Clinician and Institution Level Variation: The Road Ahead

Douglas A Colquhoun, MB ChB, MSc, MPH

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Associate Research Director, MPOG

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Financial relationships:

- Medscape, Inc – Honorarium (2022)

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- National Institutes of Health
  - Heart Lung and Blood Institute (K08-HL159327)
  - Institute on Drug Abuse (R61-DA059168)

- Foundation for Anesthesia Education and Research (2021)
- Merck & Co – Research Funding involving Sugammadex (2019-2021 to U-M)

National Heart, Lung, and Blood Institute

National Institute on Drug Abuse

Outline:

- Understanding variation in care is foundational to research and quality improvement practice
- Why structure of healthcare organizations matters in thinking about variation
- MPOG Initiatives to incorporate and understand structure on variation for research and quality improvement

Thank You!

- Synthesis of work of many across MPOG Missions
- Presenting these ideas and work from across MPOG team
- Feedback from many in the iterative development of this talk

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Some (Fictional) Hospitals:

Hospital A

Hospital B

Hospital C

Hospital D

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Some (Fictional) Hospitals:

Ardnamurchan General

Ballachulish Regional

Coldbackie District

Drumnadrochit Memorial

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Mrs McTavish Needs Surgery:

Ardnamurchan General

5% GA

Ballachulish Regional

3% GA

Coldbackie District

10% GA

Drumnadrochit Memorial

80% GA

Mrs McTavish needs Carpal Tunnel Release Will she receive General or Regional Anesthesia?

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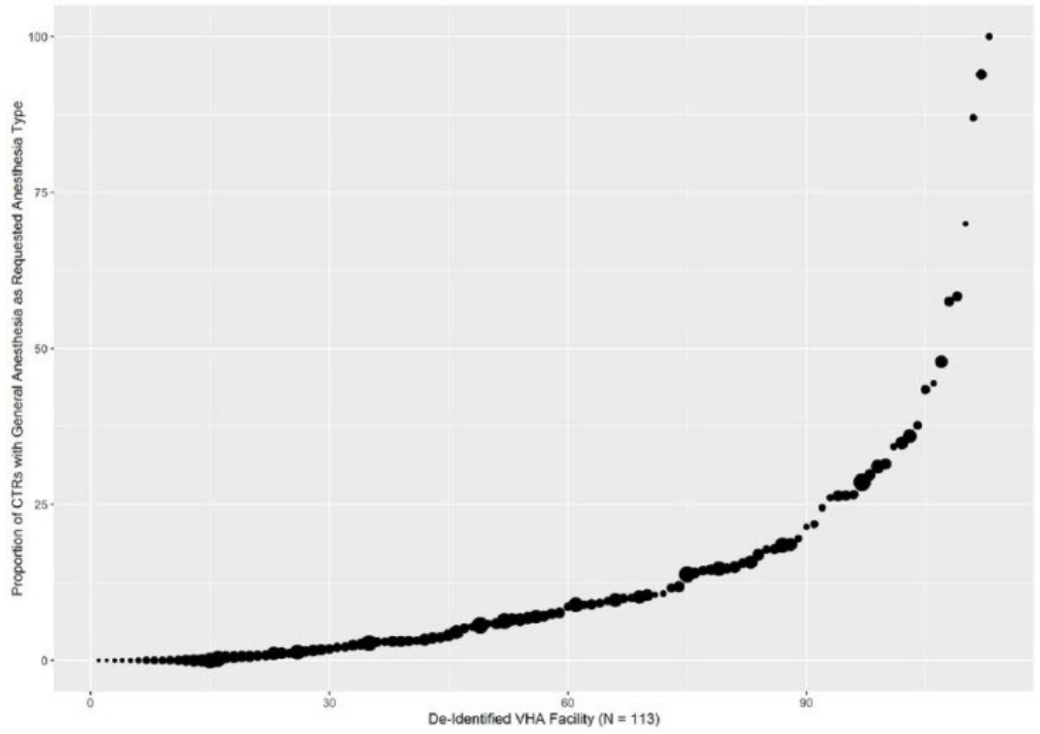
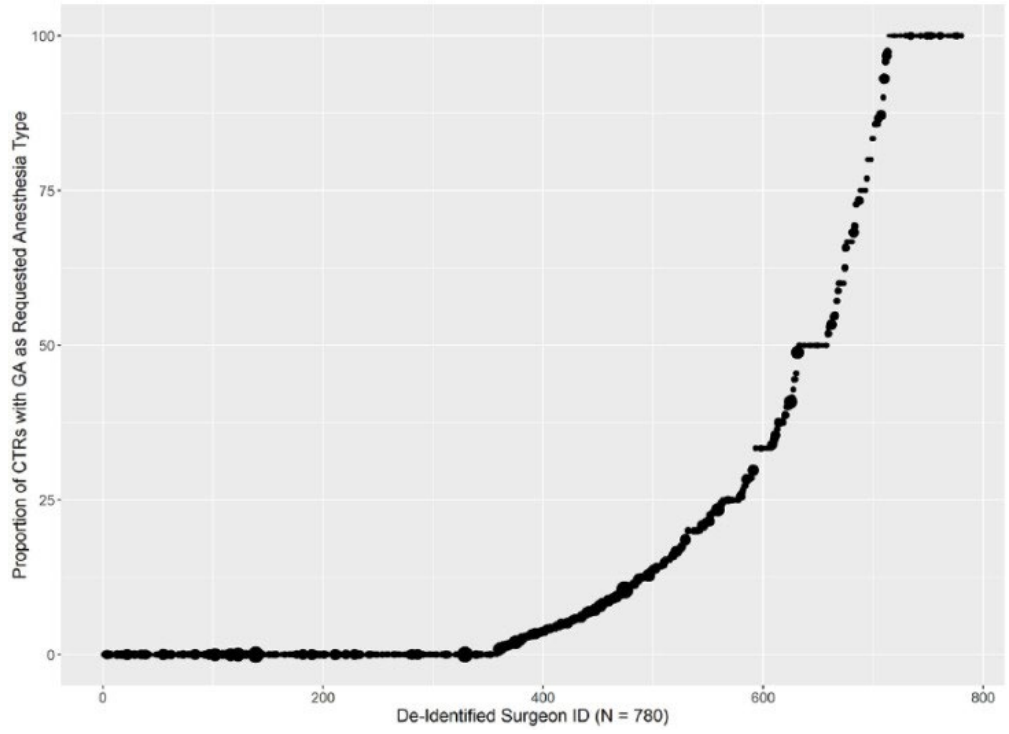
Carpal Tunnel Under General – Really?

Rate of General Anesthesia



By Center (n = 113)



By Surgeon (n=780)

Harris et al. Hand. 2020

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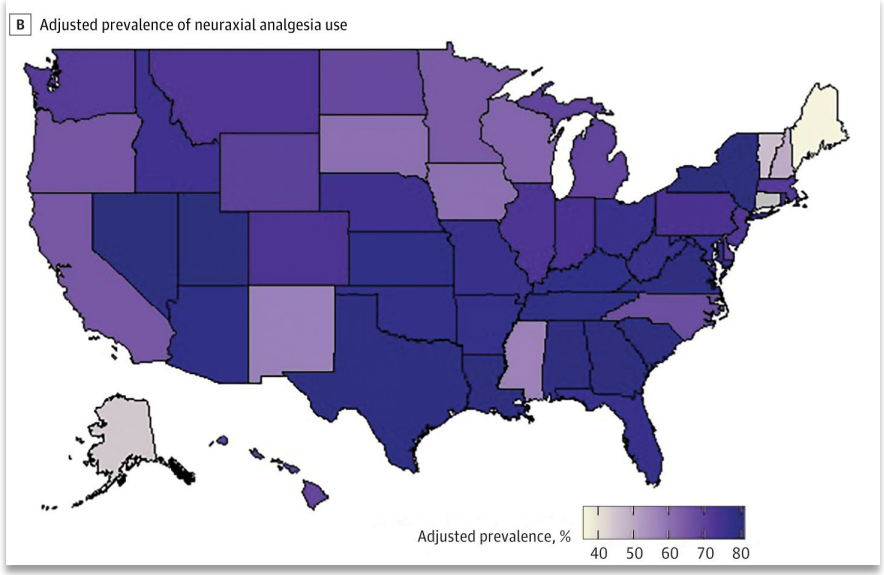
What is Unexplained Variation in Healthcare?

- Differences in healthcare process, resources or outcome
- Measured across (examples):
  - Time
  - Patient groups
  - Clinicians
  - Hospitals
  - Geographic
- “Care that differs in ways that are not a direct and proportionate response to available evidence; or to the healthcare needs and informed choices of patients.”



State Level Variation in Neuraxial Use in Labor

Butwick et al JAMA Netw Open 2018

ORIGINAL PAPER

Journal of Evaluation in Clinical Practice
International Journal of Public Health Policy and Health Services Research

WILEY

Unwarranted clinical variation in health care: Definitions and proposal of an analytic framework

Kim Sutherland MSc, MBA, PhD, Conjoint Professor[1] |
Jean-Frederic Levesque MD, PhD, Conjoint Professor[1,2]

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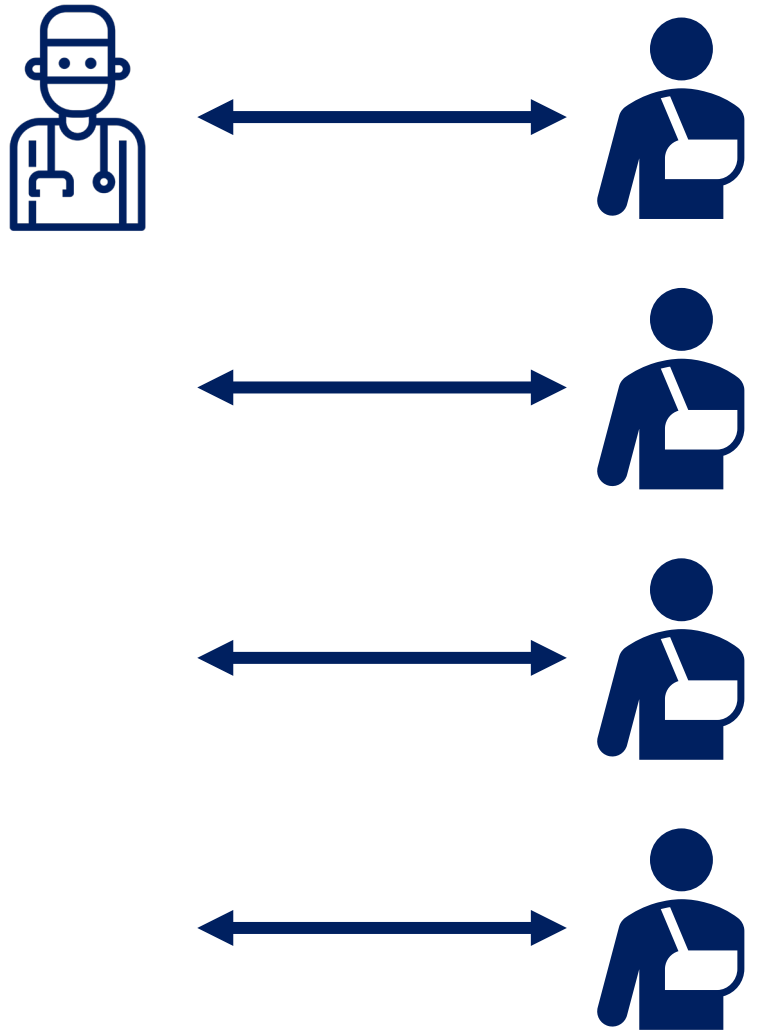
Structure and Variation

- The clinician-patient interaction is informed by professional training and prior experience
- But also impacted by facilities and resources available and culture and “normal practice”
- Structures result in differences in patient care



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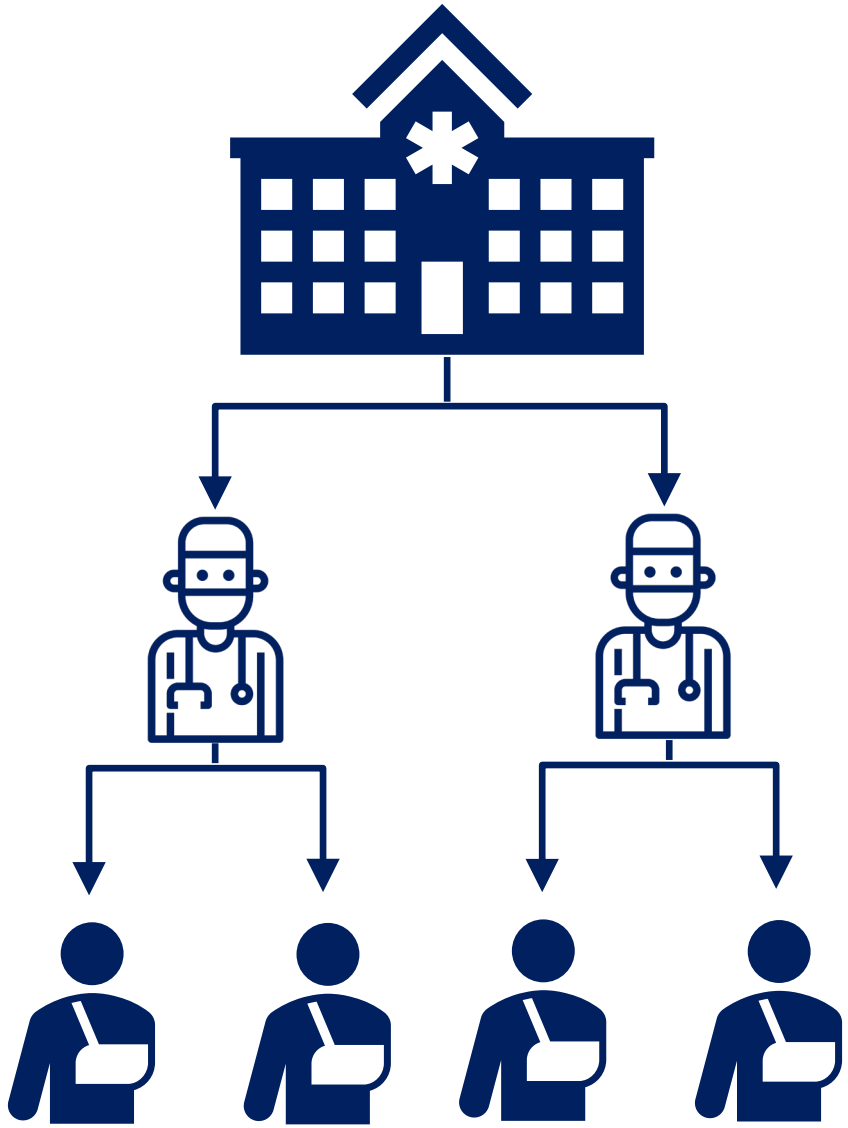
Structure and Variation

- The clinician-patient interaction is informed by professional training and prior experience
- But also impacted by facilities and resources available and culture and “normal practice”
- Structures result in differences in patient care
- May be described as “levels”



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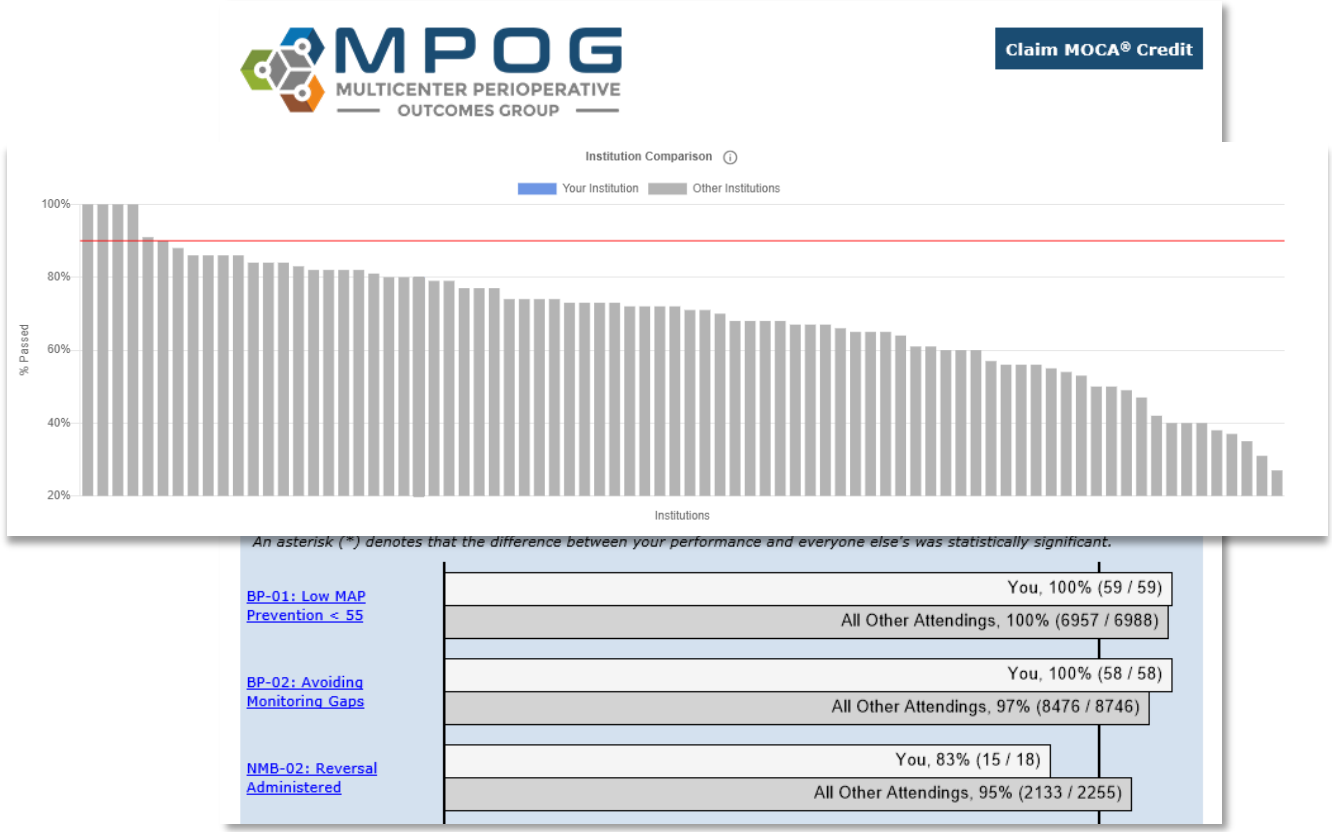
Why Study Unexplained Variation?

- Programmatic QI is about understanding and minimizing unexplained variation
- In areas where there are established practices or standards
- Emphasizes role of processes, equipment, training and practice
- Understanding contribution of structural and systematic features
- Tension between responding to individual events and looking for patterns across organizational units

Quality Improvement



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Why Study Unexplained Variation?

Research

- Unexplained Variation as a Focus:
  - Variation in practice and patient outcome
  - Differences in practice across hospitals or geographical areas
  - Differences across clinicians
  - Understand questions of equity and efficacy of care

- Statistical approaches can quantify contribution to overall variation

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These effects are real…

		Mathis MR et al Anesthesiology 2023	McIssac D et al Anesthesiology 2018	Pennington B et al Unpublished	Janda AM et al BJA 2022
	Question	Inotrope Use in Cardiac Surgery	GA vs Neuraxial for Hip Fracture	TIVA for General Anesthesia	Benzodiazepines in Cardiac Surgery
Percent Variation At Each Level	**Hospital**				
	Clinician				
	Patient or Unexplained				

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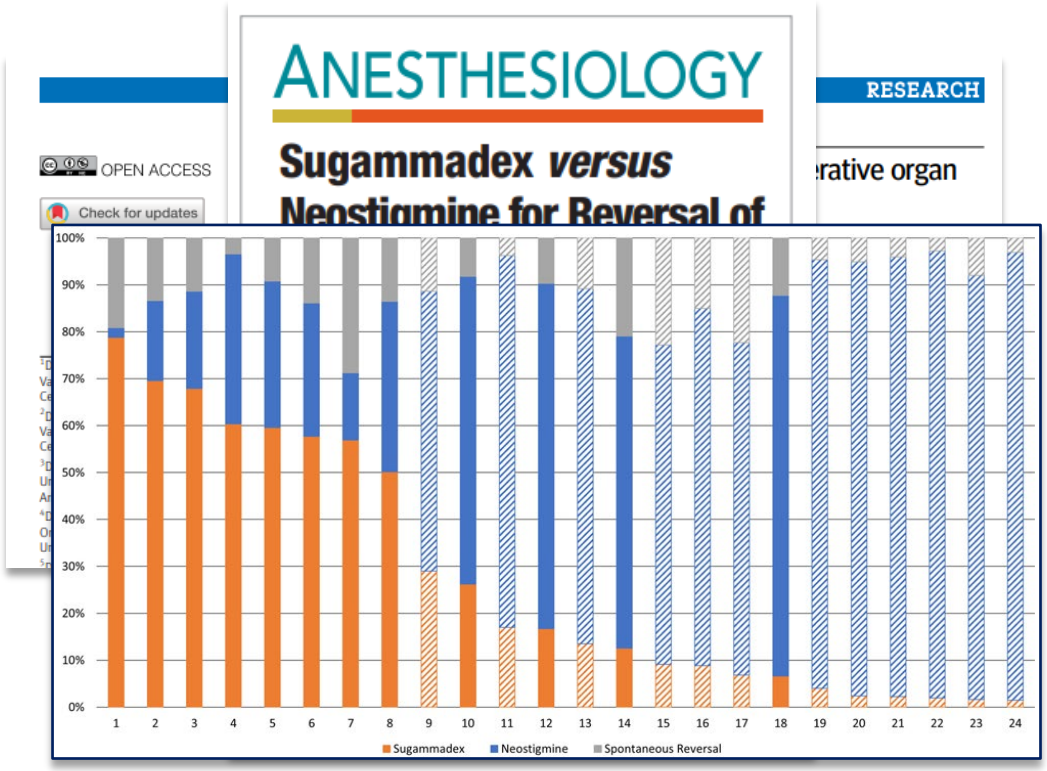
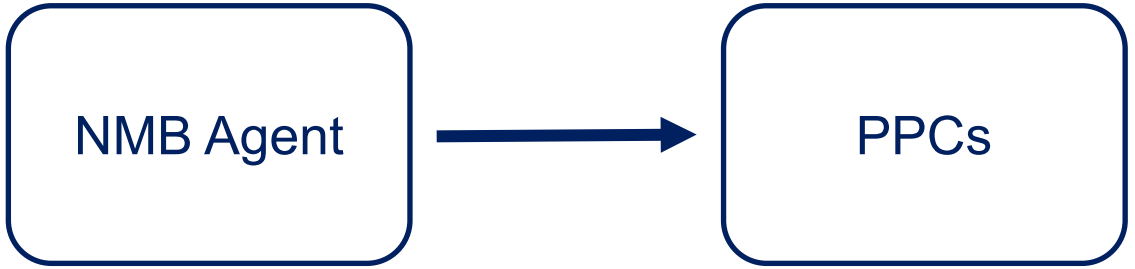
Why Study Unexplained Variation? Research



- Variation in Practice is Necessary for Inference:
  - Emerges from uncertainty
  - Everybody is doing what they believe is best for individual patient
  - Foundational for understanding connection between an exposure and an outcome



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Patient Level	Clinician Level	Hospital Level

Examples of Warranted Variation

Patient Level	Clinician Level	Hospital Level
Precision Medicine	Clinician experience or preference absent robust data	Accredited Center of Excellence
Patient's Informed Expectations		Intractable Resource Constraints

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Patient Level

Clinician Level

Hospital Level

Unwarranted Variation Addressed By:

Research to determine efficacious clinical care

Inequities / Disparities Research

QI Initiative (individualized feedback)

Practice Guidance

Accreditation Boards / Specialty Training

QI Initiative (departmental structure / process focus)

Health Policy / Health Services Research

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Looking at the Story of Hip Fractures:

Observing Variation:

Hospital-, Anesthesiologist-, and Patient-level Variation in Primary Anesthesia Type for Hip Fracture Surgery

A Population-based Cross-sectional Analysis

BJA

British Journal of Anaesthesia, 115 (S2): ii57–ii67 (2015)

doi: 10.1093/bja/aev381
Regional Anaesthesia

Epidemiology, trends, and disparities in regional anaesthesia for orthopaedic surgery

C. Cozowicz[1,2], J. Poeran[3] and S. G. Memtsoudis[1,2,*]

[1]Department of Anesthesiology, Hospital for Special Surgery, Weill Cornell Medical College, 535 East 70th Street, New York, NY 10065, USA, [2]Department of Anaesthesiology, Perioperative Medicine and Intensive Care Medicine, Paracelsus Medical University, Muellner Hauptstrasse 48, Salzburg 5020, Austria, and [3]Institute for Healthcare Delivery Science, Department of Population Health Science & Policy, Icahn School of Medicine at Mount Sinai, 1468 Madison Avenue, New York, NY 10029, USA

*Corresponding author. E-mail: memtsoudiss@hss.edu

Inference Powered By Variation:

Comparative Effectiveness of Regional

BMI

PERIOPERATIVE MEDICINE

Association of Hospital-level Neuraxial Anesthesia Use for Hip Fracture Surgery with Outcomes

A Population-based Cohort Study

Daniel I. McIsaac, M.D., M.P.H., F.R.C.P.C., Duminda N. Wijeysundera, M.D., Ph.D., F.R.C.P.C., Allen Huang, M.D., F.R.C.P.C., Gregory L. Bryson, M.D., F.R.C.P.C., M.Sc., Carl van Walraven, M.D., F.R.C.P.C., M.Sc.

Elisabetta Patorno *instructor*[1], Mark D Neuman *assistant professor*[2], Sebastian Schneeweiss *professor*[1], Helen Mogun *programmer*[1], Brian T Bateman *assistant professor*[1 3]

[1]Division of Pharmacoepidemiology and Pharmacoeconomics, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA 02120, USA; [2]Department of Anesthesiology and Critical Care, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA; [3]Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA, USA

OBJECTIVE To test the association of regional (ie, spinal or epidural) anesthesia vs general anesthesia with 30-day mortality and hospital length of stay after hip fracture.

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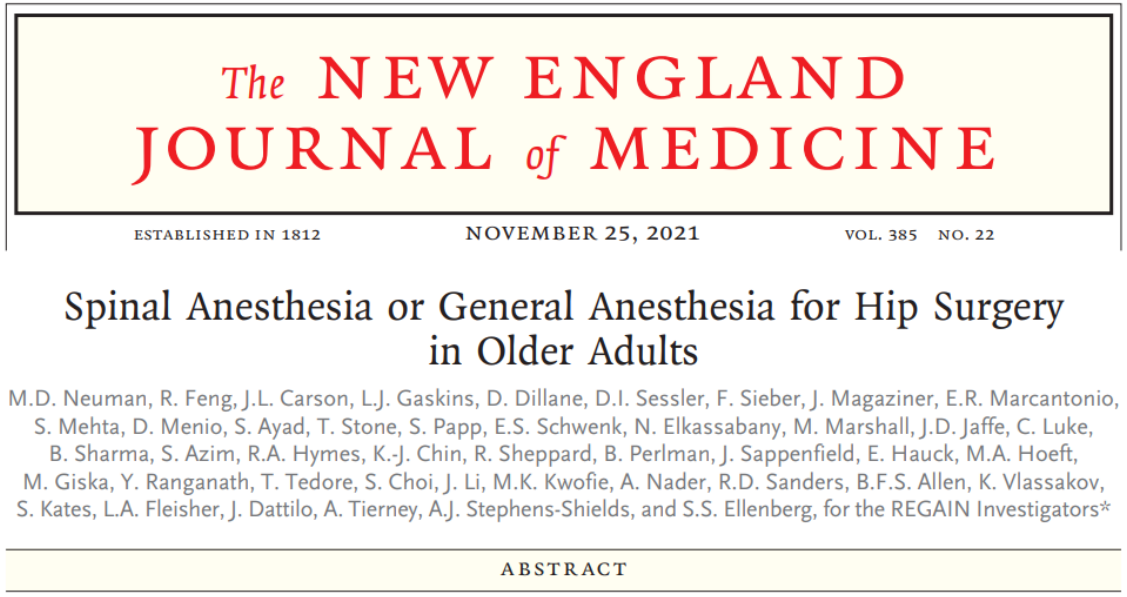
Looking at the Story of Hip Fractures:



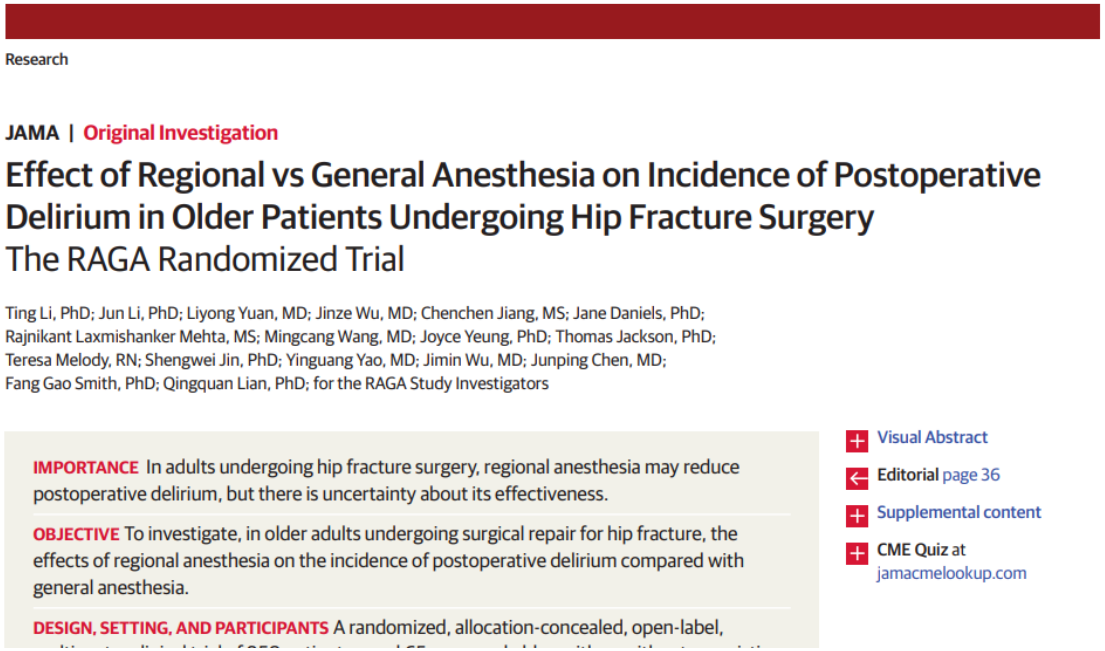
The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 NOVEMBER 25, 2021 VOL. 385 NO. 22

Spinal Anesthesia or General Anesthesia for Hip Surgery in Older Adults

M.D. Neuman, R. Feng, J.L. Carson, L.J. Gaskins, D. Dillane, D.I. Sessler, F. Sieber, J. Magaziner, E.R. Marcantonio, S. Mehta, D. Menio, S. Ayad, T. Stone, S. Papp, E.S. Schwenk, N. Elkassabany, M. Marshall, J.D. Jaffe, C. Luke, B. Sharma, S. Azim, R.A. Hymes, K.-J. Chin, R. Sheppard, B. Perlman, J. Sappenfield, E. Hauck, M.A. Hoeft, M. Giska, Y. Ranganath, T. Tedore, S. Choi, J. Li, M.K. Kwofie, A. Nader, R.D. Sanders, B.F.S. Allen, K. Vlassakov, S. Kates, L.A. Fleisher, J. Dattilo, A. Tierney, A.J. Stephens-Shields, and S.S. Ellenberg, for the REGAIN Investigators*

ABSTRACT



Research

JAMA | Original Investigation

Effect of Regional vs General Anesthesia on Incidence of Postoperative Delirium in Older Patients Undergoing Hip Fracture Surgery
The RAGA Randomized Trial

Ting Li, PhD; Jun Li, PhD; Liyong Yuan, MD; Jinze Wu, MD; Chenchen Jiang, MS; Jane Daniels, PhD; Rajnikant Laxmishanker Mehta, MS; Mingcang Wang, MD; Joyce Yeung, PhD; Thomas Jackson, PhD; Teresa Melody, RN; Shengwei Jin, PhD; Yinguang Yao, MD; Jimin Wu, MD; Junping Chen, MD; Fang Gao Smith, PhD; Qingquan Lian, PhD; for the RAGA Study Investigators

IMPORTANCE In adults undergoing hip fracture surgery, regional anesthesia may reduce postoperative delirium, but there is uncertainty about its effectiveness.

OBJECTIVE To investigate, in older adults undergoing surgical repair for hip fracture, the effects of regional anesthesia on the incidence of postoperative delirium compared with general anesthesia.

DESIGN, SETTING, AND PARTICIPANTS A randomized, allocation-concealed, open-label,

Visual Abstract
Editorial page 36
Supplemental content
CME Quiz at jamacmelookup.com

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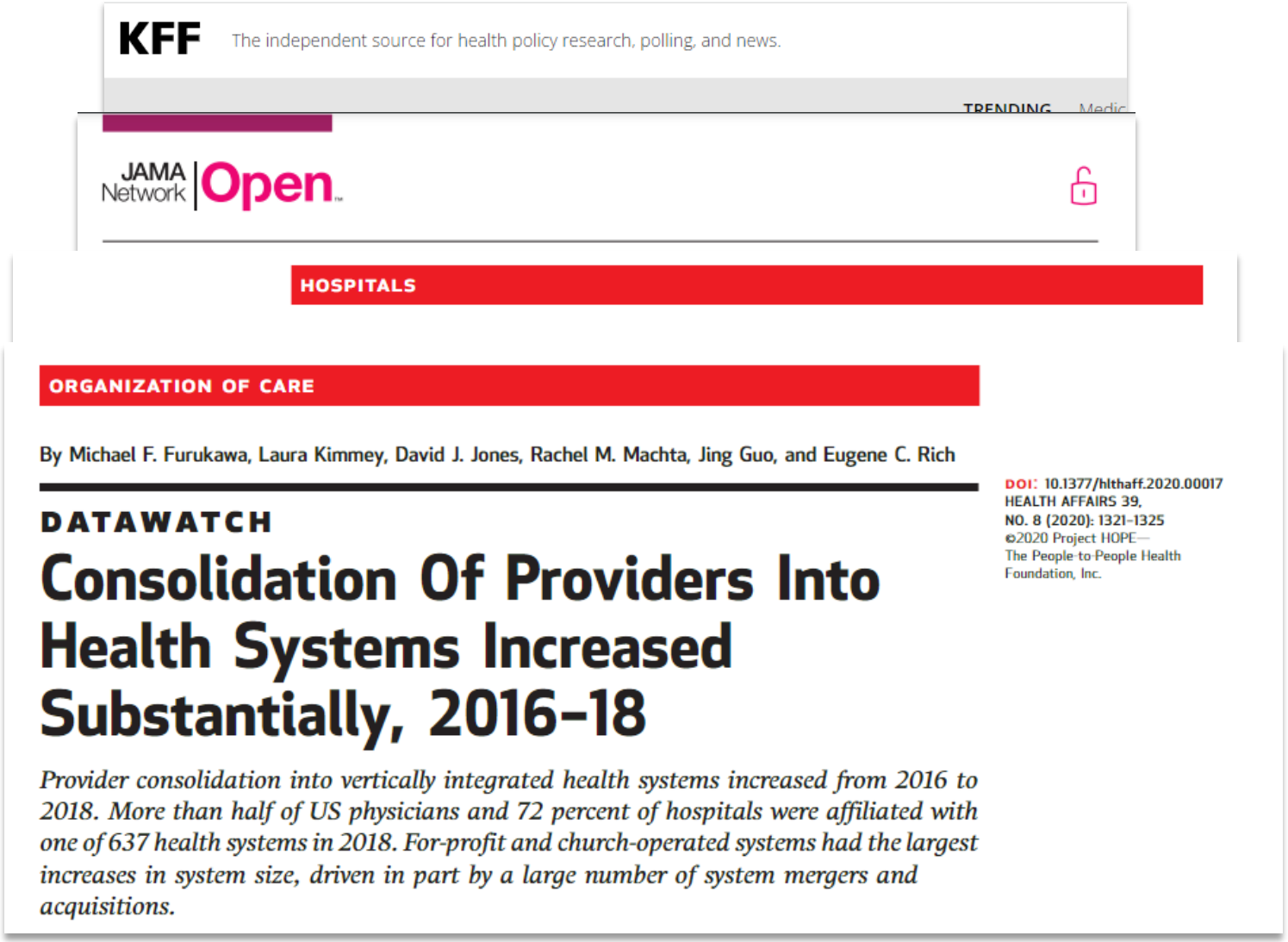
STRUCTURES ARE EVERYWHERE AND EVOLVING

Evolving Healthcare Landscape:



KFF The independent source for health policy research, polling, and news.

TRENDING Medic

JAMA Network | Open

HOSPITALS

ORGANIZATION OF CARE

By Michael F. Furukawa, Laura Kimmey, David J. Jones, Rachel M. Machta, Jing Guo, and Eugene C. Rich

DOI: 10.1377/hlthaff.2020.00017
HEALTH AFFAIRS 39,
NO. 8 (2020): 1321–1325
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The People-to-People Health
Foundation, Inc.

DATAWATCH

Consolidation Of Providers Into Health Systems Increased Substantially, 2016–18

Provider consolidation into vertically integrated health systems increased from 2016 to 2018. More than half of US physicians and 72 percent of hospitals were affiliated with one of 637 health systems in 2018. For-profit and church-operated systems had the largest increases in system size, driven in part by a large number of system mergers and acquisitions.

- Hospitals: Evolution and Development of The Networked Healthcare System
  - Single hospitals expanding as healthcare system
  - Purchases/mergers with other hospitals in surrounding area
  - National chains and cross-market mergers
- Clinician groups forming across hospital or health system boundaries

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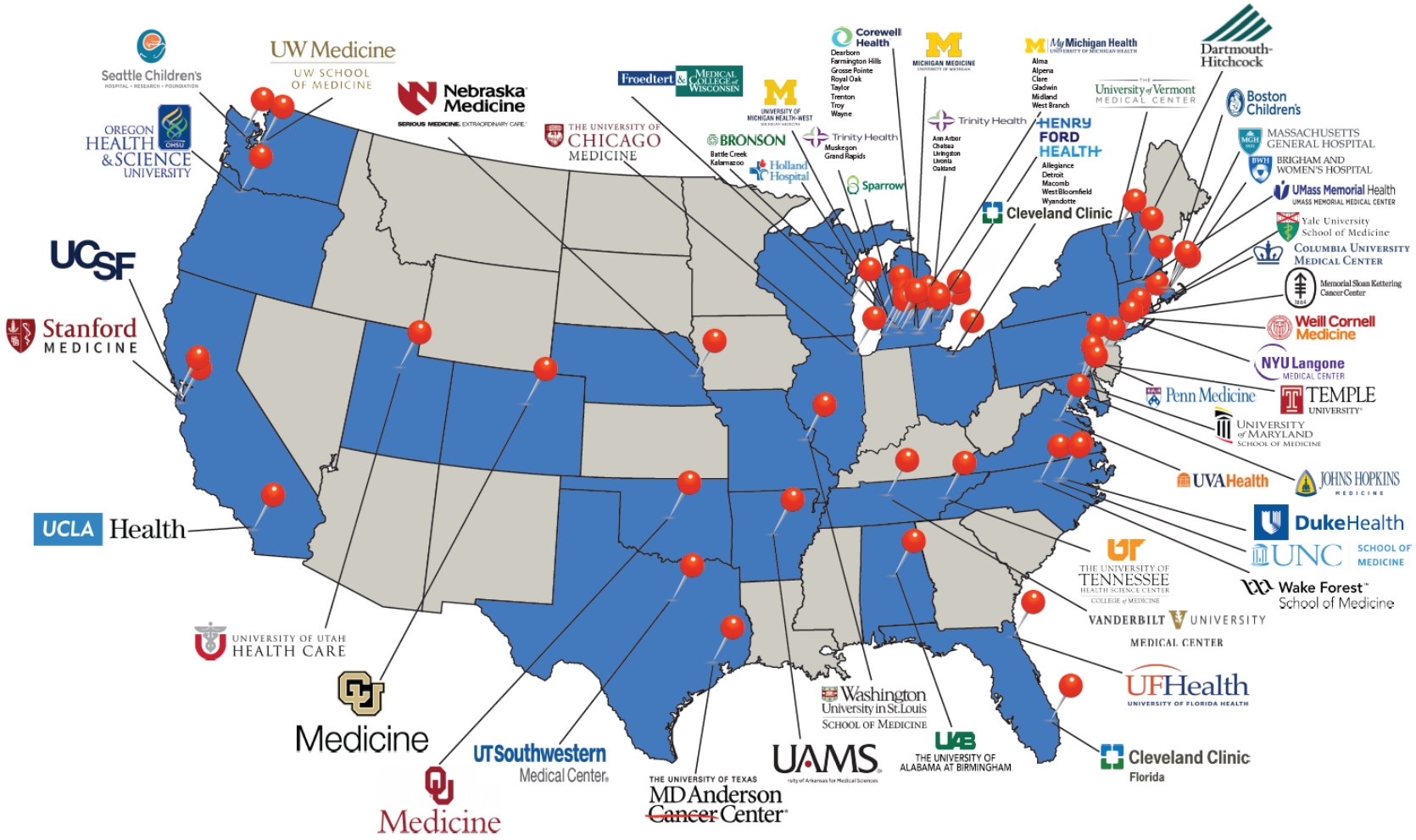
Current MPOG Community:



- Single Centers becoming parts of health systems
- Mergers of health systems participating within MPOG
- Concentration of Healthcare Provision
- Anesthesiologists working across multiple MPOG hospitals

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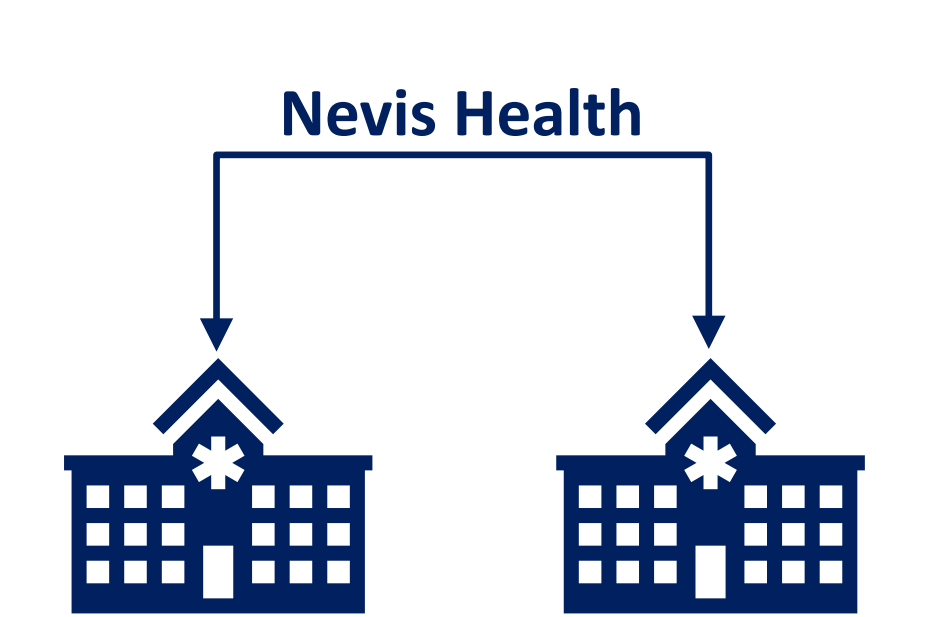
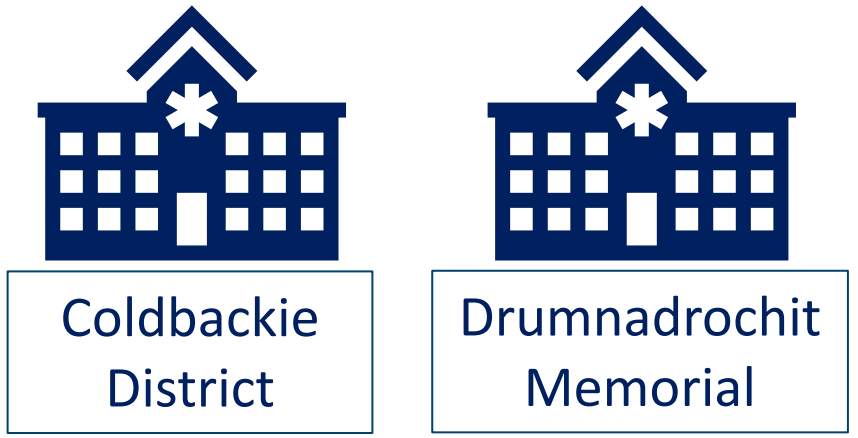
Fictional Examples – Hospitals Merge:





Will Ardnamurchan start following Ballaculish's Best Practice?

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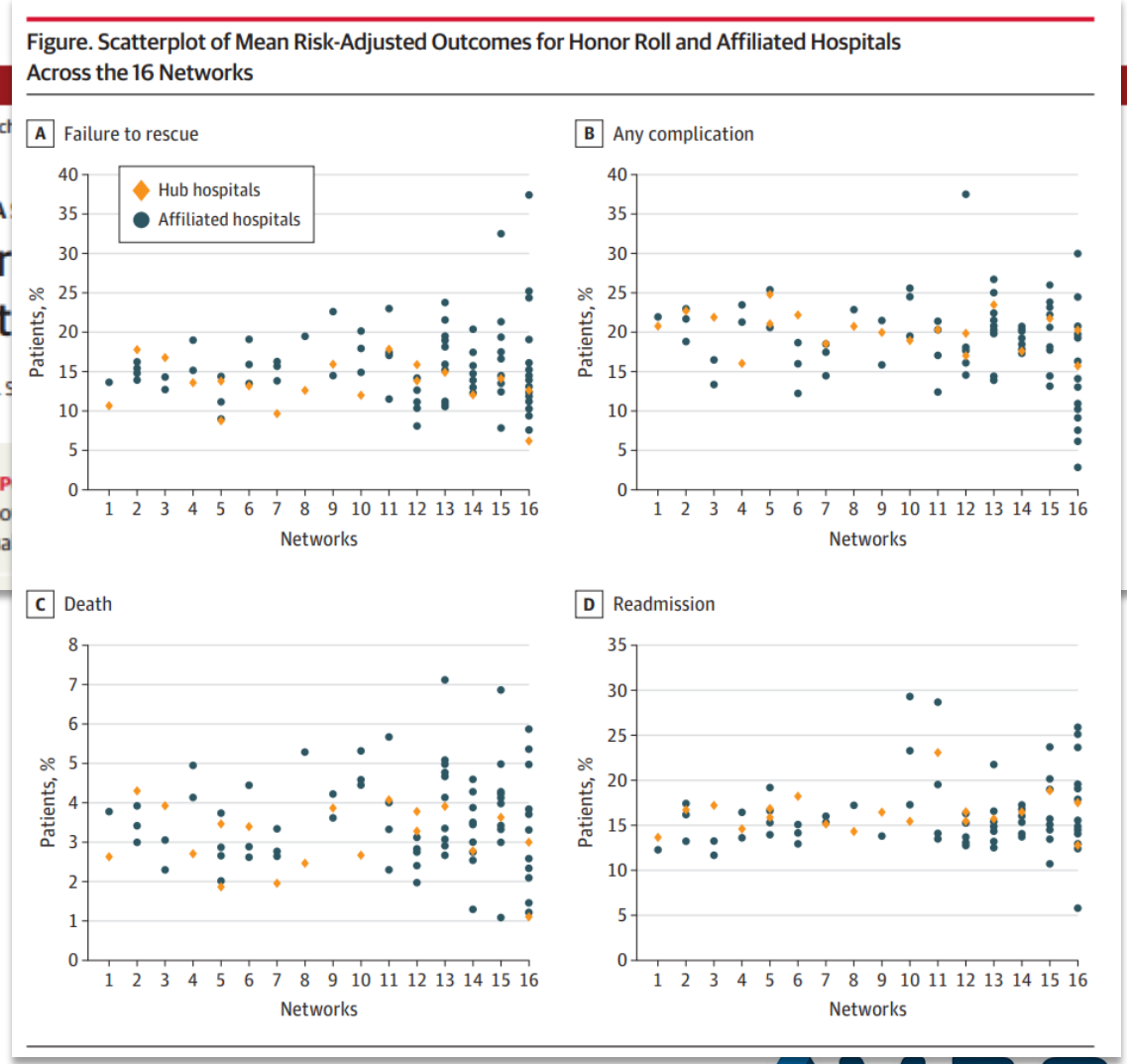
Variation May Exist Within Health Systems:

- Health system networks offer promise of sharing best practice
- Reality of variable integration across hospitals within a network
- This can lead to significant variation between sites
- Looking at USNWR “Honor Roll” Health Systems:
  - Complications: 1.1 – 4.3 x variation
  - Mortality: 1.1 – 4.1 x variation



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Fictional Examples – Dr Ferguson Gets a New Job:

Ardnamurchan General

5% GA

Ballachulish Regional

3% GA

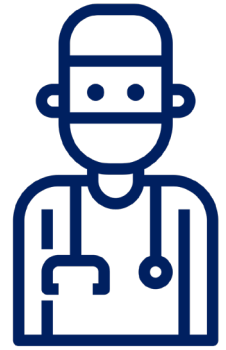
Coldbackie District

10% GA

Drumnadrochit Memorial

80% GA

Will she start offering Carpal Tunnel Repairs under Regional?



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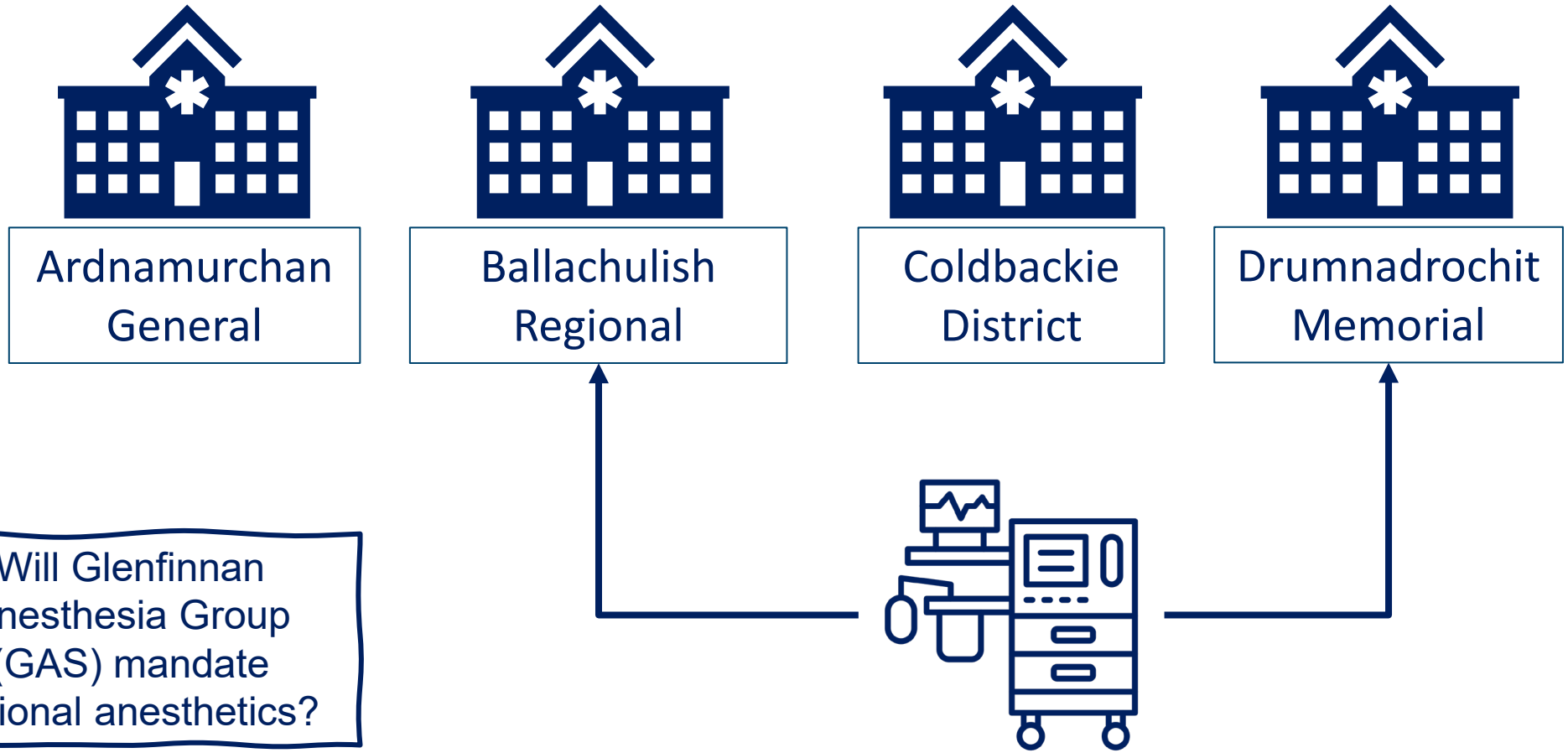
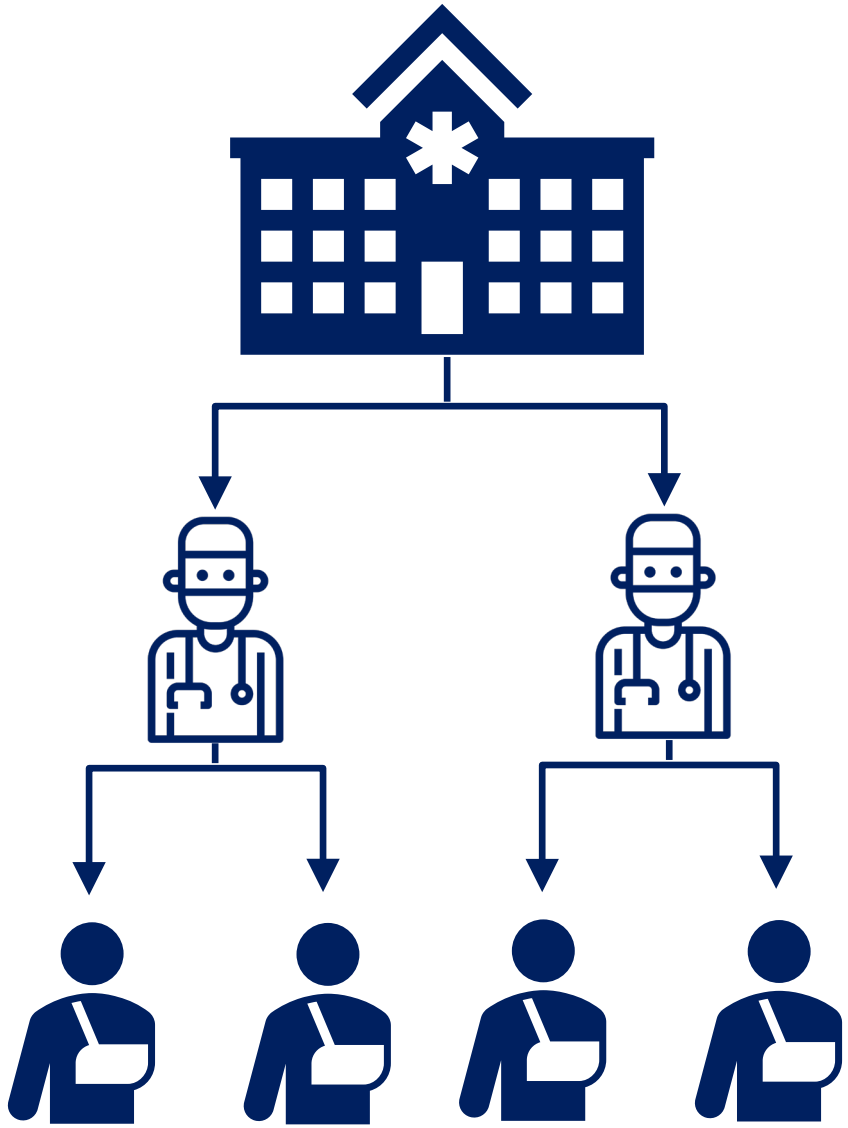
Fictional Examples – New Anesthesia Group:



Clinician Changes

- Our structures are becoming more complex
  - Clinicians work across hospitals
  - Anesthesia groups cover multiple hospitals
  - Multiple groups within a single hospital
  - One health system might have multiple anesthesia groups



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Clinician Changes

- Our structures are becoming more complex
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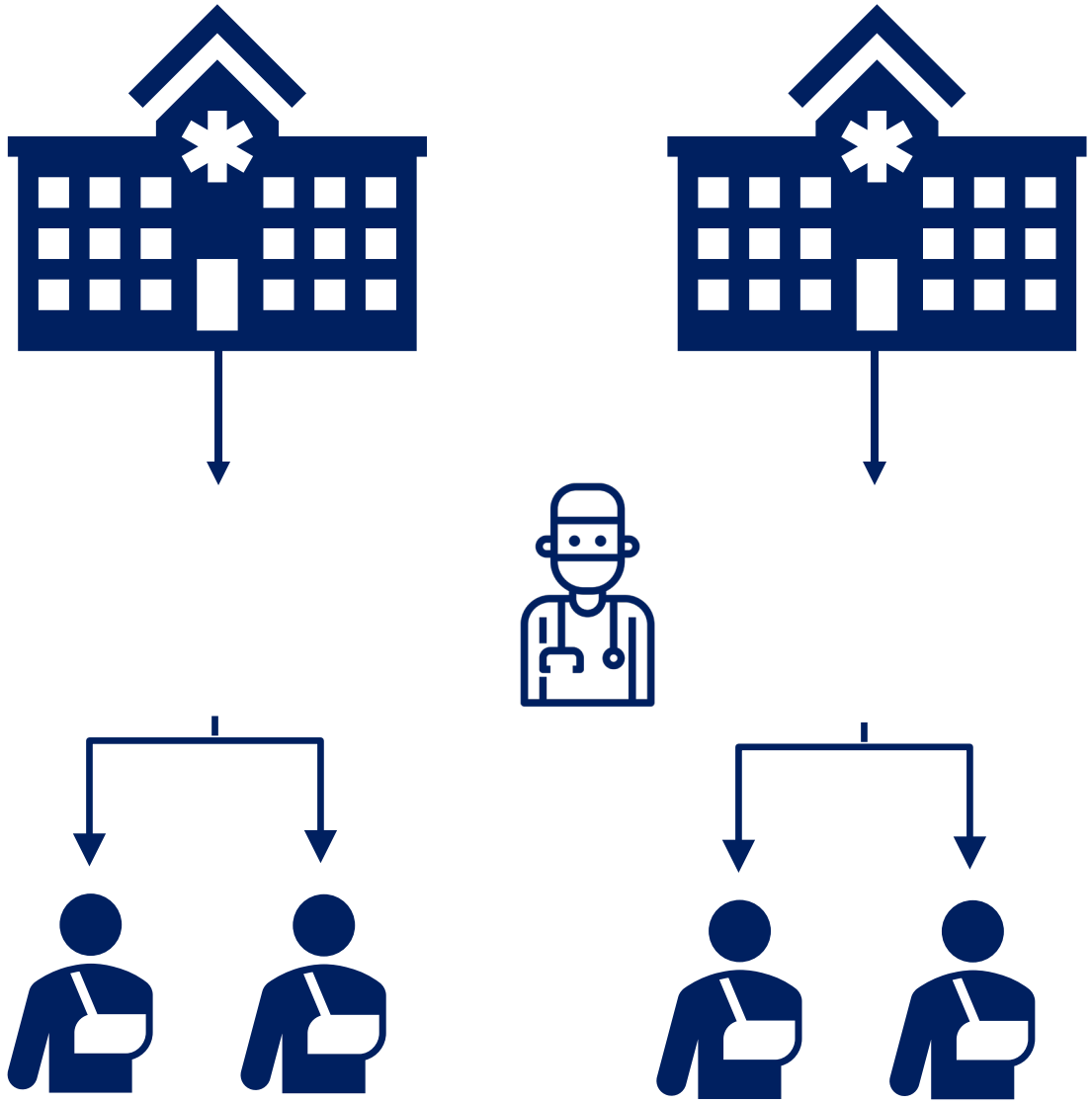
  - Multiple groups within a single hospital
  - One health system might have multiple anesthesia groups

- More complex structures are possible:
  - Cross classified structures
  - Explainable if boundaries of clinicians and hospitals



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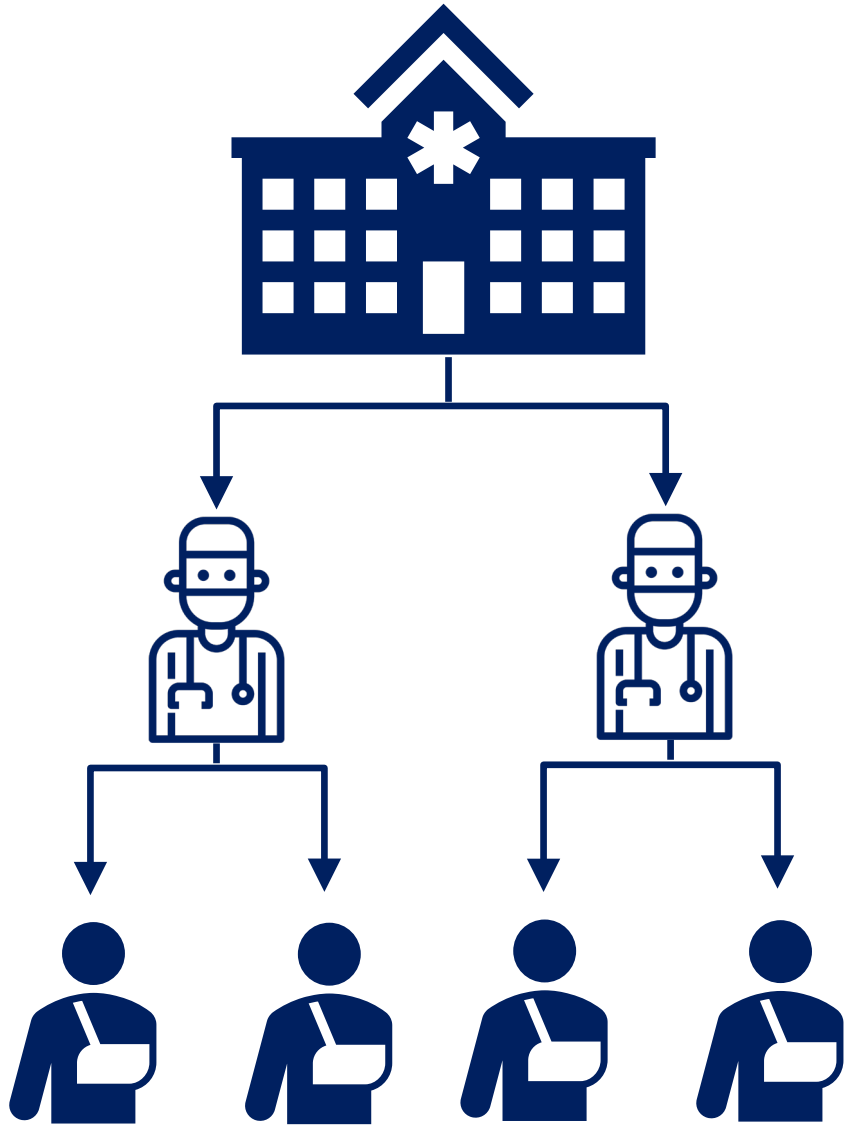
Why does this matter? (Statistically)

- Two patients being cared for at the same hospital or clinician are not independent
- Practice (and outcome) is correlated within health systems, hospitals and clinicians
- Gives falsely precise estimates underestimates differences)
- **Ignores opportunities to explore and understand sources of warranted and unwarranted variation**



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30 Second Terminology Detour…

		Mathis MR et al Anesthesiology 2023	McIssac D et al Anesthesiology 2018	Pennington B et al Unpublished	Janda AM et al BJA 2022
Question		Inotrope Use in Cardiac Surgery	GA vs Neuraxial for Hip Fracture	TIVA for General Anesthesia	Benzodiazepines in Cardiac Surgery
Percent Variation At Each Level (ICC)	**Hospital**	23%	20%	34%	55%
	Clinician	6.8%	20%	18%	15%
	Patient or Unexplained	71%	60%	48%	31%

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30 Second Terminology Detour…

		Mathis MR et al Anesthesiology 2023		McIssac D et al Anesthesiology 2018		Pennington B et al Unpublished		Janda AM et al BJA 2022	
Question		Inotrope Use in Cardiac Surgery		GA vs Neuraxial for Hip Fracture		TIVA for General Anesthesia		Benzodiazepines in Cardiac Surgery	
Measure of Variation		**ICC**	**MOR**	**ICC**	**MOR**	**ICC**	**MOR**	**ICC**	**MOR**
Variation At Each Level	**Hospital**	23%	3.55	20%	2.36	34%	2.8	55%	4.19
	Clinician	6.8%	1.73	20%	2.36	18%	2.2	15%	2.68
	Patient or Unexplained	71%		60%		48%		31%	

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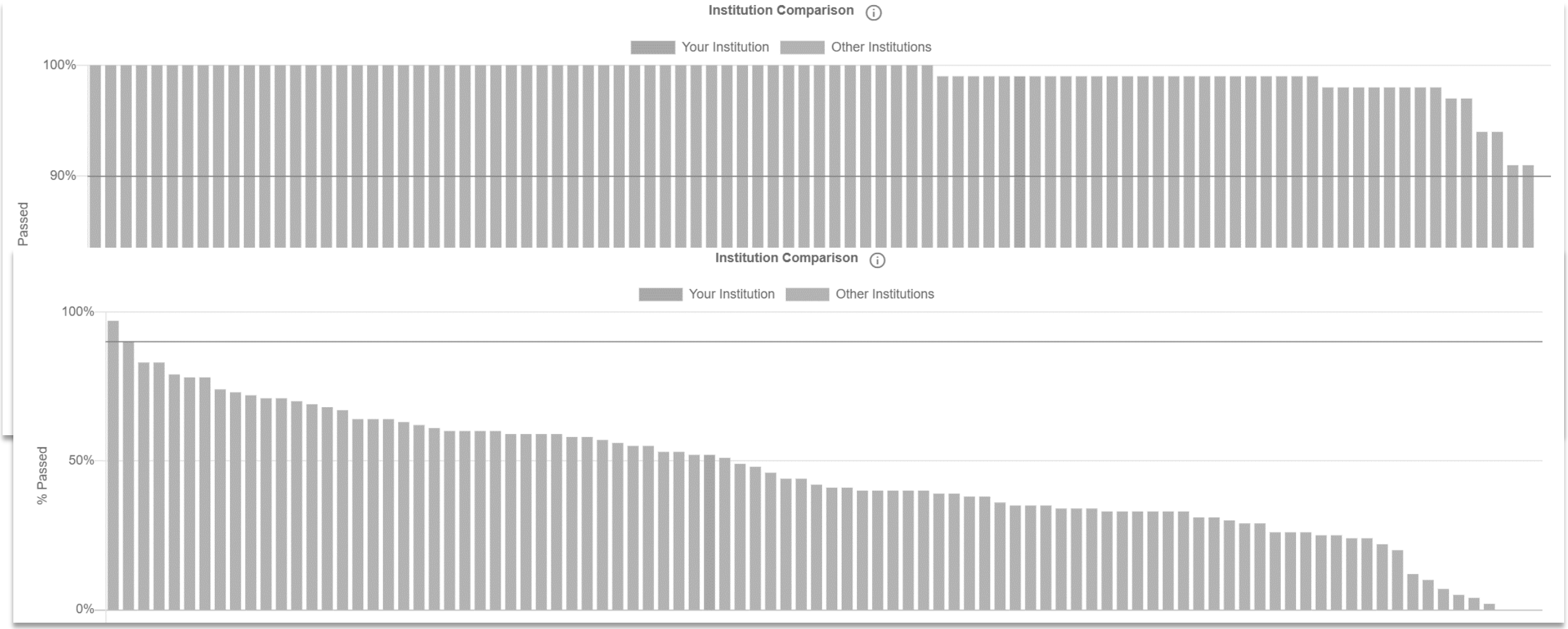
Difference between ICC and MOR:



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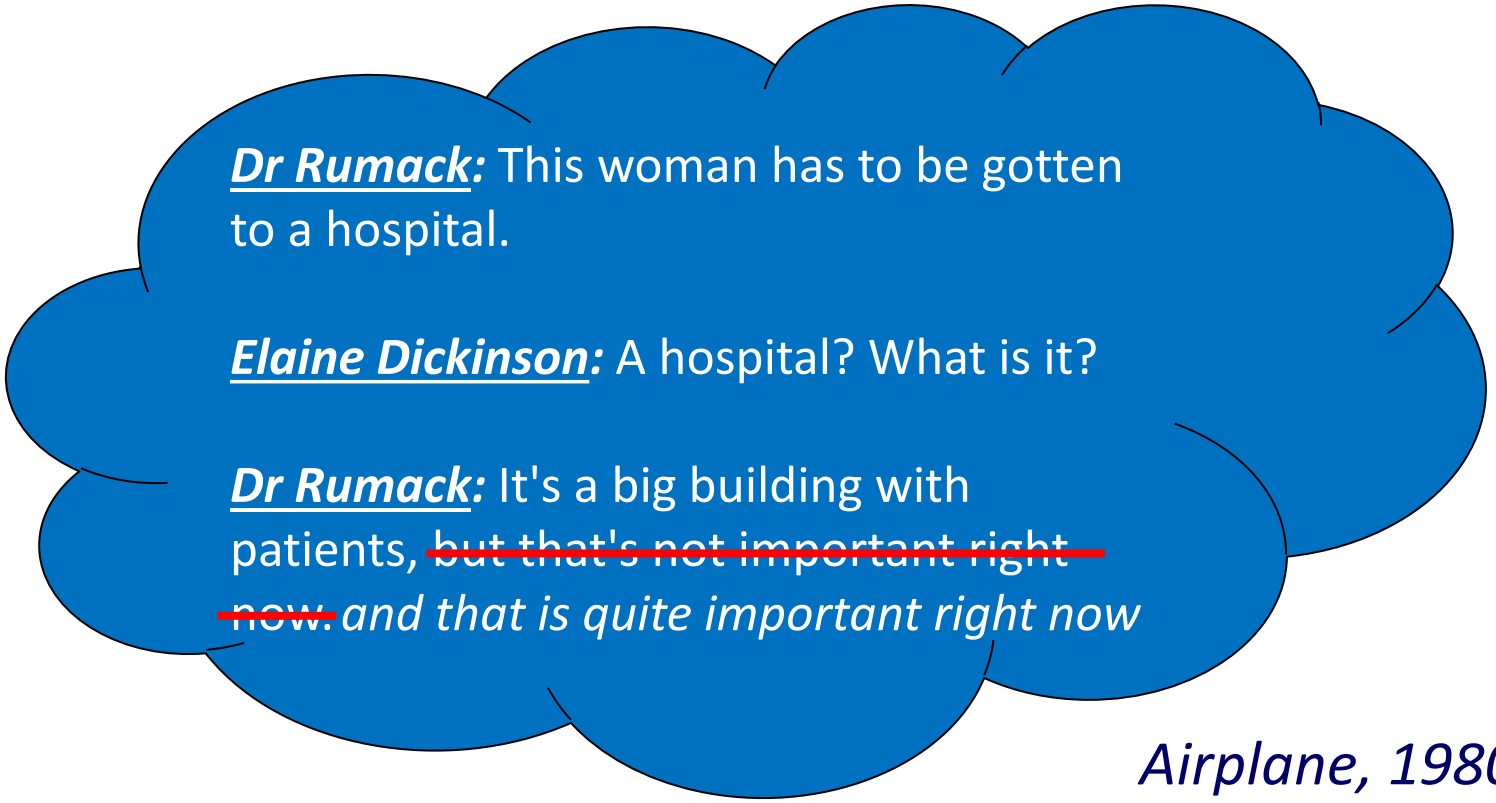
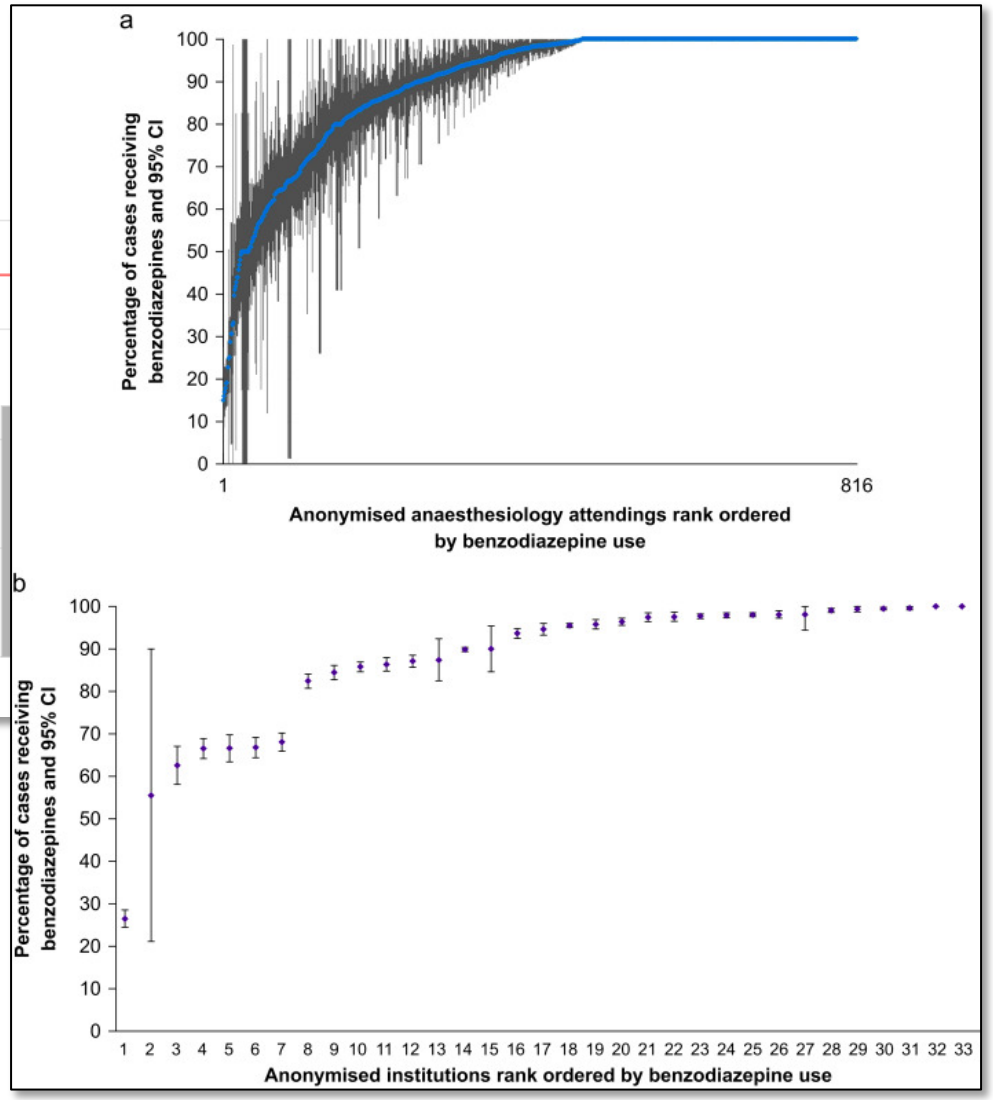


Airplane, 1980

MPOG INITIATIVES TO SUPPORT AND UNDERSTAND STRUCTURE

Problems To Solve:



1. Reflect organizational realities in hospitals and clinician care groups
2. Use this to understand and explain clinician and hospital level variation

Janda AM et al. BJA 2022

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A Note of Caution

Attempts to identify individual patients, clinicians or hospitals are against both the spirit and the letter of the MPOG Data Use Agreement

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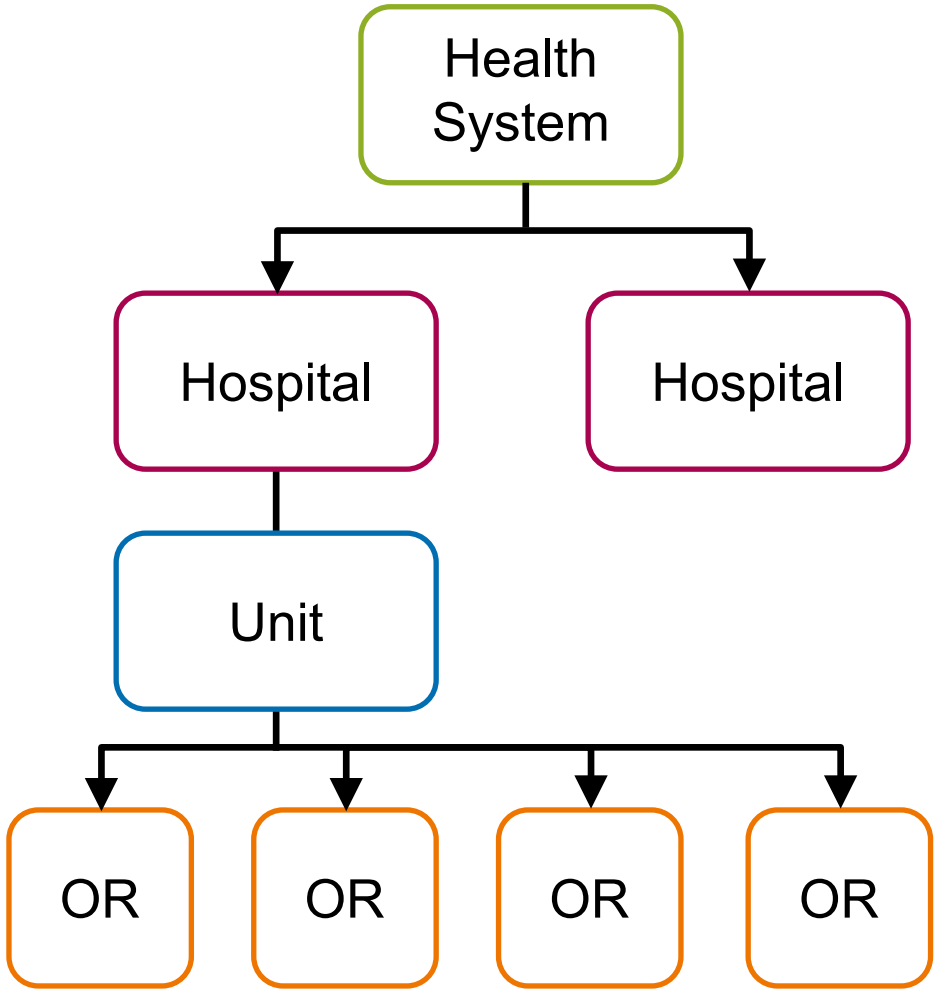
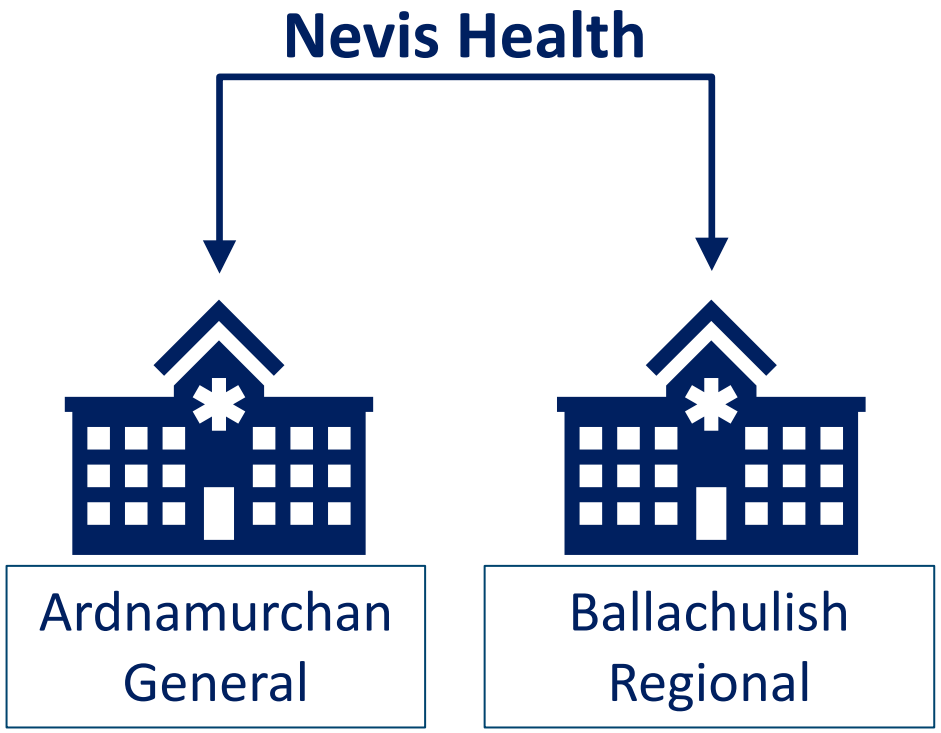
“A Hospital, What is it?”

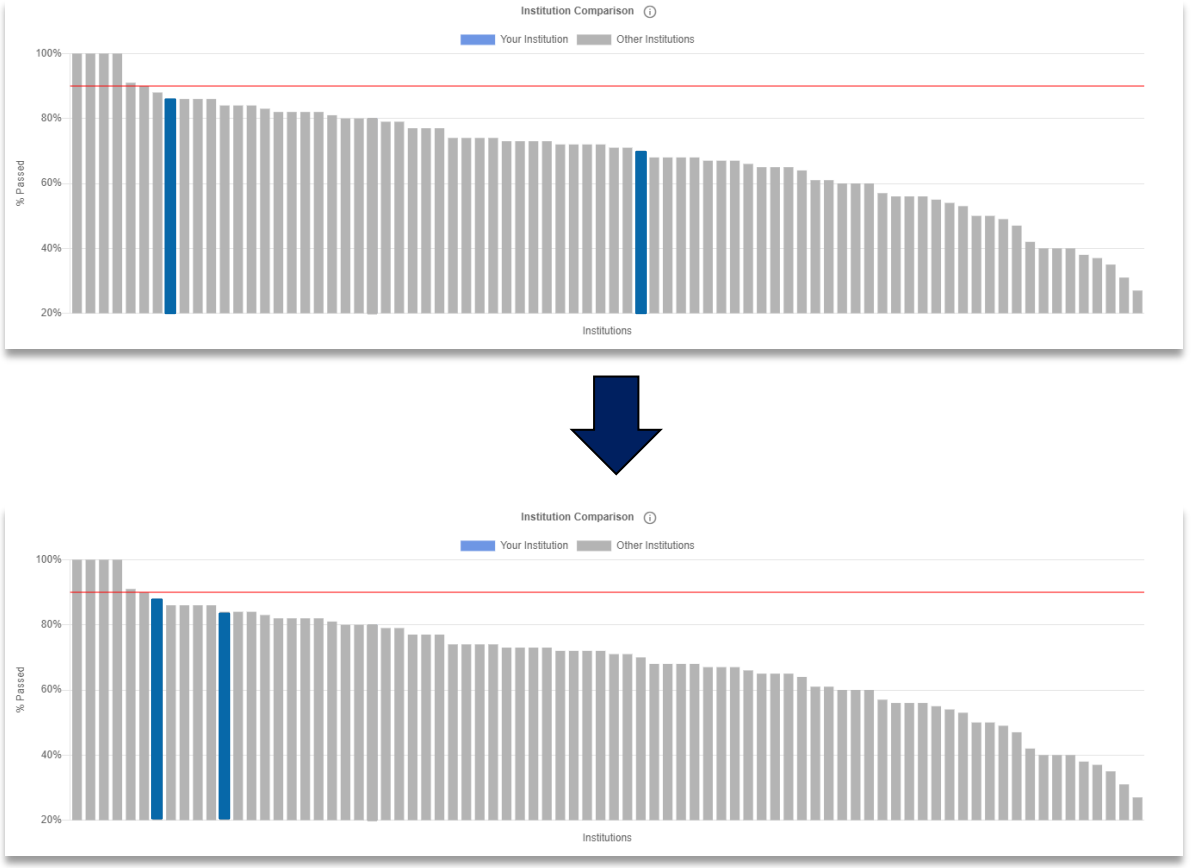
- Revisited data infrastructure for describing hospitals and health systems
- Understand that some organizations consider “hospital” differently
- Developed new location mapping hierarchies

- New hospital definition aligns with American Hospital Association
  - Provides objective reference standard
  - Allows connection to this dataset to understand in detail the available resources



Why: Did Nevis Health Equalize Glucose ASPIRE Performance?

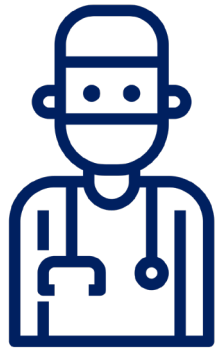




MPOG
MULTICENTER PERIOPERATIVE OUTCOMES GROUP

Applying this to Clinicians

- Most clinicians in MPOG have an NPI number (National Provider Identifier)
- Observe the same provider across multiple hospitals over time with good confidence
- Required to sort out hospital effects from clinician ones
- Description of practice based on observed cases or potentially joining to external datasets



Drumnadrochit Memorial

Ardnamurchan General

MPOG
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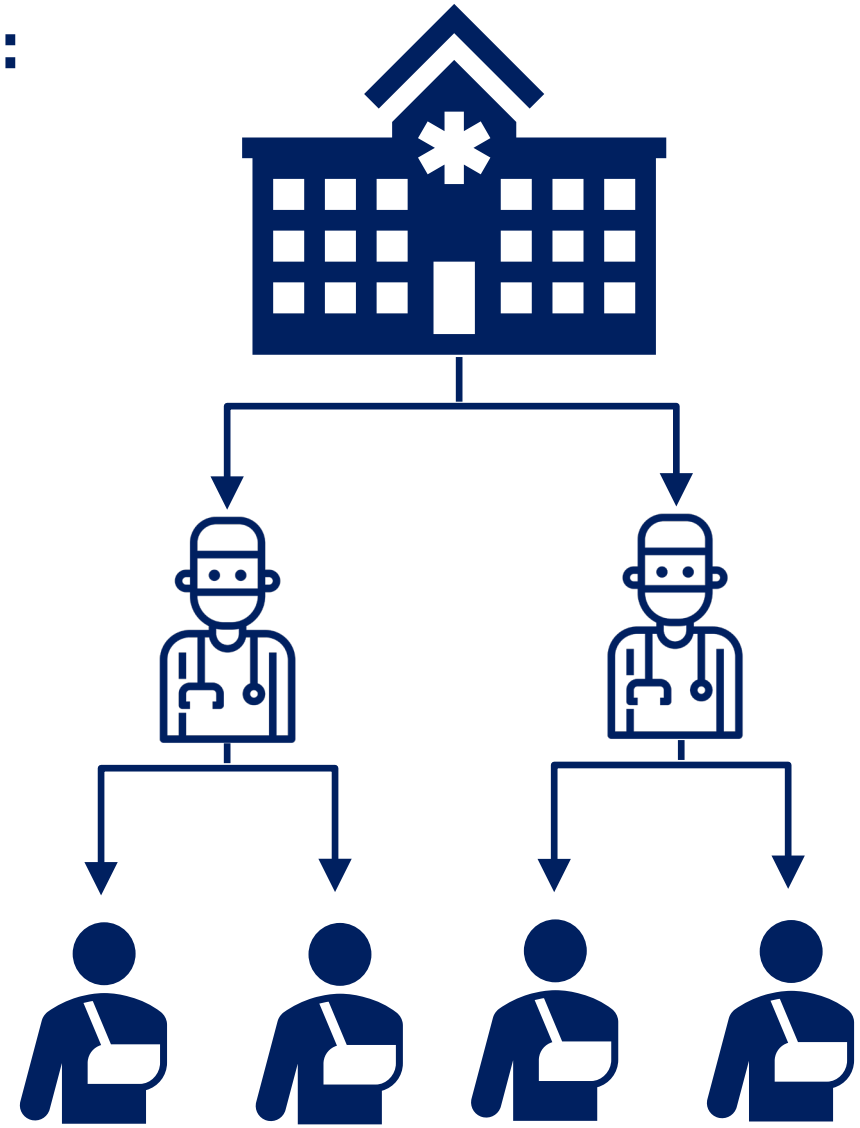
Explaining Hospital and Clinician Variation:

- Commonly large amounts of observed variation attributable to Hospital or Clinician
- Explanatory variables typically focus on patient or case factors
- Future opportunities exist to test hospital or clinician related hypotheses:
  - Hospital (examples): Bed Size, Case Volume, presence of specialty services
  - Clinician (examples): Practice pattern or specialization, board certification, length of practice



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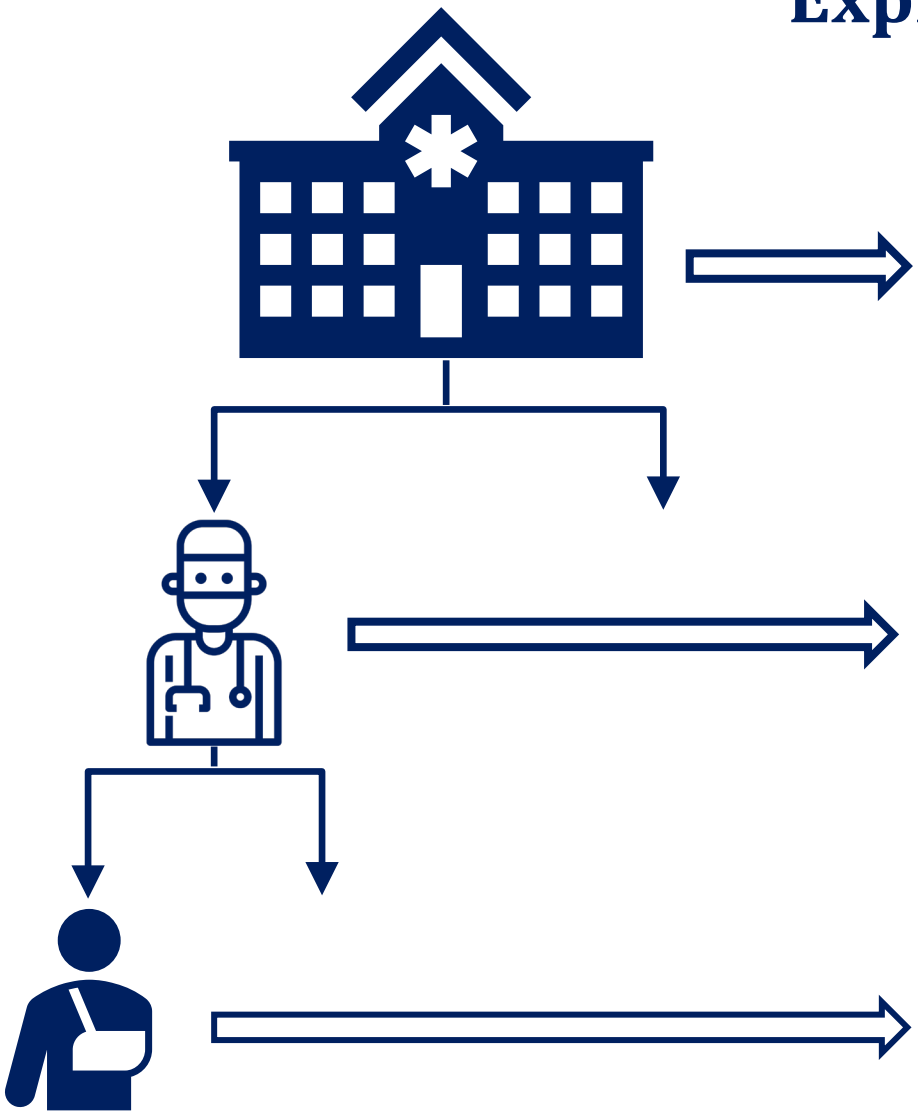
Explaining Hospital and Clinician Variation:



Hospital ID	Bed Size	L&D Volume	Trauma Center
2222	325	1200	Y

Clinician ID	Cases Per Year	C-Sections Per Year	Board Certified
3333	600	60	Y

Case ID	Patient Age	Preop Hb	GA C-Section
5555	34	11.6	Y

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MPOG Records May Be Self Descriptive

- MPOG captures every electronic anesthetic record at a given hospital
- This creates a longitudinal and comprehensive picture of practice
- Must be created from the entire MPOG dataset, not just the patients meeting inclusion/exclusion criteria for a study
- **Future work:** build a library of these, analogous to our case level phenotypes

Take Away Points:

- Variation is ubiquitous in healthcare and is central to both research and quality improvement
- Structure of healthcare system must be understood to ensure correct QI and Research solutions are used
- Healthcare Systems and Hospitals are complex organizationally but can be reflected in MPOG Data.
- This allows correct attribution of variation by differences in hospitals and clinicians
- MPOG Data may be self descriptive of practice to calculate explanatory variables