



# The short IQCODE as a predictor for delirium in hospitalized geriatric patients

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## Abstract

**Background** Delirium is a serious complication, which occurs frequently in older patients with pre-existing cognitive impairment. There is a need for a simple tool to assess chronic cognitive impairment and the associated risk of delirium during hospitalization.

**Aims** To assess the usefulness of the short IQCODE questionnaire in predicting delirium during hospitalization in older patients in a geriatric ward.

**Methods** A prognostic study in the Geriatric Department at Aarhus University Hospital, Aarhus Denmark. Consecutive patients were enrolled during March to December, 2017. After consent of the patient, the staff interviewed the relatives by phone using the short IQCODE questionnaire. Delirium was assessed morning and evening until discharge by the Confusion Assessment Method. The ability of short IQCODE to predict delirium was examined.

**Results** Three hundred and fifty-three patients were eligible, and 306 completed the IQCODE. Delirium occurred among 19% of the patients during hospitalization. The IQCODE score was associated with the risk of delirium with a receiver operating characteristic (ROC) area of 0.72. A cut-point of 3.3 could separate the patients in a larger group with a risk of approximately 26% to develop delirium and a smaller group having a risk of approximately 6%.

**Conclusion** The IQCODE is a useful tool to predict delirium among older inpatients, but it may not stand alone. It can be a useful supplement to other clinical information and observations in detecting patients needing dementia-friendly treatment and care.

**Keywords** IQCODE · Delirium predictor · Older patient · Geriatrics

## Background

Delirium is an acute state of confusion characterized by inattention and cognitive dysfunction. It is estimated that delirium is present in up to 56% of older inpatients [1]. Delirium affects health adversely in terms of increased morbidity and mortality, poor rehabilitation outcomes, prolonged hospitalization, and increased institutionalization [2–9].

Delirium is most prevalent in older patients with pre-existing cognitive impairment [2, 10, 11]. The cause of delirium is thought to be multifactorial, dependent on a

complex interplay of predisposing and precipitating factors [12]. Predisposing factors are in particular high age and dementia [11, 13, 14]. In a meta-analysis of older medical patients, Ahmed et al. found that higher age is associated with delirium and that dementia increases the probability of delirium nearly seven times [14].

In Denmark, 6% of persons aged 75 years or older have a dementia-related diagnosis [15]. Based on international population surveys, the Danish Health and Medicines Authority considers that dementia is under-diagnosed and has estimated a three times higher prevalence in Denmark [15–17]. Accordingly, it is needed to find an easy tool by which clinicians can assess chronic cognitive impairment and the risk of delirium during hospitalization.

The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) is a sensitive tool for detecting clinical dementia. The original IQCODE questionnaire includes 26 items. It was developed in the 1980s as a tool for assessing

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a change from previous to current levels of cognitive function [18]. In 1994, a validated short form IQCODE questionnaire with 16 items gave similar results [18–20]. The score ranges from 1 to 5, low scores being favorable. Harrison et al. examined the diagnostic accuracy in a systematic review from 2015. They found that a cut-point of 3.3 had a sensitivity of 0.91 and a specificity of 0.66 to detect undifferentiated dementia in adult patients in the secondary sector [21]. The test involves family or friends, but not the patients, and it may be used on delirious and cognitively impaired patients [20].

Priner et al. [22] demonstrated that the short IQCODE could predict postoperative delirium in older patients undergoing elective surgery. We located no studies of the usefulness of the short IQCODE in predicting delirium in patients hospitalized with medical problems.

## Objectives

We aimed to assess the usefulness of the short IQCODE questionnaire in predicting delirium in older patients during hospitalization in a geriatric ward.

## Patients and methods

### Study design and patients

The project was conducted as a prognostic study as part of a quality development project in the Geriatric Department of Aarhus University Hospital, Denmark. Consecutive patients were enrolled in the emergency department between 20 March and 19 December in 2017. Delirium was assessed using the Confusion Assessment Method (CAM), and patients who had no CAM assessments during hospital stay were excluded from the analysis. The reasons for exclusion were that the patient (1) had been included before; (2) was somnolent or dying at the time of admission; (3) was unable to communicate for various reasons, e.g., aphasia, dementia or were deaf-mute; (4) was unable to communicate in Danish; (5) was hospitalized during Easter 2017 (1 week) and summer holiday 2017 (4 weeks) when staff was reduced.

### IQCODE measurements

When a patient was included, the geriatric staff in the emergency department asked the patient for consent to contact a family member or a close friend to complete the short IQCODE questionnaire. The interviews with relatives were most often done while the patient was in the emergency department, in some cases, the interview was done after the patient had left the emergency department

or arrived in the geriatric ward. Most interviews were performed by phone, but in a few cases face to face. The interview was conducted in the same way in both situations, with a typical duration of 10 min.

IQCODE asks about changes in the older patient's cognitive performance over the previous 10 years. The informant must assess the patient's ability for each question on a five-point scale; (1) much improved, (2) a bit improved, (3) not much changed, (4) a bit worse, (5) much worse. The IQCODE score is calculated as the mean of item responses, with a possible range of 1–5, low scores being favorable and three corresponding to no overall change in cognitive performance. The questions concern various everyday situations where the patient needs memory and intellect, e.g., remembering recent things, learning new things, handling money, etc. [19]. The geriatric staff was educated in using the short form IQCODE (Danish-version) [23] by a research assistant and peer-to-peer training.

### Measurements of delirium

The method to measure delirium is presented in more detail in a previous paper [11]. At admission, all enrolled patients were assessed for delirium by the geriatric staff using a Danish translation of the Confusion Assessment Method (CAM), originally developed by Inouye [24]. Every morning and evening until discharge, the patients were assessed by CAM.

CAM is the most widespread psychometric test for diagnosing delirium [13]. The method is an easy-to-use screening tool that includes four criteria: (1) an acute beginning and a fluctuating course, (2) inattention, (3) disorganized thinking, and (4) an altered level of consciousness. A delirium diagnosis requires the presence of criteria 1 and 2, and at least one of criteria 3 and 4 [25, 26].

### Data collection

From the patient records, the following information was extracted: age, gender, length of hospital stay (LOS), housing conditions, prior diagnosis of dementia, main hospitalization diagnosis, body mass index (BMI), physical functional ability (Modified Barthel-100 index, MBI) [27], and the usual clinical and biochemical measurements.

Charlson Comorbidity Index [28] was calculated from all diagnoses recorded in the patient records of the current admission. The systemic inflammatory response syndrome (SIRS) was defined as temperature  $> 38$  °C or  $< 36$  °C, pulse  $> 90$  bpm, respiratory rate  $> 20$  breaths per minute and white cell count  $> 12 \times 10^9/L$  or  $< 4 \times 10^9/L$  with at least two positive criteria for the definition of sepsis [29].

## Statistics

To compare delirious and non-delirious patients, we used Student's *t* test or Wilcoxon's rank-sum test for continuous variables and Pearson's Chi-squared test or Fisher's exact test for categorical variables.

A receiver operating characteristic (ROC) curve was prepared, and the area under the curve was calculated. Sensitivity, specificity, and positive (PV +) and negative predictive (PV –) values were calculated at selected IQCODE cut-points. The association between IQCODE score and the occurrence of delirium was examined by logistic regression with a nested analysis to estimate the independent predictive contribution of IQCODE beyond other available information.

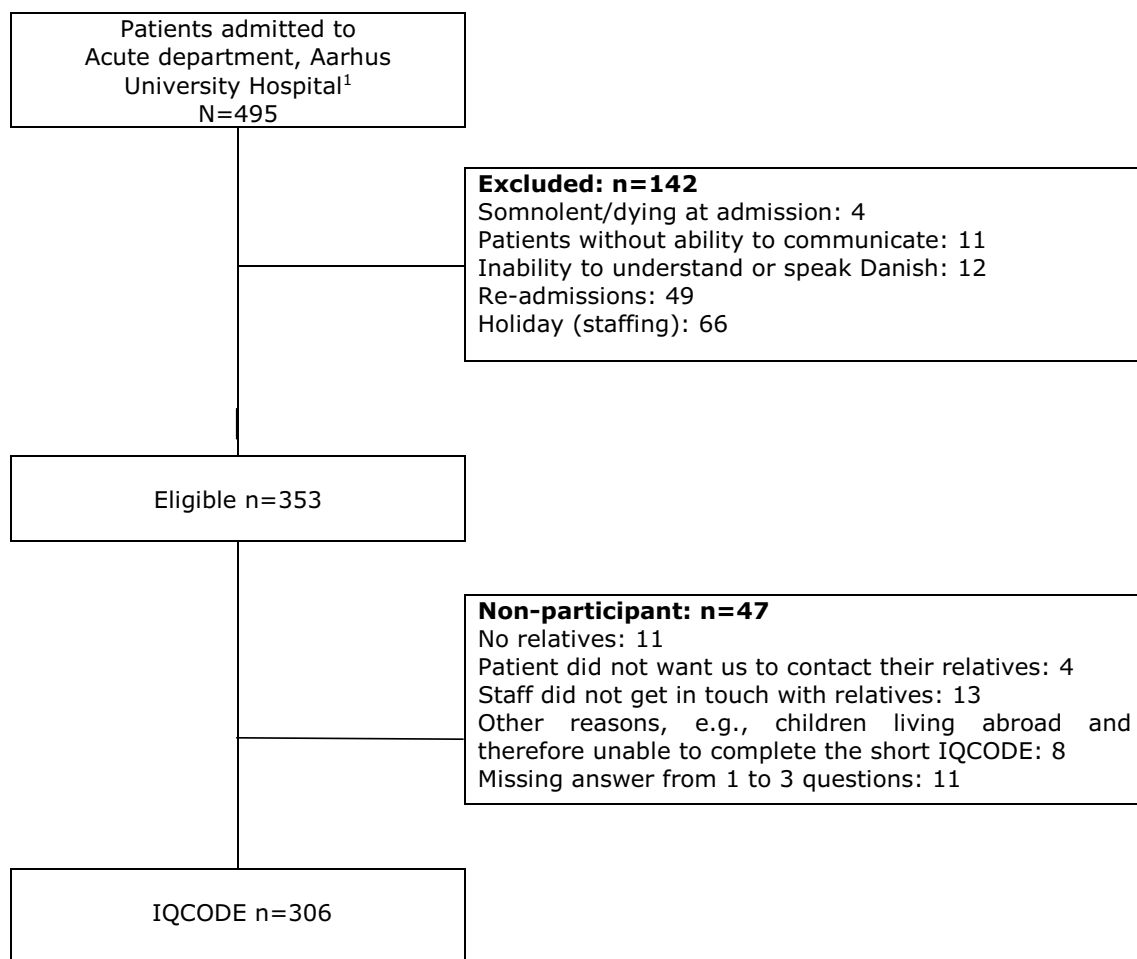
Statistical analyses were performed with Stata software, version 15.1 (StataCorp LLC, College Station, Texas). We used 95% confidence intervals, and *p* values less than 0.05 were considered statistically significant.

## Ethics

As a quality development project with no intervention, the study was exempted from notification to the Central Denmark Region Ethical Committee (Inquiry number 200/2017). The IQCODE is a recognized method for assessing cognitive status [16]. It is not perceived as a burden on the older patient. Patients and relatives had the right to renounce participation. The study protocol was approved by the Danish Data Protection Agency, case no. 1-16-02-254-16. Data were stored according to good research practice in Research Electronic Data Capture (REDCap) hosted at Aarhus University, Denmark [30]. The study was registered at ClinicalTrials.gov (Identifier NCT03175276).

## Results

A total of 353 patients were eligible, and 306 patients (87%) participated in the study, see Fig. 1. About a third of non-participants were relatives that could not answer all or some



**Fig. 1** Included and excluded patients, flowchart

of the IQCODE items. There was no substantial difference between participants and non-participants in age, gender, living arrangements, prior diagnosis of dementia, comorbidity, physical ability, length of stay (LOS), and risk of delirium.

In Table 1, baseline patient characteristics are shown in patients with and without delirium during hospitalization. Patients with delirium were significantly older than patients without delirium; mean difference 2.1 years (95% CI 0.5–3.8,  $p=0.01$ ). There was a significant difference between the two groups in IQCODE score, physical ability, prior diagnosis of dementia and body mass index (BMI).

At the first CAM screening after admission, 28 patients had delirium, and later, during hospital stay, 30 patients developed delirium, in total 58 patients (19%). In Table 2, a crude analysis shows associations between the risk of delirium and high IQCODE score, high age, a prior diagnosis of dementia, and impaired physical ability, while overweight appeared to protect against delirium. In an analysis with mutual adjustment for the other risk factors, the IQCODE score retained its predictive value, while a prior diagnosis of dementia did not contribute further to prediction once the IQCODE score was known.

Table 3 shows the association between the IQCODE score level and the risk of delirium. Figure 2 and Table 4 show the sensitivity and specificity of IQCODE at various cut-points as a predictor of development of delirium.

The ROC area was 0.72, and choosing an IQCODE cut-point of 3.3, a third of the patients would be in a low-risk group with a risk of 6% of developing delirium, and two-thirds would be in a high-risk group with a risk of 26%. It would predict 51 (88%) of the 58 patients with delirium with a cost of 144 false-positive predictions. Increasing the cut-point would reduce the number of false-positive predictions, but also reduce the number of true-positive predictions.

The above analyses included patients who had delirium at the first CAM test after admission, and some of these may have had delirium before admission. In a supplementary analysis, we excluded these patients without any substantial changes in the main results.

## Discussion

The geriatric patients in this study were a high-risk group with an overall risk to develop delirium during hospitalization of 19%. The IQCODE score at admission was associated with the risk to develop delirium, and with an ROC area of 0.72, IQCODE has a predictive potential. Selecting an IQCODE cut-point of 3.3 could identify two-thirds of the patients with a risk of approximately 26% to develop delirium and one-third of the patients with a lower risk of

approximately 6%. IQCODE retained its predictive value after adjustment for a number of known risk factors for delirium.

In principle, a triage of patients according to the risk to develop delirium could help allocating attention and resources to the high-risk patients to prevent delirium episodes. The relevant interventions could be frequent screening, e.g., CAM, multi-component non-pharmacological risk reduction as single-bed room, promoting sleep hygiene, early mobilization, ensuring that patients have their glasses and hearing aids, optimizing hydration, nutrition, and bladder and bowel function, and, if needed, providing supplementary oxygen [11, 31, 32].

The cost of applying the IQCODE questionnaire is modest, and the information obtained may also be useful in the general clinical care. It is not a burden to the patient, and we have not experienced complaints from the informants. On the contrary, many informants expressed satisfaction with the perceived relevance of the questions.

Although it is possible to categorize patients in a larger high-risk group and a smaller lower risk group, patients in the lower risk group still had a risk of approximately 6% to develop delirium during hospitalization. This reflects the fact that patients hospitalized at a geriatric department in general are quite vulnerable, typically with multiple diseases and physical and mental impairments.

For these patients, we do not suggest the use of IQCODE as a strict screening tool with a fixed cut-point to decide which patients require special attention and care. First, even patients in the low-risk group have a considerable risk to develop delirium. Second, IQCODE does not make other information about risk factors unimportant. The IQCODE score and the individual responses can be a useful supplement to other clinical information.

Two-thirds of the older inpatients had an IQCODE score of 3.3 or higher. Only 7% of inpatients had a prior diagnosis of dementia. It seems that there is a marked underdiagnosing of dementia in these older inpatients. This is in agreement with the estimates of the Danish Health Authority [15–17].

We found that delirium is a common incident in the older inpatients with high age, dementia, and low physical ability. Our observations are in accordance with other studies [14, 33, 34]. Carrasco et al. found that low physical ability measured by the Barthel Index and a proxy score for dehydration measured by blood urea nitrogen creatinine ratio predict delirium. The Barthel Index was compared with a test for cognitive impairment; the Pfeffer Functional Activities Questionnaire. The two tests were highly correlated [35].

Different tests for cognitive impairment have been part of the predictive models for incident delirium [35, 36]. In many studies, the Mini Mental State Examination (MMSE) has been used. This test may have some problems in patients just

**Table 1** Baseline characteristics of delirious and non-delirious patients

Baseline characteristics	Patient without delirium Number (%) or median (IQR <sup>1</sup> )	Patient with delirium Number (%) or median (IQR <sup>1</sup> )	<i>p</i> value
N	248 (100%)	58 (100%)	
Age	86 (82–89)	88 (83–93)	0.01
Sex			
Male	94 (38%)	27 (47%)	0.22
Female	154(62%)	31 (53%)	
Length of stay	7 (5–8)	7 (5–9)	0.88
Living arrangements			
Own home	221 (89%)	53 (91%)	0.61
Nursing home	27 (11%)	5 (8%)	
Medical history			
Prior diagnosis of dementia	14 (6%)	8 (14%)	0.03
Falls	29 (12%)	5 (9%)	0.50
Charlson comorbidity index			
0	92 (37%)	22 (38%)	0.45
1–2	117 (47%)	31 (53%)	
3–5	33 (13%)	5 (9%)	
6–12	6 (2%)	0	
Diagnosis at admission			
Infection	88 (35%)	23 (40%)	0.56
Fracture	54 (22%)	13 (22%)	0.92
SIRS $\geq 2^2$	56 (23%)	13 (22%)	0.98
Physical ability (MBI) <sup>3</sup>			
Minor (100–80)	35 (14%)	2 (4%)	<0.001
Slight (79–50)	88 (36%)	11 (19%)	
Moderate (49–25)	78 (32%)	14 (25%)	
Severe (24–0)	46 (19%)	30 (53%)	
BMI <sup>4</sup>			
Underweight (<18.5)	21 (9%)	8 (15%)	<0.001
Normal weight (18.5–24.9)	121 (50%)	38 (70%)	
Overweight ( $\geq 25$ )	102 (42%)	8 (15%)	
IQCODE	3.5 (3.1–4.1)	4.3 (3.6–4.8)	<0.001
Blood samples			
Hemoglobin, mmol/L <sup>5</sup>	7.4 (6.4–8.2)	7.3 (6.5–8.1)	0.53
Sodium, mmol/L <sup>6</sup>	139 (136–142)	138 (137–142)	0.78
Creatinine, $\mu\text{mol/L}^6$	80 (61–116)	81 (62–119)	0.91
Albumin, g/L <sup>6</sup>	28 (25–31)	28 (24–31)	0.72
White blood cells, 10/L <sup>7</sup>	9.9 (7.7–12.8)	9.2 (7.7–11.9)	0.47
C-reactive protein, mg/L <sup>7</sup>	72 (26–140)	69 (26–117)	0.99

<sup>1</sup>Interquartile range, i.e. 25% and 75% percentiles

<sup>2</sup>Systemic inflammatory response syndrome (SIRS)

<sup>3</sup>Modified Barthel Index-100 (Missing: 2)

<sup>4</sup>Missing: 9

<sup>5</sup>Hemoglobin taken in the period: 4 days before or 3 days after admission

<sup>6</sup>Sodium, creatinine, and albumin (missing 1) taken in the period up to 4 days before admission

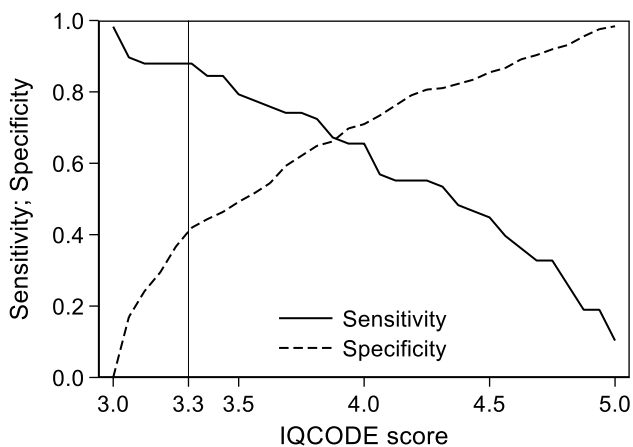
<sup>7</sup>White blood cells and C-reactive protein taken in the period: 4 days before to 2 days after admission

**Table 2** Risk factors for development of delirium

	Crude odds ratio (95% CI)	<i>p</i> value	Mutually adjusted Odds ratio (95% CI)	<i>p</i> value
IQCODE per unit	3.53 (2.22–5.60)	<0.001	2.64 (1.54–4.53)	<0.001
Age per 10 years	1.92 (1.15–3.20)	0.01	1.89 (1.05–3.39)	0.03
Prior diagnosis of dementia	2.67 (1.06–6.72)	0.04	1.14 (0.36–3.58)	0.82
Severe to moderate physical disability	3.36 (1.72–6.54)	<0.001	1.97 (0.94–4.12)	0.07
BMI < 18.5	1.21 (0.50–2.97)	0.67	0.91 (0.33–2.52)	0.86
18.5 ≤ BMI ≤ 25	1 (reference)			
BMI > 25	0.25 (0.11–0.58)	<0.001	0.29 (0.12–0.67)	<0.01

**Table 3** IQCODE score and risk of delirium

IQCODE score	All patients	Patients with delirium
< 3.0	1	1 (100%)
3.0 to < 3.3	110	6 (5%)
3.3 to < 3.5	23	5 (22%)
3.5 to < 4.0	62	8 (13%)
4.0 to < 4.5	48	12 (25%)
4.5–5.0	62	26 (42%)
Total	306	58 (19%)



**Fig. 2** Sensitivity and specificity in relation to IQCODE’s ability to predict delirium during hospitalization

**Table 4** Sensitivity, specificity, and predictive values at selected IQCODE cut-points

IQCODE cut-point	Sensitivity	Specificity	PV +	PV –	OR
≥ 3.0	0.98	0	0.19	0	0
≥ 3.3	0.88	0.42	0.26	0.94	5.3 (2.3–12.1)
≥ 3.5	0.79	0.49	0.27	0.91	3.7 (1.9–8.0)
≥ 4.0	0.66	0.71	0.35	0.90	4.6 (2.5–8.5)

admitted to hospital with acute illness [36]. The IQCODE has the advantage that no patient involvement is required [20, 37] and can, therefore, be a part of a predictive model including risk factors.

**Strengths and limitations of the study**

In this study, only 13% of the questionnaires were not completed. A normal procedure in our department is to invite one of the patients’ family or closest friend to set goals for the admission and to plan the discharge, unless the patients refuse involvement of their relatives. This regular contact with relatives made it easy to collect the IQCODE data. In some cases, the relatives who responded to the IQCODE questionnaire told that the questions were spot on the difficulties in the patient’s everyday life.

Moreover, the interviews were made by a trained geriatric staff. Also, a trained staff completed the CAM assessments twice a day during the hospitalization. The staff completed the same course before using IQCODE and CAM, and the clinical guidelines for delirium did not change during the study. Finally, as delirium fluctuates, the CAM screening twice a day during the hospital stay reduced the risk of missing episodes of delirium.

We excluded 11 patients who were unable to communicate for various reasons. A part of this group was very sick of dementia and had no language. However, the high risk of delirium among such patients is evident, also without using an instrument like IQCODE.

The patients that are hospitalized at our geriatric department are a selected group of quite vulnerable older patients and it might be different in other hospitals with geriatric department or beds.

**Conclusion**

The IQCODE is a useful tool to predict the risk of delirium among hospitalized geriatric patients. A previous study of IQCODE as a predictor of dementia recommended a cut-point of 3.3. The overall risk to develop delirium during



hospitalization was 19%, but using IQCODE with a cut-point of 3.3 allowed to identify a low-risk group with a risk of 6% and a high-risk group with a risk of 26% to develop delirium during hospitalization. The IQCODE does not stand alone, but it is a useful supplement to other observations in detecting patients needing dementia-friendly treatment and care.

The cost of data collection, analysis, and preparation of the manuscript was covered by the Department of Geriatrics, Aarhus University Hospital.

## Compliance with ethical standards

**Conflict of interest** The cost of data collection, analysis, and preparation of the manuscript was covered by the Department of Geriatrics, Aarhus University Hospital. The authors declare no conflicts of interest.

**Research involving human participants** It was a quality development project with no intervention, the study was exempted from notification to the Central Denmark Region Ethical Committee (Inquiry number 200/2017). The study protocol was approved by the Danish Data Protection Agency, case no. 1-16-02-254-16. The study was registered at ClinicalTrials.gov (Identifier NCT03175276).

**Informed consent** Not needed according to Ethical Committee.

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