Context Knowledge and Generalizable Knowledge: The Underpinnings for Intelligent Action

Robert C. Groom, MS, CCP
Associate Vice President, Cardiac Services
Director of Cardiovascular Perfusion
Maine Medical Center

ICEBP Tampa, October 16, 2008
The Northern New England Cardiovascular Disease Study Group exists to develop and exchange information concerning the treatment of cardiovascular disease. It is a regional, voluntary, multi-disciplinary group of clinicians, hospital administrators, and health care research personnel who seek to improve continuously the quality, safety, effectiveness, and cost of medical interventions in cardiovascular disease.
Objective: It takes both context knowledge and generalizable knowledge to provide a solid foundation for designing intelligent tests of change. Participants will learn the crucial role of these two types of knowledge to guide improvement efforts that result in effective and sustainable improvement.
What I hope you will take away from this lecture.

✔ The “Microsystems” level is the place to begin transforming healthcare.

✔ Observational research is highly underrated and involving ourselves in observational research is a moral imperative.

✔ Explain the crucial role of two types of knowledge to guide improvement efforts that result effective and sustainable improvement.

✔ Have a healthy disregard for the status quo and understand that you have two jobs to do everyday
  1. Do the work
  2. Improve the work
The Great Travesty
The Great Travesty

“Scientific knowledge about best care is not applied systematically or expeditiously to clinical practice. It takes an average of 17 years for new knowledge generated by randomized controlled trials to be incorporated into practice, and even then application is highly uneven.”
Moral Imperative to Advocate for Change

“We have an extraordinary capacity to deliver the best care in the world, but we repeatedly fail to translate knowledge and capacity into clinical practice.”
SRU - Smallest Replicable Unit

Successful companies continually reengineer the front line interface
Clinical Microsystem

A clinical microsystem is a small group of people who work together to provide care to discrete subpopulations of patients.

It has shared clinical and business aims, linked processes, shared informational environment, and produces services which can be measured as outcomes.
“Best efforts and hard work, not guided by knowledge only dig deeper the pit that we are in.”

The New Economics, W. Edwards Deming
How do we improve the microsystem?

- Generalizable Scientific Evidence
  - Published studies
  - RCTs,
  - Observational studies
  - Case-control studies,
  - Case Series,
  - Systematic Reviews

+ Context
  - Measurement of our system
  - Enumerative Statistics

→ Improvement
  - Intelligent Action!
Generalizable Knowledge

Cardiopulmonary Support and Physiology

An evidence-based review of the practice of cardiopulmonary bypass in adults: A focus on neurologic injury, glycemic control, hemodilution, and the inflammatory response

Kenneth G. Shann, CCP,a Donald S. Likosky, PhD,b John M. Murkin, MD,c Robert A. Baker, PhD CCP(Aust),d Yvon R. Baribeau, MD,e Gordon H. DaFoe, CCP,f Timothy A. Dickinson, MS,f Timothy J. Gardner, MD,g Hilary P. Grocott, MDb, Gerald T. O'Connor, PhD, DSc, David J. Rosinski, CCP, Frank W. Sellke, MD, and Timothy W. Willcox, CCP(Aust)h

Cardiopulmonary bypass (CPB) can be used during cardiac surgery to oxygenate and subsequently recirculate blood that has been diverted from the heart and lungs. The practice of CPB has changed—and continues to change—dramatically since its advent in the 1950s. Although structured reviews of the evidence supporting the practice of cardiac surgery have been in the literature for more than a decade and continue to be refined in the wake of new and emerging evidence,11,12 additional targeted reviews, focusing on issues such as minimizing the effect of the inflammatory response or minimizing neurologic injury, are warranted.13-25 Previous attempts, by Edwards and colleagues16 and Bartels and associates,27 at synthesizing the evidence base to support the principles of CPB have selectively reviewed the cardiac surgery literature or focused on unique patient
Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery: The Society of Thoracic Surgeons and The Society of Cardiovascular Anesthesiologists Clinical Practice Guideline*

The Society of Thoracic Surgeons Blood Conservation Guideline Task Force: Victor A. Ferraris, MD, PhD (Chair), Suellen P. Ferraris, PhD, Sibu P. Saha, MD, Eugene A. Hessel II, MD, Constance K. Haan, MD, MS, B. David Royston, MD, Charles R. Bridges, MD, ScD, Robert S. D. Higgins, MD, George Despotis, MD, and Jeremiah R. Brown, PhD

The Society of Cardiovascular Anesthesiologists Special Task Force on Blood Transfusion: Bruce D. Spiess, MD, FAHA (Chair), Linda Shore-Lesserson, MD, Mark Stafford-Smith, MD, C. David Mazer, MD, Elliott Bennett-Guerrero, MD, Steven E. Hill, MD, and Simon Body, MB, ChB

University of Kentucky Chandler Medical Center, Lexington, Kentucky (VAE, SPF, SPS, EAH), University of Florida, Jacksonville, Florida (CKH), University of Pennsylvania Health System, Philadelphia, Pennsylvania (CRB), Harefield Hospital, London, United Kingdom (BDR), Rush Presbyterian St. Luke’s Medical Center, Chicago, Illinois (RSDH), Washington University Medical Center, St. Louis, Missouri (GD), Center for the Evaluative Clinical Sciences, Dartmouth Medical School, Lebanon, New Hampshire (JRB), Virginia Commonwealth University, Richmond, Virginia (BDS), Montefiore Medical Center, Bronx, New York (LJ-L), Duke University Medical Center, Durham, North Carolina (MS-S, EB-G, SEH), Keenan Research Center in the Li Ka Shing Knowledge Institute of St. Michael’s Hospital, University of Toronto, Toronto, Ontario, Canada (CDM), and Brigham and Women’s Hospital, Harvard Medical School, Boston, Massachusetts (SB)
Using a Registry to Build Context Knowledge

Myocardial Protection

Prime Volume Management

Fluid Management

Temperature Management

Hemodilution Transfusion

Filtration

Glycemic Management

Cerebral Monitoring
Knowing to Doing

Generalizable Scientific Evidence + Context → Improvement

Knowing → Doing
How do we improve the microsystem?

Generalizable Scientific Evidence

+ Context

Improvement

Published studies
RCTs, Systematic Reviews, Case-control studies, Prospective CoHort Studies, Case Series, Observational studies,

Measurement /Understanding of the system
“Real World” Example

Strategies To Reduce the Occurrence of Brain Embolization and hypoperfusion (STROBEh)

Improvement Working Group
STROBEh’s Objective

1. To form a multidisciplinary team (Surgeons, Anesthesiologists, perfusionists, others)
2. To disseminate to our clinical team
   a. published evidence related to embolization and risk of brain injury
   b. Contextual information (how well does our system perform the timing and frequency of cerebral emboli and brain hypoperfusion)
3. To redesign processes of the surgical procedure that contribute to the risk of embolization and hypoperfusion of the brain during surgery.
Evidence and Context
Retinal and Cerebral Microembolization During Coronary Artery Bypass Surgery: A Randomized, Controlled Trial

*Circulation.* 2005; 112: 3815

Raimondo Ascione, FRCS; Arup Ghosh, FRCS; Barnaby C. Reeves, DPhil; John Arnold, BA; Mike Potts, FRCS; Atul Shah, MBBch; Gianni D. Angelini, FRCS

HITS were 14.7 times more frequent (95% CI, 3.5 to 62; \(P=0.001\)) and S100B level was 2.1 times higher (95% CI, 1.3 to 3.5; \(P=0.005\)) when retinal microvascular damage was present.

Injury was associated with embolic dose. Identified by images and biochemical assay
Evidence that Surgical Technique is important

Coronary Artery Bypass Grafting With Single Cross-Clamp Results in Fewer Persistent Neuropsychological Deficits Than Multiple Clamp or Off-Pump Coronary Artery Bypass Grafting

John W. Hammon, MD, David A. Stump, PhD, John F. Butterworth, MD, Dixon M. Moody, MD, Kashemi Rorie, PhD, Dwight D. Deal, BS, Edward H. Kincaid, MD, Timothy E. Oaks, MD, and Neal D. Kon, MD

Departments of Cardiothoracic Surgery, Anesthesiology, and Radiology, Wake Forest University School of Medicine, Winston-Salem, North Carolina

Background. In coronary artery bypass grafting (CABG) patients, neuropsychological deficits that are present from the time of the operation through 6 months postoperatively are considered permanent and represent organic brain damage related to the operation. We hypothesized that changes in our surgical method would reduce persistent deficits.

Methods. From 1999 to 2004, consenting CABG patients were randomly assigned to multiple aortic cross-clamp or single aortic cross-clamp technique. An additional contemporary group of patients treated with off-pump CABG was studied. All patients underwent an 11-part neuropsychologic examination preoperatively, and at 1 week, 6 weeks, and 6 months postoperatively. One hundred seven patients with no postoperative neurologic $p < 0.05$ patients. At 6 months, $26\%$ of 27 multiple aortic cross-clamp patients had neuropsychological deficits, $27\%$ of 26 off-pump CABG patients had neuropsychological deficits, and only $9\%$ of 54 single aortic cross-clamp patients had neuropsychological deficits ($p = 0.067$ versus multiple aortic cross-clamp and off-pump CABG).

Conclusions. These results suggest that surgical technique is very important in determining cognitive outcome after CABG. Cardiopulmonary bypass is not the most important factor in determining outcome and when carefully performed with single cross-clamp and minimal aortic manipulation is equal or may be superior to off-pump operation. We suspect that mild hypothermia in on-pump surgery is additionally neuroprotective, a
Evidence that Surgical Technique is important
TCD R&L Middle Cerebral Arteries

Doppler CPB inflow & outflow

Time

Video
CPB Components

Venous Cannula

Arterial Cannula

M mode doppler

Filter

Oxygenator

Pump

Venous Reservoir
Use of this model for improvement resulted in an 87% reduction in Circuit Emboli and a 77% reduction in brain Emboli.
Strategies To Reduce the Occurrence of Brain Embolization and hypoperfusion (STROBEh)

Improvement Working Group

✓ Meets monthly to discuss findings and opportunities to improve care.
✓ Changed technique of initiating cardiopulmonary bypass.
✓ Changed CPB prime additives
✓ Modified the use of vacuum assisted venous drainage
✓ Insertion of retrograde cardioplegia cannula prior to onset of CPB
✓ Redesigned the CPB circuit with the use of improved reservoirs and filters
✓ Reduced the use of cardiotomy suction
✓ Use of an extra tie around the venous catheter and right atrium to prevent air entrainment into the CPB circuit
Generalizable Scientific Evidence + Context → Best Possible Care

Intelligent Action!

88% reduction outflow emboli
76% reduction in Cerebral emboli
“Every system is perfectly designed to achieve exactly the results it gets.”

Paul Batalden