Society of Pediatric Anesthesia

Editors Best Picks

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Decreasing PICU Catheter-Associated Bloodstream Infections: NACHRI's Quality Transformation Efforts

Pediatrics 2010;125:206–213

Marlene R. Miller, Michael Griswold, J. Mitchell Harris, II, Gayane Yenokyan, W. Charles Huskins, Michele Moss, Tom B. Rice, Debra Ridling, Deborah Campbell, Peter Margolis, Stephen Muething and Richard J. Brilli

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Background

- CA-BSIs are a significant cause of morbidity, mortality, and added medical costs
- The incidence of 6.6 CA-BSIs per 1000 catheter
- CA-BSIs in adult ICUs have been nearly eliminated by applying a multifaceted intervention

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Study Aim

To identify and test the impact of pediatric specific catheter-care practices in reducing pediatric CA-BSI rates.

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Outcome Outcomes & Design

50% decrease in rates by using the interventions (insertion) for 90% of insertions and by reliably performing the maintenance for 70% of catheter

multiinstitutional, interrupted time-series design (historical control) in 29 PICUs (NACHRI)

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Study Design: Methods

Design: multiinstitutional, interrupted time-series design (historical control)

Participants: 29 PICUs (NACHRI)

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Study Design: Methods

The team: PICU leader, 2-3 members, nursing, QA, ID service

The process: 4 face-to-face learning workshops, monthly conference call

PICU team, using quality-improvement methods of small tests of change

The Interventions: 1) Insertion; 2) maintenance

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Study Design: Intervention 1

- Wash hands before the procedure.
- Chlorhexidine gluconate (30 sec and 2 mins for groin)
- Air drying (60 sec)
- No iodine skin prep or ointment
- Prepackage
- Create an insertion checklist
- Use only polyurethane or Teflon catheters
- Insertion training for all providers (slides & video)

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Study Design: Intervention 2

- **Assess daily whether catheter is needed**
- **Catheter-site care**
  - **No iodine ointment.**
  - **Use a chlorhexidine gluconate**
  - **Change gauze dressings every 2 d**
  - **Change clear dressings every 7 d**
  - **Use a prepackaged dressing-change**

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Study Design: Intervention 2

- **Catheter hub, cap, and tubing care**

  - **Replace administration sets every 72 h**
  - **Replace tubing that is used to administer blood or lipids**
  - **Change caps no more often than 72 h**
  - **The prepackaged cap-change kit to be designated by the loca institution.**

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Study Design: Measures

Compliance: self-reported daily

Infection Rate: PICU CA-BSI/1000 d of CL days

Data collection: hospital-based, ID practitioners in accordance with CDC definitions.

Statistical Analysis

- **Clustering effect:** hierarchical modeling including marginal generalized linear models with log-links, negative binomial distributions, and working autoregressive correlation structures.

- **Analysis over time:** baseline, ramp up, stable effect

- **Confounding variables:** geographic region, length of stay, and bed capacity

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Results

- The 29 PICUS reported 324 CA-BSI events during the 12-month post intervention study period (95 205 total central-line days.).

- Rate Change: 5.4 CA-BSIs per 1000 central-line-days to 4.3 (ramp up) to 3.1 (stable-effect rate) (p=0.001)

- 43% reduction in CA-BSI rates; insertion-bundle compliance of 84% and maintenance-bundle compliance goal of 82%

- Controlled by Hierarchical cluster-analysis regression modeling, only maintenance-bundle compliance was significant

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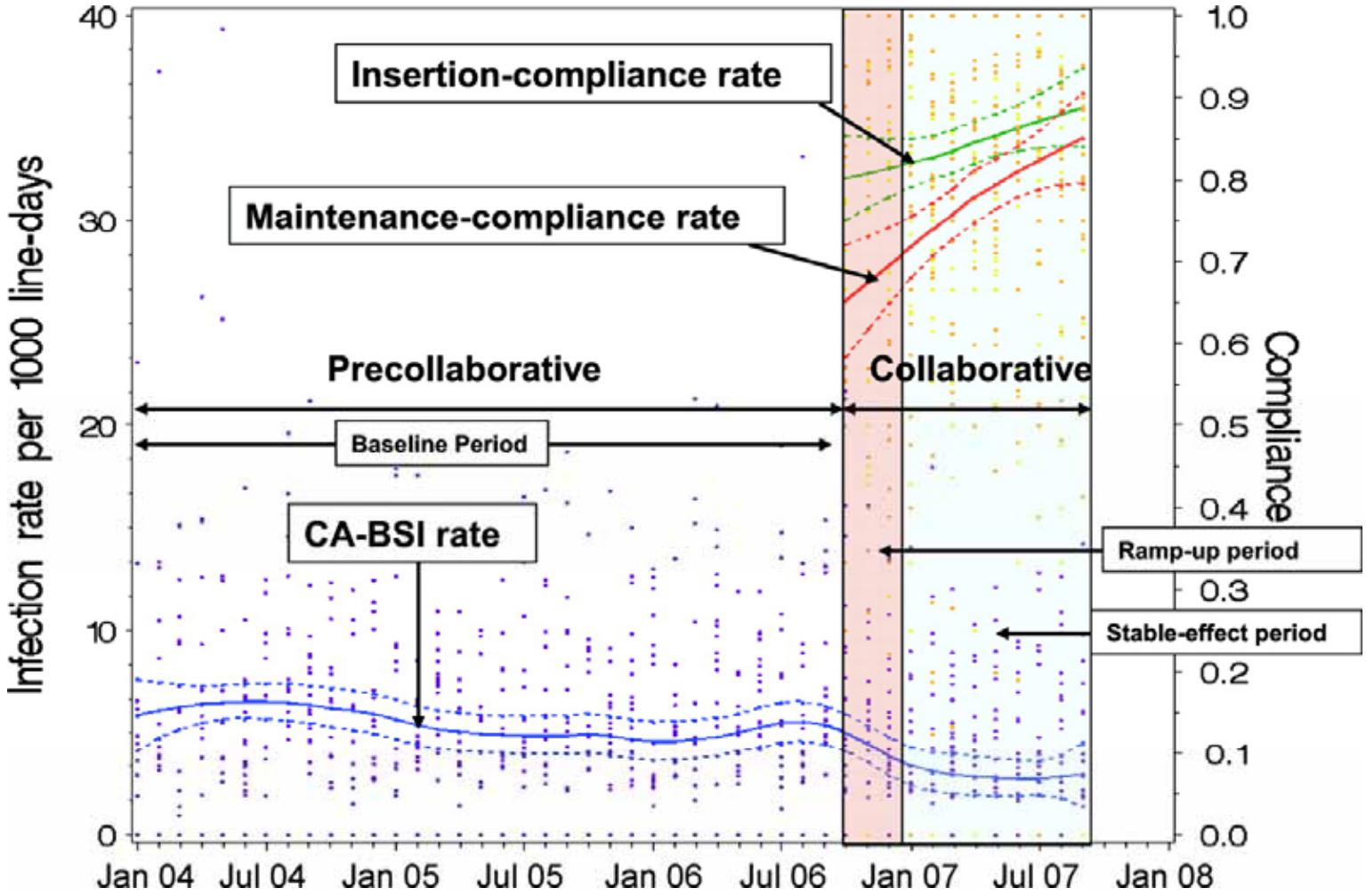
FIGURE 1 Data from 29 PICUs showing the rates of CA-BSIs and insertion and maintenance compliance and 95% CIs in the precollaborative and collaborative periods



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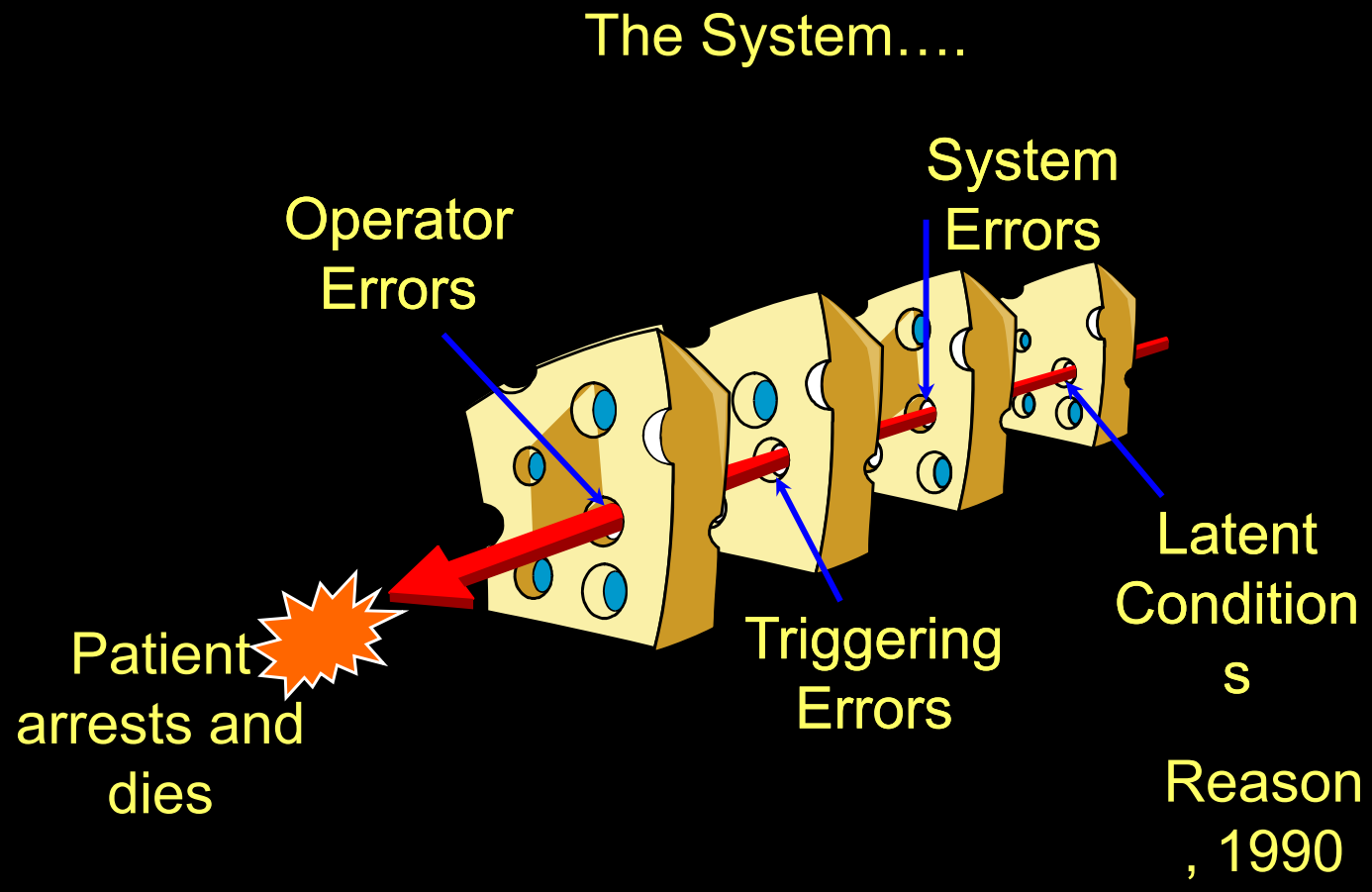
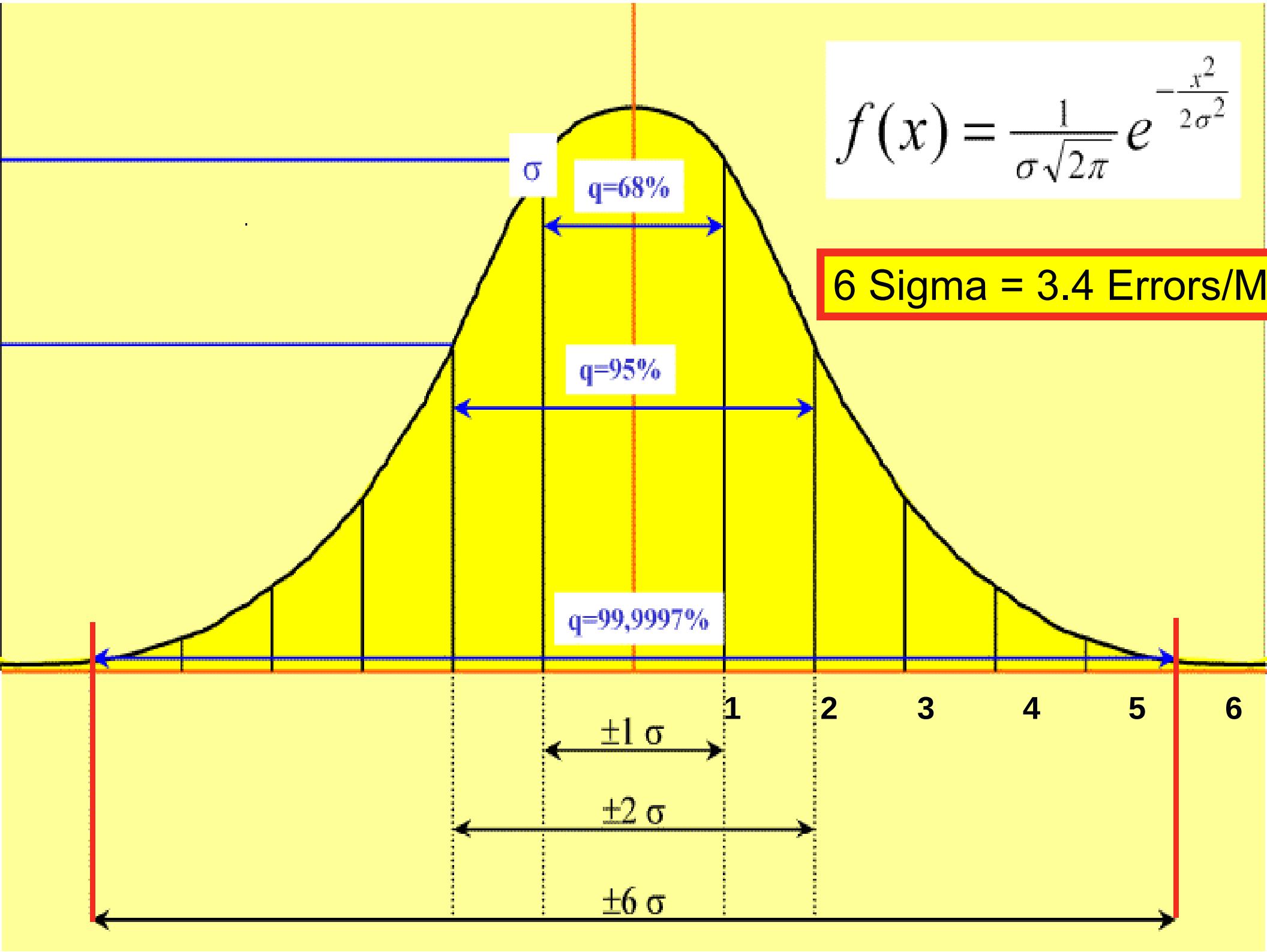
What is Six Sigma?

"A quality *improvement methodology* that applies statistics to measure and reduce variation in processes."




$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}}$
σ
q=68%
q=95%
q=99,9997%
6 Sigma = 3.4 Errors/M
1
2
3
4
5
6
±1 σ
±2 σ
±6 σ

Measurement: Six Sigma as a Quality Goal

The higher the sigma, the fewer the defects.

A increase from 3 to 6 Sigma represents a 20,000 fold improvement in quality.

σ	Defects Per Million Opportunities
1	697,672.15
2	308,770.21
3	66,810.63
4	6,209.70
5	232.67
6	3.40

3400

99% "Good" (3.8 Sigma)

No electricity for 7 hours per month

5,000 incorrect operations per week

20,000 wrong prescriptions per year

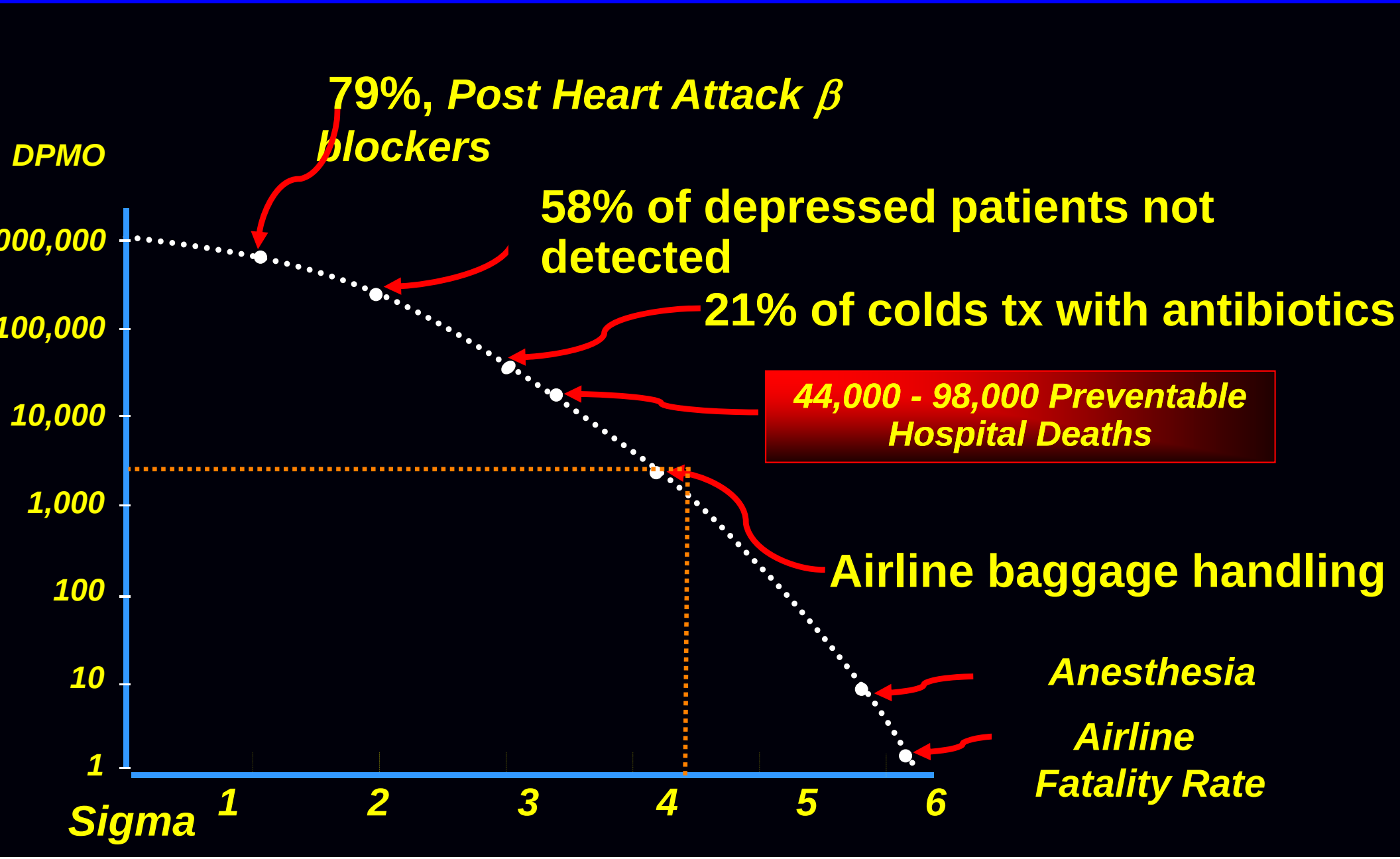
99.99966% "Good" (6 Sigma)

No electricity for 1 hour every 34 years

1.7 incorrect operations per week

68 wrong prescriptions per year

Sigma and Errors: Doing the math



Discussion

- **Maximizing insertion-bundle compliance alone cannot help PICUs eliminate CA-BSIs**
- **reducing pediatric CA-BSI rates seem to be issues that surround daily maintenance care for central lines, an attribute of bedside nursing care and practice**
- **This is contrast with the adult data**

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Cardiopulmonary Resuscitation for Bradycardia With Poor Perfusion Versus Pulseless Cardiac Arrest

Pediatrics 2009;124:1541–1548

JAaron Donoghue, MD, MSCE,a,b Robert A. Berg, MD,b Mary Fran Hazinski, RN,c Amy H. Praestgaard, MS,d Kathryn Roberts, RN, MSN,e and Vinay M. Nadkarni, MD, MS,b for the American Heart Association National Registry of CPR Investigators

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Background

- CPR for cardiac arrest is provided for 1% -2% of PICU patients
- Only 27% of these children with in-hospital cardiac arrests survive to hospital discharge
- Infants and children with progressive respiratory failure typically have bradycardia with a pulse before the development of pulseless arrest.

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Background

- PALS recommends chest compressions and ventilation when bradycardia with poor perfusion persists despite adequate oxygenation and ventilation

- However, this can create AV dyssynchrony and may worsen hemodynamics (?)

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Study Aim

To evaluate whether children who receive in hospital CPR for bradycardia with pulses and poor perfusion have improved survival compared with children who receive CPR for an initial presentation of pulseless arrest

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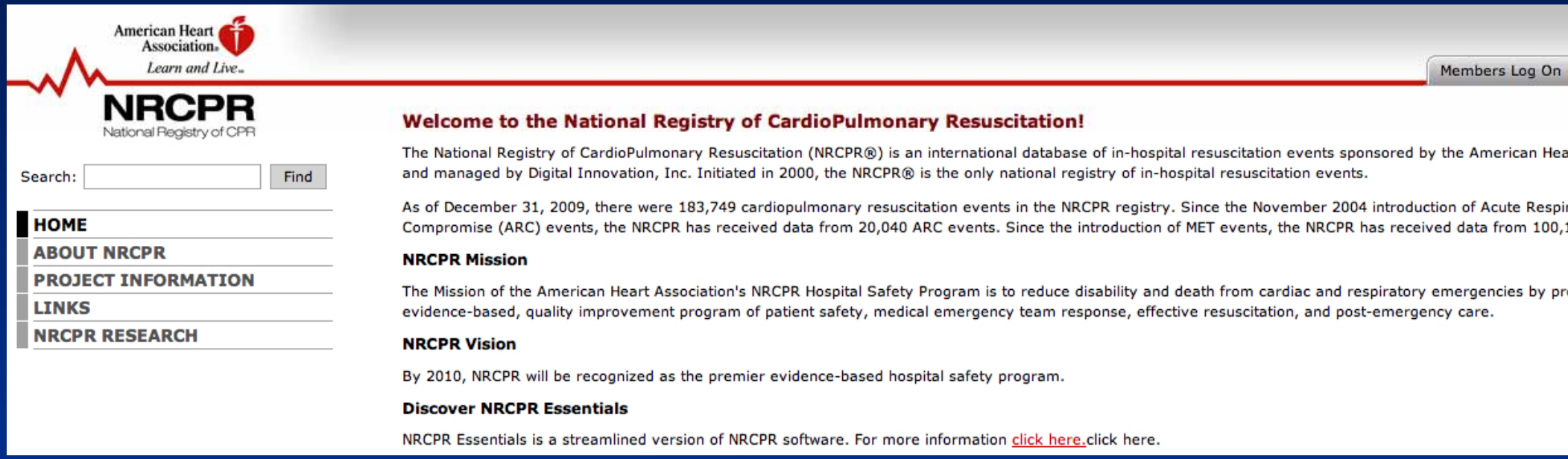
Study Design: Methods



Design: 2000-2008, cross sectional

Participants: 18 years<; in hospital, comp>2mins

Exclusion Criteria: out of hospital, neonates

)

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Outcome Measures

Primary:

- **Survival to hospital discharge**

Secondary:

- **Return of spontaneous circulation (ROSC)**
- **24-hour survival**

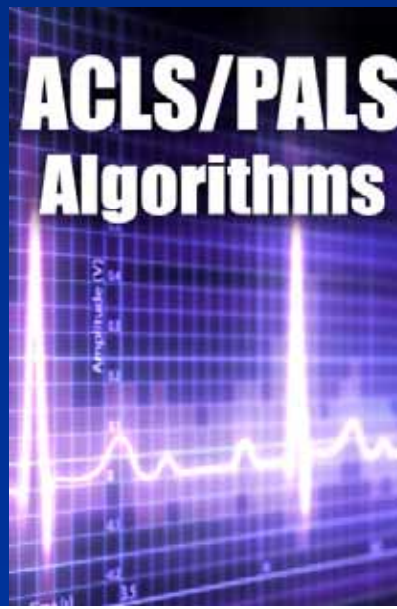

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FIGURE 1 Utstein outcome diagram (entire data set)

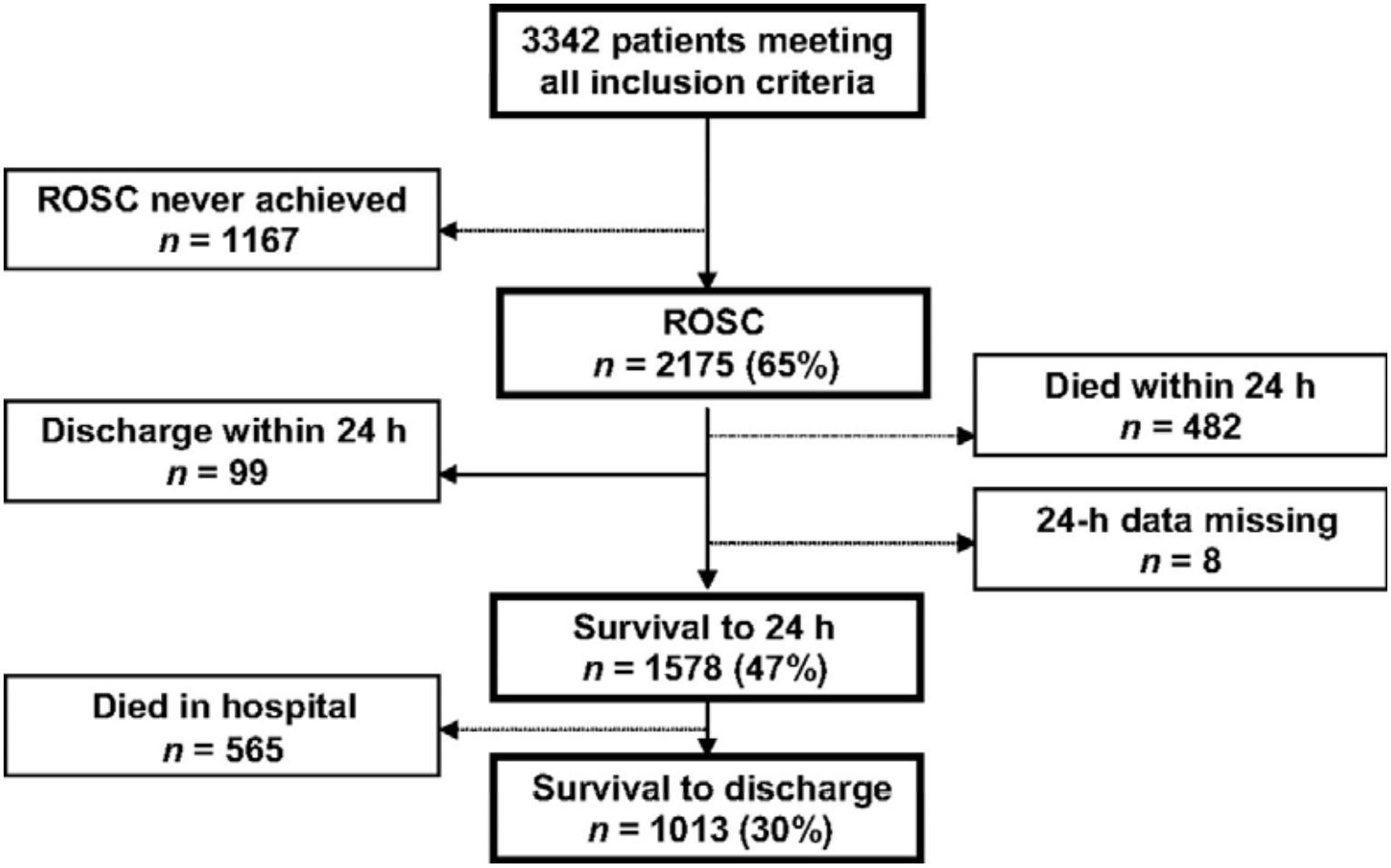

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FIGURE 2 Utstein outcome diagram, according to patient group

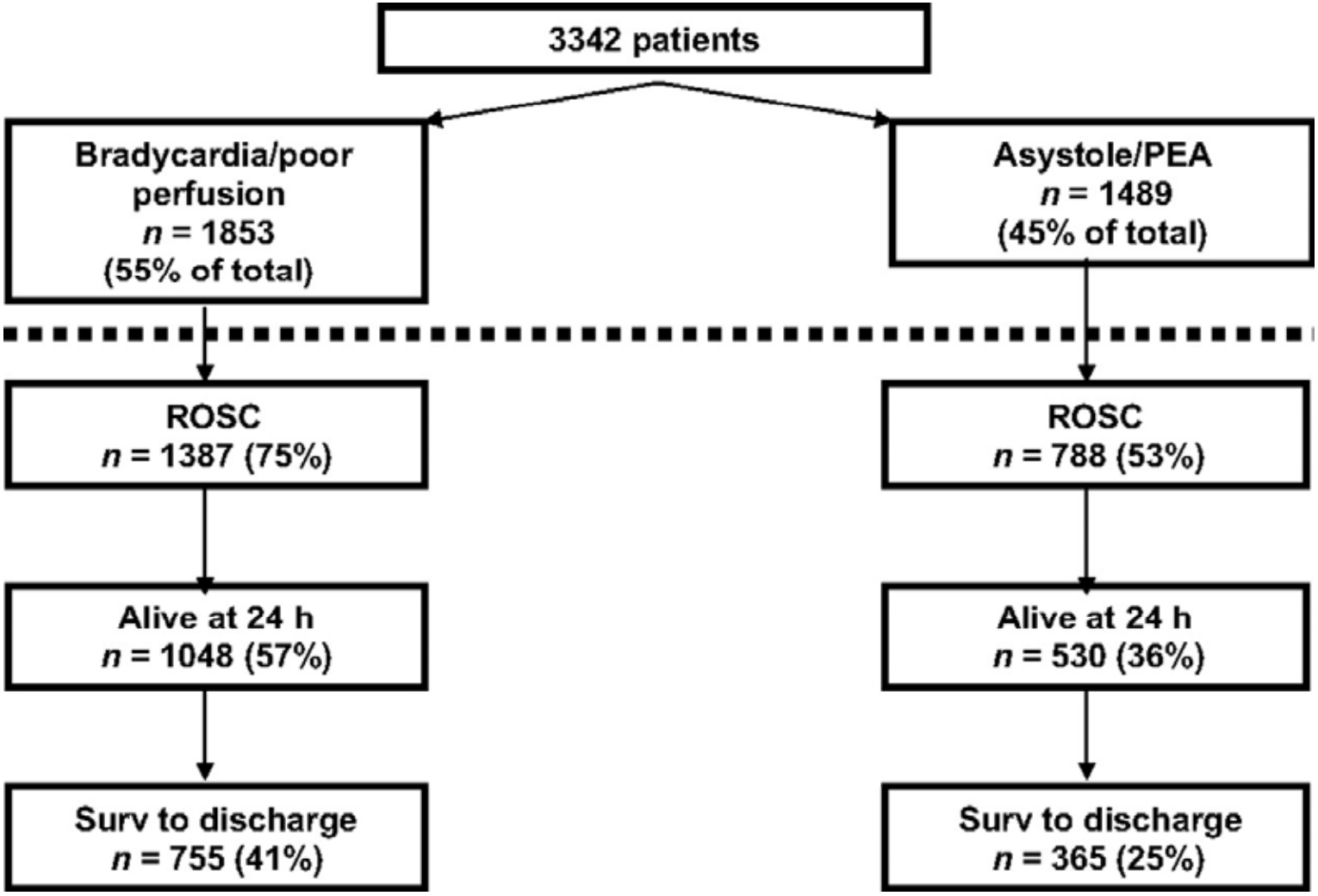
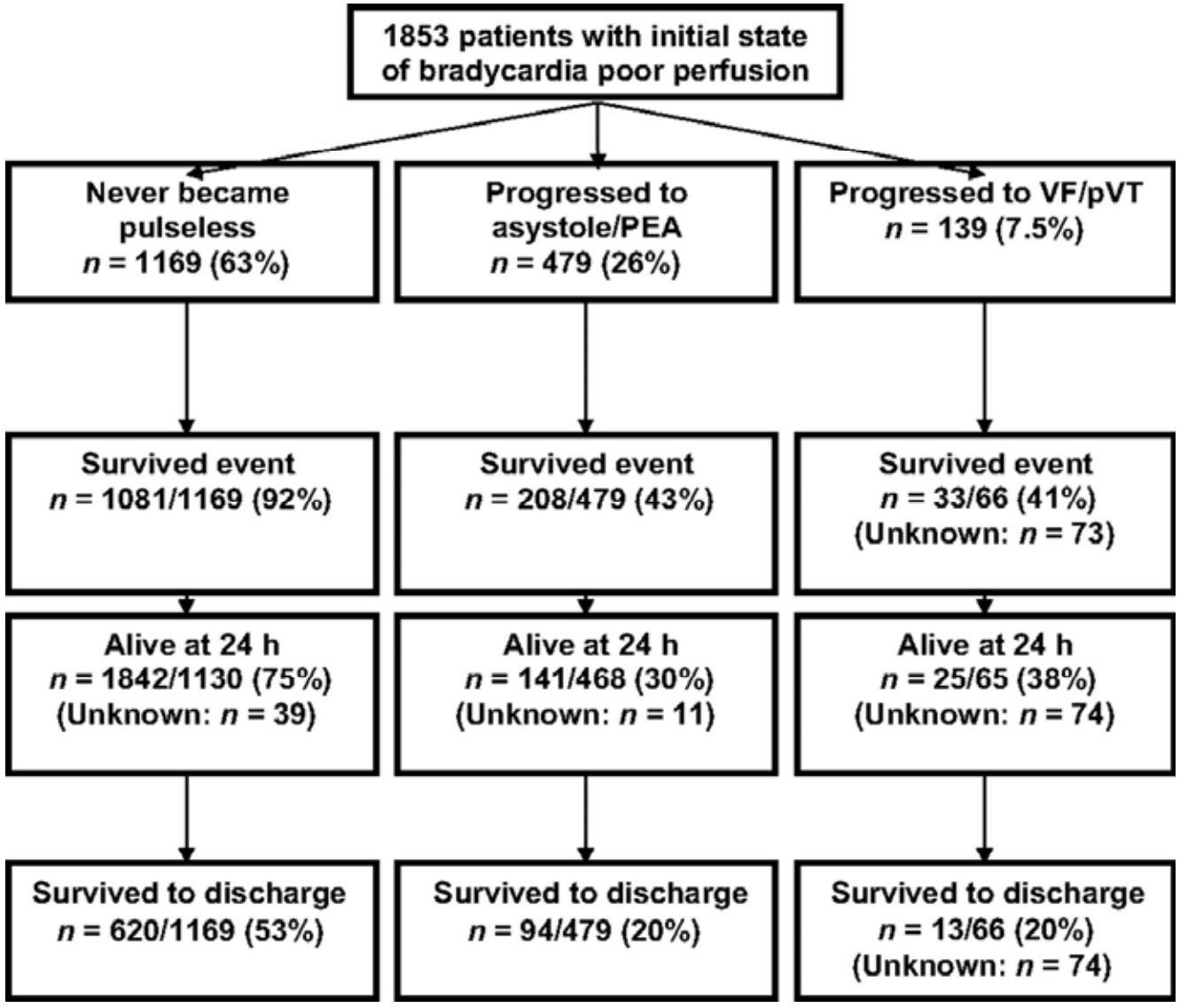


FIGURE 3 Outcomes of patients with bradycardia/poor perfusion according to subsequent rhythm (Utstein diagram)



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American Heart Association
Learn and Live

***Survival from in-hospital cardiac arrest during nights and weekends*. Peberdy MA, OrnatoJP, Larkin GL, et al: JAMA 2008; 299: 785-792**

Survival to discharge from in-hospital cardiac arrest is higher during day/evening shifts than during night and weekend shifts

Fewer CPA events are monitored or witnessed
Better mechanisms for rapid identification of CPA
Hospitals need to evaluate their staff, training, and response to CPA, especially during the night shift

NRCPR
National Registry of CPR

Discussion

Children who received chest compressions for bradycardia with pulses and poor perfusion before the onset of pulselessness were more likely to survive to hospital discharge compared with children who received chest compressions for pulselessness

Smile we are done!