



**European Delirium Association**  
**19th Annual Meeting**  
**TEAM UP Against Delirium**  
**The Hague 6-8 November 2024**  
**Conference proceedings**



[www.europeandeliriumassociation.org](http://www.europeandeliriumassociation.org)

# About the conference

The 19th Annual Meeting of the European Delirium Association (EDA), held from November 6 to 8, 2024, at Madurodam in The Hague, The Netherlands. This year's conference, themed "Team Up Against Delirium," brought together a diverse group of experts including scientists, physicians, nurses and a variety of allied healthcare professionals from around the world to share the latest advancements in delirium research and clinical practice.

The two-day Annual Meeting was preceded by the yearly Pathophysiology Symposium, which united established scientists with a background in the basic sciences with PhD-students who pitched their upcoming projects. Simultaneously, the first Dutch Interactive Delirium Masterclass for nurses and allied healthcare professionals provided a solid set of refresher lectures on delirium prevention, recognition, treatment and aftercare. Through the participation of ex-ICU-delirium patients, the masterclass stayed close to what matters most: our patients.

## Keynote speakers

We were honored by the presence of three keynote speakers.

**Björn Weiss** is a professor of Anesthesiology at Charité University Hospitals, Berlin, Germany. His lecture was titled "*Virtual Critical Care, lessons for interprofessional teamwork*"



**Meera Agar** is a professor of palliative medicine at the University of Technology, Sydney, Australia. Her lecture was titled "*Delirium in the Palliative Phase*"

**Carsten Hermes** is an MSc Advanced Nurse Practitioner with a background in anesthesiology and intensive care nursing, affiliated to the Hamburg University of Applied Sciences. His lecture was titled "*Delirium prevention, detection and management: A holistic approach*"



# The organising committee

**Dr. Thomas Ottens, chair**

*Thomas is a consultant anesthesiologist-intensivist at the department of Intensive Care Medicine, HagaZiekenhuis, The Hague, The Netherlands.*

**Prof. Dr. Barbara van Munster, member**

Barbara is a professor of geriatric medicine at the University Medical Center Groningen, Groningen, The Netherlands.

**Prof. Dr. Mark van den Boogaard, member**

Mark is a professor of critical care nursing at Radboud University, Nijmegen, The Netherlands, and an EDA Executive Committee member.

For the Pathophysiology Symposium

**Dr. Colm Cunningham, member**

Colm is an associate professor of neuroscience and biochemistry at Trinity College, Dublin, Ireland, and an EDA Executive Committee member.

## Abstract Committee

- Mark van den Boogaard
- Kevin Seiler
- Colm Cunningham
- Emma Cunningham
- Edwin van Dellen
- Wolfgang Hasemann
- Bjørn Erik Neerland
- Birgitta Olofsson
- Cynthia Oluto
- Christian Pozzi
- Jacqueline Strik
- Emma Vardy



# Acknowledgements

The invitation of the 19th Annual Meeting of the EDA to The Hague was courtesy of the **Department of Intensive Care Medicine, HagaZiekenhuis, The Hague.**

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The conference organisation was supported by **Interactie Groep, Ede, The Netherlands**



We are very grateful for the support of  
the sponsors of EDA2024:

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# Adapting the Cornell Assessment of Pediatric Delirium for the Swedish Context: Translation, Cultural Validation, and Inter-Rater Reliability

## Authors:

1. Sara Åkerman, Department of Surgical Sciences, Uppsala Centre for Paediatric Anaesthesia and Intensive Care Research, Uppsala University, Sweden
2. Anna Axelin, Department of Nursing Science, University of Turku,, Finland
3. Chani Traube, Department of Pediatrics, Weill Cornell Medical Center, New York, NY, United States
4. Robert Frithiof, Department of Surgical Sciences, Uppsala Centre for Paediatric Anaesthesia and Intensive Care Research, Uppsala University, Sweden
5. Ylva Thernström Blomqvist, Uppsala University, Department of Women's and Children's Health, Uppsala, Sweden

## Background:

Pediatric delirium causes prolonged hospital stays, increased costs, and distress for children and caregivers. Due to a lack of validated, easy-to-use tools, delirium is rarely assessed in Swedish pediatric intensive care units. This study aimed to translate, culturally adapt, and assess the suitability of the Cornell Assessment of Pediatric Delirium (CAPD) for implementation in Swedish healthcare settings.

## Method:

The ten-step process recommended by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Task Force for Translation and Cultural Adaptation was used to translate and culturally adapt the CAPD to Swedish conditions. The instrument was tested in the pediatric intensive care unit of Uppsala University Hospital, a tertiary hospital in Sweden. Registered nurses were interviewed to culturally adapt the CAPD to Swedish conditions. Inter-rater reliability was tested using intraclass correlation (ICC), where registered nurses and assistant nurses performed parallel assessments of the patient regarding the CAPD. An ICC >0.75 was considered good reliability.

## Results:

The cultural adaptation revealed problems related to instructions, education, and wording. The wording was improved by changing words (e.g., 'action' to 'acts') to ensure correct interpretation. In addition, education was extended and improved to ensure the best possible competence of the users of the instrument. Regarding problems with instructions, the instrument was modified to clarify when assessment should be performed and when it is not possible. Furthermore, instructions were added to increase clarity and usability (e.g., adding the cut-off score for delirium). The ICC was 0.857 (95% confidence interval: 0.708-0.930).

## Conclusions:

This investigation successfully undertook the translation and cultural adaptation of the CAPD to align with Swedish contextual parameters. The resulting adapted instrument demonstrated good inter-rater reliability. Hence, it presents as a viable tool for evaluating the presence of delirium among pediatric patients within Swedish pediatric intensive care units.

# Prevalence and Risk Factors of Delirium in Swedish Pediatric Intensive Care Units: A Longitudinal Multicenter Study

## Authors:

1. Sara Åkerman, Department of Surgical Sciences, Uppsala Centre for Paediatric Anaesthesia and Intensive Care Research, Uppsala University, Sweden
2. Chani Traube, Department of Pediatrics, Weill Cornell Medical Center, New York, NY, United States
3. Robert Frithiof, Department of Surgical Sciences, Uppsala Centre for Paediatric Anaesthesia and Intensive Care Research, Uppsala University, Sweden
4. Ylva Thernström Blomqvist, Uppsala University, Department of Women's and Children's Health, Uppsala, Sweden

## Background:

Delirium in children remains an underexplored area within Swedish pediatric intensive care units (PICUs), despite its association with longer hospital stays, prolonged mechanical ventilation, increased suffering for children and their families, and higher mortality rates. This study aims to implement a delirium screening process in Swedish PICUs, measure delirium prevalence, and identify associated risk factors.

## Method:

Since February 2024, a longitudinal multicenter study has been conducted in three out of four Swedish PICUs. All children admitted with an anticipated overnight stay are enrolled, excluding those in end-of-life care. Delirium is assessed three times daily using the Swedish version of Cornell Assessment of Pediatric Delirium (CAPD). Data on medication, family presence, mechanical ventilation, and other relevant factors are collected, supplemented by a comprehensive journal review.

## Results:

This study is ongoing, and preliminary data will be presented. To date, over 200 patients have been enrolled. The study is expected to continue until June 2025.

# Improving the safety of antipsychotic prescribing in delirious patients

## Author:

Fawziya Huq, Liverpool Heart and Chest Hospital NHS Foundation Trust, United Kingdom

## Background/Aims:

Up to 50% of delirious patients within our hospital are prescribed antipsychotics. Antipsychotics should only be used when necessary, at low doses and short duration due to potential adverse outcomes. Our quality improvement project aimed to improve the safe prescribing of antipsychotics in line with UK guidelines and hospital policy.

## Methods:

A randomised sample of antipsychotic prescriptions (Haloperidol, Quetiapine and Risperidone) in delirious patients were selected 2021-2023. The rationale of prescribing, start doses and duration prescribed were recorded. Interventions to improve safe prescribing included simulation, de-escalation training, prescribing programme, and a delirium management tool with medication guidance.

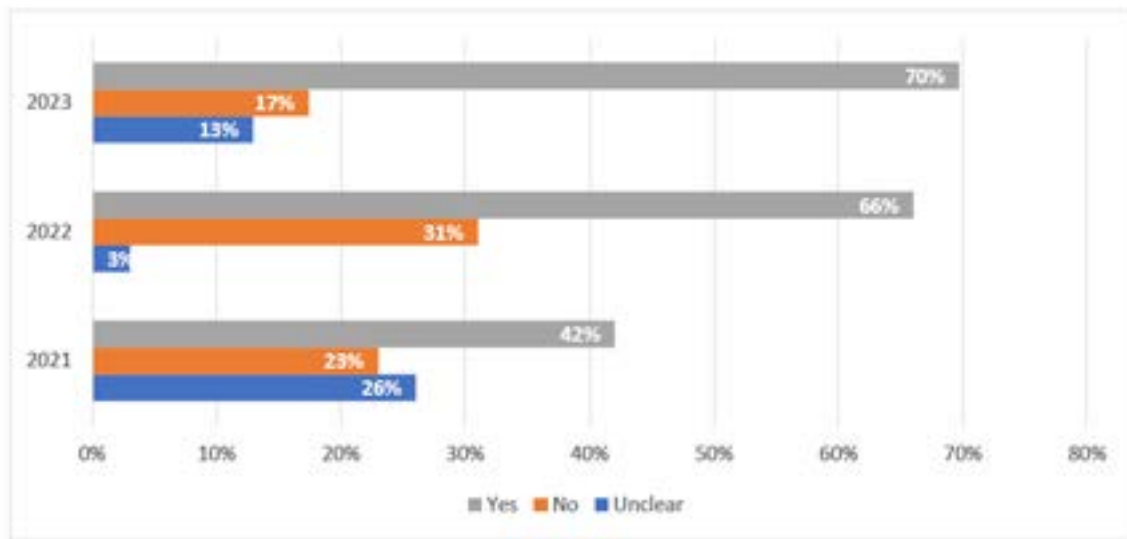
## Results:

A sample of 93 prescriptions in 2021, 177 prescriptions in 2022 and 310 prescriptions in 2023 were reviewed. Appropriate rationale of prescriptions improved from 48% (2021) to 68% (2022) however reduced to 51% in 2023. Start dose compliance remained consistently high for Quetiapine in all years (100%), poor for Risperidone (50% 2021; 0% 2022; 9% 2023) and improved for Haloperidol (79% 2021 to 90% 2023). The duration of antipsychotics stopped within 7 days improved from 65% (2021); 88% (2022) to 98% (2023). Overall compliance with the policy improved from 42% (2021); 66% (2022) to 70% (2023).

## Conclusions:

The interventions helped sustain improvements in overall compliance with the policy, start doses for Quetiapine and Haloperidol and stopping antipsychotics within 7 days. Some improvements were not sustained, possibly due to large staff turnover. Future interventions include a pre-set prescribing bundle for delirium patients, updating the hospital delirium policy and creating a delirium e-module for new staff.

**Graph 1: Compliance with delirium policy**



**Graph 2: NICE guidelines compliance stopping antipsychotics within 7 days**



# Comparison of delirium observation screening scale versus single-channel EEG after cardiac surgery: The Brain Pro-TCT study

## Authors:

1. Miarca ten Broeke, Medisch Spectrum Twente, Enschede, Netherlands
2. Wim P.R. Henckens, Medisch Spectrum Twente, Enschede, Netherlands
3. Anna Weierink, Medisch Spectrum Twente, Enschede, Netherlands
4. Ron G.H. Speekenbrink, Medisch Spectrum Twente, Enschede, Netherlands
5. Job Van der Palen, Medisch Spectrum Twente, Enschede, Netherlands
6. Frank Halfwerk, Medisch Spectrum Twente, Enschede, Netherlands

## Background:

Delirium in elderly patients following cardiac surgery is related to increased complications, hospitalization duration and mortality. Identifying delirium in high-risk patients is essential, yet hypoactive delirium is often overlooked in nurse-reported screening. Polymorphic delta waves, detectable through single-channel electroencephalography (SC-EEG), are linked to delirium. This study compared screening with SC-EEG to the nurse-reported delirium observation screening scale (DOSS) for the detection of postoperative delirium and compare hospitalization duration for delirious patients.

## Methods:

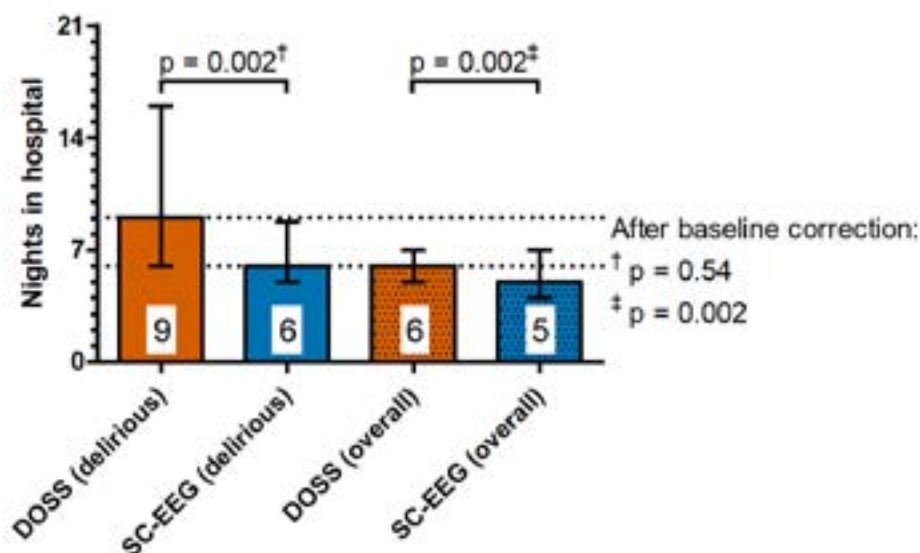
In a prospective quasi-experimental study on a nursing ward, we compared DOSS screening (442 patients) with SC-EEG screening (462 patients) to identify postoperative delirium in cardiac surgery patients aged over 70 years. Delirium diagnoses were based on DSM-5 criteria. Analyses were corrected for baseline differences through multivariable regression analyses.

## Results:

The SC-EEG group had a higher delirium detection rate (20%) compared to the DOSS group (14%),  $p = 0.016$ . Unadjusted, a reduced median length of stay for delirious patients, identified with SC-EEG was observed ( $p = 0.002$ ) but in multivariable analysis pneumonia and EuroSCORE II, rather than screening method were responsible ( $p = 0.54$ ). Overall hospital stay was 0.11 [0.04 to 0.18] days shorter for patients in the SC-EEG cohort compared to those in the DOSS cohort,  $p = 0.002$  (figure 1).

## Conclusions:

SC-EEG screening increased the delirium detection rate after cardiac surgery. While a reduction in the length of stay for all patients in the SC-EEG cohort was modest, it can be relevant for high-volume cardiac surgery centres.



**Figure 1** Length of stay. This figure shows the difference between length of stay (median) for delirious patients screened with DOSS (9 nights) vs SC-EEG (6 nights) ( $p = 0.002$ ). After multivariable analysis the use of SC-EEG did not reduce length of stay for delirious patients ( $p = 0.54$ ). Length of stay for the overall group screened with DOSS (6 nights) vs SC-EEG (5 nights) was significantly different ( $p = 0.002$ ). After multivariable analysis SC-EEG remains a predictor of length of stay ( $p = 0.002$ ).

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## CSF concentrations of Neurofilament light chain in patients with delirium following hip fracture: a multicenter prospective study

### Authors:

1. Irit Titlestad, Oslo, Norway
2. Leiv Otto Watne, Oslo, Norway
3. Lasse M Gil, Oslo, Norway
4. Nathalie Bodd Halaas, Oslo, Norway

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### Background:

Previous findings suggest that the pathophysiology of delirium may be associated with neuronal injury, which could be assessed through Neurofilament light chain (NfL) concentrations in the cerebrospinal fluid (CSF).

**Aim:** To investigate the association of CSF concentrations of NfL with delirium in patients with hip fractures and whether CSF NfL concentrations are associated with mortality in patients with delirium.

### Methods:

The study comprised two prospective Norwegian cohorts of 496 acutely hospitalized hip fracture patients with CSF samples. Delirium was assessed daily from admission until the fifth postoperative day using either The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, or the Confusion Assessment Method criteria. CSF was collected at the onset of spinal anesthesia. Findings regarding NfL concentrations from participants in the first cohort were previously published.

### Results:

In total, 259 (52%) patients developed delirium. Median CSF NfL was higher among patients with delirium (2116 pg/ml versus 1366 pg/ml; Gini coefficient = 0.40,  $P < 0.001$ ). However, the differences in NfL concentrations did not remain significant in the adjusted analysis and can be explained by additional factors, including age, dementia status and Activities of daily living function. In the subgroup analysis (dementia versus no dementia), after adjustment for covariates, CSF NfL concentrations were associated with delirium in patients without dementia (OR 1.68, [1.15, 2.45]  $P = 0.007$ ). CSF NfL concentrations among patients with delirium were not associated with mortality in the adjusted analysis.

### Conclusion:

In patients without dementia, our findings support a possible association between neuroaxonal injury and delirium.

## Control of course temperature in major orthopedic surgery and neurotraumatology using levobupivacaine for spinal anesthesia in elderly patients with delirium

### Authors:

1. Barbara Amarisse, University of Perugia, Italy
2. Vito Aldo Peduto, University of Perugia, Italy
3. Bruno Ciammitti, University of Perugia, Italy
4. Giovanni Ziuliani, University of San Marino and Ferrara, Italy
5. Amedeo Zuliani, University of San Marino and Ferrara, Italy

Randomised study of geriatric patients aged between 75–85, divided into two groups with and without intraoperative heating, undergoing major orthopaedic surgery. 46% of patients manifest delirium in the postoperative stage. From the study, postoperative pain is correlated to the onset of delirium in the postoperative stage.

In major orthopaedic surgery in geriatric patients (N=25) aged between 75–85 with intraoperative heating, the incidence of overall delirium is 15%; delirium with a single event in the controls during the stay is 40%; severe delirium is 5%; delirium in the postoperative stage is 15%; and delirium on discharge is 5%.

In major orthopaedic surgery in geriatric patients (N=25) aged between 75–85 without intraoperative heating, the incidence of overall delirium is 32%; delirium with a single event in the controls during the stay is 50%; severe delirium is 12%; delirium in the postoperative stage is 29%; and delirium on discharge is 13%.

Pharmacological treatment of delirium:

With intraoperative heating: quetiapine 25 mg ( $\frac{1}{2}$  or 1 pill twice/day), Haloperidol 8 drops.

Without intraoperative heating: quetiapine 25 mg (1 pill twice/day) and Haloperidol 1 dose i.m.

Without intraoperative heating, with low mini nutritional assessment: olanzapine 1 pill once/day, quetiapine 25 mg (2 pills once/day), Haloperidol 1 dose i.m.

Preoperative IADL score in geriatric patients (N=50; aged between 75–85) undergoing major orthopaedic surgery is  $5\pm 4$ . Postoperative IADL score in geriatric patients group A (N=25) undergoing major orthopaedic surgery with intraoperative heating is  $3\pm 2$ . Postoperative IADL score in geriatric patients group B (N=25) undergoing major orthopaedic surgery without intraoperative heating is  $2\pm 1$ . In the 50 patients before the operation, the mini nutritional assessment score is  $23\pm 2$ . On discharge, in group A with intraoperative heating, the mini nutritional assessment score is  $21\pm 2$ . In group B without intraoperative heating, the mini nutritional assessment score is  $19\pm 1.8$ .

Postoperative pressure sores in geriatric patients:

Group A (with intraoperative heating): 15% sacrum pressure lesions first stage; 5% sacrum pressure lesions second stage.

Group B (without intraoperative heating): 8% sacrum pressure lesions fourth stage; 10% sacrum pressure lesions third stage.

Minimal test postoperative score in geriatric patients:

Group A:  $22\pm 1.8$

Group B:  $18\pm 1.5$

Delirium is most frequent in geriatric patients.



# Systemic oxidative stress associates with delirium in a geriatric population with hip fracture

## Authors:

1. Monika Trzpis, University Medical Center Groningen, Groningen, Netherlands
2. Maria Zernova, University Medical Center Groningen, Groningen, Netherlands
3. Karin Vermeulen, University Medical Center Groningen, Groningen, Netherlands
4. Marian Bulthuis, University Medical Center Groningen, Groningen, Netherlands
5. Marjan Reinders-Luinge, University Medical Center Groningen, Groningen, Netherlands
6. Harry van Goor, University Medical Center Groningen, Groningen, Netherlands
7. Barbara van Munster, University Medical Center Groningen, Groningen, Netherlands
8. Arno Bourgonje, University Medical Center Groningen, Groningen, Netherlands

## Background:

Oxidative stress ensues in patients undergoing surgery for hip fracture and has been implicated in the pathophysiology of delirium. Circulating free thiols (R-SH, sulfhydryl groups) serve as biomarker of systemic oxidative stress since they are rapidly oxidized by reactive species, acting as potent antioxidants. We aimed to investigate the relationship between delirium and systemic oxidative stress in older patients hospitalized with hip fracture.

## Methods:

Patients aged 65 years or more, acutely admitted due to hip fracture, were included between 2005 and 2008. Plasma samples were collected longitudinally during hospitalization. Delirium was diagnosed by the Confusion Assessment Method. Free thiols were determined in plasma using colorimetric detection. Baseline albumin-adjusted plasma free thiol concentrations were both cross-sectionally and longitudinally evaluated in relation to delirium.

## Results:

In total 813 plasma samples from 336 patients were analysed. Delirium was experienced by 110 (33%) patients. Mean albumin-adjusted free thiols of patients who experienced delirium ( $7.3 \pm \text{SD } 1.4 \mu\text{M/g}$ ) was lower than that of non-delirious patients ( $7.5 \pm \text{SD } 1.3 \mu\text{M/g}$ ) ( $P=0.050$ ). Multivariable logistic regression analysis, adjusted for age, preexisting cognitive impairment and complications, indicated that delirium was significantly inversely associated with albumin-adjusted free thiol concentrations ( $P=0.006$ ). The significant association between delirium and albumin-adjusted free thiols tested in all the samples was also shown by linear mixed model analysis after adjusting for age, preexisting cognitive impairment, complications and time in relation to surgery ( $P=0.029$ ).

## Conclusions:

Reduced concentrations of free thiols, reflecting systemic oxidative stress, are associated with delirium onset among patients with hip fracture.



# Medication associated delirium risk in patients with and without dementia: A systematic review

## Authors:

1. Anita E Weidmann, Innsbruck University; Dept. Clinical Pharmacy, Austria
2. Guðný Björk Proppé, Faculty of Pharmaceutical Sciences, University of Iceland, Reykjavík, Iceland
3. Rut Matthíasdóttir, Faculty of Pharmaceutical Sciences, University of Iceland, Reykjavík, Iceland
4. Pétur Sigurdur Gunnarsson, Faculty of Pharmaceutical Sciences, University of Iceland, Reykjavík, Iceland
5. Freyja Jónsdóttir, Faculty of Pharmaceutical Sciences, University of Iceland, Reykjavík, Iceland

## Background:

Medication has been considered as both a predisposing and precipitating factor for delirium. The same medications that are thought to increase the risk of precipitating delirium, such as Antipsychotics and Hypnotics, are also used as treatment. This study aimed to comprehensively review all available literature on medication associated causes, management and treatment of delirium in adult patients (>18 years) with and without dementia.

## Methods:

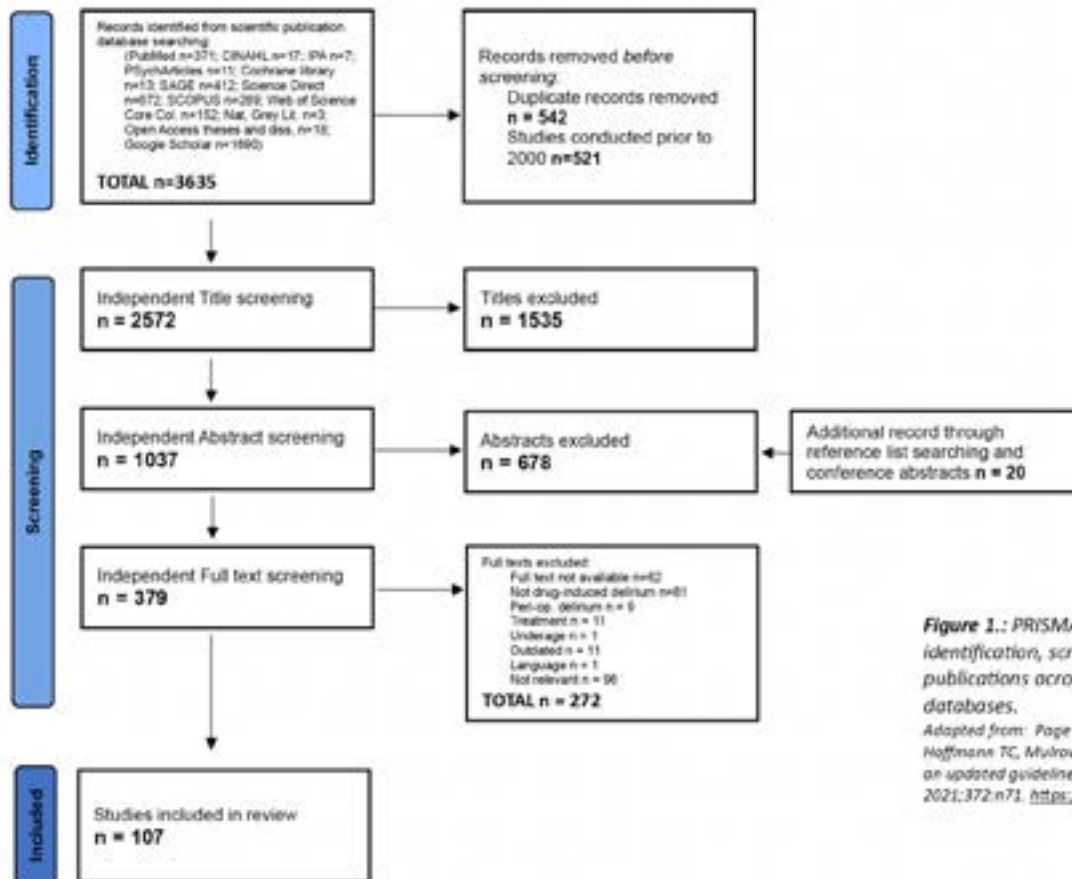
Following Protocol registration (PROSPERO CRD42022366020) a search strategy was developed with the help of a research librarian at both the Universities of Iceland and Innsbruck. A systematic search across 12 databases was conducted. The SRs were conducted according to the Cochrane best practice standards and reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

## Results:

A total of 3635 records were identified across 12 scientific databases of which 107 publications were included in this study. Good quality studies, as well as comprehensive medication related information was, scarce. A total of n=158 individual drugs were identified across 20 different drug classes. Causative drug related mechanisms include Neurotransmitter imbalances, Pharmacokinetic changes and Physiological processes. The most serious combinations are those involving Opioid analgesic & Dopamine agonists. Therapeutic alternatives and specific information on drug dosage and form was almost entirely missing.

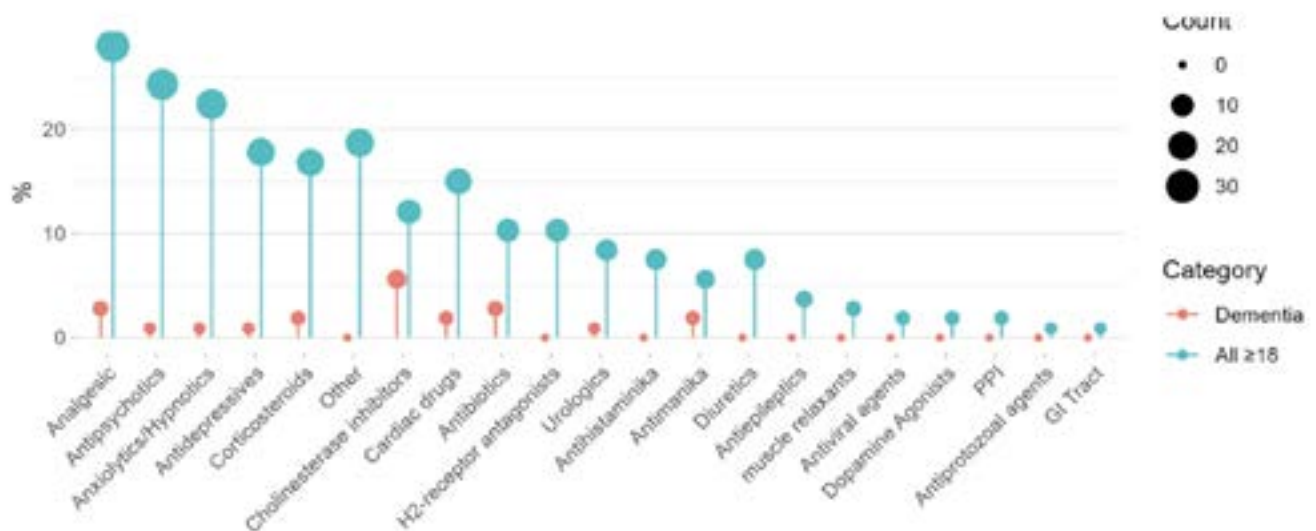
## Conclusion

This research has shown the paucity of specific medication related information and prescribing guidance available in the literature. Further studies will focus on extending the information to include several other patient groups (peri-operative, cancer etc.).



**Figure 1.:** PRISMA flowchart showing the identification, screening and selection of delirium publications across 12 scientific publication databases.

Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. <https://doi.org/10.1136/bmj.n71>



**Figure 2.:** Reporting frequency of 20 different drug classes associated with an increased risk of delirium with and without dementia across all included publications **Figure 2.:** Reporting frequency of 20 different drug classes associated with an increased risk of delirium with and without dementia across all included publications (n=107)

# Experiences of healthcare staff caring for hospitalised people with delirium: A qualitative systematic review

## Authors:

1. Siostrom Kristy, Peninsula Health, Australia
2. David Snowdon, National Centre for Healthy Ageing, Australia
3. Rumes Sriamareswaran, Peninsula Health, Australia
4. Yu Mei Law, Peninsula Health, Australia
5. Laura Jolliffe, National Centre for Healthy Ageing, Australia
6. Chris Moran, National Centre for Healthy Ageing, Australia

## Background:

To review and synthesise existing qualitative evidence on multidisciplinary healthcare providers' experiences of caring for inpatients with delirium.

## Methods:

We systematically searched OVID Medline, CINAHL, Embase, Emcare, PsychINFO, AMED and Web of Science databases for articles published between 1990 and 2022. Primary qualitative research articles published in English language peer reviewed journals were included. Questionnaires, surveys and secondary analysis of qualitative data were excluded. Article inclusion and study quality was assessed by two independent reviewers. Themes were identified using a qualitative, meta-summary approach, including both thematic synthesis and content analysis. The Confidence in the Evidence from Reviews of Qualitative Research (GRADE-CERQual) approach was used to determine the level of confidence for synthesised findings.

## Results:

Within the 25 included studies, we identified six major themes: 1) Identifying and caring for patients with delirium is challenging; 2) caring for patients with delirium can place an emotional and physical burden on nursing staff; 3) staff often feel unsupported and ill-equipped when identifying and managing delirium; 4) attitudes towards delirium are variable; 5) screening tools and delirium guidelines are inconsistently used and not universally valued; 6) delirium knowledge and education is lacking but desired.

## Conclusions:

Healthcare providers often find caring for hospitalised patients with delirium challenging and complex. Organisational facilitation of multidisciplinary teams that communicate well and are supported by appropriate, needs-focussed education and tools can improve the experience of providing care for inpatients with delirium. Further research is needed to better inform implementation of multidisciplinary delirium prevention and management

# Comparison of Prognostic Performance of Three Delirium Assessments in Older Hospitalized Emergency Department Patients shows Promising Results for Clinical Impression from Primary Care

## Author:

Eline Haan, Universitair Centrum Ouderengeneeskunde, UMC Groningen, Netherlands

## Background:

Delirium is frequent in older acute hospitalized patients and has significant adverse effects, but remains underdiagnosed, despite the development and implementation of various delirium screening methods. This study aimed to investigate the performance of three delirium assessments – clinical impression from primary care (consulting primary care notes), a risk assessment (VMS delirium score), and screening instrument (4AT-score) - in predicting delirium occurrence during hospitalization of older Emergency Department (ED) patients.

## Methods:

This was a single-centre, retrospective cohort study including acute hospitalized patients aged  $\geq 70$ . Data was extracted from Acutelines, a hospital-based biobank, and hospital electronic health records. A chart-based review for delirium during hospitalization was used as reference standard delirium. Logistic regression analysis was performed to evaluate the prognostic performance of the assessments.

## Results:

Data of 655 patients was included. Median age was 76 years and 407 (62%) were male. In 146 patients (22%), delirium was present during hospitalization. Male gender, frailty, and increased respiratory frequency were associated with delirium occurrence. Positive impression from primary care yielded an odds ratio (OR) of 7.9 for predicting delirium occurrence, VMS delirium score an OR of 3.2 and 4AT-score an OR of 3.3.

## Conclusion:

The delirium assessments primary care clinical impression, VMS delirium score, and 4AT-score were all significant predictors for delirium occurrence in older acute hospitalized patients. The good performance of primary care clinical impression appears particularly promising, as it is easy and early available and has potential to be further optimized and integrated into early delirium detection strategies.

# Delirium in the Emergency and Assessment Department (E&AD): Use of 3D-CAM and Prevalence in a Metropolitan Emergency Room

## Authors:

1. Matteo Maria Carelli, UOC Medicina Interna ASST Santi Paolo e Carlo, Ospedale San Carlo, Milano - Aiuto PS - successivamente a Niguarda Milano, Italy
2. Marta Mansi, UOC Medicina Interna ASST Santi Paolo e Carlo, Ospedale San Carlo, Milano - Aiuto PS - successivamente a San Donato Milano, Italy
3. Martina Vitrone, UOC Medicina Interna ASST Santi Paolo e Carlo, Ospedale San Carlo, Milano - Aiuto PS - successivamente ad Alessandria, Italy
4. Massimiliano Eteri, UOC Pronto Soccorso – Medicina d'Urgenza ASST Santi Paolo e Carlo, Ospedale San Carlo, Milano, Italy
5. Dario Cremonesi, Direttore Assistenziale e Direttore ff delle Professioni sanitarie dell'Azienda Ospedaliero Universitaria di Parma, Italy
6. Marco Froidi, Dipartimento di Scienze Cliniche e di Comunità, Dipartimento di Eccellenza 2023-2027 IRCCS Maugeri, Milano, Italy

## Background:

Delirium is a geriatric syndrome characterized by alteration of multiple cognitive functions, during acute clinical condition, with consequences of health outcomes and costs. According to some studies in the Emergency Department the prevalence is 40%. Our aim was to estimate the prevalence and features of Delirium in ED.

## Methods:

After a careful knowledge and systematic review of International and National literature on medical databases, we have used the 3D-CAM scale.

## Results:

We analyzed 100 subjects in the ED in time frame Sept-Dec 2023. Average age 86 years. In 47% of cases the 3D-CAM was administered with physical examination. The Delirium prevalence was 48%. The triggering causes include infections (70%), cardiorespiratory problems (20%), pain, anemia, dehydration (10%); an overlap with dementia occurred in 62% of cases. Pharmacological treatment was implemented in 52%. Quetiapine and Haloperidol were the most used drugs (31% - 23%), Promazine (19%). Benzodiazepines (6-10%), soft restraints reach 40%. The 67% of delirium patients were hospitalized vs 46% of non-delirium, with an average hospital stay of 26 days vs 18. Regarding outcomes we detected that patients with Delirium noted an increase in hospitalization days, greater probability of developing complications(40%), greater number of laboratory-radiological tests (41), worsen residual autonomy, access to rehabilitation or residential facilities (30%), death in 13%.

## Conclusions:

Through knowledge and use of 3D-CAM it is possible to recognize and carefully manage Delirium in the ED, improving the approach to elderly patients. Prevention and management of Delirium in the ED is highlighted as Best Practice in International Geriatric Guidelines.

# **Understanding the rehabilitation and support needs after an episode of delirium: A realist analysis of interviews with older people with delirium, carers and healthcare professionals**

## **Authors:**

1. Shruti Raghuraman, University of Exeter, United Kingdom
2. Ellen Richards, Royal Devon University Healthcare (RDUH) NHS Foundation Trust, United Kingdom
3. Aseel Mahmoud, University of Exeter, United Kingdom
4. Sarah Morgan-Trimmer, University of Exeter, United Kingdom
5. Linda Clare, University of Exeter, United Kingdom
6. Rob Anderson, University of Exeter, United Kingdom
7. Vicki Goodwin, University of Exeter, United Kingdom
8. Louise Allan, University of Exeter, United Kingdom

## **Background:**

Delirium is associated with several negative outcomes in older people. It is an independent risk factor for subsequent development or progression of dementia. Despite evidence of symptoms persisting up to 12 months, little is known about non-pharmacological strategies to manage delirium in the long-term. This study's objective was to conduct a qualitative investigation of the perceived home rehabilitation and support needs of older people who have experienced delirium and have been discharged home.

## **Methods:**

A realist approach was employed to qualitatively investigate the perceived home rehabilitation needs of older people who have experienced delirium during a hospital. Semi-structured interviews were conducted with 41 key stakeholders (older people (5), carers (12), and healthcare professionals (24)). Data were analysed using a realist approach to identify what works, for whom, and in what context.

## **Results:**

Several inter-connected themes were identified as potential resources that enable recovery from delirium - a) social contact and recovery of social lives, b) the need for information, support, and education, c) personalisation and personhood, d) relationship continuity with professional carers, e) the experience and involvement of carers, f) treating the cause and healthy lifestyle. When considered against the specific contextual factors that emerged from the data, these findings can help identify features of an effective rehabilitation intervention to help people recover from delirium at home.

## **Conclusions:**

This study addresses notable research and practice gaps in the long-term treatment of delirium for at home. This knowledge can contribute to an evidence-based theory of community-based delirium recovery.

# Delirium among older people living at home: a systematic review

## Authors:

1. Karin van Os, UMCG, Netherlands
2. Marike Schokker, UMCG, Netherlands
3. Sytse Zuidema, UMCG, Netherlands
4. Dika Luijendijk, UMCG, Netherlands

## Background:

Delirium will occur more often in community-dwelling people as the population ages, increasing the a-priori risk. The primary aim of our study was to determine delirium prevalence and incidence in older people living at home. The secondary aim was to examine delirium risk factors in this population.

## Methods:

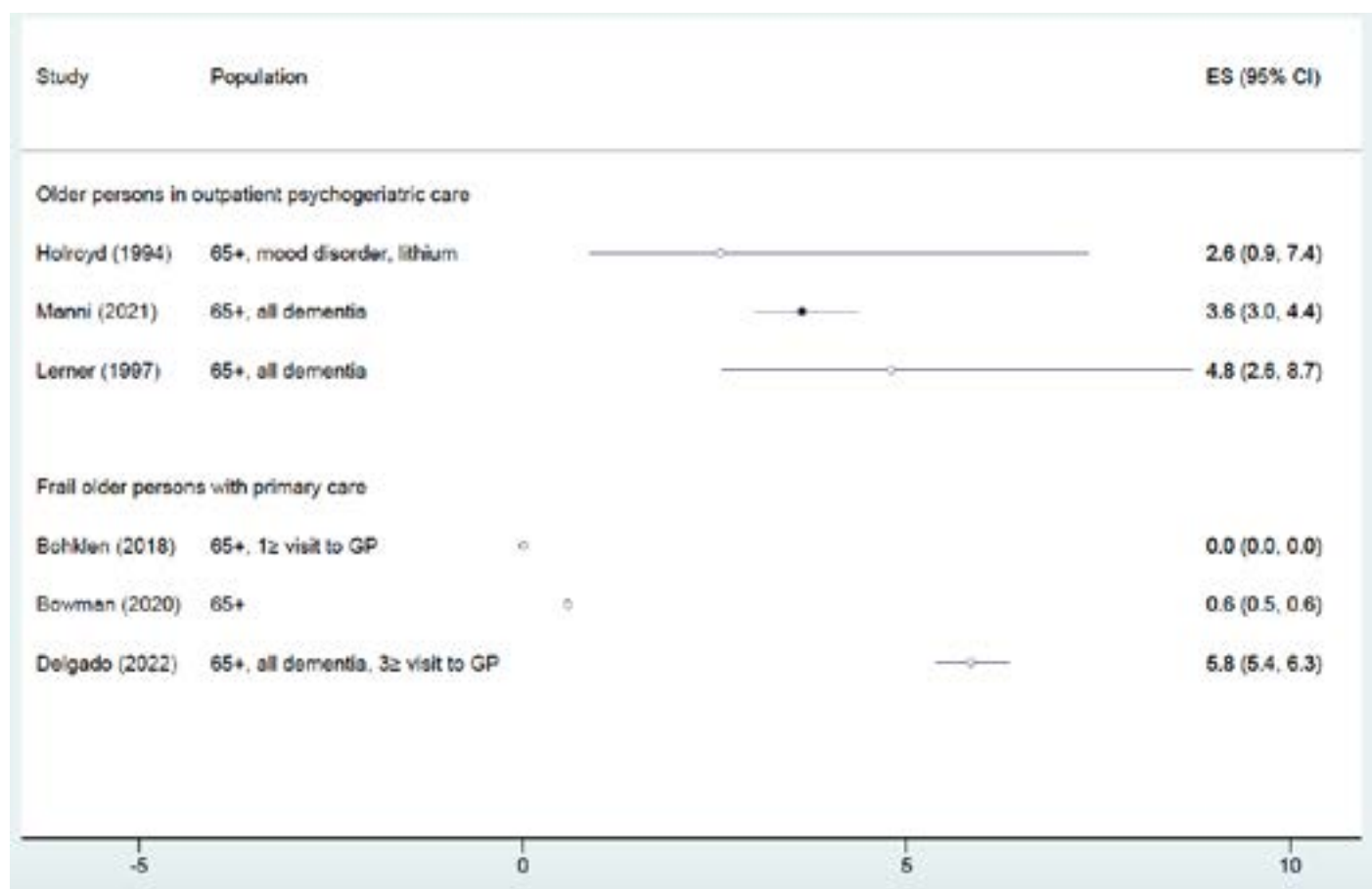
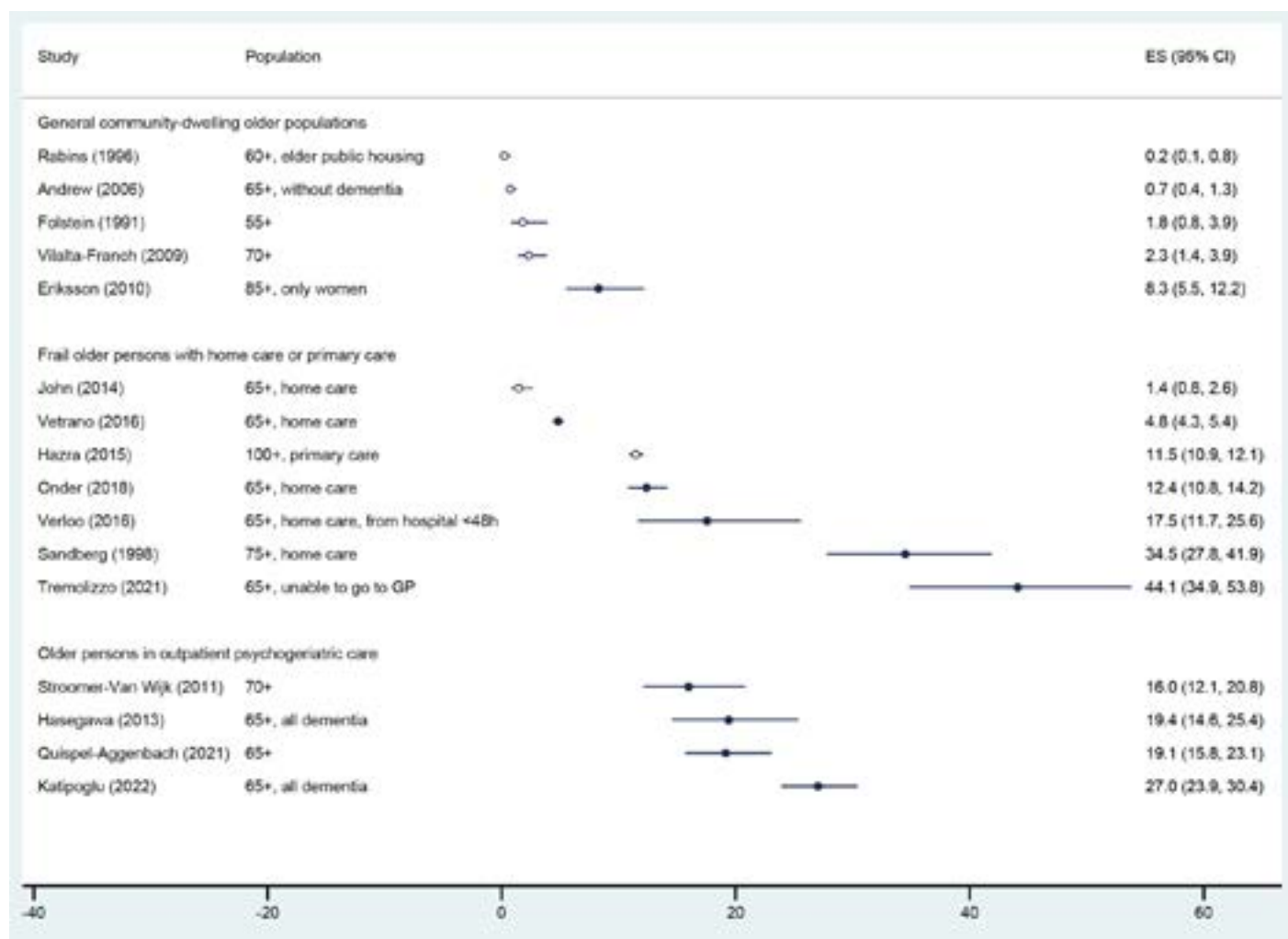
This is a systematic review guided by the Joanna Briggs Institute Manual for Evidence Synthesis. We queried PubMed/MEDLINE, CINAHL, Embase and Google Scholar from inception to July 2023. We selected studies reporting delirium prevalence or incidence rate in individuals aged  $\geq 65$  years and residing at home. Studies about delirium caused by alcohol or recreational drugs were excluded. We extracted and analysed study characteristics, point prevalence, one-year period prevalence or incidence, and risk factors.

## Results:

We identified 23 studies. The delirium prevalence rate was 0.2%-8.3% in older community dwelling people, 1.4%-44.1% in frail persons with home care or who consulted a general practitioner, and 16.0%-27.6% in persons referred for outpatient psychogeriatric care. The one-year period prevalence and incidence was 0.1%-5.8%. Studies that employed a delirium-specific instrument reported higher rates than studies based on routinely collected healthcare data. We identified nine studies that examined 22 risk factors of delirium. A statistically significant association was found consistently with frailty, but not with demographics, medical history, or other factors.

## Conclusions:

Delirium prevalence rates were substantial in frail community-dwelling older people and persons referred for outpatient psychogeriatric care. Studies relying on routine healthcare data showed the lowest prevalence rates, which suggests that delirium is often missed or not registered.





# Higher Pan-Immune Inflammation Value At Hospital Admission is a Risk Factor for Delirium: Preliminary Results From a Single-Center Study

## Authors:

*From Hacettepe University Department of Internal Medicine, Division of Geriatric Medicine, Ankara, Turkey, Türkiye*

Arzu Okyar Baş, Mihriban Güngör, Elif Gecegel, Okan Turhan, Ceyda Kayabaşı, Hande Yıldırım Mert Eşme, Burcu Balam Doğu, Meltem Gülhan Halil, Mustafa Cankurtaran, Cafer Balcı

*From Hacettepe University Faculty of Medicine, Ankara, Turkey, Türkiye*  
İlsu Duman

From Turkish Ministry of Health Eskişehir City Hospital, Division of Geriatric Medicine, Eskişehir Turkey, Türkiye  
Yelda Öztürk

## Background:

Inflammation is one of the essential hypotheses in the pathogenesis of delirium. Although various peripheral blood inflammation markers are shown to be related to delirium in different settings, there is no evidence of the relationship between delirium and Pan-immune inflammation value (PIV), a novel composite biomarker to predict inflammation. This study aimed to assess the relationship between PIV at hospital admission and delirium.

## Methods:

The study included 125 hospitalized patients over 60 years old. Delirium was screened via the Turkish version of the 4-AT Test. Frailty status was assessed with the Clinical Frailty Scale (CFS) and scores >4 were defined as frailty. PIV was calculated using the formula (neutrophil x monocyte x platelet)/lymphocyte. High PIV was defined as scores >372.

## Results:

Median (IQR) age was 73 (66-80) and 54.4% (n=68) were female. The median (IQR) follow-up time was 20 (11-38) days. Delirium occurred in 22.4% (n=28) of the patients during hospitalization. Patients who developed delirium were older, more frequently had frailty, dementia, depression, congestive heart failure, and hypothyroidism and had higher C-reactive protein (CRP), Leukocyte, Neutrophil, Neutrophil lymphocyte ratio (NLR) and Pan-immune Inflammation value (PIV). According to the previously defined cut-off for PIV (>372), patients with delirium more frequently had high PIV ( $p<0.05$ ) (Table 1). In the logistic regression analyses, high PIV was related to delirium, regardless of age, sex, frailty, dementia, depression, congestive heart failure, and hypothyroidism (OR: 4.99, 95%CI: 1.02 – 24.34,  $p=0.047$ ). (Table 2)

## Conclusions:

This is the first study revealing the relationship between high PIV at hospital admission and delirium occurrence. PIV may be a novel biomarker for delirium prediction.

**Table 1. Baseline demographical characteristics and comprehensive geriatric assessments of participants at hospital admission, according to delirium development.**

	<b>Patients with delirium</b> n= 28 (22.4%)	<b>Patients without delirium</b> n= 97 (77.6%)	<b>P value</b>
Age, median (IQR)	71 (64-76)	83 (73-87)	<b>&lt;0.001</b>
Older Age (≥ 75 years), n (%)	28 (28.9%)	20 (71.4)	<b>&lt;0.001</b>
Female sex , n (%)	52 (53.6%)	16 (57.1%)	0.741
Hospitalization time (days), median (IQR)	16 (9.0-25.5)	45.0 (33.0- 64.0)	<b>&lt;0.001</b>
Diabetes Mellitus, n (%)	41 (45.6%)	9(32.1 %)	0.210
Hypertension, n (%)	62 (68.9%)	17 (60.7%)	0.422
Depression, n (%)	1 (1.1%)	5 (17.9%)	<b>&lt;0.001</b>
Congestive Heart Failure, n (%)	11 (12.2%)	9 (32.1%)	<b>0.014</b>
Cardiovascular Diseases, n (%)	24 (26.7%)	8 (28.6%)	0.843
Hypothyroidism, n (%)	7 (7.8%)	6 (21.4%)	<b>0.044</b>
Hyperthyroidism, n (%)	3 (3.3%)	1 (3.6%)	0.952
Malignancies, n (%)	16 (17.8%)	5 (17.9%)	0.992
Dementia, n (%)	3 (3.3%)	9 (32.1%)	<b>&lt;0.001</b>
Rheumatologic diseases, n (%)	16 (17.8%)	3 (10.7%)	0.374
Pulmonary Diseases, n (%)	14 (15.6%)	6 (21.4%)	0.669
Chronic Renal diseases, n (%)	16 (17.8%)	6 (21.4%)	0.665
Osteoporosis, n (%)	13 (14.4%)	8 (28.6%)	0.088
Multimorbidity, n (%)	78 (86.7%)	27 (96.4%)	0.150
4- AT score	0 (0.0-2.0)	8 (6.5-10.0)	<b>&lt;0.001</b>
Prehospitalization CFS score, median (IQR)	5 (4.0-5.0)	6 (6.0-7.0)	<b>&lt;0.001</b>
Prehospitalization Frailty (CFS>4), n (%)	49 (50.5%)	26 (92.9%)	<b>&lt;0.001</b>
Current mFFI score, median (IQR)	3 (1.0-4.0)	4 (3.0-4.5)	<b>&lt;0.001</b>
Current Physical Frailty (FFI >2), n (%)	57 (58.8%)	25 (92.6%)	<b>0.001</b>
MNA-sf score, median(IQR)	9 (8.0-11.0)	7 (5.5- 8.5)	<b>&lt;0.001</b>
SARC-f score, median (IQR)	3 (1.0-6.0)	6 (5.0- 8.0)	<b>&lt;0.001</b>
Malnutrition (MNA<8)	24 (24.7%)	16 (57.1%)	<b>0.001</b>
Waist circumference, median(IQR)	95 (81.0-106.0)	98 (88.0-103.0)	0.498
Calf circumference, median(IQR)	33(30.5- 35.0)	30 (27.0- 34.0)	<b>0.046</b>
Mid-arm circumference, median(IQR)	26(24.0- 30.0)	34 (23.0-28.5)	0.200
BMI, median(IQR)	25(22.7- 29.2)	26 (24.4- 31.3)	0.243
Number of drugs, median (IQR)	7(5.0- 10.0)	9 (6.0- 12.0)	0.299
Polypharmacy, n (%)	63 (75.0%)	21 (80.8%)	0.749
Falls, n (%)	39 (40.2%)	12 (42.9%)	0.801
Urinary incontinence, n(%)	31 (32.3%)	20 (71.4%)	<b>&lt;0.001</b>
Hospital mortality, n (%)	3 (3.1%)	5 (17.9%)	<b>0.005</b>
C reactive protein, median (IQR)	12.6 (3.7–46.9)	29.8 (10.8–79.8)	<b>0.025</b>
Leukocyte, median (IQR)	7.5 (5.4–9.2)	9.7 (7.6–12.8)	<b>0.003</b>
Lymphocytes, median (IQR)	1.3 (0.8–1.8)	1.2 (0.9–1.8)	0.976
Neutrophil, median (IQR)	5.2 (3.2–7.2)	7.8 (5.2–10.8)	<b>&lt;0.001</b>
Platelet, median (IQR)	233.5 (178.5–297.5)	233.0 (153.0–317.5)	0.847
Monocyte, median (IQR)	0.6 (0.4–0.8)	0.6 (0.4–0.7)	0.274
Hemoglobin, median (IQR)	10.9 (9.1–13.2)	10.0 (8.5–11.7)	0.078
Neutrophil lymphocyte ratio, median (IQR)	3.8 (2.4–6.9)	5.9 (4.0- 8.7)	<b>0.014</b>
Pan-immune Inflammation value, median (IQR)	599.8 (251.2–1112.0)	678.8 (505.7–1894.0)	<b>0.036</b>
PIV-High (>372), n (%)	59 (60.8%)	24 (85.7%)	<b>0.014</b>

**Table 2- Logistic Regression Analysis of the independent factors associated with delirium.**

		Delirium		
		Odds Ratio	95%CI	p-value
<b>Model 1*</b>	Age	1.10	1.01 - 1.19	<b>0.020</b>
	Female sex	0.50	0.13 – 1.79	0.288
	Frailty (CFS >4)	4.75	0.91-24.80	0.065
	Dementia	2.56	0.39-16.73	0.324
	Depression	15.9	0.73-242.50	0.056
	Congestive Heart Failure	4.49	1.09-19.70	<b>0.037</b>
	Hypothyroidism	7.59	1.44-39.79	<b>0.016</b>
	High PIV(>372)	4.99	1.02 -24.34	<b>0.047</b>

\*The model is adjusted for age, sex, frailty (CFS > 4), presence of dementia, depression, congestive heart failure, and hypothyroidism. (Nagelkerke R square: 0.550)

# Co-development of a digital program to prevent falls and delirium and improve well-being in community-dwelling people living with dementia

## Authors:

1. Jaheeda Gangannagaripalli, The University of Manchester, United Kingdom
2. Emma Vardy, The University of Manchester, United Kingdom
3. Emma Stanmore, The University of Manchester, United Kingdom

## Background:

Falls are common and costly for people living with Dementia (PLwD). Dementia and falls are strongly associated with delirium. Utilising digital technology to prevent falls and delirium has the potential to improve quality-of-life and provide cost savings to health and social care. Hence, it is crucial that digital interventions are well-designed and user-centred to be acceptable and usable. 'Keep On Keep Up' (KOKU) is a UK National Health Service approved gamified digital health program developed to maintain function and reduce falls through tailored FaME/OTAGO strength & balance exercises, and health literacy games to educate and encourage older people including PLwD about brain health and prevention delirium.

## Methods:

Informed by the Medical Research Council framework, we co-developed KOKU with PLwD in the community (KOKU-LITE). We initially conducted stakeholder consultations with 29 participants including focus groups, one-to-one interviews, and one-to-one interactive sessions. We then discussed the feedback from the stakeholder consultations with our project advisory group (formed of 4 members- PLwD), conducted an ideation session with a software development company and our project team; further consulted with the participants then agreed and refined the content.

## Results:

KOKU-LITE program was developed through an iterative process. The final prototype is the refined KOKU-LITE dementia-friendly program.

## Conclusion:

Digital technologies have emerged as promising interventions for PLwD but need to be designed and tested by taking their needs into account. This research will examine how the KOKU-LITE program can be delivered effectively in the community dwelling PLwD with an aim to prevent falls and delirium.

# Optimizing Clinical Nurse-Documented Delirium Assessments in the ICU to Predict Research Assessments

## Authors:

1. Kelly Potter, University of Pittsburgh, United States
2. Zahra Aghababa, University of Pittsburgh, United States
3. Jason Kennedy, University of Pittsburgh, United States
4. Chukwudi Onyemekwu, University of Pittsburgh, United States
5. Niall Prendergast, University of Pittsburgh, United States
6. Michael Reznik, University of Pittsburgh, United States
7. Brian Jiang, University of Pittsburgh, United States
8. Brett Curtis, University of Pittsburgh, United States
9. Syed Hussain, University of Pittsburgh, United States
10. Faraaz Shah, University of Pittsburgh, United States
11. Bryan McVerry, University of Pittsburgh, United States
12. Georgios Kitsios, University of Pittsburgh, United States
13. Timothy Girard, University of Pittsburgh, United States

## Background:

The accuracy of clinical nurse-documented delirium assessments in the ICU varies, limiting utility in clinical research. We sought to evaluate and optimize agreement between clinical nurse-documented delirium assessments and trained researcher assessments.

## Methods:

We analyzed data from two prospective cohorts that enrolled ICU patients with acute respiratory failure or shock who were assessed daily for delirium by bedside nurses (using the ICDSC) and trained researchers (using the CAM-ICU). We categorized delirium status using validated cutoffs and graphically examined agreement between matched nurse/researcher assessments. We derived logistic regression models that used individual ICDSC components, mechanical ventilation status, and admission SOFA to predict delirium in non-comatose patients with complete ICDSC data, using researcher CAM-ICU assessments as the reference standard. We internally validated models using ten-fold cross-validation.

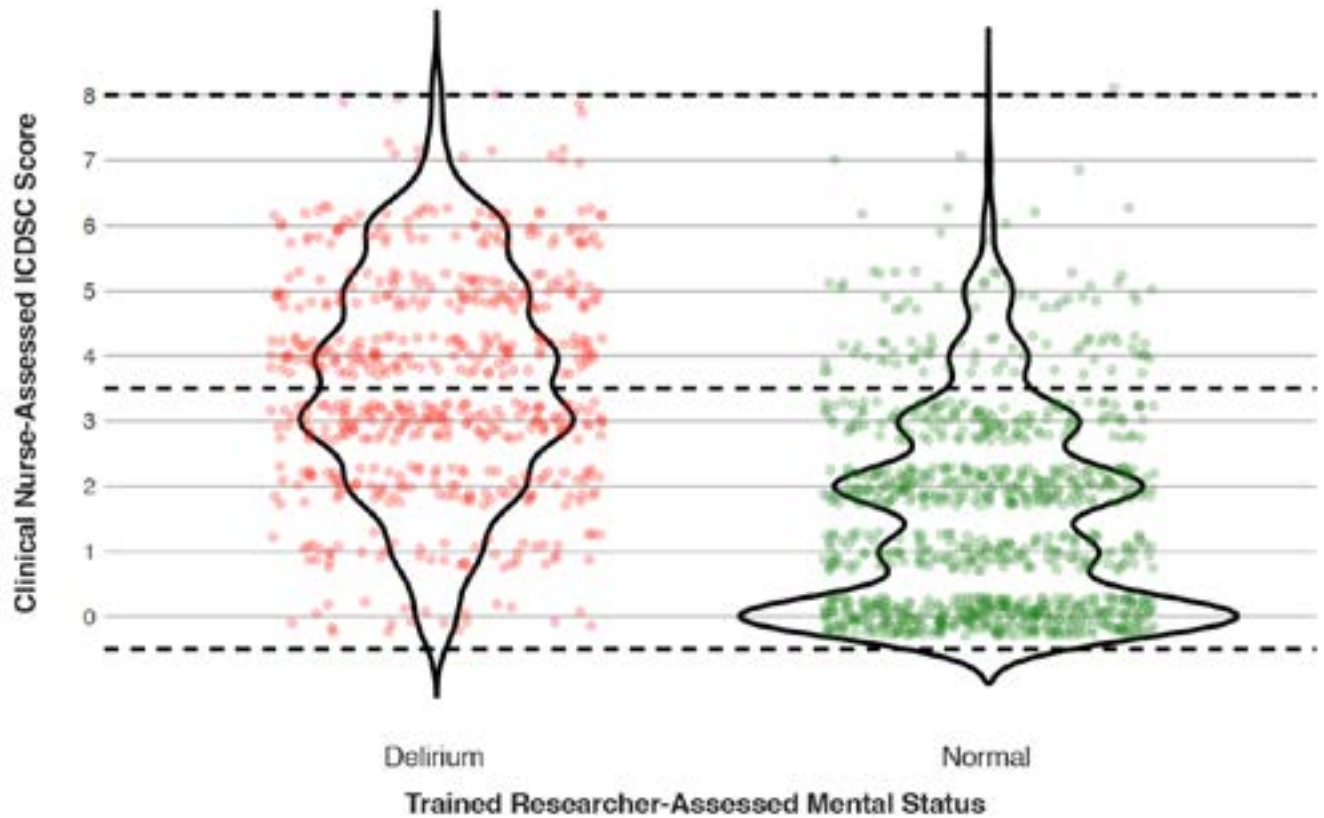
## Results:

In 279 patients, 1,535 clinical ICDSC assessments were matched with researcher CAM-ICU assessments. Figure 1 shows inconsistent agreement between clinical nurse assessments using the established cutoff (ICDSC  $\geq 4$ ) and trained researcher assessments. Alternatively, a logistic regression model informed by individual ICDSC components and clinical data predicted a positive research CAM-ICU with good discrimination (Figure 2) and performed well in cross-validation (F1-score: 0.72). Mechanical ventilation status and ICDSC component scores for hyperactivity and hypervigilance were the strongest predictors of a positive researcher assessed CAM-ICU.

## Conclusions:

A delirium model informed by bedside nurse ICDSC findings and clinical variables accurately detects delirium in the ICU and can therefore be used in future research that leverages large, multicenter clinical datasets to advance understanding of delirium mechanisms, trajectories, and outcomes.

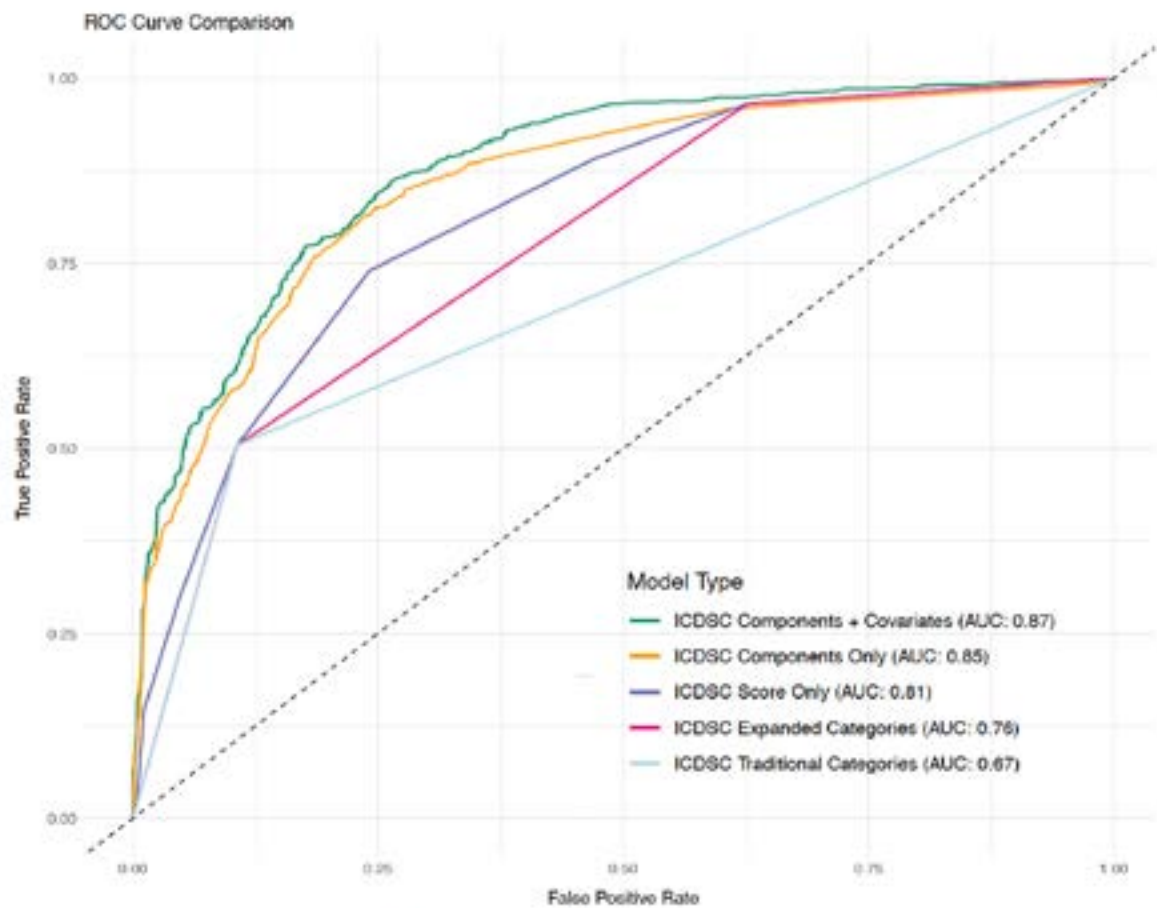
Figure 1.



*Abbrev:* ICDSC = Intensive Care Delirium Screening Checklist, CAM-ICU = Confusion Assessment Method for the ICU

The violin plot illustrates the distribution of delirium assessments by trained researchers using the CAM-ICU and the matched delirium assessment by the clinical nurse using the ICDSC. The dashed lines represent the validated cutoffs for delirium using the ICDSC. ICDSC scores between 0-3 are considered "Normal" according to validated cutoffs, and scores between 4-8 indicate "Delirium."

Figure 2.



Abbrev: ICDSC = Intensive Care Delirium Screening Checklist; AUC = Area under the curve.

Comparison of receiver operating characteristic curves (ROCs) for prediction of a positive researcher-assessed CAM-ICU.

The ICDSC Expanded Categories define a score of 0 as Normal, 1-3 as Subsyndromal Delirium, and 4-8 as Delirium. The ICDSC Traditional Categories using validated cutoffs define a score between 0-3 as Normal, and 4-8 as Delirium.

# Prediction of Delirium in Korean General Internal Medicine Patients: A Comparative Study of Machine Learning Algorithms

## Authors:

1. Yuna Jang, Department of Neuropsychiatry, Seoul National University Bundang Hospital, South Korea
2. Hye Youn Park, Department of Neuropsychiatry, Seoul National University Bundang Hospital, South Korea
3. E Kyoung Yoon, Department of Neuropsychiatry, Seoul National University Bundang Hospital, South Korea
4. Arum Hong, Department of Neuropsychiatry, Seoul National University Bundang Hospital, South Korea

## Background:

Delirium increases mortality and leads to poor clinical outcomes. This study was conducted to explore the risk factors associated with delirium in internal medicine inpatients. We aimed to develop a model to predict delirium early in the hospitalization of inpatients requiring acute medical care.

## Methods:

We analyzed data from 1,288 patients in the general internal medicine unit, encompassing 64 variables such as demographics, clinical data, and information on medications, including psychotropic medications. Synthetic Minority Over-sampling Technique was applied to the training set to address data imbalance, and features were selected using the forward feature selection method, with 10 features chosen for each algorithm. The ML algorithms used in this study were extreme gradient boosting (XGB), light gradient boosting machine (LGBM), logistic regression (LR), random forest (RF), and support vector machine (SVM).

## Results:

The analysis revealed that LR was the most effective in predicting delirium. The performance of LR showed an AUC of 0.807, sensitivity of 0.750, accuracy of 0.866, specificity of 0.875, and an F1 score of 0.447. The most influential variables for predicting delirium were respiratory medications, antipsychotics, and gastrointestinal medications.

## Conclusions:

This study developed and validated an LR-based ML model for predicting delirium in general internal medicine patients. The model includes modifiable variables such as medications, which could be useful in establishing guidelines for preventing delirium in various internal medicine patients.



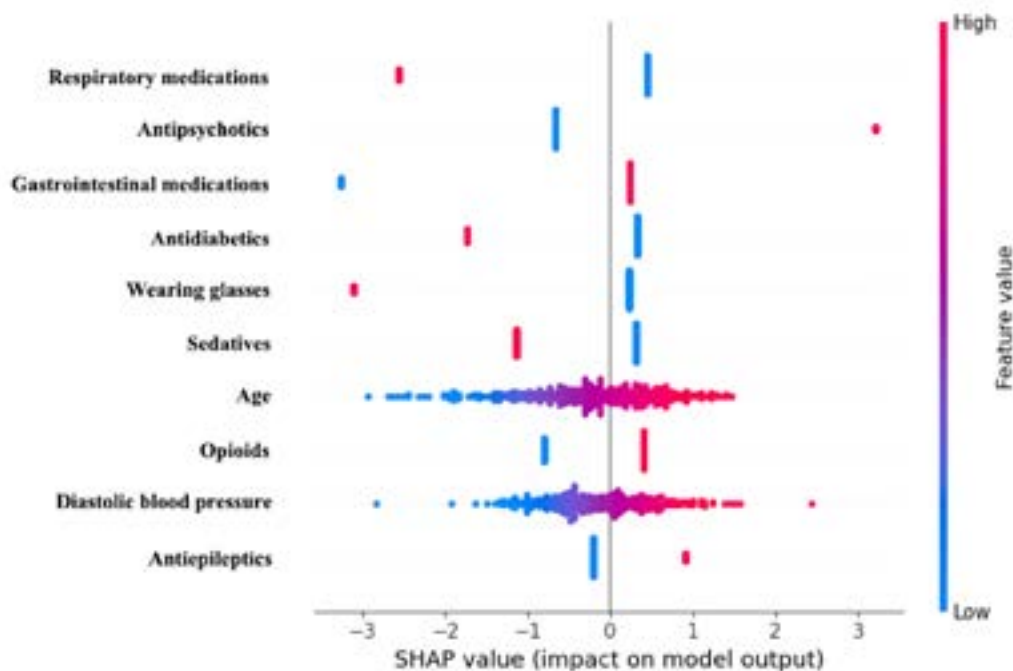
**Table 1. Evaluation of prediction model performance**

Algorithms		AUC (95% CI)	Sensitivity (95% CI)	Accuracy (95% CI)	Specificity (95% CI)	F1 score (95% CI)
LR	Train	0.937 (0.925 - 0.948)	0.926 (0.908 - 0.944)	0.882 (0.866 - 0.897)	0.838 (0.813 - 0.862)	0.887 (0.872 - 0.902)
	Test	<b>0.807 (0.684 - 0.908)</b>	<b>0.750 (0.583 - 0.913)</b>	<b>0.866 (0.832 - 0.899)</b>	<b>0.875 (0.842 - 0.906)</b>	<b>0.447 (0.316 - 0.562)</b>
RF	Train	0.973 (0.967 - 0.979)	0.935 (0.919 - 0.951)	0.893 (0.878 - 0.907)	0.851 (0.827 - 0.875)	0.898 (0.883 - 0.912)
	Test	0.673 (0.581 - 0.770)	0.429 (0.250 - 0.613)	0.770 (0.724 - 0.809)	0.797 (0.751 - 0.837)	0.212 (0.117 - 0.317)
XGB	Train	0.996 (0.994 - 0.997)	0.996 (0.992 - 1.000)	0.889 (0.874 - 0.905)	0.782 (0.755 - 0.811)	0.900 (0.885 - 0.914)
	Test	0.697 (0.608 - 0.793)	0.500 (0.308 - 0.711)	0.685 (0.641 - 0.729)	0.699 (0.652 - 0.746)	0.187 (0.107 - 0.272)
LGBM	Train	0.986 (0.981 - 0.990)	0.938 (0.921 - 0.954)	0.947 (0.936 - 0.958)	0.957 (0.941 - 0.969)	0.947 (0.936 - 0.957)
	Test	0.832 (0.741 - 0.909)	0.500 (0.304 - 0.690)	0.902 (0.873 - 0.930)	0.933 (0.905 - 0.959)	0.424 (0.259 - 0.568)
SVM	Train	0.997 (0.994 - 1.000)	0.993 (0.987 - 0.998)	0.987 (0.981 - 0.992)	0.982 (0.972 - 0.991)	0.987 (0.981 - 0.992)
	Test	0.736 (0.637 - 0.829)	0.179 (0.038 - 0.333)	0.884 (0.850 - 0.917)	0.939 (0.914 - 0.964)	0.182 (0.042 - 0.328)

Several performance metrics and their 95% confidence intervals were calculated within both the training and test sets for the comparison of predictive performance between the developed machine learning models. They are presented as performance metric value (95% confidence interval). To estimate the confidence intervals, 1,000 iterations of bootstrap resampling were performed on both the training and test sets.

Note. AUC, area under the receiver operating characteristic curve; LR, logistic regression; RF, random forest; LGBM, light gradient boosting machine; XGB, extreme gradient boosting classifier; SVM, support vector machine

The best algorithm was LR, which showed the highest AUC and sensitivity values in the test set, and is indicated in bold.



**Figure 1. SHapley Additive exPlanations (SHAP) summary plot of LR model**

Note. The x-axis displays SHAP values, where positive values indicate an increased risk of delirium and negative values indicate a decreased risk. Each dot represents a data point, with red indicating high feature values and blue indicating low values.

# Correlation between subjective and objective cognitive function in post-intensive care patients: a dual-center prospective cohort study

## Authors:

1. Rens Kooken, Radboud university medical center, Netherlands
2. Soes Bohart, Copenhagen University Hospital, Denmark
3. Arjen Slooter, University Medical Center Utrecht, Netherlands
4. Thordis Thomsen, Copenhagen University Hospital, Denmark
5. Bram Tilburgs, Radboud university medical center, Netherlands
6. Mark van den Boogaard, Radboud university medical center, Netherlands

## Background:

One-third of ICU survivors suffer from long-term cognitive impairment, not exclusively after delirium. Self-reported screening tools may provide an efficient method to assess cognitive impairment in large patient populations simultaneously. We evaluated the correlation between a subjective and objective cognitive screening tool in ICU survivors, and explored associated factors.

## Methods:

Patients from two Dutch University ICUs underwent cognitive assessment using a subjective (Cognitive Failure Questionnaire [CFQ-14]) and an objective (modified Telephone Interview for Cognitive Status [TICS-m]) screening tool during a structured telephone interview, conducted median 3.6 months post-ICU. Correlation was assessed using Spearman's rank correlation test. Associations were explored using multiple linear regression, including relevant covariates and concurrent health problems such as depression (Hospital Anxiety and Depression Scale [HADS-D]).

## Results:

Cognitive impairment was present in 20% (n=76) of 380 patients (only CFQ-14 score  $\geq 43$ , n=19, 5%; only TICS-m score  $\leq 33$ , n= 53, 14%; based on both definitions, n=4, 1%). CFQ-14 and TICS-m scores were not relevantly correlated ( $r=-0.12$ ,  $p=0.02$ ). HADS-D scores were significantly associated with standardized CFQ-14 scores (adjusted  $\beta$  0.17; 95% CI 0.09 – 0.25;  $p<0.01$ ), whereas age (adjusted  $\beta$  -0.02; 95% CI -0.04 – -0.01;  $p<0.01$ ) and coma (adjusted  $\beta$  -0.40; 95% CI -0.81 – -0.01;  $p=0.05$ ) were significantly associated with standardized TICS-m scores.

## Conclusions:

Subjective and objective cognition were not relevantly correlated. Depression was significantly associated with subjective cognition, whereas age and coma were significantly associated with objective cognition. Although both subjective and objective cognitive screening tools may be equally valuable, they should not be used or interpreted interchangeably.

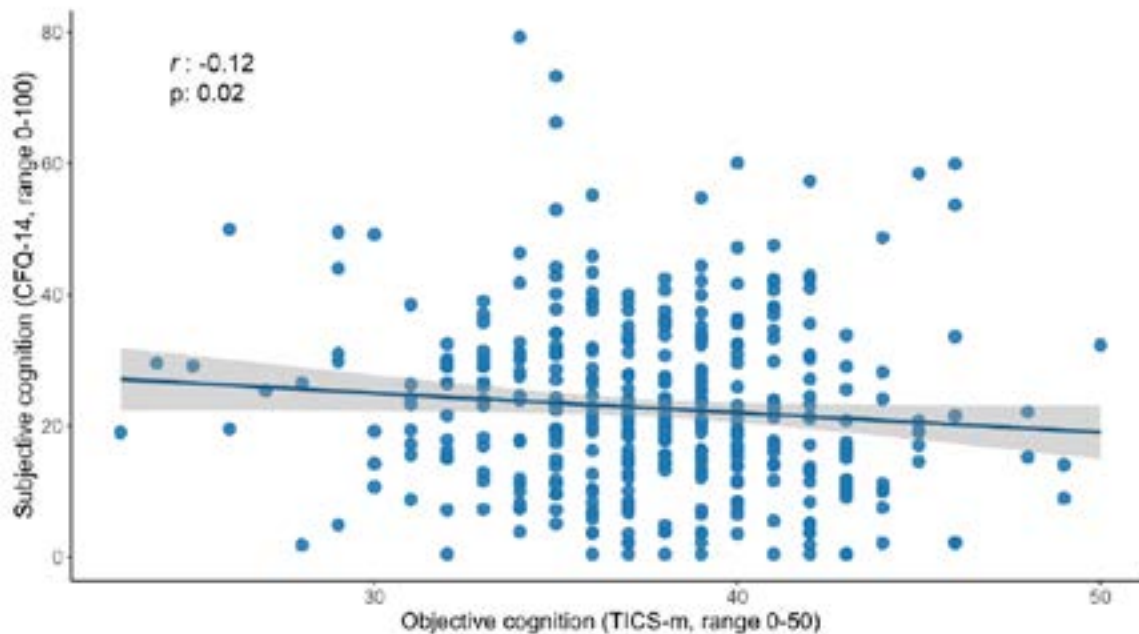


Figure 1. Correlation between subjective (CFQ-14) and objective (TICS-m) cognition scores  
 Note: a higher CFQ-14 score indicates worse cognitive functioning, while a higher score on the TICS-m indicates better cognitive functioning. The shaded grey area represents the standard error of the regression line.  
 Abbreviations: CFQ-14=Cognitive Failure Questionnaire-14; TICS-m=Telephone Interview for Cognitive Status - modified.

Table 1. Multivariable linear regression models to explore factors associated with subjective and objective cognition

Factor	Subjective cognition (CFQ-14, standardized) <sup>a</sup> (n=123)			Objective cognition <sup>a</sup> (TICS-m, standardized) (n=123)		
	Adj. Beta <sup>a</sup>	95% CI	p-value	Adj. Beta <sup>a</sup>	95% CI	p-value
Standardized CFQ-14 score <sup>a</sup>	-	-	-	-0.05	-0.20, 0.10	0.5
Standardized TICS-m score <sup>a</sup>	-0.08	-0.31, 0.15	0.4	-	-	-
Male sex	-0.23	-0.67, 0.20	0.3	-0.13	-0.49, 0.22	0.5
Age (years)	0.00	-0.02, 0.02	0.8	-0.02	-0.04, -0.01	<b>&lt;0.01</b>
Delirium	-0.01	-0.57, 0.54	>0.9	-0.06	-0.50, 0.39	0.8
Coma	0.11	-0.41, 0.62	0.7	-0.40	-0.81, -0.01	<b>0.05</b>
Severity of Illness (SOFA)	-0.02	-0.10, 0.06	0.6	0.02	-0.04, 0.08	0.6
Length of ICU stay	0.00	-0.03, 0.03	0.8	-0.01	-0.03, 0.01	0.4
Fatigue score (CIS-8)	-0.01	-0.03, 0.01	0.5	0.00	-0.02, 0.02	0.8
Depression score (HADS-D)	0.17	0.09, 0.25	<b>&lt;0.01</b>	-0.02	-0.09, 0.05	0.5

<sup>a</sup>CFQ-14 and TICS-m scores were z-standardized in order to allow for direct comparisons between the two models. The beta coefficients in the models represent the number of standard deviations change in the outcome variable for a one-unit change in the predictor variable.

Abbreviations: CFQ-14=Cognitive Failure Questionnaire-14; CIS-8=Checklist Individual Strength-8; HADS-D=Hospital Anxiety and Depression Scale – Depression; ICU=intensive care unit; SOFA=Sequential Organ Failure Assessment; TICS-m=Telephone Interview for Cognitive Status – modified.

# Dynamic redundancy in brain functional connectivity: a metric of cognitive reserve associated with risk factors of postoperative delirium

## Authors:

*From the School of Medicine and Health, Technical University of Munich, Germany*

1. Julia Schwarz
2. Franziska Zistler
3. Anika Fix
4. Adriana Usheva
5. Franziska Knolle
6. Sebastian Zinn
7. Juliana Zimmermann
8. Svenja Letz
9. Rachel Nuttall
10. Gerhard Schneider

## Background:

Cognitive reserve (CR) modulates the relationship between life-course related brain changes (lifeBC) and cognitive decline. Although underlying mechanisms of CR remain unknown, increased preoperative CR attenuates postoperative delirium (POD) risk. We investigated whether the probability of the brain being in a functionally redundant state - the existence of multiple independent pathways between brain regions - across time (DFR) 1) is a mechanism of CR and 2) relates to preoperative POD risk factors.

## Methods:

**Aim1:** An open-access fMRI/behavioural dataset (n=301 healthy subjects, 18-89yrs) was analysed. DFR was calculated from regional grey matter (GM) dynamic functional connectivity matrices. Mean cortical GM amplitude (GMamp) and cortical GM volume (GMvol, based on structural T1 images) served as our measures of lifeBC. Multiple linear regression tested the modulating effect of DFR on the relationship between lifeBC and cognitive function: executive functioning, episodic memory, semantic memory. **Aim2:** Preoperative fMRI data (n=27 surgical patients >65yrs) was acquired and the patientwise DFR was correlated with the Clinical Frailty Score and the MoCA score of cognitive impairment.

## Results:

DFR modulated the association between GMamp and semantic memory ( $t=3.7687$ ,  $p=0.0002$ ) and executive function ( $t=-1.9782$ ,  $p=0.0489$ ). DFR didn't modulate the association between GMvol and cognitive function. Increased DFR showed a trend towards an association with reduced frailty when controlling for age ( $r=-0.4015$ ,  $p=0.0576$ ) but not with cognitive impairment.

## Conclusions:

DFR serves as a metric of CR when looking at specific cognitive elements and defined dimensions of lifeBC. DFR may serve as a protective factor against frailty and potentially POD risk.

# Melatonin does not reduce delirium severity in hospitalized older adults: results of a randomized placebo-controlled trial

## Authors:

1. Peter Lange, University of Melbourne, Australia
2. Alisa Turbic, Australian Catholic University, Australia
3. Cheng Hwee Soh, University of Melbourne, Australia
4. Daniel Clayton-Chubb, Monash University, Australia
5. Kwang Lim, University of Melbourne, Australia
6. Rachel Conyers, University of Melbourne, Australia
7. Rosie Watson, University of Melbourne, Australia
8. Andrea Maier, National University of Singapore, Singapore

## Background:

Delirium is common in older inpatients, causing distress, cognitive decline, and death. There is an urgent need for effective delirium treatment. Sleep wake cycle is disturbed in delirium; endogenous Melatonin is perturbed, and exogenous Melatonin is a safe and effective medication for sleep disorders. This study aims to determine the effect of oral Melatonin 5mg immediate release (IR) nightly for 5 nights on severity of delirium in older ( $\geq 65$  years) medical inpatients.

## Methods:

This was a double-blinded, randomized controlled trial in general internal medicine units of a tertiary teaching hospital. Older inpatients with Confusion Assessment Method positive, hyperactive or mixed delirium within 48 hours of admission or onset of in-hospital delirium were included. The primary outcome was change in delirium severity measured with the Memorial Delirium Assessment Scale (MDAS). A previous pilot trial showed 120 participants randomized 1:1 to Melatonin or Placebo would provide 90% power to demonstrate a 3-point reduction in the MDAS.

## Results:

One hundred and twenty participants were randomized, 61 to Melatonin 5mg and 59 to Placebo. The medication was well tolerated. The mean MDAS improvement was 4.9 (S.D. 7.6) in the Melatonin group and 5.4 (S.D. 7.2) in the Placebo group, p-value 0.42, a non-significant difference. A post-hoc analysis showed length of stay (LOS) was shorter in the intervention group (median 9 days [Interquartile Range (IQR) 4,12] vs Placebo group 10 [IQR 6,16] p-value =0.033, Wilcoxon Rank Sum test).

## Conclusion:

This trial does not support the hypothesis that Melatonin reduces the severity of delirium.

# Delirium occurrence rates across settings and effects of implementing a Delirium Prevention Unit at a tertiary care university hospital

## Authors:

Mira Schomann, University Medicine Greifswald, Germany  
Sophie Leroy, University Medicine Greifswald, Germany  
Annika Haase, University Medicine Greifswald, Germany  
Liane Janßen, University Medicine Greifswald, Germany  
Agnes Flöel, University Medicine Greifswald, Germany  
Robert Fleischmann, University Medicine Greifswald, Germany

## Background:

Delirium is characterized by an acute onset and fluctuation of altered consciousness, as well as impaired attention and disorganized thinking. In non-ICU settings, it affects approximately 10-20% of elderly patients, putting them at risk for increased complication rates, inferior outcome and long-term care dependency. A Delirium Prevention Unit (DPU) was established to mitigate these negative effects of delirium in inpatients treated at the University Hospital Greifswald (UMG). Data collected during the implementation process and subsequent routine business provides a unique opportunity to investigate actual delirium occurrence rates across medical disciplines at a tertiary care hospital.

## Methods:

The DPU was first implemented in routine inpatient care at the departments of internal medicine, neurology and general surgery in July 2021. Patients at increased risk for delirium were screened using the confusion assessment method (CAM) and managed by a team consisting of neurologists, pharmacists and specialized nurses.

## Results:

A total of 5533 patients were seen by the DPU in the departments of internal medicine (n=1901), neurology (n=2019), and general surgery (n=1613) during the period from 01/04/22 to 25/04/24. The mean delirium occurrence rate amounted to 11.54%, comprising of 12.45% in internal medicine, 15.4% in neurology, and 5.65% in general surgery.

## Conclusion:

Delirium remains an underestimated neuropsychiatric complication. Interestingly, the implementation of a DPU led to a more profound decrease in delirium occurrence rates in surgical as compared to medical settings. We hypothesize that prevention of postoperative delirium is more effective than delirium of other etiologies.

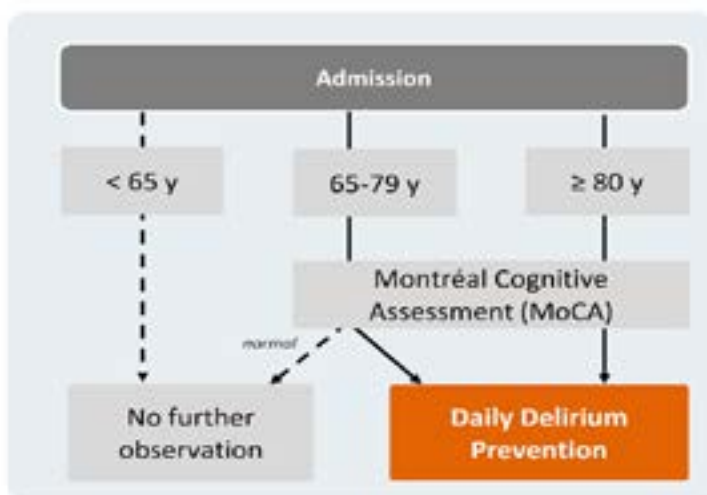


Figure 1: Workflow of the DPU

# Integrating biofluid, neurophysiological and imaging biomarkers of postoperative delirium: a systematic review

## Authors:

1. Lili Grit Pesau, University Medicine Greifswald, Germany
2. Sophie Leroy, University Medicine Greifswald, Germany
3. Thomas Saller, University Medicine Munich, Germany
4. Johannes Ehler, University Medicine Jena, Germany
5. Leiv Otto Watne, Akershus University Hospital, Norway
6. Robert Fleischmann, University Medicine Greifswald, Germany

## Background:

Postoperative delirium (POD) is a severe issue in healthcare, particularly affecting older patients. Marked by a rapid onset and varying levels of consciousness and attention, POD results in longer hospital stays, impaired outcomes, and increased healthcare costs. Management is challenging due to symptom variability and lack of routine biomarkers. Most studies are limited to a single biomarker type, our multimodal approach includes biofluids (blood, CSF), neurophysiological measures (EEG, NIRS), and imaging (MRI). We aim to categorize biomarkers (risk, diagnostic, prognostic, monitoring etc.) by their clinical utility while exploring POD's pathophysiological patterns, such as neuroinflammation or blood-brain barrier disruption.

## Methods:

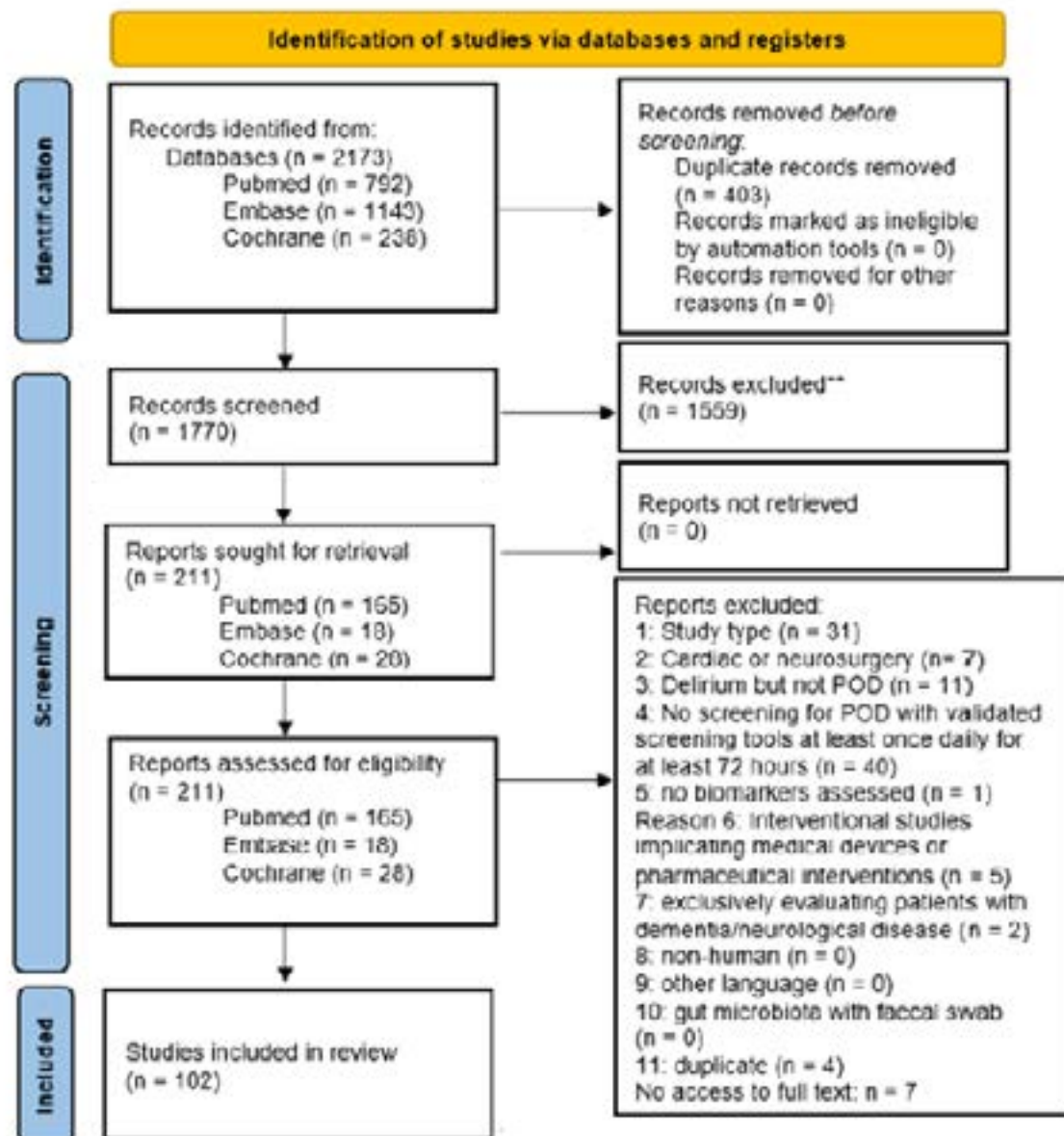
We systematically searched PubMed, Embase, and Cochrane databases, reviewing 1770 publications independently by two researchers. Included were clinical and observational trials, excluding case reports, reviews, and interventional studies. We excluded studies focusing exclusively on patients with dementia or other postoperative neurocognitive disorders and those involving cardiac or neurosurgery. Studies including both patients with and without dementia were not excluded. Our study design followed Bernhardt et al., 2023, for unifying biomarker classification across neurological diseases.

## Results:

From 211 eligible studies, 102 were included for data extraction. We identified 50 blood-, 37 CSF-, 5 EEG- and 9 MRI-based studies. Data extraction parameters were peer-reviewed by experts in the field. Initial results are expected by November. The number of included studies may change due to further screening.

## Conclusion:

This review will provide a comprehensive overview of biomarkers for delirium, offering a valuable framework for future research.



**Figure 1: PRISMA Flow-Chart and reasons for exclusion of studies**



# **Modulating postoperative delirium with transcranial electrical stimulation (MoDeSt): a prospective, randomized, double-blind, sham-controlled trial**

## **Authors:**

1. Sophie Leroy, University Medicine Greifswald, Germany
2. Viktor Bublitz, University Medicine Greifswald, Germany
3. Ulrike Grittner, Charité University Medicine Berlin, Germany
4. Robert Fleischmann, University Medicine Greifswald, Germany
5. Falk von Dincklage, University Medicine Greifswald, Germany
6. Daria Antonenko, University Medicine Greifswald, Germany

## **Background:**

Postoperative delirium (POD) is the most common neurological adverse event among elderly patients undergoing surgery. Delirium prevention and treatment interventions are currently limited. This study will evaluate the effect of transcranial electrical stimulation (tES) on the incidence of POD.

## **Methods:**

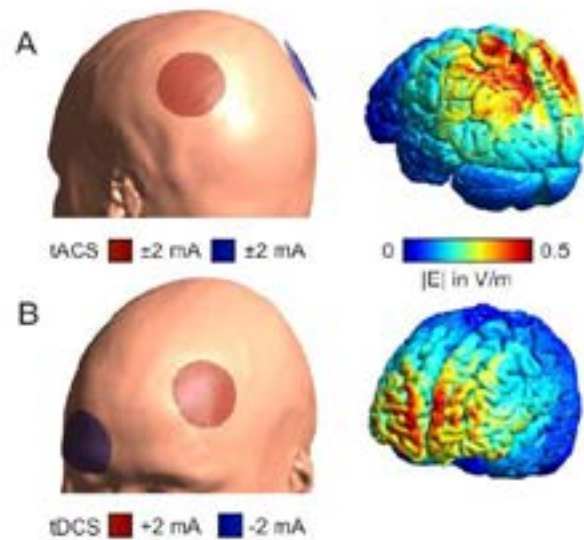
We are performing a randomized, double-blind, sham-controlled trial using single-session postoperative application of tES in the recovery room in 225 patients (>65 years) undergoing elective major surgery. Patients are randomly allocated (ratio 1:1:1) to one of three study groups: (1) transcranial alternating current stimulation in the alpha frequency range (alpha-tACS) over posterior parietal cortex [2 mA, 20 min], (2) anodal transcranial alternating direct current stimulation (tDCS) over left dorsolateral prefrontal cortex [2 mA, 20 min], (3) sham [2 mA, 30 s] (Figure 1). Delirium is screened twice daily with the 3-minute diagnostic interview Confusion Assessment Method (3D-CAM) in the five days following surgery. The primary outcome is the incidence of POD defined as at least one positive screening during the five first postoperative days compared between tACS and sham groups. Secondary outcomes include delirium severity, duration, phenotype, postoperative pain, postoperative nausea and vomiting, electroencephalographic (EEG) markers, and fluid biomarkers (Figure 2).

## **Discussion:**

If effective, tES is a novel, easily applicable, non-invasive method to prevent the occurrence of POD.

## **Status:**

Over 90% of the patients have been enrolled in the trial. The recruitment is planned to be completed by mid-September 2024. We will be presenting the first results of the primary and secondary analyses at the EDA 2024.



**Figure 1: Illustration of electrode placement and electric field distribution.** Applied transcranial electrical stimulation on an MNI head/brain for (A) tACS group (stimulation frequency: 9.5 Hz; electrodes centered over P3 and P4; electrode diameter: 5 cm) and (B) tDCS group (electrodes centered over F3, anode, and Fp2, cathode; electrode diameter: 5 cm), simulated using SimNibs. tACS: transcranial alternating current stimulation, tDCS: transcranial direct current stimulation. (Figure from DOI: 10.1101/2024.07.11.24310269)



**Figure 2: Timeline of the study interventions and visits.** PACU: post-anesthesia care unit, EEG: electroencephalography, tES: transcranial electrical stimulation, RASS: Richmond Agitation-Sedation Scale, 3D-CAM: 3-minute diagnostic interview Confusion Assessment Method, NRS: Numerical Rating Scale. (Figure from DOI: 10.1101/2024.07.11.24310269).

# **Dementia, delirium and frailty co-occurrences and causality as perceived by geriatricians across Europe**

## **Authors:**

1. Suzanne Timmons, University College Cork, Ireland
2. Giuseppe Bellelli, Università degli Studi Milano-Bicocca, Italy
3. Catriona Curtin, University College Cork, Ireland
4. Mary Faherty, University College Cork, Ireland
5. Antonio Cherubini, National Institute for the Care of the Elderly, Milan, Italy
6. Pinar Soysal, Bezmialem Vakıf University, Türkiye

## **Introduction:**

This study aimed to explore the perceptions of geriatricians and senior geriatric trainees in Europe of the complex relationship between dementia, delirium and frailty, including relative prevalence, overlaps and causality.

## **Methods:**

An online anonymous survey was administered across 30 European countries, via the mailing list of the European Geriatric Medicine Society (EuGMS), national member groups and the authors' professional networks. Questions were framed in the context of recently hospitalised 80-year old patients with unplanned admissions.

## **Results:**

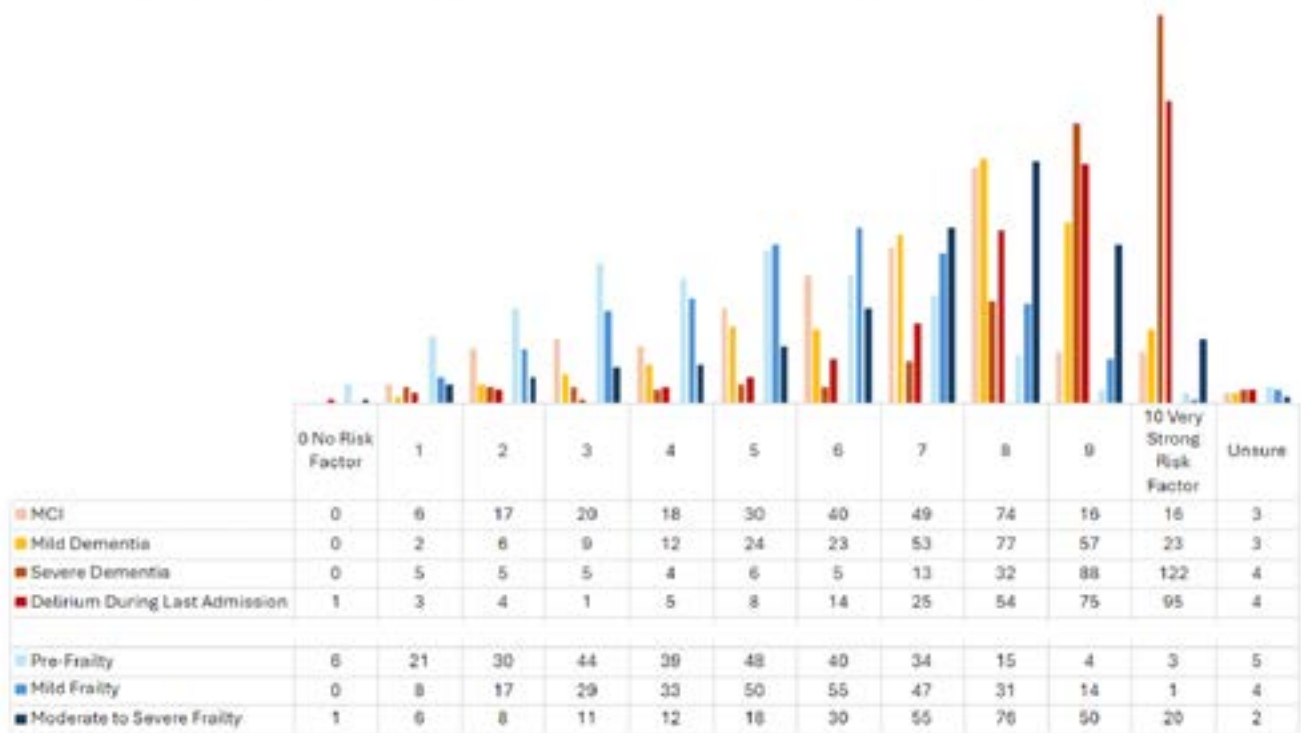
Within the 440 included surveys, respondents considered frailty to be more common and dementia to be less common than delirium in our hypothetical cohort. Most respondents felt that 41-60% of such patients with dementia would also have delirium (i.e. delirium superimposed on dementia, DSD) but that only 21-40% of such patients with frailty would also have delirium. Severe dementia and previous delirium were considered the strongest risks for future in-patient delirium. However, many considered pre-frailty a moderate (44%) or even strong (19%) risk for future delirium; a minority considered severe dementia a low risk for future delirium. Respondents viewed DSD as having the strongest influence on in-hospital mortality and discharge to residential care, while dementia was perceived to more influence future residential care, and frailty to influence future mortality.

## **Conclusions:**

Geriatricians and trainees across Europe gave quite varied responses to questions about delirium, dementia and frailty prevalence, co-occurrence and consequences. This indicates a need for the performance and wide dissemination of robust, prospective research examining all three conditions in older hospital cohorts.

## Respondents' assessment of the strength of selected risk factors for developing incident delirium

■ MCI 
 ■ Mild Dementia 
 ■ Severe Dementia 
 ■ Delirium During Last Admission 
 ■ Pre-Frailty 
 ■ Mild Frailty 
 ■ Moderate to Severe Frailty



# The role of neopterin in delirium

## Authors:

1. Eli Rudi, Oslo Delirium Research Group, Institute of Clinical Medicine, University of Oslo, Norway
2. Lasse M. Giil, Neuro-SysMed, Haralds plass Deaconess Hospital, Norway
3. Adrian McCann, Bevital AS, Norway
4. Leiv Otto Watne, Oslo Delirium Research Group, Institute of Clinical Medicine, University of Oslo, Norway

## Background:

Inflammation has been proposed to play a key role in the pathophysiology of delirium. Neopterin is a marker of cellular immune activation and a proxy measure of interferon gamma (INF- $\gamma$ ) activity. Few studies have examined neopterin concentrations in cerebrospinal fluid (CSF) from delirium patients, but a 2016 study found levels to be increased.

## Methods:

In this prospective cohort study CSF and serum was collected from 345 hip fracture patients (167 with delirium) and 24 patients with delirium precipitated by a medical condition (all with delirium). Delirium was assessed daily according to the DSM-5 criteria. IQCODE was used for pre-fracture dementia status. Neopterin concentrations in CSF and serum were measured using liquid chromatography-tandem mass spectrometry.

## Results:

In hip fracture patients, delirium was associated with higher neopterin concentrations in both CSF (36.2 nmol/mL vs 29.7 nmol/mL,  $p < 0.001$ ) and serum (38.0 nmol/mL vs 30.0 nmol/mL,  $p < 0.001$ ). Stratified according to dementia status, the difference in neopterin concentrations were only statistically significant in serum in the group without dementia. Neopterin concentrations were much higher in patients with delirium precipitated by a medical condition (CSF 59.2 nmol/mL, serum 50.6 nmol/mL).

## Conclusions:

Our findings suggest a role for cell-mediated immunity in delirium. However, dementia is a strong confounder. Further investigations are needed to understand why neopterin concentrations are much higher in patients with delirium precipitated by a medical condition.

# The relationship between malnutrition, frailty, and delirium defined by 4A's Test in hospitalized older patients

## Authors:

1. Yelda Ozturk, Ministry of Health, Eskisehir City Hospital, Division of Geriatrics, Türkiye
2. Kübra Uyaniker, Ministry of Health, Eskisehir City Hospital, Healthy Aging Center, Türkiye
3. Ceylan Isık, Ministry of Health, Eskisehir City Hospital, Healthy Aging Center, Türkiye
4. Fatmanur Sazak, Ministry of Health, Eskisehir City Hospital, Healthy Aging Center, Türkiye
5. Cigdem Karter Yıldız, Ministry of Health, Eskisehir City Hospital, Healthy Aging Center, Türkiye
6. Arzu Okyar Bas, Ankara Training and Research Hospital, Division of Geriatrics, Türkiye
7. Merve Guner, Ministry of Health, Erzurum City Hospital, Türkiye
8. Alper Ayyıldız, Ministry of Health, Eskisehir City Hospital, Department of Emergency Medicine, Türkiye

## Background:

Delirium can cause morbidity and mortality in older hospitalized patients. Geriatric syndromes have close relationships with each other. This study aimed to find out the relationship between malnutrition, frailty, and delirium in older hospitalized patients.

## Methods:

The study included patients aged  $\geq 65$  years at a tertiary hospital. 4 A's Test was used for delirium detection. Anthropometric measurements, comorbidities, and number of medications were recorded at admission by the nurse and home care professional. Clinical Frailty Scale (CFS), Mini-Nutritional Assessment Short Form (MNA-SF), Activities of daily living (ADL), and Instrumental Activities of daily living (IADL) were performed by the geriatrician and gerontologist.

## Results:

A total of 124 patients, aged 65 years or older (min 65, max 96) were evaluated. The point prevalence of delirium was 24.2% according to 4A's Test. The group with delirium was older than the group without delirium. Patients with delirium had higher CFS, SARC-F, and lower MNA-SF, ADL, and IADL scores ( $p < 0.005$ ) (Table 1). Therefore, patients with delirium had lower BMI, CC, and MAC values. The multivariable analysis model included age, sex, CFS, MNA-SF, and multimorbidity. Age (OR 1.100,  $p = 0.015$ ), CFS (OR 1.692,  $p = 0.015$ ), and MNA-SF score (OR 0.807,  $p = 0.045$ ) were independently associated with delirium (Table 2)

**Conclusions:** The higher age, higher CFS score, and lower MNA-SF score assessed at admission may be a sign of higher risk of delirium. Performing MNA-SF and CFS may help to define the risk of delirium. Therefore, managing malnutrition and frailty may be rational to prevent delirium.

**Table 1 Comparison of patients with and without delirium**

	No delirium (n:94)	Delirium (n:30)	P value
Age	72.9(69.4-77.7)	81.4(73.6-84.8)	<b>0.001</b>
Sex, female, n(%)	37(39.4)	17(56.7)	0.096
MNA-SF	11.0(9.0-12.0)	8.0(4.0-10.5)	<b>&lt;0.001</b>
Clinical frailty scale	4.0(3.0-5.0)	6.0(5.0-7.0)	<b>&lt;0.001</b>
SARC-F	2.0(0.0-6.0)	8.0(4.7-9.0)	<b>&lt;0.001</b>
ADL	6.0(5.0-6.0)	3.5(0.7-5.0)	<b>&lt;0.001</b>
IADL	8.0(7.0-8.0)	2.0(0.0-7.0)	<b>&lt;0.001</b>
Body mass index	27.1(23.7-31.2)	25.3(21.9-27.8)	<b>0.041</b>
Calf circumference	35.0(31.5-37.0)	31.5(27.7-34.2)	<b>&lt;0.001</b>
Mid-arm circumference	27.0(25.7-30.0)	25.0(23.0-27.0)	<b>0.001</b>
Number of comorbidities	2.0(1.5-3.0)	2.0(2.0-4.0)	0.364
Number of medications	4.0(2.0-6.0)	5.0(3.0-8.0)	0.369

ADL: activities of daily living; IADL, instrumental activities of daily living; MNA-SF, Mini-Nutritional Assessment Short Form

**Table 2 Multivariable regression analysis**

	OR 95%CI	P value
Age	1.100(1.019-1.188)	0.015
Clinical Frailty Scale	1.692(1.106-2.588)	0.015
MNA-SF	0.807(0.655-0.995)	0.045

The model included age, sex, clinical frailty scale, mini-nutritional assessment short form, multimorbidity

(Nagelkerke R square 0.447, hosmer lemeshow 0.177)

# Impact of Under-Diagnosed Postoperative Delirium on Short-Term Health Outcomes

## Authors:

1. Rami Aldwikat, Monash University, Australia
2. Elizabeth Manias, Monash University, Australia
3. Emily Tomlinson, Deakin University, Australia
4. Pat Nicholson, Deakin University, Australia

## Background:

Delirium, a serious neurocognitive disorder is common in surgical patients yet is consistently under-diagnosed. This study evaluated how missed delirium, and delayed diagnosis impacts on the length of hospital stay and rates of discharge to long-term care facilities among older surgical patients.

## Methods:

This secondary analysis of data from a prospective cohort study, included older (70.8-88.7 years) surgical patients admitted to a tertiary hospital in Melbourne, Australia, from July to December 2021. Researchers used DSM-5 criteria to diagnose delirium post-operatively. Medical records were reviewed to determine rates of delirium diagnosis by clinicians.

## Results:

Of the 271 included patients, 44 (16.2%) were diagnosed with delirium by the researchers. The review of medical records indicated that 20% of cases were diagnosed promptly within 12 hrs, 16% were missed (no diagnosis), and 64% experienced delayed diagnosis of between 24-72 hours. Multivariate analysis revealed that missed diagnosis (adjusted coefficient 9.47, 95% CI 3.22–15.72;  $p = 0.003$ ) and delayed diagnosis (between 24-48h) (adjusted coefficient 14.01, 95% CI 10.30–17.72;  $p = 0.001$ ) was associated with a longer hospital stay. Missed diagnosis (adjusted OR: 24.0, 95% CI 2.58–224.84;  $p = 0.005$ ) and a 24-72 hour diagnosis delay (OR:10, 95% CI 3.45–29.04;  $p = 0.001$ ) also predicted higher likelihood of discharge to long-term care.

## Conclusions:

Missed or delayed diagnosis of delirium can have severe consequences for older adults recovering from surgery. Routine delirium screening is essential for improving patients' outcomes and reducing the healthcare costs associated with this condition.



# Music intervention to reduce preoperative anxiety and its relationship with postoperative delirium in older patients: a secondary analysis

## Authors:

1. Ke-Lu Yang, Department of Public Health and Primary Care, Academic Center for Nursing and Midwifery, KU Leuven - University of Leuven, Belgium
2. Elke Detroyer, Department of Public Health and Primary Care, Academic Center for Nursing and Midwifery, KU Leuven - University of Leuven, Belgium
3. Danny Hoogma, Department of Anesthesiology, University Hospitals Leuven, Belgium
4. Christophe Dubois, Department of Cardiovascular Medicine, University Hospitals Leuven, Belgium
5. Bart Meuris, Department of Cardiac Surgery, University Hospitals Leuven, Belgium
6. Bart Meyns, Department of Cardiac Surgery, University Hospitals Leuven, Belgium
7. Steffen Rex, Department of Anesthesiology, University Hospitals Leuven, Belgium
8. Koen Milisen, Department of Public Health and Primary Care, Academic Center for Nursing and Midwifery, KU Leuven - University of Leuven, Belgium

## Background/Aims:

Postoperative delirium (POD) is a common complication following surgery, associated with multiple adverse outcomes. Preoperative anxiety (PA) may contribute to POD, and music intervention has been shown to reduce PA. We aimed to pilot-test the effect of the music intervention on reducing PA in older patients and to explore the relationship between PA reduction and POD.

## Methods:

In a secondary analysis of a feasibility study of music intervention, patients 60 years or older, scheduled for elective cardiac surgery or Transcatheter Aortic Valve Implantation (TAVI) were recruited. Participants received one 20-30 minutes music session one day before and on the day of surgery/TAVI. PA was assessed using six-item state scale of State-Trait Anxiety Inventory (STAI-6), Amsterdam Preoperative Anxiety and Information System anxiety subscale (APAIS-A) and Visual Analogue Scale for anxiety (VAS-A). POD was assessed using 3-Minute Diagnostic Interview for Confusion Assessment Method (3D-CAM) and Chart-based Delirium Identification Instrument.

## Results:

Among 71 patients, significant PA reductions were observed after the first session (APAIS-A:  $p=0.002$ , STAI-6:  $p<0.001$ , VAS-A:  $p=0.002$ ), with 60 patients (84.5%) feeling relaxed immediately afterwards. Although PA reductions were not significant for any measurement among 56 patients completing assessments after the second session, 51 (91%) felt relaxed immediately afterwards. Assessment for POD was performed in 56 patients of whom 11 (20%) developed POD. Changes in PA levels from baseline to the first and second sessions were not significantly associated with POD, respectively.

## Conclusions:

Music can reduce PA levels immediately, but no significant relationship between PA reduction and POD was found.

# A Decade of Deliriummanagement: Trends and Outcomes at University Hospital Vienna

## Authors:

1. Roman Breuer, University Hospital Vienna, Austria
2. Sonja Schneeweiss, University Hospital Vienna, Austria
3. Christine Németh, University Hospital Vienna, Austria
4. Karin Mühl, University Hospital Vienna, Austria
5. Ursula Sommer, University Hospital Vienna, Austria

## Background:

Since 2014, targeted nurse-led initiatives have improved delirium care through training, audits, and coordinator structures.

A study at University Hospital Vienna assessed delirium prevalence. Results from 2015 showed a significant proportion (19.11%) of patients with delirium. Postoperative and intensive care units caring for elderly patients had particularly high rates.

The 2022 study evaluates current practices, identifies trends, and informs future improvements using outcome and process data.

## Methods:

A cross-sectional study was conducted involving all patients at AKH Vienna during a twoweek period. Patients were assessed using standardized data collection forms, and data was descriptively analyzed using SPSS®.

## Results:

The study included 811 adult patients who were interviewed and whose medical records were analyzed. The overall prevalence of delirium was 7% (n=57), more than half the rate observed in 2015 (19.1%; n=282/1475). Patients aged 75 and older experienced a more substantial reduction in delirium prevalence than younger individuals. The vulnerable group of non-interviewable individuals experienced delirium three times as often (22,6%; n=37). Notably, the documentation revealed a substantial increase in the identification of delirium risk at admission from 49.5% in 2015 to 73.1% in 2022.

## Conclusions:

The implemented nursing strategies for delirium prevention have proven effective. These findings emphasize the importance of ongoing monitoring and adaptation of nursing practices. By promoting the digital collection of delirium and medical data, we can better analyze patient journeys and identify areas for improvement in care delivery.

# Role of preoperative neural metastability in postoperative neurocognitive disorders

## Authors:

*Department of Anesthesiology and Intensive Care, School of Medicine and Health, Technical University of Munich, Germany*

1. Adriana Usheva
2. Anika Fix
3. Julia Schwarz
4. Franziska Zistler
5. Julian Ostertag
6. Matthias Kreuzer
7. Juliana Zimmermann
8. Stefanie Pilge
9. Svenja Letz
10. Rachel Nuttall
11. Gerhard Schneider

*Department of Neuroradiology, School of Medicine and Health, Technical University of Munich, Germany*

1. Afra Wohlschläger

30

## Background:

'Metastability' describes the temporal dynamics in global functional brain synchrony necessary for optimal cognitive function. As changes in metastability (e.g. with age) are linked to cognitive impairment and altered consciousness, we aimed to investigate the association between preoperative metastability and the occurrence of postoperative neurocognitive disorders, as well as delirium-related risk factors.

## Methods:

Two preoperative resting-state electroencephalography datasets from patients aged  $\geq 65$  years were analysed. After determining the standard deviation of the Kuramoto order parameter (across frontal, central, parietal and occipital oscillators) across time, metastability was calculated as its mean across canonical frequency bands.

In a pre-acquired dataset, metastability was compared between patients with (n=19) and without (n=50) post-anaesthesia care unit delirium (PACU-D) using Mann-Whitney U tests. A second preliminary analysis of correlation between metastability and delirium risk factors (e.g. MoCA and CFS scores) was performed on data from an ongoing study (n=26 patients).

## Results:

PACU-D-patients showed significantly higher preoperative metastability, as compared to noPACU-D-patients (Mdn=0.294 vs. Mdn=0.289; U=651, z=2.36, p=0.018, r=0.28). Additionally, the variability of metastability across frequencies was significantly lower in the PACU-D-group (Mdn=0.012 vs. Mdn=0.016; U=255, z=-2.95, p=0.003, r=0.36). No statistically significant correlations between preoperative metastability and delirium risk factors were found.

## Conclusions:

Increased preoperative temporal fluctuations of network state may suggest abnormal flexibility that inhibits the maintenance of contextually appropriate states. Perioperative stress on functional network configuration may further exacerbate this impairment, possibly leading to delirium symptoms. Our findings suggest metastability could potentially be used to predict PACU-D, however its exact role needs further clarification.

# Impact of age and comorbid dementia status on delirium occurrence and 10-year mortality in a large cohort of adult general medicine patients

## Authors:

1. Jasmine Ming Gan, University of Oxford, Oxford University Hospitals NHS Foundation Trust, United Kingdom
2. Emily Boucher, University of Oxford, United Kingdom
3. Nicola Lovett, Oxford University Hospitals NHS Foundation Trust, United Kingdom
4. Sophie Roche, University of Oxford, United Kingdom
5. Sarah Smith, Oxford University Hospitals NHS Foundation Trust, United Kingdom
6. Sarah Pendlebury, University of Oxford, Oxford University Hospitals NHS Foundation Trust, United Kingdom

## Background:

Delirium is common in acute general medicine but data from unselected cohorts of all adults with long-term follow-up are limited. In an observational, longitudinal study, we determined the age-specific delirium occurrence, factors associated with delirium, and mortality to 10 years.

## Methods:

Consecutive patients aged >65 years or aged <65 years with confusion were prospectively screened for delirium using the Confusion Assessment Method (CAM) with diagnosis by the DSM-IV criteria. Other clinical data were collected during routine care. Mortality data was acquired from the national database and Hazard Ratios (HRs) were calculated adjusted for age, sex, comorbidity, illness severity and frailty.

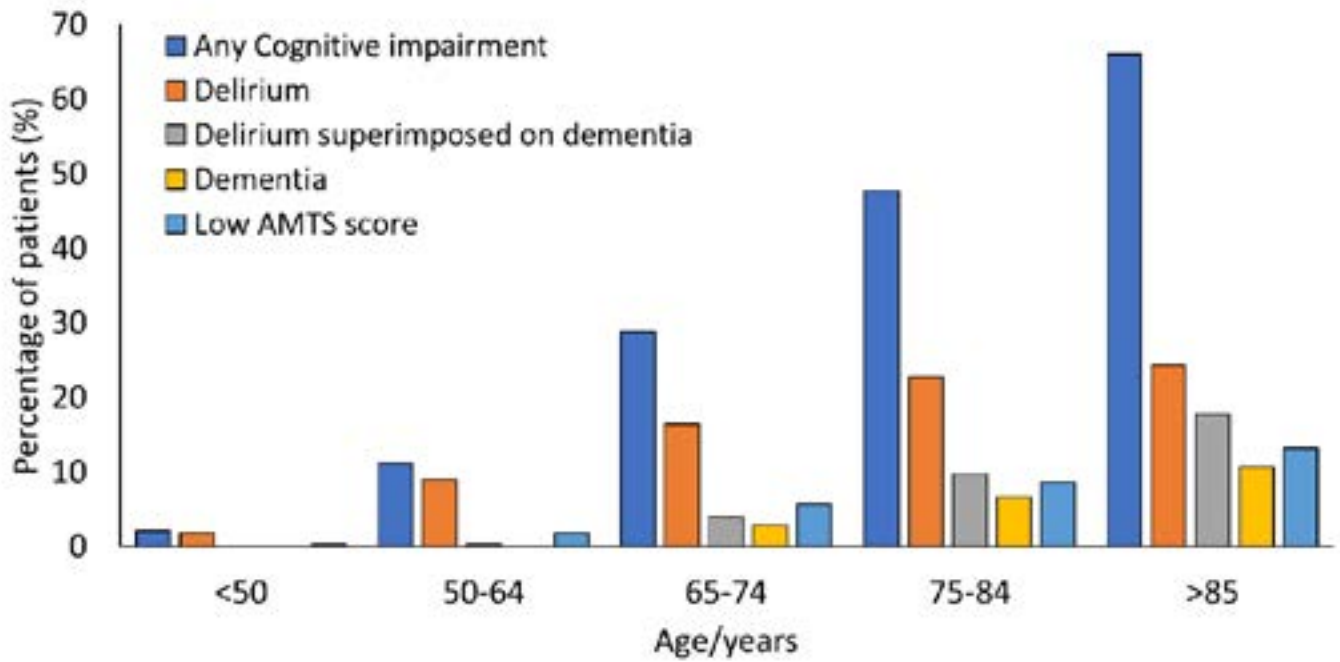
## Results:

Of 1846 patients (median age/IQR=74/55-84 years, 51% female), 426 (23%) had delirium. Delirium increased with age: age <50 years=2%, age 50-64 years= 9%, age 65-74 years=20%, age >75 years=37%. Dementia prevalence was lower: age <65=0.1%, age 65-74=7%, aged >75 years=22%. Delirium-associated mortality was maintained over 10-years but attenuated over time (adjHR 30-day mortality=2.03, 1.40-2.97 vs 10-year mortality=1.52, 1.30-1.77). Delirium associated 30-day mortality was strongest in younger age groups (adjHR age 65-74=3.50, 1.12-10.9, p=0.031, age 75-84=2.31, 1.20-4.46, p=0.013, age >85 years=1.67, 1.00-2.79, p=0.051) and those without comorbid dementia (adjHR=2.27, 1.48-3.48, p<0.001 vs with dementia=1.42, 0.66-3.04, p=0.372).

## Conclusions:

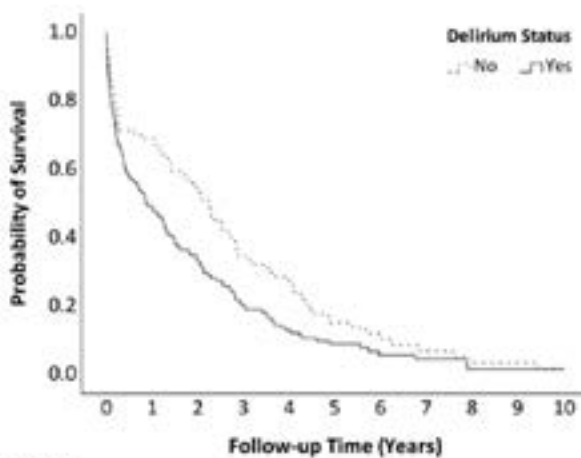
The substantial increase in delirium from the age of 65 years justifies current guidance for routine delirium screening of older adults in the acute hospital setting. The relatively greater mortality with delirium in younger patients, and those without co-morbid dementia, highlights groups in whom interventions and selection for trials should be prioritised.

**Figure 1. Percentage of patients with cognitive impairment by age group**



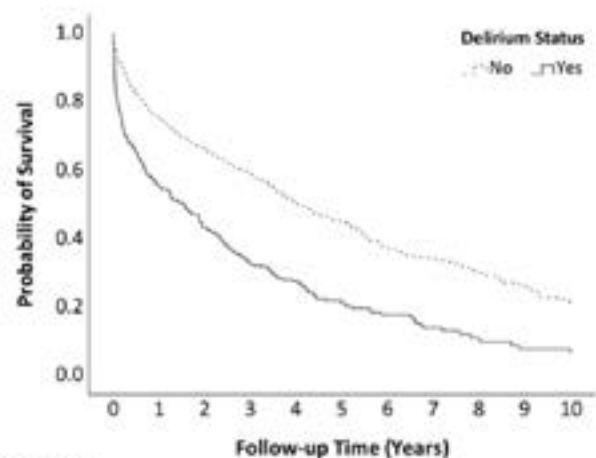
**Figure 2. Kaplan-Meier survival curve from admission and up to 10 years follow-up stratified by status of comorbid dementia**

**a) Patients with history of dementia**



Number at risk		0	1	2	3	4	5	6	7	8	9	10
Delirium	No	133	64	44	26	17	11	5	4	1	1	1
Delirium	Yes	84	58	45	29	23	12	7	4	2	1	1

**b) Patients without history of dementia**



Number at risk		0	1	2	3	4	5	6	7	8	9	10
Delirium	No	256	142	110	83	70	47	28	17	10	7	7
Delirium	Yes	699	525	460	409	350	268	158	111	56	48	39

# Investigation of logistic regression approaches to observational cohort studies of delirium

## Authors:

1. Shanti Subrahmanian, Centre for Public Health, Queen's University Belfast, United Kingdom
2. Jacob Simpson, Centre for Public Health, Queen's University Belfast, United Kingdom
3. Emily Bowman, Centre for Public Health, Queen's University Belfast, United Kingdom
4. Christopher Cardwell, Centre for Public Health, Queen's University Belfast, United Kingdom
5. Emma Cunningham, Centre for Public Health, Queen's University Belfast, United Kingdom

## Background:

Cohort studies show delirium as a risk-factor for future cognitive impairment, raising the question of whether it is an independent predictor or an indicator of pre-existing vulnerability. One of the ways to investigate the association between delirium and subsequent cognitive impairment is through logistic regression models. An important part of building these models is selecting which variables to include and deciding how to incorporate them into the model, as these can affect the results produced. This work aims to i) describe the methodology used in relevant studies and ii) to consider them with reference to current reporting guidelines.

## Methods:

Studies on postoperative delirium with long-term follow-up and cognitive impairment and/or dementia as the outcome were identified using recent systematic reviews of papers and additional searches on PubMed. The following data was extracted: the number of variables that were included, the rationale for inclusion, and the methods used in deciding which variables to add to the model. Extracted data was considered alongside relevant STROBE guidelines.

## Results:

Of the n=9 studies reviewed, 1/9 had more than 10 events per variable. Regarding confounders, 6/9 studies explicitly mentioned adjusting for them. For variable selection methods, all 9 papers carried out pre-selection of which 2/9 specified the final method used to add variables into the model.

## Conclusions:

Reporting of logistic regression methods varies across studies of delirium and subsequent cognitive impairment. Further detail may be required to fulfil recommendations set by STROBE guidelines.

# Oxford and Reading Cognitive Health After Recovery from acute illness and Delirium- Prospective Study (ORCHARD-PS): Feasibility and baseline data

## Authors:

1. Jasmine Ming Gan, University of Oxford, Oxford University Hospitals NHS Foundation Trust, United Kingdom
2. Lily Elderton, University of Oxford, United Kingdom
3. Aldazier Jakiran, Oxford University Hospitals NHS Foundation Trust, United Kingdom
4. Meenu Vijayakumar Sheela, Oxford University Hospitals NHS Foundation Trust, United Kingdom
5. Sarah Evans, Oxford University Hospitals NHS Foundation Trust, United Kingdom
6. Kinza Shahab, Oxford University Hospitals NHS Foundation Trust, United Kingdom
7. Nicola Lovett, Oxford University Hospitals NHS Foundation Trust, United Kingdom
8. Aubretia McColl, Royal Berkshire NHS Foundation Trust, United Kingdom
9. Sarah Pendlebury, University of Oxford, Oxford University Hospitals NHS Foundation Trust, United Kingdom

## Background:

The pathophysiology of delirium and its association with subsequent cognitive decline is uncertain, but biomarker studies are limited with few neuroimaging data. We set up a prospective, bi-centre study of delirium and subsequent dementia (3-year follow-up), to enable acquisition of multimodal biomarkers (clinical, bloods, genetics, neuroimaging). We present the first six-month baseline clinical data.

## Methods:

All acute medical patients age >70 years without advanced dementia, nursing home residence or terminal illness were eligible. Potential participants were identified by clinical teams and subsequently interviewed by researchers after written consent/consultee agreement. Assessments included AMTS, 4AT, MDAS, MoCA and Clinical Frailty Score. Delirium was diagnosed using the DSM-V criteria.

## Results:

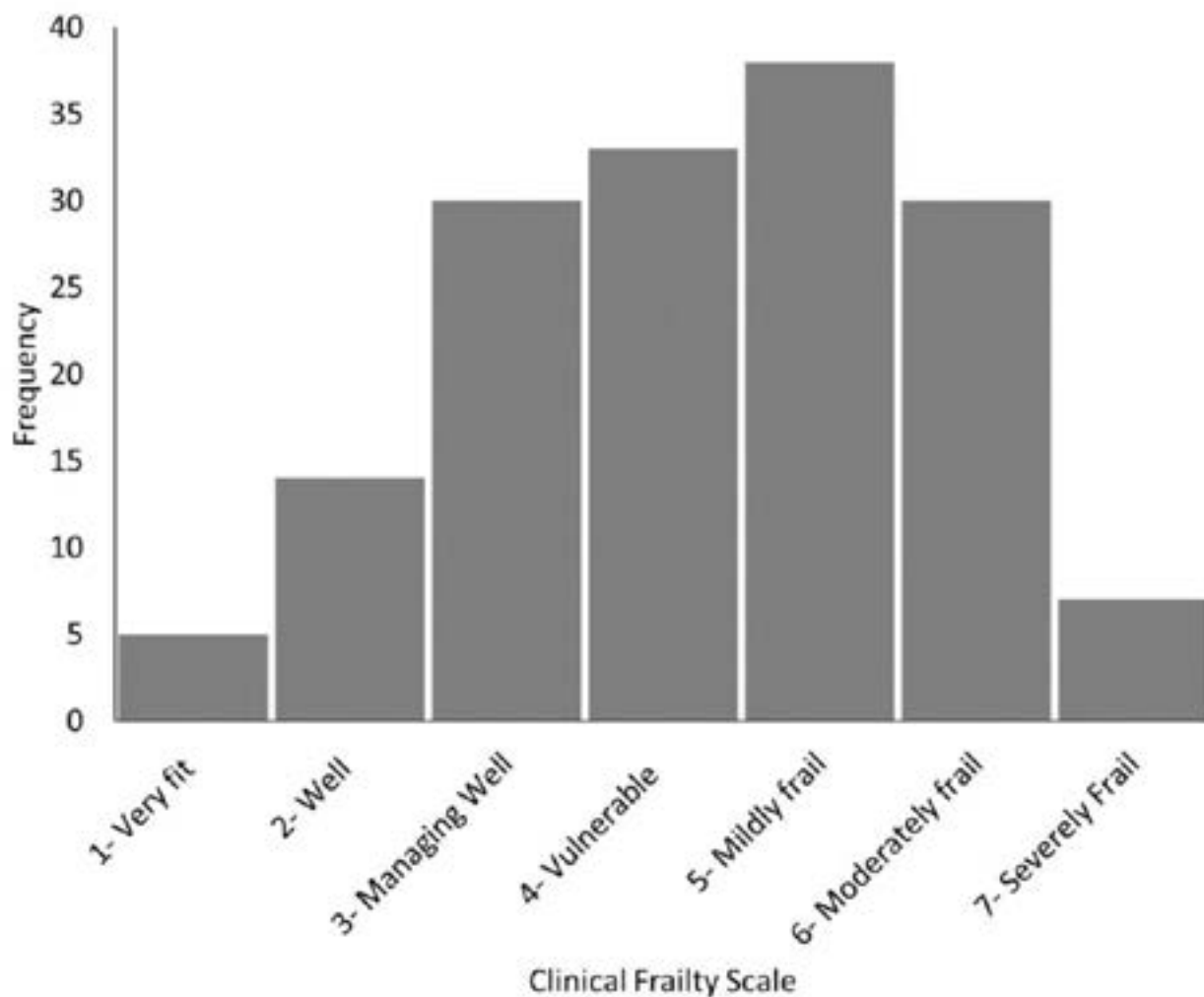
Of 243 patients approached (August 2023-January 2024), 159 (65%) were recruited (mean/SD age=82.7/6.1, 85 (53%) female, 32 (20%) consultee declaration, 75 (47%) frail). Delirium occurred in 46 (29%), and 14 (9%) had dementia diagnosis. Of 152 patients with AMTS (median[IQR]=9[7-10]), 55 (36%) had AMTS <9. MoCA was performed in 142 (89%) patients, of whom 112 had a full MOCA (mean/SD=20.7/6.1, range=3-30, n=91 MOCA<26), and the remainder had short MOCA (n=14 e.g. telephone, visual problems) or incomplete test (n=16). Blood banking was completed in n=138(87%), and 120(75%) had CT-brain (clinical scan=89, research scan=31).

## Conclusions:

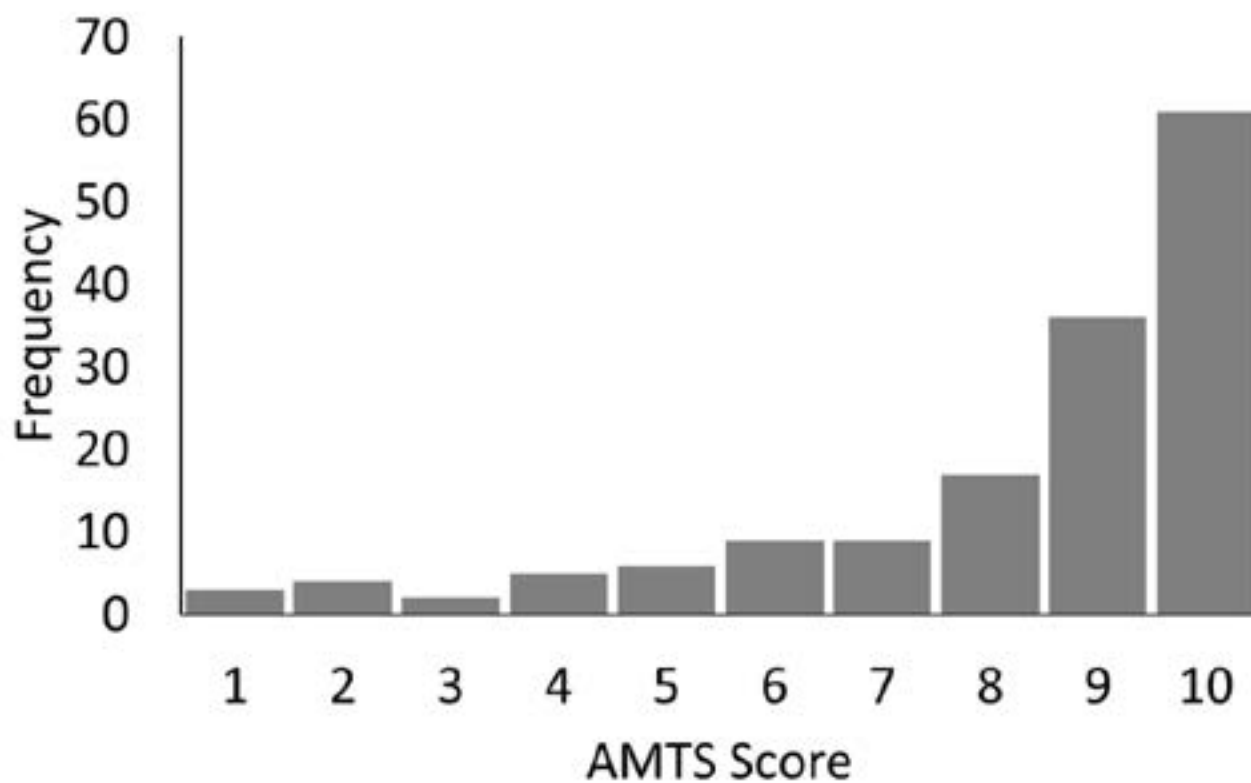
Recruitment was feasible in this older population with acute illness despite high prevalence of physical and cognitive frailty, with one-fifth of participants lacking capacity to consent to research. Three-quarters of patients had blood banking and neuroimaging completed, demonstrating the potential value of this cohort for multimodal biomarker studies.



**Figure 1: Histogram of Clinical Frailty Scale (CFS) scores**



**Figure 2: Histogram of Abbreviated Mental Test Score (AMTS) scores**





# Quantitative EEG Characteristics in Delirium Across Various Etiologies: A Multicenter Study

## Authors:

1. Julia van der A, University Medical Center Utrecht, Netherlands
2. Robert Fleischmann, University Medicine Greifswald, Germany
3. Annerose Mengel, University of Tübingen, Germany
4. Cornelis J Stam, Amsterdam University Medical Center, Netherlands
5. Sophie Leroy, University Medicine Greifswald, Netherlands
6. Pauline Schneider, University of Tübingen, Germany
7. Arjen Slooter, University Medical Center Utrecht, Netherlands
8. Johannes Ehler, Jena University Hospital, Germany
9. Edwin van Dellen, University Medical Center Utrecht, Netherlands

## Background:

Delirium is a heterogeneous syndrome with various precipitating factors. This study aimed to investigate whether quantitative electroencephalography (qEEG) characteristics differ among delirium subtypes or converge on a common neurophysiological pattern regardless of etiology.

## Methods:

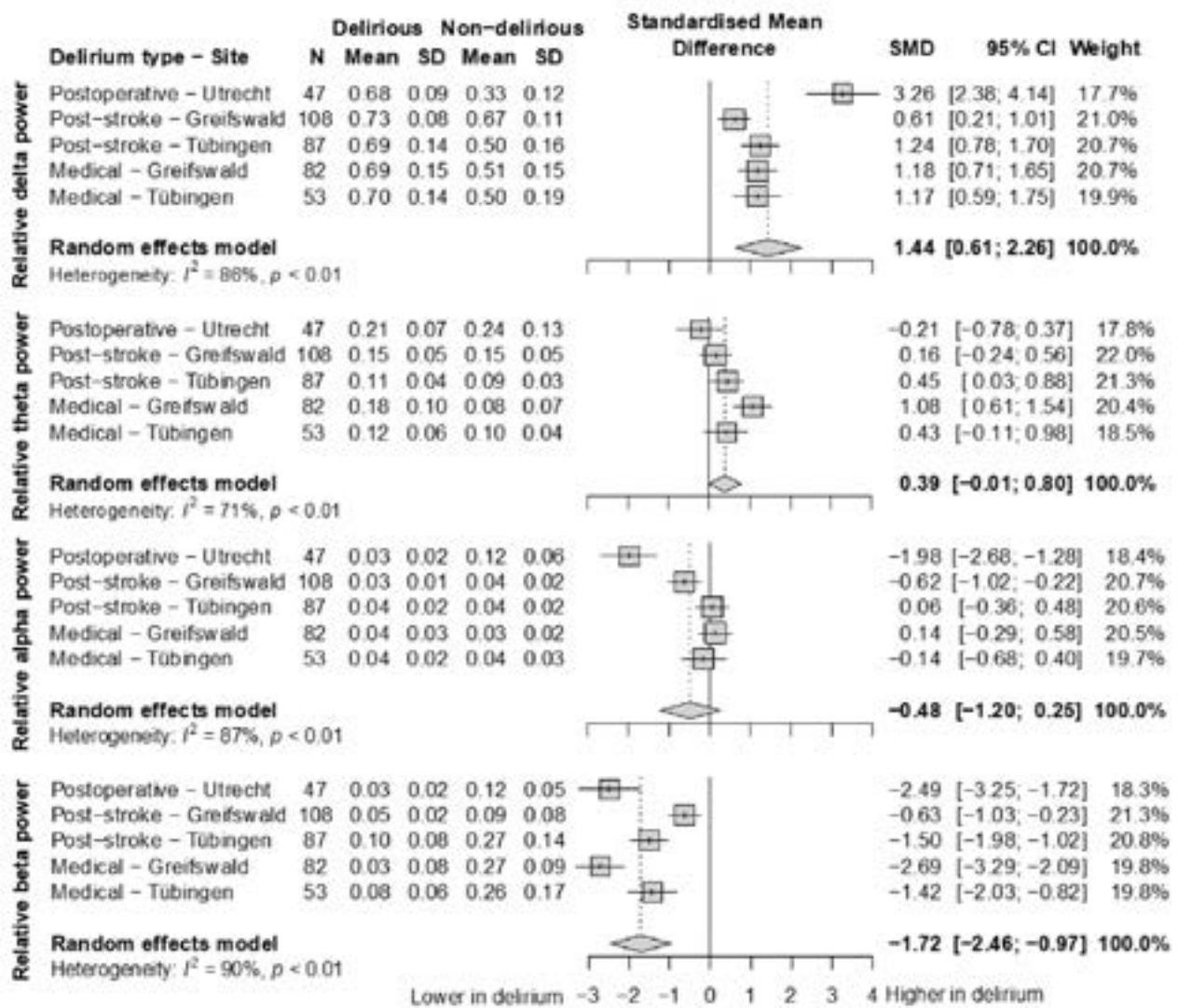
In this multicenter observational study, we analyzed qEEG data from 377 patients (173 delirious, 204 non-delirious) across three study sites. Delirium subtypes included post-stroke, postoperative, and medical ward delirium. We compared peak frequency, relative power, and phase lag index between delirious and non-delirious patients across different etiologies using standardized mean differences (SMDs).

## Results:

Consistent qEEG changes were observed across all delirium subtypes for spectral qEEG characteristics, including decreased peak frequency (SMD=-0.81, 95%CI:-1.50 to -0.13), increased relative delta power (SMD=1.44, 95%CI:0.61 to 2.26), and decreased relative beta power (SMD=-1.72, 95%CI:-2.46 to -0.97). Differences in phase lag index between delirious and non-delirious controls were not consistent across subtypes. Heterogeneity of qEEG characteristics was lower in delirious patients compared to non-delirious patients.

## Conclusions:

Our findings demonstrate consistent patterns in spectral qEEG characteristics across delirium subtypes, suggesting a common neurophysiological pathway of global EEG slowing in delirium regardless of etiology. However, differences in phase lag index did not converge across subtypes, which indicates that phase-based functional connectivity may be more subtype-specific. Non-delirious patients showed higher heterogeneity in qEEG characteristics compared to delirious patients, which highlights the importance of control group selection in future delirium EEG studies.



**Figure 1.** Forest plot of standardized effect sizes ( $g$ ) of spectral power in patients with and without delirium. Total standardized mean difference with 95% confidence interval, weight and heterogeneity reported. SD = standard deviation, CI = confidence interval.

# AI Supported Delirium Management 2.0

## Authors:

1. Wolfgang Hasemann, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
2. Tamara Eichenbrenner, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
3. Vanessa Vater, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
4. Valerie Ryser, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
5. Isabella Glaser, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland

## Background:

Patients with delirium are at higher risk of falls in hospitals compared to other patient groups. To prevent unattended bed exits, a common precursor to falls, hospitals often use bed rails, mechanical, and chemical restraints, as well as pressure point-controlled electromechanical bed exit monitoring systems. However, these traditional bed-exit systems have shown low effectiveness in preventing falls. We implemented a paradigm shift by (1) managing delirious patients in a dedicated geriatric ward (Delirium Unit) regardless of their underlying condition, (2) avoiding mechanical and chemical restraints, (3) using low-floor beds without bed rails, and (4) extending the bed surface with an additional mattress if needed. We also employed a contactless radar and AI-supported system to monitor bed exits and detect falls, developed within our department.

**Aims:** To evaluate the effectiveness of a newly developed bed-exit warning and fall detection tool (Qumea®) compared to a conventional pressure-sensitive mat placed at the bedside.

## Methods:

Patients, coming mainly from medical and surgical wards, as well as from ICU of a University Hospital in Switzerland were assigned to rooms equipped with either contact mats or the Qumea system.

## Results:

Data collection spanned from December 2022 to October 2023, involving 130 patients. In rooms with contact mats, the fall rate associated with bed exits was 24 per 1,000 hospital days, compared to 13 per 1,000 in rooms with the Qumea system, representing a 47% reduction.

## Conclusions:

Qumea not only significantly reduces fall rates but is also the first system to objectively detect falls.

# The Risk of Delirium Following Discontinuation of Antidepressant Home Medication in Intensive Care Unit Patients

## Authors:

1. Thomas Van Gelder, University Medical Center Utrecht, Netherlands
2. Irene Van Diem-Zaal, Franciscus Hospital, Netherlands
3. Arief Lalmohamed, University Medical Center Utrecht, Netherlands
4. Toine Egberts, University Medical Center Utrecht, Netherlands
5. Arjen Slooter, University Medical Center Utrecht, Netherlands

## Background/Aims:

Many intensive care unit (ICU) patients are on antidepressants prior to admission. Discontinuing these medications in the ICU may lead to withdrawal symptoms, potentially causing or worsening delirium. This study aimed to assess the impact of discontinuing home antidepressants on the incidence of delirium in ICU patients.

## Methods:

This single-center, prospective cohort study included all adult ICU patients admitted for at least 24 hours between January 2011 and June 2013, and from 2015 to 2019. Daily delirium assessments were conducted using a validated algorithm. Patients with acute neurological disorders or those receiving palliative sedation were excluded. From this cohort, patients who were using antidepressants prior to ICU admission were identified. Patients were then categorized into “Discontinued” or “Continued” groups. The primary outcome was the incidence of delirium in each group.

## Results:

Of the 3603 patients included in the study, 241 (7%) were using antidepressants prior to ICU admission. Delirium was observed in 44 out of 111 (40%) patients who continued and in 50 out of 130 (38%) patients who discontinued their antidepressant. A Cox proportional hazard regression analysis showed no significant increase in the risk of delirium for patients who discontinued antidepressants compared to those who continued (adjusted HR 1.063, 95%CI 0.719–1.571, P=0.76).

## Conclusions:

Discontinuing home antidepressants in ICU patients does not significantly increase the risk of delirium compared to continuing these medications. These results indicate that the decision to either continue or discontinue antidepressants in the ICU should be guided by individual clinical circumstances rather than a general concern over delirium.

# Nurses' perception of an AI-sensor based bedexit warning on a specialized unit for patients with delirium

## Authors:

1. Ryser Valerie, University Department of Geriatric Medicine FELIX PLATTER, Switzerland
2. Vanessa Vater, University Department of Geriatric Medicine FELIX PLATTER, Switzerland
3. Tamara Eichenbrenner, University Department of Geriatric Medicine FELIX PLATTER, Switzerland
4. Wolfgang Hasemann, University Department of Geriatric Medicine FELIX PLATTER, Switzerland

## Background:

Patients with delirium are at an increased risk of falls during hospitalization, leading to potential subsequent health complications. Various technologies to prevent falls have been developed in previous years. Many of these have disappeared from the market again due to their poor practicability and subsequent non-acceptance by nursing staff. At the DeliriumUnit of the University Department of Geriatric Medicine, FELIX PLATTER, the innovative fall prevention and fall detection system QUMEA® was developed and used as standard practice over a three-year period. Since staff acceptance is crucial when new technologies are implemented in clinical practice, we were interested in opinions of the nursing staff.

## Methods:

A survey was conducted among the multidisciplinary team of the DeliriumUnit (N=24) to assess the usefulness, reliability, handling and privacy of the system. The questionnaire consisted of 42 questions scored on a 4-point Likert scale. Descriptive statistics were calculated using R Studio and inferential statistical tests were used to identify differences between different professional groups. In addition, responses were compared with a previous survey conducted during the implementation of QUMEA®.

## Results:

Based on a previous internal survey at the time of QUMEA®'s introduction, it is expected that employee satisfaction will be positively evaluated. We assume that registered nurses due to their work experience, may have a more differentiated and more critical view of QUMEA® compared to nursing assistants.

## Conclusions:

The evaluation provides current and future users with key information in the implementation process of new fall prevention technologies.

## Postoperative delirium is associated with accelerated brain aging

### Authors:

1. Edwin van Dellen, UMC Utrecht, Netherlands
2. Hugo Schnack, UMC Utrecht, Netherlands
3. Aryaa Apotikar, UMC Utrecht, Netherlands
4. Daan Westland, UMC Utrecht, Netherlands
5. Julia van der A, UMC Utrecht, Netherlands
6. Ilse Kant, UMC Utrecht, Netherlands
7. Jeroen de Bresser, LUMC, Netherlands
8. Simone van Montfort, UMC Utrecht, Netherlands
9. Claudia Spies, Charité, Germany
10. Jeroen Hendrikse, UMC Utrecht, Netherlands
11. Arjen Slooter, UMC Utrecht, Netherlands

### Background:

Advanced age is a major risk factor for both delirium and dementia. The predicted age difference between one's brain age and chronological age (brainPAD) is a potential early biomarker for dementia. We hypothesized that advanced brain age increases the risk of postoperative delirium (POD), and that POD is associated with accelerated brain aging.

### Methods:

Brain MRI scans were made in 287 patients aged  $\geq 65$  years, before and three months after major elective surgery, and two MRI scans with similar time interval were made in 46 non-surgical control participants. We computed grey matter brainPAD in patients with (POD+) or without (POD-) subsequent delirium, and in non-surgical controls. We tested for group and time effects on brainPAD and explored correlations with cognitive performance changes assessed with the trail making test. Scanning site (i.e. UMC Utrecht, The Netherlands, and Charité University Hospital Berlin, Germany) and sex were added to the model as confounders.

### Results:

Grey matter brainPAD increased in the POD+ group with 4.5 additional months compared to POD- and non-surgical control groups ( $\beta=0.52$ ;  $p=0.002$ ). Accelerated brain aging was associated with a decline in visual attention as assessed with the trail making test (part A;  $\beta=2.14$ ;  $p=0.022$ ).

### Conclusions:

Elective surgery and postoperative delirium are associated with accelerated brain aging. These findings help to understand the complex relationship between aging, delirium and dementia.

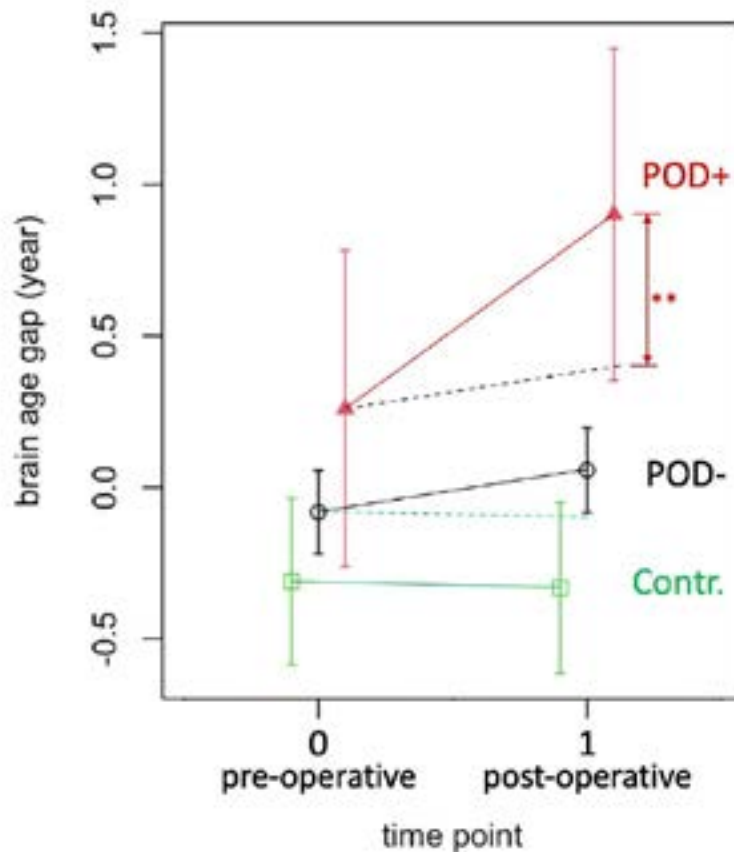


Figure 1. Mean brain age gaps at baseline (time point 1) and follow-up (time point 2), for patients with POD (POD+; red triangles), patients without POD (POD-; black circles), and controls (green squares). Error bars reflect the standard errors. Full lines connect the two time points. Dashed lines are drawn for comparison between POD- and Contr., and POD+ and POD- groups, respectively. There is a significant accelerated aging in the POD+ group between the two time points as compared to the POD- group ( $p=0.002$ , marked \*\*).

**Table 1. Characteristics of the study population**

	Patients POD+ N=31	Patients POD- N=256	Non-surgical controls N=46
Mean (SD) age at baseline (year)	73.03 (3.36)	71.42 (5.12)	71.24 (4.75)
Mean (SD) scan interval (year)	0.37 (0.15)	0.34 (0.12)	0.31 (0.09)
Age range (year)	66 – 81	65 – 87	65 – 82
Sex (% male)	64.5	65.2	54.3
Site (% UMC Utrecht)	41.9	44.1	82.6

Age and scan interval did not significantly differ between groups.

POD = postoperative delirium, SD = standard deviation.

# The Personalised Risk Tool: Automated Machine Learning-Based Delirium Risk Prediction in Austrian Secondary Care Facilities

## Authors:

1. Stefanie Jauk, Steiermärkische Krankenanstaltengesellschaft, Austria
2. Diether Kramer, Steiermärkische Krankenanstaltengesellschaft & Predicting Health GmbH, Austria

## Background:

The growing volume of electronic health record (EHR) data has led to the development of numerous machine learning (ML)-based models for predicting delirium. However, evidence regarding their performance in clinical practice is limited. The aim of this project was to integrate and validate an ML-based decision support software for delirium in a real-time setting in routine clinical practice.

## Methods:

The Personalised Risk Tool (PRT) is a medical device software that predicts the occurrence of delirium using routinely documented EHR data. This includes diagnoses, laboratory values, nursing assessments, and medications. Delirium risk is predicted within the first hours of hospitalization to enable timely delirium management. Since 2018, the PRT has been integrated into the hospital information systems of various secondary care hospitals across Austria and has undergone extensive validation.

## Results:

Since 2018, the PRT has predicted delirium risk for over 300,000 patient admissions in a real-time clinical setting. Multiple prospective evaluations have demonstrated the high prognostic accuracy of the algorithm, with AUROC values ranging from 0.86 to 0.92 including internal medicine and surgical in-patients. Technology acceptance surveys indicate that the software provides strong support for decision-making. The tool has successfully identified at-risk patients who might have otherwise been overlooked.

## Conclusions:

The findings suggest that ML algorithms can effectively predict delirium, align with clinical expertise, and be well-received by healthcare professionals. In future, ML-tools may help in the early detection, prevention, and treatment of older patients and, hence, ensure patient safety despite shortcomings of hospital resources.



# One-size fits all? A secondary analysis of a controlled before-after study identifying patient groups benefitting most from delirium prevention

## Authors:

1. Benjamin Dodsworth, PIPRA AG, Switzerland
2. Kelly Reeve, PIPRA AG, Switzerland
3. Reto Stocker, Klinik Hirslanden, Switzerland
4. Martin Zozman, Küssnacht Practice, Switzerland
5. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland

## Background:

To identify if the delirium risk of the patient affects the potency of non-pharmacological delirium prevention strategies by comparing length of stay.

## Methods:

This secondary analysis used data from a quality improvement project performed according to an controlled before-after study in a 335-bed Swiss private hospital. All non-cardiac surgery inpatients 60 or older were analyzed over a three-month period. Phase 0 was the month prior to any training, Phase 1 focused on delirium identification and treatment training for nurses and in Phase 2, PIPRA was used for risk prediction and non-pharmacological prevention strategies were implemented on at least medium-risk patients. We assessed the average length of stay as a surrogate measure for successful delirium prevention compared to the delirium risk over phase 0, 1 and 2.

## Results:

The analysis revealed that delirium prevention strategies were not uniformly effective across delirium risk. Patients with medium delirium risk showed the most significant benefit from the prevention strategies, whereas those with very high or low risk did not show similar levels of improvement.

## Conclusions:

The findings suggest that a 'one-size-fits-all' approach to delirium prevention may not be optimal. Tailoring prevention strategies to specific patient risk profiles, particularly focusing on medium-risk patients, could enhance the effectiveness of delirium prevention in clinical settings. This secondary analysis underscores the importance of personalized medicine and targeted healthcare interventions for better patient outcomes in delirium prevention.

# Preoperative attentional control and risk of postoperative neurocognitive disorders: a multimodal neuroimaging study

## Authors:

*From the Department of Anesthesiology and Intensive Care, School of Medicine and Health, Technical University of Munich, Germany:*

Anika Fix, Adriana Usheva, Franziska Zistler, Julia Schwarz, Julian Ostertag, Matthias Kreuzer, Juliana Zimmermann, Stefanie Pilge, Svenja Letz, Rachel Nuttall, Gerhard Schneider

*From the Department of Neuroradiology, School of Medicine and Health, Technical University of Munich; TUM-Neuroimaging Center, School of Medicine and Health, Germany:*

Cilia Jäger, Afra Wohlschläger

## Background:

Postoperative neurocognitive disorders (POCD) are often characterised by attentional impairments and related to preoperative attentional performance.

The power ratio between theta (1-4Hz) and beta (13-25Hz) neural oscillations (TBR) is a proposed electrophysiological marker of attentional control (AC) that may offer a biologically informed POCD-risk assessment tool. We aimed to 1) investigate differences in preoperative TBR between patients who did/did not develop POCD; 2) identify whether impaired control of attentional network activity relates to TBR.

## Methods:

Two pre-acquired datasets were analysed separately.

1) Preoperative resting-state eyes-closed 10-channel electroencephalography recordings (n=19 'POCD', n=51 'noPOCD', all >65yrs) were processed using Fast Fourier Transformation to extract the TBR per channel per patient. Wilcoxon rank sum tests were performed for statistical group comparisons.

2) Using simultaneous resting-state eyes-closed EEG-fMRI recordings from healthy subjects (n=32, mean age= 27.32), TBR was extracted from the EEG and fMRI-based functional networks subserving attention were identified via group-ICA. The mean anticorrelation between internally-oriented vs. externally-oriented attention networks as a network metric of AC was correlated with the TBR.

## Results:

1) POCD patients showed significantly higher preoperative TBR (i.e. lower AC) in frontal (z=1.981, p=0.048) and central (z=2.206, p=0.027) electrodes than no-POCD patients.

2) However, there was no significant association between frontal/central TBR and our network metric of AC in healthy subjects (r=0.090 and r=-0.102, respectively).

## Conclusions:

TBR as a marker of AC may be a promising clinically accessible POCD risk assessment tool.

However, it is still unclear whether/how the TBR relates to altered attentional network function.

# Developing a Reliable Quality Indicator for Delirium: Meaningfully Assessing Incidence Without Penalizing Good Screening Compliance

## Authors:

1. Benjamin Dodsworth, PIPRA AG, Switzerland
2. Marius Möller, Klinik Hirslanden, Switzerland
3. Simone Pascale Wildhaber, Klinik Hirslanden, Switzerland
4. Martin Zozman, Küsnacht Practice, Switzerland
5. Reto Stocker, Klinik Hirslanden, Switzerland
6. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland

## Background:

Quality indicators are crucial for evaluating the effectiveness of quality improvement programs. However, delirium incidence is an unreliable indicator due to underdiagnosis, leading to an apparent increase in incidence with improved screening. Additionally, patient characteristics (such as age or frailty) influence incidence rates, making it challenging to accurately assess quality improvements. This study aims to identify a reliable quality indicator for delirium that does not penalize hospitals with high screening compliance or more challenging patient populations. This is our initial exploration into finding a potential solution.

## Methods:

Data from a 335-bed hospital was analyzed over one year following the implementation of the automatic delirium risk assessment software, PIPRA. The study focused on surgical inpatients aged 60 and above, excluding cardiac and intracranial surgeries, using aggregate data over monthly or quarterly intervals. We examined the correlation between delirium screening compliance and apparent incidence based on the Delirium Observation Screening (DOS) tool. To take into account the screening compliance, the expected delirium incidence (the average delirium risk) of the unscreened patient cohort was combined with the apparent incidence of the screened population. The patient baseline risk was accounted for by normalising to the overall expected incidence of all patients using the average delirium risk (PIPRA score).

## Results:

A significant correlation was observed between apparent delirium incidence and screening compliance with higher screening compliance showing higher apparent incidence. Incorporating expected incidence from the low-screening group stabilized the data. By accounting for baseline risk, the data became more interpretable, normalizing for patient characteristics. In the case study of the hospital, improvements were observed in both compliance and incidence reduction.

## Conclusions:

This method appears more reliable than using average incidence, as it avoids penalizing high screening compliance or hospitals with more at-risk patients. The authors advocate for further dialogue on this approach to refining quality indicators for delirium.

# Revolutionizing Fall Detection: AI-Enhanced Accuracy for the Safety of Patients with Delirium

## Authors:

1. Tamara Eichenbrenner, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
2. Vanessa Vater, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
3. Valerie Ryser, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
4. Isabella Glaser, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland
5. Wolfgang Hasemann, University Department of Geriatric Medicine, FELIX PLATTER, Switzerland

## Introduction:

Falls are more common in hospitalized patients with delirium than in other patient groups. In clinical settings, falls are often self-reported, observed by healthcare professionals, or go unnoticed. Not all falls that meet the World Health Organization's definition are recognized by healthcare professionals, who may instead focus on the speed of the fall or resulting injuries to classify an event as a fall. This leads to underreporting. In our hospital, patients with delirium are treated in a specialized acute geriatric ward with low-low beds and no bed rails. We use Qumea®, a 3D radar and AI-based system, to alert nurses via smartphone when a fall occurs.

**Aims:** This study aims to compare nurse-reported falls with Qumea-detected falls, calculate Qumea's psychometric data, and describe fall patterns in delirium patients using low-low beds.

## Methods:

Falls were recorded during a 6-minute sequence with a thermal imaging camera. Nurses could mark false alarms on their smartphones to account for non-fall events.

## Results:

Qumea showed high accuracy with 88.89% sensitivity, 99.99% specificity, 92.31% positive predictive value, 99.98% negative predictive value, a positive likelihood ratio of 8195.56, and a negative likelihood ratio of 0.11.

## Conclusions:

Qumea's high positive likelihood ratio (8195.56) indicates it is highly reliable in confirming falls when detected, while its low negative likelihood ratio (0.11) suggests strong accuracy in ruling out non-falls. The system's 92.31% positive predictive value and 99.98% negative predictive value demonstrate its effectiveness, making it superior to traditional nurse assessments for improving patient safety.

# Long-term effects of an automated delirium risk assessment tool – the impact of PIPRA one year later

## Authors:

1. Benjamin Dodsworth, PIPRA AG, Switzerland
2. Marius Möller, Klinik Hirslanden, Switzerland
3. Simone Pascale Wildhaber, Klinik Hirslanden, Switzerland
4. Martin Zozman, Küsnacht Practice, Switzerland
5. Reto Stocker, Klinik Hirslanden, Switzerland
6. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland

## Background:

Delirium prevention programs are effective, but their impact often diminishes over time. This study aimed to evaluate the long-term effectiveness of a targeted prevention enabled through the automated delirium risk assessment tool, PIPRA, integrated into the electronic health record system.

## Methods:

The study was conducted in a 335-bed private Swiss hospital, focusing on surgical inpatients aged 60 and above, excluding those undergoing cardiac or intracranial surgeries. It was performed for 12 months after implementation of PIPRA. Routine hospital data, including length of stay, delirium incidence, and delirium risk, were extracted in aggregate by quarter and analyzed, alongside compliance with delirium screening protocols. Delirium incidence was adjusted for patients who were not screened by assuming the average delirium risk represents the incidence for this group. The study assessed changes in delirium incidence and length of stay following the implementation of PIPRA.

## Results:

Since the introduction of PIPRA there is a sustained reduction in delirium incidence by 31% compared to pre-implementation levels. There was also a significant reduction in the length of hospital stay, with an overall average decrease of 0.65 days. The most notable reduction was observed in medium-risk patients, who experienced an average reduction in length of stay by 1.06 days. The screening compliance was 58%.

## Conclusions:

In the context of a 335-bed private Swiss hospital, the integration of the PIPRA tool into the electronic health record system demonstrated long-term improvements in patient outcomes, with sustained decreases in delirium incidence and reduced hospital stay durations. These findings highlight the potential of automated risk assessment tools to enhance the effectiveness and longevity of delirium prevention programs in clinical settings.

# Can 4AT Score on Hospital Admission be Useful to Identify Patients Requiring Dementia Assessment? A Cohort Study of 75,221 Admissions Using Linked Primary Care, Hospital Discharge and Community Prescribing Data

## Authors:

1. Rose Penfold, Ageing and Health, Usher Institute, University of Edinburgh and Advanced Care Research Centre, University of Edinburgh, United Kingdom
2. Temi Ibitoye, Ageing and Health, Usher Institute, University of Edinburgh, United Kingdom
3. Atul Anand, Centre for Cardiovascular Sciences, University of Edinburgh, United Kingdom
4. Bruce Guthrie, Advanced Care Research Centre, University of Edinburgh, United Kingdom
5. Alasdair MacLulich, Ageing and Health, Usher Institute, University of Edinburgh, United Kingdom

## Introduction:

Undiagnosed dementia is common among acutely hospitalised older adults, and brief delirium screening tools could help identify patients for further cognitive assessment. This study determined the distribution of admission 4AT scores by dementia status and the accuracy of 4AT $\geq$ 1 for identifying dementia.

## Methods:

We included all emergency medical admissions  $\geq$ 65 years in Southeast Scotland from 01/04/2016 to 01/04/2020. The 4AT ([www.the4AT.com](http://www.the4AT.com)) was performed to detect delirium as part of routine care on admission. Dementia diagnoses at hospital admission and discharge were identified using linked primary care, hospital discharge and community prescribing data. Dementia recorded at discharge was the reference standard for calculating diagnostic test accuracy.

## Results:

Of 75,221 admissions (38,254 unique patients; mean age 80.0 years, 55.6% female), 62,188 (82.7%) had a documented 4AT score. Dementia was recorded for 11,607 (15.4%) patients at admission and newly diagnosed in another 1293 (1.7%) at discharge. 4AT $\geq$ 1 demonstrated a sensitivity of 86.8% (95%CI 86.1-87.4%), specificity 70.6% (70.2-71.0%), positive predictive value 39.2% (38.8-39.6%) and negative predictive value 96.1% (95% CI 95.9-96.2%) for dementia at discharge.

## Conclusions:

The 4AT has a good sensitivity and acceptable specificity as an initial dementia screening tool and may be useful to identify hospitalised patients requiring further memory assessment.

	4AT 0 No delirium, no cognitive impairment N (%)	4AT 1-3 Possible cognitive impairment N (%)	4AT 4+ Probable delirium N (%)
No dementia	36049 (70.6%)	8803 (17.2%)	6191 (12.2%)
Dementia at admission	1327 (13.3%)	3630 (36.5%)	4991 (50.2%)
Dementia newly recorded at discharge	149 (12.4%)	479 (40.0%)	569 (47.5%)

# Profound changes: experiences of family carers of older patients with delirium in Aotearoa New Zealand

## Authors:

1. Engelina Groenewald, University of Auckland, New Zealand
2. Sarah Cullum, University of Auckland, New Zealand
3. Lillian Ng, University of Auckland, New Zealand

## Background:

Follow-up care of patients with delirium upon discharge from hospital can improve cognitive and functional outcomes, yet such services are limited. To develop follow-up services, we must first understand the experience of patients with delirium and the family members who care for them. The aim of the study was to understand the experience of caregivers of older people who had delirium in the period after discharge from hospital.

## Methods:

Semi-structured in-depth interviews were conducted with the family caregivers who cared for a patient with delirium in the one-to-two-month period after discharge from Middlemore hospital. Transcripts were analysed using reflexive thematic analysis.

## Results:

Twelve interviews were conducted. Three overarching themes were identified:

1. Dealing with a different person: there was a profound transformation in the person who experienced delirium during and after their inpatient admission, which had an impact on the life of the caregiver.
2. Making sense: caregivers desired to make sense of traumatic hospital experiences and the changes in their family member. More information and the opportunity to share their story would help.
3. Seeking support: caregivers wanted proactive healthcare, as well as practical and emotional support.

## Conclusions:

Family caregivers witness major changes in people with delirium, and they require support to deal with the additional demands placed on them. Healthcare support needs to be proactive, and more information about delirium shared with family to help them make sense of a distressing experience.

# P-Tau217 as a potential blood-based biomarker in delirium

## Authors:

*From the Oslo Delirium Research Group, Oslo, Norway*

1. Kristin Markus,
2. Jon Brynildsen
3. Thomas Gundersen
4. Leiv Otto Watne

## Background:

The underlying pathophysiology of delirium remains unclear but is believed to be closely linked with dementia. Tau phosphorylated at threonine 217 (p-tau217) is a newly recognized Alzheimer's disease (AD) plasma biomarker. This study aimed to determine whether higher levels of serum p-tau217 are associated with delirium.

## Methods:

Hip fracture patients (n = 332) were screened for delirium with the Confusion Assessment Method (CAM) daily. Serum was collected preoperatively (serum available from n = 200), postoperatively (serum from n = 289) and after 4 (n = 194) and 12 months (n = 137). In a pilot, we analysed 62 from baseline (postoperatively) 31 with delirium and 31 without delirium. We also included 9 samples from the 4 month follow up in those with dementia at baseline and delirium.

## Results:

The pilot found higher p-tau217 in delirium compared to no delirium (median 7.1 pg/ml vs 2.8 pg/ml,  $p < 0.001$ ) and even higher concentrations at the 4 months follow up (8.8 pg/ml). When stratifying by dementia status, serum p-tau217 was higher in delirium in both strata, with largest difference in the non-dementia group.

## Conclusions:

Pilot data from our study finds an association between higher levels of serum p-tau217 at baseline and delirium. p-tau217 concentrations were even higher at the follow up controls and this could indicate that delirium accelerates neuronal damage. Analyses of the full study cohort (containing 820 serum samples) is planned autumn 2024 and results will hopefully be ready for presentation at the EDA 2024.



# Nurses' recognition of delirium in nursing home residents; a systematic review

## Authors:

1. Daisy Quispel-Aggenbach, University Medical Center Groningen
2. Karin van Os, University Medical Center Groningen
3. Hendrika Luijendijk, University Medical Center Groningen
4. Marike Schokker, University Medical Center Groningen

## Background:

Delirium occurs frequently in nursing home residents but is easily missed. Nurses observe the residents 24 hours a day. The aim of this study was to review nurses' the recognition of delirium in nursing home residents.

## Methods:

A literature search was performed in PubMed, PsycINFO, Embase, CINAHL and Google Scholar, and in references of included articles, and prior reviews. Studies were included if they investigated the recognition of delirium by nurses and nurse-assistants working in long-term care. We extracted study characteristics, risk of bias, and rate of recognized delirium.

## Results:

We identified seven studies. One study scored low risk of bias on all domains. Five studies were based on recognition in daily practice. They were performed in the United States (2), Canada (2), and South-Korea (1). In four studies with one assessment moment per resident, the rate of recognized delirium in persons with delirium varied between 8% and 27%. In a fifth study with seven monthly assessments, the rate was 51%. Two of the seven studies used case vignettes. In one study among 760 American nurses and nurse-assistants, 17-53% recognized delirium correctly. In the other study among 13 German nursing home nurses, 23-62% detected delirium in vignettes describing delirium. Three studies investigated recognition by delirium subtype and reported the lowest rate for hypoactive delirium.

## Conclusions:

Nurses' recognition of delirium in nursing home residents has not been studied often. The rate of delirium recognized by nurses and nurse-assistant is generally low and seems to be overestimated in vignette studies.

# The diagnostic accuracy of the 4AT varies with baseline cognition: results from two prospective studies

## Authors:

- 1 Amy McWhirter, 1. Central and North West London NHS Foundation Trust, United Kingdom
2. Dominic Gardner, 1. Central and North West London NHS Foundation Trust, United Kingdom
3. Hannah Cheston, 1. Central and North West London NHS Foundation Trust, United Kingdom
4. Imogen Stoodley, 1. Central and North West London NHS Foundation Trust, United Kingdom
5. Daniel Davis, 1. Central and North West London NHS Foundation Trust. 2. UCL Institute of Health Informatics, University College London, United Kingdom
6. Alex Tsui, 1. Central and North West London NHS Foundation Trust. 2. UCL Institute of Health Informatics, University College London, United Kingdom
7. Louise Allan, 1. University of Exeter, United Kingdom
8. Sarah Richardson, 1. Newcastle University, United Kingdom
9. Patrick Hogan, 1. Central and North West London NHS Foundation Trust. 2. UCL Institute of Health Informatics, University College London, United Kingdom

## Background:

The 4 'A's Test (4AT) is a screening test for delirium which is validated for patients with cognitive impairment, however it may have different diagnostic accuracy depending on underlying dementia. This study is the first to prospectively evaluate the sensitivity and specificity of the 4AT, and its individual components, for detecting delirium across a range of cognitive baselines.

## Methods:

We used data from two prospective studies (DELPHIC and DECIDE). Participants were assessed at baseline and at subsequent hospital admissions, which included 4AT items. Baseline cognition was quantified using established comprehensive cognitive tests from epidemiological studies. The reference standard for delirium was DSM-IV. We calculated sensitivity, specificity and AUROC of the 4AT for delirium at each tertile of baseline cognition, both as a composite score and according to its individual components.

## Results:

400 patients were included (DELPHIC=196, DECIDE=204). Broadly consistent in both cohorts, 4AT had better diagnostic accuracy in those with higher baseline cognition, declining progressively in lower cognitive tertiles (Figure 1). Overall, orientation was the most sensitive component, while alertness and fluctuations were the most specific (Table 1). The specificity of both orientation and inattention declined with baseline cognition; conversely, sensitivity improved.

## Conclusions:

4AT is a valid screening test for delirium irrespective of baseline cognition. However, cognitive items perform best in those with higher baseline cognition, while non-cognitive features are more useful in those with lower baseline cognition. The findings may help to refine 4AT interpretation according to a patient's baseline cognitive state.

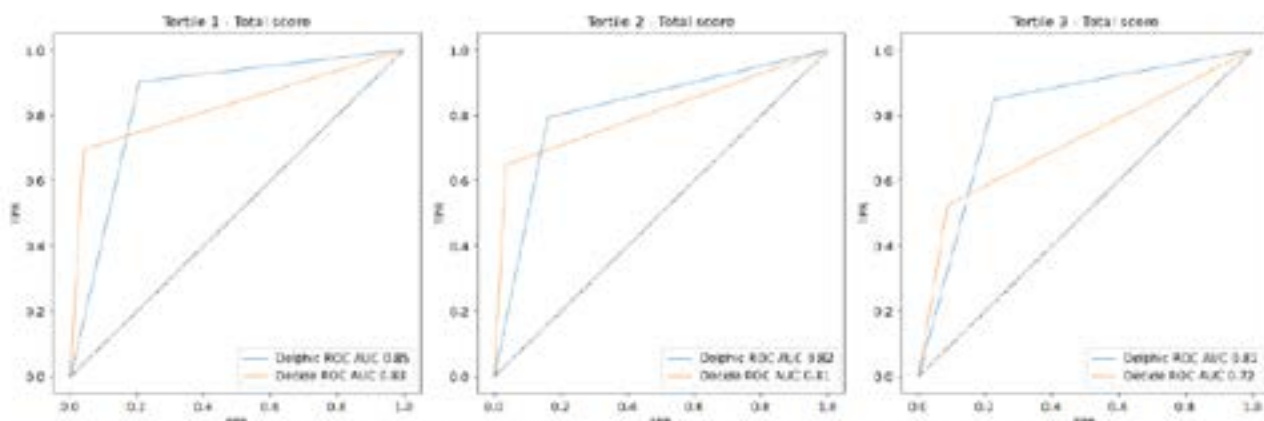


Figure 1. Receiver operating characteristic (ROC) curves for total 4AT score at each cognitive baseline tertile in both DELPHIC and DECIDE cohorts.

		Sensitivity		Specificity		AUROC	
		DELPHIC	DECIDE	DELPHIC	DECIDE	DELPHIC	DECIDE
Tertile 1 (high)	Total 4AT	0.90	0.69	0.79	0.96	0.85	0.83
	Alertness	0.77	0.00	0.86	1.00	0.81	0.50
	Orientation	0.87	0.81	0.72	0.83	0.80	0.82
	Attention	0.58	0.42	0.80	0.89	0.69	0.65
	Acute change	0.67	0.72	0.92	0.96	0.79	0.84
Tertile 2 (medium)	Total 4AT	0.79	0.65	0.84	0.97	0.82	0.81
	Alertness	0.66	0.04	0.86	1.00	0.76	0.52
	Orientation	0.95	0.87	0.65	0.61	0.80	0.74
	Attention	0.58	0.72	0.85	0.63	0.71	0.68
	Acute change	0.55	0.61	0.96	0.97	0.75	0.79
Tertile 3 (low)	Total 4AT	0.85	0.53	0.77	0.91	0.81	0.72
	Alertness	0.68	0.06	0.84	1.00	0.76	0.52
	Orientation	0.97	0.95	0.39	0.35	0.68	0.65
	Attention	0.71	0.82	0.66	0.39	0.68	0.61
	Acute change	0.60	0.53	0.93	0.92	0.76	0.72

Table 1. Sensitivity, specificity and AUROC for 4AT and its individual components at each cognitive baseline tertile in both DELPHIC and DECIDE cohorts.

# The feasibility of using wearable devices in inpatients with Parkinson's and delirium: Developing a digital framework for continuous monitoring of rest-activity and sleep

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## Authors:

1. Gemma Bate, Translational and Clinical Research, Newcastle University, United Kingdom
2. Florence Gerakios, Translational and Clinical Research, Newcastle University, United Kingdom
3. Sarah Richardson, Translational and Clinical Research, Newcastle University, United Kingdom
4. Laura Wright, Translational and Clinical Research, Newcastle University, United Kingdom
5. John-Paul Taylor, Translational and Clinical Research, Newcastle University, United Kingdom
6. David Burn, Faculty of Medical Sciences, Newcastle University, United Kingdom
7. Glenn Stebbins, Department of Neurological Sciences, Rush University Medical Center,, United States
8. Louise Allan, Institute of Health Research, University of Exeter, United Kingdom
9. Silvia Del-Din, Translational and Clinical Research Institute, Newcastle University, United Kingdom
10. Alison Yarnall, Translational and Clinical Research Institute, Newcastle University, United Kingdom
11. Rachael Lawson, Translational and Clinical Research Institute, Newcastle University, United Kingdom

## Background:

Patients with Parkinson's disease (PD) are at increased risk of delirium. However, identifying and monitoring delirium in PD is a challenge due to overlapping symptoms and under-reporting. Wearable devices can provide objective activity and sleep measures; however, identifying which measures to use is unclear. This study aimed to determine differences in digital rest-activity measures in PD inpatients with and without delirium and to propose a digital framework to aid clinical interpretation.

## Methods:

In parallel to longitudinal delirium assessments based on the DSM-5 criteria, participants wore an Axivity AX6 device on their wrist for up to seven days. Recorded sensor signals were processed using open-source software (GGIR) to provide 70 separate rest-activity and sleep measures averaged over the admission period. Measures showing differences between cases with and without delirium ( $p > .05$ ) were entered into a Principal Component Analysis (PCA).

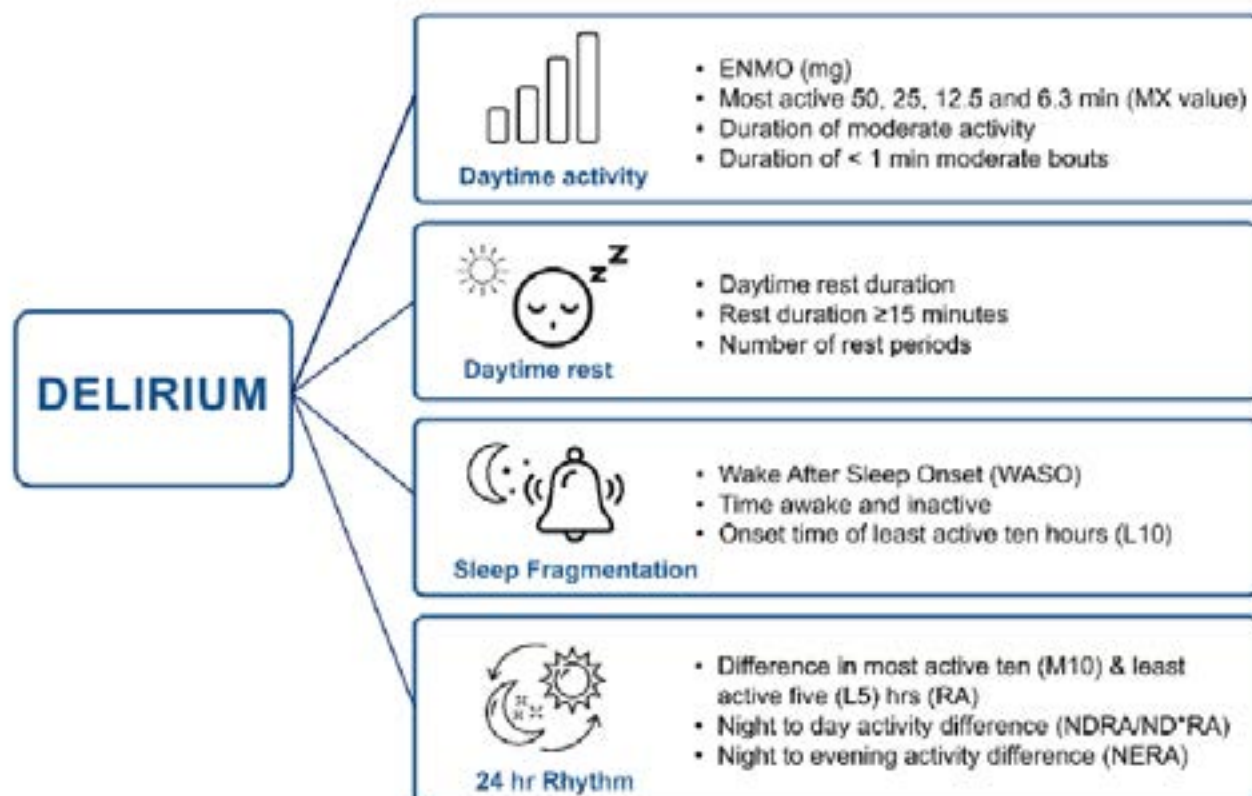
## Results:

Digital measures were derived for 52 participant admissions (34-delirium, 18-without). Seventeen separate digital-measures were significantly different in participants with delirium compared to those without. The PCA identified four components: daytime activity, daytime rest, sleep fragmentation and 24-hour rhythm. Delirium was associated with disrupted rest-activity patterns with increased daytime rest periods and increased wake duration at night.

## Conclusions:

We identified digital measures that are significantly different in PD inpatients with delirium compared to those without. The digital framework aids clinical interpretation and provides a foundation to explore the delirium profile across the admission period. The framework could facilitate the monitoring of inpatient recovery and establish common objective endpoints in future clinical trials.

## Digital measures framework for inpatients with Parkinson's disease



*Abbreviations: M10, Most active consecutive 10 hours; L5, Least active consecutive 5 hours; NDRA, Night-Day Relative Amplitude (day 7am-5pm); NDRA\*, Night-Day Relative Amplitude (day- includes evening hours, 7am-12pm); NERA, Night-Evening Relative Amplitude (evening 5pm-12pm); RA, Relative Amplitude.*

# Exploring the longitudinal changes in digital rest-activity and sleep outcomes in inpatients with Parkinson's and delirium

## Authors:

1. Gemma Bate, Translational and Clinical Research, Newcastle University, United Kingdom
2. Florence Gerakios, Translational and Clinical Research, Newcastle University, United Kingdom
3. Sarah Richardson, Translational and Clinical Research, Newcastle University, United Kingdom
4. Laura Wright, Translational and Clinical Research, Newcastle University, United Kingdom
5. John-Paul Taylor, Translational and Clinical Research, Newcastle University, United Kingdom
6. David Burn, Faculty of Medical Sciences, Newcastle University, United Kingdom
7. Glenn Stebbins, Department of Neurological Sciences, Rush University Medical Center,, United States
8. Louise Allan, Institute of Health Research, University of Exeter, United Kingdom
9. Silvia Del-Din, Translational and Clinical Research Institute, Newcastle University, United Kingdom
10. Alison Yarnall, Translational and Clinical Research Institute, Newcastle University, United Kingdom
11. Rachael Lawson, Translational and Clinical Research Institute, Newcastle University, United Kingdom

## Background:

Delirium is common in Parkinson's disease (PD) and is associated with an increased risk of mortality and dementia. Clinical tools only provide information for a snapshot of time and don't capture symptom fluctuations. This study aimed to explore the changes in digital rest-activity and sleep measures in Parkinson's inpatients with and without delirium and its subtypes over the hospital admission.

## Methods:

In parallel to longitudinal delirium assessments based on the DSM-5 criteria, participants wore an Axivity AX6 device on their wrist for up to seven days. Delirium subtypes were based on validated criteria (DMSS-4) and classified over the hospital stay. Open-source software (GGIR) was used for data processing. Seventeen digital measures were included, representing: daytime activity, daytime rest, sleep fragmentation and night-to-day variability. Linear mixed-effects modelling identified changes ( $p < .05$ ) in the digital outcomes over the hospital admission.

## Results:

Digital measures were derived for 52 participant admissions (34-delirium;  $n=6$  hyperactive,  $n=8$  hypoactive,  $n=20$  mixed). Daytime activity declined during the hospital stay in delirium and all delirium subtypes compared to cases without delirium. Daytime rest increased over time in hypoactive delirium compared to no-delirium ( $\beta=0.43, p=0.040$ ) or mixed ( $\beta=0.44, p=0.039$ ). Night-time wake duration increased in mixed delirium compared to no-delirium ( $\beta=18.08, p=0.005$ ) or hyperactive delirium ( $\beta=24.12, p=0.031$ ).

## Conclusions:

Digital daytime activity measures can identify change over time in inpatients with PD and delirium. Daytime rest and sleep fragmentation measures may have clinical utility for monitoring change in subgroups of delirium. Results are exploratory, and replication in a larger study is needed.

# Delirium care in the United Kingdom: Priorities and opportunities for healthcare policy

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## Authors:

Irini E Kounoupas, Claudia Cooper, Charlotte Kenten, Zena Aldridge, Camille Carroll, Daniel Davis, Helen Pratt, Sarah Richardson, Rachel Thompson, Alex Tsui, Emma Vardy, Elizabeth L Sampson.

## Background:

With the rising older population, significant benefits exist for patients and the wider system in improving delirium care. The Dementia and Neurodegeneration Policy Research Unit (DeNPRU-QMUL) aimed to assess how well current UK policy considers delirium, and generate key levers for change with the English Department of Health and Social Care (DHSC) to inform new policy.

## Methods:

A policy scoping study, documentary analysis and policy mapping exercise to understand the extent to which delirium is referenced in healthcare policy relevant to older adults within England and Wales. Thematic analysis identified overarching themes which were developed and refined with an expert panel group and expert by experience focus group.

## Results:

From a total of 81 healthcare policies relevant to older people, 14 were chosen for analysis. 11 policies contained 20 separate references to delirium and 7 policies contained 9 references to “confusion”. Key themes were: preventing & diagnosing delirium, triaging patients, reducing falls & admissions, and improving care. The expert panel identified further themes: appropriate identification & naming of delirium, absence of reference to delirium within broader health policy, integrating delirium into current policy focus areas, the social care cost, delivering community care, and practitioner training. Experts by experience identified a lack of awareness of delirium, reducing precipitating factors and improving education for staff and family carers.

## Conclusions:

Delirium is under-recognised in healthcare policy. This data informs discussion and planning with the DHSC to improve delirium care.

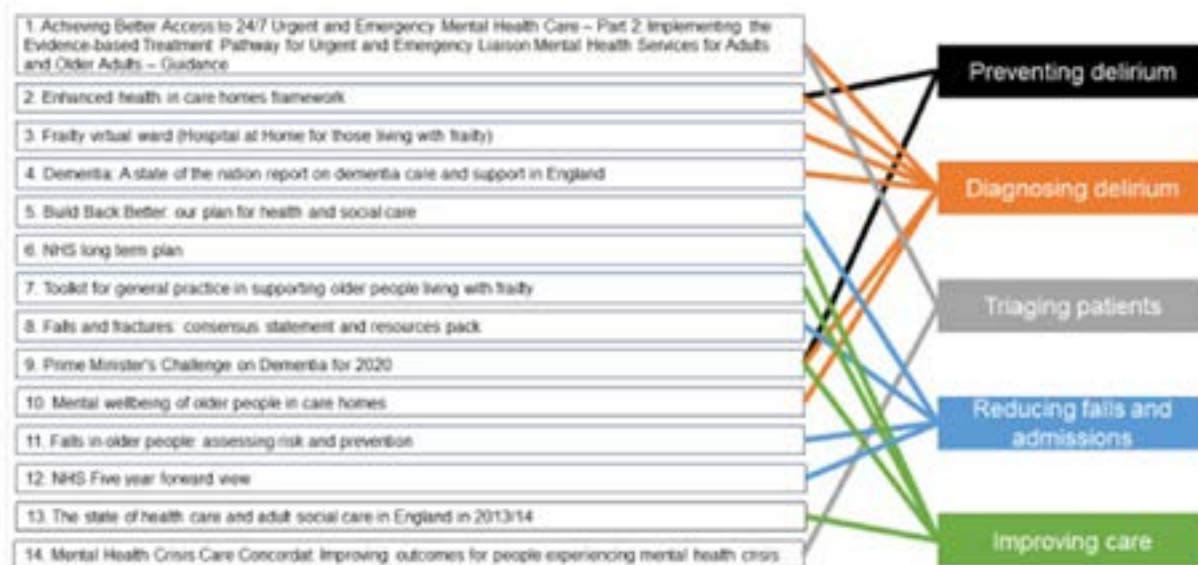


Figure 1: 14 policies were chosen for analysis and were mapped to five key themes

# Prospective external validation of the PIPRA postoperative delirium risk prediction model

## Author:

1. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland and University Hospital Basel, Basel, Switzerland
2. Kelly Reeve, PIPRA AG, Switzerland and Zurich University of Applied Sciences, Winterthur, Switzerland
3. John Gaudet, Lausanne University Hospital, Lausanne, Switzerland
4. Bernhard Walder, Geneva University Hospital, Geneva, Switzerland
5. Beate Sick, Zurich University of Applied Sciences, Winterthur, Switzerland
6. Martin Frey, Zurich University of Applied Sciences, Winterthur, Switzerland
7. Luzius Steiner, University Hospital Basel, Basel, Switzerland
8. Benjamin T. Dodsworth, PIPRA AG, Zurich, Switzerland

## Background:

Postoperative delirium (POD) is a frequent postoperative complication and is associated with poor prognosis. Early identification of patients at risk is paramount because adequate, well-timed interventions could reduce the occurrence of POD. PIPRA is a machine learning aiming to predict a patient's risk of developing POD based on routine preoperative medical data.

The aim of this study is to externally validate the PIPRA prediction model in the Swiss clinical setting.

## Methods:

Data were prospectively collected from three Swiss centres between 2022-2023, according to a publicly available protocol (NCT05639348). Subjects 60+ years with two or more days planned postoperative stay and who consented were included. Patients with preoperative delirium, insufficient German or French, intracranial or cardiac surgery were excluded. Subjects were assessed for POD twice daily for the first 5 postoperative days using the 4"A"Test. Measures of discrimination and calibration evaluated the performance of the model.

## Results:

993 patients were enrolled. POD was present in 14% of the patients. The mean age of the participants was 73.63 years (SD = 8.04). The AUC of the PIPRA model was 0.73 (95% CI from 0.68 to 0.77). The calibration plot suggested relatively good calibration for the lower risk subjects but displayed evidence of overprediction for those at highest risk.

## Conclusions:

This first prospective external validation of the PIPRA model shows that the model can accurately discriminate between those at high and low risk of POD in the pre-surgical setting. Further work will focus on improving POD prediction using both pre- and peri-operative predictors.



# Machine vs Anaesthesiologist: who can better predict delirium?

## Authors:

1. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland and University Hospital Basel, Basel, Switzerland
2. Kelly Reeve, PIPRA AG, Switzerland and Zurich University of Applied Sciences, Winterthur, Switzerland
3. John Gaudet, Lausanne University Hospital, Lausanne, Switzerland
4. Bernhard Walder, Geneva University Hospital, Geneva, Switzerland
5. Beate Sick, Zurich University of Applied Sciences, Winterthur, Switzerland
6. Martin Frey, Zurich University of Applied Sciences, Winterthur, Switzerland
7. Luzius Steiner, University Hospital Basel, Basel, Switzerland
8. Benjamin T. Dodsworth, PIPRA AG, Zurich, Switzerland

## Background:

This study aims to compare the effectiveness of the PIPRA algorithm against clinical assessments by anesthesiologists in predicting postoperative delirium (POD).

## Methods:

Conducted as a multicentric prospective cohort study (Protocol NCT05639348) across three major hospitals in Switzerland since November 2022, the study includes patients aged 60 years and older with a planned postoperative stay of at least two days. Exclusion criteria encompassed preoperative delirium, limited proficiency in German or French, recent intracranial or cardiac surgery, or surgery within the past two weeks. During pre-anesthetic consultations, experienced anesthesiologists independently assessed each patient's risk of delirium, which was also evaluated using the PIPRA algorithm. Postoperatively, patients were systematically monitored for POD using the 4 "A" Test, with assessments conducted twice daily for the first five days.

## Results:

A total of 993 patients were enrolled, of whom 894 were evaluated using both the PIPRA algorithm and anesthesiologist assessments. The anesthesiologists had a mean of 7.9 years (SD 3.8 years) of medical training, including 4.23 years (SD 4.1 years) in anesthesia). The predictive performance of the anesthesiologists for POD was found to have an area under the curve (AUC) of 0.7 (95% CI: 0.65-0.74), while the PIPRA algorithm achieved an AUC of 0.73 (95% CI: 0.68-0.77).

## Conclusions:

In conclusion, the PIPRA algorithm demonstrates predictive accuracy comparable to that of experienced anesthesiologists, suggesting it is a reliable tool for assessing the risk of delirium in the perioperative setting.

# Disparities in ICU delirium detection in Spanish-speaking Latinx patients

## Author:

Ana Lucia Fuentes, University of California, San Diego

## Background:

Delirium is common in the intensive care unit (ICU) and is associated with adverse outcomes. Guidelines recommend daily delirium screening with tools such as Confusion Assessment Method for the ICU (CAM-ICU), but consistent screening is challenging when there is patient-provider language discordance. Thus, we evaluated disparities in delirium detection in Spanish-speaking ICU patients and assessed the Spanish-language FAM-CAM (Spanish-FAM) as a potential alternative tool to overcome these barriers.

## Methods:

We identified Spanish-speaking ICU patients and their family caregivers on ICU admission. A trained, bilingual assessor administered the validated Spanish-language CAM-ICU, which was our gold-standard for delirium assessments. This was compared to usual care, defined as CAM-ICU documented by the bedside provider. Additionally, family caregivers independently completed Spanish-FAM and were blinded to the other assessments.

## Results:

Among 15 patients, 9 patients (60%) were identified as delirious, and 1 patient (6%) was scored as unable to assess (UTA) via the gold-standard Spanish-language CAM-ICU. In contrast, only 2 patients (13%) were documented as delirious and 7 patients (47%) as UTA via usual care. The Spanish-FAM identified 11 patients (74%) as delirious, without UTA scores as that is not possible with this tool. The Spanish-FAM had higher agreement (Cohen's kappa) with the gold-standard Spanish-language CAM-ICU ( $\kappa = 0.71$ ) than did usual care ( $\kappa = 0.14$ ).

## Conclusions:

Spanish-speaking Latinx patients in the ICU may experience under-recognition and misdiagnosis of delirium. Among this patient population, the Spanish-FAM may be a more accurate delirium detection tool than usual care.

# A new tool to easily process resting-state EEG using Python MNE functions

## Authors:

1. Yorben Lodema, UMC Utrecht, Netherlands
2. Herman van Dellen, UMC Utrecht, Netherlands
3. Arjen Slooter, UMC Utrecht, Netherlands
4. Edwin van Dellen, UMC Utrecht, Netherlands

## Background:

Electroencephalography (EEG) allows for precise measurements of neurophysiological data at a patient's bedside, a particular strength in delirium research. While the EEG field increasingly moves toward open-source packages to process and analyze EEG, the required programming background presents a possible hurdle for researchers.

**Aims:** To make EEG processing accessible to clinical researchers and clinicians with an interest in EEG analysis without programming.

## Methods:

We developed an open-source software package for resting-state EEG processing. The tool uses functions from the Python MNE package, wrapped in a simple graphical user interface.

## Results:

The tool currently supports simultaneously loading multiple resting-state EEG files with several extensions and applying multiple processing steps: re-referencing, downsampling, source localization, independent component analysis, dropping or interpolating channels, and epoch selection. Embedded links to relevant documentation enable a deeper understanding of the theory behind different EEG processing steps. Clear visualizations of epochs and power spectra support decision-making for data selection. Reproducibility of analyses is guaranteed by automatic logging of the performed steps and the option to reload previous analyses. The software is freely available on GitHub while development continues. The use of this software within our group has already led to significantly reduced processing time for EEG datasets.

## Conclusions:

Despite its simple interface, our EEG processing software allows for flexible construction of many powerful processing pipelines. We hope that our colleagues in the delirium field can benefit from this software, while development of additional features continues.

# Performance and validation of two ICU delirium assessment and severity tools; a prospective observational study

## Authors:

1. Bram Tilburgs, Radboudumc, Netherlands
2. Margot Leenders, Radboudumc, Netherlands
3. Monica Pop, Radboudumc, Netherlands
4. Mark van den Boogaard, Radboudumc, Netherlands

## Introduction:

The clinical statistical performance of the Confusion Assessment Method Intensive Care Unit (CAM-ICU(-7)) and Intensive Care Delirium Screening Checklist (ICDSC) have rarely been studied. Additionally, delirium severity is often not measured due to a lack of validation of delirium assessment tools. We aimed to determine the statistical performance of both assessment tools in practice and the correlation with the gold standard Delirium Rating Scale (DRS)-R98, for delirium severity.

## Methods:

A prospective observational study performed between October and December 2020. CAM-ICU-7 and ICDSC (performed by nurses) were compared with the DRS-R98 (assessed by delirium experts), twice weekly. Within a time-window of one hour all assessments were independently performed. Sensitivity, specificity, positive and negative predictive value of both tools was determined. The correlation between DRS-R98 and CAM-ICU-7 and ICDSC was used for validation of delirium severity.

## Results:

In total, 104 CAM-ICU-7 and 105 ICDSC assessments in 86 patients were compared with the DRS-R98. For the CAM-ICU-7 and ICDSC, respectively, the sensitivity was 90% and 95%, the specificity was 92.4% and 92.3%. The positive predictive value was 0.76 and 0.80, and negative predictive value was 0.77 and 0.97. Correlation of the CAM-ICU-7 score and ICDSC score with the DRS-R98 score was 0.74 (95% CI 0.64–0.81) and 0.70 (95%CI 0.59–0.79; both  $p < 0.001$ ), respectively.

## Conclusion:

CAM-ICU-7 and ICDSC demonstrated good statistical performance and correlation with DRS-R98. Nurses can use the CAM-ICU(-7) or the ICDSC. Both are accurate in delirium diagnosis. Total CAM-ICU-7 and ICDSC scores reflect delirium severity well.

# Informal judgements underestimate delirium prevalence while training improves delirium assessment tool use: World Delirium Awareness Day 2023 in Irish Hospitals

## Authors:

1. Zahra Azizi, University College Cork, Ireland
2. Teresa Bohane, Health Service Executive, Ireland
3. Claire Noonan, Health Service Executive, Ireland
4. Susan O'Reilly, Health Service Executive, Ireland
5. Ida Carroll, Health Service Executive, Ireland
6. Suzanne Timmons, University College Cork, Ireland

## Introduction:

The importance of prevention and timely recognition of delirium is well established, but clinical practice may still lag behind policy and guidelines.

## Methods:

The study was an observational, cohort study of the point prevalence of delirium in multiple clinical sites in Ireland on a single day (i.e. World Delirium Awareness Day, March 2023). It also assessed the usual practice with regard to delirium screening, assessment and management in the participating sites, and the factors influencing delirium screening.

## Results:

In total, 132 wards were included, within 15 hospitals. Delirium prevalence, using a formal assessment tool, was 15.9% across all wards. The prevalence rate of delirium using 'personal judgment' rather than a formal tool was 11.5%, suggesting potential missed delirium, with almost 60% of wards using this method. Having at least one delirium training session in the preceding year was associated with greater use formal assessment tools (60.3% versus 18.8%;  $p < 0.001$ ). A protocol for delirium assessment, prevention, and management was present in 63.6% of wards, highest in intensive care units (76.2%), geriatric wards (70%), and Emergency Departments (66.7%). Few wards had a written protocol for sleep, mobility, or family engagement. Ward managers reported staff training/educating as their main priority to improve care, but 72.7% of wards stated insufficient time to train staff as a key barrier.

## Conclusions:

Delirium is prevalent in Irish hospitals and appears under-detected without screening. Clinical practice related to delirium care requires improvement. Awareness raising and staff training require more focus and time in busy clinical settings.

# Functional connectivity EEG measures in post-stroke delirium

## Authors:

1. Fenne Vandervorst, UZ Brussel, Belgium
2. Edwin van Dellen, UMC Utrecht, Netherlands
3. Yorben Lodema, UMC Utrecht, Netherlands
4. Guy Nagels, UZ Brussel, Belgium
5. Robin Gens, UZ Brussel, Belgium
6. Yacine Boudiba, UZ Brussel, Belgium
7. Anissa Ourtani, UZ Brussel, CHU Brugmann, Belgium
8. Anne-Marie Vanbinst, UZ Brussel, Belgium
9. Sebastiaan Engelborghs, UZ Brussel, Belgium
10. Arjen Slooter, UZ Brussel, Belgium, UMC Utrecht, Netherlands
11. Sylvie De Raedt, UZ Brussel, Belgium

## Background:

Decreased functional network connectivity seems to be a key factor in delirium pathophysiology. Previous studies demonstrated loss of  $\alpha$  band functional connectivity in postoperative delirium. They did not include patients with brain lesions, which themselves may induce global network changes. This study aims to determine whether functional connectivity measures differ between patients with and without delirium after ischemic stroke (IS).

## Methods:

We consulted a previously published dataset of 514 patients with IS in which 39% of patients developed post-stroke delirium (PSD). For 185 patients (50 with PSD and 135 without PSD) stroke localization could be determined and a high-quality EEG was available, recorded during delirium episode for those who developed PSD. Case control matching analysis was performed, matching patients with and without delirium based on stroke location, severity (NIHSS) and age. For each patient, the first 8 artifact-free epochs of 8 seconds were selected and PLI and corrected amplitude envelope correlation (AEC-c) in the  $\alpha$  band were calculated and averaged over all channels and epochs.

## Results:

We included 80 patients (74 patients with middle cerebral artery (MCA) infarction, 6 with vertebrobasilar IS). Median age was 76 in both groups, median NIHSS was 11 in the delirium group and 8 in the non-delirium group.  $\alpha$  band PLI and AEC-c were both lower in the delirium group (table 1).

## Conclusions:

In patients with PSD,  $\alpha$  band functional connectivity measures are lower compared to patients without PSD. These findings are consistent with results from postoperative delirium studies suggesting a common pathogenetic pathway.

	Delirium (N=40)	No Delirium (N=40)	P-value
PLI (IQR)	0,130 (0,037)	0,149 (0,055)	0,044
AEC-c (IQR)	0,517 (0,029)	0,526 (0,030)	0,029

Table 1. Median PLI (Phase Lag Index) and AEC-c (corrected amplitude envelope correlation measure) and interquartile range (IQR) in  $\alpha$  frequency band in patients with and without PSD and p-values (Mann-Whitney U test).

# Music Interventions for Delirium in Older Adults

## Author:

Bjørn Erik Neerland, Oslo Delirium Research Group, Norway

## Background:

Emerging evidence support the use of music interventions (MI) in treating conditions similar to delirium, suggesting that MI could also be effective in managing delirium symptoms. In this randomized trial, we aimed to test the feasibility, acceptability, fidelity, safety, and preliminary effectiveness of music interventions (MIs) in delirious patients.

## Methods:

Participants from an acute geriatric ward were randomised to Preferred Recorded Music (PRM) and Preferred Live Music (PLM), delivered by a trained music therapist for 30 minutes over three consecutive days. Feasibility outcomes included recruitment rate, retention, adherence, and treatment fidelity. Secondary clinical outcomes were delirium symptom trajectories, delirium duration, hospitalisation stay length, and medication.

## Results:

Twenty-six participants (PLM = 14; PRM = 12), median age 87, most with hypoactive delirium, were recruited at a rate of 3 participants per month. Retention rates were 64% for PLM and 33% for PRM, with adherence to intervention protocols at 83% and 58%, respectively. PLM showed higher treatment fidelity (93%) compared to PRM (83%). All delirium symptoms except arousal improved on day 3 compared to baseline, statistically significant for attention. No conclusive pre-post or between-group differences were detected.

## Conclusions:

The trial demonstrated feasibility, with greater acceptability, safety, and fidelity for PLM. The trial provided a foundation and recommendations for designing future conclusive trials of music interventions for treating delirium, suggesting exploring a broader set of outcomes and intervention dosages. Future trials is warranted and should consider using external assessors to improve recruitment and adherence.

# A review of 'checklists' for non-pharmacological interventions for delirium in adult patients in non-ICU inpatient healthcare settings

## Authors:

1. Shirley H Bush, Department of Medicine, Division of Palliative Care, University of Ottawa; Bruyère Research Institute and Ottawa Hospital Research Institute, Canada
  2. Monisha Kabir, Bruyère Research Institute, Canada
  3. Lindsey Sikora, Health Sciences Library, University of Ottawa, Canada
  4. Véronique French Merkley, Department of Family Medicine, Division of Care of the Elderly, University of Ottawa, Canada
  5. Meera Agar, Centre for Improving Palliative, Aged and Chronic Care through Clinical Research and Translation (IMPACCT), University of Technology Sydney, Sydney, Australia
  6. Annmarie Hosie, School of Nursing and Midwifery, The University of Notre Dame Australia; St Vincent's Health Network Sydney, Sydney, Australia
  7. Imogen Featherstone, Mental Health and Addiction Research Group, University of York, York, United Kingdom
  8. Sarina R Isenberg, Department of Medicine, Division of Palliative Care, University of Ottawa; Bruyère Research Institute, Canada
  9. Peter G Lawlor, Department of Medicine, Division of Palliative Care, University of Ottawa; Bruyère Research Institute and Ottawa Hospital Research Institute, Canada
- PROSPERO registration (CRD42022342328).

## Background:

The use of checklists to support systematic implementation of multicomponent non-pharmacological interventions for delirium is unknown. We aimed to identify 'checklists' used in non-ICU inpatient healthcare settings, their content, and reported implementation.

## Methods:

Cochrane CENTRAL, MEDLINE, Embase, CINAHL, and PsycINFO were searched from January 1, 1999 to July 12, 2022, restricted to adults 18+ and English and French articles. A comprehensive grey literature search was conducted in February 2024. Data was extracted onto a proforma template. Studies were assessed using JBI Critical Appraisal tools.

## Results:

From the database searches, 4105 records were identified with 71 records from the grey literature citation searches. The final 27 studies were: quasi-experimental (n=17), RCTs (n=6), qualitative (n=2), expert opinion (n=1) and policy/consensus guidelines (n=1). 'Checklists' included algorithms and order sets which were paper-based, or part of electronic delirium order sets, but format was not described in 18 records. Three studies included the target population as stakeholders with checklist development. Target users were healthcare staff, trained volunteers, family caregivers, and study intervention nurses. Frequency of use varied from 1 to 3 times/day. Three studies included all 10 NICE clinical factors for non-pharmacological interventions. For the remaining studies, missing domains varied and included: therapeutic/cognitive activity, nutrition, urinary catheterisation, and medication review. Family involvement in performing the interventions occurred in 30%. Reported formal economic analysis was limited.

## Conclusion:

Further research is needed to establish whether using checklists enables the high levels of adherence with non-pharmacological interventions needed to optimize their effectiveness, in addition to economic evaluation.





# **A systematic review and individual patient data meta-analysis to identify prognostic factors associated with delirium in hospitalized older adults**

## **Authors:**

1. Benjamin Dodsworth, PIPRA AG, Switzerland
2. Behnam Sadeghirad, McMaster University, Canada
3. Nayeli Schmutz Gelsomino, PIPRA AG, Switzerland
4. Jessica Spence, McMaster University, Canada
5. Maura Marcucci, McMaster University, Canada
6. Mary-Anne Kedda, PIPRA AG, Switzerland
7. Kelly Reeve, PIPRA AG, Switzerland
8. Justin Lee, McMaster University, Canada
9. David Cowan, McMaster University, Canada
10. Alexandra Papaioannou, McMaster University, Canada
11. Sarah Pendlebury, Oxford University, United Kingdom
12. Thomas Saller, Ludwig-Maximilians-University, Germany
13. Lawrence Mbuagbaw, McMaster University, Canada

## **Background:**

To date, there is no risk prediction model specific to delirium in hospitalized older adults that has been developed using individual patient data (IPD) meta-analysis methodology. This methodology has several important advantages for research on prognostic factors in terms of internal and external validity, both over aggregate data conventional meta-analysis and over single-centre data.

## **Aims:**

We aim to develop a comprehensive risk prediction model for delirium in hospitalized older adults. To identify relevant prognostic factors for inclusion in the model, we will 1) conduct a systematic review of prospective randomized and non-randomized studies to identify eligible data that can be used to 2) design and develop an international repository of individual patient data (IPD).

## **Methods:**

We will identify eligible studies through a systematic search of online databases from their inception date to July 2024. We will include prospective studies that enrolled non-critically ill older inpatient adults outside palliative care and emergency settings, assessed risk factors for delirium, and followed participants prospectively assessing delirium using a validated and reliable diagnostic method. We will contact authors of eligible studies, as well as experts and researchers in this field, to inform them about our initiative, ask if they are willing to share data, and inquire about any ongoing eligible studies, and relevant patient registries. We will use a one-stage approach for IPD meta-analysis and the development of a delirium risk prediction model, and we will publish our findings in open-access peer-reviewed journals.

# Reduced global grey matter activity - cerebrospinal fluid flow coupling with increasing age and frailty is driven by neural BOLD components

## Authors:

*From the Department of Anesthesiology and Intensive Care, School of Medicine and Health, Technical University of Munich, Germany:*

Franziska Zistler, Julia Schwarz, Juliana Zimmermann, Adriana Usheva, Anika Fix, Svenja Letz, Rachel Nuttall, Gerhard Schneider.

*From the Department of Neuroradiology / TUM-Neuroimaging Center, School of Medicine and Health, Technical University of Munich, Germany:*

Christian Sorg, Benedikt Zott, Christine Preibisch.

*From the Department of Anesthesiology, Columbia University, New York, United States:*

Sebastian Zinn.

## Background:

Brain waste clearance (BWC) is reduced with increasing age, contributing to cognitive impairment and neurodegenerative disease, risk factors for postoperative delirium. The coupling of CSF influx with global grey matter activity (CSF-GM) via fMRI is a macroscopic BWC correlate, showing decreases with age and neurodegenerative pathology. fMRI signals are driven by neural (BOLD fluctuations via neurovascular coupling) and non-neural sources, both of which show age-related impairment and can be separated via multi-echo-fMRI. We aimed to investigate 1) whether there is an age-related reduction in CSF-GM when removing non-neural sources from GM activity and 2) whether CSF-GM coupling is related to preoperative risk factors for postoperative delirium.

## Methods:

**Aim1:** Non-neural sources from a multi-echo-fMRI dataset (OpenNeuro ds003592, n=301 healthy subjects, 18-89yrs) were removed via ICA-denoising. Multiple linear regression tested whether age, total cortical GM volume (estimated from structural T1 scans) and GM amplitude were significant predictors of (fourth ventricular) CSF-GM coupling (Pearson's correlation). **Aim2:** In a preliminary neuroimaging dataset (n=27 surgical patients >65yrs), analysis correlating preoperative CSF-GM coupling with Montreal Cognitive Assessment score of cognitive impairment and Clinical Frailty Score was performed, controlling for age.

## Results:

Age was the only significant predictor of CSF-GM coupling ( $t(283)=-5.70$ ,  $p<.001$ ,  $\beta=-0.003$ ). Reduced CSF-GM coupling was significantly associated with increased frailty ( $r=-0.48$ ,  $p=0.04$ ), but not cognitive impairment ( $r=0.07$ ,  $p=0.79$ ).

## Conclusions:

Neural activity and/or neurovascular coupling changes predict the decrease in CSF-GM coupling seen with age; these may be useful biomarkers for intervention in older subjects, especially critical in frail subjects at risk of delirium.

# The association of renal function and infection markers with the development of ICU delirium post-cardiac surgery: a retrospective cohort evaluation

## Authors:

1. Maria Reguenga, Imperial College Healthcare NHS Trust, United Kingdom
2. Smaragda Lampridou, Imperial College Healthcare NHS Trust, United Kingdom
3. Stephen Brett, Imperial College London, United Kingdom
4. Natalie Pattison, Imperial College London, United Kingdom
5. Mark van den Boogaard, Radboud University Medical Center, Netherlands
6. Sanooj Soni, Imperial College Healthcare NHS Trust, United Kingdom

## Background:

Delirium is a common complication post-cardiac surgery and is associated with poor patient outcomes. Its pathophysiology remains unclear due to numerous risk factors. Given this condition's complexity, using biomarkers is becoming widely common to identify and assess the risk of delirium. We aimed to explore the association of routine blood tests (e.g. infection/inflammatory and renal markers) with ICU-delirium post-cardiac surgery.

## Methods:

A 2-year retrospective cohort evaluation was conducted between October-2023 and March-2024. Data were extracted from cardiac surgical ICU patient records at a single London hospital. Differences between patients with and without delirium were tested and explored for associations.

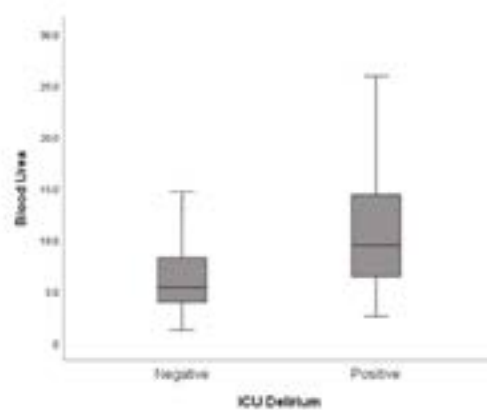
## Results:

A total of 899 ICU-patients post-cardiac surgery were included, their mean age was 63.1±10.7. Most were male (n=695, 77%) and underwent cardiac bypass graft surgery (n=498, 55%). One-in-six patients (n=151, 17%) developed ICU-delirium. Renal markers were associated with ICU-delirium, including urea (9.5 vs 5.5mg/dL,  $p < 0.001$ ) and creatinine (77.0 vs 68.0µmol/L,  $p < 0.001$ ), whilst infection/inflammatory biomarkers, involving C-reactive protein (CRP, 91.2 vs 98.1mg/dL,  $p = 0.609$ ) and white blood cells (WBC, 10.8 vs 10.7x10<sup>9</sup>/L,  $p = 0.054$ ), were not. Regression analysis showed that raised blood urea was an ICU-delirium predictor (OR=1.15, 95% CI: 1.13–1.17), whilst creatinine levels (OR=0.99; 95% CI: 0.99–1.00), CRP (OR=1.00, 95% CI: 0.99–1.00) and WBC (OR=1.00, 95% CI: 0.99–1.01) were not significant predictors.

## Conclusions:

Our findings confirm an association between urea levels and ICU-delirium post-cardiac surgery. Considering that blood urea is included in existing prediction models, our results validate the importance of monitoring its levels in predicting ICU-delirium post-surgery.

Graph 1 – Differences in blood urea levels between patients with and without ICU delirium post-cardiac surgery.



# Androgen Receptor Pathway Inhibitors (ARPI) is Well Tolerated in Elderly Patients with Advanced Prostate Cancer despite Cognitive Adverse Effects

## Authors:

1. Anne Hong, Austin Health, Australia
2. Siyu Huang, Austin Health, Australia
3. Zein Alhamdani, Austin Health, Australia
4. Michelle Xin, Austin Health, Australia
5. Henry Yao, Austin Health, Australia
6. Damien Bolton, Austin Health, Australia

## Background:

Treatment of metastatic and castration-resistant prostate cancer has evolved with the introduction of androgens receptor pathway inhibitors (ARPI), as pharmacological alternatives to conventional chemotherapy (CC). However, existing landmark studies for ARPI included limited geriatric patients and were frequently without specific subgroup analysis of this cohort. Geriatric patients are often frailer with multiple co-morbidities, resulting in increased susceptibility to adverse effects (AEs). This study aims to analyse the AEs profile of ARPI (especially the cognitive domain) and CC.

## Methods:

A retrospective analysis was performed comparing those treated with ARPI (abiraterone, enzalutamide, or darolutamide) and those treated with CC (taxanes or platinum-based). AEs were grouped and graded according to the Common Terminology Criteria for Adverse Events (CTCAE) v5.0.

## Results:

100 patients treated with ARPI were compared with those receiving CC. The median age was 75 years, with mean Charlson Comorbidity Index of 10. 14 patients reported cognitive AEs with ARPI, including memory impairment/amnesia (7), and non-memory cognitive disturbances including delirium (7). Most (13/14) were graded  $\leq 2$  on CTCAE and could be managed with dose reduction or 'drug holiday' period (11/14). While there were no reported cognitive AEs in the CC group, 90% reported other AEs (fatigue, GI disturbances, neuropathy, and febrile neutropaenia), with half of those graded  $\geq 3$  on CTCAE and henceforth requiring dose reduction or therapy cessation.

## Conclusions:

Our study showed that despite a proportion of patients experiencing cognitive AEs, ARPI is well-tolerated in elderly patients, compared with CC. Most of the cognitive AEs were mild, and could be managed conservatively.



**The 2025 Annual Meeting will be held  
in Hamburg from 12-14 November.  
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