Ogden Surgical and Medical Society
15 May 2024 – ***Patient Safety***

We are irrational humans- a source of medicine's flaws/failures

Alan H. Morris, M.D.

furnished with the senses, so as to be impressed with the *properties of things*…acquires a degree of *knowledge*.

John Hunter

V Johnson. A History of the Ogden Surgical-Medical Society 1946-2005

Preface:

Human cognitive and behavioral challenges impede clinicians from achieving their decision-making goals

I have unbridled respect for clinicians

Physicians often do a remarkable job under almost impossible circumstances

Subjects for Discussion:

Human limitations
Need models/tools → desired actions

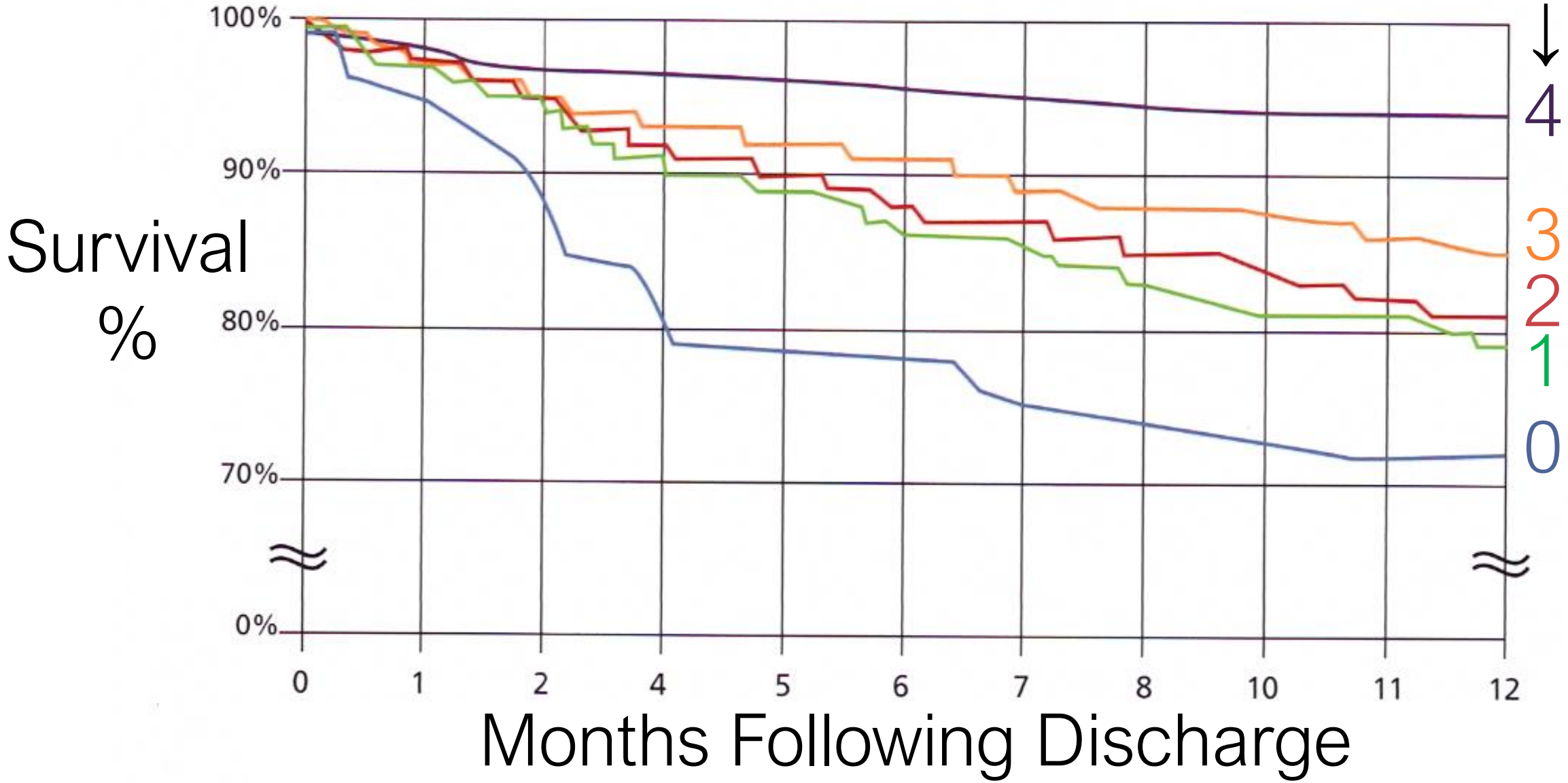
A partial cure with *eActions*
(computerized replicable methods)

Human limitations

Goal:

Make the evidence-based decision the first time and every time.

Adherence to Heart Failure Core Measures



(Kfoury, French – Updated, Intermountain Nov 2008); Kfoury AG, French TK, Horne BD, et al. Incremental survival benefit with adherence to standardized heart failure core measures: a performance evaluation study of 2958 patients. J Card Fail. 2008;14(2):95-102.

How good are we?

389 children evaluated

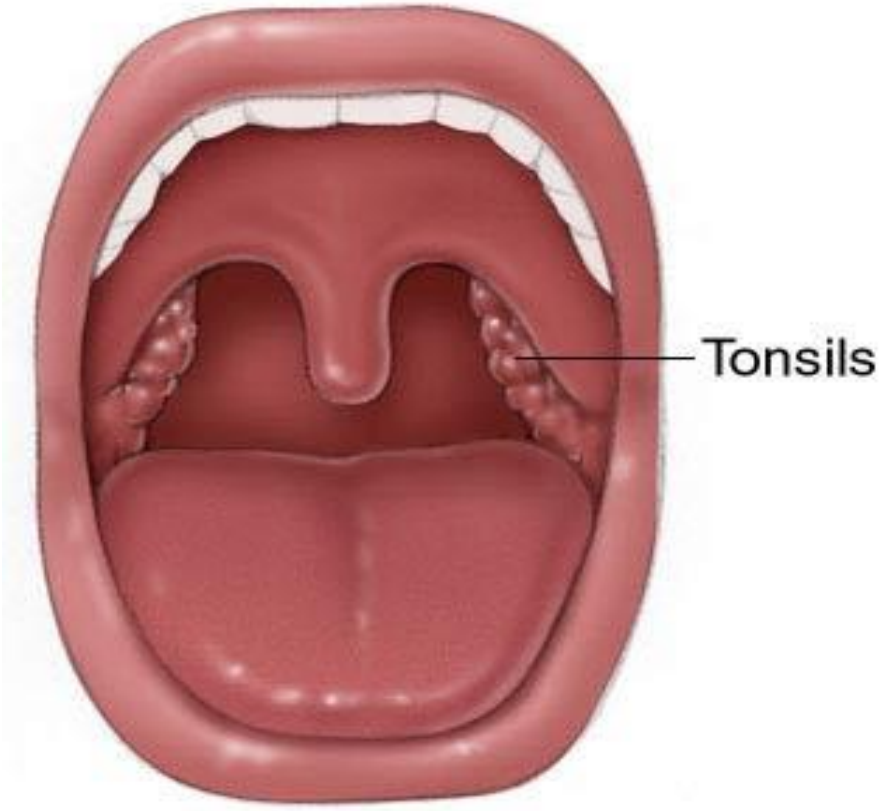
Referral rate: *45%*

175 remaining children

Referral rate: *46%*

80 remaining children

Referral rate: *44%*



Bakwin H. Rate of referral for Tonsillectomy. New Engl J Medicine. 1945:232-691

MD Compliance with Guidelines/Evidence:

			%
Gout	10 studies	=	3-71
Mechanical Ventilation	Lung protective	=	65
Surviving Sepsis Campaign	Bundle	=	15-20
ED Hepatic Encephalopathy	≤24 hrs	=	22
Outpatient Parenteral	Antibiotics (VAH)	=	20
	with ID consult	=	54
Canadian PCP for 13	CKD Quality	=	18-86

Ho GH, Pillinger MH, Toprover M. Adherence to gout guidelines: where do we stand? Curr Opin Rheumatol. 2021;33(2):128-34
Bellani G, et al. Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome... JAMA. 2016;315(8):788-800.
Levy M et al. The Surviving Sepsis Campaign: results of an international guideline-based performance improvement... Intens Care Med. 2010;36(2):222-31
Kumral D et al. Adherence to Recommended Inpatient Hepatic Encephalopathy Workup. J Hosp Med. 2019;14(3):157-60
Spivak E, et al. Evaluation of Outpatient Parenteral Antimicrobial Therapy at a Veterans Affairs Hospital. Infect Control Hosp Epidemiol. 2015;36(9):1103-5
Bello AK, et al. Quality of Chronic Kidney Disease Management in Canadian Primary Care. JAMA Network Open. 2019;2(9):e1910704-e.

Treatment Gap

Epilepsy {Kale ’02}
Addiction {Office of the Surgeon General ’16}
Heart Failure {Fonarow ’08}
Critical Care, Mechanical Ventilation {Bellani ’16}
Hand hygiene-prevention of sepsis {Tubbs-Cooley ’15}
Proton pump inhibitor use {Kurlander ’17, ’18}
Laboratory testing (Zhi ’13)

Kale R. Global Campaign Against Epilepsy:the treatment gap. Epilepsia. 2002;43 Suppl 6:31-3.
Office of the Surgeon General. FACING ADDICTION IN AMERICA - The Surgeon General’s Report on Alcohol, Drugs, and Health. Washington, DC: U.S. Department of Health and Human Services (HHS); 2016 November 2016.
Fonarow GC, et al. Heart Failure Care in the Outpatient Cardiology Practice Setting: Findings From IMPROVE HF. Circulation: Heart Failure. 2008;1(2):98-106.
Bellani G, et al. Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome in intensive care units in 50 countries. JAMA. 2016;315(8):788-800.
Tubbs-Cooley HL, et al.. A descriptive study of nurse-reported missed care in neonatal intensive care units. J Adv Nurs. 2015;71(4):813-24.
Kurlander JE, et al. The Right Idea for the Wrong Patient: Results of a National Survey on Stopping PPIs. Clinical Gastroenterology and Hepatology.2017;15(9):1475-6.
Kurlander JE, et al. Internists’ Perceptions of Proton Pump Inhibitor Adverse Effects and Impact on Prescribing Practices: Results of a Nationwide Survey. Gastroenterology Research. 2018;11(1):11-7.
Zhi M, et al. The Landscape of Inappropriate Laboratory Testing: A 15-Year Meta-Analysis. PLoS ONE. 2013;8(11):e78962

We're nationally and internationally known for the design of quality care, and our caregivers have done an amazing job for decades

Rob Allen, chief operating officer
Intermountain Stories 5 March, 2018

with all we know about how to give the best evidence-based care to patients, ***we do it maybe 40 percent of the time***

Rob Allen, chief operating officer
Intermountain Stories 5 March, 2018

An Introduction to Error Analysis

The Study of Uncertainties in Physical Measurements

John R. Taylor

Signal-to-noise ratio for many issues we explore is small and requires careful, systematic study - not obvious like this accident.

Taylor JR. An introduction to error analysis : the study of uncertainties in physical measurements. Mill Valley, Calif.: University Science Books; 1982

it all starts from our senses

Polanía R, Burdakov D, Hare TA. Rationality, preferences, and emotions with biological constraints: it all starts from our senses. Trends Cognit Sci. 2024.

Biological information processing costly (energy)

Sensing-output systems, like brain have noisy communication channels: Always lose information

Senses should adapt to sensory-input-maximizing rules at earliest processing [*adjust sensory input*]

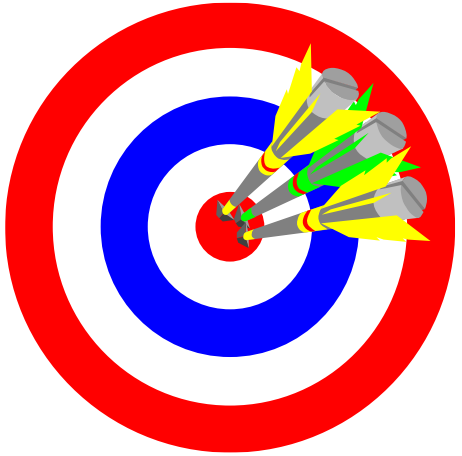
Senses not to enrich subjective experience, but to ↑ species survival

Representing the world as accurately as possible probably not the purpose of senses

Polanía R, Burdakov D, Hare TA. Rationality, preferences, and emotions with biological constraints: it all starts from our senses. Trends Cognit Sci. 2024.

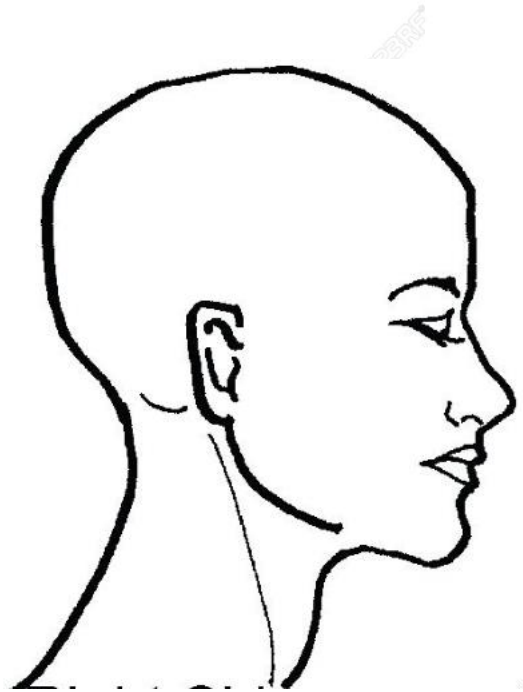
Avoid Lion and *evolve*

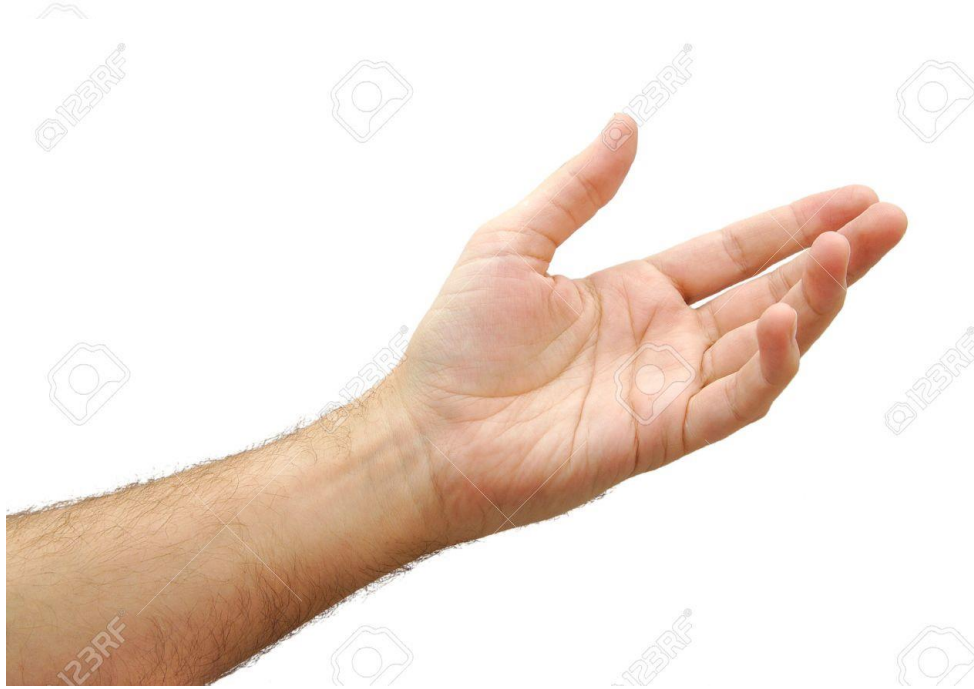
Recognize patterns

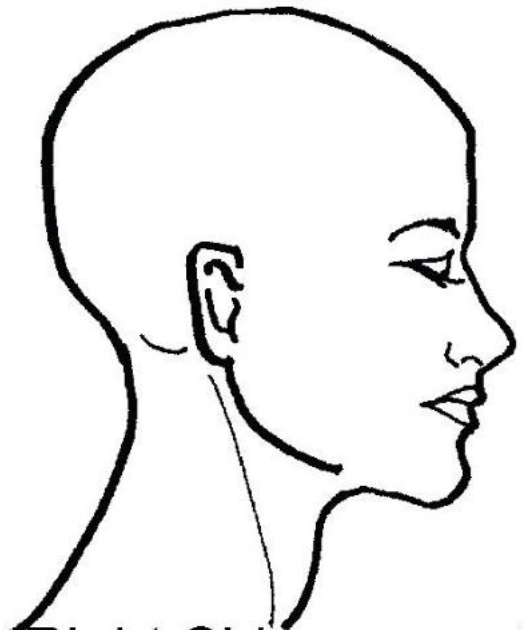


Provide *evidence-based treatment* the first and every time.

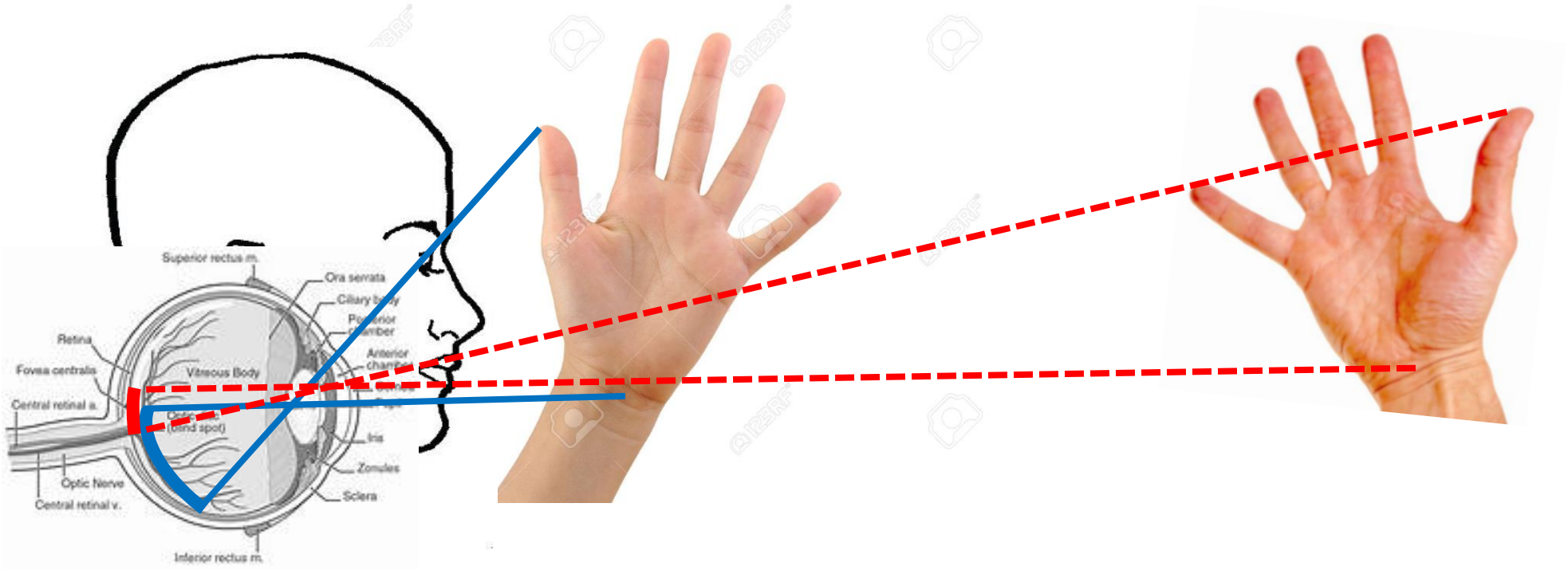
Accurately sense and interpret the world



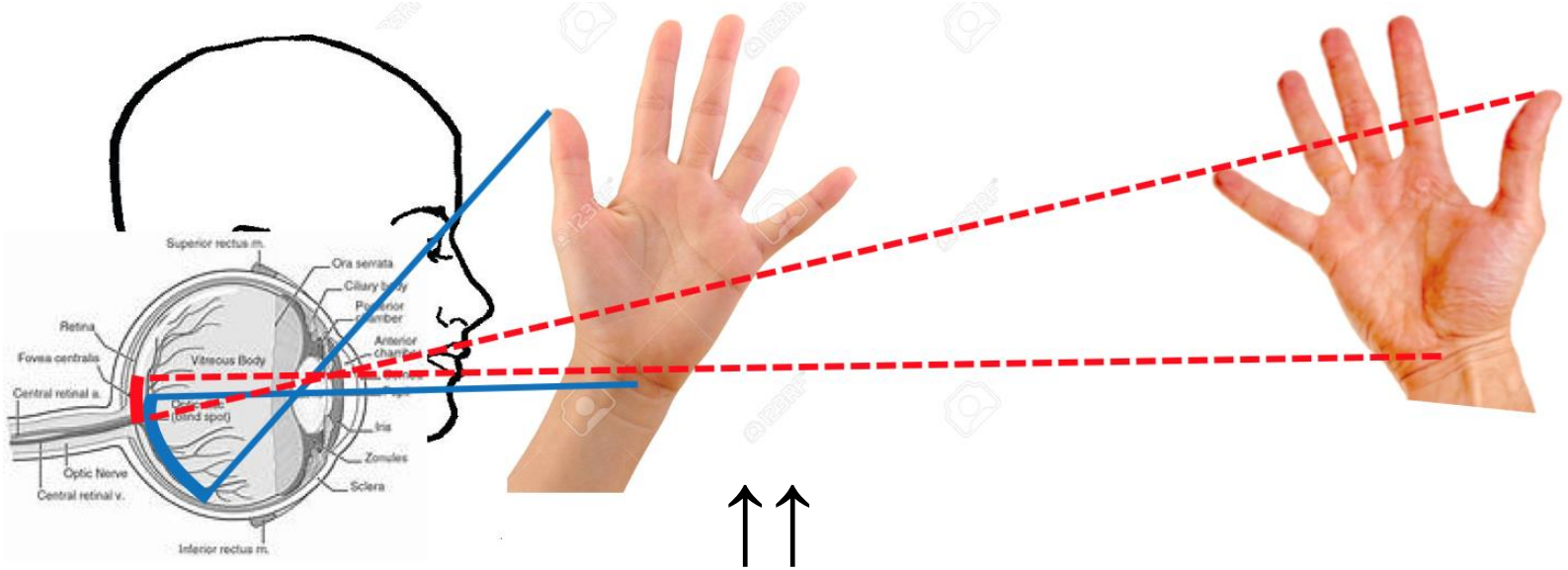




Inverse Square Law: size $\propto 1/d^2$



Camera at the eye



↑↑

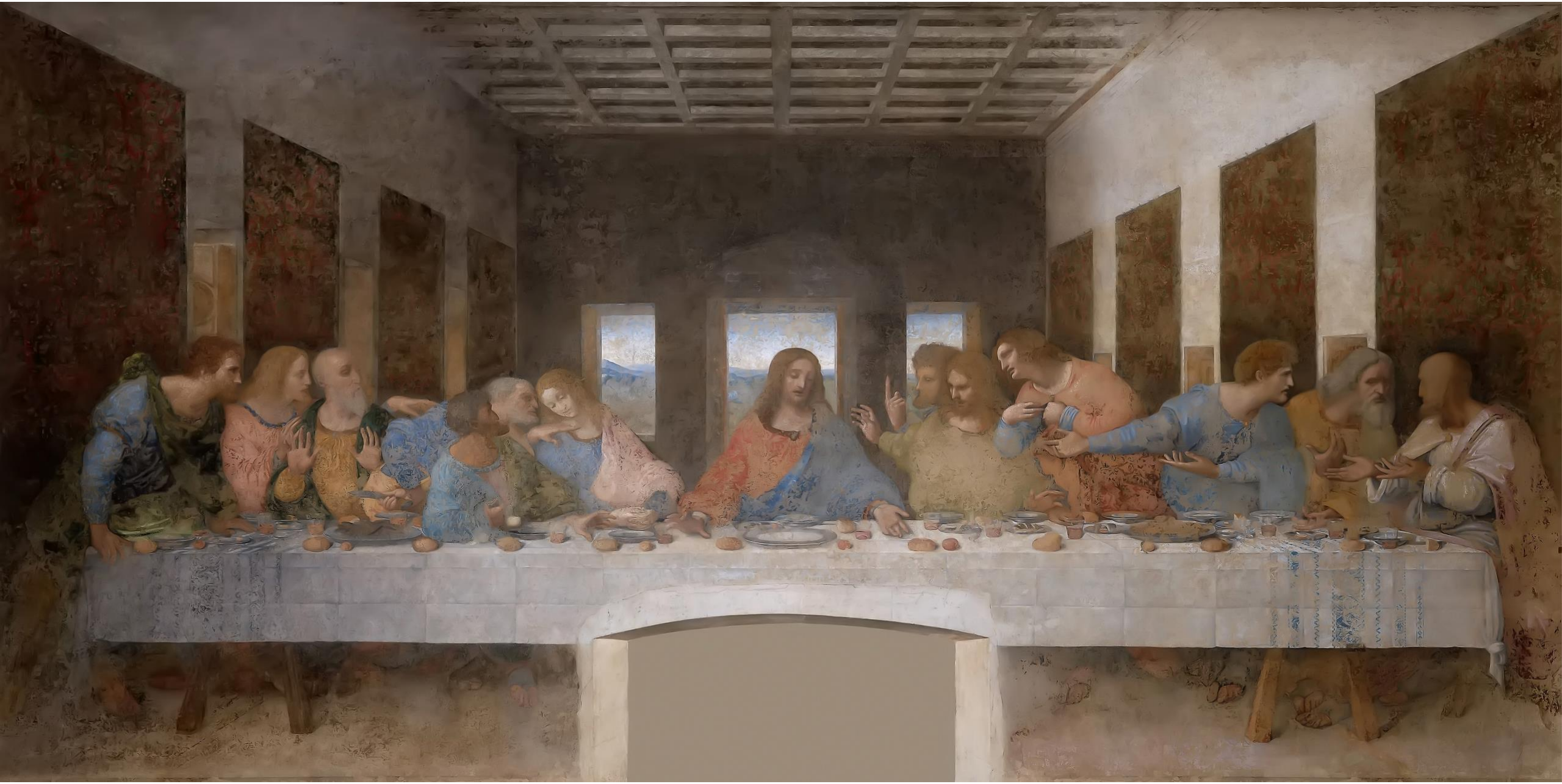
Image our ***Brain*** ***"Perceives"*** **-** ***We see***
the World through ***Internal Models***

Science:
describe the world ***as it is***,
not as we ***perceive it***

Retinal Image
we "See"

↓↓

iPad 2
Your iPad is even more powerful in the hands of a teacher.



https://www.google.com/search?q=role+of+the+camera+obscura+in+the+architectural+perspective+of+renaissance+artists&oq=role+of+the+camera+obscura+in+the+architectural+perspective+of+renaissance+artists&gs_lcrp=EgZjaHJvbWUyBggAEEUYOdIBCTI3MzgwajBqMagCALACAA&sourceid=chrome&ie=UTF-8

https://nicofranz.art/en/leonardo-da-vinci/the-last-supper

How good are our perceptions for identifying credible evidence?

If we were honest about the ***shortcomings of human physiology*** the “optical illusions” would instead be labeled “*brain failures*.”

Neil deGrasse Tyson

Human limitations

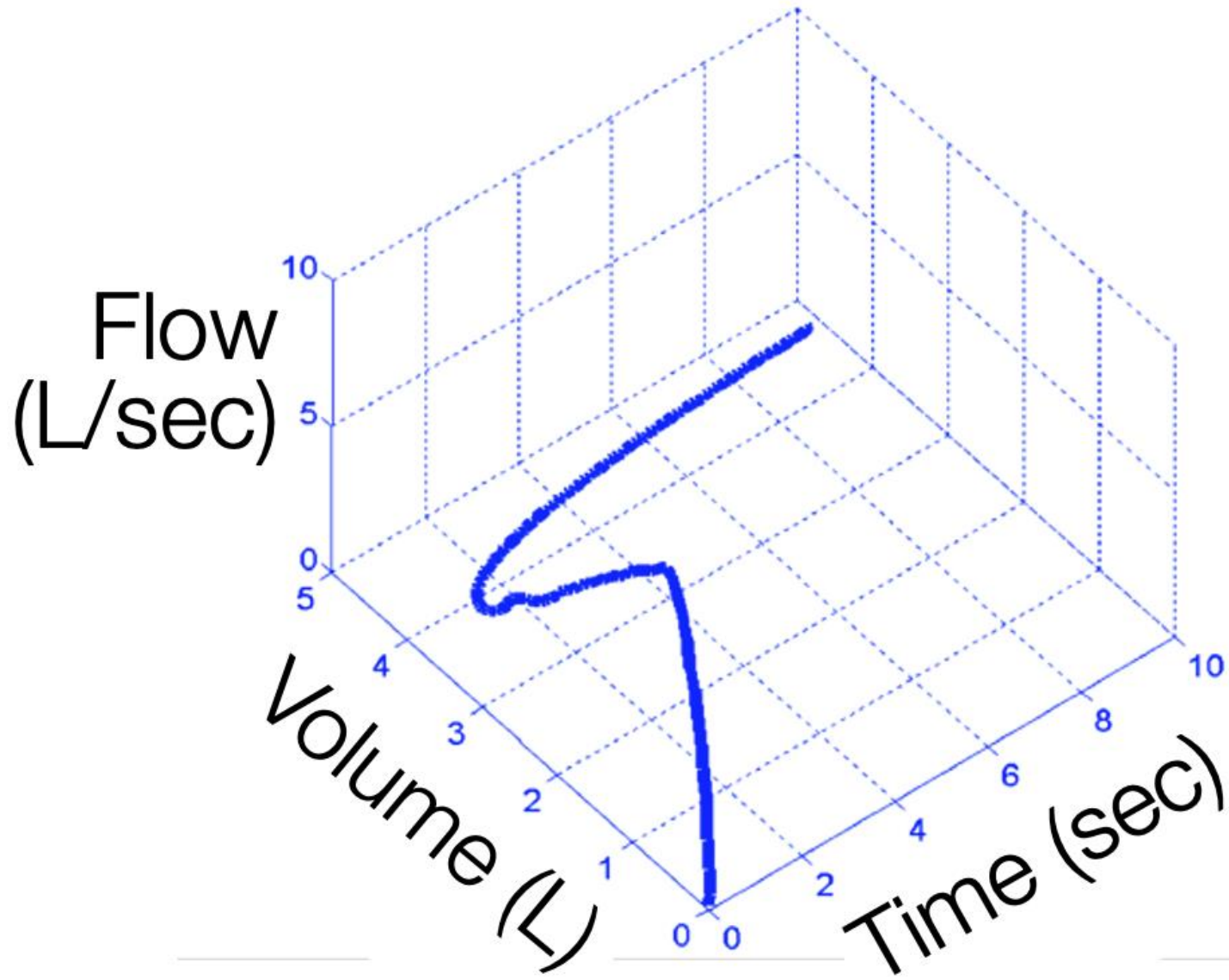
Need models/tools → desired actions

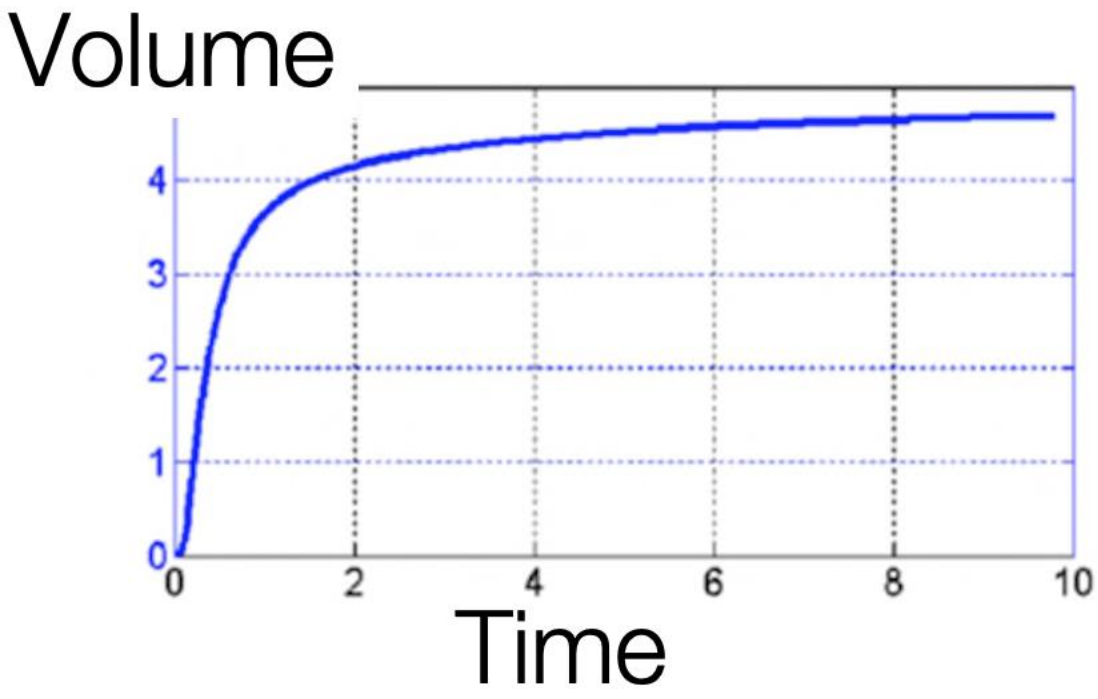
A partial cure with *eActions*
(computerized replicable methods)

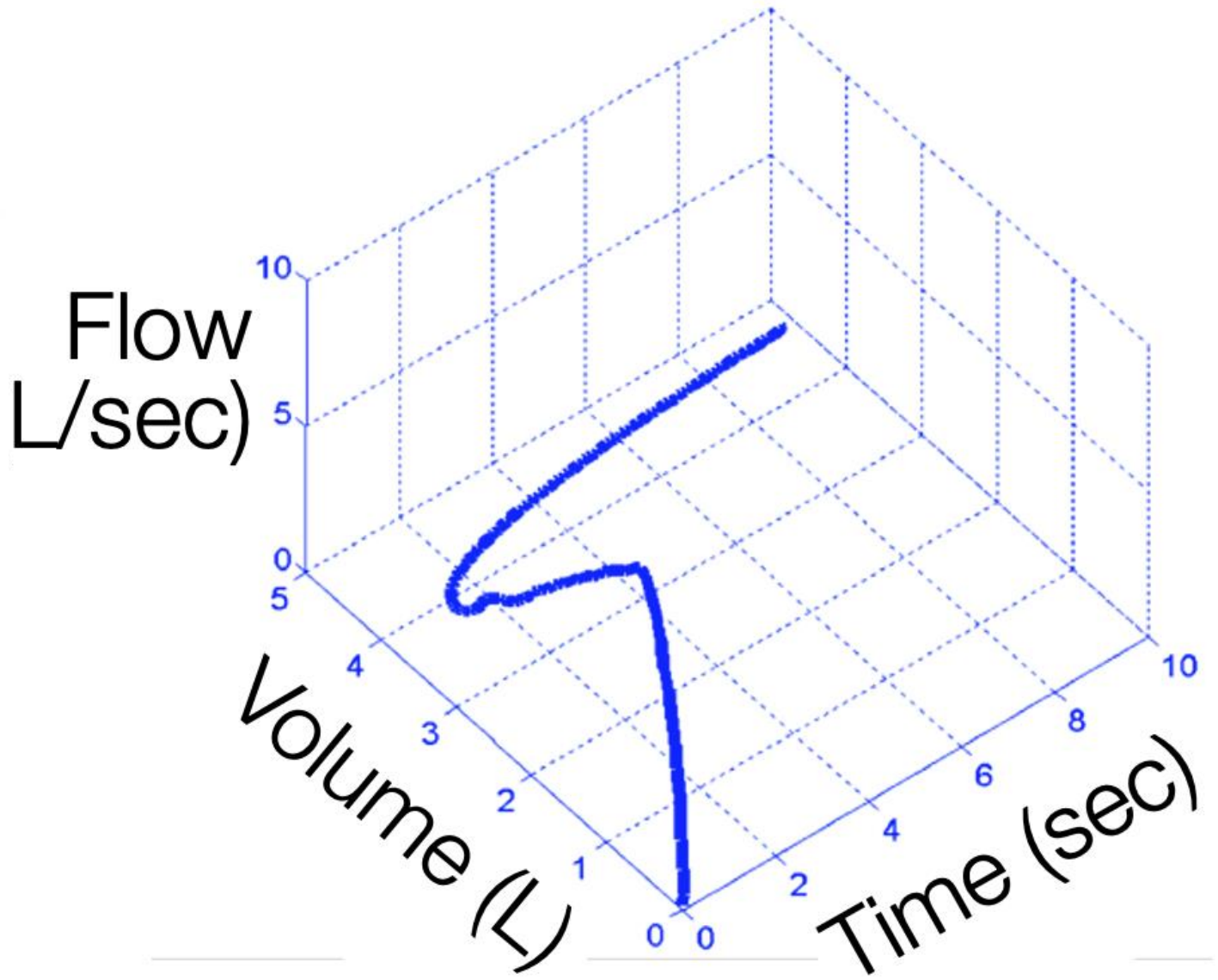
Clinical medicine always required doctors to handle enormous amounts of data

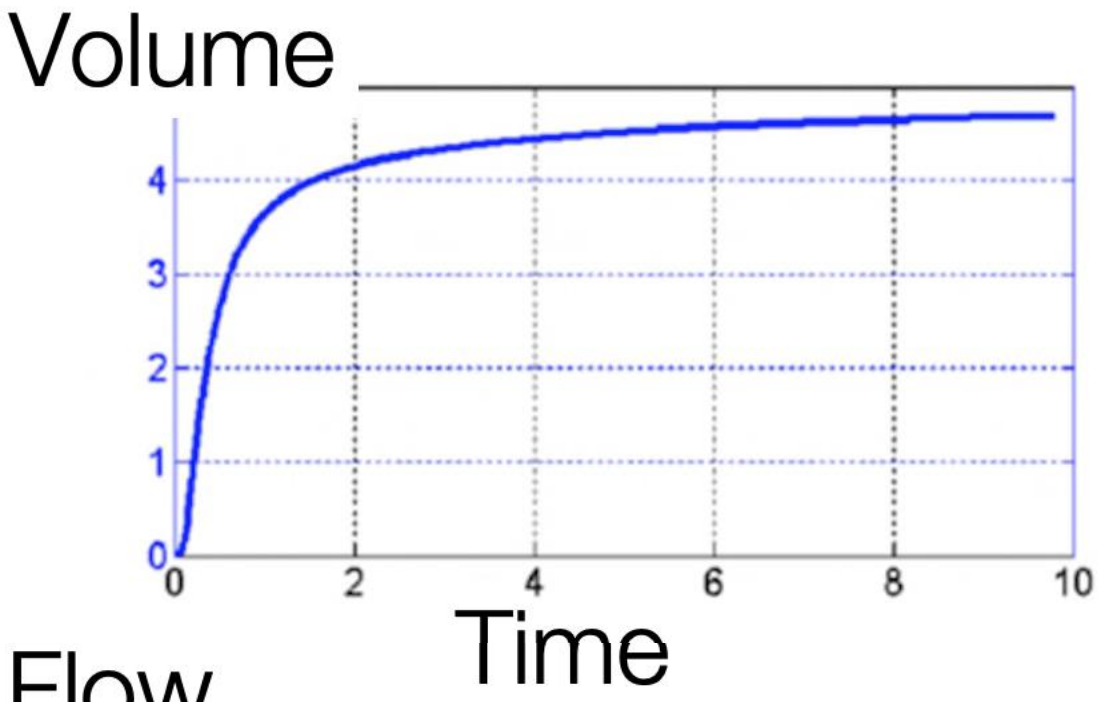
Ability to manage complexity sets good doctors apart from the rest.

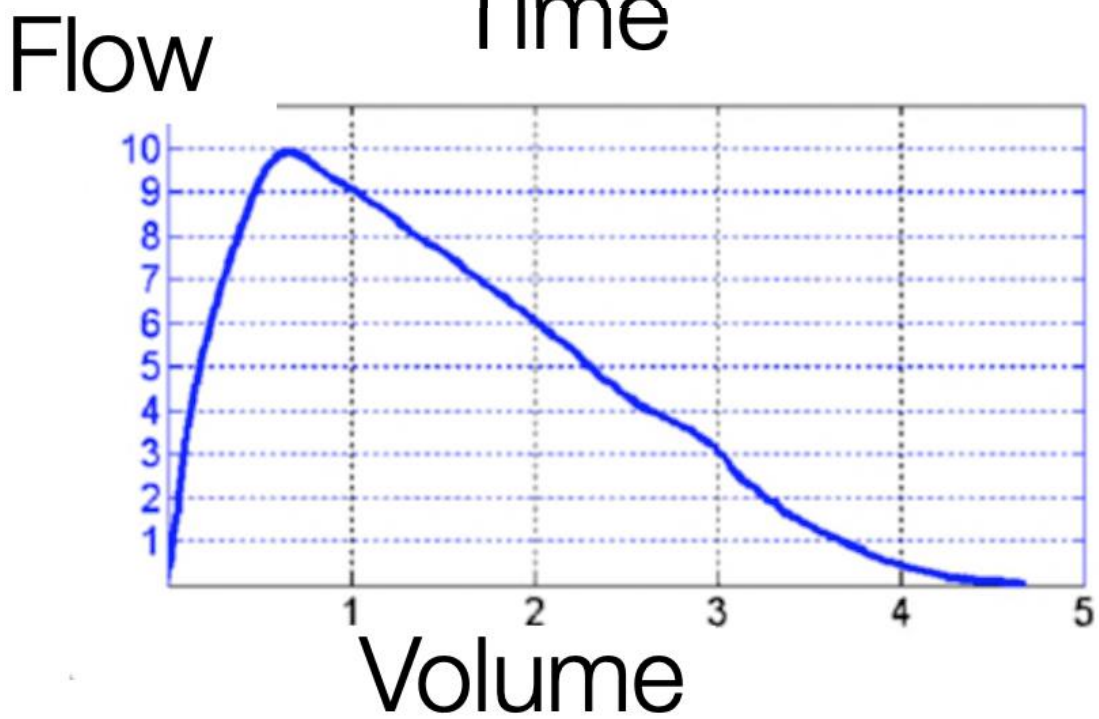
Obermeyer Z, Emanuel EJ. Predicting the Future — Big Data, Machine Learning, and Clinical Medicine. New England Journal of Medicine. 2016;375(13):1216-9

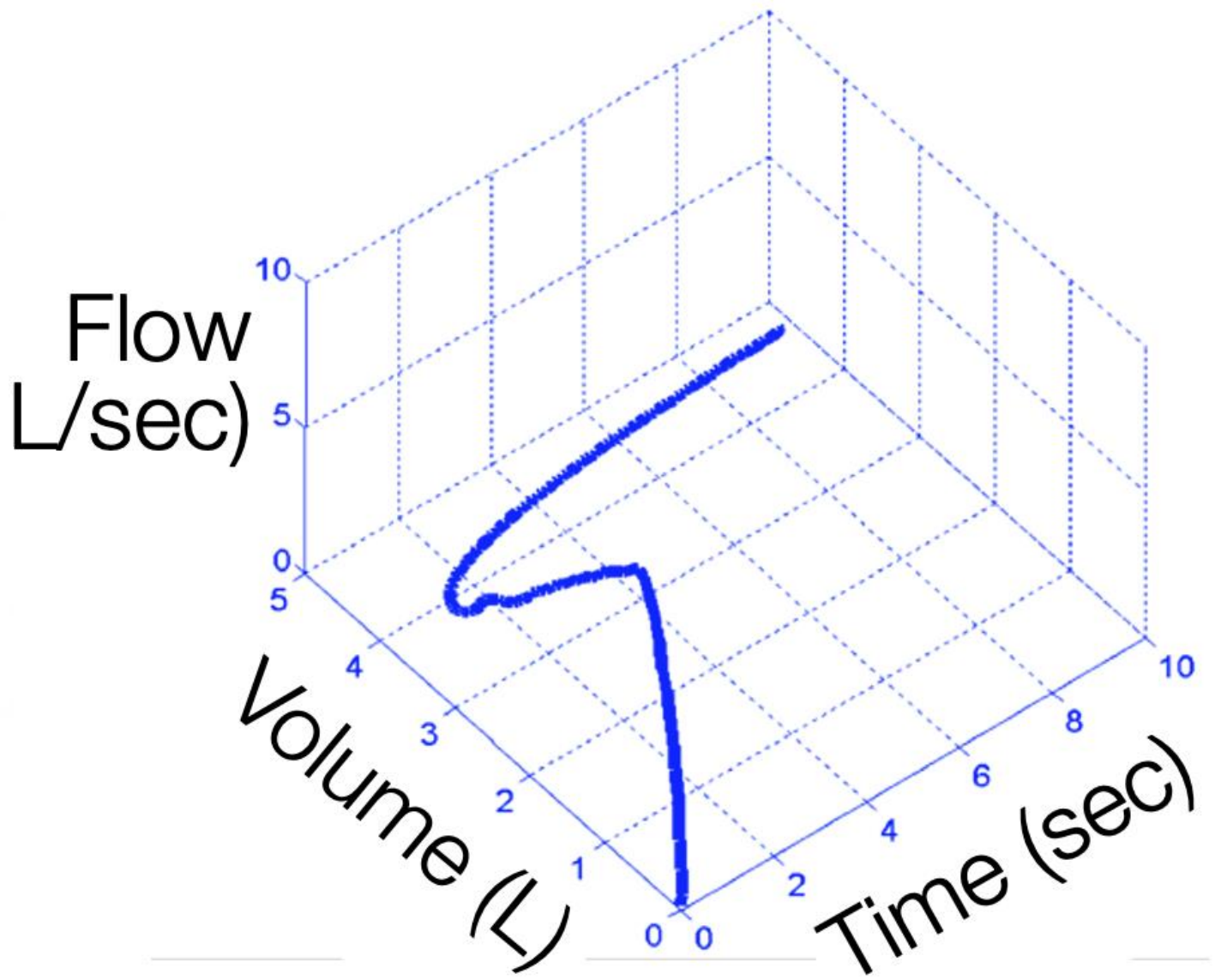

Flow
(L/sec)
10
5
0
5
4
3
2
1
0
Volume (L)
0
2
4
6
8
10
Time (sec)

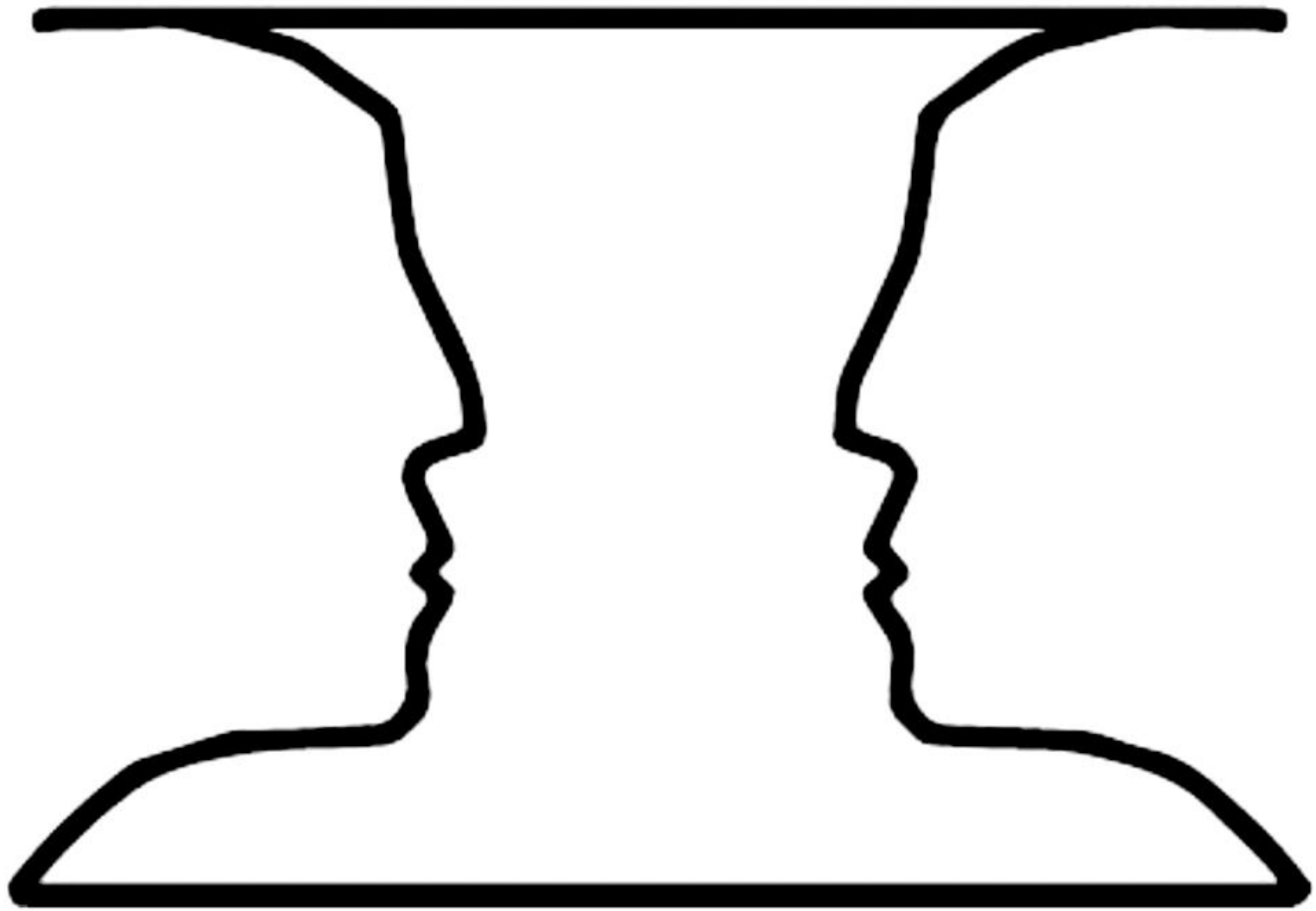

Volume
0
1
2
3
4
0
2
4
6
8
10
Time


Flow
L/sec)
10
5
0
5
4
3
2
1
0
0
2
4
6
8
10
Volume (L)
Time (sec)


Volume
0
1
2
3
4
0
2
4
6
8
10
Time


Flow
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
Volume

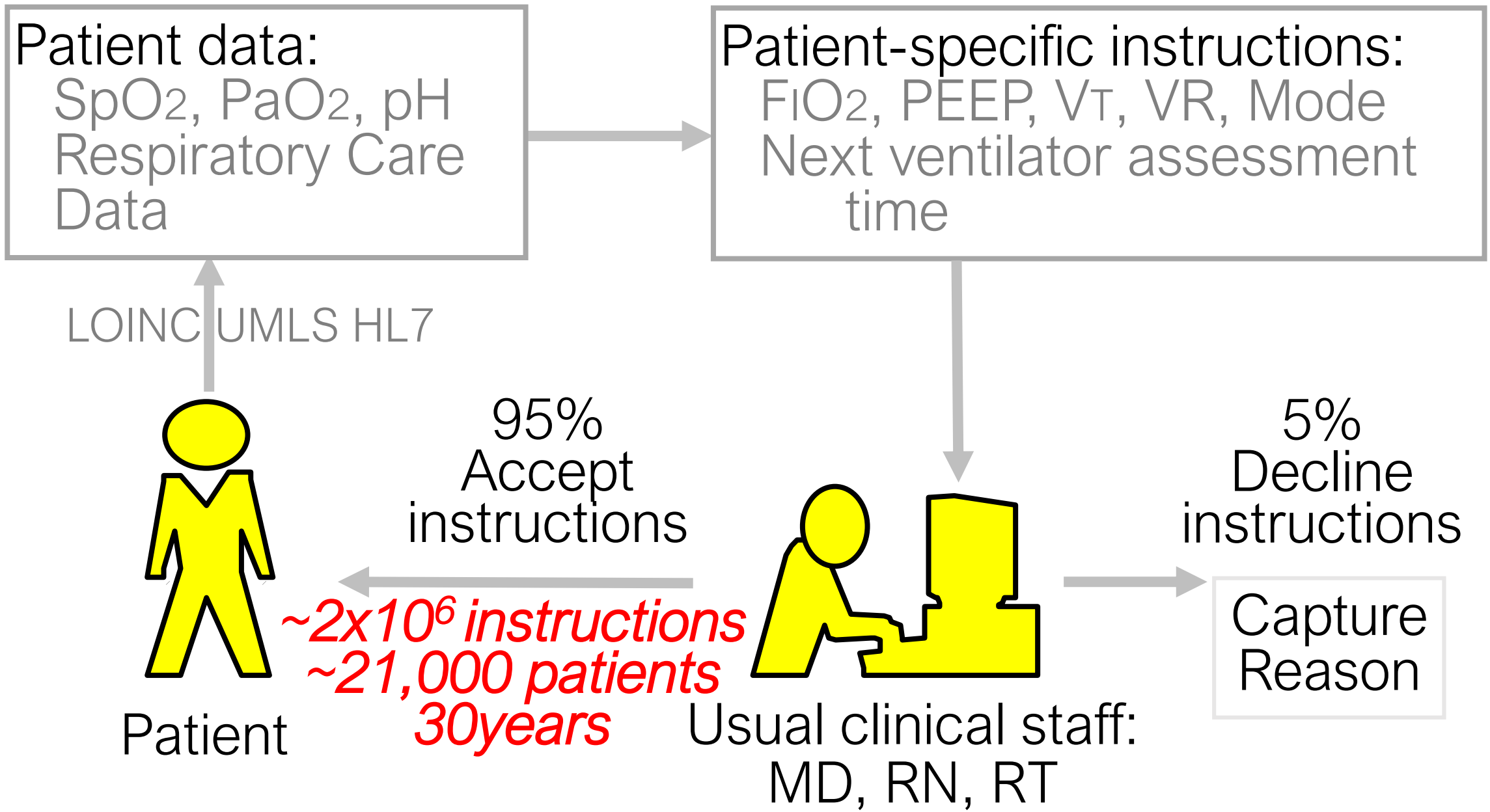

Flow
L/sec)
0
5
10
5
4
3
2
1
0
Volume (L)
0
2
4
6
8
10
Time (sec)



Human limitations
Need models/tools → desired actions

A partial cure with eActions
(computerized replicable methods)

Mechanical Ventilation



Adequately Explicit Instructions that deliver personalized patient care:

Reduce Inspired O2 by 10% from 90 to 80%

Reassess Oxygenation in 15 Minutes

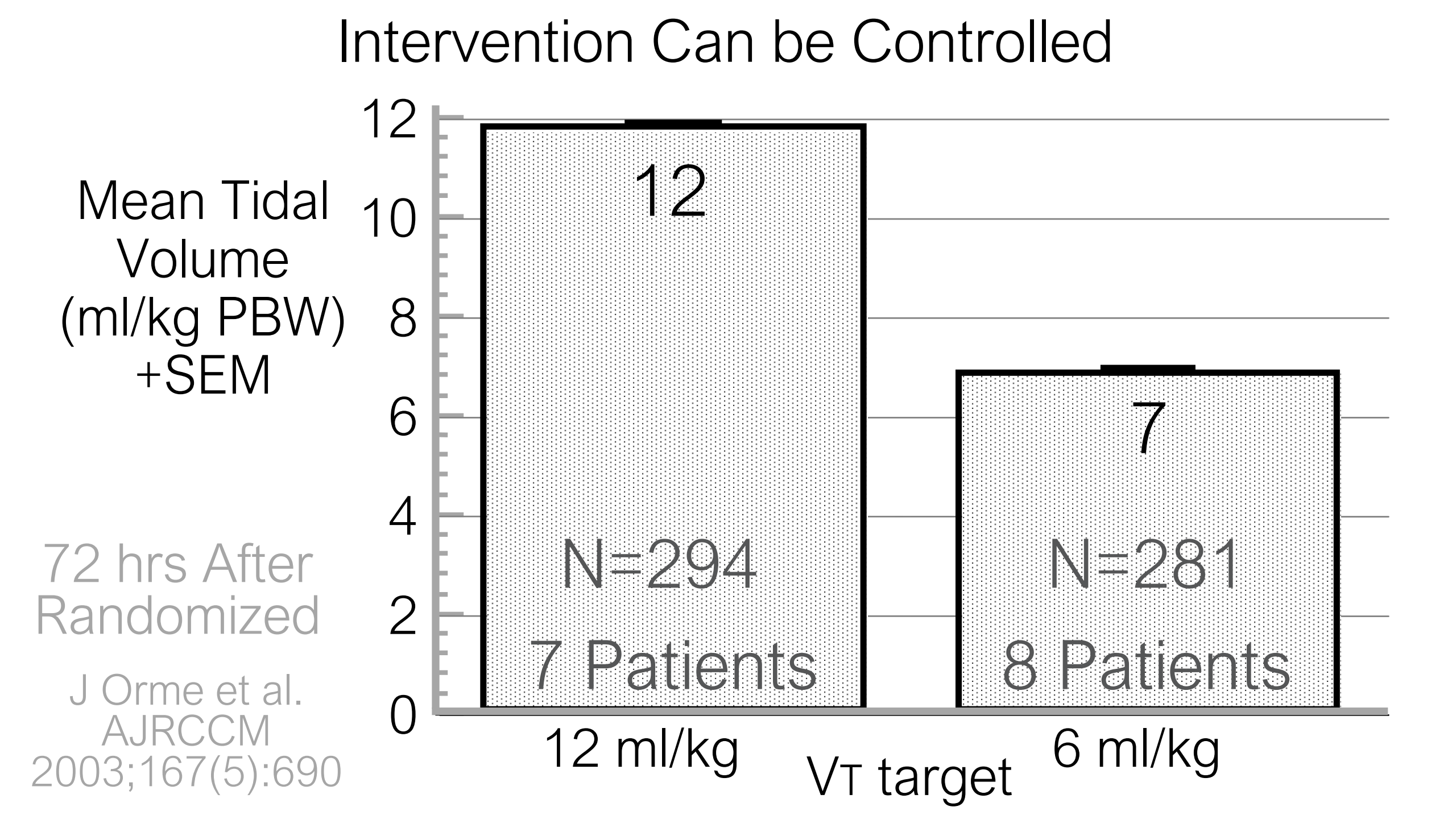
Maintain Tidal Volume at 540ml

Increase VR by 3 from 22 to 25 per minute

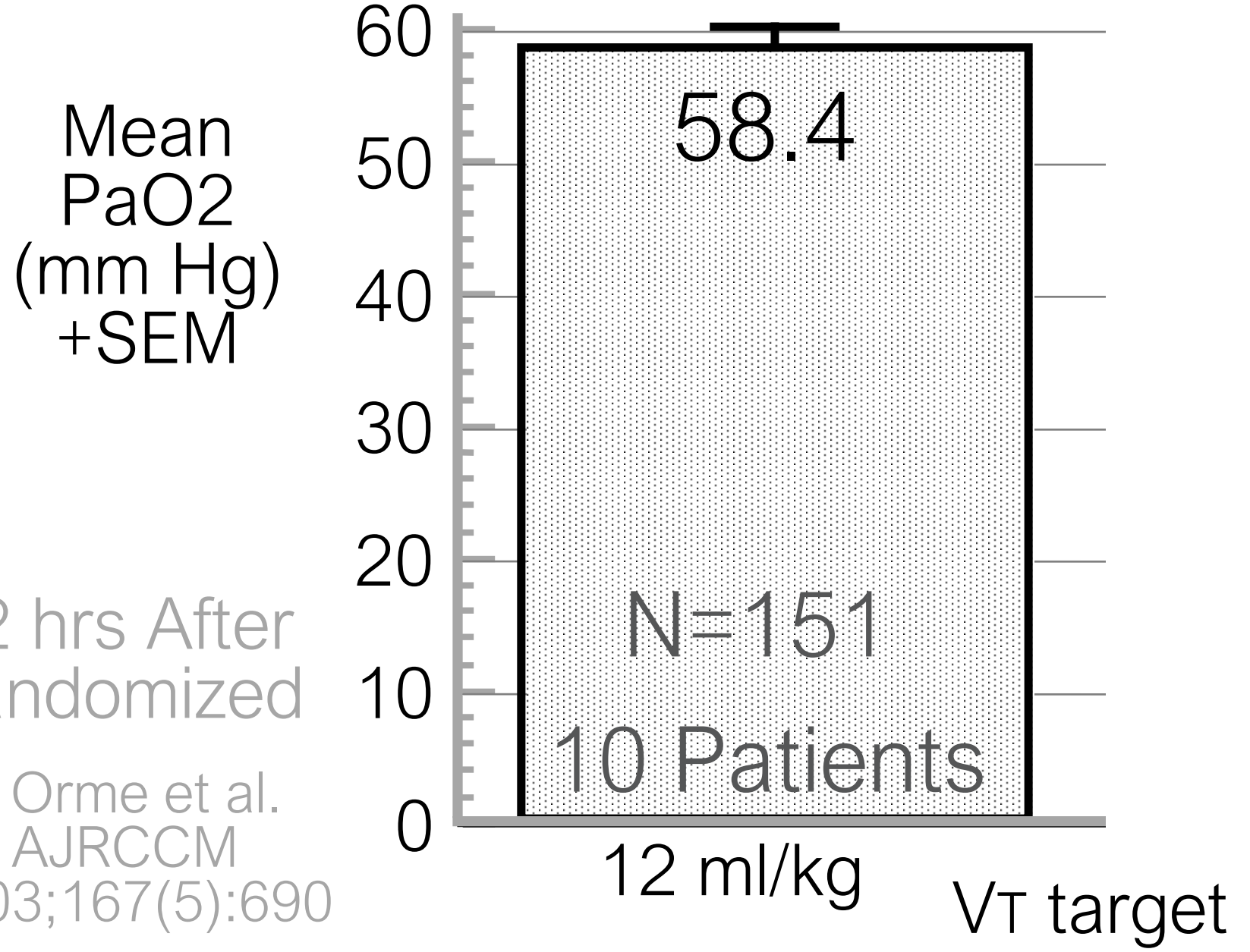
Sample Arterial Blood in 15 minutes at 15:40

= Standardized Decisions ≠ Standardized Care

Intervention Can be Controlled



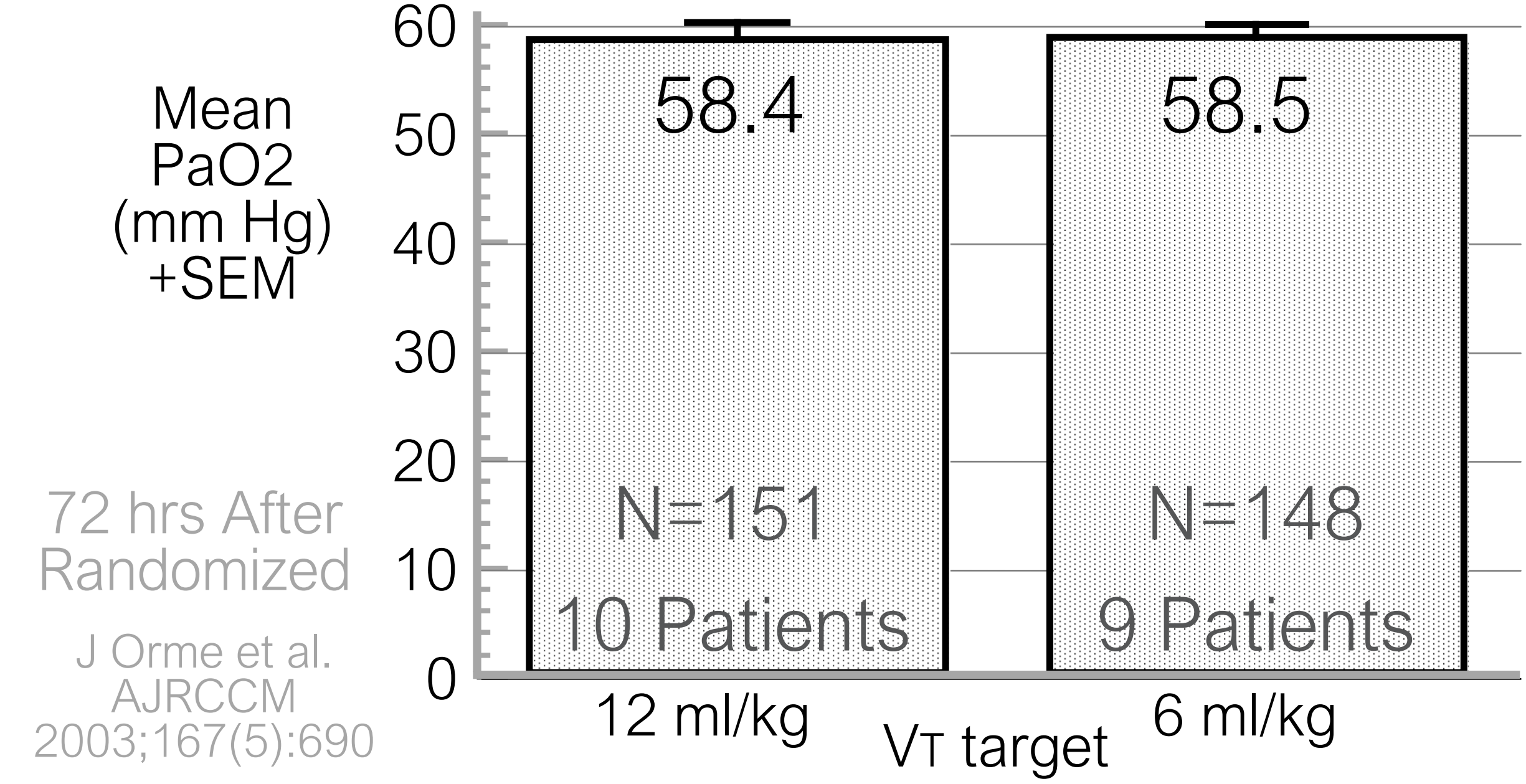
Intermediate Outcomes (Endpoints) Can be Controlled



72 hrs After Randomized

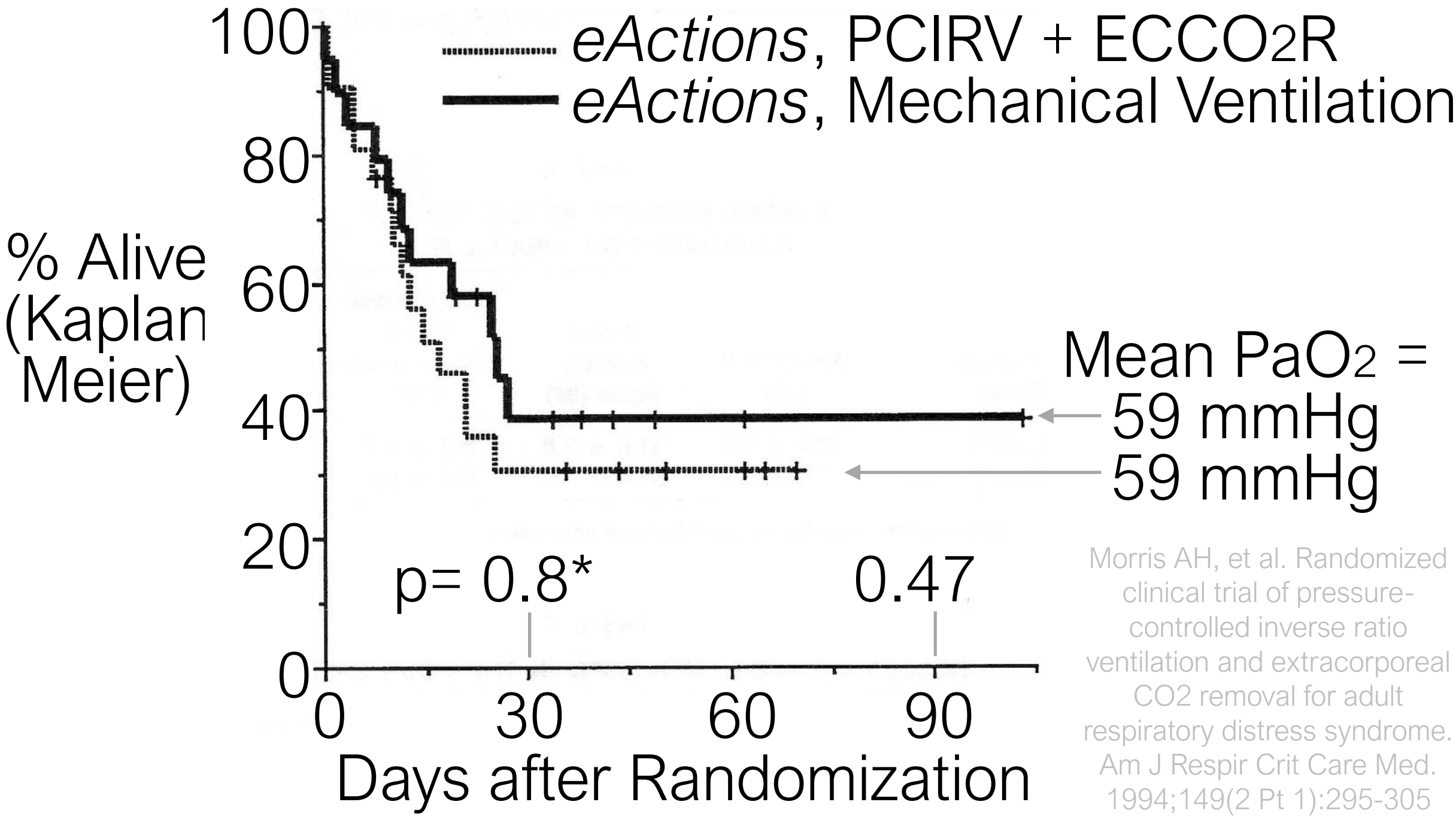
J Orme et al. AJRCCM 2003;167(5):690

Potential Cointerventions Can be Controlled



72 hrs After Randomized

J Orme et al. AJRCCM 2003;167(5):690



Morris AH, et al. Randomized clinical trial of pressure-controlled inverse ratio ventilation and extracorporeal CO2 removal for adult respiratory distress syndrome. Am J Respir Crit Care Med. 1994;149(2 Pt 1):295-305

Blood Glucose/Insulin Protocol: Adults and Children

Assessment date: 04/06/2008 Assessment time: 21:06

178 Serum glucose (mg/dL)

Get Instructions

3 Insulin drip (U/h)

Definition of Glucose Calories

Receiving Glucose Calories: ☐ Yes ☐ No

Insulin will be stopped for 1 hour if glucose calories are stopped

Accept
Decline

Start IV insulin at 3 Units/hour

21:06

Fix current error

01:59:42

Next assessment: 23:06

Graph

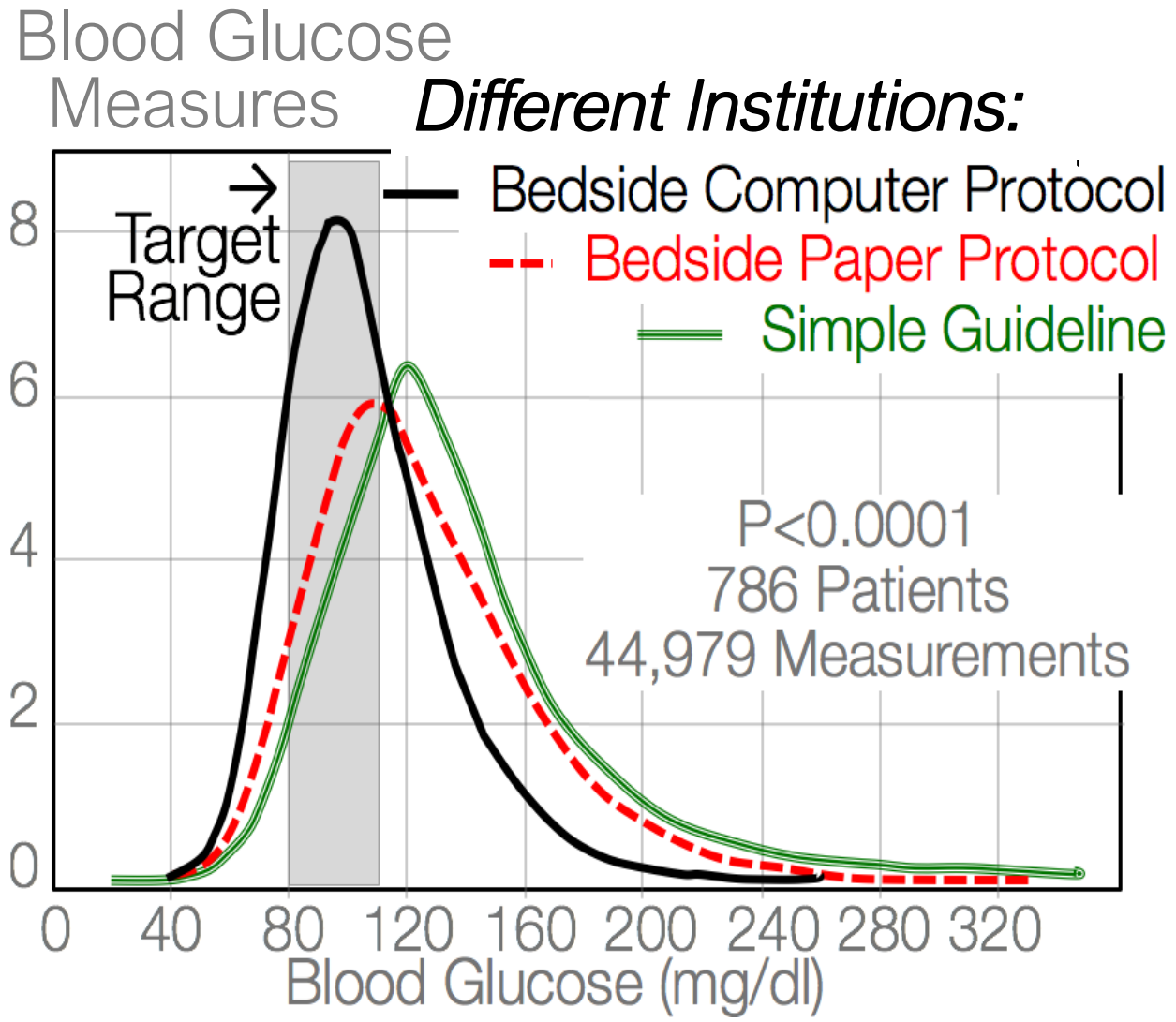
Date	Time	Prev Insulin	Glucose	IV Insulin (U/h)	D50W	Accept
4/06/2008	21:06		178		0	

Simple Guideline – Tufts U

Common bedside Paper Protocol - U Virginia

Bedside Computer Protocol (eProtocol) – Salt Lake City

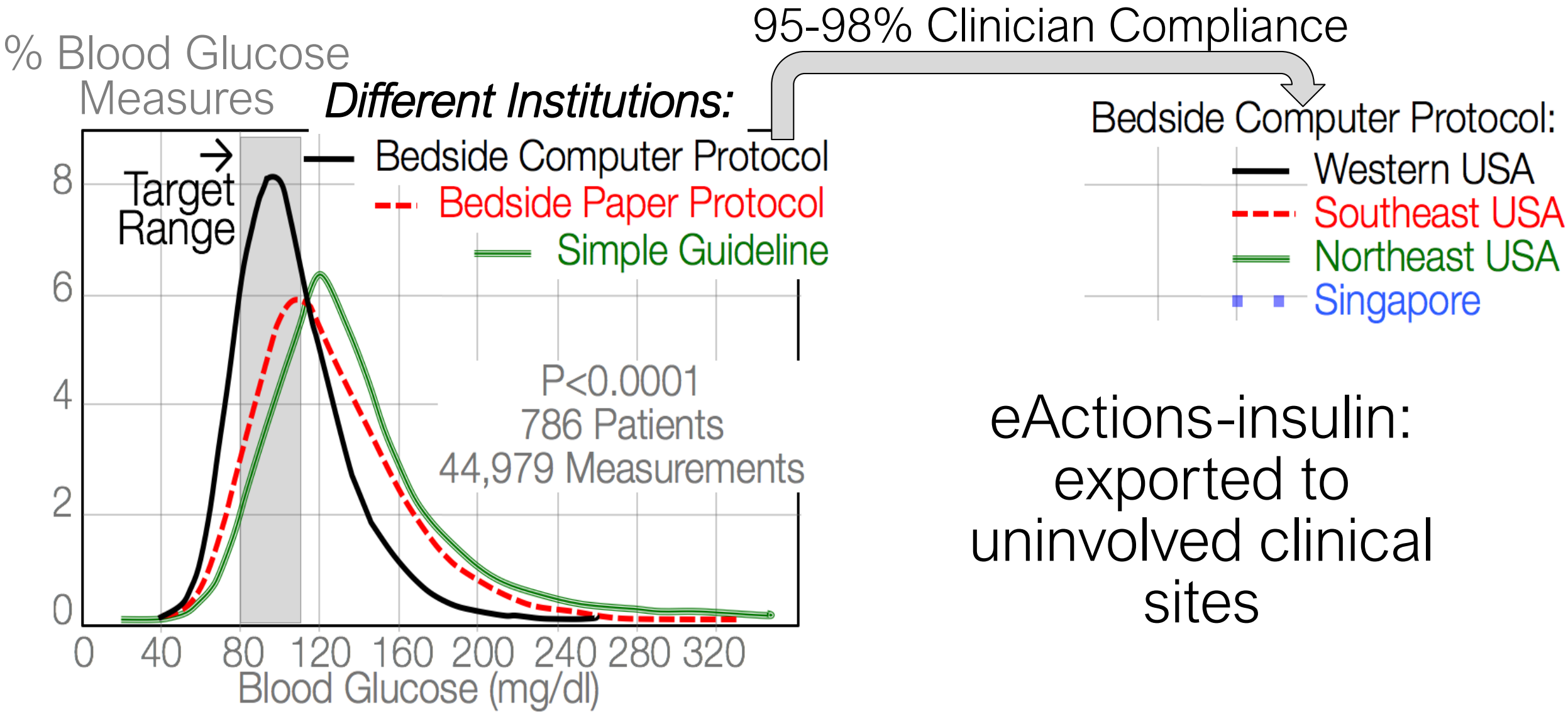
Exportation of Replicable method (eActions)



Clinicians add missing paper protocol / guideline detail

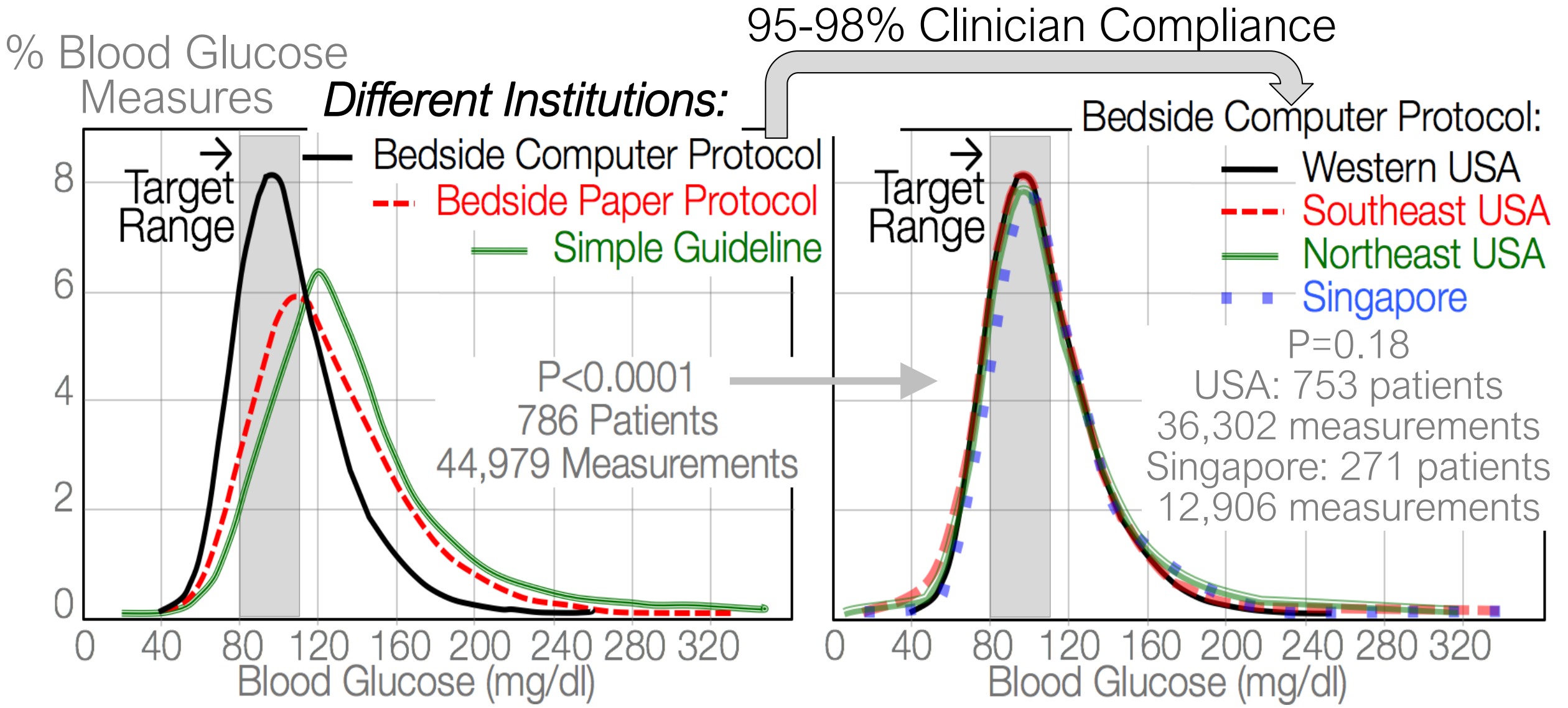
→ *UNKNOWN METHOD*

(protocol / guideline + *unknown* physician decision rules)



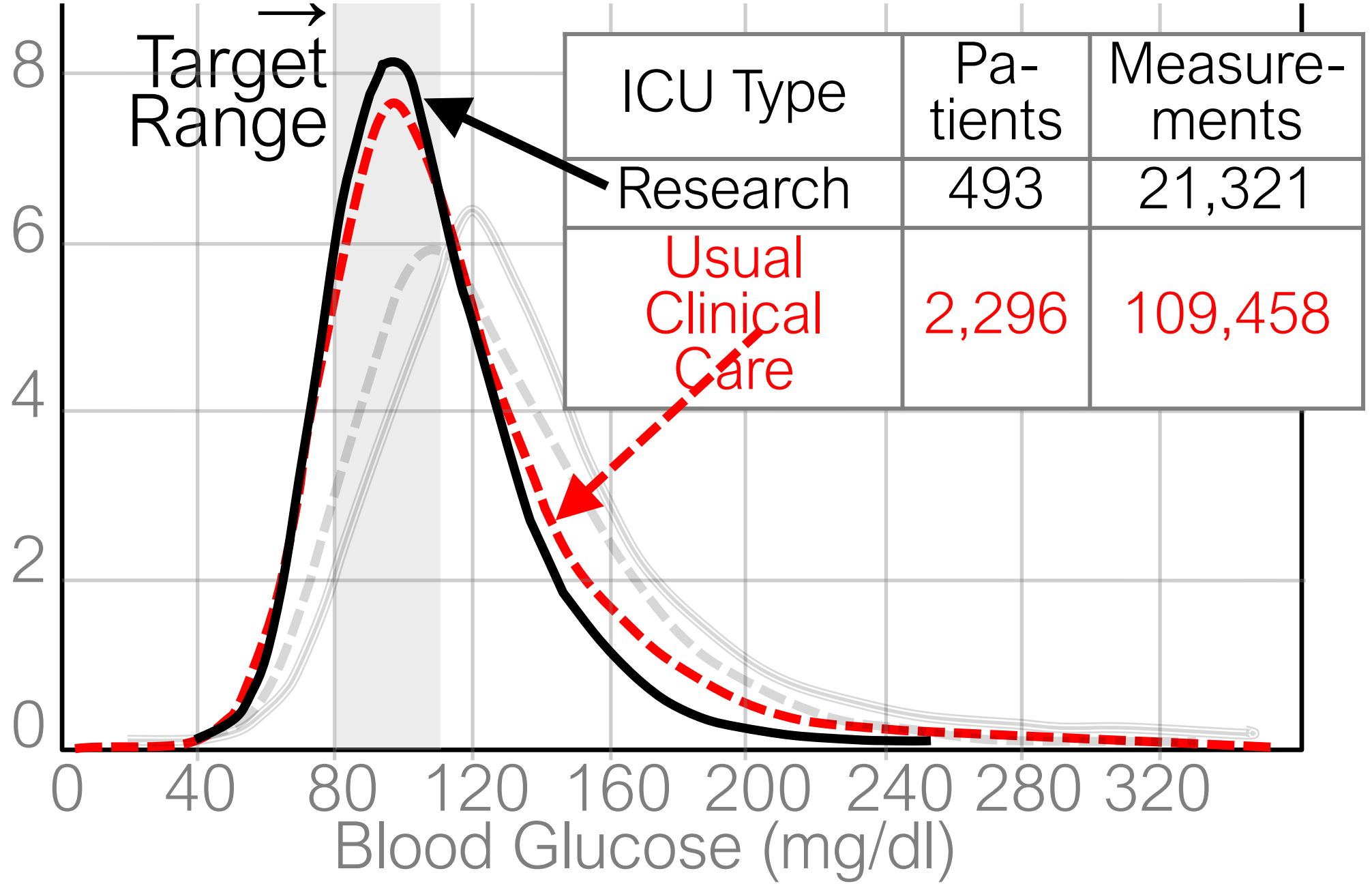
eActions-insulin: exported to uninvolved clinical sites

Clinicians add missing paper protocol / guideline detail
→*UNKNOWN METHOD*
(protocol / guideline + *unknown* physician decision rules)



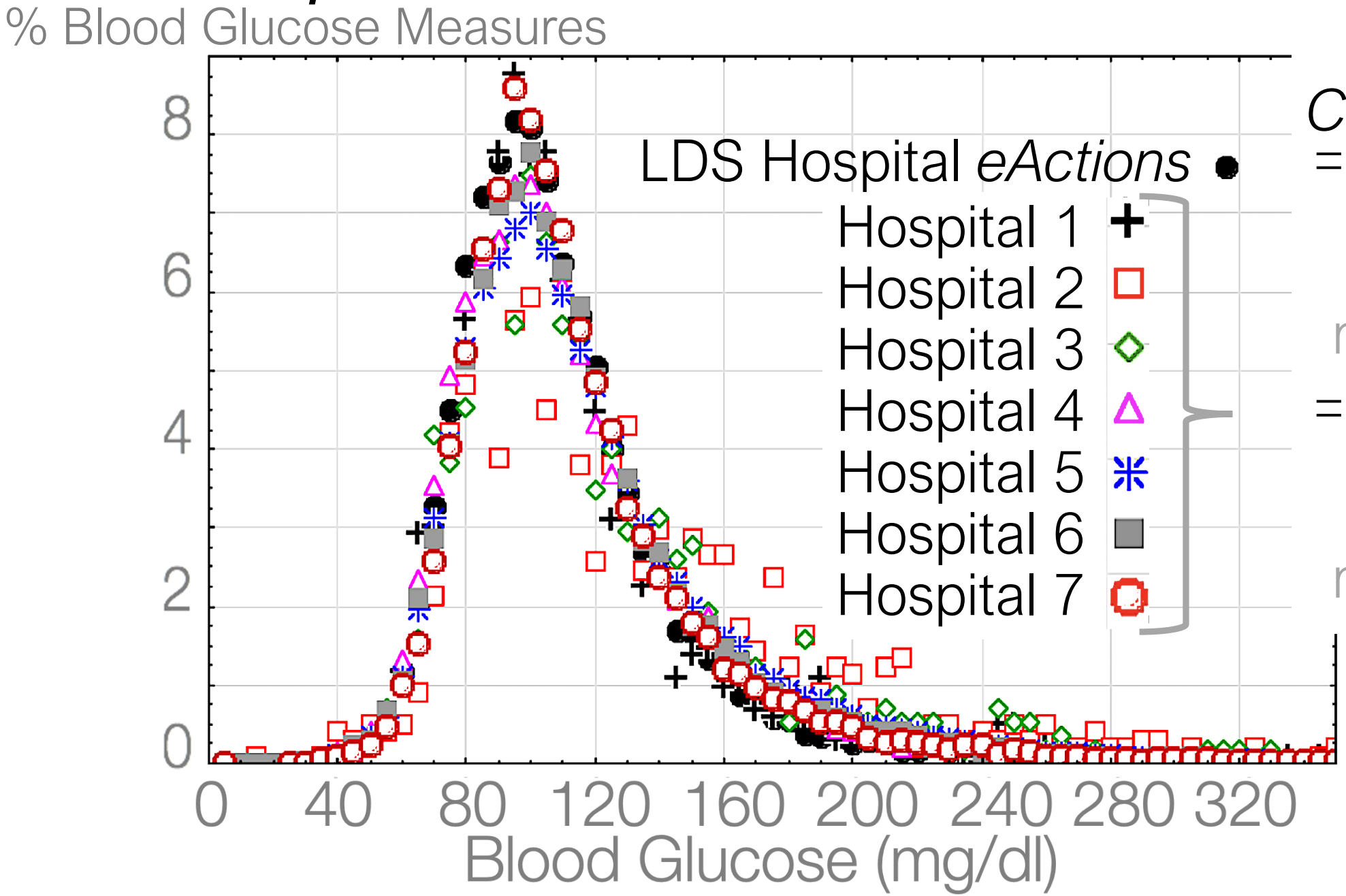
Morris AH, et al. A replicable method for blood glucose control in critically Ill patients. Crit Care Med. 2008;36(6):1787-95.
Morris AH, Orme J, Rocha BH, Holmen J, Clemmer T, Nelson N, et al. An Electronic Protocol for Translation of Research Results to Clinical Practice: A Preliminary Report. J Diabetes Sci Technol. 2008;2(5):802-8

Same hospital: Research Results → Usual Clinical Care



ICU Type	Pa-tients	Measure-ments
Research	493	21,321
Usual Clinical Care	2,296	109,458

Same corporation: Research Results → Usual Clinical Care

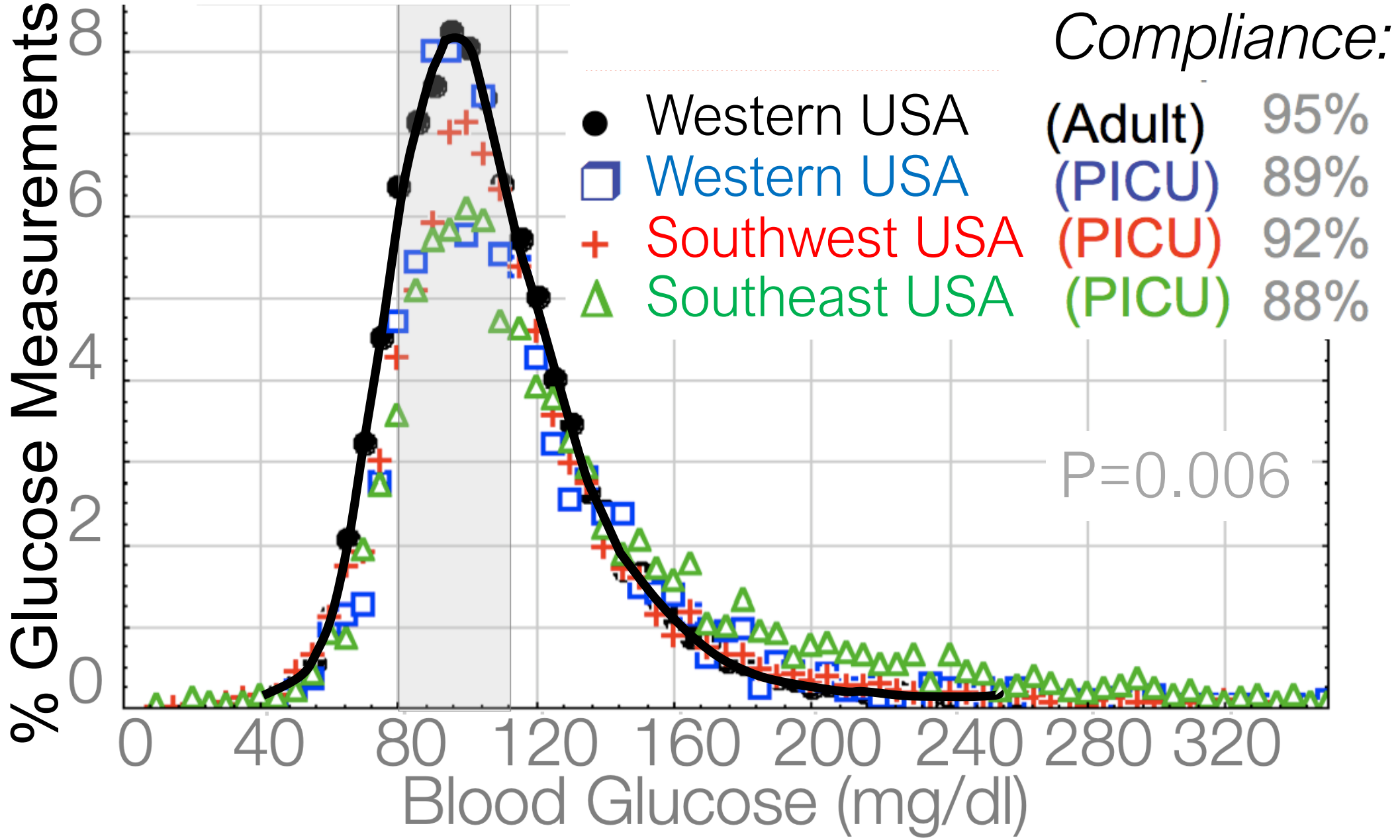


Clinician Compliance:

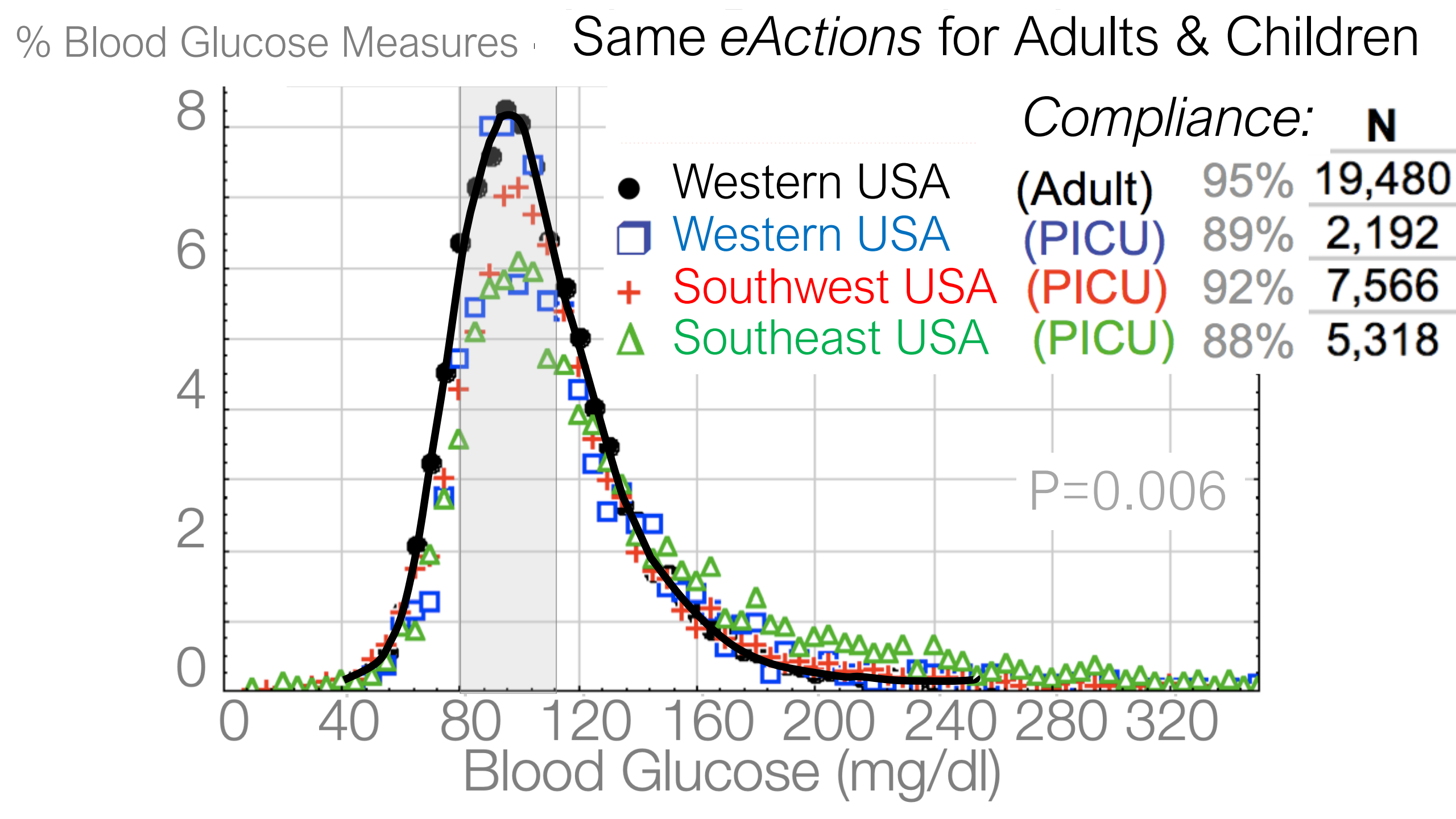
= 95% (of 21,321 measures)

= 92% (of 106,032 measures)

Same *eActions* for Adults & Children



Same *eActions* for Adults & Children



Compliance:		N
(Adult)	95%	19,480
(PICU)	89%	2,192
(PICU)	92%	7,566
(PICU)	88%	5,318

eActions:

Mechanical Ventilation

~$2x10^6$ decisions for ~2,000 patients (850hrs automatically in 2 patients)

Insulin for Blood glucose

IV Fluids,

PFT interpretation: Used for >5years

HALF-PINT: NEJM 2017 – detailed computer protocols 97-98% compliance

Agus MSD, Wypij D, Hirshberg EL, Srinivasan V, Faustino EV, Luckett PM, et al. Tight Glycemic Control in Critically Ill Children. New England Journal of Medicine. 2017;376(8):729-41

Human limitations
Need models/tools → desired actions

A partial cure with *eActions*
(computerized replicable methods)

Reed Gardner, PhD
Homer Warner, MD, PhD
James Orme, Jr., MD
Guy Zimmerman, MD
Brad Rasmusson, MD
Robert Crapo, MD
Gregg Elliott, MD
George Thompson, MD
Terry Clemmer, MD
Lindell Weaver, MD
Frank Thomas, MD
R Scott Evans, MS, PhD
Steve Howe, MS

C DuWayne Schmidt, MD
Thomas East, PhD
Matthew Sailors, PhD
Jane Wallace, RN
Marge Cengiz, RN
Radene Chapman, RN
Judy Blaufuss, RN
Kathy Sward. RN, PhD
Dean Sittig, PhD
Peter Haug, MD
Stan Huff, MD
Olinto Linares, PhD
Marilyn Morris, PT, MS

Thank you

Alan.Morris@hsc.Utah.edu

Morris AH, Stagg B, Lanspa M, Orme J, Clemmer TP, Weaver LK, et al. Enabling a learning healthcare system with automated computer protocols that produce replicable and personalized clinician actions.

J Am Med Inform Assoc. 2021;28(6):1329-43

Morris AH, Horvat C, Stagg B, Grainger DW, Lanspa M, Orme J, et al. Computer clinical decision support that automates personalized clinical care: a challenging but needed healthcare delivery strategy.

J Am Med Inform Assoc. 2023;30(1):178-94.