Severity of Illness Scoring in ICU

Clearing away the mist of uncertainty ?

That foggy, closed-in feeling will dissipate soon, giving you a clear view of what is ahead.

Prediction

The reduction of clinical uncertainty

"The omission of prediction from basic medical science has impoverished clinical work ..."

"...a modern clinician's main challenge in the care of patients is to make predictions"

Feinstein AR Ann Int Med 1983

History of predicting outcomes

- Edwin Smith Papyrus (3000 BC)

  "A disease which I will treat

  A disease with which I will contend

  A disease not to be treated"

- American Civil War (1862)

  Risk stratification based on tissue trauma reduced unnecessary amputations

- "Third Medical Revolution" (1988)

  = Outcomes research

  Dr Relman NEJM Nov 3, 1988 pg 1220

Why bother?

- Administrator's revenge on clinician ?

  Spy in the cab?

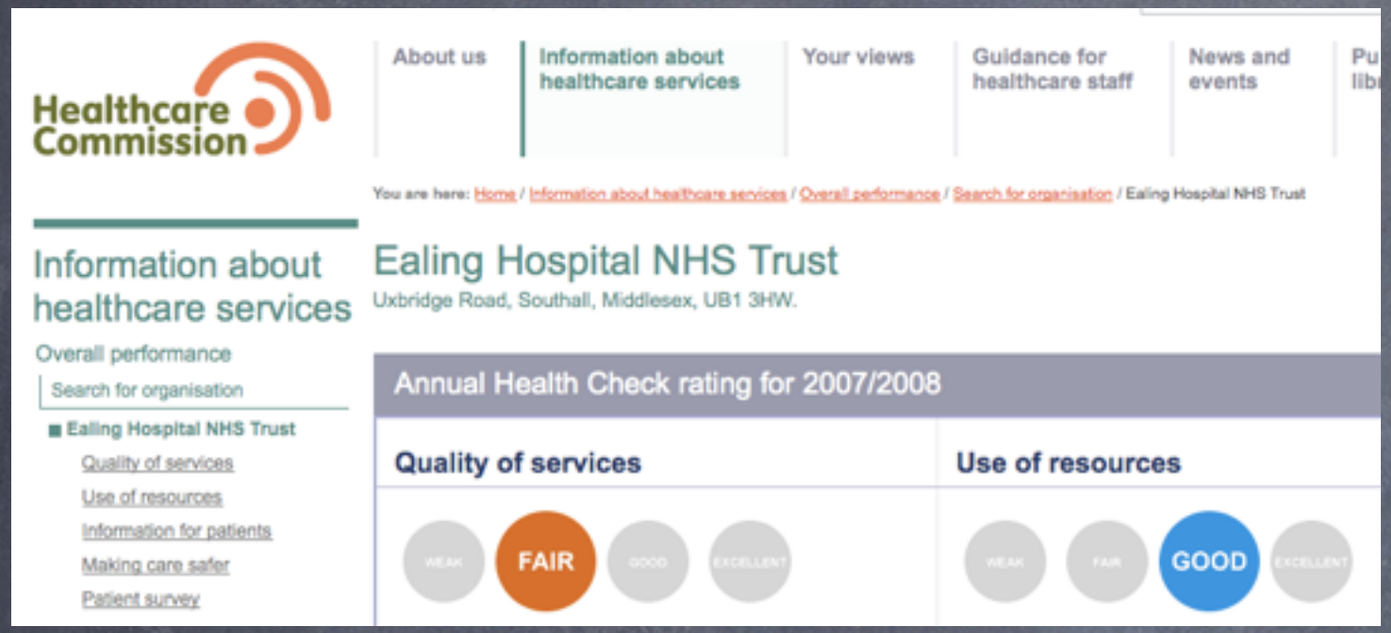
- Defense against public's right to know?

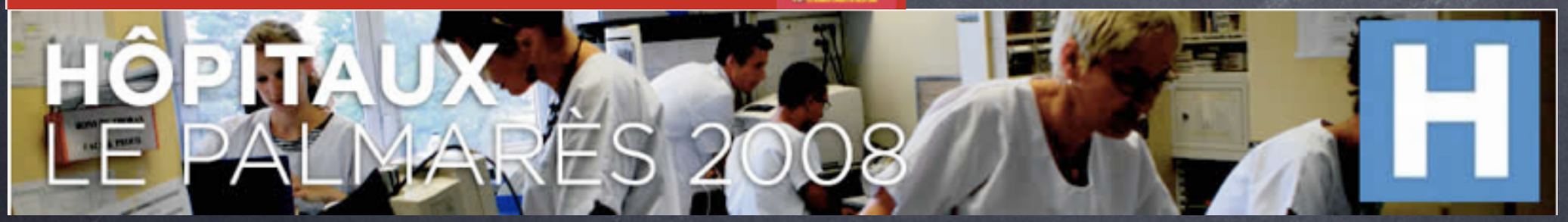
  Politically imposed "Michelin Guide" to medical results

  Beware of raw data!

- "Craig's List"

Because if you don't someone else will !





Why bother? Good Medical Reasons

- Risk stratification
- Research
- Audit of quality of care
    - ✦ S.M.R. (standard mortality ratio)
- Resource utilization
- Clinical decision analysis

Good Medical Reasons

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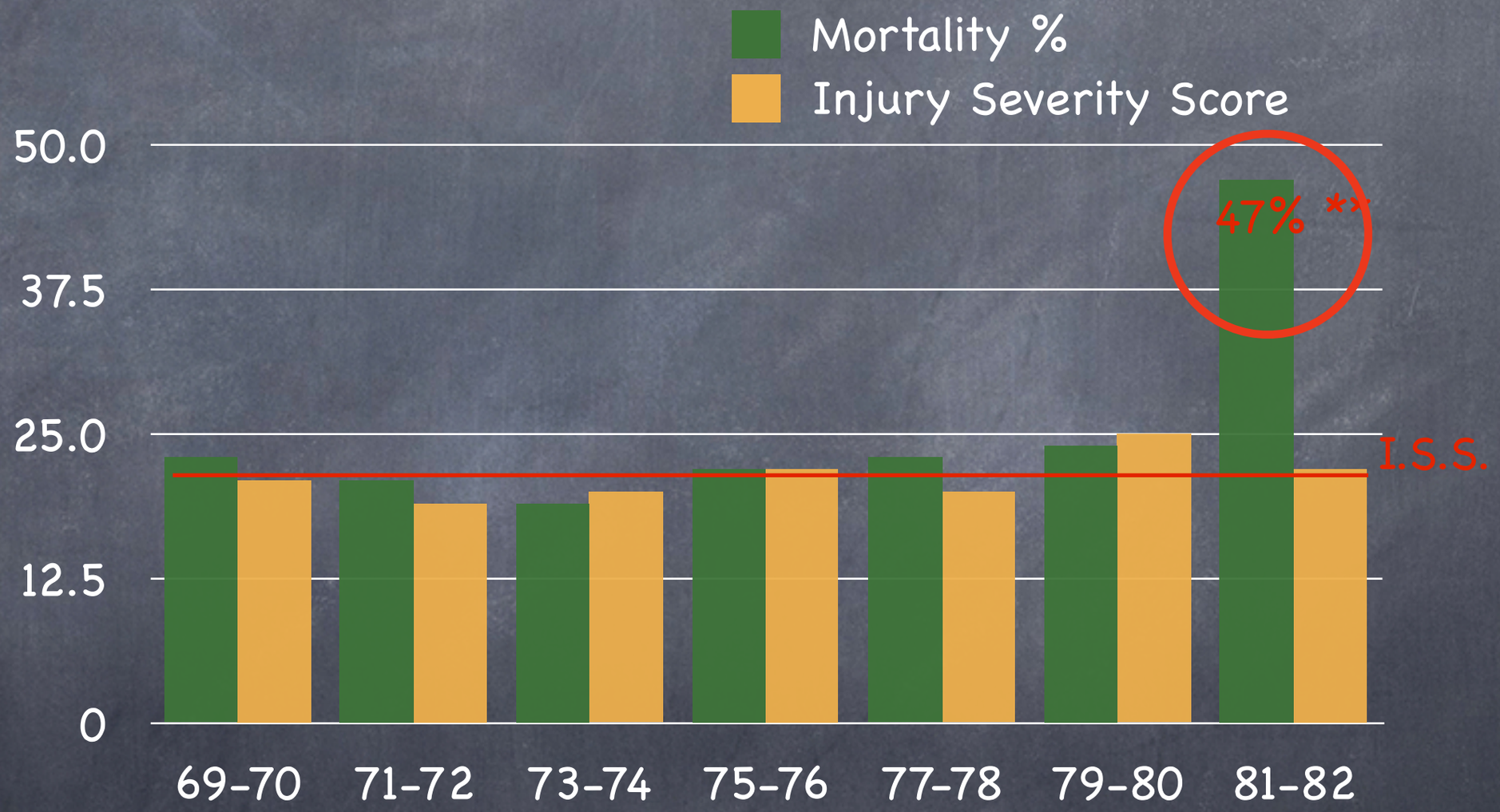
Risk stratification

Anaesthesia

Journal of the Association of Anaesthetists of Great Britain and Ireland

Mortality amongst multiple trauma patients admitted to an intensive therapy unit



Watt I, Ledingham IM.
Anaesthesia 1984;39:973–81.

Risk stratification

Thanks to scoring systems

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Volume 310:1415-1421 May 31, 1984 Number 22

Inhibition of adrenal steroidogenesis by the anesthetic etomidate

Wagner RL, White PF, et al
NEJM 1984, Vol 310:1415-1421–81.

Now a treatment(!) in 2009

Etomidate Infusion in the Critical Care Setting for Suppressing the Acute Phase of Cushing's Syndrome

Ali Dabbagh, MD*
Navid Sa'adat, MD†
Zahra Heidari, MD‡

A 17-year-old, 55 kg girl was referred to the endocrinology department of a university hospital to determine the etiology of suspected Cushing's syndrome. The patient was treated with oral ketoconazole for 3 days, but a rapid and severe elevation in her liver function test results led to selection of IV etomidate as a therapeutic option. This approach led to decreasing levels of serum cortisol, and the patient was able to tolerate surgical adrenalectomy.

(Anesth Analg 2009;108:238-9)

Risk stratification

So, was this important?

	Change in ICU mortality
ARDSnet	- 8.8 %
Activated Protein C	- 6.1%
Etomidate	+ 49%

Why bother? Good Medical Reasons

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- **Research**
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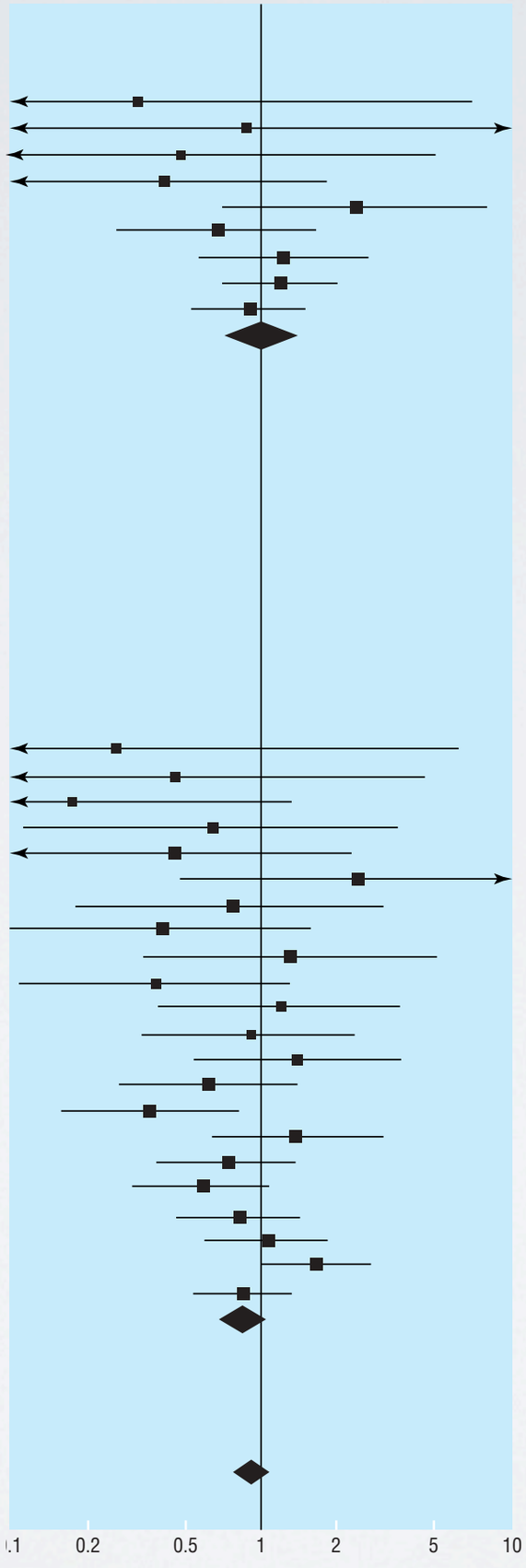
Research

Focus on risk groups most likely to benefit

Mortality

Severity of disease	No. patient	Old therapy		New therapy		
Entire	100	50		42		Not significant
Low risk	33	3	9%	3	9%	
Middle risk	34	17	50%	9	26%	Significant **
High risk	33	30	91%	30	91%	

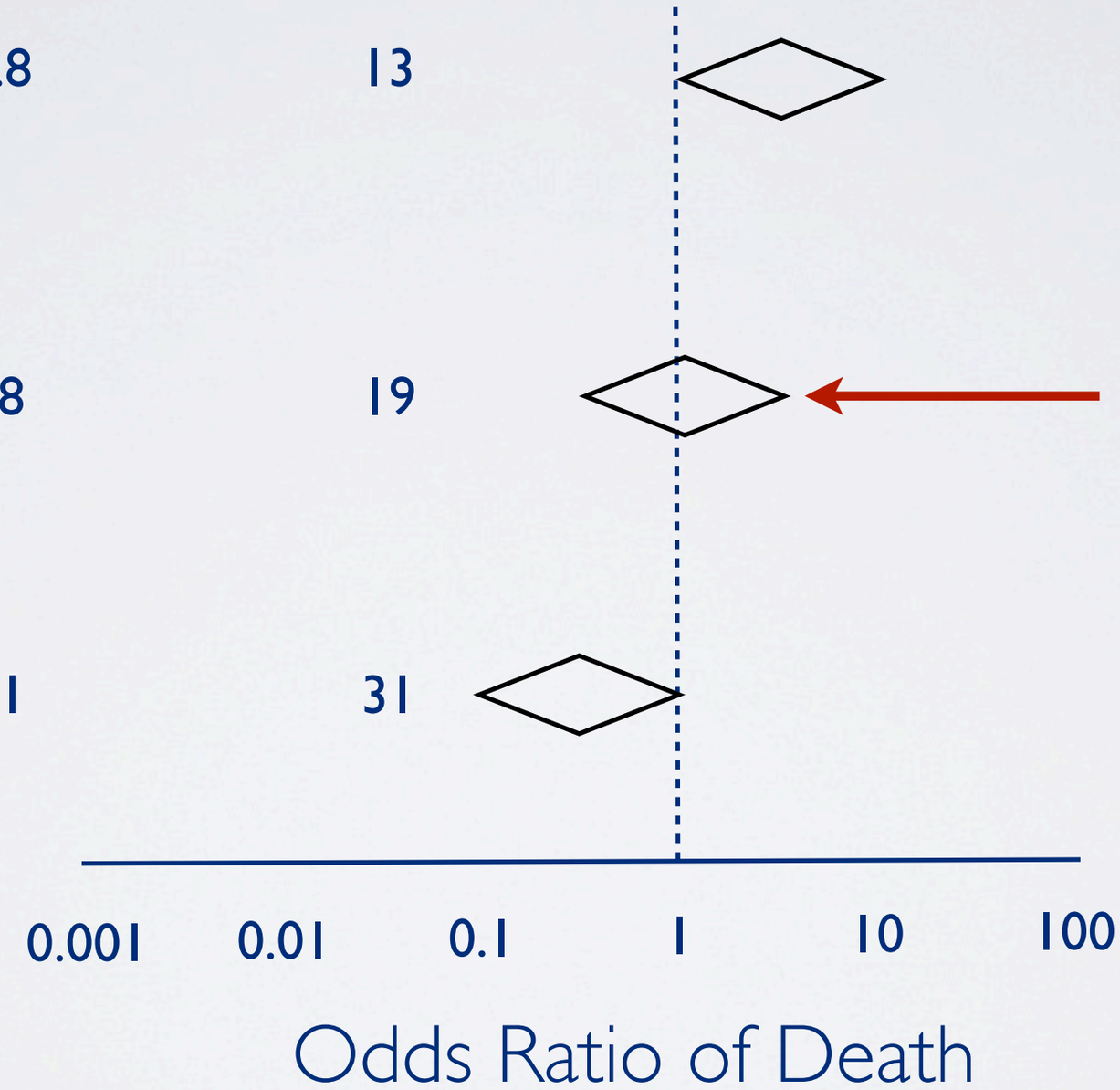
No Mortality Difference between Mono vs Combination Therapy in Severe Infection



BMJ 2004; 328: 668 – 679

This is Why We Stratify for Risk of Death

Monotherapy Mortality	Monotherapy mortality (%)	Combination therapy mortality (%)	Odds ratio of Combination Therapy
<15%	8.8	13	1.53
15-25%	18	19	1.05
>25%	41	31	0.86



Crit Care Med 2010 Vol. 38, No. 8

Why bother? Good Medical Reasons

- Risk stratification
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- **Audit of quality of care**
  - ✦ S.M.R. (standard mortality ratio)
- Resource utilization
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Audit of quality of care

- TRISS trauma scoring allowed detection of an underperforming California hospital

- Knaus' 13 ICU study detected factors distinguishing good vs poor performance

- Allows focused unit audit on unexpected results

Why bother? Good Medical Reasons

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  - ✦ S.M.R. (standard mortality ratio)
- **Resource utilization**
  - Clinical decision analysis

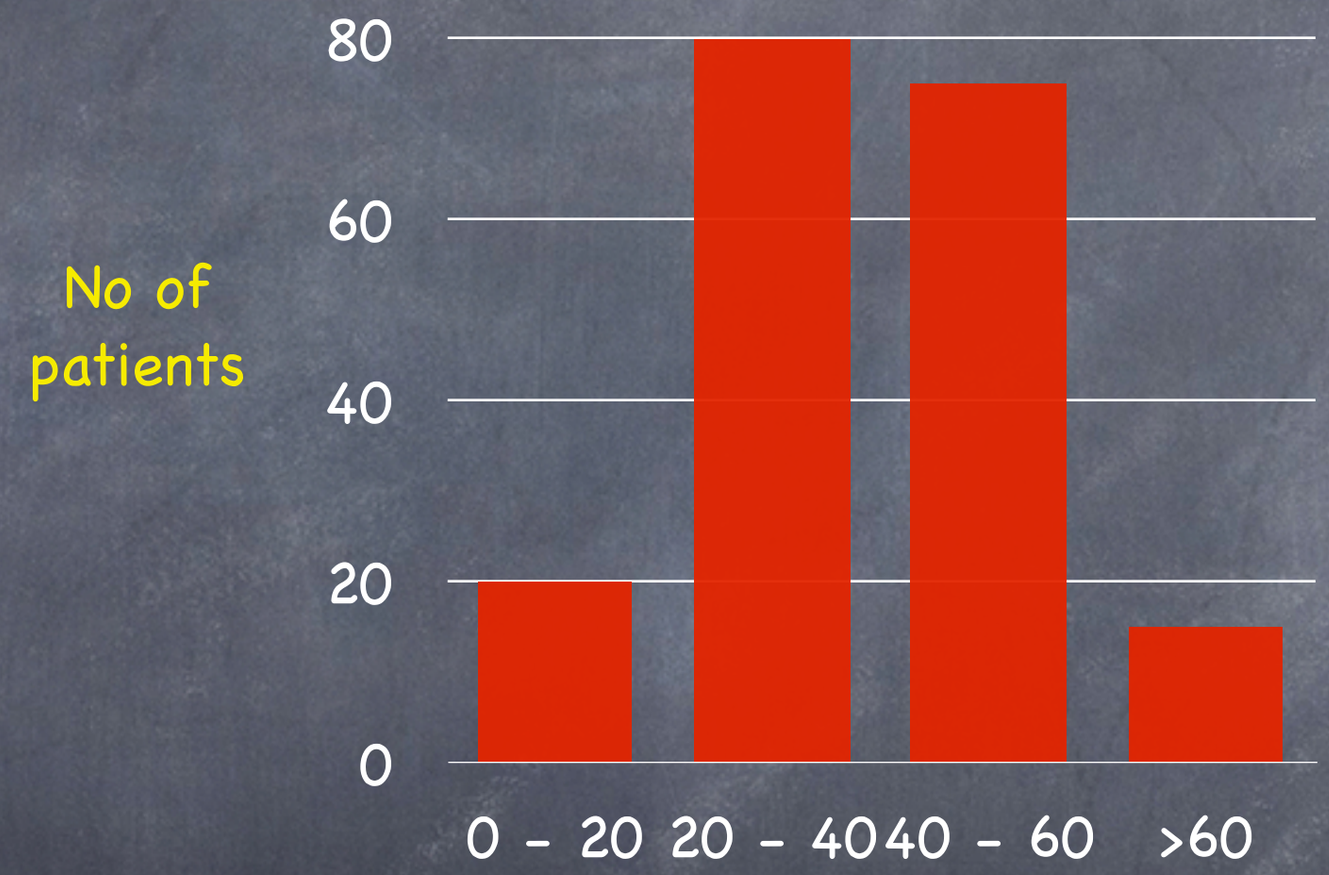
Resource utilization

- 1% GDP spent on ICU
- 15 -25% of hospitals cost

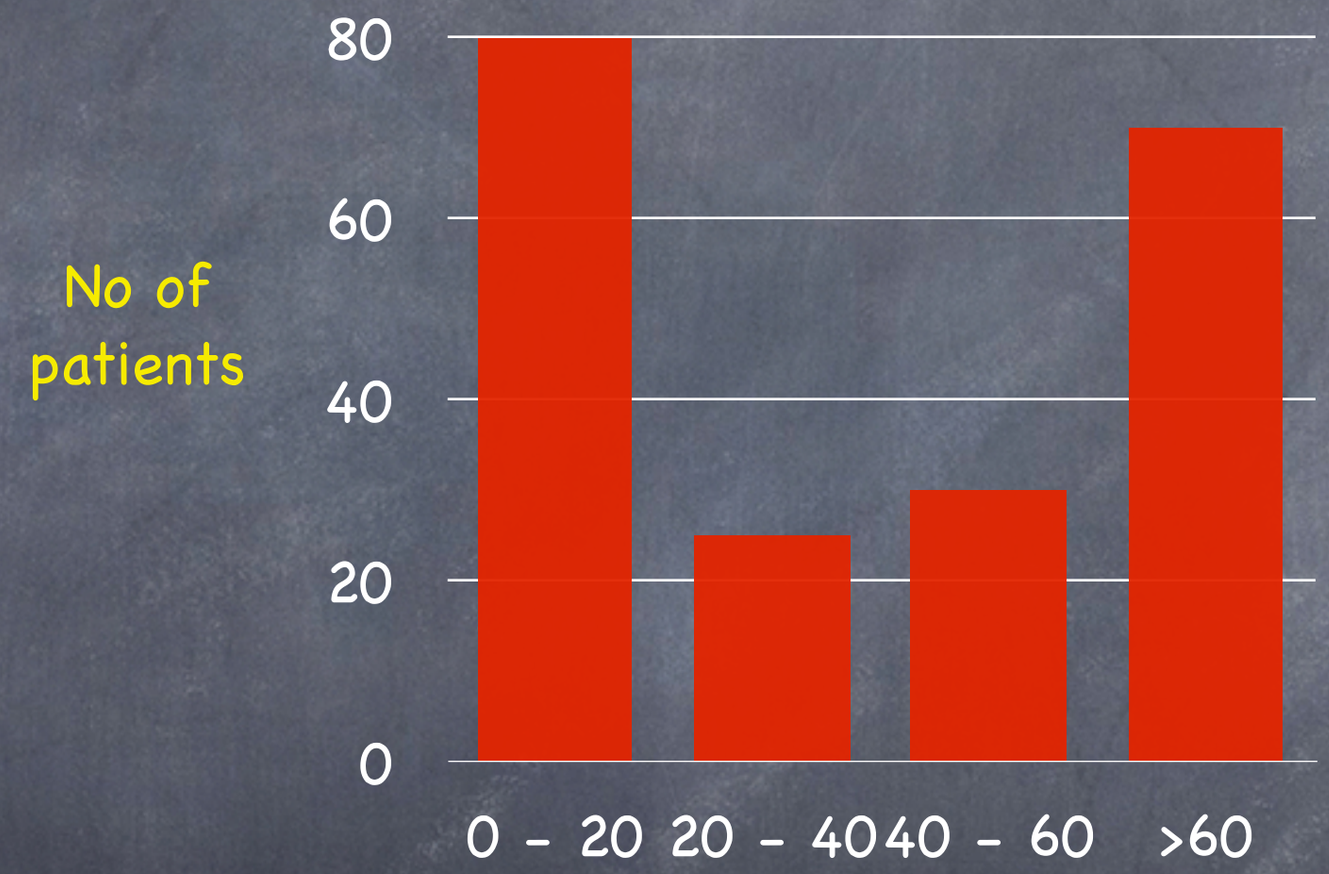
Effective cost per survivor methodology

- Method used in industry
- Analyse the most cost effective method for the same result
- Centoxin vs re-organisation
  - £300,000 vs ~ £5000

TISS on Discharge - Optimal



TISS on Discharge - Sub optimal



Why bother? Good Medical Reasons

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- Resource utilization

- **Clinical decision analysis**

Clinical decision analysis

Protection from pessimistic physicians?

BMJ

BMJ 2007;335;1103-1104

Deciding who to admit to a critical care unit

Scarce resources may cause doctors to be pessimistic about prognosis and refuse critical care admissions

So which score ?

Pick your score

Title and clinical area	Acronym	Theoretical basis
Intensive care		
Acute physiology and chronic health evaluation	APACHE	Physiological
APACHE II	APACHE II	Physiological
APACHE III	APACHE III	Physiological
Simplified acute physiology score (I,II)	SAPS	Physiology + therapy
Organ system failure	OSF	Physiology + therapy
Riyadh intensive care program	RIP	APACHE II + OSF
Sickness score	SS	Dynamic APACHE
Mortality prediction model (0, I, II)	MPM	Binary variables
Physiology stability model	PSI	Physiology
Paediatric risk of mortality	PRISM	Derived from PSI
Therapeutic intervention scoring system	TISS	Workload/costs
Time orientated score system	TOSS	Workload/costs
Sepsis related organ failure score	SOFA	Physiological
Logistic Organ Dysfunction System	LODS	Physiological
Organ failure and or infection score	ODIN	Physiological
Trauma		
Glasgow coma scale	GCS	Clinical neurology
Abbreviated injury scale	AIS	Anatomical
Injury severity score	IS	Anatomical
Revised trauma score	RTS	Physiological
TRISS methodology	TRISS	Combined

Methodology

- Selection of an outcome
- Selection of predictor variables
  - ✦ Diagnosis
  - ✦ Severity of disease
  - ✦ Physiological reserve
- Weighting of variables

0090-3493/85/1309-0818$02.00/0
CRITICAL CARE MEDICINE

Vol. 13, No. 10
Printed in U.S.A.

APACHE II: A severity of disease classification system

WILLIAM A. KNAUS, MD; ELIZABETH A. DRAPER, MS; DOUGLAS P. WAGNER, PHD; JACK E. ZIMMERMAN, MD

Gives a prediction of risk of death for a group of patients

Risk of Death is NOT the APACHE II Score

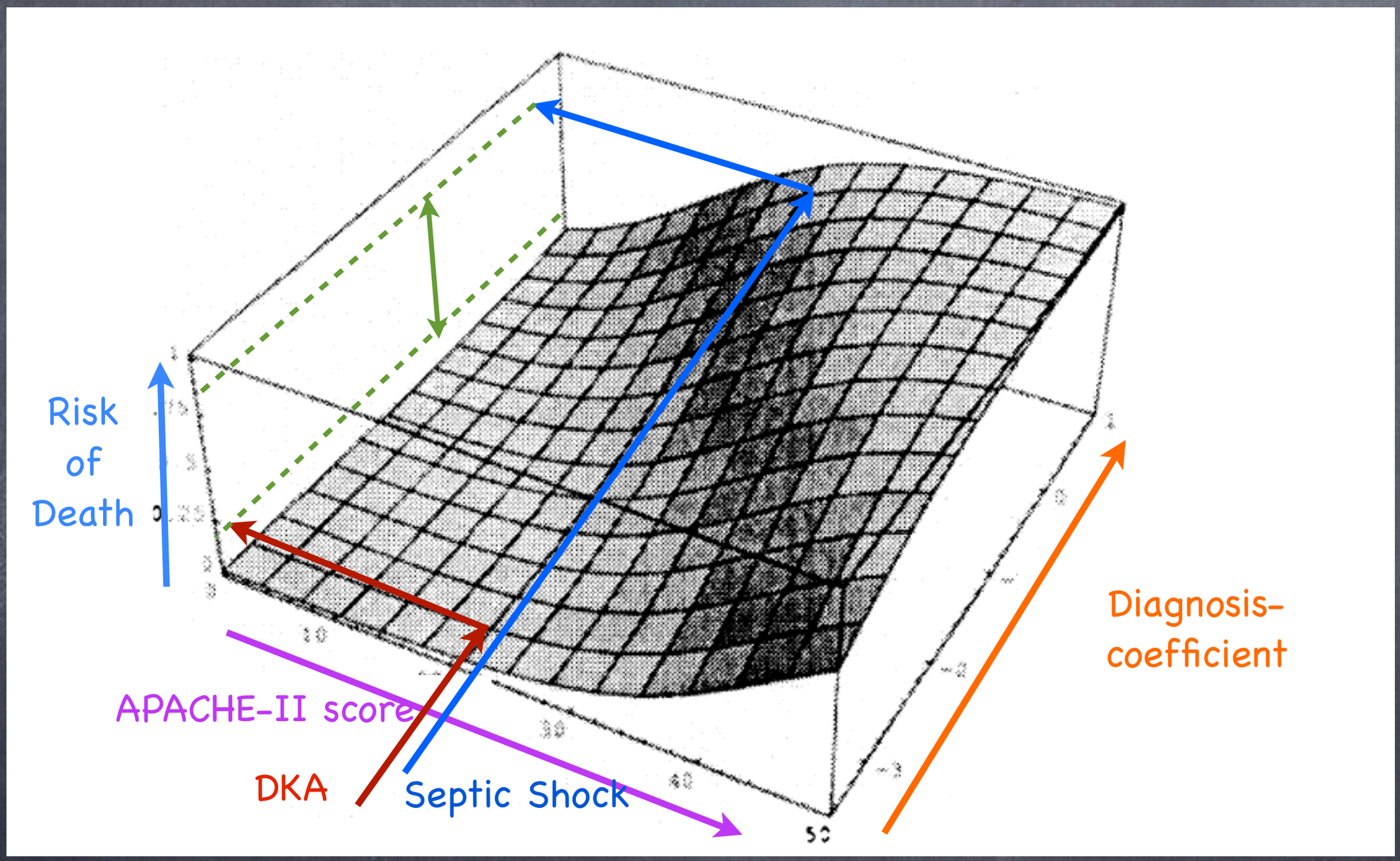
You need :

- "APACHE II score"
  - ✦ Acute Physiology Score
  - ✦ Age
  - ✦ Chronic health evaluation
- Reason for Admission
- Emergency Surgical Admission

Risk of Death is NOT the APACHE II Score

Ln (R/1-R) = -3.517+(APACHE II score * 0.146)
+(0.603, only if post emergency surgery)
+(Diagnostic category weight)

Risk of Death is NOT the APACHE II Score



The PROWESS study

Surviving Sepsis Campaign

Recombinant human activated protein C (rhAPC)

- Consider rhAPC in adult patients with sepsis-induced organ dysfunction with clinical assessment of high risk of death (typically APACHE II ≥ 25 or multiple organ failure) if there are no contraindications. (2B; 2C for post-operative patients)
- Adult patients with severe sepsis and low risk of death (eg: APACHE II <20 or one organ failure) should not receive rhAPC. (1A)

Example of misuse - PROWESS

The New England Journal of Medicine

VOLUME 344 MARCH 8, 2001 NUMBER 10

EFFICACY AND SAFETY OF RECOMBINANT HUMAN ACTIVATED PROTEIN C FOR SEVERE SEPSIS

CHARACTERISTIC	PLACEBO GROUP (N=840)	DROTRECOGIN ALFA ACTIVATED GROUP (N=850)
Age (yr)	60.6±16.5	60.5±17.2
Age (%)		
<60 yr	43.6	44.1
<65 yr	53.5	51.4
<75 yr	78.5	75.9
Male sex (%)	58.0	56.1
APACHE II score	25.0±7.8	24.6±7.6

Example of misuse - PROWESS

Surviving Sepsis Campaign

U.S. Food and Drug Administration

Xigris [drotrecogin alfa (activated)]: Market Withdrawal - Failure to Show Survival Benefit

Recombinant Human Activated Protein C (rhAPC)

...with sepsis-induced organ ...assessment of high risk of death (typi- ...or multiple organ failure) if there are no ...ns. (2B; 2C for post-operative patients)

...ients with severe sepsis and low risk of death ...APACHE II <20 or one organ failure) should not receive rhAPC. (1A)

Statistical descriptors

Calibration

Discrimination

Calibration and discrimination describe the overall predictive power for a group of a prediction model.

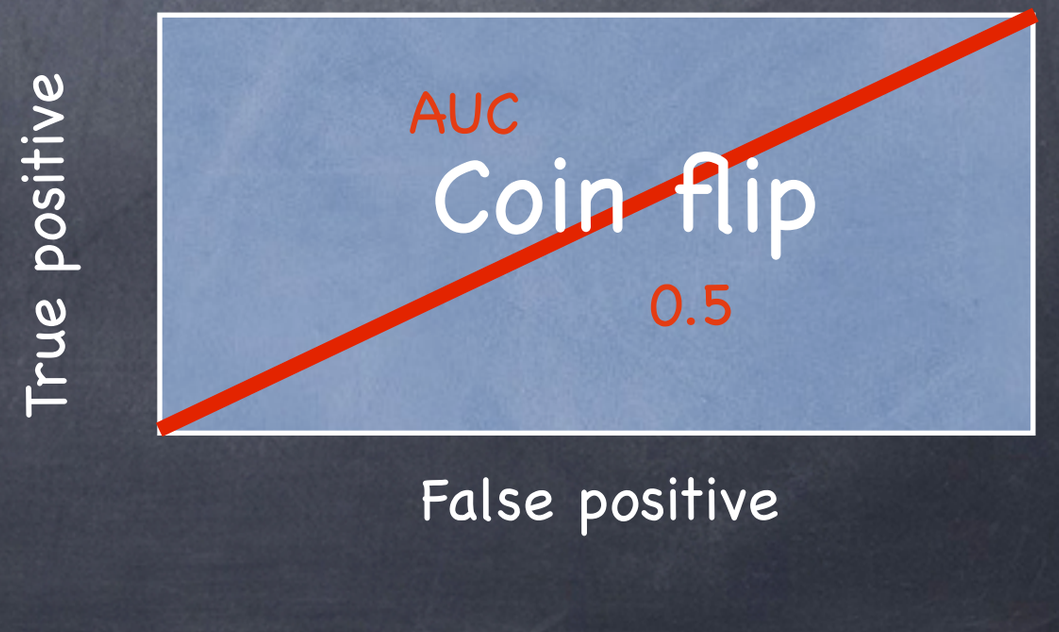
Accuracy

the difference between predictions and observed outcomes of an individual.

Receiver Operating Characteristic Curve

- ROC curve is a graphical tool allowing one to determine the sensitivity and specificity of a diagnostic test.
- Statistical tool used by radar operators during WW II to distinguish:

from

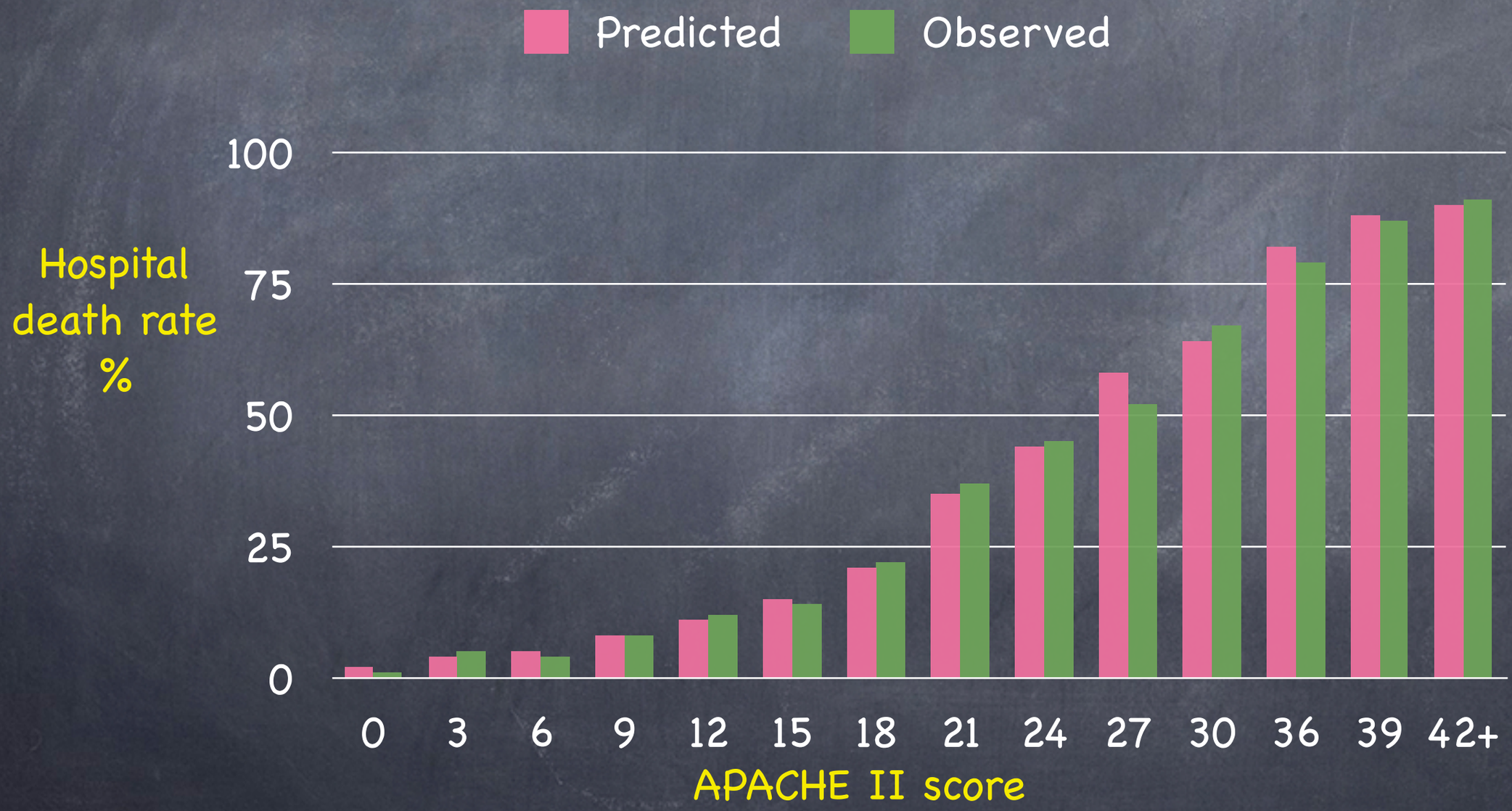


Calibration

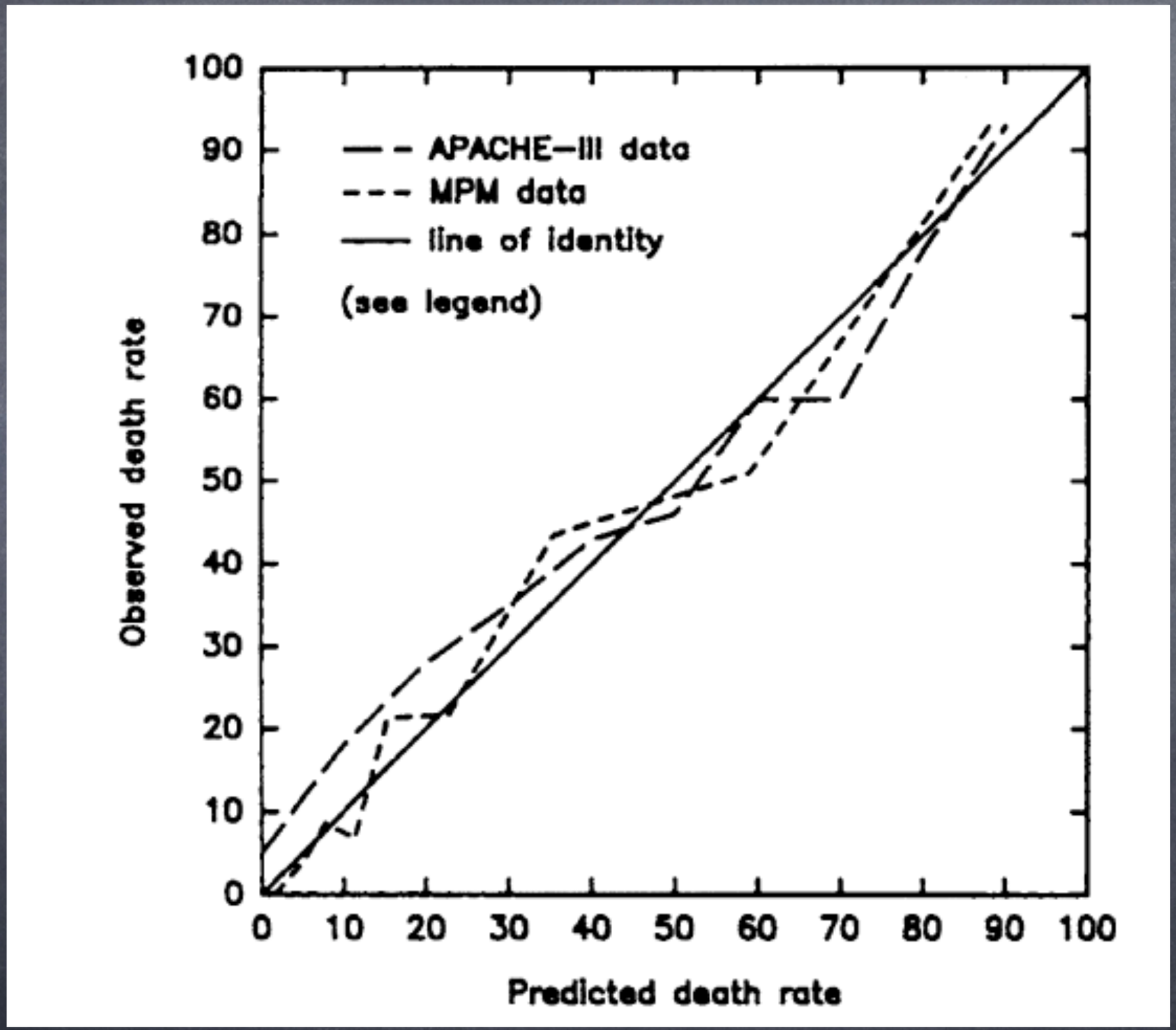
- Refers to the agreement between predicted probabilities and the "true" probabilities throughout the range of risks.
- Described by the Hosmer-Lemeshow statistics

Calibration

5030 consecutive ICU admissions



Calibration



Dynamic scores

- These prediction models "follow" patients response to treatment and make individual predictions

Dynamic scores

R.I.P

- the "Riyadh ICU Program"

NOT Rest in Peace !

- Predicts "survival unprecedented" or "don't know"

Leapers and Creepers

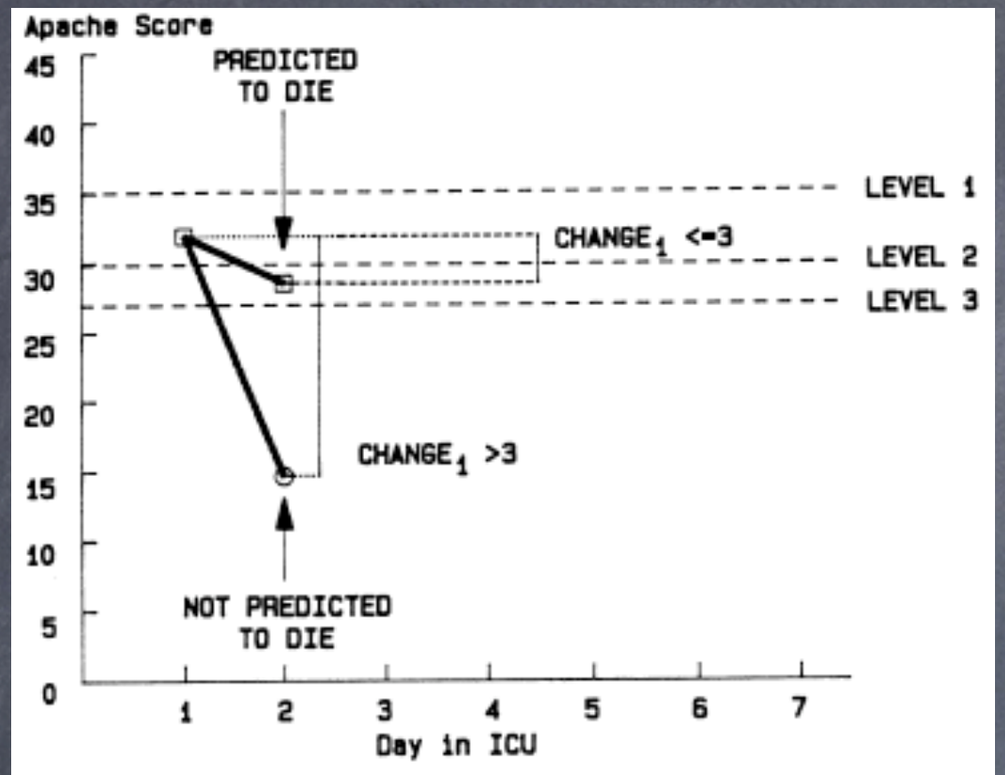


FIG. 1. Rate of change in APACHE II scores on day 2 relative to that of day 1 of survivors and nonsurvivors with a day 1 score in the fuzzy zone.

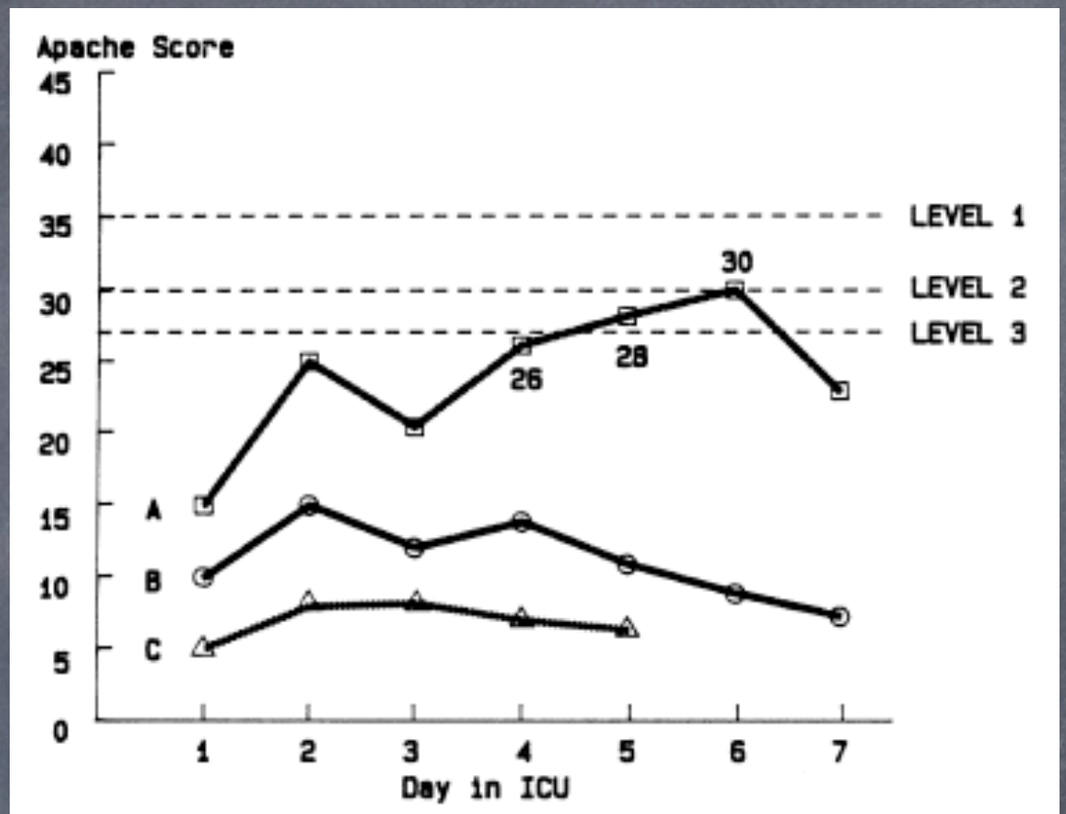


FIG. 3. Examples of curves of daily APACHE II scores of survivors.

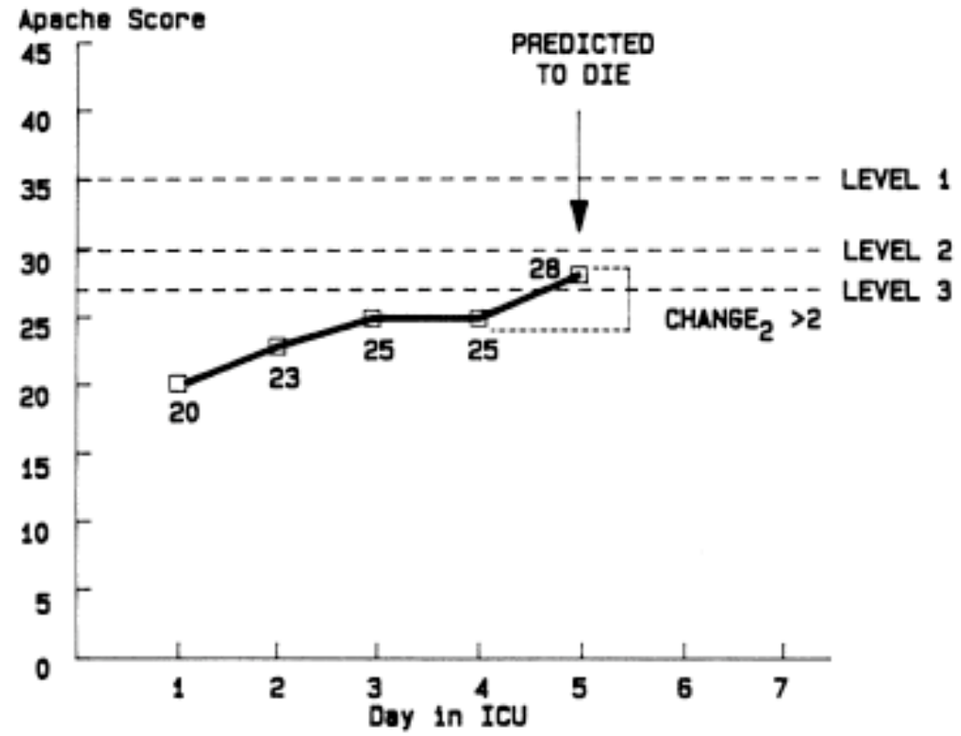


FIG. 2. Typical curves of daily APACHE II scores of patients who

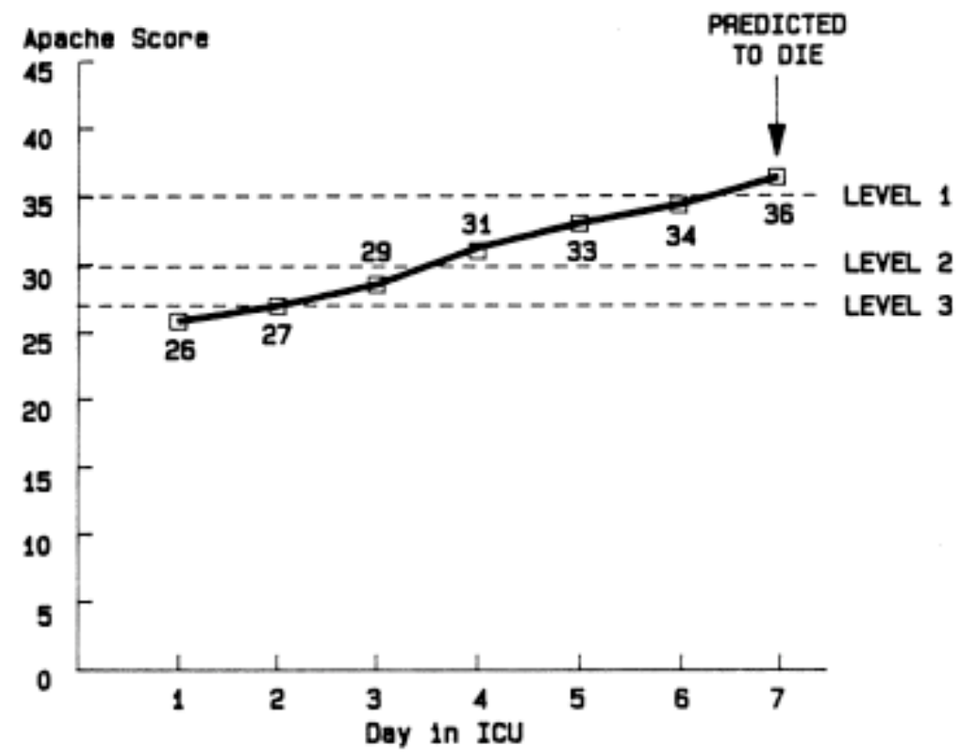


FIG. 4. Typical curve of the daily APACHE II scores of nonsurvivors

R.I.P.

- Individual predictions - "society is not yet ready"
- But we do it all the time - implicitly
- Brain death criteria not held to same standard
- Often is more "optimistic" cf. to clinician

Pitfalls of scores

- Case-mix
  - ✦ Age has different impact in different countries

    Compare Glasgow vs Sweden
  - ✦ the type of patient must be well represented in the model's database
- Missing data entry is significant

Case-mix - an excuse?

- Knaus showed that mortality was higher in France vs US for necrotizing pancreatitis
- Vogel using a multi-score computer program showed that
- APACHE II - an American derived score
- SAPS II - an European derived score

Both confirmed the same result!

Case-mix ?

Quality, cost, and outcome of intensive care in a public hospital in Bombay, India.

Parikh, Chirag R. MD; Karnad, Dilip R. MD et al

Conclusions: Intensive care in India is cheaper than in the West; however, mortality is **1.67** times that for patients with similar APACHE II scores in ICUs in the United States

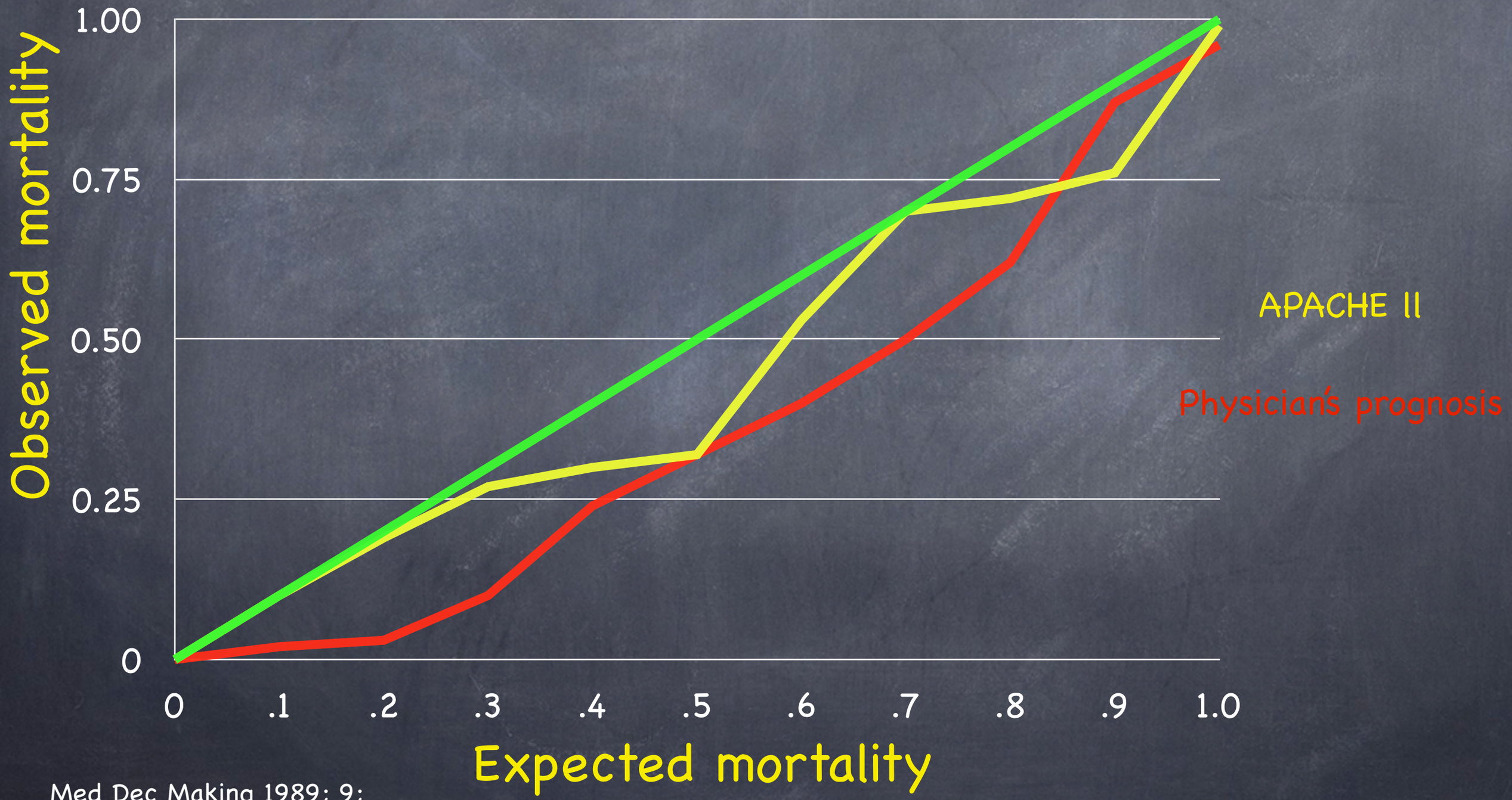
Critical Care Medicine. 27(9):1754-1759, September 1999

Lots of pitfalls - but how do clinicians compare ?

- Variable - depending on study
- Senior doctors more optimistic, junior doctors more pessimistic
- Various studies - including recent COPD outcomes study show "physician pessimism"

Clinical decision analysis

APACHE II vs Clinician



Med Dec Making 1989; 9;
125-132

So, will scores replace the clinician?

"One should use scores as the drunk man uses the lamp post, for support rather than illumination"

Lancet anon. 1984

???

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http://

www.jvsmedicscorner.com