

Supplementary Material: The Global Open Source Severity of Illness Score (GOSSIS)

March 2, 2022

1 Introduction

In this supplementary material we provide additional information related to GOSSIS-1 not contained in the paper itself. In the methods section, additional information related to development and implementation of GOSSIS-1 are discussed. We encourage users to visit the GOSSIS consortium website: <https://gossis.mit.edu/> and GitHub repositories: <https://github.com/MIT-LCP/GOSSIS/> for up to date information and support. In Section 2.1 documentation related to the variables contained in the GOSSIS-1 dataset are described. In Sections 2.2 and 2.3 we discuss the diagnosis grouping and data transformations, respectively. The model tuning process is described in Section 2.4. The process by which missing data was imputed is detailed in Section 2.5 and includes descriptions of the missing data distributions.

In the results section, additional descriptive statistics of the GOSSIS-1 cohort are presented in Section 3.1. An outline of the model fitting and tuning process is contained in Section 3.2. A description of the final GOSSIS-1 model is presented in Section 3.3 Finally, an evaluation of the model in certain subgroups is presented in Section 3.4.

2 Methods

An outline of the model development process, outlining the four components: extraction, data splitting, tuning and evaluation are presented in Supplementary Figure 1.

2.1 Variables

The list of variables collected for development of the GOSSIS-1 model are listed in Supplementary Tables 1 and 2. This list represents version 1.0 of the variable list, and is available and will be updated in a machine readable format at <https://github.com/MIT-LCP/GOSSIS/docs/>.

Supplementary Table 1: Variable Inputs for GOSSIS

Variable Type	Name	Units of Measurement	Data Type	Use in Prediction	Used in Imputation
APACHE comorbidity	aids	None	binary	Yes	Yes
APACHE comorbidity	cirrhosis	None	binary	Yes	Yes
APACHE comorbidity	diabetes_mellitus	None	binary	Yes	Yes
APACHE comorbidity	hepatic_failure	None	binary	Yes	Yes
APACHE comorbidity	immunosuppression	None	binary	Yes	Yes
APACHE comorbidity	leukemia	None	binary	Yes	Yes
APACHE comorbidity	lymphoma	None	binary	Yes	Yes
APACHE comorbidity	solid_tumor_with_metastasis	None	binary	Yes	Yes
APACHE covariate	albumin_apache	g/dL	numeric	No	Yes
APACHE covariate	apache_2_diagnosis	None	string	No	No
APACHE covariate	apache_3j_diagnosis	None	string	Yes	Yes
APACHE covariate	apache_post_operative	None	binary	No	No
APACHE covariate	arf_apache	None	binary	Yes	Yes
APACHE covariate	bilirubin_apache	micromol/L	numeric	No	Yes

APACHE covariate	bun_apache	mmol/L	numeric	No	Yes
APACHE covariate	creatinine_apache	micromol/L	numeric	No	Yes
APACHE covariate	fio2_apache	Fraction	numeric	No	Yes
APACHE covariate	gcs_eyes_apache	None	integer	Yes	Yes
APACHE covariate	gcs_motor_apache	None	integer	Yes	Yes
APACHE covariate	gcs_unable_apache	None	binary	Yes	Yes
APACHE covariate	gcs_verbal_apache	None	integer	Yes	Yes
APACHE covariate	glucose_apache	mmol/L	numeric	No	Yes
APACHE covariate	heart_rate_apache	Beats per minute	numeric	No	Yes
APACHE covariate	hematocrit_apache	Fraction	numeric	No	Yes
APACHE covariate	intubated_apache	None	binary	Yes	Yes
APACHE covariate	map_apache	Millimetres of mercury	numeric	No	Yes
APACHE covariate	paco2_apache	Millimetres of mercury	numeric	No	Yes
APACHE covariate	paco2_for_ph_apache	Millimetres of mercury	numeric	No	Yes
APACHE covariate	pao2_apache	Millimetres of mercury	numeric	No	Yes
APACHE covariate	ph_apache	None	numeric	No	Yes
APACHE covariate	resprate_apache	Breaths per minute	numeric	No	Yes
APACHE covariate	sodium_apache	mmol/L	numeric	No	Yes
APACHE covariate	temp_apache	Degrees Celsius	numeric	No	Yes
APACHE covariate	urineoutput_apache	Millilitres	numeric	No	Yes
APACHE covariate	ventilated_apache	None	binary	Yes	Yes
APACHE covariate	wbc_apache	10 ⁹ /L	numeric	No	Yes
APACHE prediction	apache_3j_hospital_death_prob	None	numeric	No	No
APACHE prediction	apache_3j_score	None	integer	No	No
APACHE prediction	apache_4a_hospital_death_prob	None	numeric	No	No
APACHE prediction	apache_4a_icu_death_prob	None	numeric	No	No
APACHE prediction	apsiii	None	integer	No	No
demographic	age	Years	numeric	Yes	Yes
demographic	bmi	kilograms/metres ²	string	No	No
demographic	country	None	string	No	No
demographic	elective_surgery	None	binary	Yes	Yes
demographic	ethnicity	None	string	No	No
demographic	gender	None	string	No	No
demographic	height	centimetres	numeric	No	No
demographic	hospital_admit_source	None	string	No	No
demographic	hospital_bed_size	None	string	No	No
demographic	hospital_bed_size_numeric	None	string	No	No
demographic	hospital_death	None	binary	No	No
demographic	hospital_disch_location	None	string	No	No
demographic	hospital_los_days	Days	numeric	No	No
demographic	hospital_type	None	string	No	No
demographic	icu_admit_source	None	string	Yes	Yes
demographic	icu_admit_type	None	string	No	No
demographic	icu_death	None	binary	No	No
demographic	icu_disch_location	None	string	No	No
demographic	icu_id	None	integer	No	No
demographic	icu_los_days	Days	numeric	No	No
demographic	icu_stay_type	None	string	No	No
demographic	icu_type	None	string	No	No
demographic	pre_icu_los_days	Days	numeric	No	No
demographic	pregnant	None	binary	No	No
demographic	readmission_status	None	binary	No	No
demographic	smoking_status	None	binary	No	No
demographic	teaching_hospital	None	binary	No	No
demographic	weight	kilograms	numeric	No	No
identifier	data_source	None	string	No	No

identifier	encounter_id	None	integer	No	No
identifier	hospital_id	None	integer	No	No
identifier	patient_id	None	integer	No	No
labs	d1_albumin_max	g/dL	numeric	Yes	Yes
labs	d1_albumin_min	g/dL	numeric	Yes	Yes
labs	d1_bilirubin_max	micromol/L	numeric	Yes	Yes
labs	d1_bilirubin_min	micromol/L	numeric	Yes	Yes
labs	d1_bun_max	mmol/L	numeric	Yes	Yes
labs	d1_bun_min	mmol/L	numeric	Yes	Yes
labs	d1_calcium_max	mmol/L	numeric	Yes	Yes
labs	d1_calcium_min	mmol/L	numeric	Yes	Yes
labs	d1_creatinine_max	micromol/L	numeric	Yes	Yes
labs	d1_creatinine_min	micromol/L	numeric	Yes	Yes
labs	d1_glucose_max	mmol/L	numeric	Yes	Yes
labs	d1_glucose_min	mmol/L	numeric	Yes	Yes
labs	d1_hco3_max	mmol/L	numeric	Yes	Yes
labs	d1_hco3_min	None	numeric	Yes	Yes
labs	d1_hemaglobin_max	g/dL	numeric	Yes	Yes
labs	d1_hemaglobin_min	g/dL	numeric	Yes	Yes
labs	d1_hematocrit_max	Fraction	numeric	Yes	Yes
labs	d1_hematocrit_min	Fraction	numeric	Yes	Yes
labs	d1_inr_max	micromol/L	numeric	Yes	Yes
labs	d1_inr_min	micromol/L	numeric	Yes	Yes
labs	d1_lactate_max	mmol/L	numeric	Yes	Yes
labs	d1_lactate_min	mmol/L	numeric	Yes	Yes
labs	d1_platelets_max	10 ⁹ /L	numeric	Yes	Yes
labs	d1_platelets_min	10 ⁹ /L	numeric	Yes	Yes
labs	d1_potassium_max	mmol/L	numeric	Yes	Yes
labs	d1_potassium_min	mmol/L	numeric	Yes	Yes
labs	d1_sodium_max	mmol/L	numeric	Yes	Yes
labs	d1_sodium_min	mmol/L	numeric	Yes	Yes
labs	d1_wbc_max	10 ⁹ /L	numeric	Yes	Yes
labs	d1_wbc_min	10 ⁹ /L	numeric	Yes	Yes
labs blood gas	d1_arterial_pco2_max	Millimetres of mercury	numeric	Yes	Yes
labs blood gas	d1_arterial_pco2_min	Millimetres of mercury	numeric	Yes	Yes
labs blood gas	d1_arterial_ph_max	None	numeric	Yes	Yes
labs blood gas	d1_arterial_ph_min	None	numeric	Yes	Yes
labs blood gas	d1_arterial_po2_max	Millimetres of mercury	numeric	Yes	Yes
labs blood gas	d1_arterial_po2_min	Millimetres of mercury	numeric	Yes	Yes
labs blood gas	d1_pao2fio2ratio_max	Fraction	numeric	Yes	Yes
labs blood gas	d1_pao2fio2ratio_min	Fraction	numeric	Yes	Yes
vitals	d1_diasbp_max	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_diasbp_min	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_heartrate_max	Beats per minute	numeric	Yes	Yes
vitals	d1_heartrate_min	Beats per minute	numeric	Yes	Yes
vitals	d1_mbp_max	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_mbp_min	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_resprate_max	Breaths per minute	numeric	Yes	Yes
vitals	d1_resprate_min	Breaths per minute	numeric	Yes	Yes
vitals	d1_spo2_max	Percentage	numeric	Yes	Yes
vitals	d1_spo2_min	Percentage	numeric	Yes	Yes

vitals	d1_sysbp_max	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_sysbp_min	Millimetres of mercury	numeric	Yes	Yes
vitals	d1_temp_max	Degrees Celsius	numeric	Yes	Yes
vitals	d1_temp_min	Degrees Celsius	numeric	Yes	Yes

Supplementary Table 2: Variable Descriptions for GOSSIS

Variable Type	Name	Description	Example
APACHE comorbidity	aids	Whether the patient has a definitive diagnosis of acquired immune deficiency syndrome (AIDS) (not HIV positive alone)	1
APACHE comorbidity	cirrhosis	Whether the patient has a history of heavy alcohol use with portal hypertension and varices, other causes of cirrhosis with evidence of portal hypertension and varices, or biopsy proven cirrhosis. This comorbidity does not apply to patients with a functioning liver transplant.	1
APACHE comorbidity	diabetes_mellitus	Whether the patient has been diagnosed with diabetes, either juvenile or adult onset, which requires medication.	1
APACHE comorbidity	hepatic_failure	Whether the patient has cirrhosis and additional complications including jaundice and ascites, upper GI bleeding, hepatic encephalopathy, or coma.	1
APACHE comorbidity	immunosuppression	Whether the patient has their immune system suppressed within six months prior to ICU admission for any of the following reasons; radiation therapy, chemotherapy, use of non-cytotoxic immunosuppressive drugs, high dose steroids (at least 0.3 mg/kg/day of methylprednisolone or equivalent for at least 6 months).	1
APACHE comorbidity	leukemia	Whether the patient has been diagnosed with acute or chronic myelogenous leukemia, acute or chronic lymphocytic leukemia, or multiple myeloma.	1
APACHE comorbidity	lymphoma	Whether the patient has been diagnosed with non-Hodgkin lymphoma.	1
APACHE comorbidity	solid_tumor_with_metastasis	Whether the patient has been diagnosed with any solid tumor carcinoma (including malignant melanoma) which has evidence of metastasis.	1
APACHE covariate	albumin_apache	The albumin concentration measured during the first 24 hours which results in the highest APACHE III score	30
APACHE covariate	apache_2_diagnosis	The APACHE II diagnosis for the ICU admission	308
APACHE covariate	apache_3j_diagnosis	The APACHE III-J sub-diagnosis code which best describes the reason for the ICU admission	1405
APACHE covariate	apache_post_operative	The APACHE operative status; 1 for post-operative, 0 for non-operative	1

APACHE covariate	arf_apache	Whether the patient had acute renal failure during the first 24 hours of their unit stay, defined as a 24 hour urine output <410ml, creatinine $\geq$ 133 micromol/L and no chronic dialysis	0
APACHE covariate	bilirubin_apache	The bilirubin concentration measured during the first 24 hours which results in the highest APACHE III score	20
APACHE covariate	bun_apache	The blood urea nitrogen concentration measured during the first 24 hours which results in the highest APACHE III score	None
APACHE covariate	creatinine_apache	The creatinine concentration measured during the first 24 hours which results in the highest APACHE III score	70
APACHE covariate	fio2_apache	The fraction of inspired oxygen from the arterial blood gas taken during the first 24 hours of unit admission which produces the highest APACHE III score for oxygenation	0.21
APACHE covariate	gcs_eyes_apache	The eye opening component of the Glasgow Coma Scale measured during the first 24 hours which results in the highest APACHE III score	4
APACHE covariate	gcs_motor_apache	The motor component of the Glasgow Coma Scale measured during the first 24 hours which results in the highest APACHE III score	6
APACHE covariate	gcs_unable_apache	Whether the Glasgow Coma Scale was unable to be assessed due to patient sedation	1
APACHE covariate	gcs_verbal_apache	The verbal component of the Glasgow Coma Scale measured during the first 24 hours which results in the highest APACHE III score	5
APACHE covariate	glucose_apache	The glucose concentration measured during the first 24 hours which results in the highest APACHE III score	5
APACHE covariate	heart_rate_apache	The heart rate measured during the first 24 hours which results in the highest APACHE III score	75
APACHE covariate	hematocrit_apache	The hematocrit measured during the first 24 hours which results in the highest APACHE III score	0.4
APACHE covariate	intubated_apache	Whether the patient was intubated at the time of the highest scoring arterial blood gas used in the oxygenation score	0
APACHE covariate	map_apache	The mean arterial pressure measured during the first 24 hours which results in the highest APACHE III score	None
APACHE covariate	paco2_apache	The partial pressure of carbon dioxide from the arterial blood gas taken during the first 24 hours of unit admission which produces the highest APACHE III score for oxygenation	40
APACHE covariate	paco2_for_ph_apache	The partial pressure of carbon dioxide from the arterial blood gas taken during the first 24 hours of unit admission which produces the highest APACHE III score for acid-base disturbance	40
APACHE covariate	pao2_apache	The partial pressure of oxygen from the arterial blood gas taken during the first 24 hours of unit admission which produces the highest APACHE III score for oxygenation	80

APACHE covariate	ph_apache	The pH from the arterial blood gas taken during the first 24 hours of unit admission which produces the highest APACHE III score for acid-base disturbance	7.4
APACHE covariate	resprate_apache	The respiratory rate measured during the first 24 hours which results in the highest APACHE III score	14
APACHE covariate	sodium_apache	The sodium concentration measured during the first 24 hours which results in the highest APACHE III score	145
APACHE covariate	temp_apache	The temperature measured during the first 24 hours which results in the highest APACHE III score	33
APACHE covariate	urineoutput_apache	The total urine output for the first 24 hours	2000
APACHE covariate	ventilated_apache	Whether the patient was invasively ventilated at the time of the highest scoring arterial blood gas using the oxygenation scoring algorithm, including any mode of positive pressure ventilation delivered through a circuit attached to an endo-tracheal tube or tracheostomy	1
APACHE covariate	wbc_apache	The white blood cell count measured during the first 24 hours which results in the highest APACHE III score	10
APACHE prediction	apache_3j_hospital_death_prob	The APACHE III-J probabilistic prediction of in-hospital mortality for the patient which utilizes the APACHE III score and other covariates, including diagnosis	0.24
APACHE prediction	apache_3j_score	The composite APACHE III score describing the severity of the patient's condition	53
APACHE prediction	apache_4a_hospital_death_prob	The APACHE IVa probabilistic prediction of in-hospital mortality for the patient which utilizes the APACHE III score and other covariates, including diagnosis.	0.31
APACHE prediction	apache_4a_icu_death_prob	The APACHE IVa probabilistic prediction of in ICU mortality for the patient which utilizes the APACHE III score and other covariates, including diagnosis	0.24
APACHE prediction	apsiii	The Acute Physiology Score III, which describes the severity of the patient's condition	34
demographic	age	The age of the patient on unit admission	None
demographic	bmi	The body mass index of the person on unit admission	21.5
demographic	country	Country in which this patient was admitted	None
demographic	elective_surgery	Whether the patient was admitted to the hospital for an elective surgical operation	0
demographic	ethnicity	The common national or cultural tradition which the person belongs to	Caucasian
demographic	gender	The genotypical sex of the patient	M
demographic	height	The height of the person on unit admission	180
demographic	hospital_admit_source	The location of the patient prior to being admitted to the hospital	Home
demographic	hospital_bed_size	The total number of beds at the admitting hospital, grouped	None

demographic	hospital_bed_size_numeric	The total number of beds at the admitting hospital	None
demographic	hospital_death	Whether the patient died during this hospitalization	0
demographic	hospital_disch_location	The location of the patient after being discharged from the hospital	Skilled nursing facility
demographic	hospital_los_days	The length of stay of the patient at the hospital	12
demographic	hospital_type	A classification which indicates the level of care the hospital is capable of providing	Tertiary
demographic	icu_admit_source	The location of the patient prior to being admitted to the unit	Operating room
demographic	icu_admit_type	The type of unit admission for the patient	Cardiothoracic
demographic	icu_death	Whether the patient died during this unit stay	0
demographic	icu_disch_location	The location of the patient after discharge from the unit	Ward
demographic	icu_id	A unique identifier for the unit to which the patient was admitted	None
demographic	icu_los_days	The length of stay of the patient in the unit	1.5
demographic	icu_stay_type	TODO	None
demographic	icu_type	A classification which indicates the type of care the unit is capable of providing	Neurological ICU
demographic	pre_icu_los_days	The length of stay of the patient between hospital admission and unit admission	3.5
demographic	pregnant	Whether the person is currently pregnant	0
demographic	readmission_status	Whether the current unit stay is the second (or greater) stay at an ICU within the same hospitalization	0
demographic	smoking_status	Whether the patient is currently an active smoker	0
demographic	teaching_hospital	Whether the admitting hospital provides teaching services to medical students	None
demographic	weight	The weight (body mass) of the person on unit admission	80
identifier	data_source	Identifies the data source from which information was extracted	eicu
identifier	encounter_id	Unique identifier associated with a patient unit stay	None
identifier	hospital_id	Unique identifier associated with a hospital	None
identifier	patient_id	Unique identifier associated with a patient	None
labs	d1_albumin_max	The lowest albumin concentration of the patient in their serum during the first 24 hours of their unit stay	30
labs	d1_albumin_min	The lowest albumin concentration of the patient in their serum during the first 24 hours of their unit stay	30
labs	d1_bilirubin_max	The highest bilirubin concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	20
labs	d1_bilirubin_min	The lowest bilirubin concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	20

labs	d1_bun_max	The highest blood urea nitrogen concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	5
labs	d1_bun_min	The lowest blood urea nitrogen concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	5
labs	d1_calcium_max	The highest calcium concentration of the patient in their serum during the first 24 hours of their unit stay	2.5
labs	d1_calcium_min	The lowest calcium concentration of the patient in their serum during the first 24 hours of their unit stay	2.5
labs	d1_creatinine_max	The highest creatinine concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	70
labs	d1_creatinine_min	The lowest creatinine concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	70
labs	d1_glucose_max	The highest glucose concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	5
labs	d1_glucose_min	The lowest glucose concentration of the patient in their serum or plasma during the first 24 hours of their unit stay	5
labs	d1_hco3_max	The highest bicarbonate concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	30
labs	d1_hco3_min	The lowest bicarbonate concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	30
labs	d1_hemoglobin_max	The highest hemoglobin concentration for the patient during the first 24 hours of their unit stay	10
labs	d1_hemoglobin_min	The lowest hemoglobin concentration for the patient during the first 24 hours of their unit stay	10
labs	d1_hematocrit_max	The highest volume proportion of red blood cells in a patient's blood during the first 24 hours of their unit stay, expressed as a fraction	0.4
labs	d1_hematocrit_min	The lowest volume proportion of red blood cells in a patient's blood during the first 24 hours of their unit stay, expressed as a fraction	0.4
labs	d1_inr_max	The highest international normalized ratio for the patient during the first 24 hours of their unit stay	1
labs	d1_inr_min	The lowest international normalized ratio for the patient during the first 24 hours of their unit stay	1
labs	d1_lactate_max	The highest lactate concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	1
labs	d1_lactate_min	The lowest lactate concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	1

labs	d1_platelets_max	The highest platelet count for the patient during the first 24 hours of their unit stay	200
labs	d1_platelets_min	The lowest platelet count for the patient during the first 24 hours of their unit stay	200
labs	d1_potassium_max	The highest potassium concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	3.8
labs	d1_potassium_min	The lowest potassium concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	3.8
labs	d1_sodium_max	The highest sodium concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	145
labs	d1_sodium_min	The lowest sodium concentration for the patient in their serum or plasma during the first 24 hours of their unit stay	145
labs	d1_wbc_max	The highest white blood cell count for the patient during the first 24 hours of their unit stay	10
labs	d1_wbc_min	The lowest white blood cell count for the patient during the first 24 hours of their unit stay	10
labs blood gas	d1_arterial_pco2_max	The highest arterial partial pressure of carbon dioxide for the patient during the first 24 hours of their unit stay	40
labs blood gas	d1_arterial_pco2_min	The lowest arterial partial pressure of carbon dioxide for the patient during the first 24 hours of their unit stay	40
labs blood gas	d1_arterial_ph_max	The highest arterial pH for the patient during the first 24 hours of their unit stay	7.4
labs blood gas	d1_arterial_ph_min	The lowest arterial pH for the patient during the first 24 hours of their unit stay	7.4
labs blood gas	d1_arterial_po2_max	The highest arterial partial pressure of oxygen for the patient during the first 24 hours of their unit stay	80
labs blood gas	d1_arterial_po2_min	The lowest arterial partial pressure of oxygen for the patient during the first 24 hours of their unit stay	80
labs blood gas	d1_pao2fio2ratio_max	The highest fraction of inspired oxygen for the patient during the first 24 hours of their unit stay	0.21
labs blood gas	d1_pao2fio2ratio_min	The lowest fraction of inspired oxygen for the patient during the first 24 hours of their unit stay	0.21
vitals	d1_diasbp_max	The patient's highest diastolic blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	60
vitals	d1_diasbp_min	The patient's lowest diastolic blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	60
vitals	d1_heartrate_max	The patient's highest heart rate during the first 24 hours of their unit stay	75
vitals	d1_heartrate_min	The patient's lowest heart rate during the first 24 hours of their unit stay	75

vitals	d1_mbp_max	The patient's highest mean blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	80
vitals	d1_mbp_min	The patient's lowest mean blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	80
vitals	d1_resprate_max	The patient's highest respiratory rate during the first 24 hours of their unit stay	14
vitals	d1_resprate_min	The patient's lowest respiratory rate during the first 24 hours of their unit stay	14
vitals	d1_spo2_max	The patient's highest peripheral oxygen saturation during the first 24 hours of their unit stay	None
vitals	d1_spo2_min	The patient's lowest peripheral oxygen saturation during the first 24 hours of their unit stay	100
vitals	d1_sysbp_max	The patient's highest systolic blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	120
vitals	d1_sysbp_min	The patient's lowest systolic blood pressure during the first 24 hours of their unit stay, either non-invasively or invasively measured	120
vitals	d1_temp_max	The patient's highest core temperature during the first 24 hours of their unit stay, invasively measured	33
vitals	d1_temp_min	The patient's lowest core temperature during the first 24 hours of their unit stay	33

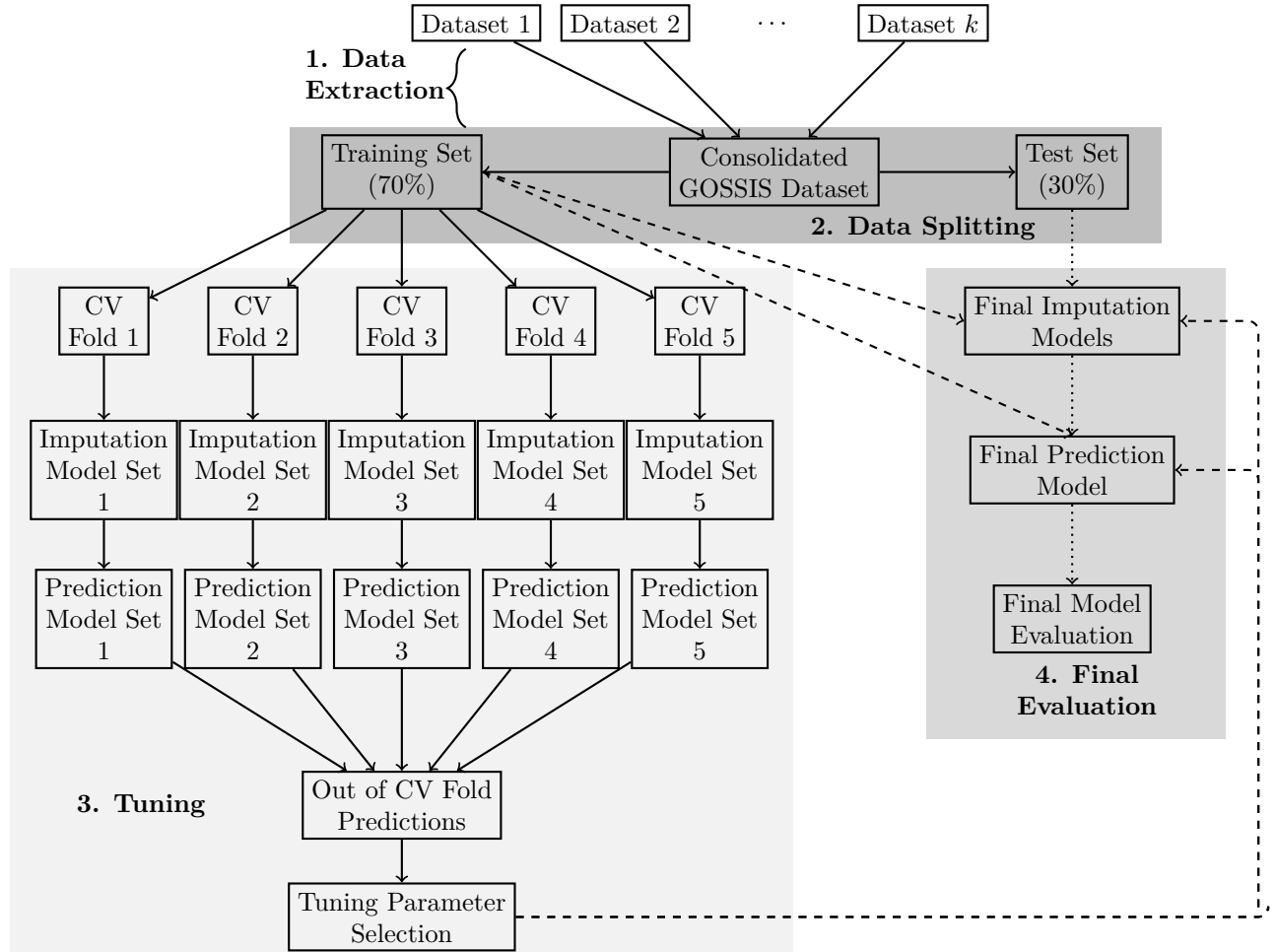
The variables or features used for prediction of patient outcomes can be classified into one of six groups: *demographic/admission-level* variables, *physiological variables* collected for the Acute Physiology Score (APS)¹, *APACHE admission diagnosis*², *APACHE chronic comorbidities* variables, *extrema data for APS* variables (laboratory results and vital signs), and *extrema data for non-APS* variables (laboratory results and vital signs). Because these data are often collected at centers which routinely collect data for use in APACHE III or IV, the first three groups consist of data collected for these purposes. The physiological variables comprising APS generally represent the ‘worst’ or ‘most abnormal’ value observed for each patient during the first ICU day. Of the APS variables collected, urine output was not used in GOSSIS-1 due to concerns about its validity. Of the set of variables used in APACHE-IV, length of stay before ICU stay and the binary variable indicating thrombolytic therapy were also excluded.

2.2 Diagnosis Groupings

Under the new approach, a new category encompassing a previously defined category, organ transplants, and all other/undefined medical disorders was created, along with new gynecological and sepsis categories. These three new categories add to the remaining nine pre-existing body systems: cardiovascular, gastrointestinal, hematological, metabolic, musculoskeletal/skin disease, neurological, renal/genitourinary, respiratory and trauma for a total of 12 body systems. A full listing of the hierarchical structure for admission diagnoses can be found in Supplementary Tables 12 and 13. A machine readable form of this mapping is available on the GOSSIS GitHub repository.

2.3 Data Transformations

The Glasgow coma scale (GCS) and ventilation status were transformed to simplify and minimize the effects of measurement error associated with these two variables. GCS was looked at component-wise (eyes, motor



Supplementary Figure 1: Overview of the GOSSIS version 1.0 model building process. Processes in solid lines indicated data extraction, data splitting and model tuning, which occur before dashed lines indicating model fitting, which in turn occur before dotted lines indicating model evaluation.

and verbal), grouping patients into four groups: all components are lowest score (all values of one), all three components are highest score (all high, eyes=4, verbal=5, motor=6), one or two components are the highest score (some high), and a fourth group capturing all other patients. The approach does not consider the unable to assess Glasgow Coma Scale score variable. We denote this grouping the Derived Coma Scale (DCS). There are two binary APACHE variables collected to adjust arterial blood gases if the patients was invasively ventilated or intubated. We created a new ventilation variable to indicate if either the intubation or invasive ventilation variable were present.

2.4 Model tuning

Model tuning is the process by which different algorithm-specific parameter values are tried to assess which values yield optimal performance of the algorithm. We accomplished this using five-fold CV, where for each tuning parameter combination, the model is fit five separate times, one time each withholding each of the folds. Within each fold, the entire process of training the model is completed on 80% of the training set, and performance is evaluated on the withheld 20%. Performance is then pooled over the five folds for specific tuning parameter values, with the process repeated over the other tuning parameters under evaluation.

Three sets of tuning parameters were varied in order to find the best approach for these data. The first two sets of parameters involve how imputation is conducted. Imputation is used to fill in missing values for which clinical or patient variables were not collected or not available. We evaluated three different approaches or algorithms (discussed below) to do imputation. Second, for two of the imputation algorithms, the maximum complexity of the imputation models considered must be specified. As each variable's imputation model was developed independently, this complexity parameter applied globally (i.e., to all imputation variables), as evaluating all possible combinations under a variable specific approach would be intractable.

The third set of tuning parameters relate to the methods and settings used to fit the mortality prediction model – that is map the clinical and patient features to an estimated probability of in-hospital death. Both the imputation and prediction model fitting are discussed in full next, along with the values for each tuning parameters chosen. Once models have been built tuning parameters will be chosen by computing measures of discrimination: area under the receiver operator characteristic curve (AUROC)³, and measures of calibration: the Brier score⁴, and standardize mortality ratio (SMR)⁵. The final model was chosen by assessing the overall and data-set (ANZICS-APD and eICU-CRD) specific performance across all performance metrics.

2.5 Imputation

The proportion of missing data stratified by data source is presented in Supplementary Figures 2 to 5. There are many significant differences between the two datasets, in terms of what is available and the frequency of missingness. An imputation approach was undertaken to make full use of all variables instead of removing potentially important information from any prediction systems developed.

Imputation involves filling in data points that are missing with a value so that a prediction model for a patient outcome can be fit. An outline of the overall approach for a single variable is presented in Supplementary Figure 6. In all approaches, patients with a variable present are used to build a model to fill in the values for patients with missing values.

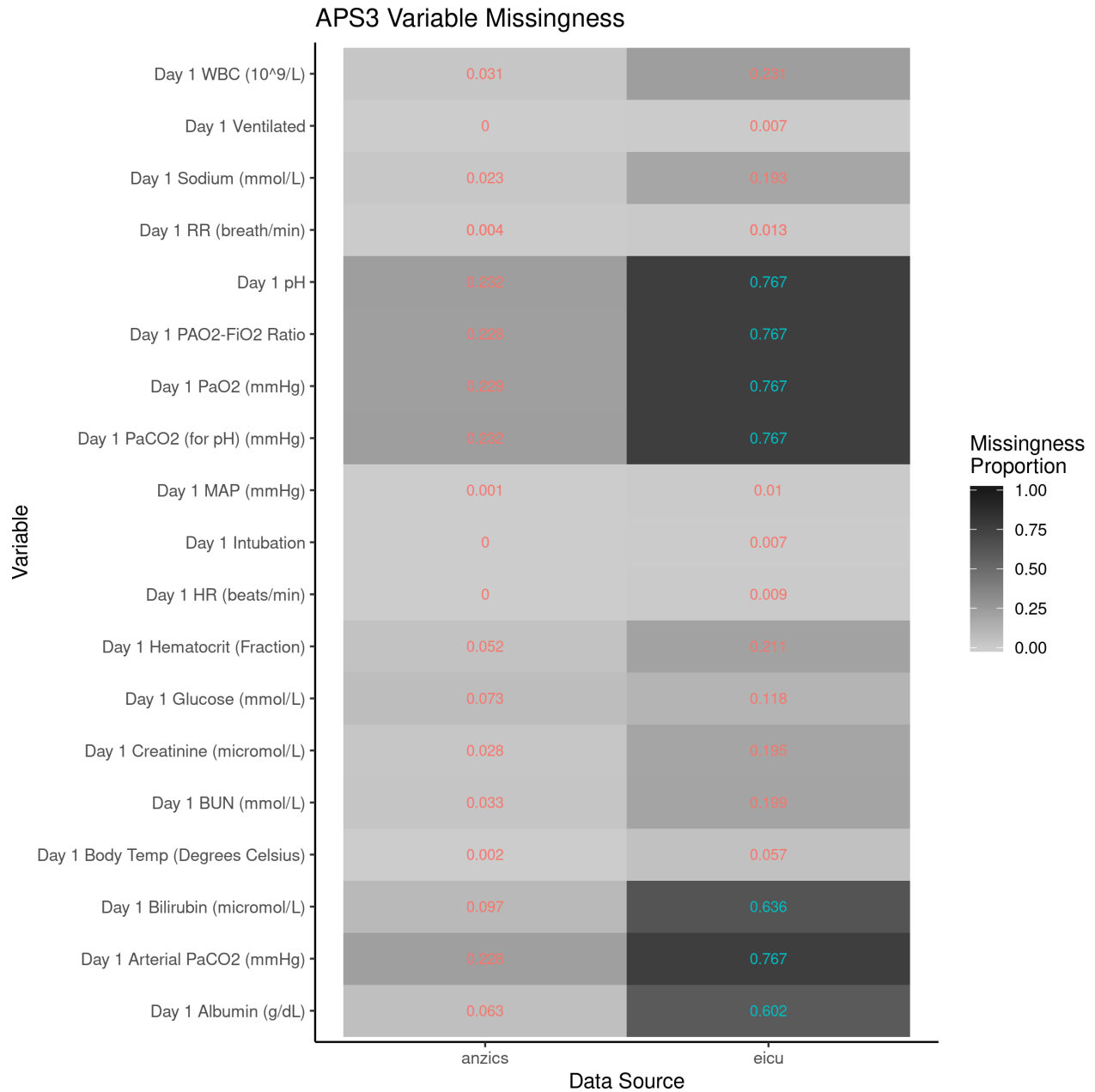
An overview of the imputation Algorithms is outlined in Supplementary Table 3.



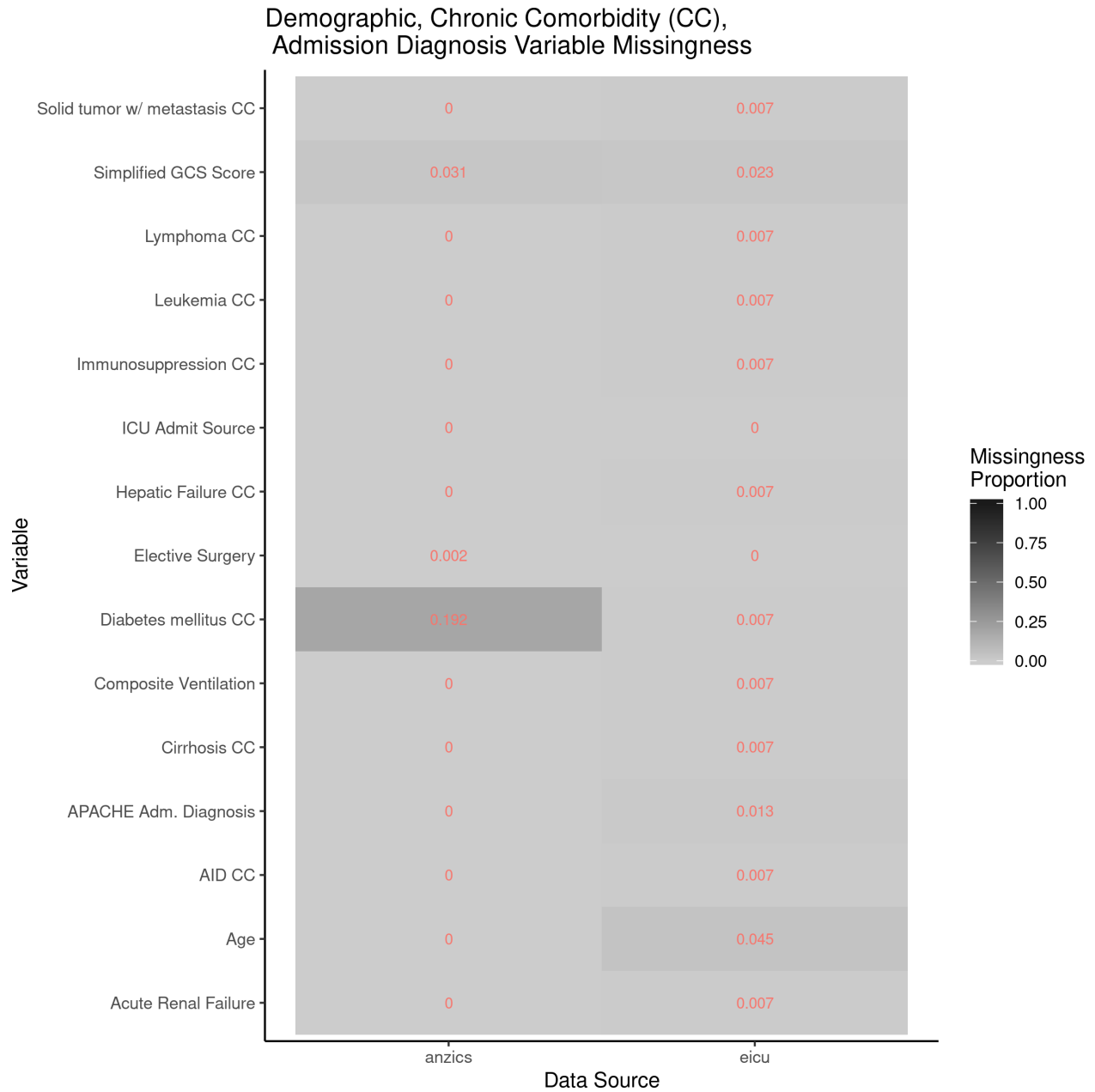
Supplementary Figure 2: Missingness proportion by data source for each day 1 maximum variable



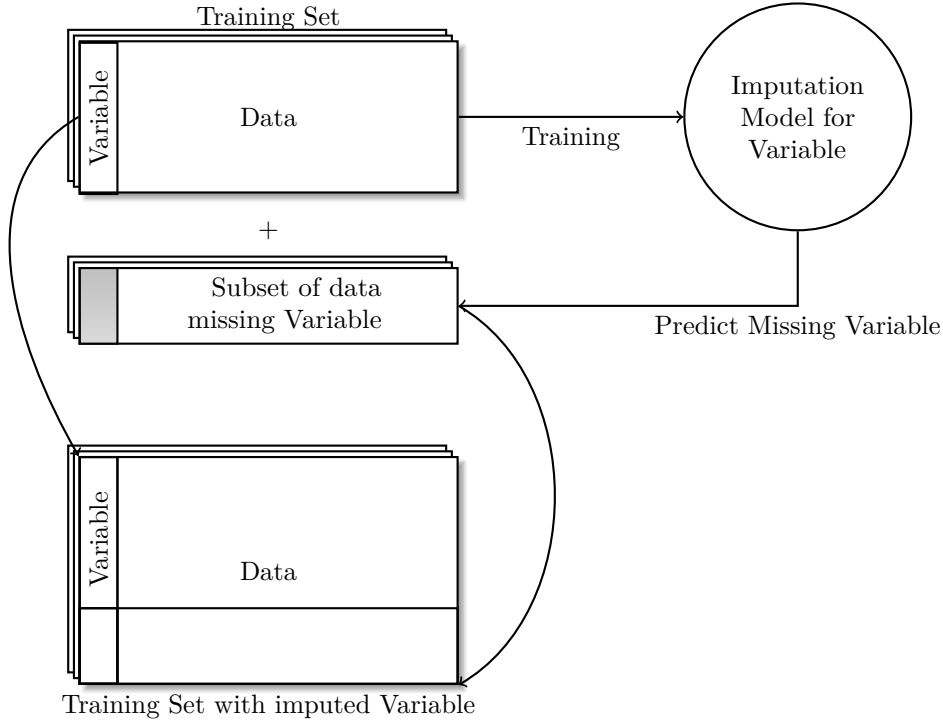
Supplementary Figure 3: Missingness proportion by data source for each day 1 minimum variable



Supplementary Figure 4: Missingness proportion by data source for each APS3 variable



Supplementary Figure 5: Missingness proportion by data source for each Demographic, Chronic Comorbidity, Admission Diagnosis Variable



Supplementary Figure 6: Overall Missing Data Imputation Approach for a single variable to be imputed

Supplementary Table 3: Algorithm Overview

Algorithm	Algorithm Name	Variables Used in Algorithm	Variables Excluded
0	Median Imputation	Only Variable to be imputed	N/A
1	Algorithm 1	All imputation variables	None
2	Algorithm 2	All imputation variables	Variables of the same quantity (e.g., Max systolic blood pressure when imputing min systolic blood pressure)
3	Algorithm 3	All imputation variables	Depends on patient: if patient has variable of same quantity, then Algorithm 1 exclusions, if patient has no variable of the same type, Algorithm 2 exclusions

The simplest approach we considered imputes the median value for numeric variables, or the most common value (mode) for categorical variables – calculated in the training set patients, after excluding those patients for the variable was missing. This is denoted Algorithm 0. Algorithms 1 and 2 use a machine/statistical learning to build models using an approach known as eXtreme gradient boosting using trees (xgboost⁶), which is used to create separate imputation models for each variable. Algorithms 2 and 3 differ primarily in what variables are used to build the model. Algorithm 1 focuses on building an imputation model for a variable using all variable denoted in 1. Algorithm 2 is similar to Algorithm 1 but, excludes variables of the same type (e.g., it would not use minimum body temperature in an imputation model for maximum body temperature). Algorithm 1 had poor performance when the imputation model for a variable was applied to patients where they had no variables of the same type. Algorithm 3 combines two different algorithms – applying Algorithm 2 for patients missing *all* variables of the same type, and Algorithm 1 for any patient which has one or more of these variables. For Algorithms 2 and 3, there is a tuning parameter governing the complexity of the relationships between the variable to be imputed and the other models. This complexity controls how many different possible models will be considered. Models will differ in the number of variables used in predicting the value to be imputed in addition to the complexity of the relationships between the variables.

The complexity tuning parameter used in Algorithms 2 and 3 controls the number of different models considered. In Supplementary Table 4 we describe which xGboost⁶ parameters are evaluated under each value of the parameter. As you can see in Supplementary Table 4, the number of different models evaluated varies from 4 in the least complex case, to 256 in the most complex setting. The individual tuning parameters control the learning rate (eta), the maximum depth of the tree, proportion of variables used to build a single tree (Col Sample by Tree), proportion of the data used to generate trees (Subsample), and number of iterations the algorithm is run (number of rounds). Cross-validation within cross-validation is performed to select a model for each variable, where three-folds were fit within each of the five previously split validation folds, and models were selected by choosing the parameters which minimized the MSE for numeric variables, or maximized the accuracy for categorical variables.

Supplementary Table 4: Description of the Complexity Tuning Parameter

Complexity Tuning parameter	eta	Max. Depth	gamma	Col. Sample by Tree	Min. Child Weight	Subsample	Number of Rounds	Different Models
1	0.3, 0.4	1	0	0.8	1	1/2	50	4
2	0.3, 0.4	1 - 2	0	0.6, 0.8	1	1/2, 1	50, 100	32
3	0.3, 0.4	1 - 3	0	0.6, 0.8	1	1/2, 3/4, 1	50, 100, 150	108
4	0.3, 0.4	1 - 4	0	0.6, 0.8	1	1/2, 2/3, 5/6, 1	50, 100, 150, 200	256

3 Results

3.1 Descriptive Summaries of the GOSSIS-1 Study Population

A comparison of the training and test set characteristics, similar to that found in the main paper in Table 1 for data source, is presented in Supplementary Table 5.

Supplementary Table 5: Patient Characteristics by Training/Test Partition

	Group	Test Set	Training Set
n		114079	266201
Age (median [IQR])		64.90 [51.10, 75.10]	64.90 [51.10, 75.00]
Gender (%)	F	49857 (43.7)	115993 (43.6)
	M	64201 (56.3)	150143 (56.4)
	Other or Missing	21 (0.0)	65 (0.0)
Data Source (%)	ANZICS-APD	74761 (65.5)	174468 (65.5)
	eICU-CRD	39318 (34.5)	91733 (34.5)
Country (%)	Australia	67586 (59.2)	157724 (59.2)
	New Zealand	7175 (6.3)	16744 (6.3)
	USA	39318 (34.5)	91733 (34.5)
ICU Admission Source (%)	Other or Unknown	111 (0.1)	272 (0.1)
	Accident & Emergency	42897 (37.6)	99641 (37.4)
	Floor	16211 (14.2)	38165 (14.3)
	Operating Room / Recovery	48737 (42.7)	113783 (42.7)
	Other Hospital	5065 (4.4)	11893 (4.5)
Type of ICU (%)	Other ICU	1058 (0.9)	2447 (0.9)
	General ICU	74761 (65.5)	174468 (65.5)
	Cardiac ICU	2535 (2.2)	5802 (2.2)
	CCU-CTICU	3467 (3.0)	7817 (2.9)
	CSICU	1501 (1.3)	3521 (1.3)
	CTICU	1358 (1.2)	3147 (1.2)
	Med-Surg ICU	21552 (18.9)	50420 (18.9)
	MICU	3278 (2.9)	7732 (2.9)
	Neuro ICU	3167 (2.8)	7449 (2.8)
	SICU	2460 (2.2)	5845 (2.2)
APACHE III Diagnosis Bodysystem (%)	Cardiovascular	31339 (27.5)	73602 (27.6)
	Gastrointestinal	16131 (14.1)	37603 (14.1)
	Genitourinary	3700 (3.2)	8861 (3.3)
	Gynecological	1260 (1.1)	2936 (1.1)
	Hematological	604 (0.5)	1342 (0.5)
	Metabolic	8316 (7.3)	19292 (7.2)
	Musculoskeletal/Skin	4854 (4.3)	11264 (4.2)
	Neurological	14766 (12.9)	34155 (12.8)
	Other medical disorders	1178 (1.0)	2760 (1.0)
	Respiratory	16241 (14.2)	37760 (14.2)
	Sepsis	9823 (8.6)	23158 (8.7)
	Trauma	5867 (5.1)	13468 (5.1)
	1	9597 (8.4)	22527 (8.5)
	0	104482 (91.6)	243674 (91.5)
		0.14 (0.20)	0.13 (0.20)
APACHE IIIj Hospital Death Probability (mean (SD))			
APACHE IVa Hospital Death Probability (mean (SD))		0.12 (0.17)	0.12 (0.17)
Death during ICU Admission (%)	1	6184 (5.4)	14298 (5.4)
	0	107731 (94.4)	251518 (94.5)
	Other or Missing	164 (0.1)	385 (0.1)
Hospital Length of Stay (days) (median [IQR])		6.96 [3.66, 12.47]	6.97 [3.66, 12.60]
ICU Length of Stay (days) (median [IQR])		1.74 [0.92, 3.19]	1.75 [0.92, 3.20]

APACHE III Score
(mean (SD))

53.75 (25.53)

53.75 (25.40)

A comparison of the clinical characteristics of patients in ANZICS-APD and eICU-CRD is presented in Supplementary Table 6 for numeric values, with clinical categorical variables presented in Supplementary Table 7.

Supplementary Table 6: Median and Q1-Q3 of Patient Clinical Characteristics (numeric variables) in Training Set

Group	ANZICS-APD	eICU-CRD	p-value	% Missing
n	174468	91733		
Max. Day 1 Diastolic BP (mmHg)	70.00 [61.00, 80.00]	87.00 [75.00, 99.00]	<0.001	1.3
Min. Day 1 Diastolic BP (mmHg)	50.00 [45.00, 60.00]	50.00 [41.00, 58.00]	<0.001	1.0
Max. Day 1 HR (beats/min)	95.00 [84.00, 110.00]	101.00 [88.00, 117.00]	<0.001	0.1
Min. Day 1 HR (beats/min)	69.00 [60.00, 80.00]	70.00 [60.00, 81.00]	<0.001	0.1
Max. Day 1 MAP (mmHg)	95.00 [86.00, 106.00]	102.00 [90.00, 116.00]	<0.001	0.2
Min. Day 1 MAP (mmHg)	67.00 [60.00, 75.00]	64.00 [54.00, 74.00]	<0.001	0.2
Max. Day 1 RR (breath/min)	22.00 [19.00, 26.00]	26.00 [22.00, 32.00]	<0.001	0.4
Min. Day 1 RR (breath/min)	12.00 [10.00, 14.00]	13.00 [10.00, 16.00]	<0.001	0.6
Max. Day 1 SpO2 (%)	NA [NA, NA]	100.00 [99.00, 100.00]	NA	65.7
Min. Day 1 SpO2 (%)	NA [NA, NA]	93.00 [89.00, 95.00]	NA	65.7
Max. Day 1 Systolic BP (mmHg)	143.00 [130.00, 160.00]	146.00 [130.00, 164.00]	<0.001	0.2
Min. Day 1 Systolic BP (mmHg)	100.00 [90.00, 110.00]	95.00 [83.00, 110.00]	<0.001	0.2
Max. Day 1 Body Temp (Degrees Celsius)	37.10 [36.70, 37.60]	37.20 [36.90, 37.60]	<0.001	1.4
Min. Day 1 Body Temp (Degrees Celsius)	36.00 [35.50, 36.40]	36.40 [36.10, 36.70]	<0.001	1.6
Max. Day 1 Albumin (g/dL)	NA [NA, NA]	3.00 [2.50, 3.40]	NA	84.4
Min. Day 1 Albumin (g/dL)	NA [NA, NA]	2.90 [2.40, 3.40]	NA	84.4
Max. Day 1 Bilirubin (micromol/L)	NA [NA, NA]	0.70 [0.40, 1.10]	NA	85.8
Min. Day 1 Bilirubin (micromol/L)	NA [NA, NA]	0.60 [0.40, 1.00]	NA	85.8
Max. Day 1 BUN (mmol/L)	NA [NA, NA]	19.00 [13.00, 31.00]	NA	69.2
Min. Day 1 BUN (mmol/L)	NA [NA, NA]	17.00 [12.00, 29.00]	NA	69.2
Max. Day 1 Calcium (mmol/L)	NA [NA, NA]	8.40 [7.90, 8.80]	NA	69.9
Min. Day 1 Calcium (mmol/L)	NA [NA, NA]	8.20 [7.70, 8.70]	NA	69.9
Max. Day 1 Creatinine (micromol/L)	0.94 [0.74, 1.30]	1.00 [0.76, 1.52]	<0.001	5.4
Max. Day 1 Glucose (mmol/L)	158.56 [129.73, 198.20]	150.00 [117.00, 201.00]	<0.001	7.1
Min. Day 1 Glucose (mmol/L)	115.32 [97.30, 135.14]	108.00 [91.00, 131.00]	<0.001	9.0

Max. Day 1 Bicarbonate (mmol/L)	24.00 [22.00, 27.00]	24.00 [22.00, 27.00]	0.007	8.5
Min. Day 1 Bicarbonate (mmol/L)	22.20 [20.00, 25.00]	23.00 [21.00, 26.00]	<0.001	11.6
Max. Day 1 Hemoglobin (g/dL)	11.80 [10.30, 13.30]	11.40 [9.90, 13.00]	<0.001	15.6
Min. Day 1 Hemoglobin (g/dL)	10.90 [9.30, 12.40]	10.90 [9.20, 12.60]	0.006	19.0
Max. Day 1 Hematocrit (Fraction)	35.00 [31.00, 39.70]	34.50 [30.00, 39.00]	<0.001	7.8
Min. Day 1 Hematocrit (Fraction)	33.00 [28.00, 37.00]	33.20 [28.00, 37.90]	<0.001	10.9
Max. Day 1 INR (micromol/L)	NA [NA, NA]	1.30 [1.10, 1.60]	NA	87.0
Min. Day 1 INR (micromol/L)	NA [NA, NA]	1.20 [1.10, 1.50]	NA	87.0
Max. Day 1 Lactate (mmol/L)	NA [NA, NA]	1.90 [1.20, 3.30]	NA	90.8
Min. Day 1 Lactate (mmol/L)	NA [NA, NA]	1.50 [1.00, 2.30]	NA	90.8
Max. Day 1 Platelets (10 ⁹ /L)	207.00 [159.00, 264.00]	194.00 [147.00, 250.00]	<0.001	16.3
Min. Day 1 Platelets (10 ⁹ /L)	185.00 [140.00, 239.00]	185.00 [137.00, 240.00]	0.005	19.9
Max. Day 1 Potassium (mmol/L)	4.40 [4.10, 4.80]	4.20 [3.80, 4.60]	<0.001	5.0
Min. Day 1 Potassium (mmol/L)	4.00 [3.70, 4.30]	3.90 [3.60, 4.30]	<0.001	8.2
Max. Day 1 Sodium (mmol/L)	139.00 [137.00, 141.00]	139.00 [137.00, 142.00]	0.059	5.1
Min. Day 1 Sodium (mmol/L)	137.00 [135.00, 139.00]	138.00 [135.00, 141.00]	<0.001	8.3
Max. Day 1 WBC (10 ⁹ /L)	12.50 [9.40, 16.60]	11.10 [8.05, 15.30]	<0.001	6.7
Min. Day 1 WBC (10 ⁹ /L)	10.27 [7.70, 13.50]	10.10 [7.47, 13.70]	0.004	11.5
Max. Day 1 Arterial PCO2 (mmHg)	NA [NA, NA]	42.80 [36.10, 50.00]	NA	87.9
Min. Day 1 Arterial PCO2 (mmHg)	NA [NA, NA]	37.00 [32.00, 43.00]	NA	87.9
Max. Day 1 Arterial pH	NA [NA, NA]	7.39 [7.34, 7.44]	NA	88.0
Min. Day 1 Arterial pH	NA [NA, NA]	7.34 [7.27, 7.40]	NA	88.0
Max. Day 1 Arterial PO2 (mmHg)	NA [NA, NA]	127.00 [88.00, 205.00]	NA	87.8
Min. Day 1 Arterial PO2 (mmHg)	NA [NA, NA]	85.00 [68.00, 116.00]	NA	87.8
Max. Day 1 PAO2-FiO2 Ratio	NA [NA, NA]	275.00 [191.67, 368.33]	NA	90.2
Min. Day 1 PAO2-FiO2 Ratio	NA [NA, NA]	205.00 [132.00, 300.19]	NA	90.2
Min. Day 1 Creatinine (micromol/L)	0.84 [0.67, 1.13]	0.94 [0.71, 1.40]	<0.001	9.5
Patient Age (years)	65.00 [50.80, 75.20]	64.00 [52.00, 75.00]	0.502	1.5

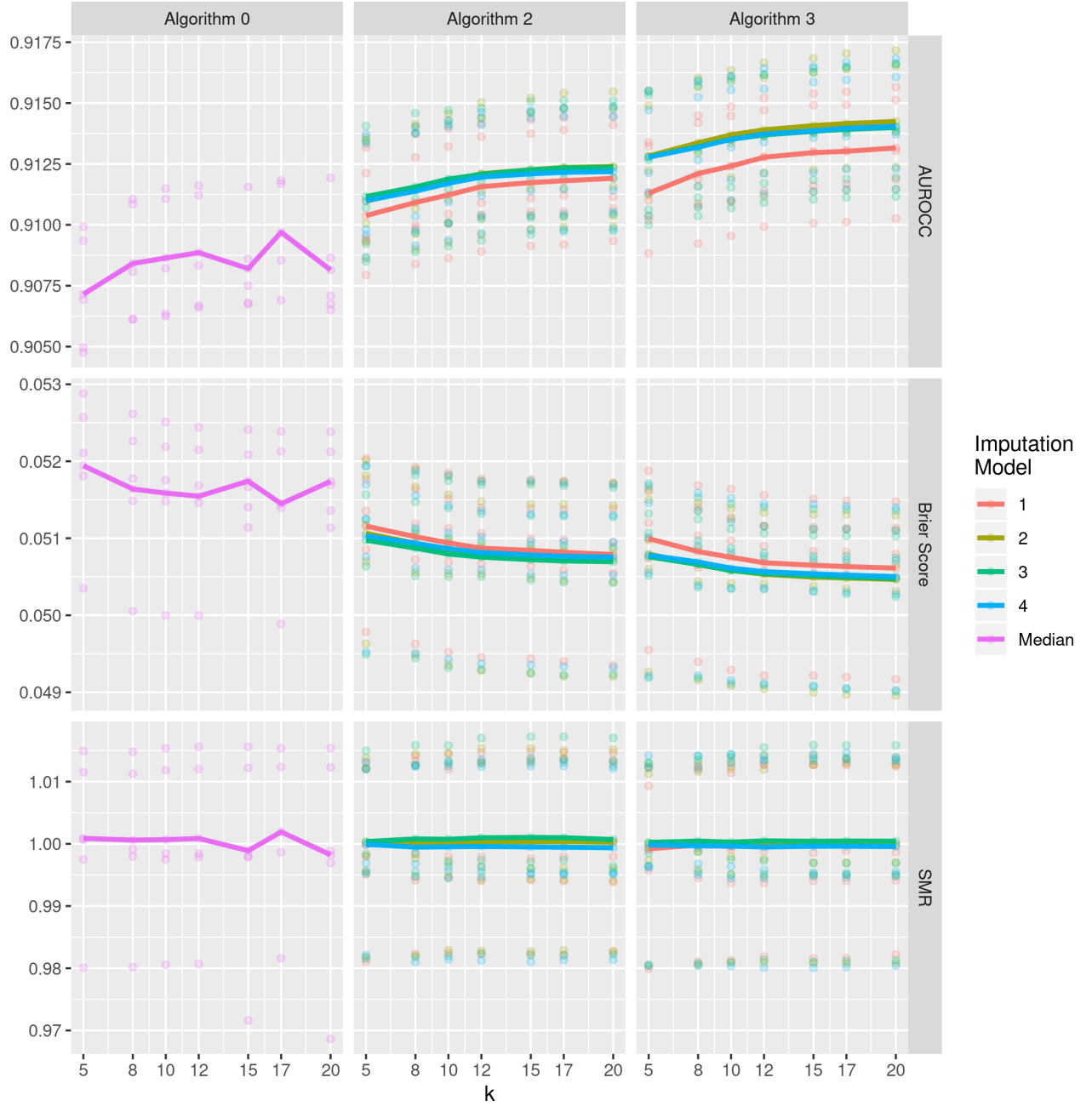
Supplementary Table 7: Patient Clinical Characteristics (categorical variables) in Training Set

	Group	ANZICS-APD	eICU-CRD	p-value	% Missing
n		174468	91733		
Derived GCS Categories (%)	All GCS Components at Max	120363 (71.2)	52958 (59.1)	<0.001	2.8
	All GCS Components at Min	9470 (5.6)	4787 (5.3)		
	One or Two GCS Components at Max	29082 (17.2)	21139 (23.6)		
	Otherwise	10134 (6.0)	10719 (12.0)		
Combined Ventilation/Intubation Variable (%)	0	109112 (62.5)	61003 (66.9)	<0.001	0.2
	1	65356 (37.5)	30122 (33.1)		
Elective Surgery (%)	0	95726 (55.0)	74433 (81.1)	<0.001	0.1
	1	78440 (45.0)	17300 (18.9)		
AIDS Chronic Co-morbidity (%)	0	174380 (99.9)	91029 (99.9)	<0.001	0.2
	1	88 (0.1)	96 (0.1)		
Diabetes mellitus Co-morbidity (%)	0	134608 (95.5)	71304 (78.2)	<0.001	12.8
	1	6415 (4.5)	19821 (21.8)		
Lymphoma Co-morbidity (%)	0	172979 (99.1)	90744 (99.6)	<0.001	0.2
	1	1489 (0.9)	381 (0.4)		
Solid tumor with metastasis Co-morbidity (%)	0	168458 (96.6)	89243 (97.9)	<0.001	0.2
	1	6010 (3.4)	1882 (2.1)		
Cirrhosis Co-morbidity (%)	0	171795 (98.5)	89606 (98.3)	0.009	0.2
	1	2673 (1.5)	1519 (1.7)		
Hepatic Failure Co-morbidity (%)	0	173779 (99.6)	89853 (98.6)	<0.001	0.2
	1	689 (0.4)	1272 (1.4)		
APACHE Acute Renal Failure Variable (%)	0	166211 (95.3)	88610 (97.2)	<0.001	0.2
	1	8257 (4.7)	2515 (2.8)		

3.2 Model Tuning

During model tuning, one cross-validation fold for one of the many sets of tuning parameters we evaluated failed to converge. This case was fold three using median imputation at $k=17$. The resulting fit model performed very poorly and was excluded from evaluation in the following Figures and Tables. We further tested $k=16$ and $k=18$ for the same fold and tuning parameters and were able to achieve convergence, but did not find that these models performed any differently than the observed trends, and were satisfied that this set of models, in fact any model resulting from the median imputation algorithm, would not be considered for use in the final model due to inferior performance when compared to the alternatives.

During model tuning overall model performance was assessed in the combined dataset (Supplementary Figure 7), but the candidate models were also assessed in validation samples for their discrimination and calibration in ANZICS-APD and eICU-CRD separately as well. Supplementary Figures 8 to 13 show the within dataset performance. Similarly, the performance of each set of tuning parameters we considered is presented overall in Supplementary Table 8 and in ANZICS-APD and eICU-CRD separately in Supplementary Tables 9 and 10, respectively.



Supplementary Figure 7: Model performance across different sets of tuning parameters for three metrics: area under the receiver operator characteristic curve (AUROC, top), Brier score (middle), and standardized mortality ratio (SMR, bottom). The left panel demonstrates imputation algorithm 2 and median imputation, while the right panel illustrates the chosen approach, algorithm 3. Lines represent the pooled metric over validation folds, while the individual points represent performance within each of the five folds. See note above regarding median imputation at $k=17$.

Supplementary Table 8: Overall Performance and Performance Rank in Overall GOSSIS-1 Validation Samples

Imputation Algorithm	Imputation Model	k	AUROC in Validation Samples	Brier Score in Validation Samples	SMR in Validation Samples	AUROC Rank	Brier Rank	SMR Rank
0	Median	5	0.907	0.052	1.001	63	63	46
0	Median	8	0.908	0.052	1.001	60	60	46
0	Median	10	0.909	0.052	1.001	59	59	46
0	Median	12	0.909	0.052	1.001	58	58	46
0	Median	15	0.908	0.052	0.999	61	62	46
0	Median	17	0.910	0.051	1.002	57	57	62
0	Median	20	0.908	0.052	0.998	62	61	62
2	1	5	0.910	0.051	1.000	56	56	1
2	1	8	0.911	0.051	1.000	55	53	1
2	1	10	0.911	0.051	1.000	51	50	1
2	1	12	0.912	0.051	1.000	46	46	1
2	1	15	0.912	0.051	1.000	44	43	1
2	1	17	0.912	0.051	1.000	42	41	1
2	1	20	0.912	0.051	1.000	40	36	1
2	2	5	0.911	0.051	1.000	54	55	1
2	2	8	0.911	0.051	1.000	48	48	1
2	2	10	0.912	0.051	1.000	43	44	1
2	2	12	0.912	0.051	1.000	36	37	1
2	2	15	0.912	0.051	1.000	31	29	1
2	2	17	0.912	0.051	1.000	28	27	1
2	2	20	0.912	0.051	1.000	27	26	1
2	3	5	0.911	0.051	1.000	52	51	1
2	3	8	0.912	0.051	1.001	47	47	46
2	3	10	0.912	0.051	1.001	41	39	46
2	3	12	0.912	0.051	1.001	38	30	46
2	3	15	0.912	0.051	1.001	32	25	46
2	3	17	0.912	0.051	1.001	30	24	46
2	3	20	0.912	0.051	1.001	29	23	46
2	4	5	0.911	0.051	1.000	53	54	1
2	4	8	0.911	0.051	0.999	49	49	46
2	4	10	0.912	0.051	1.000	45	45	1
2	4	12	0.912	0.051	1.000	39	40	1
2	4	15	0.912	0.051	1.000	37	34	1
2	4	17	0.912	0.051	0.999	34	33	46
2	4	20	0.912	0.051	0.999	33	31	46
3	1	5	0.911	0.051	0.999	50	52	46
3	1	8	0.912	0.051	1.000	35	42	1
3	1	10	0.912	0.051	1.000	26	28	1
3	1	12	0.913	0.051	1.000	25	21	1
3	1	15	0.913	0.051	1.000	21	18	1
3	1	17	0.913	0.051	1.000	20	17	1
3	1	20	0.913	0.051	1.000	19	16	1
3	2	5	0.913	0.051	1.000	22	38	1
3	2	8	0.913	0.051	1.000	16	19	1
3	2	10	0.914	0.051	1.000	12	14	1
3	2	12	0.914	0.051	1.000	8	9	1
3	2	15	0.914	0.050	1.000	3	4	1
3	2	17	0.914	0.050	1.000	2	3	1
3	2	20	0.914	0.050	1.000	1	1	1
3	3	5	0.913	0.051	1.000	23	32	1
3	3	8	0.913	0.051	1.000	17	20	1
3	3	10	0.914	0.051	1.000	14	13	1
3	3	12	0.914	0.051	1.000	13	11	1
3	3	15	0.914	0.051	1.000	10	7	1
3	3	17	0.914	0.050	1.000	7	5	1
3	3	20	0.914	0.050	1.000	5	2	1
3	4	5	0.913	0.051	1.000	24	35	1
3	4	8	0.913	0.051	1.000	18	22	1
3	4	10	0.914	0.051	1.000	15	15	1
3	4	12	0.914	0.051	0.999	11	12	46
3	4	15	0.914	0.051	1.000	9	10	1

3	4	17	0.914	0.051	1.000	6	8	1
3	4	20	0.914	0.051	1.000	4	6	1

Supplementary Table 9: Performance and Performance Rank in ANZICS-APD GOSSIS-1 Validation Samples

Imputation Algorithm	Imputation Model	k	AUROC in Validation Samples	Brier Score in Validation Samples	SMR in Validation Samples	AUROC Rank	Brier Rank	SMR Rank
0	Median	5	0.914	0.049	1.024	63	63	62
0	Median	8	0.915	0.049	1.013	62	62	32
0	Median	10	0.915	0.049	1.013	61	61	32
0	Median	12	0.916	0.049	1.012	60	58	29
0	Median	15	0.916	0.049	1.012	59	59	29
0	Median	17	0.916	0.049	1.014	57	60	34
0	Median	20	0.916	0.049	1.011	58	57	21
2	1	5	0.917	0.049	1.020	56	56	55
2	1	8	0.918	0.049	1.017	51	53	42
2	1	10	0.918	0.049	1.016	48	49	38
2	1	12	0.918	0.048	1.016	44	45	38
2	1	15	0.919	0.048	1.015	41	43	35
2	1	17	0.919	0.048	1.015	38	42	35
2	1	20	0.919	0.048	1.015	36	37	35
2	2	5	0.918	0.049	1.022	53	55	61
2	2	8	0.918	0.049	1.020	49	51	55
2	2	10	0.918	0.048	1.019	45	47	50
2	2	12	0.919	0.048	1.018	34	41	48
2	2	15	0.919	0.048	1.017	31	38	42
2	2	17	0.919	0.048	1.017	30	35	42
2	2	20	0.919	0.048	1.017	29	33	42
2	3	5	0.918	0.049	1.021	54	52	59
2	3	8	0.918	0.048	1.019	50	48	50
2	3	10	0.918	0.048	1.018	46	40	48
2	3	12	0.919	0.048	1.017	42	32	42
2	3	15	0.919	0.048	1.017	35	30	42
2	3	17	0.919	0.048	1.016	33	29	38
2	3	20	0.919	0.048	1.016	32	26	38
2	4	5	0.918	0.049	1.024	55	54	62
2	4	8	0.918	0.049	1.021	52	50	59
2	4	10	0.918	0.048	1.020	47	46	55
2	4	12	0.918	0.048	1.020	43	39	55
2	4	15	0.919	0.048	1.019	40	36	50
2	4	17	0.919	0.048	1.019	39	34	50
2	4	20	0.919	0.048	1.019	37	31	50
3	1	5	0.919	0.048	1.011	28	44	21
3	1	8	0.920	0.048	1.011	27	28	21
3	1	10	0.920	0.048	1.011	26	23	21
3	1	12	0.920	0.048	1.011	23	21	21
3	1	15	0.920	0.048	1.010	19	18	9
3	1	17	0.920	0.048	1.010	18	17	9
3	1	20	0.921	0.048	1.010	17	15	9
3	2	5	0.920	0.048	1.011	20	27	21
3	2	8	0.921	0.048	1.010	14	19	9
3	2	10	0.921	0.048	1.009	10	14	1
3	2	12	0.921	0.048	1.009	4	11	1
3	2	15	0.921	0.048	1.009	3	8	1
3	2	17	0.921	0.048	1.009	2	5	1
3	2	20	0.921	0.048	1.009	1	2	1
3	3	5	0.920	0.048	1.011	25	24	21
3	3	8	0.920	0.048	1.010	22	20	9
3	3	10	0.921	0.048	1.010	16	13	9
3	3	12	0.921	0.048	1.010	13	10	9
3	3	15	0.921	0.048	1.009	11	7	1
3	3	17	0.921	0.048	1.009	9	4	1

3	3	20	0.921	0.048	1.009	7	1	1
3	4	5	0.920	0.048	1.012	24	25	29
3	4	8	0.920	0.048	1.011	21	22	21
3	4	10	0.921	0.048	1.010	15	16	9
3	4	12	0.921	0.048	1.010	12	12	9
3	4	15	0.921	0.048	1.010	8	9	9
3	4	17	0.921	0.048	1.010	6	6	9
3	4	20	0.921	0.048	1.010	5	3	9

Supplementary Table 10: Performance and Performance Rank in eICU-CRD GOSSIS-1 Validation Samples

Imputation Algorithm	Imputation Model	k	AUROC in Validation Samples	Brier Score in Validation Samples	SMR in Validation Samples	AUROC Rank	Brier Rank	SMR Rank
0	Median	5	0.893	0.057	0.963	63	62	62
0	Median	8	0.896	0.056	0.981	60	60	25
0	Median	10	0.896	0.056	0.980	59	59	30
0	Median	12	0.896	0.056	0.982	57	58	16
0	Median	15	0.894	0.057	0.977	61	61	33
0	Median	17	0.898	0.056	0.981	51	55	25
0	Median	20	0.894	0.057	0.977	62	63	33
2	1	5	0.897	0.056	0.967	56	56	53
2	1	8	0.897	0.056	0.973	54	54	44
2	1	10	0.898	0.056	0.974	50	47	43
2	1	12	0.898	0.055	0.975	44	42	39
2	1	15	0.899	0.055	0.976	39	37	37
2	1	17	0.899	0.055	0.977	37	32	33
2	1	20	0.899	0.055	0.977	34	27	33
2	2	5	0.898	0.056	0.965	52	51	60
2	2	8	0.899	0.055	0.968	40	43	52
2	2	10	0.899	0.055	0.970	32	29	51
2	2	12	0.899	0.055	0.972	28	21	49
2	2	15	0.900	0.055	0.973	22	8	44
2	2	17	0.900	0.055	0.973	16	7	44
2	2	20	0.900	0.055	0.973	12	6	44
2	3	5	0.898	0.056	0.967	46	49	53
2	3	8	0.899	0.055	0.971	33	38	50
2	3	10	0.899	0.055	0.973	25	23	44
2	3	12	0.900	0.055	0.975	21	22	39
2	3	15	0.900	0.055	0.975	13	14	39
2	3	17	0.900	0.055	0.976	7	10	37
2	3	20	0.900	0.055	0.975	8	12	39
2	4	5	0.898	0.056	0.961	48	52	63
2	4	8	0.899	0.055	0.964	38	44	61
2	4	10	0.899	0.055	0.966	30	40	59
2	4	12	0.899	0.055	0.967	26	36	53
2	4	15	0.899	0.055	0.967	24	28	53
2	4	17	0.900	0.055	0.967	19	24	53
2	4	20	0.900	0.055	0.967	18	26	53
3	1	5	0.896	0.056	0.980	58	57	30
3	1	8	0.897	0.056	0.981	55	53	25
3	1	10	0.898	0.056	0.981	53	46	25
3	1	12	0.898	0.055	0.982	47	41	16
3	1	15	0.898	0.055	0.983	42	33	12
3	1	17	0.899	0.055	0.983	41	31	12
3	1	20	0.899	0.055	0.983	36	30	12
3	2	5	0.898	0.056	0.982	49	50	16
3	2	8	0.899	0.055	0.983	35	34	12
3	2	10	0.899	0.055	0.984	27	18	8
3	2	12	0.900	0.055	0.984	20	11	8
3	2	15	0.900	0.055	0.985	11	3	2
3	2	17	0.900	0.055	0.985	9	2	2
3	2	20	0.900	0.055	0.985	2	1	2

3	3	5	0.898	0.056	0.982	43	45	16
3	3	8	0.899	0.055	0.984	29	35	8
3	3	10	0.900	0.055	0.984	17	19	8
3	3	12	0.900	0.055	0.985	14	17	2
3	3	15	0.900	0.055	0.985	6	9	2
3	3	17	0.900	0.055	0.986	4	5	1
3	3	20	0.900	0.055	0.985	1	4	2
3	4	5	0.898	0.056	0.980	45	48	30
3	4	8	0.899	0.055	0.981	31	39	25
3	4	10	0.899	0.055	0.982	23	25	16
3	4	12	0.900	0.055	0.982	15	20	16
3	4	15	0.900	0.055	0.982	10	16	16
3	4	17	0.900	0.055	0.982	5	15	16
3	4	20	0.900	0.055	0.982	3	13	16

As demonstrated in Supplementary Figures 8 to 13, AUROC and Brier score performance of the models built from median imputed datasets were consistently poor across both ANZICS-APD and eICU-CRD, when compared to the models built using xgboost imputed data. Across all methods, SMR values were slightly greater than and less than one in the ANZICS-APD and eICU-CRD validation samples, respectively. This bias was in the order of 1-2% and persists when evaluating the SMRs for the individual datasets using the test set.

A calibration plot of the final model using the validation samples is presented in Supplementary Figure 14.

3.3 Model Fit and Description

The model description involves three components: the fixed effects of non-smooth terms, the random effects related to admission diagnosis, and the smooth terms characterizing the relationship between the physiological and demographic variables and the in-hospital mortality outcome.

3.3.1 Fixed Effects Non-Smooth Terms

The fixed effects of non-smooth terms can be reported as odds ratios, confidence intervals and p-values in Supplementary Table 11. Among the coefficients estimated of this class, all terms except the AIDS comorbidity variable were statistically significant at the 0.05 significance level. Among those variables which had a direct analog to APACHE (e.g., chronic co-morbidities, elective surgery, ICU admission source), the direction of the association remained the same as those used in APACHE-IV, with the notable exception of having an AIDS diagnosis. The change represented and the lack of statistical significant in the AIDS chronic co-morbidity coefficient likely represent the advances in the treatment of HIV infection among all HIV/AIDS patients within the three represented countries.

Supplementary Table 11: Model Fit Categorical Predictor

Variable	Coefficient	Odds Ratio	95% CI	p-value
Elective Surgery	-0.374	0.688	0.638-0.742	<0.001
DCS Group: All Min Components (relative to All High)	1.341	3.822	3.574-4.086	<0.001
DCS Group: One or Two Max Components	0.375	1.455	1.391-1.523	
DCS Group: Otherwise	0.712	2.038	1.923-2.161	
ICU Admit Source: Accident & Emergency (relative to Operating Room/Recovery)	0.173	1.189	1.183-1.194	<0.001
ICU Admit Source: Floor	0.407	1.503	1.496-1.51	

ICU Admit Source: Other ICU	0.202	1.223	1.207-1.24	
ICU Admit Source: Other Hospital	0.177	1.193	1.186-1.201	
ICU Admit Source: Other/Unknown	0.665	1.944	0.741-5.103	
AIDS Diagnosis	-0.217	0.805	0.543-1.194	0.28
Liver cirrhosis	0.364	1.439	1.288-1.606	<0.001
Diabetes Mellitus	-0.048	0.953	0.912-0.996	0.03
Lymphoma	0.195	1.216	1.043-1.416	0.01
Solid Tumor with Metastasis	0.770	2.160	1.985-2.351	<0.001

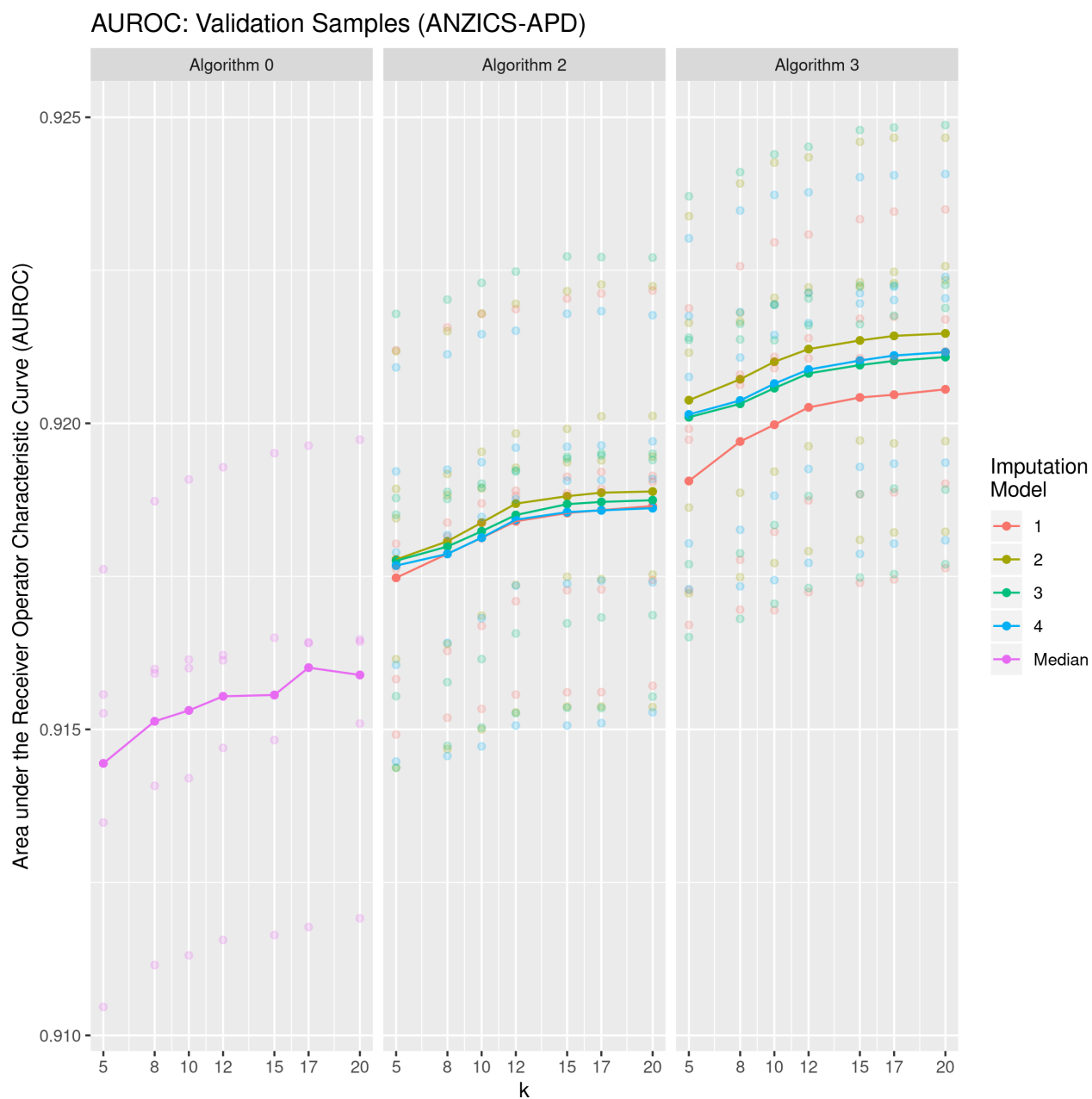
3.3.2 Admission Diagnosis

Admission diagnosis was modeled using three levels of nested random effects. The three levels go from most general to most specific: diagnosis body system group, admission diagnosis group, and admission diagnosis. Random effects, in general, exhibit a property known as shrinkage, where in the absence of evidence and substantial data, predictions are ‘shrunk’ towards the overall population mean. Under a nested scheme, this property would be pooled within the nesting structure, so admission diagnoses of the same diagnosis grouping will be shrunk toward the group mean, particularly when one of the diagnoses has a limited number of observations. In turn, diagnosis group will be shrunk towards the body system mean. This structure allows for the inclusion of specific diagnoses with small numbers of observed patients, or new diagnoses from future consortium members who have patients admitted to the ICU who do not have a diagnosis which fits neatly into one of the pre-existing diagnoses.

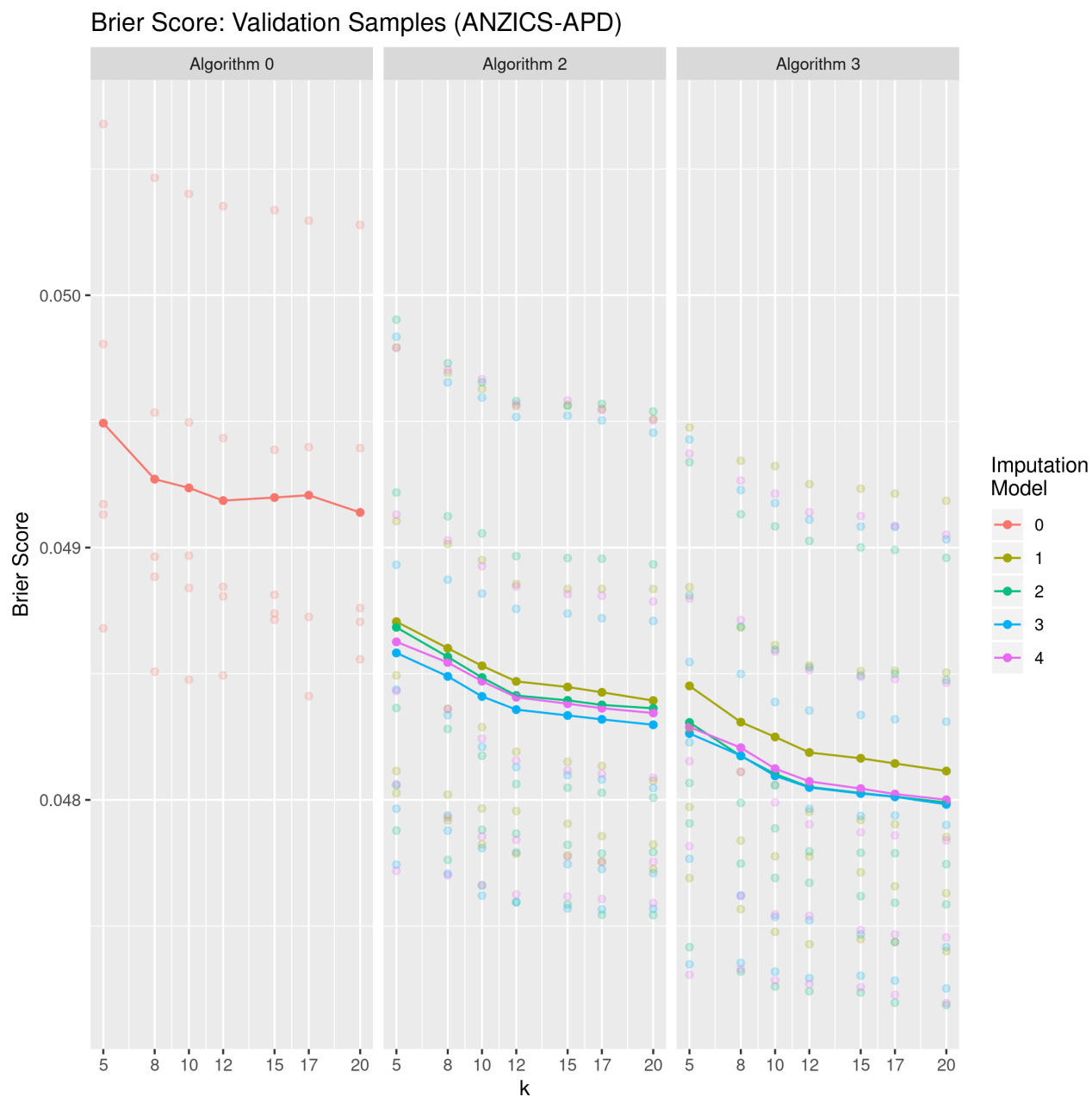
The predicted body system or Level 1 random effects, along with the sample sizes and within body system group death rates are presented in Supplementary Table 12, where they are presented in descending order by random effect coefficient predictions. When compared to the observed death rate it is of note that the order of the coefficients do not trend in an identical order. For example, a Sepsis body system diagnosis has the highest risk of mortality, but its predicted random effect is much smaller than bodysystem groups with lower mortality rates, such as neurological and trauma. This is largely because the physiological variables capture much of the increased risk of mortality for diagnoses such as sepsis and has already been adjusted for. Another way of thinking about this is the trauma and neurological patients have higher risk of in-hospital death than what their physiological variables would suggest, and a highly negative coefficient (e.g., metabolic) would have patients who have better outcomes than what their physiological state would indicate.

Supplementary Table 12: Level 1 Random Effect Predictions

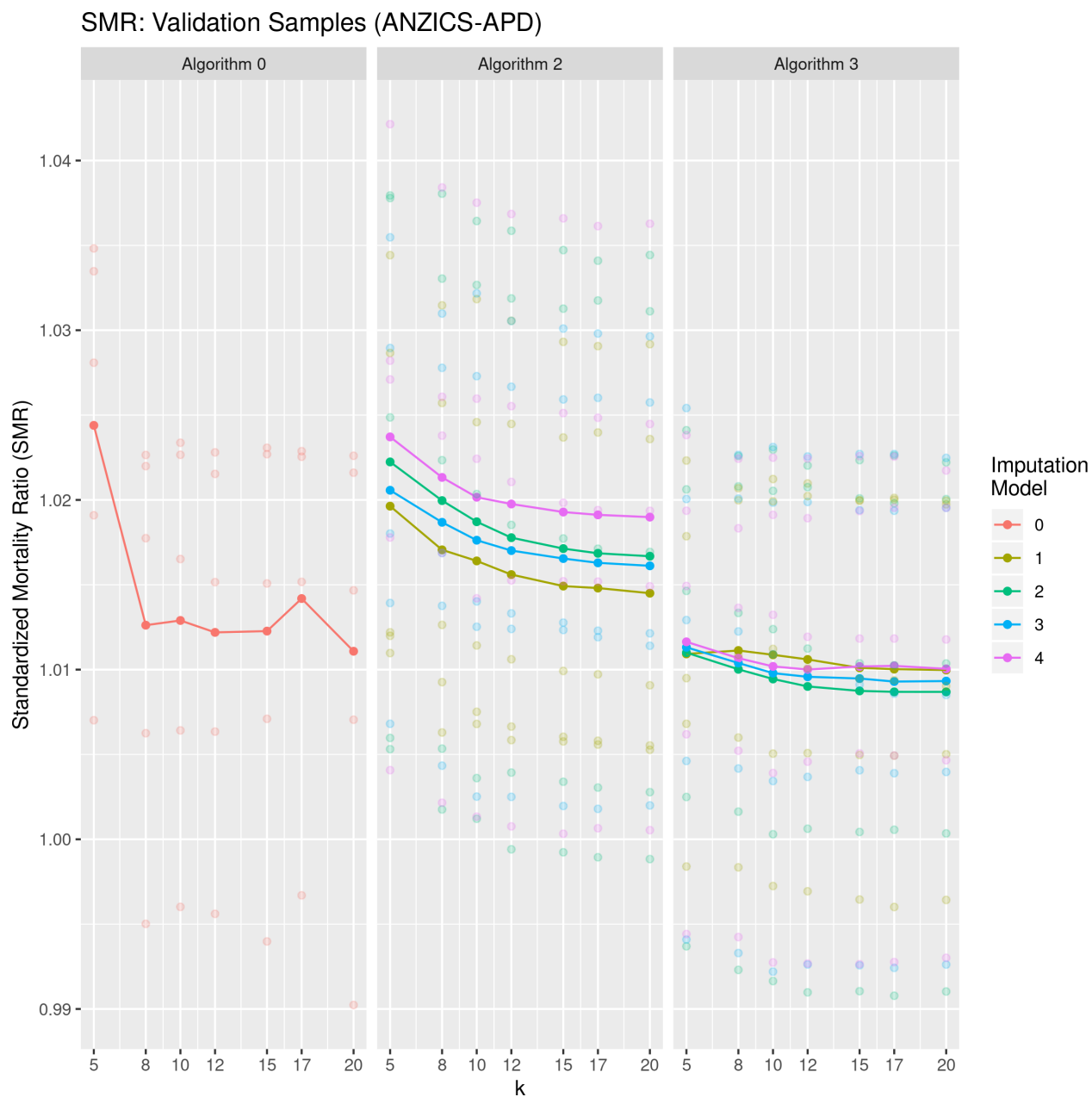
Group	Sample Size	Death Rate (%)	Coefficient
Neurological	34155	9.041	0.965
Trauma	13533	8.239	0.589
Respiratory	38446	10.909	0.259
Hematological	1342	15.276	0.177
Cardiovascular	118196	6.181	0.109
Gastrointestinal	37603	7.164	0.081
Musculoskeletal/Skin	11264	2.681	-0.144
Sepsis	23158	16.690	-0.157
Other medical disorders	2760	6.522	-0.219
Metabolic	55762	1.483	-0.433
Genitourinary	8861	5.406	-0.517
Gynecological	2936	0.511	-0.710



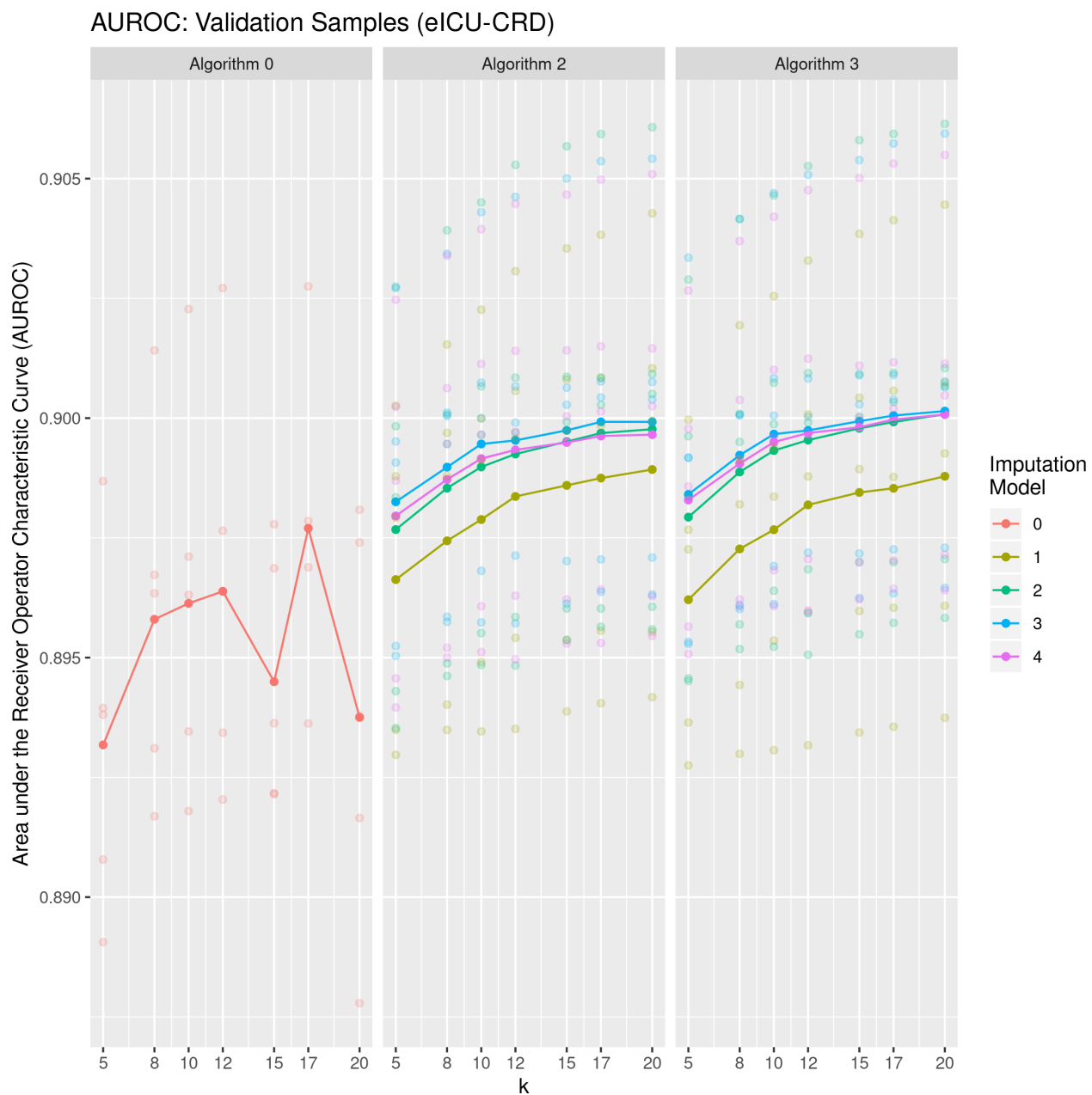
Supplementary Figure 8: Tuning AUROC, ANZICS-APD Only



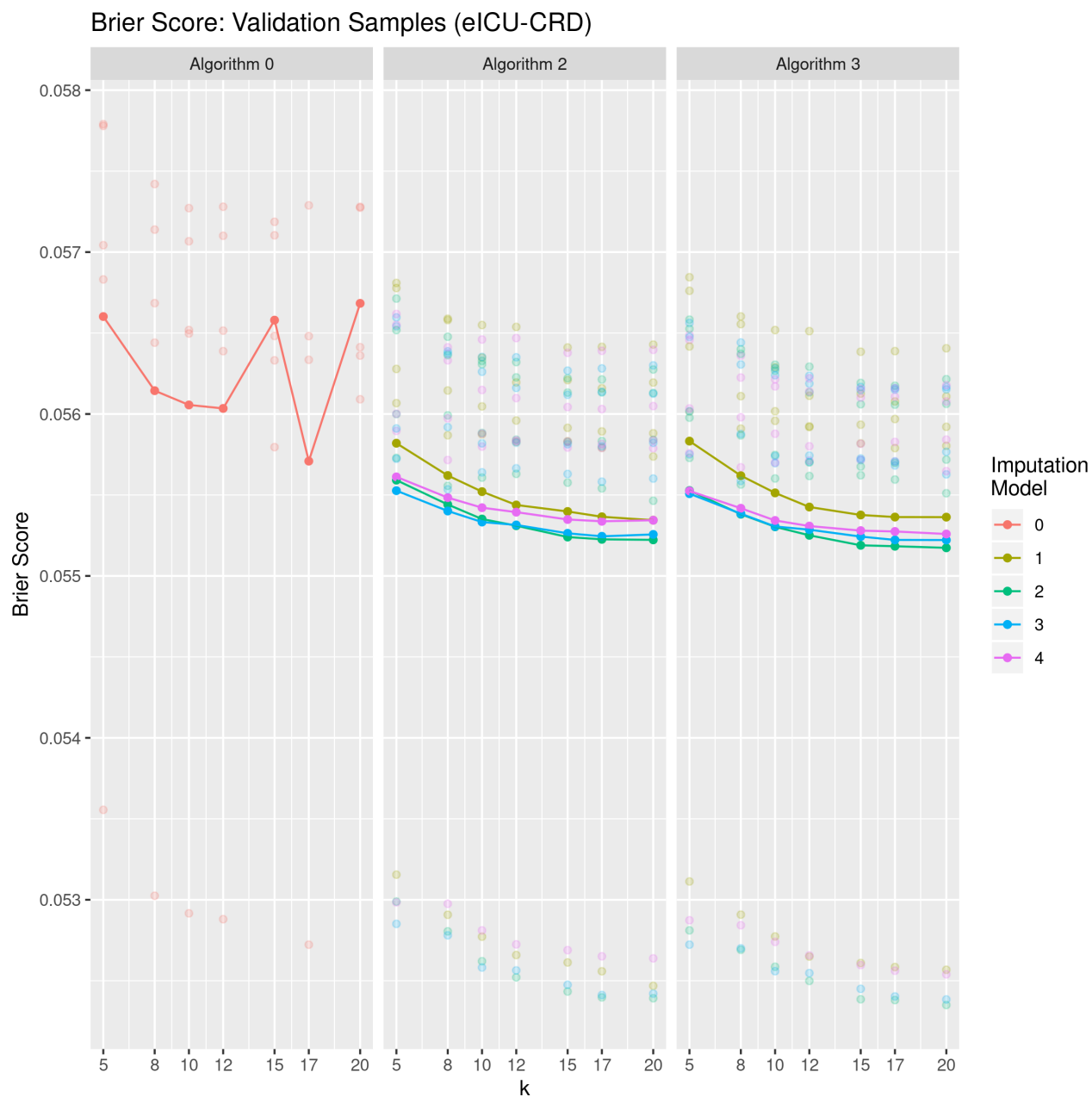
Supplementary Figure 9: Tuning Brier Score, ANZICS-APD Only



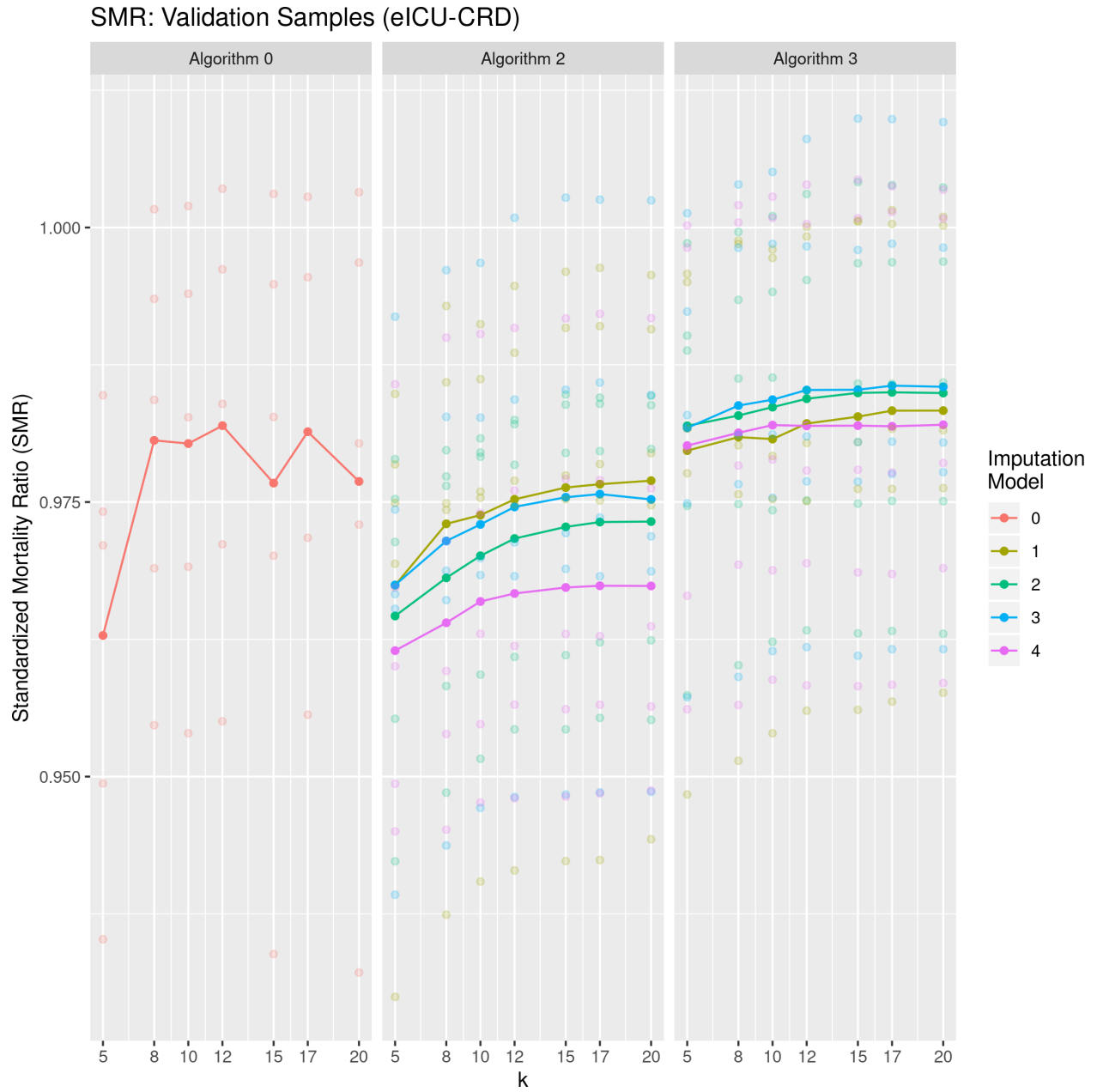
Supplementary Figure 10: Tuning SMR, ANZICS-APD Only



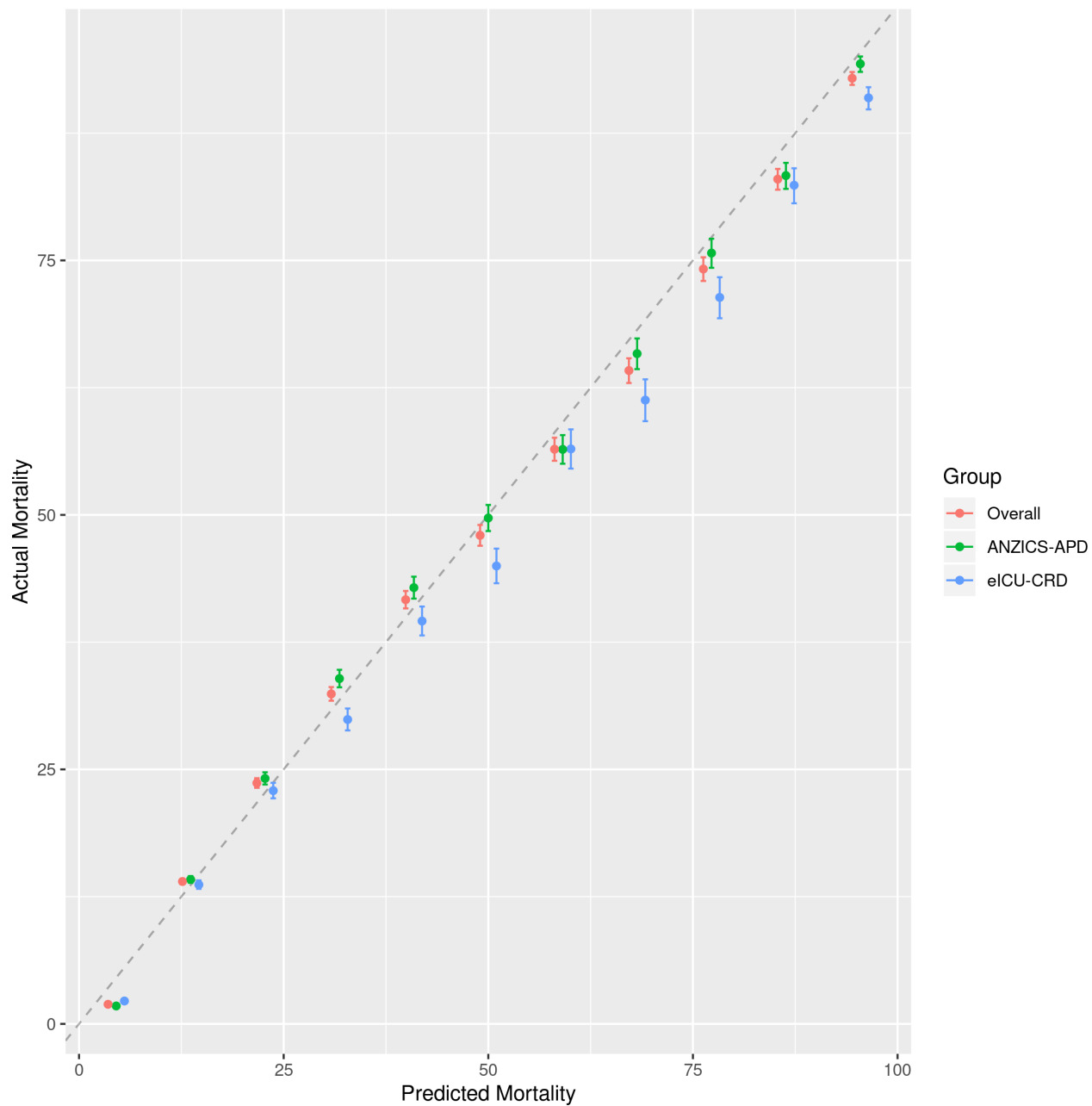
Supplementary Figure 11: Tuning AUROC, eICU-CRD Only



Supplementary Figure 12: Tuning Brier Score, eICU-CRD Only



Supplementary Figure 13: Tuning SMR, eICU-CRD Only



Supplementary Figure 14: Tuning Set Calibration Plot Using Validation Data

Supplementary Table 13: Random Effect Predictions for Levels 2 and 3 of the Admission Diagnoses

Admission Diagnosis	n	Dx Class	Class RE	Dx Subclass	Dx Sub RE	Total RE
Cardiovascular Diagnoses						
CARDSHOCK	1115	101	0.395	01	0.030	0.534
PAPMUSCLE	14	101	0.395	02	-0.118	0.386
New: Cardiovascular 101	363	101	0.395	99	0.177	0.681
CARDARREST	5099	102	0.937	01	-0.017	1.028
NTCOMA	46	102	0.937	02	0.094	1.140
POISON	46	102	0.937	02	0.094	1.140
New: Cardiovascular 102	988	102	0.937	99	0.133	1.178
DISAANEUR	404	103	0.712	01	0.201	1.022
New: Cardiovascular 103	38	103	0.712	99	-0.041	0.780
CHF	4095	104	0.001	01	0.089	0.198
New: Cardiovascular 104	476	104	0.001	99	-0.089	0.021
OTHERANEUR	135	105	0.291	01	0.102	0.502
ARTHROMBUS	425	105	0.291	02	0.006	0.406
New: Cardiovascular 105	24	105	0.291	99	-0.043	0.356
RHYTHATR	4540	106	-0.302	01	0.122	-0.071
RHYTHCON	4540	106	-0.302	01	0.122	-0.071
RHYTHVEN	4540	106	-0.302	01	0.122	-0.071
New: Cardiovascular 106	440	106	-0.302	99	-0.190	-0.384
AMI	4910	107	0.399	01	0.062	0.570
New: Cardiovascular 107	309	107	0.399	99	0.027	0.535
HYPERTENS	1166	108	-0.207	01	-0.072	-0.171
New: Cardiovascular 108	79	108	-0.207	99	0.026	-0.072
ANAPHYLAX	859	109	-0.142	01	-0.597	-0.630
STABANGINA	332	109	-0.142	02	0.060	0.026
M-CAROTHER	749	109	-0.142	03	0.120	0.086
ATYPCHSTPA	503	109	-0.142	04	-0.162	-0.195
CP-MUSCLSK	503	109	-0.142	04	-0.162	-0.195
CP-RESP	503	109	-0.142	04	-0.162	-0.195
CP-UNK	503	109	-0.142	04	-0.162	-0.195
PERICEFFUS	176	109	-0.142	05	-0.052	-0.085
ENDOCARDIT	232	109	-0.142	06	0.504	0.470
HEMATOMAS	91	109	-0.142	07	-0.253	-0.287
HEMORRHAGE	287	109	-0.142	08	0.023	-0.011
HYPOVOLEM	856	109	-0.142	09	0.051	0.017
OTH_MI	375	109	-0.142	1	0.344	0.310
PREHEMMON	158	109	-0.142	11	-0.038	-0.072
PERICARDIT	47	109	-0.142	12	-0.087	-0.121
PERITAMPON	105	109	-0.142	13	-0.123	-0.156
DVT	327	109	-0.142	14	0.024	-0.010
DRUGTOXIC	82	109	-0.142	15	-0.082	-0.116
M-VASOTHER	357	109	-0.142	16	0.235	0.202
New: Cardiovascular 109	305	109	-0.142	99	0.003	-0.031
CARDIOMYOP	398	110	0.281	01	-0.075	0.315
New: Cardiovascular 110	51	110	0.281	99	0.138	0.528
UNSTANGINA	1348	111	-0.248	01	0.026	-0.114
New: Cardiovascular 111	34	111	-0.248	99	-0.081	-0.221
S-DILWANES	28	1202	0.485	01	0.069	0.662
S-DILWOANE	15	1202	0.485	02	-0.031	0.562
S-EMBWANES	181	1202	0.485	03	0.219	0.812
S-EMBWOANE	40	1202	0.485	04	-0.069	0.525
S-OTHGRAFT	202	1202	0.485	05	-0.189	0.405
S-RENGRAFT	10	1202	0.485	06	0.046	0.640
S-THROMBWA	220	1202	0.485	07	0.083	0.676
S-THROMWOA	59	1202	0.485	08	-0.003	0.590
New: Cardiovascular 1202	219	1202	0.485	99	-0.017	0.576
S-AILGRAFT	112	1203	-0.032	01	-0.052	0.024
S-FEMPGRAF	452	1203	-0.032	02	0.018	0.095
New: Cardiovascular 1203	318	1203	-0.032	99	0.026	0.103
S-AAANEUR	1067	1204	0.016	01	0.081	0.205
S-TAANEUR	282	1204	0.016	02	0.035	0.160

New: Cardiovascular 1204	274	1204	0.016	99	-0.112	0.013
S-CAROTEND	1826	1205	-0.350	01	-0.103	-0.345
New: Cardiovascular 1205	542	1205	-0.350	99	0.025	-0.217
S-VALVAM	781	1206	-0.786	01	0.037	-0.641
S-VALVSINGLE	375	1206	-0.786	02	0.069	-0.609
S-VALVAO	6464	1206	-0.786	03	-0.292	-0.970
S-VALVMI	6464	1206	-0.786	03	-0.292	-0.970
S-VALVMR	6464	1206	-0.786	03	-0.292	-0.970
S-VALVPULM	6464	1206	-0.786	03	-0.292	-0.970
S-VALVTRI	6464	1206	-0.786	03	-0.292	-0.970
S-VALVTRIPLE	94	1206	-0.786	05	-0.032	-0.710
New: Cardiovascular 1206	1964	1206	-0.786	99	0.042	-0.636
S-CABG	11917	1207	-0.943	01	-0.287	-1.121
S-CABGREDO	241	1207	-0.943	02	0.035	-0.799
S-CABGWOTH	441	1207	-0.943	03	0.164	-0.671
New: Cardiovascular 1207	3338	1207	-0.943	99	-0.124	-0.958
S-CONDXMAP	236	1208	-0.290	01	-0.033	-0.215
S-VENANEUR	16	1208	-0.290	02	-0.017	-0.199
S-OTHANEUR	232	1208	-0.290	03	-0.057	-0.239
S-CARCONG	201	1208	-0.290	04	-0.121	-0.303
S-CARDASD	201	1208	-0.290	04	-0.121	-0.303
S-CARDVSD	201	1208	-0.290	04	-0.121	-0.303
S-CABGMINI	74	1208	-0.290	05	-0.022	-0.204
S-CAROTHER	798	1208	-0.290	06	0.062	-0.120
S-VASCOMPL	112	1208	-0.290	07	-0.030	-0.212
S-CARDCOMP	68	1208	-0.290	08	-0.009	-0.191
S-AICD	102	1208	-0.290	09	0.046	-0.136
S-ENDOTHER	297	1208	-0.290	1	-0.024	-0.206
S-DIALGRAF	42	1208	-0.290	11	-0.071	-0.253
S-REMGRAFT	27	1208	-0.290	12	0.089	-0.093
S-PERIEFFU	192	1208	-0.290	13	0.119	-0.063
S-PERICARD	71	1208	-0.290	14	-0.010	-0.192
S-CVTUMOR	119	1208	-0.290	15	-0.119	-0.301
S-VASOTHER	454	1208	-0.290	16	0.139	-0.043
S-VENACLIP	1	1208	-0.290	17	0.000	-0.182
S-VENAFILT	16	1208	-0.290	18	0.051	-0.131
New: Cardiovascular 1208	902	1208	-0.290	99	-0.057	-0.239
S-AAANEUDI	142	1209	-0.159	01	-0.233	-0.283
S-TAANEUDI	228	1209	-0.159	02	0.237	0.186
New: Cardiovascular 1209	138	1209	-0.159	99	-0.039	-0.090
S-AAANEUUP	214	1210	0.409	01	-0.053	0.464
S-TAANEURU	29	1210	0.409	02	0.038	0.555
New: Cardiovascular 1210	94	1210	0.409	99	0.106	0.624
S-AFEMGRAF	300	1211	0.304	01	0.010	0.422
S-FEMFGRAF	119	1211	0.304	02	-0.063	0.349
New: Cardiovascular 1211	51	1211	0.304	99	0.122	0.534
S-CABREVAL	321	1212	-0.571	01	-0.203	-0.666
S-CABGROTH	321	1212	-0.571	01	-0.203	-0.666
S-CABGDVAL	200	1212	-0.571	02	0.126	-0.337
S-CABGAOV	2460	1212	-0.571	03	-0.192	-0.654
S-CABGMIV	2460	1212	-0.571	03	-0.192	-0.654
S-CABGMVR	2460	1212	-0.571	03	-0.192	-0.654
S-CABGVALV	2460	1212	-0.571	03	-0.192	-0.654
New: Cardiovascular 1212	726	1212	-0.571	99	0.141	-0.322
S-AAAENDOLU	473	1213	-0.082	01	-0.064	-0.037
S-TAAENDOLU	66	1213	-0.082	02	0.013	0.040
New: Cardiovascular 1213	281	1213	-0.082	99	0.032	0.059
Gastrointestinal Diagnoses						
S-GIPERFOR	1708	1401	0.191	01	0.095	0.367
New: Gastrointestinal 1401	667	1401	0.191	99	-0.052	0.220
S-LGIBLEED	263	1403	0.031	01	-0.144	-0.031
S-GIBLEOTH	143	1403	0.031	02	0.011	0.124
S-UGIBLEED	500	1403	0.031	03	-0.063	0.050
S-VARBLEED	176	1403	0.031	04	0.229	0.342

New: Gastrointestinal 1403	468	1403	0.031	99	-0.025	0.088
S-GIOBSTRX	2284	1404	0.163	01	0.218	0.462
New: Gastrointestinal 1404	813	1404	0.163	99	-0.181	0.063
S-THESTOPCA	232	1405	0.292	01	0.280	0.653
S-LGINTCA	3092	1405	0.292	02	-0.158	0.215
S-ESOPHCA	338	1405	0.292	03	0.332	0.706
S-GIOTHCA	1361	1405	0.292	04	-0.255	0.119
S-SMINTCA	191	1405	0.292	05	-0.034	0.339
S-STOMACCA	419	1405	0.292	06	-0.022	0.351
S-PANCRECA	863	1405	0.292	07	-0.171	0.203
New: Gastrointestinal 1405	1600	1405	0.292	99	0.092	0.465
S-CHOLANGI	1374	1406	-0.659	01	-0.106	-0.684
New: Gastrointestinal 1406	431	1406	-0.659	99	-0.041	-0.619
S-LIVTRAN	329	1407	-1.132	01	-0.239	-1.290
New: Gastrointestinal 1407	13	1407	-1.132	99	-0.015	-1.066
S-APPENDIX	348	1408	-0.128	01	-0.065	-0.112
S-CAPD	5	1408	-0.128	02	-0.009	-0.056
S-GICOMPL	712	1408	-0.128	03	0.053	0.006
S-ESOPHOTH	139	1408	-0.128	04	-0.021	-0.068
S-GASTROST	87	1408	-0.128	05	0.068	0.021
S-GIOTHER	1604	1408	-0.128	06	0.139	0.092
S-HIATALH	310	1408	-0.128	07	-0.002	-0.049
S-HERNIA	683	1408	-0.128	08	0.049	0.002
S-OBESITY	1710	1408	-0.128	09	-0.066	-0.113
S-PERITLAV	8	1408	-0.128	1	-0.018	-0.065
S-PVENSHUN	8	1408	-0.128	11	0.030	-0.017
S-PORTSHUN	15	1408	-0.128	12	-0.013	-0.060
S-SPLEEN	187	1408	-0.128	13	-0.175	-0.222
New: Gastrointestinal 1408	954	1408	-0.128	99	0.000	-0.047
S-GIFISTAB	244	1409	-0.404	01	0.223	-0.100
S-GIABSCYS	138	1409	-0.404	02	-0.087	-0.410
New: Gastrointestinal 1409	105	1409	-0.404	99	-0.226	-0.549
S-GIVASISC	472	1410	0.640	01	0.216	0.938
New: Gastrointestinal 1410	188	1410	0.640	99	-0.072	0.650
S-PANCREAT	109	1411	-0.090	01	0.043	0.034
New: Gastrointestinal 1411	40	1411	-0.090	99	-0.063	-0.072
S-PERITON	255	1412	0.021	01	0.148	0.250
New: Gastrointestinal 1412	118	1412	0.021	99	-0.143	-0.040
S-DIVERTIC	256	1413	0.020	01	0.132	0.234
S-INFOWDI	157	1413	0.020	02	-0.039	0.062
New: Gastrointestinal 1413	207	1413	0.020	99	-0.089	0.013
ACUHEPFAIL	468	301	0.306	01	0.175	0.562
HEPENCEPH	429	301	0.306	02	-0.187	0.201
HEPRENSYN	79	301	0.306	03	-0.012	0.376
LIVERTRAN	5	301	0.306	04	-0.052	0.335
New: Gastrointestinal 301	136	301	0.306	99	0.145	0.533
VARICBLEED	304	303	-0.200	01	-0.108	-0.227
New: Gastrointestinal 303	101	303	-0.200	99	0.064	-0.055
UNKGIBLEED	1268	305	-0.337	01	-0.020	-0.276
UGIBLEED	2250	305	-0.337	02	-0.031	-0.287
New: Gastrointestinal 305	282	305	-0.337	99	-0.024	-0.280
LOWGIBLEED	1511	306	-0.263	01	-0.133	-0.314
New: Gastrointestinal 306	81	306	-0.263	99	0.073	-0.108
M-GIOTHER	414	307	-0.081	01	-0.020	-0.020
PERITOHEN	227	307	-0.081	02	-0.049	-0.049
PEPULCER	9	307	-0.081	03	0.010	0.010
ADRENNEO	4	307	-0.081	04	-0.008	-0.008
CP-GASTRO	43	307	-0.081	05	0.011	0.011
New: Gastrointestinal 307	199	307	-0.081	99	0.039	0.038
GIPERFORAT	327	308	0.090	01	0.004	0.175
New: Gastrointestinal 308	83	308	0.090	99	0.016	0.188
GIOBSTRX	528	309	0.270	01	0.137	0.489
New: Gastrointestinal 309	131	309	0.270	99	-0.077	0.275
GIVASINSUF	119	310	0.914	01	-0.016	0.980
New: Gastrointestinal 310	25	310	0.914	99	0.221	1.216

PANCRITIS	1066	311	0.118	01	0.008	0.207
New: Gastrointestinal 311	256	311	0.118	99	0.019	0.218
COLONRECCA	57	312	0.571	01	-0.170	0.483
ESOPHAGCA	20	312	0.571	02	0.115	0.768
PANCREATCA	37	312	0.571	03	0.082	0.735
STOMACHCA	12	312	0.571	04	0.178	0.831
OTHERGICA	57	312	0.571	05	0.078	0.731
New: Gastrointestinal 312	67	312	0.571	99	-0.156	0.497
CHOLANGIT	299	313	-0.244	01	-0.145	-0.308
DIVERTIC	54	313	-0.244	02	0.010	-0.152
GIABSCYST	68	313	-0.244	03	-0.108	-0.271
INFLAMBOWD	108	313	-0.244	04	0.070	-0.092
PERITONIT	78	313	-0.244	05	0.075	-0.088
New: Gastrointestinal 313	77	313	-0.244	99	0.043	-0.119
Genitourinary Diagnoses						
S-CYSTNEO	436	1701	0.314	01	0.235	0.033
S-NEPHRNEO	659	1701	0.314	02	-0.247	-0.450
S-SUPROSCA	413	1701	0.314	03	0.038	-0.165
S-TURCA	94	1701	0.314	04	0.069	-0.133
New: Genitourinary 1701	334	1701	0.314	99	-0.024	-0.227
S-REPBLAD	35	1703	-0.134	01	0.051	-0.599
S-CYSTOTH	93	1703	-0.134	02	-0.097	-0.747
S-NEPHROTH	197	1703	-0.134	03	-0.042	-0.692
S-OBNEPHRO	301	1703	-0.134	04	-0.211	-0.861
S-OBSTROTH	209	1703	-0.134	05	0.104	-0.546
S-ORCHIECT	7	1703	-0.134	06	-0.007	-0.657
S-SPBPH	67	1703	-0.134	07	0.028	-0.623
S-TURBPH	94	1703	-0.134	08	-0.016	-0.666
New: Genitourinary 1703	161	1703	-0.134	99	0.160	-0.490
S-KIDTRAN	217	1704	-0.097	01	-0.062	-0.676
New: Genitourinary 1704	16	1704	-0.097	99	0.040	-0.574
S-PELVEXM	77	1705	0.012	01	-0.049	-0.553
S-PELVEXEN	84	1705	0.012	02	-0.001	-0.505
S-GENOTHER	490	1705	0.012	03	-0.074	-0.578
S-LYMPHDIS	24	1705	0.012	04	0.034	-0.470
S-LYMPHDSX	42	1705	0.012	05	-0.028	-0.532
S-PELVREL	8	1705	0.012	06	-0.003	-0.507
New: Genitourinary 1705	481	1705	0.012	99	0.124	-0.380
M-GUOTHER	170	901	0.323	01	0.392	0.199
RENALBLEED	96	901	0.323	02	0.013	-0.181
ARENFAIL	2696	901	0.323	03	0.067	-0.126
RENINFX	151	901	0.323	04	-0.291	-0.484
RENALNEO	30	901	0.323	05	0.079	-0.114
RENALOBST	123	901	0.323	06	-0.159	-0.353
KIDNEYTRAN	19	901	0.323	07	-0.019	-0.212
New: Genitourinary 901	441	901	0.323	99	-0.009	-0.202
PRE-ECLAMP	265	902	-0.419	01	-0.086	-1.022
New: Genitourinary 902	33	902	-0.419	99	-0.009	-0.945
POSTPARHEM	262	903	-0.557	01	-0.107	-1.180
New: Genitourinary 903	36	903	-0.557	99	-0.018	-1.092
Gynecological Diagnoses						
S-HYSTERCA	591	1801	-0.178	01	-0.103	-0.992
S-HYSTFIB	293	1801	-0.178	02	0.018	-0.870
New: Gynecological 1801	217	1801	-0.178	99	0.045	-0.844
S-CSECTION	826	1802	-0.653	01	-0.176	-1.540
S-ECTOPIC	74	1802	-0.653	02	0.052	-1.312
New: Gynecological 1802	373	1802	-0.653	99	-0.022	-1.386
S-RUPOVCYS	29	1803	0.065	01	-0.010	-0.655
S-OOPHOREC	267	1803	0.065	02	-0.097	-0.742
New: Gynecological 1803	266	1803	0.065	99	0.122	-0.523
Hematological Diagnoses						
S-HEMOTHER	42	2101	-0.041	01	0.024	0.160
S-HODGKINL	3	2101	-0.041	02	-0.005	0.131
S-NONHODGL	5	2101	-0.041	03	-0.019	0.117

New: Hematological 2101	30	2101	-0.041	99	-0.009	0.127
COAGULOP	133	801	0.118	01	-0.131	0.164
NEUTROPEN	154	801	0.118	02	-0.155	0.140
PANCYTOPEN	34	801	0.118	03	0.039	0.333
THROMBOCYT	77	801	0.118	04	0.311	0.605
New: Hematological 801	123	801	0.118	99	-0.037	0.258
ANEMIA	398	802	0.114	01	-0.377	-0.086
BLOODREACT	22	802	0.114	02	-0.082	0.209
ALL	33	802	0.114	03	0.013	0.305
AML	70	802	0.114	04	0.343	0.634
CLL	9	802	0.114	05	0.103	0.394
CML	4	802	0.114	06	-0.010	0.281
HODGKINLYM	13	802	0.114	07	-0.010	0.281
NONHODGLYM	56	802	0.114	08	-0.078	0.213
SICKLECELL	22	802	0.114	09	0.026	0.318
New: Hematological 802	114	802	0.114	99	0.097	0.389
Metabolic Diagnoses						
S-ADRENAL	198	2201	-0.111	01	0.084	-0.460
S-METENOTH	81	2201	-0.111	02	-0.041	-0.585
S-PARATHYR	185	2201	-0.111	03	0.042	-0.502
S-THYPARA	103	2201	-0.111	04	-0.038	-0.582
S-THYROID	840	2201	-0.111	05	0.021	-0.523
New: Metabolic 2201	162	2201	-0.111	99	-0.093	-0.637
DHNKA	460	701	0.246	01	-0.109	-0.296
ENCEPHALOP	326	701	0.246	02	0.035	-0.152
New: Metabolic 701	59	701	0.246	99	0.129	-0.058
DKA	3321	702	-0.474	01	-0.174	-1.082
New: Metabolic 702	516	702	-0.474	99	0.068	-0.840
ETOHWITHD	232	703	-0.391	01	-0.027	-0.851
DRUGWITHD	633	703	-0.391	02	0.024	-0.800
ODALCOH	7294	703	-0.391	03	-0.148	-0.972
ODANALG	7294	703	-0.391	03	-0.148	-0.972
ODDEPRES	7294	703	-0.391	03	-0.148	-0.972
ODOOTHER	7294	703	-0.391	03	-0.148	-0.972
ODSEDHYP	7294	703	-0.391	03	-0.148	-0.972
ODSTREET	7294	703	-0.391	03	-0.148	-0.972
New: Metabolic 703	1659	703	-0.391	99	0.063	-0.761
ACIDBASE	1772	704	0.262	01	0.043	-0.128
ADDISON	47	704	0.262	02	-0.023	-0.194
CUSHING	1	704	0.262	03	0.000	-0.171
HEATSTROKE	23	704	0.262	04	-0.009	-0.180
HYPERTHERM	29	704	0.262	05	0.036	-0.135
HYPERSTORM	30	704	0.262	06	-0.067	-0.238
HYPOGLYCEM	320	704	0.262	07	0.257	0.086
HYPOTHERM	93	704	0.262	08	-0.105	-0.276
HYPOTHYMYX	25	704	0.262	09	0.035	-0.136
M-MENOTHER	485	704	0.262	1	-0.037	-0.207
THYROIDNEO	5	704	0.262	11	-0.006	-0.177
New: Metabolic 704	393	704	0.262	99	-0.064	-0.235
Musculoskeletal / Skin Diagnoses						
RHARTHRIT	3	1101	0.366	01	-0.003	0.219
SEPARTHRIT	19	1101	0.366	02	0.059	0.281
MIXEDCTDIS	9	1101	0.366	03	0.035	0.257
M-MUSOTHER	110	1101	0.366	04	0.029	0.251
SYSTLUPUS	9	1101	0.366	05	-0.025	0.197
VIRALMYOSI	2	1101	0.366	06	0.057	0.279
RHABDOMYO	74	1101	0.366	07	0.005	0.227
SCLERODERM	1	1101	0.366	08	0.000	0.222
VASCULITIS	12	1101	0.366	09	-0.085	0.137
New: Musculoskeletal/Skin 1101	45	1101	0.366	99	0.011	0.233
CELLULITIS	430	1102	-0.153	01	-0.019	-0.315
New: Musculoskeletal/Skin 1102	76	1102	-0.153	99	-0.016	-0.312
S-AMPUTATN	208	1902	-0.091	01	0.226	-0.009
S-FRXOTHER	278	1902	-0.091	02	0.157	-0.078

S-TOTALHIP	2026	1902	-0.091	03	-0.259	-0.494
S-TOTALKNE	2122	1902	-0.091	04	-0.375	-0.609
S-ORTHOTH	2032	1902	-0.091	05	0.219	-0.015
New: Musculoskeletal/Skin 1902	1611	1902	-0.091	99	0.012	-0.223
S-COSMETIC	204	1903	-0.585	01	-0.051	-0.779
S-SKINGRAF	185	1903	-0.585	02	-0.113	-0.842
S-SKINOTH	588	1903	-0.585	03	-0.051	-0.780
New: Musculoskeletal/Skin 1903	318	1903	-0.585	99	0.085	-0.643
S-CELLINFX	673	1904	0.308	01	-0.084	0.080
New: Musculoskeletal/Skin 1904	229	1904	0.308	99	0.153	0.317
Neurological Diagnoses						
S-ICH	481	1501	1.007	01	0.226	2.199
New: Neurological 1501	108	1501	1.007	99	0.000	1.973
S-EPIHEMA	43	1502	0.273	01	0.047	1.286
S-SDH	578	1502	0.273	02	0.187	1.426
New: Neurological 1502	160	1502	0.273	99	-0.172	1.067
S-AVMALFOR	165	1503	0.701	01	-0.184	1.483
S-SAH/ICA	764	1503	0.701	02	0.170	1.837
New: Neurological 1503	96	1503	0.701	99	0.171	1.837
S-SPINCOMP	98	1504	-1.391	01	0.010	-0.416
S-SPINDEV	87	1504	-1.391	02	-0.069	-0.495
S-SPINFUS	3176	1504	-1.391	03	-0.228	-0.654
S-SPINNEO	265	1504	-1.391	04	0.112	-0.314
S-SPINEOTH	926	1504	-1.391	05	0.079	-0.347
S-SYMPATH	3	1504	-1.391	06	-0.001	-0.427
New: Neurological 1504	1644	1504	-1.391	99	-0.217	-0.643
S-CRANNEO	2461	1505	-0.454	01	0.200	0.712
S-TRANSPHE	350	1505	-0.454	02	-0.044	0.468
New: Neurological 1505	1090	1505	-0.454	99	-0.258	0.254
S-CRANINFX	99	1506	0.042	01	0.046	1.054
S-VASCANAS	27	1506	0.042	02	0.031	1.039
S-BRAINBIO	136	1506	0.042	03	0.148	1.155
S-BURRHOLE	95	1506	0.042	04	0.111	1.119
S-CSFLEAK	43	1506	0.042	05	0.023	1.031
S-CRANCOMP	130	1506	0.042	06	-0.144	0.864
S-NEUOTHER	1095	1506	0.042	07	-0.184	0.824
S-SEIZURE	38	1506	0.042	08	0.024	1.031
S-SHUNTS	272	1506	0.042	09	-0.076	0.932
S-STEREOPR	203	1506	0.042	1	-0.143	0.865
S-VENTRIC	49	1506	0.042	11	0.090	1.098
New: Neurological 1506	591	1506	0.042	99	0.085	1.093
ICH	2310	401	1.250	01	0.104	2.319
New: Neurological 401	293	401	1.250	99	0.176	2.391
SAH/AVMAL	193	402	0.931	01	-0.067	1.830
SAH/IANEUR	915	402	0.931	02	0.142	2.039
New: Neurological 402	201	402	0.931	99	0.134	2.031
CVASTROKE	4988	403	0.861	01	-0.145	1.681
New: Neurological 403	348	403	0.861	99	0.338	2.164
NEURABSCES	106	404	-0.577	01	0.221	0.609
ENCEPHALIT	193	404	-0.577	02	-0.056	0.333
MENINGITIS	332	404	-0.577	03	-0.140	0.249
New: Neurological 404	136	404	-0.577	99	-0.154	0.234
NEURONEO	530	405	0.106	01	-0.018	1.053
New: Neurological 405	65	405	0.106	99	0.042	1.114
ALS	13	406	-0.160	01	-0.023	0.783
GUILLIANBS	164	406	-0.160	02	-0.107	0.698
MYASTHENIA	92	406	-0.160	03	-0.147	0.658
M-NMUSOTH	134	406	-0.160	04	0.243	1.048
New: Neurological 406	48	406	-0.160	99	-0.002	0.804
SEIZURES	2907	407	-1.068	01	-0.057	-0.160
New: Neurological 407	702	407	-1.068	99	-0.183	-0.286
OHYDROCEPH	106	408	-0.236	01	0.166	0.896
M-NEUROTH	648	408	-0.236	02	-0.085	0.645
CRANEPALSY	8	408	-0.236	03	-0.014	0.716

New: Neurological 408	219	408	-0.236	99	-0.121	0.609
EPIHEMATOM	31	409	0.390	01	0.052	1.408
SDH	810	409	0.390	02	0.024	1.380
New: Neurological 409	14	409	0.390	99	0.011	1.366
COMA	2229	410	-0.634	01	-0.168	0.164
New: Neurological 410	147	410	-0.634	99	0.025	0.356
Other medical disorders Diagnoses						
TRANOTHER	2	1002	-0.112	01	0.257	-0.074
OTHMEDICAL	527	1002	-0.112	01	0.257	-0.074
LUNGTRAN	1	1002	-0.112	03	-0.001	-0.332
HEARTRAN	3	1002	-0.112	04	-0.008	-0.339
S-TRANOTH	4	1002	-0.112	09	-0.010	-0.341
S-HEARTRAN	14	1002	-0.112	11	-0.056	-0.387
S-KIDPTRAN	5	1002	-0.112	13	-0.007	-0.339
S-LNGSTRAN	5	1002	-0.112	14	-0.021	-0.353
S-LUNGTRAN	3	1002	-0.112	15	-0.003	-0.335
LEUKOTHER	2	1002	-0.112	18	0.029	-0.303
CARDCOMP	13	1002	-0.112	19	-0.020	-0.351
M-HEMOTHER	24	1002	-0.112	2	0.011	-0.320
MYOCONTUS	2	1002	-0.112	21	-0.004	-0.336
S-CRANERVE	79	1002	-0.112	22	0.035	-0.296
S-MASTECT	42	1002	-0.112	23	-0.011	-0.342
S-OBSTRNEO	21	1002	-0.112	24	-0.041	-0.372
S-SPINDECO	368	1002	-0.112	25	-0.078	-0.410
New: Other medical disorders	431	1002	-0.112	99	-0.097	-0.428
1002						
New: Other medical disorders 99	1214	99	-0.125	99	-0.028	-0.372
Respiratory Diagnoses						
S-OTHINFX	379	1301	-0.577	01	-0.015	-0.333
S-RESPINFX	229	1301	-0.577	02	-0.093	-0.411
New: Respiratory 1301	168	1301	-0.577	99	-0.022	-0.341
S-BENTUMOR	186	1302	-0.033	01	-0.165	0.060
S-LUNGCA	1630	1302	-0.033	02	0.116	0.341
S-CHESTMAL	312	1302	-0.033	03	0.149	0.374
New: Respiratory 1302	858	1302	-0.033	99	-0.107	0.118
S-ORASINCA	642	1303	-0.215	01	-0.207	-0.163
S-LARTRACA	407	1303	-0.215	02	0.234	0.278
New: Respiratory 1303	480	1303	-0.215	99	-0.076	-0.032
S-SLEEPAPN	524	1304	-0.253	01	-0.043	-0.037
S-LUNGBIOP	146	1304	-0.253	02	-0.098	-0.092
S-BULLECT	18	1304	-0.253	03	-0.009	-0.003
S-FACIAL	680	1304	-0.253	04	-0.196	-0.191
S-RESOTHER	986	1304	-0.253	05	0.232	0.238
S-BPFISTUL	21	1304	-0.253	06	-0.064	-0.059
S-THORREDU	165	1304	-0.253	07	0.251	0.256
S-THOROTH	374	1304	-0.253	08	0.102	0.108
S-PLEURDIS	385	1304	-0.253	09	0.115	0.121
S-TRACHEOT	153	1304	-0.253	1	-0.064	-0.058
New: Respiratory 1304	1021	1304	-0.253	99	-0.282	-0.276
PNEUMASPIR	1102	201	0.246	01	-0.023	0.482
New: Respiratory 201	374	201	0.246	99	0.078	0.582
LARYNXCA	343	202	0.858	01	0.249	1.366
ORALCA	343	202	0.858	01	0.249	1.366
TRACHCA	343	202	0.858	01	0.249	1.366
New: Respiratory 202	56	202	0.858	99	-0.056	1.060
RESPARREST	1469	203	0.320	01	-0.127	0.452
New: Respiratory 203	137	203	0.320	99	0.198	0.777
ARDS	851	204	0.021	01	0.044	0.323
New: Respiratory 204	216	204	0.021	99	-0.039	0.240
EMPHYSBRON	4057	206	-0.006	01	0.040	0.293
New: Respiratory 206	1113	206	-0.006	99	-0.041	0.211
PULMEMBOL	1644	207	-0.055	01	0.080	0.283
New: Respiratory 207	280	207	-0.055	99	-0.092	0.111
AIROBSTRX	1218	208	-0.110	01	-0.093	0.056

New: Respiratory 208	243	208	-0.110	99	0.068	0.217
ASTHMA	1294	209	-0.949	01	-0.121	-0.812
New: Respiratory 209	356	209	-0.949	99	-0.092	-0.782
PNEUMFUNG	31	210	0.727	01	0.003	0.989
PNEUMPARAS	41	210	0.727	02	0.191	1.177
New: Respiratory 210	19	210	0.727	99	-0.030	0.956
SLEEPAPNEA	146	211	0.426	01	-0.272	0.413
ATELECTAS	240	211	0.426	02	-0.280	0.405
PLEUREFFUS	606	211	0.426	03	-0.207	0.478
PULMONHEM	271	211	0.426	04	0.210	0.895
HEMOTHORAX	89	211	0.426	05	-0.141	0.544
PRIMHYPERT	66	211	0.426	06	0.163	0.848
NEARDROWN	65	211	0.426	07	-0.052	0.633
PNEUMOTHOR	354	211	0.426	08	-0.194	0.491
M-RESOTHER	1900	211	0.426	09	-0.217	0.468
RESLUNGDIS	306	211	0.426	1	0.782	1.467
SMOKEINHAL	49	211	0.426	11	-0.051	0.634
WEANVENT	138	211	0.426	12	0.106	0.791
New: Respiratory 211	589	211	0.426	99	0.250	0.935
PNEUMBACT	4420	212	-0.022	01	-0.044	0.192
PNEUMOTHER	1114	212	-0.022	02	0.127	0.363
New: Respiratory 212	1578	212	-0.022	99	-0.087	0.149
PNEUMVIRAL	749	213	-0.098	01	0.067	0.228
New: Respiratory 213	472	213	-0.098	99	-0.089	0.072
Sepsis Diagnoses						
SEPSISCUT	1520	501	0.169	01	-0.092	-0.080
SEPSISGI	2133	501	0.169	02	-0.005	0.007
SEPSISGYN	122	501	0.169	03	-0.097	-0.086
SEPSISOTH	1392	501	0.169	04	0.098	0.110
SEPSISPULM	5210	501	0.169	05	0.096	0.107
SEPSISUNK	2338	501	0.169	06	-0.009	0.003
New: Sepsis 501	1013	501	0.169	99	0.047	0.059
SEPSISUTI	3762	502	-0.292	01	-0.014	-0.462
New: Sepsis 502	515	502	-0.292	99	-0.052	-0.501
SEPSHOCK	2596	503	0.223	01	0.143	0.209
New: Sepsis 503	1452	503	0.223	99	-0.093	-0.027
SEPSHOCKUT	743	504	-0.269	01	0.071	-0.355
New: Sepsis 504	362	504	-0.269	99	-0.131	-0.558
Trauma Diagnoses						
S-TRAUMHEA	313	1601	0.984	01	0.238	1.811
S-TRHEABD	18	1601	0.984	02	0.053	1.627
S-TRHECHES	50	1601	0.984	03	0.018	1.591
S-TRHEEXTR	68	1601	0.984	04	-0.073	1.500
S-TRHEFACE	97	1601	0.984	05	0.049	1.622
S-TRHEMULT	185	1601	0.984	06	-0.158	1.416
S-TRHEPELV	8	1601	0.984	07	0.003	1.576
S-TRHESPIN	33	1601	0.984	08	0.310	1.884
New: Trauma 1601	204	1601	0.984	99	-0.220	1.353
S-TRAUMABD	166	1602	-0.659	01	-0.130	-0.199
S-TRABEXTR	68	1602	-0.659	02	-0.088	-0.158
S-TRABFACE	11	1602	-0.659	03	-0.015	-0.084
S-TRABMULT	131	1602	-0.659	04	-0.116	-0.186
S-TRABPELV	31	1602	-0.659	05	0.038	-0.031
S-TRCHABD	110	1602	-0.659	06	0.177	0.107
S-TRCHEXTR	61	1602	-0.659	07	-0.038	-0.108
S-TRCHFACE	4	1602	-0.659	08	-0.004	-0.073
S-TRCHMULT	77	1602	-0.659	09	0.006	-0.064
S-TRCHPELV	12	1602	-0.659	1	0.120	0.051
S-TRAUMCHE	80	1602	-0.659	11	-0.013	-0.083
S-TRAUMEXT	618	1602	-0.659	12	0.099	0.029
S-TREXTFAC	21	1602	-0.659	13	-0.055	-0.125
S-TREXTMUL	153	1602	-0.659	14	-0.103	-0.172
S-TRAUMFAC	52	1602	-0.659	15	-0.045	-0.114
S-TRFACMUL	21	1602	-0.659	16	-0.040	-0.109

S-TRPELEXT	56	1602	-0.659	17	-0.029	-0.098
S-TRPELFAC	2	1602	-0.659	18	-0.002	-0.071
S-TRAUMPEL	228	1602	-0.659	19	0.110	0.041
S-TRPELMUL	45	1602	-0.659	2	0.315	0.246
S-TRAUMOTH	65	1602	-0.659	21	0.161	0.092
S-TRPELSPI	65	1602	-0.659	21	0.161	0.092
New: Trauma 1602	251	1602	-0.659	99	-0.036	-0.106
S-BURNS	70	1603	-0.169	01	0.025	0.444
New: Trauma 1603	31	1603	-0.169	99	-0.063	0.357
S-TRABSPIN	14	1604	-0.391	01	-0.024	0.175
S-TRCHSPIN	27	1604	-0.391	02	-0.019	0.179
S-TRSPIEXT	32	1604	-0.391	03	-0.066	0.133
S-TRSPIFAC	5	1604	-0.391	04	0.057	0.255
S-TRSPIMUL	75	1604	-0.391	05	-0.047	0.152
New: Trauma 1604	37	1604	-0.391	99	0.011	0.210
S-TRAUMSPI	110	1605	0.146	01	0.002	0.737
New: Trauma 1605	22	1605	0.146	99	0.031	0.767
TRAUMHEAD	1616	601	0.573	01	0.301	1.462
TRHEADABD	53	601	0.573	02	-0.057	1.105
TRHEADCHES	321	601	0.573	03	-0.214	0.948
TRHEADEXTR	225	601	0.573	04	0.033	1.195
TRHEADFACE	373	601	0.573	05	-0.176	0.986
TRHEADMULT	736	601	0.573	06	-0.181	0.981
TRHEADPELV	40	601	0.573	07	-0.073	1.089
TRHEADSPIN	230	601	0.573	08	0.325	1.487
New: Trauma 601	696	601	0.573	99	0.172	1.334
TRAUMABD	255	602	-0.613	01	0.122	0.097
TRABDEXTR	59	602	-0.613	02	-0.049	-0.073
TRABDFACE	11	602	-0.613	03	-0.004	-0.028
TRABDMULT	118	602	-0.613	04	0.017	-0.007
TRABDPELV	28	602	-0.613	05	-0.052	-0.077
TRCHESTABD	286	602	-0.613	06	-0.050	-0.074
TRCHESTEXT	271	602	-0.613	07	-0.037	-0.061
TRCHESTFAC	81	602	-0.613	08	-0.116	-0.140
TRCHESTMUL	429	602	-0.613	09	-0.108	-0.132
TRCHESTPEL	58	602	-0.613	1	-0.015	-0.039
TRAUMCHEST	737	602	-0.613	11	0.120	0.096
TRAUMEXTR	222	602	-0.613	12	-0.002	-0.026
TREXTRFACE	41	602	-0.613	13	-0.035	-0.059
TREXTRMULT	79	602	-0.613	14	-0.038	-0.062
TRAUMFACE	114	602	-0.613	15	-0.120	-0.144
TRFACEMULT	73	602	-0.613	16	0.002	-0.022
TRPELVEXTR	51	602	-0.613	17	-0.051	-0.075
TRPELVFACE	2	602	-0.613	18	0.000	-0.025
TRAUMPELV	97	602	-0.613	19	0.262	0.238
TRPELVMULT	80	602	-0.613	2	-0.175	-0.199
M-TRAUMOTH	184	602	-0.613	21	0.315	0.291
New: Trauma 602	643	602	-0.613	99	-0.151	-0.175
BURN	388	603	0.081	01	0.006	0.676
New: Trauma 603	136	603	0.081	99	0.013	0.683
TRABDSPINE	33	604	-0.027	01	-0.030	0.531
TRCHESTSPI	214	604	-0.027	02	-0.073	0.489
TRPELVSPIN	31	604	-0.027	03	0.072	0.634
TRSPINEXTR	74	604	-0.027	04	-0.059	0.503
TRSPINFACE	43	604	-0.027	05	-0.005	0.556
TRSPINMULT	255	604	-0.027	06	-0.030	0.532
New: Trauma 604	83	604	-0.027	99	0.119	0.681
TRAUMSPINE	308	605	0.710	01	0.176	1.475
New: Trauma 605	32	605	0.710	99	-0.016	1.283

In Supplementary Table 13 the hierarchical structure of the random effects are show along with their predicted random effects. The Level 2 random effect (labelled as Dx Class) is conditional on the Level 1 random effect (bodysystem), whereas the Level 3 (denoted Dx subclass) random effect is conditional on both the

Level 1 and Level 2 effects. You can see diagnoses within the same Dx Class (e.g., class 101) have the same predicted Class random effect (0.395), but have different Level 3 random effects. The coefficient for each unique diagnosis is simply the sum of the Level 1, 2 and 3 random effects. For example for the diagnosis CARDSHOCK, the Level 1, 2 and 3 effects are 0.109, 0.395, and 0.030, and when summed is the Total RE (rightmost column in Supplementary Table 13), 0.534. This is the coefficient which is input for patients with this diagnosis in the prediction model, and the partitioning of the effect into the different levels pools the strength of similar diagnoses and makes efficient use of the data.

3.3.3 Smooth Terms

The smooth terms represent the relationships between the physiological variables and the outcome. Many variables are collected as extrema values (minimum and maximum), but parameterized in the model as the mid-point (also average of min and max values) between minimum and maximum ($\frac{min+max}{2}$) and the difference or range of values ($max - min$). We used this parameterization and model the midpoint and range of each variable together in a tensor product smooth. To illustrate the relationships between these variables we have plotted the mid-point or average value on the x-axis, choosing four different values for each variable for the difference, evaluating how the estimated log-odds of in-hospital death change as we look at both the mid-point and difference jointly. The four values to chosen to evaluate the difference of the minimum and maximum were determined by calculating the inter-quartile range of the mid-points of the variables in the training set, and using the values 0, $0.5 \times IQR$, $1.0 \times IQR$ and $1.5 \times IQR$. For example, the heart rate (HR) plot, Supplementary Figure 15 has 4 lines, where the difference between the day 1 minimum HR and day 1 maximum HR are evaluated at values 0, 11, 22 and 33, representing zero IQRs, half an IQR, one IQR and 1.5 IQRs of difference, respectively. Supplementary Figures 15 to 18 illustrate the complex relationships exhibited by each of the physiological variables, as well as patient age at admission. Patient age at admission was not modeled in any way which made use of the extrema data. Further, patient respiratory rate, and arterial blood gas measurements were modeled separately for those patients which had invasive ventilation or intubation during the first 24 hours of their ICU stay. Similarly, patients with an acute renal failure diagnosis had their relationship between the log-odds of in-hospital death and creatinine modeled separately from patients without a diagnosis.

3.4 Model Evaluation

Funnel plots similar to those in Figure 3 in the main paper, but for AUROC and Brier Scores are shown in Supplementary Figures 19 and 20, respectively.

3.4.1 Assessment of Performance within Subgroups

Subgroup performance of GOSSIS-1 is presented in Supplementary Table 14. In general, performance was consistently high across all subgroups, excluding any subgroups with small test set sample sizes. Data-source specific performance is presented in Supplementary Tables 15 and 16

Supplementary Table 14: Performance Sensitivity Analysis by Subgroup

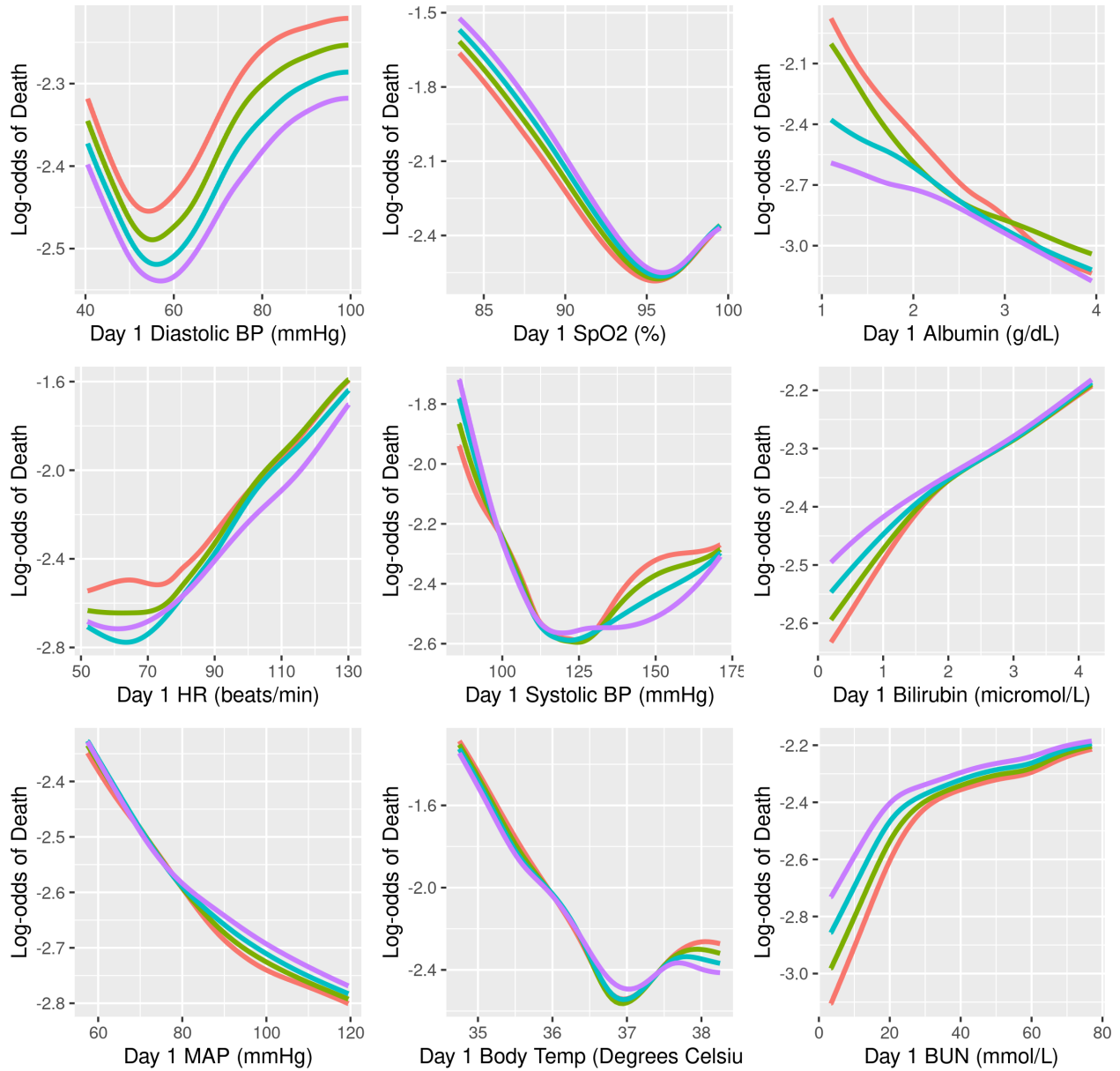
Variable	Level	n	Observed Death Rate	Predicted Death Rate	AUROC	AUROC (95% CI)	SMR	SMR (95% CI)	Brier Score
AIDS Chronic Co- morbidity	0	113716	8.402	8.516	0.918	0.916- 0.921	0.987	0.967- 1.006	0.050
	1	77	11.688	9.703	0.887	0.796- 0.979	1.205	0.418- 1.992	0.081
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073

APACHE III Diagnosis Bodysys- tem	Missing/Other	777	7.979	8.195	0.898	0.857- 0.939	0.974	0.731- 1.216	0.048
	Cardiovascular	31339	8.469	8.641	0.940	0.936- 0.944	0.980	0.943- 1.017	0.044
	Gastrointestinal	16131	6.943	7.011	0.899	0.89- 0.908	0.990	0.932- 1.048	0.045
	Genitourinary	3700	4.378	4.709	0.916	0.895- 0.937	0.930	0.787- 1.073	0.033
	Gynecological	1260	0.556	0.572	0.783	0.59- 0.975	0.972	0.252- 1.692	0.005
	Hematological	604	16.887	15.076	0.865	0.83- 0.901	1.120	0.903- 1.338	0.098
	Metabolic	8316	1.864	2.190	0.914	0.89- 0.938	0.851	0.717- 0.985	0.015
	Musculoskeletal / Skin	4854	2.637	2.719	0.915	0.892- 0.939	0.970	0.802- 1.138	0.020
	Neurological	14766	9.021	9.055	0.923	0.916- 0.93	0.996	0.943- 1.05	0.050
	Other medical disorders	401	5.237	4.884	0.925	0.863- 0.988	1.072	0.614- 1.531	0.031
	Respiratory	16241	10.646	10.746	0.872	0.865- 0.88	0.991	0.944- 1.037	0.071
	Sepsis	9823	16.869	17.029	0.863	0.854- 0.873	0.991	0.943- 1.038	0.096
	Trauma	5867	7.977	8.057	0.920	0.909- 0.932	0.990	0.9-1.08	0.048
Cirrhosis Co- morbidity	0	112102	8.193	8.320	0.918	0.916- 0.921	0.985	0.965- 1.005	0.049
	1	1691	22.413	21.558	0.859	0.839- 0.878	1.040	0.935- 1.144	0.119
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Country	Australia	67586	7.889	8.093	0.927	0.923- 0.93	0.975	0.949- 1.001	0.046
	New Zealand	7175	9.854	9.474	0.914	0.903- 0.924	1.040	0.963- 1.117	0.055
	USA	39318	9.049	9.123	0.904	0.9- 0.909	0.992	0.959- 1.024	0.055
Data Source	anzics	74761	8.078	8.226	0.925	0.922- 0.928	0.982	0.957- 1.007	0.047
	eicu	39318	9.049	9.123	0.904	0.9- 0.909	0.992	0.959- 1.024	0.055
Ethnicity	Missing/Other	70262	8.007	8.134	0.925	0.922- 0.929	0.984	0.959- 1.01	0.047
	African American	4160	8.918	9.572	0.910	0.894- 0.926	0.932	0.837- 1.026	0.051
	Asian	679	9.867	8.788	0.893	0.849- 0.937	1.123	0.854- 1.392	0.058

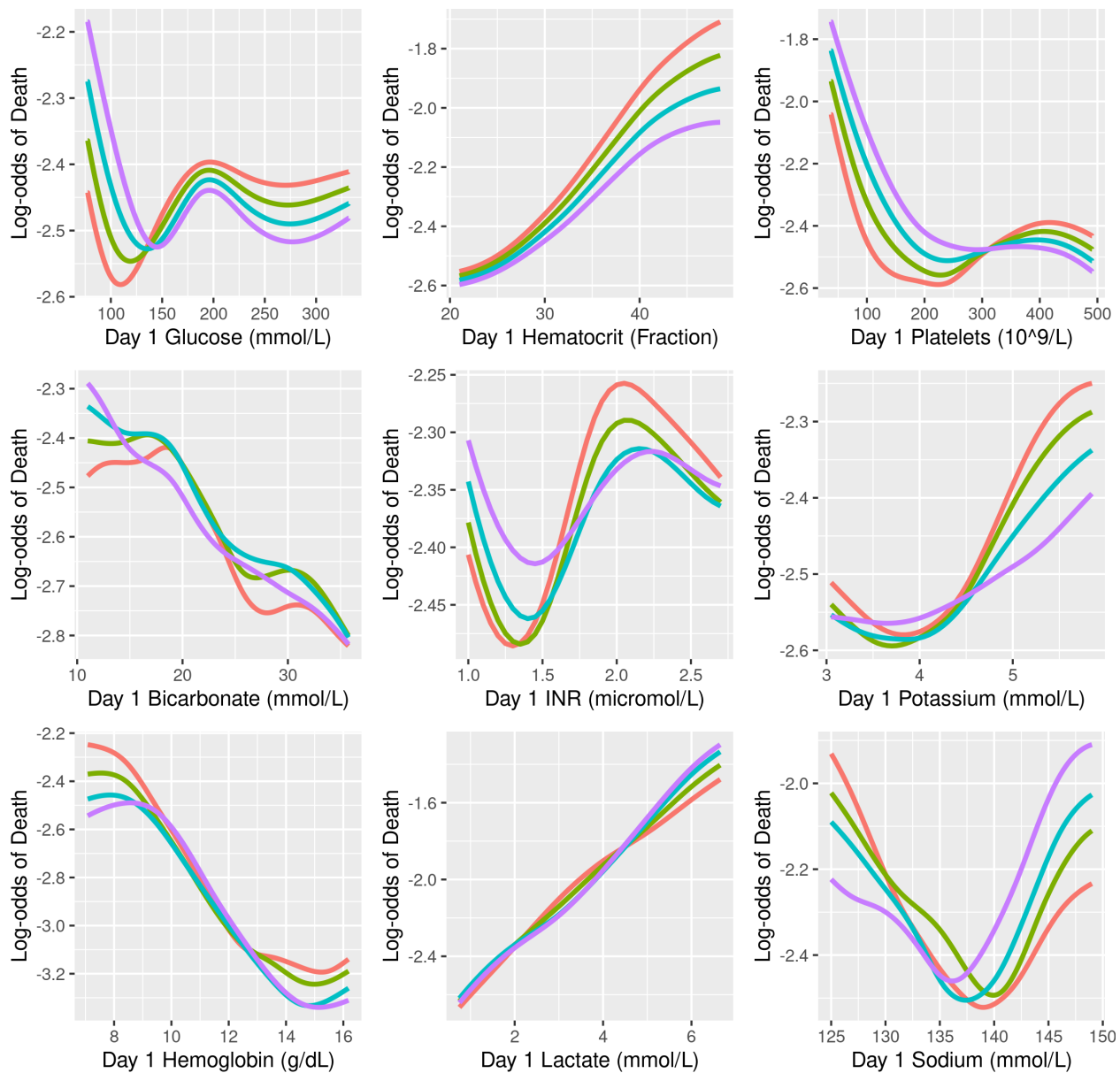
	Caucasian	30321	9.076	9.101	0.902	0.897-0.908	0.997	0.96-1.035	0.056
	Hispanic	1512	9.325	9.415	0.914	0.891-0.937	0.990	0.827-1.154	0.054
	Indigenous	4978	9.180	9.544	0.923	0.911-0.935	0.962	0.874-1.05	0.051
	Native American	280	8.571	8.899	0.951	0.915-0.986	0.963	0.578-1.348	0.043
	Other/Unknown	1887	8.426	8.566	0.911	0.89-0.931	0.984	0.831-1.137	0.053
Gender	Missing/Other	21	14.286	13.224	0.981	0.93-1	1.080	-0.142-2.303	0.036
	F	49857	8.336	8.516	0.918	0.914-0.922	0.979	0.949-1.009	0.049
	M	64201	8.470	8.548	0.919	0.915-0.922	0.991	0.965-1.017	0.050
Hepatic Failure Co-morbidity	0	112988	8.286	8.410	0.918	0.916-0.921	0.985	0.965-1.005	0.049
	1	805	24.969	23.536	0.854	0.825-0.884	1.061	0.914-1.208	0.125
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Hospital Size (beds)	Missing/Other	79498	8.030	8.229	0.923	0.92-0.927	0.976	0.952-1	0.047
	<100	2192	6.113	6.845	0.908	0.885-0.931	0.893	0.742-1.044	0.041
	>= 500	15089	10.518	9.824	0.903	0.895-0.91	1.071	1.018-1.123	0.061
	100 - 249	8124	7.767	8.693	0.918	0.908-0.928	0.894	0.824-0.963	0.048
	250 - 499	9176	9.383	9.334	0.900	0.89-0.909	1.005	0.938-1.072	0.058
Hospital Type	Missing/Other	39318	9.049	9.123	0.904	0.9-0.909	0.992	0.959-1.024	0.055
	Metropolitan	12334	10.491	10.971	0.913	0.906-0.921	0.956	0.904-1.008	0.059
	Private	20475	2.691	3.038	0.936	0.925-0.947	0.886	0.812-0.96	0.019
	Rural / Regional	9779	8.764	9.502	0.912	0.903-0.921	0.922	0.861-0.984	0.053
	Tertiary	32173	10.372	10.087	0.914	0.91-0.919	1.028	0.993-1.063	0.059
ICU Admission Source	Missing/Other	111	8.108	11.176	0.917	0.808-1	0.726	0.252-1.2	0.051
	Accident & Emergency Floor	42897	10.642	10.861	0.913	0.909-0.917	0.980	0.951-1.008	0.059
		16211	17.007	16.664	0.870	0.864-0.877	1.021	0.982-1.059	0.096
	Operating Room / Recovery	48737	3.043	3.165	0.910	0.902-0.918	0.961	0.912-1.01	0.022

	Other Hospital	5065	12.438	13.033	0.889	0.877- 0.902	0.954	0.88- 1.029	0.074
	Other ICU	1058	14.461	15.205	0.827	0.794- 0.861	0.951	0.8- 1.102	0.099
ICU Admission Type	Missing/Other	58	13.793	10.883	0.910	0.792-1	1.267	0.389- 2.146	0.071
	admit	37622	8.995	9.010	0.906	0.901- 0.911	0.998	0.965- 1.032	0.054
	HDU	19309	4.490	4.985	0.914	0.906- 0.923	0.901	0.841- 0.961	0.032
	ICU	55394	9.322	9.353	0.925	0.921- 0.928	0.997	0.97- 1.024	0.052
	readmit	189	7.407	7.708	0.811	0.703- 0.918	0.961	0.458- 1.464	0.061
	transfer	1507	10.617	12.117	0.872	0.845- 0.899	0.876	0.74- 1.012	0.069
Type of ICU	Missing/Other	74761	8.078	8.226	0.925	0.922- 0.928	0.982	0.957- 1.007	0.047
	Cardiac ICU	2535	11.479	10.452	0.923	0.907- 0.938	1.098	0.972- 1.224	0.061
	CCU- CTICU	3467	7.413	7.351	0.908	0.891- 0.925	1.008	0.885- 1.132	0.046
	CSICU	1501	4.997	5.759	0.915	0.886- 0.945	0.868	0.671- 1.064	0.035
	CTICU	1358	5.228	5.737	0.915	0.879- 0.95	0.911	0.699- 1.123	0.033
	Med-Surg ICU	21552	9.099	9.419	0.902	0.896- 0.909	0.966	0.923- 1.009	0.056
	MICU	3278	12.752	12.575	0.892	0.877- 0.907	1.014	0.917- 1.111	0.074
	Neuro ICU	3167	8.210	8.383	0.898	0.878- 0.918	0.979	0.86- 1.098	0.050
	SICU	2460	9.146	7.931	0.887	0.862- 0.911	1.153	1.002- 1.304	0.054
Immuno- suppressed	0	38719	9.070	9.033	0.905	0.9-0.91	1.004	0.971- 1.037	0.055
	1	75074	8.060	8.251	0.925	0.922- 0.928	0.977	0.952- 1.001	0.047
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Leukemia Co- morbidity	0	112659	8.251	8.404	0.918	0.915- 0.921	0.982	0.962- 1.002	0.049
	1	1134	23.633	19.736	0.880	0.858- 0.902	1.197	1.054- 1.341	0.115
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Lymphoma Co- morbidity	0	112975	8.332	8.454	0.918	0.916- 0.921	0.986	0.966- 1.006	0.049
	1	818	18.337	17.289	0.893	0.867- 0.918	1.061	0.891- 1.23	0.094

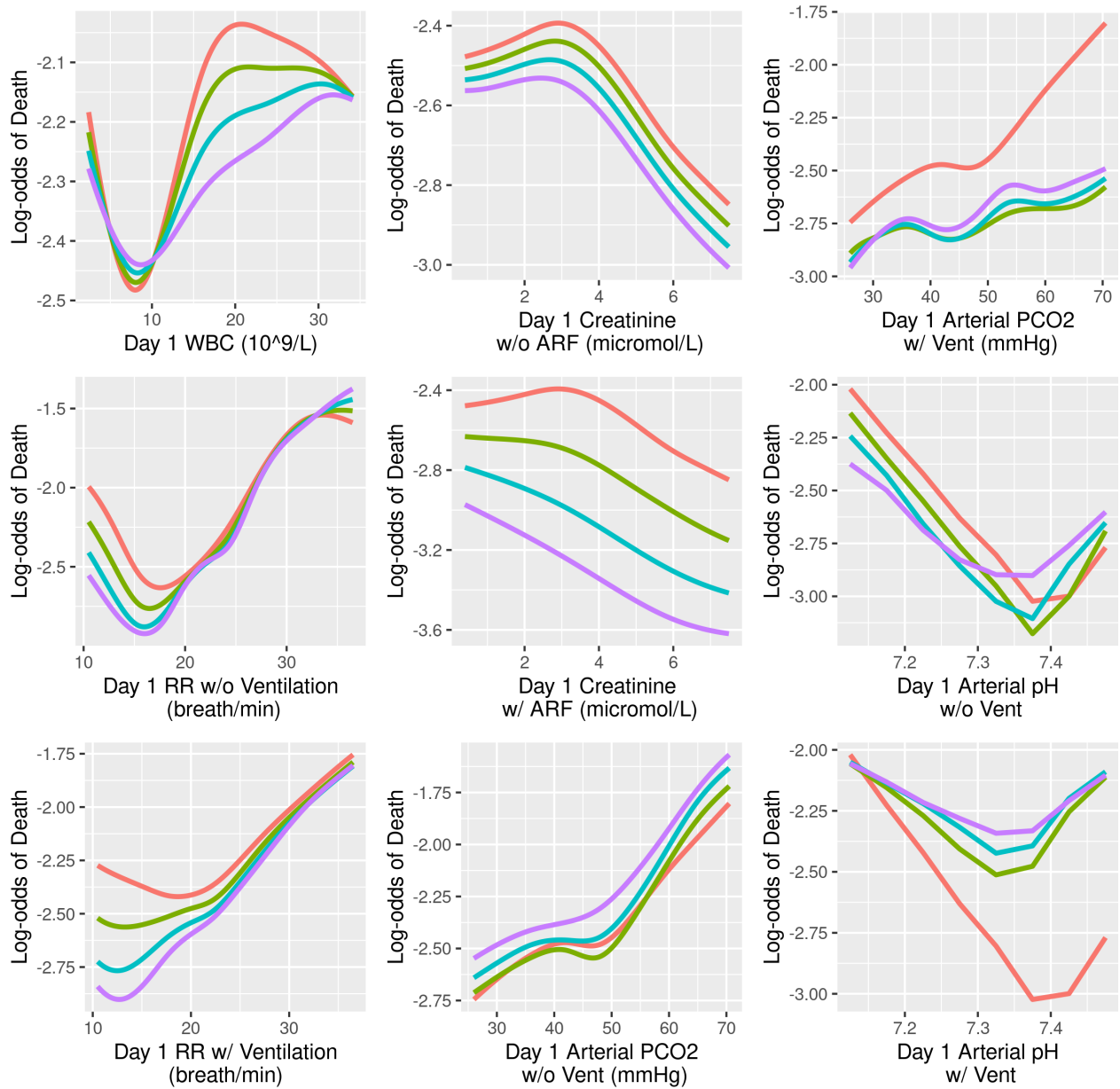
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Admission Length Before ICU Admission	[-82.0285,7.01e-02)	22818	10.965	11.211	0.912	0.906- 0.917	0.978	0.94- 1.016	0.061
	[0.0701,2.19e-01)	22741	9.986	10.419	0.920	0.915- 0.926	0.958	0.919- 0.998	0.055
	[0.2194,4.33e-01)	22696	5.023	5.530	0.927	0.92- 0.935	0.908	0.856- 0.961	0.032
	[0.4333,1.25e+00)	22774	4.821	5.311	0.922	0.914- 0.93	0.908	0.854- 0.961	0.033
	[1.2507,5.51e+03]	22724	11.156	10.105	0.897	0.891- 0.903	1.104	1.061- 1.147	0.067
	Missing/Other	326	15.644	14.793	0.870	0.818- 0.922	1.058	0.767- 1.348	0.092
Patient Pregnancy	0	10662	4.980	5.253	0.950	0.942- 0.958	0.948	0.867- 1.029	0.029
	1	197	1.523	2.089	0.967	0.928-1	0.729	-0.096- 1.554	0.013
	Missing/Other	103220	8.780	8.886	0.915	0.912- 0.917	0.988	0.968- 1.008	0.052
Smoking Status	Missing/Other	91828	8.809	8.861	0.917	0.914- 0.92	0.994	0.972- 1.016	0.052
	Current Smoker	5245	7.684	8.245	0.925	0.913- 0.937	0.932	0.841- 1.023	0.046
	Ex-Smoker	8825	7.592	7.526	0.909	0.898- 0.92	1.009	0.932- 1.085	0.048
	Never Smoked	8181	5.317	6.148	0.937	0.927- 0.947	0.865	0.784- 0.946	0.033
Solid tumor with metastasis Co-morbidity	0	110391	8.204	8.320	0.919	0.916- 0.921	0.986	0.966- 1.006	0.049
	1	3402	14.903	14.898	0.893	0.879- 0.907	1.000	0.913- 1.087	0.081
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Elective Surgery	0	73060	12.026	12.176	0.900	0.896- 0.903	0.988	0.967- 1.008	0.069
	1	40901	1.966	2.032	0.897	0.885- 0.908	0.968	0.901- 1.034	0.016
	Missing/Other	118	5.932	8.687	0.843	0.732- 0.954	0.683	0.177- 1.189	0.060
Teaching Hospital	0	53872	7.490	7.895	0.918	0.914- 0.922	0.949	0.919- 0.978	0.046
	1	60207	9.238	9.108	0.918	0.914- 0.921	1.014	0.988- 1.041	0.053



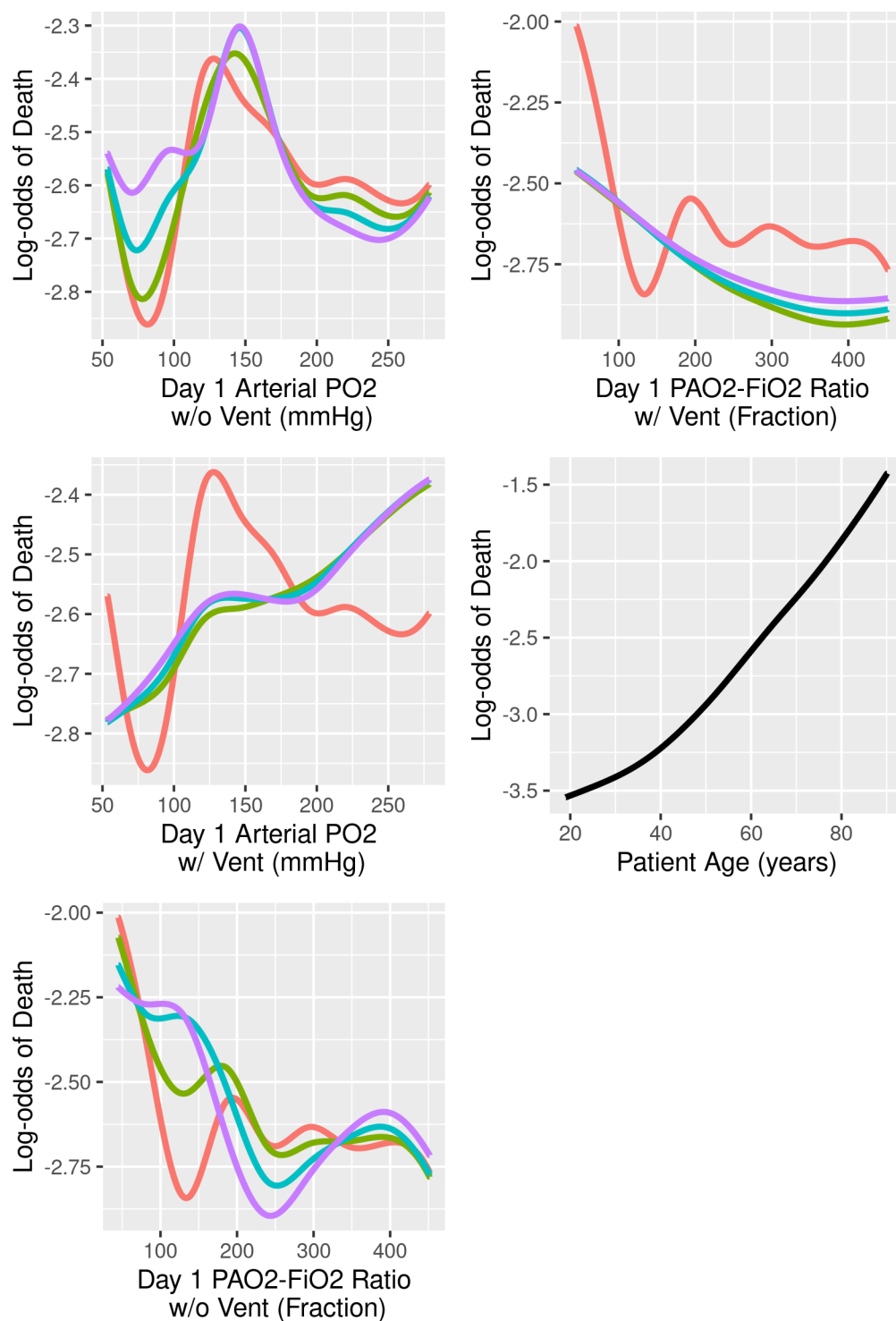
Supplementary Figure 15: Figure Smooths of the change in log-odds of in-hospital death for a randomly selected patient while varying physiological variable and holding all other variables constant. The x-axis represents the midpoint between the min and max variable values, and the coloring on each plot represent a difference between the min and max values of 0 (red), $0.5 \times IQR(\text{avg})$ (green), $IQR(\text{avg})$ (blue) and $1.5 \times IQR(\text{avg})$ (purple).



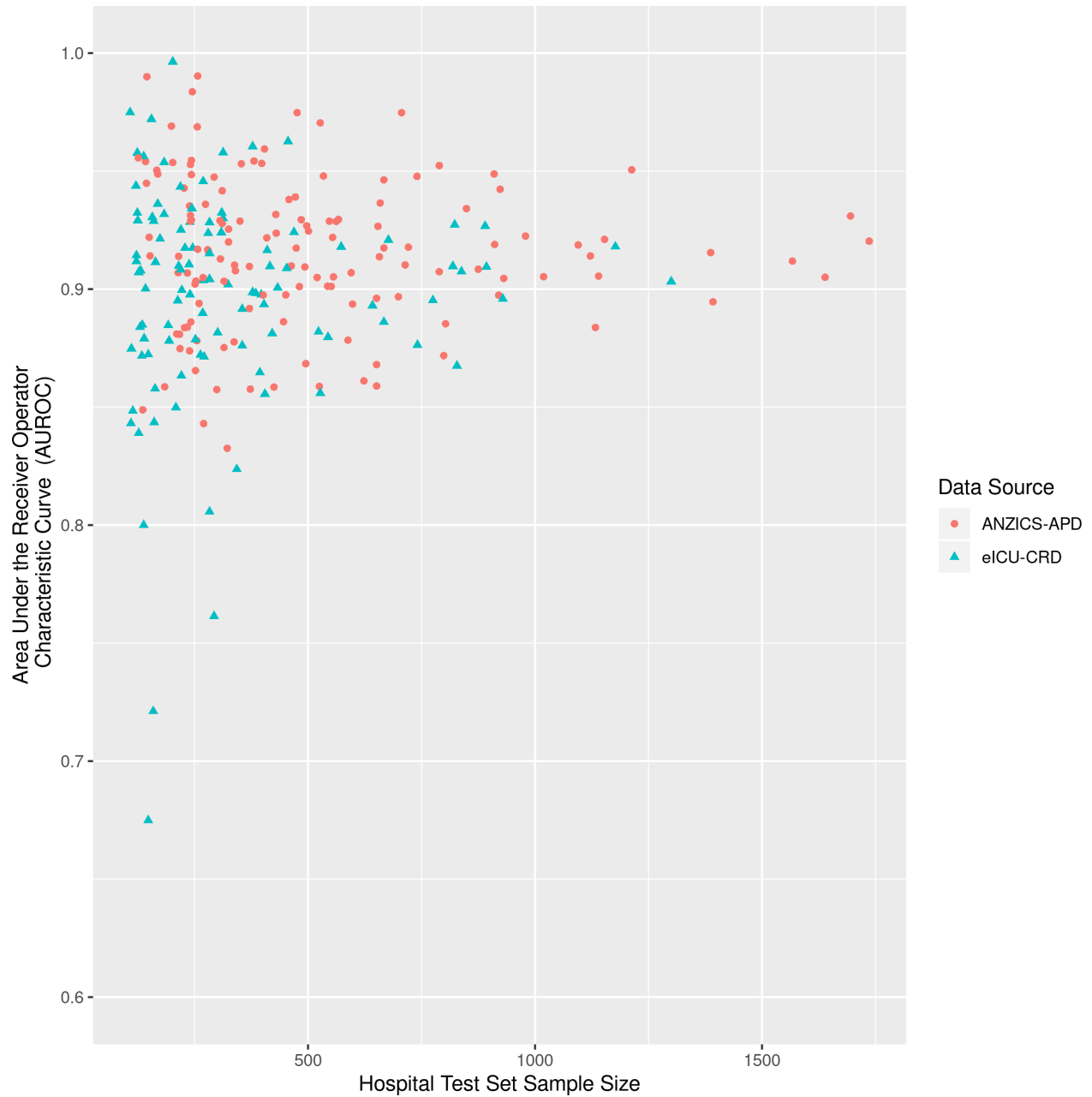
Supplementary Figure 16: Figure Smooths of the change in log-odds of in-hospital death for a randomly selected patient while varying physiological variable and holding all other variables constant. The x-axis represents the midpoint between the min and max variable values, and the coloring on each plot represent a difference between the min and max values of 0 (red), $0.5 \times IQR(avg)$ (green), $IQR(avg)$ (blue) and $1.5 \times IQR(avg)$ (purple).



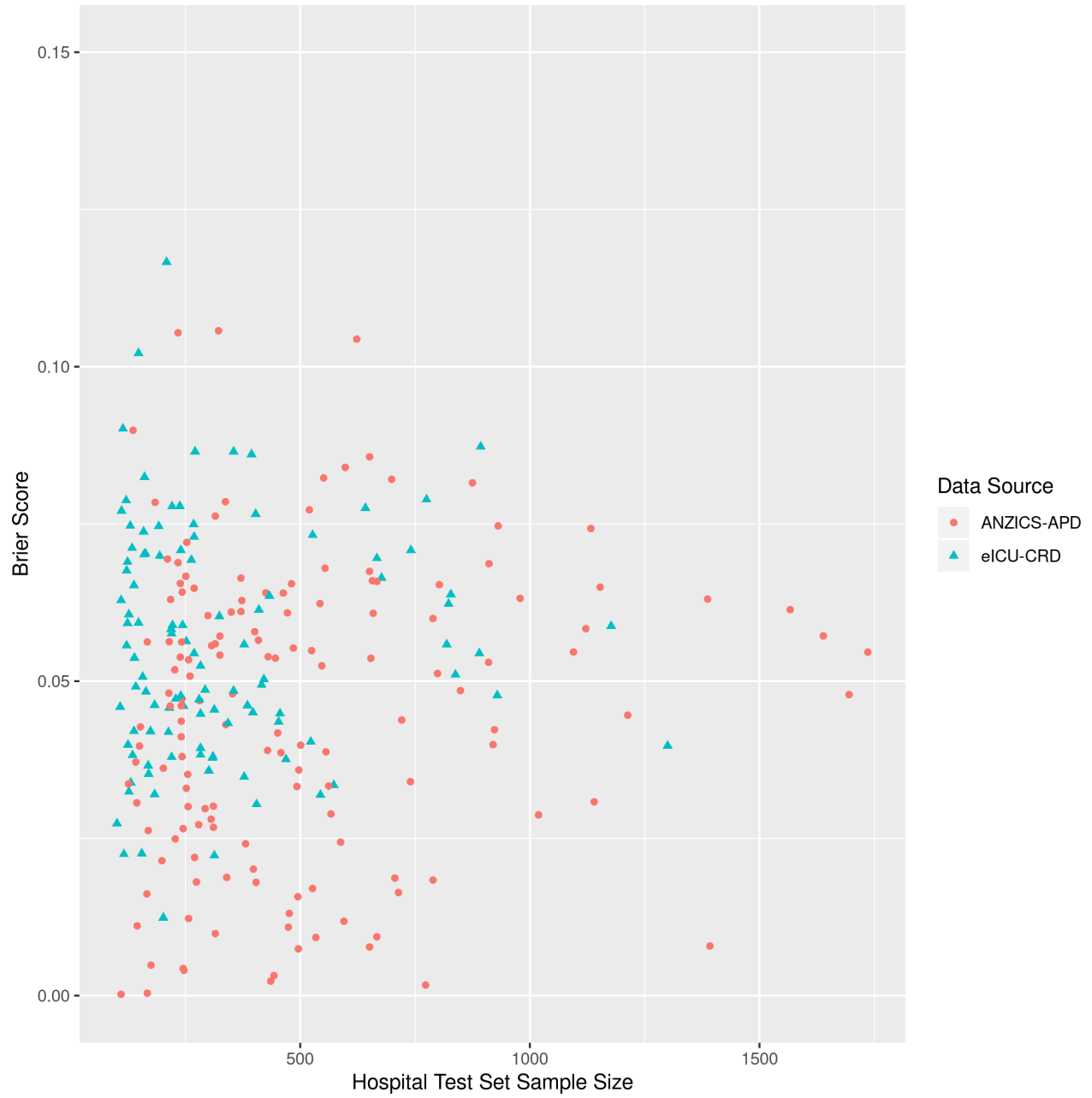
Supplementary Figure 17: Figure Smooths of the change in log-odds of in-hospital death for a randomly selected patient while varying physiological variable and holding all other variables constant. The x-axis represents the midpoint between the min and max variable values, and the coloring on each plot represent a difference between the min and max values of 0 (red), $0.5 \times IQR(avg)$ (green), $IQR(avg)$ (blue) and $1.5 \times IQR(avg)$ (purple).



Supplementary Figure 18: Figure Smooths of the change in log-odds of in-hospital death for a randomly selected patient while varying physiological variable and holding all other variables constant. The x-axis represents the midpoint between the min and max variable values, and the coloring on each plot represent a difference between the min and max values of 0 (red), $0.5 \times IQR(avg)$ (green), $IQR(avg)$ (blue) and $1.5 \times IQR(avg)$ (purple).



Supplementary Figure 19: Funnel Plot of Hospital Sample Size and Hospital Area Under the Receiver Operator Characteristic Curve (AUROC). Only hospitals with ≥ 5 observed deaths and > 100 admissions in the test set included



Supplementary Figure 20: Funnel Plot of Hospital Sample Size and Brier Score. Hospitals with <100 admissions in the test set are excluded.

Supplementary Table 15: Performance Sensitivity Analysis for ANZICS-APD by Subgroup

Variable	Level	n	Observed Death Rate	Predicted Death Rate	AUROC	AUROC (95% CI)	SMR	SMR (95% CI)	Brier Score
AIDS Chronic Co- morbidity	0	74722	8.075	8.225	0.925	0.922- 0.928	0.982	0.957- 1.007	0.047
	1	39	12.821	10.361	0.865	0.745- 0.984	1.237	0.153- 2.322	0.106
APACHE III Diagnosis Bodysys- tem	Cardiovascular	18856	8.692	8.885	0.943	0.938- 0.949	0.978	0.931- 1.026	0.044
	Gastrointestinal	12270	6.707	6.808	0.902	0.891- 0.912	0.985	0.918- 1.053	0.044
	Genitourinary	2820	3.759	4.535	0.936	0.916- 0.955	0.829	0.671- 0.987	0.028
	Gynecological	1112	0.450	0.570	0.872	0.765- 0.978	0.789	0.097- 1.481	0.004
	Hematological	326	23.620	19.732	0.859	0.816- 0.901	1.197	0.93- 1.464	0.126
	Metabolic	5161	2.209	2.503	0.917	0.89- 0.945	0.883	0.721- 1.045	0.017
	Musculoskeletal / Skin	4327	2.427	2.585	0.915	0.888- 0.942	0.939	0.759- 1.118	0.019
	Neurological	9386	9.045	8.708	0.937	0.929- 0.944	1.039	0.969- 1.109	0.047
	Other medical disorders	401	5.237	4.884	0.925	0.863- 0.988	1.072	0.614- 1.531	0.031
	Respiratory	11105	10.059	10.134	0.887	0.878- 0.896	0.993	0.934- 1.051	0.066
	Sepsis	5036	16.938	17.820	0.872	0.859- 0.884	0.951	0.887- 1.014	0.094
	Trauma	3961	8.331	8.576	0.923	0.91- 0.936	0.971	0.867- 1.076	0.048
Cirrhosis Co- morbidity	0	73644	7.827	8.003	0.925	0.922- 0.929	0.978	0.953- 1.003	0.046
	1	1117	24.620	22.894	0.856	0.832- 0.88	1.075	0.948- 1.202	0.127
Country	Australia	67586	7.889	8.093	0.927	0.923- 0.93	0.975	0.949- 1.001	0.046
	New Zealand	7175	9.854	9.474	0.914	0.903- 0.924	1.040	0.963- 1.117	0.055
Data Source	anzics	74761	8.078	8.226	0.925	0.922- 0.928	0.982	0.957- 1.007	0.047
Ethnicity	Missing/Other	69783	7.999	8.132	0.925	0.922- 0.929	0.984	0.958- 1.01	0.047

	Indigenous	4978	9.180	9.544	0.923	0.911-0.935	0.962	0.874-1.05	0.051
Gender	Missing/Other	7	14.286	4.769	1.000	NA-NA	2.995	-2.875-8.866	0.097
	F	31846	7.838	7.973	0.928	0.923-0.932	0.983	0.944-1.022	0.045
	M	42908	8.255	8.414	0.923	0.919-0.928	0.981	0.949-1.013	0.048
Hepatic Failure Co-morbidity	0	74454	7.963	8.136	0.925	0.922-0.928	0.979	0.954-1.004	0.046
	1	307	35.831	29.943	0.839	0.794-0.884	1.197	0.973-1.42	0.158
Hospital Size (beds)	Missing/Other	74761	8.078	8.226	0.925	0.922-0.928	0.982	0.957-1.007	0.047
Hospital Type	Metropolitan	12334	10.491	10.971	0.913	0.906-0.921	0.956	0.904-1.008	0.059
	Private	20475	2.691	3.038	0.936	0.925-0.947	0.886	0.812-0.96	0.019
	Rural / Regional	9779	8.764	9.502	0.912	0.903-0.921	0.922	0.861-0.984	0.053
	Tertiary	32173	10.372	10.087	0.914	0.91-0.919	1.028	0.993-1.063	0.059
ICU Admission Source	Missing/Other	47	10.638	15.311	0.933	0.855-1	0.695	0.086-1.304	0.080
	Accident & Emergency Floor	19742	12.405	12.646	0.917	0.912-0.923	0.981	0.942-1.02	0.065
		9763	18.416	17.846	0.871	0.863-0.88	1.032	0.984-1.08	0.101
	Operating Room / Recovery	40426	2.914	3.064	0.911	0.903-0.92	0.951	0.897-1.005	0.021
	Other Hospital	4029	12.584	13.632	0.894	0.881-0.907	0.923	0.843-1.003	0.074
	Other ICU	754	13.528	15.336	0.830	0.788-0.872	0.882	0.711-1.053	0.091
ICU Admission Type	Missing/Other	58	13.793	10.883	0.910	0.792-1	1.267	0.389-2.146	0.071
	HDU	19309	4.490	4.985	0.914	0.906-0.923	0.901	0.841-0.961	0.032
	ICU	55394	9.322	9.353	0.925	0.921-0.928	0.997	0.97-1.024	0.052
Type of ICU	Missing/Other	74761	8.078	8.226	0.925	0.922-0.928	0.982	0.957-1.007	0.047
Immuno-suppressed	0	734	19.482	15.250	0.883	0.856-0.91	1.277	1.068-1.487	0.109
	1	74027	7.965	8.156	0.925	0.922-0.929	0.977	0.952-1.001	0.046
Leukemia Co-morbidity	0	73946	7.890	8.097	0.925	0.922-0.929	0.974	0.949-0.999	0.046

	1	815	25.153	19.887	0.877	0.851- 0.903	1.265	1.092- 1.438	0.123
Lymphoma Co- morbidity	0	74107	7.983	8.141	0.925	0.922- 0.929	0.981	0.956- 1.006	0.047
	1	654	18.807	17.869	0.887	0.857- 0.916	1.053	0.867- 1.239	0.097
Admission Length Before ICU Admission	[0.000, 0.136)	14889	13.607	13.885	0.912	0.906- 0.919	0.980	0.937- 1.023	0.071
	[0.136, 0.301)	14894	7.016	7.650	0.937	0.93- 0.943	0.917	0.862- 0.973	0.041
	[0.301, 0.681)	14886	4.662	5.247	0.919	0.908- 0.929	0.888	0.822- 0.955	0.032
	[0.681, 1.559)	14881	3.972	4.500	0.933	0.923- 0.943	0.883	0.811- 0.954	0.026
	[1.559,5513.688]	14885	10.964	9.700	0.903	0.896- 0.91	1.130	1.075- 1.185	0.064
	Missing/Other	326	15.644	14.793	0.870	0.818- 0.922	1.058	0.767- 1.348	0.092
Patient Pregnancy	0	10662	4.980	5.253	0.950	0.942- 0.958	0.948	0.867- 1.029	0.029
	1	197	1.523	2.089	0.967	0.928-1	0.729	-0.096- 1.554	0.013
	Missing/Other	63902	8.615	8.741	0.921	0.917- 0.924	0.986	0.96- 1.012	0.050
Smoking Status	Missing/Other	52510	8.629	8.665	0.926	0.922- 0.929	0.996	0.967- 1.025	0.049
	Current Smoker	5245	7.684	8.245	0.925	0.913- 0.937	0.932	0.841- 1.023	0.046
	Ex- Smoker	8825	7.592	7.526	0.909	0.898- 0.92	1.009	0.932- 1.085	0.048
	Never Smoked	8181	5.317	6.148	0.937	0.927- 0.947	0.865	0.784- 0.946	0.033
Solid tumor with metastasis Co- morbidity	0	72191	7.871	8.036	0.926	0.923- 0.929	0.979	0.954- 1.005	0.046
	1	2570	13.891	13.542	0.901	0.884- 0.917	1.026	0.919- 1.132	0.074
Elective Surgery	0	41151	13.227	13.423	0.900	0.896- 0.904	0.985	0.959- 1.012	0.073
	1	33492	1.759	1.838	0.894	0.881- 0.908	0.957	0.879- 1.034	0.014
	Missing/Other	118	5.932	8.687	0.843	0.732- 0.954	0.683	0.177- 1.189	0.060
Teaching Hospital	0	25048	6.220	6.738	0.933	0.928- 0.939	0.923	0.877- 0.969	0.038
	1	49713	9.014	8.975	0.921	0.917- 0.925	1.004	0.975- 1.034	0.052

Supplementary Table 16: Performance Sensitivity Analysis for eICU-CRD by Subgroup

Variable	Level	n	Observed Death Rate	Predicted Death Rate	AUROC	AUROC (95% CI)	SMR	SMR (95% CI)	Brier Score
AIDS Chronic Co- morbidity	0	38994	9.027	9.075	0.905	0.9-0.91	0.995	0.962- 1.028	0.055
	1	38	10.526	9.026	0.912	0.766-1	1.166	0.023- 2.309	0.056
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
APACHE III Diagnosis Bodysys- tem	Missing/Other	777	7.979	8.195	0.898	0.857- 0.939	0.974	0.731- 1.216	0.048
	Cardiovascular	12483	8.131	8.273	0.934	0.927- 0.942	0.983	0.922- 1.043	0.043
	Gastrointestinal	3861	7.692	7.659	0.891	0.872- 0.91	1.004	0.89- 1.119	0.048
	Genitourinary	880	6.364	5.266	0.868	0.819- 0.918	1.208	0.892- 1.525	0.048
	Gynecological	148	1.351	0.585	0.586	0.039-1	2.309	-0.891- 5.508	0.014
	Hematological	278	8.993	9.616	0.829	0.747- 0.912	0.935	0.569- 1.302	0.065
	Metabolic	3155	1.300	1.679	0.900	0.847- 0.953	0.774	0.537- 1.011	0.011
	Musculoskeletal / Skin	527	4.364	3.821	0.903	0.859- 0.947	1.142	0.675- 1.609	0.034
	Neurological	5380	8.978	9.660	0.895	0.88- 0.91	0.929	0.846- 1.012	0.055
	Respiratory	5136	11.916	12.068	0.840	0.825- 0.855	0.987	0.909- 1.066	0.083
	Sepsis	4787	16.795	16.196	0.855	0.841- 0.869	1.037	0.965- 1.109	0.098
	Trauma	1906	7.240	6.977	0.916	0.895- 0.937	1.038	0.865- 1.211	0.046
Cirrhosis Co- morbidity	0	38458	8.893	8.928	0.905	0.9-0.91	0.996	0.963- 1.029	0.054
	1	574	18.118	18.957	0.860	0.824- 0.896	0.956	0.772- 1.139	0.104
	Missing/Other	286	11.888	15.670	0.906	0.863- 0.948	0.759	0.504- 1.014	0.073
Country	USA	39318	9.049	9.123	0.904	0.9- 0.909	0.992	0.959- 1.024	0.055
Data Source	eicu	39318	9.049	9.123	0.904	0.9- 0.909	0.992	0.959- 1.024	0.055
Ethnicity	Missing/Other	479	9.186	8.528	0.919	0.887- 0.951	1.077	0.759- 1.395	0.057

	African American	4160	8.918	9.572	0.910	0.894-0.926	0.932	0.837-1.026	0.051
	Asian	679	9.867	8.788	0.893	0.849-0.937	1.123	0.854-1.392	0.058
	Caucasian	30321	9.076	9.101	0.902	0.897-0.908	0.997	0.96-1.035	0.056
	Hispanic	1512	9.325	9.415	0.914	0.891-0.937	0.990	0.827-1.154	0.054
	Native American	280	8.571	8.899	0.951	0.915-0.986	0.963	0.578-1.348	0.043
	Other/Unknown	1887	8.426	8.566	0.911	0.89-0.931	0.984	0.831-1.137	0.053
Gender	Missing/Other	14	14.286	17.452	1.000	1-1	0.819	-0.316-1.953	0.006
	F	18011	9.217	9.476	0.899	0.892-0.907	0.973	0.926-1.019	0.056
	M	21293	8.904	8.820	0.909	0.902-0.915	1.010	0.964-1.055	0.054
Hepatic Failure Co-morbidity	0	38534	8.909	8.939	0.905	0.9-0.91	0.997	0.963-1.03	0.054
	1	498	18.273	19.586	0.851	0.808-0.894	0.933	0.741-1.125	0.105
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Hospital Size (beds)	Missing/Other	4737	7.283	8.273	0.892	0.876-0.909	0.880	0.787-0.973	0.050
	<100	2192	6.113	6.845	0.908	0.885-0.931	0.893	0.742-1.044	0.041
	>= 500	15089	10.518	9.824	0.903	0.895-0.91	1.071	1.018-1.123	0.061
	100 - 249	8124	7.767	8.693	0.918	0.908-0.928	0.894	0.824-0.963	0.048
	250 - 499	9176	9.383	9.334	0.900	0.89-0.909	1.005	0.938-1.072	0.058
Hospital Type	Missing/Other	39318	9.049	9.123	0.904	0.9-0.909	0.992	0.959-1.024	0.055
ICU Admission Source	Missing/Other	64	6.250	8.139	0.904	0.724-1	0.768	0.015-1.521	0.031
	Accident & Emergency Floor	23155	9.138	9.339	0.907	0.9-0.913	0.978	0.937-1.02	0.054
		6448	14.873	14.874	0.867	0.856-0.878	1.000	0.937-1.063	0.089
	Operating Room / Recovery	8311	3.670	3.658	0.904	0.887-0.921	1.003	0.891-1.116	0.026
	Other Hospital	1036	11.873	10.705	0.873	0.84-0.906	1.109	0.913-1.305	0.074
	Other ICU	304	16.776	14.881	0.828	0.773-0.882	1.127	0.818-1.437	0.118

ICU Admission Type	admit	37622	8.995	9.010	0.906	0.901-0.911	0.998	0.965-1.032	0.054
	readmit	189	7.407	7.708	0.811	0.703-0.918	0.961	0.458-1.464	0.061
	transfer	1507	10.617	12.117	0.872	0.845-0.899	0.876	0.74-1.012	0.069
Type of ICU	Cardiac ICU	2535	11.479	10.452	0.923	0.907-0.938	1.098	0.972-1.224	0.061
	CCU-CTICU	3467	7.413	7.351	0.908	0.891-0.925	1.008	0.885-1.132	0.046
	CSICU	1501	4.997	5.759	0.915	0.886-0.945	0.868	0.671-1.064	0.035
	CTICU	1358	5.228	5.737	0.915	0.879-0.95	0.911	0.699-1.123	0.033
	Med-Surg ICU	21552	9.099	9.419	0.902	0.896-0.909	0.966	0.923-1.009	0.056
	MICU	3278	12.752	12.575	0.892	0.877-0.907	1.014	0.917-1.111	0.074
	Neuro ICU	3167	8.210	8.383	0.898	0.878-0.918	0.979	0.86-1.098	0.050
	SICU	2460	9.146	7.931	0.887	0.862-0.911	1.153	1.002-1.304	0.054
Immuno-suppressed	0	37985	8.869	8.913	0.905	0.9-0.91	0.995	0.962-1.029	0.054
	1	1047	14.804	14.975	0.867	0.84-0.894	0.989	0.833-1.144	0.091
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Leukemia Co-morbidity	0	38713	8.940	8.991	0.904	0.9-0.909	0.994	0.961-1.028	0.054
	1	319	19.749	19.351	0.894	0.855-0.933	1.021	0.769-1.273	0.096
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Lymphoma Co-morbidity	0	38868	8.997	9.050	0.905	0.9-0.909	0.994	0.961-1.027	0.055
	1	164	16.463	14.977	0.930	0.89-0.971	1.099	0.685-1.514	0.084
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Admission Length Before ICU Admission	[-82.0285, 0.0278)	7914	9.148	9.272	0.904	0.893-0.915	0.987	0.915-1.058	0.054
	[0.0278, 0.1035)	7825	8.805	9.164	0.921	0.912-0.931	0.961	0.889-1.033	0.051
	[0.1035, 0.2271)	7853	8.786	9.276	0.909	0.898-0.919	0.947	0.877-1.018	0.053
	[0.2271, 0.6410)	7866	6.217	6.370	0.910	0.897-0.923	0.976	0.889-1.062	0.039

	[	7860	12.290	11.534	0.873	0.862-0.884	1.066	0.998-1.133	0.078
	0.6410,175.6278]								
Patient Pregnancy	Missing/Other	39318	9.049	9.123	0.904	0.9-0.909	0.992	0.959-1.024	0.055
Smoking Status	Missing/Other	39318	9.049	9.123	0.904	0.9-0.909	0.992	0.959-1.024	0.055
Solid tumor with metastasis	0	38200	8.832	8.857	0.905	0.9-0.91	0.997	0.964-1.031	0.054
Co-morbidity	1	832	18.029	19.088	0.866	0.837-0.895	0.945	0.793-1.096	0.101
	Missing/Other	286	11.888	15.670	0.906	0.863-0.948	0.759	0.504-1.014	0.073
Elective Surgery	0	31909	10.477	10.567	0.897	0.892-0.903	0.991	0.958-1.025	0.063
	1	7409	2.902	2.904	0.899	0.877-0.92	0.999	0.866-1.133	0.022
Teaching Hospital	0	28824	8.594	8.900	0.905	0.899-0.911	0.966	0.928-1.004	0.053
	1	10494	10.301	9.736	0.903	0.894-0.912	1.058	0.995-1.121	0.061

3.4.2 Assessment of Performance by the presence of Missing Data

We assessed GOSSIS-1 performance in the test stratified by a variable’s missingness status, and present this in Supplementary Table 17. In general the performance does not deteriorate due to the missingness of one variable. We also computed the cumulative effect of having multiple missing variables (total number of missing extrema variables and APS variables), and this is presented in Supplementary Figure 21. The amount of missing variables seems to be largely independent of SMR, and surprisingly seems to slightly increase performance in AUROC and Brier scores. This latter observation is also present when assessing APACHE III/IVa in the same fashion, but APACHE III/IVa SMR seems to vary significantly with the amount of missing data.

Since our imputation models can make use of APACHE variables to impute missing extrema data, we also evaluated GOSSIS-1 performance stratified by whether each APACHE variable was missing. This is presented in Supplementary Table 18. We look at the cumulative number of APS variables only in Supplementary Figure 22. In general, the trends follow those we saw in Supplementary Figure 21 when we looked at the sum of extrema and APS variables.

Supplementary Table 17: Performance Sensitivity Analysis by Missing Data Status for Day 1 Min/Max variables

Variable	Missing	AUROC	AUROC 95% CI	SMR	SMR 95% CI	Brier Score
Day 1 Max Diastolic BP (mmHg)	No	0.919	0.916-0.921	0.984	0.964-1.004	0.050
	Yes	0.895	0.869-0.921	1.095	0.933-1.257	0.065
Day 1 Min Diastolic BP (mmHg)	No	0.918	0.916-0.921	0.983	0.964-1.003	0.050
	Yes	0.898	0.87-0.926	1.146	0.963-1.328	0.069
Day 1 Max HR (beats/min)	No	0.918	0.916-0.921	0.985	0.966-1.005	0.050
	Yes	0.900	0.816-0.985	1.434	0.586-2.281	0.085

Day 1 Min HR (beats/min)	No	0.918	0.916-0.921	0.985	0.966-1.005	0.050
	Yes	0.900	0.816-0.985	1.434	0.586-2.281	0.085
Day 1 Max MAP (mmHg)	No	0.918	0.915-0.921	0.985	0.966-1.005	0.050
	Yes	0.917	0.869-0.966	1.097	0.698-1.496	0.069
Day 1 Min MAP (mmHg)	No	0.918	0.915-0.921	0.985	0.965-1.005	0.050
	Yes	0.917	0.875-0.959	1.093	0.758-1.427	0.074
Day 1 Max RR (breath/min)	No	0.918	0.915-0.921	0.985	0.966-1.005	0.050
	Yes	0.940	0.898-0.972	1.030	0.753-1.307	0.054
Day 1 Min RR (breath/min)	No	0.918	0.915-0.921	0.985	0.966-1.005	0.050
	Yes	0.950	0.927-0.973	1.027	0.806-1.248	0.055
Day 1 Max SpO2 (%)	No	0.904	0.899-0.909	0.991	0.958-1.024	0.055
	Yes	0.925	0.922-0.928	0.983	0.958-1.007	0.047
Day 1 Min SpO2 (%)	No	0.904	0.899-0.909	0.991	0.958-1.024	0.055
	Yes	0.925	0.922-0.928	0.983	0.958-1.007	0.047
Day 1 Max Systolic BP (mmHg)	No	0.918	0.915-0.921	0.985	0.965-1.004	0.050
	Yes	0.924	0.872-0.975	1.359	0.921-1.797	0.075
Day 1 Min Systolic BP (mmHg)	No	0.918	0.915-0.921	0.985	0.965-1.005	0.050
	Yes	0.915	0.868-0.962	1.174	0.823-1.525	0.079
Day 1 Max Body Temp (Degrees Celsius)	No	0.918	0.915-0.92	0.983	0.963-1.002	0.049
	Yes	0.936	0.92-0.951	1.123	0.981-1.264	0.064
Day 1 Min Body Temp (Degrees Celsius)	No	0.918	0.915-0.92	0.982	0.962-1.002	0.050
	Yes	0.937	0.922-0.951	1.120	0.984-1.255	0.061
Day 1 Max Albumin (g/dL)	No	0.898	0.892-0.905	0.998	0.954-1.042	0.067
	Yes	0.921	0.918-0.924	0.982	0.96-1.005	0.047
Day 1 Min Albumin (g/dL)	No	0.898	0.892-0.905	0.998	0.954-1.042	0.067
	Yes	0.921	0.918-0.924	0.982	0.96-1.005	0.047
Day 1 Max Bilirubin (micromol/L)	No	0.899	0.892-0.906	0.999	0.954-1.044	0.068
	Yes	0.921	0.918-0.924	0.982	0.961-1.004	0.047
Day 1 Min Bilirubin (micromol/L)	No	0.899	0.892-0.906	0.999	0.954-1.044	0.068
	Yes	0.921	0.918-0.924	0.982	0.961-1.004	0.047
Day 1 Max BUN (mmol/L)	No	0.901	0.896-0.906	0.987	0.953-1.021	0.056
	Yes	0.926	0.923-0.929	0.985	0.961-1.009	0.047
Day 1 Min BUN (mmol/L)	No	0.901	0.896-0.906	0.987	0.953-1.021	0.056
	Yes	0.926	0.923-0.929	0.985	0.961-1.009	0.047
Day 1 Max Calcium (mmol/L)	No	0.901	0.896-0.906	0.982	0.948-1.017	0.056
	Yes	0.925	0.922-0.928	0.987	0.963-1.011	0.047
Day 1 Min Calcium (mmol/L)	No	0.901	0.896-0.906	0.982	0.948-1.017	0.056
	Yes	0.925	0.922-0.928	0.987	0.963-1.011	0.047
Day 1 Max Creatinine (micromol/L)	No	0.916	0.913-0.919	0.980	0.96-1	0.050
	Yes	0.947	0.938-0.956	1.081	0.994-1.168	0.041
Day 1 Min Creatinine (micromol/L)	No	0.915	0.912-0.918	0.982	0.962-1.003	0.051
	Yes	0.944	0.936-0.952	1.026	0.954-1.098	0.035
Day 1 Max Glucose (mmol/L)	No	0.916	0.913-0.919	0.985	0.964-1.005	0.051
	Yes	0.946	0.937-0.956	1.004	0.919-1.089	0.033
Day 1 Min Glucose (mmol/L)	No	0.915	0.913-0.918	0.985	0.965-1.006	0.052
	Yes	0.945	0.936-0.953	0.988	0.911-1.065	0.031
Day 1 Max Bicarbonate (mmol/L)	No	0.917	0.914-0.919	0.982	0.962-1.003	0.050
	Yes	0.933	0.925-0.941	1.021	0.953-1.09	0.044
Day 1 Min Bicarbonate (mmol/L)	No	0.916	0.913-0.919	0.984	0.963-1.005	0.051
	Yes	0.936	0.928-0.943	1.000	0.939-1.062	0.039
Day 1 Max Hemoglobin (g/dL)	No	0.917	0.914-0.92	0.972	0.951-0.994	0.049
	Yes	0.924	0.918-0.931	1.054	1.004-1.104	0.051
Day 1 Min Hemoglobin (g/dL)	No	0.916	0.913-0.919	0.975	0.954-0.997	0.050
	Yes	0.926	0.921-0.932	1.031	0.984-1.078	0.047
Day 1 Max Hematocrit (Fraction)	No	0.916	0.913-0.919	0.981	0.961-1.002	0.051
	Yes	0.944	0.935-0.952	1.043	0.968-1.118	0.039
Day 1 Min Hematocrit (Fraction)	No	0.915	0.912-0.918	0.985	0.964-1.005	0.051
	Yes	0.940	0.933-0.948	0.996	0.932-1.061	0.036
Day 1 Max INR (micromol/L)	No	0.893	0.886-0.901	1.014	0.968-1.06	0.072
	Yes	0.921	0.919-0.924	0.979	0.957-1.001	0.046
Day 1 Min INR (micromol/L)	No	0.893	0.886-0.901	1.014	0.968-1.06	0.072
	Yes	0.921	0.919-0.924	0.979	0.957-1.001	0.046
Day 1 Max Lactate (mmol/L)	No	0.878	0.87-0.886	1.053	1.006-1.101	0.096
	Yes	0.920	0.917-0.923	0.971	0.949-0.992	0.045
Day 1 Min Lactate (mmol/L)	No	0.878	0.87-0.886	1.053	1.006-1.101	0.096
	Yes	0.920	0.917-0.923	0.971	0.949-0.992	0.045

Day 1 Max Platelets (10 ⁹ /L)	No	0.916	0.913-0.919	0.973	0.952-0.995	0.050
	Yes	0.926	0.92-0.932	1.045	0.996-1.094	0.051
Day 1 Min Platelets (10 ⁹ /L)	No	0.916	0.913-0.919	0.977	0.955-0.999	0.051
	Yes	0.928	0.922-0.933	1.022	0.976-1.067	0.046
Day 1 Max Potassium (mmol/L)	No	0.916	0.913-0.919	0.982	0.962-1.002	0.050
	Yes	0.948	0.939-0.957	1.049	0.96-1.137	0.041
Day 1 Min Potassium (mmol/L)	No	0.915	0.913-0.918	0.984	0.964-1.004	0.051
	Yes	0.946	0.938-0.954	1.008	0.933-1.082	0.036
Day 1 Max Sodium (mmol/L)	No	0.916	0.914-0.919	0.982	0.962-1.002	0.050
	Yes	0.946	0.937-0.955	1.052	0.962-1.142	0.040
Day 1 Min Sodium (mmol/L)	No	0.916	0.913-0.918	0.984	0.963-1.004	0.051
	Yes	0.945	0.936-0.953	1.012	0.937-1.088	0.035
Day 1 Max WBC (10 ⁹ /L)	No	0.916	0.913-0.919	0.980	0.959-1	0.050
	Yes	0.944	0.936-0.953	1.064	0.986-1.142	0.041
Day 1 Min WBC (10 ⁹ /L)	No	0.915	0.913-0.918	0.982	0.961-1.002	0.051
	Yes	0.937	0.93-0.945	1.023	0.959-1.087	0.038
Day 1 Max Arterial PCO2 (mmHg)	No	0.879	0.872-0.886	1.022	0.98-1.064	0.091
	Yes	0.921	0.918-0.924	0.975	0.952-0.997	0.044
Day 1 Min Arterial PCO2 (mmHg)	No	0.879	0.872-0.886	1.022	0.98-1.064	0.091
	Yes	0.921	0.918-0.924	0.975	0.952-0.997	0.044
Day 1 Max Arterial pH	No	0.879	0.872-0.886	1.023	0.981-1.065	0.092
	Yes	0.921	0.918-0.924	0.975	0.952-0.997	0.044
Day 1 Min Arterial pH	No	0.879	0.872-0.886	1.023	0.981-1.065	0.092
	Yes	0.921	0.918-0.924	0.975	0.952-0.997	0.044
Day 1 Max Arterial PO2 (mmHg)	No	0.880	0.872-0.887	1.020	0.979-1.062	0.091
	Yes	0.921	0.918-0.924	0.975	0.953-0.998	0.044
Day 1 Min Arterial PO2 (mmHg)	No	0.880	0.872-0.887	1.020	0.979-1.062	0.091
	Yes	0.921	0.918-0.924	0.975	0.953-0.998	0.044
Day 1 Max PAO2-FiO2 Ratio	No	0.880	0.872-0.887	1.029	0.983-1.074	0.095
	Yes	0.920	0.917-0.923	0.975	0.953-0.997	0.045
Day 1 Min PAO2-FiO2 Ratio	No	0.880	0.872-0.887	1.029	0.983-1.074	0.095
	Yes	0.920	0.917-0.923	0.975	0.953-0.997	0.045

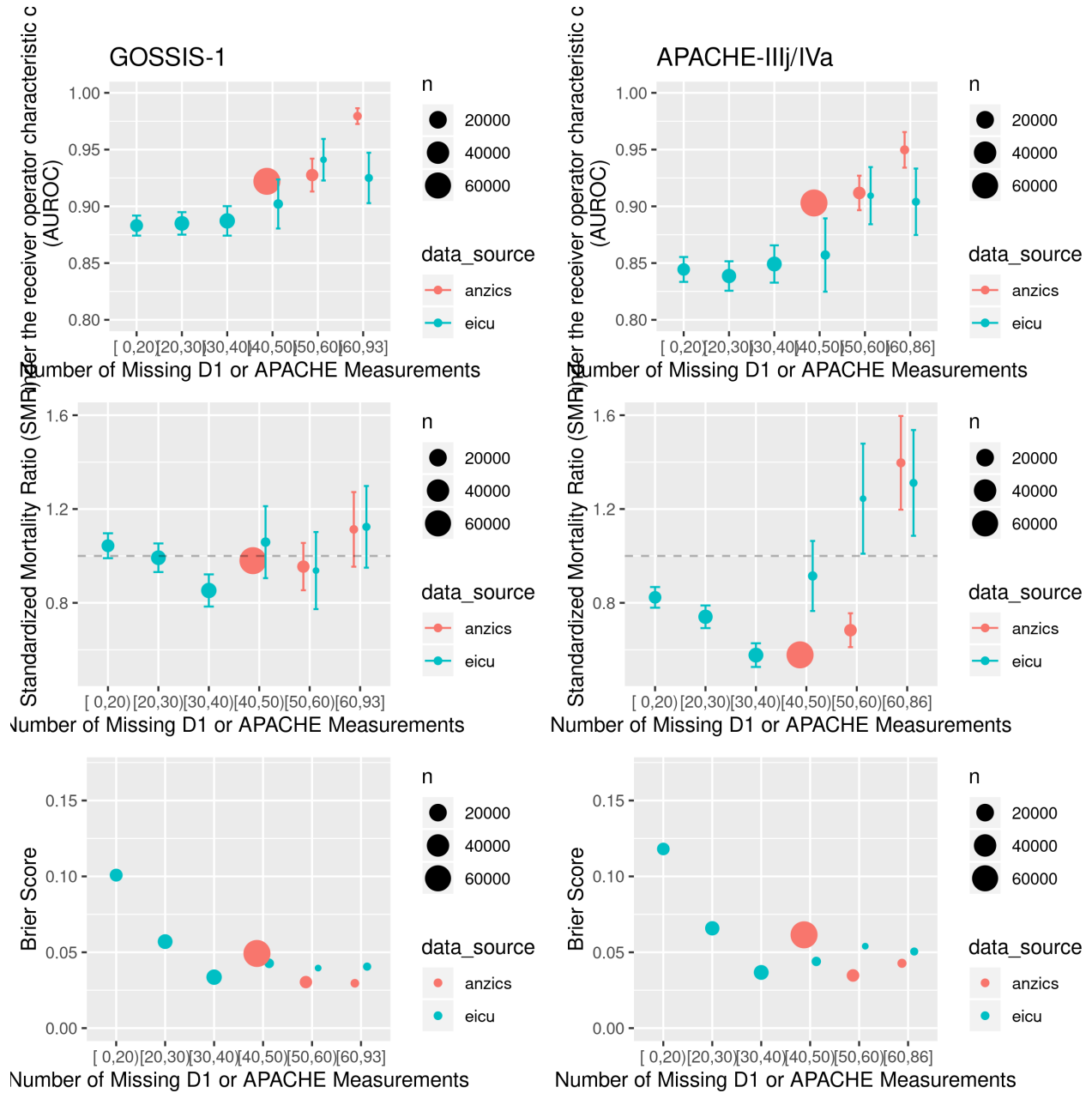
Supplementary Table 18: Performance Sensitivity Analysis by Missing Data Status for APACHE variables

Variable	Missing	AUROC	AUROC 95% CI	SMR	SMR 95% CI	Brier Score
APACHE Albumin (g/dL)	No	0.918	0.915-0.921	0.981	0.959-1.003	0.052
	Yes	0.918	0.912-0.924	1.002	0.959-1.045	0.043
Acute Renal Failure APACHE Variable	No	0.918	0.916-0.921	0.987	0.967-1.006	0.050
	Yes	0.906	0.863-0.948	0.759	0.504-1.014	0.073
APACHE Bilirubin (micromol/L)	No	0.918	0.915-0.921	0.981	0.959-1.004	0.052
	Yes	0.916	0.911-0.922	0.999	0.959-1.039	0.044
APACHE BUN (mmol/L)	No	0.916	0.913-0.919	0.981	0.961-1.002	0.050
	Yes	0.937	0.93-0.945	1.029	0.962-1.097	0.043
APACHE Creatinine (micromol/L)	No	0.916	0.913-0.919	0.981	0.96-1.001	0.050
	Yes	0.937	0.929-0.945	1.041	0.972-1.111	0.043
APACHE FiO2 Ratio	No	0.917	0.914-0.92	0.995	0.971-1.018	0.058
	Yes	0.911	0.906-0.916	0.963	0.927-1	0.038
GCS Eye Component	No	0.918	0.915-0.921	0.985	0.965-1.005	0.050
	Yes	0.917	0.9-0.934	1.018	0.906-1.131	0.055
GCS Motor Component	No	0.918	0.915-0.921	0.985	0.965-1.005	0.050
	Yes	0.917	0.9-0.934	1.019	0.906-1.131	0.055
GCS Unable to Assess Component	No	0.905	0.9-0.91	0.993	0.96-1.026	0.055
	Yes	0.925	0.922-0.928	0.982	0.957-1.006	0.047
GCS Verbal Component	No	0.918	0.916-0.921	0.984	0.964-1.004	0.050
	Yes	0.915	0.898-0.932	1.023	0.911-1.136	0.055
APACHE Glucose (mmol/L)	No	0.915	0.913-0.918	0.984	0.964-1.005	0.051
	Yes	0.945	0.937-0.953	1.006	0.932-1.081	0.036
APACHE Heart Rate	No	0.918	0.916-0.921	0.986	0.967-1.006	0.050
	Yes	0.897	0.853-0.941	0.862	0.613-1.111	0.073
APACHE Hematocrit (Fraction)	No	0.916	0.913-0.919	0.982	0.961-1.003	0.051
	Yes	0.935	0.927-0.942	1.016	0.953-1.079	0.043
APACHE Intubated Variable	No	0.918	0.916-0.921	0.987	0.967-1.006	0.050
	Yes	0.906	0.864-0.948	0.759	0.504-1.014	0.073

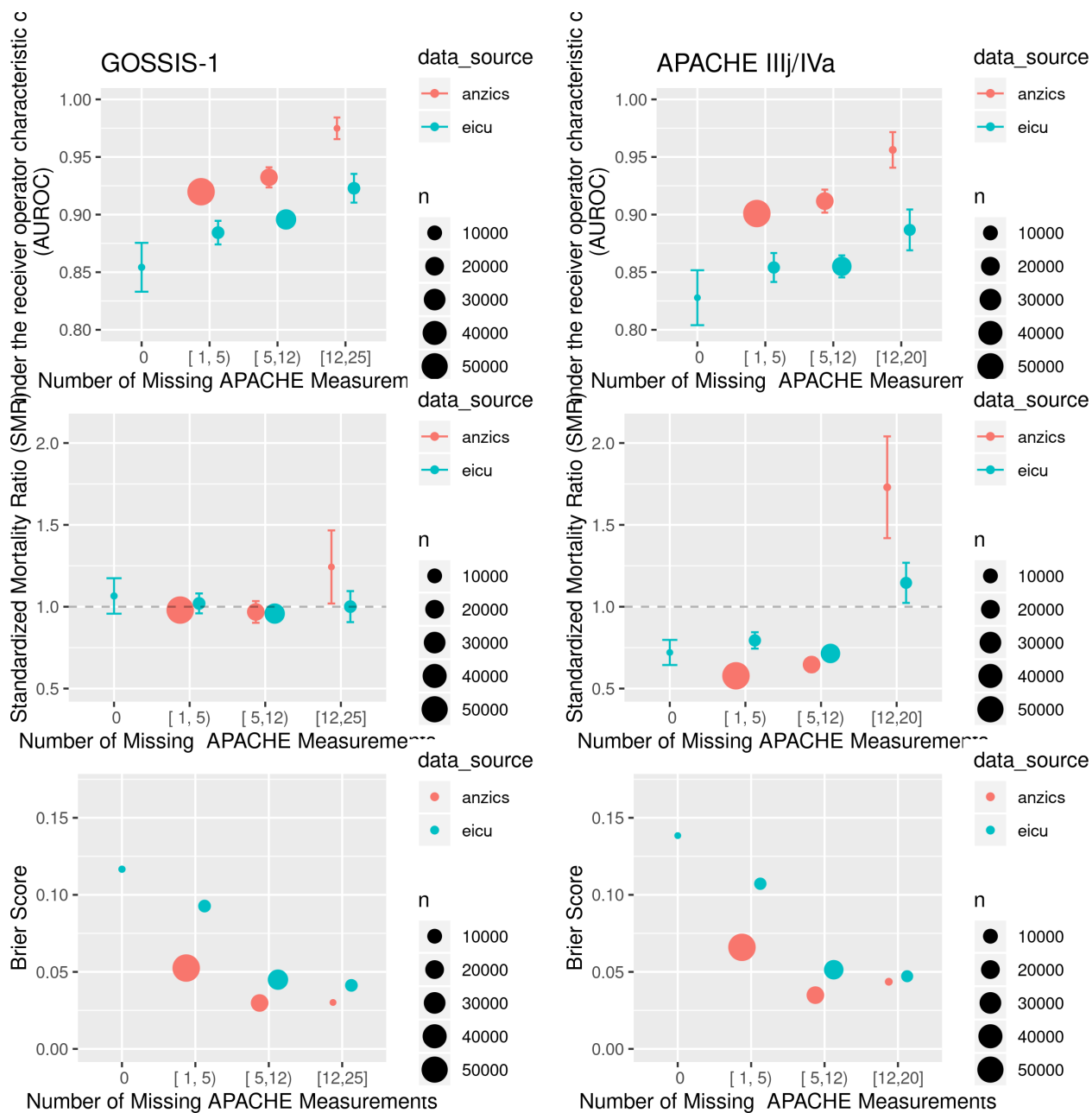
APACHE MAP	No	0.918	0.916-0.921	0.986	0.966-1.006	0.050
	Yes	0.905	0.864-0.945	0.918	0.691-1.145	0.069
APACHE PaCO2	No	0.917	0.914-0.92	0.995	0.972-1.018	0.058
	Yes	0.911	0.906-0.916	0.962	0.926-0.999	0.038
APACHE PaCO2 for pH	No	0.918	0.914-0.921	0.993	0.97-1.017	0.058
	Yes	0.910	0.905-0.916	0.967	0.931-1.004	0.038
APACHE PaO2	No	0.917	0.914-0.92	0.995	0.971-1.018	0.058
	Yes	0.911	0.906-0.916	0.963	0.926-0.999	0.038
APACHE pH	No	0.918	0.914-0.921	0.993	0.969-1.016	0.058
	Yes	0.911	0.905-0.916	0.968	0.931-1.004	0.038
APACHE RR (breath/min)	No	0.918	0.915-0.921	0.986	0.966-1.006	0.050
	Yes	0.928	0.901-0.955	0.940	0.747-1.133	0.060
APACHE Sodium (mmol/L)	No	0.916	0.914-0.919	0.983	0.962-1.003	0.050
	Yes	0.936	0.928-0.944	1.020	0.948-1.091	0.043
APACHE Body Temp (Degrees Celsius)	No	0.918	0.915-0.92	0.983	0.963-1.003	0.049
	Yes	0.930	0.917-0.944	1.052	0.942-1.163	0.063
APACHE Urine Output	No	0.919	0.916-0.922	0.991	0.968-1.013	0.049
	Yes	0.915	0.909-0.921	0.970	0.93-1.009	0.053
APACHE Ventilation Variable	No	0.918	0.916-0.921	0.987	0.967-1.006	0.050
	Yes	0.906	0.863-0.948	0.759	0.504-1.014	0.073
APACHE WBC (10 ⁹ /L)	No	0.916	0.913-0.919	0.981	0.96-1.002	0.050
	Yes	0.934	0.926-0.941	1.029	0.966-1.093	0.045

3.4.3 Comparison of APACHE and GOSSIS-1 and Predicted Risk of Death

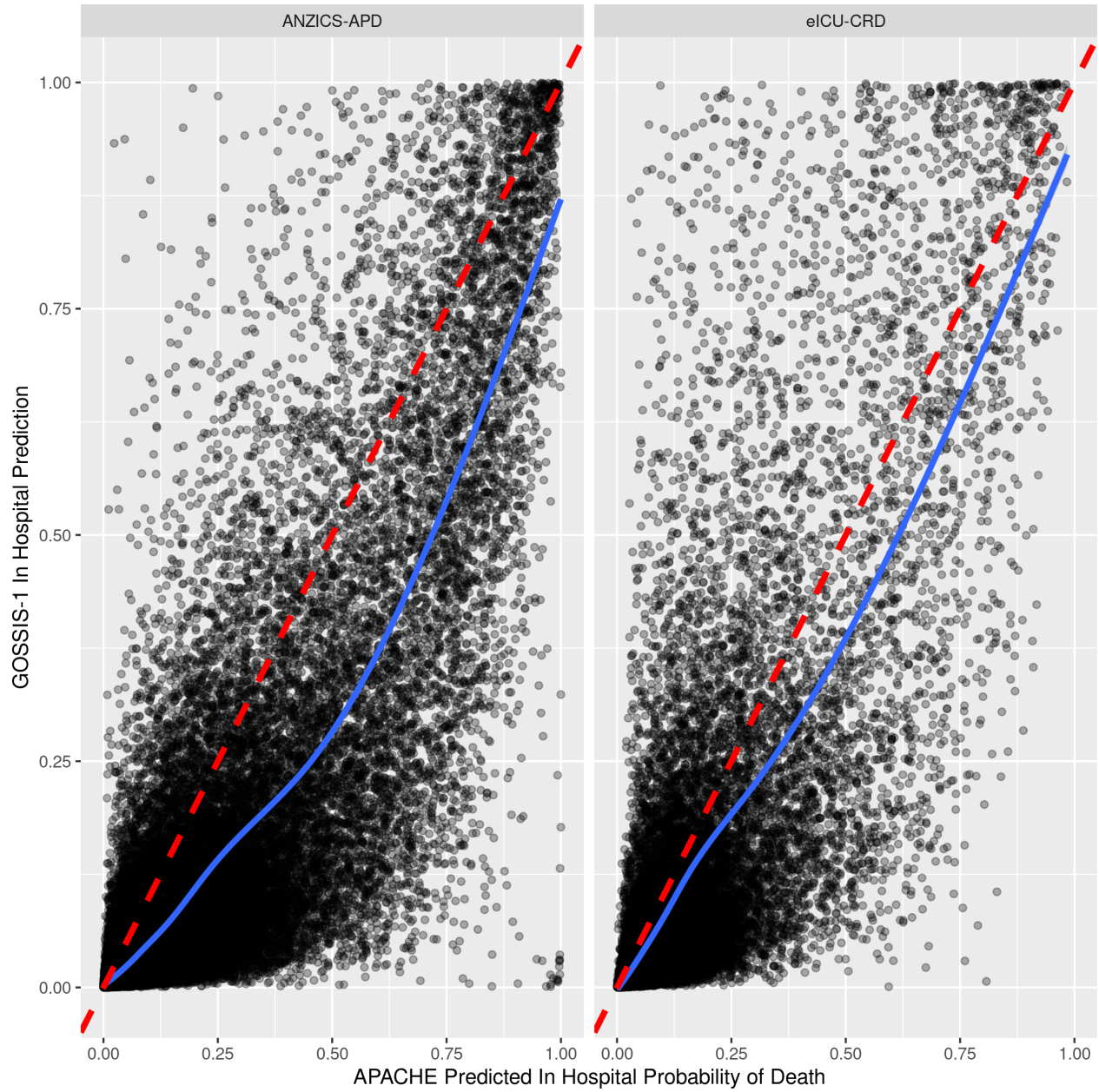
An assessment of the degree to which predictions have changed from APACHE-III/IVa to GOSSIS-1 can be seen in Supplementary Figure 23. In this plot we see that on average GOSSIS-1 predictions are significantly lower than APACHE-III/IVa scores, particularly for ANZICS-APD patients. We also see that while the probabilities are in general correlated, there are marked differences among the predictions.



Supplementary Figure 21: Discrimination (AUROC) and Calibration (SMR and Brier Score) performance by amount of total missing physiological variables (day 1 extremas + number of APS variables missing)



Supplementary Figure 22: Discrimination (AUROC) and Calibration (SMR and Brier Score) performance by amount of total missing APS variables



Supplementary Figure 23: Scatterplot of individual patient prediction of in-hospital death for both GOSIS-1 and APACHE III/IVa.

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