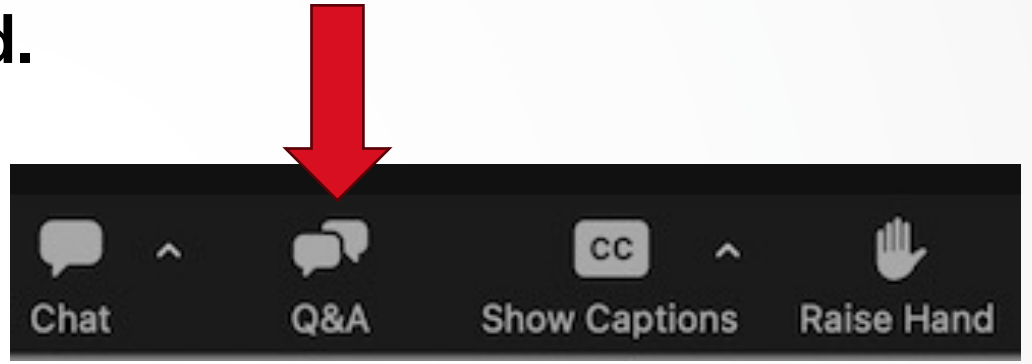
Advancements in Pediatric Sepsis Diagnosis: Introducing the Phoenix Sepsis Score

SEPSIS ALLIANCE

Housekeeping

SEPSIS ALLIANCE

- Your audio is automatically muted.
- Please submit all questions to the Q&A box.



- This webinar is being recorded. The link will be shared with you via email, as well as posted to SepsisInstitute.org in the coming days.
- CE credit claiming instructions will be sent after the webinar.

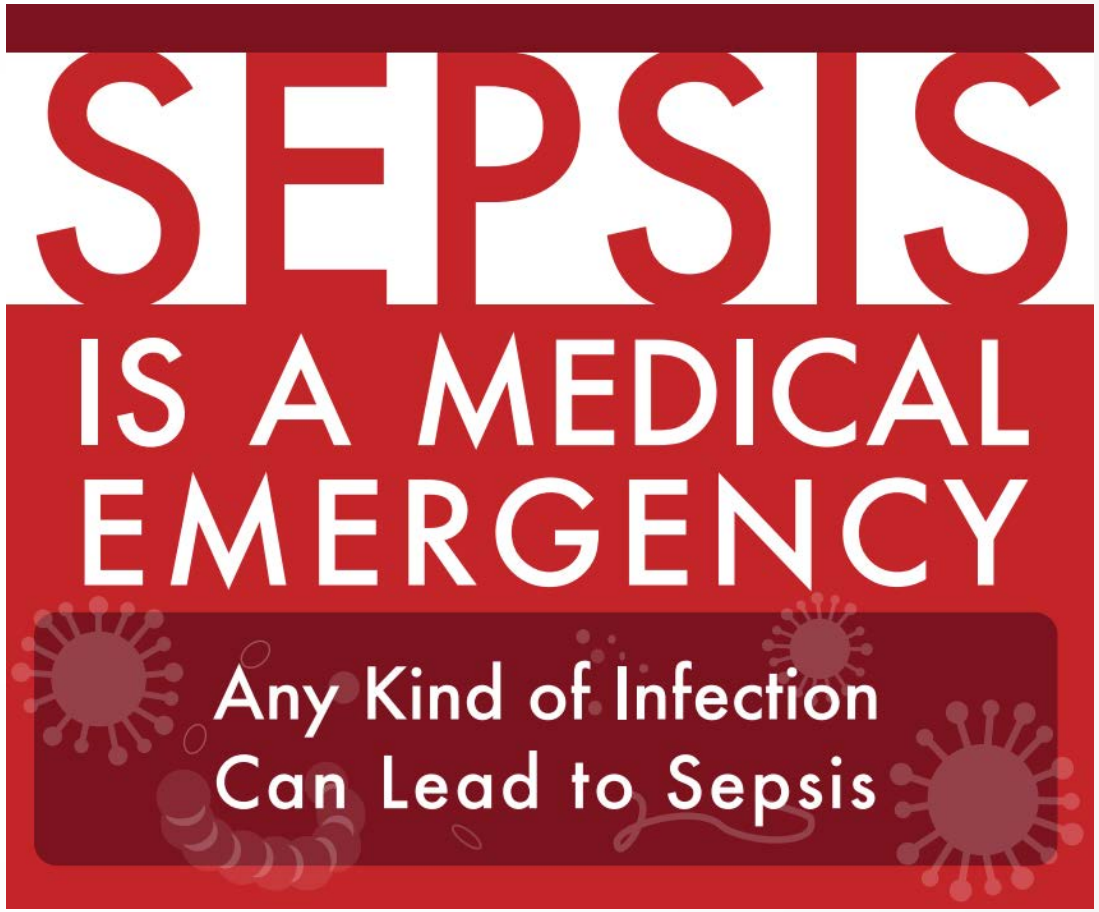
Webinar Supporters

Sepsis Alliance gratefully acknowledges the support provided for this webinar by our Sepsis Alliance Institute sponsors, Wolters Kluwer and Baxter.

Sepsis Alliance Mission

To save lives and reduce suffering by improving sepsis awareness and care.

https://www.sepsis.org



Disclaimer

The information in this webinar is only intended for educational purposes. The presentations and content are the opinions, experiences, views of the specific authors/presenters and are not statements of advice or opinion of Sepsis Alliance. The presentation has not been prepared, screened, approved, or endorsed by Sepsis Alliance.

Presenters

L. Nelson Sanchez-Pinto, MD, MBI, FAMIA

Associate Professor, Pediatrics (Critical Care) & Preventive Medicine (Health & Biomedical Informatics)

Northwestern University – Feinberg School of Medicine

Lauren Sorce, PhD, APRN-NP, CPNP, AC/PC, FCCM

Founder's Board Nurse Scientist; Senior Scientist, Division of Pediatric Critical Care; Associate Director of Nursing Research, Department of Nursing

Ann & Robert H. Lurie Children’s Hospital of Chicago

Development and Validation of the Phoenix Pediatric Sepsis Criteria

Lauren R. Sorce, PhD, RN, CPNP-AC/PC, FCCM, FAAN

L. Nelson Sanchez-Pinto, MD, MBI, FAMIA

On behalf of the

SCCM Pediatric Sepsis Definition Taskforce

Disclosures

This work was supported by NICHD (R01 HD105939) and the Society of Critical Care Medicine.

NIH *Eunice Kennedy Shriver* National Institute of Child Health and Human Development

Society of Critical Care Medicine
The Intensive Care Professionals

Background

TIMELINE

2005: IPSCC Pediatric Sepsis criteria published (AKA "Goldstein")

- ***Sepsis*** *= infection + SIRS*
- Expert-based, non-specific, excessively sensitive (e.g., bronchiolitis = sepsis?)
- Concept of "severe sepsis" is strange and ambiguous

2016: Adult Sepsis-3 criteria published

- ***Sepsis*** *= infection + organ dysfunction*
- Based on adult SOFA score, not applicable to children
- Developed mostly by intensivists from high-resource settings

2019: SCCM Pediatric Sepsis Definition Task Force convened

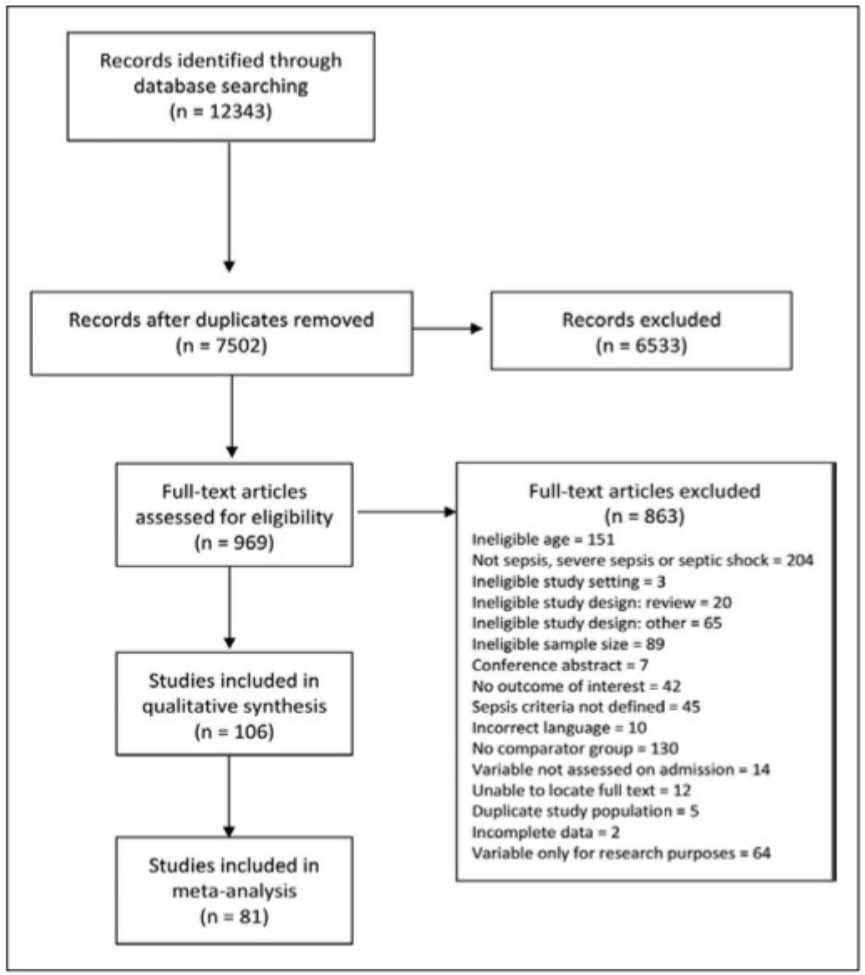
- Is ***"Sepsis*** *= infection + organ dysfunction"* right for children too?
- **Goal**: new criteria applicable to children of all ages (except premature neonates) and in high- and low-resource settings

SCCM Pediatric Sepsis Definition Task Force
Salzburg, Austria, June 2019

- **Diverse members** including CCM, PEM, ID, NICU, nursing, high- and low-resource.
- **Three-pronged effort**: systematic review, international survey, data analysis
- Final criteria = Data results + modified **Delphi consensus**

OPEN

Criteria for Pediatric Sepsis—A Systematic Review and Meta-Analysis by the Pediatric Sepsis Definition Taskforce*



Variable	No. of Studies	No. of Participants With Outcome[a]	No. of Participants Without Outcome[a]	Pooled Estimate[b] (95% CI)	Mean Value in Two Groups[c]	*p* for Heterogeneity	I^2
Variables significantly associated with outcome of mortality							
Demographic variables							
Severe acute malnutrition	3	30/135	57/450	4.7 (1.4–16.3)		0.094	
Chronic conditions	11	859/1,464	13,013/25,664	2.4 (1.4–4.1)		< 0.0001	
Oncologic conditions	8[d]	104/402	616/2,422	2.3 (1.7–3.1)		0.63	
Clinical variables							
Hypotension	4	1,013/1,910	10,828/41,283	2.3 (1.8–2.9)		0.052	
Vasoactive agents	20	623/739	1,831/3,475	6.5 (4.2–10.0)		< 0.0001	
Vasoactive-inotropic score	6	175	468	23.5 (3.4–43.6)	49.3 vs 20.4	< 0.0001	
Stroke index	3	165	295	0.2 (0.1–0.4)	1.8 vs 1.7	0.42	
Mechanical ventilation	30	2,778/3,350	22,874/51,151	11.0 (7.4–16.3)		< 0.0001	
Decreased LOC	3	1,147/1,813	10,975/38,744	4.1 (2.9–5.9)		0.22	
Glasgow Coma Scale	3	134	176	−4.0 (−6.2 to −1.8)	6.6 vs 11.0	0.10	

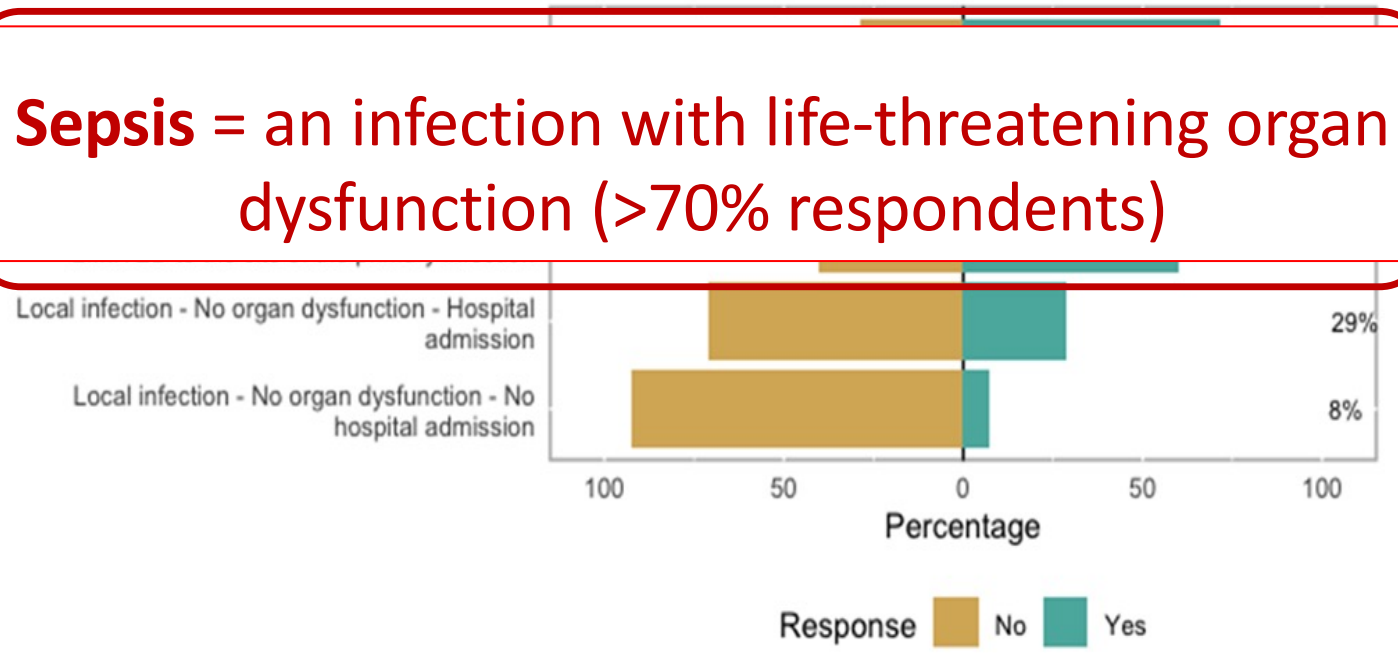
The Current and Future State of Pediatric Sepsis Definitions: An International Survey

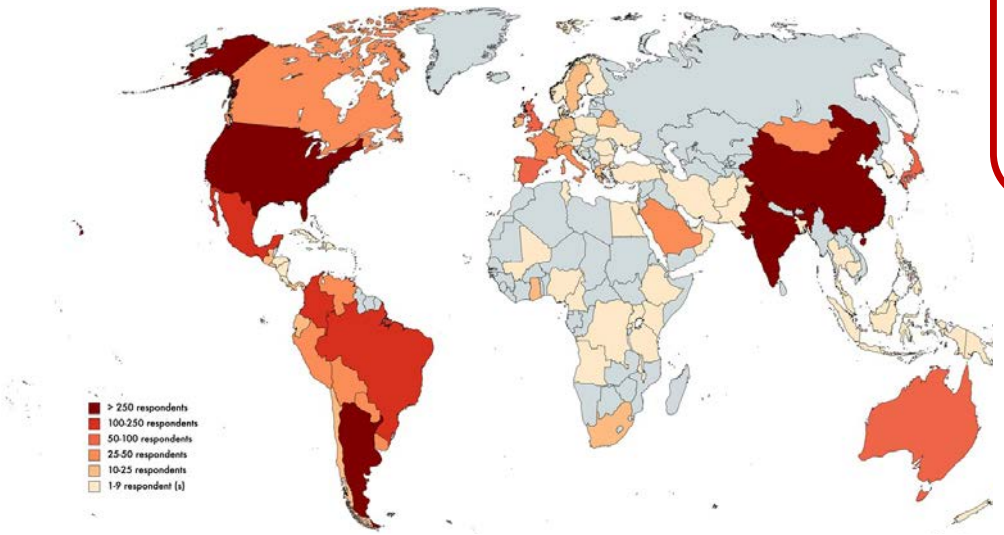
Luc Morin, MD, MSc,[a] Mark Hall, MD,[b] Daniela de Souza, MD, PhD,[c,d] Lu Guoping, MD,[e] Roberto Jabornisky, MD,[f,g] Nobuaki Shime, MD,[h] Suchitra Ranjit, MD, FCCM,[i] Patricia Gilholm, PhD,[j] Satoshi Nakagawa, MD,[k] Jerry J. Zimmerman, MD, PhD,[l] Lauren R. Sorce, PhD, RN,[m,n] Andrew Argent, MBBCh, MD,[o,p] Niranjan Kissoon, MD,[q,r] Pierre Tissières, MD, DSc,[s,t] R. Scott Watson, MD, MPH,[l,*] Luregn J Schlapbach, MD, PhD, FCICM,[j,u,*] on behalf of the Pediatric Sepsis Definition Taskforce

PEDIATRICS®

What should be called “sepsis”?

Sepsis = an infection with life-threatening organ dysfunction (>70% respondents)





>2800 respondents from around the world

Derivation and validation study

JAMA | Original Investigation

Development and Validation of the Phoenix Criteria for Pediatric Sepsis and Septic Shock

L. Nelson Sanchez-Pinto, MD, MBI; Tellen D. Bennett, MD, MS; Peter E. DeWitt, PhD; Seth Russell, MS; Margaret N. Rebull, MA; Blake Martin, MD; Samuel Akech, MBChB, MMED; David J. Albers, PhD; Elizabeth R. Alpern, MD, MSCE; Fran Balamuth, MD, PhD, MSCE; Melania Bembea, MD, MPH, PhD; Mohammod Jobayer Chisti, MBBS, MMed, PhD; Idris Evans, MD, MSc; Christopher M. Horvat, MD, MHA; Juan Camilo Jaramillo-Bustamante, MD; Niranjan Kissoon, MD; Kusum Menon, MD, MSc; Halden F. Scott, MD, MSCS; Scott L. Weiss, MD; Matthew O. Wiens, PharmD, PhD; Jerry J. Zimmerman, MD, PhD; Andrew C. Argent, MD, MBBCh, MMed; Lauren R. Sorce, PhD, RN, CPNP-AC/PC; Luregn J. Schlapbach, MD, PhD; R. Scott Watson, MD, MPH; and the Society of Critical Care Medicine Pediatric Sepsis Definition Task Force

Conceptual framework

Pediatric Sepsis =

"An infection with life-threatening organ dysfunction"

Conceptual framework

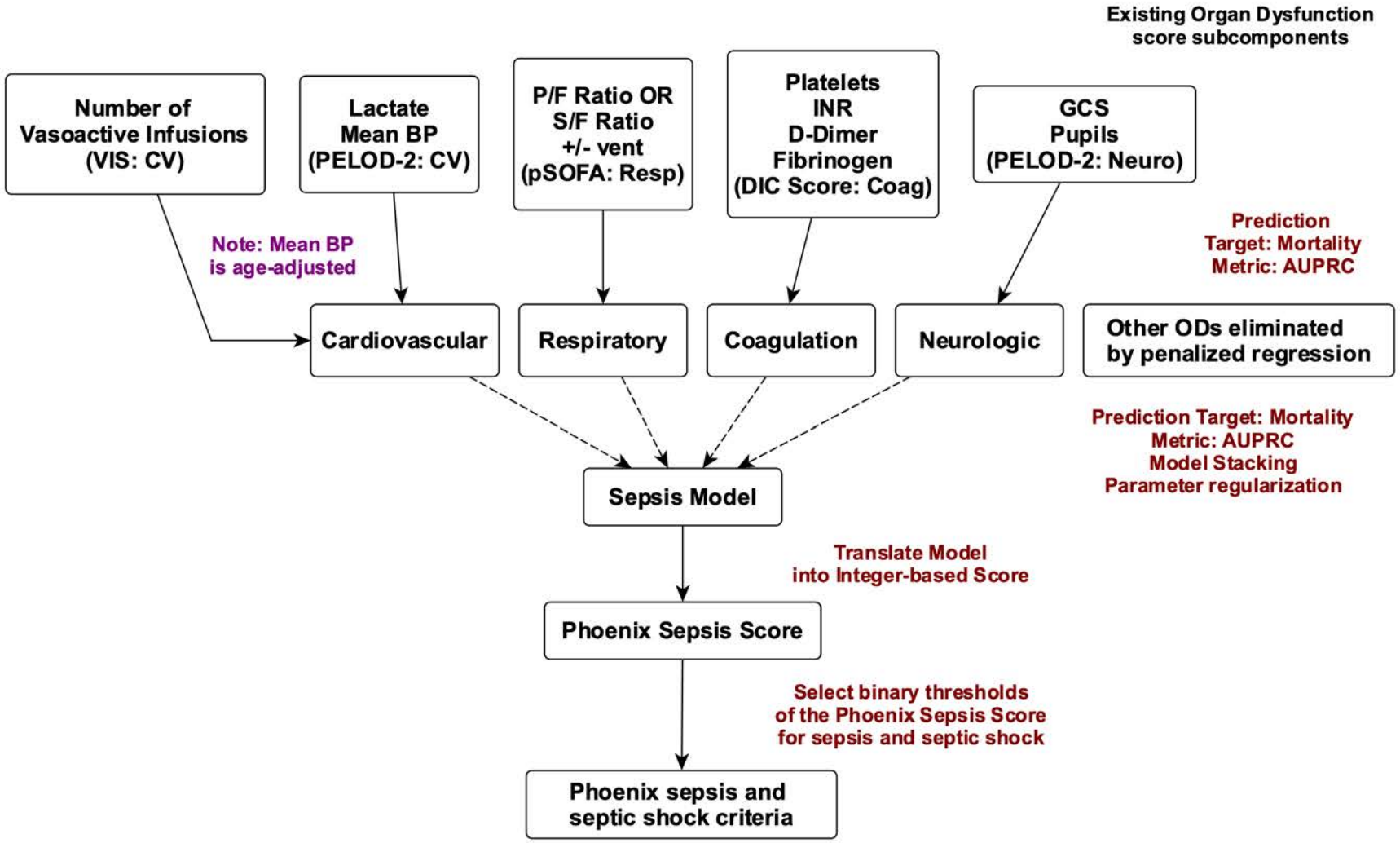
Suspected infection <24 hours

"An infection with life-threatening organ dysfunction"

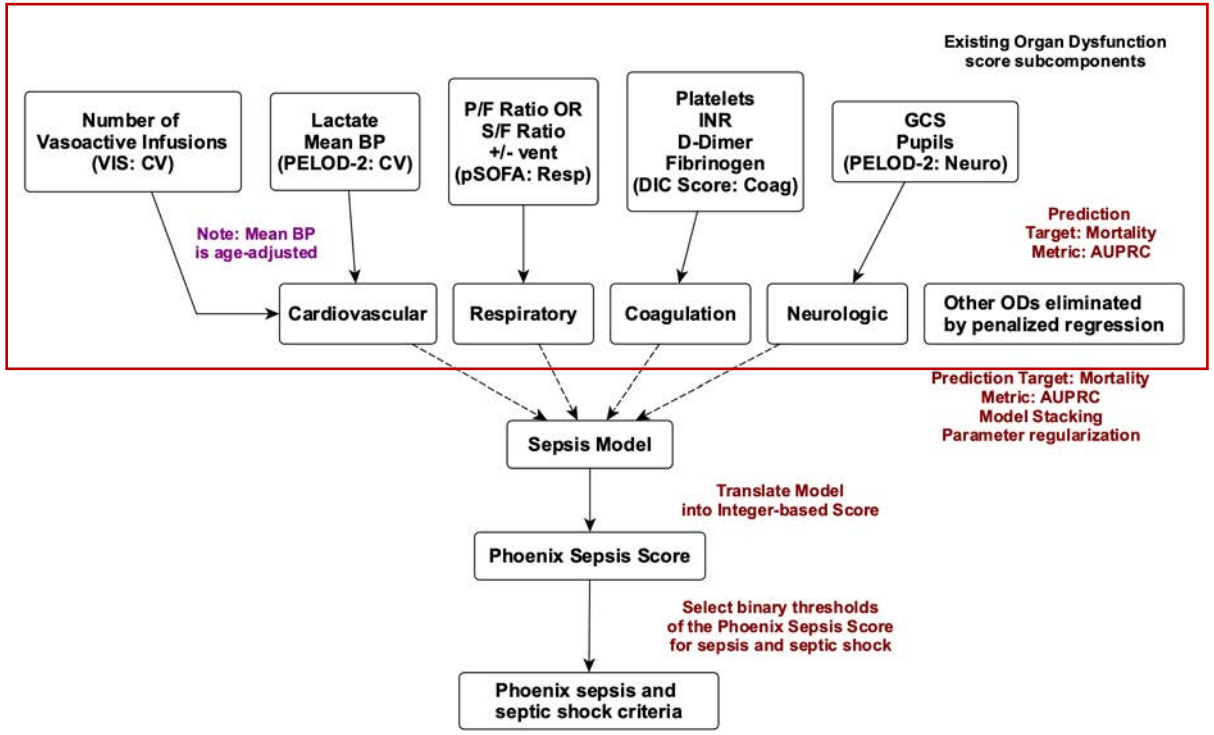
Primary outcome: in-hospital **mortality**

Identify the **best-performing organ dysfunction subcomponents** from existing scores, applicable to higher and lower resource settings

Overview


Existing Organ Dysfunction score subcomponents
Number of Vasoactive Infusions (VIS: CV)
Lactate Mean BP (PELOD-2: CV)
P/F Ratio OR S/F Ratio +/- vent (pSOFA: Resp)
Platelets INR D-Dimer Fibrinogen (DIC Score: Coag)
GCS Pupils (PELOD-2: Neuro)
Note: Mean BP is age-adjusted
Prediction Target: Mortality Metric: AUPRC
Cardiovascular
Respiratory
Coagulation
Neurologic
Other ODs eliminated by penalized regression
Prediction Target: Mortality Metric: AUPRC Model Stacking Parameter regularization
Sepsis Model
Translate Model into Integer-based Score
Phoenix Sepsis Score
Select binary thresholds of the Phoenix Sepsis Score for sepsis and septic shock
Phoenix sepsis and septic shock criteria

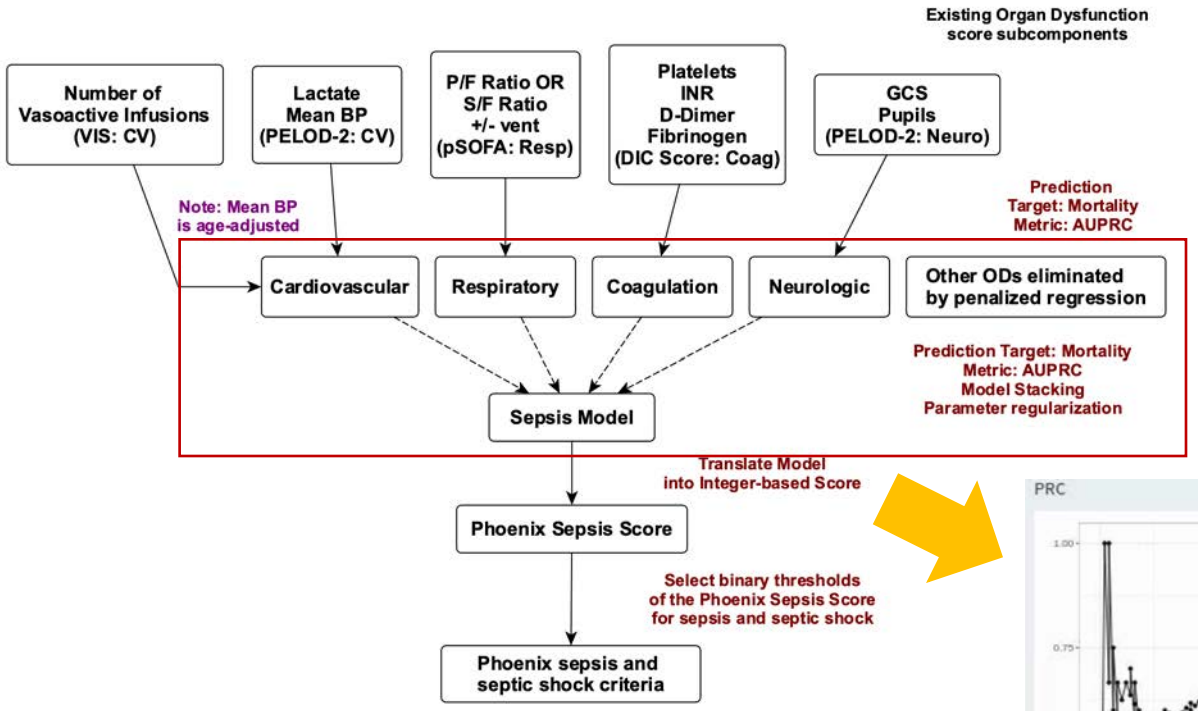
Step 1: Identify the best* organ dysfunction subcomponents of existing scores



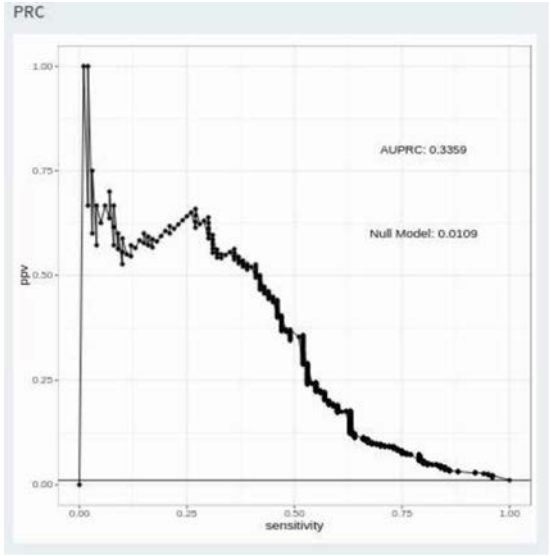
Organ system	Organ Dysfunction Score/Criteria							
	IPSCC	PELOD-2	PODIUM	Proulx	pSOFA	DIC	VIS	SI
Cardiovascular	X	X	X	X	X		X	X
Respiratory	X	X	X	X	X			
Neurological	X	X	X	X	X			
Renal	X	X	X	X	X			
Hepatic	X		X	X	X			
Heme/Coag	X	X	X	X	X	X		
Immunologic			X					
Endocrine			X					

*best = predicting mortality in infected vs. non-infected patients in <24h

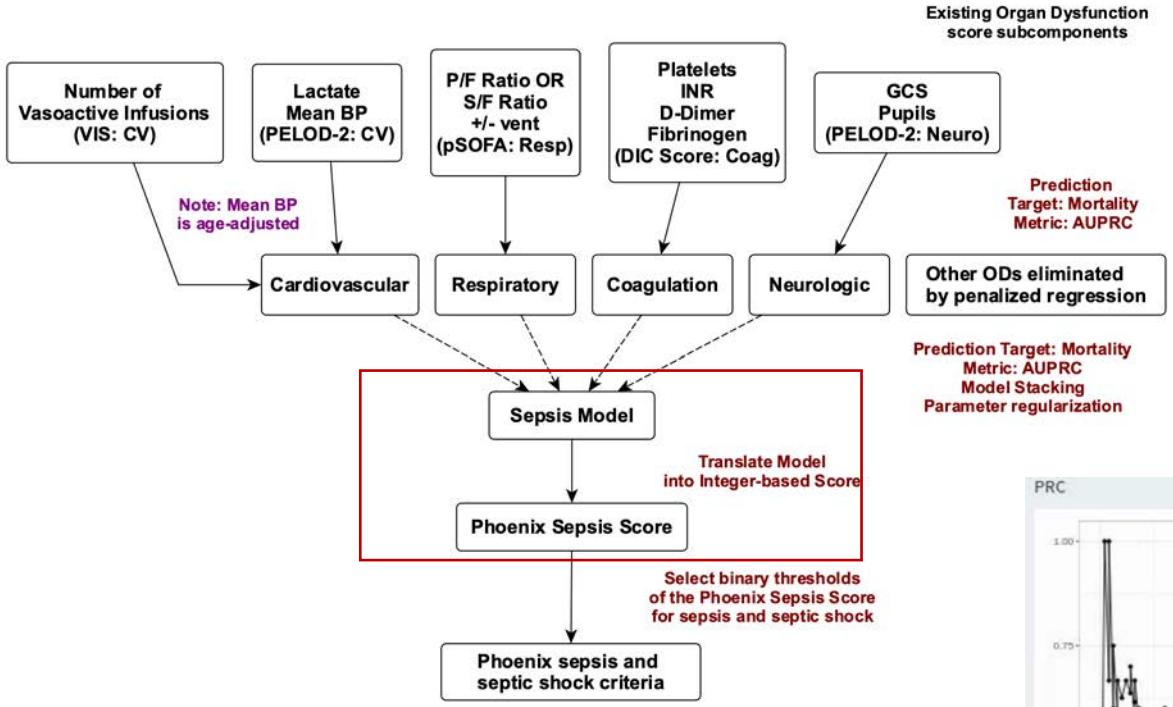
Step 2: Build sepsis models using a machine learning approach

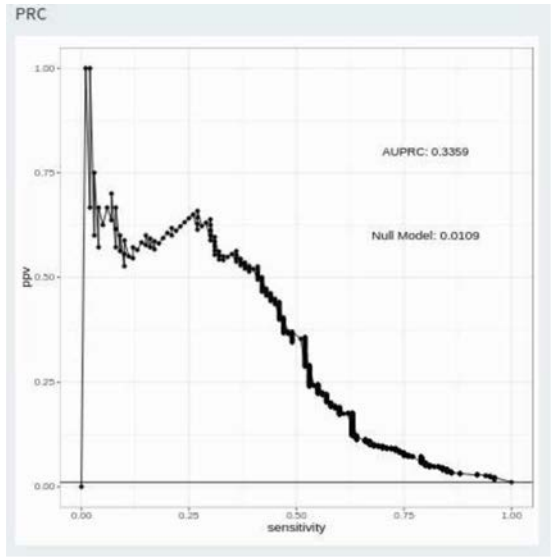


- Using the best OD subcomponents
- Stacked regression (ML) models (ridge, LASSO, elastic net)
- Predict mortality among those with suspected infection



Step 3: Translate best model into integer score

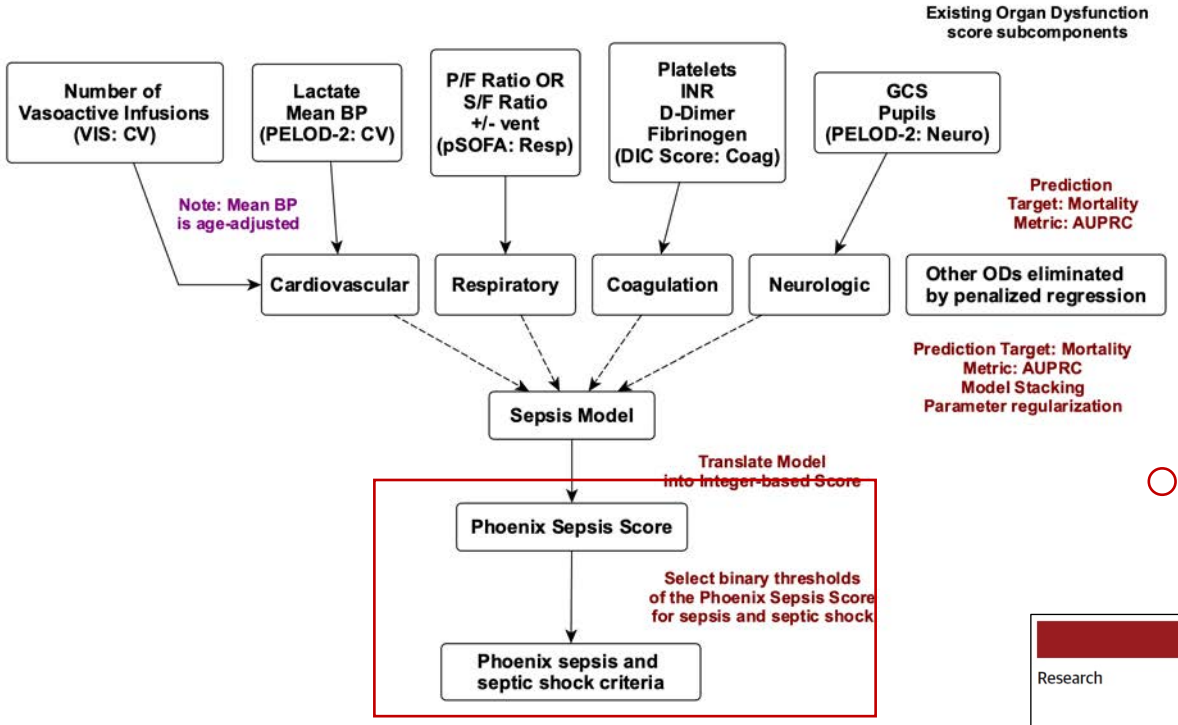




	1 point	2 points	3 points
Respiratory (0-3 points)	P/F <400 or S/F <292	P/F 101-200 and MV or S/F 149-220 and MV	P/F <100 and MV or S/F <148 and MV
Cardiovascular (0-6 points)	1 point each (up to 3 points) for: 1 Vaso-inotrope inf. Lactate 5-10.9 mmol/L Age-based MAP (mmHg) <1 mo. 17-30 1-11 mo. 25-38 12-23 mo. 31-43 24-59 mo. 32-44 60-143 mo. 36-48 144-216 mo. 38-51	2 points each (up to 6 points) for: ≥2 Vaso-inotrope inf. Lactate ≥11 mmol/L MAP (mmHg) <17 <25 <31 <32 <36 <38	
Coagulation (0-2 points)	1 point each (max. 2 points) for: Platelets <100 K/µL INR >1.3 D-Dimer >2 mg/L Fibrinogen <100 mg/dL		
Neurologic (0-2 points)	GCS ≤10	Fixed pupils	

- Grid search
- Category collapse when no effect on performance

Step 4: Select binary thresholds for new sepsis and septic shock criteria



	1 point	2 points	3 points
Respiratory (0-3 points)	P/F <400 or S/F <292	P/F 101-200 and MV or S/F 149-220 and MV	P/F <100 and MV or S/F <148 and MV
Cardiovascular (0-6 points)	1 point each (up to 3 points) for:	2 points each (up to 6 points) for:	
	1 Vaso-inotrope inf.	≥2 Vaso-inotrope inf.	
	Lactate 5-10.9 mmol/L	Lactate ≥11 mmol/L	
	Age-based MAP (mmHg)	MAP (mmHg)	
	<1 mo. 17-30	<17	
	1-11 mo. 25-38	<25	
	12-23 mo. 31-43	<31	
	24-59 mo. 32-44	<32	
	60-143 mo. 36-48	<36	
	144-216 mo. 38-51	<38	
Coagulation (0-2 points)	1 point each (max. 2 points) for:		
	Platelets <100 K/μL		
	INR >1.3		
	D-Dimer >2 mg/L		
	Fibrinogen <100 mg/dL		
Neurologic (0-2 points)	GCS ≤10	Fixed pupils	

- Task Force Delphi process

Research

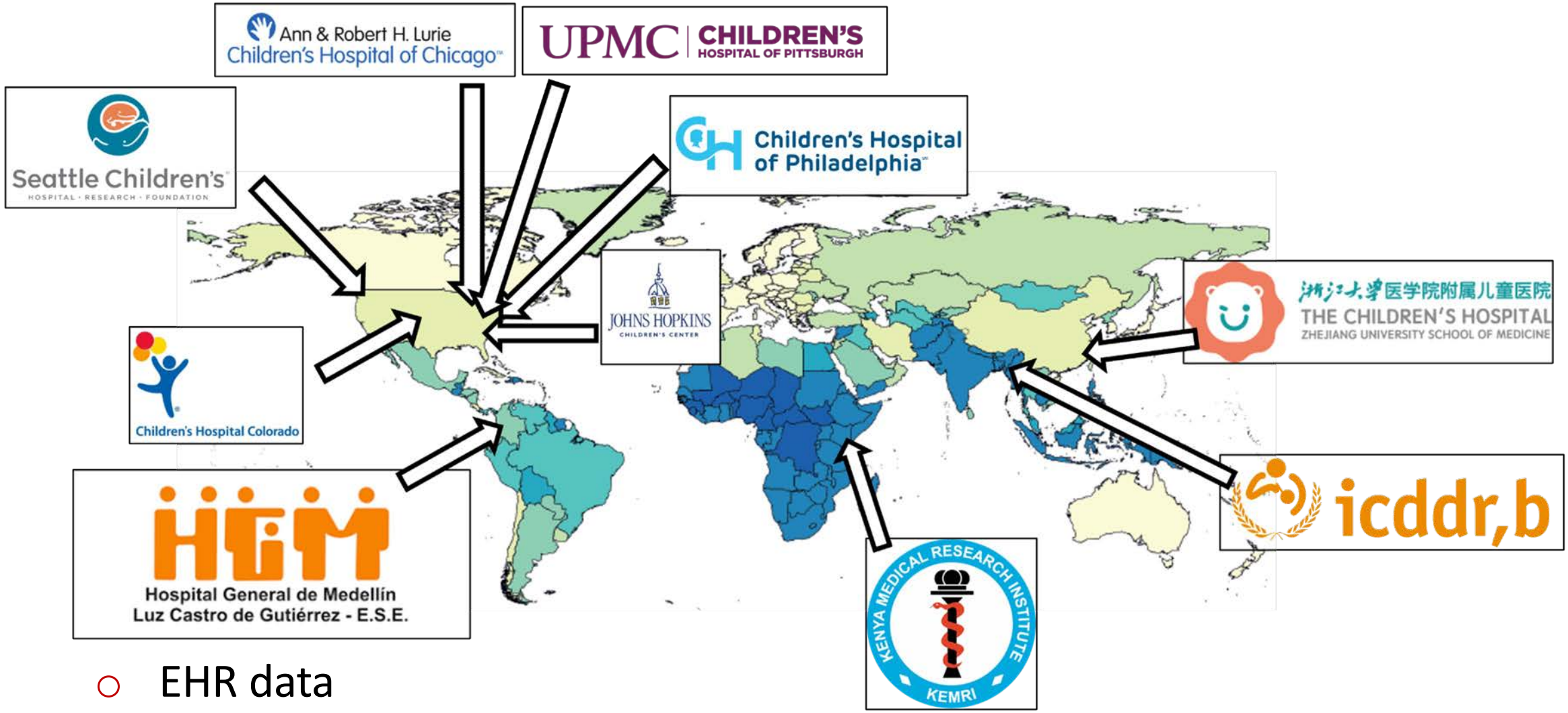
JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

International Consensus Criteria for Pediatric Sepsis and Septic Shock

Luregn J. Schlapbach, MD, PhD; R. Scott Watson, MD, MPH; Lauren R. Sorce, PhD, RN; Andrew C. Argent, MD, MBBCh, MMed; Kusum Menon, MD, MSc; Mark W. Hall, MD; Samuel Akech, MBChB, MMED, PhD; David J. Albers, PhD; Elizabeth R. Alpern, MD, MSCE; Fran Balamuth, MD, PhD, MSCE; Melania Bembea, MD, PhD; Paolo Biban, MD; Enitan D. Carrol, MBChB, MD; Kathleen Chiotos, MD; Mohammod Jobayer Chisti, MBBS, MMed, PhD; Peter E. DeWitt, PhD; Idris Evans, MD, MSc; Cláudio Flauzino de Oliveira, MD, PhD; Christopher M. Horvat, MD, MHA; David Inwald, MB, PhD; Paul Ishimine, MD; Juan Camilo Jaramillo-Bustamante, MD; Michael Levin, MD, PhD; Rakesh Lodha, MD; Blake Martin, MD; Simon Nadel, MBBS; Satoshi Nakagawa, MD; Mark J. Peters, PhD; Adrienne G. Randolph, MD, MS; Suchitra Ranjit, MD; Margaret N. Rebull, MA; Seth Russell, MS; Halden F. Scott, MD; Daniela Carla de Souza, MD, PhD; Pierre Tissieres, MD, DSc; Scott L. Weiss, MD, MSCE; Matthew O. Wiens, PharmD, PhD; James L. Wynn, MD; Niranjan Kissoon, MD; Jerry J. Zimmerman, MD, PhD; L. Nelson Sanchez-Pinto, MD; Tellen D. Bennett, MD, MS; for the Society of Critical Care Medicine Pediatric Sepsis Definition Task Force

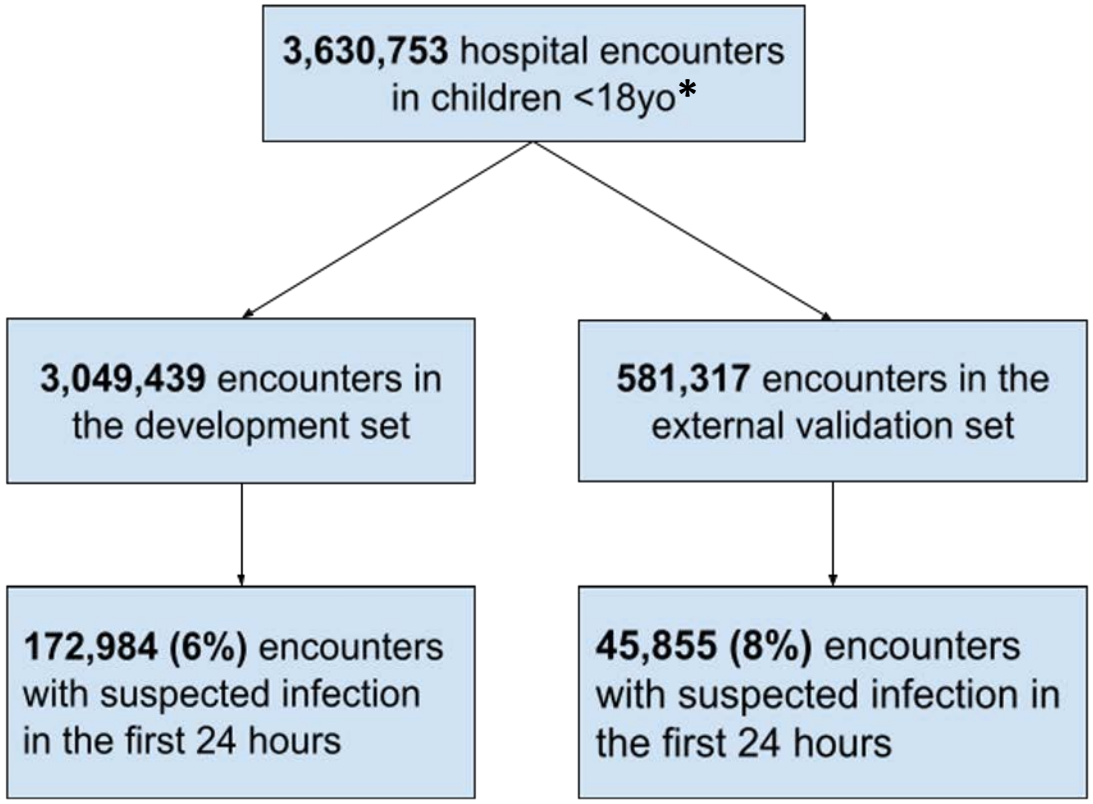
Results

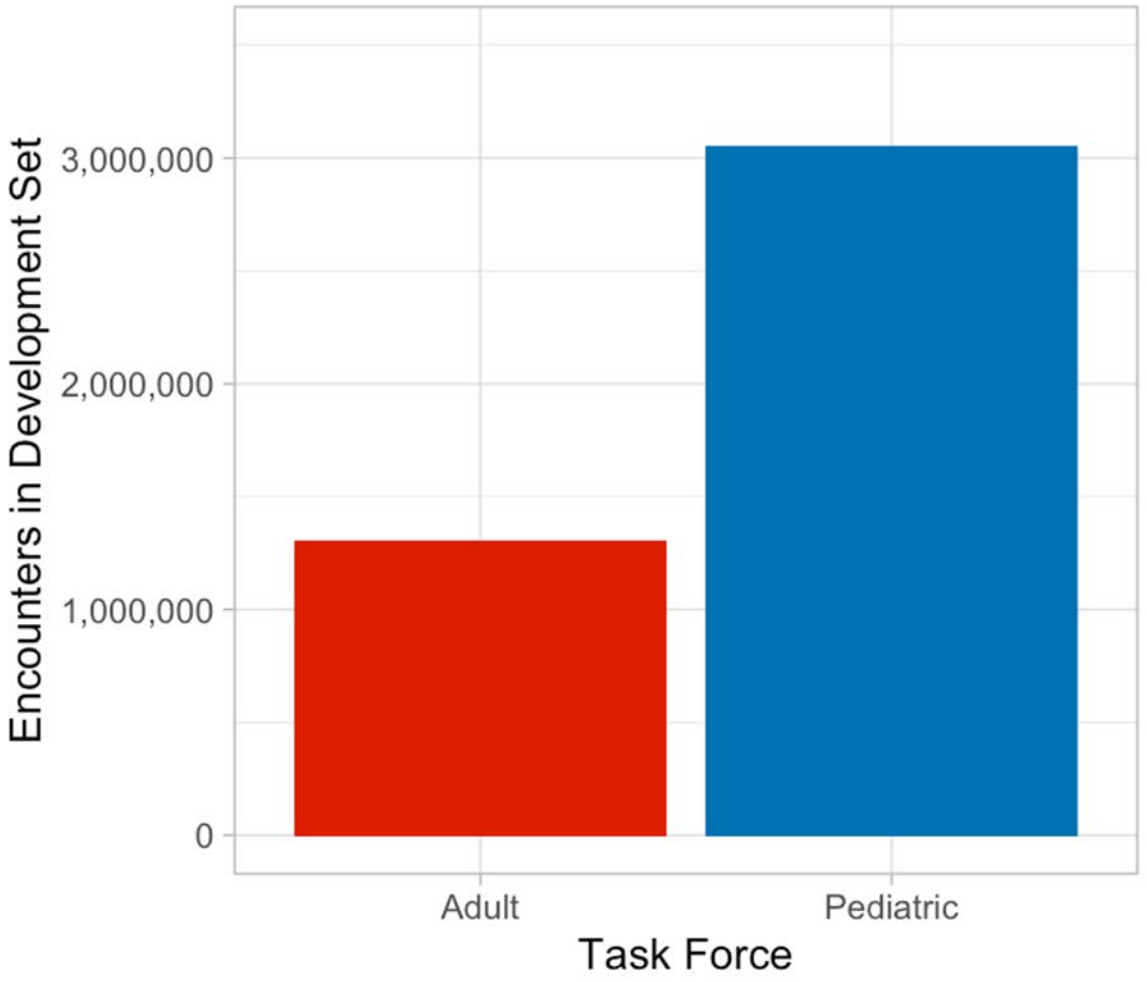
10 study sites: 6 higher and 4 lower resource settings



- EHR data
- Date range 2010-2019

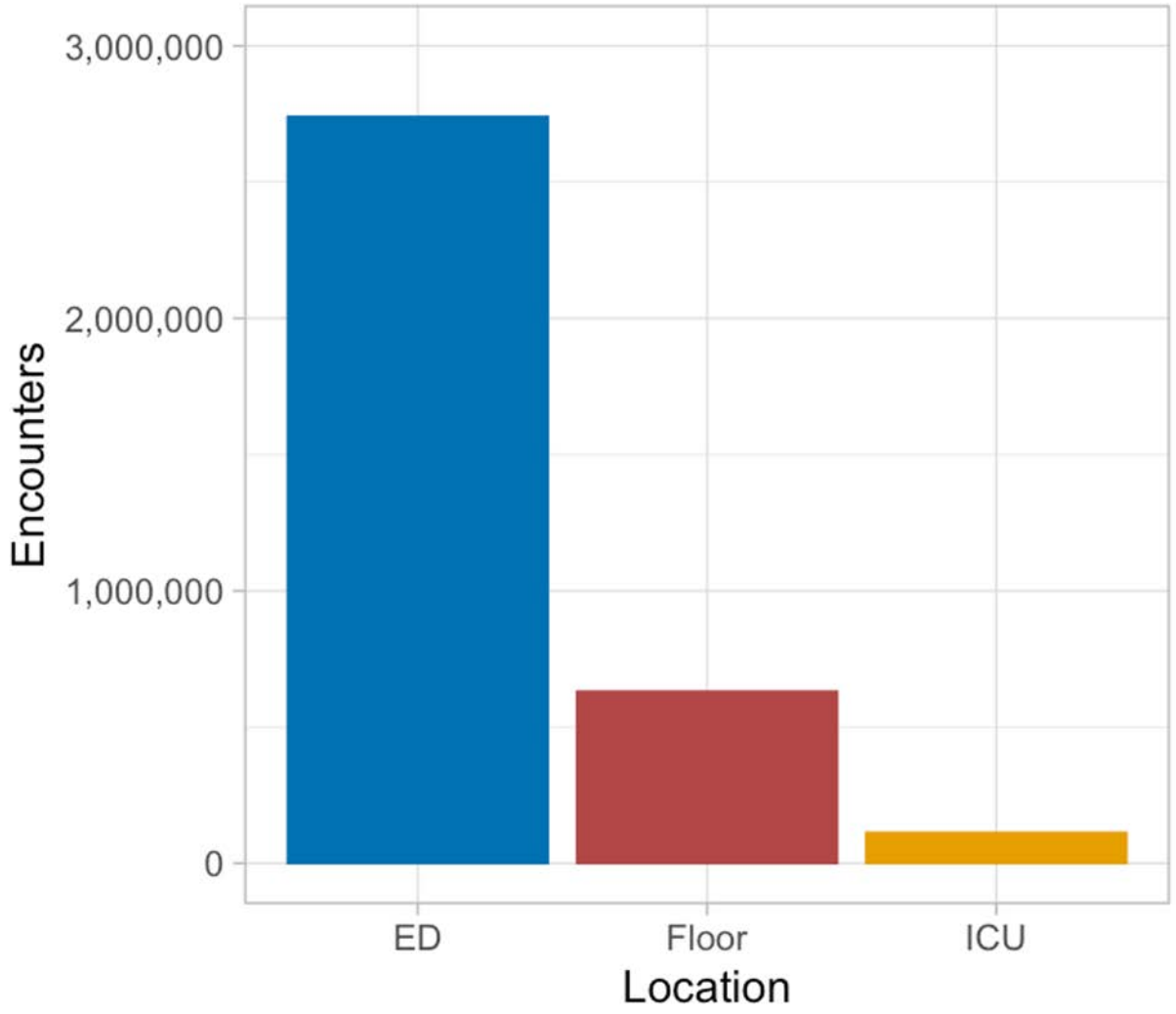
Cohort size: >3.6 million pediatric hospital encounters



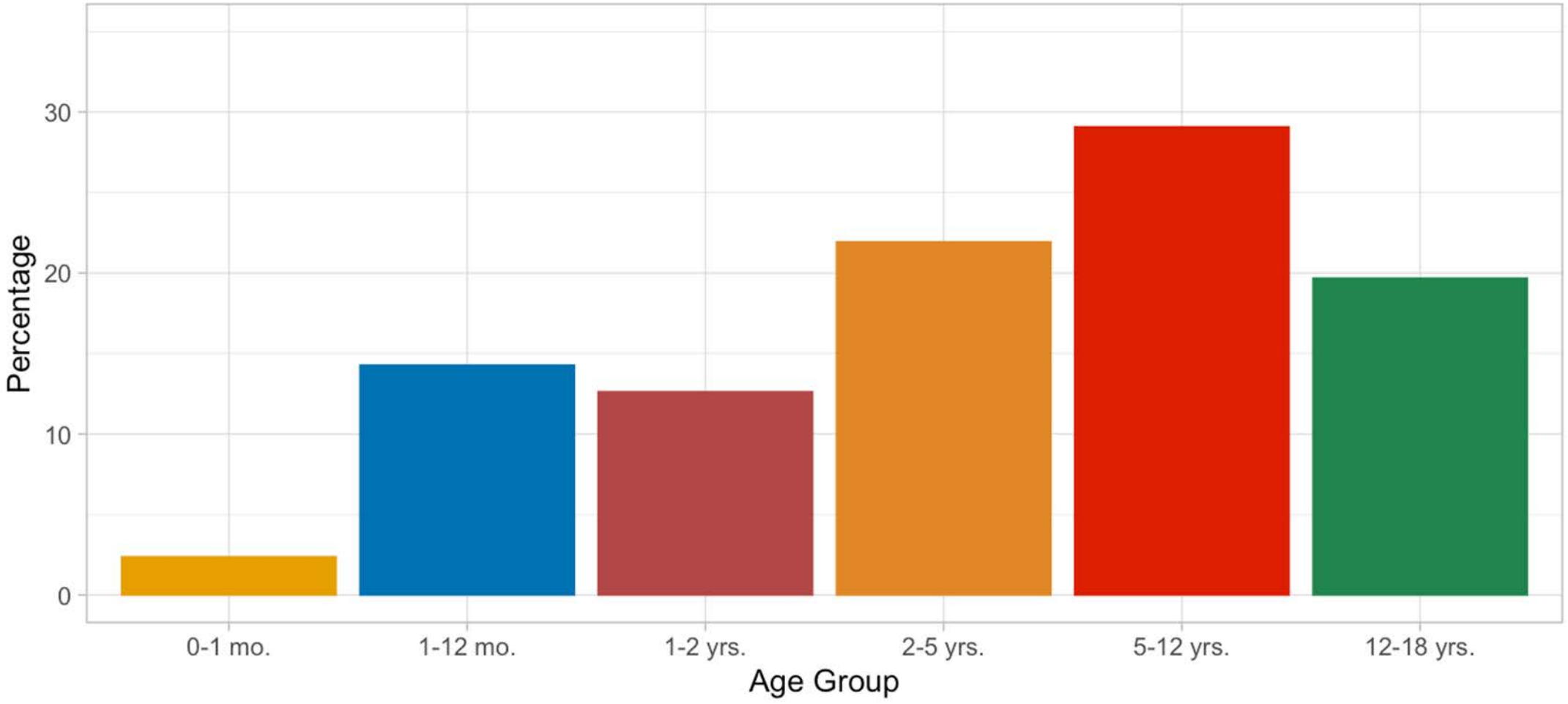


*excluded birth hospitalization and post-conception age <37wks

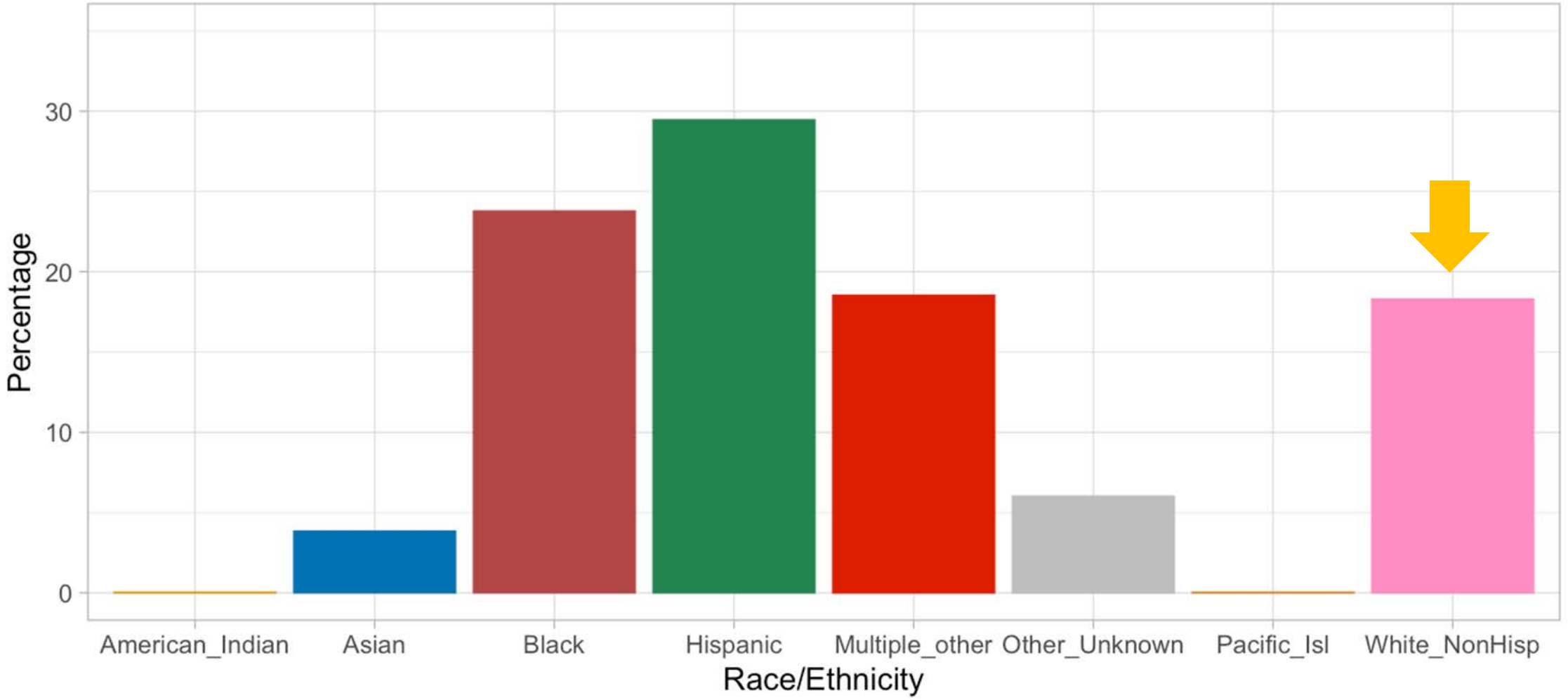
Not just ICU: Data representing the hospital care continuum



Representative population: adequate age distribution

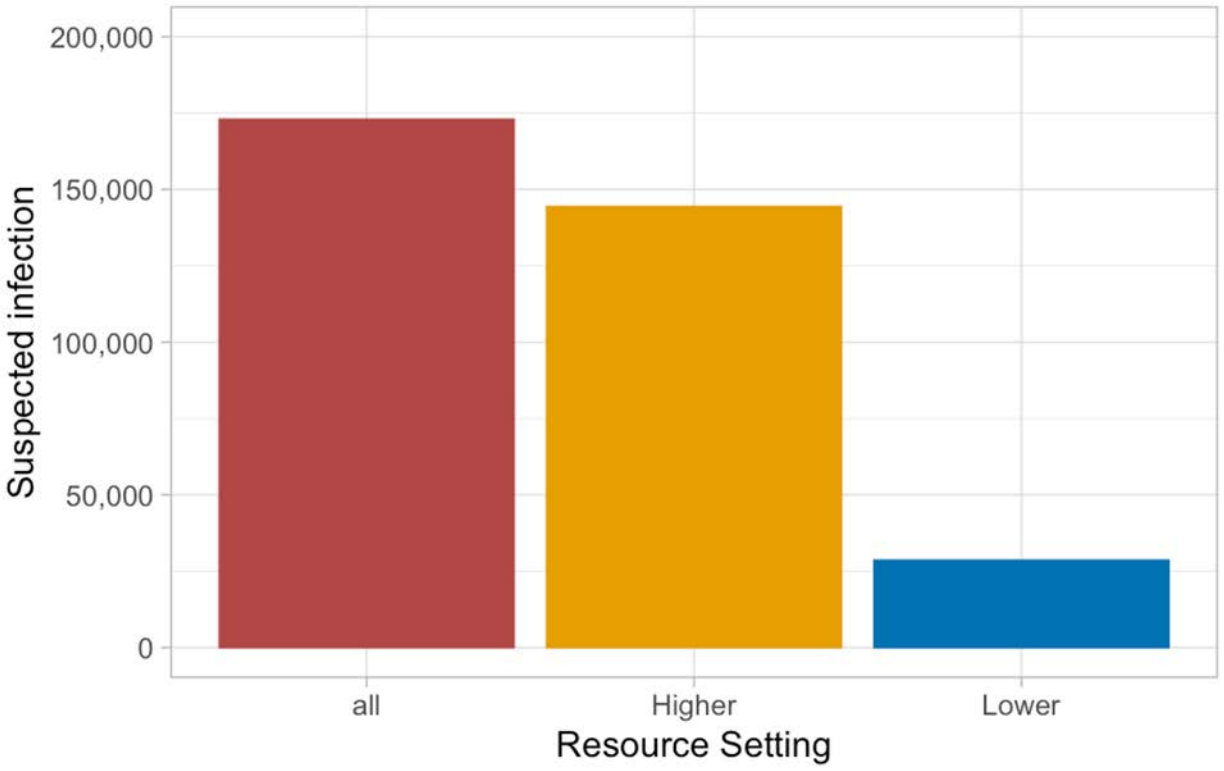


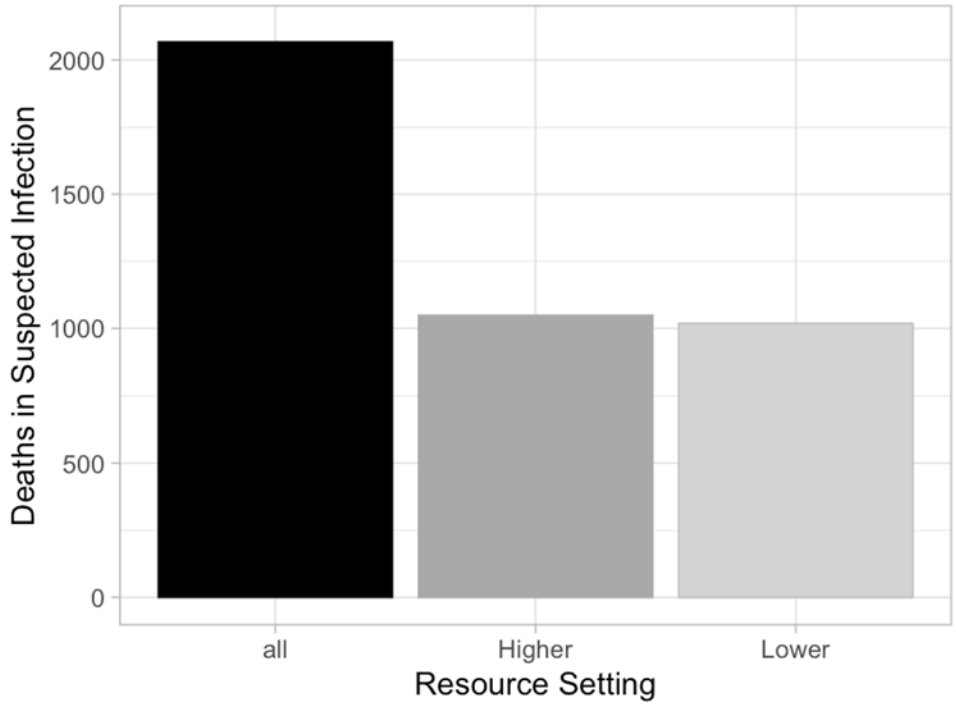
Representative population: diverse Race and Ethnicity



Note = At most international sites, NIH categories are not meaningful

Suspected infection*: higher total N in higher resource settings, but similar number of absolute deaths (primary outcome)





*combination of antimicrobials and microbiologic test in first 24 hours of admission

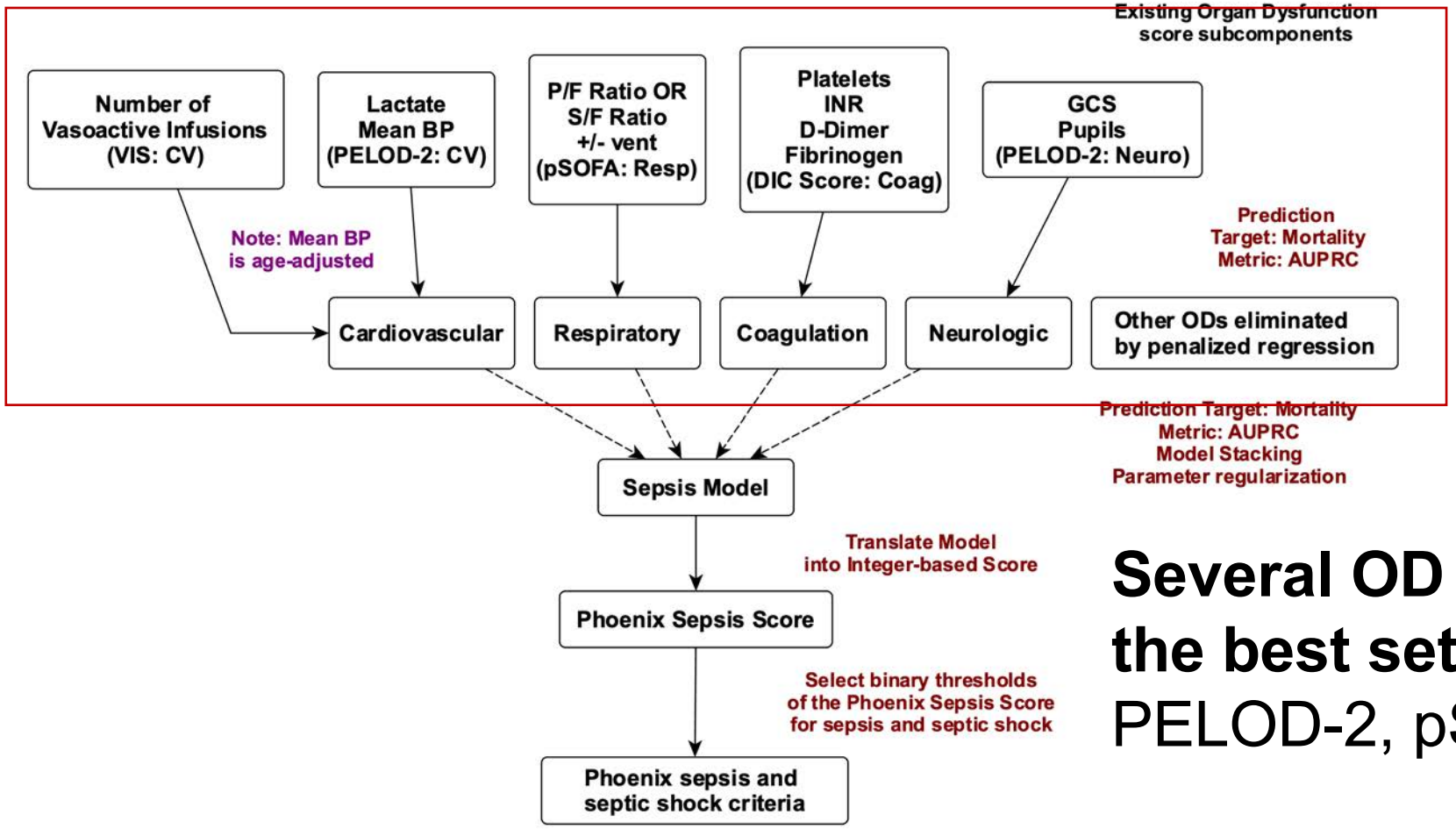
Step 1 Results: Identified the best* organ dysfunction subcomponents of existing scores

(*best = predicting mortality in infected vs. non-infected patients)

Example: Cardiovascular

Organ System	Criteria (first 24 hours)	Mean AUPRC	AUPRC 95% CI	Mean AUROC	AUROC 95% CI
Cardiovascular	IPSCC	0.017	(0.016, 0.018)	0.773	(0.769, 0.777)
Cardiovascular	**PELOD-2***	0.131	(0.128, 0.135)	0.746	(0.742, 0.750)
Cardiovascular	PODIUM	0.047	(0.045, 0.049)	0.720	(0.716, 0.725)
Cardiovascular	Proulx	0.044	(0.042, 0.046)	0.737	(0.733, 0.741)
Cardiovascular	pSOFA	0.063	(0.061, 0.065)	0.780	(0.776, 0.784)
Cardiovascular	Shock Index	0.012	(0.011, 0.013)	0.673	(0.668, 0.677)
Cardiovascular	Vasoactive inotrope score	0.108	(0.105, 0.111)	0.731	(0.727, 0.735)
Cardiovascular	**Vasoactive medication count***	0.135	(0.132, 0.138)	0.712	(0.708, 0.717)

Step 1 Results: Identified the best organ dysfunction subcomponents of existing scores

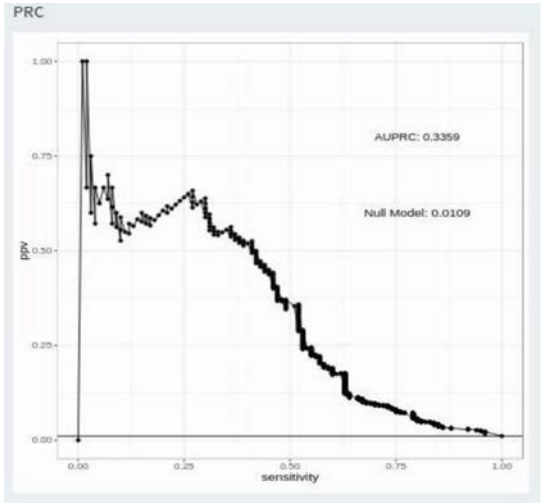


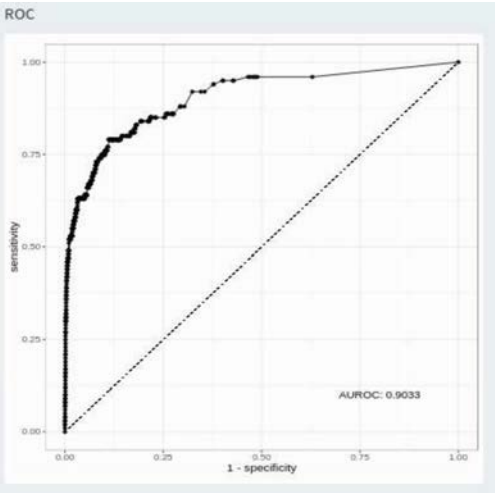
Several OD scores represented in the best set of subcomponents:
PELOD-2, pSOFA, DIC score, VIS

Step 2 Results: Sepsis models based on stacked regression

Ridge-based sepsis model

8 organs: CV, Resp, Coag, Neuro, Endo, Renal, Immuno, Hepatic

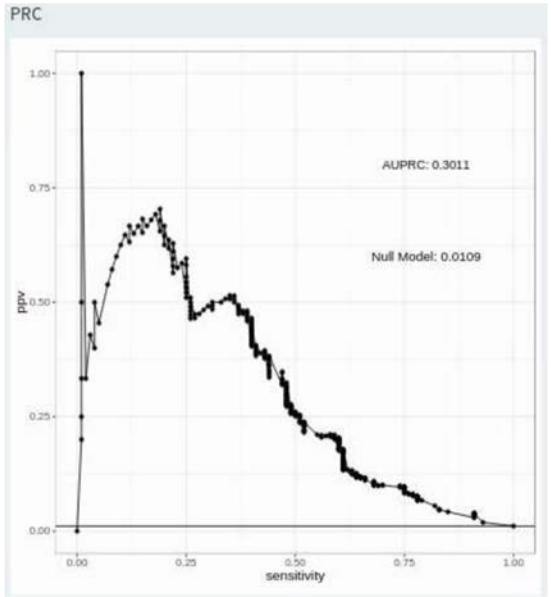


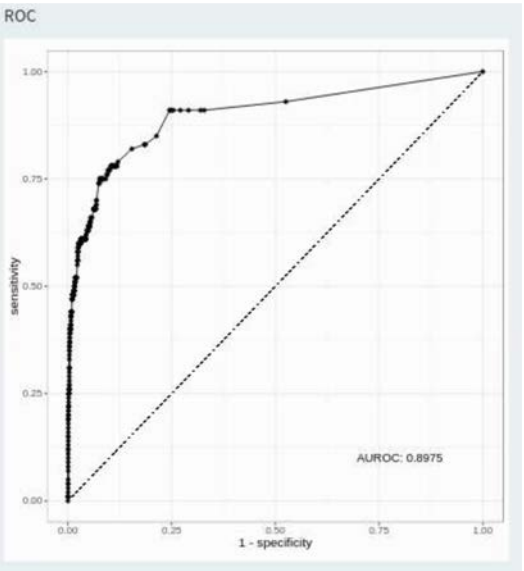


Similar performance by AUPRC and AUROC

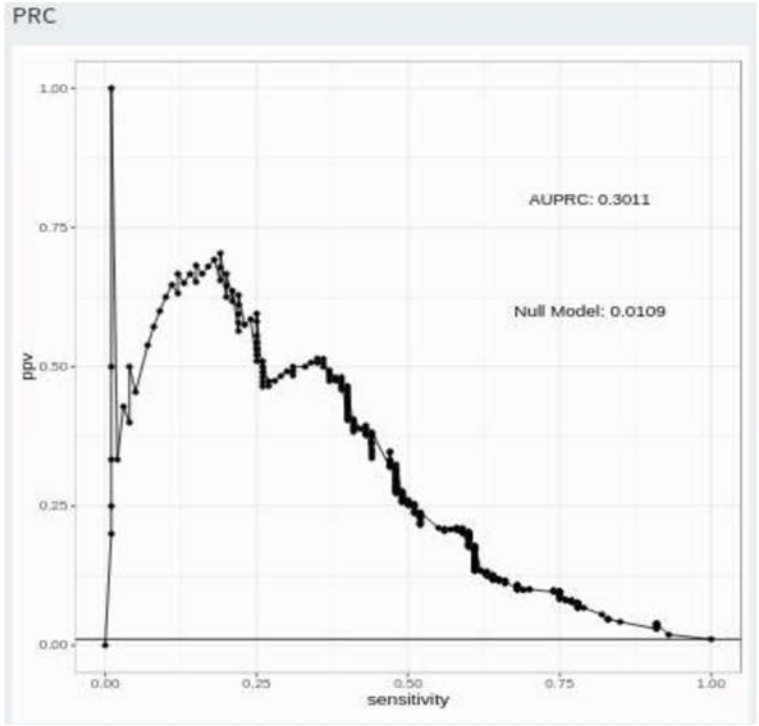
LASSO-based sepsis model

4 organs: CV, Resp, Coag, Neuro





Step 3 Results: Translation of LASSO-based Sepsis Model to Phoenix Sepsis Score



	1 point	2 points	3 points
Respiratory (0-3 points)	P/F <400 or S/F <292	P/F 101-200 and MV or S/F 149-220 and MV	P/F <100 and MV or S/F <148 and MV
Cardiovascular (0-6 points)	1 point each (up to 3 points) for: 1 Vaso-inotrope inf. Lactate 5-10.9 mmol/L Age-based MAP (mmHg) <1 mo. 17-30 1-11 mo. 25-38 12-23 mo. 31-43 24-59 mo. 32-44 60-143 mo. 36-48 144-216 mo. 38-51	2 points each (up to 6 points) for: ≥2 Vaso-inotrope inf. Lactate ≥11 mmol/L MAP (mmHg) <17 <25 <31 <32 <36 <38	
Coagulation (0-2 points)	1 point each (max. 2 points) for: Platelets <100 K/μL INR >1.3 D-Dimer >2 mg/L Fibrinogen <100 mg/dL		
Neurologic (0-2 points)	GCS ≤10	Fixed pupils	

Similar performance by AUPRC and AUROC

Phoenix Sepsis Score

	1 point	2 points	3 points
Respiratory (0-3 points)	P/F <400 or S/F <292	P/F 101-200 and MV or S/F 149-220 and MV	P/F <100 and MV or S/F <148 and MV
Cardiovascular (0-6 points)	1 point each (up to 3 points) for: 1 Vaso-inotrope inf. Lactate 5-10.9 mmol/L Age-based MAP (mmHg) <1 mo. 17-30 1-11 mo. 25-38 12-23 mo. 31-43 24-59 mo. 32-44 60-143 mo. 36-48 144-216 mo. 38-51	2 points each (up to 6 points) for: ≥2 Vaso-inotrope inf. Lactate ≥11 mmol/L MAP (mmHg) <17 <25 <31 <32 <36 <38	
Coagulation (0-2 points)	1 point each (max. 2 points) for: Platelets <100 K/µL INR >1.3 D-Dimer >2 mg/L Fibrinogen <100 mg/dL		
Neurologic (0-2 points)	GCS ≤10	Fixed pupils	

Step 3 Results: Phoenix Sepsis Score's AUPRC and AUROC is higher than other scores in validation sets

A Area under the precision recall curve (AUPRC)

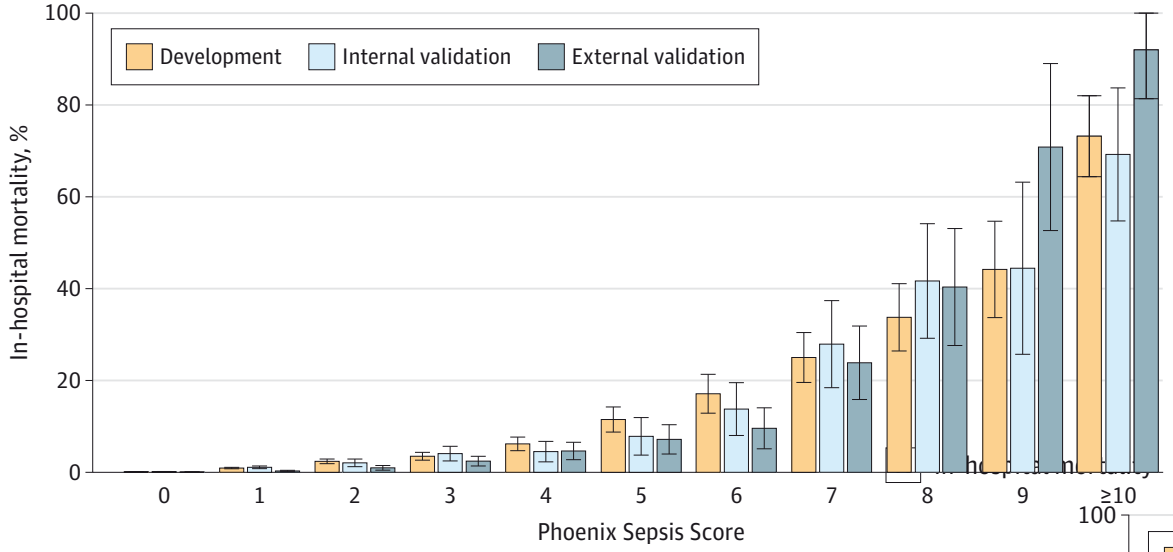
	Internal validation set						
	Phoenix sepsis	IPSCC	Phoenix-8	PELOD-2	pSOFA	Proulx	PODIUM
Higher-resource sites 1-5	0.28 (0.27-0.28)	0.16 (0.16-0.16)	0.28 (0.27-0.28)				
Lower-resource site 1	0.37 (0.35-0.39)	0.18 (0.16-0.20)	0.33 (0.31-0.35)				
Lower-resource site 2	0.31 (0.30-0.32)	0.27 (0.26-0.28)	0.34 (0.32-0.35)				
Higher-resource site 6	0.38 (0.37-0.38)	0.16 (0.15-0.16)	0.37 (0.36-0.37)				
Lower-resource site 3	0.26 (0.24-0.28)	0.15 (0.13-0.16)	0.23 (0.21- 0.24)				
Lower-resource site 4	0.23 (0.22-0.24)	0.13 (0.13-0.14)	0.20 (0.19-0.206)				
All sites (internal and external validation sets)	0.21 (0.20-0.21)	0.12 (0.12-0.12)	0.20 (0.20-0.21)				

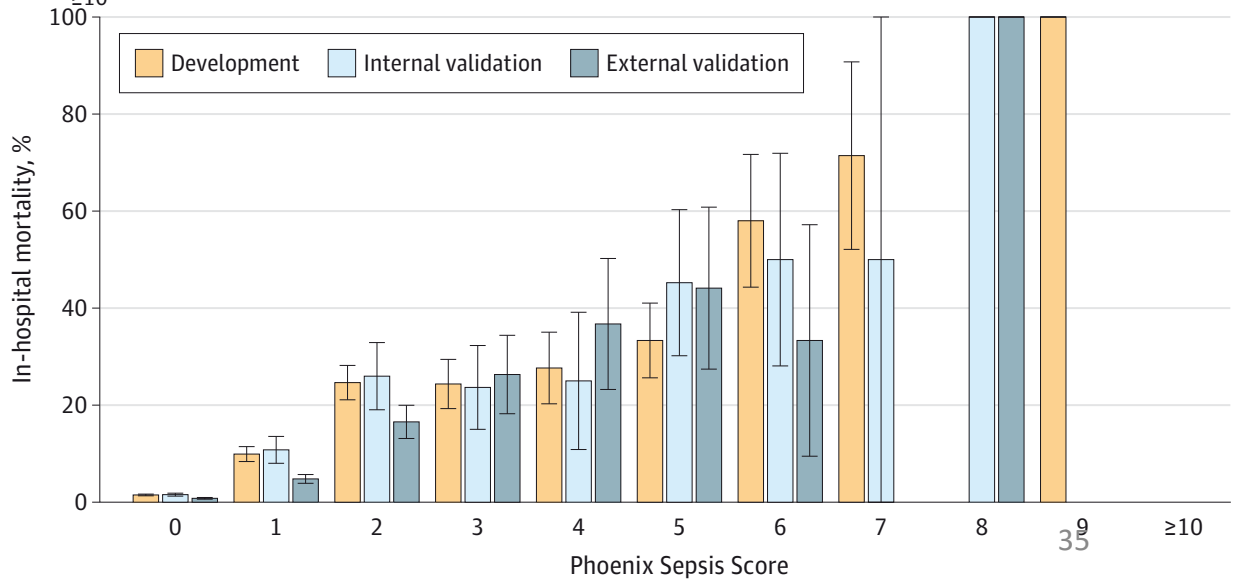
B Area under the receiver operating characteristic curve (AUROC)

	Internal validation set						
	Phoenix sepsis	IPSCC	Phoenix-8	PELOD-2	pSOFA	Proulx	
Higher-resource sites 1-5	0.88 (0.88-0.88)	0.88 (0.88-0.88)	0.91 (0.90-0.91)	0.86 (0.86-0.87)	0.90 (0.89-0.90)	0.86 (0.85-0.86)	0.8
Lower-resource site 1	0.91 (0.90-0.92)	0.85 (0.83-0.86)	0.90 (0.89-0.91)	0.84 (0.83-0.86)	0.89 (0.87-0.90)	0.90 (0.89-0.91)	0.7
Lower-resource site 2	0.71 (0.70-0.72)	0.78 (0.77-0.80)	0.85 (0.84-0.86)	0.78 (0.77- 0.79)	0.83 (0.82-0.84)	0.72 (0.70-0.73)	0.7
	External validation set						
Higher-resource site 6	0.92 (0.92-0.92)	0.91 (0.91-0.92)	0.94 (0.94-0.94)	0.92 (0.92-0.92)	0.93 (0.93-0.93)	0.91 (0.91-0.91)	0.9
Lower-resource site 3	0.81 (0.80-0.83)	0.76 (0.74-0.78)	0.78 (0.76-0.79)	0.70 (0.67-0.71)	0.73 (0.71-0.75)	0.71 (0.69-0.73)	0.7
Lower-resource site 4	0.80 (0.79-0.81)	0.81 (0.80-0.81)	0.80 (0.79-0.80)	0.73 (0.72-0.74)	0.82 (0.81- 0.83)	0.74 (0.73-0.75)	0.7
All sites (internal and external validation sets)	0.82 (0.82-0.83)	0.83 (0.83-0.84)	0.87 (0.87-0.87)	0.80 (0.80-0.81)	0.86 (0.86-0.87)	0.81 (0.81-0.81)	0.8

Step 3 Results: Phoenix Sepsis Score has good calibration in higher and lower resource sites

A In-hospital mortality





Step 4 Results: Translation of Phoenix Sepsis Score to Phoenix sepsis/Septic shock criteria selecting thresholds

	1 point	2 points	3 points
Respiratory (0-3 points)	P/F <400 or S/F <292	P/F 101-200 and MV or S/F 149-220 and MV	P/F <100 and MV or S/F <148 and MV
Cardiovascular (0-6 points)	1 point each (up to 3 points) for:	2 points each (up to 6 points) for:	
	1 Vaso-inotrope inf.	≥2 Vaso-inotrope inf.	
	Lactate 5-10.9 mmol/L	Lactate ≥11 mmol/L	
Age-based	MAP (mmHg)	MAP (mmHg)	
<1 mo.	17-30	<17	
1-11 mo.	25-38	<25	
12-23 mo.	31-43	<31	
24-59 mo.	32-44	<32	
60-143 mo.	36-48	<36	
144-216 mo.	38-51	<38	
Coagulation (0-2 points)	1 point each (max. 2 points) for:		
	Platelets <100 K/μL		
	INR >1.3		
	D-Dimer >2 mg/L		
	Fibrinogen <100 mg/dL		
Neurologic (0-2 points)	GCS ≤10	Fixed pupils	

Task Force Delphi process:

- **Sepsis**: **≥ 2 points** on Phoenix Sepsis Score
- **Septic Shock**: Sepsis and **≥ 1 CV point**

Research

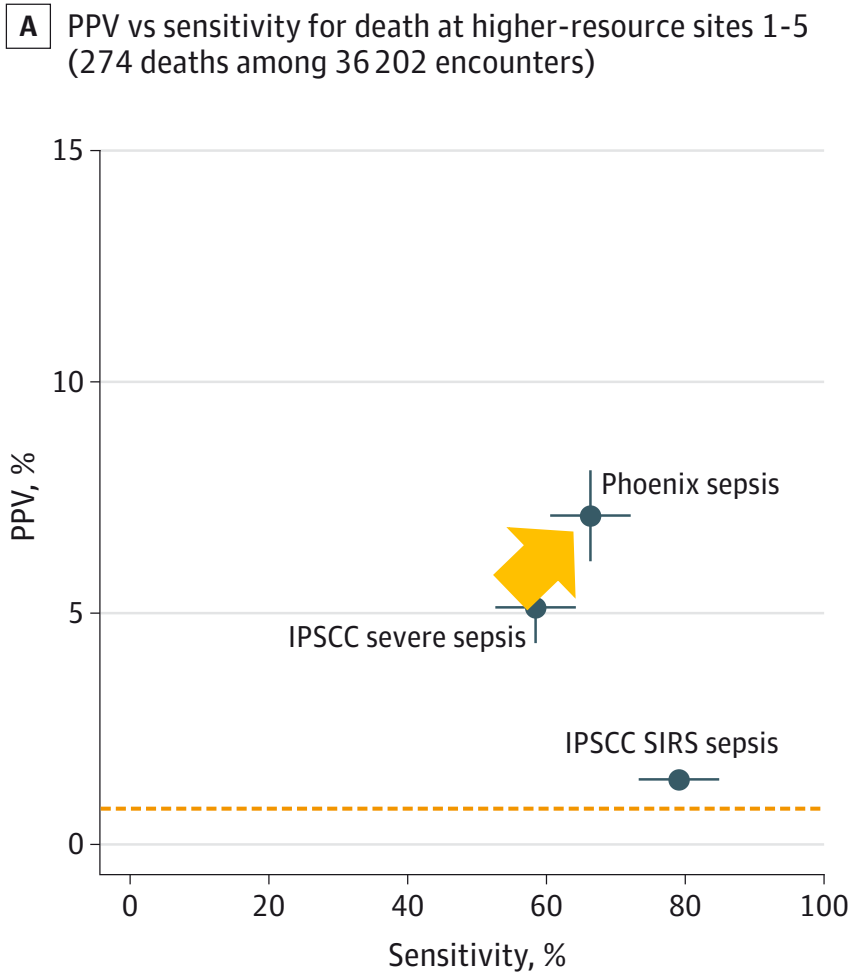
JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

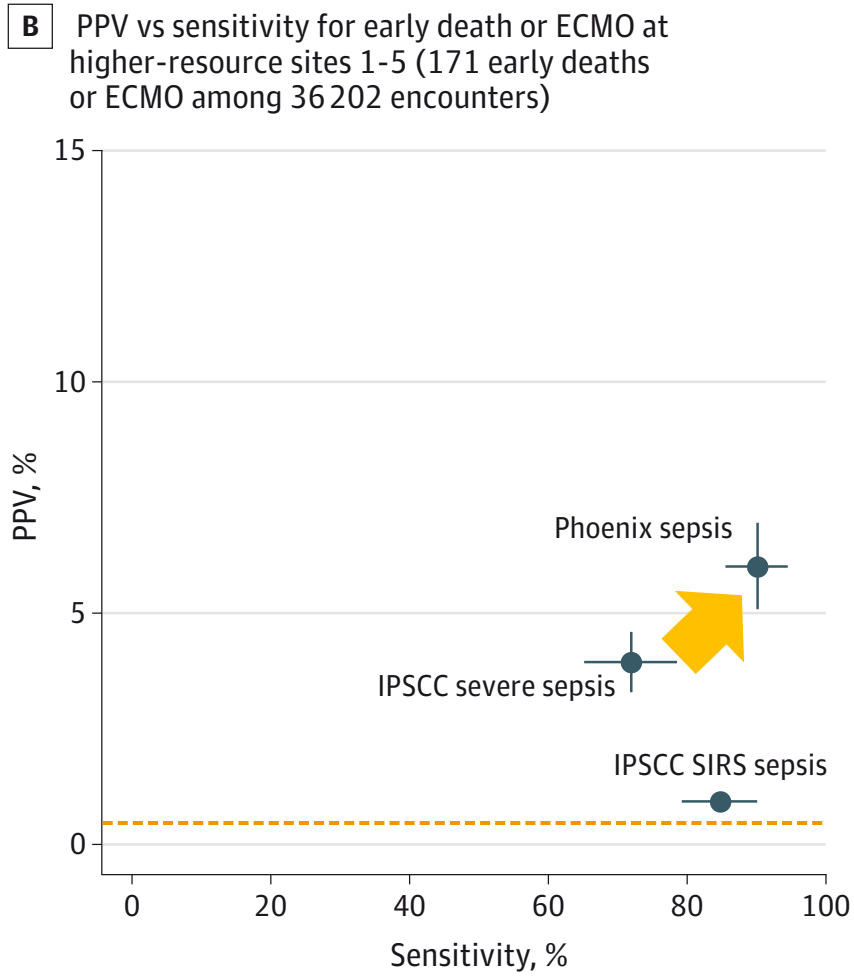
International Consensus Criteria for Pediatric Sepsis and Septic Shock

Luregn J. Schlapbach, MD, PhD; R. Scott Watson, MD, MPH; Lauren R. Sorce, PhD, RN; Andrew C. Argent, MD, MBBCh, MMed; Kusum Menon, MD, MSc; Mark W. Hall, MD; Samuel Akech, MBChB, MMED, PhD; David J. Albers, PhD; Elizabeth R. Alpern, MD, MSCE; Fran Balamuth, MD, PhD, MSCE; Melania Bembea, MD, PhD; Paolo Biban, MD; Enitan D. Carrol, MBChB, MD; Kathleen Chiotos, MD; Mohammod Jobayer Chisti, MBBS, MMed, PhD; Peter E. DeWitt, PhD; Idris Evans, MD, MSc; Cláudio Flauzino de Oliveira, MD, PhD; Christopher M. Horvat, MD, MHA; David Inwald, MB, PhD; Paul Ishimine, MD; Juan Camilo Jaramillo-Bustamante, MD; Michael Levin, MD, PhD; Rakesh Lodha, MD; Blake Martin, MD; Simon Nadel, MBBS; Satoshi Nakagawa, MD; Mark J. Peters, PhD; Adrienne G. Randolph, MD, MS; Suchitra Ranjit, MD; Margaret N. Rebull, MA; Seth Russell, MS; Halden F. Scott, MD; Daniela Carla de Souza, MD, PhD; Pierre Tissieres, MD, DSc; Scott L. Weiss, MD, MSCE; Matthew O. Wiens, PharmD, PhD; James L. Wynn, MD; Niranjan Kissoon, MD; Jerry J. Zimmerman, MD, PhD; L. Nelson Sanchez-Pinto, MD; Tellen D. Bennett, MD, MS; for the Society of Critical Care Medicine Pediatric Sepsis Definition Task Force

Step 4 Results: PPV and Sensitivity for Phoenix sepsis criteria are higher than for 2005 IPSCC sepsis criteria

Death

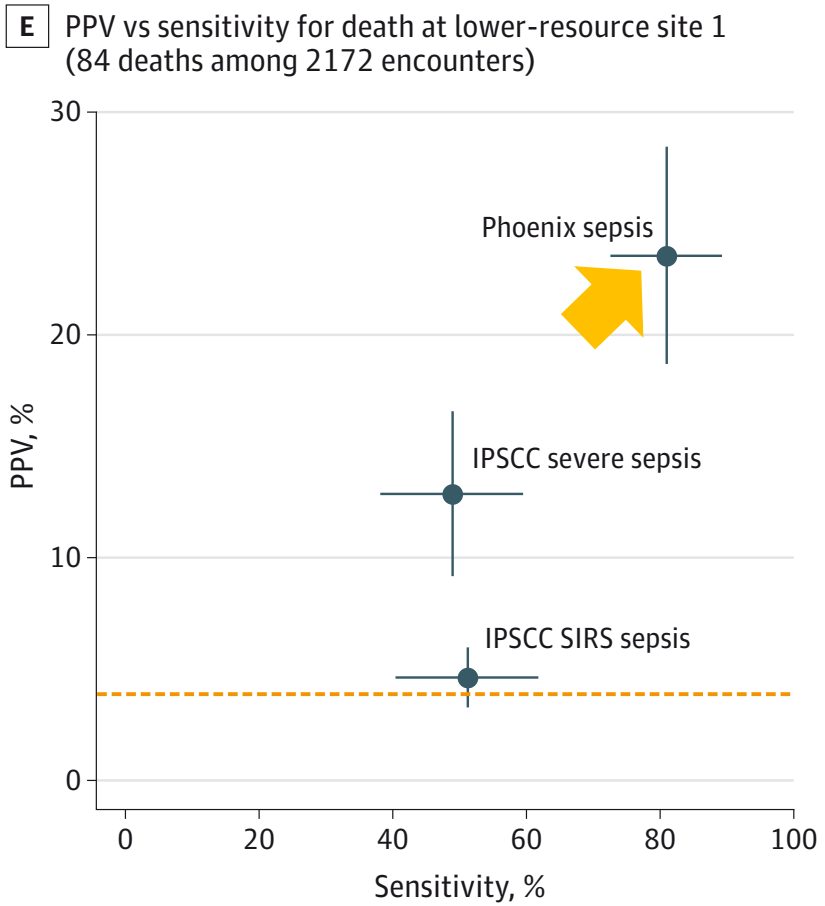




Early death or ECMO

Step 4 Results: PPV and Sensitivity for Phoenix sepsis criteria are higher than for 2005 IPSCC sepsis criteria

Lower Resource Site
(with complete data)

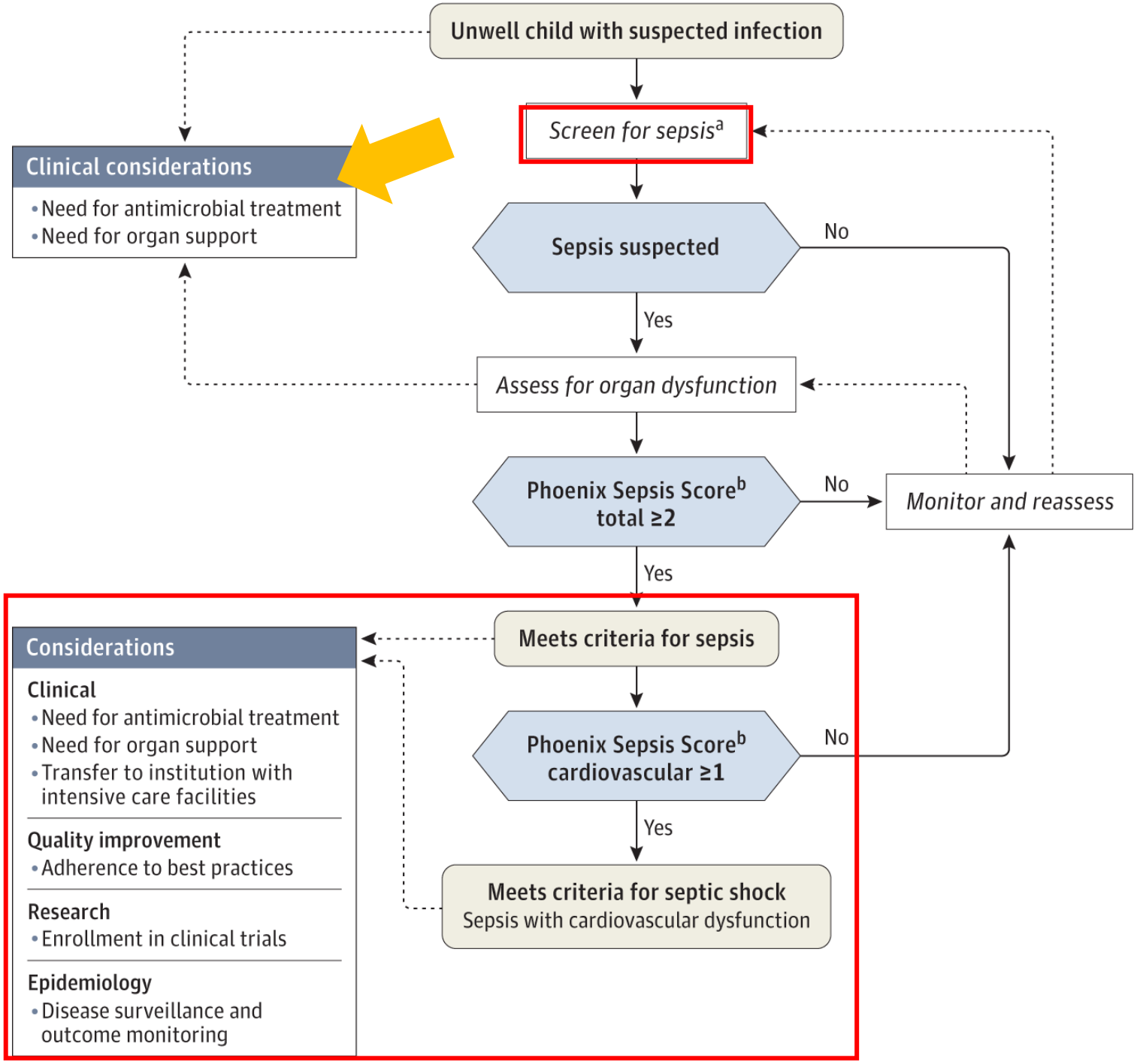


Discussion

Can we use it to screen for possible sepsis?

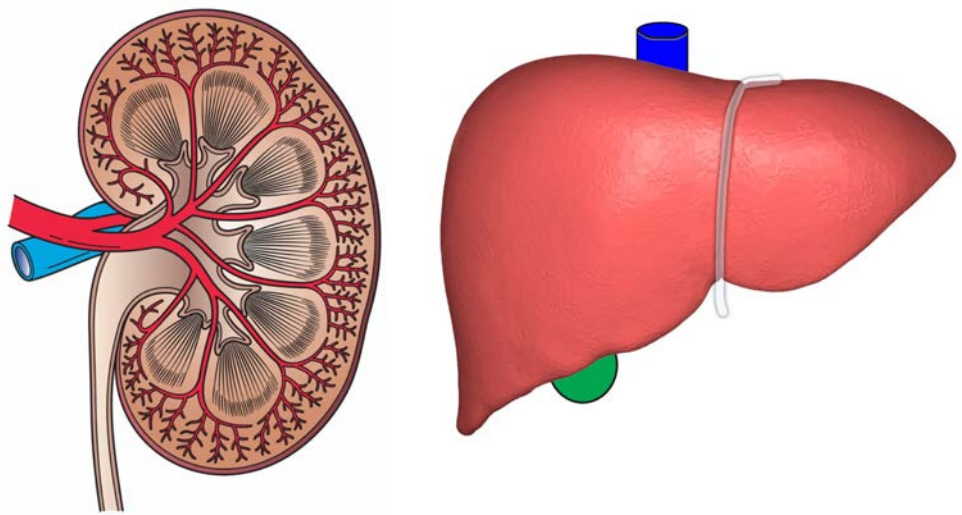
- **Not designed for early screening** but for diagnosis.

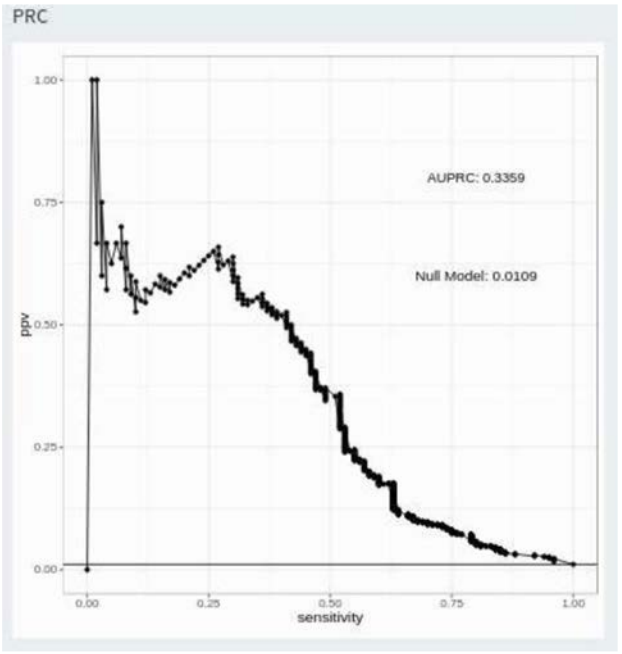
- **Diagnosis** is important for:
  - Clinical best practices
  - QI/Benchmarking
  - Epidemiology
  - Research



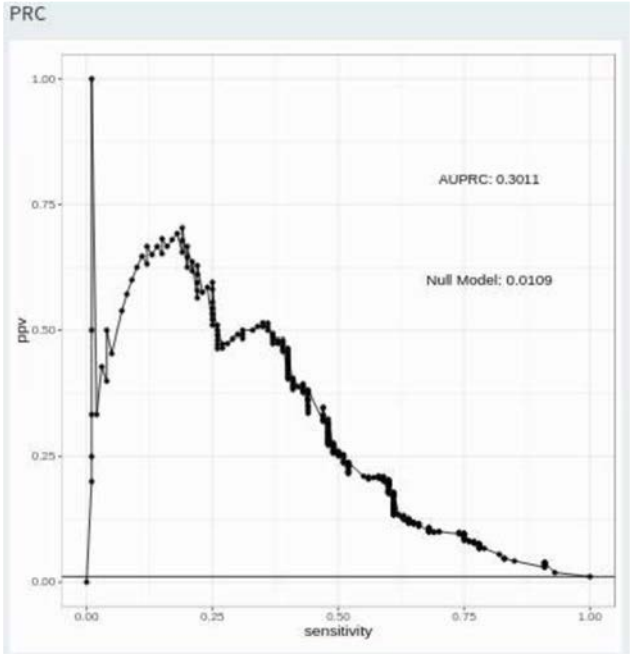
Renal and hepatic dysfunction aren’t important anymore?

- On the contrary! Very important for **management**, **stratification**
- But mortality discrimination equal for 4 vs. 8 organ systems in infected patients (with *current* biomarkers), i.e. for **diagnosis** of sepsis they are not necessary





8 organs models



4 organs models

Renal and hepatic dysfunction aren't important anymore?

- **Phoenix-8 score** also developed (in the Supplement) for research use

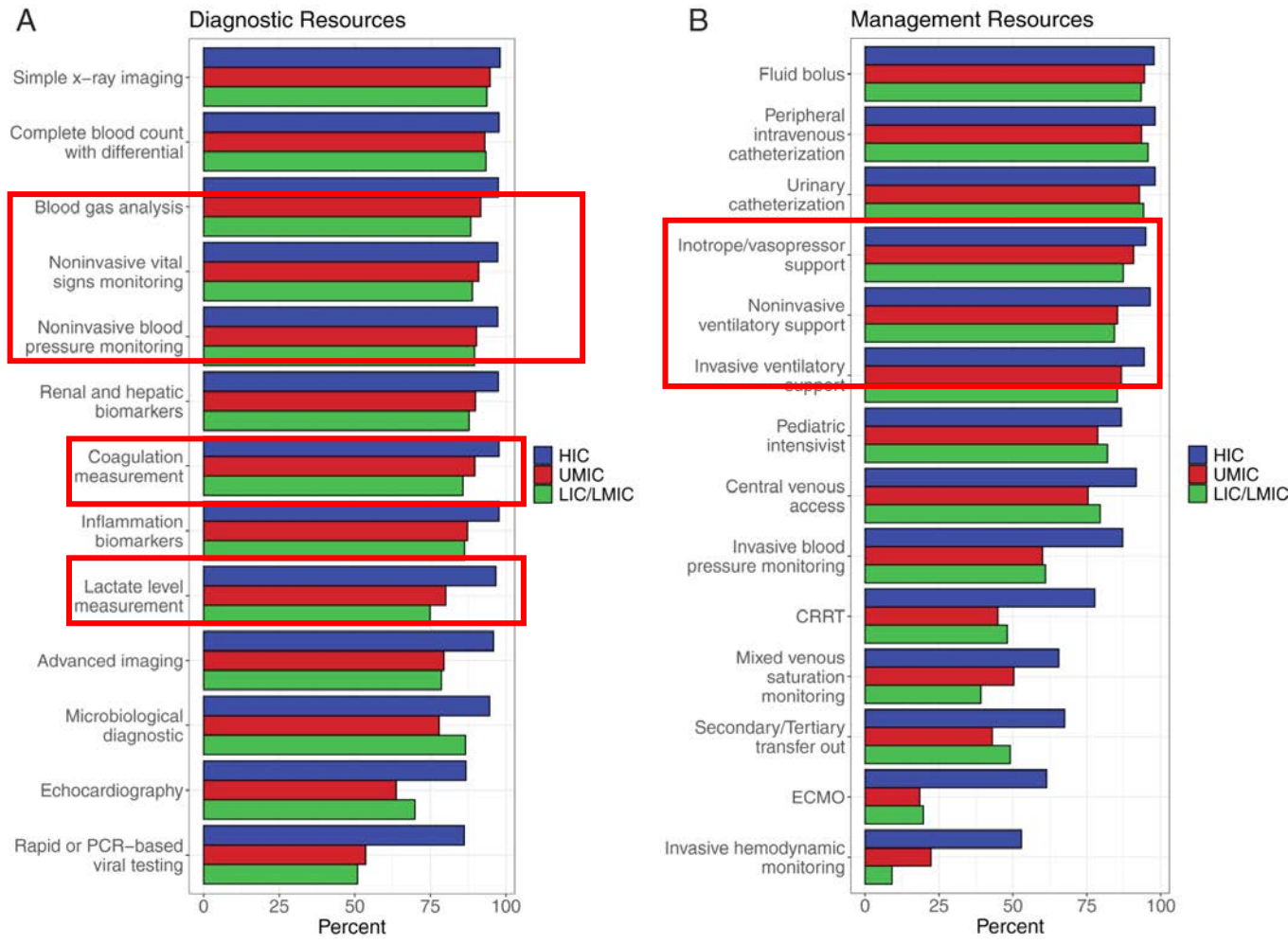
+ Endocrine, Hepatic, Immunologic, and Renal

Endocrine (0-1 point)	Blood glucose <50 or >150 mg/dL		
Immunologic (0-1 point)	ANC <500 and/or ALC <1000 cells/mm^3		
Renal (0-1 point) Age-based <1 mo. 1-11 mo. 12-23 mo. 24-59 mo. 60-143 mo. 144-216 mo.	Creatinine (mg/dL) ≥0.8 ≥0.3 ≥0.4 ≥0.6 ≥0.7 ≥1.0		
Hepatic (0-1 point)	Total bilirubin ≥4mg/dL and/or ALT>102 IU/L		

Internal validation set		
Phoenix-8	PELOD-2	pSOFA
0.91 (0.90-0.91)	0.86 (0.86-0.87)	0.90 (0.89-0.90)
0.90 (0.89-0.91)	0.84 (0.83-0.86)	0.89 (0.87-0.90)
0.85 (0.84-0.86)	0.78 (0.77- 0.79)	0.83 (0.82-0.84)
External validation set		
0.94 (0.94-0.94)	0.92 (0.92-0.92)	0.93 (0.93-0.93)
0.78 (0.76-0.79)	0.70 (0.67-0.71)	0.73 (0.71-0.75)
0.80 (0.79-0.80)	0.73 (0.72-0.74)	0.82 (0.81- 0.83)
0.87 (0.87-0.87)	0.80 (0.80-0.81)	0.86 (0.86-0.87)

What if a healthcare facility doesn't routinely collect all variables in the Phoenix Sepsis Score (e.g. D-Dimer)?

- According to **international survey**, most variables in the score are available in most settings
- Score is **built with redundancy**, median score in children with sepsis is 3 (and only need 2 points)
- Example: Excellent performance at **lower resource site 1** despite few coagulation tests and lactates



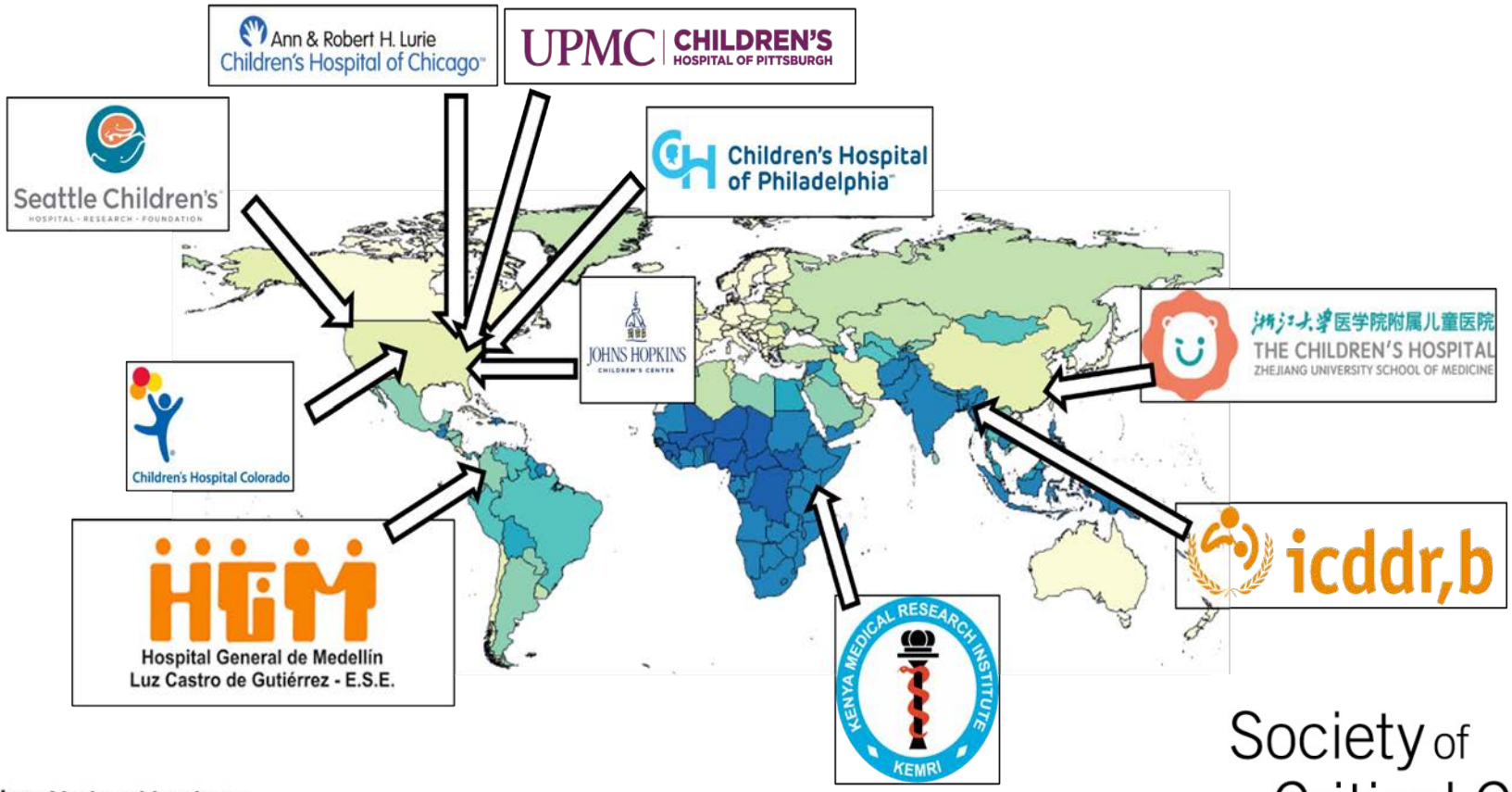
Limitations

- **EHR data can have missing data and errors**
  Mitigation: reproducible harmonization and data quality
  Advantage: Real-world data where criteria will be used
- **Some organ dysfunctions are iatrogenic** (e.g. GCS in intubated/sedated pts)
- **Did not distinguish chronic organ dysfunction** (similar to Sepsis-3)

Next Steps

- Need for **screening tools for early/possible sepsis**
- Need to do validation in **hospital-acquired sepsis**
- Ongoing development of **clinical decision support tools** for implementation of these criteria in both higher and lower resource settings

It takes a village, THANK YOU to the funders, collaborators, and the members of the Task Force!



NIH *Eunice Kennedy Shriver* National Institute of Child Health and Human Development

Society of Critical Care Medicine
The Intensive Care Professionals

Questions?

Sepsis Alliance Symposium: Maternal and Neonatal Sepsis

SEPSIS ALLIANCE

OFFERING FREE CE CONTACT HOURS FOR NURSES!

Join us for a half-day virtual event exploring the burden of sepsis in maternal and neonatal patients and hear from healthcare experts about improving clinical outcomes for this population.

May 16, 2024

Register at SepsisInstitute.org

Upcoming Events

September 25-26, 2024

Be the first to know when registration opens!

Sign up for our Healthcare Professional email list by scanning the QR code below.

SEPSIS
ALLIANCE

SepsisInstitute.org