APPENDIX 1 – ELSO Registry Case Report Form

ECLS Registry Form

Extracorporeal Life Support Organization (ELSO)

Center ID:_____ Center name: _____ Run No _____
(for this patient)

Unique ID: _____ Birth Date/Time _____
Month d, yyyy hh:mm

Sex: _____ (M, F) Race: _____ (Asian, Black, Hispanic, White, Other)

Neonatal patients:

Birth weight: _____ kg Maternal age: _____

Apgar (1 min): _____ Apgar (5 min): _____

Delivery: ☐ Vaginal ☐ C-sect ☐ Elective C-sect

Gestational age: _____

CDH present? ☐ (Check if yes) If Yes: Prenatal diagnosis? ☐ (Check if yes)

Side of CDH: ____ (R,L,B) Repair: ☐ None ☐ Pre-ECLS ☐ On ECLS ☐ Post-ECLS

Infant Transported? ☐ (Check if yes) Cardiac arrest at birth? ☐ (Check if yes)

Diagnoses and Procedures

	ICD-9 Codes		
Primary diagnosis:	_____		Use ICD-9 codes for diagnoses (see diagnosis codes sheet)
Secondary diagnoses:	_____	_____	_____
(unlimited)	_____	_____	_____

	CPT Code	**Date/Time of Procedure**	
Procedures: (unlimited)	_____	_____	Use CPT codes for procedures (see procedure codes sheet)
	_____	_____	
	_____	_____	

(List all relevant procedures related to the patient even if preceding this admission)

Cultured Organisms:

(unlimited)

Organism: _____ Site:_____ Date/Time _____

Organism: _____ Site:_____ Date/Time _____

Organism: _____ Site:_____ Date/Time _____

Organism: _____ Site:_____ Date/Time _____

Sites: Blood, Bone, Cerebrospinal fluid, Peritoneal fluid, Pleural fluid, Respiratory tract, Skin/soft tissue, Stool, Urine, Wound – surgical, Wound – traumatic, Other, Unknown

Pre-ECLS Course

Date / Time admitted: _____ Intubated: _____
(to ECLS center) Month d, yyyy hh:mm Month d, yyyy hh:mm

Current weight (kg): _____

Patient Transported: ☐ Pre-ECLS cardiac arrest: ☐ Bridge to transplant: ☐

Pre-ECLS support: _____ _____ _____ _____ _____ (Use Support Codes)

_____ _____ _____ _____ _____

Pre-ECLS blood gases:

Date/Time: _____ (Worst in last 6 hours)

pH: _____ PaCO2: _____ PaO2:_____ HCO3: _____ SaO2(%):_____

Pre-ECLS ventilator settings:

Date/Time:_____ (Worst in last 6 hours)

Rate/Hz: _____ FiO2(%):_____ PIP/Ampl: _____ PEEP: _____ MAP: _____

Hand bagging: ☐ (check if yes) Vent type: ☐ Conventional ☐ HFO ☐ Other HFV

Pre-ECLS hemodynamics:

Date/Time: _____ (Worst in last 6 hours)

BP: _____ _____ _____ SvO_2: _____ PCWP: _____
Systolic Diastolic Mean

PAP: _____ _____ _____ CI: _____
Systolic Diastolic Mean

ECLS Course

Date/Time on ECLS: _____ Date/Time off ECLS: _____
Month d, yyyy hh:mm Month d, yyyy hh:mm

Reason for support: ☐ Pulmonary ☐ Cardiac ☐ ECPR

ECLS mode: _____
(VA, VA+V, VA-VV, VV, VV-VA, VVA, VVDL, VVDL+V, Other)

Cannulations:

Site	Percutaneous	Manufacturer	Size (Fr)	Length (cm)
____	☐ Yes	_____	_____	_____
____	☐ Yes	_____	_____	_____
____	☐ Yes	_____	_____	_____

Site: RCCA, LCCA, RIJV, RIJVC, LIJV, RFA, LFA, RFV, LFV, RA, LA, PA, Aorta, Other

Equipment used:

Membrane lung: _____

Heat exchanger: _____

Pump: _____

Hemofilter: _____

Pump flow: Units: ☐ ml/kg/min ☐ ml/min ☐ L/min (Check one)

4th hour flow: _____ 24th hour: _____

24 hour ECLS blood gases:

Date/Time: _____ (Best values at 24 hours of ECLS)

pH: _____ PaCO2: _____ PaO2:_____ HCO3: _____ SaO2(%):_____

24 hour ECLS ventilator settings:

Date/Time: _____ (Best values at 24 hours of ECLS)

Rate/Hz: _____ FiO2(%):_____ PIP/Ampl: _____ PEEP: _____ MAP: _____

Hand bagging: ☐ (check if yes) Vent type: ☐ Conventional ☐ HFO ☐ Other HFV

24 hour hemodynamics:

Date/Time: _____ (Best values at 24 hours of ECLS)

BP: _____ (Systolic) _____ (Diastolic) _____ (Mean) SvO_2: _____ PCWP: _____

PAP: _____ (Systolic) _____ (Diastolic) _____ (Mean) CI: _____

ECLS Complications

Mechanical complications: (requiring change of equipment or intervention)

- ☐ Oxygenator failure
- ☐ Raceway rupture
- ☐ Other tubing rupture
- ☐ Pump malfunction
- ☐ Heat exch. Malfunction
- ☐ Clots: oxygenator
- ☐ Clots: bridge
- ☐ Clots: bladder
- ☐ Clots: hemofilter
- ☐ Clots: other
- ☐ Air in circuit
- ☐ Cracks: connectors
- ☐ Cannula problems

Patient complications:

Hemorrhagic complications: (requiring transfusion or other intervention)

- ☐ GI hemorrhage
- ☐ Cannulation site bleeding
- ☐ Surgical site bleeding
- ☐ Hemolysis (plasma hgb > 50 mg/dl)
- ☐ DIC

Neurologic complications:

- ☐ Clinical brain death
- ☐ Clinical seizures
- ☐ EEG seizures
- ☐ Infarction (US or CT)
- ☐ Hemorrhage (US or CT)

Renal complications:

- ☐ Creatinine 1.5-3.0
- ☐ Creatinine > 3.0
- ☐ Hemodialysis
- ☐ Hemofiltration
- ☐ CAVHD

Pulmonary complications: (requiring intervention)

- ☐ Pneumothorax
- ☐ Pulmonary hemorrhage

Cardiopulmonary complications: (requiring intervention)

- ☐ Inotropes on ECLS
- ☐ CPR required
- ☐ Myocardial stun by echocardiography
- ☐ Cardiac arrhythmia
- ☐ Hypertension requiring vasodilator treatment
- ☐ PDA: R→L
- ☐ PDA: L→R
- ☐ PDA: Bidirectional
- ☐ PDA: Unknown
- ☐ Tamponade: Blood
- ☐ Tamponade: Serous
- ☐ Tamponade: Air

Infectious complications:

- ☐ Culture proven new infection (code organism under Diagnosis and Procedures)
- ☐ WBC < 1,500

Metabolic complications:

- ☐ Glucose < 40
- ☐ Glucose > 240
- ☐ pH < 7.20
- ☐ pH > 7.60
- ☐ Hyperbilirubinemia (> 2 direct, > 13 indirect, or > 15 total)

Outcome

Reason for discontinuing ECLS: ☐ Recovery (survived ECMO) ☐ Died on ECLS, or ECLS withdrawn in anticipation of death

If died on ECLS or ECLS withdrawn in anticipation of death select 1 reason:

☐ Parental or family request
☐ Hemorrhage
☐ Diagnosis incompatible with life
☐ Irreversible organ failure: (Select all that apply)
- ☐ CNS ☐ Pulmonary ☐ Cardiac
- ☐ Liver ☐ Infection ☐ Other

Cannula site repair: ☐None ☐ Carotid artery ☐ Jugular vein ☐ Both ☐ Other

Date / time of final extubation: _____

☐ Discharged alive (from ECLS center)

Date / time of discharge / transfer: _____

Discharge location: ☐ Home ☐ In-hospital service ☐ Referral hospital ☐ Other facility (hospital or rehab facility)

Date / time of death: _____

If death, code primary cause of death and contributing causes under Diagnosis and Procedures

Form completed by: _____ Date completed: _____

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APPENDIX 2 – Patient Selection

- ICD9 diagnosis

  Primary or Secondary diagnosis < 1 day after the initiation of ECMO:

  112.4 Candidal pneumonia

  112.5 Systemic candidiasis

  112.81 Candidal endocarditis

  112.83 Candidal meningitis

  114.0 Primary coccidioidomycosis (pulmonary)

  115* Histoplasmosis

  116* Blastomycotic infection

  117.1 Sporotrichosis

  117.3 Aspergillosis

  117.5 Cryptococcosis

  117.6 Allescheriosis [Petriellidosis]

  117.7 Zygomycosis [Phycomycosis or Mucormycosis]

  117.8 Infection by dematiacious fungi [Phaehyphomycosis]

  117.9 Other and unspecified mycoses

  484.6 Pneumonia in aspergillosis

- Organisms ID:

50	*Aspergillus fumigatus*
51	*Aspergillus sp.*
21	*Candida albicans*
81	*Candida krusei*
53	*Candida parapsilosis*
99	*Candida sp.*
82	*Candida tropicalis*
41	Yeast sp.

APPENDIX 3 – Details of *Aspergillus* involvement

	n
Aspergillosis Diagnosis	51
Aspergillus Pneumonia Diagnosis	24
AspergillusBloodCult	29
AspergillusRespCult	200
AspergillusOtherCult	36

APPENDIX 4 – Survival of patients according to number of cultures other than blood positive for *Candida*

Number of cultures	Survival
1	53.1%
2	52.3%
3	55.0%

APPENDIX 5 – Multiple Logistic Regression for *Aspergillus*

	Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Age / 10 years	-0.015	0.046	0.111	1	0.739	0.985
	Male gender	0.465	0.153	9.234	1	0.002	1.592
	Weight	-0.141	0.033	18.488	1	0	0.869
	Tobacco	0.365	0.367	0.988	1	0.32	1.441
	Chronic Pulmonary Disease	-0.155	0.259	0.358	1	0.55	0.856
	Diabetes	0.14	0.258	0.295	1	0.587	1.15
	CKD	-0.411	0.492	0.7	1	0.403	0.663
	Chronic Liver Disease	0.703	0.557	1.59	1	0.207	2.019
	Hematological malignancy	0.745	0.406	3.372	1	0.066	2.107
	Non-hematological malignancy	0.021	0.404	0.003	1	0.959	1.021
	AKI	-0.158	0.195	0.652	1	0.419	0.854
	Stroke	0.202	0.58	0.121	1	0.728	1.223
	Pancreatitis	-0.937	1.04	0.81	1	0.368	0.392
	Acute Liver Disease	0.425	0.427	0.992	1	0.319	1.53
	Tuberculosis	-1.184	1.076	1.209	1	0.271	0.306
	HIV	-0.592	0.778	0.579	1	0.447	0.553
	Viral Pneumonia	0.146	0.24	0.372	1	0.542	1.157
	Aspiration Pneumonitis	-1.144	0.531	4.65	1	0.031	0.318
	ARDS	-0.322	0.211	2.345	1	0.126	0.724
	Acute Resp Failure NOS	-0.551	0.168	10.763	1	0.001	0.576
	Cardiac Arrest	-0.279	0.331	0.712	1	0.399	0.756
	Inotropes/vasopressors	0.033	0.164	0.04	1	0.842	1.033
	Steroids	0.242	0.191	1.596	1	0.207	1.274
	Plasmapheresis	0.837	0.825	1.028	1	0.311	2.309
	Influenza	0.879	0.183	23.046	1	0	2.408
	Sepsis	0.096	0.179	0.289	1	0.591	1.101
	Solid Organ Transplant	0.581	0.235	6.123	1	0.013	1.788
	Renal Replacement Therapy	0.032	0.179	0.031	1	0.86	1.032

	Non-viral Pneumonia	-0.411	0.184	5.005	1	0.025	0.663
	Respiratory Support	0.918	0.225	16.607	1	0	2.504
	Heart Failure	-0.127	0.223	0.324	1	0.569	0.881
	Constant	-1.616	0.401	16.242	1	0	0.199
Step 22	Male gender	0.441	0.148	8.901	1	0.003	1.554
	Weight / 10kg	-0.136	0.032	18.215	1	0	0.873
	Hematological malignancy	0.778	0.401	3.765	1	0.052	2.178
	Aspiration Pneumonitis	-1.099	0.524	4.393	1	0.036	0.333
	ARDS	-0.29	0.204	2.028	1	0.154	0.748
	Acute Resp Failure NOS	-0.548	0.16	11.708	1	0.001	0.578
	Influenza	0.909	0.175	26.887	1	0	2.482
	Solid Organ Transplant	0.605	0.228	7.031	1	0.008	1.831
	Non Viral Pneumonia	-0.37	0.176	4.4	1	0.036	0.691
	Respiratory Support	1.013	0.184	30.442	1	0	2.755
	Constant	-1.762	0.293	36.112	1	0	0.172

Bootstrap Aspergillus Model

Variable	OR	CI.95	p-value
Male gender	1.55	1.13-2.15	0.003
Weight / 10kg	0.87	0.82-0.92	0.001
Hematological malignancy	2.18	0.81-5.05	0.056
Aspiration Pneumonitis	0.33	0.08-0.70	0.022
ARDS	0.75	0.52-1.04	0.152
Acute Respiratory Failure NOS	0.58	0.41-0.75	0.001
Influenza	2.48	1.76-3.50	0.001
Solid Organ Transplant	1.83	1.09-2.79	0.010
Non-Viral Pneumonia	0.69	0.46-0.97	0.040
Respiratory Support	2.75	1.92-3.93	0.001

APPENDIX 6 – Multiple Logistic Regression for *Candida* bloodstream infection

	Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Age / 10 years	0.118	0.051	5.319	1	0.021	1.125
	Male	0.115	0.162	0.5	1	0.479	1.122
	Weight / 10 kg	0.055	0.027	4.059	1	0.044	1.057
	Tobacco	-0.555	0.436	1.617	1	0.203	0.574
	Chronic Pulmonary Disease	0.068	0.281	0.058	1	0.81	1.07
	Diabetes	-0.376	0.274	1.876	1	0.171	0.687
	CKD	0.46	0.35	1.726	1	0.189	1.583
	Chronic Liver Disease	-0.112	0.652	0.029	1	0.864	0.894
	Hematological malignancy	0.165	0.555	0.089	1	0.766	1.18
	Non-hematological malignancy	-0.136	0.427	0.101	1	0.751	0.873
	AKI	0.011	0.197	0.003	1	0.954	1.012
	Stroke	-0.293	0.633	0.215	1	0.643	0.746
	Pancreatitis	0.789	0.591	1.786	1	0.181	2.202
	Acute Liver Disease	0.282	0.366	0.591	1	0.442	1.325
	Tuberculosis	0.445	0.793	0.314	1	0.575	1.56
	Viral Pneumonia	-0.006	0.312	0	1	0.984	0.994
	Aspiration Pneumonitis	-0.269	0.423	0.404	1	0.525	0.764
	ARDS	-0.279	0.243	1.312	1	0.252	0.757
	Acute Resp Failure NOS	-0.052	0.173	0.089	1	0.766	0.95
	Cardiac Arrest	-0.123	0.276	0.199	1	0.656	0.884
	Inotropes/vasopressors	0.055	0.187	0.086	1	0.77	1.056
	Steroids	-0.023	0.223	0.011	1	0.917	0.977
	Plasmapheresis	-0.082	1.08	0.006	1	0.939	0.921
	Influenza	-0.118	0.239	0.245	1	0.621	0.888
	Sepsis	0.532	0.179	8.815	1	0.003	1.702
	Solid Organ Transplant	0.205	0.279	0.538	1	0.463	1.228
	Renal Replacement Therapy	0.407	0.178	5.231	1	0.022	1.502
	Non-viral Pneumonia	-0.305	0.201	2.313	1	0.128	0.737
	Respiratory Support	-0.225	0.224	1.014	1	0.314	0.798
	Heart Failure	-0.196	0.211	0.862	1	0.353	0.822
	Femoral cannula	-0.049	0.167	0.088	1	0.767	0.952
	IABP	0.309	0.25	1.531	1	0.216	1.362
	VAD	0.27	0.395	0.469	1	0.493	1.31
	CBP	-0.672	0.372	3.257	1	0.071	0.511

	Laparotomy	0.378	0.358	1.116	1	0.291	1.459
	Constant	-3.139	0.448	49.012	1	0	0.043
Step 29	Age /10 years	0.124	0.049	6.509	1	0.011	1.132
	Weight / 10 years	0.048	0.026	3.501	1	0.061	1.049
	Sepsis	0.471	0.168	7.847	1	0.005	1.602
	Renal Replacement Therapy	0.437	0.163	7.186	1	0.007	1.548
	Non Viral Pneumonia	-0.352	0.193	3.321	1	0.068	0.704
	Intra-Aortic Balloon Pump	0.377	0.223	2.865	1	0.091	1.458
	Cardiopulmonary Bypass	-0.576	0.363	2.522	1	0.112	0.562
	Constant	-3.29	0.355	85.76	1	0	0.037

Bootstrap CBSI model

Variable	**OR**	**CI.95**	**p-value**
Age /10 years	1.13	1.03-1.24	0.005
Weight / 10 years	1.04	0.98-1.10	0.122
Sepsis	1.64	1.17-2.34	0.001
Renal Replacement Therapy	1.49	1.04-2.03	0.010
Non-Viral Pneumonia	0.77	0.54-1.06	0.166
Intra-Aortic Balloon Pump	1.43	0.84-2.23	0.111
Cardiopulmonary Bypass	0.62	0.27-1.09	0.142

APPENDIX 7 – Multiple Logistic Regression for Survival

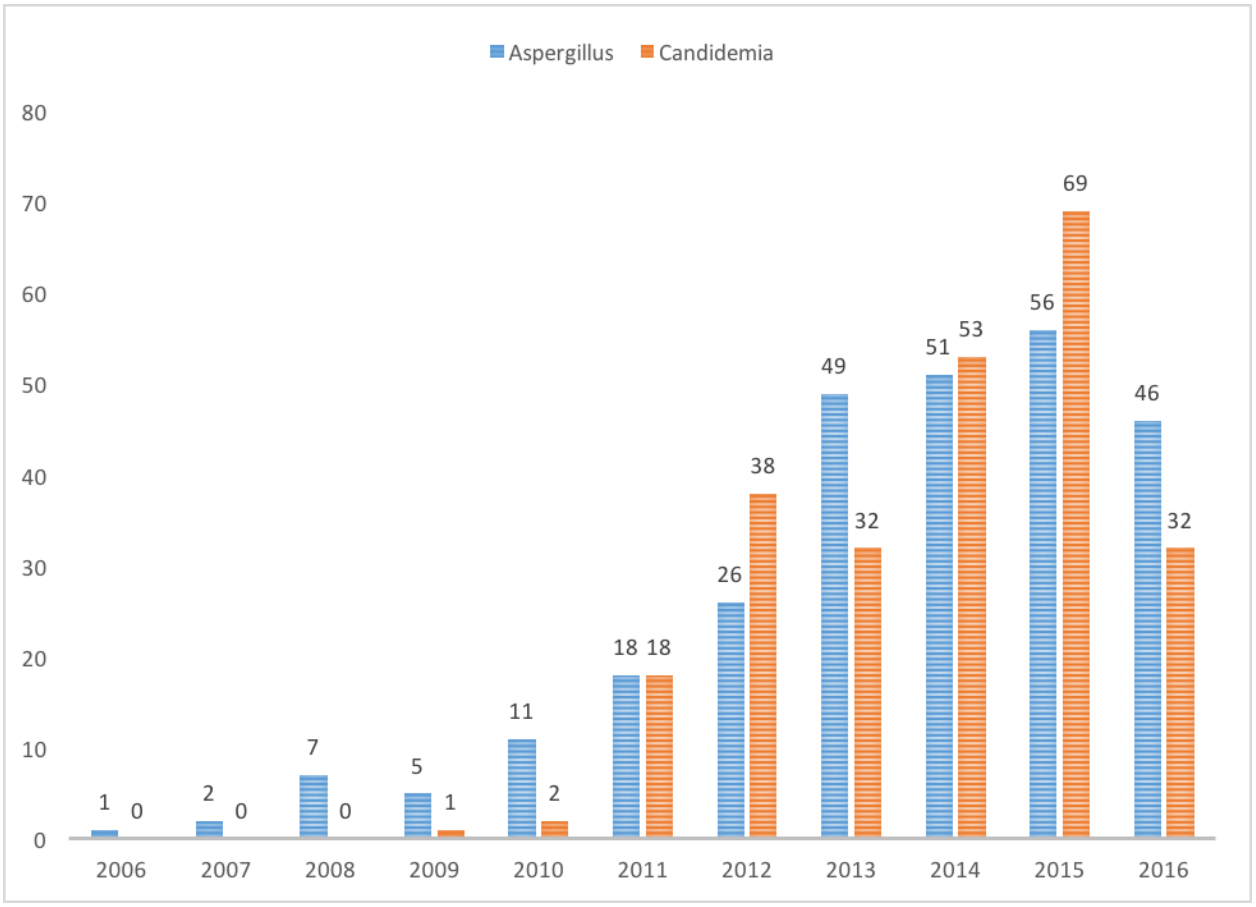
	Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Age	-0.202	0.032	39.514	1	0	0.817
	Male	-0.083	0.102	0.659	1	0.417	0.92
	Weight	0.045	0.019	5.518	1	0.019	1.046
	Tobacco	0.352	0.251	1.958	1	0.162	1.421
	Chronic Pulmonary Disease	-0.098	0.178	0.305	1	0.581	0.906
	Diabetes	0.224	0.167	1.788	1	0.181	1.251
	CKD	0.027	0.267	0.01	1	0.92	1.027
	Chronic Liver Disease	-0.499	0.447	1.244	1	0.265	0.607
	Hematological malignancy	-0.819	0.39	4.415	1	0.036	0.441
	Non-hematological malignancy	-0.218	0.284	0.593	1	0.441	0.804
	AKI	-0.129	0.13	0.975	1	0.323	0.879
	Stroke	-0.507	0.393	1.667	1	0.197	0.602
	Pancreatitis	0.056	0.469	0.014	1	0.906	1.057
	Acute Liver Disease	-0.271	0.267	1.029	1	0.31	0.763
	Tuberculosis	0.321	0.58	0.306	1	0.58	1.378
	HIV	-2.327	0.777	8.97	1	0.003	0.098
	Viral Pneumonia	-0.125	0.194	0.415	1	0.52	0.883
	Aspiration Pneumonitis	0.686	0.262	6.856	1	0.009	1.987
	ARDS	-0.387	0.148	6.865	1	0.009	0.679
	Acute Resp Failure NOS	0.012	0.11	0.011	1	0.917	1.012
	Cardiac Arrest	-0.033	0.188	0.031	1	0.861	0.968
	Inotrope/vasopressor	-0.074	0.115	0.413	1	0.52	0.929
	Steroids	-0.113	0.148	0.583	1	0.445	0.893
	Plasmapheresis	-0.269	0.65	0.171	1	0.68	0.765
	Influenza	0.481	0.15	10.321	1	0.001	1.617
	Sepsis	-0.198	0.124	2.523	1	0.112	0.821
	Solid Organ Transplant	0.318	0.189	2.85	1	0.091	1.375
	Renal Replacement Therapy	-0.009	0.124	0.005	1	0.944	0.991
	Non-viral Pneumonia	0.278	0.124	5.033	1	0.025	1.32
	Heart Failure	-0.053	0.139	0.147	1	0.702	0.948

	IABP	-0.173	0.174	0.989	1	0.32	0.841
	VAD	-0.236	0.298	0.628	1	0.428	0.79
	CBP	0.198	0.211	0.886	1	0.347	1.219
	Laparotomy	-0.376	0.272	1.906	1	0.167	0.687
	Candida Bloodstream Infection	-0.733	0.157	21.791	1	0	0.48
	Aspergillus	-0.89	0.151	34.539	1	0	0.411
	Nitric Oxide	-0.614	0.145	17.934	1	0	0.541
	Epoprostenol	0.081	0.249	0.107	1	0.744	1.085
	NMB	0.257	0.112	5.308	1	0.021	1.293
	Support Type			12.875	2	0.002	
	Cardiac Support	-0.447	0.154	8.447	1	0.004	0.64
	ECPR Support	-0.715	0.234	9.295	1	0.002	0.489
	Constant	1.09	0.247	19.427	1	0	2.975
Step 25	Age /10 years	-0.205	0.031	44.048	1	0	0.814
	Weight / 10 years	0.044	0.018	5.595	1	0.018	1.044
	Hematological malignancy	-0.813	0.387	4.421	1	0.035	0.444
	Acute Kidney Injury	-0.186	0.118	2.474	1	0.116	0.83
	HIV	-2.375	0.772	9.465	1	0.002	0.093
	Aspiration Pneumonitis	0.627	0.255	6.052	1	0.014	1.873
	ARDS	-0.411	0.142	8.366	1	0.004	0.663
	Influenza	0.513	0.145	12.448	1	0	1.67
	Sepsis	-0.219	0.121	3.293	1	0.07	0.803
	Solid Organ Transplant	0.315	0.183	2.947	1	0.086	1.37
	Non-Viral Pneumonia	0.284	0.121	5.453	1	0.02	1.328
	Candida Bloodstream Infection	-0.762	0.155	24.086	1	0	0.467
	Aspergillus colonization or infection	-0.917	0.15	37.487	1	0	0.4
	Nitric Oxide	-0.593	0.142	17.322	1	0	0.553
	Neuromuscular Blockers	0.233	0.105	4.898	1	0.027	1.262
	SupportType			28.082	2	0	
	Cardiac support	-0.52	0.118	19.359	1	0	0.595
	ECPR support	-0.795	0.204	15.204	1	0	0.452
	Constant	1.011	0.229	19.527	1	0	2.75

Bootstrap Survival model

Variable	OR	CI.95	p-value
Age /10 years	0.81	0.77-0.86	0.001
Weight / 10 years	1.04	1.00-1.09	0.026
Hematological malignancy	0.43	0.18-0.88	0.038
Acute Kidney Injury	0.82	0.64-1.06	0.108
HIV	0.09	0.00-0.22	0.002
Aspiration Pneumonitis	1.93	1.23-3.23	0.008
ARDS	0.66	0.50-0.87	0.003
Influenza	1.71	1.24-2.35	0.002
Sepsis	0.80	0.63-1.01	0.080
Solid Organ Transplant	1.38	0.95-2.09	0.086
Non-Viral Pneumonia	1.32	1.03-1.69	0.023
Nitric Oxide	0.55	0.43-0.72	0.001
Neuromuscular Blockers	1.27	1.02-1.58	0.022
Cardiac support	0.60	0.48-0.75	0.001
ECPR	0.45	0.29-0.69	0.001
Candida Bloodstream Infection	0.48	0.35-0.63	0.001
Aspergillus colonization or infection	0.40	0.31-0.51	0.001

APPENDIX 8 – Case distribution by year



*Please note patients were included up to September 2016.