DELIRIUM IN CRITICALLY ILL PATIENTS

Detection, Impact, Prediction and Prevention of ICU delirium

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Expanding Horizons of Critical Care Nursing in Europe
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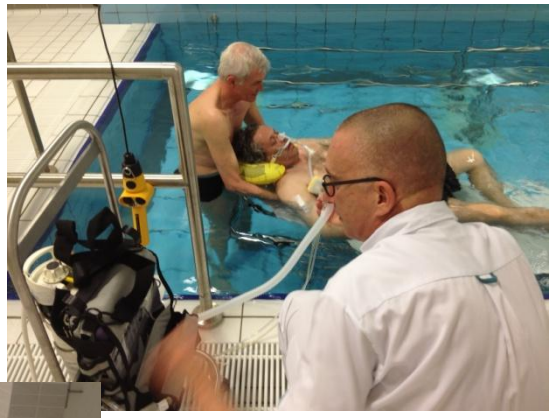
Nijmegen: 150,000 inhabitants

Main entrance

4-days of marching



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Colleagues ICU Research

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Delirium features

- Acute onset (hours, days)

- Fluctuations and altered level of consciousness (using RASS/SAS or GCS)

- Cognitive disturbances: memory problems, disorientation (t,p,p), language problems, hallucinations and delusions

(DSM-V criteria)

There is always a physical problem causing delirium

Agenda

- Detection
- Occurrence and outcome
- Prediction of delirium
- Prevention of delirium

Delirium detection

-‘Gold standard’: Psychiatrist, geriatrist or neurologist using DSM criteria

- Undoable in daily practice

- Five delirium assessment tools developed for ICU patients

Psychometric Criteria Scored	Delirium Monitoring Tools				
	Confusion Assessment Method for the ICU	Intensive Care Delirium Screening Checklist	Cognitive Test for Delirium	Nursing Delirium Screening Scale	Delirium Detection Score
Item selection description	2	1	2	1	1
Content validation	1	0	2	0	0
Limitations presented	1	1	1	0	1
Interrater reliability	2	2	2	2	2
Interrater reliability tested with nonresearch team	1	1	0	0	0
Interrater reliability tested if interrater reliability is low or inconsistent	NA	NA	NA	NA	0
Total number of participants	2	2	2	2	2
Criterion validation: sensitivity	2	2	2	2	0
Criterion validation: specificity	2	1	2	2	2
Predictive validation	2	2	0	1	0
Feasibility	1	0	0	0	0
Directives of use	1	1	1	1	1
Relevance of scale in practice	1	1	0	0	0
Total score (range: 0–19 or 21)	18/19	14/19	14/19	11/19	9/21
Weighted score[a] (range: 0–20)	19.6	16.8	13.0	12.4	8.2
Quality of psychometric evidence (based on weighted scores)	VG	VG	M	M	VL

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Performance of assessment tools

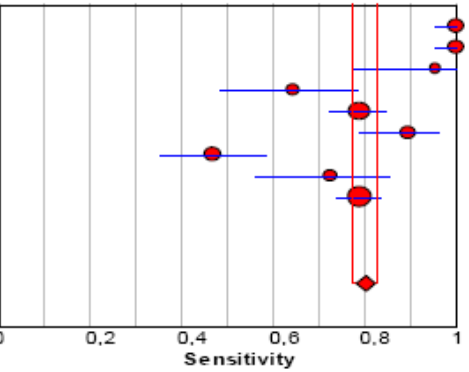
The confusion assessment method for the intensive care unit (CAM-ICU) and intensive care delirium screening checklist (ICDSC) for the diagnosis of delirium: a systematic review and meta-analysis of clinical studies

Dimitri Gusmao-Flores[1,2*], Jorge Ibrain Figueira Salluh[3,4], Ricardo Ávila Chalhub[2] and Lucas C Quarantini[2,5,6]

CRITICAL CARE

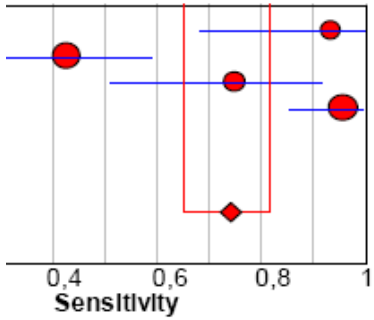
Gusmao-Flores *et al. Critical Care* 2012, **16**:R115
http://ccforum.com/content/16/4/R115

CAM-ICU vs. ICDSC



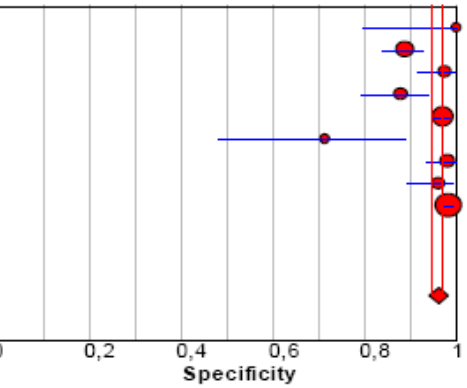
	Sensitivity (95% CI)	
Ely 2001	1,00	(0,95 - 1,00
Ely 2001	1,00	(0,95 - 1,00
Lin 2004	0,95	(0,77 - 1,00
Van Eijk 2009	0,64	(0,48 - 0,78
Luetz 2010	0,79	(0,72 - 0,85
Heo 2011	0,89	(0,78 - 0,96
Van Eijk 2011	0,47	(0,35 - 0,59
Gusmao-Flores 2011	0,73	(0,56 - 0,85
Mitasova 2011	0,79	(0,74 - 0,84

Pooled sensitivity=0.80



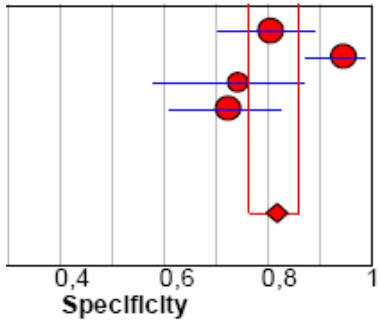
	Sensitivity (95% CI)	
Bergeron 2001	0,93	(0,68 - 1,00
Van Eijk 2009	0,43	(0,28 - 0,59
George 2011	0,75	(0,51 - 0,91
Gusmao-Flores 2011	0,96	(0,85 - 0,99

Pooled sensitivity=0.74



	Specificity (95% CI)	
Ely 2001	1,00	(0,79 - 1,00
Ely 2001	0,89	(0,84 - 0,93
Lin 2004	0,98	(0,91 - 1,00
Van Eijk 2009	0,88	(0,79 - 0,94
Luetz 2010	0,97	(0,95 - 0,99
Heo 2011	0,71	(0,48 - 0,89
Van Eijk 2011	0,98	(0,93 - 1,00
Gusmao-Flores 2011	0,96	(0,89 - 0,99
Mitasova 2011	0,98	(0,97 - 0,99

Pooled specificity=0.96



	Specificity (95% CI)	
Bergeron 2001	0,81	(0,70 - 0,89
Van Eijk 2009	0,95	(0,87 - 0,99
George 2011	0,74	(0,58 - 0,87
Gusmao-Flores 2011	0,73	(0,61 - 0,82

Pooled specificity=0.82

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Still the CAM-ICU?

Routine Use of the Confusion Assessment Method for the Intensive Care Unit

A Multicenter Study

Maarten M. van Eijk[1], Mark van den Boogaard[2], Rob J. van Marum[3], Paul Benner[4], Piet Eikelenboom[5,6], Marina L. Honing[7], Ben van der Hoven[8], Janneke Horn[9], Gerbrand J. Izaks[10], Annette Kalf[11], Attila Karakus[12], Ine A. Klijn[13], Michael A. Kuiper[14], Frank-Erik de Leeuw[15], Tjarda de Man[16], Roos C. van der Mast[17], Robert-Jan Osse[18], Sophia E. de Rooij[19], Peter E. Spronk[20], Peter H. van der Voort[21], Willem A. van Gool[5], and Arjen J. Slooter[1]

Am J Respir Crit Care Med Vol 184. pp 340–344, 2011

Subpopulation (n)	Sensitivity (*95% CI*)	Specificity (*95% CI*)
Total population (n = 181)	47% (35%–58%)	98% (93%–100%)
Psychoactive medication between assessments		
Yes (n = 46)	54% (33%–74%)	95% (75%–99%)
No (n = 135)	43% (30%–58%)	99% (93%–100%)
Delirium subtypes*		
Hypoactive (delirious n = 36; not delirious n = 106)	31% (17%–48%)	98% (92%–99%)
Hyperactive (delirious n = 7; not delirious n = 106)	100% (56%–100%)	98% (93%–100%)
Mixed-type (delirious n = 32; not delirious n = 106)	53% (35%–74%)	98% (93%–100%)
Admitting discipline		
Internal medicine (n = 52)	54% (33%–73%)	96% (78%–100%)
General surgery (n = 64)	38% (21%–59%)	97% (85%–100%)
Cardiology and cardiothoracic surgery (n = 43)	58% (34%–79%)	100% (83%–100%)
Neurology and neurosurgery (n = 22)	17% (1%–64%)	100% (76%–100%)

Highest sensitivity in center who had a delirium protocol !

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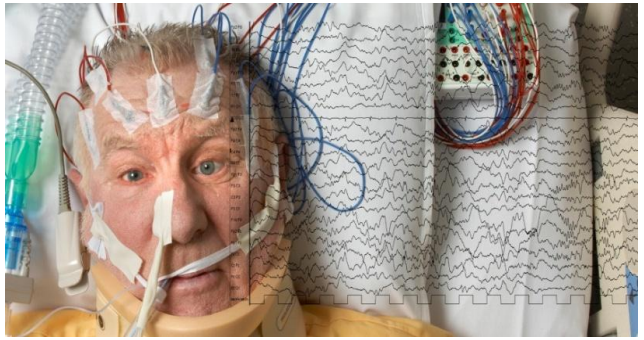
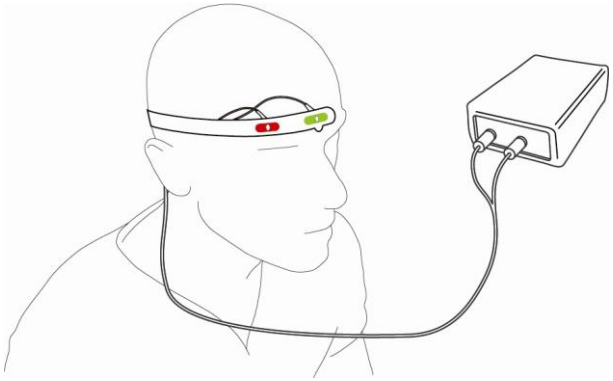
So there is a need for improvement in delirium assessment



Deliero-electrode



Promising new assessment tool: three leads EEG monitor

but for what reason;

is delirium a problem?

Occurrence and outcome

- Prevalence of ICU delirium 11-89% (depending on time, methods of measurement, patient category)
- Incidence overall is around **25-50%**

- Surgical patients	15%
- Medical patients	42.9%
- Trauma patients	68%
- Neurology patients	90.5%

Short term outcome

- Median delirium duration 2 days [IQR 1-7]

	Delirious (n=411)	Non-delirious (n=1202)	*p-value* *(adj. APACHE-II score)*
Time on ventilator (d)	4.6 [1-11]	0.3 [0-1]	<0.0001
Re-intubation	10%	0.5%	<0.0001
Unplanned removal of catheters	23.1%	0.6%	<0.0001
LOS-ICU (d)	6 [2-13]	1 [1-2]	<0.0001
LOS-Hospital (d)	20 [10-39]	7 [5-14]	<0.0001
In-Hospital mortality	73 (17.8%)	40 (3.3%)	<0.0001

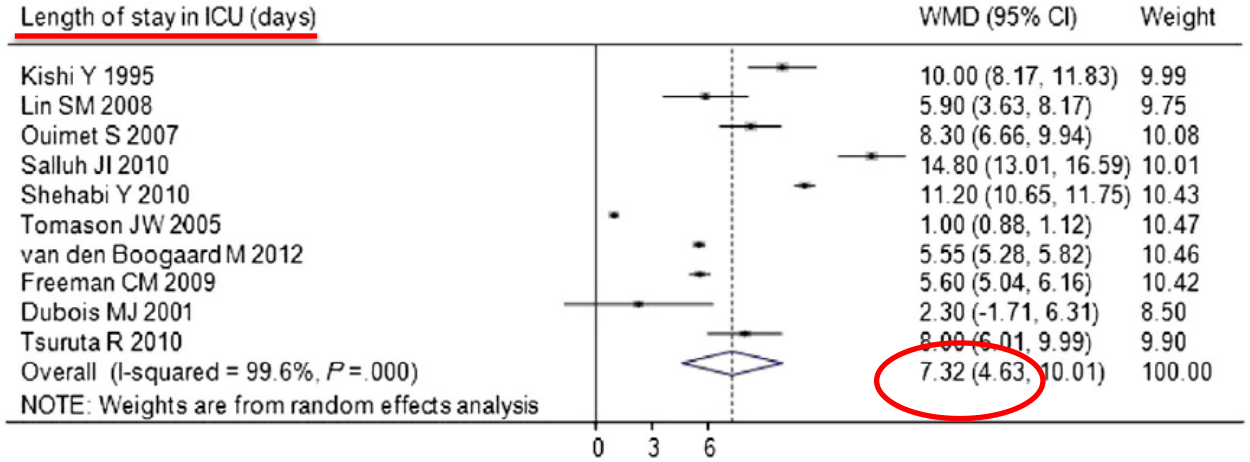
Data expressed as median and IQR or absolute number and %

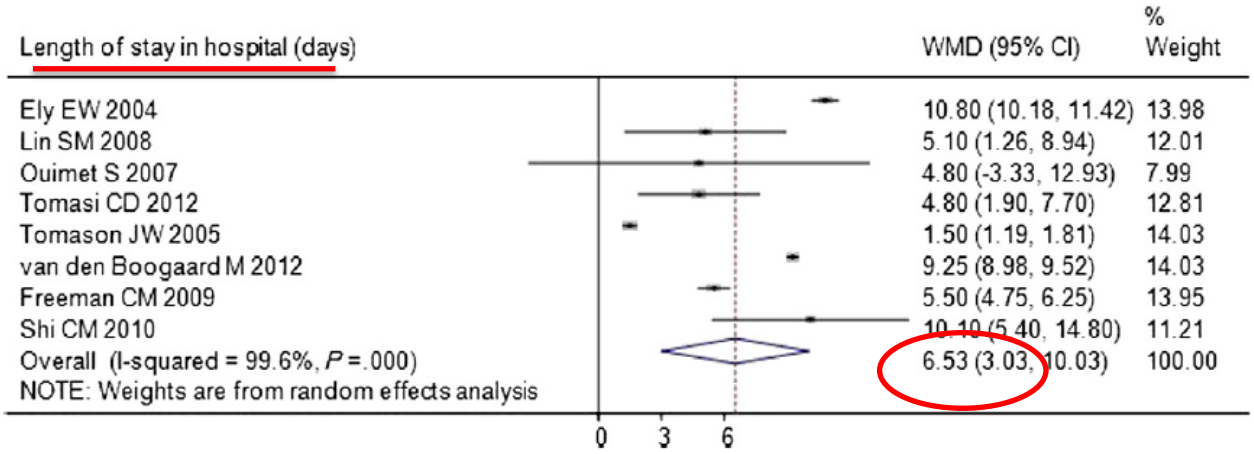
Short term outcome

Impact of delirium on clinical outcome in critically ill patients: a meta-analysis☆,☆☆,★

Zhongheng Zhang, M.M.*, Lifei Pan, M.B., Hongying Ni, M.M.

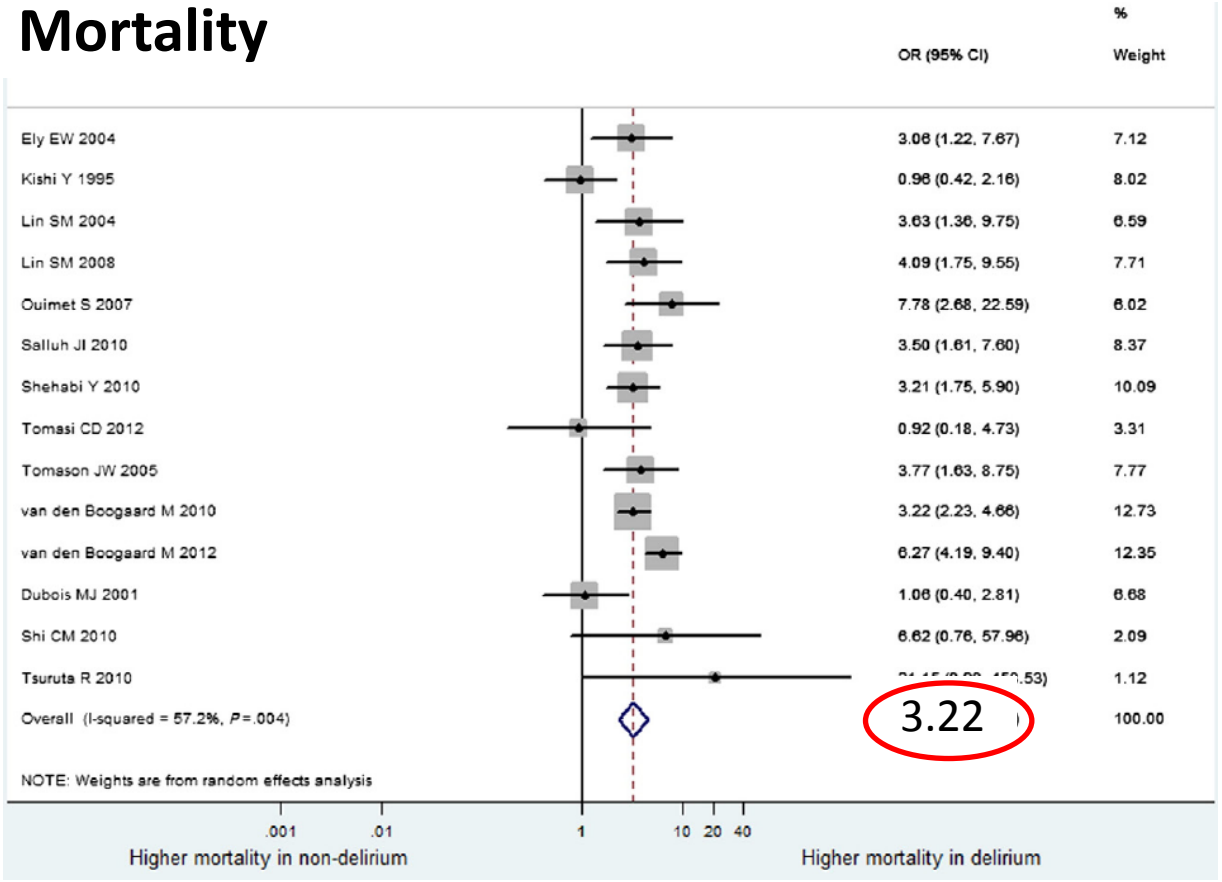
Gen Hosp Psychiatry (2012), http://dx.doi.org/10.1016/j.genhosppsych.2012.11.003





Short term outcome

Mortality



- Adjusted voor APACHE-II, but no SOFA!

Using another statistical approach

Table 2| **Effect estimates for association between delirium and mortality in intensive care unit using various statistical approaches**

Variables	Logistic regression	Competing risks survival regression	Marginal structural model
Adjustment factors:			
Baseline covariables	Yes	Yes	Yes
Time varying onset of delirium	No	Yes	Yes
Competing risks of death and discharge	No	Yes	Yes
Evolution of disease before delirium onset*	No	No	Yes
Effect estimate†‡:			
Crude	2.60 (1.76 to 3.85)	3.14 (2.32 to 5.04)	3.14 (2.32 to 5.04)§¶
Adjusted**	1.77 (1.15 to 2.72)	2.08 (1.40 to 3.09)	1.19 (0.75 to 1.89)††‡‡

BMJ 2014;349:g6652 doi: 10.1136/bmj.g6652 (Published 24 November 2014) Page 1 of 10

RESEARCH

The attributable mortality of delirium in critically ill patients: prospective cohort study

Peter M C Klein Klouwenberg *PhD student*[1], Irene J Zaal *PhD student*[1], Cristian Spitoni *statistician*[2], David S Y Ong *PhD student*[1], Arendina W van der Kooi *clinical technologist*[1], Marc J M Bonten *epidemiologist*[3], Arjen J C Slooter *neurologist-intensivist*[1], Olaf L Cremer *anaesthesiologist-intensivist*[1]

Conclusion overall:

Delirium is associated with poor outcome on the short term

Delirium and long-term outcome

- Quality of Life: no differences on physical outcome between delirium vs non-delirium (12 and18mos after ICU) (Van Rompaey (CC, 2011); van den Boogaard (CCM, 2012))
- Sustained cognitive disturbances (Girard (CCM, 2010); van den Boogaard (CCM, 2012)) associated with duration of delirium

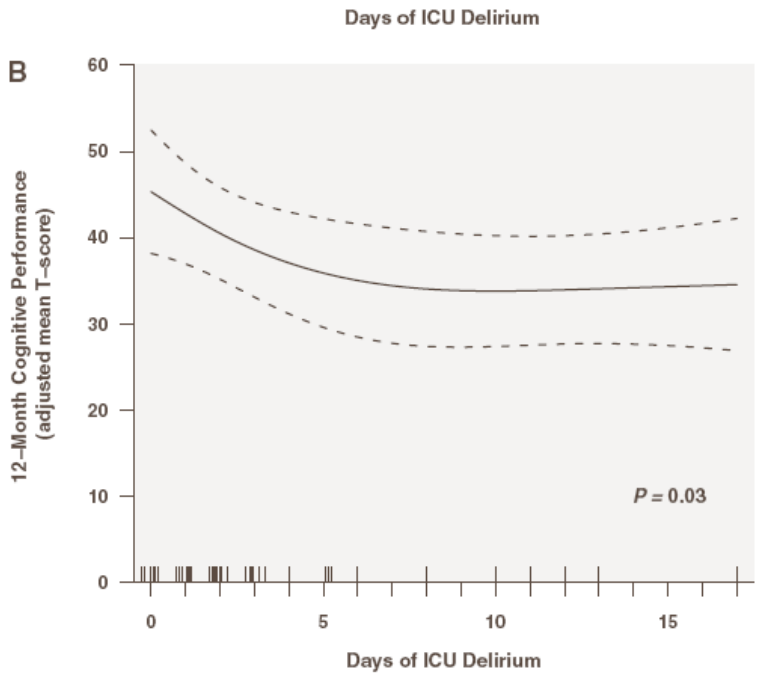
Crit Care Med 2010 Vol. 38, No. 7

Delirium as a predictor of long-term cognitive impairment in survivors of critical illness

Timothy D. Girard, MD, MSCI; James C. Jackson, PsyD; Pratik P. Pandharipande, MD, MSCI; Brenda T. Pun, MSN; Jennifer L. Thompson, MPH; Ayumi K. Shintani, PhD, MPH; Sharon M. Gordon, PsyD; Angelo E. Canonico, MD; Robert S. Dittus, MD, MPH; Gordon R. Bernard, MD; E. Wesley Ely, MD, MPH

Cognitive outcomes during follow-up

	Follow-up Assessment	
Outcome, % (n/Total)	3 mos (n = 76)[a]	12 mos (n = 52)[a]
No impairment	21% (16/76)	29% (15/52)
Mild/moderate impairment	17% (13/76)	35% (18/52)
Severe impairment	62% (47/76)	36% (19/52)

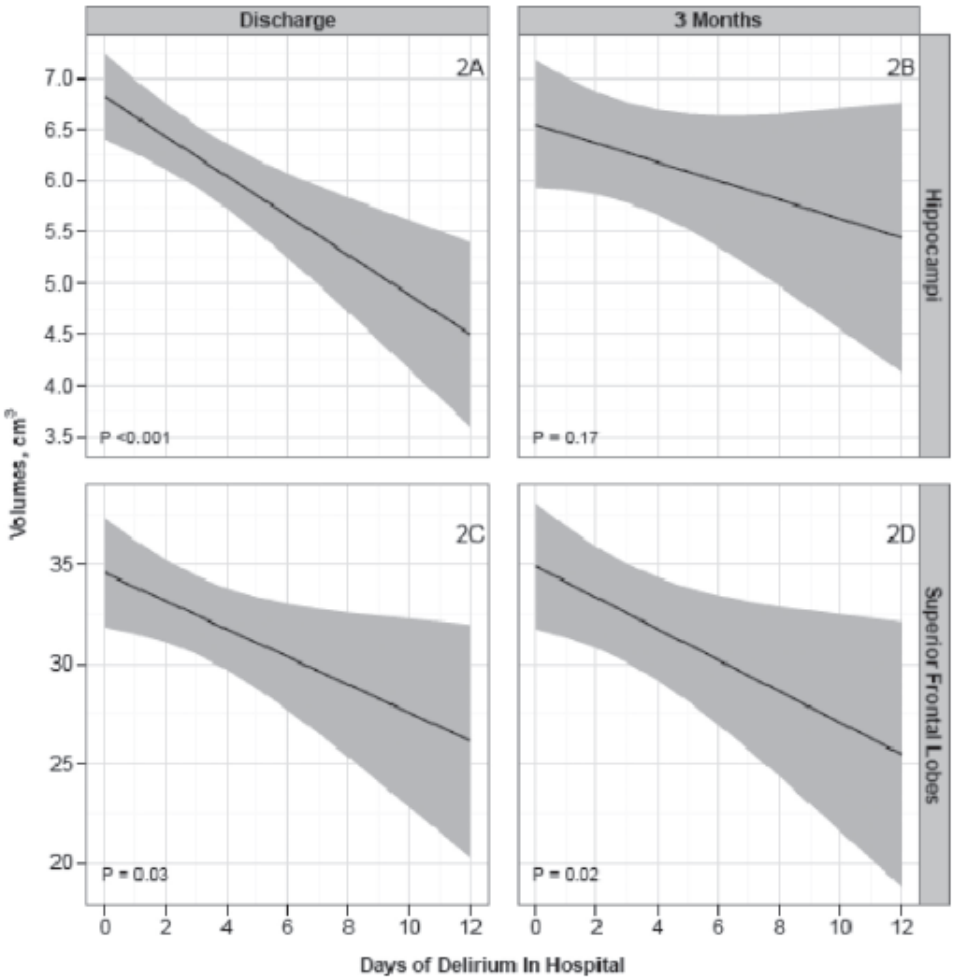


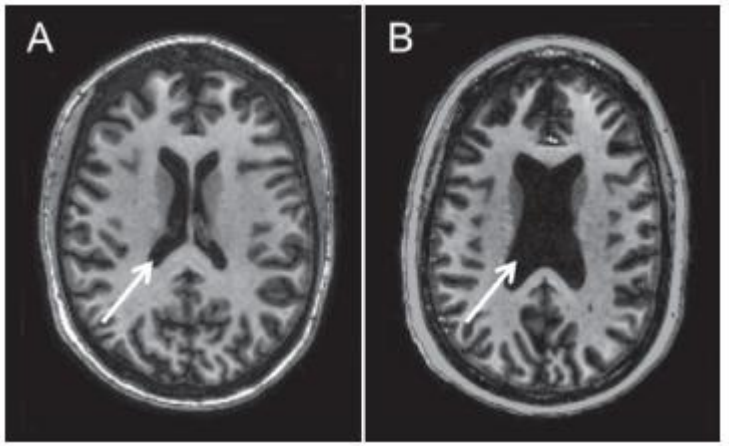
The association between brain volumes, delirium duration, and cognitive outcomes in intensive care unit survivors: The VISIONS cohort magnetic resonance imaging study*

Max L. Gunther, PhD; Alessandro Morandi, MD, MPH; Erin Krauskopf, BS; Pratik Pandharipande, MD, MSCI; Timothy D. Girard, MD, MSCI; James C. Jackson, PsyD; Jennifer Thompson, MPH; Ayumi K. Shintani, PhD; Sunil Geevarghese, MD, MSCI; Russell R. Miller III, MD, MPH; Angelo Canonico, MD; Kristen Merkle, BA; Christopher J. Cannistraci, MS; Baxter P. Rogers, PhD; J. Chris Gatenby, PhD; Stephan Heckers, MD, MSC; John C. Gore, PhD; Ramona O. Hopkins, PhD; E. Wesley Ely, MD, MPH; for the VISIONS Investigation (VISualizing Icu SurvivOrs Neuroradiological Sequelae)

Crit Care Med 2012 Vol. 40, No. 7

N=47; 3 mnd follow-up





DELIRIUM IS BAD, AND PREVENTION IS BETTER THAN CURE

It is unnecessary to apply preventive measures in all patients:

- Less effective (dilution effect)
- Labor intensive
- Exposure to side-effects

Need for a **delirium prediction model** to identify high risk patients

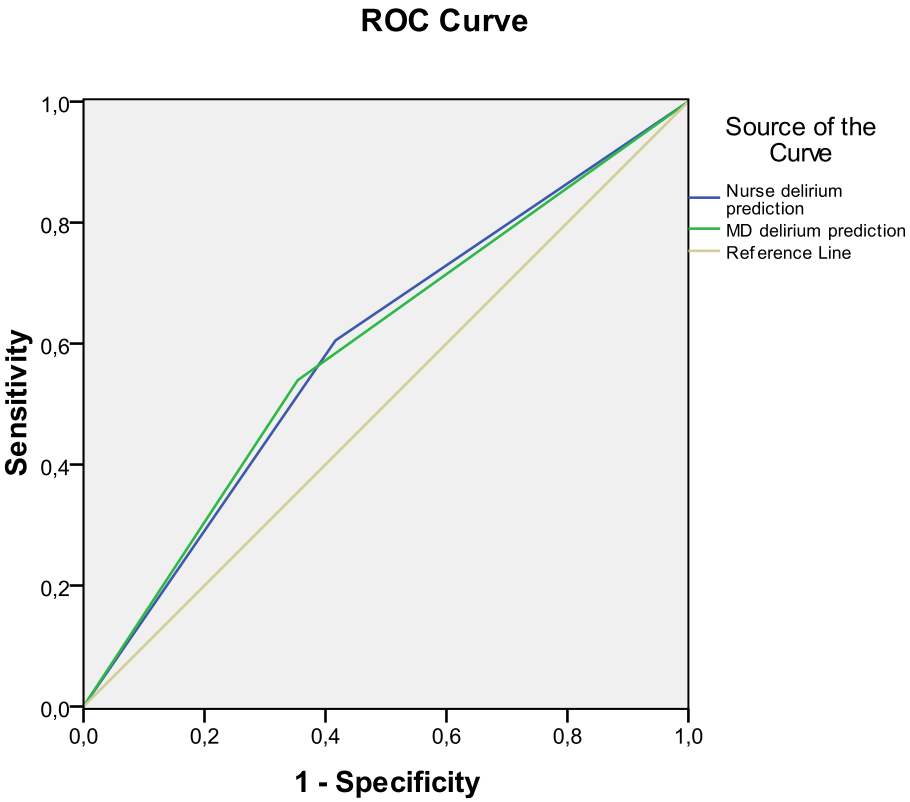
Can we predict it?

Case

Male 41yr old injured during moutainbiking resulting in mild brain damage and #femur.
After the operation he was admitted to the ICU:
- sedated with propofol
- morphine 1mg/hr
- there were no signs of infection
- urea level 9 mmol/L
- metabole acidosis
- APACHE-score is 11

What do you think this patient is delirious during ICU stay?

Prediction of nurses and physicians



Area Under the Curve

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Nurse delirium prediction	,594	,053	,078	,491	,697
MD delirium prediction	,593	,052	,083	,490	,695

No, we cannot…

But, a model might do better!

Currently there is/was no delirium prediction model for ICU patients available, but there are known risk factors in ICU patients

Delirium prediction studies

1. Cohort study (1yr) including >1600 patients to develop a model
2. Cohort study (4mos) including >550 patients to validate the model
3. Multicenter cohort study including >900 patients for external validation
4. Multinational cohort study including > 1800 patients to recalibrate the model

For all studies, all consecutive patients were screened

Delirium prediction model

- **25 known risk factors** for ICU patients
  - Age
  - APACHE-II
  - Infection
  - Coma
  - Renal and liver function
  - Dementia
  - Sedative use
  - Morphine use,
  - etc

Delirious

Minimal 1 positive CAM-ICU screening

Statistical approach: logistic regression analyses and bootstrapping

Development of PRE-DELIRIC-model

Variables	Odds ratio
1. **Age** per year	1.04
2. **APACHE-II** score per point	1.06
3. **Coma**: - Medication induced - Miscellaneous - Combination	RC 1.81 18.46 21.33
4. **Diagnose** group - Surgery - Medical - Trauma - Neurological/neurosurgery	 RC 1.39 3.38 4.45
5. **Infection**	3.12
6. **Metabolic acidosis** (yes/no)	1.37
7. **Morphine** use - 0.01 - 7.1mg/day - 7.2 - 18.6mg/day - >18.6mg/day	RC 1.56 1.15. 1.74
8. **Sedation**	4.52
9. **Urea** increased per mmol/L	1.03
10. **Urgent** admission	1.54

Delirium prediction studies

1. Cohort study (1yr) including >1600 patients to develop a model
2. **Cohort study (4mos) including >550 patients to validate the model**
3. **Multicenter cohort study including >900 patients for external validation**
4. Multinational cohort study including > 1800 patients to recalibrate the model

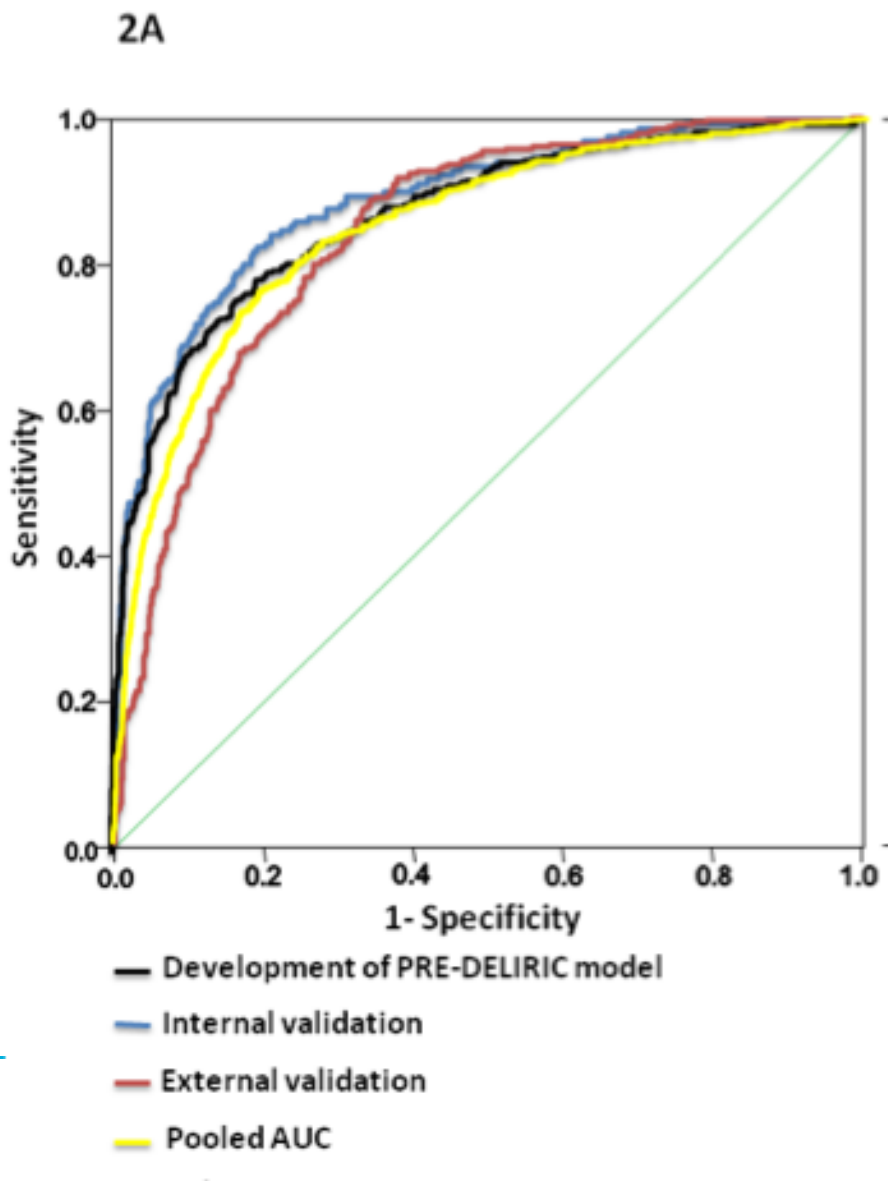
For all studies, all consecutive patients were screened

How well does this model predict?

Performance is expressed with AUC

- Development: 0.86
- Internal validation: 0.89
- External validation: 0.84
- Pooled (N=3054) (yellow line): 0.85

85% good prediction of ICU delirium



What is the performance of the model in other countries?

Delirium prediction studies

1. Cohort study (1yr) including >1600 patients to develop a model
2. Cohort study (4mos) including >550 patients to validate the model
3. Multicenter cohort study including >900 patients for external validation
4. **Multinational cohort study including > 1800 patients to recalibrate the model**

For all studies, all consecutive patients were screened

Multinational cohortstudy

- 8 hospitals from 6 countries particpated (Australia, Belgium, Germany, Spain, Sweden, and UK)
- Data collection period for 3 months
- 1850 patients were included

Results

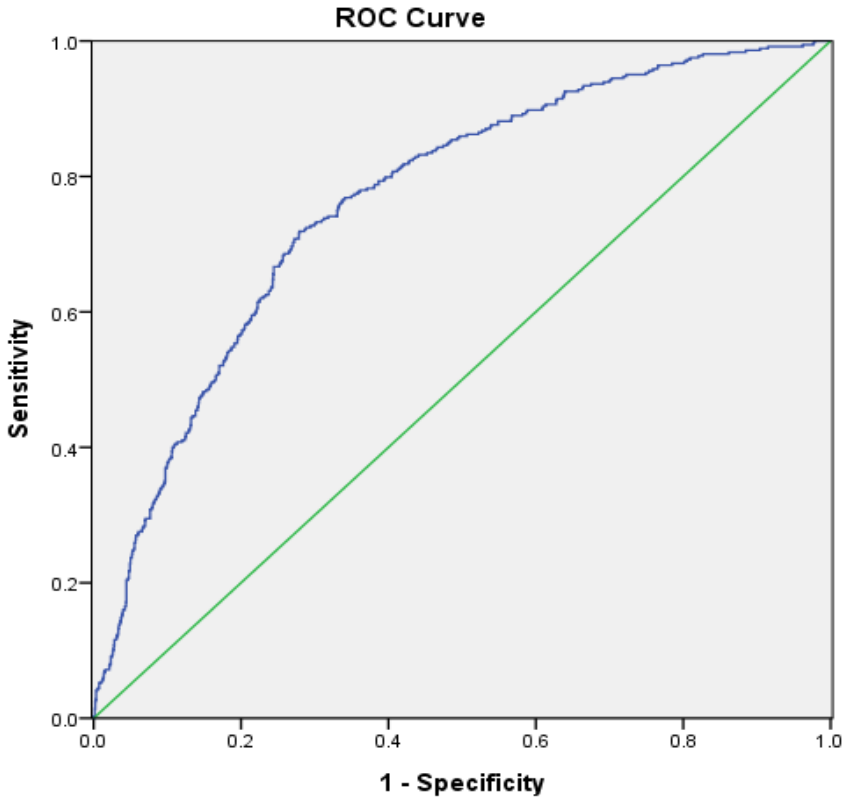
Table 1. Patient characteristics and predictors of included patients of the participating hospitals

	Belgium Antwerp (n=566)	**Germany** Berlin (n=223)	**Spain** Madrid (n=128)	**Sweden** Stockholm (n=77)	**Australia** Brisbane (n=329)	**Australia** Canberra (n=195)	**UK** Prescot (n=235)	**UK** Kent (n=71)
Age, years (mean, SD)	61±15	62±16	60±17	61±17	55±18	63±16	62±17	62±17
APACHE-II points (mean, SD)	26±8	17±8	8±5	14±7	16±6	18±6	17±7	15±7
No coma	499 (88%)	184 (83%)	114 (89%)	47 (61%)	239 (73%)	146 (75%)	138 (59%)	38 (54%)
Coma due to:								
- Medication induced	58 (10%)	37 (17%)	14 (11%)	23 (30%)	31 (9%)	34 (17%)	70 (30%)	28 (39%)
- Miscellaneous	0	2 (1%)	0	1 (1%)	5 (2%)	4 (2%)	4 (2%)	5 (7%)
- Combination	9 (2%)	0	0	6 (8%)	54 (16%)	11 (6%)	23 (10%)	0
No morphine use	347 (79%)	203 (91%)	77 (61%)	25 (42%)	258 (82%)	182 (94%)	175 (75%)	66 (93%)
- Morphine 0.01-7.1mg/day	30 (7%)	10 (5%)	13 (10%)	11 (18%)	7 (2%)	2 (1%)	4 (2%)	0
- Morphine 7.2-18.6mg/day	41 (9%)	8 (4%)	23 (18%)	15 (25%)	19 (6%)	3 (2%)	6 (3%)	0
- Morphine >18.6mg/day	20 (5%)	2 (1%)	13 (10%)	9 (15%)	31 (10%)	7 (4%)	48 (21%)	5 (7%)
Sedated	194 (34%)	35 (16%)	21 (16%)	43 (56%)	271 (82%)	83 (43%)	94 (40%)	33 (47%)
Urgent admission	330 (58%)	114 (51%)	45 (35%)	61 (79%)	159 (48%)	149 (76%)	228 (97%)	61 (86%)
Diagnose group								
- Surgical	286 (51%)	110 (49%)	92 (72%)	26 (34%)	196 (60%)	63 (32%)	65 (28%)	31 (44%)
- Medical	164 (29%)	55 (25%)	8 (6%)	39 (51%)	77 (23%)	112 (57%)	161 (69%)	38 (54%)
- Trauma	1 (0%)	24 (11%)	2 (2%)	12 (16%)	42 (13%)	12 (6%)	4 (2%)	2 (3%)
- Neurology/neurosurgical	115 (20%)	34 (15%)	26 (20%)	0	14 (4%)	8 (4%)	5 (2%)	0
Infection or strong suspicion	92 (16%)	39 (18%)	19 (15%)	51 (66%)	99 (30%)	80 (41%)	97 (41%)	39 (55%)
Metabolic acidosis	205 (36%)	18 (8%)	26 (20%)	29 (38%)	57 (17%)	91 (47%)	90 (38%)	9 (13%)
Highest urea level in mmol/L	4.9±3.7	16.0±11.3	15.5±7.6	11.1±8.7	7.9±6.4	9.3±5.9	11.5±9.6	13.5±12.7
Delirious, n (%)	86 (15%)	60 (27%)	23 (18%)	30 (39%)	42 (13%)	23 (12%)	73 (31%)	26 (37%)

Data are expressed as mean with standard deviation, unless reported otherwise

Significant differences on predictors between the centers

Performance PREDELIRIC internationally



AUC: 0.77 (95%CI: 0.74-0.79) = 77% good prediction

Case

Male 41yr old injured during moutainbiking resulting in mild brain damage, #femur. After the operation he was admitted to the ICU, sedated with propofol, morfine 1mg/uur, there were no signs of infection, urea level 9 mmol/L, metabole acidosis, APACHE-score is 11

In formula:

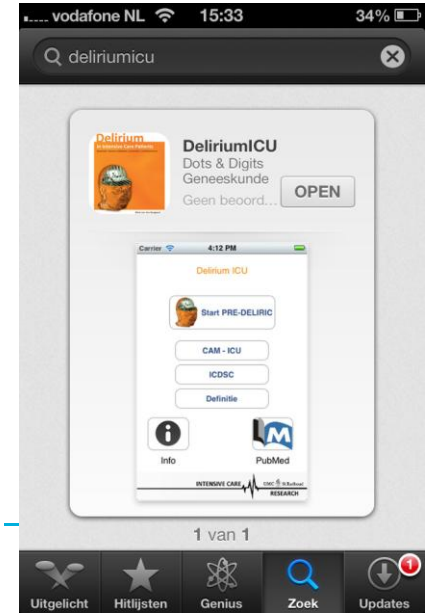
*-6.31 (41*0.04+22*0.06+0.55+1.13+0.13+0.29 +0+1.39 +9.4*0.03+0.4)= 1.526791*

EXP(1.526791)/(1+EXP 1.526791)=

Delirium probability: **94%**

DeliriumICU app

- http://itunes.apple.com/us/app/deliriumicu/id511306390
- https://play.google.com/store/apps/details?id=dotsdigits.deliriumicu



“Last” prediction study

- Can we predict ICU delirium immediately after ICU admission ?

- Multinational cohort study with 13 participating ICUs from 7 countries

Results

Variables	Development (N= 1962)	Validation (N= 952)
Age in years*	61.7 (53-74)	60.6 (51-73)
Male, N (%)	1166 (59.4)	550 (57.8)
Admission category, N (%) - surgical - medical - trauma - neurology/neurosurgical	 1019 (51.9) 683 (34.8) 90 (4.6) 170 (8.7)	 476 (50.0) 338 (35.5) 44 (4.6) 94 (9.9)
Urgent admission, N (%)	1163 (59.3)	570 (59.9)
LOS-ICU in days*	2.0 (1-6)	2.0 (1-5)
Delirium, N (%)	481 (24.5)	208 (21.8)

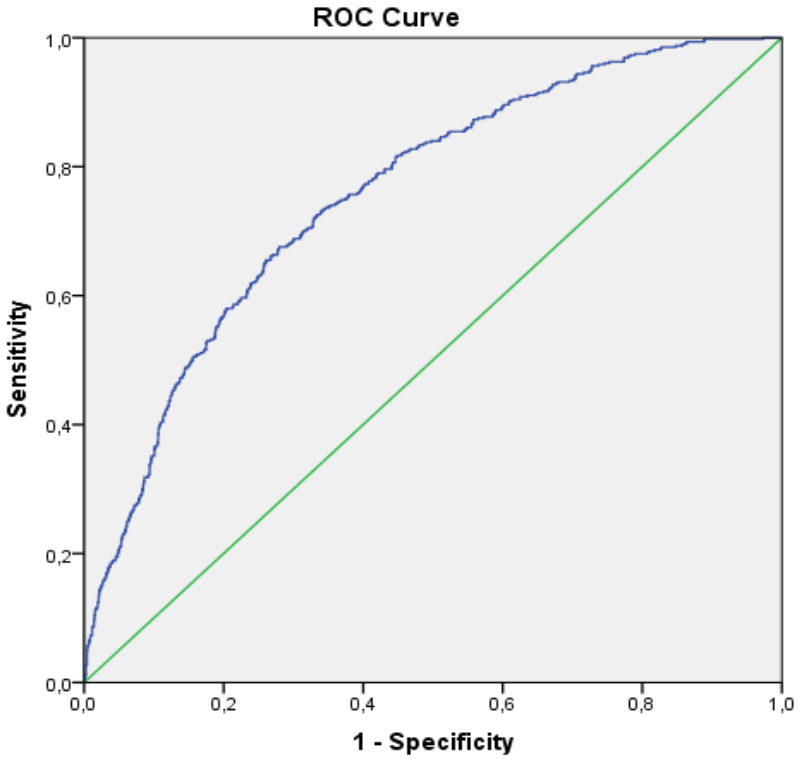
Results

Model consist of 9 predictors available at time of ICU admission:

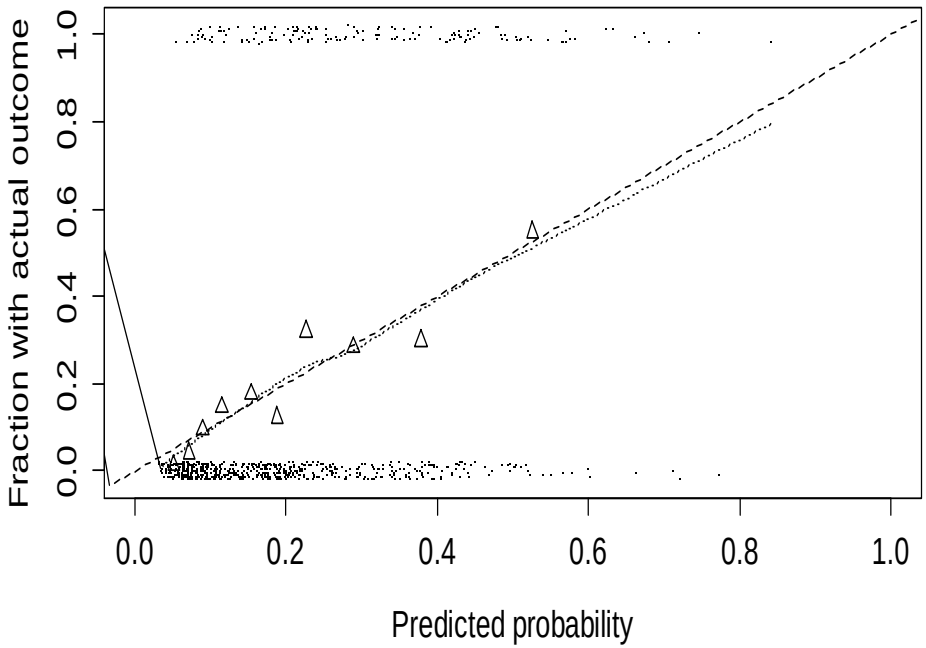
1. *age*
2. *cognitive impairment* (history of dementia, MCI, delirium)
3. *alcohol abuse* (documented history)
4. *admission category* (surgical, medical, trauma, neurology/-surgical)
5. *urgent admission*
6. *mean arterial blood pressure*
7. use of *corticosteroids* (except inhalation corticosteroids)
8. *respiratory failure*
9. *blood urea* level (mmol/L)

Results

Discrimination of E-PREDELIRIC



Calibration



AUC: development 0.76 and validation: 0.77

Now we can predict delirium,

can we also prevent ICU delirium?

Early delirium treatment

- Early vs late treatment: decrease in mortality, less infections and lower workload

TABLE 2:
Main outcomes in patients with delirium in the intensive care unit whose delirium treatment began within 24 h (immediate therapy) or > 24 h (delayed therapy) after delirium diagnosis

Outcome	Immediate therapy $n = 184$	Delayed therapy $n = 20$	Statistical significance[a]
Mortality	16 (8.7)	7 (35.0)	$P = 0.003$
Nosocomial infections	134 (72.8)	19 (95.0)	$P = 0.029$
Pneumonia	92 (50.0)	16 (80.0)	$P = 0.017$
Mechanical ventilation (days)	8.5 (0 – 90)	12.8 (0 – 41)	NS
Length of ICU stay (days)	17.2 (3 – 90)	20.0 (3 – 42)	NS
APACHE II score at discharge	16.9 (6 – 43)	24.1 (7 – 45)	$P = 0.002$
SOFA score at discharge	3.9 (0 – 18)	7.5 (1 – 19)	$P = 0.005$
TISS-28 score at discharge	27.3 (3 – 66)	36.9 (13 –60)	$P = 0.001$

The Journal of International Medical Research
2010; 38: 1584 – 1595

Delayed Treatment of Delirium Increases Mortality Rate in Intensive Care Unit Patients

A Heymann[1]*, F Radtke[1]*, A Schiemann[1], A Lütz[1], M MacGuill[1], KD Wernecke[1,2] and C Spies[1]

ICU delirium prevention

- Pharmacological
- Non-pharmacological prevention

Pharmacological delirium prevention

- Haloperidol low dosage is maybe effective
  - In non-cardiac surgery ICU patients randomized to haloperidol (n=229) max. of 5mg (continuously) or placebo (n=228) resulted in a decrease of delirium, increase of delirium-coma-free days. No risk stratification was made (Wang et al., 2012)

Table 3. Efficacy outcomes of all patients

	Haloperidol (n = 229)	Placebo (n = 228)	*p*
Length of stay in intensive care unit[a], median (95% CI), hr	21.3 (20.3–22.2)	23.0 (20.9–25.1)	.024
Time to onset of delirium[a], mean (95% CI), d	6.2 (5.9–6.4)	5.7 (5.4–6.0)	.021
Occurrence of brain dysfunction[b], n (%)			
Coma[c]	2 (0.9)	2 (0.9)	1.000
Delirium	35 (15.3)	53 (23.2)	.031
Coma or delirium[c]	36 (15.7)	54 (23.7)	.032
Number of days without brain dysfunction[d], mean ± SD, d			
Coma-free[c]	7.0 ± 0.5	7.0 ± 0.2	.608
Delirium-free	6.8 ± 0.5	6.7 ± 0.8	.027
Coma-free and delirium-free[c]	6.8 ± 0.7	6.7 ± 0.9	.030
Occurrence of nondelirium complications, n (%)			
Within 7 d after surgery	35 (15.3)	40 (17.5)	.514
Within 28 d after surgery	41 (17.9)	48 (21.1)	.395
Length of stay in hospital after surgery[a], median (95% CI), d	11.0 (10.1–11.9)	11.0 (10.2–11.8)	.255

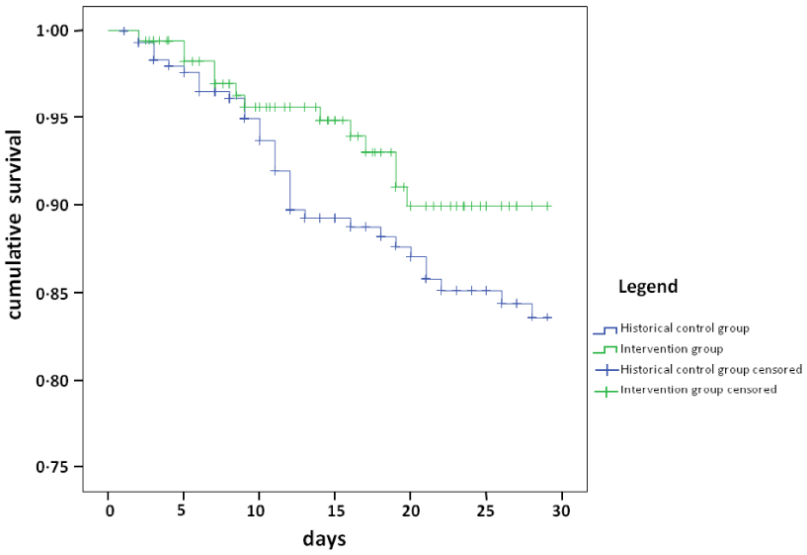
  - Hope trial: randomized to haloperidol (3x2.5mg) or placebo. No differences were found on outcome. Small study of 140 patients, delirium before inclusion was no exclusion criteria, no risk stratification was made (Page et al., 2013)

Pharmacological delirium prevention

- Haloperidol low dosage is maybe effective
  - Pre-Posttest study (van den Boogaard et al., 2013) in high risk patients (predicted risk ≥50%) using 3x1 mg haloperidol had beneficial effects on outcome.

Table 2. Differences between control group and complete intervention group.

	Control group (N=299)	*Intervention group (N=177)*	*Differences (P-value)*
Predicted delirium chance	*73±22*	*75±19*	*0.50*
Observed delirium incidence (n,%)	225 (75%)	115 (65%)	*0.01*
Non-delirium:	74 (25%)	62 (35%)	*0.38*
Delirium subtype:			
- Hyperactive	20 (7%)	6 (3%)	
- Hypoactive	81 (27%)	33 (19%)	
- Mixed	124 (41%)	76 (43%)	
Number of delirium free days without coma in 28 days	13 [3-27]	20 [8-27]	*0.003*
Re-intubation (%)	25 (8%)	15 (9%)	*0.51*
Duration mechanical ventilation in hrs.	118 [39-250]	90 [36-229]	*0.24*
Unplanned removal tubes/lines (%)	58 (19%)	21 (12%)	*0.02*
- Tube	8 (3%)	4 (2%)	
- Gastric tube	26 (9%)	14 (8%)	
- CVC/arterial line	24 (8%)	1 (<1%)	
- Other	0 (0%)	2 (1%)	
Re-admission	55 (18%)	20 (11%)	*0.03*
LOS-ICU	7 [3-13]	6 [3-12]	*0.65*
LOS-in hospital	21 [12-41]	20 [11-31]	*0.16*
28-day mortality	36 (12%)	13 (7.3%)	*0.03**



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Delirium risk <70%	Control (N=110)	Intervention (N=68)
PRE-DELIRIC score	50±19	55±16
Delirium incidence (N,%)	55 (50%)	30 (44%)
Delirium-free-days 28 days [median, IQR]	26 [10-28]	26 [13-28]
28-day mortality	13 (12%)	6 (9%)

Delirium risk 71-90%	Control (N=111)	Intervention (N=60)
PRE-DELIRIC score	81±5	81±5
Delirium incidence (N,%)	94 (85%)	44 (73%)
Delirium-free-days 28 days [median, IQR]	11 [3-22]	20 [7-27]
28-day mortality	13 (12%)	5 (8%)

Delirium risk >90%	Control (N=78)	Intervention (N=48)
PRE-DELIRIC score	94±3	95±3
Delirium incidence (N,%)	76 (97%)	41 (85%)
Delirium free days 28 days [median, IQR]	4 [0-14]	13 [6-21]
28-day mortality	10 (13%)	2 (4%)

- The higher the risk, the more beneficial prevention was

- Confirms the need for a delirium prediction model

- Confirmation in RCT is needed

Non-pharmacological measures

- **Early mobilization** (Schweickert et al.) results in shorter duration of delirium (median 2 days vs median 4 days). Small study that needs to be confirmed
- **Multicomponent interventions** in non-ICU patients focusing on several risk factors (cognitive impairment, sleep deprivation, immobility and visual and hearing impairment) resulted in a significant reduction on delirium incidence and duration
- Studies to confirm this in ICU patients should be performed
- Interestingly: **reorientation strategy** resulted in less delirium and **bright-light therapy** resulted in reduced severity of delirium

Small prevention studies in the ICU showed positive effects on delirium Outcome (pharmacological and non-pharmacological interventions) but needed all to be confirmed in larger randomized controlled trials

Final conclusion

- ICU delirium **occurs frequently** and is associated with **poor outcome**
- Delirium **detection** by ICU nurses is possible but there is a **need for improvement** in delirium assessment tools
- We now can **predict** ICU delirium in an early stage of ICU admission which is **helpfull for preventive** measures in high risk patients
- Delirium **prevention** seems **beneficial** for ICU patients

BUT THERE IS STILL MUCH TO GAIN IN ICU DELIRIUM

Welcome to next Venticare congres for ICU nurses

International program
Sepsis *Chairs: Prof. J. Bakker, MD, PhD & Prof. P. Pickkers, MD, PhD*
1. The approach to a patient in septic shock; *P. Pickkers* 2. Physiology of the heart in sepsis; *J. Bakker* 3. Advanced measurements of the circulation in shock; *E. Boerma*
BREAK
Sedation, Analgesia and Delirium
4. Delirium or not, that's the question; *I. Zaal* 5. What can we do for our delirious patient; *M. van der Jagt*
LUNCH
Respiratory failure treatment options *Chairs: Prof. D. Gommers, MD, PhD & L. Heunks, MD, PhD*
1. NAVA (invasive and non-invasive); *L. Heunks* 2. Lung monitoring; *D. Gommers*
BREAK
3. Difficult weaning made easy; *L. Heunks*

International program
Shock *Chairs: P. Kingma & Dos Reis Miranda , MD, PhD*
1. The heart in different types of shock; *F. de Lange* 2. Vasopressors or vasodillators; a dilemma; *P. van der Voort* 3. Fluid management; *H. van der Hoeven*
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Infections
4. The gut as reservoir for infection and resistance; *Dos Reis Miranda* 5. Update of selective gut decontamination; *E. de Jonge*
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Renal failure *Chairs: J. Epker, MD & E. Kompanje, PhD*
1. How to care for the kidney in the ICU; *H. van der Hoeven* 2. Start and stopping rules for hemofiltration; *H. Oudemans* 3. Principles and practice of citrate based filtration and dialysis; *P. Kingma*
BREAK
End of Life
1. End of Life; *J. Epker* 2. Organ donation; *E. Kompanje*

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Thank you for your attention and have safe drive/flight home

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