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Impact of an evidence-based intervention on urinary catheter utilization, associated process indicators, and infectious and non-infectious outcomes

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SUMMARY

Background: Multi-centre intervention studies tackling urinary catheterization and its infectious and non-infectious complications are lacking.
Aim: To decrease urinary catheterization and, consequently, catheter-associated urinary tract infections (CAUTIs) and non-infectious complications.
Methods: Before/after non-randomized multi-centre intervention study in seven hospitals in Switzerland. Intervention bundle consisting of: (1) a concise list of indications for urinary catheterization; (2) daily evaluation of the need for ongoing catheterization; and (3) education on proper insertion and maintenance of urinary catheters. The primary outcome was urinary catheter utilization. Secondary outcomes were CAUTIs, non-infectious complications and process indicators (proportion of indicated catheters and frequency of catheter evaluation).
Findings: In total, 25,880 patients were included in this study [13,171 at baseline (August–October 2016) and 12,709 post intervention (August–October 2017)]. Catheter utilization decreased from 23.7% to 21.0% (P=0.001), and catheter-days per 100 patient-days decreased from 17.4 to 13.5 (P=0.167). CAUTIs remained stable at a low level with 0.02 infections per 100 patient-days (baseline) and 0.02 infections (post intervention)

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(P=0.98). Measuring infections per 1000 catheter-days, the rate was 1.02 (baseline) and 1.33 (post intervention) (P=0.60). Non-infectious complications decreased significantly, from 0.79 to 0.56 events per 100 patient-days (P<0.001), and from 39.4 to 35.4 events per 1000 catheter-days (P=0.23). Indicated catheters increased from 74.5% to 90.0% (P<0.001). Re-evaluations increased from 168 to 624 per 1000 catheter-days (P<0.001).
Conclusion: A straightforward bundle of three evidence-based measures reduced catheter utilization and non-infectious complications, whereas the proportion of indicated urinary catheters and daily evaluations increased. The CAUTI rate remained unchanged, albeit at a very low level.

Introduction

The use of transurethral urinary catheters is common in acute care hospitals. With catheterization proportions of 12–25% [1–5] and nearly 1.5 million hospitalizations in Switzerland in 2016 (Source: Federal Statistics Office, accessed 27th February 2018), it is estimated that more than 200,000 urinary catheters are placed in Switzerland each year, eventually causing infectious and non-infectious complications, increased morbidity and mortality, and additional healthcare costs.

Catheter-associated urinary tract infections (CAUTIs) are a well-known complication of urinary tract catheterization, with rates ranging from 0.2 to 4.8 per 1000 catheter-days. Non-infectious complications from catheterization have not received widespread attention to date [6,7], although they may be as common as CAUTIs [8,9]; they include mechanical trauma to the lower urinary tract, false passage, and accidental inflation of a catheter balloon in the urethra or prostate. Up to 5% of all catheterized patients develop acute gross haematuria, and approximately 3% suffer urethral strictures in the long term [8].

The presence of a urinary catheter and the duration of catheterization are the main risk factors for catheter-associated complications; however, 21–65% of all catheter insertions are not necessary [10–12], and prolonged catheterization without clear indication is common [5,13].

Therefore, prior intervention studies have focused on the following main pillars: (1) strict indications for catheter insertion; (2) rapid removal of unnecessary urinary catheters; and (3) proper insertion of and care for urinary catheters. For example, the Keystone Bladder Bundle Initiative implemented a protocol for catheter utilization, reminders and stop orders, use of alternative strategies for urinary management, portable ultrasound to measure bladder volume, and adherence to protocols for insertion of and care for urinary catheters. Consequently, the CAUTI rate decreased by 25% and 6% in the state of Michigan and the entire USA, respectively [14,15]. Based on this success, several programmes started worldwide and produced similar results [16–19]. In Switzerland, a few single-centre studies have addressed urinary catheterization [20–22]; however, a uniform nationwide approach has been lacking to date. As such, the aim of this study was to reduce urinary catheterization by implementing a three-fold bundle: (1) a nationally endorsed list of indications for urinary catheterization; (2) daily evaluation of the need for ongoing catheterization; and (3) education on proper insertion and maintenance of a urinary catheter.

Methods

A before/after non-randomized multi-centre intervention study, corresponding to a quasi-experimental study type 1, was conducted [23]. The primary outcome was urinary catheter utilization. Secondary outcomes were symptomatic CAUTIs, non-infectious outcomes and process indicators, such as the proportion of indicated catheters and the frequency of catheter evaluation. It was hypothesized that the intervention would significantly reduce catheter utilization, and infectious and non-infectious complications, and significantly improve process indicator endpoints. The study design and results presented here were an integral part of the 'Progress! Safe urinary catheterization' pilot programme that ran from 2015 to 2018 in Switzerland. In addition to the awareness campaign that accompanied the programme and started in 2016 after completion of the baseline surveillance, two large surveys were launched in parallel to the baseline and intervention periods, respectively; their goal was to better understand knowledge, perceptions, attitudes and behaviours of healthcare workers (HCWs) surrounding the topic of urinary catheterization [24,25].

Sample size calculation

A baseline prevalence of urinary catheterization of 15% and a potential relative reduction of 10% following the intervention were assumed. Given a two-sided statistical significance of 5% and statistical power of 80%, at least 8524 patients were required in each group (17,048 overall) to detect a significant difference.

Surveillance

Surveillance was performed for catheterization, and infectious and non-infectious complications prior to (August–October 2016; baseline surveillance) and after (August–October 2017; postintervention surveillance) implementation of the intervention. All patients hospitalized in participating hospitals, irrespective of the location of catheter placement (i.e. emergency room, operating room or other), during the baseline and postintervention periods were included in the analysis. Refusal of general consent to use of data for scientific research led to patient exclusion. Data were entered into an online database provided by the Clinical Trials Unit of the University of Bern, Switzerland using Secutrial (Interactive Systems GmbH, Berlin, Germany). Data consisted of demographic data,

Table I
List of indications for urinary catheter insertion per the Swiss 'Progress! Safe urinary catheterization' programme

Indication	Specification	Examples
Urinary retention	• Acute urinary retention regardless of aetiology • Symptomatic chronic outlet obstruction plus >300 mL residual urine	• Benign hyperplasia of prostate gland, urethral strictures, bladderstones • Drug induced (anticholinergics, opioids, antidepressants)
Measurement of urine volume/ fluid balance	• At regular intervals (hourly or as defined by hospitals) plus direct consequence on treatment of patients • Fluid balance if patient weight not measurable on a daily basis	• Haemodynamic instability, severe rhabdomyolysis • Coma, sedated and ventilated patient
Surgery	• Long surgery (>4 h) • Peri-interventional: need for empty bladder during surgery, removal of catheter after surgery necessary if no other indication present • Surgery in urogenital or pelvic floor region • Epidural/peridural anaesthesia	
Pressure ulcers plus urinary incontinence	• Stage III or IV pressure ulcers or skin transplants in sacral/ perineal region plus urinary incontinence after exhaustion of alternative strategies for urinary management	
Prolonged immobilization	• Immobilization for medical reasons, especially for pain management, after exhaustion of alternative strategies for urinary management	• Acute fractures with severe pain due to patient movement (pelvic fractures, fracture of the neck of the femur) • Haemodynamic instability possibly caused by movement of the patient • Transient immobility after specific interventions
Palliative care plus comfort	• Palliative care plus abnormal bladder function plus/or inability for regular voiding after exhaustion of alternative strategies for urinary management • High burden of suffering plus wish of informed patient (or relatives)	

hospitalization data (day of hospital admission, discharge date), catheter-specific data (time and duration of catheterization, type of catheter, re-insertion of further catheters), process parameters (indication for catheterization, frequency of evaluation) and complications (CAUTI, urethral bleeding, gross haematuria, paraphimosis, incorrect positioning, re-insertion within 24 h, unintentional removal, catheter obstruction). Process parameters were only considered to be executed if documented in the patient's chart. The study group trained local surveillance teams in workshops and at site visits prior to the surveillance. In addition, audits were performed on site in the postintervention surveillance to ensure the quality of data.

Intervention

Seven pilot hospitals in Switzerland were included in the intervention, including university hospitals, and tertiary, secondary and primary care centres. The three major language regions (German, French and Italian) were represented. Each hospital formed a project group with a dedicated leader. Education in the form of a project handbook, workshops on the use of urinary catheters, content of the intervention, surveillance methodology and site visits was provided prior to and during the project. To accommodate local differences, strict instructions were not provided; rather, hospitals were free to design how to deliver the intervention as long as they followed the primary components of the intervention bundle. Except for one larger hospital that participated as a whole, each hospital was required to capture 100–200 of their surgical beds for surveillance purposes (i.e. either the whole hospital in the case of a smaller institution or selected wards in a larger hospital). The bundle was implemented on participating wards as well as units with a central function for the hospital (e.g. emergency room, operating room and similar). The intervention bundle consisted of an evidence-based indication list, the instruction to evaluate this indication daily, and training HCWs in the correct, non-traumatic and aseptic insertion of urinary catheters. The indication list (Table I) consisted of six major indications: (1) urinary retention; (2) monitoring of fluid input and output; (3) surgery; (4) pressure ulcers and urinary incontinence; (5) prolonged immobilization; and (6) palliative care and comfort for patients. A group of national experts including physicians and nurses developed the indications specifically for this programme based on the Ann Arbor Criteria for Appropriate Urinary Catheter Use in Hospitalized Medical Patients [26]. The list included practical examples, specific situations in which urinary catheterization is unnecessary, and alternative methods for urinary management. Daily evaluation of the catheter indication was an explicit goal, and unnecessary catheters were expected to be removed on the same day. Finally, theoretical and practical training of HCWs ensured that catheter insertion was only performed by adequately trained personnel. The education had to include a 'refresher course'

Table II
Definition of symptomatic catheter-associated urinary tract infection [27]

Criterion[a]	
1. Epidemiological	Patient had an indwelling urinary catheter that had been in place for >2 days on the date of the event and was either: • present for any portion of the calendar day on the date of the event or • removed the day before the date of the event
2. Clinical	Patient has at least one of the following signs or symptoms: • fever (>38.0°C) • suprapubic tenderness • costovertebral angle pain or tenderness • urinary urgency (only if catheter removed) • urinary frequency (only if catheter removed) • dysuria (only if catheter removed)
3. Microbiological	Patient has a urine culture with no more than two species of organisms identified, at least one of which is present at $\geq 10^5$ colony-forming units/mL

[a] All three criteria must be met, and have to occur during the window of infection.

for all HCWs inserting and taking care of catheters. The course consisted of general information on urinary catheters and alternatives for urine diversion, CAUTIs, non-infectious complications, and insertion of and care for catheters. Also, a 10-min educational video was produced by one institution and displayed the indication list, the proper insertion technique and elements of catheter maintenance; this was made available to all pilot hospitals in the local language. In addition, certain hospitals offered practical training on dummies. This intervention bundle was implemented from February 2017, after a workshop had convened all local project leaders and representatives for both infection prevention and quality management from the participating hospitals, and was monitored until October 2017, when the postintervention surveillance ended.

Definitions

CAUTI was defined in accordance with the 2015 Centers for Disease Control and Prevention National Healthcare Safety Network criteria, as described in Table II [27]. Only events of 'symptomatic CAUTI' were included in the analysis. Non-infectious complications due to urinary catheterization are defined less succinctly in the literature; in this study, urethral bleeding was defined as frank hemorrhage from the urogenital tract, gross haematuria was defined as blood-tinged urine, paraphimosis was defined as constriction of the prepuce, catheter obstruction was defined as absence of urine flow, incorrect positioning (false passage, malplacement) was defined as the need to reposition a recently placed catheter, and unintentional catheter removal was defined as removal not ordered by the medical team. The need for catheter re-insertion within 24 h was also considered a complication. For analyses, these complications were grouped into medical (the first four) and procedural (the last three) complications.

The following terms were used to calculate complication rates:

$$\text{Catheter-days} = [\text{day of removal}] - [\text{day of insertion}] + 1$$

$$\text{Patient-days} = [\text{day of discharge}] - [\text{day of admission}] + 1$$

Statistical analysis

Patients from one centre were excluded from the analyses of non-infectious complications and indicated catheters, as these items had not been recorded during baseline surveillance. Patients from three centres were excluded from evaluation of the daily re-evaluation rate as this information was not collected during baseline surveillance. For binary endpoints, the proportion with a 95% Wilson confidence interval (CI) in each phase is shown. For count endpoints, rates (per 100 or per 1000 days) with a 95% exact CI are presented.

Mixed-effects, generalized, linear models were used for comparison of the before/after surveillance periods. A binomial distribution with logit-link was used for binary endpoints. A negative binomial distribution with log-link fitted with a square increase of variance was used for count endpoints. A random intercept for hospitals was integrated in the models to account for interhospital heterogeneity. In models for count endpoints, the number of patient- or catheter-days was considered as exposure. They were also corrected for zero inflation. Due to the small number of CAUTIs, it was not possible to apply a model with negative binomial distribution. Instead, a Poisson distribution with a random intercept for hospitals and patients was used to control for overdispersion.

Differences between the two periods are depicted as adjusted odds ratios (aOR) or rate ratios (aRR) for binary and count endpoints, respectively, with a 95% CI. The ratios were adjusted for age, sex, organizational unit and provenance of the patient. All provenances except for 'hospital admission from home' were merged due to low patient numbers. With regard to organizational units, internal medicine, gynaecology and intensive care units (ICUs) were also merged for adjustment due to low patient numbers in gynaecology and intensive care.

All analyses were performed using the statistical package R (R-project 3.2).

Results

Data on 25,880 patients were analysed, with 13,171 patients included at baseline (August–October 2016) and 12,709 patients included post intervention (August–October 2017)

Table III
Overview of outcome data before (baseline) and after an intervention aimed at reducing unnecessary urinary catheterization

	Baseline surveillance	Postintervention surveillance			
Number of patients	13,171	12,709			
	Proportion or rate (95% CI)	Proportion or rate (95% CI)	Crude Odds or rate ratio (95% CI)	Adjusted[a] Odds or rate ratio (95% CI)	*P*-value
Catheter utilization					
Patients with catheters/patients overall (%)	23.69 (22.97–24.42)	21.02 (20.32–21.73)	0.83 (0.79–0.89)	0.90 (0.84–0.96)	0.001
Catheter-days/100 patient-days overall	17.40 (17.14–17.67)	13.53 (13.29–13.78)	0.84 (0.78–0.89)	0.96 (0.90–1.02)	0.167
Symptomatic CAUTIs					
Infections/100 patient-days overall	0.02 (0.01–0.03)	0.02 (0.01–0.03)	1.00 (0.51–1.99)	1.01 (0.51–2.00)	0.983
Infections/1000 catheter-days	1.02 (0.60–1.64)	1.33 (0.76–2.17)	1.23 (0.62–2.44)	1.20 (0.60–2.39)	0.603
Non-infectious complications					
Complications/100 patient-days overall	0.79 (0.72–0.86)	0.56 (0.51–0.63)	0.75 (0.63–0.90)	0.73 (0.61–0.88)	<0.001
Complications/1000 catheter-days	39.43 (36.16–42.93)	35.36 (31.69–39.35)	0.93 (0.79–1.10)	0.90 (0.77–1.07)	0.232
Process parameters					
Indicated catheters/all catheters (%)	74.49 (72.80–76.11)	90.03 (88.72–91.20)	3.70 (3.06–4.47)	4.08 (3.35–4.95)	<0.001
Re-evaluations/1000 catheter-days	167.66 (159.50–176.13)	623.92 (604.99–643.29)	3.08 (2.87–3.31)	3.13 (2.92–3.36)	<0.001

CAUTI, catheter-associated urinary tract infection; CI, confidence interval.
[a] Adjusted for age, sex, organizational unit and provenance of patients.

(Table III). The average age was 61 [standard deviation (SD) 20.13] years and 53% were female. The minimum number of patients accrued from a single hospital during the study period was 1903 and the maximum was 8584. Most patients were either from general medical or surgical wards, with the relative contributions varying between the participating hospitals. In total, 3494 catheters were placed during the baseline period and 2929 were placed during the postintervention period. The mean duration of catheterization decreased from 4.8 (SD 5.82) days to 4.1 (SD 4.16) days between the two periods. Information on the catheter material for all catheters (2956 at baseline and 2375 post intervention) was not received; however, the mix of known materials was 84% silicone, 10% latex and 6% others (coated and irrigation catheters) (baseline), and 70% silicone, 24% latex and 6% others (post intervention).

The proportion of catheterized inpatients decreased from 23.7% to 21.0% (aOR 0.90, 95% CI 0.84–0.96; P=0.001), and in terms of catheter-days per 100 patient-days decreased from 17.4 to 13.5 (aRR 0.96, 95% CI 0.90–1.02; P=0.167). The CAUTI rate remained stable at a low level with 0.02 infections per 100 patient-days (baseline) and 0.02 infections per 100 patient-days (post intervention) (aRR 1.01, 95% CI 0.51–2.00; P=0.98). In an alternative approach, measuring infections per 1000 catheter-days, the rate was 1.02 (baseline) and 1.33 (post intervention) [aRR 1.20, 95% CI 0.60–2.39; P=0.6). Non-infectious complications decreased significantly, from 0.79 to 0.56 events per 100 patient-days (aRR 0.73, 95% CI 0.61–0.88; P<0.001), and from 39.4 to 35.4 events per 1000 catheter-days (aRR 0.90, 95% CI 0.77–1.07; P=0.23). The most common non-infectious complications were gross haematuria (235 cases out of 17,296 patient episodes; 1.4%), unintentional catheter removal (72/17,296; 0.4%) and urethral bleeding (56/17,296; 0.3%). When grouping non-infectious complications into 'medical complications' and 'procedural complications', medical complications decreased from 188/8887 (2.1%) to 80/8409 (0.95%) (aOR 0.46, 95% CI 0.35–0.60; P<0.001), without a significant decrease in procedural complications [i.e. 222/8887 (2.5%) vs 183/8409 (2.2%); aOR 0.87, 95% CI 0.71–1.06; P=0.161). Except for paraphimosis, all types of medical complications decreased significantly [urethral bleeding: 38/8887 (0.4%) vs 18/8409 (0.2%); aOR 0.54, 95% CI 0.31–0.95; P=0.031; macrohaematuria: 164/8887 (1.9%) vs 71/8409 (0.8%); aOR 0.47, 95% CI 0.36–0.63; P<0.001; removal of an obstructed catheter: 21/8887 (0.2%) vs 7/8409 (0.1%); aOR 0.36, 95% CI 0.15–0.83; P=0.016]. Indicated catheters increased from 74.5% to 90.0% (aOR 4.08, 95% CI 3.35–4.95; P<0.001). Documented re-evaluations increased from 168 to 624 per 1000 catheter-days (aRR 3.13, 95% CI 2.92–3.36; P<0.001).

The most common reasons for placing the first urinary catheter were surgery (61% at baseline and 57% post intervention), urine monitoring (16% at baseline and post intervention) and urinary retention (13% at baseline and 17% post intervention). Re-insertions were mainly due to urinary retention (60% vs 66%), surgery (21% vs 18%) and urine monitoring (14% vs 10%).

Age, sex, organizational unit and origin of the patient had an impact on catheter utilization, rate of non-infectious

complications and compliance with process parameters. Data are provided in Table S1 (see online supplementary material).

Discussion

This multi-centre intervention study is the first to shed light on urinary catheter utilization, its *infectious and non-infectious* consequences, and the impact of an evidence-based bundle of prevention measures on these outcome measures. In the seven pilot hospitals, almost every fourth inpatient was catheterized, and these patients experienced many more non-infectious complications than CAUTIs at baseline. A straightforward three-fold intervention — consisting of distributing an indication list for placing a catheter, promoting daily evaluation for ongoing need of a urinary catheter, and ensuring adequate education in catheter handling — managed to decrease catheter utilization and non-infectious complications, and increase the proportion of documented justified catheterization and the frequency of documented daily catheter evaluations. The authors were unable to determine if this increase was due to raised awareness because of the study or general improvements in documentation, or if it is misleading in the sense that practices before the intervention were correct but simply not documented properly. In summary, this pilot study has set the stage for planning a national surveillance and disseminating the successfully piloted intervention tools.

While certain countries have set up CAUTI surveillances, this has not been the case for Switzerland, where urinary catheters are the first medical device to come under scrutiny. Elsewhere, regional [16] and national [28] studies have demonstrated that device use can be reduced (along with the corresponding complications from unnecessary and incorrect device placement). Among the best evidence currently available is a study by Saint *et al.*, who selected the three core elements 'daily assessment of the need for a catheter', 'avoiding catheter use by considering alternatives' and 'emphasizing the importance of aseptic insertion technique' to form their intervention in 926 ICU and non-ICU settings in North America, and succeeded in lowering CAUTI rates [28]. The majority of intervention studies published to date, however, are single-centre pre—post studies that used different combinations of measures in their intervention bundles [29—34]. It therefore remains to be determined which combination of measures provides the best balance between required effort and expected effect.

The present study attempted to replicate the success of the studies cited above. For this purpose, a relatively straightforward bundle was assembled, of which two elements appear to be the most relevant drivers to reduce unnecessary catheter use: (1) offering an evidence-based indication list for catheter placement; and (2) prompting HCWs to evaluate the need for ongoing catheterization [19]. A concise list of indications for catheterization, along with a description of situations that do not warrant catheterization, is the primary step towards the reduction of unnecessary catheterization [14], and several evidence-based indication lists are available in the literature [4,26,35,36]. The use of reminders or stop orders facilitates the daily re-evaluation of a catheter's indication and potential for removal, thus reducing complications [14,19,37,38]. The third element, ensuring that HCWs are trained properly in the aseptic insertion of urinary catheters and subsequent maintenance, lacks the level of supporting evidence of the other bundle components, yet is a prominent feature in recent CAUTI prevention guidelines [39] and was therefore included in the bundle [35,40]. The authors intentionally left the participating hospitals to decide how they planned to deliver the intervention bundle. This permitted electronic capturing of the catheterization indication in one of the pilot hospitals, whereas other hospitals relied on simply disseminating the indication list among their workforce. Despite the flexibility of this approach, the authors are fully aware of the corresponding heterogeneity, which was evidenced during site visits by the study team. The issue of implementation challenges, however, is not new to CAUTI prevention efforts and should even be expected [19]. It is felt that the intervention bundle assembled for this study is intuitive and easy to memorize and convey. Given that the optimal bundle is yet to be determined, it seems sensible to keep the number of bundle components small.

In contrast to previous studies, this collaboration of infection prevention and patient safety experts also meant that — in addition to the primary endpoint (urinary catheter utilization) — both infectious and non-infectious complications were targeted. Although the importance of non-infectious complications of urinary catheters was highlighted in a recent multicentre study [7], to the best of the authors' knowledge, no trials have been launched with these complications in mind. It is worth noting that this study found that non-infectious complications (both medical and procedural) were more common than CAUTI events — this may change how preventable harm is viewed in future surveillance surrounding urinary catheters. Considering these results, policy makers may opt to forego CAUTI surveillance in favour of surveillance of non-infectious complications.

As a sizable proportion of inpatients were expected to have an indwelling urinary catheter in the baseline surveillance, catheter utilization was chosen as the primary endpoint, and the sample size calculation was based on this variable. The results indicate that catheter utilization decreased, but an effect on CAUTIs could not be corroborated. Consequently, focusing on the reduction of catheter utilization may be a more cost-effective approach to surveillance than focusing on complications of catheterization, particularly in settings where the CAUTI rate is very low. Similarly, Fakih *et al.* proposed the 'device utilization ratio' as a measure when undertaking device stewardship or quality improvements efforts [41].

While this study selected a three-component intervention bundle and promoted it as such, the programme also included a broad awareness campaign, during which media releases were issued. Moreover, the HCWs of the participating pilot hospitals received a detailed questionnaire on their knowledge about urinary catheterization, their attitudes and their practices, both at baseline [24] and post intervention [25]. The results suggest that changes occurred over the course of the study. As such, the questionnaire can be viewed as an additional component which helped raise awareness and self-reflection concerning local practices.

This was not a randomized study, and it is possible that certain differences between the baseline and postintervention populations were not accounted for. The uptake of the intervention was only partially monitored (i.e. with respect to the daily re-evaluation); it is known that subtle differences in the implementation of infection prevention interventions are a

major confounder when assessing the effects of administered measures. The participating hospitals — being 'volunteers' and possibly top performers — may have exhibited lower levels of urinary catheterization and its infectious and non-infectious complications than other Swiss hospitals, and therefore may not be representative for the country. Also, thorough information on past CAUTI prevention activities in the study hospitals was not collected. Finally, the mix of catheter materials may have influenced the complication rates. Unfortunately, it was not possible to determine the catheter material employed in all cases, and therefore it is not possible to draw a robust conclusion.

In conclusion, in this before/after intervention study of urinary catheter utilization, a straightforward bundle of three evidence-based measures (provision of a catheter indication list, promotion of daily catheter evaluation and teaching state-of-the-art catheter insertion) reduced catheter utilization and led to increases in indicated urinary catheters and daily evaluations. The intervention had an impact on non-infectious complications, whereas the CAUTI rate remained at a low level, The next step is planning the national roll-out of both the surveillance module and the intervention bundle, the components of which have been made available to the public.

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Conflict of interest statement
None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2020.07.002.

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