YOUR CHILD IS HAVING AN OPERATION:

CURRENT MORBIDITY IN PEDIATRIC ANESTHESIA

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MORBIDITY AND MORTALITY IN ANESTHETIZED CHILDREN: OVERVIEW (I)

- a concern since Hannah Greener in 1848
- what are reasonable endpoints?
- identification of risk factors & risk reduction strategies

MORBIDITY AND MORTALITY IN ANESTHETIZED CHILDREN: OVERVIEW (II)

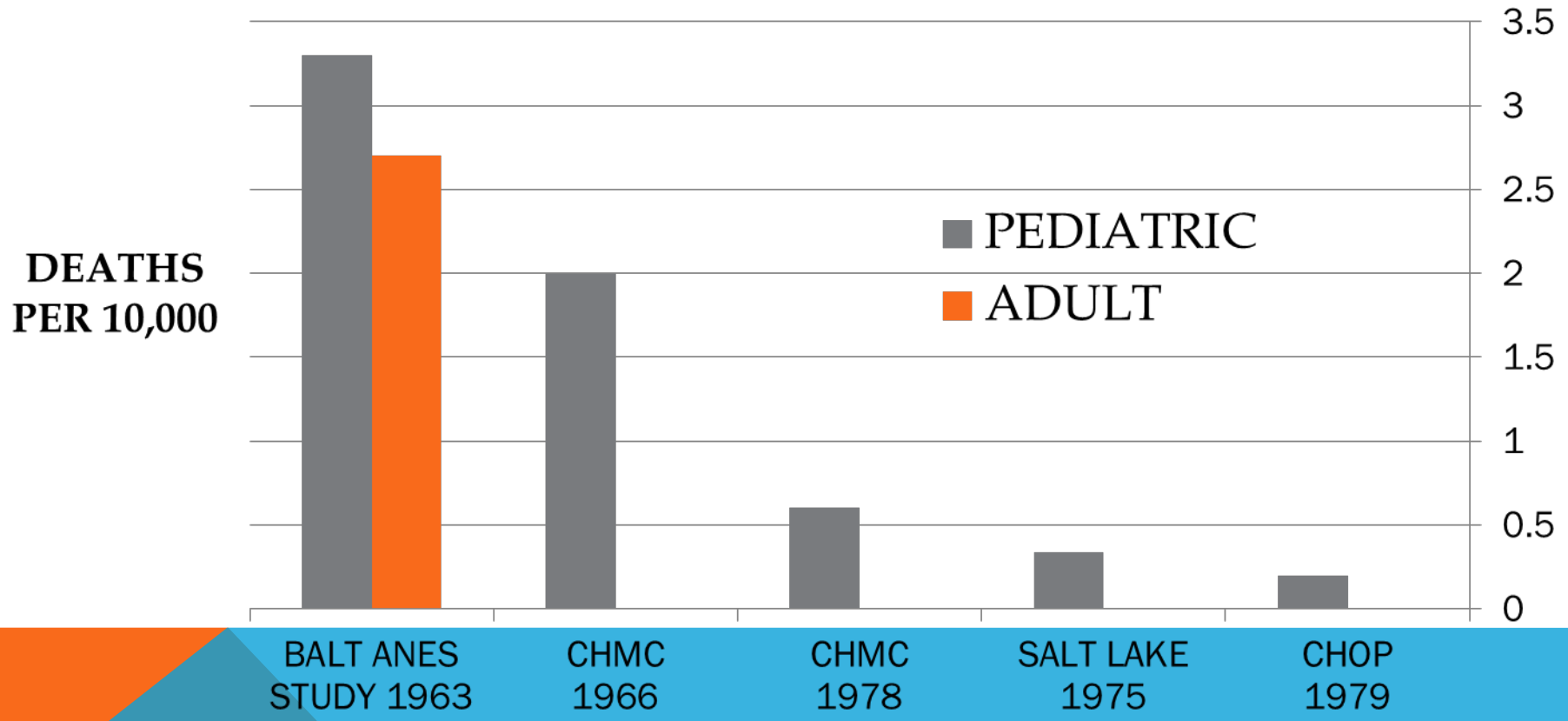
basic mechanisms for anesthetic-related mishaps

- cardiorespiratory depressant effects of anesthetics
- technical airway problems, including aspiration
- miscellaneous drug issues / errors
- surgical misadventure (with inadequate resuscitation)

THE REAL QUESTION

What is the risk of a *serious* complication to a healthy child undergoing a routine, peripheral procedure?

OLDER OUTCOME STUDIES IN PEDIATRIC SURGICAL PATIENTS: MORTALITY



IMPROVED SAFETY FOR ANESTHETIZED CHILDREN OVER THE PAST QUARTER-CENTURY

- improved (standardized) cardiorespiratory monitoring
- modern anesthetic agents / techniques / machines
- high-risk pts → *perioperative* specialty management
- JCAHO driven quality assurance programs
- ASA practice guidelines
- specialty organizations devoted *solely* to safety

EVOLVING NATURE OF SERIOUS COMPLICATIONS IN PEDIATRIC ANESTHESIA: CLOSED CLAIMS (CC)

primary event

	1970's	1980's	1990's
all respiratory	51%	41%	23% ↓
↓ ventilation	26%	14%	3% ↓↓
cardiovascular	19%	18%	26%
equipment	9%	11%	15%
death/brain damage	78%	75%	62% ↓
monitoring preventive?	63%	41%	16% ↓↓

Jiminez.*Anesth Analg* 2007;104:147

CLOSED CLAIMS: LESSONS LEARNED

- **Morray compared pediatric and adult CC ; pediatrics →**
  - ↑ median payment; ↑ respiratory etiology; ↑ likelihood death as injury; ↑↑ payment (11X higher) if "better monitoring" deemed preventive [1]
- Jiminez analyzed trends , reviewed CC from the 1990's in detail [2]
  - ↑ death/brain damage in ASA III-V, age < 3 (trend to younger age)
  - CV events surpassed respiratory as dominant cause of liability
  - resp events trended towards ↓ preventable, such as aspiration
  - specific preventable causes injury include prompt Rx of blood loss in infants; recognition of bleeding after T & A; appropriate med doses

1 *Anesthesiology* 1993;78:461
2 *Anesth Analg* 2007;104:147

OLDER OUTCOME STUDIES IN PEDIATRIC SURGICAL PATIENTS: CARDIAC ARREST

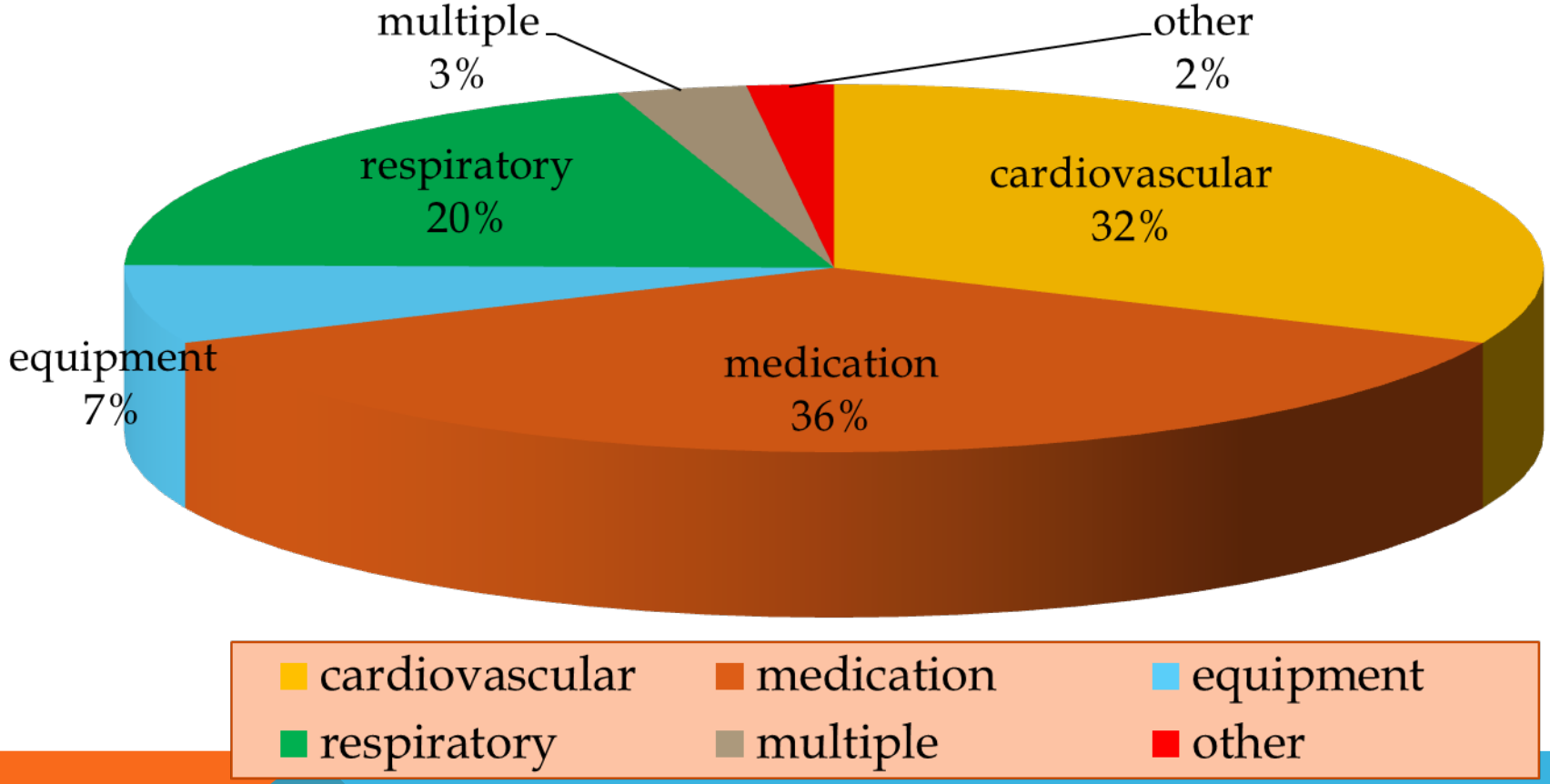
- Beecher & Todd: ↑ risk children compared to adults (1954)
- Closed Claims (1961): respiratory events predominant
- Keenan (1983-90): arrest 3-fold more likely < 12 years
  - ALL (1.2) < PEDI (2.9) << INFANT (9.2)
- Cohen (1990): risk stratified to first *month* of life

ANESTHESIA-RELATED CARDIAC ARREST IN CHILDREN: INITIAL FINDINGS OF THE PEDIATRIC PERIOPERATIVE CARDIAC ARREST REGISTRY (POCA)

- 1994: anonymous voluntary data bank
  - 63 institutions in US and Canada
  - 75% university / 40% children's hospital
- 289 cases (1994-1997) reviewed
- cardiac arrest →chest compressions and/or death
- 150 deemed anesthetic related (1.4:10,000)

Morray JP et al. *Anesthesiology* 93:6;2000

POCA REGISTRY: CAUSES OF CARDIAC ARREST (2000)



Morray JP et al. *Anesthesiology* 93:6;2000

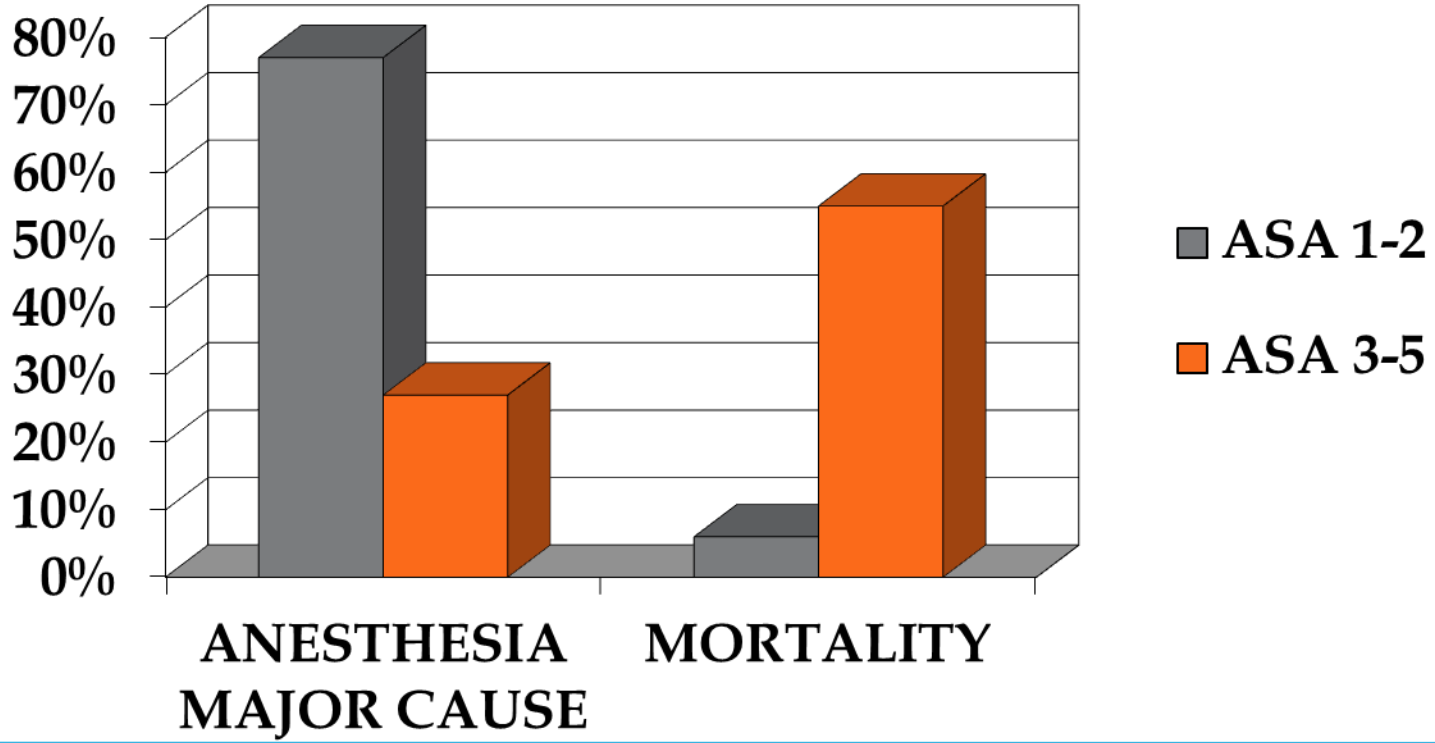
POCA REGISTRY: SUMMARY OF INITIAL FINDINGS (1994-1997)

- **surprising finding: medication-related > respiratory**
  - better monitoring (SPO_2 and $ETCO_2$) compared to "historical" studies where respiratory more common diagnosis
- **33% of anes-related arrests in ASA I-II; 64% of these are medication related, predominantly halothane (↑ infants)**
  - infants →55% of anesthesia-related arrests; low mortality
- **sicker patients less likely to be anes-related, higher likelihood cardiovascular etiology, higher mortality**

Morray JP et al. *Anesthesiology* 93:6;2000

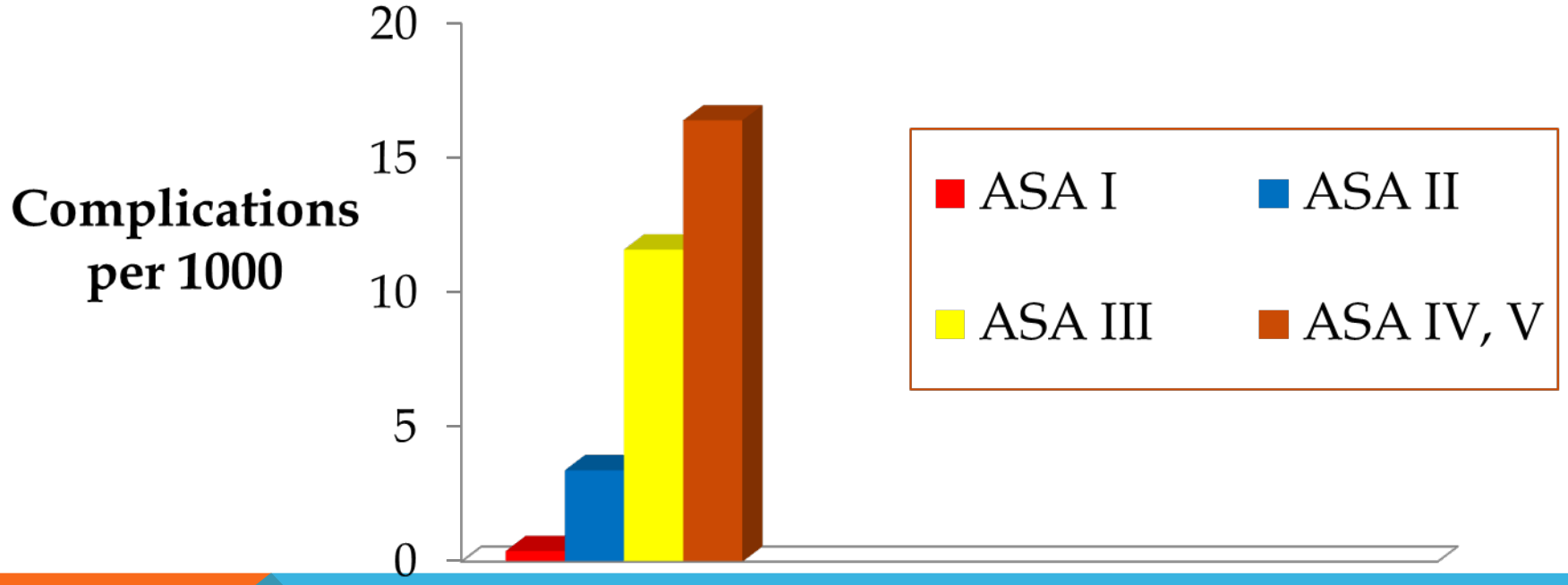
POCA REGISTRY AND ASA STATUS (2000)

mortality 26%
↑ ASA III-V,
emergency



Morray JP et al. *Anesthesiology* 93:6;2000

COMPLICATIONS RELATED TO ANAESTHESIA IN INFANTS AND CHILDREN: PROSPECTIVE SURVEY OF 40,240 ANESTHETICS



Tiret L. Br J Anaesth 61:263;1988

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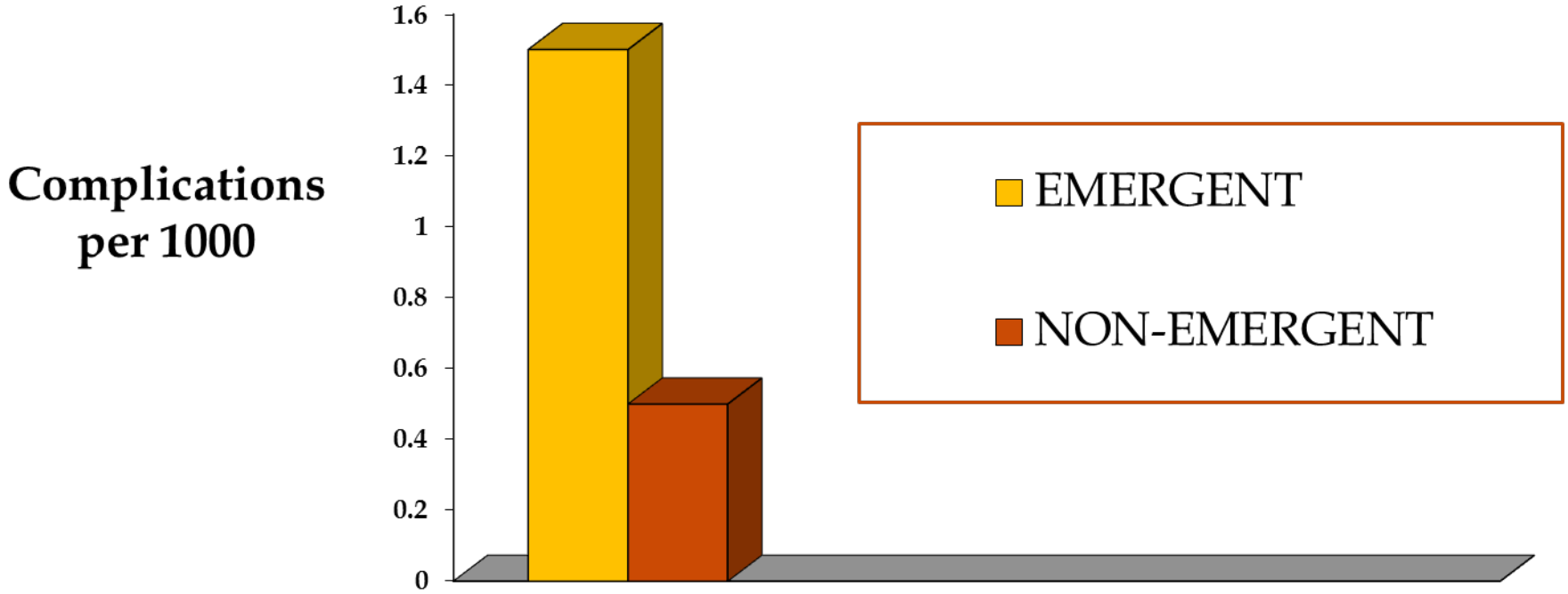

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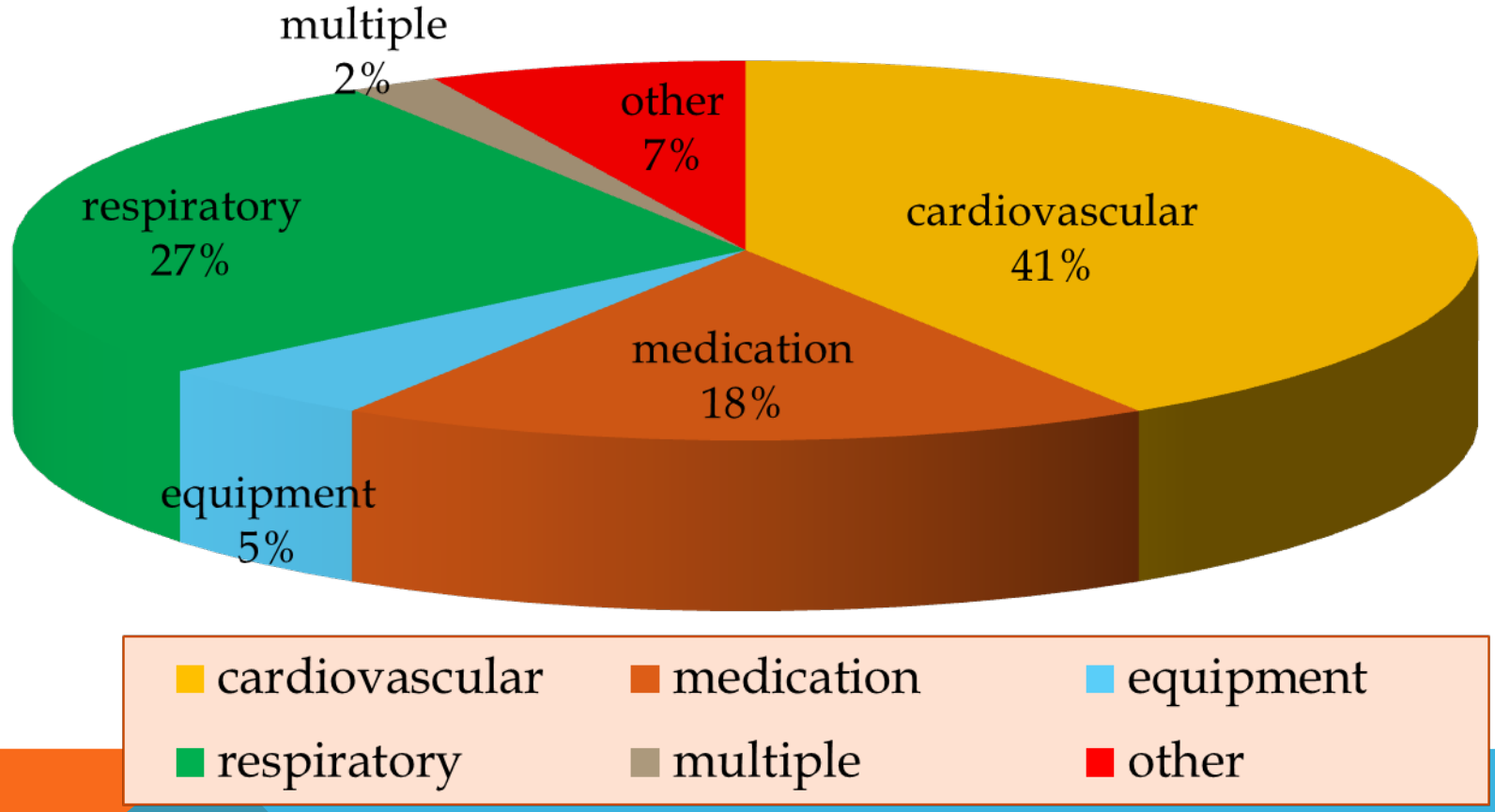
ANESTHESIA-RELATED CARDIAC ARREST IN CHILDREN: UPDATE FROM THE PEDIATRIC PERIOPERATIVE CARDIAC ARREST REGISTRY (POCA)

- 193 anes-related cases 1998 - 2004
- cardiovascular ↑; medication ↓ (sevo effect)
- infants account for 38% arrests (↓ from 55%)
- mortality (28%) → ASA III-V; emergency (ND)

Bhananker et al. *Anest Analg* 2007;105:344

POCA REGISTRY: CAUSES OF CARDIAC ARREST (2007)



Bhananker et al. *Anest Analg* 2007;105:344

POCA REGISTRY: LESSONS LEARNED (2007)

- cardiovascular arrests most commonly attributed to inadequate resuscitation; hyper-K^+ from rbc transfusion
  - preventability in these cases is often discretionary, but consideration to better lines and monitoring emphasized
  - rapid transfusion stored and/or irradiated blood ↑ K risk
- half equipment-related due to CVL insertion (w/out US)
- most common respiratory etiology was laryngospasm

Bhananker et al. *Anest Analg* 2007;105:344

ANESTHESIA-RELATED CARDIAC ARREST IN CHILDREN WITH HD: DATA FROM POCA REGISTRY

- 373 anes-related arrests 1994-2005 / 34% with heart disease
  - 24/127 single ventricle / highest mortality: AS, cardiomyopathy
  - 54% occurred in general OR's (26% card OR / 17% cath lab)

	With HD (127)	Without HD (245)
ASA III - IV	92%	62%
Emergency case	14%	24%
CV etiology	50%	38%
Medication related	20%	22%
Respiratory related	17%	28%
Mortality	33%	23%

Ramamoorthy et al. *Anesth Analg* 2010;110:1376

PERIOPERATIVE CARDIAC ARRESTS (POCA) IN CHILDREN AT TERTIARY CENTER 1988-2005

- 92,881 anesthetics Mayo Clinic; 5% repair of CHD
- poca 2.9:10,000 non cardiac / 127:10,000 cardiac
  - incidence of neonates with cardiac surgery 435:10,000
  - 88% of children who had poca had some form of CHD
- incidence of *anesthesia-related* poca 0.65:10,000
  - unlike POCA registry, excludes poca related to hemorrhage
  - unlike POCA registry, does not depend on self-reporting

Flick et al. *Anesthesiology* 2007;106:226

CRITICAL INCIDENTS (CI) IN PAEDIATRIC ANAESTHESIA: AUDIT OF 10,000 ANESTHETICS IN SINGAPORE

- 1997-1999; full spectrum, including complex CHD repair
- CI: "affected or could have affected patient safety" (297)
- 80% occurred in ASA I-II but 4x likely in ASA III-IV patients
- elective vs. emergency equally likely to have CI (2.7-2.9%)
- infants 4X likely to have a CI, especially with lower weight
- most CI (80%) occurred during maintenance phase
- respiratory (77%) most common (laryngospasm 36% total)

Tay. *Paediatric Anaesthesia* 2001;11:711

30 MONTH MORBIDITY IN A PEDIATRIC TEACHING HOSPITAL: 24,165 ANAESTHETICS

- **724 adverse intraoperative events (3.1%)**
  - respiratory most common (53%) - ↑ infants, ENT, ETT
  - 19 episodes aspiration→ 2 had clinical significance
  - cardiac 12.5% of events with risk ASA III-V
  - 8 cardiac arrests (2 anesthesia related)
- **no anesthesia related mortality**

Murat. *Pediatric Anesthesia* 2004;14:158

PERIOPERATIVE PULMONARY ASPIRATION IN INFANTS AND CHILDREN (MAYO CLINIC)

- prospective 63,180 pediatric GA 1985-1997
- 24 cases pulmonary aspiration (3.8:10,000)
- emergency surgery (26.8) >> elective (2.2)
- 9/24 (1.2) had symptoms - all by 2 hours
  - 3 required mechanical ventilation
- no mortality or long-term sequelae

Warner MA. *Anesthesiology* 90:66,1999

INCIDENCE AND RISK FACTORS OF PERIOPERATIVE RESPIRATORY ADVERSE EVENTS (PRAE) IN CHILDREN UNDERGOING ELECTIVE SURGERY

- prospective Swiss study 755 children 1-14 (exclude URI)
- overall incidence 21% in OR and 13% in PACU
  - most common occurrence was recurrent cough (OR & PACU)
  - laryngospasm (3.9% incidence) was confined to OR
- risk ↑: younger age, ENT surgery, lack of pediatric specialist
- tracheal intubation less likely to result in PRAE if use of NMB
- most PRAE easily managed without sequelae

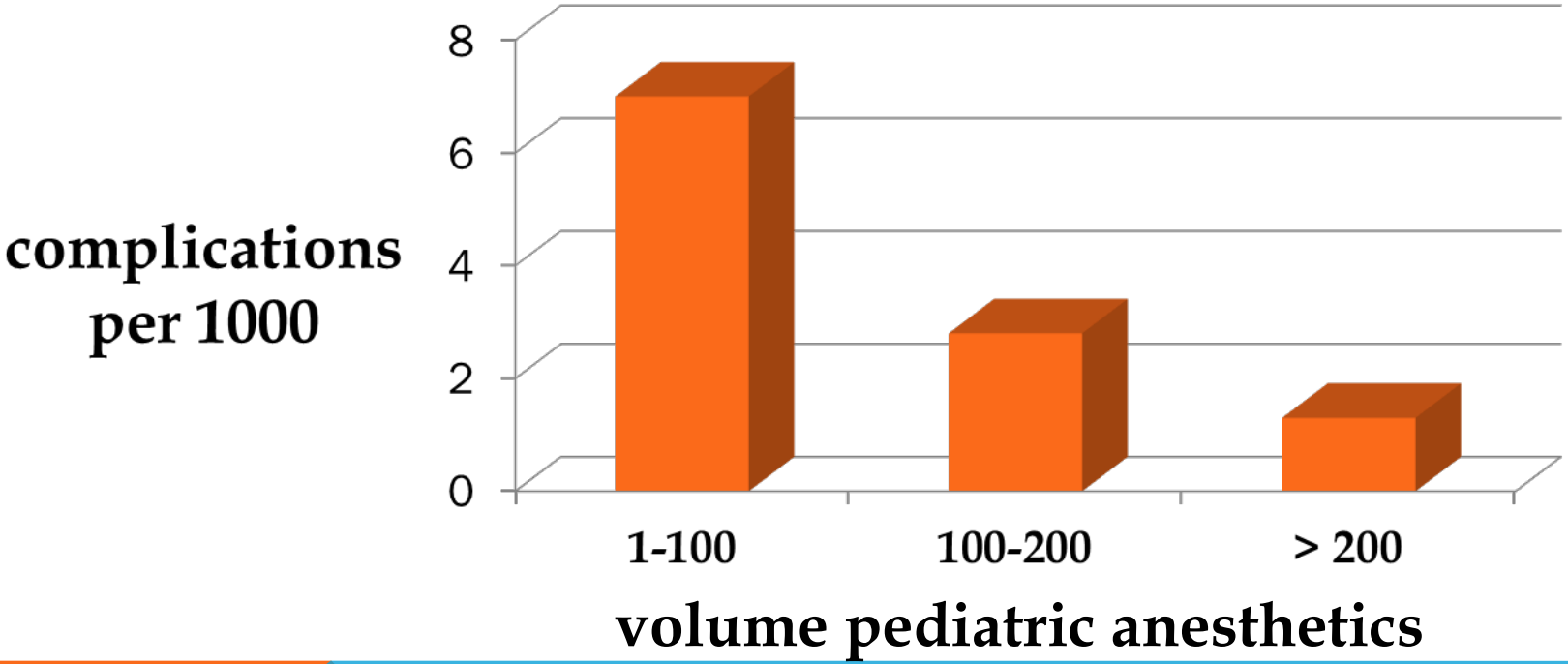
Mamie. *Pediatric Anesthesia* 2004;14:218

DOES IT MATTER WHO ADMINISTERS THE ANESTHETIC?

- *Frequency of Anesthetic Cardiac Arrests in Infants: Effect of Pediatric Anesthesiologists* [1]
  - P: 0 arrests in 2310 cases / NP: 4 arrests in 2033 cases (although none anesthesia-related)
- *Bradycardia During Anesthesia in Infants* [2]
  - 2.12% (NP) Vs. 0.82% (P) occurrence rate

1 Keenan RL. *J Clin Anesth* 3:433,1991
2 Keenan RL. *Anesthesiology* 80:976,1994

COMPLICATIONS OF PEDIATRIC ANESTHESIA AND VOLUME OF PEDIATRIC ANESTHETICS



Auroy Y. Anesth Analg 84:234,1997

EFFECTING MORBIDITY IN ANESTHETIZED CHILDREN

WITHIN OUR CONTROL	OUTSIDE OUR CONTROL
specialized care	ASA status
patient preparation	± age
quality assurance / protocols	emergency status
vigilance	± the procedure itself
safety monitoring	the unforeseen

"A MAJORITY OF HOSPITALS CARE FOR A FEW CHILDREN, AND MOST CHILDREN ARE CARED FOR IN A FEW HOSPITALS"

- retrospective - 1 year northern California
- children < 5 years 162/205 institutions
- total 14,435 "procedure days"
- 59% institutions < 20 procedure days

Macario. *J Clin Anest* 7:507;1995

PERIOPERATIVE RISK IN CHILDREN:
NEED ALL CHILDREN BE ANESTHETIZED BY PEDIATRIC ANESTHESIOLOGISTS?

NO	*YES*
• manpower issues • definition not clear • benefit uncertain for "routine" cases	• there is no "routine" case • outcome improved in higher risk situations • more efficient • parents more at ease

NATIONAL SOCIETIES ADVOCATE FOR SPECIALIZED CARE OF ANESTHETIZED CHILDREN

- importance of the perioperative environment as a whole (specialists, labs, ICU, equipment etc)
- AAP section on Anesthesiology has published guidelines to “reduce risk adverse events” [1]
- credentialing for pediatric specialists advocated for by Society for Pediatric Anesthesia

1 Hackel et al. *Pediatrics* 1999;103:512

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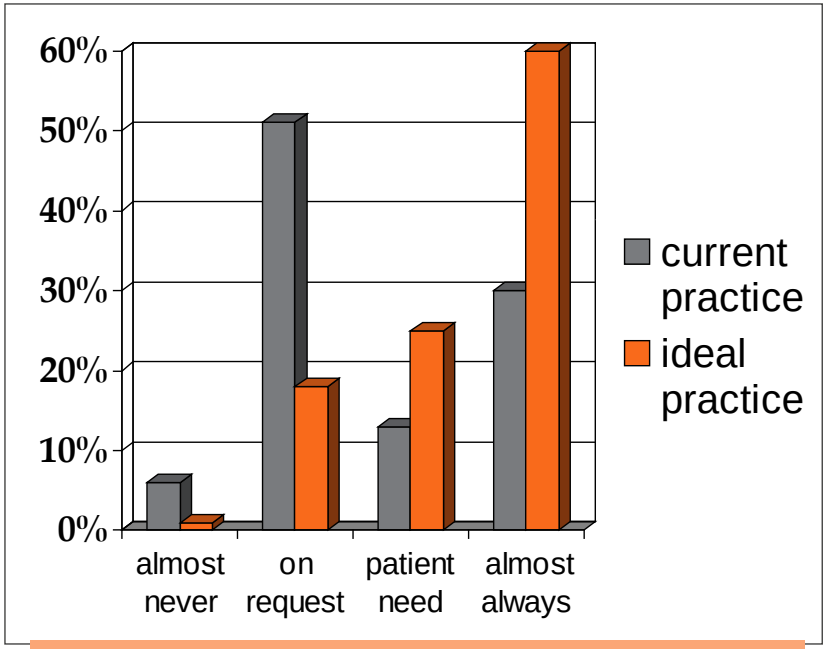
PREPARATION FOR SURGERY: MEDICAL

- history and physical examination
  - ASA status, meds, drug allergies, prior anesthetics
  - focused physical exam, including airway assessment
- routine labs no longer mandated
  - CBC, coags, C-spine (TRI 21) all discretionary
- preoperative fasting
  - liberalized clear fluids encouraged

"CLEAR FOR SURGERY": CURRENT ATTITUDES AND PRACTICES OF PEDIATRICIANS

- poll 2500 AAP members
- 7.6% had "training" in preop eval
- 17% felt expertise appreciated
- most had little contact with OR team
- variable (often incorrect) response to clinical management problems
- over half felt that they should "almost always" be consulted "



consultation patterns

Fisher QA. *Clin Pediatr* 1991;30:35

PREPARATION FOR SURGERY: POTENTIAL ROLE OF THE PEDIATRICIAN

- elucidate medical problems
- optimize child's condition
- consultation when appropriate
  - need for better communication and/or training regarding perioperative issues
- emotional support for child and family

PREPARATION FOR SURGERY: PSYCHOLOGICAL *

- hidden morbidity of pediatric anesthesia → behavioral stress with (relatively common) post-op regressive Δ's
- preoperative education crucial to reduce child and parental anxiety, promote coping skills
- induction plan to alleviate behavioral distress might include premedication, parental presence and flexibility in mode of induction *

* covered more fully in PowerPoint presentations→ *induction techniques* and *behavioral stress*

COMMUNICATING RISK TO PARENTS

- serious complications in a healthy child are very rare
- details about safety monitoring that prevent or allow early and effective Rx of untoward responses, such as “allergy”*
- anticipatory guidance “common” side effects, especially if might witness in OR/PACU (distress, vomiting, agitation)
- unresolved risk of developmental neurotoxicity *→ *only* if initiated by parents (but then, at length, if need be)

** these topics covered in separate PowerPoint lectures*

PREOPERATIVE DISCUSSION SHOULD ALSO PREPARE FOR EMERGENCE AND PACU STAY

- attention to VS, airway, oxygenation a priority
- PACU presence "most important" to surveyed parents
  - parents in PACU may ↓ behavior Δ's even if little apparent impact on agitation, which remains a vexing issue
- common side effects appear to have little impact on postoperative behavior changes (but deserve Rx)
  - nausea & vomiting, pain, shivering etc..

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CURRENT NATIONAL SAFETY INITIATIVES IN PEDIATRIC ANESTHESIA

- Society for Pediatric Anesthesia initiatives
  - Wake Up Safe (WUS) (with APSF)
    - 15 institutions self-reporting adverse events→QI initiatives
    - wrong-site surgery, syringe swap, medication errors
  - Pediatric Regional Anesthesia Network
    - ongoing QI initiative assessing risk w/regional anesthesia
- Smarttots – FDA and IARS partnership *
  - anesthetic developmental neurotoxicity

** covered in a separate PowerPoint presentation*

ANESTHETIZING CHILDREN: RATIONAL STRATEGY FOR RISK REDUCTION

- modern perioperative safety monitoring
- anesthetic techniques that ameliorate risks
  - fiscally responsible use of “safer” anesthetic agents
  - attention - hidden morbidity of pediatric anesthesia
- *some* criteria for who does case
- ongoing quality assurance processes