

# The impact of guidelines on sterility precautions during indwelling urethral catheterization at two acute-care hospitals in Sweden - a descriptive survey

Aysel Kulbay (✉ [aysel.kulbay@ki.se](mailto:aysel.kulbay@ki.se))

Karolinska Institutet

Eva Joelsson-Alm

Karolinska Institutet

Ann Tammelin

Karolinska Institutet

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## Research article

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# Abstract

**Background:** To support a uniform and evidence-based practice for indwelling urinary catheterization in adults The European association of Urology Nurses (EAUN) published guidelines for this procedure in 2012. The Swedish national guidelines are based on the sterility precautions advocated by EAUN. Nevertheless, some hospitals have local guidelines with other requirements concerning sterility and leave to staff to decide how to perform the catheterization. The aim of this descriptive survey was to investigate the nurses' self-reported sterility precautions during indwelling urethral catheterization at two acute-care hospitals, where the local guidelines differ in their sterility requirements. The study also aimed to analyse factors affecting the participants' conformity with sterility precautions in the EAUN-guidelines.

**Methods:** A structured questionnaire with questions concerning the participant, working conditions and performance of indwelling urethral catheterization was left to 931 nurses in two acute care hospitals. Chi-square test, Fisher's exact test and Mann-Whitney U-test were used for descriptive statistics. Logistic regression was used to analyse variables associated with practicing the sterility precautions in the EAUN-guidelines.

**Results:** Answers were obtained from 852 persons (91.5%). A majority of the participants called their insertion technique "non-sterile". Regardless of designation of the technique the participants said that the indwelling urinary catheter (IUC) should be kept sterile during procedure. In spite of that not everyone used sterile equipment to maintain the sterility of the catheter. The nurses' conformity with all the sterility precautions in the EAUN-guidelines were associated with working at departments for surgery and cardiology (OR 2.35, 95% CI 1.69-3.26), use of sterile set for catheterization (OR 2.08, 95% CI 1.44-3.00), use of sterile drapes for dressing on insertion area (OR 1.87, 95% CI 1.21-2.89) and using the term "sterile technique" for indwelling urethral catheterization (OR 1.70, CI 1.15-2.51).

**Conclusions:** The study showed that only 55-74% of the nurses practised one or more precautions that secured sterility of the IUC thus demonstrating a gap between the EAUN-guidelines and the actual performance. Compliance to disinfection of hands prior to the procedure was however around 90%. Healthcare-settings should ensure education and skill training to achieve sterile IUC-insertion according to the requirements in the EAUN-guidelines.

## Background

Healthcare-associated urinary tract infection (HAUTI) is one of the most common healthcare-associated infections and is mostly linked to presence of an indwelling urinary catheter (IUC) [1-4]. In two point prevalence surveys of healthcare-associated infections (HAI) conducted by the European Centre for Disease Prevention and Control (ECDC) among in-patients at acute-care hospitals in European countries during 2011-2012 (1149 hospitals) and 2016-2017 (1209 hospitals), HAUTI constituted 19.0% and 18.9% of all HAI. In the first survey HAUTI was the third most common type of HAI and in the later survey the second most common. [5, 6]

In a point prevalence survey conducted in 2018 among 3547 patients in acute-care hospitals in Stockholm, Sweden, the prevalence of HAUTI was 20.2% among inpatients with HAI. [7]

Prevention of HAUTI has been the subject of many national guidelines in countries within and outside Europe. [8-11] With the believe that “excellent healthcare goes beyond geographical boundaries” [12, p. 3] and to support a uniform evidence-based practice for indwelling urethral catheterization in adults the European association of Urology Nurses (EAUN) published guidelines for this procedure in 2012 [12].

One of the main strategies in preventing HAUTI in patients needing an IUC is to avoid contamination of the sterile IUC during insertion. This requires knowledge about sterility precautions and practice in aseptic technique during IUC-insertion on a regular basis [8-11]. To keep the IUC sterile during insertion EAUN recommends use of sterile lubricants, sterile equipment and aseptic technique [12]. The current Swedish national guidelines for indwelling urethral catheterization are based on the sterility precautions advocated by EAUN. [13] At the same time there exist local Swedish hospital guidelines with different requirements regarding sterility of the IUC and equipment during IUC-insertion. These local hospital guidelines supersede the national guidelines and vary with respect to how much they leave to staff to decide what equipment to use and how to perform the catheterization (see Table 1). A situation where international, national and local guidelines are available in parallel could easily cause confusion among staff performing urethral catheterization. Uncertainty might lead to inconsistent use and interpretation of terms, a non-uniform performance of the procedure and impaired patient safety. Therefore, we wanted to explore how the situation with several guidelines affected behaviour in daily nursing and if this could jeopardize patient safety.

## **Aim**

The aim of the study was to investigate the nurses’ self-reported sterility precautions during indwelling urethral catheterization at two acute-care hospitals in Sweden, where the local guidelines differ in their sterility requirements. The study also aimed to analyse factors affecting the participants’ conformity with sterility precautions recommended in the EAUN-guidelines for indwelling urethral catheterization on adults.

## **Methods**

### **Design and questionnaire**

The study had a descriptive design and was based on a structured questionnaire, with 19 questions in total. Nine questions concerned the participant and the working conditions (profession, graduation year, years in profession, department, years at present department, ward, work shift, origin of the insertion technique, frequency of IUC-insertion) and ten questions concerned the indwelling urethral catheterization procedure (insertion technique, sterility of the IUC during insertion, hand hygiene prior to preparing for procedure, solution for periurethral cleaning, area for preparing equipment prior to IUC-insertion, sterility of

the set for catheterization if used, sterility of dressing on insertion area if used, sterility of utilities used for IUC-insertion, disposable/reusable equipment used for IUC-insertion, fluid for urinary washouts if used).

The questionnaire was constructed by the researchers in collaboration with expertise in urology nursing and infection control and the questions concerning sterility precautions during IUC-insertion procedure were based on the EAUN-guidelines for indwelling urethral catheterization in adults [12]. The questionnaire was pilot tested for comprehensiveness on healthcare-personnel in urology at another hospital in Sweden prior to the study. Each person taking part in the pilot test was instructed to read the questions and describe thoughts and associations for each question and the corresponding answer options by thinking aloud. After completed questionnaire each person was interviewed about the need of any additional questions to describe the IUC-insertion procedure. The pilot test did not result in any changes of the questions or answer options.

## Setting

The study was conducted at two acute-care hospitals, hospital A and hospital B, with approximately 600 and 500 beds respectively, both situated in Stockholm County, Sweden. Wards for in-patient care at the departments for general surgery, cardiology and general internal medicine were chosen for the study as they had a similar level of care and urethral catheterization was performed regularly in all those wards by registered nurses and assistant nurses. At the time for the survey each hospital had local guidelines for indwelling urethral catheterization. The local guidelines at hospital A were launched in 2006 and updated in 2011. The local guidelines at hospital B were launched in 2011 and updated in 2013. See Table 1 for an overview of the required sterility precautions for indwelling urethral catheterization according to the EAUN-guidelines and both local hospital guidelines. EAUN used the term “sterile procedure” to summarize their requirements whereas hospital A used the heading “sterile technique” for their procedure and hospital B called their procedure “non-sterile technique”. At both hospitals it was possible for the newly employed nurses from the included wards to practice their IUC-insertion procedure at the hospital clinical training centres, but none of the wards required repeated training to keep up skills.

**Table 1.** Overview of guidelines concerning sterility precautions during indwelling urethral catheterization.

Requirements	EAUN-guidelines [12]	Local guidelines Hospital A	Local guidelines Hospital B
Hand hygiene	Bactericidal alcohol hand rub	Bactericidal alcohol hand rub	Not mentioned
Sterility of the IUC during insertion	Sterile catheter	Sterile catheter	Non-sterile catheter
Preparation area for equipment	On a clean trolley	Not mentioned	Not mentioned
Insertion of the urethral catheter	With sterile gloves	With sterile gloves or sterile forceps held by non-sterile gloves	Not mentioned, refers to the national guidelines
Fluid for urinary bladder washouts	Sterile fluid	Sterile normal saline	Not mentioned

## Participants

Head Nurses at all 28 wards for in-patient care at departments for surgery, cardiology and internal medicine at both study hospitals were asked about taking part in the study after verbal and written information. At hospital A fourteen of 15 eligible wards (3 wards at the department for surgery, 4 wards at the department for cardiology, 7 wards at the department for internal medicine) accepted participation in the study. One Head Nurse (a ward at the department for surgery) declined study participation due to other ongoing studies and workload at the ward. At hospital B, all 13 eligible wards (3 wards at the department for surgery, 3 wards at the department for cardiology, 7 wards at the department for internal medicine) accepted participation. The participants were registered nurses and assistant nurses. Employees on sick leave, parental leave and temporary staff were not included.

## Data collection

Verbal and written information was given by the study conductor to the nurses and assistant nurses at the participating wards during ward meetings. The voluntary participation in the study was emphasized and the printed questionnaires were distributed by the study conductor or the Head Nurse to the employees fulfilling the inclusion criteria. The participants were instructed not to discuss the questions in the questionnaire during the study period. The Head Nurses reminded the staff about the questionnaire at ward meetings. Consent was implied when nurses voluntarily returned the answered questionnaires to the study conductor in preaddressed and sealed envelopes within two weeks after distribution. At hospital A, 563 questionnaires were distributed during December 2015 - March 2016. At hospital B, 368 questionnaires were distributed during May 2016 - January 2017. The answers in the returned questionnaires were anonymized prior to data analysis. See Figure 1 for flowchart of the study inclusion process.

## Data analysis

Differences in background characteristics and indwelling urethral catheterization procedure of the participants were evaluated with Chi-square test, Fisher's exact test and Mann-Whitney U-test. Continuous variables were expressed as medians (IQR) and categorical variables as numbers (%).

Binary logistic regression was used to identify variables associated with practicing the sterility precautions for indwelling urethral catheterization required in the EAUN-guidelines. The dependent variable was performing in agreement with all the five components of the sterility precautions in the EAUN-guidelines as described in Table 1 (bactericidal alcohol hand rub, sterile catheter, on a clean trolley, with sterile gloves, sterile fluid). Twelve explanatory variables were tested, among these seven background factors (hospital, department, profession, years in profession, work shift, frequency of IUC-insertion, origin of the insertion-technique) and five technique-related factors (type of insertion-technique, periurethral cleaning solution, use of set for catheterization, dressing on insertion area and disposable vs reusable equipment) which could affect the sterility during IUC-insertion. We categorized the following variables into two groups: department (internal medicine and cardiology/surgery), years in profession (0-2 years and >2 years), work shift (day/evening/alternating shift and night shift), frequency of IUC-insertion (each week or month and less than each month), origin of the insertion technique (according to the hospital guidelines and other answers), insertion technique (sterile technique and non-sterile technique), use of set for catheterization (sterile set and non-sterile set/no set used), dressing on insertion area (sterile drapes and non-sterile drapes/no drapes) and equipment for catheterization (disposable and reusable/don't know). Periurethral cleansing solution was categorized into three groups (soap/tap water, sterile normal saline and other solutions) to reflect to participants' choices for cleaning prior to IUC-insertion. First, univariable analyses was used to study crude associations of each explanatory variable with the odds (OR) of factors affecting the participants' conformity with the sterility precautions required in the EAUN-guidelines. Secondly, multivariable logistic models were used in a backward and forward procedure to study the adjusted associations. Variables with a p-value < 0.10 in the univariable analyses were included in the multivariable analyses. The associations are presented as odds ratios (OR) with 95% confidence intervals (CI). Finally, Hosmer-Lemeshow goodness-of-fit test was used to assess the adjusted model, with a p-level above 0.05 indicating an acceptable fit. The IBM Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA) was used for all analyses: and a two-sided p-value of <0.05 was considered statistically significant.

## Results

### Participants

Answers were obtained from 518 of 563 included persons (92%) at hospital A and from 334 of 368 included persons (91%) at hospital B. Among the respondents at both hospitals 33 of them (26 at hospital A, 7 at hospital B) answered that they never inserted indwelling urinary catheters and were excluded from analysis. Not all questions were answered by every participant, thus leading to different numbers of analysed answers for each question.

In total, answers from 492 participants at hospital A and 327 answers from participants at hospital B were analysed.

The characteristics of the participants from both study hospitals are displayed in Table 2.

The participation is described on department level hence ward is not included in Table 2.

At hospital A, a higher proportion of participants worked at the department of cardiology, worked alternating shifts (both day, evening and night shifts) and had longer professional experience compared to the participants at hospital B.

**Table 2.** Characteristics of participants from the two study hospitals.

Characteristics	Hospital A (n=492)	Hospital B (n=327)	p-value
Profession, n (%) Registered nurse Assistant nurse	311 (63.2) 181 (36.8)	201 (61.5) 126 (38.5)	0.658
Departments, n (%) Cardiology Internal Medicine Surgery	186 (37.8) 223 (45.3) 83 (16.9)	62 (19.0) 180 (55.0) 85 (26.0)	<0.001*
Years in profession, median (IQR)	8 (3.5-18)	5 (2-13)	<0.001*
Graduation year During the 1980s During the 1990s During the 2000s Missing	65 (13.3) 80 (16.4) 342 (70.1) 1 (0.2)	25 (7.7) 48 (14.8) 252 (77.5) 0 (0.0)	0.045*
Years at present department, median (IQR)	3 (1-8)	2 (1-6)	0.019*
Work shift, n (%) Day/evening shift Night shift Alternating shifts (day/evening/night) Other answers	237 (48.2) 66 (13.4) 181 (36.8) 8 (1.6)	198 (60.6) 51 (15.6) 77 (23.5) 1 (0.3)	<0.001*
Frequency of IUC-insertion, n (%) 2 times or more/week 1-5 times/month Less frequently Other answers Missing	26 (5.3) 212 (43.1) 249 (50.6) 2 (0.4) 3 (0.6)	20 (6.1) 143 (43.7) 163 (49.8) 0 1 (0.3)	0.657
Origin of the insertion technique, n (%) The hospital guidelines Other answers (national guideline, nursing school, local routine at ward, don't know)	287 (60.3) 189 (39.7)	202 (62.9) 119 (37.1)	0.459

\* p-value <0.05 was considered as statistically significant difference between hospital A and hospital B.

### Sterility precautions during procedure

The participants' answers about their denomination of the insertion technique – sterile or non-sterile – and sterility precautions when describing how they performed indwelling urethral catheterization are shown in Table 3.

**Table 3.** Participants' answers about sterility precautions during indwelling urethral catheterization.

Survey questions	Hospital A	Hospital B	p-value
Insertion technique, n (%) Sterile technique** Non-sterile technique	139 (28.5) 348 (71.5)	74 (23.1) 247 (76.9)	0.011*
Sterility of the IUC during insertion, n (%) Sterile IUC** Non-sterile IUC	403 (82.2) 87 (17.8)	255 (78.2) 71 (21.8)	0.175
Hand hygiene prior to preparing for procedure, n (%) Disinfected hands** Other answers (e.g. clean hands)	446 (91.2) 43 (8.8)	284 (87.1) 42 (12.9)	0.079
Solution for periurethral cleaning, n (%) Soap and tap water Sterile normal saline 9mg/ml Other answers	404 (82.8) 44 (9.0) 40 (8.2)	274 (84.0) 31 (9.5) 21 (6.4)	0.640
Area for preparing equipment prior to IUC-insertion, n (%) On a disinfected trolley** Other answers (e.g. bedside table, bed)	304 (55.8) 188 (38.2)	241 (74.2) 84 (25.8)	<0.001*
Set for catheterization, n (%) Sterile set Non-sterile set Do not use a set	274 (56.7) 115 (23.8) 94 (19.5)	186 (57.4) 91 (28.1) 47 (14.5)	0.127
Dressing on insertion area, n (%) Sterile drapes for dressing Non-sterile drapes for dressing No drapes used on insertion area	95 (19.5) 329 (67.4) 64 (13.1)	53 (16.2) 239 (73.1) 35 (10.7)	0.225
Insertion of the IUC, n (%) With sterile gloves/forceps/inner cover** With non-sterile gloves/forceps	336 (68.6) 154 (31.4)	201 (61.7) 125 (38.3)	0.042*
Type of equipment for IUC-insertion, n (%) Disposable equipment Reusable equipment	472 (97.1) 14 (2.9)	302 (92.6) 24 (7.4)	0.004*
Fluid for urinary bladder washouts, n (%) Sterile normal saline 9mg/ml** Tap water Other fluids (e.g. disinfectants)	434 (97.3) 3 (0.7) 9 (2.0)	279 (96.9) 5 (1.7) 4 (1.4)	0.331

**Bold figure indicates that the hospital guidelines were followed at each hospital.**

\* p-value <0.05 was considered as statistically significant difference between Hospital A and Hospital B.

\*\* Correct aseptic technique according to EAUN guidelines.

### **Performing in agreement with sterility precautions in the EAUN-guidelines**

The final multivariable logistic regression analysis showed that performing in agreement with all the five components of the sterility precautions in the EAUN-guidelines (see Table 1) was associated with working at departments for surgery and cardiology (OR 2.35, CI 1.69-3.26), use of sterile set for catheterization (OR 2.08, CI 1.44-3.00), use of sterile drapes for dressing on insertion area during procedure (OR 1.87, CI 1.21-2.89) and using the term “sterile technique” for indwelling urethral catheterization (OR 1.70, CI 1.15-2.51). See Table 4 for details in the univariable and multivariable analyses.

**Table 4.** Factors associated with performing indwelling catheterization in agreement with all the sterility precautions in the EAUN-guidelines.

Explanatory variable	Univariable		Multivariable	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Hospital		0.930		-
Hospital A	0.99 (0.72-1.34)		N/A	
Hospital B (ref)	Reference			
Department		<0.001*		
Cardiology & Surgery	2.31 (1.70-3.16)		2.35 (1.69-3.26)	<0.001**
Internal medicine	Reference		Reference	
Profession		0.653		-
Registered nurse	Reference		N/A	
Assistant nurse	1.07 (0.79-1.47)			
Years in profession		0.109		-
0-2 years	1.35 (0.94-1.94)		N/A	
>2 years	Reference			
Years at present department		0.123		-
0-2 years	1.27 (0.94-1.73)		N/A	
>2 years	Reference			
Work shift		0.49		-
Day/evening/alternating shift	1.25 (0.79-1.95)		N/A	
Night shift	Reference			
Frequency of IUC-insertion		0.742		-
Each week or month	1.05 (0.78-1.42)		N/A	
Less than each month	Reference			
Origin of the insertion technique		0.654		-
According to the hospital guidelines	1.07 (0.79-1.47)		N/A	
Other answers	Reference			
Insertion technique		<0.001*		-
Sterile technique	2.61 (1.86-3.66)		-	0.008**
Non-sterile technique	Reference		1.70 (1.15-2.51)	
Periurethral cleansing solution		0.127		-
Soap and tap water	0.80 (0.45-1.41)		N/A	
Sterile normal saline	1.33 (0.64-2.74)			
Other solutions	Reference			
Use of set for catheterization		<0.001*		<0.001**
Sterile set	2.84 (2.04-3.94)		2.08 (1.44-3.00)	
Non-sterile set or no set used	Reference		Reference	
Dressing on insertion area		<0.001*		0.005**
Sterile drapes	3.17 (2.16-4.65)		1.87 (1.21-2.89)	
Non-sterile drapes or no drapes	Reference		Reference	
Equipment for catheterization		0.123		-
			N/A	

Disposable Reusable or don't know	Reference 1.71 (0.86-3.37)		
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The five components of the sterility precautions in the EAUN-guidelines are bactericidal alcohol hand rub, sterile catheter, on a clean trolley, insertion with sterile gloves and sterile fluid for bladder washouts.

\* with  $p < 0.1$  in the univariable analyses were included in the multivariable analyses.

\*\* Variables with  $p < 0.05$  in the multivariable analyses were considered as statistically significant associations.

N/A = not applicable.

## Discussion

### Sterility precautions

Proper aseptic insertion of the sterile IUC, meaning maintaining the sterility of the IUC during procedure, is one of the corner stones in evidence-based international guidelines for prevention of healthcare-associated urinary tract infections among patients in need of an IUC. The sterility of the catheter is kept by using sterile equipment, lubricants and solutions, by proper hand hygiene and by skills in ensuring not to contaminate the IUC during the whole procedure [5-9 8-12]. In this study it was mostly considered by the participants that the IUC should be kept sterile during insertion (hospital A 82.2%, hospital B 78.2%) which is in accordance with the EAUN-guidelines but not required by the local guidelines at hospital B. Despite of that only 62-69% of the participants used sterile gloves/forceps for catheter insertion or practised a non-touch technique by keeping the catheter within its inner plastic cover during insertion. The latter method was uncommon to practice and was not mentioned in neither of the hospital guidelines. The nurses at hospital A reported higher adherence to those techniques compared to hospital B ( $p = 0.04$ ).

In effort to protect a catheter from unintended contact with the patient's legs or bed linen, sterile drapes on insertion area are required during procedure. This is not required in the EAUN guidelines but is advocated in national guidelines from for example the United States of America and Ireland [8, 10]. Only 16-20% of the participants at both study hospitals used sterile drapes on the insertion area to protect the sterile catheter from contamination during catheterization.

Another measure aimed at securing an aseptic procedure is to use a disinfected trolley to prepare the equipment needed for catheterization. This arrangement was reported from 56-74% of the participants and significantly more often at hospital B ( $p < 0.001$ ).

A standardized set for urethral catheterization, including all necessary sterile equipment, such as gloves, forceps, fenestrated drapes, gallipots and swabs can both facilitate a uniform behaviour when performing indwelling urethral catheterization and secure sterility of the IUC throughout the whole

procedure. This is also supported in our study as the participants performing in agreement with the sterility precautions described in the EAUN-guidelines (see Table 1) used a sterile set for catheterization (OR 2.08, CI 1.44-3.00).

### **Sterile or non-sterile technique**

In contrast to the opinion among around 80 % of participants that the catheter should be kept sterile and to around 60 % practicing a behaviour to keep sterility a majority of the study participants at both hospitals called their insertion technique “non-sterile” (hospital A 71.5%, hospital B 76.9%). There was however a small difference in favour of hospital A where nurses used the designation “sterile” for the procedure slightly more often ( $p = 0.011$ ). This might be associated with the requirement for keeping the catheter sterile and mentioning the term “sterile technique” in the local hospital guidelines contrary to the local guidelines at hospital B where non-sterile technique was advocated.

The discrepancy between the nurses’ reported behaviour and their use of the term “non-sterile technique” for the procedure might originate from the introduction of “non-sterile technique” in the Swedish national guidelines for indwelling urethral catheterization during the 1990s. This was influenced by a study from Carapeti et al in 1994 where the authors compared “sterile technique” with “non-sterile technique” [14]. Important to notice was however that the IUC was kept sterile during the whole procedure with both insertion techniques. The Swedish national guidelines from the 1990s defined “non-sterile technique” as use of soap and tap water for periurethral cleaning, no dressing on insertion area, use of non-sterile equipment and non-sterile gloves. The sterility requirements of the fluids for urinary bladder washouts were however kept. The previous emphasis on the importance of intact sterility of the catheter was left out [15]. “Non-sterile technique” was regarded as easier to practice and was also cheaper as sterile gloves and solutions were omitted. An updated version of the national guidelines based on same sterility precautions as in the EAUN-guidelines was launched in 2015 and thus valid during the study period. This return to an earlier approach to the principles of keeping the sterility of the IUC during insertion in the national guidelines does not seem to have had an impact on what the participants in this study called their insertion technique. One reason could be that both designations “non-sterile” and “sterile” was kept for the procedure in this new version of the national guidelines. Another possible reason for the participants calling their technique “non-sterile” could be that the advocated use of soap and water for periurethral washing is associated with the concept “non-sterile”. The inconsistent use of different terms for insertion technique during urethral catheterization and uncertainties in understanding how proper aseptic insertion of the sterile catheter is accomplished has also been reported by others [16-20].

National and local hospital guidelines for indwelling urethral catheterization should use a harmonized description of the term “sterile technique” accompanied with an explanation of what necessary sterile equipment to use for successful aseptic procedure, with the emphasis on the use of a sterile set for catheterization and sterile drapes on the insertion area to create a protective field for the sterile urinary catheter so that it is not accidentally contaminated during procedure.

### **Conformity with the EAUN-guidelines**

The different requirements for keeping the catheter sterile in the local hospital guidelines from Hospital A and Hospital B did not affect the adherence to the EAUN-guidelines (OR 0.99, CI 0.72-1.34).

Performing indwelling urethral catheterization according to the EAUN-guidelines was associated with working at departments for surgery and cardiology (OR 2.35, CI 1.69-3.26).

An explanation may be that skill training was more common at those departments compared with the department of internal medicine.

An association with performing according to the EAUN-guidelines was also found for the use of sterile set for catheterization (OR 2.08, CI 1.44-3.00) and sterile drapes for dressing on insertion area during procedure (OR 1.87, CI 1.21-2.89). There was also an association between adherence to the EAUN-guidelines and using the term "sterile technique" for indwelling urethral catheterization (OR 1.70, CI 1.15-2.51). A possible explanation for this may be that the term "sterile" is easier to relate to an aseptic performance than the term "non-sterile".

### **Problems and potential interventions**

Different requirements on sterility and equipment in the local hospital guidelines, infrequency in IUC-insertion performance combined with the lack of a detailed description of the IUC-insertion process in local hospital guidelines are factors that counteract a uniform performance of indwelling urethral catheterization. This may jeopardize the patient safety.

The effect of different kinds of interventions to improve urinary catheterization have been studied by others. Among those validating the compliance to aseptic technique by evaluating the practiced skills on a yearly basis, validated checklists used as a facilitator and "computer-assisted learning" and "simulation-based learning" have been successful [19, 21-26].

Further, the healthcare-settings need to have a strategy regarding repeated training of the staff in aseptic IUC-insertion procedure and also how to implement changes in updated guidelines for urethral catheterization.

### **Methodological considerations**

Knowledge may differ from behaviour why self-reported descriptions of sterility precautions during indwelling urethral catheterization rather than observing the actual performance of the nurses may be a limitation in our study. As the aim of the study was to investigate the nurses' self-reported sterility precautions in indwelling urethral catheterization in the light of different sterility requirements in present local hospital guidelines and the EAUN-guidelines, a questionnaire made it possible to cost-efficiently reach many more nurses from different departments at two hospitals than observation. A validation of the procedure described by the participants requires an observational study of the practiced skills such as conducted by Manojlovich et al [19]. Another limitation is may be that the study did not include physicians. Although IUC-insertion can be performed by physicians, urethral catheterization in Sweden is

performed mostly by nurses hence the focus on nurses in the study. The guidelines for catheterization are usually written by registered nurses.

## Conclusions

There is a gap between the sterility precautions in the national guidelines for urethral catheterization based on evidence based guidelines from EAUN and the actual performance of sterility precautions during procedure among nurses. For a uniform performance securing sterility of the urinary catheter, and thus patient safety, the updated guidelines should include a clear description of what sterile equipment to use, how and where to prepare for procedure and how to maintain the sterility of the IUC during procedure [16]. As there is an obvious confusion about the meaning of the term “non-sterile technique” this should be omitted in any guideline. Healthcare-settings should ensure educational support and skill training to achieve sterile IUC-insertion according to the sterility requirements in the EAUN-guidelines.

## List Of Abbreviations

HAUTI: healthcare-associated urinary tract infection

IUC: indwelling urinary catheter

ECDC: the European Centre for Disease Prevention and Control

EAUN: the European Association of Urology Nurses

IQR: interquartile range

OR: odds ratio

CI: confidence interval

SPSS: the IBM Statistical Package for the Social Sciences

## Declarations

### Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Participation was voluntary. The study was approved by the Chief Medical Officer at both study hospitals. Permissions were also obtained from Head of the Departments and the Head Nurses concerned. Collected data did not include patients or relatives or sensitive personal information as stated in the Swedish Act, why no ethical approval was required under the Swedish Act concerning the Ethical Review of Research Involving Humans, from the Ministry of Education and Research [23 27]. Data were analysed on group level. Neither the Head Nurses nor other managers did receive any information concerning who answered the

questionnaires and who did not. None of the researchers had any professional or private relation to any of the study participants.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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No funding was obtained for the study.

### **Authors' contributions**

AK and AT designed the study. AK coordinated the data collection. All authors participated in data analysis and drafting of the manuscript. All authors read and approved the final version.

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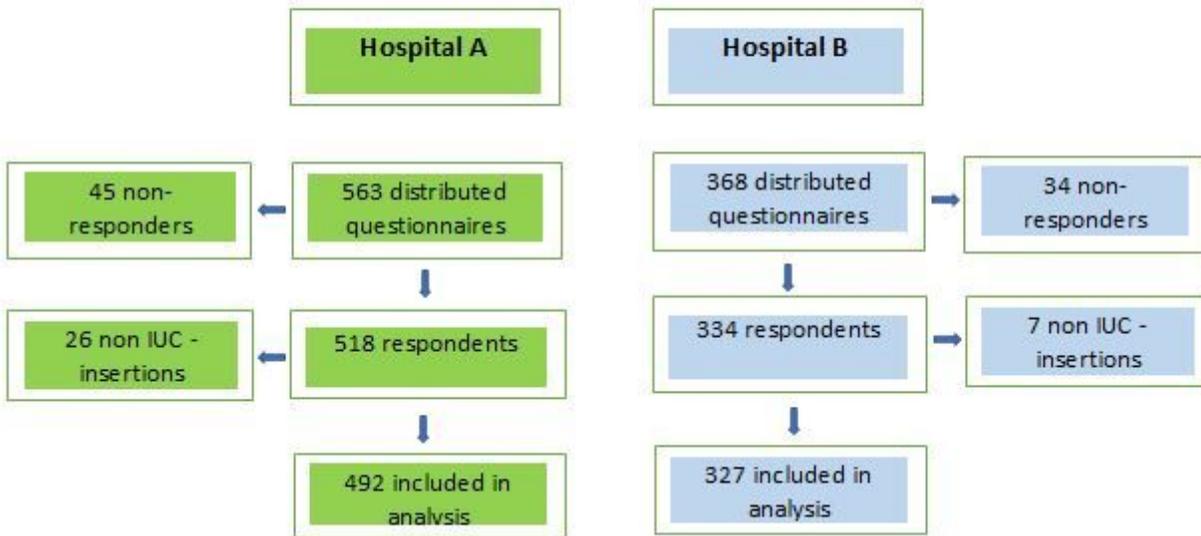
## **References**

1. Wagenlehner FM, Cek M, Naber KG, Kiyota H, Bjerklund-Johansen TE. Epidemiology, treatment and prevention of healthcare-associated urinary tract infections. *World J Urol.* 2012;30(1):59-67. doi:[10.1007/s00345-011-0757-1](https://doi.org/10.1007/s00345-011-0757-1)
2. Meddings J, Rogers MA, Krein SL, Fakhri MG, Olmsted RN, Saint S. Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: an integrative review. *BMJ Qual Saf.* 2014;23(4):277-89. doi:[10.1136/bmjqs-2012-001774](https://doi.org/10.1136/bmjqs-2012-001774)
3. Nicolle LE. Catheter associated urinary tract infections. *Antimicrob Resist Infect Control.* 2014;3(23). doi:[10.1186/2047-2994-3-23](https://doi.org/10.1186/2047-2994-3-23)
4. Shuman EK, Chenoweth CE. Urinary Catheter-Associated Infections. *Infect Dis Clin North Am.* 2018;32(4):885-97. doi:[10.1016/j.idc.2018.07.002](https://doi.org/10.1016/j.idc.2018.07.002)

5. European Centre for Disease Prevention and Control. Point prevalence survey of healthcare associated infections and antimicrobial use in European acute care hospitals 2011-2012. ECDC. 2013. <https://www.ecdc.europa.eu/en/healthcare-associated-infections-acute-care-hospitals/surveillance-disease-data/report>. Accessed 5 Nov 2020.
6. Suetens C, Latour K, Kärki T, Ricchizzi E, Kinross P, Moro ML, et al. Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European point prevalence surveys, 2016 to 2017. *Euro Surveill*. 2018;23(46).doi:10.2807/1560-7917.ES.2018.23.46.1800516
7. Johansson I, Tammelin A. Healthcare-associated infections in Stockholm County Council 2008-2018. *Lakartidningen*. 2020;117.
8. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infect Control Hosp Epidemiol* 2010;31(4):319-26. doi:10.1086/651091
9. Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clin Infect Dis*. 2010;50(5):625-63. doi:10.1086/650482
10. HSE Health Protection Surveillance Centre. Guidelines for the prevention of catheter-associated urinary tract infection. 2011. <https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/urinarycatheters/publications/>. Accessed 7 Nov 2020.
11. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect*. 2014;86 Suppl 1:S1-70.doi:10.1016/S0195-6701(13)60012-2
12. Geng V, Cobussen-Boekhorst H, Farrell J, Gea-Sanchez M, Pearce I, et al. Evidence-based guidelines for best practice in urological health care. Catheterisation Indwelling catheters in adults – Urethral and Suprapubic. European Association of Urology Nurses. 2012. <https://nurses.uroweb.org/guideline/catheterisation-indwelling-catheters-in-adults-urethral-and-suprapubic/>. Accessed 6 November 2020.
13. Lauritzen M, Thulin H. Kateterisering av urinblåsa In: National Handbook for Healthcare. 2019. <https://www.vardhandboken.se/katetrar-sonder-och-dran/kateterisering-av-urinblasa/principer-vid-kateterisering/>. Accessed 7 Nov 2020.
14. Carapeti EA, Andrews SM, Bentley PG. Randomised study of sterile versus non-sterile urethral catheterisation. *Ann R Coll Surg Engl*. 1994;76:59-60.
15. van der Vliet A, Nyström B, Widegren M, Andersson L, Zachrisson L, editors. Kateterisering av urinblåsa och val av urindränagesystem. In: *Metodbok för sjukvårdsarbete*. Stockholm: Natur och Kultur; 1994.

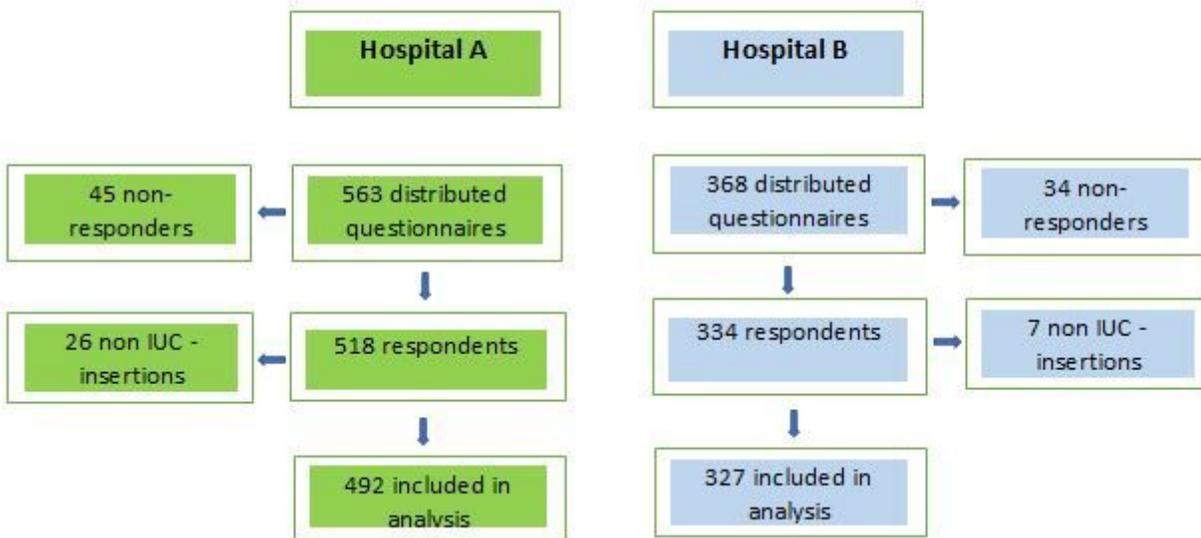
16. Magnall J, Watterson L. Principles of aseptic technique in urinary catheterisation. *Nurs Stand.* 2006;21(8):49-56. doi:[10.7748/ns2006.11.21.8.49.c6378](https://doi.org/10.7748/ns2006.11.21.8.49.c6378)
17. Aziz AM. Variations in aseptic technique and implications for infection control. *Br J Nurs.* 2009;18(1):26-31. doi:[10.12968/bjon.2009.18.1.32073](https://doi.org/10.12968/bjon.2009.18.1.32073)
18. Vahr S, Cobussen-Boekhorst H, Eikenboom J, Geng V, Holroyd S, Lester M, et al. Catheterisation Urethral intermittent in adults: Dilatation, urethral intermittent in adults. *European Association of Urology Nurse.* 2013. <https://nurses.uroweb.org/guideline/catheterisation-urethral-intermittent-in-adults/>. Accessed 7 Nov 2020.
19. Manojlovich M, Saint S, Meddings J, Ratz D, Havey R, Bickmann J, et al. Indwelling urinary catheter insertion practices in the emergency department: An observational study. *Infect Control Hosp Epidemiol.* 2016;37(1):117-9. doi:[10.1017/ice.2015.238](https://doi.org/10.1017/ice.2015.238)
20. Fink R, Gilmartin H, Richard A, Capezuti E, Boltz M, Wald H. Indwelling urinary catheter management and catheter-associated urinary tract infection prevention practices in Nurses Improving Care for Healthsystem Elders hospitals. *Am J Infect Control.* 2012; 40(8):715-20. doi:[10.1016/j.ajic.2011.09.017](https://doi.org/10.1016/j.ajic.2011.09.017)
21. Cole M. The application of epic3 guidelines: the complexity of practice. *Br J Nurs.* 2015;24(17):858, 860-62. doi:[10.12968/bjon.2015.24.17.858](https://doi.org/10.12968/bjon.2015.24.17.858)
22. Mizerek E, Wolf L. To Foley or not to Foley: Emergency nurses' perceptions of clinical decision making in the use of urinary catheters in the emergency department. *J Emerg Nurs.* 2015;41(4):329-34. doi:[10.1016/j.jen.2014.09.009](https://doi.org/10.1016/j.jen.2014.09.009)
23. Clayton JL. Indwelling urinary catheters: A pathway to health care-associated infections. *AORN J.* 2017;105(5):446-52. doi:[10.1016/j.aorn.2017.02.013](https://doi.org/10.1016/j.aorn.2017.02.013)
24. Berg K, Berg D, Riesenber LA, Mealey K, Schaeffer A, Weber D, et al. The development of validated checklist for Foley catheterization. *Am J Med Qual.* 2013;28(6):519-24. doi:[10.1177/1062860613480523](https://doi.org/10.1177/1062860613480523)
25. Walsh CM, Rose DN, Dubrowski A, Ling SC, Grierson LEM, Backstein D, et al. Learning in the simulated setting: a comparison of expert-, peer-, and computer-assisted learning. *Acad Med.* 2011;86 Suppl 10:S12-16. doi:[10.1097/ACM.0b013e31822a72c7](https://doi.org/10.1097/ACM.0b013e31822a72c7)
26. Todsén T, Henriksen MV, Kromann CB, Konge L, Eldrup J, Ringsted C. Short- and long-term transfer of urethral catheterization skills from simulation training to performance on patients. *BMC Med Educ.* 2013;13(29). doi:[10.1186/1472-6920-13-29](https://doi.org/10.1186/1472-6920-13-29)
27. The Ministry of Education and Research. The Act concerning the Ethical Review of Research Involving Humans (SFS 2003:460). Stockholm. <https://www.kliniskastudier.se/english/for-researchers/laws-regulations/act-concerning-ethical-review-research-involving-humans-.html>. Accessed 7 Nov 2020.

## Figures



**Figure 1**

Flowchart of study inclusion process at both hospitals.



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Flowchart of study inclusion process at both hospitals.