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Improving the Outcome Prognostication of Critically Ill Patients with moderate-severe TBI

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Disclosures

- No conflict of interest

- Research support:
  - American Heart Association AHA 09SDG2030022
  - Worcester Research Foundation 2010
  - Faculty Scholar Award 2011
  - Departmental

Traumatic Brain Injury remains a real public health problem in the U.S. (and worldwide).

Appr. 1.7 million Americans sustain a TBI annually

52,000
Deaths

275,000
Hospitalizations

1,365,000
Emergency Department Visits

???
Receiving Other Medical Care or No Care*

Moderate-severe TBI
GCS 3-12

From: www.break.com

From: www.nutridesk.com.au

From: http://www.cdc.gov/traumaticbraininjury/statistics.html
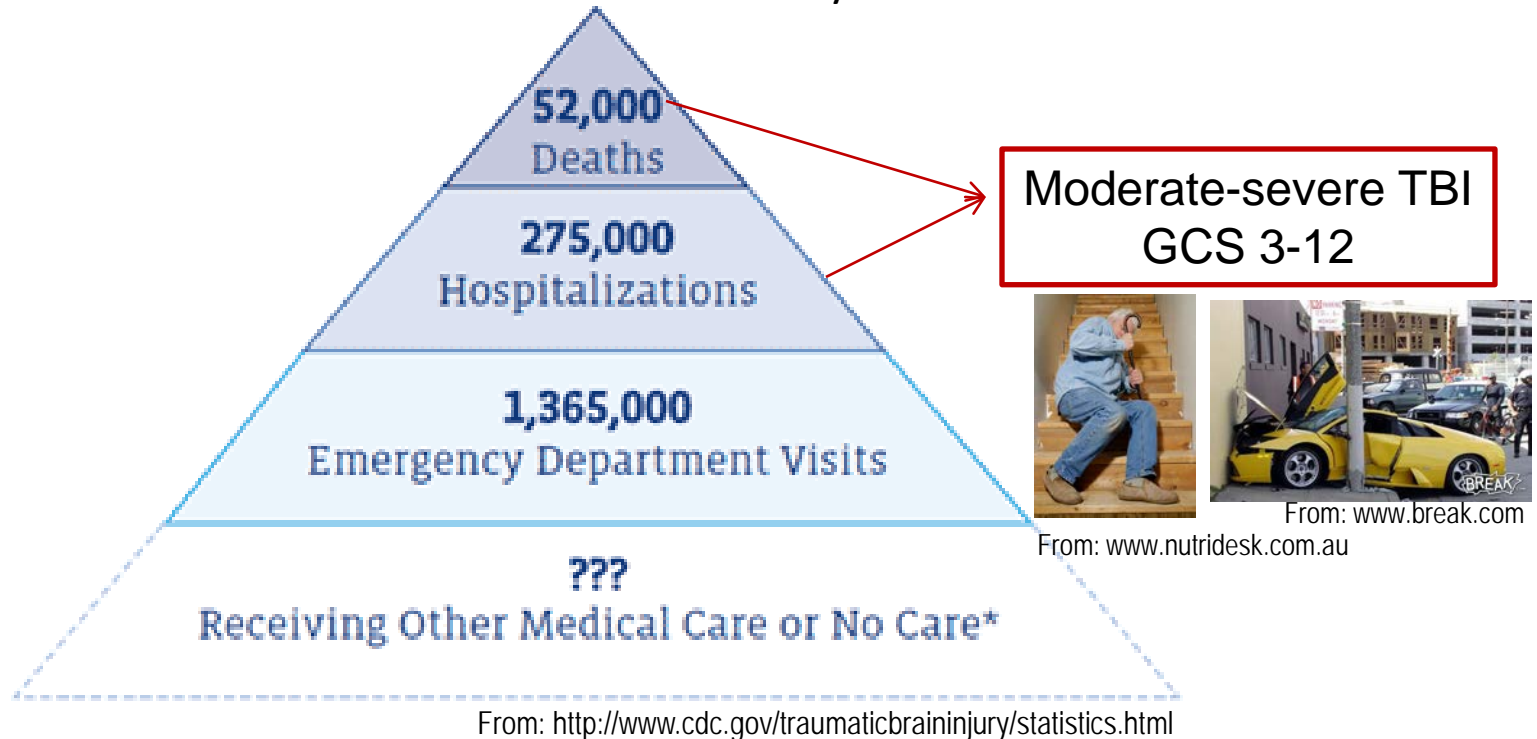
- 25% of these are moderate-severe TBI.

Outcome prognostication is extremely important for families and clinicians.

Families ⟷ **Clinicians**

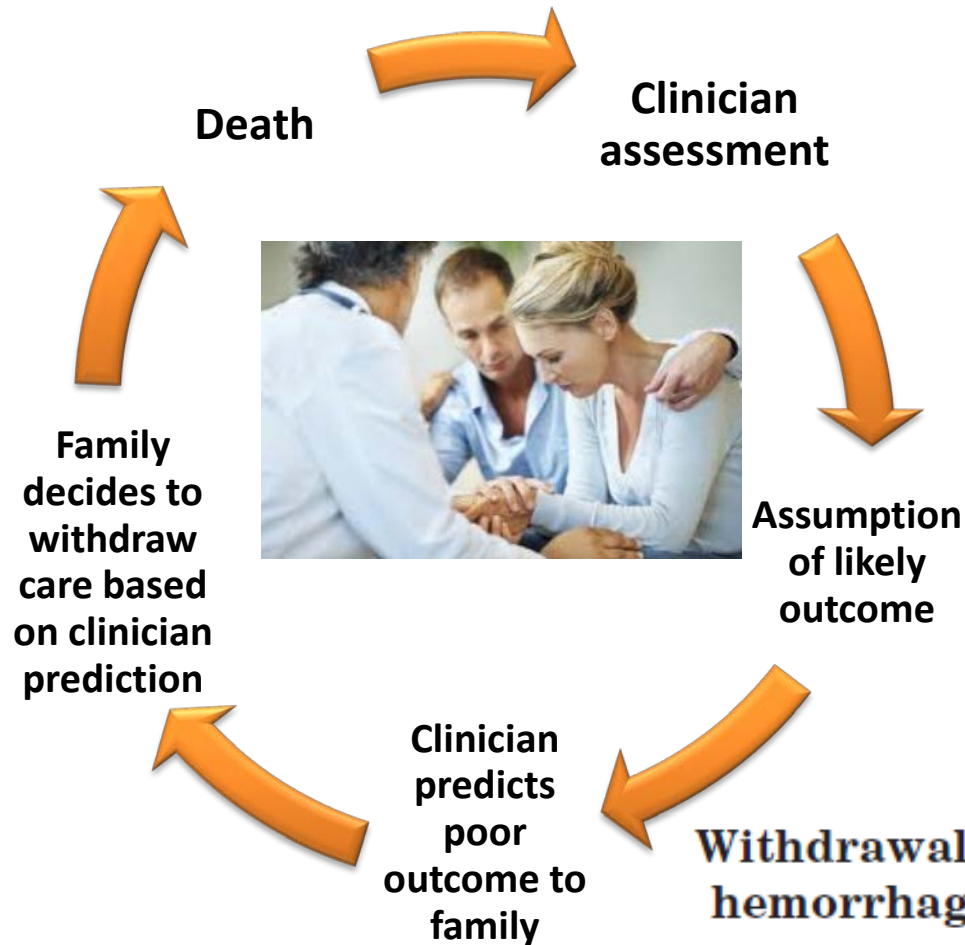Informed decisions about
Aggressiveness of care and
Future planning

Need to provide information to
Families and other providers which will
Guide aggressiveness of care
(prevent self-fulfilling prophecies)

Improved Outcome Prognostication
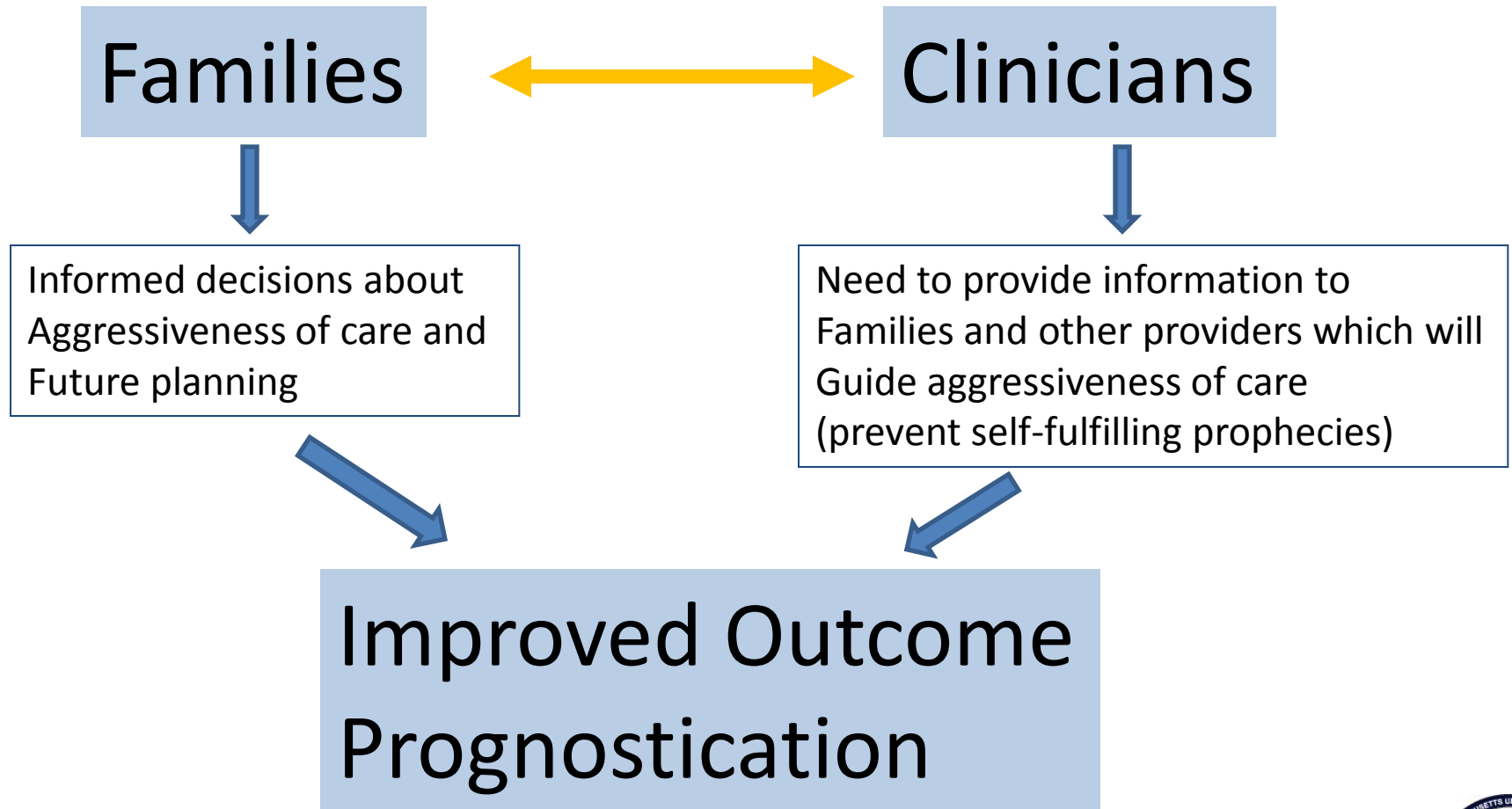
Withdrawal of Care may lead to self-fulfilling prophecies.

Death → **Clinician assessment**

Clinician assessment → **Assumption of likely outcome**

Assumption of likely outcome → **Clinician predicts poor outcome to family**

Clinician predicts poor outcome to family → **Family decides to withdraw care based on clinician prediction**

Family decides to withdraw care based on clinician prediction → **Death**

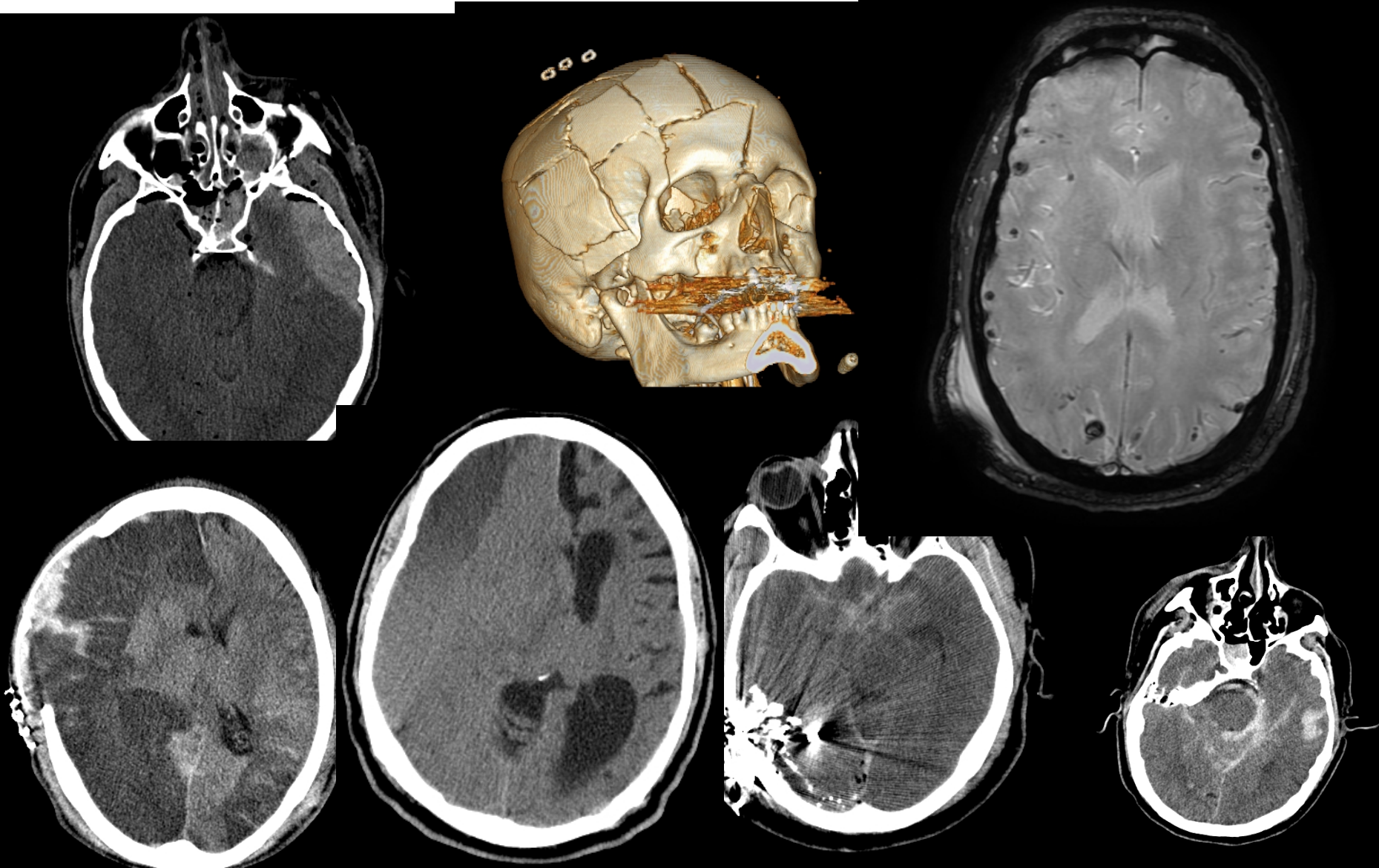## Withdrawal of support in intracerebral hemorrhage may lead to self-fulfilling prophecies

K.J. Becker, MD; A.B. Baxter, MD; W.A. Cohen, MD; H.M. Bybee, BSN; D.L. Tirschwell, MD, MSc; D.W. Newell, MD; H.R. Winn, MD; and W.T. Longstreth, Jr., MD

Becker et al. Neurology 2001

TBI is a heterogeneous disease, making outcome prognostication difficult.
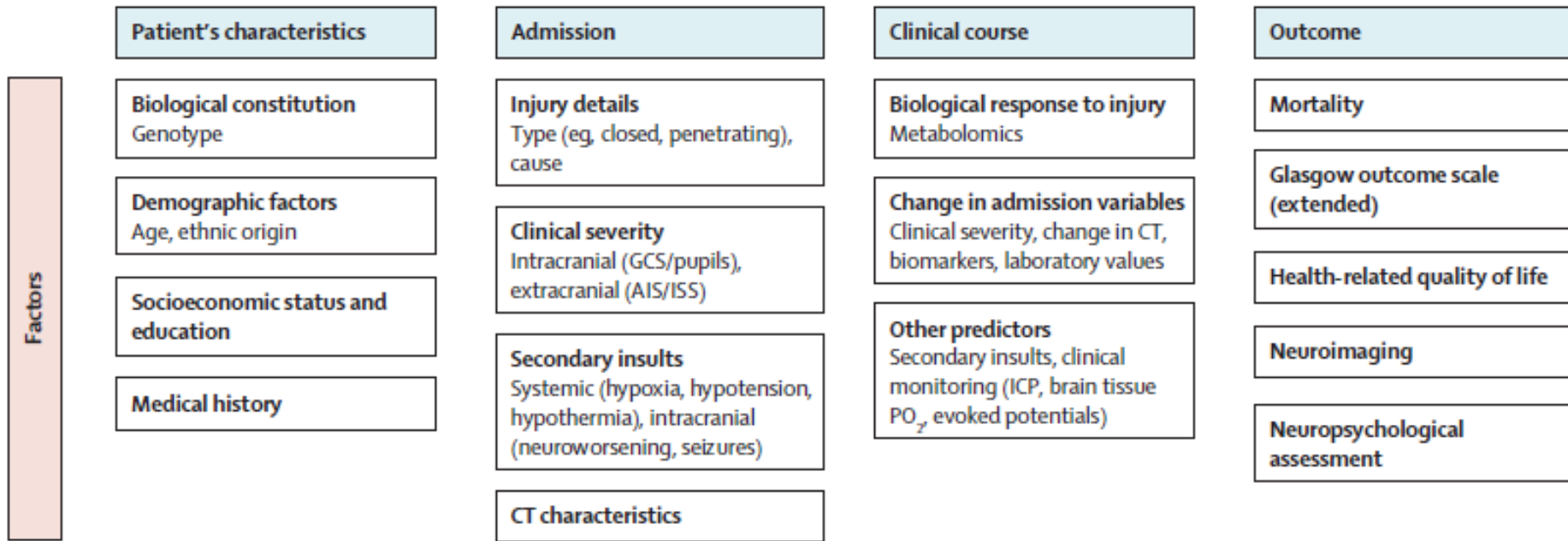
The outcome prediction in TBI is complex.

Figure 1: Overview of the components of prognosis in traumatic brain injury
GCS=Glasgow coma scale. AIS/ISS=abbreviated injury score/injury severity score. ICP=intracranial pressure. PO₂=partial pressure of oxygen.

From: Lingsma et al. Lancet Neurol 2010

The IMPACT data set has lead to the validated IMPACT predictors.

http://www.tbi-impact.org/

IMPACT = **I**nternational **M**ission for **P**rognosis **a**nd **C**linical Trial design in **TB**I
<u>3 centers:</u>
Erasmus University in Rotterdam, Netherlands
University of Edinburgh, Scotland,
Virginia Commonwealth University Medical College,Richmond, VA

IMPACT: 11 studies total (8 RCT; 3 observational cohort studies) n=9099

The IMPACT study risk calculator is a free online tool to estimate the 6-month outcome after TBI.
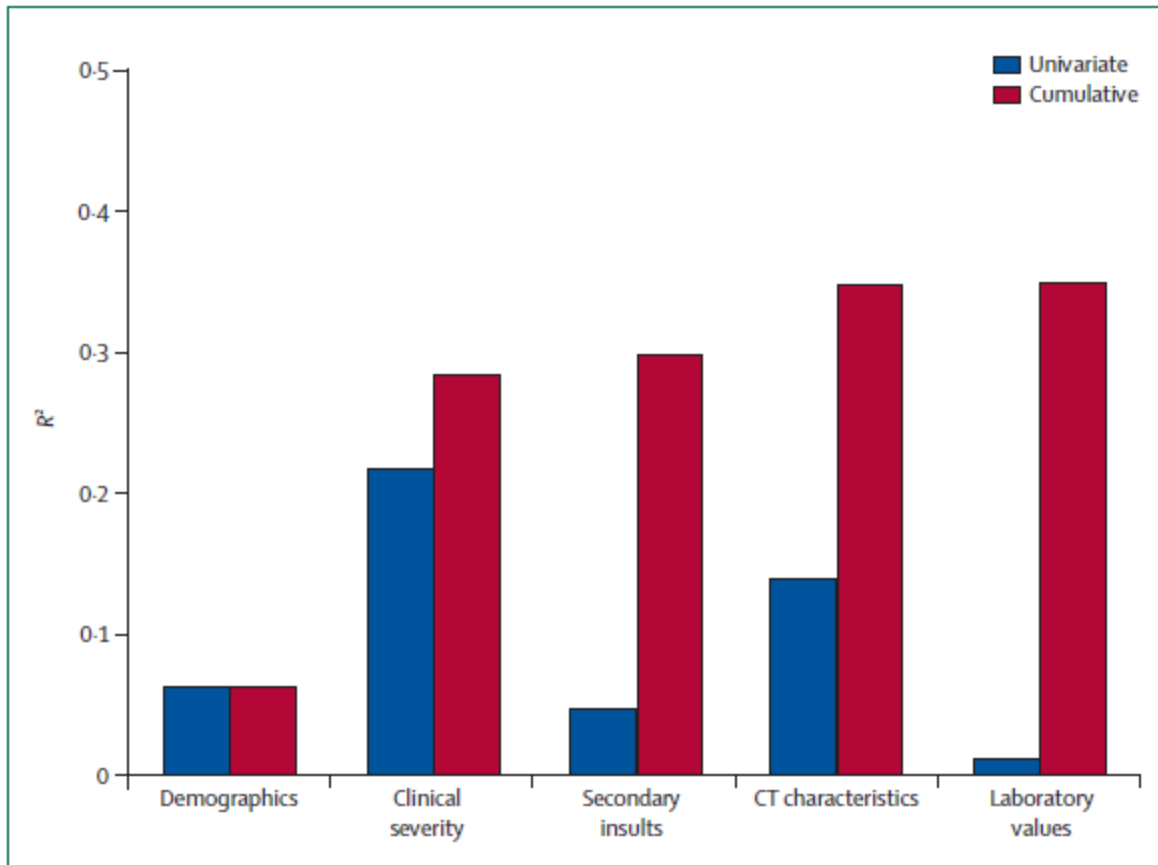
Prediction models for 6 month outcome after TBI

Admission Characteristics	Value
Core	
Age (14-99 years)	37
Motor Score	Extension
Pupils	One
Core+CT	
Hypoxia	No
Hypotension	Yes
CT Classification	Diffuse Injury II
tSAH on CT	No
Epidural mass on CT	No
Core+CT+Lab	
Glucose (3-20 mmol/L)	
Hb (6-17 g/dL)	

Calculate   Reset

From: http://www.tbi-impact.org

Admission characteristics are strong prognosticators as shown by the IMPACT data.

Figure 2: Prognostic value of different components of traumatic brain injury prognosis (R^2) in the IMPACT dataset (n=8686)

The cumulative R^2 of the full model is 0·35. IMPACT=International Mission for Prognosis and Clinical Trial design in TBI. R^2=proportion of variability in outcome explained by the predictor(s). Data from Murray and colleagues.[10]

The cumulative R^2 of the full model is 0.35.

The IMPACT predictors only explain about 1/3 of the outcome variability.

The IMPACT score ignores the hospital course.

- Our hypothesis:
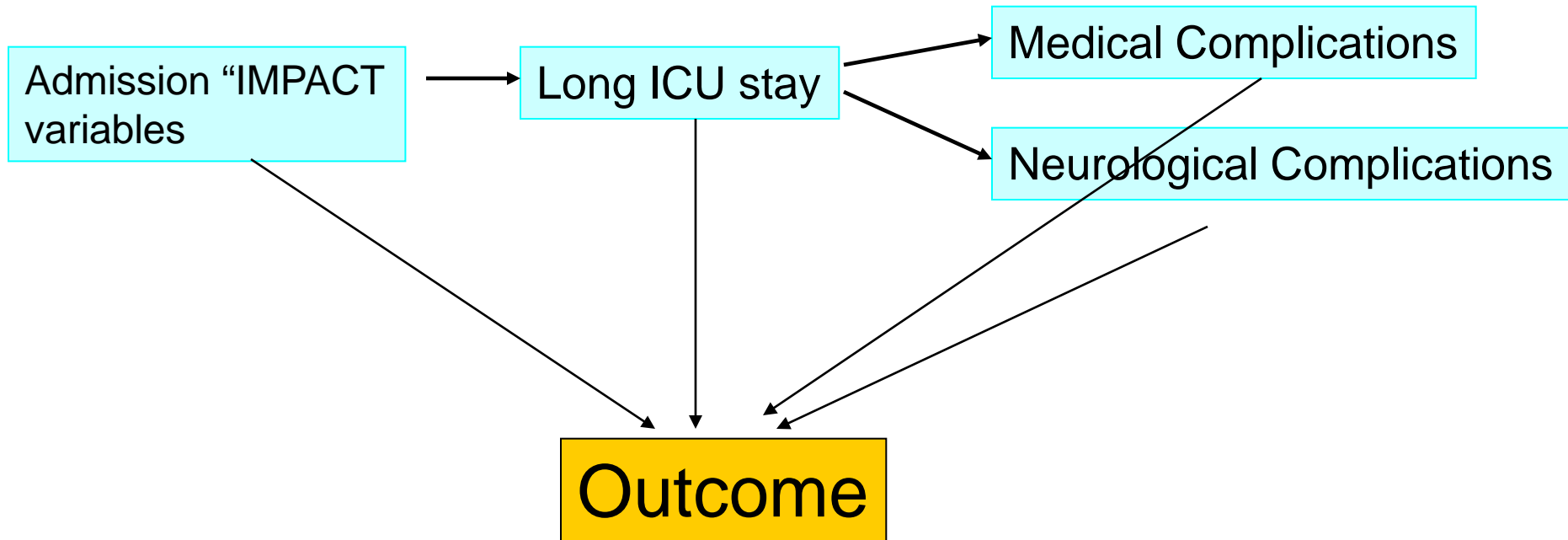
Prior literature shows that non-neurologic organ failure may contribute to 2/3 of all TBI deaths.

- The number of organs failing correlates with mortality.
- All studies retrospective and largest n=209

Kemp et al. American Surgeon 2008; Zguyn et al. CCM 2005

UMASS OPTIMISM Study (Outcome Prognostication in Traumatic Brain Injury)

Started Nov 2009, ongoing
Total n=238

limited to moderate-severe TBI
456 datafields

Demographics
Pre-hospital data
Trauma ED data
Head CT data – consensus by all three neurointensivists
ICU admission "enrollment" post-rescucitation GCS first 24h unless intoxicated
NSG interventions
Specific ICU complications, predefined,
      reviewed weekly, – consensus by all three neurointensivists
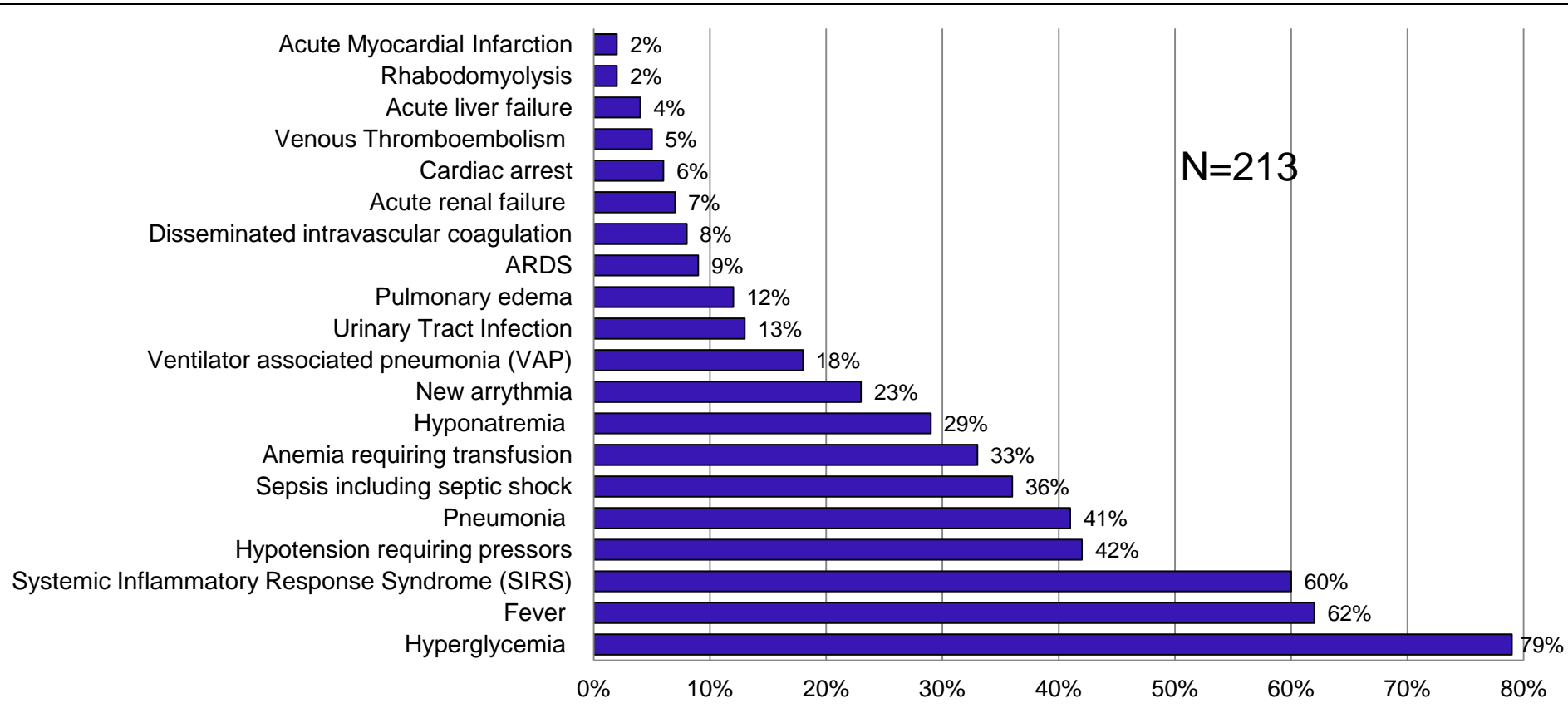Outcome: GOS at hospital discharge
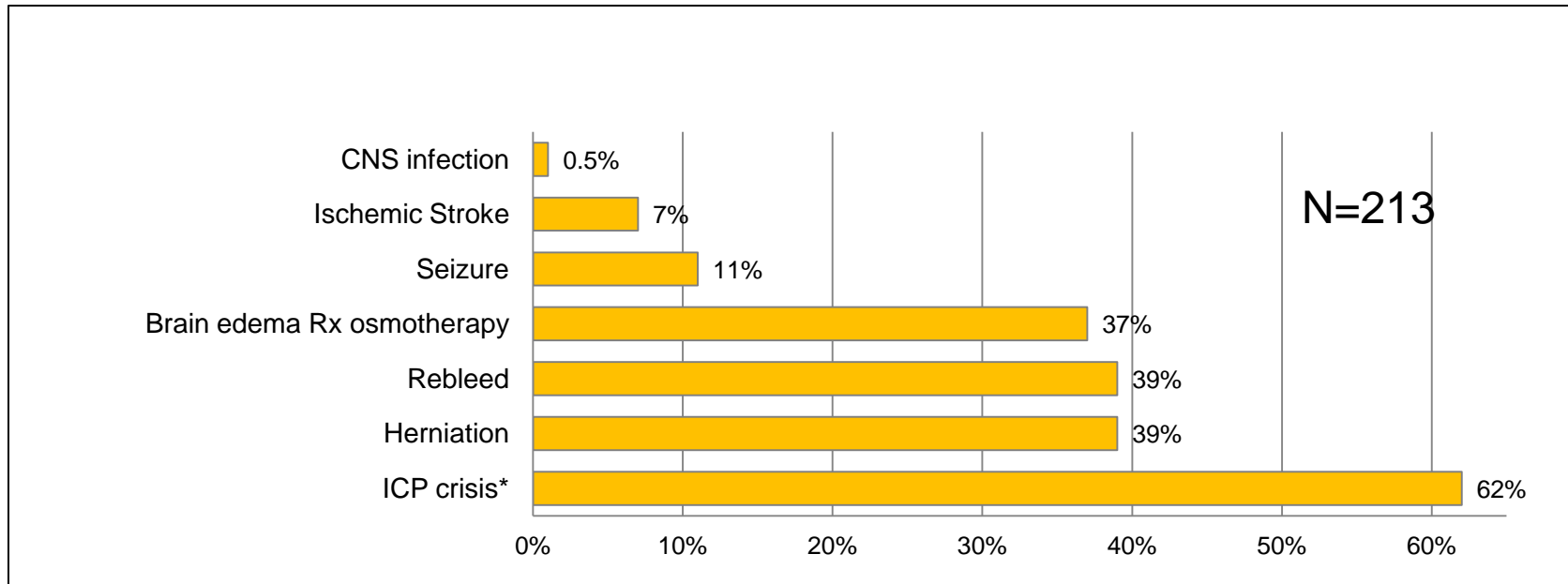3-month, 12-month by phone, recently added 6-month:
      GOS, GOSE, mRS, Lawton ADL, SF-12, TICS

ICU medical complications are common in our cohort:

Chart: Percentage of patients with each complication (N=213)

Complication	Percentage
Acute Myocardial Infarction	2%
Rhabdomyolysis	2%
Acute liver failure	4%
Venous Thromboembolism	5%
Cardiac arrest	6%
Acute renal failure	7%
Disseminated intravascular coagulation	8%
ARDS	9%
Pulmonary edema	12%
Urinary Tract Infection	13%
Ventilator associated pneumonia (VAP)	18%
New arrythmia	23%
Hyponatremia	29%
Anemia requiring transfusion	33%
Sepsis including septic shock	36%
Pneumonia	41%
Hypotension requiring pressors	42%
Systemic Inflammatory Response Syndrome (SIRS)	60%
Fever	62%
Hyperglycemia	79%

N=213

Muehlschlegel et al. Neurocritical Care 2013

These are the neurological ICU complications in our cohort:

N=213

Bar chart of neurological ICU complications (percent of cohort):

| Complication	Percent
CNS infection	0.5%
Ischemic Stroke	7%
Seizure	11%
Brain edema Rx osmotherapy	37%
Rebleed	39%
Herniation	39%
ICP crisis*	62%

*ICP crisis in n=62 patients with ICP monitor in place

Muehlschlegel et al. Neurocritical Care 2013

ICU complications contribute significantly and to a high degree to the outcome variability.

Muehlschlegel et al. Neurocritical Care 2013
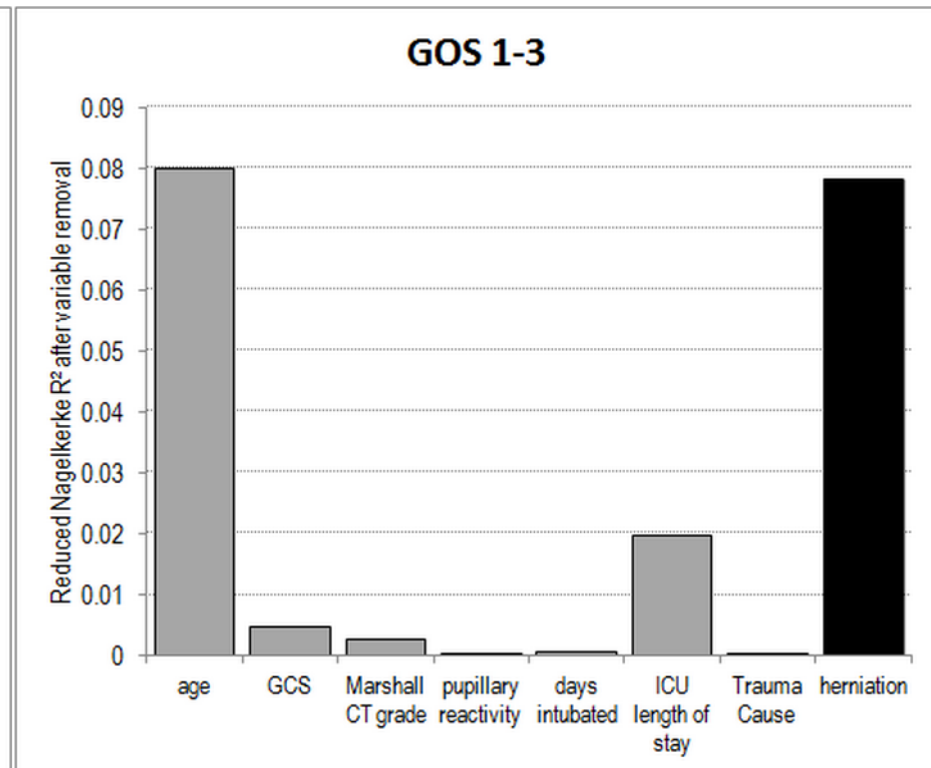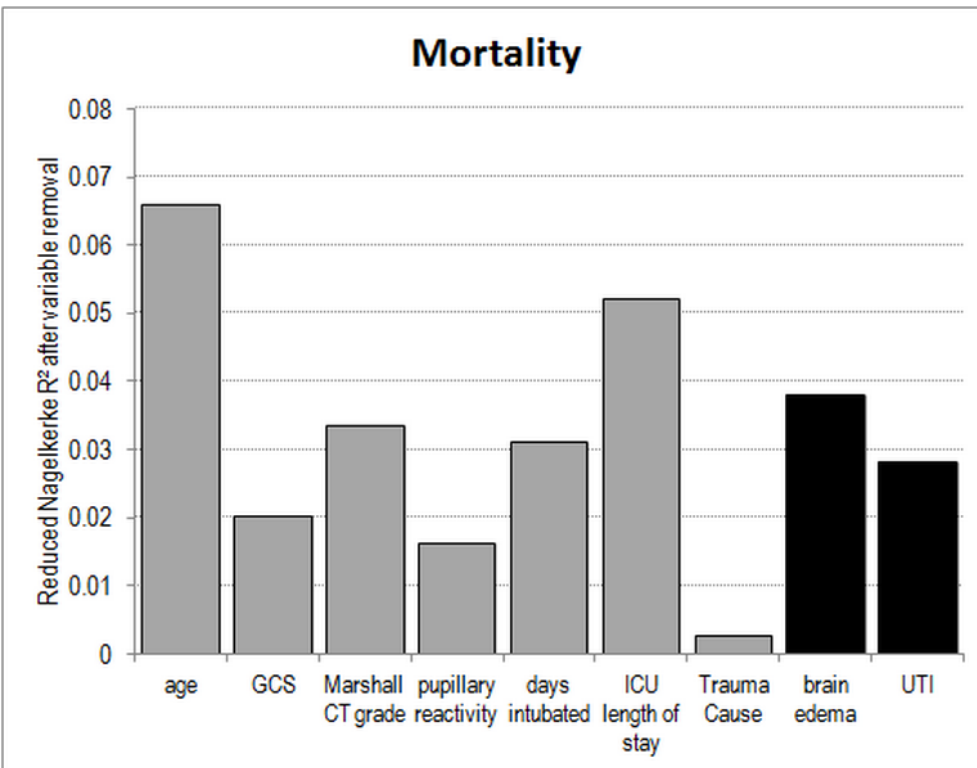
In summary, outcomes research may identify modifiable predictors of outcome.

- Outcome prognostication is extremely important

- Be aware of self-fulfilling prophecies

- Focus on ICU course to identify factors that may explain the other 2/3 of the variability of outcome after TBI

Thank you...

....Any questions?

"How do you want it—the crystal mumbo-jumbo or statistical probability?"