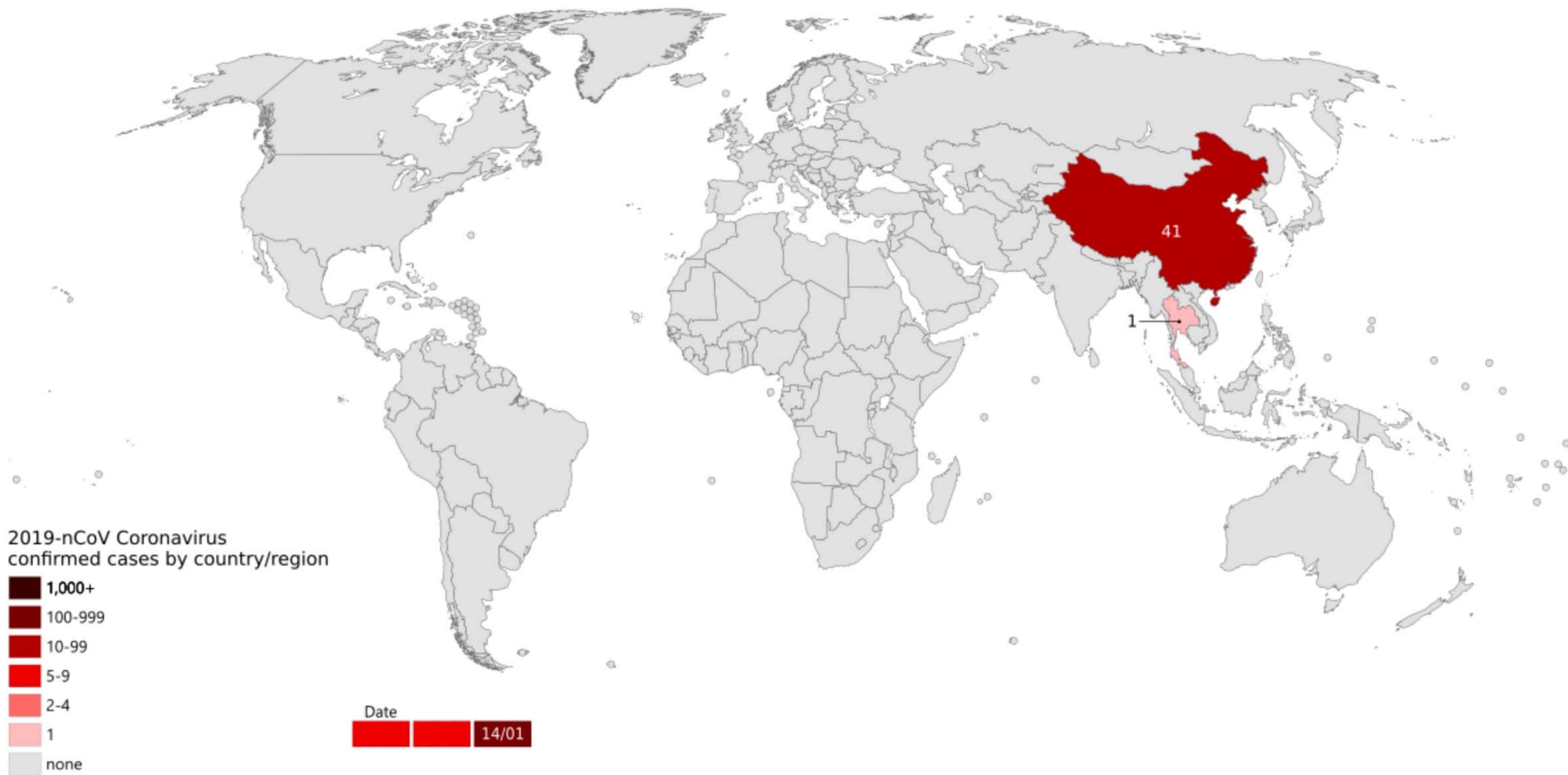
What we learnt from COVID-19 outbreak in Wuhan?

Zhiyong PENG, MD, PhD

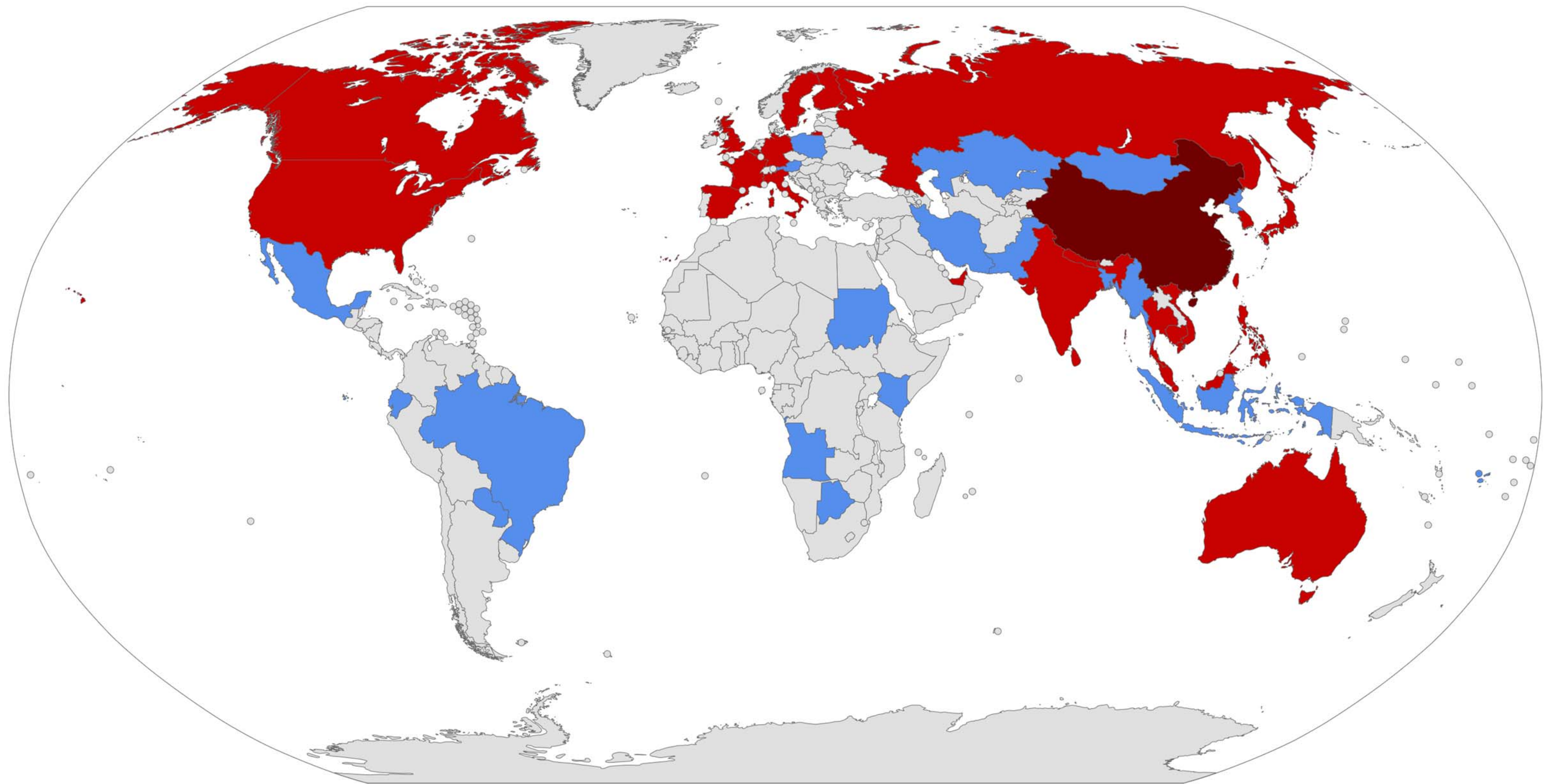
Dept of Critical Care Medicine, Wuhan University
Zhongnan Hospital, Wuhan, China

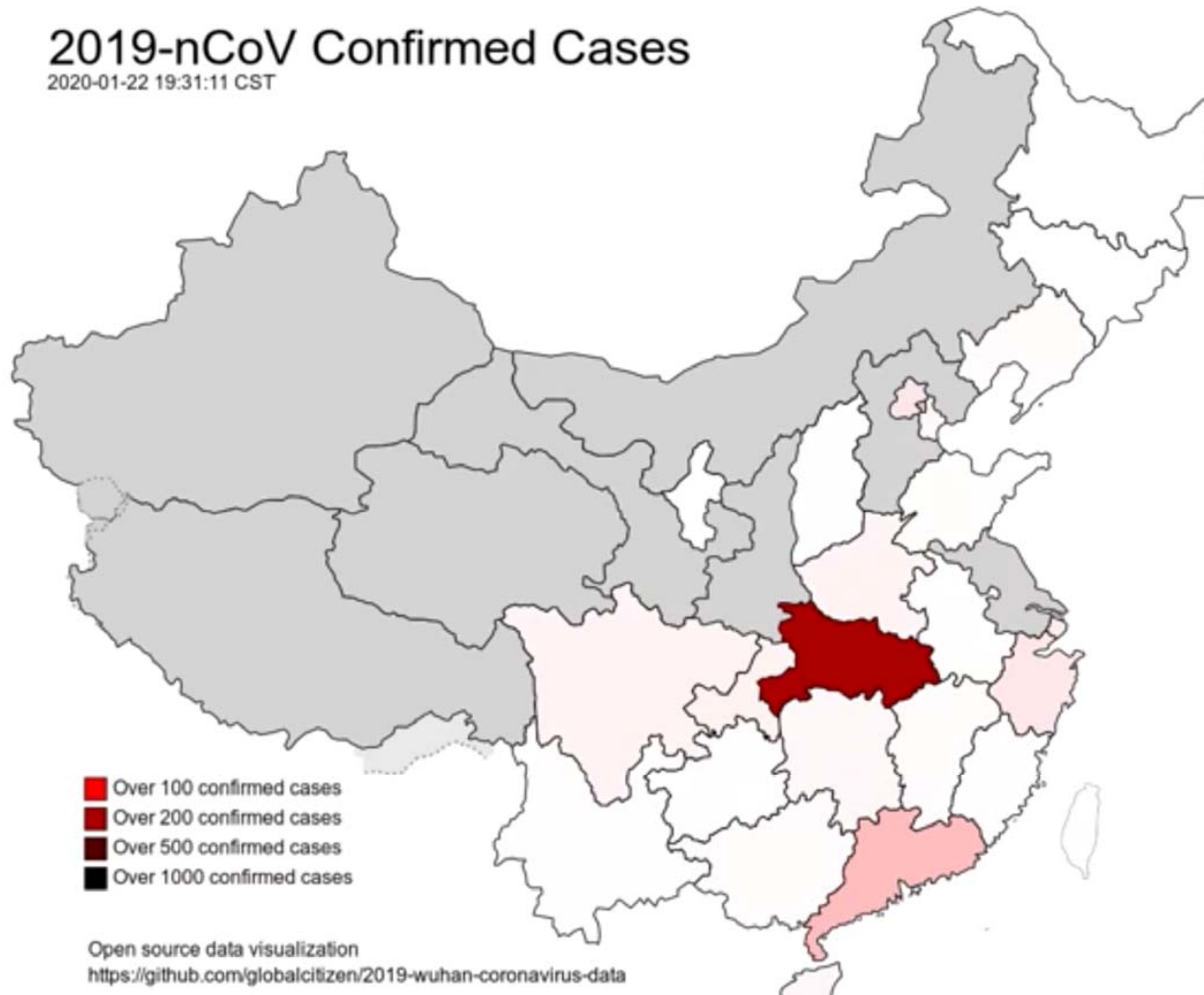
Contents

- Preparing the outbreak of COVID-19
- General characteristics of COVID-19
- Diagnosing the COVID-19
- Managing the critically ill patients with COVID-19
- Outcome of the patients with COVID-19



Animated map of confirmed 2019-nCoV cases spreading from 12 January 2020 to 5 February 2020





Animation showing the spread of confirmed 2019-nCoV cases since 22 January

Prepare the additional medical resources

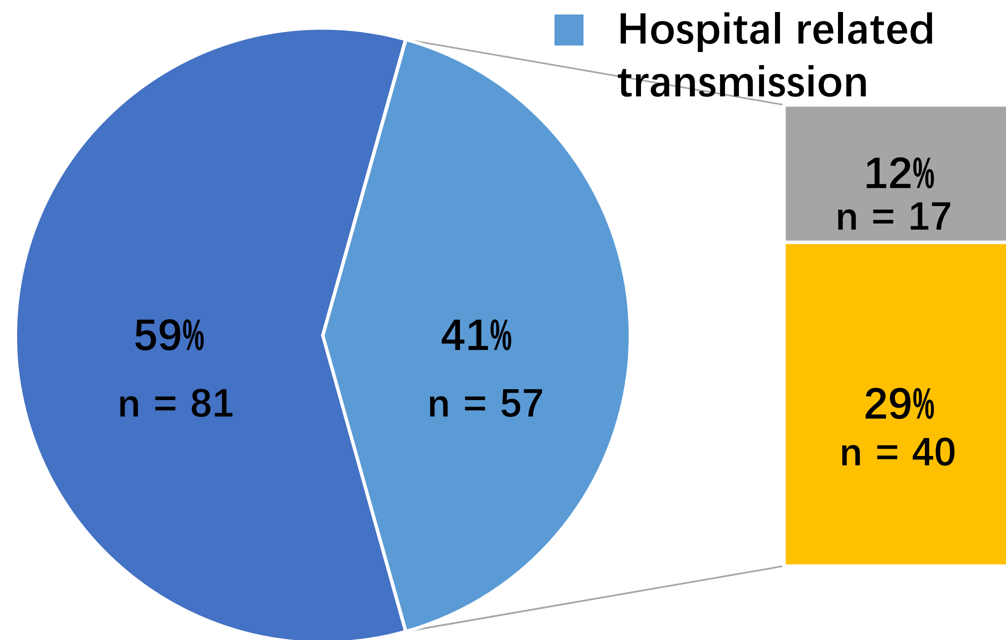
- Lack of medical/ICU beds
- Lack of human resources
- Mobilizing the medical resource
- Organizing new teams

Top priority: Personal protection

- PPE: cap, surgical gloves, fluid-resistant gown/protective suits, fit-tested respirator(N95 or FFP3), goggles(anti-fog), face shield/full hood
- Precautions for droplet, close contact and airborne
- Protocols for wearing PPE and taking off PPE
- Environment monitoring for virus

Feature of transmission

- The human-to-human transmission was frequent, especially in hospitals.



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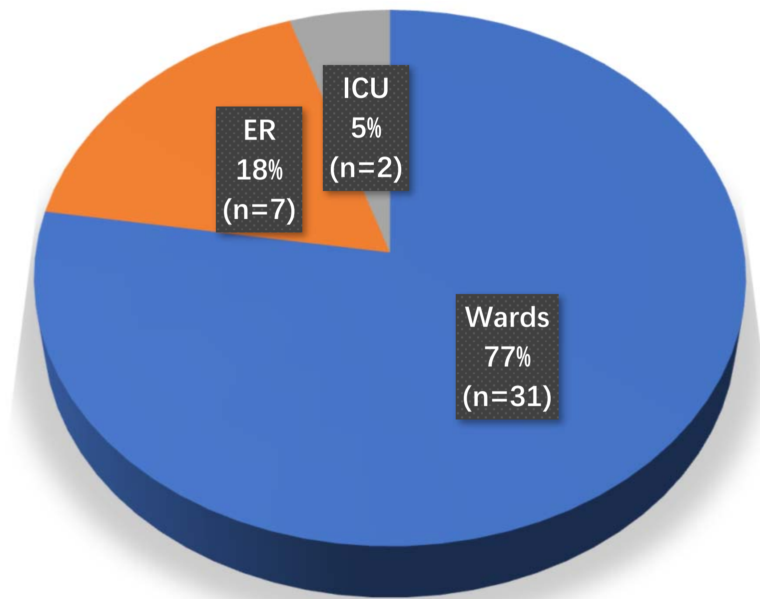
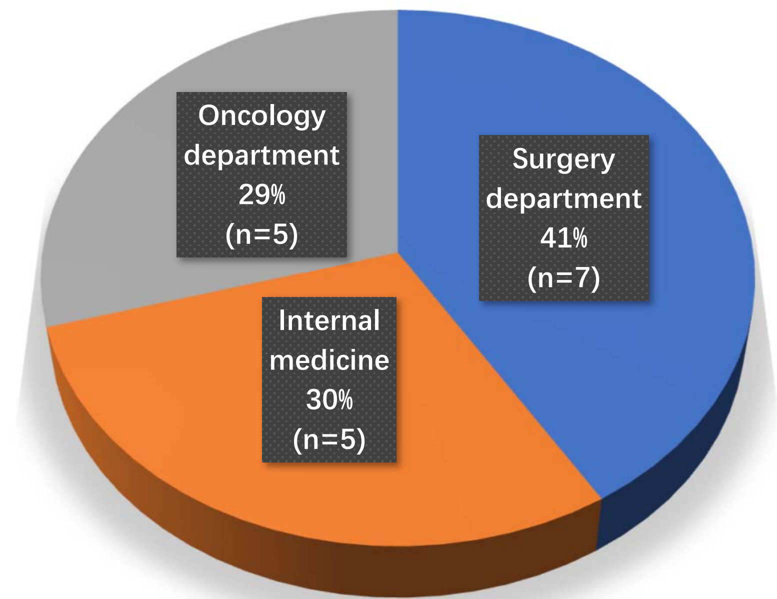
Hospital related transmission

Health care workers (70%, n=40)



Hospitalized patients (30%, n=17)



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Set up the policy for triage

- unknown fever clinics
- ER
- Isolated wards
- ICU

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Basic Characteristics of COVID-19

	Total (n=138)	ICU (n=36)	Non-ICU (n=102)	*P* value
Age, years	56(42-68)	66(57-78)	51(37-62)	<0.001
Gender, Male	75(54.3%)	22(61.1%)	53(52.0%)	0.343
Comorbidities	64(46.4%)	26(72.2%)	38(37.3%)	<0.001
Hypertension	43(31.2%)	21(58.3%)	22(21.6%)	<0.001
Diabetes	14(10.1%)	8(22.2%)	6(5.9%)	0.009
Cardiovascular disease	20(14.5%)	9(25.0%)	11(10.8%)	0.037
Cerebrovascular disease	7(5.1%)	6(16.7%)	1(1.0%)	0.001
COPD	4(2.9%)	3(8.3%)	1(1.0%)	0.054
CKD	4(2.9%)	2(5.6%)	2(2.0%)	0.279
Chronic liver disease	4(2.9%)	0(0%)	4(3.9%)	0.573
Malignancy	10(7.2%)	4(11.1%)	6(5.9%)	0.287
HIV infection	2(1.4%)	0(0%)	2(2.0%)	1.000

It was likely to infect older persons with comorbidities

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Symptoms and signs

- Most common symptoms at onset

fever (98.6%), fatigue (69.6%), dry cough (59.4%), myalgia (34.8%), and dyspnea (31.2%).

- About 10% of patients presented initially with diarrhea 1-2 days prior to development of fever and dyspnea.
- Dyspnea, dizzy, abdominal pain and anorexia frequently occurred in ICU patients.

Signs and symptoms	Total (n=138)	ICU (n=36)	Non-ICU (n=102)	P value
Fever	136(98.6%)	36(100%)	100(98.0%)	1.000
Dry cough	82(59.4%)	21(58.3%)	61(59.8%)	0.877
Expectoration	37(26.8%)	8(22.2%)	29(28.4%)	0.346
Myalgia	48(34.8%)	12(33.3%)	36(35.3%)	0.832
Fatigue	96(69.6%)	29(80.6%)	67(65.7%)	0.096
Dyspnea	43(31.2%)	23(63.9%)	20(19.6%)	<0.001
Dizzy	13(9.4%)	8(22.2%)	5(4.9%)	0.007
Abdominal pain	3(2.2%)	3(8.3%)	0(0%)	0.017
Diarrhea	14(10.1%)	6(16.7%)	8(7.8%)	0.195
Vomiting	5(3.6%)	3(8.3%)	2(2.0%)	0.127
Anorexia	55(39.9%)	24(66.7%)	31(30.4%)	<0.001

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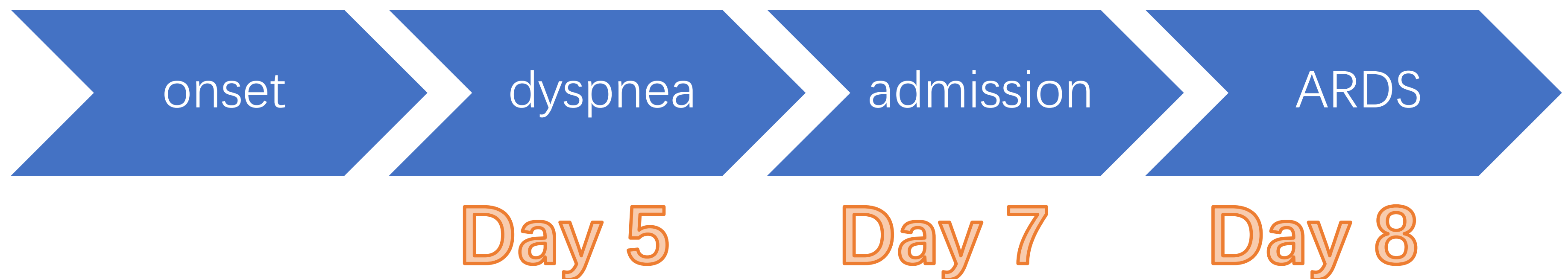
Clinical Process

- The time from onset to dyspnea was 5.0 days, 7.0 days to hospital admission, and 8.0 days to ARDS.



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laboratory parameters

	Normal range	Total (n=138)	ICU (n=36)	Non-ICU (n=102)	*P* value
White blood cell count, $\times 10^9$/L	3.5-9.5	4.5(3.3-6.2)	6.6(3.6-9.8)	4.3(3.3-5.4)	0.003
Neutrophil count, $\times 10^9$/L	1.8-6.3	3.0(2.0-4.9)	4.6(2.6-7.9)	2.7(1.9-3.9)	<0.001
Lymphocyte count, $\times 10^9$/L	1.1-3.2	0.8(0.6-1.1)	0.8(0.5-0.9)	0.9(0.6-1.2)	0.033
Monocyte count, $\times 10^9$/L	0.1-0.6	0.4(0.3-0.5)	0.4(0.3-0.5)	0.4(0.3-0.5)	0.955
Platelet count, $\times 10^9$/L	125-350	163(123-191)	142(119-202)	165(125-188)	0.775
Prothrombin time, s	9.4-12.5	13.0(12.3-13.7)	13.2(12.3-14.5)	12.9(12.3-13.4)	0.373
Activated partial thromboplastin time, s	25.1-36.5	31.4(29.4-33.5)	30.4(28.0-33.5)	31.7(29.6-33.5)	0.093
D-dimer, mg/L	0-500	203(121-403)	414(191-1324)	166(101-285)	<0.001
Creatine kinase, U/L	<171	92(56-130)	102(62-252)	87(54-121)	0.076
Creatine kinase-MB, U/L	<25	14(10-18)	18(12-35)	13(10-14)	<0.001
Lactate dehydrogenase, U/L	125-243	261(182-403)	435(302-596)	212(171-291)	<0.001
Alanine aminotransferase, U/L	9-50	24(16-40)	35(19-57)	23(15-36)	0.007
Aspartate aminotransferase, U/L	15-40	31(24-51)	52(30-70)	29(21-38)	<0.001
Total bilirubin, mmol/L	5-21	9.8(8.4-14.1)	11.5(9.6-18.6)	9.3(8.2-12.8)	0.016
Urea, mmol/l	2.8-7.6	4.4(3.4-5.8)	5.9(4.3-9.6)	4.0(3.1-5.1)	<0.001
Creatinine, μmol/L	64-104	72(60-87)	80(66-106)	71(58-84)	0.037
Hypersensitive troponin I, pg/mL	<26.2	6.4(2.8-18.5)	11.0(5.6-26.4)	5.1(2.1-9.8)	0.004

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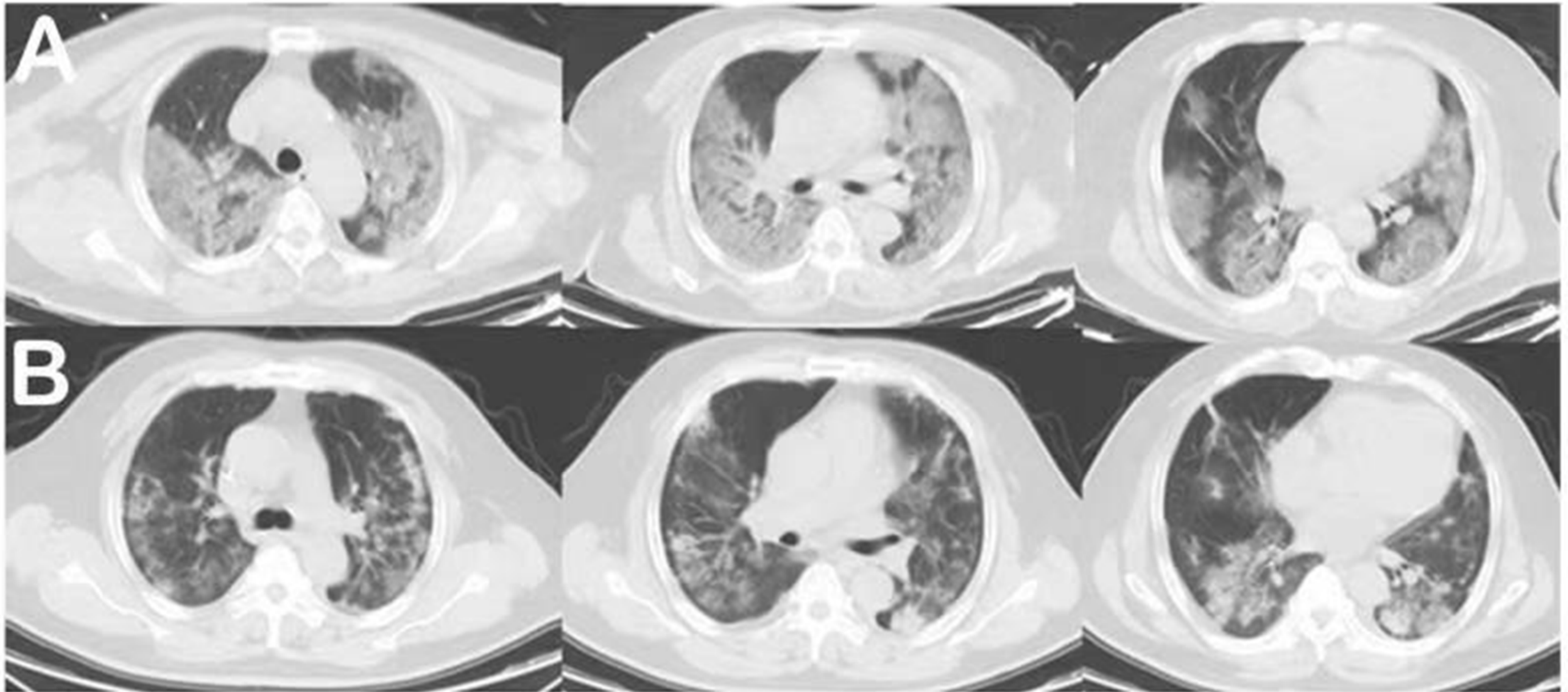
Typical chest CT: ground-glass opacity



Chest CT images of a 52-year-old patient infected with 2019-nCoV

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Diagnosis criterion

- Epidemiology history
- Typical symptoms/signs: febrile/fatigue /dyspnea
- Lab: lymphopenia , flu-test (-)
- Typical Chest CT: multiple patches starting from outer parts
- Virus test: low sensitivity
- Serum Ab test: suspect if negative virus test

- Confirmed diagnosis: symptoms/signs+Lab test+typical chest CT+positive viral test
- Clinical diagnosis: symptoms/signs+Lab test+typical chest CT

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Characteristics of ICU patients

	Normal range	ICU (n=36)
Onset of symptom to ICU admission (d)	NA	10 (6-12)
GCS	NA	15 (9-15)
APACHE II	NA	17 (10-22)
SOFA	NA	5 (3-6)
PH	7.35-7.45	7.43 (7.39-7.47)
Lactate, mmol/l	0.5-1.6	1.3 (0.7-2.0)
PaO2, mm/Hg	83-108	68 (56-89)
PaO2/FiO2, mm/Hg	400-500	136 (103-234)
PaCO2, mm/Hg	35-48	34 (30-38)

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Organ injury & Complications

- ICU patients had higher incidence of complications
- The common complications were ARDS, cardiac injury and shock.

Complications	Total (n=138)	ICU (n=36)	Non-ICU (n=102)	P value
Shock	12(8.7%)	11(30.6%)	1(1.0%)	<0.001
Acute cardiac injury	10(7.2%)	8(22.2%)	2(2.0%)	<0.001
Arrhythmia	23(16.7%)	16(44.4%)	7(6.9%)	<0.001
ARDS	27(19.6%)	22(61.1%)	5(4.9%)	<0.001
AKI	5(3.6%)	3(8.3%)	2(2.0%)	0.111

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Ventilation supports

Treatment	Total (n=138)	ICU (n=36)	Non-ICU (n=102)
High-flow Oxygen	106(76.81%)	4(11.11%)	102(100%)
NIV	15(10.9%)	15(41.7%)	0(0.0%)
IMV	17(12.32%)	17(47.22%)	0(0.0%)
ECMO	4(2.9%)	4(11.1%)	0(0.0%)

Half of the critically ill patients needed invasive ventilation and four of them switched to ECMO

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Data from current patients (Feb 7- March 6)

Treatments and outcomes	Patients (number with percentage, n=50)
Parameter measured at ICU admission (median with IQR)	
PaO2/FiO2 (mmHg)	115(87-190)
Cstat (ml/cmH_2O)	22.5(17.0-40.5)
IL-6 (pg/ml)	62.2(18.2-129.5)
Lymphocyte count ($\times 10^9$/L)	0.59(0.32-0.85)
Modes of respiratory supports	
HFNC+NIMV	14(28.0)
IMV	19(38.0)
IMV+ECMO	17(34.0)
IMV+Prone ventilation	15(30.0)
Medications	
Antiviral therapy	37(74.0)
Glucocorticoid therapy	38(76.0)
Antibiotics	45(90.0)
Complications	
ARDS	47(94.0)
Shock	22(44.0)
Arrhythmia	19(38.0)
Acute cardiac injury	13(26.0)
AKI	11(22.0)
Secondary infection	17(34.0)

Very sick with severe lung injury
28% patients recovered with only NIMV
72% requiring IMV, and half of them switched to ECMO
64% patients complicated with heart problems

Hu B, et al. Under review.

Key points for ventilation supports

- Lung protective approach is extremely important
- Prone the patients as early as possible
- Evaluate the mode/parameters set frequently, and switch/change if not appropriate
- Titrate PEEP and tidal volume based on the transpulmonary pressure or driving pressure. Keep driving pressure<15 , and Ppleuto<28
- Prevent acute CorPulmonale
- Be careful of lung RM. Set highest PEEP at 20

When to switch the modes of ventilation

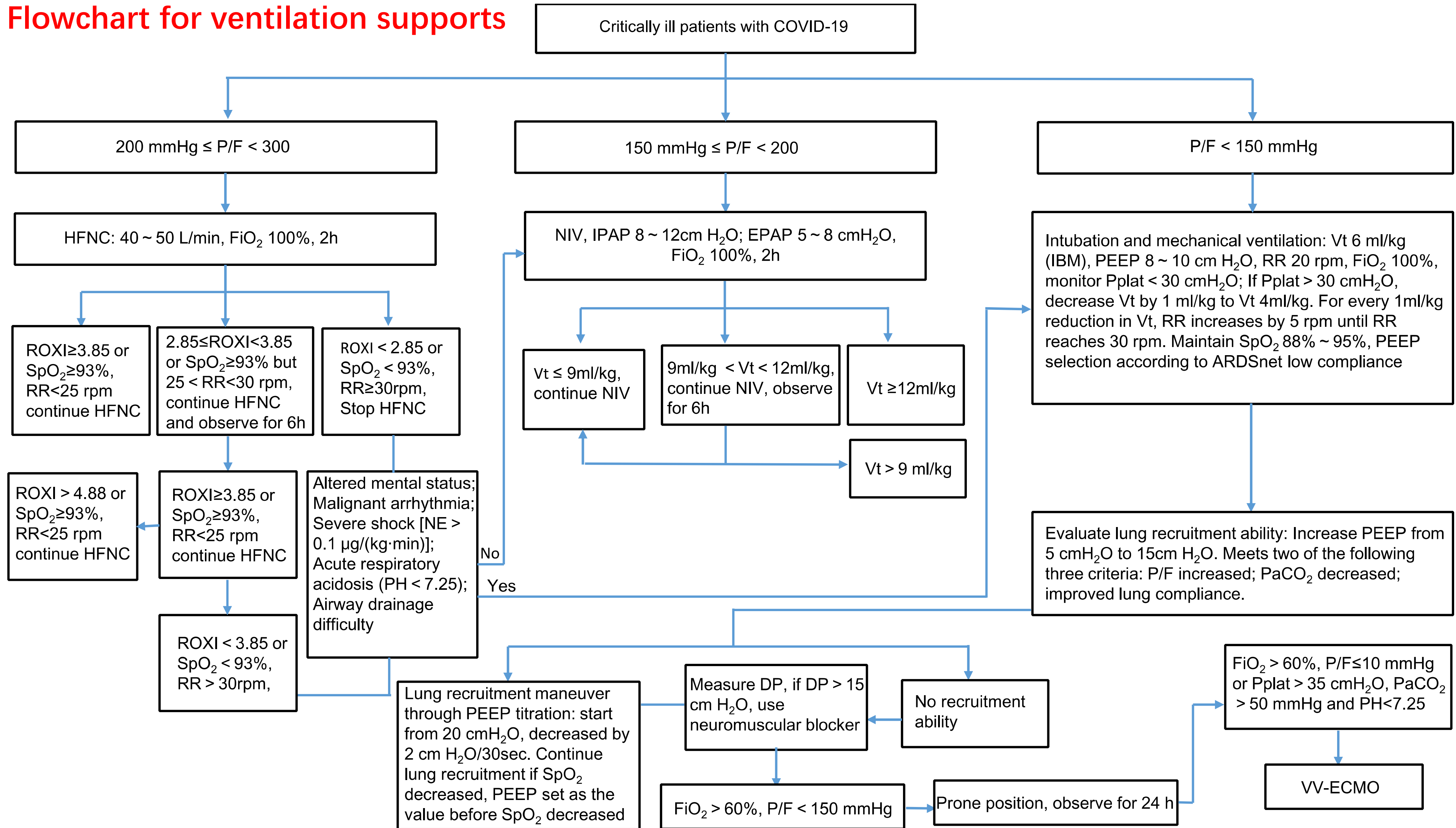
- **HFNC**: recommend in the room with negative-pressure
- If P/F 200-300mmHg, set flow rate at 40-50L/min, FiO2 100%, for 2 hr
- Evaluate the efficacy based on the ROXI[RR-(SpO2/FiO2)]
- If SpO2>93% and RR<25, or ROXI>3.85, continue HFNC; if SpO2<93% and RR>30, or ROXI<2.85, stop HFNC, and the go to NIV (if conscious) or intubation
- If the values between the ranges, continue for another 2 hr, and the re-evaluate

- **NIV**: if P/F 150-200, start NIV, however BiPAP may worsen the lung injury,
- High RR or/ and tidal volume will increase trans-pulmonary or driving pressure, worsen lung injury and pulmonary edema and induce pulmonary fibrosis
- Initial set IPAP 12, EPAP 5-8,FiO2 80-100% for 2 h, follow the tidal volume (TV), if TV<9ml/kg, continue; if TV>12, intubate

IMV

- IF P/F< 150, go to IMV
- First, test if RM is available , set the highest PEEP at 20 , if not and driving pressure>15, then paralyze the patients with prone position
- Follow the lung compliance
- If FiO2>60, P/F<150 or Ppleuto>35, PaCO2>50 and PH<7.25, go to ECMO

Flowchart for ventilation supports



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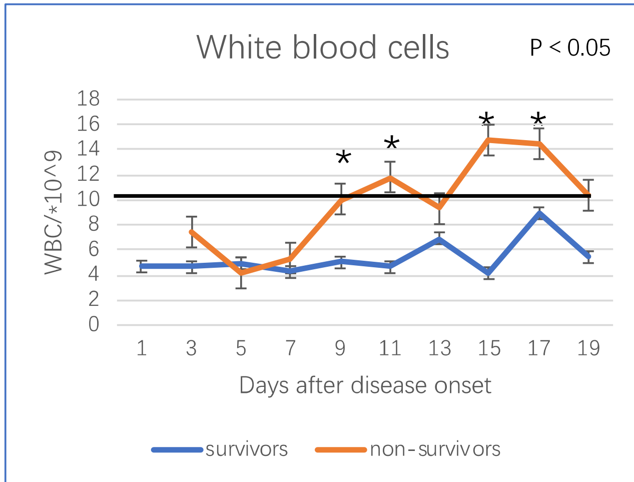
Prognosis

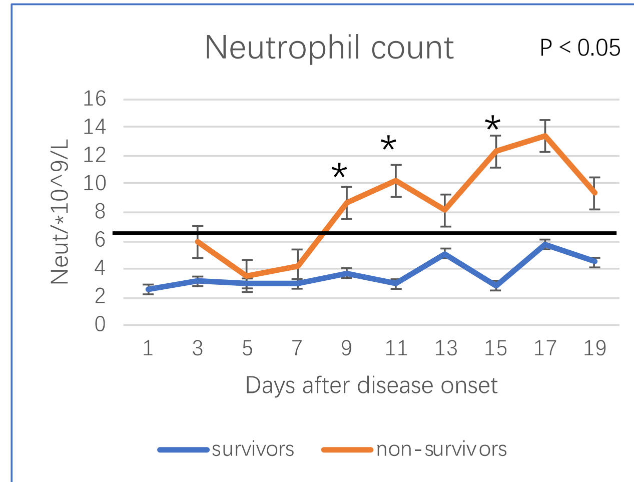
- At the end of Feb 8, 2020, 58(42.03%) patients were still in hospitalization, 72 (52.17.10%) patients had been discharged and 8 (5.79%) patients had died, and ICU mortality 18%

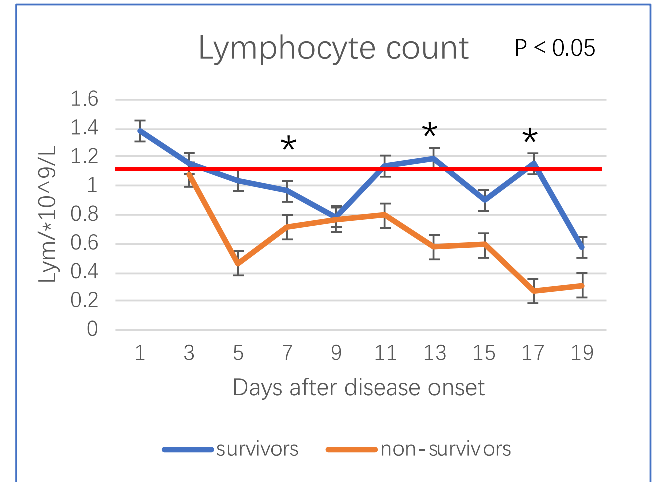
Updated information from Feb 8 to march 7

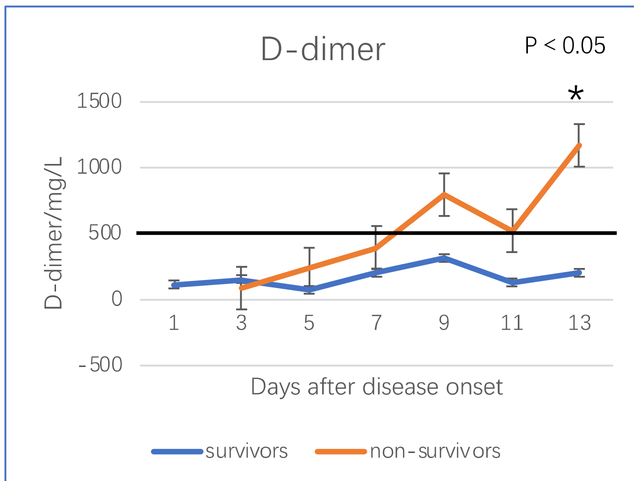
- More than 50 patients admitted in ICU from Feb 8 to March 7
- More severe patients, as some transferred from other hospitals
- Seventy percent needed IMV, half of them switched to ECMO, and 7 of them weaned off ECMO
- The predicted overall ICU mortality 25-30%

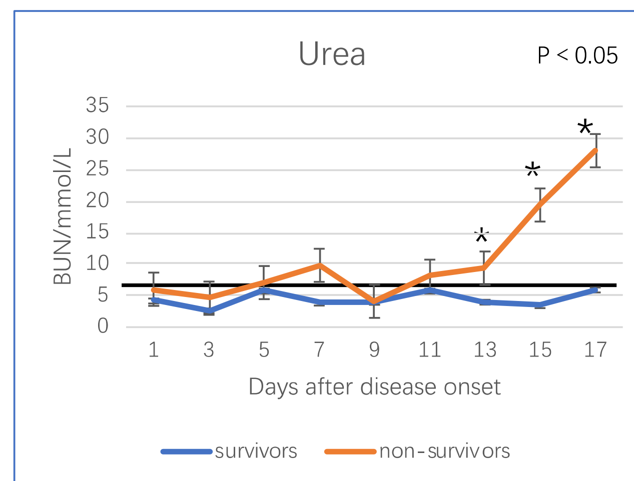
Dynamic changes of laboratory tests in survivors and non-survivors in hospitalized Pts

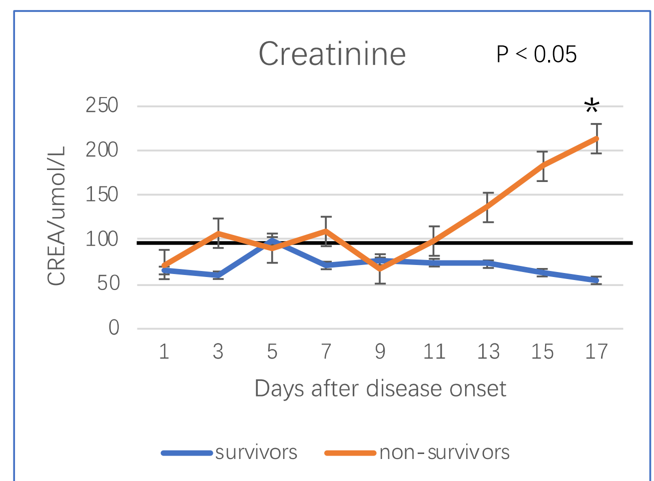












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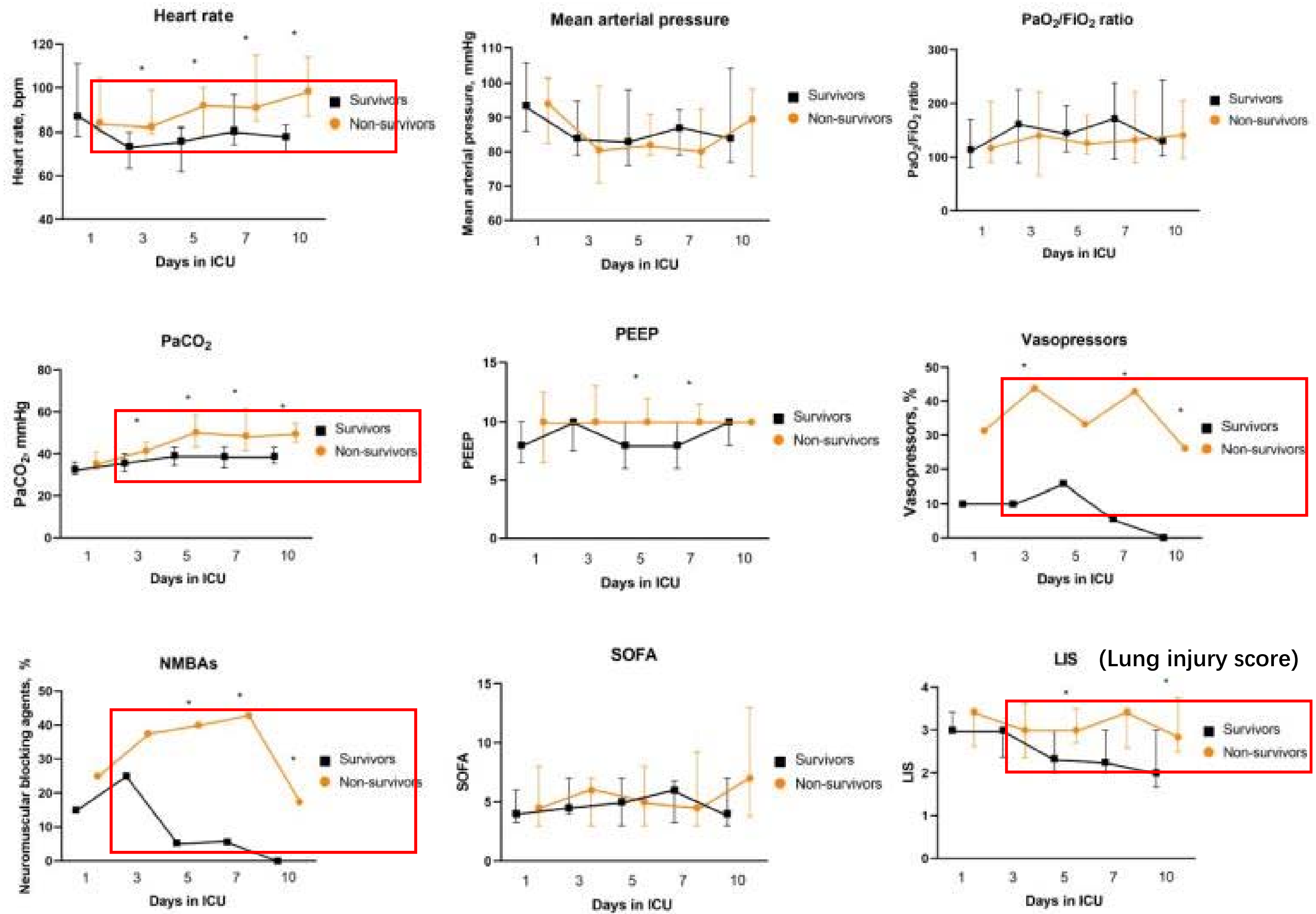
Dynamic changes of survivors and non-survivors in ICU



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Predictors at ICU admission for ICU mortality

Characteristics	All patients (n=50)	Survivors (n=20)	non-survivors (n=16)	P value
Age, years	62.0(49.5-69.0)	56.0(48.5-67.5)	66.5(61.3-75.0)	0.043
Male	34(68.0)	13(65.0)	11(68.8)	0.813
Scoring system				
APACHE II	13(11-19)	12.5(10.5-18.5)	16.5(12.0-24.3)	0.194
SOFA	5(4-8)	4.0(3.3-6.0)	4.5(3.0-8.0)	0.784
LIS	3.33(3.00-3.50)	3.0(3.0-3.42)	3.42(2.63-3.50)	0.585
Cstat (ml/cmH_2O)	22.5(17.0-40.5)	42.0(18.0-47.0)	19.5(14.0-24.2)	0.038
PaO2/FiO2	115(87-190)	114(80-170)	117(91-204)	0.633
PaCO2 (mmHg)	33.8(31.7-38.6)	32.7(30.2-36.1)	35.4(32.7-40.9)	0.115
PEEP	10.0(6.8-10.0)	8.0(6.5-10.0)	10.0(6.5-12.5)	0.386
Length of ICU stay (d)	12.0(8.3-16.8)	10.0(8.3-14.0)	12.5(8.3-22.0)	0.285
Length of mechanical ventilation (d)	8.5(5.5-15.3)	6.0(4.0-9.0)	10.5(6.9-21.3)	0.061

CONCLUSIONS

- The preparation for the outbreak of COVID-19 is quietly important, as medical resource are always limited.
- The transmission was frequent, characterized with hospital related infection but low mortality. The atypical patients were probably the main source of transmission.
- Critically ill patients tended to be older with comorbidities, specific symptoms and laboratory abnormalities.
- Titrating modes/parameters of ventilation supports with lung-protective approach is crucial.
- The most common complication was ARDS, arrhythmia and septic shock. Nearly half of the critically ill patients needed invasive ventilation.
- The lung compliance at ICU admission and persistently elevated $PaCO_2$ predicted poor outcome.

筑牢防线，坚决遏制疫情蔓延

加油，武汉！

武漢大學中南醫院