

Getting out of the Operating Room: Understanding Patient Outcome and Recovery

Douglas A Colquhoun, MB ChB, MSc, MPH

Assistant Professor of Anesthesiology

Associate Research Director, Multicenter Perioperative Outcomes Group

July 12th 2024

Disclosures:

Research Funding:

- National Heart Lung and Blood Institute (K08-HL159327) [PI]
- National Institute on Drug Abuse (R61-DA059168) [Co-PI]
- Foundation for Anesthesia Education and Research (2021) [PI]
- NIH Common Fund (UM1-NS118922) [Co-I]
- Patient Centered Outcomes Research Institute (PLACER-2020C3-21106) [Co-I]
- Agency for Healthcare Research and Quality (R01-HS029172) [Co-I]



National Heart, Lung,
and Blood Institute



National Institute
on Drug Abuse

Sponsored Research:

- Merck & Co – 2019-2022 [PI]
- GE Healthcare – [PI]
- Chiesi, USA Inc [Co-I]



Speaker/Consulting Fees:

- Medscape, Inc – Honorarium (2022)



Overview/Outline:

- Perioperative Mortality Paradox
- Understanding Postoperative Complications
- Thinking Broadly About Outcomes After Anesthesia Care
- Deepening Understanding of Perioperative Care

Willie Sutton (1901-1980)

*“Because that’s where
the money is.”*



<https://www.fbi.gov/history/famous-cases/willie-sutton>

Perioperative Mortality Paradox

Perioperative Risk Paradox:

- Intraoperative mortality is vanishingly rare
- But death within 30 days of the operating room would be 3rd leading cause of death in US
- Explore this and what this means for understanding patient outcomes



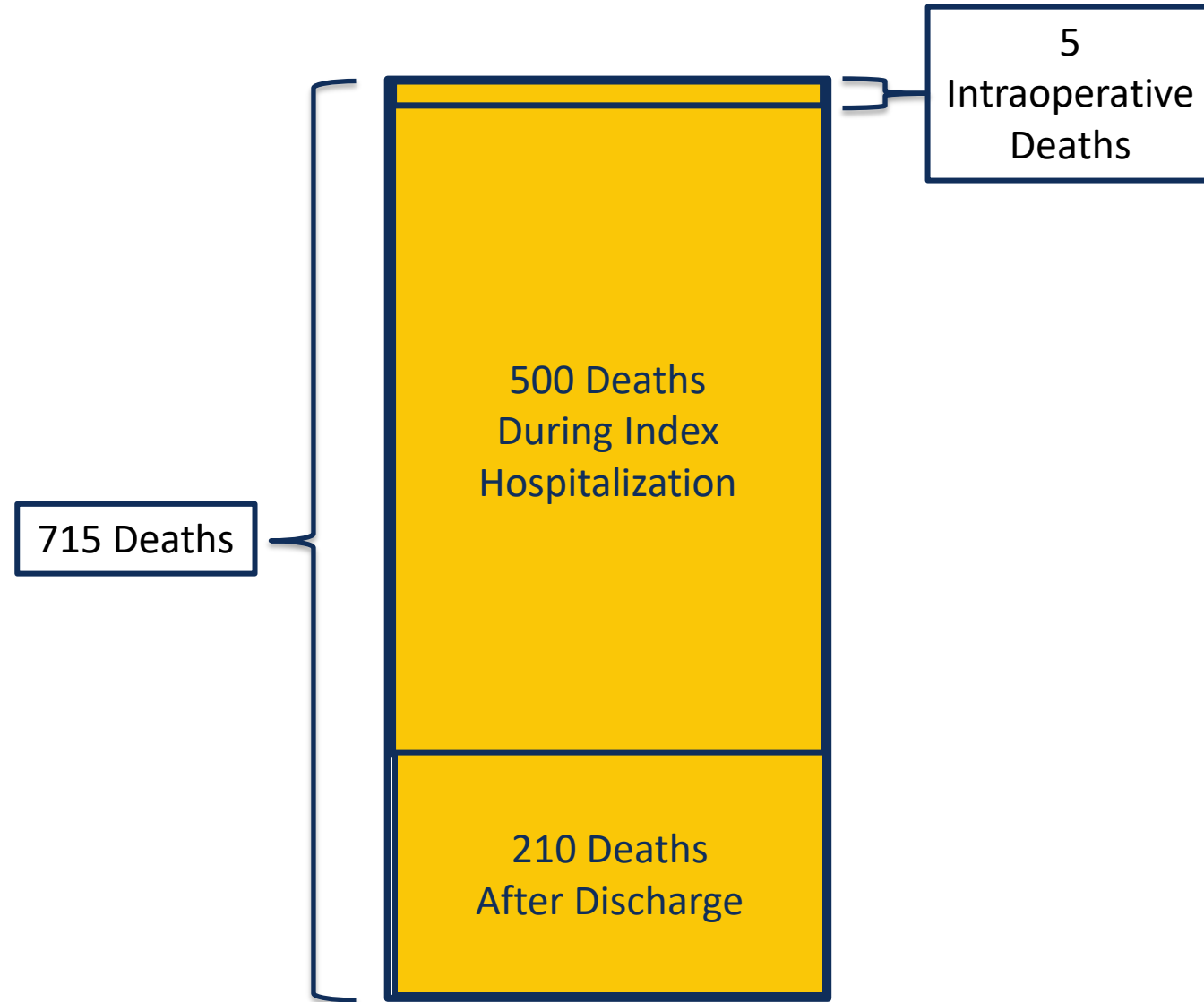
Bartels K, Anesthesiology. 2013

Incidence of Mortality: Current Literature

Study Type	Study	Outcome	Rate
Prospective Audit	EuSOS: 7 Days in Europe <i>(Pearse Lancet 2012)</i>	In Hospital Mortality	4% in hospital mortality <i>(3% elective -> 10% emergency)</i> <i>Large Between Country Differences</i>
	ISOS: 7 days in 27 Countries <i>(BJA 2016)</i>	In Hospital Mortality Development of Complications	0.5% In Hospital Mortality
Prospective Cohort	VISION: <i>(Spence, CMAJ 2019)</i>	30 Day Mortality	1.8% 30 Day Mortality
Database Study	Netherlands Pop. Registry <i>(Noordzij Anesthesiology 2010)</i>	In Hospital Mortality	1.85% In Hospital Mortality
	NACOR <i>(Whitlock Anesthesiology 2015)</i>	48hr Mortality	0.03% within 48hrs
	Community Based Anesthesia <i>(Pollard, Anesth Analg. 2018)</i>	48hr Mortality Anesthesia Related Mortality	0.08% within 48hr

The VISION Cohort:

- Population:
 - 40,004 patients:
 - >45 yrs
 - 1 night in hospital planned
 - Non-cardiac surgeries.
 - 28 Hospitals across 14 Countries
- 715 (1.8%) of patients died in the next 30 days
- *“Number of deaths was almost evenly distributed over 30-day follow-up”*

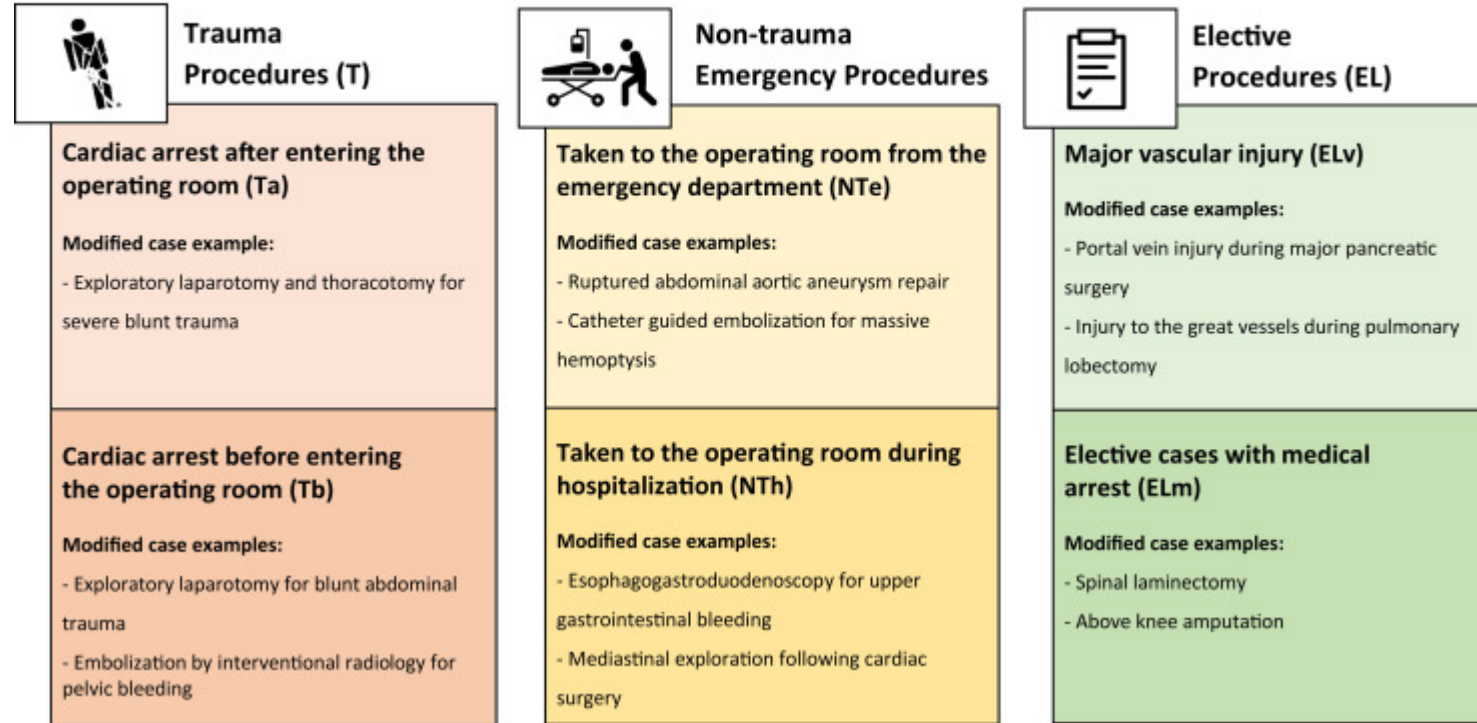


(Spence J, CMAJ 2019)

Intraoperative Mortality:

- Single Institution (MGH)
- All intraoperative deaths over a 4 year Period (n=41)
- Grouped into:
 - Trauma
 - Non-Trauma Emergency
 - Elective
- Where are the opportunities to change and improve care?

Intra-Operative Deaths



Gallastegi AD. J Surg Res. 2022

Anesthesia Related Mortality

- Intraoperative mortality is very rare
 - *Anesthesia related mortality, is rarer*
 - *But death in the next 30 days is quite common*
- Anesthesia related mortality has fallen markedly:
 - 1940's: 1 in 1,000
 - 1970's: 1 in 10,000
 - 2000's: 1 in 100,000
- In the context of increasing surgical complexity and patient comorbidity
- This is a remarkable achievement as a specialty

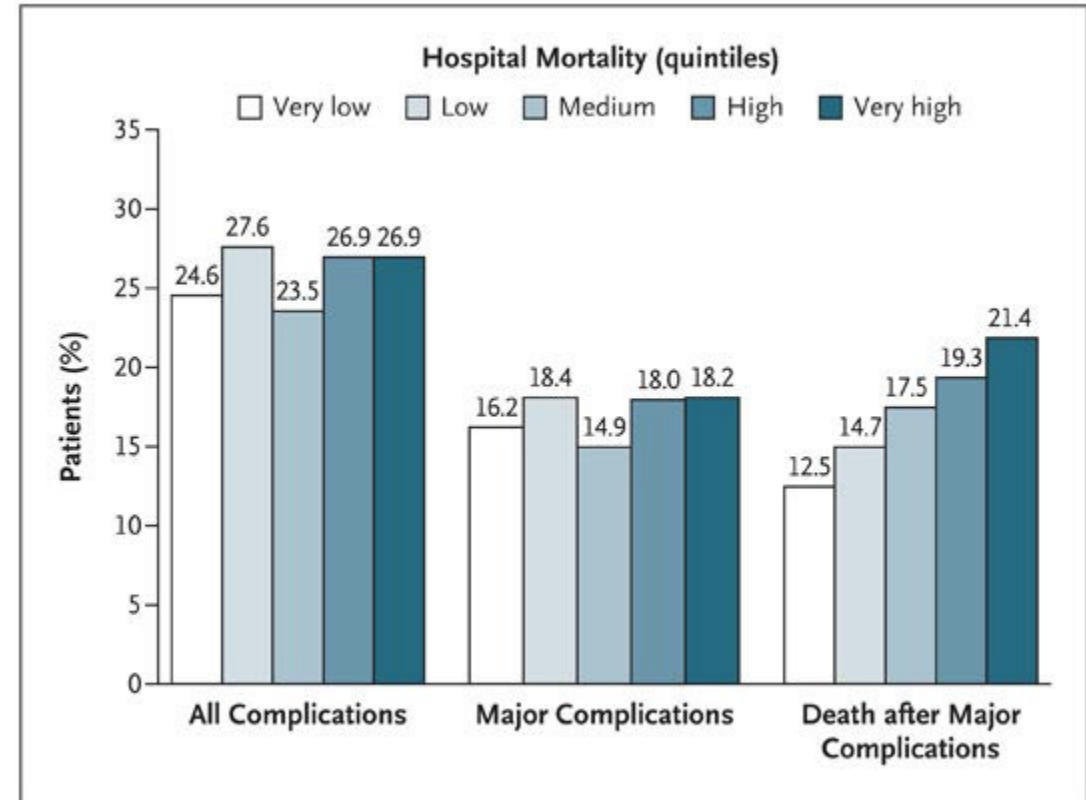


Li G et al. Anesthesiology. 2009

Understanding Postoperative Complications

Unpacking Perioperative Morbidity

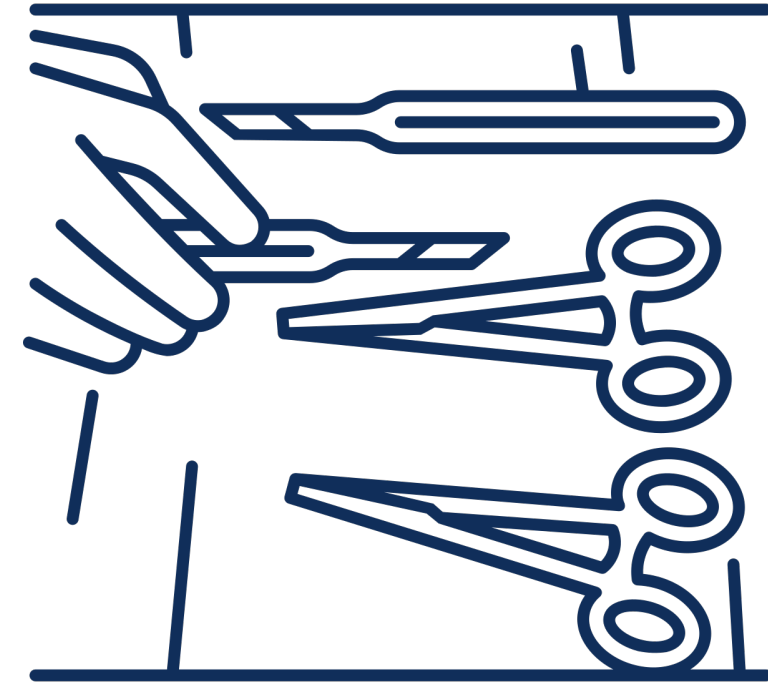
- Morbidity happens in the postoperative period
 - 2/3rds of 30-day deaths are during first admission
- Complications are common:
 - >20% of surgical patients, depending on complication and population studied
- Failure to Rescue: Translation of Complication to a Postoperative Death
 - Highly variable by institution



Ghaferi A. NEJM 2009

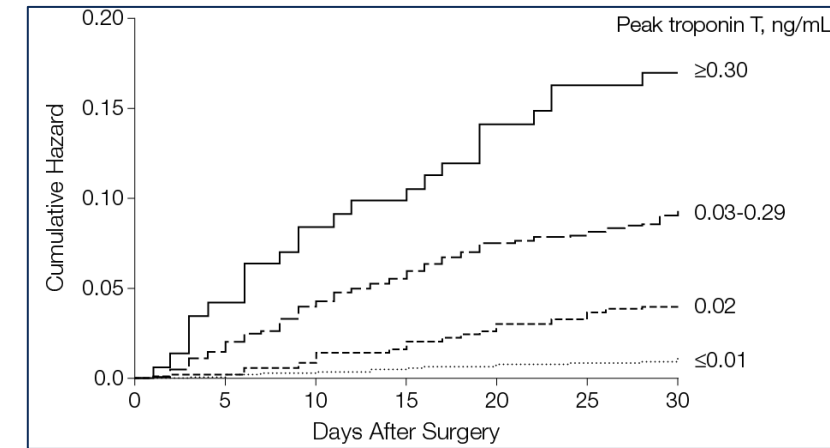
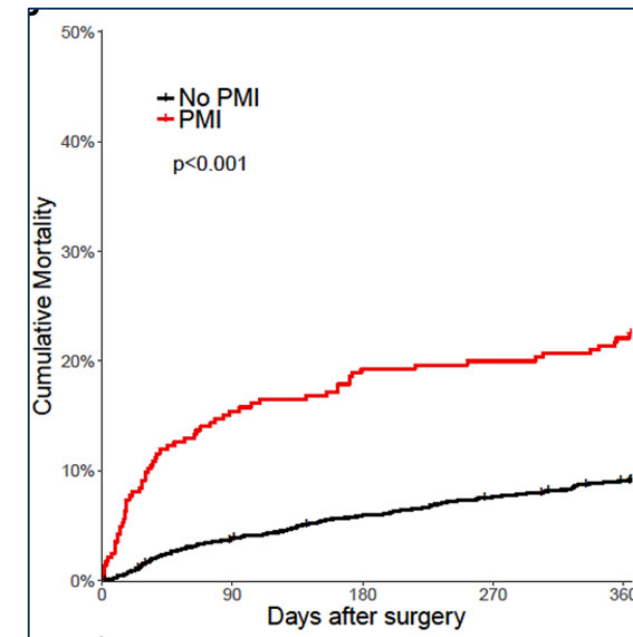
Getting Specific About Perioperative Complications:

- Specific definitions used by clinical trials / registries
- Relatively subtle or subclinical occurrences result in marked change in patient outcomes:
 - Myocardial Injury (Troponin Leak)
 - Prolonged Oxygen Requirement
 - Acute Kidney Injury
- Each impacts patient outcome and are very common



Morbidity 1: Myocardial Injury (Troponin Leak)

- Myocardial Injury in Non-Cardiac Surgery:
 - Biomarker Suggestion of Cardiac Injury/Impairment
 - Does not conform to definition of MI
- Incidence is ~20% if all patients are screened
- Co-existing features of ischemia (eg chest pain) are relatively uncommon (~5%)
- Dose dependent impact on long term outcome
- Powerfully impacts 30 day and 365 day outcome



Devereaux P, JAMA, 2012
Puelacher C. Circulation. 2017
Smilowitz NR, Cardiol Rev. 2019

Morbidity 2: Prolonged Oxygen Requirement

- Supplemental oxygen as part of the “background” of inpatient medical care
- Suggests significant degradation of respiratory function
- Included in definition of PPC’s in two large cohort studies:
 - LAS VEGAS (Eur Jr Anes 2017)
 - Fernandez-Bustamante et al (JAMA Surg 2017)
- Even “Just” supplemental O₂ is associated with, increased LOS, increased ICU utilization

Table 3. Number of PPCs and Clinical Outcomes

Variable	All Patients (N = 1202)	Hospital		ICU		7-d Mortality (n = 9)
		Patients, No. (%) (n = 1179)	LOS, Median (IQR), d	Patients, No. (%) (n = 270)	LOS, Median (IQR), d	
No. of PPCs						
0	801 (66.6)	781 (97.5)	3 (2-6)	133 (16.6)	1 (1-2)	0 (0)
1	231 (19.2)	228 (98.7)	5 (4-8)	57 (24.7)	2 (1-4)	0 (0)
2	91 (7.6)	91 (100.0)	8 (5-14)	35 (38.5)	3 (1-6)	3 (3.3)
3	58 (4.8)	58 (100.0)	9 (5-15)	32 (55.2)	4 (2-7)	4 (6.9)
4	17 (1.4)	17 (100.0)	8 (7-18)	9 (52.9)	7 (6-15)	2 (11.8)
5	2 (0.2)	2 (100.0)	22 (21-22)	2 (100.0)	14 (9-18)	0 (0)
6	2 (0.2)	2 (100.0)	25 (24-26)	2 (100.0)	9 (6-11)	0 (0)
At least 1 PPC	401 (33.4)	398 (99.3) ^a	6 (4-11) ^b	137 (34.2) ^b	3 (2-6) ^b	9 (2.3) ^b
RR or MDiff (95% CI), (≥1 PPC vs 0 PPCs)	NA	1.02 (1.00-1.03)	3.0 (2.0-5.3)	2.1 (1.7-2.5)	2.0 (0.7-3.0)	ND ^c

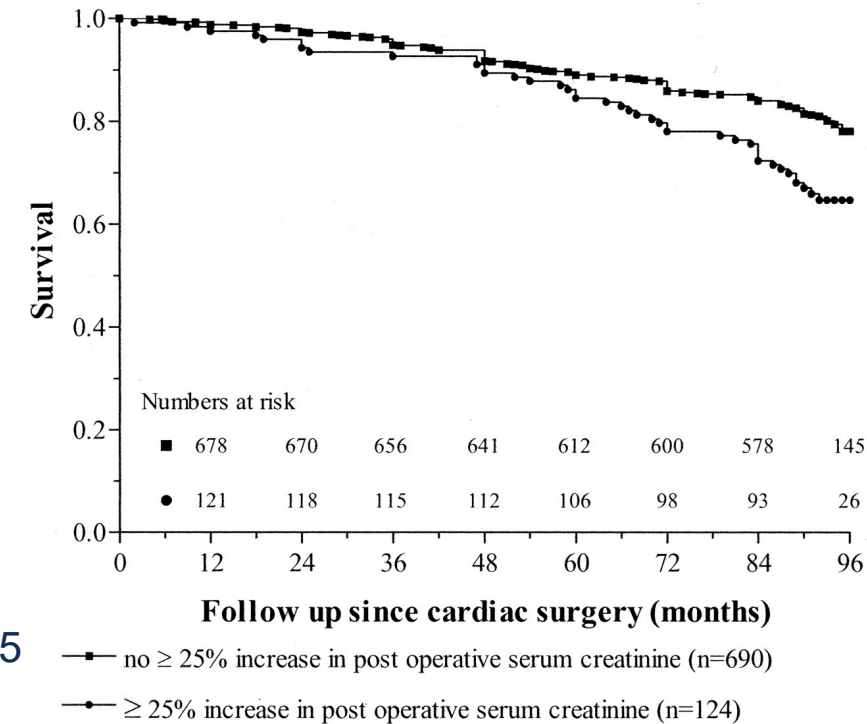
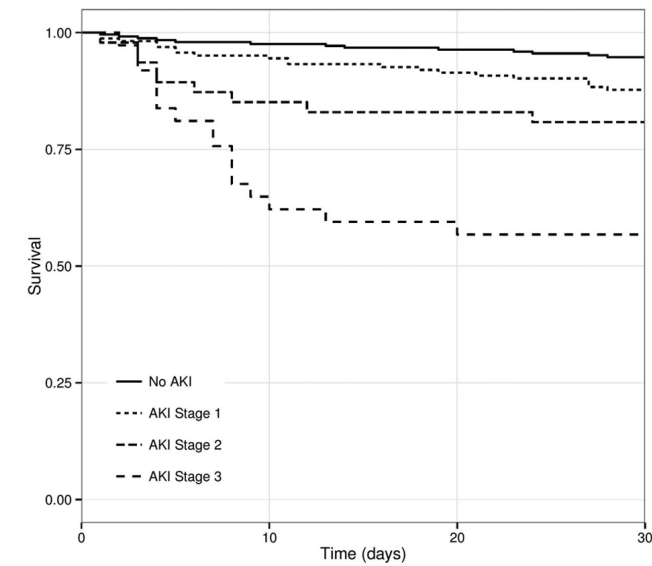
Abbreviations: ICU, intensive care unit; IQR, interquartile range; LOS, length of stay; MDiff, median difference; NA, not available; ND, not defined; PPC, postoperative pulmonary complication; RR, relative risk.

^a P < .05 in patients with at least 1 PPC vs 0 PPCs.
^b P < .001 in patients with at least 1 PPC vs 0 PPCs.
^c RR or MDiff (95% CI) calculated as not defined or not calculated.

Fernandez-Bustamante et al. JAMA Surg 2017

Morbidity 3: Acute Kidney Injury

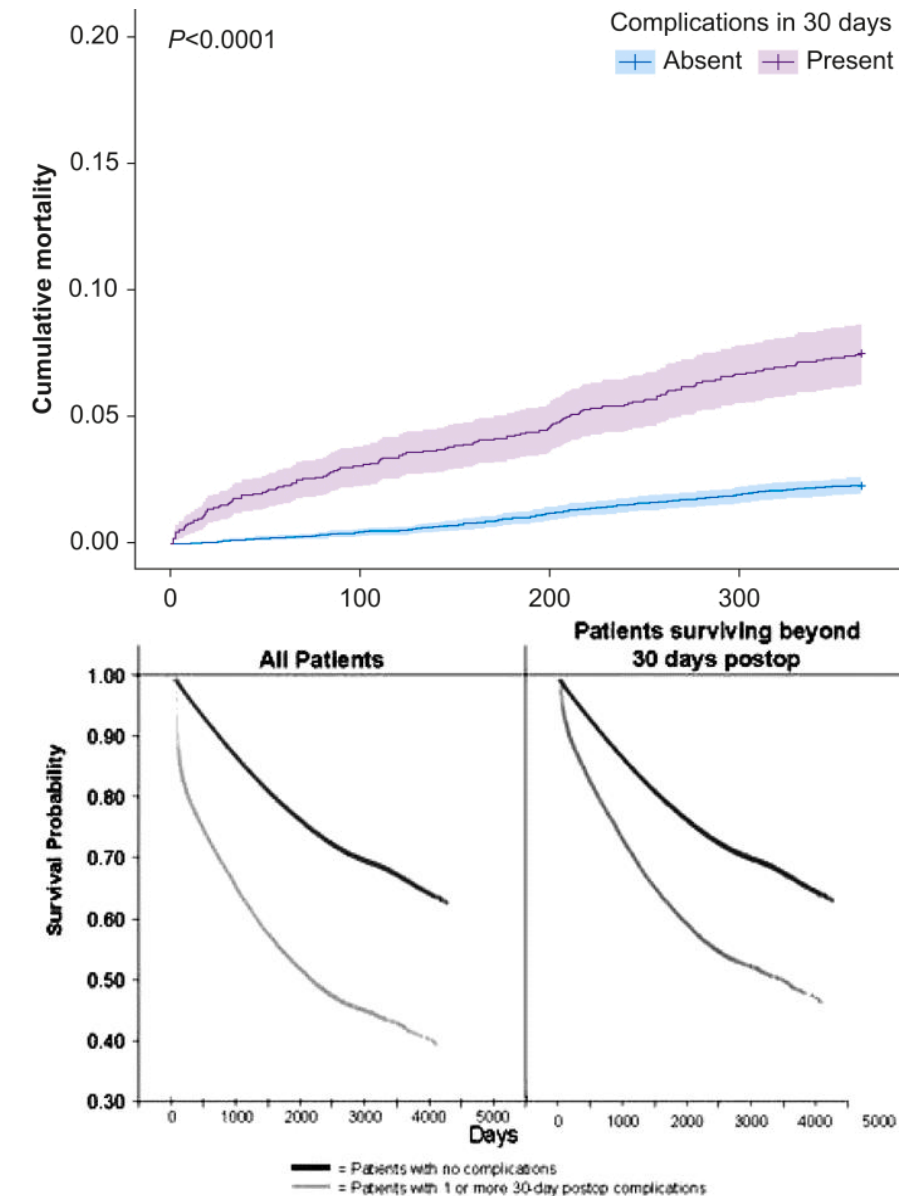
- AKI is common after inpatient surgery:
 - 13.4% in meta-analysis
 - 72% of this is Stage 1 AKI
 - Much will return to baseline
- However:
 - Associated with marked increased 30 day mortality
 - Also associated with long term mortality in cardiac surgery patients



O'Connor ME. Intensive Care Medicine. 2015
 Long T. Anesth Analg. 2016
 Loef B. JASN 2005

Complications drive long term outcomes

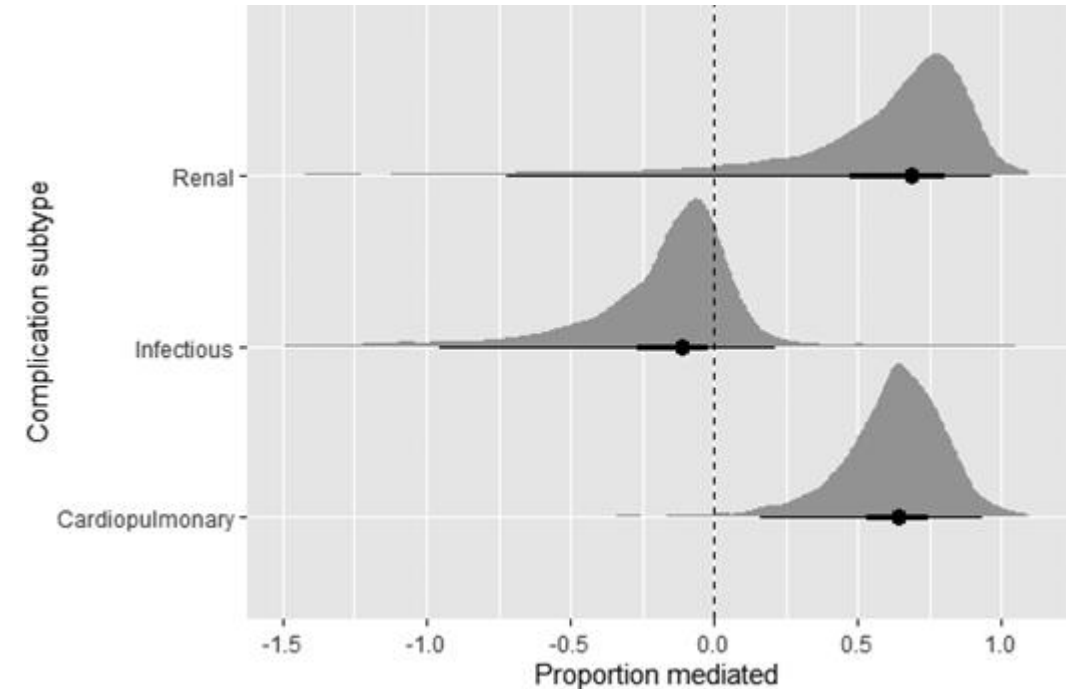
- Patients who develop complications have different long-term outcomes.
- At 1 year:
 - Died: 2.3% [no complications] vs 7.5% [complications]
- Difference persists out > 5 years.
- Early inflection point ~ 60 days for when death rate changes.



Fowler AJ. Br J Anaesth. 2022
Khuri SH. Ann Surg. 2005

Patient Risk

- Complications are not equally distributed across surgical population
- Specific groups are at particular risk:
 - Surgery Type (specialty)
 - Emergency Surgery
 - Age
 - Frailty
- Example: Over half of the relationship between frailty and mortality is mediated by the occurrence of complications



Mclsaac DI. Anesthesiology 2021

Challenge:

- Identify complications which are occurring during the inpatient admission
- Identify high risk patients and modifiable processes of care
- Make these a focus of our care improvement
- Understanding co-responsibilities with surgical colleagues



Thinking Broadly About Outcomes After Anesthesia Care

Finishing the Race: Outcomes After Anesthesia Care

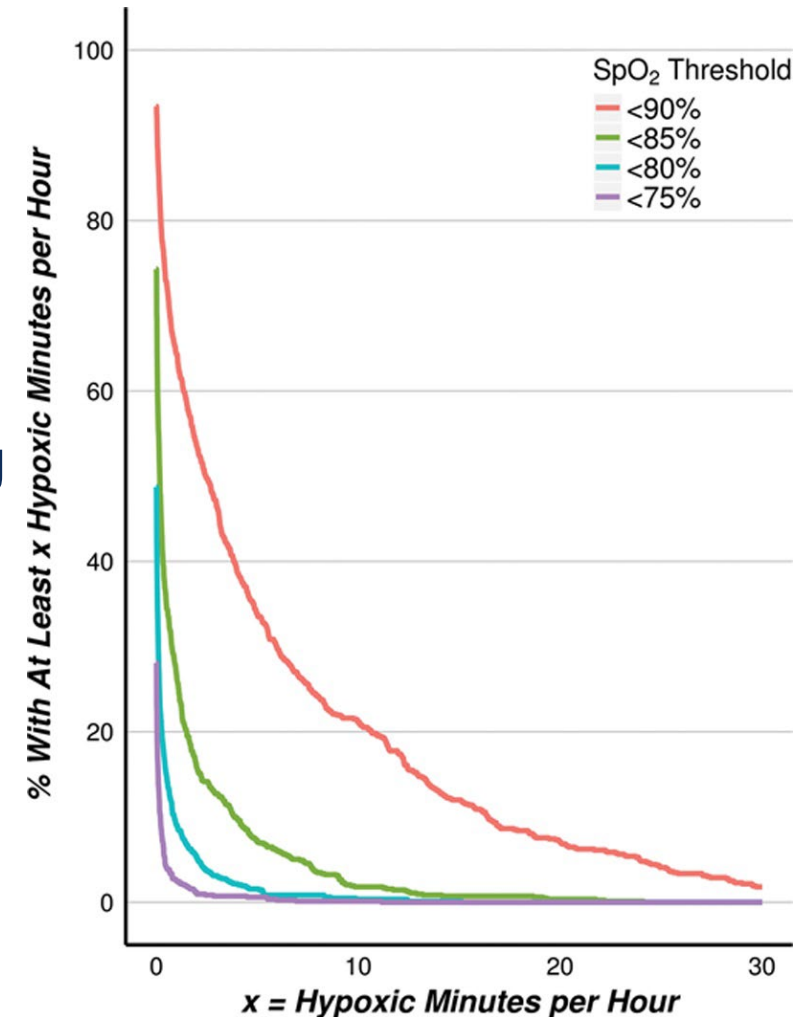


- Handover to PACU may signify “Anesthesia End”
- Recognizing PACU outcomes is key for intraoperative technique refinement
- PACU is beginning of patient recovery
- What patients value in recovery from surgery?
 - Often expressed in functional terms: return to routine, resolution of symptoms, regaining independence

Rajabiyazdi F. JAMA Surg 2021

Physiologic Monitoring in Post Operative Period:

- Potential roles for increasing monitoring in the postoperative period
- Large cohort studies have demonstrated prolonged periods:
 - Hypotension
 - ~15% of patients will have >15mins of MAP < 65 mmHg
 - Hypoxia
 - 20% of patients will have >10 mins of SpO₂ < 90% in any hour
- Poorly detected by conventional q4hr vital signs
- Remaining issues on who monitors the monitors...



Zhou S. Anesth Analg. 2015

Turan A. Anesthesiology. 2019

Patient Perspectives On Recovery

- Instruments exist to Quantify patient perspective on anesthesia + surgical recovery
 - Quality of Recovery (QOR15/40)
 - Pain, Physical Comfort, Independence, Psychological Support, Emotional State
 - Measures both Physical and Mental Well-Being
 - Bauer Patient Satisfaction:
 - Includes both physical discomfort present/absent
 - Likert-type scaled around specific domains
- Used in mostly research contexts - point to areas of patient concern

PART A

How have you been feeling in the last 24 hours?

(0 to 10, where: 0 = none of the time [poor] and 10 = all of the time [excellent])

1. Able to breathe easily
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
2. Been able to enjoy food
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
3. Feeling rested
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
4. Have had a good sleep
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
5. Able to look after personal toilet and hygiene unaided
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
6. Able to communicate with family or friends
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
7. Getting support from hospital doctors and nurses
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
8. Able to return to work or usual home activities
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
9. Feeling comfortable and in control
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time
10. Having a feeling of general well-being
None of the time 0 1 2 3 4 5 6 7 8 9 10 All of the time

PART B

Have you had any of the following in the last 24 hours?

(10 to 0, where: 10 = none of the time [excellent] and 0 = all of the time [poor])

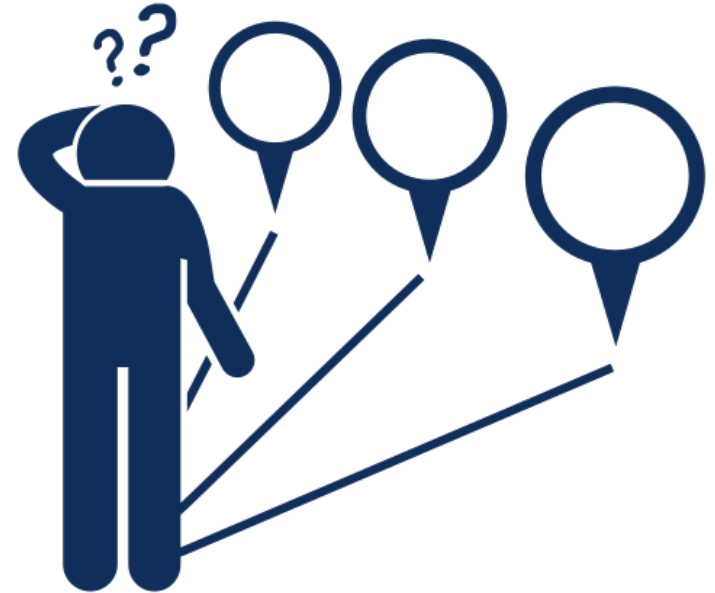
11. Moderate pain
None of the time 10 9 8 7 6 5 4 3 2 1 0 All of the time
12. Severe pain
None of the time 10 9 8 7 6 5 4 3 2 1 0 All of the time
13. Nausea or vomiting
None of the time 10 9 8 7 6 5 4 3 2 1 0 All of the time
14. Feeling worried or anxious
None of the time 10 9 8 7 6 5 4 3 2 1 0 All of the time
15. Feeling sad or depressed
None of the time 10 9 8 7 6 5 4 3 2 1 0 All of the time

Stark PA. Anesthesiology. 2013

Bauer M. Acta Anaesthesiol Scand. 2001

What Direct Anesthesia Outcomes Do Patients Seek:

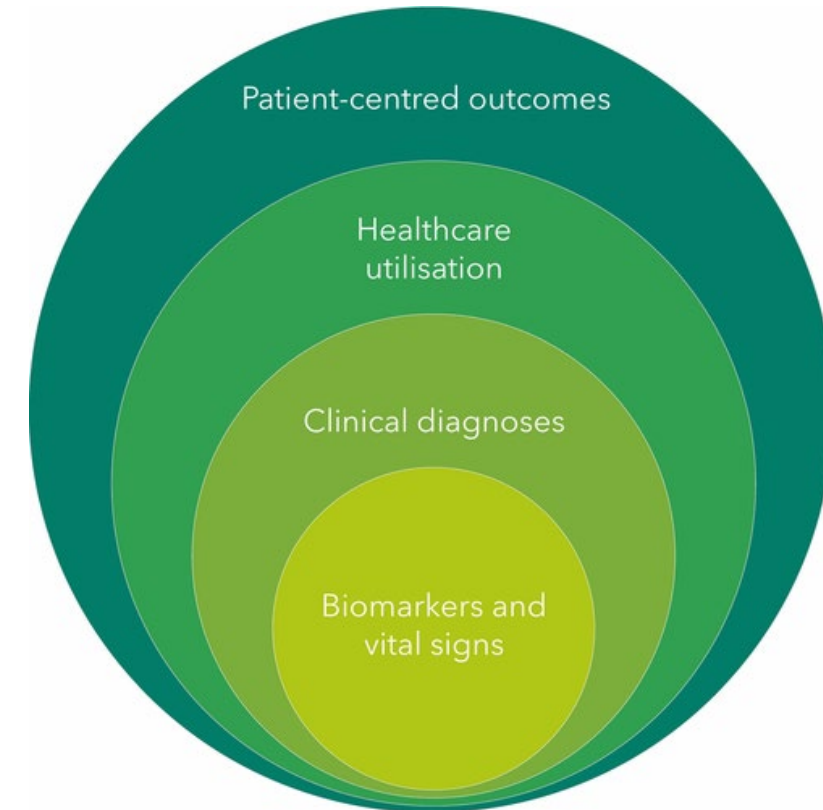
- Other researchers have sought to directly quantify patient perspectives (Top 3):
 - Emphasizing most important considerations:
 - Unawareness
 - Nausea and Vomiting
 - Return to normal function
 - Or outcomes to be most avoided:
 - Vomiting
 - Gagging on ETT
 - Pain



Tellor-Pennington BR, BMC Anesthesiology, 2023
Macario A. Anesth Analg 1999

What Matters to Patients:

- Pursuit of Patient Centered Outcomes is to Understand what Matters to Patients and their Caregivers
- Too often we have focused (solely) on what is measurable and important to physicians or the health system
- Death and complications alone do not capture this
- Lahda proposes:
 - Health Related Quality of Life Measure
 - Functional Status Measure
 - Life Impact Measure

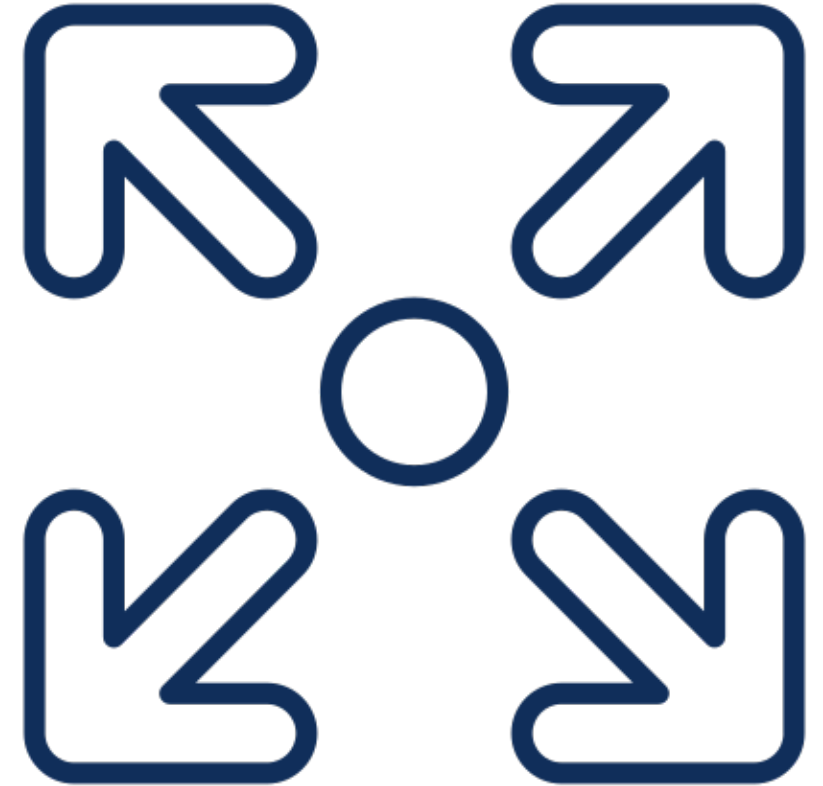


Ladha KS. Anesthesia. 2020

Deepening Understanding Of Perioperative Care

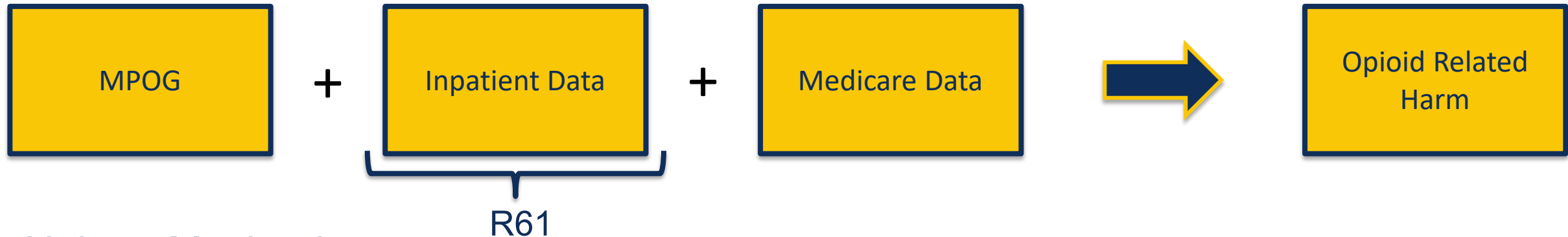
Opportunity to Expand Our Perspective:

- Expansive vision of anesthesia outcome
- Goes well beyond the intraoperative period
- How do we start? Moving towards inpatient data.
- About a year ago, an opportunity arose to help speed up this work



Deepening Understanding of Perioperative Care:

- Emerges from **Funded R61/R33 Award** - National Institute for Drug Abuse (NIDA):



- Unique Mechanism:
 - **R61**: 2 years: Build capacity
 - **R33**: 3 years: Do a project with that new capacity
- HEAL Data2Action Initiative (**H**elping **E**nd **A**ddiction **L**ong Term Initiative)
- Milestone based graduation from R61 to R33 Phases
- Co-PI's: Eric Sun (Stanford) + Douglas Colquhoun (U-M)

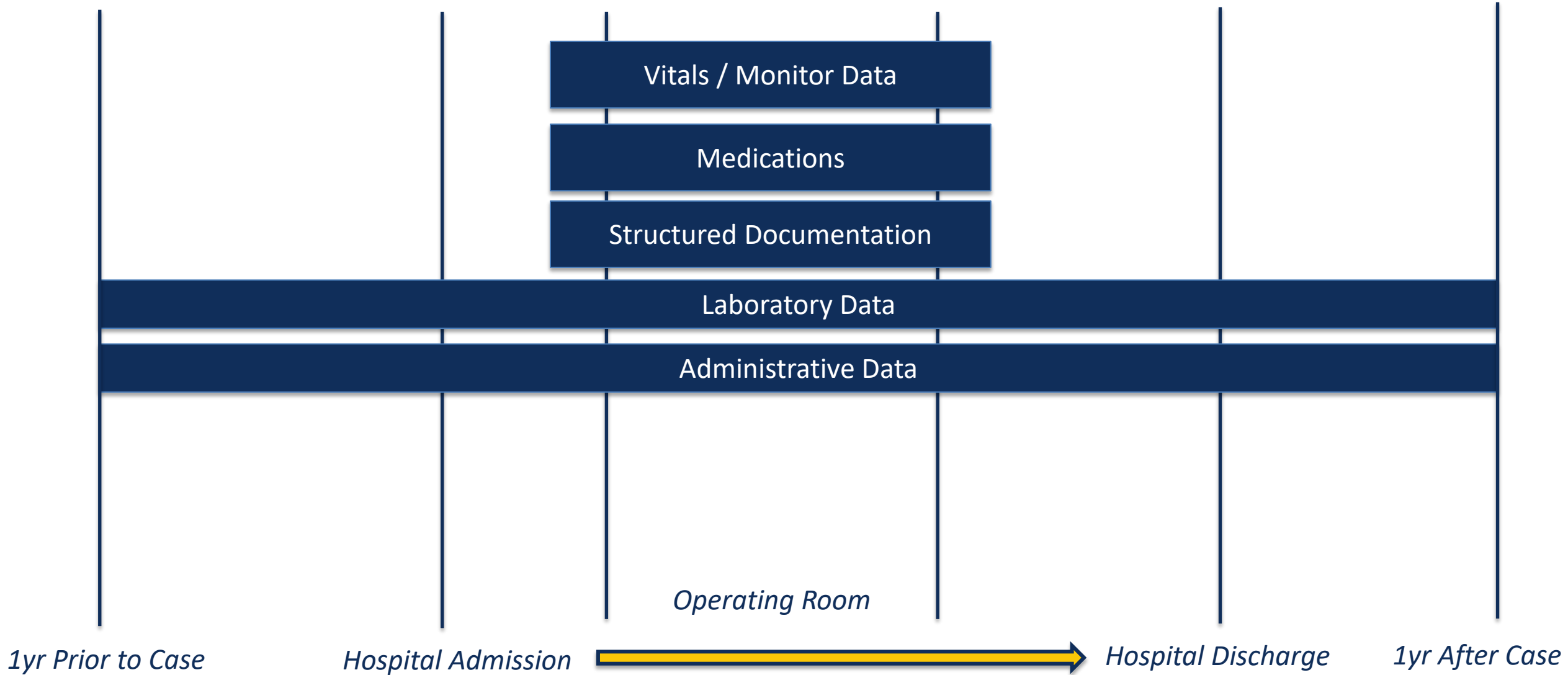


MPOG: Inpatient Data

- We got 2 years of funding to support MPOG development
- Need to pursue inpatient data
 - Specific project requires inpatient pain data
 - Opportunity to reimagine MPOG Data Types and Address Key limitations
- Prioritized list of data types which would have a good effort/payoff trade to improve understanding of postoperative care



MPOG Current State:



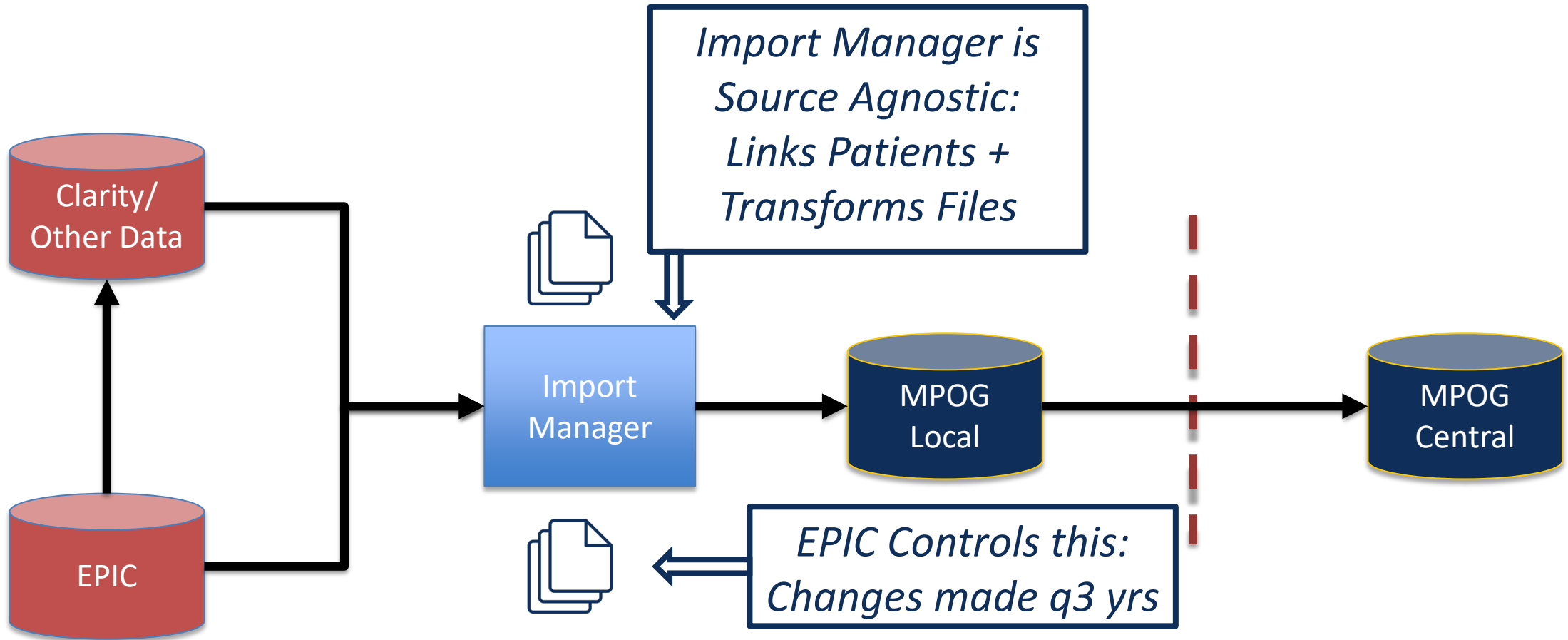
Evolution of MPOG:

- Originally MPOG was in context of freestanding Anesthesia Information Management Systems (AIMS).
 - eg Centricity, MetaVision, Innovian
 - Case centric views of anesthesia care
 - Varying degrees of connected-ness to rest of hospital
- AIMS morphed into modules of the Electronic Health Record opportunity to change:
 - MPOG / EPIC integration is anesthesia case centric
 - Opportunity to leverage the rest of the EHR to understand rest of the care
- MPOG Import Manager platform in use is central to this:
 - Allows Central + Local to move in slightly different directions
 - Agnostic to source of the data files

High Priority Other Data Types Are We Seeking:

Data Type	Detail	Relevance to MPOG
Medication Administration	Medications during hospital stay Lexicon Linked	Understand inpatient patient management, true perioperative medication
Flowsheet Data	Pain Assessments Inpatient vital signs	Understand inpatient care, fluid balance, respiratory and cardiovascular support
ADT Data	Admission, Discharge and Transfer	Understand Length of Stay, ICU Use, Discharge Disposition
Patient Attributes	Information of patient factors including: Race, Ethnicity, Sexual Orientation, Gender Identity and High Priority SDH	Understanding impact of SDH on care (BCBS Priority)
Other Data Types	Ex: Microbiology Data, Bedside Procedure Notes	Support future research and QI work.

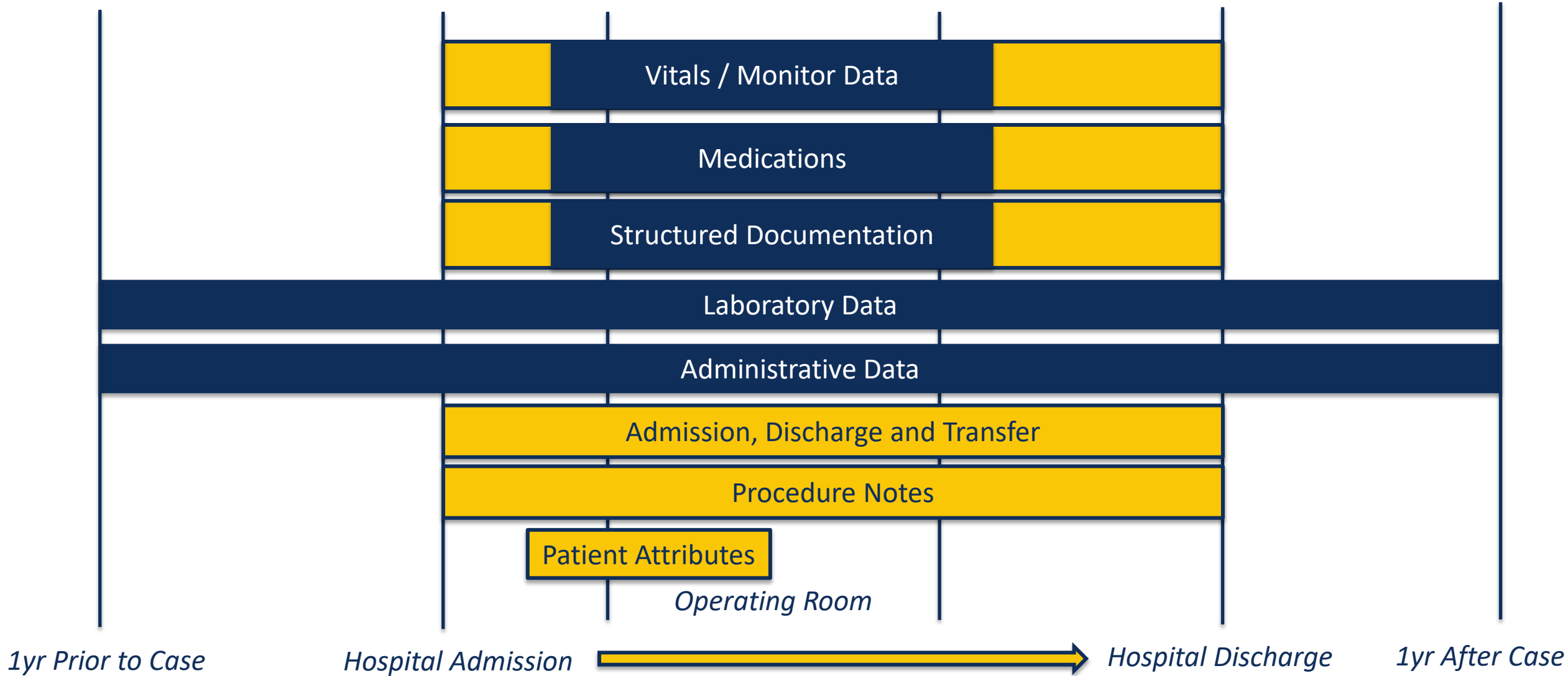
Building On Current Approach:



At Each MPOG Site

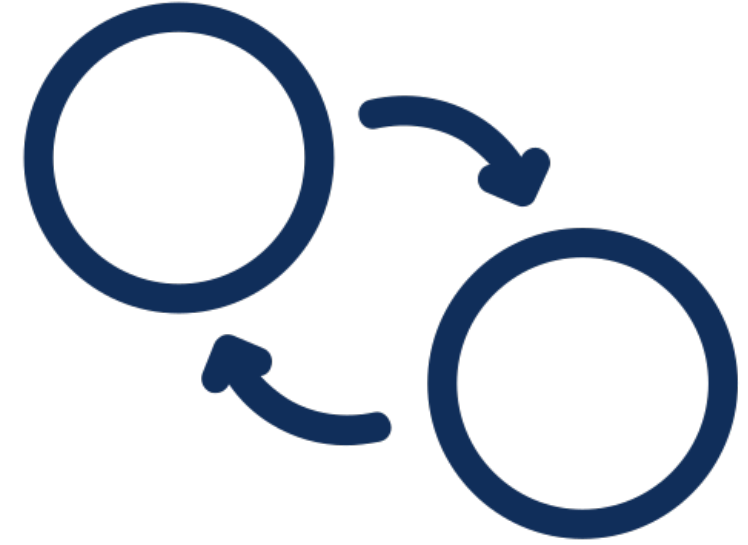
At the Coordinating Center

MPOG Future State:



MPOG Changes Coming with this:

- Changes are quite “under the hood”
 - Places for new data types
 - Process of including new data
- Thinking about Patient Linked Data vs Case Linked:
 - MPOG Currently Links to a single case
 - But we are developing narratives of patient care
 - Inpatient medications & flowsheets refers to inpatient timeline
 - Keep strict bounds of Anesthesia Start to End for case level items
 - Inpatient narrative
- Process for generating new files

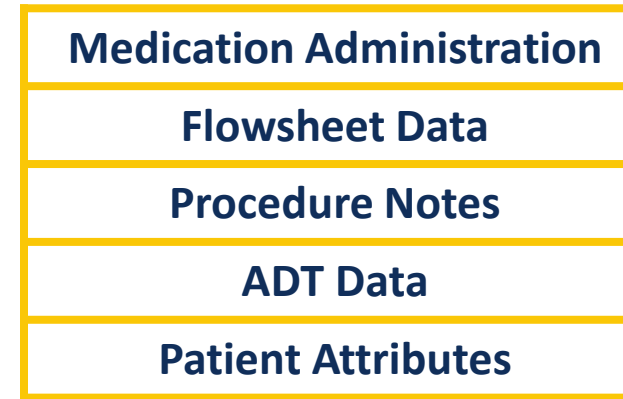


How Does Race/Ethnicity/SOGI Data Come Into This?

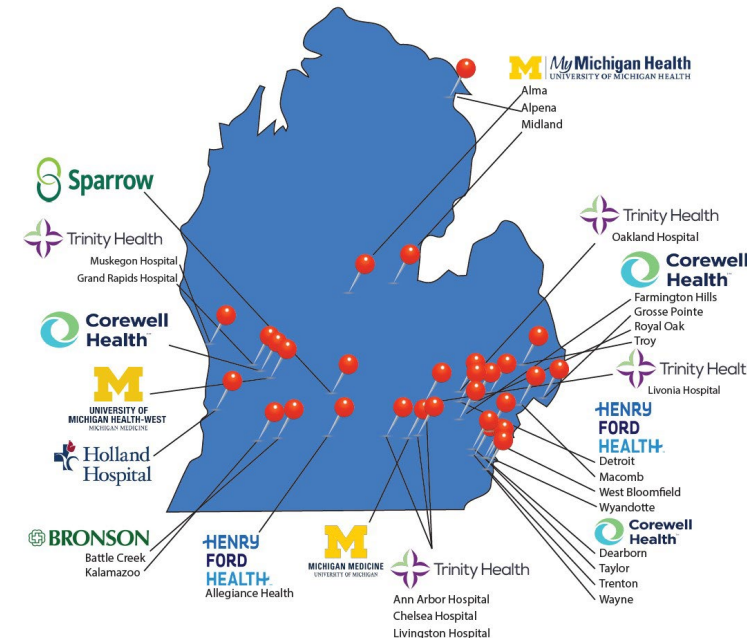
- Race/Ethnicity/SOGI data is first data elements to be captured through this method
- Strong BCBS/Across CQI imperative for these data elements
- Coordinating Center will provide extract from existing systems available at all MPOG sites (EPIC) or clear specification of how to supply this data
- State of Michigan first to gain this data type

What's Next?

- Pretty strong understanding of how to get this data
 - Validating with a Non-UM Sites
- Work on MPOG Infrastructure Changes to Support New Data types
- Patient Attributes: Race/Ethnicity/SOGI for the State of Michigan coming soon
- Confident of our approach, leadership for state of Michigan



V2: All MPOG Sites Invited
V1: BCBS Sites, 2025 Rollout



Summary:

- Intraoperative mortality is rare, but 30 day mortality is not.
- Complications drive inpatient mortality, but also impact 30 and 1 year mortality
- Common “minor” changes actually potent major differences in outcome
- We need to think and work beyond the operating room
- Have an opportunity to do this through expansion of MPOG platform
- Race/Ethnicity/SOGI data will demonstrate this is feasible

Questions?