alberto Priori
Prof. Vincenzo Silani
Prof. Alessandro Padovani
Prof. Salvatore Monaco
Dott. Elio Clemente Agostoni
Prof. Gioacchino Tedeschi
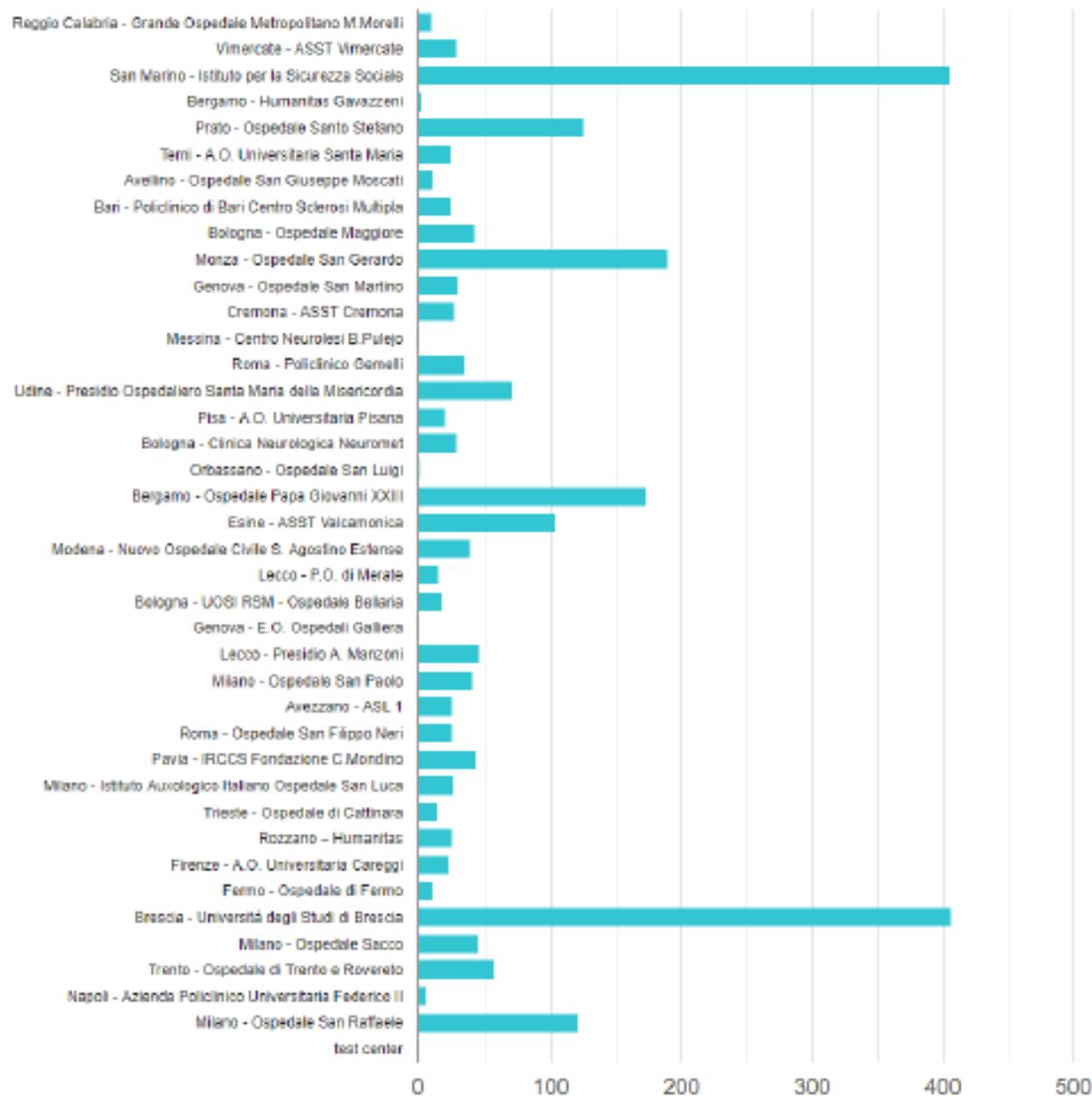
RECRUITING CENTERS

University of Milano Bicocca, University of Brescia, San Marino State Hospital, Istituto di Ricerche Farmacologiche Mario Negri, University of Milan Istituto Auxologico Italiano and ASST Santi Paolo e Carlo, Nuovo Ospedale San Stefano Prato, Italy, ASST Valcamonica Esine, Ospedale Santa Maria Della Misericordia Udine, ASST Papa Giovanni XXIII Bergamo, Ospedale Civile di Baggiovara Modena, ASST Cremona, University of Genova, IRCCS San Raffaele Scientific Institute, ASST Vimercate, Catholic University Roma, A.O. Universitaria S. Maria Terni, University of Bologna, University of Campania, **ITALY**
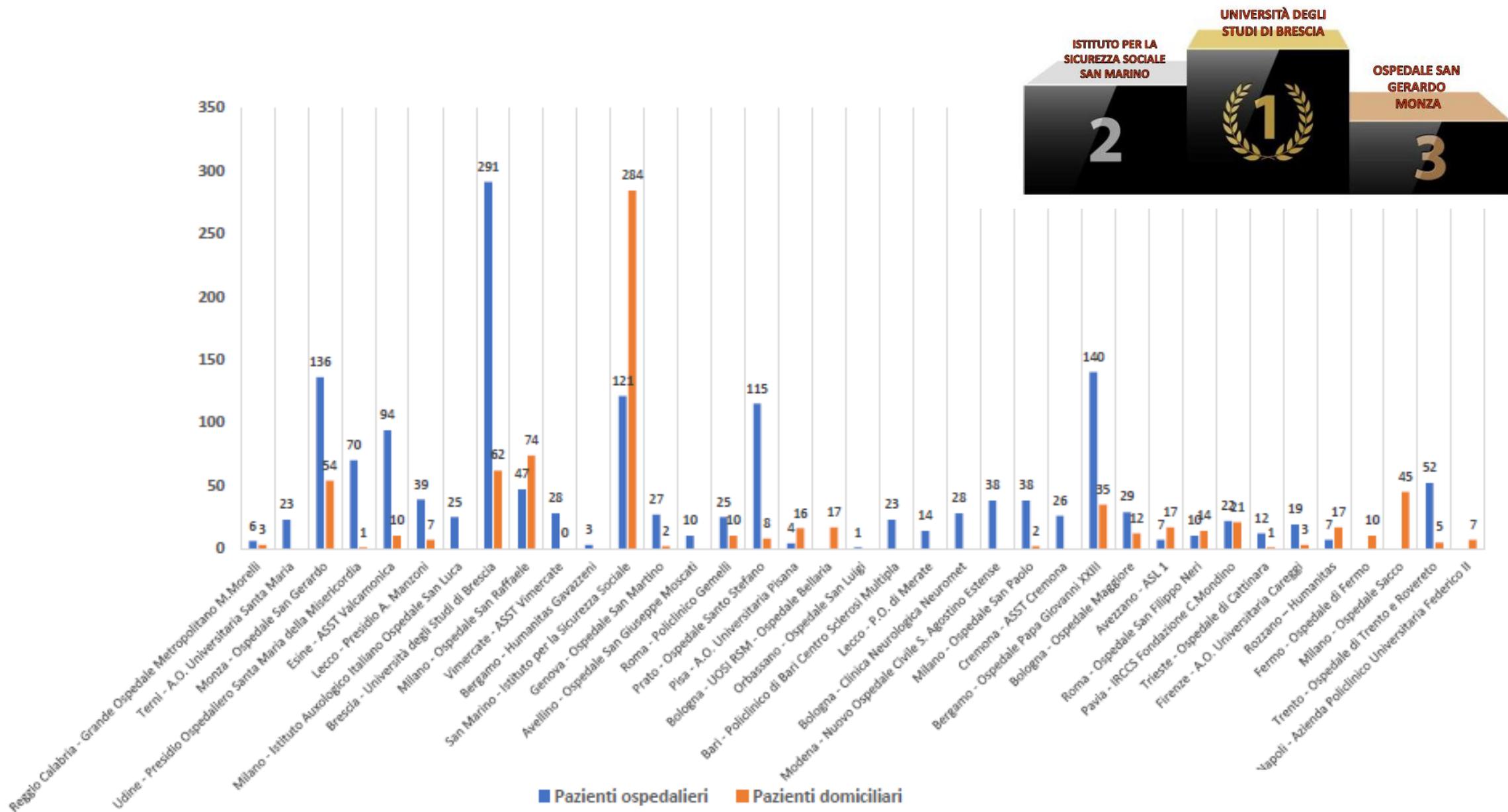
CENTRI ATTIVI: 41/51

Study Enrollment for Center

1. GRANDE OSPEDALE METROPOLITANO "BIANCHI MELACRINO MORELLI" DI REGGIO CALABRIA
2. ASST VIMERCATE UOC NEUROLOGIA
3. AZIENDA OSPEDALIERA-UNIVERSITARIA S. MARIA - TERNI
4. ASST MONZA - OSPEDALE SAN GERARDO
5. CENTRO NEUROLOGIA UNIVERSITA' VITA SALUTE SAN RAFFAELE E OSPEDALE SAN RAFFAELE
6. PRESIDIO OSPEDALIERO SANTA MARIA DELLA MISERICORDIA, AZIENDA SANITARIA UNIVERSITARIA FRIU
7. ISTITUTO PER LA SICUREZZA SOCIALE – SAN MARINO
8. UO NEUROLOGIA HUMANITAS GAVAZZENI
9. CLINICA NEUROLOGICA UNIVERSITA' DEGLI STUDI DI BRESCIA
10. USL TOSCANA CENTRO SOC NEUROLOGIA - NUOVO OSPEDALE SANTO STEFANO
11. ASST LECCO - PRESIDIO A. MANZONI
12. CLINICA NEUROLOGICA DINOGMI UNIVERSITA' DI GENOVA E OSPEDALE POLICLINICO SAN MARTINO
13. IRCCS ISTITUTO AUXOLOGICO ITALIANO
14. UOC NEUROLOGIA E STROKE AORN SAN GIUSEPPE MOSCATI
15. CLINICA NEUROLOGICA UNIVERSITA' DEGLI STUDI ALDO MORO - AOU CONSORZIALE POLICLINICO DI BA
16. UOSD NEUROLOGIA ASST VALCAMONICA
17. OSPEDALE MAGGIORE – BOLOGNA
18. ASST CREMONA
19. IRCCS CENTRO NEUROLESI BONINO PULEJO
20. FONDAZIONE UNIVERSITARIA POLICLINICO G. GEMELLI - CATTOLICA
21. AZIENDA OSPEDALIERA UNIVERSITARIA PISANA
22. SCDO NEUROLOGIA CRESM S. LUIGI GONZAGA (CENTRO RIFERIMENTO REGIONALE SCLEROSI MULTIPLA
23. CLINICA NEUROLOGICA NEUROMET
24. E.O. OSPEDALI GALLIERA
25. UOC NEUROLOGIA E STROKE UNIT ASST LECCO - P.O. DI Merate
26. UOSI RIABILITAZIONE SCLEROSI MULTIPLA, OSPEDALE BELLARIA
27. ASST PAPA GIOVANNI XXIII
28. UNITA' OPERATIVA COMPLESSA AOU UNIVERSITA' DI MODENA E REGGIO EMILIA - NUOVO OSPEDALE C
29. CLINICA NEUROLOGICA III UNIVERSITA' DEGLI STUDI DI MILANO - POLO UNIVERSITARIO SAN PAOLO ASS
30. AVEZZANO – ASL 1
31. ROMA – OSPEDALE SAN FILIPPO NERI
32. PAVIA – IRCCS FONDAZIONE MONDINO
33. TRIESTE – MANGANOTTI
34. HUMANITAS – ROZZANO
35. FIRENZE – AZIENDA OSPEDALIERO UNIVERSITARIA CAREGGI
36. OSPEDALE DI FERMO
37. SAN GIOVANNI ROTONDO - CASA SOLLIEVO DELLA SOFFERENZA
38. OSPEDALE SACCO
39. OSPEDALE DI TRENTO E ROVERETO
40. NAPOLI AZIENDA POLICLINICO UNIVERSITARIA FEDERICO II
41. ISMETT PALERMO

Podium:
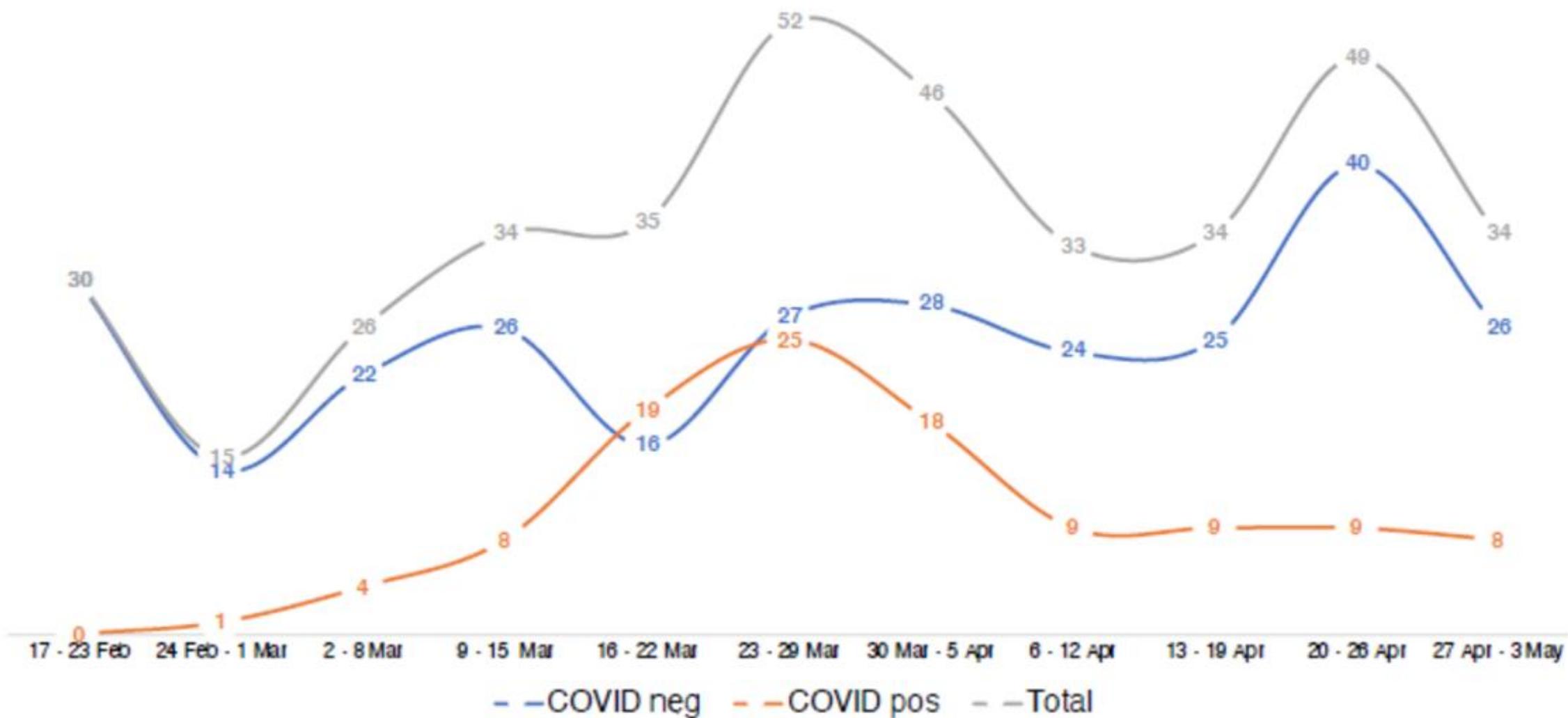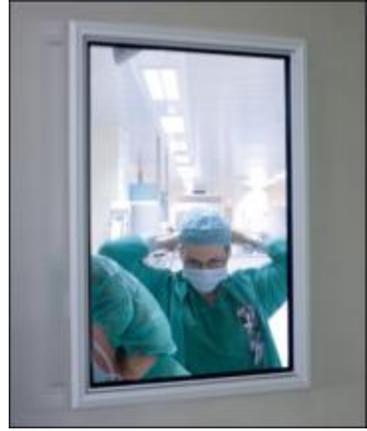- 2 — ISTITUTO PER LA SICUREZZA SOCIALE SAN MARINO
- 1 — UNIVERSITÀ DEGLI STUDI DI BRESCIA
- 3 — OSPEDALE SAN GERARDO MONZA

Bar chart values (Pazienti ospedalieri / Pazienti domiciliari):

Struttura	Pazienti ospedalieri	Pazienti domiciliari
Reggio Calabria - Grande Ospedale Metropolitano M.Morelli	6	3
Terni - A.O. Universitaria Santa Maria	23	
Monza - Ospedale San Gerardo	136	54
Udine - Presidio Ospedaliero Santa Maria della Misericordia	70	1
Esine - ASST Valcamonica	94	10
Lecco - Presidio A. Manzoni	39	7
Milano - Istituto Auxologico Italiano Ospedale San Luca	25	
Brescia - Università degli Studi di Brescia	291	62
Milano - Ospedale San Raffaele	47	74
Vimercate - ASST Vimercate	28	0
Bergamo - Humanitas Gavazzeni	3	
San Marino - Istituto per la Sicurezza Sociale	121	284
Genova - Ospedale San Martino	27	2
Avellino - Ospedale San Giuseppe Moscati	10	
Roma - Policlinico Gemelli	25	10
Prato - Ospedale Santo Stefano	115	8
Pisa - A.O. Universitaria Pisana	4	16
Bologna - UOSI RSM - Ospedale Bellaria		17
Orbassano - Ospedale San Luigi	1	
Bari - Policlinico di Bari Centro Sclerosi Multipla	23	
Lecco - P.O. di Merate	14	
Modena - Nuovo Ospedale Civile S. Agostino Estense	28	
Bologna - Clinica Neurologica Neuromet	38	
Milano - Ospedale San Paolo	38	2
Cremona - ASST Cremona	26	
Bergamo - Ospedale Papa Giovanni XXIII	140	35
Bologna - Ospedale Maggiore	29	12
Avezzano - ASL 1	7	17
Roma - Ospedale San Filippo Neri	10	14
Pavia - IRCCS Fondazione C.Mondino	22	21
Trieste - Ospedale di Cattinara	12	1
Firenze - A.O. Universitaria Careggi	19	3
Rozzano – Humanitas	7	17
Fermo - Ospedale di Fermo		10
Milano - Ospedale Sacco		45
Trento - Ospedale di Trento e Rovereto	52	5
Napoli - Azienda Policlinico Universitaria Federico II		7

Legend: ■ Pazienti ospedalieri ■ Pazienti domiciliari

The Case of Brescia

The reasons for a Neurocovid UNIT

ADMISSIONS COVID+/COVID-

	17 - 23 Feb	24 Feb - 1 Mar	2 - 8 Mar	9 - 15 Mar	16 - 22 Mar	23 - 29 Mar	30 Mar - 5 Apr	6 - 12 Apr	13 - 19 Apr	20 - 26 Apr	27 Apr - 3 May
COVID neg		14	22	26	16	27	28	24	25	40	26
COVID pos	0	1	4	8	19	25	18	9	9	9	8
Total	30	15	26	34	35	52	46	33	34	49	34

— — COVID neg — — COVID pos — — Total

Unità Neurocovid ASST Spedali Civili

- Composta da 8 stanze doppie e 4 stanze singole (O2 alto flusso)
- 1 stanza dedicata a trombolisi
- Personale Medico composto da 9 neurologi strutturati (3+2+2) di cui 1 dedicato ad attività PRIAMO e 6 medici in formazione (2+2+2) presenti H24 secondo schema
- Personale infermieristico composto da 12 infermieri (3+2+2) più Coordinatore e 8 OSS
- Strumenti di Valutazione Clinica GCS; NIHSS, qSOFA, BCRSS, CAM, NEWS
- Attività dal 20 marzo al 4 giugno
- Pazienti ricoverati 160 (inclusi false positives and grey)
- Pazienti deceduti 46

Organizzazione di scala 4.0 per piani

Piano **5** : Media e Bassa Intensità

Piano **4** : Specialistico Neuro Cardio – Medio Bassa Intensità Resp

Piano **3** : Multispecialistico ortoped./chirurg. – Medio Bassa Intensità Resp

Piano **2** : Semintensiva e alta intensità respiratoria

Piano **1** : Semintensiva | 2 stanze Terapia Intensiva | [+4PL dialisi]

UNITA' NEUROCARDIO COVID

Composta da 8 stanze 4 letti e 1 stanza 2 letti

1 stanza dedicata a trombolisi

Personale Medico composto da 7 neurologi e 6 cardiologi strutturati (2+2+1) e 6 medici in formazione presenti H24 secondo schema

Personale infermieristico composto da 12 infermieri (3+2+2) più Coordinatore e 8 OSS

Strumenti di Valutazione Clinica GCS; NIHSS, qSOFA, BCRSS, CAM, NEWS, UK Neurological Scale

Attività dal 20 ottobre

Pazienti ricoverati al 1 settembre 2021 n= 320

Pazienti deceduti totale n= 64

Pazienti ricoverati con vaccinazione completa= 16

	Mean or n (%)	*SD*
Female (%)	77 (45.3)	-
Age	67.6	17.7
Days of hospitalization	13.6	11.5
Neurocovid	106 (62.4)	-
Cardiocovid	64 (37.6)	-
Clinical Phenotype		
Covid Pneumological	62 (36.5)	-
Covid Cardiological	14 (8.2)	-
Cardiological Covid	34 (20.0)	-
Covid Neurological	19 (11.2)	-
Neurological Covid	41 (24.1)	-
Outcome		
Death	20 (11.8)	-
Home	95 (55.9)	-
Rehab	23 (13.5)	-
Other Department	32 (18.8)	-

Baseline characteristics of the study population (n = 904)

Interim analysis, 18 centers
March 2020 to March 2021
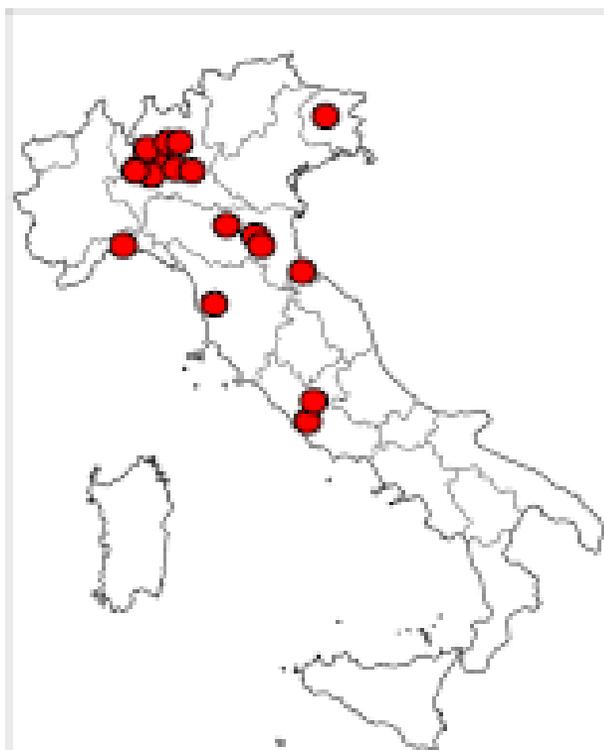
	Unit	median (IQR) or n(%)
Age	years	68 (56-78)
Sex	male (%)	524 (57.9)/372
BMI	Kg/m^2	26 (23-29)
Smoking	n (%)	227(25.1)
Systemic comorbidities	n (%)	725 (80.2)
Hypertension	n (%)	423 (46.8)
Diabetes	n (%)	173 (19.1)
Chronic heart disease	n (%)	87 (9.6)
Neurological comorbidities	n (%)	190 (21)
Neurodegenerative disorders	n (%)	87 (9.6)
Previous cerebrovascular diseases	n (%)	84 (9.3)

Infectious disease features of NeuroCOVID patients
(n = 904)

Severe acute respiratory syndrome ← 40%

	Unit	median (IQR) or n(%)
Blood tests ad admission		
D-dimer	ng/mL	849 (395-1847)
C-reactive protein	mg/dL	8.55 (1.79-23.55)
Respiratory support		
Breathing room air	n (%)	148 (16.4)
Supplemental oxygen (mask)	n (%)	241 (26.7)
CPAP	n (%)	222 (24.6)
Mechanical ventilation	n (%)	140 (15.5)
Missing information	n (%)	153 (16.8)

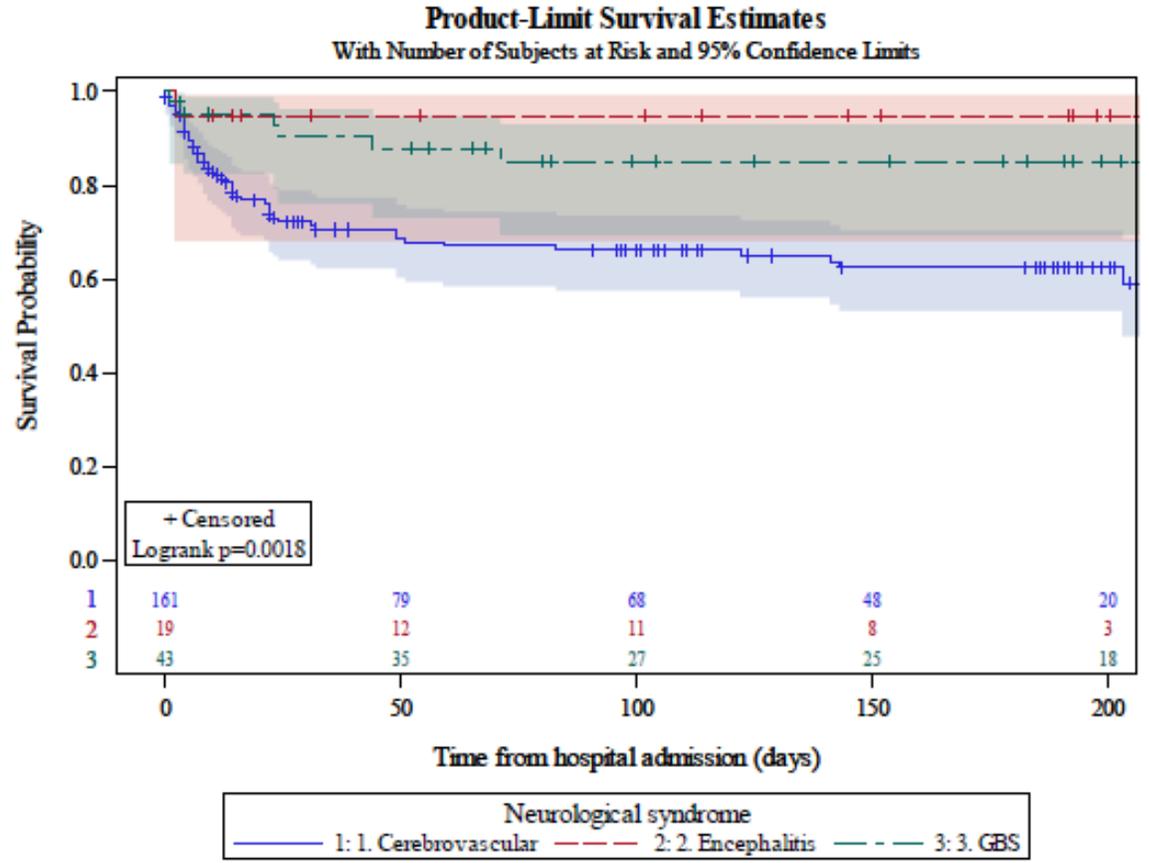# 1517 neurological disorders in 904 patients

self-reported symptoms (%)

Symptom	%
dysgeusia	21.3
hyposmia	20.8
headache	12.4
myalgia	11.9
cognitive impairment	10.9
dizziness	3
visual symptoms	3
neuralgia	1.7
diplopia	0.8

neurological syndromes (%)

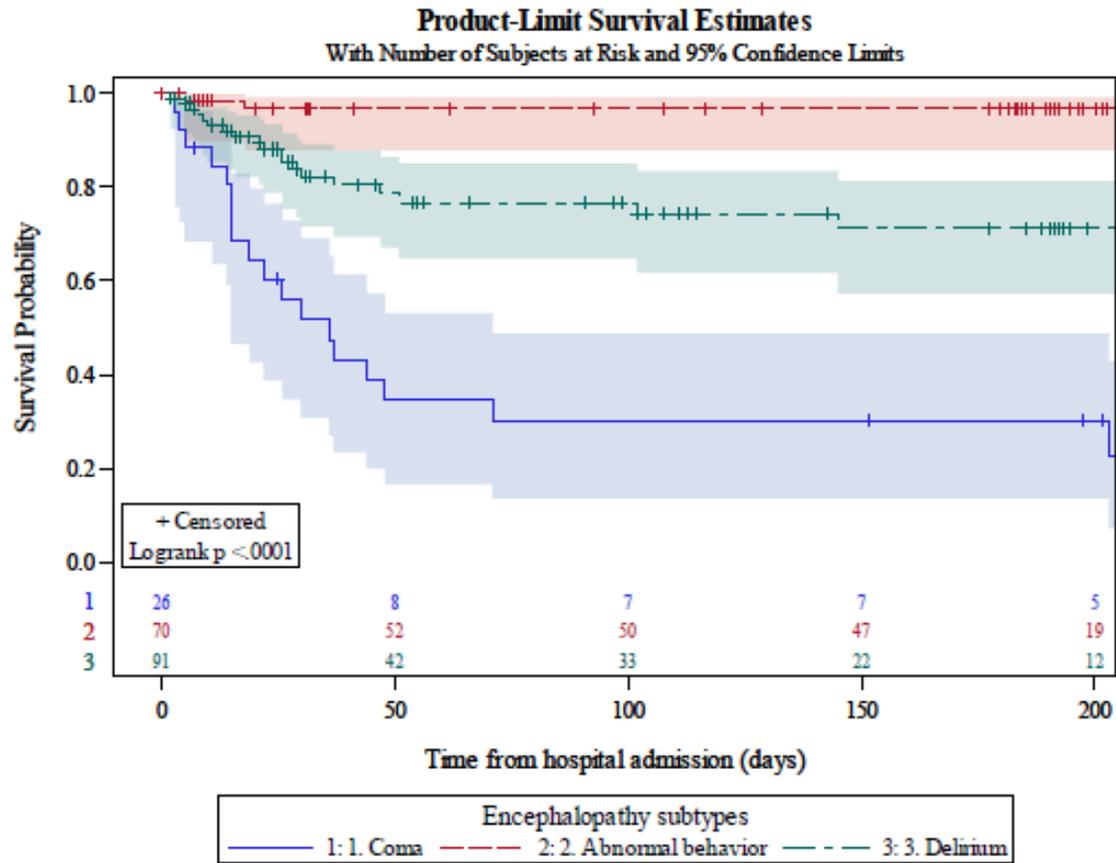| Syndrome	%
acute encephalopathy	24.2
acute ischemic stroke	20.5
seizures/SE	5.6
GBS	5.2
encephalitis	2.5
hemorrhagic stroke	2.3
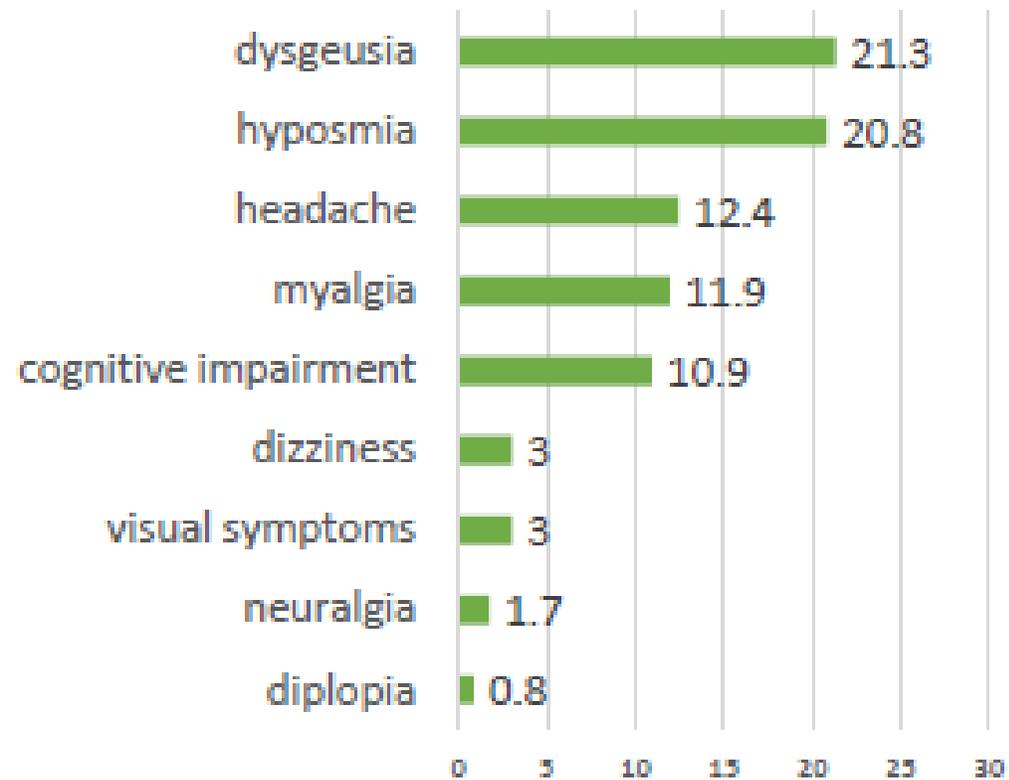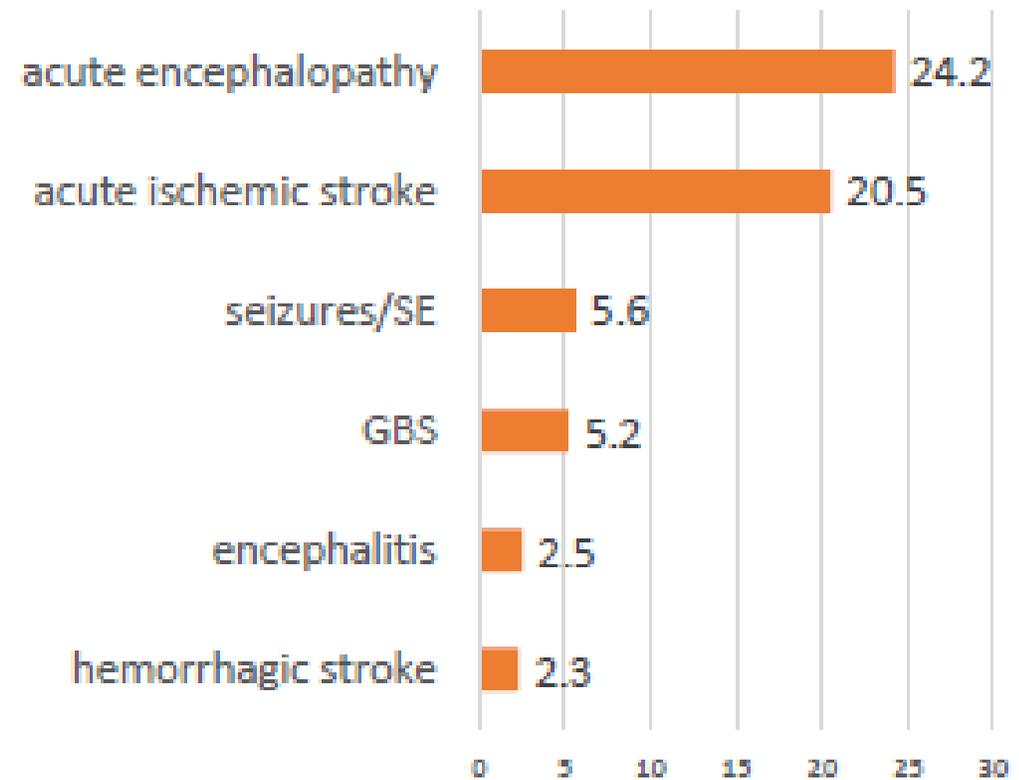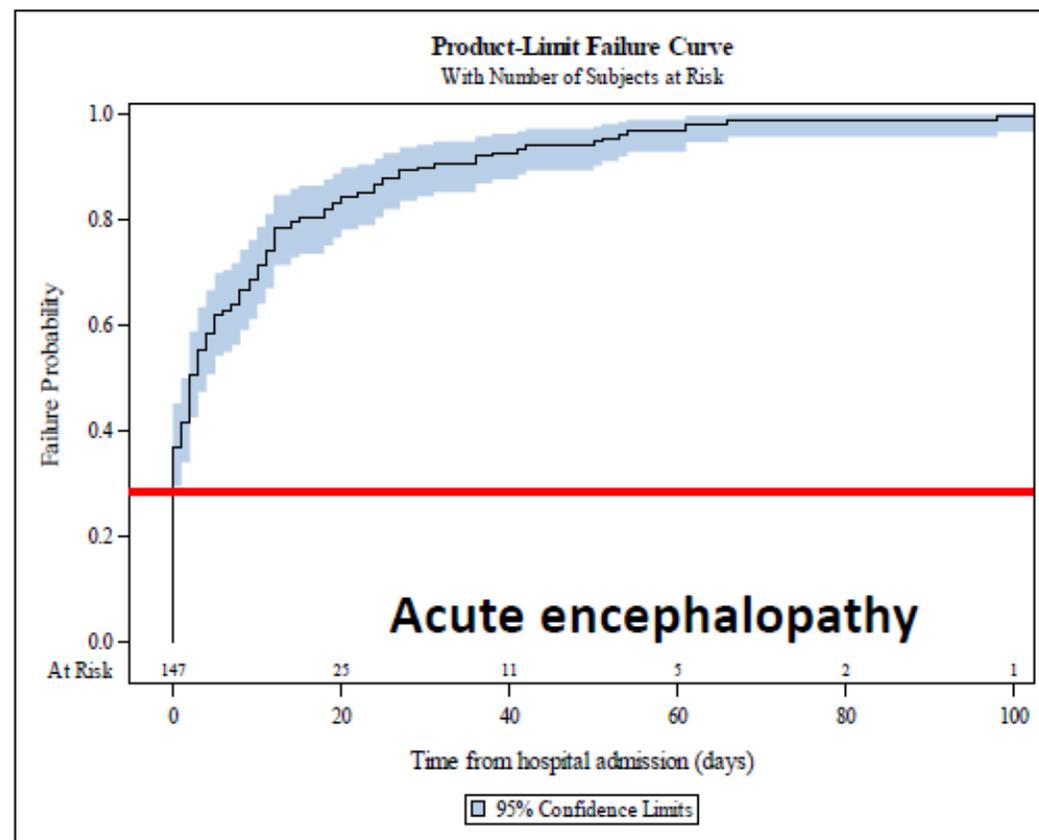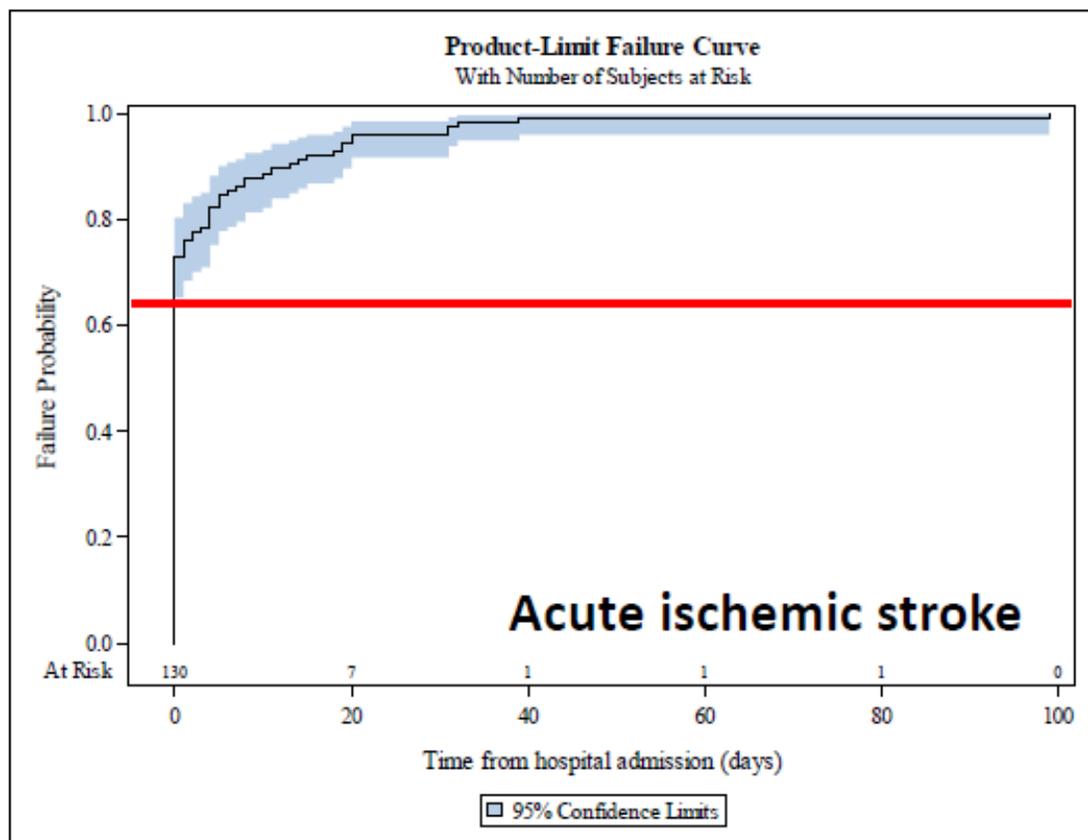
ONSET OF MAJOR NEUROLOGICAL SYNDROMES

SURVIVAL OF MAJOR NEUROLOGICAL SYNDROMES

PREDICTORS OF IN-HOSPITAL MORTALITY

	Unit	SURVIVORS (n=709) median or n (%)	NON-SURVIVORS (n=111) median or n (%)	OR	p
Age	years	65 (54-75)	79 (72-85)	1.079*	<0.0001
Sex	male (%)	56.7	67.6	1.592	0.031
CPAP or mechanical ventilation	n (%)	225(31.5)	58(52.2)	2.378	<0.0001
Acute encephalopathy	n (%)	161(22.55)	43(38.7)	2.172	0.0003
Acute ischemic stroke	n (%)	118(16.5)	43(38.7)	3.194	<0.0001
Previous neurological Disorder	n (%)	119(16.7)	32(28.8)	2.025	0.002
PCR	mg/dL	7.39	14.58	1.131	0.007
D-dimer	ng/mL	767	1437	1.023	0.0018

Check for updates

SARS-CoV-2 infection and acute ischemic stroke in Lombardy, Italy

Alessandro Pezzini1 · Mario Grassi2 · Giorgio Silvestrelli3 · Martina Locatelli1,4 · Nicola Rifino5,6 · Simone Beretta5,6 · Massimo Gamba7 · Elisa Raimondi8 · Giuditta Giussani9 · Federico Carimati10 · Davide Sangalli11 · Manuel Corato12 · Simonetta Gerevini13 · Stefano Masciocchi1 · Matteo Cortinovis1 · Sara La Gioia14 · Francesca Barbieri3 · Valentina Mazzoleni1 · Debora Pezzini1 · Sonia Bonacina1 · Andrea Pilotto1 · Alberto Benussi1 · Mauro Magoni7 · Enrico Premi7 · Alessandro Cesare Prelle8 · Elio Clemente Agostoni9 · Fernando Palluzzi2 · Valeria De Giuli4 · Anna Magherini3 · Daria Valeria Roccatagliata3 · Luisa Vinciguerra4 · Valentina Puglisi4 · Laura Fusi15 · Susanna Diamanti5,6 · Francesco Santangelo5,6 · Rubjona Xhani15 · Federico Pozzi15 · Giampiero Grampa15 · Maurizio Versino10 · Andrea Salmaggi11 · Simona Marcheselli12 · Anna Cavallini16 · Alessia Giossi4 · Bruno Censori4 · Carlo Ferrarese5,6 · Alfonso Ciccone3 · Maria Sessa14 · Alessandro Padovani1 on behalf of the STROKOVID group

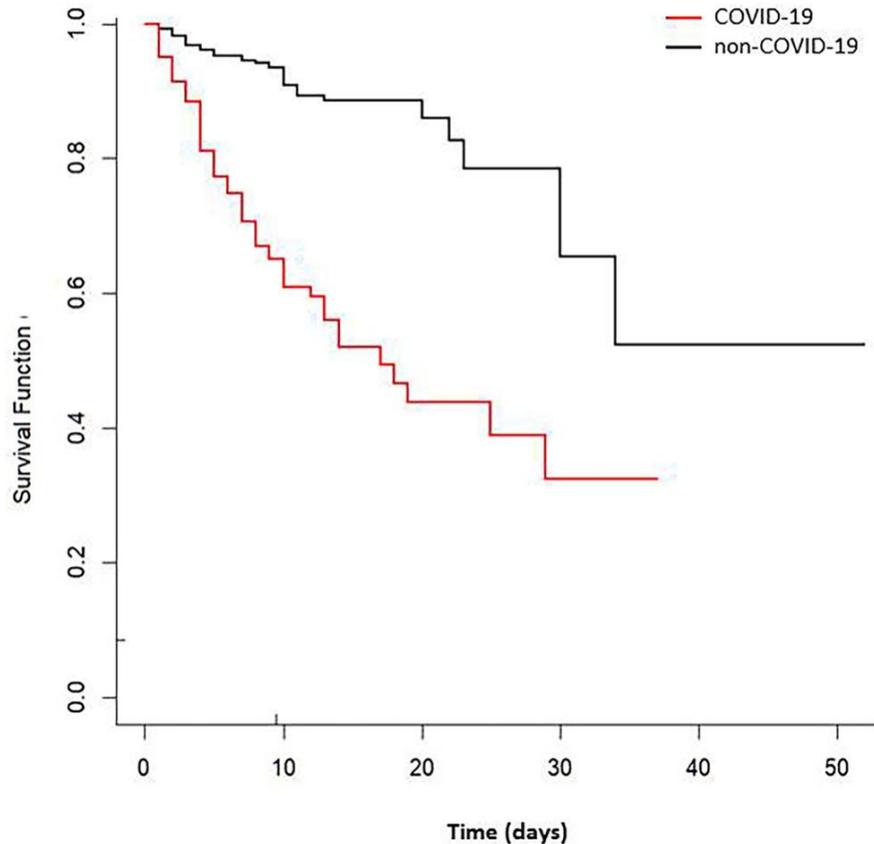**Table 3** Multivariable analysis of predictors of in-hospital death in patients with acute ischemic stroke

Variables	HR (95% CIs)	p value
SARS-CoV-2 infection	3.30 (2.17–5.02)	≤0.001
Age	1.03 (1.00–1.05)	0.017
Sex, female	0.62 (0.39–1.00)	0.049
Pre stroke modified Rankin Scale (mRS)	0.95 (0.80–1.13)	0.567
Hypertension	0.87 (0.56–1.37)	0.554
Atrial fibrillation	1.14 (0.70–1.86)	0.591
Smoking habit		
Never smoker	1	
Former smoker	1.00 (0.56–1.78)	0.994
Current smoker	0.94 (0.45–1.93)	0.857
NIHSS score	1.10 (1.06–1.14)	≤0.001
Recanalizing therapy	0.76 (0.47–1.17)	0.211
Symptomatic cerebral hemorrhage	6.90 (2.86–16.61)	≤0.001
Medical complications	3.99 (2.48–6.41)	≤0.001
Ischemic stroke recurrence	0.56 (0.16–1.99)	0.371

HR hazard ratio, *CI* confidence interval, *NIHSS* National Institute of Health Stroke Scale

Impact of SARS-CoV-2 on reperfusion therapies for acute ischemic stroke in Lombardy, Italy: the STROKOVID network

Journal of Neurology

https://doi.org/10.1007/s00415-021-10497-7

Alessandro Pezzini[1] · Mario Grassi[2] · Giorgio Silvestrelli[3] · Martina Locatelli[1,4] · Nicola Rifino[5,16] · Simone Beretta[5,16] · Massimo Gamba[6] · Elisa Raimondi[7] · Giuditta Giussani[8] · Federico Carimati[9] · Davide Sangalli[10] · Manuel Corato[11] · Simonetta Gerevini[12] · Stefano Masciocchi[1] · Matteo Cortinovis[1] · Sara La Gioia[13] · Francesca Barbieri[3] · Valentina Mazzoleni[1] · Debora Pezzini[1] · Sonia Bonacina[1] · Andrea Pilotto[1] · Alberto Benussi[1] · Mauro Magoni[6] · Enrico Premi[6] · Alessandro Cesare Prelle[7] · Elio Clemente Agostoni[8] · Fernando Palluzzi[2] · Valeria De Giuli[4] · Anna Magherini[3] · Daria Valeria Roccatagliata[3] · Luisa Vinciguerra[4] · Valentina Puglisi[4] · Laura Fusi[14] · Rubjona Xhani[14] · Federico Pozzi[14] · Susanna Diamanti[5,16] · Francesco Santangelo[5,16] · Giampiero Grampa[14] · Maurizio Versino[9] · Andrea Salmaggi[10] · Simona Marcheselli[11] · Anna Cavallini[15] · Alessia Giossi[4] · Bruno Censori[4] · Carlo Ferrarese[5,16] · Alfonso Ciccone[3] · Maria Sessa[13] · Alessandro Padovani[1] on behalf of the STROKOVID group

Table 1 Demographic and clinical features of the study group according to COVID-19 status

	COVID-19 ($n=34$)	Non-COVID-19 ($n=262$)	Univariable OR (95% CI)	p value
Age, years	76 (63–82.25)	74 (61–80)	1.02 (0.99–1.05)	0.242
Sex, male	24 (70.6)	130 (49.6)	2.43 (1.12–5.29)	0.028
Hypertension	25 (73.5)	183 (69.8)	1.19 (0.53–2.68)	0.659
Diabetes	5 (14.7)	44 (16.8)	0.85 (0.31–2.39)	1.000
Hypercholesterolemia	12 (35.3)	89 (34.0)	1.06 (0.50–2.24)	0.850
Smoking habit				
Never smoker	27 (79.4)	168 (66.4)	1	
Former smoker	4 (11.8)	36 (14.2)	0.69 (0.22–2.09)	0.515
Current smoker	3 (8.8)	49 (19.4)	0.38 (0.11–1.30)	0.125
Coronary heart disease	7 (20.6)	46 (17.6)	1.21 (0.50–2.96)	0.638
Atrial fibrillation	12 (35.3)	52 (19.8)	2.20 (1.02–4.73)	0.047
Personal history of ischemic stroke	3 (8.8)	26 (9.9)	0.87 (0.25–3.07)	1.000
Prior antiplatelets	12 (35.3)	92 (35.1)	1.00 (0.47–2.12)	0.984
Prior anticoagulants	5 (14.7)	18 (6.9)	2.33 (0.80–6.76)	0.161
Stroke severity on admission, NIHSS score	12 (7–20.25)	10 (6–16)	1.04 (0.98–1.09)	0.131
Cause of stroke				
Large-vessel disease	3 (8.8)	55 (21.0)	0.33 (0.09–1.21)	0.095
Cardiac embolism	14 (41.2)	85 (32.4)	1.02 (0.46–2.27)	0.950
Small-vessel disease	1 (2.9)	23 (8.8)	0.28 (0.03–2.26)	0.234
Other determined etiology	2 (5.9)	12 (4.6)	1.03 (0.20–5.12)	0.966
Undetermined etiology	14 (41.2)	84 (32.1)	1	
Process measures				
Time from stroke onset to hospital admission, minutes, median (IQR)	84 (63–127.5)	90 (65–125)		0.996
Time from stroke onset to brain imaging, minutes, median (IQR)	138 (112.5–181.5)	131 (102.5–178)		0.389
Time from stroke onset to treatment, minutes, median (IQR)	230 (200.5–270)	190 (150–245)		0.007

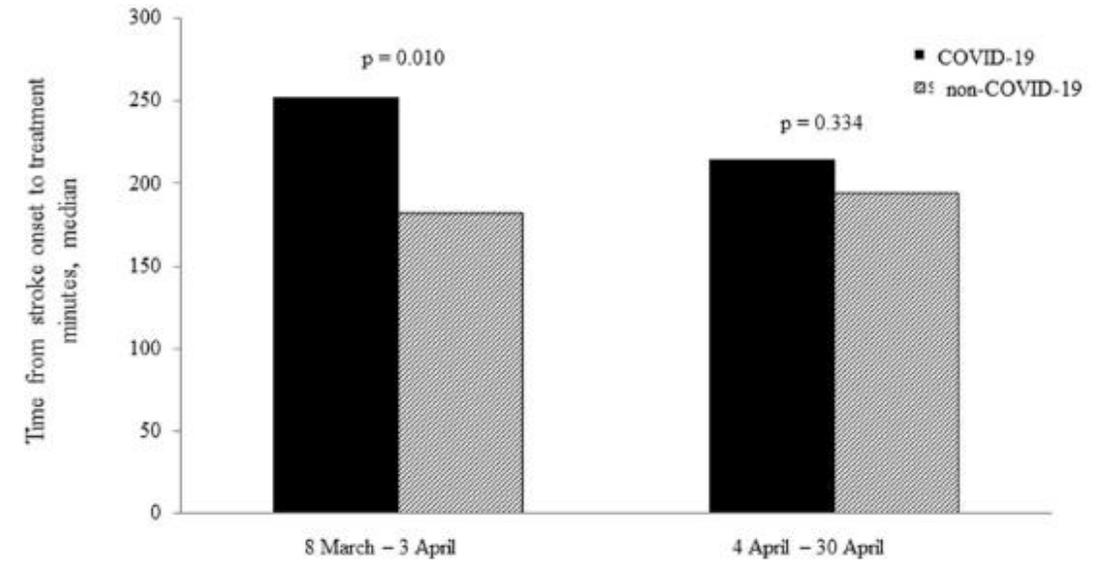*NIHSS* National Institute of Health Stroke Scale, *IQR* interquartile range

Table 3 In-hospital outcome of acute ischemic stroke patients stratified by COVID-19 status

	COVID-19 ($n=34$)	Non-COVID-19 ($n=262$)	Univariable OR (95% CI)	p value
Stroke severity at 24 h, NIHSS score	10 (4.5–18.5)	5 (2–10)	1.05 (1.01–1.10)	0.014
Any intracranial heamorrhage	12 (35.3)	51 (19.5)	2.24 (1.04–4.83)	0.035
Symptomatic intracranial hemorrhage	4 (11.8)	16 (6.1)	2.04 (0.64–6.50)	0.265
In-hospital recurrence	0 (0.0)	5 (1.9)	0.98 (0.96–0.99)	1.000
Functional independence upon hospital discharge (mRS, 0–2)	9 (30.0)	133 (56.1)	0.33 (0.14–0.76)	0.007
In-hospital death	13 (38.2)	23 (8.8)	6.43 (2.85–14.50)	≤0.001

NIHSS National Institute of Health Stroke Scale, functional independence was defined as a score on the modified Rankin scale of 0–2
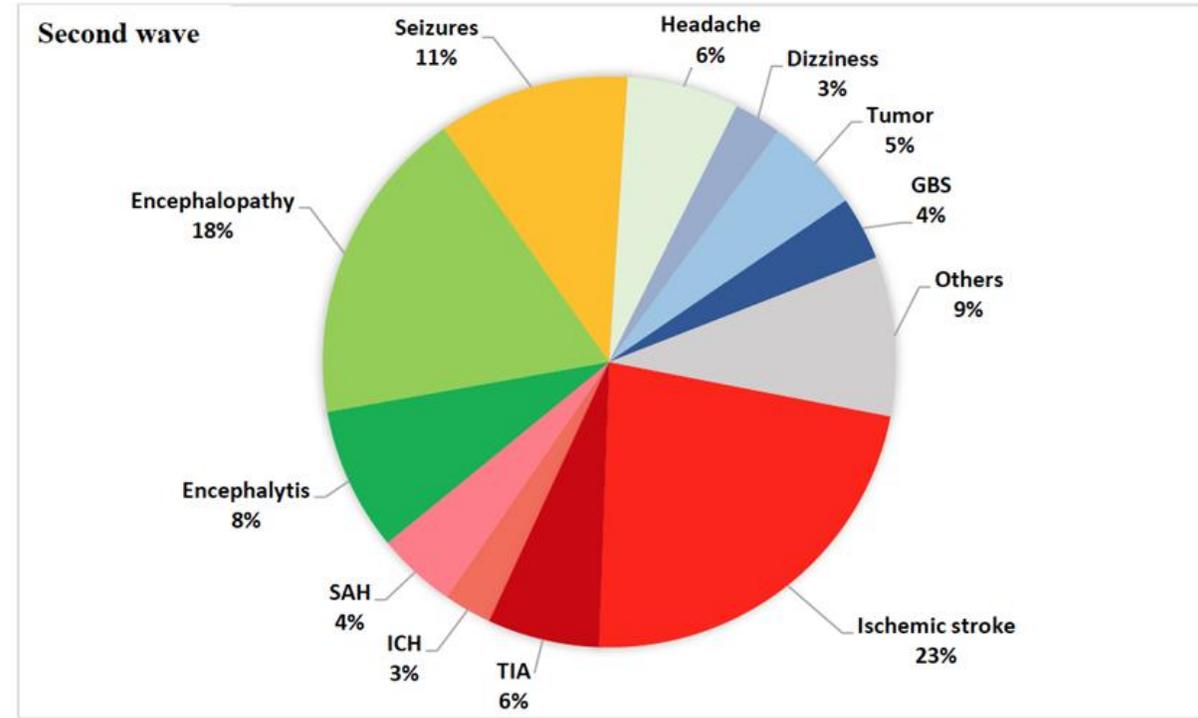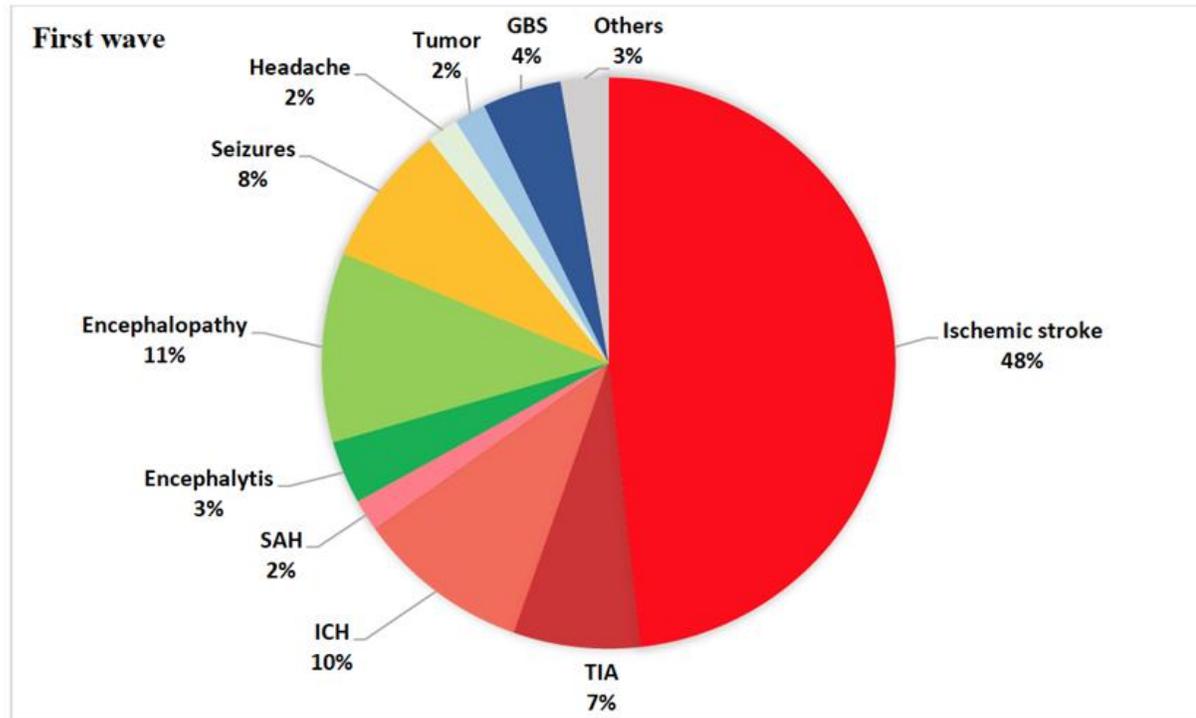
First wave vs Second Wave

The impact of Healthcare Organisation Improvement

# First versus second/third COVID wave
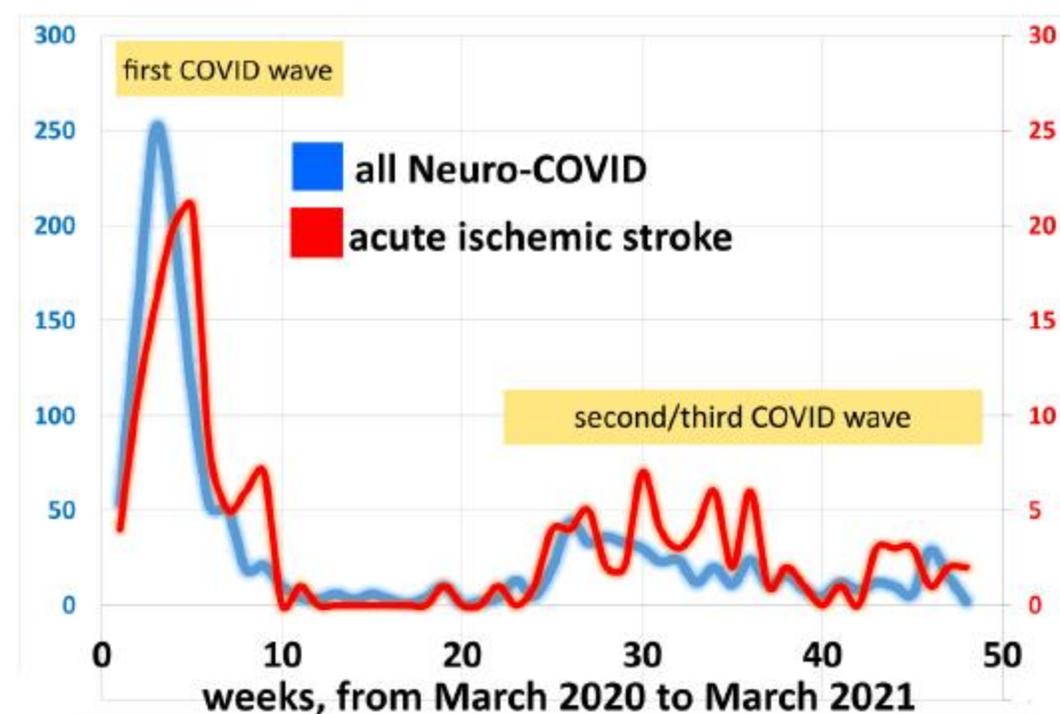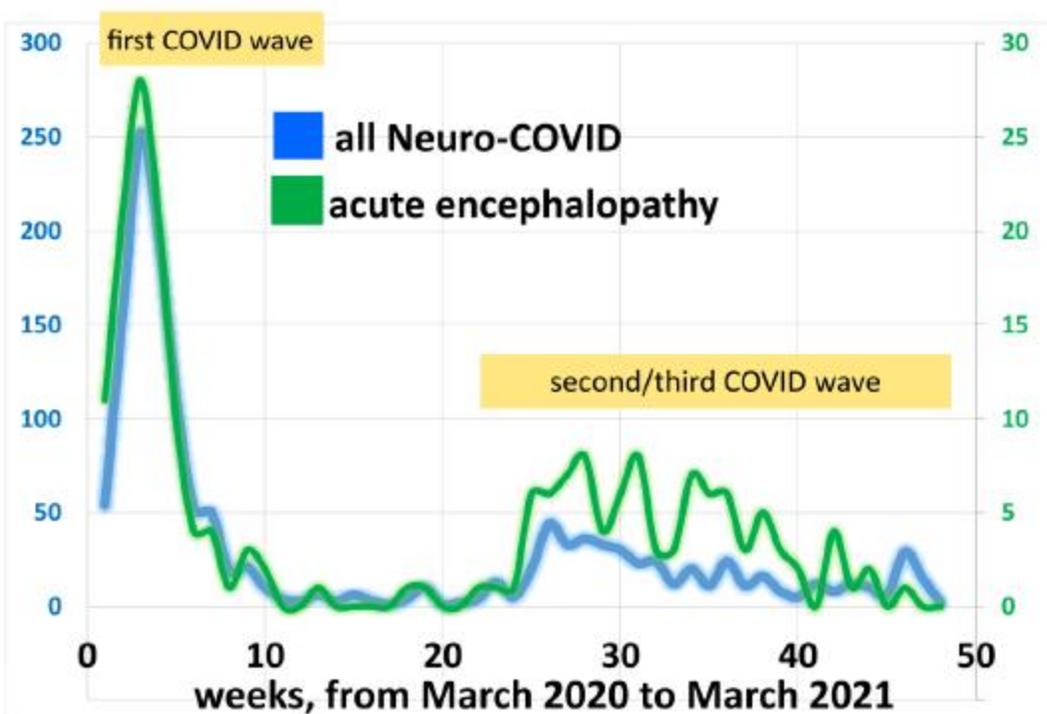
|	NeuroCOVID Total (n=223)	NeuroCOVID 1° wave (n=112)	NeuroCOVID 2° wave (n=111)	*p Value
Clinical and demographics features				
Age, years	67.74±16.5	72.6±12.1	62.9±18.9	**<0.001**
Sex, female	107 (48%)	53 (47.3%)	54 (48.6%)	0.843
Hospital length of stay, days	11.6±10.1	9.75±7.9	13.55±11.6	**0.005**
Time to admission from onset, days °	1.97±4.75	2.79 ± 7.5	0.40 ± 0.74	**0.037**
qSOFA score, mean	0.67±0.7	0.87±0.7	0.48±0.7	**<0.001**
BCRSS, mean	0.87±0.96	1.24±0.97	0.50±0.8	**<0.001**
Modified Rankin Scale premorbid	1.40±1.4	1.22±1.2	1.59±1.6	0.053
CIRS pre-admission	1.24±0.2	1.28±0.2	1.21±0.2	**0.026**
Lymphocytes	1.36±0.8	1.21±0.6	1.51±0.9	**0.006**
C-reactive protein (mg/L)	41.2±61.7	50.5±67.4	31.96±54.2	**0.027**
Creatine kinase (U/L)	219.4±554.5	276.38±755.6	165.6±235.7	0.159
D-dimer (mg/L)	1742.4±2986.2	1385.6±1683.1	2032.5±3707.9	0.109

First wave

- Others 3%
- GBS 4%
- Tumor 2%
- Headache 2%
- Seizures 8%
- Encephalopathy 11%
- Encephalytis 3%
- SAH 2%
- ICH 10%
- TIA 7%
- Ischemic stroke 48%

Second wave

- Seizures 11%
- Headache 6%
- Dizziness 3%
- Tumor 5%
- GBS 4%
- Others 9%
- Encephalopathy 18%
- Encephalytis 8%
- SAH 4%
- ICH 3%
- TIA 6%
- Ischemic stroke 23%

	NeuroCOVID Total (n=223)	NeuroCOVID 1° wave (n=112)	NeuroCOVID 2° wave (n=111)	*p Value
Admitting diagnosis				
Stroke	79 (35.4%)	54 (48.2%)	25 (22.5%)	**<0.001**
ICH	14 (6.3%)	11 (9.9%)	3 (2.7%)	0.050
SAH	7 (3.1%)	2 (1.8%)	5 (4.5%)	0.280
TIA	15 (6.8%)	8 (7.2%)	7 (6.3%)	0.789
Seizures	20 (9.0%)	9 (8.0%)	12 (10.8%)	0.501
encephalitis	13 (5.8%)	4 (3.6%)	9 (8.1%)	0.166
Encephalopathy	14 (6.3%)	12 (10.7%)	20 (18.0%)	0.050
Tumor	8 (3.6%)	2 (1.8%)	6 (5.4%)	0.171
Headache	9 (4.0%)	2 (1.8%)	7 (6.3%)	0.101
Dizziness	3 (1.3%)	0	3 (2.7%)	0.122
GBS	9 (4.0%)	5 (4.5%)	4 (3.6%)	0.744
Others	13 (5.8%)	3 (2.7%)	10 (9.0%)	0.050

	NeuroCOVID Total (n=223)	NeuroCOVID 1° wave (n=112)	NeuroCOVID 2° wave (n=111)	*p Value
Therapy:				
Oxygen therapy, n (%)	120 (53.8%)	79 (70.5%)	41 (36.9%)	**<0.001**
High-dose Treatment, n (%)	10 (4.5%)	4 (3.6%)	6 (5.4%)	0.479
Standard-dose treatment, n (%)	55 (24.7%)	5 (4.7%)	50 (48.1%)	**<0.001**
Outcomes measures				
In Hospital mortality, n (%)	51 (22.9%)	35 (31.3%)	16 (14.4%)	**0.004**
mRS at discharge (death included)	2.98±2.2	3.53±2.1	2.41±2.1	**<0.001**
mRS at discharge (Deaths excluded)	2.08±1.7	2.40±1.6	1.81±1.7	**0.019**
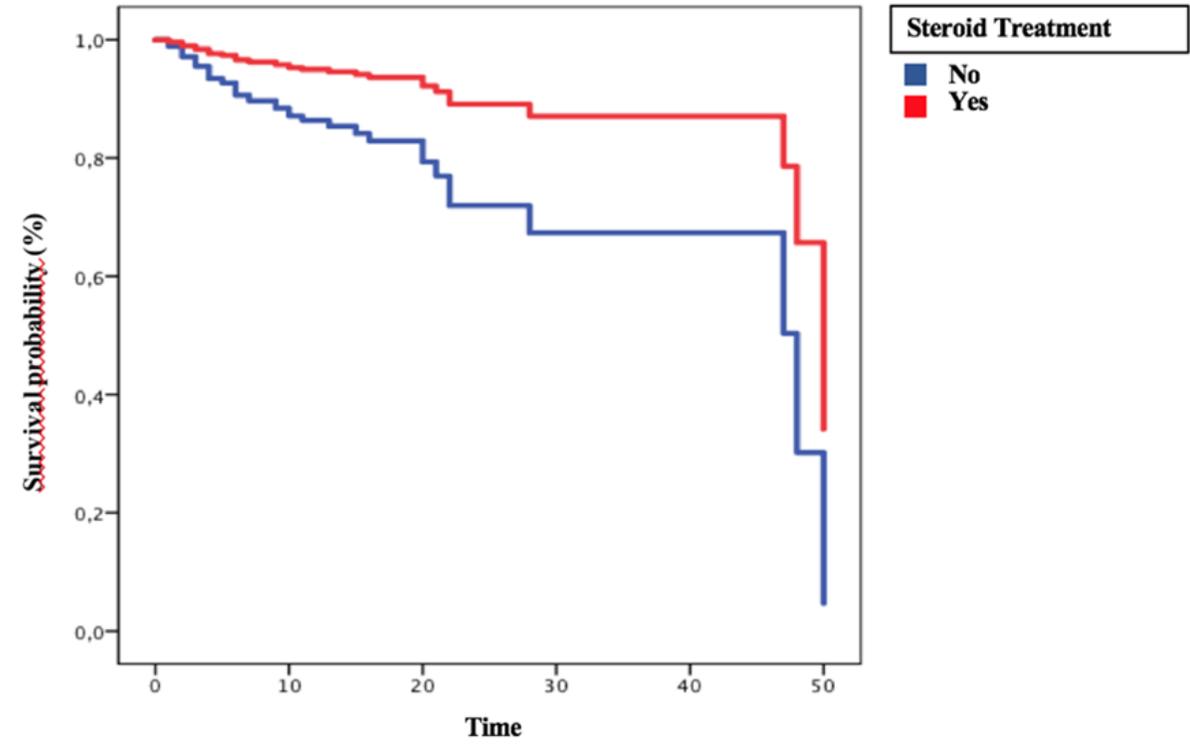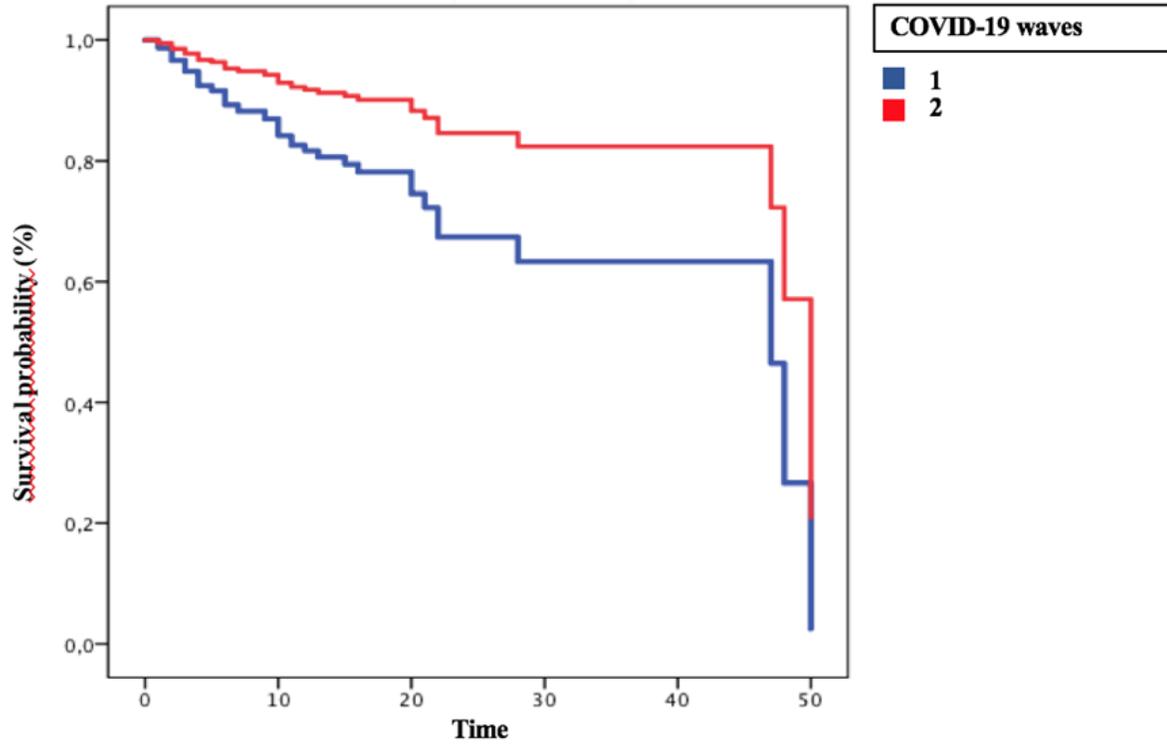
Take home messages

A wide spectrum of neurological disorders are associated with COVID-19 infection

Most cases occur in late middle-aged adults with either mild or severe respiratory syndrome

Hyposmia-dysgeusia and headache are the commonest self-reported symptoms and may last several months in a minority of patients

COVID-associated acute encephalopathy and acute ischemic stroke are the commonest neurological syndromes with high in-hospital mortality, depending on setting and health care organisations

Improvement of COVID care (including enoxaparin, steroids, earlier access to oxygen…) appear to have reduced all types of Neuro-COVID cases, comparing the first versus second-third COVID waves

According to our experience, a interdisciplinary section with a H24 team of Internal, Cardiological and Neurological specialists and a multidisciplinary health workers is associated with a better care and favourable outcome