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# The association of indwelling urinary catheter with delirium in hospitalized patients and nursing home residents: an explorative analysis from the “Delirium Day 2015”

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## Abstract

### Background

Use of indwelling urinary catheter (IUC) in older adults has negative consequences, including delirium.

### Aim

This analysis, from the “Delirium Day 2015”, a nationwide multicenter prevalence study, aim to evaluate the association of IUC with delirium in hospitalized and Nursing Homes (NHs) patients.

### Methods

Patients underwent a comprehensive geriatric assessment, including the presence of IUC; inclusion criteria were age > 65 years, being Italian speaker and providing informed consent; exclusion criteria were coma, aphasia, end-of-life status. Delirium was assessed using the 4AT test (score  $\geq 4$ : possible delirium; scores 1–3: possible cognitive impairment).

### Results

Among 1867 hospitalized patients (mean age  $82.0 \pm 7.5$  years, 58% female), 539 (28.9%) had IUC, 429 (22.9%) delirium and 675 (36.1%) cognitive impairment. IUC was significantly associated with cognitive impairment (OR 1.60, 95% CI 1.19–2.16) and delirium (2.45, 95% CI 1.73–3.47), this latter being significant also in the subset of patients without dementia (OR 2.28, 95% CI 1.52–3.43). Inattention and impaired alertness were also independently associated with IUC. Among 1454 NHs residents (mean age  $84.4 \pm 7.4$  years, 70.% female), 63 (4.3%) had IUC, 535 (36.8%) a 4AT score  $\geq 4$ , and 653 (44.9%) a 4AT score 1–3. The multivariate logistic regression analysis did not show a significant association between 4AT test or its specific items with IUC, neither in the subset of patients without dementia.

### Discussion

We confirmed a significant association between IUC and delirium in hospitalized patients but not in NHs residents.

### Conclusion

Environmental and clinical factors of acute setting might contribute to IUC-associated delirium occurrence.

## Introduction

The indwelling urinary catheter (IUC) has a wide, and sometimes inappropriate, use among older patients, especially in the acute setting [1, 2, 3, 4, 5]. In European hospitals, prevalence of IUC is reported to be 17.5%, with even higher prevalence (24.6%) in geriatric setting [1, 2, 3] while prevalence in United States (US) hospital is 23.6% [4]. A wide cross-sectional study among US acute wards shows that approximately 30–40% of IUC are placed without an appropriate indication [5].

The indwelling urinary catheter has several well-known negative effects: up to 67% of urinary tract infection in all hospital patients are catheter associated and IUC use can result in increased risk of sepsis, mortality, longer hospital stay and higher care cost [6, 7].

Delirium itself can lead to negative outcomes, such as poor quality of life, longer length of hospital stay, increased mortality, long-term cognitive and functional impairment, institutional placement, distress for family members and national health expenditure [8, 9, 10, 11].

Several studies, conducted mainly in small and selected cohorts of hospitalized patients, suggest an association between IUC and delirium (Table 1) [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27].

**Table 1** Studies examining association between delirium and indwelling urinary catheter (IUC)

Author (year)	N	Age	Setting	Delirium assessment	Association IUC—delirium
Solà-Miravete (2017) [12]	454	65+	Hospital wards	CAM	OR 3.90 (95% CI 1.85–8.62)
Tomlinson (2016) [13]	482	65+	Int. Med	Discharge summary	OR 2.00 (95% CI 1.27–3.15)
Linpawattana (2016) [14]	99	65+	ICU	CAM-ICU	OR 2.03 (95% CI 0.49–8.39)
Pendlebury (2015) [15]	503	65+	Int. Med	CAM/ DSM4	OR 5.50 (95% CI 2.27–13.34)
Noriega (2015) [16]	203	75+	Cardiology	CAM	$p = 0.004$ (univariate analysis)
De Castro (2014) [17]	209	60+	Surgery	DSM4	OR 3.7 (95% CI 1.1–11.4)
Diez-Manglano (2013) [18]	744	–	Int. Med	Database	OR 2.00 (1.19–3.68)

<b>Author (year)</b>	<b>N</b>	<b>Age</b>	<b>Setting</b>	<b>Delirium assessment</b>	<b>Association IUC—delirium</b>
Liv (2013) [19]	331	65+	Orthogeriatrics	RAI-AC	$p < 0.000$ (univariate analysis)
Gutiérrez-Rodríguez (2013) [32]	505	65+	NHs	CAM	OR 5.33 (1.46–19.49)
Martinez et al. (2012) [20]	397	18+	Int. Med	CAM	No association (univariate analysis)
Van Rompaey (2009) [21]	523	18+	ICU	Neecham Conf. Scale	OR 5.37 (2.09–13.8)
McAlpine (2008) [22]	103	60+	Gynecology	CAM	No association
Inouye (2007) [23]	952	70+	Int. Med	CAM	Yes (univariate analysis)
Ranhoff (2006) [24]	401	60+	SICU	CAM	OR 2.7 (1.4–4.9)
Inouye (2003) [25]	422	70+	Int. Med	CAM	Lower occurrence of delirium associated to reduction of IUC
Inouye (1999) [26]	852	70+	Int. Med	CAM	Lower occurrence of delirium associated to reduction of IUC
Inouye and Charpentier (1996) [27]	508	70+	Int. Med	CAM	RR 2.4 (1.2–4.7)

*CAM* confusion assessment method, *Int. Med* Internal Medicine, *ICU* intensive care unit, *CAM-ICU* Confusion Assessment Method-intensive care unit, *DSM4* diagnostic and statistical manual of mental disorders 4, *RAI-AC* resident assessment instrument for acute care, *NHs* nursing homes, *Neecham Conf. Scale* Neelon and Champagne confusion scale, *SICU* subintensive care unit, *OR* odd-ratio, *RR* relative risk

The Italian “Delirium Day 2015”, a nationwide multicenter study to assess the point-prevalence of delirium over a single-day across various settings of care, showed that 22.9% of hospitalized patients had delirium, which was significantly associated with IUC use among several other variables (age, functional dependence, dementia, malnutrition, use of antipsychotics, feeding tubes, peripheral venous catheters, physical restraints and admission to Neurology wards) [28].

Use of IUC in nursing homes (NHs) is reported to be lower than in hospital setting: a large-scale prospective project show that prevalence in 568 US community-based NHs is 4.9% [29], while in Germany ranges between 5 and 15% [30]. IUC may also cause discomfort and mobility impairment [31], thereby increasing the risk of delirium occurrence, mainly in vulnerable patients [27]. However, the association of IUC with delirium was rarely investigated in NHs settings (Table 1) [32].

The present study, an explorative analysis from the “Delirium Day 2015”, has three goals: (1) to compare the prevalence of IUC use among two cohorts of hospitalized and NHs patients; (2) to provide a more in-depth evaluation of the demonstrated association between IUC and delirium in patients admitted to acute and rehabilitation hospital wards [28], (3) to evaluate, among NHs residents, whether the use of IUC is associated with the 4AT test (a screening instrument for cognitive impairment and delirium) total score or specific 4AT items.

## **Methods**

Methods of the present study, which was a predefined objective of the “Delirium Day 2015”, have been extensively described in details elsewhere [28].

Briefly, this study was conducted on a single day (September 30th, 2015), among acute and rehabilitation hospital wards and NHs that agreed to participate. All patients admitted to the participating centers were considered potentially eligible if they were aged 65 years and older, were native Italian speakers, and if they or a proxy provided a written informed consent. Exclusion criteria were coma, aphasia and end-of-life status, as defined by clinical judgment. Informed consent was obtained from all participants or from their proxy when the participants had delirium or severe cognitive impairment. Patients underwent a standardized comprehensive geriatric assessment including functional status (ADL, Activities of Daily Living score) [33], nutritional and health status, presence of dementia, medications, use of IUC, feeding tubes, peripheral venous catheters and physical restraints [28].

The 4AT test was used to detect delirium and cognitive impairment in all participants. The 4AT is a brief and rapid tool (not requiring specific training), which has been validated for delirium screening in hospitalized older patients, showing a sensitivity of 89.7% and a specificity of 84.1% [34]. It comprises four items: item 1 assesses level of alertness; item 2 and 3 are brief cognitive screening tests (the Abbreviated Mental Test—4 and attention testing with Months Backwards); item 4 assesses acute change or fluctuation in mental status. A score of 0 suggests neither delirium nor cognitive impairment, scores between 1 and 3 suggest possible cognitive impairment (that is, corresponding to moderate to severe impairment on standard dementia screening tools), while a score of 4 or above suggests the presence of delirium and/or delirium superimposed on dementia [34].

In the present study, we explored the association of IUC with global 4AT scores (0, 1–3, and  $\geq 4$ ) and 4AT items suggesting delirium among hospitalized patients and NH residents.

The Ethical Committee of the IRCCS Fondazione Santa Lucia, Rome (Prot CE/PROG.500) approved the study protocol.

The descriptive analysis for quantitative variables was based on calculation of the mean and standard deviation (SD) while qualitative variables were reported as frequencies and percentages. Univariate analyses were performed using the Wilcoxon Mann–Whitney test for continuous variables; categorical variables were analysed by the Chi-square or Fisher's exact test as appropriate. Multivariable logistic regression analyses were used to identify variables independently associated with IUC, including 4AT scores and 4AT items. All statistical tests were two-sided. *P* values of 0.05 or less were considered statistically significant. The analysis were conducted using the SAS (SAS Institute, Cary, NC) software package, ver.9.3 for Windows.

## Results

Data were collected from 120 acute hospital wards and 71 NHs. Demographic and clinical characteristics of the two cohorts studied according to the presence of IUC are reported in Table 2. Among 1867 hospitalized patients (mean age  $82.0 \pm 7.5$  years, 58% females), IUC was present in 539 patients (28.9%), while delirium and cognitive impairment were detected in 429 patients (22.9%) and in 675 patients (36.1%), respectively. Among 1454 NHs participants who were eligible for the study (mean age  $84.4 \pm 7.4$  years, 70% female), IUC was present in 63 patients (4.3%), while a 4AT score  $\geq 4$  was detected in 535 patients (36.8%) and a 4AT score ranging from 1 to 3 in 653 patients (44.9%).

**Table 2** Demographic and clinical characteristics of patients in acute and rehabilitation hospital wards and in nursing homes according to the presence of indwelling urinary catheter (IUC)

	Acute and rehabilitation hospital wards			Nursing homes		
	IUC ( <i>n</i> = 539, 28.9%)	No IUC ( <i>n</i> = 1328, 71.1%)	<i>P</i> value	IUC ( <i>n</i> = 64, 4.3%)	No IUC ( <i>n</i> = 1391, 95.7%)	<i>P</i> value
Age, mean (SD)	83.57 (7.2)	81.33 (7.6)	< 0.001	86.35 (7.8)	84.31 (7.5)	0.015
Female sex, <i>n</i> (%)	311 (57.7)	771 (58.1)	0.887	28 (44.4)	989 (71.1)	< 0.001
Education, mean (SD)	6.30 (3.8)	6.81 (3.8)	< 0.001	5.45 (3.9)	5.82 (4.0)	0.206
ADL (functions lost), mean (SD)	3.35 (2.4)	2.10 (2.3)	< 0.001	4.83 (1.5)	4.11 (1.9)	0.003
Dementia, <i>n</i> (%)	163 (30.2)	286 (21.5)	< 0.001	34 (54.0)	709 (51.0)	0.646
Malnutrition, <i>n</i> (%)	50 (9.3)	83 (6.3)	0.021	9 (14.3)	62 (4.5)	< 0.001
No. of medications, mean (SD)	5.21 (2.2)	5.04 (2.1)	0.106	5.57 (2.0)	5.37 (2.2)	0.370
Antihypertensive drugs, <i>n</i> (%) <sup>a</sup>	323 (60.0)	854 (64.5)	0.073	38 (60.3)	733 (53.4)	0.278
Statin/lipid lowering drugs, <i>n</i> (%)	58 (10.8)	284 (21.4)	< 0.001	8 (12.7)	240 (17.3)	0.346
Antiarrhythmic drugs, <i>n</i> (%)	65 (12.1)	147 (11.1)	0.541	9 (14.3)	101 (7.3)	0.039
Antibiotics, <i>n</i> (%)	277 (51.4)	342 (25.7)	< 0.001	7 (11.1)	33 (2.4)	0.001
Benzodiazepines, <i>n</i> (%)	125 (23.2)	328 (24.7)	0.491	22 (34.9)	501 (36.0)	0.856
Antipsychotics, <i>n</i> (%) <sup>a</sup>	96 (17.8)	167 (12.6)	0.003	27 (42.9)	553 (40.3)	0.680
Antidepressants, <i>n</i> (%) <sup>a</sup>	102 (19.0)	285 (21.5)	0.219	20 (31.8)	489 (35.6)	0.533
AChEInhibitors/memanti ne, <i>n</i> (%)	11 (2.0)	28 (2.1)	0.926	1 (1.6)	43 (3.1)	0.495

	Acute and rehabilitation hospital wards			Nursing homes		
	IUC ( <i>n</i> = 539, 28.9%)	No IUC ( <i>n</i> = 1328, 71.1%)	<i>P</i> value	IUC ( <i>n</i> = 64, 4.3%)	No IUC ( <i>n</i> = 1391, 95.7%)	<i>P</i> value
Laxatives, <i>n</i> (%)	102 (18.9)	298 (22.4)	0.093	24 (38.1)	586 (42.2)	0.523
Feeding tubes, <i>n</i> (%) <sup>a</sup>	26 (4.8)	14 (1.1)	< 0.001	3 (4.8)	8 (0.6)	< 0.001
Peripheral venous catheters, <i>n</i> (%)	335 (62.2)	513 (38.6)	< 0.001	6 (9.5)	13 (0.9)	< 0.001
Physical restraints, <i>n</i> (%) <sup>a</sup>	22 (4.1)	39 (2.9)	0.208	16 (25.4)	172 (12.5)	0.003
4AT score, <i>n</i> (%)			< 0.001			0.004
0	138 (25.6)	625 (47.1)		11 (17.5)	255 (18.3)	
1–3	202 (37.5)	473 (35.6)		17 (27.0)	636 (45.8)	
≥ 4	199 (36.9)	230 (17.3)		35 (55.6)	500 (36.0)	
Item attention (score), <i>n</i> (%)			< 0.001			0.109
0	209 (38.8)	792 (59.6)		17 (27.0)	399 (28.7)	
1	236 (43.8)	425 (32.0)		23 (36.5)	644 (46.3)	
2	94 (17.4)	111 (8.4)		23 (36.5)	348 (25.0)	
Item acute change/fluctuating course (score), <i>n</i> (%)			< 0.001			0.042
0	378 (70.1)	1146 (86.3)		44 (69.8)	1118 (80.4)	
4	161 (29.9)	182 (13.7)		19 (30.2)	273 (19.6)	



Item alertness (score), <i>n</i> (%)	< 0.001				0.002
0	443 (82.2)	1263 (95.1)	44 (69.8)	1179 (84.8)	
4	96 (17.8)	65 (4.9)	19 (30.2)	212 (15.3)	

The 4A Test: screening instrument for cognitive impairment and delirium; 4AT score 4 or above:possible delirium ± cognitive impairment; 4AT score 1–3:possible cognitive impairment; 4AT score 0:delirium or cognitive impairment unlikely. Item attention, months of the year backwards:achieves 7 months or more correctly, 0; starts but scores < 7 months / refuses to start, 1; untestable (cannot start because unwell, drowsy, inattentive), 2. Item acute change of fluctuating course:No, 0; Yes, 4. Item alertness:normal, 0; mild sleepiness for < 10 s after waking, then normal, 0; clearly abnormal, 4

*IUC* indwelling urinary catheters, *ADL* activities of Daily Living Score, *AChE-I* Acetylcholinesterase inhibitors, *SD* standard deviation

<sup>a</sup>Number and percentage refer to data with missing values

In the hospital wards, prevalence of delirium and cognitive impairment was higher among patients with IUC (36.9 and 37.5%, respectively) than in those without (17.3% and 35.6%, respectively) ( $p < 0.001$ ) (Table 2). Moreover, disturbance in attention, alertness and acute change or fluctuating course, which are delirium-specific items included in 4AT test, were more prevalent in catheterized patients ( $p < 0.001$ ) (Table 2). After multivariate logistic regression analysis both delirium (OR 2.45, 95% CI 1.73–3.47) and cognitive impairment (OR 1.60, 95% CI 1.19–2.16) remained significantly associated with presence of IUC. In another multivariate logistic regression analysis, being unchanged other covariates, disturbance in attention (score 1 vs 0) (OR 1.39, 95% CI 1.05–1.83) and alertness (OR 2.48, 95% CI 1.55–3.98) were independently associated with presence of IUC. After excluding patients with known dementia, leaving a sample of 1418 patients (75.9%), delirium was still significantly associated with IUC (OR 2.28, 95% CI 1.52–3.43), as well as the disorders of attention (score 1 vs 0) (OR 1.40, 95% CI 1.02–1.91) and impaired alertness (OR 2.94, 95% CI 1.35–6.41).

Among NHs residents, those with IUC were older, more frequently males, more impaired in activities of daily living and more malnourished than those without (Table 2). Additionally, they were more likely to be prescribed antiarrhythmic and antibiotic drugs, to be fed with nasogastric or percutaneous gastrostomy tubes, to be physically restrained and to have a peripheral venous catheters than their counterpart was (Table 2). A 4AT score  $\geq 4$  was more prevalent in those with IUC (55.6%) than in those without (36.0%), while a 4AT score 1–3 was more prevalent in patients without IUC (45.8%) than in those with IUC (27.0%) ( $p = 0.004$ ) (Table 2); use of IUC was associated with two 4AT specific items (impaired alertness and acute change/fluctuating course;  $p = 0.002$  and  $p = 0.042$ , respectively) (Table 2).

After multivariate logistic regression analysis, neither 4AT scores nor 4AT items remained significantly associated with presence of IUC. Results did not change in the subset of patients without history of known dementia.

## Discussion

The present study aim to compare the prevalence of IUC use among two cohorts of hospitalized and NHs patients, to provide an in-depth evaluation of the association between use of IUC and delirium among hospitalized patients and to evaluate whether the use of IUC is associated with global 4AT score and delirium specific items among NHs residents. The latter is a topic rarely investigated in literature [32].

Our findings are in keeping with previous studies, which showed a higher prevalence of patients with IUC among those admitted to acute hospital wards than in NHs residents. In a multicentre study involving 14,252 older patients from 28 medical and surgical wards in Dutch hospitals, 21.2% had an IUC in place on the day of the survey [2]. The second National Survey of the Prevalence of Hospital Acquired Infection (HAI) in Scotland, identified 24.6% of patients with IUC within geriatric settings and 15.5% in Internal Medicine [3]. Prevalence studies reported a IUC prevalence of 17.5% in 66 European hospitals [1] and 23.6% in 183 US acute care hospitals [4].

Use of IUC in NHs is reported to be lower than in hospital setting: a recent large-scale prospective project showed a prevalence of IUC in US NHs of 4.9% [29]; in Germany ranged between 5 and 15% [30], while a questionnaire survey in United Kingdom (UK) nursing homes showed that 9% of residents had IUC [35].

The higher prevalence of IUC use observed in our cohort of hospitalized patients compared with previous studies might be accounted for either by greater severity of diseases across different settings of care or by poor widespread dissemination among hospital physicians of current recommendations about IUC use in older in-patients. On the contrary, the lower prevalence of IUC use among NHs residents suggests a wise use of urinary catheters in this setting, although participating centers should not be considered representative of the whole national NHs scenario.

Findings of this study also confirm that, in hospitalized patients, IUC use is significantly associated with delirium as well with impaired attention and alertness, suggestive items of delirium. Importantly, these associations remained statistically significant in the subset of patients without known history of dementia. Our findings are in keeping with, and add on to, previous studies, mainly conducted in smaller cohorts of patients and in selected settings (Table 1) [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27]. It is demonstrated that a multicomponent intervention including wise use of IUC has the potential to reduce the risk of developing incident delirium in hospitalized older medical

patients [25, 26, 27]. Both the National Institute for Health and clinical Excellence (NICE) guidelines for the diagnosis, prevention and management of delirium [36] and the Hospital Elder Life Program (HELP) protocol [37], a strategy to prevent delirium and functional decline in hospitalized older patients, recommend to avoid unnecessary catheterization and to remove it as soon as possible.

Among NHs residents, who have lower prevalence of IUC than that observed among hospitalized patients (4.3 vs 28.9%), we do not find significant association of IUC neither with 4AT scores suggestive of delirium and cognitive impairment nor with 4AT items. Although the lack of a significant association might be, at least in part, explained by a lack of power due to the limited number of NHs residents with IUC, findings from the Delirium Day suggest that the increased individual vulnerability in the acute clinical context in which IUC is placed or used, beyond its potential contribution to urinary infections [38] and limited mobility [39], might be crucial for delirium occurrence.

Therefore, IUC placement should be regarded as one of the several hospital-associated potentially correctable factors that may have deleterious effect on delirium occurrence in older patients in the context of acute hospitalization.

Strengths of the present study are the large sample size, the inclusion of nearly 200 healthcare facilities and the use of a simple validated tool for delirium and cognitive assessment. Furthermore, we used a comprehensive geriatric evaluation. We used several different analytical approaches to detect a potential association of IUC with delirium among NHs residents, but results were consistent in suggesting no significant association in this setting. The main limitation of the present study is that the 4AT test has been validated for detecting delirium among older hospitalized patients but not among NHs residents. However, validated methods to detect delirium in these settings are lacking [40]. Moreover, a caveat regarding the 4AT score is that severe chronic cognitive impairment might also yield a score of 4, which usually suggests delirium but is not diagnostic: more detailed assessment of mental status may be required to reach a diagnosis; in the validation study, among 234 hospitalized older patients, the 4AT cut off  $\geq 4$  showed a sensitivity of 89.7% and a specificity of 84.1% in the whole cohort, a sensitivity of 83.3% and a specificity of 91.3% in the subgroup without dementia, a sensitivity of 94.1% and a specificity of 64.9% in the subgroup with dementia [34]; although we analyzed separately items associated with delirium (alertness, attention and acute change/fluctuating course) we cannot definitely exclude that some cases of delirium were superimposed on dementia.

As a minor potential limitation, we did not collect data regarding the reasons of IUC positioning, if appropriated or not and how long did catheter remain in place. Moreover, data about possible confounders, such as main diagnoses, severity of disease i.e. physiological derangement as measured with the Acute Physiology Score, hemodynamic disturbances, are not available for the “Delirium Day 2015”, but have been collected in the more recent editions of “Delirium Day”.

In conclusion, present findings demonstrate lower prevalence of IUC use among NHs residents than in hospitalized patients, and reinforce the association between use of IUC and delirium in hospitalized patients. On the contrary, IUC use among NHs residents was not associated with neither 4AT global scores, potentially reflecting delirium and cognitive impairment, nor with its specific items. These data provide evidence of wise and safe use of IUC among NHs residents, and suggest that the “acute clinical context” in which IUC is placed or used might be crucial for delirium occurrence.

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Informed consent was obtained from all participants or from their proxy when the participants had delirium or severe cognitive impairment.

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