Beth Israel Deaconess Medical Center | HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Development and Use of the UB-CAM in Research and Practice

Edward R. Marcantonio, M.D., M.Sc.
Professor of Medicine, Harvard Medical School

NIDUS Webinar
December 10, 2024

Disclosures/Funding

- No commercial interests
- No conflicts of interest
- Funding:
  - R01AG030618
  - R01AG051658
  - R01AG065554
  - UM1TR004408

Today's Talk

- Brief overview of delirium
- Improving delirium recognition at the bedside: 3D-CAM and UB-CAM
- ***UB-CAM Practicum***
- What to do if delirium is identified

Why should we care about delirium?

A brief overview

Delirium is Common

Population	Prevalence or Incidence	Rate (%)
Medical Inpatients >70 yrs	Mixed (50:50)	30-40%
Surgery > 70 yrs	Incidence	15-50%
Intensive Care Unit > 18 yrs	Mixed	50-70%

A large hospital may have over **100 patients** actively delirious at any given time.

Inouye et. al., Ann Int Med, 1993; Marcantonio et. al., JAMA, 1994; Marcantonio et. al., JAGS, 2000; Ely et. al., JAMA, 2004; Marcantonio et. al., JAGS, 2010

Delirium is Morbid, Costly

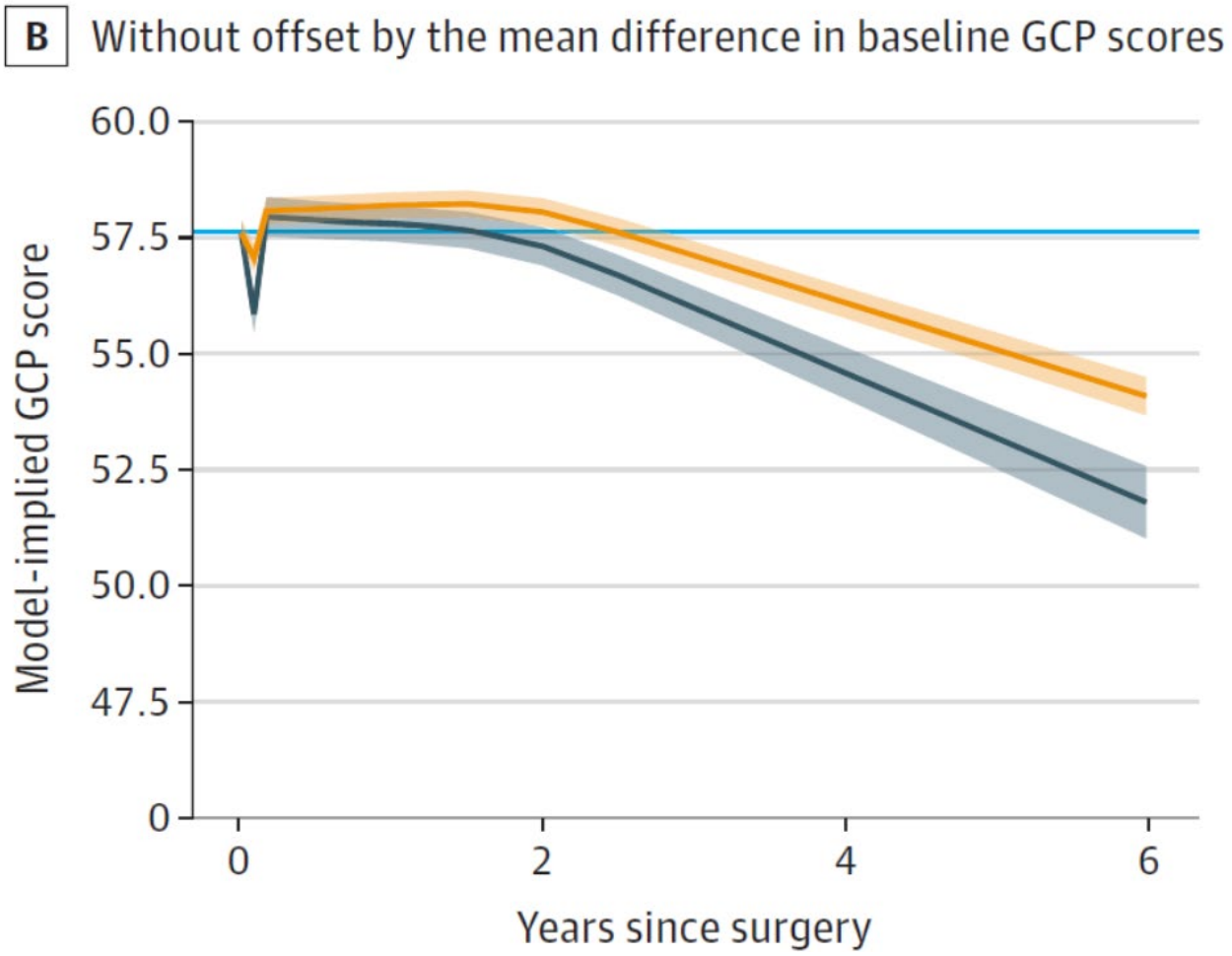
After adjusting for confounders…

- Hospital: ↑complications, ↑LOS, ↓D/C home
- Long term: ↓function, ↓cognition, ↑dementia, ↑NH
- ↑Death: In-hospital & Long term

- Costs of delirium:
  - $60K over 1 year after episode
  - Translates to $164 billion annually in U.S.

Witlox et. al., JAMA, 2010; Marcantonio et. al., Ann Int Med 2011;
Leslie et. al. Arch Int Med, 2008, JAGS, 2011

Delirium: Long Term Cognitive Decline



Kunicki et. al., JAMA-IM, 2023

Delirium is preventable

Multicomponent strategies: HELP, proactive geriatrics consultation, ↓sedation, mobilization in ICU

Inouye et. al. NEJM, 1999; Marcantonio et. al., JAGS, 2001
Needham et. al., JAMA 2008

Delirium Treatment?

- NIDUS White Paper: importance of studying delirium treatment interventions
- Delirium (non)identification is one of the biggest barriers to treatment
  - Identification not an issue for prevention
- Delirium Abatement Program (DAP) Trial
  - Identification rates: 41% DAP vs. 12% U.C.
  - Good news: intervention > tripled recognition
  - Bad news: > 50% of cases still not recognized

Devlin et.al., Crit Care Med, In Press
Marcantonio et. al, JAGS, 2010

Improving Delirium Identification at the Bedside

Funded by R01AG030618

Identifying Delirium

- Less than 50% of delirium cases identified in the hospital.
  - Hypoactive, DSD most likely missed
- Simple, standardized approaches easier to integrate into research, practice
- Most used/best validated: Confusion Assessment Method (CAM) algorithm

Inouye et. al., Arch Int Med, 2001; Wong et. al., JAMA, 2010

CAM Diagnostic Algorithm

- Feature 1: Acute change, fluctuating course
- Feature 2: Inattention
- Feature 3: Disorganized thinking
- Feature 4: Altered level of consciousness

Diagnosis of Delirium: requires presence of Features 1 and 2 and either 3 or 4.

Inouye et. al., Ann Int Med, 1990.

Clinician Challenges-CAM

- Most clinicians do not know:
  - What questions to ask
  - How to map errors on cognitive testing to specific CAM features
  - The threshold of “errors” at which a CAM feature is present
  - How to put it all together to make a diagnosis of delirium

3D-CAM Project

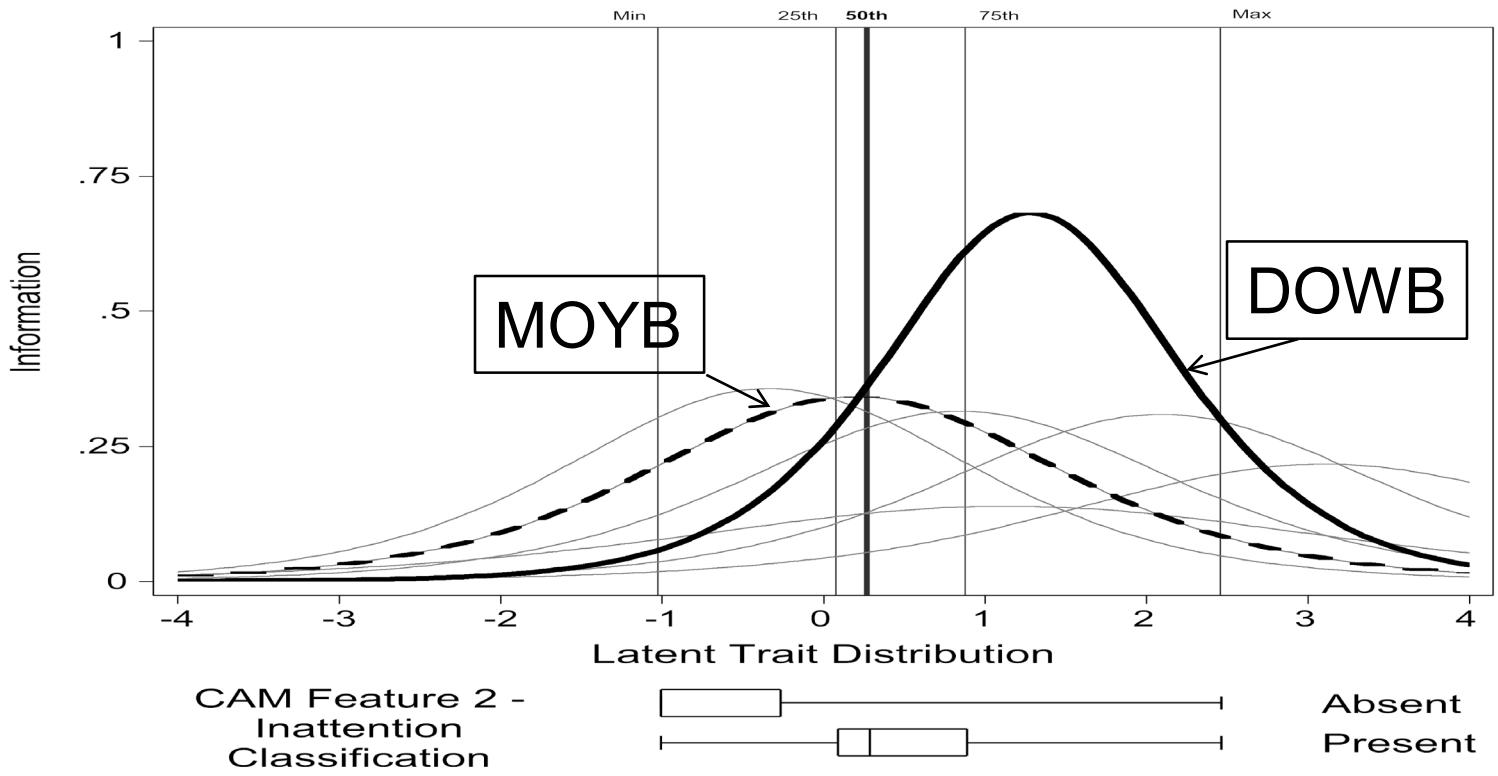
- Using modern measurement theory, to develop a structured diagnostic assessment for CAM-defined delirium that can be completed in 3 minutes (3D-CAM)
- To prospectively validate the 3D-CAM in older general medicine patients

Deriving the 3D-CAM

- Data: > 4500 CAM research assessments collected in previous studies
- IRT: identify items “most informative” to presence/absence of each feature
- Reduced to pool 36 items
- Multivariable modeling:
  - Final set of 20 items
  - Set threshold for CAM feature presence

Yang et. al., BMC Research Methods, 2013

IRT Curves: Inattention



3D-CAM Contents

CAM Feature	Cognitive testing & Patient Symptom Probes	Interviewer Observations
Feature 1: Acute Change/ Fluctuating Course	Self-report of confusion, disorientation, hallucinations	Fluctuation: consciousness, attention, speech/thinking
Feature 2: Inattention	Digit span: 3, 4 backwards Days of week, Months of year backwards	Trouble keeping track of interview Inappropriately distracted
Feature 3: Disorganized Thinking	Orientation: year, day of the week, location (hospital)	Flow of ideas: unclear, illogical Conversation: rambling, off-target, OR limited, sparse
Feature 4: Altered Level of Consciousness	None	Sleepy, stupor, or comatose Or Vigilance

Any one "positive" item triggers Feature

Validating the 3D-CAM

- General medicine patients at BIDMC
  - N=201, Avg. age 84, 28% with dementia
  - Reference Standard Assessment by Clinician
  - 3D-CAM blinded to Reference Standard
- Results:
  - Median admin time-3 minutes
  - Test characteristics: 95% sensitivity, 94% specificity
  - Excellent performance: patients with dementia

Marcantonio et. al., Ann Int Med, 2014

3D-CAM Materials, Severity

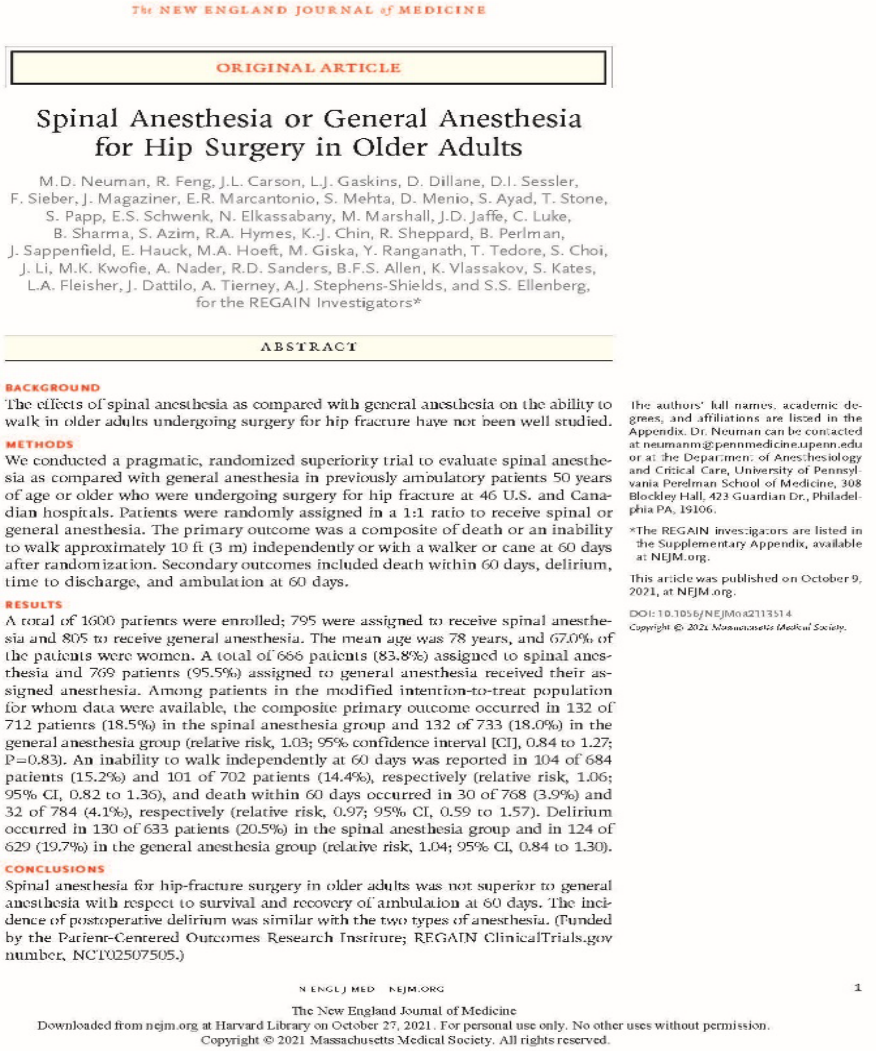
- Instrument, training materials (free):
  - American Geriatrics Society Co-Care
  - American Delirium Society
  - Multiple translations available
- 3D-CAM-S delirium severity measure
  - Does not require any additional items
  - “Raw” method: add up “positive” items
  - Score 0-20, 20 worst

Vasunilashorn, JAGS, 2020

Use of 3D-CAM

- REGAIN: RCT of General vs. Spinal Anesthesia for Hip Fracture
- PCORI funded, 1600 patients, 50 sites
- 3D-CAM integrated into study protocol
- Standardized delirium outcome measure

Neuman et. al., NEJM 2021



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

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

BACKGROUND
The effects of spinal anesthesia as compared with general anesthesia on the ability to walk in older adults undergoing surgery for hip fracture have not been well studied.

METHODS
We conducted a pragmatic, randomized superiority trial to evaluate spinal anesthesia as compared with general anesthesia in previously ambulatory patients 50 years of age or older who were undergoing surgery for hip fracture at 46 U.S. and Canadian hospitals. Patients were randomly assigned in a 1:1 ratio to receive spinal or general anesthesia. The primary outcome was a composite of death or an inability to walk approximately 10 ft (3 m) independently or with a walker or cane at 60 days after randomization. Secondary outcomes included death within 60 days, delirium, time to discharge, and ambulation at 60 days.

RESULTS
A total of 1600 patients were enrolled; 795 were assigned to receive spinal anesthesia and 805 to receive general anesthesia. The mean age was 78 years, and 67.0% of the patients were women. A total of 666 patients (83.8%) assigned to spinal anesthesia and 769 patients (95.5%) assigned to general anesthesia received their assigned anesthesia. Among patients in the modified intention-to-treat population for whom data were available, the composite primary outcome occurred in 132 of 712 patients (18.5%) in the spinal anesthesia group and 132 of 733 (18.0%) in the general anesthesia group (relative risk, 1.03; 95% confidence interval [CI], 0.84 to 1.27; P=0.83). An inability to walk independently at 60 days was reported in 104 of 684 patients (15.2%) and 101 of 702 patients (14.4%), respectively (relative risk, 1.06; 95% CI, 0.82 to 1.36), and death within 60 days occurred in 30 of 768 (3.9%) and 32 of 784 (4.1%), respectively (relative risk, 0.97; 95% CI, 0.59 to 1.57). Delirium occurred in 130 of 633 patients (20.5%) in the spinal anesthesia group and in 124 of 629 (19.7%) in the general anesthesia group (relative risk, 1.04; 95% CI, 0.84 to 1.30).

CONCLUSIONS
Spinal anesthesia for hip-fracture surgery in older adults was not superior to general anesthesia with respect to survival and recovery of ambulation at 60 days. The incidence of postoperative delirium was similar with the two types of anesthesia. (Funded by the Patient-Centered Outcomes Research Institute; REGAIN ClinicalTrials.gov number, NCT02507505.)

The authors' full names, academic degrees, and affiliations are listed in the Appendix. Dr. Neuman can be contacted at neumanm@pennmedicine.upenn.edu or at the Department of Anesthesiology and Critical Care, University of Pennsylvania Perelman School of Medicine, 308 Blockley Hall, 423 Guardian Dr., Philadelphia PA, 19106.

*The REGAIN investigators are listed in the Supplementary Appendix, available at NEJM.org.

This article was published on October 9, 2021, at NEJM.org.

DOI: 10.1056/NEJMoa2113514

READI: Researching Efficient Approaches to Delirium Identification

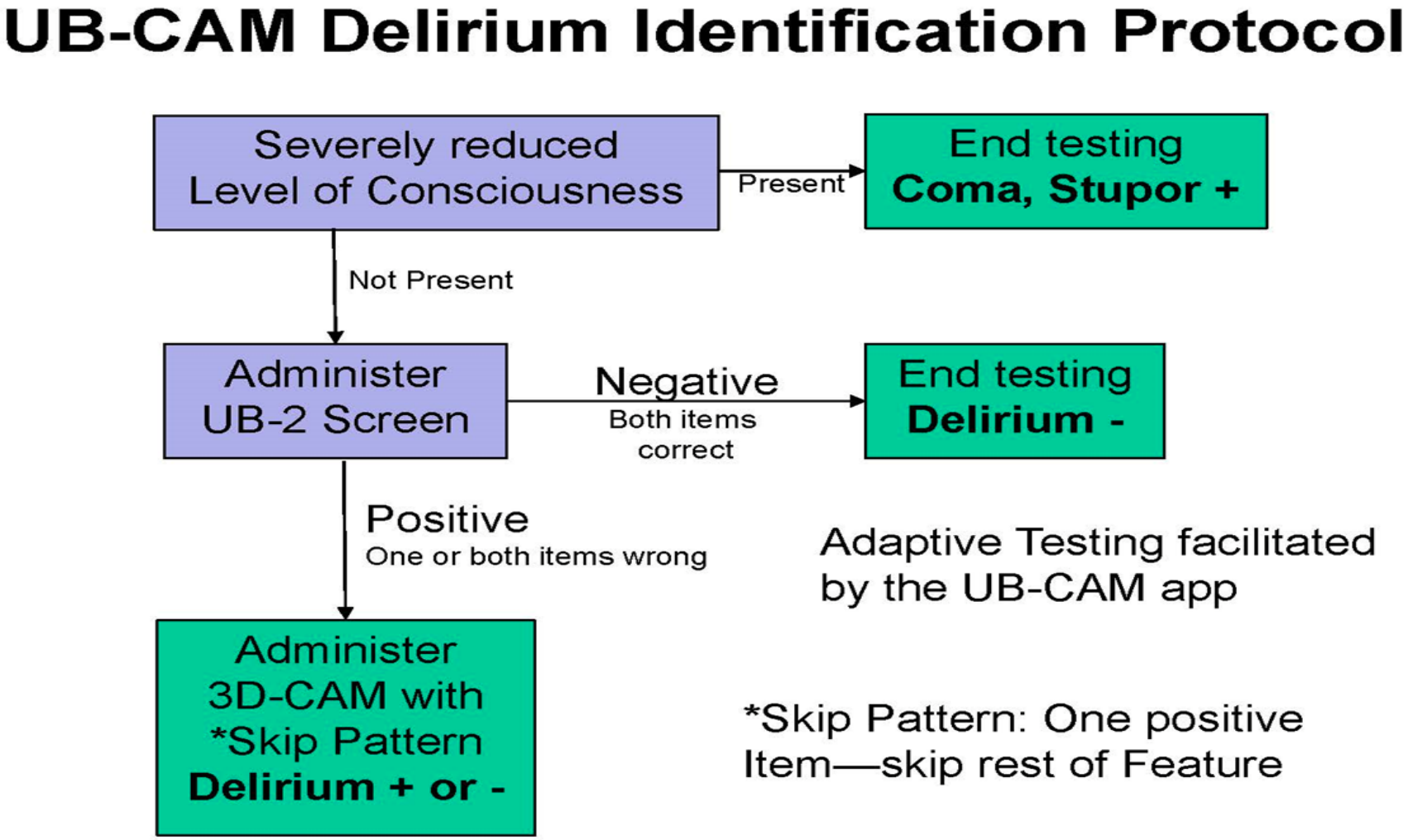
MPI's: Edward Marcantonio, MD (BIDMC)
Donna Fick, RN, PhD (Penn State)

UB-2

- Can we get it shorter? → Ultra-brief screens
  - –Initial screen to rule out delirium quickly
  - –Not diagnostic: only modest specificity
- Best single item (MOYB): detects >80%
- UB-2: Best two item screen (DOW, MOYB):
  - –Sensitivity 93%, Specificity 62%
  - –Takes 35 seconds to administer

Fick et. al., J Hosp Med, 2015

UB-CAM: Ultra-brief CAM



Motyl et. al, J Am Geriatr Soc, 2020

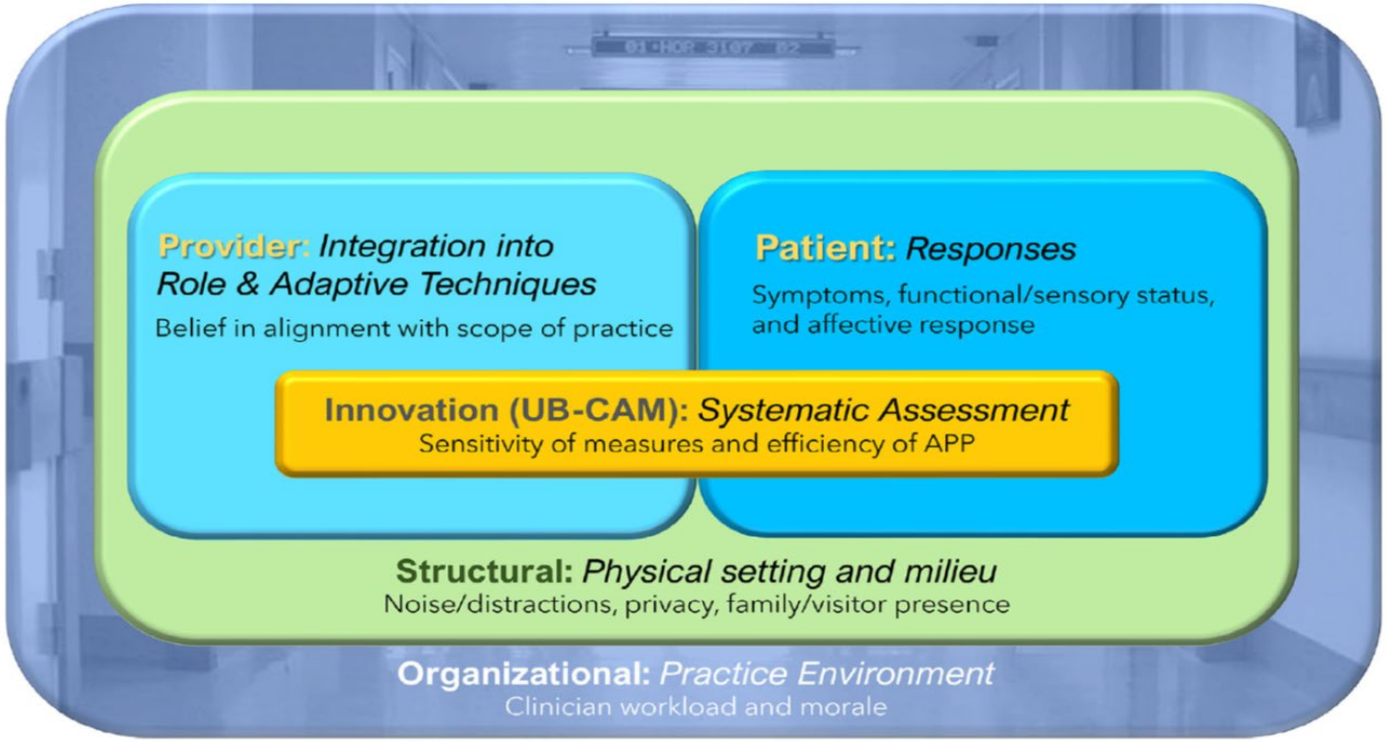
READI Main Results

- 527 hospitalized older adults, 924 days
  - BIDMC & PA. community hospital
  - Over 1/3 with dementia/AD
  - 399 MDs, RNs, CNAs vs. Reference Standard
- Main findings:
  - UB-CAM completed > 97%
  - Avg. completion time: 1 min 15 secs
  - Overall accuracy = 89%
  - RNs = MDs, CNAs can administer UB-2
  - Skip pattern ↓ admin time, no ↓ accuracy

Marcantonio, Fick, et. al, Ann Int Med 2022

READI Implementation

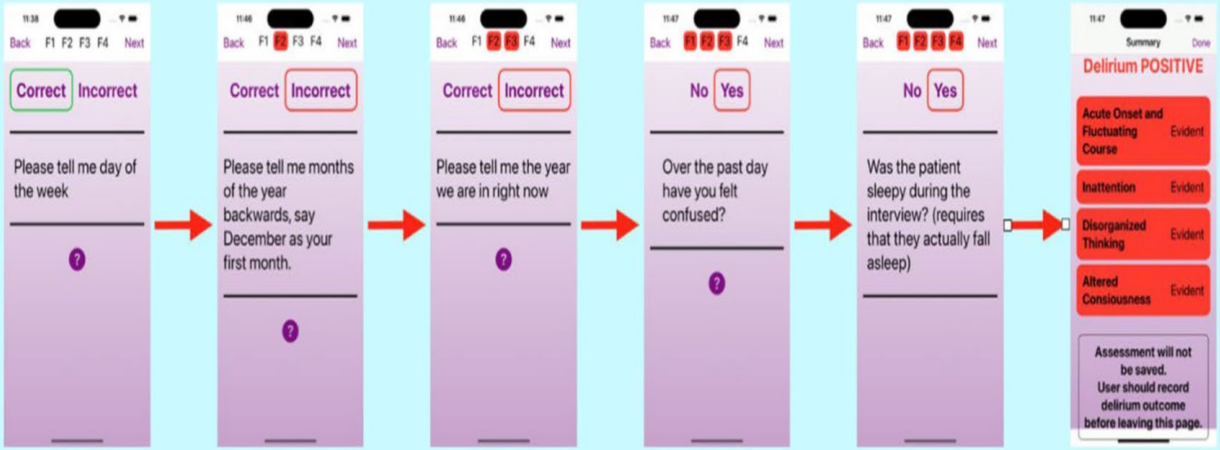
Qualitative Research: Barriers and Facilitators



Cost Analysis: Annual Cost for daily screen in 300 bed hospital < salary of 1 FTE of discipline doing the screening

Husser et. al. JAGS 2021, Leslie et. al, JAGS 2022

UB-CAM Delirium Screen App



Kusmik et. al., JAGS 2023

Available (for free) at
Apple and Google Play Store

3D-CAM/READI Collaborators

BIDMC Collaborators:

- Long Ngo, PhD [Biostatistics]
- Yoojin Jung, PhD
- Shrunjal Trivedi, MPH
- Amber Moore, MD
- Kim Sulmonte, DNP, MHA, RN
- Andrew Nashed, MD, (Android App)
- BIDMC Field Team

HSL/Brown Collaborators:

- Sharon Inouye, MD MPH
- Richard Jones, ScD
- Eran Metzger, MD

Penn State Collaborators:

- Donna Fick, RN PhD [MPI]
- Marie Boltz, RN PhD [Qualitative]
- Doug Leslie, PhD [Economist]
- Erica Husser, PhD
- John Hannan, PhD (iOS App)
- Jessica Kutz, PhD
- Field team at MNMC

- **Participating Patients, Families**
- **BIDMC, MNMC Hospital Medicine Physicians, Nurses, CNA's**
- **Funding: R01AG030618, National Institute on Aging**

UB-CAM Practicum

Download the UB-CAM App
onto your Phone

For iPhone (iOS)

SCAN ME

UB-CAM Delirium Screen App

For Android

Training Videos

- Developed by Kerry Palihnich
- 2 Assessments on Same Day
- Follow along with the App
  - Day of week shown on screen
  - Code: Correct/Incorrect or Present/Not Present
  - Hit “Next” to move to the next question

Assessment 1

Assessment 2

Clinical Use of UB-CAM

Early Experience

- UB-CAM has been implemented in Epic
  - NYU Health System, UMass
- Age-Friendly Health Systems
  - Recommend UB-CAM as part of “4M’s”
- Currently testing implementation “to scale” in new study

READI-SET-GO

Researching Efficient Approaches to Delirium Identification: Sustaining Effective Translation to create Gero-friendly Organizations

Using a stepped-wedge design, to implement systematic delirium identification using the UB-CAM on 6 acute med-surg wards at 3 hospitals in all hospitalized older adults.

Determine the impact UB-CAM implementation on:

- Aim 1: Accuracy of delirium detection
- Aim 2: Patient, family care partner, and hospital staff outcomes
- Aim 3: Rate of delirium-related complications, Use of antipsychotics, restraints

Research Use of UB-CAM

- Hospital-wide UB-CAM screening:
  - used for secondary data analyses
- Prospective studies, Clinical trials:
  - UB-CAM could be used as screen to I.D. patients for a treatment trial
  - UB-CAM positives likely need confirmation with the full 3D-CAM (measures severity)

What to do if you identify delirium?

Delirium Treatment/Management

Delirium Abatement Program
Four Key Steps

Step 1: Identify delirium (early)

Step 2: Assess/treat contributing factors

Step 3: Prevent complications

Step 4: Restore function

Bergmann et. al., JAGS. 2005, Marcantonio et. al., JAGS. 2010, Marcantonio, NEJM, 2017.

Step 1: Identify Delirium

- Administer a validated screening tool at least daily (qshift better)
- Use CAM-based screening tool appropriate to the setting:
  - CAM-ICU (ICU)
  - B-CAM (ED)
  - *UB-CAM (Med/surg)*
- Document results in EHR

Step 2: Correct reversible factors

- **D** RUGS: esp. high risk
- **E** lectrolyte imbalance (dehydration)
- **L** ack of drugs (withdrawal, uncontr. pain)
- **I** nfection
- **R** educed sensory input (vision, hearing)
- **I** ntracranial (CVA, subdural, etc.--rare)
- **U** rinary retention/fecal impaction
- **M** yocardial/Pulmonary

Marcantonio, NEJM, 2017

Step 3: Prevent Complications

- Immobility and falls
- Urinary incontinence
- Pressure injury
- Feeding disorders-malnutrition

Marcantonio, NEJM, 2017

Step 4: Restore Function

- Environmental modifications
- Cognitive reconditioning
- Rehabilitate activities of daily living
- Family education, support, and participation
- Discharge planning and education

Marcantonio, NEJM, 2017


STOP !!!
WASH YOUR HANDS
MediGuard Select
MediGuard Select
MediGuard Select
MediGuard
Fallon
Thursday
8
May 2003
You are at The Boston Center
Your Room # is:
118A
Your Room Phone # is:
(617) 363-2189
The facility phone # is:
(617) 325-5400
THE BOSTON CENTER
125 CENTRE ST.
Today is:
Return to Nurses Station

Take home points

- Delirium:
  - Short and long term adverse outcomes, high cost
  - Delirium is preventable
  - Poor identification remains barrier to treatment
- Delirium Identification Tools:
  - 3D-CAM: 3-minute diagnostic assessment
  - UB-CAM: app-facilitated 75-sec screen
- UB-CAM Delirium Screening
  - Hospital-wide delirium identification programs
  - Research use—initial screen for treatment trials

Back on the Horse Again