

The Right Patient To the Right Hospital At the Right Time



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Photo:Luc Choquer

Hospital care for children




- **Finite resources**
- **Widely varying local circumstances**
- **Ensuring quality and access without sacrificing efficiency**
- **Relationship between volume & quality**
- **Tradeoffs between care at small community hospitals and large distant regional pediatric centers**

What is unique about pediatric hospital care?



- **Children account for a small proportion of hospital activity**
- **Many children have high-risk conditions, but they include many rare disorders**
- **Experience with high-risk adults does not confer proficiency in care of high-risk infants and children**
- **Limited number of pediatric experts**
- **Limited supply of pediatric equipment**

Relative quality: What is the evidence?



- **Is quality of care better at large pediatric hospitals?**
- **Evidence for narrowly selected conditions at hospitals willing & able to collect detailed clinical data to analyze risk adjusted outcome**
 - **Intensive care**
 - **Trauma**
 - **Cardiac surgery**

Pediatric intensive care



- **Volume-Quality**
- **Retrospective analysis of ICU registry data from 16 PICUs- all disorders**
- **Risk adjusted mortality lower in units with high volume**
- **Each increase of 100 admissions/yr lowered relative risk by 5%**
- **Annual patient volume 147-1378**
 - **Tilford; Ped 2000;106:289**

Pediatric intensive care

- **Tertiary vs non-Tertiary hospital**
- **Retrospective analysis of clinical data**
- **Patients with head injury or respiratory failure**
- **For high risk patients (expected mortality risk > 30%)**
- **Risk adjusted mortality worse at non-tertiary hospitals (Odds ratio = 7.7)**
 - **Pollack; Crit Care Med 1991;19:150**

Pediatric trauma



- **Trauma centers meeting Am Col Surgeons criteria**
- **Retrospective analysis of trauma registry data**
- **Risk adjusted mortality at trauma centers lower than at other hospitals (Odds ratio = 0.75)**
 - **Osler; J Trauma 2001;50:96**

Pediatric trauma

- **Pediatric trauma centers or adult trauma centers with added pediatric qualifications**
- **Retrospective analysis of trauma registry data**
- **Better risk adjusted survival than at hospitals lacking pediatric qualifications**
 - **Potoka J Trauma 2000;49:237**

Pediatric trauma



- **Trauma centers**
- **Retrospective analysis of hospital administrative data**
- **Adherence to Am Col Surgeons' guidelines for nonoperative management of blunt splenic injuries better at trauma centers than other hospitals**
 - **Stylianios; J Am Col Surg 2006;202:247**

Pediatric heart surgery



- **Volume-Quality**
- **Retrospective analysis of hospital administrative or surgical registry data**
- **Better risk adjusted survival at high volume hospitals**
- **Independent effects of high hospital and surgeon volume**
 - **Jenkins; Pediatrics 1995;95:323**
 - **Hannan; Pediatrics 1998;101:963**

But...



- **No evidence across broad range of disorders, for a complete set of hospitals, across a region or an entire state or province**

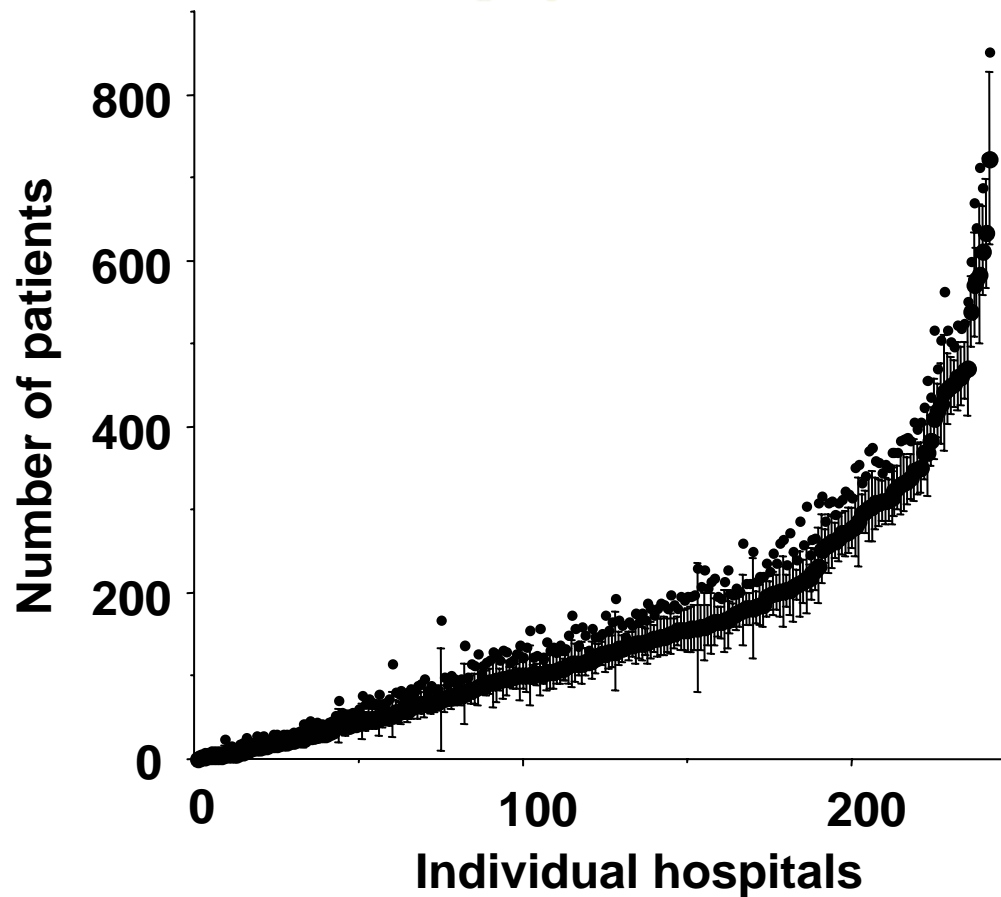
Observations in NY



- **General operations of hospitals are highly regulated**
- **Regional hospitals designated for certain services:**
 - **Trauma, perinatal, AIDS, burn, poison, sexual assault forensic examiner, stroke**
- **But pediatric hospitals are not designated**
- **NYS pediatric hospital activity provides a measure of what happens in a needs-based and market-driven environment**

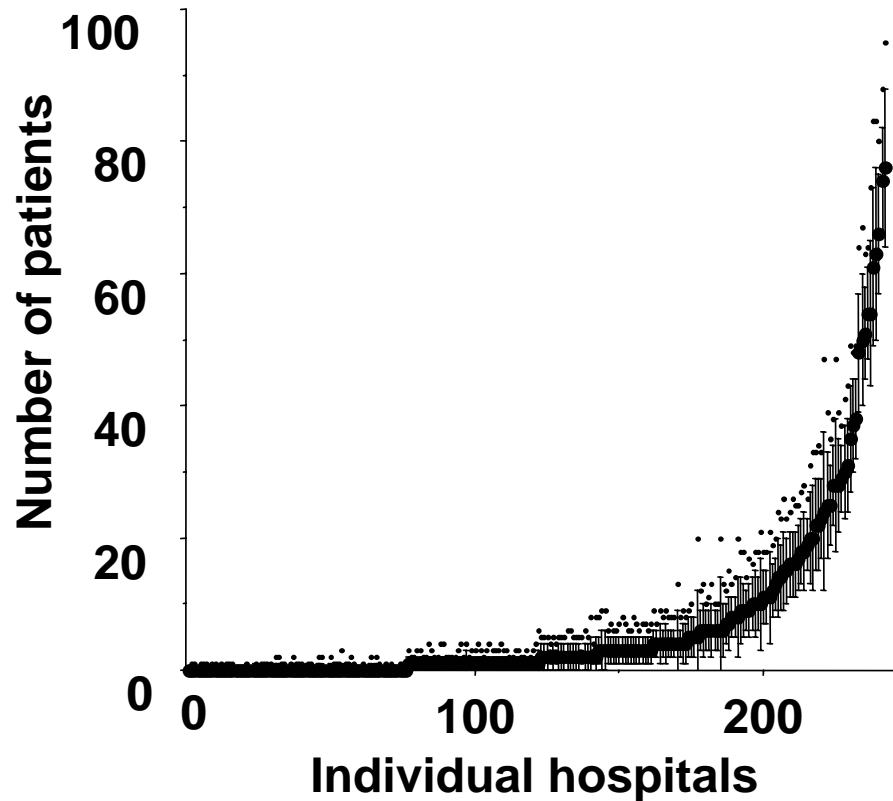
Volume sufficient for quality?

Hospital occupancy adults



Volume sufficient for Quality???

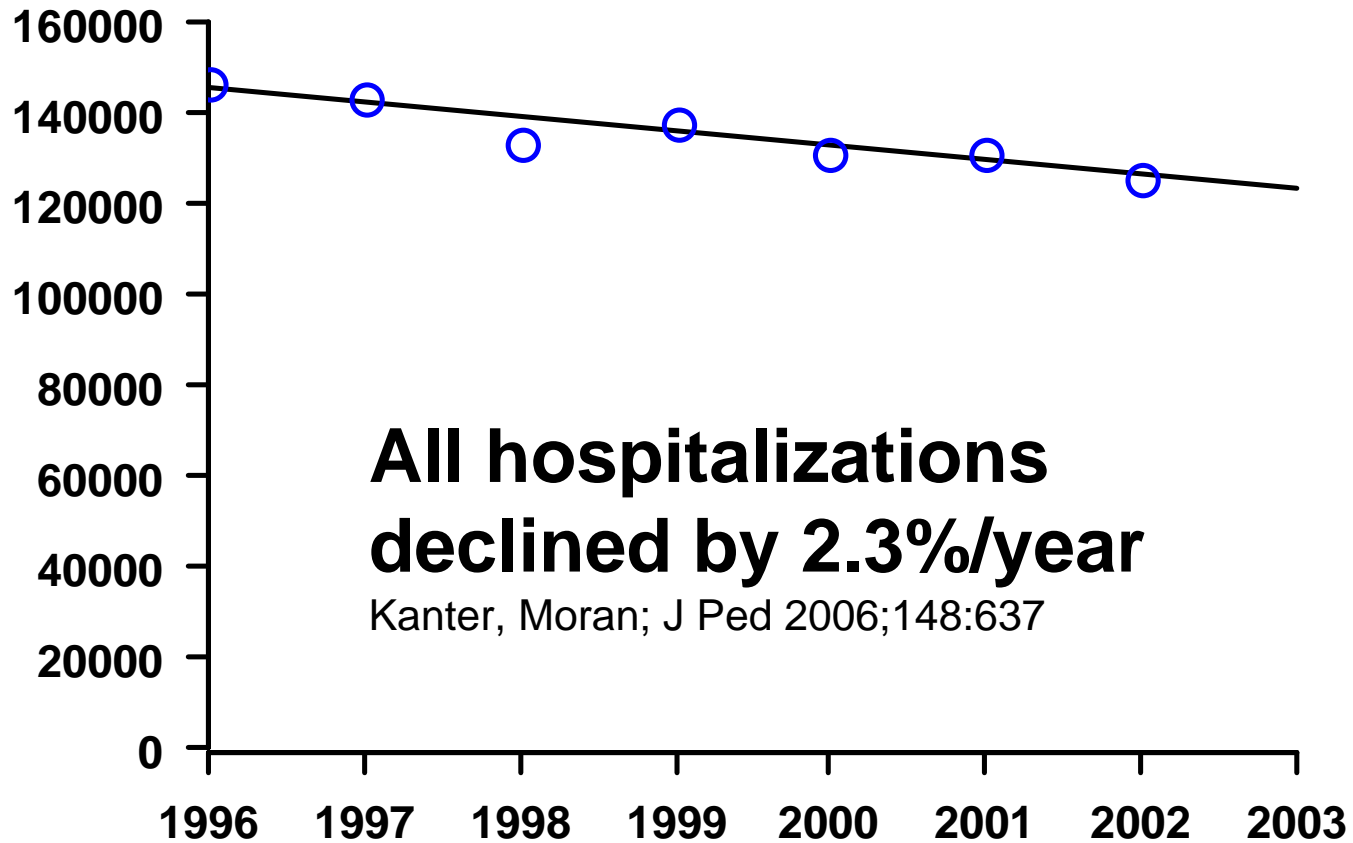
Hospital occupancy children



Kanter; PAS 2006;59:4836.118

Overall trend

Child Hospitalizations



Declining child hospitalization

- **Surgical procedures for which hospitalization is discretionary**
 - Tonsillectomy, adenoidectomy, myringotomy & tube insertion, hernia, foot, certain urological procedures
- **Trauma**
 - Decreasing occurrence or increasing outpatient care?
- **HIV-related disorders**
 - Kanter, Moran; J Ped 2006;148:637

What are the needs?

Child hospitalization NYS 1996-2002

0-14 yrs, excluding neonates

■ Asthma	6.4/1000
■ Gastroenteritis	2.6/1000
■ Pneumonia	2.2/1000
■ Nutrition/metabolic	1.8/1000
■ Seizures	1.5/1000
■ Mental illness	1.2/1000
■ Trauma	1.2/1000

- Kanter, Moran; J Ped 2006;148:637

Worrisome trends



- **Little reduction in hospitalization for ambulatory care-sensitive conditions**
 - **Asthma, gastroenteritis, pneumonia, seizures**
- **Increasing hospitalization rate for mental illness**
 - **Rising by 5.3% per year**
 - **4% of child hospitalizations in 2002**
 - Kanter, Moran; J Ped 2006;148:637

Studying quality at pediatric hospitals



- **How to identify a pediatric hospital?**
 - **ACGME (for education, not clinical service)**
 - **AHA (self report)**
 - **NACHRI (membership)**
- **No national accreditation or designation of pediatric hospitals**

“Pediatric hospitals” identified by residency accreditation

- **Teaching hospitals account for 16% of all hospitals in NY State**
- **While child hospitalization rate fell by 14% 1996-2000, hospitalization rate at pediatric teaching hospitals increased by 4%.**
 - **Kanter; Pediatr 2003;111:1068**

Patient activity at pediatric teaching hospitals

	Teaching hospitals	Other hospitals
Admissions/yr	2249	258
Interhospital transfers/yr	153	18
Referring hospitals	36	5
% of hospitalizations	67%	33%
Daily census	27	2

But...

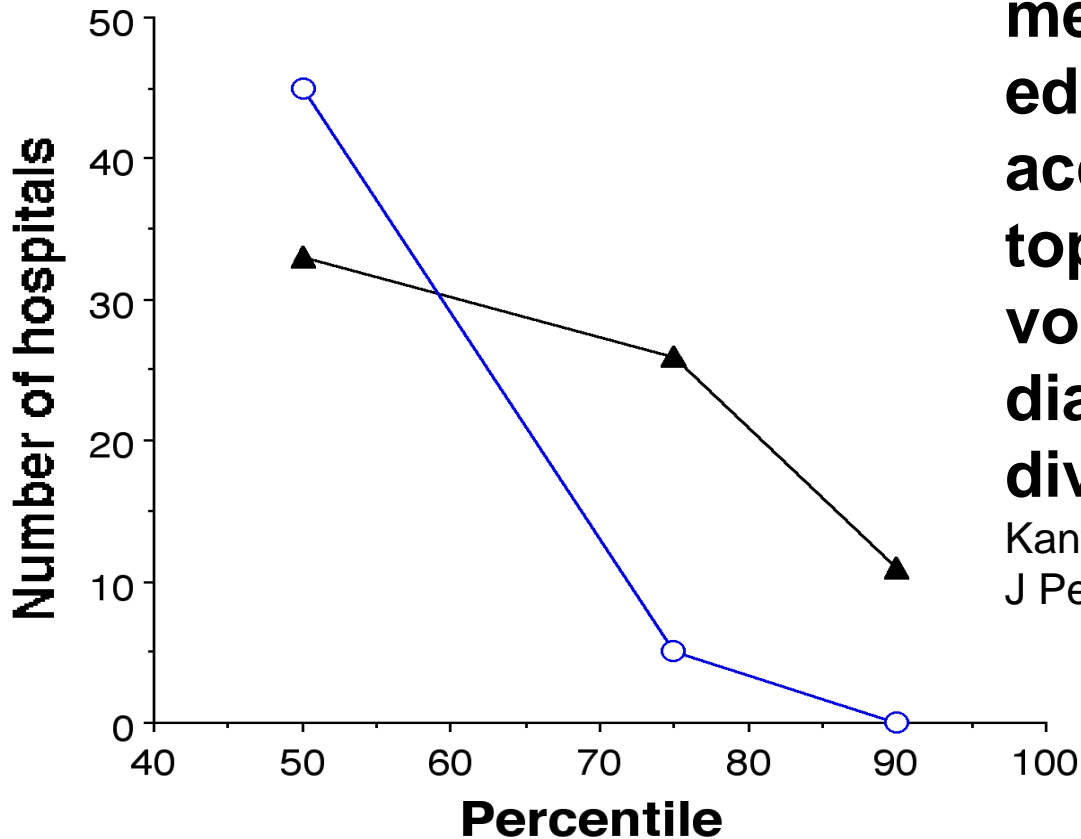


- **Teaching accreditation alone does not reliably identify comprehensive regional pediatric hospitals**
 - **Uneven distribution mostly in NY City**
 - **Some have very low utilization**
 - **Some lack subspecialty services**

How to identify a pediatric hospital?

- **Develop an objective research method to identify comprehensive pediatric hospitals on the basis of publicly available data, (SPARCS data 2000, ACGME)**
- **Combined criteria**
 - Educational accreditation
 - High clinical volume
 - Wide diversity of disorders (by DRG)
- **Evaluate the consequences of varying selectivity of the criteria.**
 - Kanter, Dexter; J Ped 2005;146:26

How to identify a pediatric hospital?



11 hospitals met criteria of educational accreditation, top decile for volume & diagnostic diversity

Kanter, Dexter;
J Ped 2005;146:26

Distribution of 11 hospitals meeting selective criteria

- These hospitals cared for 29 % of hospitalized children
- 8 referral regions
- 1-3 hospitals in each region
- Each hospital cares for population of 1.7 million
- Only one of these is a freestanding children's hospital.

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Validity of the pediatric hospital identification criteria

- **Face validity- reasonable**
- **Sampling validity-**
 - **Education, volume, diversity**
- **Construct validity- consistent with theoretical considerations**
 - **Homogeneity of population/hospital (CV = 17%)**
 - **Population/hospital similar to that needed to financially support a regional ped hospital**
 - **Billi; NEJM 1995;333:979**
- **Concurrent validity- no gold standard**
- **These are NOT regulatory criteria**

How to study outcomes across all hospitals?



- **Randomization?**
 - **Not feasible**
- **Hospital administrative data?**
 - **Case mix bias - insufficient data to analyze risk adjusted outcomes**
 - **Pseudo-randomization by instrumental variables method**
 - **Newhouse; Ann Rev Pub Health 1998;19:17**

True randomization



- **Patients are randomly assigned to treatment groups, independent of patient characteristics, so populations are similar in each group.**
- **Outcome is hypothetically affected by treatment, not by the randomization.**
- **Analysis determines difference in outcome between treatment groups.**

Pseudo-randomization

- **An instrumental variable (IV) is a patient characteristic that PARTIALLY influences choice of treatment, but is unrelated to other patient characteristics & outcome. Populations pseudo-randomized by the IV are similar.**
- **Outcome is hypothetically affected by treatment, not by the pseudo-randomization.**
- **Regression analysis determines difference in outcome between treatments, for the portion of treatment choice that is partially influenced by the pseudo-randomization.**

Pseudo-randomization

Instrumental variable

- **Differential distance =**
 - (Home to nearest pediatric hospital - home to nearest hospital)
- **PARTIALLY determines choice of hospital type.**
- **But differential distance does not directly affect outcome.**
 - **Initial stabilization at a local non-pediatric hospital with subsequent transfer to a pediatric hospital results in similar risk adjusted mortality probability as initial stabilization at a pediatric hospital.** (Kanter; Pediatrics 1997; 99: 59-63)

Hypothesis



- **Is mortality rate different at pediatric and non-pediatric hospitals?**
- **Regression analyses**
 - **Raw comparison**
 - **Controlling for observable variables**
 - **Controlling for unobservable variables, pseudo-randomization by differential distance**
- **For all patients & for high risk subgroup.**

Methods



- **Observable variables**
 - **Age**
 - **Gender**
 - **Race/ethnicity**
 - **Scheduled/unscheduled**
 - **Per capita income in patient's zip code**
 - **Health insurance**
 - **DRG**
 - **Home county (controlling for differences between rural & urban populations in the differential distance model)**

Methods



- **Patients 0-14 years, excluding neonatal DRGs**
- **High risk patients:**
 - **Infants, chronic conditions, severe trauma, organ failure on basis of age & ICD-9-CM codes**
- **11 Pediatric hospitals vs all others**
 - Kanter; J Ped 2005;146:26
- **Data NYS SPARCS 1996-2002**

Raw comparison

- **Excess mortality rate:**
- **Pediatric > non-pediatric hospital**
- **= 7.7 deaths / 1000 hospitalizations**
 - **P < .05**
 - **N = 903,388**
 - Kanter, Moran; PAS 2005;57:131

Controlling for observable variables

- Reduced the apparent excess mortality at pediatric hospitals
- Pediatric > non-pediatric hospital
- = 3.0 deaths/1000 hospitalizations
 - P < .05
 - N = 903,388
 - Kanter, Moran; PAS 2005;57:131

Controlling for unobservable variables with IV method

- **Excess mortality rate**
- **Pediatric < non-pediatric hospital**
- **= 4.7 deaths/1000 hospitalizations**
 - **P < .05**
 - **N = 903,388**
 - Kanter, Moran; PAS 2005;57:131

High risk subgroup


- **Controlling for unobservable variables with IV method**
- **Further lowers pediatric hospital mortality**
- **Pediatric \ll non-pediatric hospital**
- **= 14 deaths / 1000 hospitalizations**
 - **P < .05**
 - **N = 355,571**
 - Kanter, Moran; PAS 2005;57:131

Conclusions



- **Pediatric hospitals care for sicker patients, but some of the clinical variation is unobservable in administrative data.**
- **Pediatric hospitals provide higher quality care than other hospitals, especially for high risk patients.**

Obstacles blocking access to pediatric hospitals?



- **Deaths in hospitals lacking a PICU represent potential failures to use existing critical care resources**
- **Although there may be appropriate reasons for child deaths in non-PICU hospitals, it is expected these should occur at similar rates across regions.**
- **Regional variation in rates would suggest that obstacles exist in some areas.**

Obstacles?



- **NYS SPARCS data 1997**
- **PICU hospital - a board certified critical care physician on staff, and a separate ICU for children.**

Regional variation in non-PICU hospital deaths

Region	% of deaths in non-PICU hosp.	Deaths /100,000 regional pop.	Deaths/ 1000 non-PICU hospital pts	% of non-PICU hosps with a pediatric death
NY City	35%*	8.04*	2.25*	40%*
NY State Not NYC	17%	2.00	1.18 Kanter; CCM 2002;30:94	13% * P < .05

Obstacles?



- **If NYC transfers were handled more like that in the remainder of NYS, and if the benefit of transfers is similar to that demonstrated in selected hospitals in Oregon, then 5% of NYC pediatric hospital deaths could be avoided.**
 - Kanter; CCM 2002;30:94

Is interhospital transport a dangerous obstacle?

- **Comparison interhospital transfer by specialized vs non-specialized staff**
- **Patients all critically ill, similar severity in the two groups**
- **Adverse events (no deaths)**
 - **Specialized team (n=49) 2%**
 - **Nonspecialized staff (n=92) 20%**
 - **Edge, Kanter; Crit Care Med 1994;22:1186**

But bad weather can interfere with expert interhospital transport....



Implications



- **The results justify public efforts**
 - **To define necessary services at pediatric hospitals**
 - **To influence the appropriate utilization of these facilities for care of high risk children.**
 - **Provide the right number of pediatric hospitals**

Research agenda: Quality



- **How small a pediatric inpatient service is too small to warrant any pediatric inpatient care?**
- **How large a regional center is necessary to promote quality, and how many beds to serve region?**
- **How to identify patients at a small community hospital who would benefit from transfer to a regional pediatric hospital?**
- **Which patients would do just as well remaining at a small hospital near home?**

Research agenda:

Varying number of pediatric hospitals & tradeoffs in quality, access, cost

	Numerous hospitals <u>Widely distributed</u>	Restricted number <u>Few regional centers</u>
Quality	Proficiency limited by low volume at each hospital	Excessive distance, limited capacity, high-risk patient stays at nonpediatric hospital
Access	Short distances	Long distances
Cost	Redundant facilities Revenue < fixed costs	Unintended effects on hospitals closing their pediatric services

Effects on communities & hospitals that close inpatient pediatrics



- **Loss of pediatric services for common low-risk conditions near home**
- **Loss of capabilities in other services (eg, emergency department)**
- **Perceived loss of capabilities at that hospital may affect hospital choice for other services**

Until we have better data, some general principles

- **Rapid response by EMS any location**
- **Stabilization - widely distributed EDs**
 - AAP; Pediatrics 1995;96:526
- **Hospital care**
 - **Common low-risk conditions near home**
 - **Complex high-risk conditions at regional comprehensive pediatric hospitals**
 - AAP, SCCM; Pediatrics 2004;114:1114
- **Continuity back to community-based medical home**
 - AAP; Pediatrics 1995;96:526
 - AAP, SCCM; Pediatrics 2000;105:152

Until we have better data, some general principles

- **High clinical volume contributes to proficiency**
- **Avoid fragmenting teams of experts**
- **Volume sufficient to financially support fixed costs of comprehensive resources**
- **Avoid redundancy of expensive resources**

Until we have better data, some general principles

- **In rural areas- “standby” pediatric facilities with widespread distribution**
 - **Timely identification of severely illness / injury**
 - **Stabilize the airway, breathing, circulation**
 - **Provide timely access to definitive care**
 - **May be staffed by RN, PA, working under protocols, standing orders, or phone supervision. MD available.**
 - **Might not have inpatient pediatric services**
 - **AAP; Pediatrics 1995;96:526**

Until we have better data, some general principles

- Higher levels of care- “basic” and “general” pediatric facility
 - Physician present
 - Inpatient pediatric care, possibly a separate pediatric ward
 - Criteria for admissions, transfers
 - AAP; Pediatrics 1995;96:526

Until we have better data, some general principles

- **Comprehensive regional pediatric centers**
 - **Consultation, transfer, care of high-risk patients**
 - **Support the system - education, quality improvement, research**
 - **AAP; Pediatrics 1995;96:526**
 - **AAP, SCCM; Pediatrics 2000;105:152**
 - **AAP, SCCM; Pediatrics 2004;114:1114**
 - **Am Col Surgeons; Resources for optimal care of the injured patient, 2006**

Until we have better data, some general principles



- **Criteria for consultation, transfer, admission to a pediatric ICU**
 - **California EMS Authority; Interfacility pediatric trauma and critical care consultation and/or transfer guidelines, 1994**
 - **AAP, SCCM; Pediatr 1999;103:840**

Until we have better data, some general principles

- **Consultation at a distance**
 - **Phone**
 - **Telemedicine**
 - **Marcin; J Pediatr 2004;144:375**
 - **Echocardiograms**
 - **Sable; Pediatr 2002:109:e3**
 - **Radiology**
 - **Franken; AJR 1997;168:1349**
 - **Kirkpatrick; J Trauma 1999;46:1017**