

Sepsis: Across the Continuum of Care Webinar Series

Surviving Pediatric Sepsis: What's Next?

Speakers:



Scott L. Weiss, MD, MSCE, FCCM
Assistant Professor, Children's Hospital of Philadelphia,
University of Pennsylvania Perelman School of Medicine



Marnie Doubek, MD, FAAFP
Mother of Zachary, a pediatric sepsis survivor

This webinar is made possible with unrestricted educational support from bioMérieux, Inc.



Surviving Pediatric Sepsis: What's Next?

Scott L. Weiss, MD MSCE FCCM

Assistant Professor of Critical Care and Pediatrics

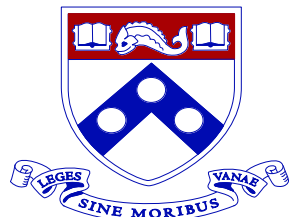
Co-Director, Pediatric Sepsis Program

Children's Hospital of Philadelphia

University of Pennsylvania Perelman School of Medicine

Sepsis: Across the Continuum of Care Series

April 24, 2019



Conflict of Interest Disclosures for

Scott L. Weiss, MD MSCE FCCM

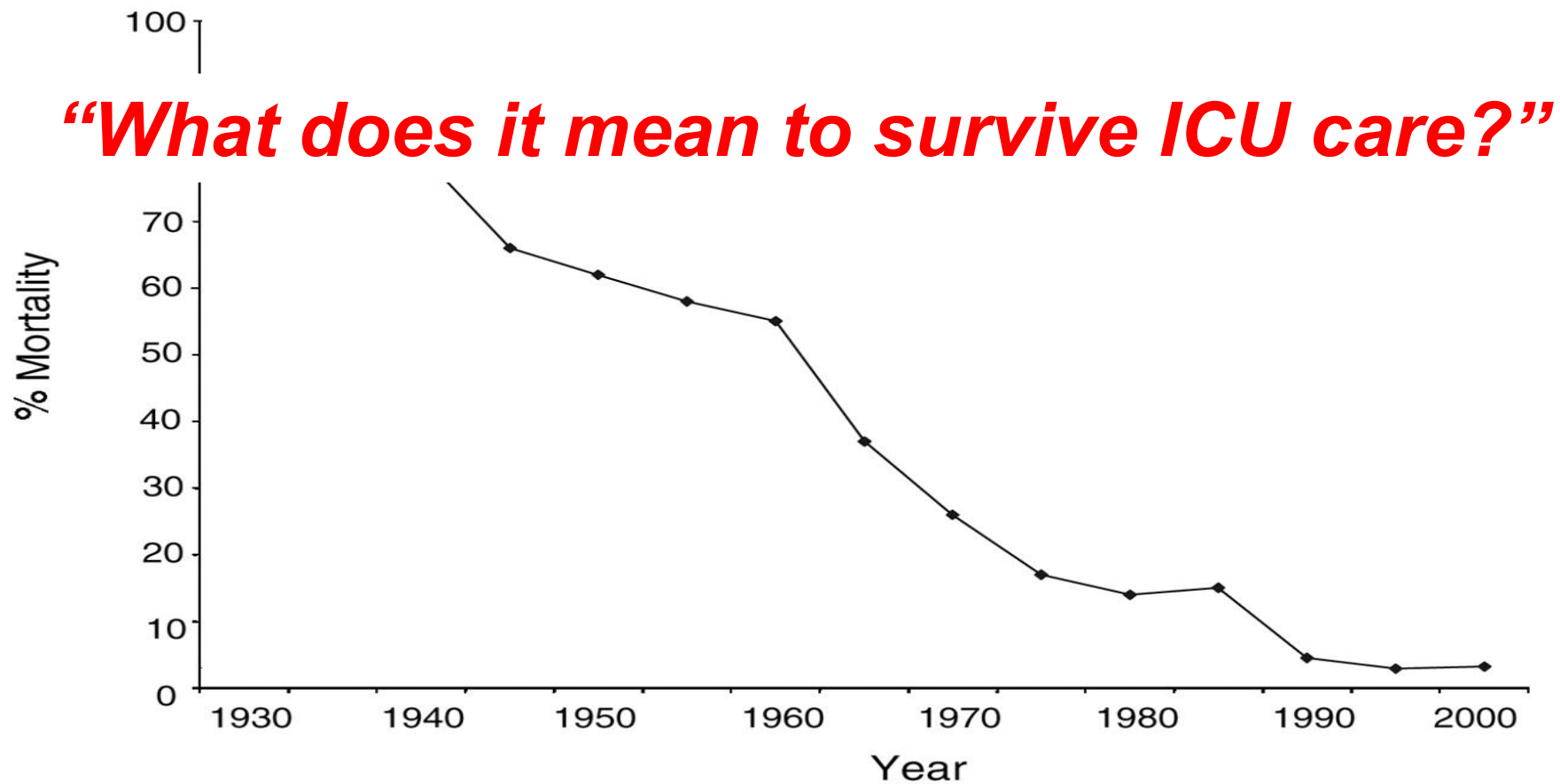
Grant/Research Support	National Institutes of Health Society of Critical Care Medicine Children's Hospital of Philadelphia
Consultant	Bristol-Meyers Squibb
Speakers Bureau	Nothing to disclose
Stock Shareholder	Nothing to disclose
Other (identify)	Royalties – Up-To-Date Honoraria – Thermo Fisher Scientific (Procalcitonin) Honoraria – Medscape/Roche (Sepsis biomarkers)

Objectives

- Review epidemiology and symptoms of post-intensive care syndrome in childhood survivors of sepsis
- Identify risk factors for long-term functional morbidity and mortality after pediatric sepsis
- Discuss efforts to improve long-term new or residual morbidity after pediatric sepsis

Outcomes After Pediatric Sepsis

- Traditional goal of intensive care is to decrease short-term mortality

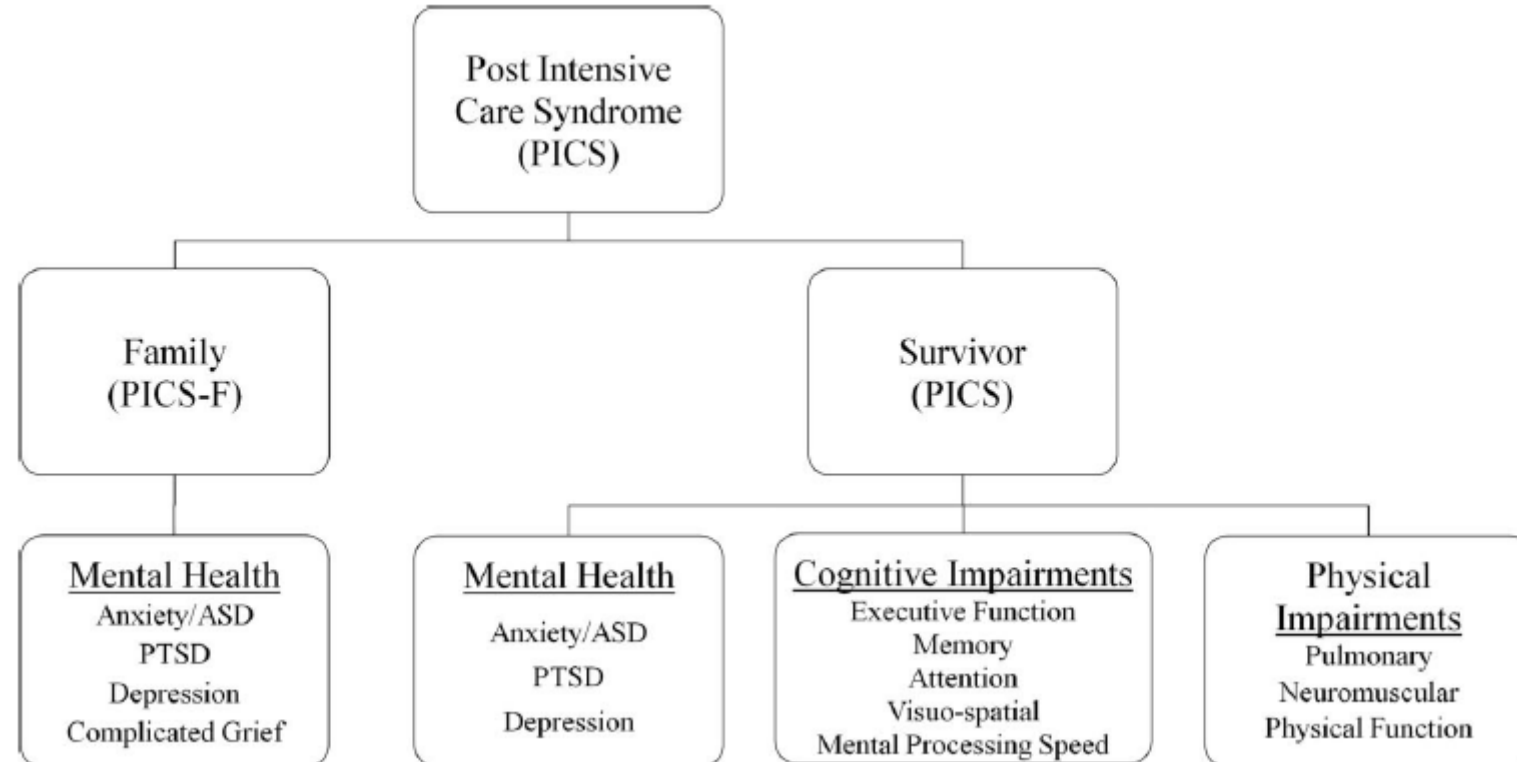


The “Sepsis Survivor”

“The early morbidity of sepsis is reflected in deranged organ function and need for ICU supportive care. However, this morbidity is not experienced by the patient but rather by the patient’s family and loved ones. After the acute illness resolves...long-term morbidity is reflected in reduced health-related quality of life [and delayed death].”

Post-Intensive Care Syndrome (PICS)

- New or worsening impairment in physical, cognitive, or mental health persisting beyond acute hospitalization

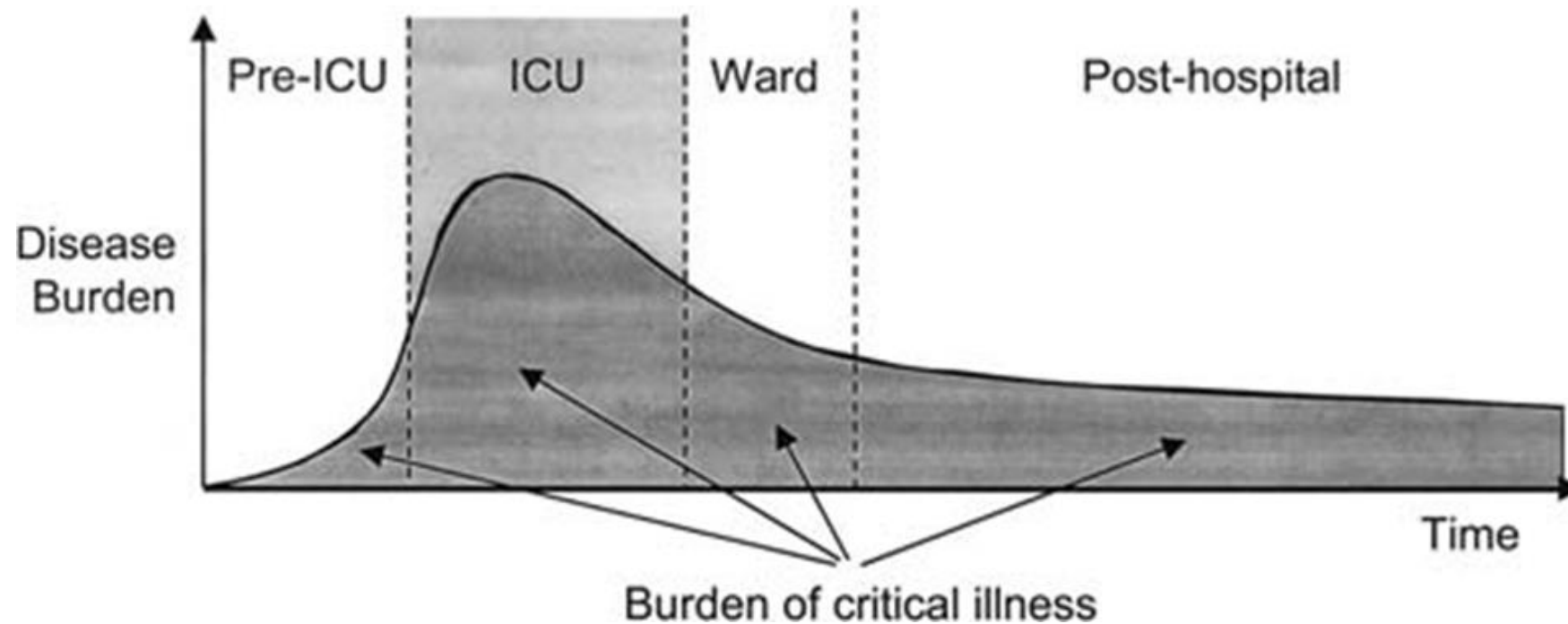


Endpoints in Pediatric Sepsis Epidemiological Studies

Study	Location	Endpoint
Watson 2003	USA	Hospital Mortality
Leclerc 2005	Canada	PICU Mortality
Odetola 2007	USA	Hospital Mortality
Wolfler 2008	Italy	PICU Mortality
Jaramillo-Bustamante 2012	Colombia	PICU Mortality
Hartman 2013	USA	Hospital Mortality
Perez 2013	Spain	Hospital Mortality
Ruth 2014	USA	Hospital Mortality
Balamuth 2014	USA	Hospital Mortality
Schlapbach 2015	Australia/New Zealand	PICU Mortality
SPROUT 2015	26 countries	Hospital Mortality
de Souza 2016	South America	PICU Mortality
Ames 2018	USA	Hospital Mortality
EUCLIDS study 2018	Europe	Hospital Mortality
Tan 2019	Meta-analysis	Hospital Mortality

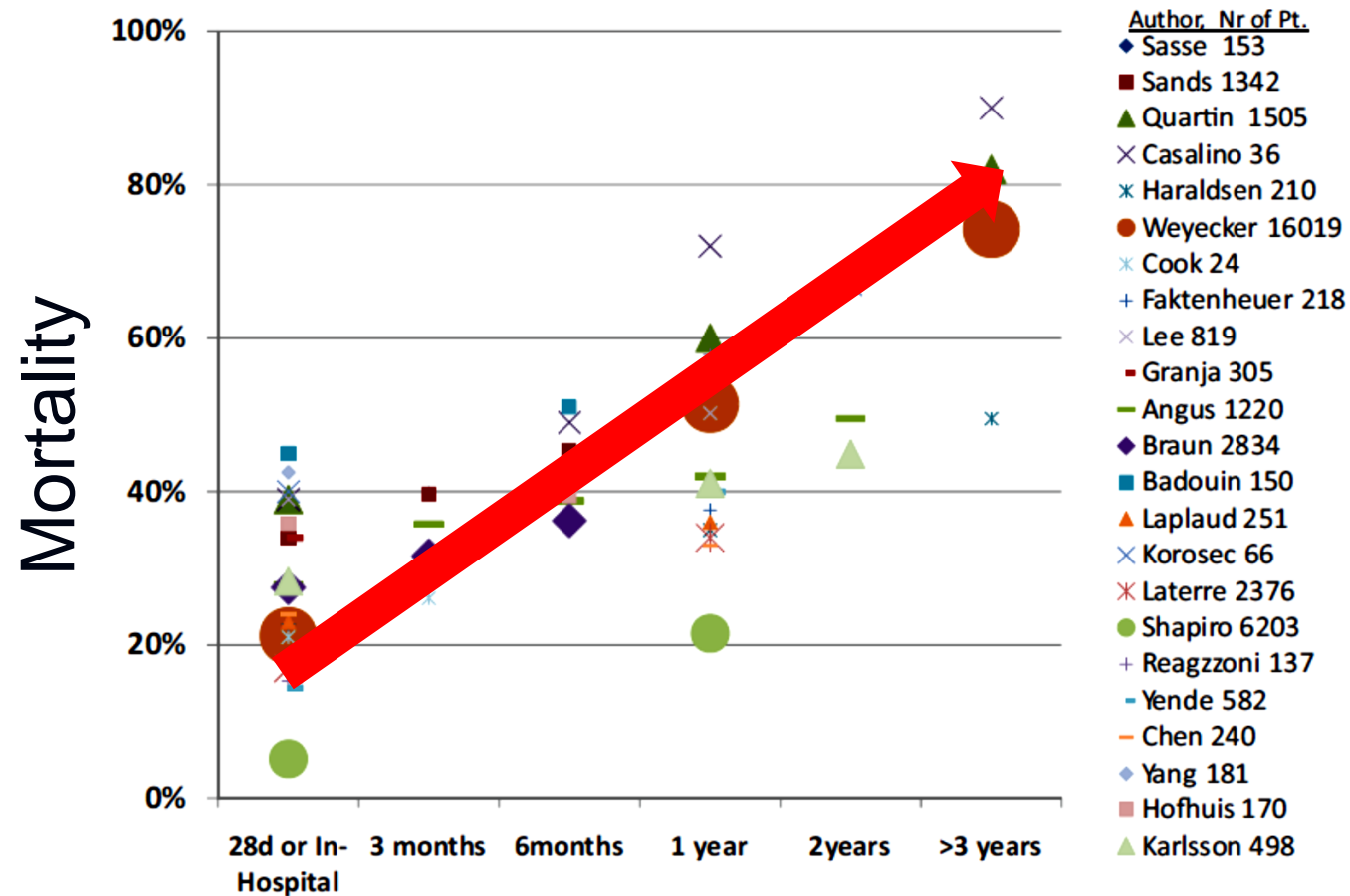
Surviving Intensive Care

“...global awareness of critical illness as an entity that begins and ends outside of the ICU”



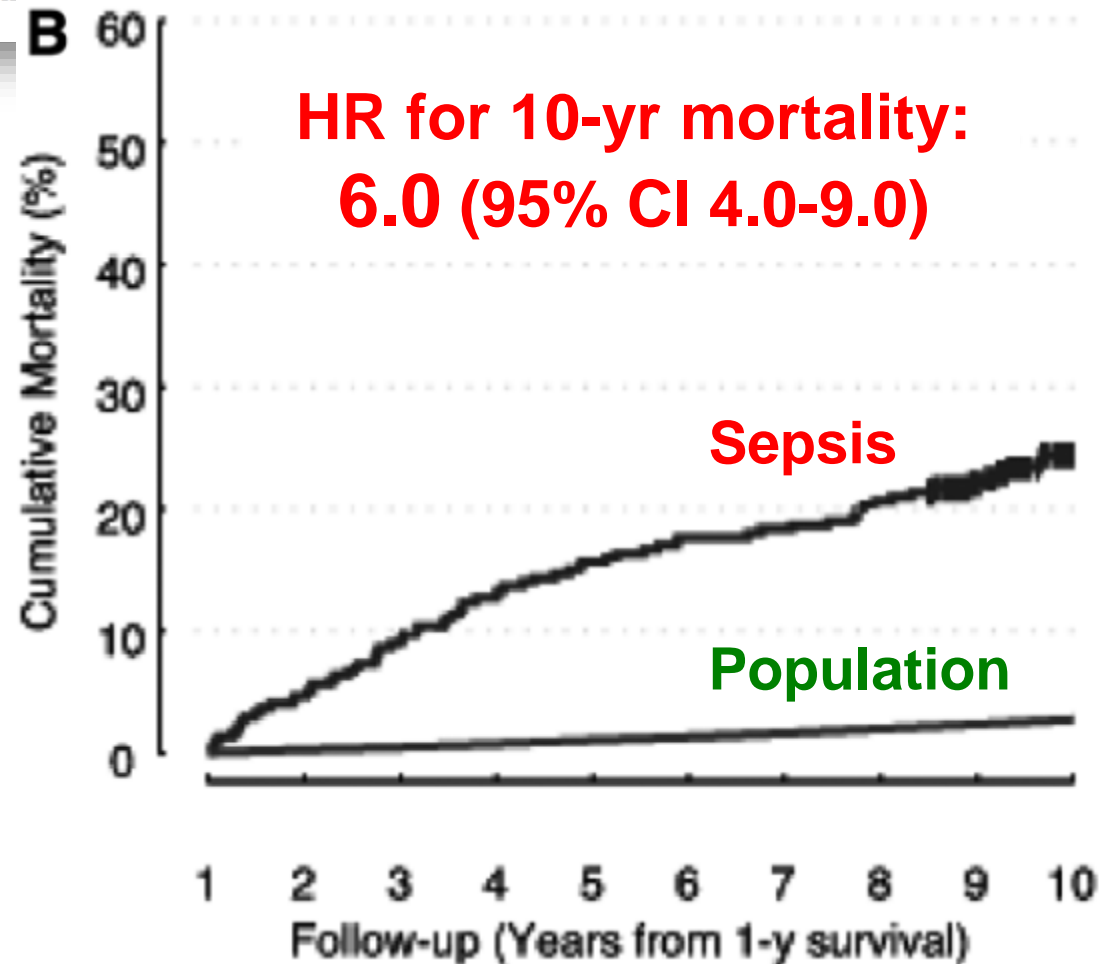
Long-term mortality and quality of life in sepsis: A systematic review*

Bradford D. Winters, MD, PhD; Michael Eberlein, MD, PhD; Janice Leung, MD; Dale M. Needham, MD, PhD;
Peter J. Pronovost, MD, PhD; Jonathan E. Sevransky, MD, MHS

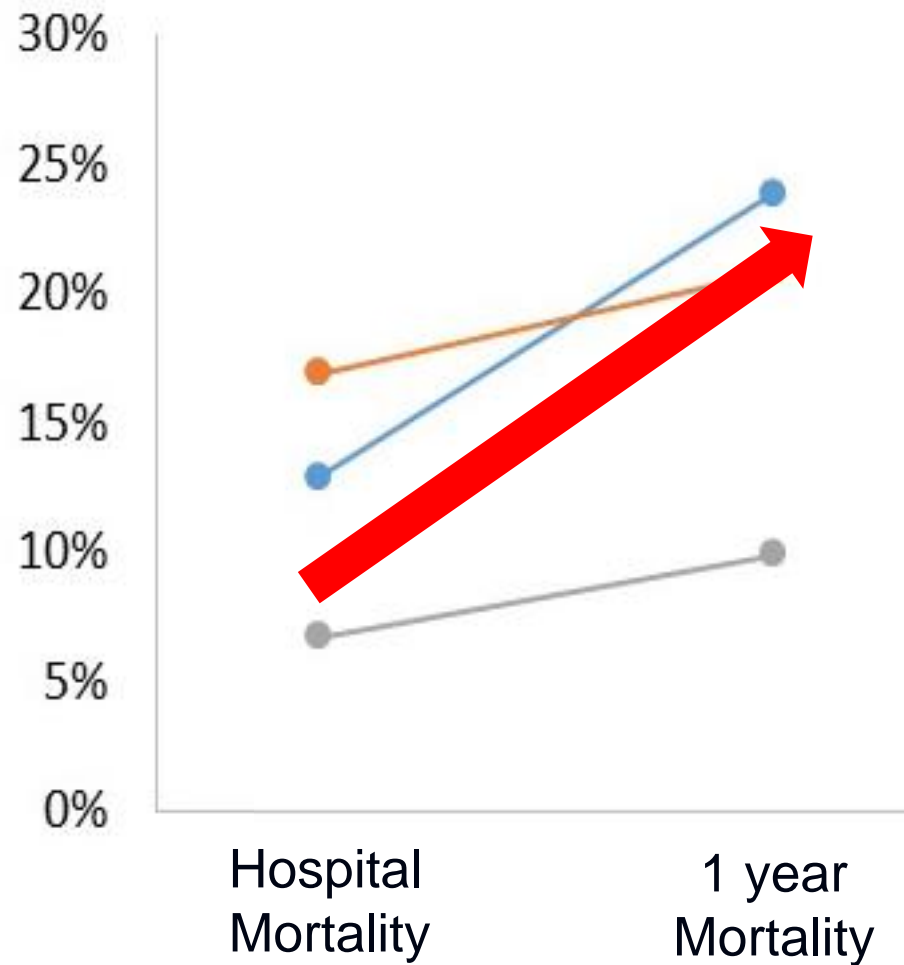


Long-Term (10-Year) Mortality of Younger Previously Healthy Patients With Severe Sepsis/Septic Shock Is Worse Than That of Patients With Nonseptic Critical Illness and of the General Population

Adam Linder, MD^{1,2}; Daphne Guh, MSc³; John H. Boyd, MD¹; Keith R. Walcott, MD¹;
Aslam H. Anis, PhD^{3,4}; James A. Russell, MD¹



Long-Term Mortality After Pediatric Sepsis

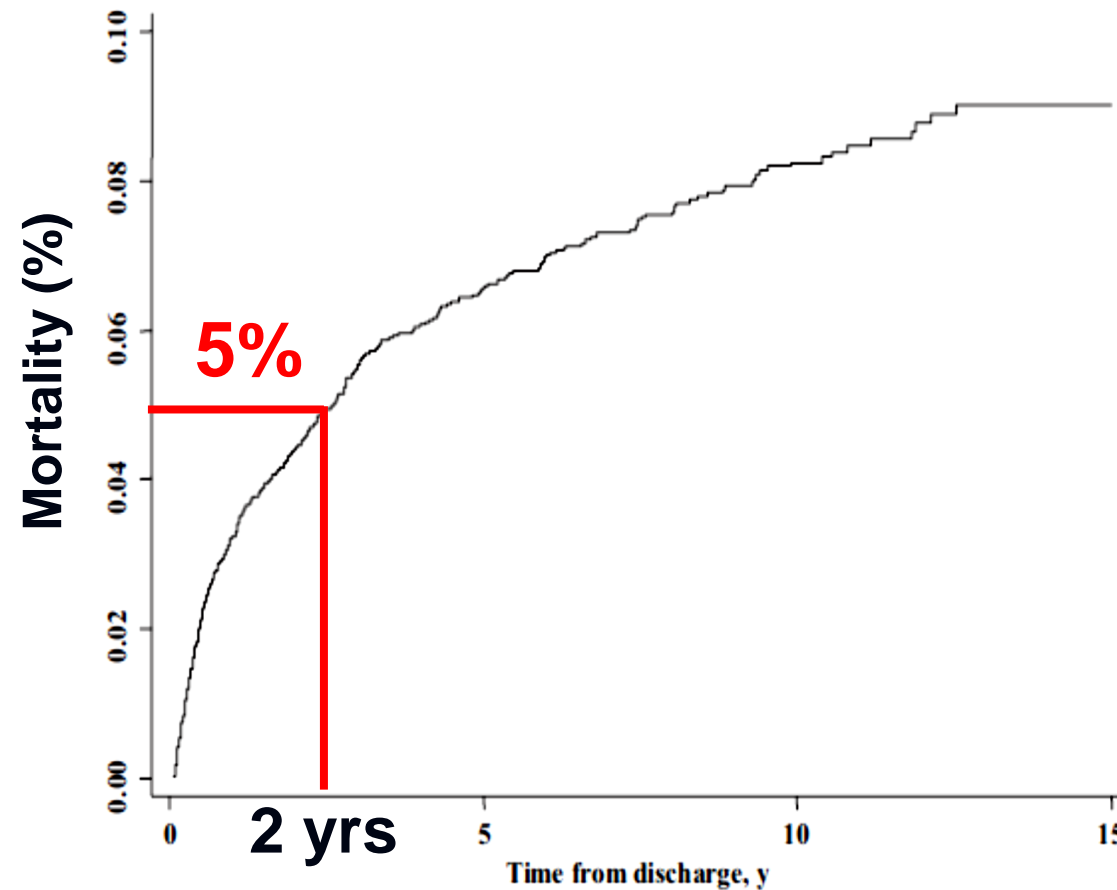


CHOP Data
Cvetkovic et al *PCCM* 2015
Czaja et al *Pediatrics* 2009

Readmission and Late Mortality After Pediatric Severe Sepsis

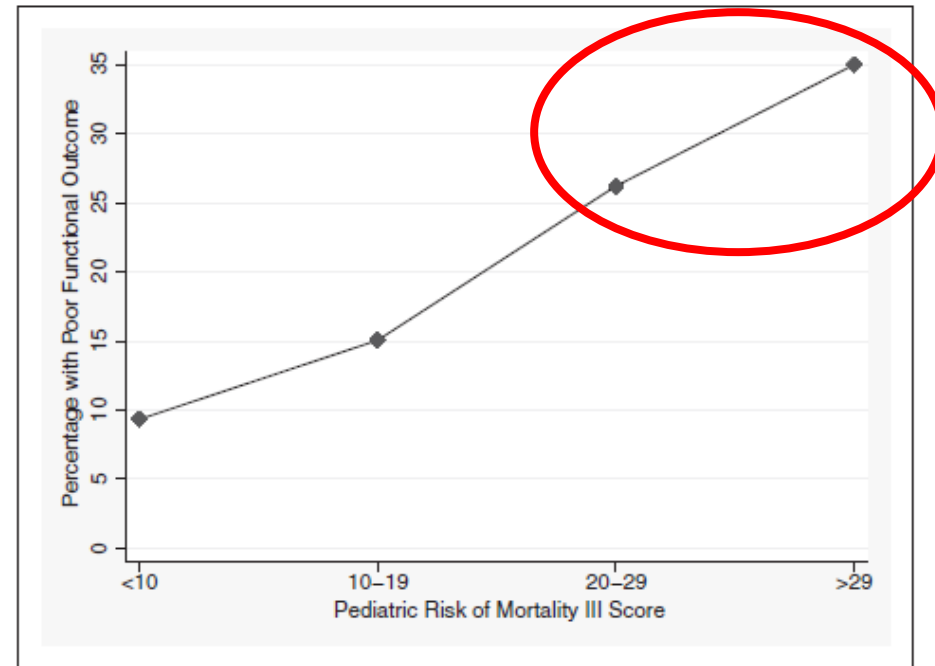
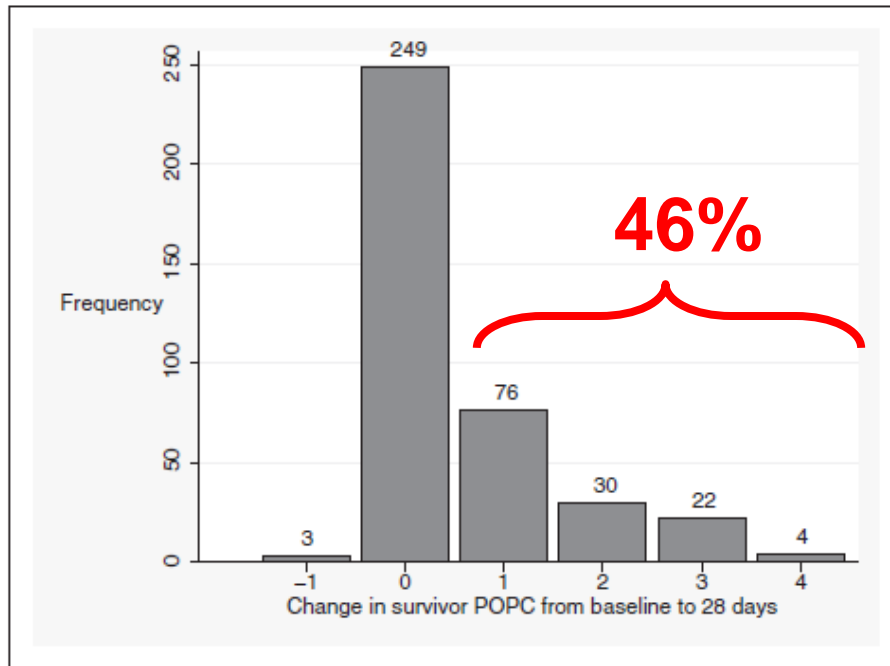
Angela S. Czaja, MD, MSc^a, Jerry J. Zimmerman, MD, PhD^b, Avery B. Nathens, MD, PhD, MPH^{c,d}

N=7,183 children with severe sepsis in Washington state



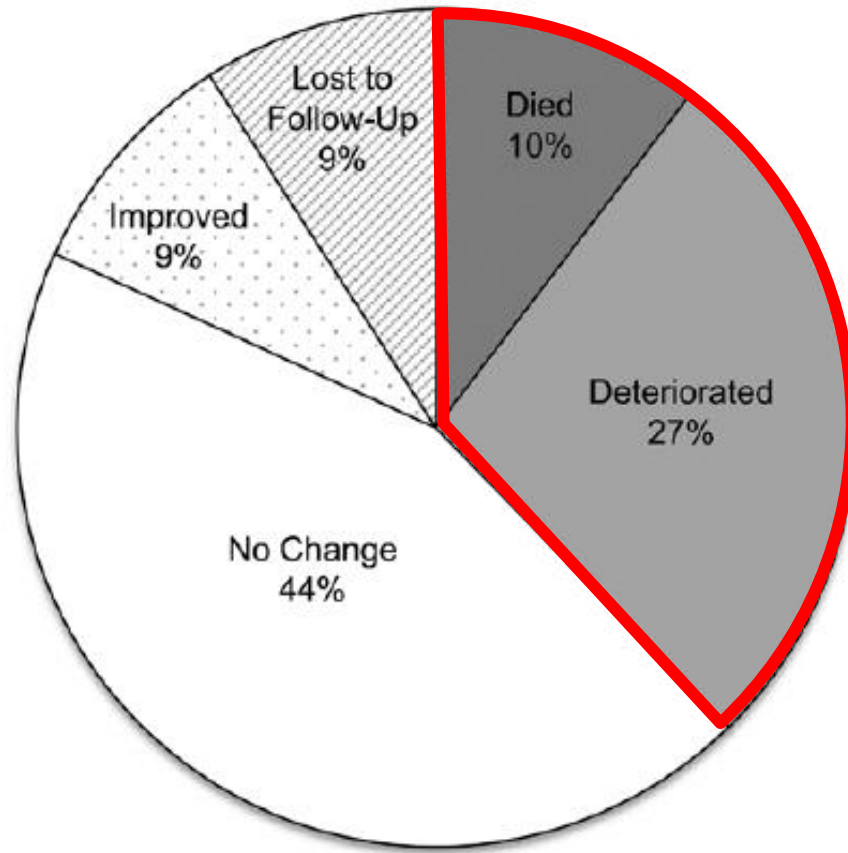
Functional Outcomes in Pediatric Severe Sepsis: Further Analysis of the Researching Severe Sepsis and Organ Dysfunction in Children: A Global Perspective Trial*

Reid W. D. Farris, MD¹; Noel S. Weiss, MD, DrPH²; Jerry J. Zimmerman, MD, PhD¹



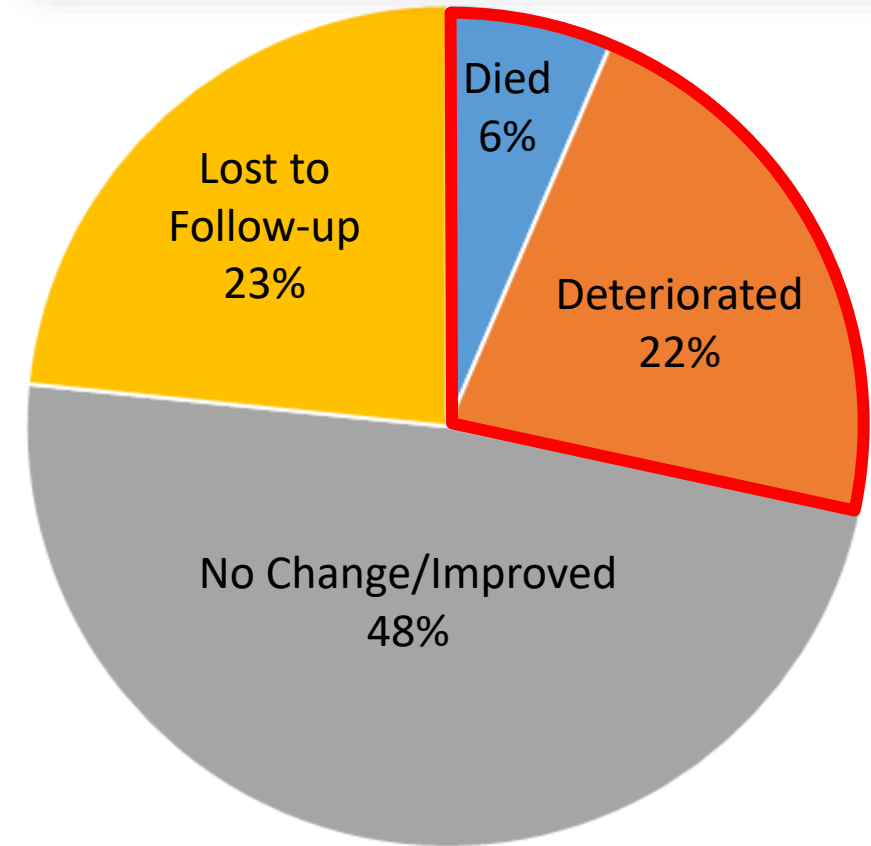
Long-Term Function After Pediatric Critical Illness: Results From the Survivor Outcomes Study*

Neethi P. Pinto, MD, MS¹; Elizabeth W. Rhinesmith, MD²; Tae Yeon Kim, BA³; Peter H. Ladner, BA³; Murray M. Pollack, MD²



Pinto et al *Pediatric Crit Care Med* 2017

Mortality and morbidity in community-acquired sepsis in European pediatric intensive care units: a prospective cohort study from the European Childhood Life-threatening Infectious Disease Study (EUCLIDS)



Boeddha et al *Crit Care Med* 2018

Global Epidemiology of Pediatric Severe Sepsis: The Sepsis Prevalence, Outcomes, and Therapies Study

Scott L. Weiss^{1*}, Julie C. Fitzgerald^{1*}, John Pappachan^{2,3}, Derek Wheeler^{4,5}, Juan C. Jaramillo-Bustamante⁶, Asma Salloo⁷, Sunit C. Singhi⁸, Simon Erickson⁹, Jason A. Roy¹⁰, Jenny L. Bush¹, Vinay M. Nadkarni¹, and Neal J. Thomas^{1,11}; for the Sepsis Prevalence, Outcomes, and Therapies (SPROUT) Study Investigators and the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network

Outcome	USA	Europe
PICU mortality	22%	30%
Hospital mortality	22%	29%
Mod-severe disability ¹	19%	18%
Death or disability	37%	43%

N=567

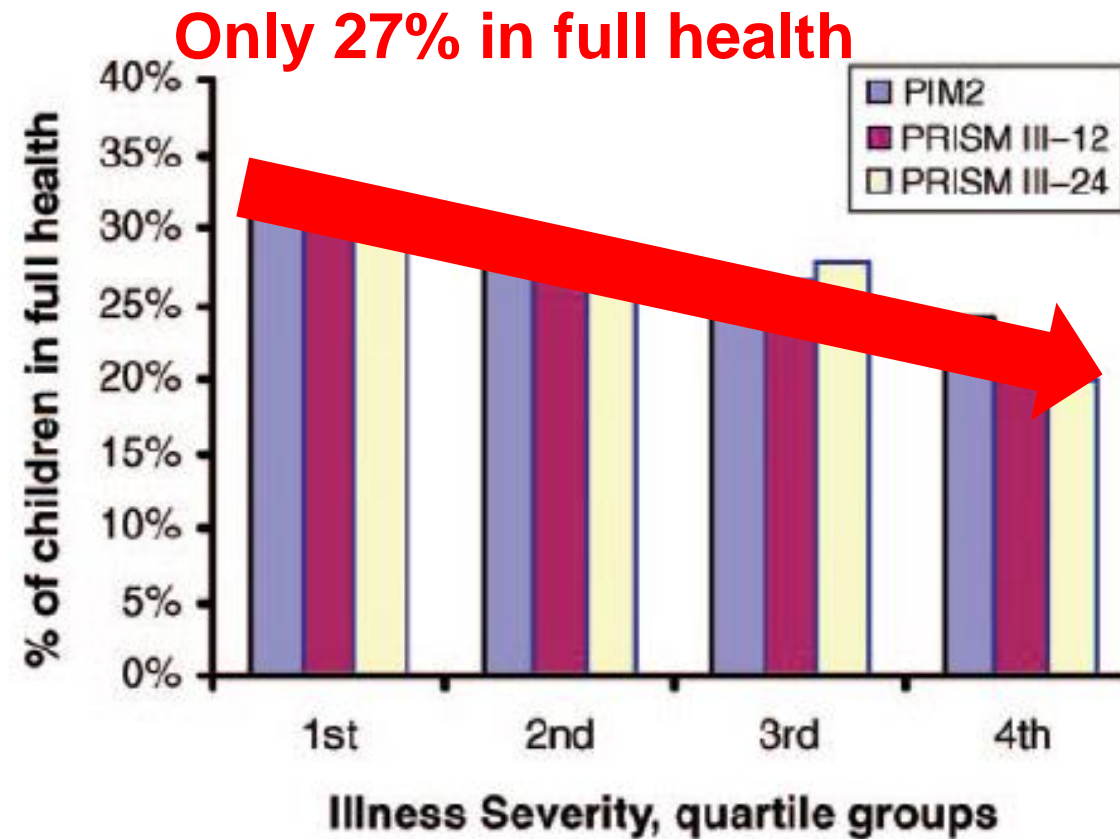
¹POPC ≥ 3 and increase ≥ 1 from baseline in survivors
(POPC = Pediatric Overall Performance Category)

Weiss, Fitzgerald et al *AJRCCM* 2015
Lin et al *Pediatric Crit Care Med* 2017

Outcome at 6 Months After Admission for Pediatric Intensive Care: A Report of a National Study of Pediatric Intensive Care Units in the United Kingdom

Samantha Jones, BSc^a, Khadija Rantell, MSc^a, Katherine Stevens, MSc^b, Brigitte Colwell, MSc^c, Jane R. Ratcliffe, MB, ChB^d, Philip Holland, MB, ChB^e, Kathy Rowan, DPhil^f, Gareth J. Parry, PhD^g, on behalf of the United Kingdom Pediatric Intensive Care Outcome Study Group

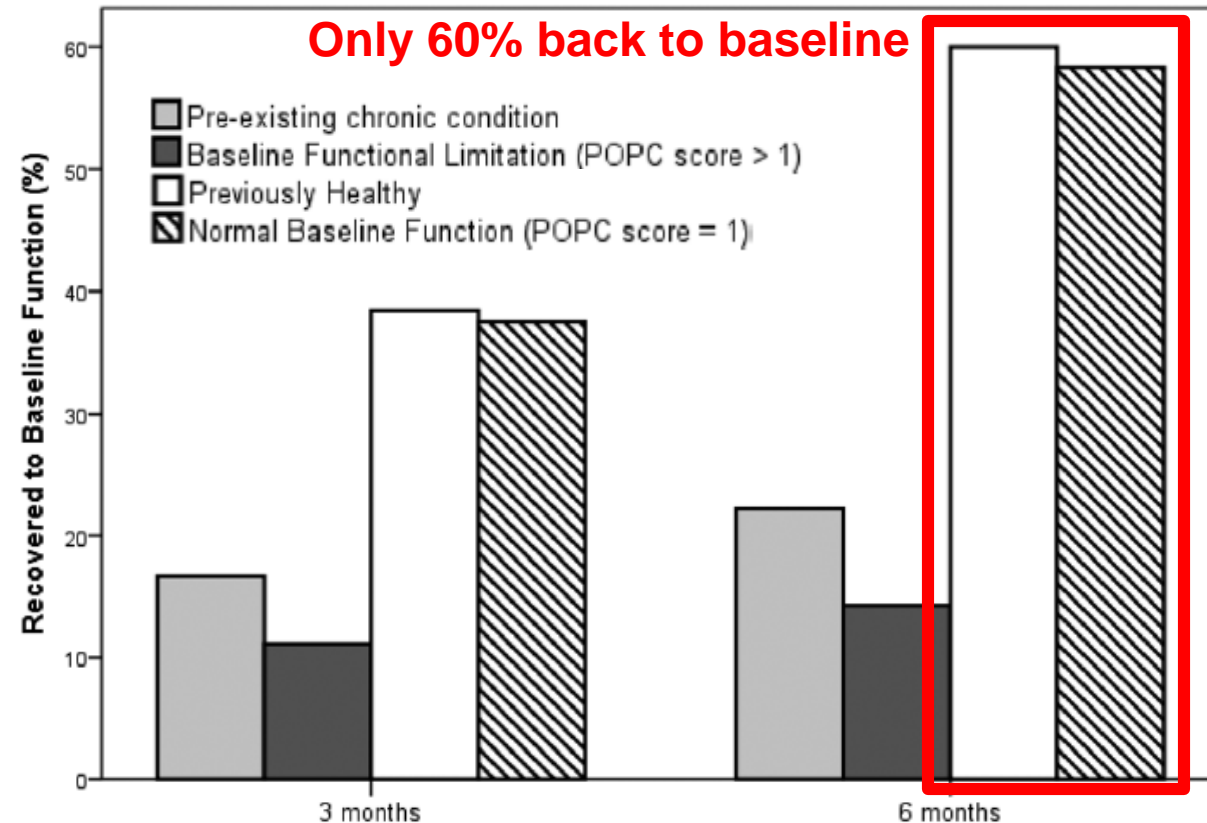
N=1455 PICU patients followed at 6 months



Functional Recovery Following Critical Illness in Children: The “Wee-Cover” Pilot Study*

Karen Choong, MB BCh, MSc¹; Samah Al-Harbi, MD²; Katie Siu, MD³; Katie Wong, BSc³; Ji Cheng, MSc⁴; Burke Baird, MD³; David Pogorzelski, BSc³; Brian Timmons, PhD³; Jan-Willem Gorter, MD, PhD^{3,5}; Lehana Thabane, PhD⁴; Mary Khetani, ScD, OTR⁶; on behalf of the Canadian Critical Care Trials Group

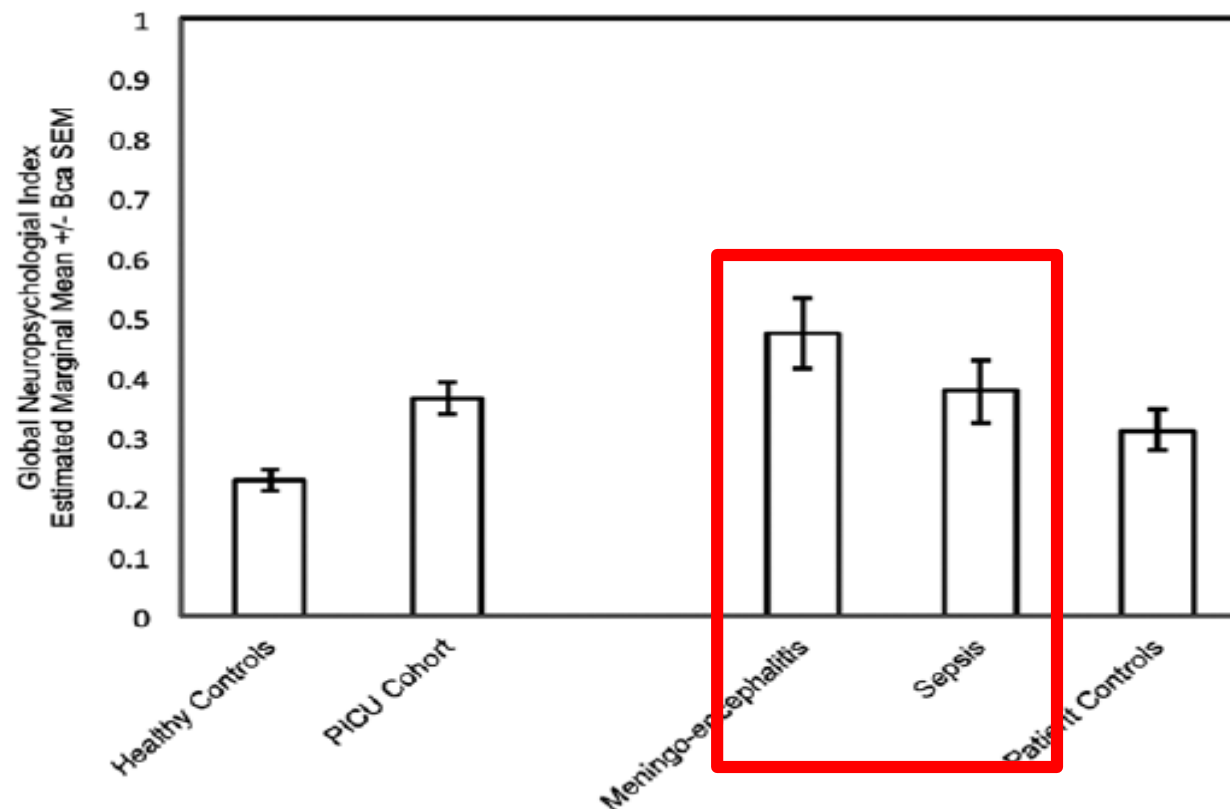
**N=33 PICU pts 1-17 yrs followed at 3 and 6 months
(51% sepsis)**



Neuropsychologic Function Three to Six Months Following Admission to the PICU With Meningoencephalitis, Sepsis, and Other Disorders: A Prospective Study of School-Aged Children*

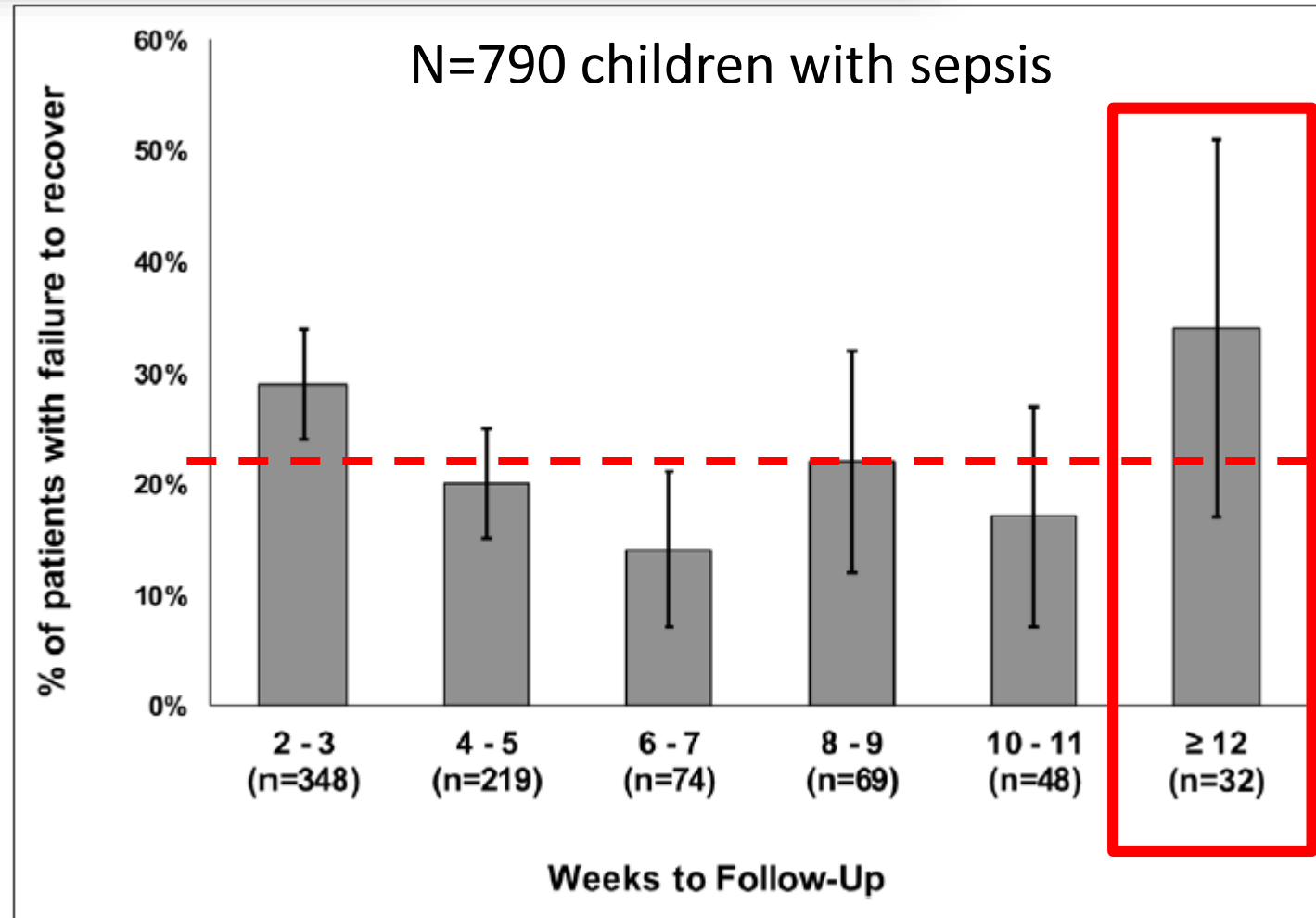
Lorraine C. Als, PhD¹; Simon Nadel, FRCP²; Mehrengise Cooper, FRCPCH²;
Christine M. Pierce, FRCPCH³; Barbara J. Sahakian, PhD, DipClinPsych, FMedSci⁴;
M. Elena Garraida, MD, FRCPsych, FRCPCH¹

N=88 PICU patients 5-16 yrs followed at 3-6 months



Health-Related Quality of Life Among Survivors of Pediatric Sepsis

Elizabeth Y. Killien, MD^{1,2}; Reid W. D. Farris, MD, MS^{1,3}; R. Scott Watson, MD, MPH^{1,4};
Leslie A. Dervan, MD, MS^{1,3}; Jerry J. Zimmerman, MD, PhD^{1,3}



Only 23% back to baseline

Health-Related Quality of Life Among Survivors of Pediatric Sepsis

Elizabeth Y. Killien, MD^{1,2}; Reid W. D. Farris, MD, MS^{1,3}; R. Scott Watson, MD, MPH^{1,4};
Leslie A. Dervan, MD, MS^{1,3}; Jerry J. Zimmerman, MD, PhD^{1,3}

Risk Factor	Relative Risk	95% CI	p
Age, yr	1.02/yr	1.01–1.05	0.04
Immune status			< 0.001
Noncompromised	Reference		
Compromised	1.83	1.40–2.40	
Sepsis category			0.006
Sepsis	Reference		
Severe sepsis	1.38	0.82–2.31	
Septic shock	1.79	1.24–2.58	
Hospital length of stay	1.03/d	1.01–1.04	0.002
Weeks to follow-up	0.96/wk	0.92–1.01	0.09

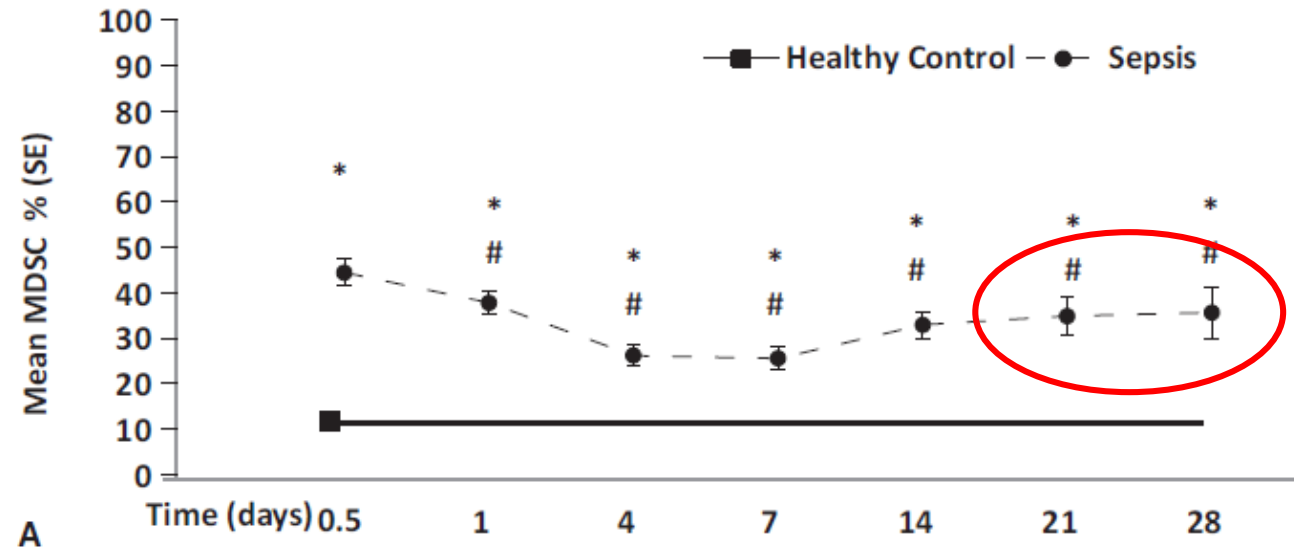
Life After Pediatric Sepsis Evaluation (LAPSE)

- Multicenter (12 sites), longitudinal study of critically ill children with septic shock
- N=387 subjects
 - 37% had not regained baseline quality of life (PedsQL) by 12 months post-discharge
 - Physical deficits most common

Why does morbidity and mortality risk continue in sepsis survivors?

- Prolonged immune suppression
- Malnutrition & deconditioning
- Persistent organ dysfunction
- Post-traumatic stress
- Comorbid conditions (e.g., cancer)

Prolonged Immune Suppression After Sepsis

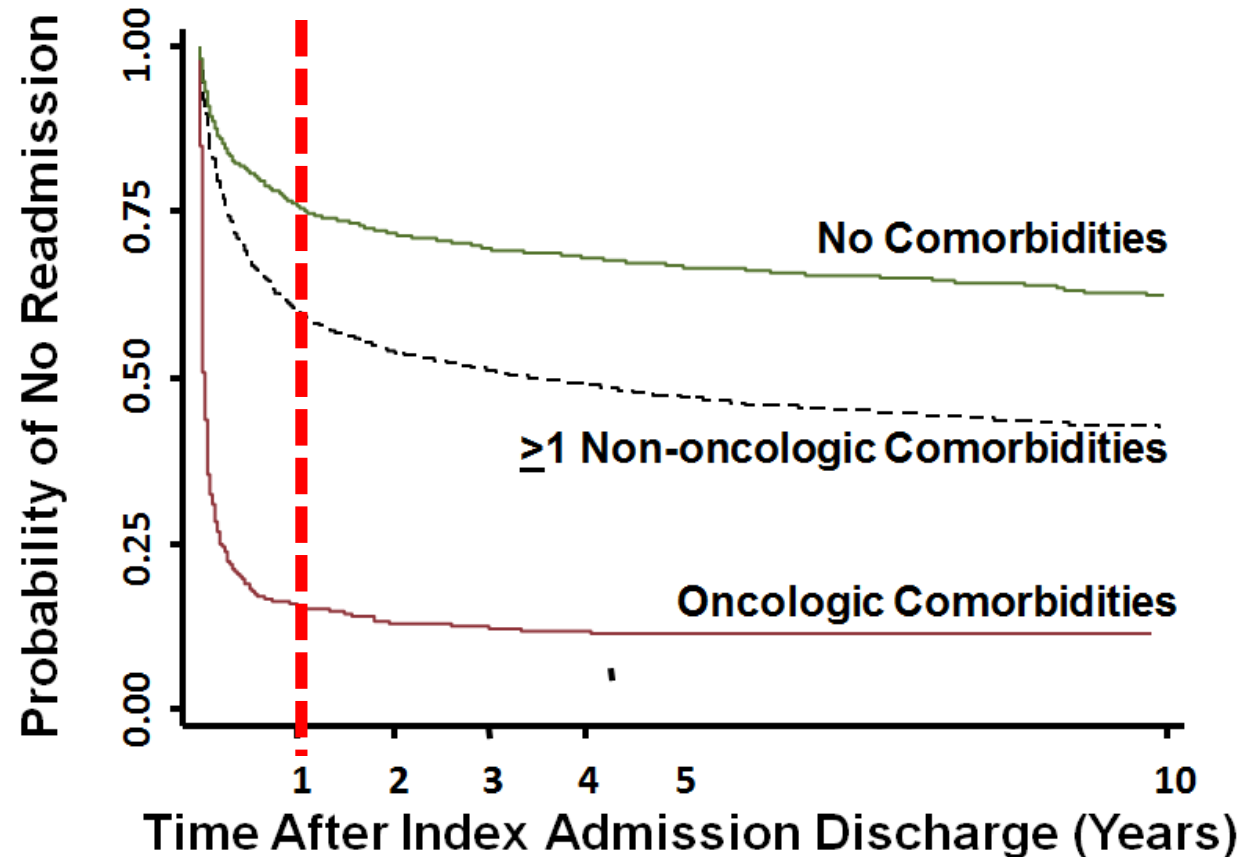


- Shift to an M2 macrophage phenotype (anti-inflammatory)
- Altered Toll-like receptor expression
- Impaired antigen presentation

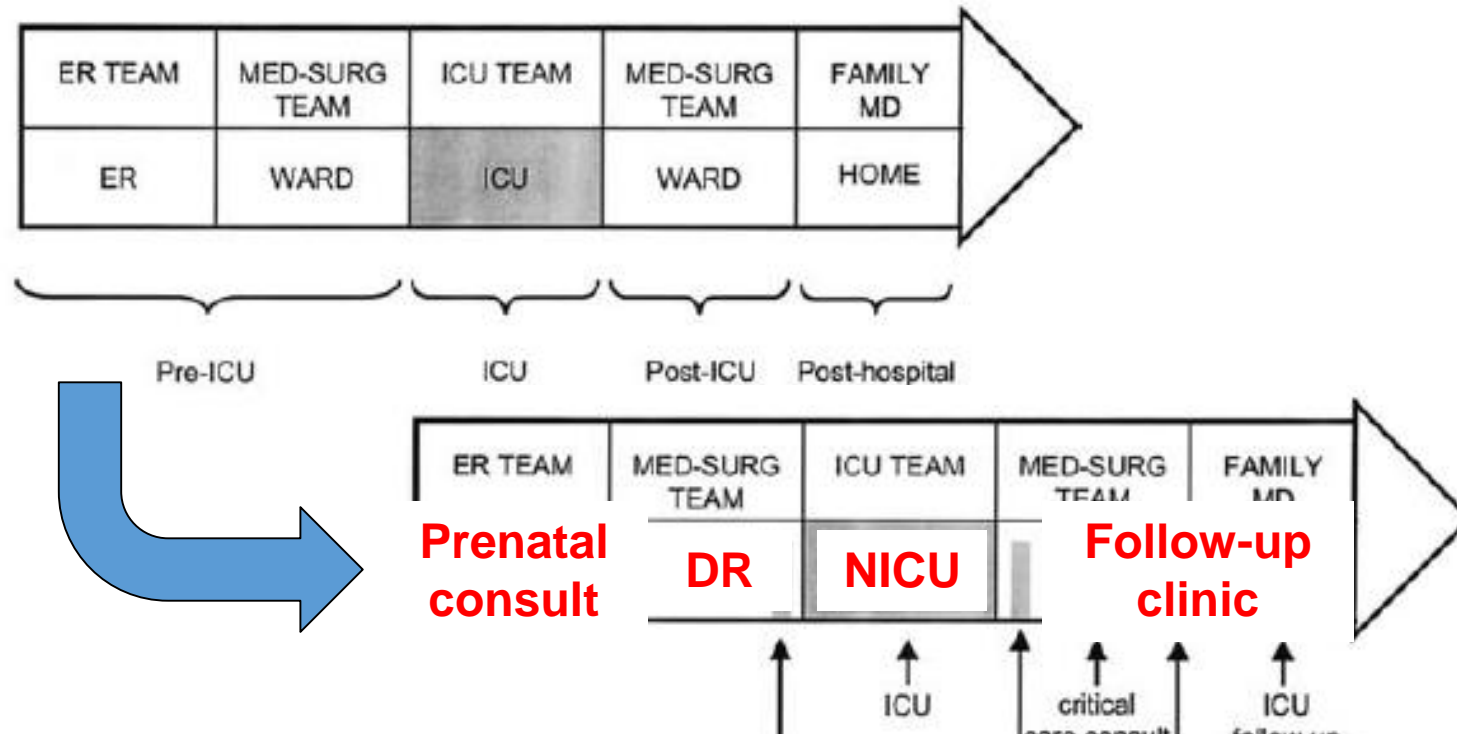
Leave host ill-prepared to fight a new pathogen

Readmission After Pediatric Sepsis

47% of survivors had at least one readmission
(HALF for new infection)



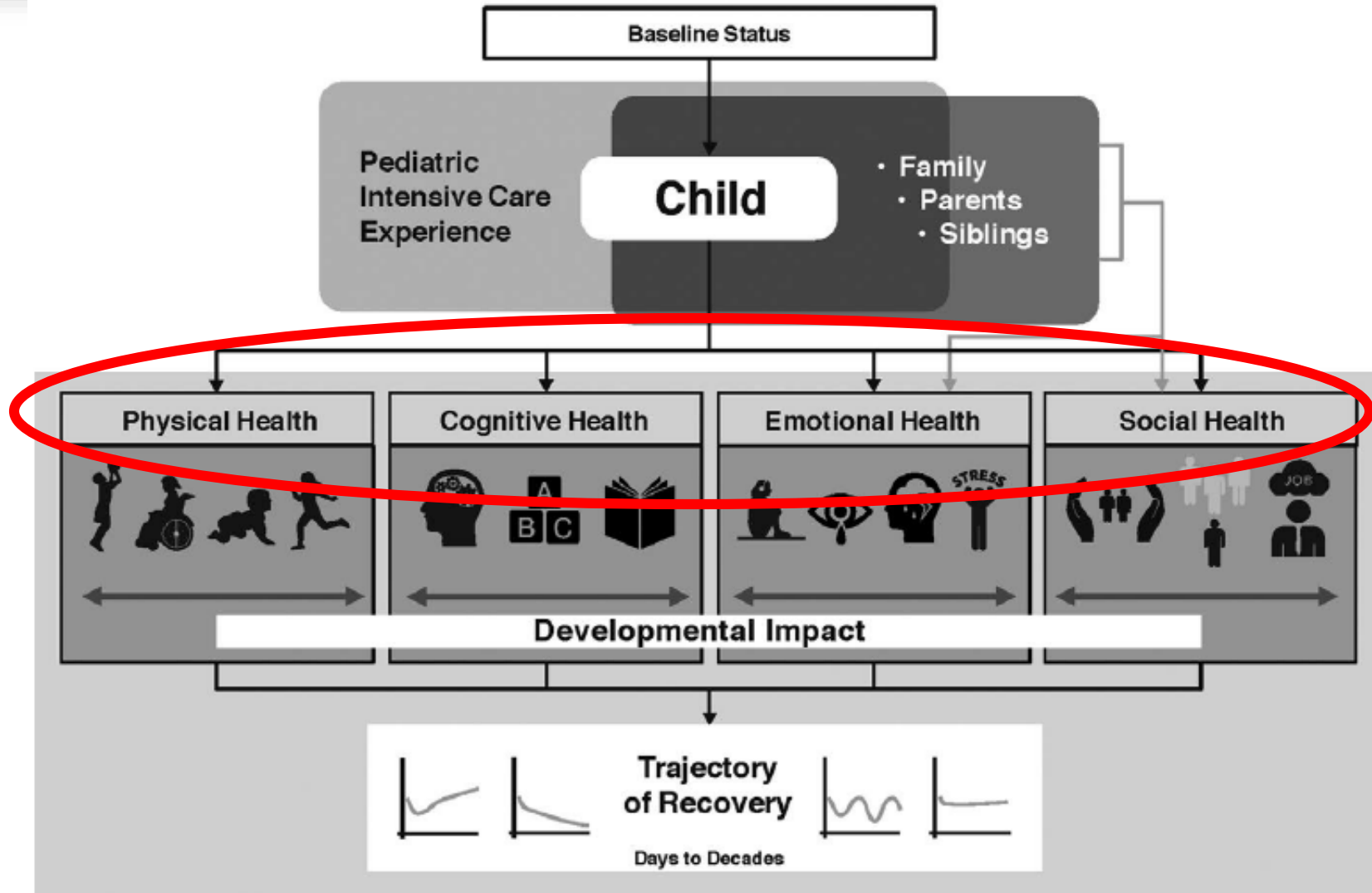
Paradigm Shift – Clinical



Neonatology as one model

Conceptualizing Post Intensive Care Syndrome in Children—The PICS-p Framework*

Joseph C. Manning, RN, PhD^{1,2,3}; Neethi P. Pinto, MD, MS⁴; Janet E. Rennick, RN, PhD^{5,6};
Gillian Colville, MPhil, CPsychol⁷; Martha A. Q. Curley, RN, PhD^{8,9,10}



Functional Deficits After Pediatric Sepsis

Domain	Deficits
Physical	Weakness Coordination Endurance
Cognitive	Memory Attention Academic performance
Emotional	Depression Anxiety PTSD (patient, family)
Social	Hyperactivity Bullying (victim) Withdrawal

Paradigm Shift - Research

SPROUT study

Outcome	Control (%)	Intervention (%)	Total N
PICU mortality	24	19	2,118

Long-term Effects of Acute Interventions

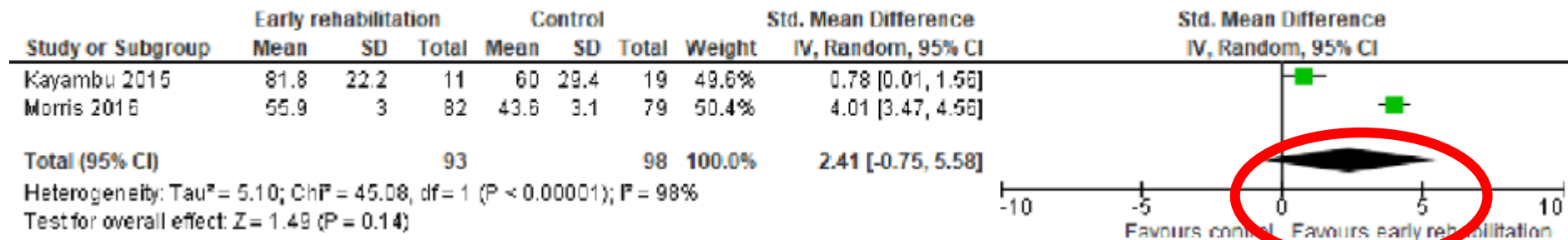
Time to Antibiotics	PICU Mortality (aOR)
> 1 hour	1.67 (0.35, 7.91)
> 2 hours	2.43 (0.74, 8.0)
> 3 hours	4.84 (1.45, 16.2)

Adjusted for severity of illness and comorbidities

Early rehabilitation to prevent postintensive care syndrome in patients with critical illness: a systematic review and meta-analysis

Ryota Fuke,¹ Toru Hifumi,² Yutaka Kondo,³ Junji Hatakeyama,⁴ Tetsuhiro Takei,⁵ Kazuma Yamakawa,⁵ Shigeaki Inoue,⁶ Osamu Nishida⁷

Physical Function (SF-36PF)

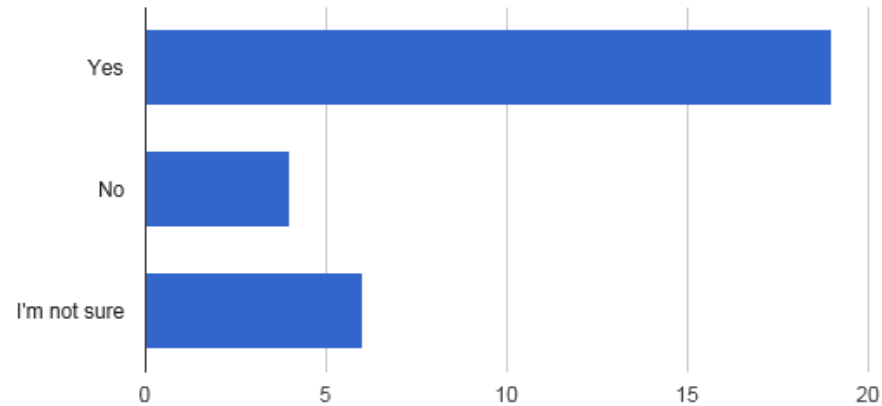


Challenges to Following Children After Discharge

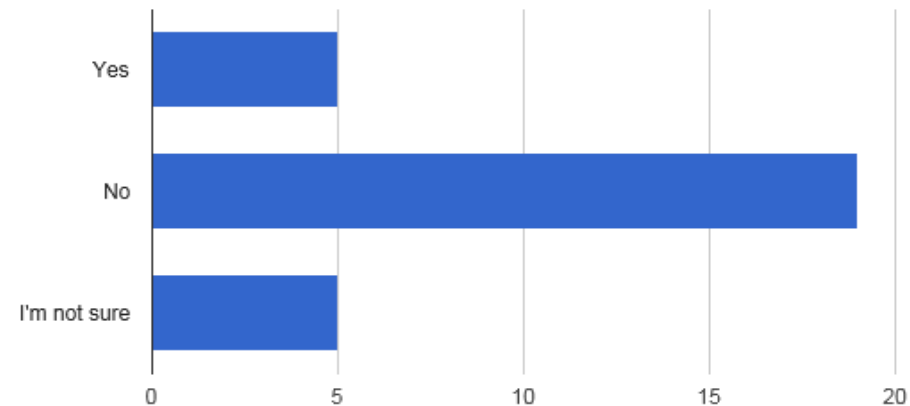
- Could minimize important short-term gains
- Delayed morbidity, mortality increasingly contaminated by unrelated events
- Expensive
- Loss to follow-up
- Personnel unclear

CHOP Primary Care Survey (N=29)

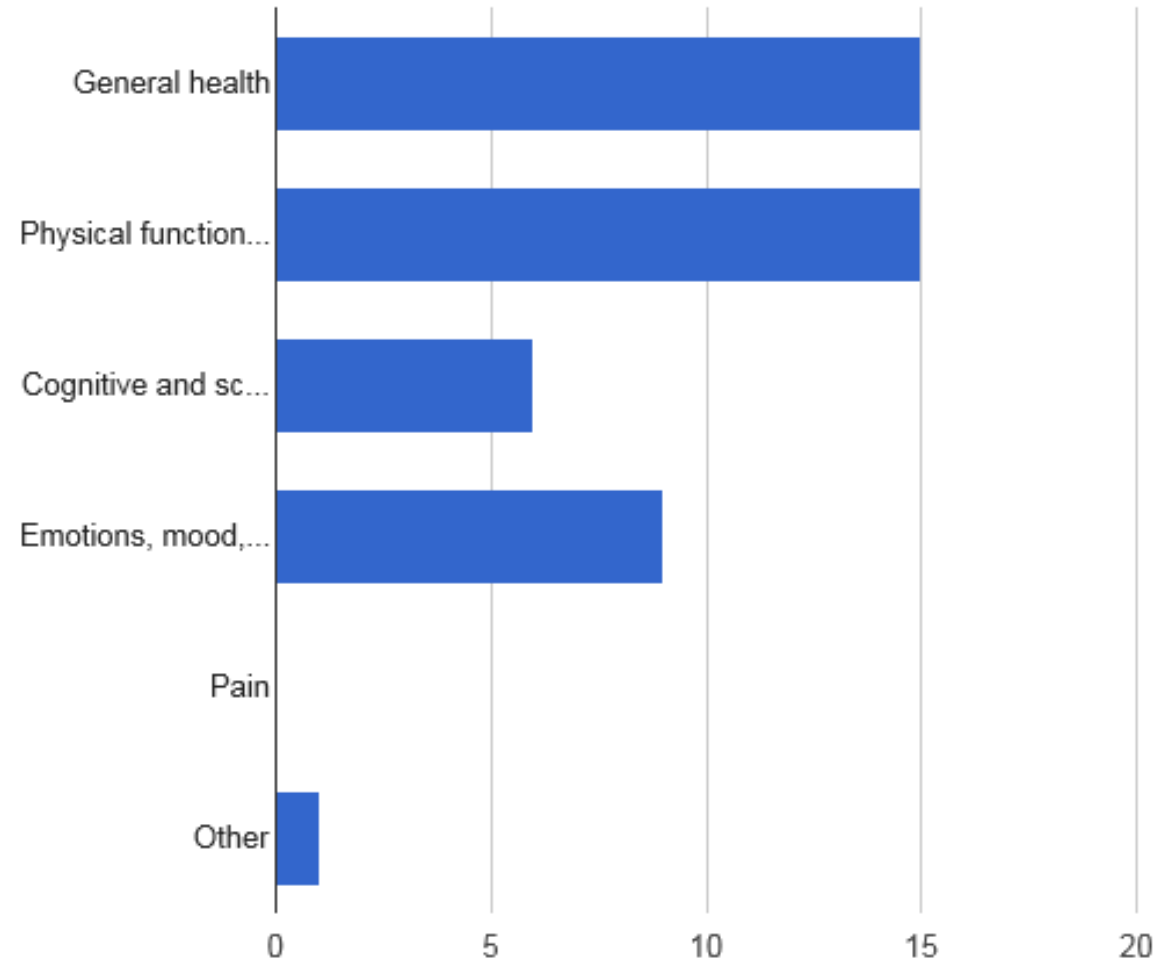
Aware of long-term functional impacts of sepsis:



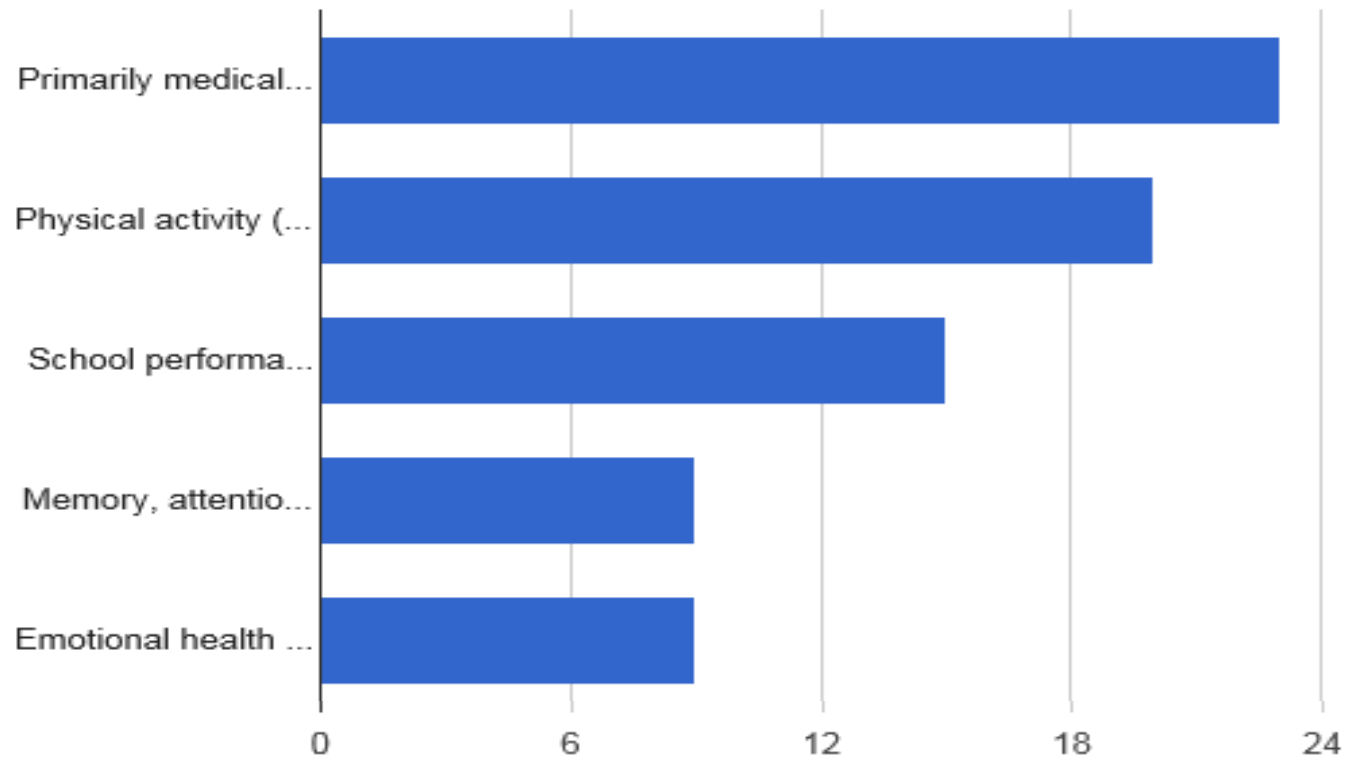
Trained to assess new functional disability:



What patient complaints or new problems have you seen after sepsis?

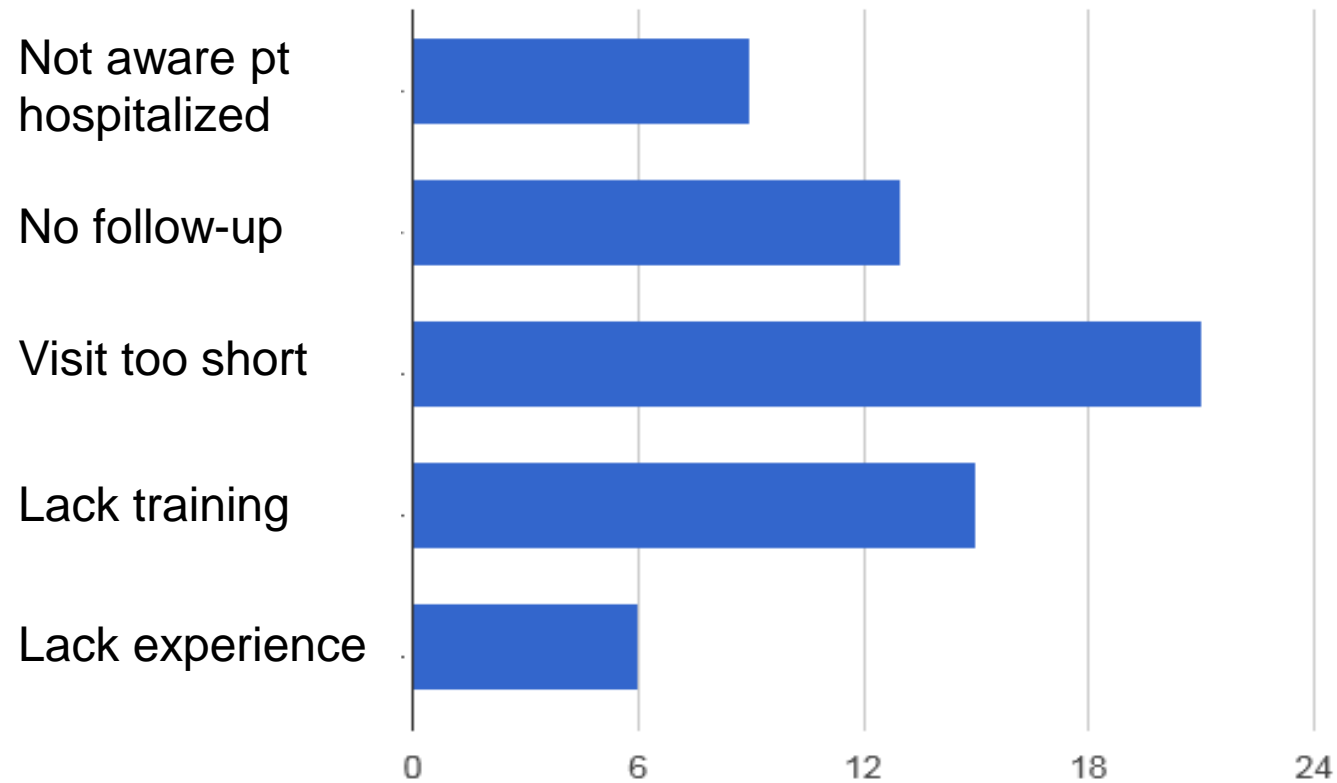


What do you assess for after sepsis?



**1 week follow-up,
20-30 minutes**

What barriers prevent determining morbidity after sepsis?



Parental Survey (N=7)

3/7 patients endorsed at least one new morbidity

Domain	Worse/Total	Deficits
Cognitive	0	
Physical	2/7 ^{A,B}	Endurance, walking, stairs
Emotional	1/7 ^C	Angry, tantrums, impulsivity, anxiety
Social	1/7 ^A	Playing with friends

^A 7 yo M

^B 5 yo M

^C 4 yo F

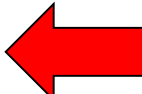
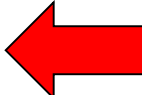
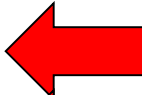
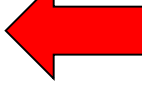
Pediatric Sepsis Program

Sepsis Survivorship Workshop

Children's Hospital of Philadelphia

CTRB Room 2012

Friday June 1, 2018

8:00 – 8:15 am	Welcome & Introduction (with breakfast)	Fran, Julie, Scott	
8:15 – 9:00 am	Life After Pediatric Sepsis	Jerry Zimmerman	
9:00 – 9:30 am	Sepsis Morbidity – The CHOP Experience	Fran, Julie, Scott	
9:30 – 9:50 am	Sepsis Morbidity – Family Experience	Darlene Barkman	
9:50 – 10:00 am	BREAK		
10:00 – 11:00 am	Panel Discussion	Becky Ichord (Stroke) Jill Ginsberg (Cancer) Sara DeMauro (NICU)	
11:00 – 11:30 am	Neurobehavioral Testing	Nina Thomas, PhD	
11:30 – 12:45 pm	Roundtable Discussion (with Lunch)	PT, OT, Speech, Education, (Possible: SW, case mgmt, coordinator, financing)	
12:45 – 1:00 pm	BREAK		
1:00 – 2:00 pm	Wrap-up & Next Steps	Fran, Julie, Scott	

Sepsis Survivorship Program



With early recognition, appropriate antibiotics, and emergency care, the majority of children who develop [sepsis](#) and septic shock are able to recover and be discharged from the hospital. Unfortunately, the effects of sepsis may not end at hospital discharge, and many survivors go on to have longer-term problems with attention, managing emotions, school work and physical activity. Children who recover from sepsis also can have recurrent infections and may need to be readmitted to the hospital. Usually these symptoms are noticed within a few months after leaving the hospital, as children attempt to return to school and their usual activities. Sometimes it is not clear if these changes are because of sepsis or just being really sick, or are caused by another medical problem.

At Children's Hospital of Philadelphia (CHOP), doctors and nurses within the [Pediatric Sepsis Program](#) have established a Sepsis Survivorship Program to screen patients for potential long-term problems related to sepsis and to help families get assistance when needed. We have partnered with the Care Management Program at CHOP to support families who have children with both pre-existing medical problems and those who were healthy prior to sepsis. Our program involves meeting with families during hospitalization when possible and following up via phone or email approximately two months after discharge to screen patients for potential concerns and assist with referrals as needed.

For further information or to contact us with concerns, please email sepsis@email.chop.edu or call the Sepsis Survivorship Nurse Coordinator at 215-590-1550.

The Sepsis Survivorship Program is supported by a [Department of Pediatrics](#) Chair's Initiative award and the Divisions of [Emergency Medicine](#) and [Critical Care](#).

CONTACT US

PEDIATRIC SEPSIS PROGRAM

Contact Us
215-590-1550

[CONTACT US ONLINE](#)

[PEDIATRIC SEPSIS PROGRAM HOME](#)

[OUR TEAM](#)

[CONDITIONS WE TREAT](#)

[PATIENT STORIES](#)

[RESOURCES](#)

[OUR RESEARCH](#)

[NEWS AND ARTICLES](#)

[RESOURCES FOR PROFESSIONALS](#)



Nancy Kelly, RN

www.chop.edu/sepsis

CHOP Sepsis Survivorship Program

1. Identify children hospitalized with sepsis/septic shock in PICU
2. Meet with family in the PICU to provide education

PEDIATRIC SEPSIS PROGRAM



The Pediatric Sepsis Program at CHOP is supported by a Department of Pediatrics Chair's Initiative award, the Division of Emergency Medicine, the Department of Anesthesiology and Critical Care Medicine, the Office of Clinical Quality Improvement, and investigator-initiated grants.



WHAT IS SEPSIS?

Sepsis occurs when the body develops an overwhelming response to an infection — such as pneumonia or a urinary tract infection — that causes organ failure. Almost any infection, if it is not stopped early, can cause sepsis.

The signs and symptoms of sepsis can include:

- Fever, shivering or feeling very cold
- High heart rate
- Breathing fast or feeling short of breath
- Confusion, disorientation and lethargy
- Cold or pale hands and feet

In the mid-1900s, more than 90 percent of patients who developed sepsis died. With improvements in care, most patients who develop sepsis now survive. However, about one in 10 children with severe sepsis still die, and many survivors go on to have longer-term problems with attention, school work and physical activity, as well as a higher risk of recurrent infections and hospital readmission.

OUR SPECIALIZED PROGRAM

The Pediatric Sepsis Program at Children's Hospital of Philadelphia (CHOP) is a center of expertise for pediatric sepsis. We provide infants, children and adolescents with sepsis top-notch clinical care and cutting-edge research opportunities in one place.

Our multidisciplinary team is made up of specialists in pediatrics, surgery, oncology, cardiology, emergency medicine, and critical care, with contributions from physicians, nurses, respiratory therapists, pharmacists, bioinformaticians, and quality improvement specialists, among others. Every day, we're searching for new ways to treat sepsis, offering hope for a better future for children and their families. Our team is helping to lead the international medical and scientific communities in the search for answers to key questions, including:

- What causes sepsis?
- What are the best methods for early detection of sepsis?
- What are the most effective therapies to reverse the effects of sepsis?

Our vision is that every child with a severe infection will be evaluated for sepsis and treated with the highest-quality medical and surgical care to reduce — and eventually eliminate — death and disability caused by sepsis.

LEARN MORE:
chop.edu/sepsis
sepsis@email.chop.edu

CHOP Sepsis Survivorship Program

1. Identify children hospitalized with sepsis/septic shock in PICU
2. Meet with family in the PICU to provide education
3. Establish a follow-up plan
 - Primary physician, subspecialty physician
 - Chronic care management team
 - *CHOP Pediatric Sepsis Program*
4. Screen at 2-3 months after discharge
5. Refer as needed
 - Primary physician (with recommendations)
 - PT/OT
 - Neuropsychologist evaluation

CHOP Sepsis Survivorship Program

- 26 patients contacted
- 14 *CHOP Pediatric Sepsis Program* follow-up
 - 6 phone surveys completed
- Survey results:
 - 2/6 flagged for new problems
 - 1 referred back to primary physician
 - 1 referred to neuropsychologist

A Real Story: 8 year-old boy

- Previously healthy, treated for *staphylococcus* toxic shock syndrome
- Spoke with mother 3 months after discharge:
 - Initially: “He’s doing great!”
 - After the screening questionnaire...
 - Anxiety (general and separation)
 - Lack of attention with hyperactivity
 - Headaches
 - Sadness, insomnia
 - Difficulty with friends

Conclusions

- Sepsis is a lethal disease...preventing early mortality will always remain a primary goal
- Adverse effects of sepsis evolve over a prolonged period, certainly beyond hospital discharge
 - Key risk factors: illness severity, older age, comorbidities
- Shift clinical, research (and QI) focus from short- to long(er)-term morbidity and mortality endpoints
 - **>600,000 pediatric sepsis survivors at-risk for PICS in the next decade**

Thank you!

**WeissS@email.chop.edu
sepsis@email.chop.edu
www.chop.edu/sepsis**



After Sepsis Hits Home

A doctor mom's story

By Marnie Doubek, MD, FAAFP



I HAVE NOTHING TO DISCLOSE

**I will not be discussing investigational and/or
unlabeled uses of a product**

**April, 2014 we had no idea
what was coming...**



**June 7, 2014 –
How can this be my healthy son?**



Zach finally out
of the coma



THE IMMEDIATE CONSEQUENCES



Transferred to Children's Specialized for Rehab



Home at last



The obvious consequences



More subtle consequences



The most subtle consequences





**AND WE ARE THE
LUCKY ONES!**

ZACHARY TODAY



Questions?



Scott L. Weiss, MD, MSCE, FCCM
Assistant Professor, Children's Hospital of Philadelphia,
University of Pennsylvania Perelman School of Medicine



Marnie Doubek, MD, FAAFP
Mother of Zachary, a pediatric sepsis survivor

Erin's Campaign for Kids Nursing Awards



Erin's Campaign for Kids Nursing Awards

- Pediatric Nurses
- Nursing Students
- Sepsis Coordinators

Apply Today!
[Sepsis.org/erin](https://www.sepsis.org/erin)

Deadline: April 26, 2019

 SEPSIS ALLIANCE

 erin's campaign for kids



Apply Today! <https://www.sepsis.org/erin>



SEPSIS ALLIANCE

Sepsis Coordinator Network

The Sepsis Coordinator Network supports ongoing communication, education and network building among health professionals passionate about improved sepsis care. Resources include:

- **Educational webinars** that highlight sepsis best practices in a variety of healthcare settings
- Active **discussion** and **peer support** via an online forum
- A **resource drive** with information on topics including core measures, clinical practice guidelines, patient screening, identification tools, education resources and more

All active healthcare providers are welcome to join including physicians, nurses, first responders, pharmacists, lab staff, etc.

Join now at SEPSISCOORDINATORNETWORK.ORG

Sponsors



Sepsis Data Abstraction: Open Forum

April 25 at 2 pm ET

Speakers:



Angela Craig, APN, MS, CCNS
Clinical Nurse Specialist for Critical
Care and Sepsis Lead Cookeville
Regional Medical Center



Michael G. Seelman, BSN, MS
Regional Quality Officer
Bon Secours Mercy Health



Betty Ealey, ADN, RN
Clinical Data Abstractor
Cookeville Regional Medical Center



Marla Jones, BSN, RN
Quality Improvement Coordinator
Bon Secours Mercy Health Youngstown

Register now: www.sepsis.org/events



SEPSIS ALLIANCE[®]

Sepsis Coordinator Network

Sponsor Innovation webinar

May 1 at 2 pm ET

Speakers:



Stephen Claypool, MD
Medical Director of the Surveillance business
Wolters Kluwer Health



Rachel Burnside
Senior Global Marketing Manager Hematology
Beckman Coulter

Register now: www.sepsis.org/events

Maternal Sepsis Day is May 15

Maternal Sepsis Webinar

May 15 at 2 pm ET

Speakers:

Lori Olvera, DNP, RNC-OB, EFM-C
Perinatal Educator
Sutter Medical Center

Katarina Lannér-Cusin, MD, FACOG
Medical Director Women's Services, Sutter Health
Alta Bates Summit Medical Center

Graciela Eldridge Maternal Sepsis Survivor



Register now: www.sepsiswebinar.org



Sepsis: Across the Continuum of Care Webinar series

The information in this webinar is intended for educational purposes only. 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.

*This webinar is made
possible with unrestricted
educational support from
bioMérieux, Inc.*

