18th International Congress of Anesthesiology, Critical Care and Pain

Rethinking Consciousness in the ICU: New Concepts and Clinical Implications

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18–20 November 2026 · Tehran, Iran · From Innovation to Resilience

ABOUT THE SPEAKER



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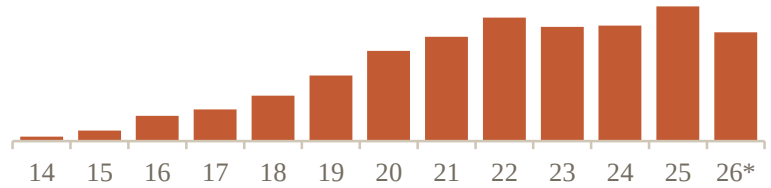
GOOGLE SCHOLAR — All · since 2021

Citations	4,392 · 3,099
h-index	23 · 22
Articles	95

CITATIONS PER YEAR — peak 594 (2025)



RESEARCH FOCUS

Critical illness · traumatic brain injury · nutritional support and enteral nutrition · malnutrition · neuroprotective pharmacology

SELECTED WORK LINKED TO TODAY'S TALK

ICON audit · worldwide burden of critical illness · Lancet Respir Med 2014

Withholding or withdrawing life support in the ICU worldwide · Chest 2017

TBI and consciousness · selenium, modafinil, pycnogenol, memantine (2017–2025)

SCOPUS PROFILE

1,666	53	15	40	16	12
Citations	Articles	h-index	g-index	First author	Corresponding



28% International collaboration



41% i10 articles (22)



22% Top-10% CiteScore journals

0.54% Self-citation

APPROVED RESEARCH PROJECTS

38 Principal investigator	25 Co-investigator	23 Reviewer

OUTLINE

From the bedside paradox to a ward-ready protocol

1. **Why this is an ICU problem**
   Hidden awareness, early decisions, late recovery
2. **What the guidelines say**
   AAN, EAN, NCS, ERC–ESICM, PADIS, ISICEM
3. **The bedside protocol**
   De-confound, examine, record, repeat
4. **Covert consciousness in practice**
   Who to test, with what, what to do next
5. **Prognosis without prophecy**
   Timing, thresholds, calibrated language
6. **Treatment**
   Proven, possible and experimental
7. **Families and decisions**
   Time-limited trials, one team message
8. **The ICU consciousness bundle**
   Day 0 to day 28 and beyond

REF Bodien et al., 2026, Intensive Care Med · Giacino et al., 2018, Neurology · Kondziella et al., 2020, Eur J Neurol

ILLUSTRATIVE CASE · MORNING ROUND

Bed 7, day 3: “GCS 3T, sedated, no change. ” Is that a diagnosis?

BED 7 · DAY 3 Severe TBI

34-year-old man, motorcycle collision.
CT: diffuse axonal injury, small frontal contusions

GCS	ICP
E1 VT M2	**12–15 mmHg**
Sedation	**Pupils**
Propofol + fentanyl	**Reactive · no EEG yet**

Family at the door: **“Will he wake up?”**

FOUR QUESTIONS FOR THIS ROUND

1. Is he unconscious — or can we simply not see it?
2. Which confounders are still in play?
3. Which test, and when?
4. What can we honestly tell his family today?

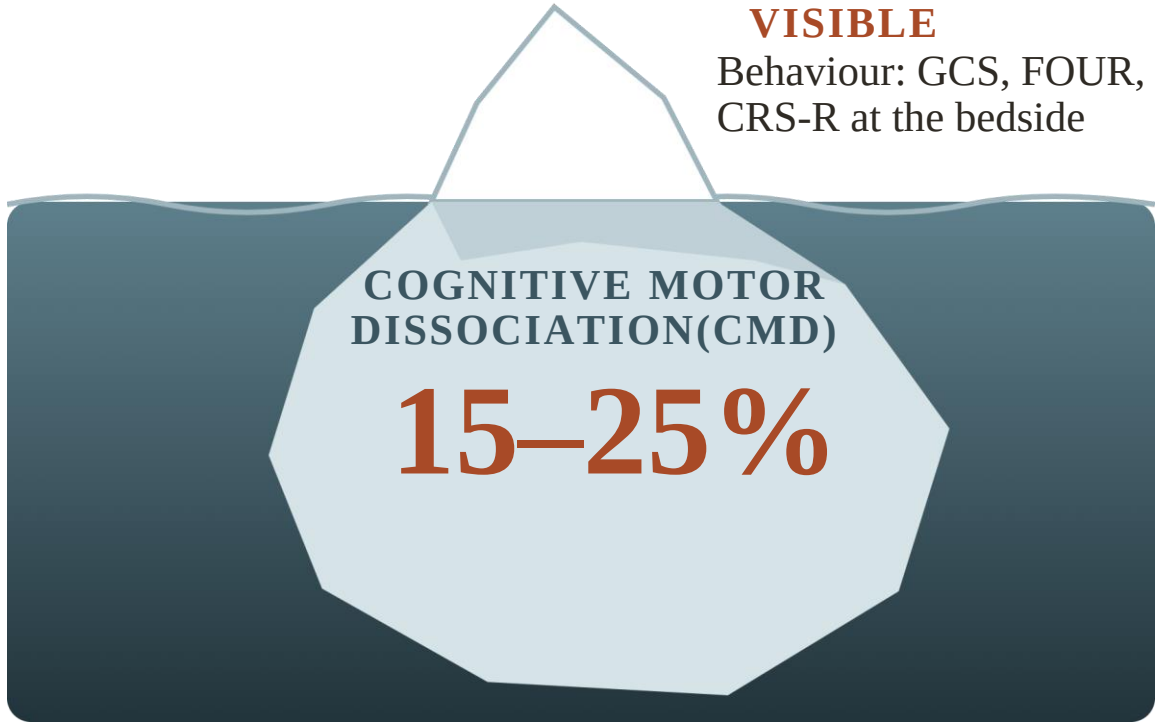
REF Framework: Bodien et al., 2026, Intensive Care Med (ISICEM roadmap for acute disorders of consciousness)

01

Why this is an ICU problem

Hidden awareness, early decisions and late recovery collide in the first days of intensive care

Unresponsive is not unconscious:
One in four to six non-responders follows commands covertly



CRS-R :The Coma Recovery Scale-Revised

What this means on the round

15% in the acute ICU
16/104 on bedside EEG, median day 4

25% in a multinational cohort
60/241 without command following

Behaviour is the floor
Treat pain, speak to the patient, avoid irreversible early decisions

REF Claassen et al., 2019, N Engl J Med · Bodien et al., 2024, N Engl J Med · Bodien et al., 2026, Intensive Care Med

Glasgow Cor

EYE OPENING



Spontaneous	4
To sound	3
To pressure	2
None	1

VERBAL RESPO



Oriented
Confused
Words
Sounds
None

GLASGOW COMA SC

Mild	Moderat
13–15	9–12

Prepared by Dr Rashad Elatar

GCS vs FOUR Score

Level of Consciousness Assessment in Critical Care)

GCS (Glasgow Coma Scale)

- E 1-4
- V 1-5
- M 1-6

Total: 3–15



- ✔ Simple & Rapid
- ✔ Part of Guidelines

FOUR Score (Full Outline of UnResponsivenesss)

- Eyes 0–4
- Motor 0–4
- Brainstem 0–4
- Respiration 0–4

Total: 0–16

- ✔ Brainstem Reflexes
- ✔ Respiratory Pattern

Evidence-Based Comparison

Feature	GCS	FOUR Score
Intubated Patient	✔ Verbal = 1T	✔ No Verbal Component
Brainstem Reflexes	✖ No	✔ Pupils, Corneal
Respiratory Pattern	✖ No	✔ Cheyne-Stokes
Detect Herniation Early	✖ Limited	✔ Better
Prognostic Accuracy	✖ Good	✔ Equal or Better (ICU)

ICU Tips & Tricks

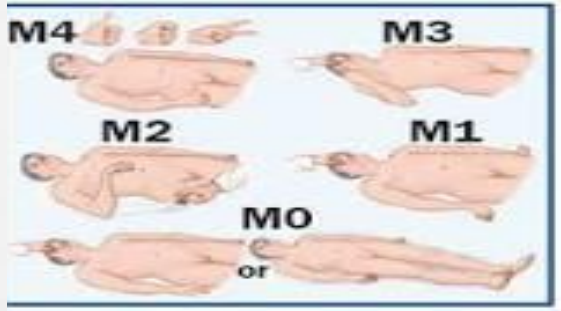
- Intubated? **Use FOUR Score**
- Suspect Herniation? **FOUR** is Key
- Check **Pupils** Size Separately
- Avoid **"GCS 3"** without Sedation Info

BOTTOM LINE

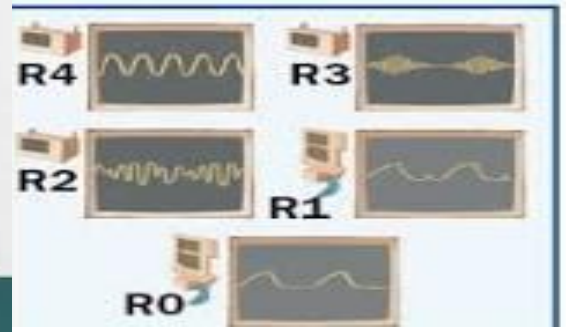
- **GCS** = Simple & Universal
- **FOUR Score** = Neurologically Comprehensive
- Use **FOUR** for Ventilated or Neurocritical Patients

- 1. Teasdale & Jennett, Lancet 1974
- 2. Wijdicks et al, Ann Neurol 2005
- 3. Crit Care Med, Neurocrit Care Reviews









Coma Recovery Scale – Revised ©2004

Record Sheet

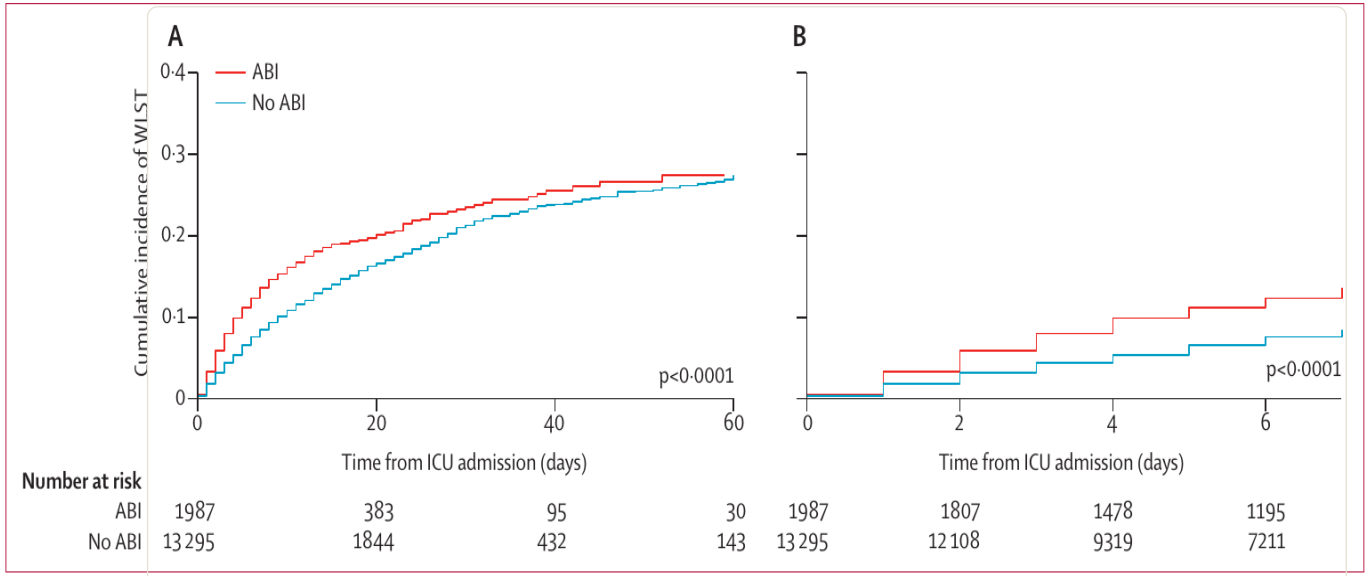
	Auditory function scale	Visual function scale	Motor function scale	Oromotor/verbal function scale	Communication scale	Arousal scale
6			Functional object use			
5		Object recognition	Automatic motor response			
4	Consistent movement to command	Object localisation: reaching	Object manipulation			
3	Reproducible movement to command	Pursuit eye movements	Localisation of noxious stimulation	Intelligible verbalisation		Attention
2	Localisation of sound	Fixation	Flexion withdrawal	Vocalisation/ oral movement	Functional: accurate	Eye opening without stimulation
1	Auditory startle	Visual startle	Abnormal posturing	Oral reflexive movement	Non-functional: intentional	Eye opening with stimulation
0	None	None	None/flaccid	None	None	Unarousable

* Description of items based on [18].

0	None															
AROUSAL SCALE																
3	Attention															
2	Eye opening without stimulation															
1	Eye opening with stimulation															
0	no arousal response															
TOTAL SCORE																

Denotes emergence from MCS**
Denotes MCS*

Brain injury brings withdrawal earlier and more often — and the unit matters as much as the patient



Cumulative incidence of WLST. Adapted from Taran et al., 2025, Lancet Respir Med

2.42 adjusted OR for WLST with acute brain injury (21,970 patients, 40 countries)

30–80% of WLST decisions fall within the first 72 h

≤80% of deaths after cardiac arrest follow WLST

Action: audit when and why your unit limits care

REF Taran et al., 2025, Lancet Respir Med · Bodien et al., 2026, Intensive Care Med · Rajajee et al., 2023, Neurocrit Care

Recovery often arrives after our decisions: early vegetative state is not a terminal diagnosis

TRACK-TBI : IN VS/UWS AT 2 WEEKS, SURVIVORS



had recovered consciousness; more than a quarter were oriented

82%

of patients admitted to rehabilitation in coma recovered consciousness (n = 17,470)

42.4%

of matched patients without WLST survived to GOS-E ≥4

VS/UWS :The vegetative state/unresponsive wakefulness syndrome
WLST: Withdraw life-sustaining therapies

REF McCrea et al., 2021, JAMA Neurol · Kowalski et al., 2021, JAMA Neurol · Sanders et al., 2024, J Neurotrauma

The Extended Glasgow Outcome Scale (GOS-E)

GOS-E Score	Performance Level
1	Dead
2	Vegetative State
3	Lower extremity disability: completely dependent on others
4	Upper severe disability: dependent on others for some activity
5	Lower moderate disability: return to work at reduced capacity, reduced participation in social activities
6	Lower good recovery: good recovery with minor social or mental deficits
7	Upper good recovery

02

What the guidelines actually say

Eight documents from 2018 to 2026 — and **one consistent message** for the bedside

The guideline map, 2018–2026: diagnosis, prognosis, sedation and a roadmap

AAN: American Academy of **Neurology**
ACRM: The American Congress of **Rehabilitation** Medicine
NIDILRR : National Institute on Disability, Independent Living, and Rehabilitation Research

ERC: European Resuscitation Council

2018
AAN / ACRM / NIDILRR
Prolonged DoC: diagnosis, prognosis, amantadine
Giacino et al., 2018

2020
EAN
Diagnosis of coma and DoC (GRADE)
Kondziella et al., 2020

2022
AHA / ASA
Spontaneous ICH: limits on early DNAR
Greenberg et al., 2022

2023
NCS
Prognostication after cardiac arrest
Rajajee et al., 2023

2024
NCS
Prognostication in TBI and ICH
Muehlschlegel; Hwang, 2024

2025
SCCM PADIS
Focused update: sedation, delirium, mobility
Lewis et al., 2025

2025
ERC–ESICM
Post-resuscitation care and prognostication
Nolan et al., 2025

2026
ISICEM roundtable
Six-step roadmap for acute DoC in the ICU
Bodien et al., 2026

EAN:European Academy of Neurology
NCS : Neurocritical Care Society
ISICEM: International Symposium on Intensive Care and Emergency Medicine.

REF Giacino et al., 2018 · Kondziella et al., 2020 · Rajajee et al., 2023 · Nolan et al., 2025 · Bodien et al., 2026

Name the state, not the score: explicit categories and the 28-day rule

eMCS	Functional communication or functional object use
MCS+	Command following, intelligible words or intentional communication
MCS−	Visual pursuit or fixation, localisation, automatic motor behaviour
VS/UWS	Eyes open, sleep–wake cycles, reflexive behaviour only
Coma	Eyes closed, no arousal, no awareness — not "GCS 3–8"

CMD No behavioural command following, but command following on EEG or fMRI

MCS: Minimally conscious state
VS/UWS :The vegetative state/unresponsive wakefulness syndrome

THE CLOCK

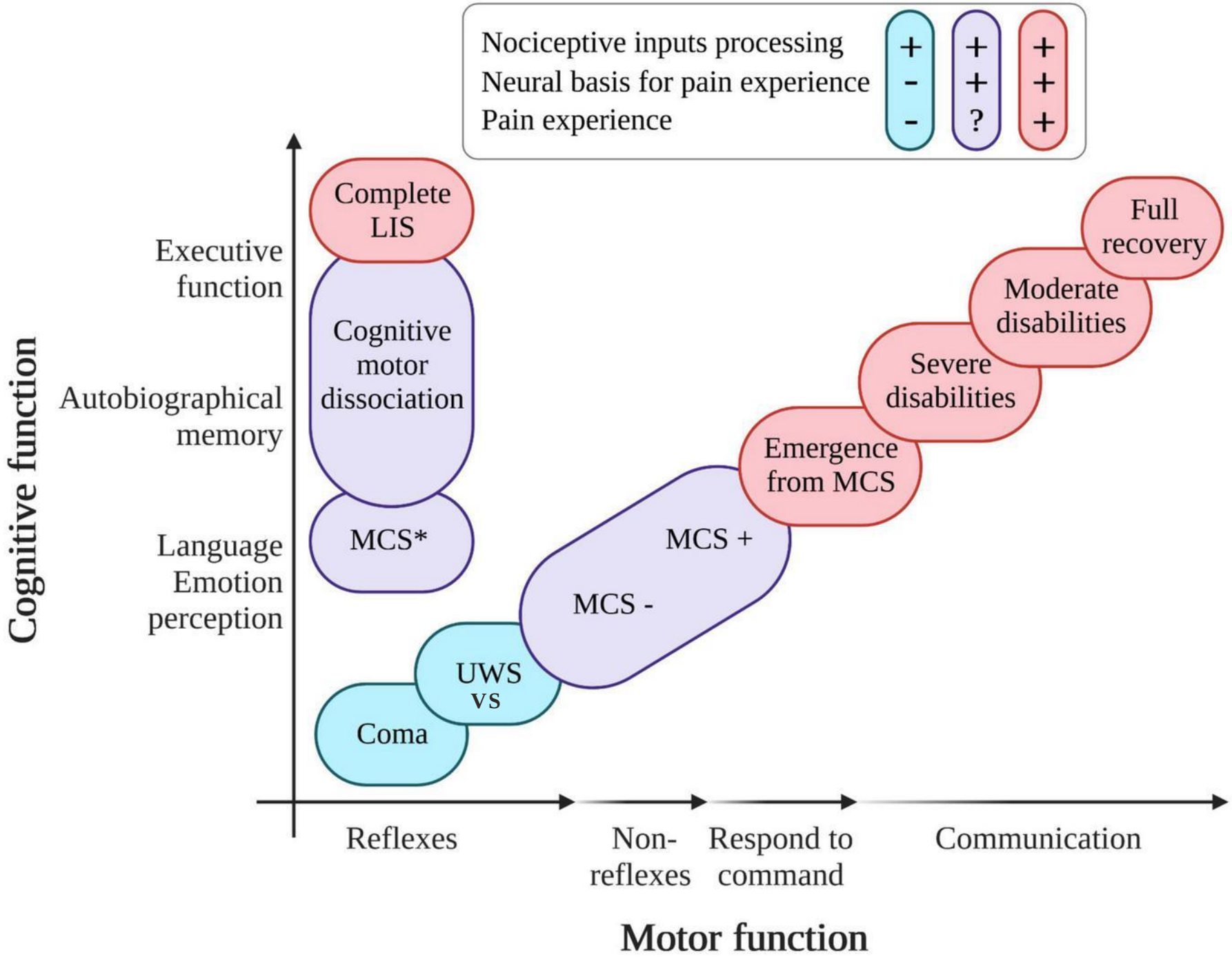
Acute <28 days · **Prolonged** ≥28 days

Chronic VS/UWS >3 months non-traumatic, >12 months traumatic

"Permanent" VS is retired (Level B)

Document it: ICD-11 now codes VS/UWS, MCS− and MCS+ separately

REF Giacino et al., 2018, Neurology · Kondziella et al., 2020, Eur J Neurol · Bodien et al., 2026, Intensive Care Med


Nociceptive inputs processing
Neural basis for pain experience
Pain experience
+
-
-
+
+
?
+
+
+
Cognitive function
Executive function
Autobiographical memory
Language
Emotion
perception
Complete LIS
Cognitive motor dissociation
MCS*
MCS -
MCS +
Emergence from MCS
Severe disabilities
Moderate disabilities
Full recovery
Coma
UWS
VS
Reflexes
Non-reflexes
Respond to command
Communication
Motor function

Eight graded recommendations any ICU can apply tomorrow

- **AAN · A** — No "universally poor" prognosis in the first 28 days
- **EAN · strong** — Use the CRS-R to classify the level of consciousness
- **EAN · strong** — Open the eyes passively; test pursuit with a mirror
- **EAN · weak** — Monitor discomfort with **NCS-R**; no CAM-ICU in DoC
- **EAN · strong** — Never classify consciousness from a single exam
- **EAN · strong** — FOUR rather than GCS in the ICU (RR 1.46)
- **EAN** — Diagnose the highest level shown by clinical, EEG or imaging
- **AAN · B** — Amantadine for traumatic DoC at 4–16 weeks

Notice that none of these require new equipment.

AAN: American Academy of Neurology

EAN:European Academy of Neurology

CRS-R :The Coma Recovery Scale-Revised

DoC : disorders of consciousness

NCS-R: Nociception Coma Scale-Revised

REF Giacino et al., 2018, Neurology · Kondziella et al., 2020, Eur J Neurol

The Neurocritical Care Society (NCS) reliability tiers: Every predictor comes with its own counselling language

RELIABLE

FPR ≤3%, upper 95% CI ≤10%

Example (Cardiac arrest):
bilateral absent pupillary reflex >72 h;
bilateral absent N20

Say: "very likely"

MODERATELY RELIABLE

FPR ≤5% — only with other predictors

Examples:
Suppressed EEG >72 h;
MRI 2–7 d;
in TBI

Say: "likely, with substantial uncertainty"

NOT RELIABLE

Fails either threshold

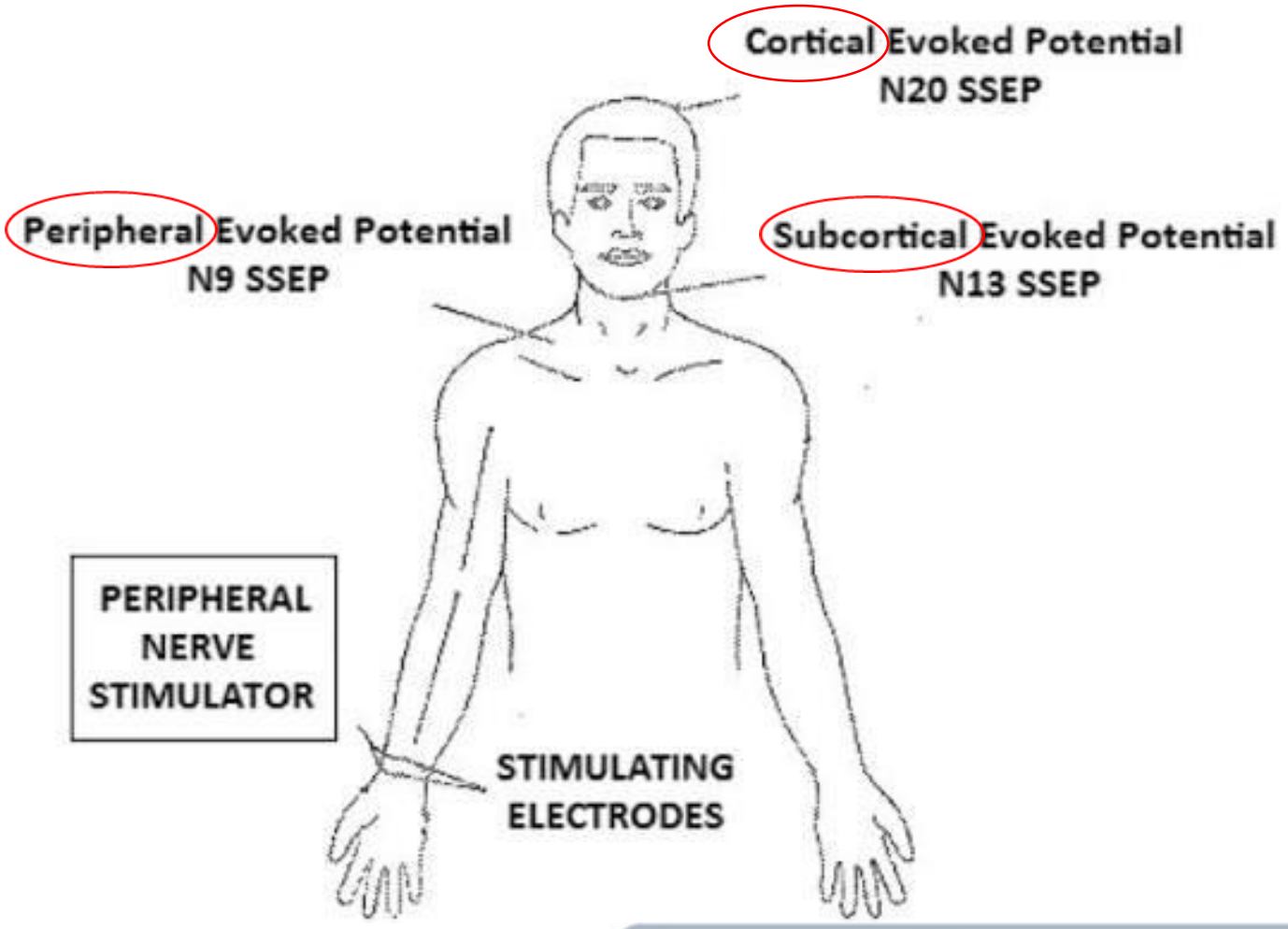
Examples:
NSE alone ≤72 h,
Age,
Initial rhythm;
Any single TBI variable

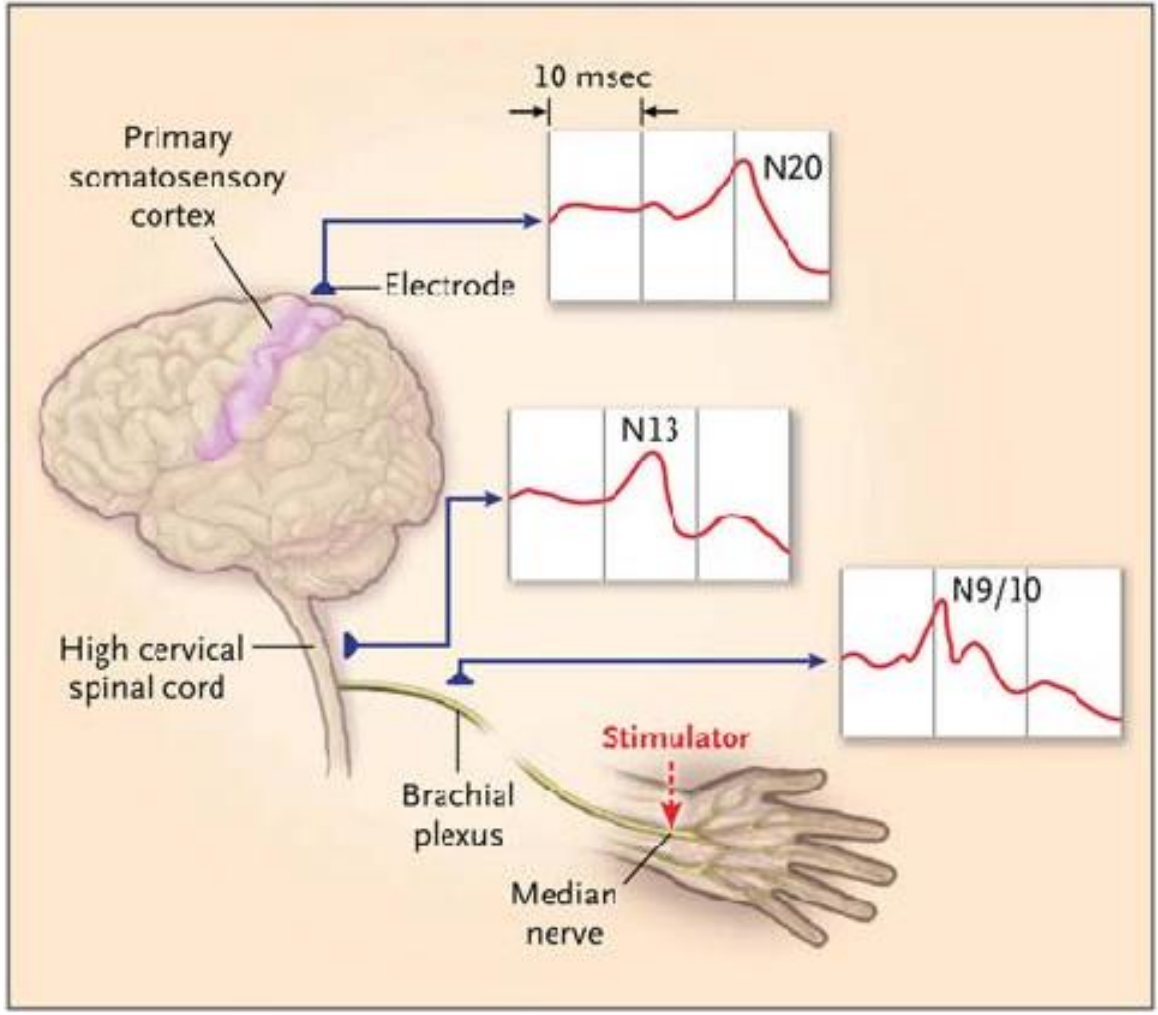
Do not use alone

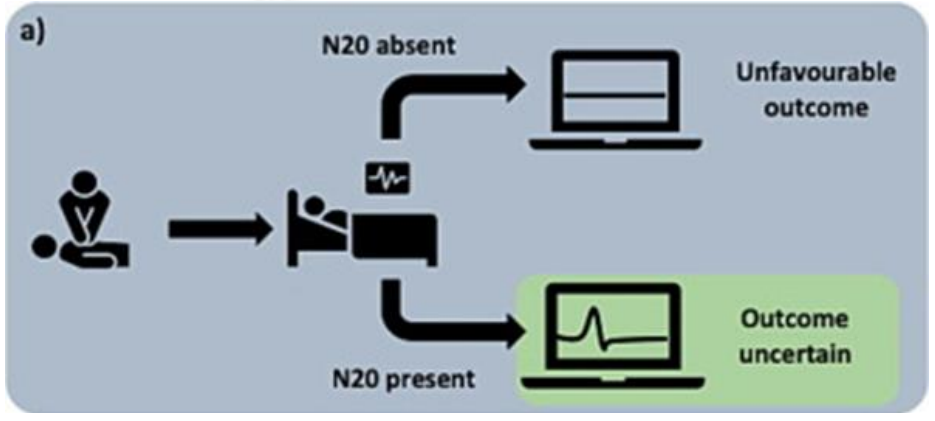
No reliable predictor? Counsel that the likelihood, extent and time course of recovery are **uncertain** — and extend observation if consistent with goals of care

NSE (Neuron-Specific Enolase),

REF Rajajee et al., 2023, Neurocrit Care · Muehlschlegel et al., 2024, Neurocrit Care · Hwang et al., 2024, Neurocrit Care


Cortical Evoked Potential
N20 SSEP
Peripheral Evoked Potential
N9 SSEP
Subcortical Evoked Potential
N13 SSEP
PERIPHERAL NERVE STIMULATOR
STIMULATING ELECTRODES


10 msec
Primary somatosensory cortex
Electrode
N20
N13
N9/10
High cervical spinal cord
Stimulator
Brachial plexus
Median nerve

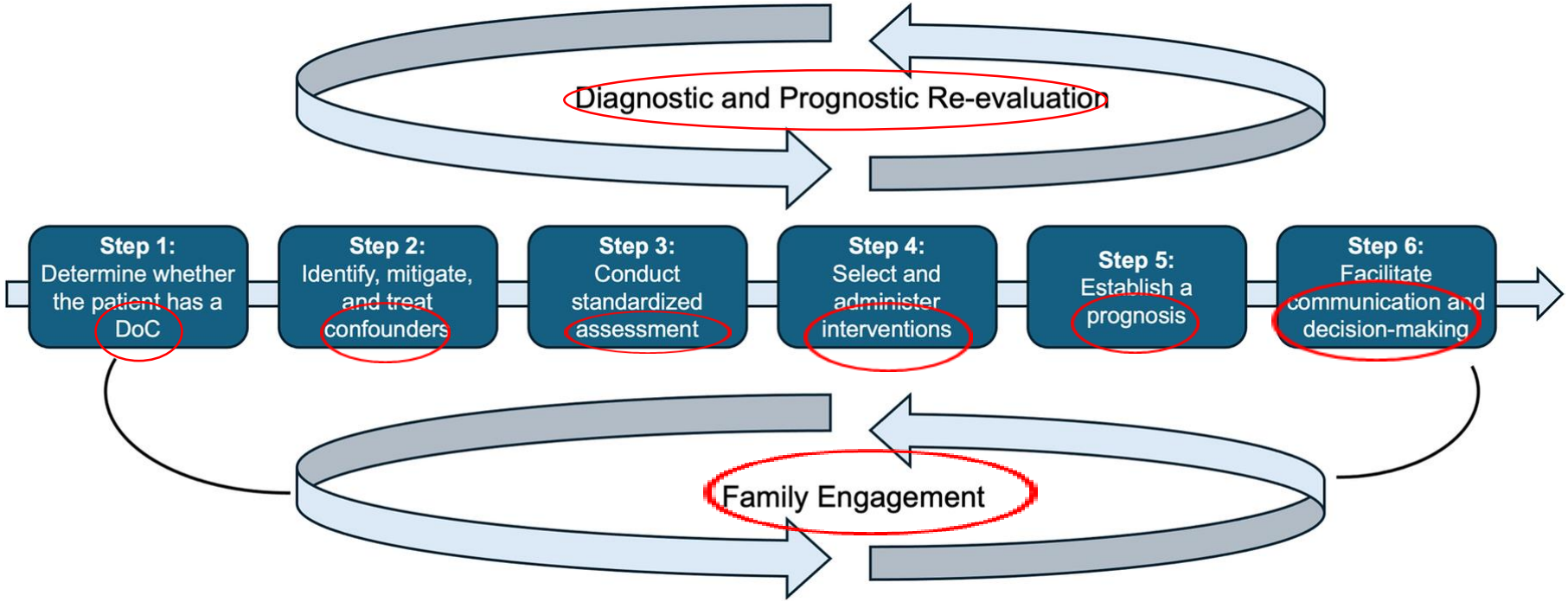

a)
N20 absent
Unfavourable outcome
N20 present
Outcome uncertain

03

The bedside protocol

De-confound, examine, record and repeat — most of it needs no scanner, only discipline

The ISICEM roadmap: Six Steps and Two Loops that never stop



Adapted from Bodien et al., 2026, Intensive Care Med (CC BY-NC 4.0)

Steps 1–3 need no scanner

Upper loop re-evaluate daily

Lower loop family at every step

REF Bodien et al., 2026, Intensive Care Med 52:42–62

Ten mimics of unconsciousness to exclude , before any label

1. **Sedatives and Opioids**
   Doses, last bolus, renal/hepatic clearance
2. **Neuromuscular blockade**
   Train-of-four **before** any motor exam
3. **Non-convulsive seizures**
   Often electrographic only: EEG required
4. **Hydrocephalus, new mass effect**
   Repeat CT for any plateau or decline
5. **Metabolic and endocrine**
   Na, glucose, urea, ammonia, liver, thyroid
6. **Fever and infection**
   Core temperature, cultures; treat
7. **Paroxysmal sympathetic hyperactivity**
   Episodic tachycardia, hypertension, sweating
8. **Polypharmacy**
   Antiepileptics, antipsychotics, baclofen
9. **Aphasia, deafness, blindness, paresis**
   Adapt commands; glasses and hearing aids
10. **Environment**
    Noise, light, sleep deprivation

Cannot remove it? Record the exam as "potentially confounded" — never as a diagnosis

REF Bodien et al., 2026, Intensive Care Med · Kondziella et al., 2020, Eur J Neurol · Snider et al., 2023, Crit Care Med

Sedate so that you can examine: short-acting, interruptible, documented

1. **Short-acting agents.** Dexmedetomidine over propofol when light sedation or less delirium is the priority
2. **Daily hold** when ICP and brain compliance allow, with a planned exam window
3. **Do not interrupt** with uncontrolled ICP, poor compliance or status epilepticus
4. **Abort criteria:** sustained ICP >20–22 mmHg, $PbtO_2$ fall, dangerous agitation
5. **Still sedated?** Label the exam "potentially confounded"

DRUG → EFFECT ON THE EXAM
Midazolam accumulates in renal or hepatic failure and after hypothermia
Fentanyl context-sensitive accumulation; alters pupillometry
Propofol fast offset, except after prolonged high doses
Dexmedetomidine patient stays rousable
Ketamine alters EEG and pupillometry

REF Lewis et al., 2025, Crit Care Med (PADIS) · Nolan et al., 2025, Resuscitation · Bodien et al., 2026, Intensive Care Med

Order the EEG with three questions, not one

Q1

Seizures?

- Many are electrographic only
- Continuous EEG for unexplained or fluctuating coma
- Report in standard ACNS terms

Q2

Background?

- Continuity and reactivity favour recovery
- After arrest: suppression ± periodic discharges or burst-suppression >24 h is highly malignant

Q3

Sleep?

- Spindles, K-complexes, slow-wave and REM sleep
- Signal of thalamocortical integrity
- Read overnight, off-bolus

Request wording: “Seizures? Background continuity and reactivity? Sleep architecture including spindles?”

REF Hirsch et al., 2021, J Clin Neurophysiol · Kondziella et al., 2020, Eur J Neurol · Nolan et al., 2025, Resuscitation

Spindles on a routine overnight EEG: a scalable marker of hidden capacity



K-complex and spindle on a standard ICU montage. Adapted from Carroll et al., 2025, Nat Med

Use: presence raises the estimate; absence should not lower it

31%
had well-formed spindles (71/226)

52%
of CMD-positive patients had spindles

0.79→0.89
AUC for 12-month outcome when spindles added

14%
with neither marker still recovered consciousness

COGNITIVE MOTOR DISSOCIATION(CMD)

REF Carroll et al., 2025, Nat Med 31:1578–1585 · Kondziella et al., 2020, Eur J Neurol

An eight-step ICU consciousness exam: ten minutes, done the same way every day

1. **Check confounders**
   Drugs, last bolus, temperature, Na, glucose, EEG
2. **Prepare the bed space**
   Quiet, TV off, glasses, hearing aids, sit up
3. **Facilitate arousal**
   CRS-R arousal protocol if eyes close
4. **Open the eyes, bring a mirror**
   Passive eye opening; fixation and pursuit
5. **Give commands**
   Own name first; eyes, hand, mouth; count repeats
6. **Observe**
   Automatic behaviour; localisation after analgesia
7. **Score**
   CRSR-FAST or SECONDs; vary the time of day
8. **Document**
   DoC category; “potentially confounded”; no CAM-ICU

CRS-R :The Coma Recovery Scale-Revised

DoC : disorders of consciousness

SECONDs:The Simplified Evaluation of CONsciousness Disorders

CRSR-FAST :the Coma Recovery Scale-Revised For Accelerated Standardized Testing)

REF Bodien et al., 2026, Intensive Care Med · Kondziella et al., 2020, Eur J Neurol · Giacino et al., 2018, Neurology

Table 1 Description of items included in the CRS-R and NCS-R

Subscale	CRS-R	Item	NCS-R
Auditory	4: Consistent movement to command		NA
	3: Reproducible movement to command		
	2: Localization to sound		
	1: Auditory startle		
	0: None		
Visual	5: Object recognition		NA
	4: Object localization: reaching		
	3: Visual pursuit		
	2: Fixation		
	1: Visual startle		
	0: None		
Motor	6: Functional object use		3: Localization to noxious stimulation
	5: Automatic motor response		2: Flexion withdrawal
	4: Object manipulation		1: Abnormal posturing
	3: Localization to noxious stimulation		0: None/flaccid
	2: Flexion withdrawal		
	1: Abnormal posturing		
	0: None/flaccid		
Oromotor/verbal	3: Intelligible verbalization		3: Verbalization (intelligible)
	2: Vocalization/oral movement		2: Vocalization
	1: Oral reflexive movement		1: Groaning
	0: None		0: None
Facial expression	NA		3: Cry
			2: Grimace
			1: Oral reflexive movement/startle response
			0: None
Communication	2: Functional: accurate		NA
	1: Nonfunctional: intentional		
	0: None		
Arousal	3: Attention		NA
	2: Eye opening without stimulation		
	1: Eye opening with stimulation		
	0: Unarousable		

Abbreviation: NA, not applicable

CRS-R :The Coma Recovery Scale-Revised

The Nociception coma scale-revised

nociception coma scale-revised

Simplified Evaluation of CONsciousness Disorders (SECONDs)

.....
.....

A. Observation

Command 1: ..../3
2: ..../3
3: ..../3
Written command: ..../3
→ The patient responds at least twice for one of the commands (= score 6)

☐ **B. Command-following** (score 6)
3 x 3 spoken commands
10'' interval between commands
(1 x 3 written command if 0/3)
Stop if 2 commands 3/3

If command-following

Code yes : .....
Code no : .....
Responses : .../5 o Verbal o Autobiographical
Correct : .../5 o Written o Situational
→ The patient responds (even incorrectly) to at least 3 questions (= score 7)
→ The patient correctly responds to the 5 questions (= score 8)

C. Communication
☐ **Intentional** (score 7)
☐ **Functional** (score 8)
Autobiographical questions
Name (no), birth date (yes), name (yes), birth date (no), children (yes/no)
If incorrect answer(s): Situational questions
Place (yes), wearing a hat (no), place (no), touching hand (yes), touching face (no)

Horizontal : .../2 Vertical : .../2
o Spontaneous o Mirror □ Manual eye-opening
→The patient shows at least 2 visual pursuits of at least 2 seconds (= score 4)

☐ **D. Visual pursuit** (score 4)
Person/mirror, 30 cm from face
Each movement on horizontal or vertical axes = 4''(→←↓↑)

Sup L : .../1 Sup R : .../1
Inf L : .../1 Inf R : .../1
o Spontaneous o Mirror □ Manual eye-opening
→The patient shows at least 2 visual fixations of at least 2 seconds (= score 3)

☐ **E. Visual fixation** (score 3)
Person/mirror, 30 cm from face
Present stimulus in each quadrant

If no command-following

Localization: L : .../1 R : .../1
Anticipation: L : .../1 R : .../1
→The patient touches the point of stimulation at least once with the non-stimulated hand (= score 2)
→The patient shows 2 anticipations (= score 6)

☐ **F. Pain localization** (score 2)
Inform patient
5'' pressure on nail bed
1 trial on each hand

.....
..... Nb :.....
→The patient shows at least one oriented behavior (= score 5)

☐ **G. Oriented behaviors** (score 5)
E.g., scratching, grabbing sheets, holding bed, laughing or crying contextually,...

0-25% / 25-50% / 50-75% / 75-100%
Spontaneously / Auditory / Tactile / Pain stimulations
→ The patient shows at least one eye-opening during the whole assessment (= score 1)

H. Arousal
☐ **Eye-opening** (score 1)
☐ **No arousal** (score 0)
Report the percentage of eye-opening time and administered stimulations

The four high-yield signs — and which scale can actually see them

MCS−

Visual pursuit with a mirror

Most frequent first sign of consciousness

GCS ✕ | FOUR ✓ | CRS-R ✓

MCS−

Automatic motor behaviour

Scratching, grabbing the bed rail, adjusting the tube

GCS ✕ | FOUR ✕ | CRS-R ✓

MCS−

Localisation to noxious stimulus

Hand crosses the midline to the stimulus

GCS ✓ | FOUR ✓ | CRS-R ✓

MCS+

Reproducible command following

Eyes, mouth or hand, ≥2 of 4 trials in a window

GCS ✓ | FOUR ✓ | CRS-R ✓

Emerging signs (research):
resistance to passive eye opening, habituation of startle, auditory localisation, spontaneous leg crossing

Rule: one reproducible sign = conscious until proven otherwise

MCS: Minimally conscious state

CRS-R :The Coma Recovery Scale-Revised

REF Kondziella et al., 2020, Eur J Neurol · Bodien et al., 2026, Intensive Care Med · Giacino et al., 2018, Neurology

Choose the scale for the job: GCS to triage, FAST or SECONDs daily, CRS-R weekly

Scale	Time	Output	Best use in the ICU	Key data
GCS	1–2 min	3–15	Triage and trend only	No pursuit; verbal lost when intubated
FOUR	2–4 min	0–16	Default instead of GCS	Brainstem, respiration; EAN strong
CRSR-FAST	~6 min	Conscious: yes/no	Daily screening	Sens 81%, spec 89% vs CRS-R
SECONDs	~7 min	0–8, category	Daily diagnosis	κ 0.78–0.85 vs CRS-R
CRS-R	25–35 min	0–23, 6 subscales	Reference standard, weekly	Feasible and safe in the ICU
NCS-R	~5 min	0–9	Pain and discomfort	≥4: treat and re-score

CRS-R :The Coma Recovery Scale-Revised

DoC : disorders of consciousness

SECONDs:The Simplified Evaluation of CONsciousness Disorders

CRSR-FAST :the Coma Recovery Scale-Revised For Accelerated Standardized Testing)

NCS-R: Nociception Coma Scale—Revised

REF Bodien et al., 2023, Ann Neurol · Aubinet et al., 2021, Ann Phys Rehabil Med · Woodward et al., 2024, Crit Care Explor · Kondziella et al., 2020

03 · STEP 3 — REPEAT

One exam is a snapshot; consciousness is a film — schedule the repeats

EXAMPLE WEEK	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Morning	FAST	FAST	FAST	FAST	FAST	FAST	CRS-R
Evening	SECONDs		SECONDs		SECONDs		SECONDs

Trigger

Extra exam after any change:
sedation stopped,
fever treated,
seizures controlled,
CSF drained

Best response counts. Record the highest level seen, not the average

Vary the clock. Arousal fluctuates across the day

Train the team. Nurses see the patient 24 h a day

REF Kondziella et al., 2020, Eur J Neurol · Bodien et al., 2026, Intensive Care Med · Woodward et al., 2024, Crit Care Explor

Assume pain is possible: score, treat, re-score — and pre-empt every procedure

NOCICEPTION COMA SCALE–REVISED (0–9)				
Score	3	2	1	0
Motor	Localises	Withdraws	Postures	None
Verbal	Words	Vocalises	Groans	None
Facial	Cries	Grimaces	Oral reflex, startle	None

Score at rest and with care

▼

NCS-R ≥4 → analgesia

▼

Re-score after the dose

Pre-empt: suction, turning, lines — and the CRS-R noxious stimulus itself

REF Kondziella et al., 2020, Eur J Neurol · Bonin et al., 2020, J Pain · Giacino et al., 2018, Neurology

04

Covert consciousness in practice

Who to test, with what tools, and what to do with a positive or a negative result

Who, when, how, then: a referral card for covert-consciousness testing

WHO

- Coma, VS/UWS or MCS− at the bedside
- Confounders removed
- Younger, traumatic injury
- Level-of-care decisions in view

WHEN

- Before any WLST discussion
- First 1–2 weeks;
- CMD appears from about day 4
- Repeat: it fluctuates

HOW

- Task EEG (motor imagery)
- Active or resting fMRI
- TMS-EEG where available
- Overnight EEG for spindles anywhere

THEN

- Positive: treat as aware
- Negative: not excluded
- Disclose with a framework
- Re-test if unchanged

Guideline status: AAN Level C “may” · EAN “whenever feasible” · no guideline mandates it

Highest level by any method = the diagnosis

REF Giacino et al., 2018 · Kondziella et al., 2020 · Claassen et al., 2024, Neurocrit Care · Bodien et al., 2026, Intensive Care Med

Use both EEG and fMRI when you can — and never read a negative as “unconscious”

NO BEHAVIOURAL COMMAND FOLLOWING · n = 241

25% had CMD (60/241)



40% were positive on only one modality:
each test alone misses about one in five

FOLLOWED COMMANDS AT THE BEDSIDE · n = 112

62% were negative on the tasks

Sensitivity is low; aphasia, sedation and fluctuation all reduce activation

A negative test is not evidence of conscious absence

REF Bodien et al., 2024, N Engl J Med 391:598–608 · Jacobson et al., 2025, Neurocrit Care

A three-tier toolkit: start with what every ICU already has

TIER 1 · EVERY ICU

- Serial CRSR-FAST or SECONDs
- Routine or continuous EEG: seizures, reactivity, spindles
- Automated pupillometry (NPi)

TIER 2 · REGIONAL CENTRE

- Task-based EEG: motor imagery with a machine-learning classifier
- Active and resting-state fMRI
- Structural MRI with expert reading

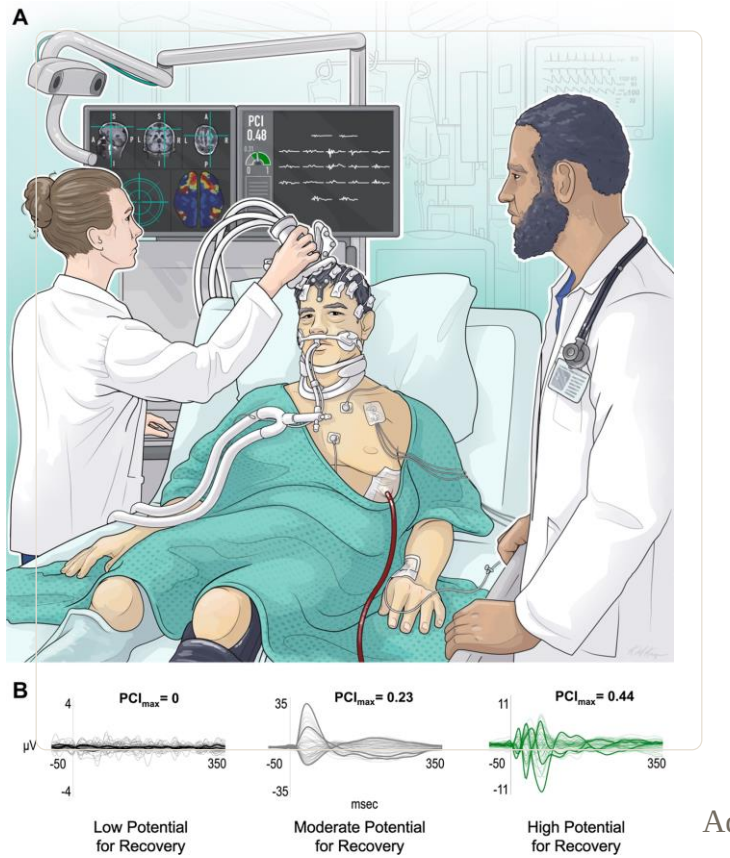
TIER 3 · EXPERT OR RESEARCH

- TMS-EEG and the perturbational complexity index
- FDG-PET, high-density EEG
- Pupil dilation during mental arithmetic
- fNIRS and hybrid brain–computer interfaces

REF Bodien et al., 2026, Intensive Care Med · Edlow et al., 2023, Neurocrit Care · Claassen et al., 2024, Neurocrit Care

TMS-EEG asks the brain directly — no command, no movement, no sensory pathway needed

Transcranial Magnetic Stimulation–Electroencephalography



Adapted from Edlow et al., 2023, Neurocrit Care

PCI* CUT-OFF

0.31

100% sensitivity and specificity in 150 benchmark subjects

MCS DETECTED

94.7%

above the cut-off

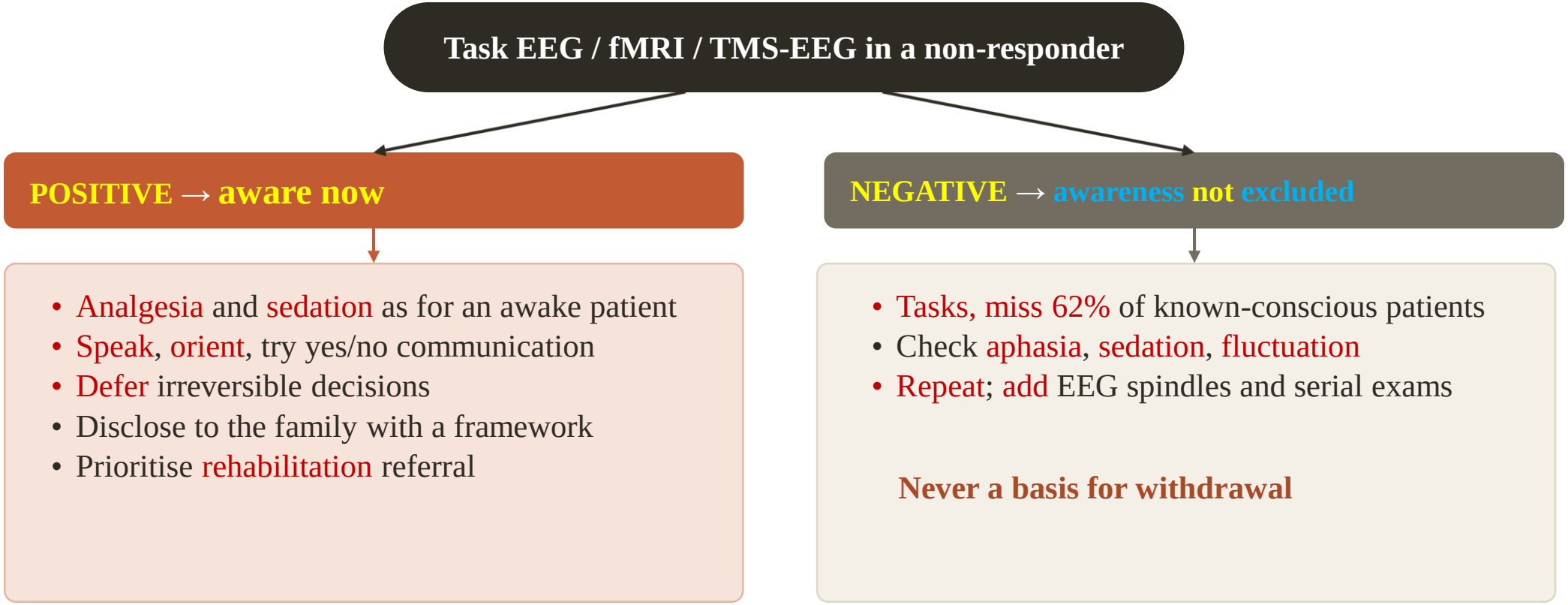
When to refer:
behaviour and task tests disagree, or aphasia, deafness or paralysis block the usual tests

Limits:
capacity, not prognosis; validated mainly beyond the acute phase; very few centres



REF Edlow et al., 2023, Neurocrit Care 38:584–590 · Bodien et al., 2026, Intensive Care Med

The result is asymmetric: A positive , changes care today; a negative, changes nothing



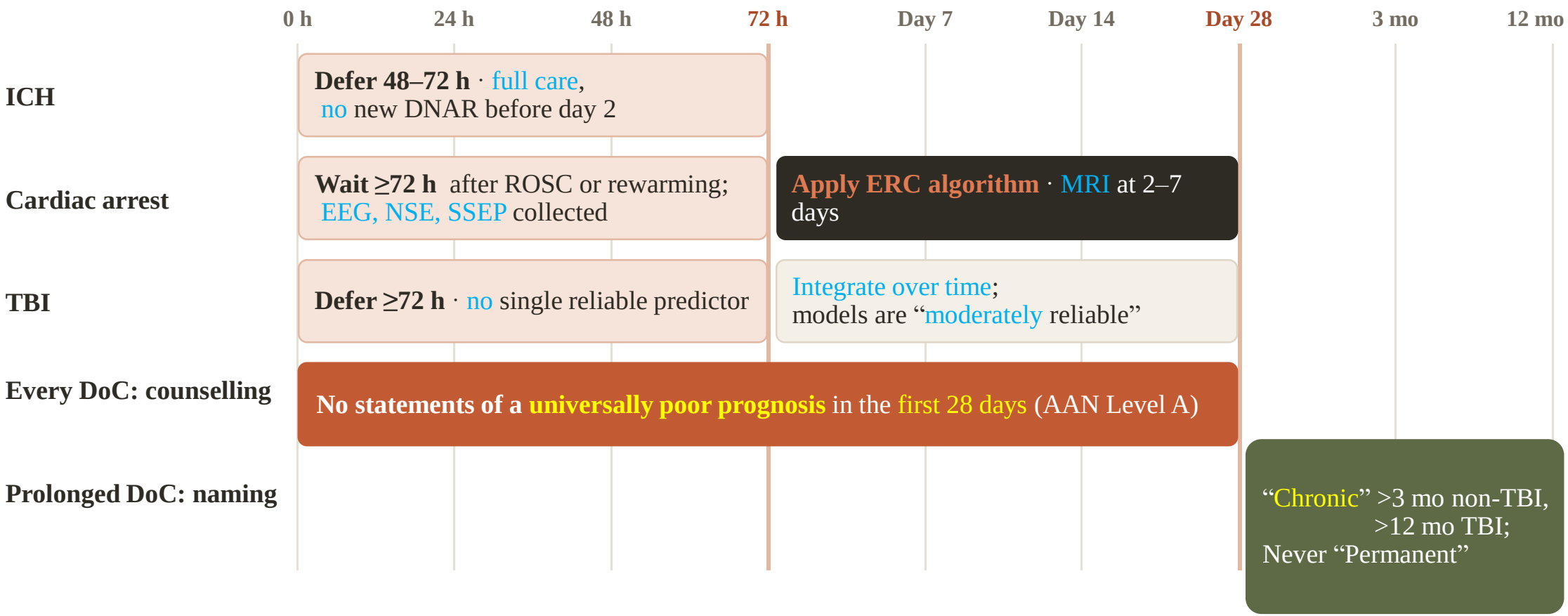
REF Young et al., 2024, Neurocrit Care · Bodien et al., 2024, N Engl J Med · Claassen, Kondziella & Young, 2025, Intensive Care Med

05

Prognosis without prophecy

When to speak, which predictors count, and the words that match the evidence

When may we speak? The prognostic clock by aetiology

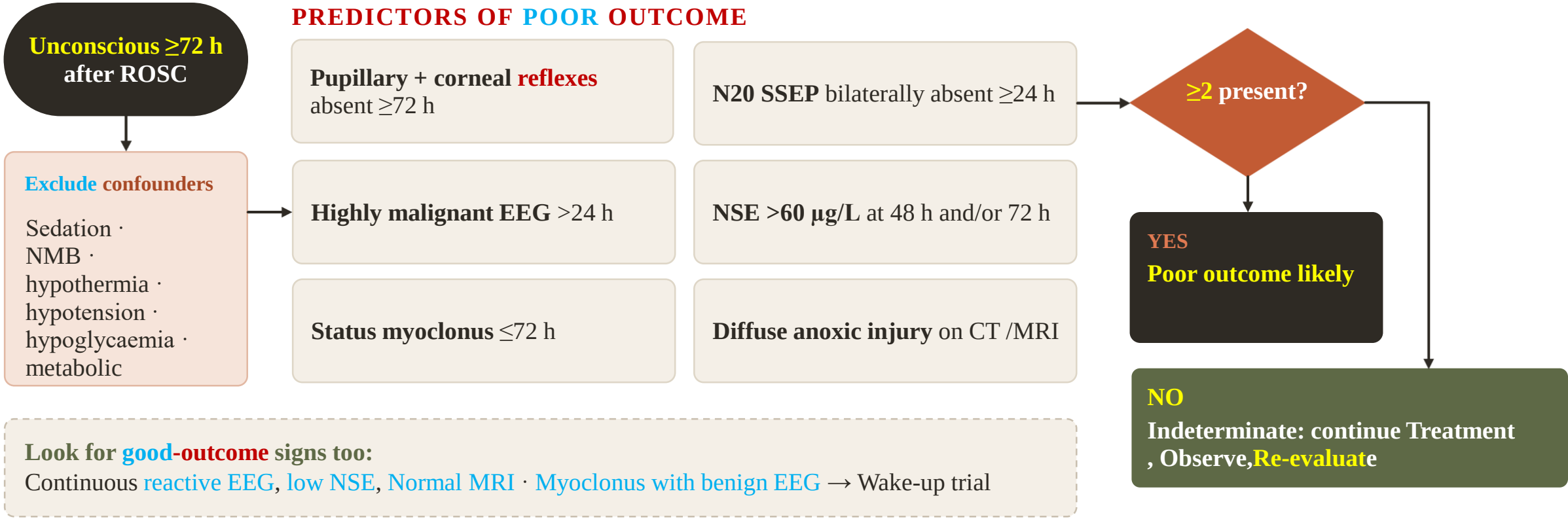


REF Hwang et al., 2024 · Greenberg et al., 2022 · Rajajee et al., 2023 · Nolan et al., 2025 · Muehlschlegel et al., 2024 · Giacino et al., 2018

ERC: European Resuscitation Council

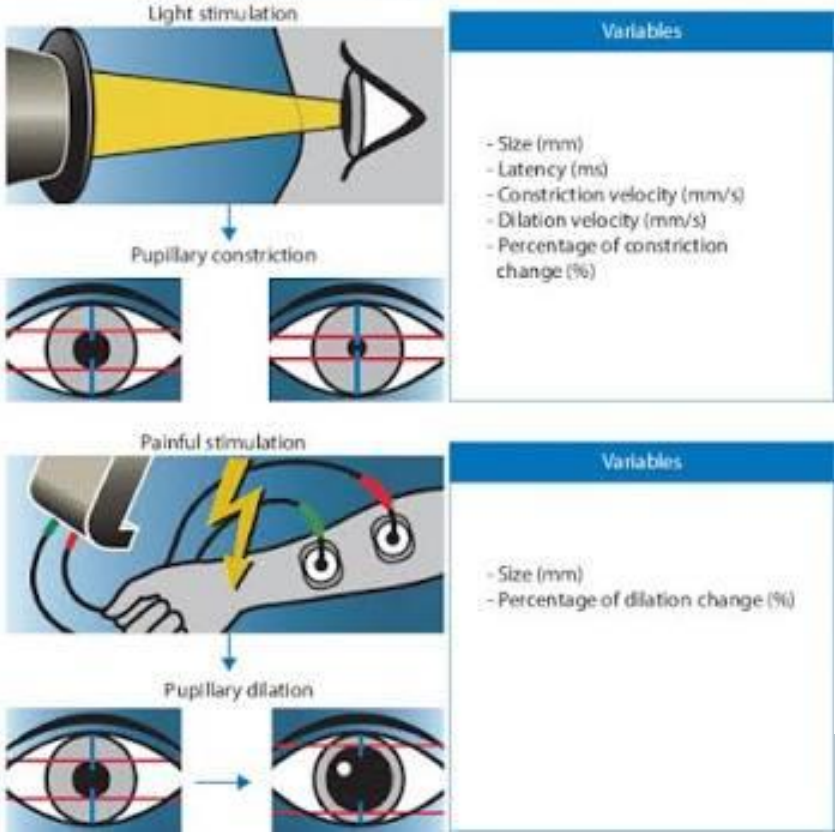
NSE:Neuron-Specific Enolase,**SSEP:**Somatosensory Evoked Potentials , **ROSC**:Return of Spontaneous Circulation, **DNAR**(Do Not Attempt Resuscitation

ERC–ESICM 2025: “Poor outcome likely” needs two or more predictors

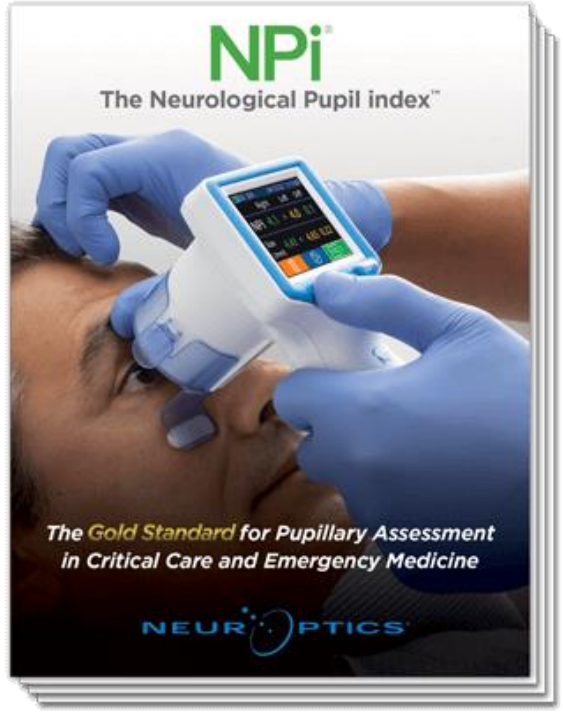


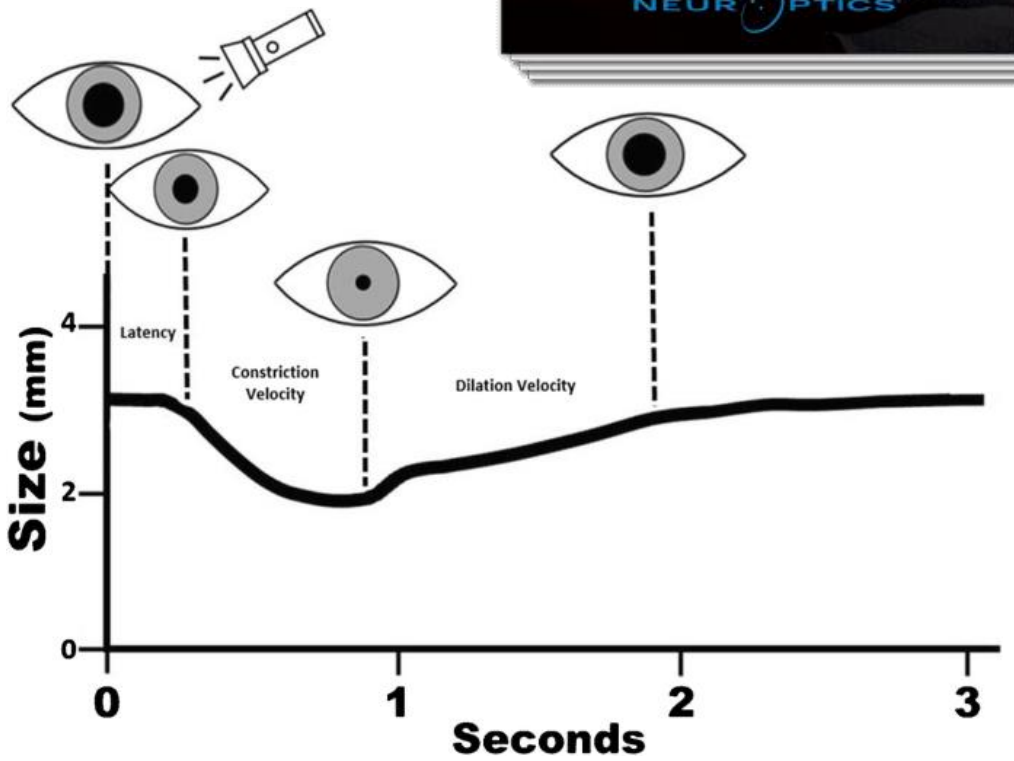
REF Adapted from Nolan et al., 2025, Resuscitation 215:110809 (ERC–ESICM post-resuscitation care guidelines)


Size
Right Eye
CV
2.08 mm
PLR
0.39 mm/s
Latency
27%
226 ms


Light stimulation
Pupillary constriction
Variables
- Size (mm)
- Latency (ms)
- Constriction velocity (mm/s)
- Dilation velocity (mm/s)
- Percentage of constriction change (%)
Painful stimulation
Pupillary dilation
Variables
- Size (mm)
- Percentage of dilation change (%)


ID: 123456789
06/01/21 01:38:00
Right
Left
Diff
NPi
3.8
>
3.5
0.3
Size [mm]
4.89
<
5.16
0.27
1
RIGHT
LEFT
NPi


NPi
The Neurological Pupil index™
The Gold Standard for Pupillary Assessment in Critical Care and Emergency Medicine
NEUROPTICS


Latency
Constriction Velocity
Dilation Velocity
Size (mm)
0
2
4
0
1
2
3
Seconds

Read the pupil as a number: NPi is specific, repeatable and cheap to trend

NEUROLOGICAL PUPIL INDEX (NPi, 0–5)



CARDIAC ARREST · n = 456

NPi ≤2: specificity 100%, but low sensitivity

BOX SUBSTUDY

NPi ≤2 + NSE >60 µg/L: sensitivity ~50–55% at 0% FPR

ORANGE · TBI, SAH, ICH

Abnormal NPi linked to 6-month outcome; NPi 0 carries the highest mortality

Pitfalls: opioids and ketamine shift the reading; a poor ICP surrogate; one value never decides

REF Oddo et al., 2018, Intensive Care Med · Obling et al., 2024, Intensive Care Med · Oddo et al., 2023, Lancet Neurol

For biomarkers and imaging, the timing is part of the test

24 h · NSE	48 h · NSE · CT	72 h · NSE · CT	Day 2–7 · MRI (DWI)

Blood

- NSE serially: a rising curve adds weight
- >60 µg/L at 48/72 h = one ERC criterion
- **Haemolysis** falsely raises NSE — check the sample
- NfL, GFAP, tau: as **accurate** or **better**, not yet in the algorithm
- Point-of-care GFAP/UCH-L1 is for CT triage in mild TBI, not coma prognosis

Imaging

- CT ≥48–72 h: diffuse grey–white loss (FPR 0–3%, sensitivity low)
- MRI 2–7 d: diffuse restriction (FPR 0–6%)
- Expert reading; tele-neuroradiology if needed
- TBI: corpus callosum, dorsolateral upper brainstem, corona radiata lesions link to persistent VS

NfL (Neurofilament light chain)
GFAP (Glial Fibrillary Acidic Protein)
UCH-L1 (Ubiquitin Carboxy-terminal Hydrolase L1)
Tau (Tau protein)

REF Nolan et al., 2025, Resuscitation · Rajajee et al., 2023, Neurocrit Care · Giacino et al., 2018, Neurology

08

The ICU consciousness bundle

Day by day, from admission to rehabilitation — and what never to do

The ICU consciousness bundle, from day 0 to rehabilitation

Day 0–3
De-confound, do not predict

- DoC category + FOUR
- Short-acting sedation
- EEG; cEEG if unexplained
- NPi; NSE 24/48/72 h after arrest
- No prognostic WLST <72 h
- Meeting 1: propose TLT

Day 3–7
Multimodal assessment

- ERC algorithm ≥72 h after arrest
- MRI day 2–7
- Daily FAST or SECONDs
- NCS-R before and after analgesia
- Read spindles
- Start rehabilitation

Day 7–14
Look beneath first

- Re-screen confounders
- Weekly full CRS-R
- CMD testing where available
- Disclose with a framework
- TLT milestone meeting

Day 14–28
Plan for recovery

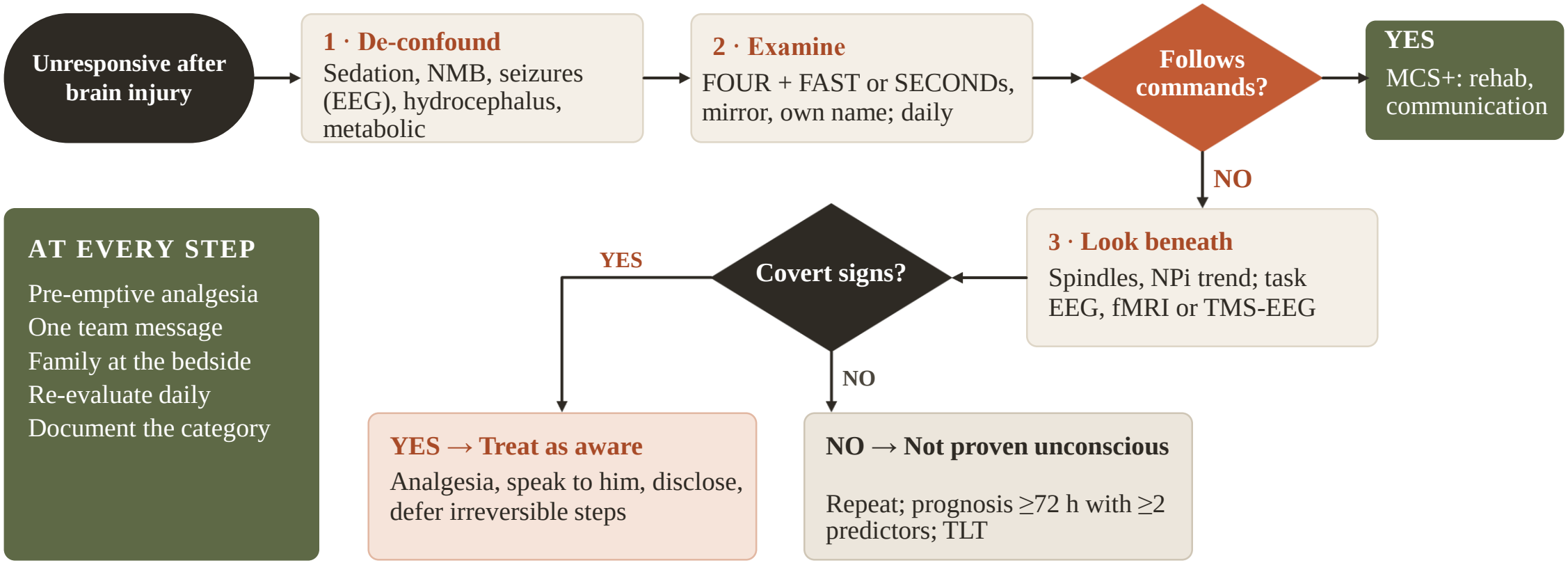
- Tracheostomy, gastrostomy
- Rehabilitation referral
- Amantadine from week 4 in TBI
- Serial CRS-R continues

>28 days
Prolonged DoC

- Specialised DoC rehab
- “Chronic”, never “permanent”
- Follow-up for years

REF Bodien et al., 2026 · Nolan et al., 2025 · Lewis et al., 2025 · Giacino et al., 2018 · Kruser et al., 2024

One algorithm for every unresponsive brain-injured patient



REF Synthesised from Bodien et al., 2026 · Kondziella et al., 2020 · Young et al., 2024 · Nolan et al., 2025

TAKE-HOME MESSAGES

Five messages for Saturday morning

1. **Unresponsive is not unconscious:** 15–25% of non-responders follow commands covertly
2. **De-confound, then examine serially** with FAST, SECONDs or CRS-R — never once, never GCS alone
3. **No prognosis before 72 h**, no “universally poor” before 28 days, never on one predictor
4. **A positive CMD test changes care today;** a negative one never justifies withdrawal
5. **Time-limited trials and one team message** break the self-fulfilling prophecy

REF Bodien et al., 2026 · Giacino et al., 2018 · Kondziella et al., 2020 · Nolan et al., 2025 · Bodien et al., 2024

CONCLUSION

The guidelines already agree on what to do. Our task is to do it every day:

de-confound, examine, look beneath, communicate — and treat every unresponsive patient as potentially aware.

Questions and discussion

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