Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

TABLE
Intrauterine device choice and concern for complications among patients in clinic for intrauterine device insertion

Patient IUD preferences and concerns	n (%)
IUD type (n=599)	
52mg-LNG IUD (Mirena)	295 (49)
Low-cost 52mg-LNG IUS (Liletta)	25 (4)
19.5mg-LNG IUS (Kyleena)	166 (28)
13.5mg-LNG IUS (Skyla)	58 (10)
Copper IUD (Paragard)	55 (9)
Concern for complications (n=533)	
Ectopic pregnancy	188 (35)
Embedded IUD	285 (53)
Expulsion	235 (44)
Uterine perforation or injury	271 (51)
Pelvic inflammatory disease	156 (29)
Unable to see strings or difficult removal	131 (25)
Malpositioned IUD	185 (35)
Other	22 (4)

IUD, intrauterine device; *LNG IUS*, levonorgestrel-releasing intrauterine system.

Abern. Patient preference for intrauterine device follow-up. Am J Obstet Gynecol 2022.

With recent publications describing the traditional in-office IUD check as having limited use, many clinicians are not advising patients to schedule these appointments. However, our data demonstrate that patients have concerns, and the majority preferred to return to the office for an IUD check. These results indicate that patients should be counseled about the option of an in-office visit for an IUD check. Healthcare providers should encourage patient autonomy in IUD surveillance. ■

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Extracorporeal membrane oxygenation in pregnancy: a bridge to delivery and pulmonary recovery for COVID-19–related severe respiratory failure

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OBJECTIVE: SARS-CoV-2 and its clinical disease, COVID-19, are associated with severe maternal respiratory morbidity and mortality in pregnancy.[1] Extracorporeal membrane oxygenation (ECMO) has been used as a bridge to pulmonary recovery in nonpregnant patients,[2] but there are limited data regarding the management of ECMO in pregnancy. This case series aimed to obtain data on ECMO initiation before delivery in the setting of the ongoing COVID-19 pandemic.

STUDY DESIGN: All pregnant patients with confirmed COVID-19 based on polymerase chain reaction testing were

TABLE
Use of extracorporeal membrane oxygenation in pregnancy for COVID-19–related respiratory failure and associated outcomes

	Median (range) or N %						
Demographics Month of admission	**Jan. 2021**	**(July 2020 to July 2021)**	**Case 1 July 2020**	**Case 2 July 2020**	**Case 3 Jan. 2021**	**Case 4 June 2021**	**Case 5 July 2021**
Age (y)	33	(27–43)	27	43	30	34	33
Body mass index (kg/m^2)	36	(30–45)	36	35	45	36	30
Gravidity	2	(2–3)	3	2	2	2	3
Parity	1	(0–1)	0	0	1	1	1
Previous OB history	4	80%	No	CD × 1, PPROM	CD × 1	CD × 1	CD × 1
Race (non-White)	3	60%	Black	Latinx	Latinx	White	White
Health insurance (public)	2	40%	Public	Managed care	Public	Private	Private
Hypertensive disease	2	40%	Preeclampsia	Chronic	No	No	No
Diabetes	1	20%	No	Gestational	No	No	No
Pulmonary disorders	0	0%	No	No	No	No	No
Other medical problems	2	40%	No	No	Hypothyroidism	Hypothyroidism	No
ECMO outcomes							
Gestational age at ECMO initiation	25wk6d	(24wk6d–30wk5d)	30wk5d	26wk5d	24wk6d	25wk1d	25wk6d
Total ECMO length (d)	11	(10–68)	11	8	41	68	10
Length of antepartum ECMO[a] (d)	10	(1–32)	8	1[a]	32	29	10
Birth to decannulation (d)	8.5	(3–39)	3	8	9	39	—
Extubation while on ECMO	1	20%	No	No	No	No	Yes
Mobilization while on ECMO	2	40%	No	No	No	Yes	Yes
ECMO complications							
Circuit exchanges	0	(0–4)	0	0	1	4	0
Pressor use	4	80%	No	Yes	Yes	Yes	Yes
Antihypertensive use	3	60%	Yes	No	Yes	Yes	No
Cardiac	1	20%	No	No	No	Heart block, cardiac arrest	No
Lung	2	40%	Bronchoscopy mucus plug	No	No	Pneumothorax	No

Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

(continued)

TABLE

Use of extracorporeal membrane oxygenation in pregnancy for COVID-19–related respiratory failure and associated outcomes *(continued)*

Demographics Month of admission	Median (range) or N % Jan. 2021	 (July 2020 to July 2021)	Case 1 July 2020	Case 2 July 2020	Case 3 Jan. 2021	Case 4 June 2021	Case 5 July 2021
Infectious	4	80%	Pseudomonas pneumonia	Pseudomonas pneumonia	ESBL UTI and pneumonia	Canula site infection	No
Renal	1	20%	Acute kidney injury	No	No	No	No
Liver	1	20%	No	No	HELLP	No	No
Gastrointestinal	3	60%	No	Dysphagia	Lower bleed	Lower bleed	No
Neurologic	0	0%	No	No	No	No	No
Anticoagulation agent (addition to heparin)	3	60%	Heparin	Heparin	Heparin then argatroban	Heparin then argatroban	heparin then argatroban
Venous thromboembolism	4	80%	No	Left popliteal to common femoral and pulmonary embolism	Bilateral external iliac, inferior vena cava, right brachial	Right common femoral	Left gastrocnemius
Bleeding complication	4	80%	Disseminated intravascular coagulation	No	Anterior rectus and uterine hematomas, delayed postpartum hemorrhage	Rectus hematoma, postpartum abdominal wash-out and inferior epigastric embolization	Hemolytic anemia with thrombocytopenia
Red cells	12	(0–48)	12	2	42	48	0
Plasma	0	(0–4)	0	0	0	4	0
Platelets	1	(0–2)	2		0	2	1
Cryoprecipitate	1	(0–2)	1	0	1	2	1
Anticoagulation at discharge	4	80%	No	Yes, apixaban	Yes, enoxaparin	Yes, apixaban	Yes, enoxaparin
Neonatal outcomes							
Gestational age at birth	29wk3d	(26wk5d-31wk6d)	31wk6d	26wk5d	29wk3d	29wk2d	—
Mode of delivery (CD)	4	100%	Emergent cesarean	Emergent cesarean	Planned cesarean	Planned cesarean	—
Indication for delivery	NA	NA	Concern for HELLP vs abruption	Preterm labor	Improving maternal status so delivery to facilitate decannulation	Maternal cardiac arrest with worsening status	—
1-minute Apgar score	2.5	(1–4)	4	1	2	3	—

Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022. *(continued)*

TABLE

Use of extracorporeal membrane oxygenation in pregnancy for COVID-19–related respiratory failure and associated outcomes *(continued)*

Demographics	Median (range) or N %						
Month of admission	Jan. 2021	(July 2020 to July 2021)	Case 1 July 2020	Case 2 July 2020	Case 3 Jan. 2021	Case 4 June 2021	Case 5 July 2021
5-minute Apgar score	6	(5–9)	7	5	5	9	—
UA pH	7.36	(7.23–7.41)	NA	7.23	7.36	7.41	—
UA base excess	5	(1-5)	NA	1	5	5	—
Live birth	4	100%	Yes	Yes	Yes	Yes	—
Birthweight (g)	1234	(1000–1465)	1465	1000	1194	1274	—
NICU length of stay (d)	58	(31–58)	31	NA	65	58	—
Neonatal morbidity	NA	NA	Ventilation, bradycardia	Ventilation, persistent ductus	Sepsis, chronic lung disease persistent ductus	Respiratory distress syndrome, anemia	—
Neonatal survival to discharge	4	100%	Yes	Yes	Yes	Yes	—
Positive COVID-19 PCR	0	0%	No	No	No	No	—
COVID-19+ antibodies	1	25%	Yes	No	No	No	—
Maternal outcomes							
Survival to delivery	4	100%	Yes	Yes	Yes	Yes	—
Survival to discharge	5	100%	Yes	Yes	Yes	Yes	Yes
Tracheostomy (d)	10	(0–113)	16	0	10	113	0
Discharged on O_2	2	40%	No	No	No	Yes	Yes
Discharge with rehabilitation	1	20%	No	No	Yes	No	No
Total length of stay (d)	30	(16–80)	30	16	55	80	17
ICU length of stay (d)	26	(11–77)	26	11	49	77	12
Postpartum mood disorder	3	75%	Depression	No	Anxiety	Insomnia	—
Breastfeeding	1	25%	No	No	Pumping POD1-POD5, POD11	No	—

Neonatal outcomes for case 5 were not available because the pregnancy was ongoing at time of discharge.

CD, cesarean delivery; *ECMO*, extracorporeal membrane oxygenation; *ESBL*, extended spectrum beta lactamase; *HELLP*, hemolysis, elevated liver enzymes, low platelets syndrome; *ICU*, intensive care unit; *POD*, postoperative day; *PPROM*, preterm premature rupture of membranes; *UA*, umbilical arterial; *UTI*, urinary tract infection.

[a] ECMO antepartum time was <1 day (17 hours), rounded up to 1 day.

Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

identified at the University of California, Los Angeles (UCLA) from March 2020 to August 2021, and those who required ECMO were enrolled (institutional review board approval, #20-000579). Case 1 and 2 were previously described.[3] The Supplemental Table details institutional protocols for COVID-19, ECMO, and delivery management. COVID-19 therapeutics used include remdesivir (4 of 5), dexamethasone (5 of 5), convalescent plasma (3 of 5), and tocilizumab (2 of 5). All patients were cannulated with 2 veno-venous femoral catheters within 2 days of ventilation and placed on heparin as anticoagulation therapy. The partial pressure of O_2 to fraction of inspired O_2 ratio at ECMO initiation was 94 (range, 54−109) with a Murray score for acute lung injury of 3.5 (range, 3.3−5.0) and a Respiratory ECMO Survival Prediction Score of 5 (range, 3−6).[4,5] All neonates received steroids for prematurity and were monitored intermittently unless there was a change in the maternal or fetal status.

RESULTS: Of the 25 pregnant patients hospitalized for COVID-19 during the enrollment period, 16 were admitted to the intensive care unit and 5 of them required ECMO for respiratory support. Of those, 4 delivered while on ECMO and 1 was decannulated and discharged with an ongoing pregnancy. All outcomes are presented in the Table and timelines are presented in the Supplemental Figure. Obesity was a risk factor for 5 of 5 patients and 3 of 5 patients belonged to the Black, indigenous, people of color group. ECMO was initiated at a median of 25 weeks and 6 days of gestation. The total median time on ECMO was 11 days (range, 10−68) with 10 days (range, 1−32) of ECMO antepartum. The most common complications occurred in 4 of 5 cases, namely pressor use, infection, venous thromboembolism, and bleeding including postoperative hematomas, disseminated intravascular coagulation, and delayed postpartum hemorrhage. Hematologic morbidity occurred within days of cesarean birth and or decannulation. The median gestational age at birth was 29 weeks 3 days (range, 26 weeks 5 days to 31 weeks 6 days) and all deliveries were by cesarean delivery for a wide range of maternal and fetal indications with 4 of 4 livebirths and neonatal survival to discharge. There was significant neonatal respiratory morbidity with a median neonatal intensive care unit length of stay of 58 days (range, 31−58). The maternal survival to delivery and discharge was 5 of 5, with a total median length of stay of 30 days (range, 16−80). Postpartum mood disorder was commonly diagnosed by psychiatry (3 of 4 cases) and breastfeeding occurred in 1 patient.

CONCLUSION: This case series presents outcomes for the use of ECMO during pregnancy for acute respiratory failure caused by COVID-19. Our findings concur with the 2 other cases in literature,[6] showing that pregnancy can be prolonged on ECMO, delivery on ECMO can be performed safely, and ECMO can serve as a bridge to maternal respiratory recovery. There were high rates of maternal and neonatal survival. Significant hematologic morbidity and neonatal respiratory morbidity were observed. ECMO in pregnancy should be managed with an experienced multidisciplinary team that can make key decisions about initiation, cannulation, timing of delivery, management of complications, and postpartum care. ■

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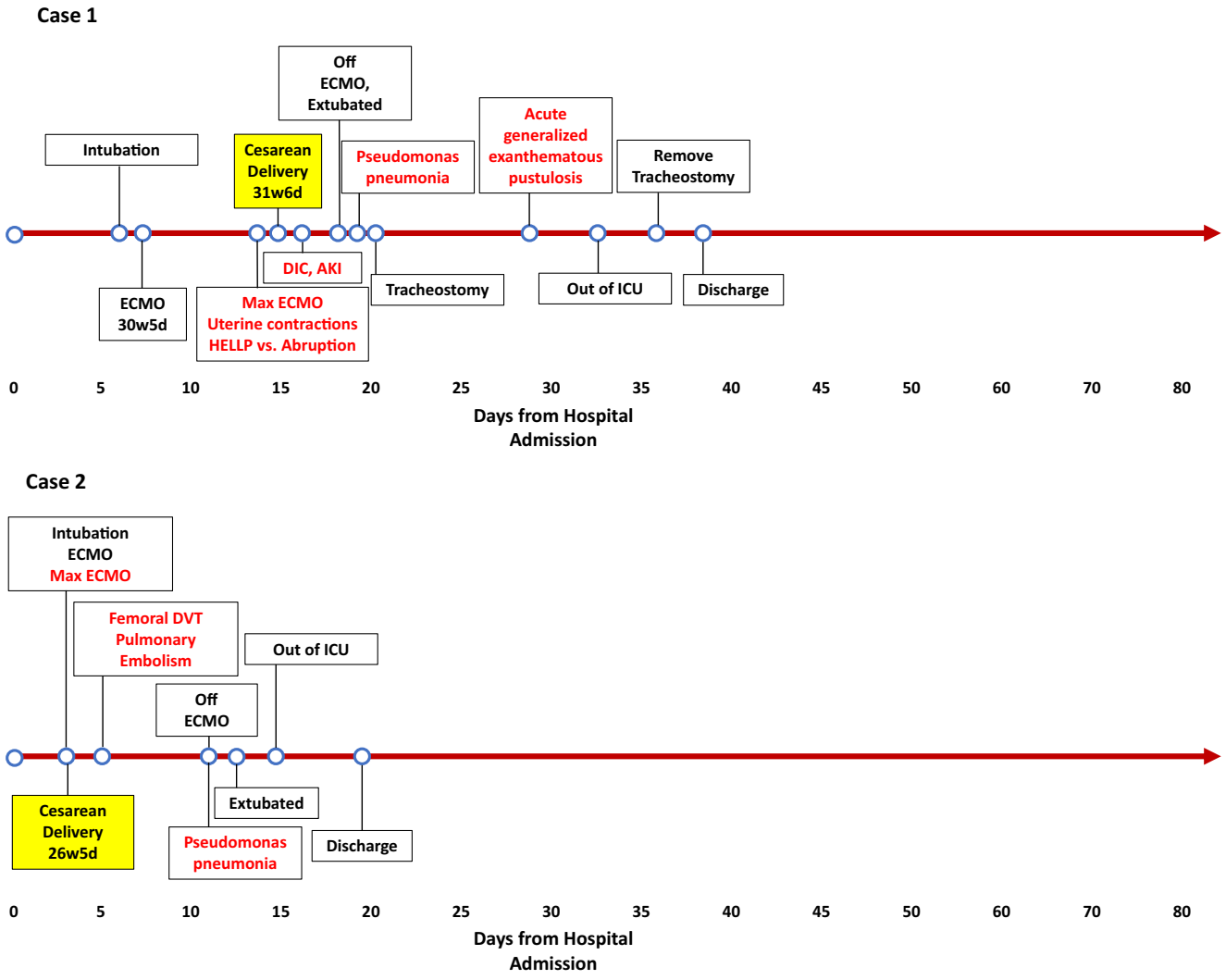
Unified standard for fetal growth: the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Fetal Growth Studies

Check for updates

OBJECTIVE: The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Fetal Growth Studies—Singletons developed fetal growth standards in a contemporary, race and ethnicity diverse, and healthy multisite population in the United States.[1] The study revealed differences in fetal growth, represented as size-for-gestational-age, by maternally self-reported race and ethnicity, demonstrable as early as 10 to 16 weeks' gestation.[2,3] Based on these findings, fetal growth standards stratified by race and ethnicity were developed because pooling results among self-identified racial and ethnic groups may differentially classify growth at the extremes, namely small for gestational age (SGA) or large for gestational age (LGA).[4,5] For example, the study-derived standard based solely on the White racial and ethnic group classified up to 15% of fetuses born to non-White mothers as SGA (estimated fetal weight [EFW] of <fifth percentile).[2,3] Since that time, there has been recognition that inclusion of self-reported race and ethnicity in clinical algorithms may create unintended consequences for diagnosis and intervention.[6,7] In addition, if an individual does not identify as one of the specified racial and ethnic groups, then a unified standard may be more useful as a first step in the diagnostic process. We sought to create a contemporary, unified fetal growth standard, including all healthy participants in the NICHD Fetal Growth Studies—Singletons, weighted to represent the US population of pregnant women, to supplement our previous work and compare with (1) our previous racial- and ethnic-specific standards[3] and (2) the Hadlock reference[8] because the Society for Maternal-Fetal Medicine (SMFM) recommends the use of "population-based fetal growth references (such as Hadlock)."[9]

STUDY DESIGN: Analyses included the same sample used for the racial- and ethnic-specific standards,[1] composed of 1737 pregnant individuals without obesity with low-risk antenatal profiles from 12 US clinical sites (2009—2013) who delivered at ≥37 weeks' gestation.[1,2] Statistical analysis included 1732 eligible women (99.7%) with ultrasound measurements, of which 27.7%, 24.4%, 28.1%, and 19.8% self-identified as non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic, and Asian or Pacific Islander (Asian), respectively. To approximate a nationally representative standard, the study sample was weighted back to a US population distribution of pregnant women using the natality statistics from 2011, which was the midpoint of the enrollment years (Supplement).[10] Human subjects' approval was obtained from all participating sites, and all women provided informed consent. A total of 6 research ultrasounds were performed measuring fetal biparietal diameter, head circumference (HC), abdominal circumference (AC), humerus, and femur length (FL). EFW was calculated from HC, AC and FL.[11] The individual measurements, HC-to-AC ratio, and EFW were log-transformed to stabilize variances across gestational ages and improve normal approximations for error structures. Linear mixed models with cubic splines for the fixed and random effects were used to flexibly model fetal growth trajectories.[12] Models were weighted on race and ethnicity

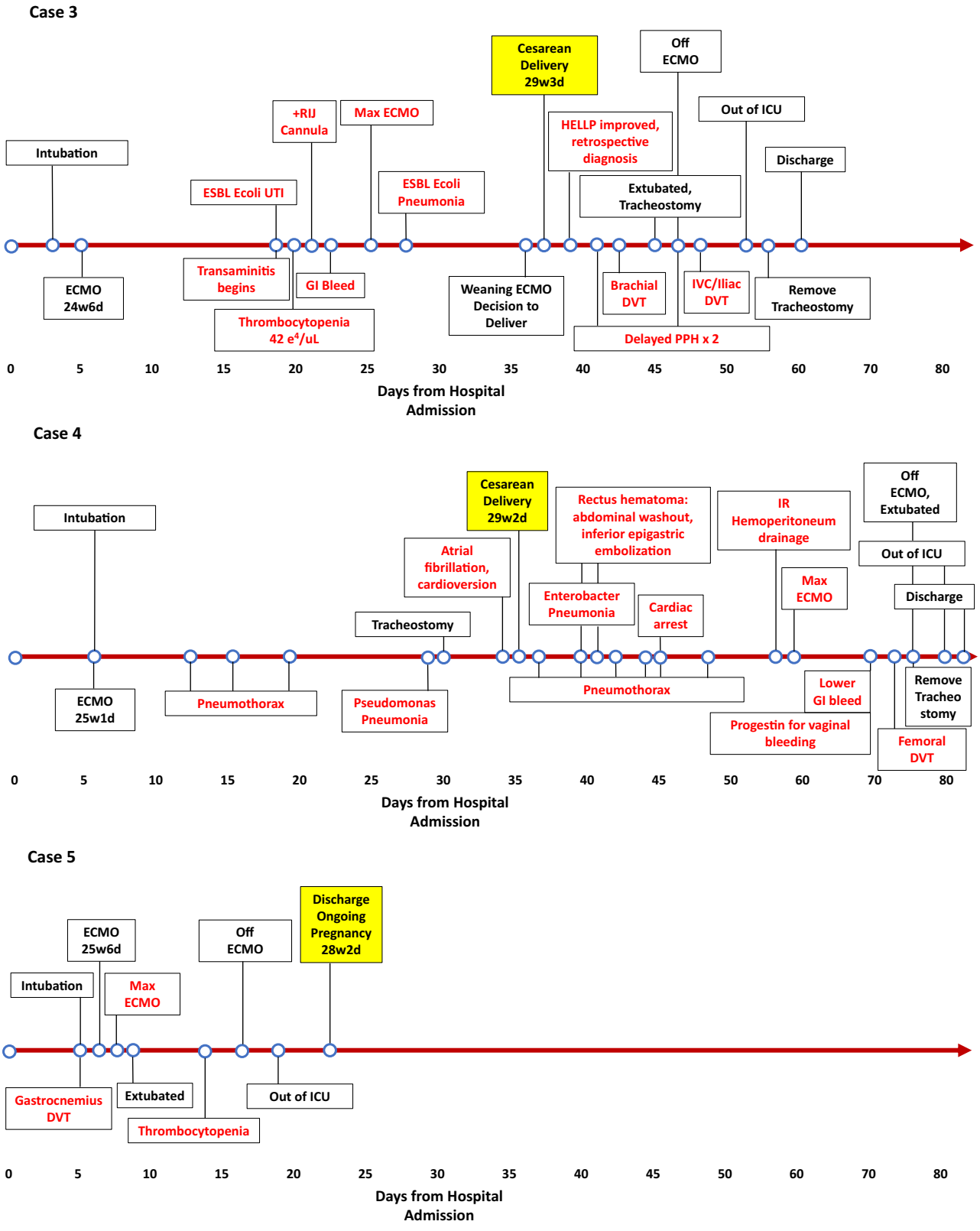
SUPPLEMENTAL FIGURE
Detailed clinical course and graphical abstract



AKI, acute kidney failure; *DIC*, disseminated intravascular coagulation; *DVT*, deep vein thrombosis; *ECMO*, extracorporeal membrane oxygenation; *ESBL*, extended spectrum beta lactamase; *GA*, gestational age; *GI*, gastrointestinal tract; *HELLP*, hemolysis, elevated liver enzymes, low platelets syndrome; *ICU*, intensive care unit; *IVC*, inferior vena cava; *RIJ*, right internal jugular; *UTI*, urinary tract infection; *VTE*, venous thromboembolism.

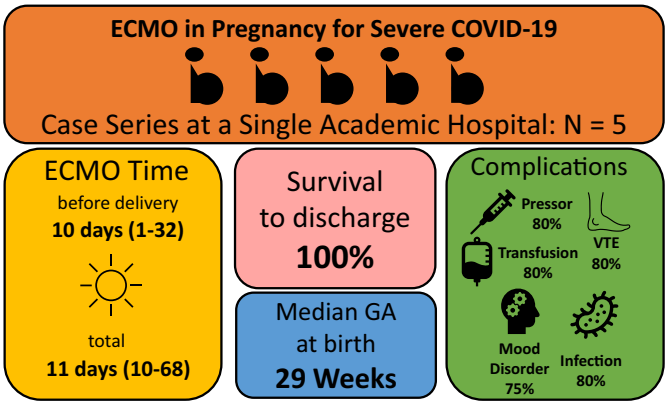
Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

SUPPLEMENTAL FIGURE
Continued



Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

SUPPLEMENTAL FIGURE
Continued



Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

SUPPLEMENTAL TABLE

Institutional protocols for management of COVID-19 and extracorporeal membrane oxygenation in pregnancy

COVID-19 treatment	Median (range) or N %		Case 1	Case 2	Case 3	Case 4	Case 5
Remdesivir	4	80%	Yes	Yes	Yes	Yes	No
Dexamethasone	5	100%	Yes	Yes	Yes	Yes	Yes
Antibiotics (ceftriaxone, azithromycin)	5	100%	Yes	Yes	Yes	Yes	Yes
Convalescent plasma	3	60%	Yes	Yes	No	Yes	No
Monoclonal antibodies	2	40%	Tocilizumab	No	No	No	Tocilizumab
Anticytokines	0	0%	No	No	No	No	No
Hydroxychloroquine	0	0%	No	No	No	No	No
COVID-19 vaccination	0	0%	No	No	No	No	No
Pulmonary vasodilator	2	40%	No	No	Yes	Yes	No
Prone	1	20%	Yes	No	No	No	No
ECMO initiation							
Arterial pH	7.35	(7.22–7.48)	7.38	7.31	7.22	NA	7.48
$PaCO_2$	45	(31–50)	47	43	50	NA	31
PaO_2/FiO_2 ratio	94	(54–109)	94	68	54	95	109
Murray score	3.5	(3.3–5)	3.5	4	3.8	3.3	3.5
RESP score	5	(3–6)	3	5	4	6	6
Echo ejection fraction	58%	(55%–68%)	55%	NA	NA	68%	58%
Admit to ventilation (d)	4	(2–5)	5	2	2	5	4
Ventilation to ECMO (d)	1	(0–2)	1	0	2	0	1
Site (mobile)	4	80%	On site	Mobile	Mobile	Mobile	Mobile
Cannulation (femoral vein)	5	100%	21 RFV, 25 LFV	21 RFV, 25 LFV	21 RFV, 25 LFV	21 RFV, 25 LFV	21 RFV, 25 LFV
Anticoagulation agent (addition to heparin)	3	60%	Heparin	Heparin	Heparin then argatroban	Heparin then argatroban	Heparin then argatroban
% time on therapeutic anticoagulation antepartum	100%	(46–100%)	100%	100%	52%	46%	100%
% time on therapeutic anticoagulation postpartum	86%	(0–100%)	0%	100%	77%	95%	—
ECMO settings (maximum)							

Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.

(continued)

SUPPLEMENTAL TABLE

Institutional protocols for management of COVID-19 and extracorporeal membrane oxygenation in pregnancy *(continued)*

COVID-19 treatment	Median (range) or N %		Case 1	Case 2	Case 3	Case 4	Case 5
Pump flow (L/min)	4.2	(3.8–4.99)	4.2	3.85	6	3.8	4.99
Pump speed (rotations/min)	2810	(2260–3200)	2350	2260	3200	2850	2810
Cardiac index (L/min/m^2)	2.15	(1.99–2.91)	2.15	2.06	2.91	1.99	2.57
FiO_2 (%)	100	(70–100)	70	100	100	100	100
Sweep (L/min)	6	(4–15)	6	4	11	15	5
Fetal interventions							
Length since last steroids (for any reason) at delivery (d)	0	0%	3	0	0	0	—
Magnesium	2	50%	Yes	No	No	Yes	—
% continuous monitoring	29%	(0-59%)	25%	33%	59%	0%	—
Delivery interventions							
Hysterotomy (low transverse)	3	75%	Low transverse	Inverted T	Low transverse	Low transverse	—
Oxytocin (units)	30	(10–60)	60	30	10	30	—
Methylergonovine	1	25%	No	No	200 μg q4 × 24 h	No	—
Carboprost	0	0%	No	No	No	No	—
Misoprostol	2	50%	No	No	1000 μg	800 μg	—
Tranexamic acid	1	20%	No	No	No	1 g	—
Mechanical balloon for hemorrhage	1	25%	No	No	Balloon	No	—
Surgical antibiotics	4	100%	Piperacillin tazobactam, vancomycin	Ceftriaxone, azithromycin	Cefazolin, metronidazole	Cefazolin	—

ECMO, extracorporeal membrane oxygenation; *RESP score*, Respiratory ECMO Survival Prediction Score.

Yin. Extracorporeal membrane oxygenation in pregnancy for severe respiratory failure in COVID-19. Am J Obstet Gynecol 2022.