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REVIEW ARTICLE

POSSIBILITIES OF DOCUMENTATION MANAGEMENT DURING BLADDER CATHETERIZATION

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Abstract
Together, careful record keeping on bladder catheterization and accepting the indication of bladder catheterization form one area of preventing catheter-associated urinary tract infection – CAUTI. Regarding the prevention of these infections, not only one preventive factor is applied, but sets of measures are preferred. The goal of this review study was to determine what methods of catheterization records are used and what are the possibilities of these records. Furthermore, the study provides an overview of indications for catheterization that are accepted in clinical practice. Studies show the effectiveness of the implementation of the so-called nurse-led protocol when nurses regularly re-evaluate the reasons for catheterization. Part of the protocol is an overview of indications for catheterization that are accepted at the workplace. Regarding the prevention of healthcare-related urinary tract infections, the effectiveness of multifactorial prevention measures has been clearly proven. Therefore, we followed the list of measures that were implemented together with a record of catheterization and the indication for bladder catheterization. The included articles were searched in full-text databases that were focused on healthcare – ProQuest STM + Hospital Collection – Medline, Web of Science, and citation databases – PubMed, Scopus, Google Scholar. The full texts of the articles were retrieved after studying the abstracts, and assessed as relevant or potentially relevant sources. The studies were selected using keywords: urinary tract infection, indication, bladder catheterization, prevention, documentation, and according to other criteria – full text article, peer-reviewed periodicals, English language, and a period of publication between 2011 and 2018. The result included 13 studies.

Keywords: *Bladder catheterization; Documentation; Indication; Prevention; Urinary tract infection*

Abbreviations:
CAUTI – Catheter-Associated Urinary Tract Infection; CDC – The Centers for Disease Control and Prevention; EAU – European Association of Urology; EBP – Evidence-Based Practice; HAI – Health Care-Associated Infections; HICPAC – Healthcare Infection Control Practices Advisory Committee; IDSA – Infectious Diseases Society of America; NHS – National Health Service; SHEA – Society for Healthcare Epidemiology of America, Inc/Infectious Disease Society of America; UAA – Urological Association of Asia; WOCN – Wound, Ostomy, and Continence Nurses Society

INTRODUCTION

Brabcová et al. (2015) report that studies which monitor the incidence and prevalence of Healthcare-associated infections (HAI) that were conducted in the United States, as well as in the Czech Republic, show several times higher incidence of these infections than reported cases. According to Jindrák et al. (2014) healthcare-associated infections prolong hospitalization in the countries of the European Union by 16 million treatment days. They also increase costs by 4.5 billion euros per year, of which the cost of treatment of multi-resistant bacteria accounts for a third. The authors also point out that HAI fall into the group of adverse events associated with the neglect of health care. Baker et al. (2002) identify CAUTI as one of the four most common healthcare-associated infections.

In 2009, the Healthcare Infection Control Practices Advisory Committee (HICPAC) and The Centers for Disease Control and Prevention (CDC) (Tenke et al., 2008) published an updated recommended practice for the prevention of healthcare-associated urinary tract infections. It is an update and an extension of the previous version of the 1981 recommended practices issued by the Centers for Disease Control and Prevention (CDC). The Guideline for Prevention of Catheter-associated Urinary Tract Infections 2009 (2019) is based on EBP (Evidence-based practice) and recommends verified interventions to prevent urinary tract infections associated with bladder catheterization. In connection with the documentation, the guidelines recommend the implementation of a system for recording information on the indication for catheterization, the date and time of catheterization and catheter removal, as well as the name of the healthcare worker who performed the procedure.

The recommended procedure also analyzes three crucial areas of prevention, sets out precise rules for the indication of catheterization, and lists risk factors for CAUTI. The recommendation for this is unambiguous, namely the minimization of the use of urinary catheters and the indication for catheterization for the time strictly necessary (Guideline for Prevention, 2019; Hedlová, 2010). CDC recommended procedures are accepted by clinical practice in the Czech Republic.

MATERIALS AND METHODS

The goal of this study was to find out what records of catheterization are kept in practice, the possibilities of these records, as well as to compare the indications for bladder catheterization that are mentioned in the analyzed studies. The sources were searched in full-text databases that are focused on healthcare – ProQuest STM + Hospital Collection – Medline, Web of Science and also in citation databases – PubMed, Scopus, Google Scholar. The full texts of the articles were retrieved after studying the abstracts and assessed as relevant or potentially relevant sources. The studies were selected using keywords: urinary tract infection, indication, bladder catheterization, prevention, documentation, and according to other criteria – full text article, peer-reviewed periodicals, English language, and a period of publication between 2011 and 2018. The time period was chosen intentionally. In 2009 an update of the Guideline for Prevention of Catheter-associated Urinary Tract Infections was issued; this is continuously updated, most recently in 2019. It should be noted that the recommendations on the indication for catheterization and documentation management have not changed since 2009. A two-year period from the publication of the recommended procedure is an adequate time for practice to be able to implement these measures. The final review included 13 studies that met the criteria (qualitative study, observational study, quasi-experimental study, descriptive study, study). The exclusive factor was the monitoring of the indication for catheterization or keeping documentation in domestic and community care and the studies from paediatric care. An overview of the resource search is shown in Diagram 1.

RESULTS

This study included 13 studies from 2011–2017 (Annex). The authors of the articles state that preventive measures were implemented, and their effectiveness was monitored. Rather than one intervention, sets of preventive measures were implemented. However, this article only monitors how to document catheterization indications and urinary catheter

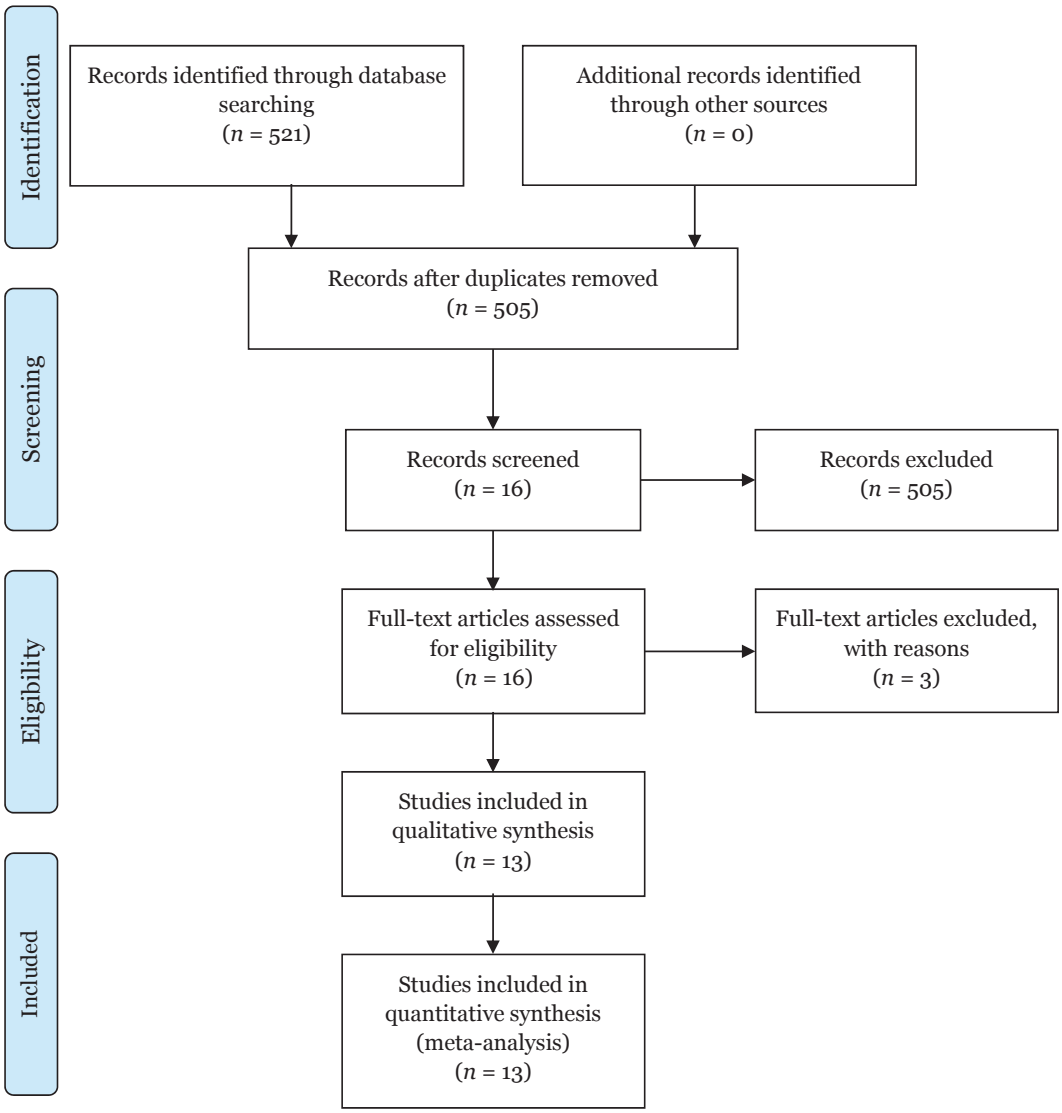

Diagram 1 – Procedure of source searching according to PRISMA

documentation. Monitoring the effectiveness of studies, in this case, would not be relevant due to the choice of sources as well as the authors' intention to assess the implementation of protocols.

In two studies (Underwood, 2015; Yatim et al., 2016), the HOUDINI protocol was implemented in the same way. In the other studies, they are protocols/records for daily reassessments of the indication for catheterization by a nurse. Studies have usually introduced more interventions to prevent CAUTI. Only the study published by Kim et al. (2017) introduced a protocol to re-evaluate the catheterization indication.

Fuchs et al. (2011) published a descriptive study (2011) between 7/2009 and 2/2010 at intensive care units. The prevention step was the introduction of the Duke Infection Control Outreach Network (DICON) protocol. The protocol contains a clear scheme/algorithm for assessing the indication for cathe-

terization. It is used for daily reassessments of catheterization necessities. During the implementation of the protocol, nurses were first trained by members of the multidisciplinary team in the field of CAUTI prevention and the use of the protocol. The document was implemented in the hospital computer system. The study also included a survey on satisfaction with the established protocol (Fuchs et al., 2011). The study of Oman et al. (2012) (here, the CAUTI prevention team initiated a project to increase the quality of care) introduced interventions aimed at preventing CAUTI. One of the measures was the implementation of the catheter care protocol, which reminded the staff of the reassessment of the catheter indication. In this case, the 2008 recommendation of indications was adopted according to the Society for Healthcare Epidemiology of America, Inc./Infectious Disease Society of America (SHEA).

The study of Andreessen et al. (2012) regarding the implementation of measures in the acute care department lasted 8 months and patients' data were compared – 1,200 before and 1,385 after the implementation of the programme. The indication for catheterization was implemented by the 2009 guidelines. The management of the documentation on the catheter accepted this procedure, and the necessity for catheterization was reassessed every day. According to audit results, catheter documentation management improved to 98%. The results of another study were published by Carter et al. (2014). The facility implemented documentation for nurses and physicians with a reminder to reassess the indication of catheterization. Educational programmes for nurses were implemented and regular care audits were performed. The documentation of the inserted urinary catheter contains an algorithm for indicating the continuation/daily reassessment of the catheterization indication. Prior to the implementation of the measures, they found insufficient knowledge about CAUTI preventive measures. The reassessment of the indication was not carried out. After the implementation of the measures, they proved a decrease in catheterization time from 5.11 to 2.59/day and recorded a decrease in CAUTI cases. Purvis et al. (2014) present the results of a study where, in the first phase, a protocol for nurses with a daily reminder function to reassess the need for catheterization was implemented. Also, an educational programme for nurses was implemented and regular quality audits were performed. All patients with a urinary catheter were included in the study. Prior to the implementation of the measures, they found insufficient knowledge about CAUTI preventive measures. Leaving a urinary catheter at the patient's request or to facilitate care (incontinence). The indication was not reassessed.

Alexantis and Broome (2014) evaluated the effectiveness of the implementation of the protocol/documentation of nurses, which contains indications for catheterization and the urgency of daily reassessment of the need for a catheter. At the beginning of the study, the FADE methodology (Focusing on the problem; Analyzing the data; Developing a plan to reduce CAUTIs; Executing the plan and Evaluating results) was used and an audit was performed. As a result, the nurses' knowledge of caring for a patient with a urinary catheter was insufficient and reassessment of the catheterization indication was inconsistent (usually, indicated by a physician). The aim of the study (Underwood, 2015) was to determine the effectiveness of implemented interventions, which included the implementation of the HOUDINI system/guidelines, which serves to re-evaluate the indication for catheterization. Among other things, an educational programme for healthcare professionals regarding the prevention of CAUTI was implemented in the facility, as well as standard procedures for performing bladder catheterization and urinary catheter care. According to Underwood (2015), the need to implement standard procedures of care and the performance of catheterization, staff training, and the implementation of uniform criteria for catheterization indications were confirmed. Paula Quinn (2015) describes the implementation of the protocol for nurses for the reassessment of catheterization indication ("Question the Foley criteria"). The protocol contained 8 indication criteria for bladder catheterization. Part of the implementation of this protocol was the education of nurses on the prevention of urinary tract infections. The support of doctors and the appointment of a competent employee who reassesses the need for catheterization on a daily basis at the ward and also reports and monitors the level of

CAUTI, as well as the results of microbiological examination of urine, was very important.

The effectiveness of the implementation of the HOUDINI system/guidelines in the documentation that was used to keep records of catheterization and for daily reassessments of the indication of catheterization by nurses was also dealt with in a study published by Yatim et al. (2016). This study was carried out at a 75-bed ward at the Singapore General Hospital. Prior to the start of the study, nurses were trained to assess the indication or use of a scanner to detect urinary residue after catheter removal. The result of the six-month study during the post-implementation phase was a slight increase in the number of catheter days, probably due to the composition of the patients; no CAUTI case was identified. The results were compared to the observed period of nine months before the implementation of the measures, where 4 cases of CAUTI were identified. A decision algorithm for the use of a scanner in the case of retention after catheter extraction was added to the HOUDINI system in the protocol.

McCoy et al. (2016) describe the implementation of a nurse-led protocol to re-evaluate the indication for catheterization in the oncology ward. Documenting catheterization with a reassessment of the indication for catheterization was implemented as a part of the electronic patient documentation, and an educational programme for nurses was carried out. Its content, in addition to monitoring the indication of catheterization, also included proper catheter care including handling the collection system. The use of documentation as well as the acceptance of indications was monitored by audits.

The introduction of a protocol for nurses to re-evaluate/reduce catheterization is described by Johnson et al. (2016). This protocol contains criteria for indicating catheterization that can be re-evaluated by a nurse and she/he can decide about removing the catheter. It also contains indications when the nurse is competent to reconsider them, but only a doctor can decide about removing the catheter. This protocol clearly divides the competences in deciding on the need for catheterization. If a nurse decides that catheter should be removed, it is mainly in palliative care or in case of terminal diseases, sacral wounds in case of incontinence, diuresis monitoring area, or immobility due to trauma. As part of a prospective cohort study (Kim et al., 2017) that was conducted in six hospitals, a protocol was implemented to continuously monitor catheterization indications. The implementation of the protocol was the only intervention in this study that is different compared to other studies. The results confirmed that prolonged catheterization caused by incorrect indication increases the incidence of CAUTI and that the number was reduced by the implementation of a protocol with clear criteria (Kim et al., 2017). Annex presents the form of documentation, an overview of accepted indications, and an overview of other interventions implemented regarding the prevention of CAUTI. In a study by Zurmehly (2018), a nurse-led protocol was established to reduce CAUTI as well as to clear criteria. Indications for catheterization included, e.g. neurogenic bladder. Other indications were already identical to other presented protocols. The documentation record was introduced as a part of the electronic documentation. It contained an automatically established warning about the need to re-evaluate the indication for catheterization after 12 hours.

DISCUSSION

The goal of the authors of this study was to find out what protocols/records on catheterization are used and how the reassessment of the indication for catheterization is solved. An overview study was conducted by Galiczewski (2016) in 2015, when 14 studies performed in intensive care units were analyzed (protocol/recording was implemented as the only preventive measure in 5 studies; multifactorial prevention measures were implemented in other studies). The effect of the established protocol for evaluation of indications for catheterization and documentation management was assessed. Seven studies showed a positive effect regarding the reduction of CAUTI. Prolonged catheterization, as well as bladder catheterization without relevant indication, were confirmed risk factors of CAUTI (Hedlová, 2010; Jindrák, 2014). The Guideline for the Prevention of Catheter-associated Urinary Tract Infections 2009 (2019) recommends evaluating the indications for catheterization as part of CAUTI prevention and introducing

catheters for as long as necessary, especially in at-risk patients (e.g. immunocompromised patients, elderly patients, women). It is essential to warn of the often irrelevant indication for catheterization in incontinent patients and patients in the postoperative period (it is recommended to remove the catheter within 24 hours if there is no indication for longer catheterization).

Since 2001, recommended practices have initiated the implementation of regular catheterization indication re-evaluations and standardized indication protocols as an effective prevention tool (Andreessen et al., 2012; Conway and Larson, 2012; Trautner, 2010). Hedlová (2010) adds that electronic data monitoring is recommended due to easy statistical processing in organizations. All studies that were evaluated in the search (Alexantis and Broome, 2014; Andreessen et al., 2012; Carter et al., 2014; Fuchs et al., 2011; Johnson et al., 2016; Kim et al., 2017; McCoy et al., 2016; Oman et al., 2012; Purvis et al., 2014; Quinn, 2015; Underwood, 2015; Yatim et al., 2016; Zurmehly, 2017) mention the management of catheterization documentation as part of electronic patient documentation in the clinical system.

In connection with this, it is necessary to add the opinion of other authors (Conway and Larson, 2012; Jindrák, 2014; Shehab, 2017; Tenke et al., 2008), who state that the group of CAUTI preventive measures mainly includes the acceptance of relevant indications for catheterization, daily reassessments of the need for urinary catheterization (especially if the catheterization lasts longer than 48 hours), shortening catheterization to a necessary time length, correct and aseptic catheterization technique, catheter care and collection system according to an updated standard procedure. It is also important to keep documentation and monitor the number of possible infections and catheter days, and to perform care audits. According to the CDC, these aspects have strong recommendations, which are supported by weak practical and quality evidence (Guideline for Prevention, 2019; Hedlová, 2010). It is also stated that catheterization date and time must be documented, as well as the information on who performed the catheterization, and the date and time of catheter removal. The Guideline for Prevention… (2019) assessed these recommendations as weak and unsubstantiated by evidence.

Conway and Larson (2012) compared the CAUTI prevention guidelines from 1980–2010, and their review confirms that CDC assesses documentation of catheterization indications and catheterization date and time records are weak and clinically unsubstantiated, and the same can be said for the NHS recommendations. On the contrary, the recommendations of SHEA and IDSA are strong. The comparison of the recommended practices by Conway and Larson (2012) regarding specific indications for catheterization is interesting. The recommended procedures of eight professional societies (CDC, EAU, HICPAC, IDSA, NHS, SHEA, UAA, WOCN) are vague. They only agree on the evidence regarding catheter insertion for the necessary time and in indicated cases.

The recommended procedures of six professional societies agree on a clear catheterization indication: acute urinary retention or obstruction, postoperative care, accurate measurement of diuresis in critically ill patients. Catheterization for healing the pressure ulcer/wound in the sacrum or perineal region in the case of incontinence is mentioned in the guidelines of three companies, and the four guidelines state terminal disease and palliative care as an indication for catheterization. HICPAC is the only one to identify long-term immobility. In this context, we should mention that long-term immobility, e.g. due to instability or pelvic fractures as an indication for catheterization, was introduced in the study protocols of Alexantis and Broome (2014), Andreessen et al. (2012), Carter et al. (2014), Fuchs et al. (201), Johnson et al. (2016), Kim et al. (2017), McCoy et al. (2016), Oman et al. (2012), Underwood (2015), Yatim et al. (2016), Zurmehly (2018)., i.e. eleven studies. Purvis et al. (2014) mention only indications based on EBP (Evidence-based practice).

The mentioned studies show that the established protocols/records contain an overview of indications for catheterization, and possibly also algorithms for deciding on the need for catheterization (Carter et al., 2014; Fuchs et al., 2011; Yatim et al., 2016), or basic points of infection prevention for complexity (Underwood, 2015). In two studies (Underwood, 2015; Yatim et al., 2016), a protocol where HOUDINI was used (indications:

Hematuria, **O**bstruction, **U**rological surgery, **D**ecubitus (pressure) ulcer in incontinent patients, **I**nput/output monitoring – accurate measurement of diuresis, "**N**o code" – end of life care, comfort in palliative care, **I**mmobility) was implemented. The protocol presented in the study by Johnson et al. (2016) is unique. The indications are specified, and nurses can re-evaluate the relevance and possibly decide to remove the catheter, and the indication when the nurse can assess the relevance of indication. The final decision to keep the catheter remains with the physician.

The findings of Yatim et al. (2016) are also interesting. During their study, 89% agreement of the use of the protocol by healthcare professionals was found during the six-month follow-up period. In the study of McCoy (2016), it was 66–90% during the two-month period (verified by audits). In the seventh month of the study, the agreement was 95%. This parameter was also monitored in a study published by Andreessen et al. (2012), which demonstrated the use of the protocol by 98% of healthcare professionals in the post-implementation phase (9 months). Regarding the identified use of the protocol by healthcare professionals, the results of the study by Olson-Sitki et al. (2015) are also interesting. They mapped the satisfaction of nurses with the established care protocol for patients with urinary catheters. The nurses in this study stated that the implementation of the protocol facilitated their work, and the authors also provided positive feedback from patients. In their conclusions, the authors also mention the fact stated by Paula Quinn (2015) that the implementation of the protocol for nurses required the support of physicians. The author Martha Quinn and her co-authors subsequently published the results of a qualitative study in The Joint Commission Journal on Quality and Patient Safety in 2019. Interviews were conducted, as well observations by nurses and physicians in connection with efforts to remove urinary catheters and vascular accesses in a timely manner. The results of the study showed that barriers are often unclear data in the documentation, and there was not sufficient IT equipment in the departments, e.g. tablets. The elimination of invasive entry was not a priority due to the patient's condition, there were no clear decision-making competencies for indication or uniform catheter protocols and clear indications catheterization (Quinn et al., 2019).

This research article has provided an overview of how urinary catheter records are kept and what indications for catheterization are accepted. The limitations may include that the articles were written only in English, as well as the fact that most studies implemented multifactorial measures of infection prevention – so it was not possible to independently assess the effectiveness of one measure from the so-called "packages". The authors of the presented studies also often consider their studies limited due to a short monitoring period, study duration, etc., or also the implementation of measures only in a certain number of care units. Another limitation may be the choice of keywords, where key terms were entered into the databases in conjunction with "and", and thus many irrelevant sources were found.

CONCLUSIONS

Keeping records of urinary catheter care, accepting indications for catheterization, and daily reassessments of catheterization needs are some of the components of CAUTI infection prevention. Sets of multifactorial measures are used in the prevention of these infections. It is recommended to keep records in the clinical computer system and record the date and time of catheterization and the name of the healthcare professional that performed the catheterization. The same rule applies when removing a urinary catheter. From the records that are kept electronically, it is possible to statistically continuously evaluate important parameters, such as catheterization days, number of infections, etc. Documentation on bladder catheterization must be kept uniformly throughout the facility according to the law and based on EBP findings. In the case of reassessing the relevance of the indication for bladder catheterization, it is necessary to determine clear indications for catheterization according to valid recommended procedures, and it is also necessary to accurately determine the competences of health professionals for such activities. A valuable helper is a warning to re-evaluate catheterization indications at a time interval of e.g. 24 hours. In the case of electronic documentation, this

function is certainly feasible. It is important, especially in the case of the introduction of new documentation or the updating of the existing one, to evaluate users' opinion on this documentation, as well as the simplicity of filling it in and the effectiveness of its functions. Of course, there is also regular/periodic training of competent employees in the issues of CAUTI prevention and proper catheterization techniques, as well as in adequate catheter care.

Conflict of interests

The authors have no conflict of interests to declare.

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Annex – Overview of documentation management options

Author/year/ study type	Form of documentation	Indication	Other CAUTI preventive measures	Notes
Fuchs et al. (2011), descriptive study	DICON electronic documentation: indications for initiating and continuing urinary catheterization	• diuresis monitoring • immobility due to pelvic or hip surgery or injury or impaired consciousness • incontinence - only in case of strict monitoring of diuresis and non-healing wound in the sacrum and groin • perioperative and postoperative indications • long-established epidural catheter • in case of chemotherapy or bleeding lavages • indications for catheterization for more than 28 days	• multidisciplinary teams/ specialists • introduction of using a scanner for detection	Contains a decision scheme and clear catheterization indications. Recommendation for discussion with a doctor if the reason for the indication disappears.
Oman et al. (2012), study	Educational program for nurses, including information about indication, implementation of an electronic catheter recording system with a catheter removal notification	Indications as recommended by the 2008 Society for Healthcare Epidemiology of America, Inc/ Infectious Disease Society of America • urinary tract surgery or postoperative period • pressure ulcer/wound in the sacrum or perineum and current incontinence • palliative care, terminal stage of the disease • accurate measurement of fluid balance • urine retention • patient‘s wishes in case of incontinence	• conducting audits • multidisciplinary teams/ specialists • patient/family education • implementation of catheterization alternatives • fixation of the urinary catheter to the thigh • education of medical professionals	As part of the educational program, notification for nurses that this is not an indication for catheterization: • impaired mobility • facilitating the work of the nursing team • skin damage
Andreessen et al. (2012), study	Implementing electronic documentation about an inserted catheter, including daily warnings to consider the need to remove the catheter	Indications according to CDC	• fixation of the urinary catheter to the thigh • multidisciplinary teams/ specialists • implementation of the use of smaller sizes	Documentation about the inserted catheter - date of insertion, removal, indications, complications.

Annex *(continued)*

Author/year/ study type	Form of documentation	Indication	Other CAUTI preventive measures	Notes
Carter et al. (2014), study	Documentation about an inserted urinary catheter – contains an algorithm for an indication of continuation/daily reassessment of catheterization indication	• The need for accurate monitoring of urine output in haemodynamically/ physiologically unstable patients • Instability or fracture of the spine. • Pressure ulcers of the 2nd degree or higher in the line from the nipple to the knee associated with incontinence • Unresolved dermatitis associated with incontinence • Urinary obstruction, urinary retention • Necessary monitoring of fluid balance • Epidural catheters or vascular catheters in the groin • Urinary catheter is necessary for perioperative and postoperative care • Doctor's indications with regard to the patient's state of health • A patient's comfort in palliative care	• carrying out audits • introduction or updating of standards	The protocol also includes an assessment of the risks/benefits of catheterization for patients, control of verification of the patient's identity, allergies. The algorithm includes a warning of invalidity in patients with renal insufficiency, paediatric patients. It also emphasizes caution in hemocoagulation therapy. The algorithm also includes the exact procedure of patient care after catheter removal.
Purvis et al. (2014), study	Introduction of a standardized care protocol and re-evaluation of indication. An algorithm for the procedure after removing urinary catheter	• The author states: indications according to EBP	• multidisciplinary teams/ specialists • carrying out audits • education of health professionals	Implementation of two algorithms for the procedure after removing UC - patients after surgery, other patients. The protocol is not used in the following cases: patients after urological and gynaecological operations, patients with a long-term catheter, chronic retention, urethral obstruction, significant haematuria, patients with an epidural catheter, patients after pelvic surgery.

Annex *(continued)*

Author/year/ study type	Form of documentation	Indication	Other CAUTI preventive measures	Notes
Alexantis and Broome (2014), study	FADE and the subsequent implementation of protocol and criteria for catheterization with the warning of the reassessment of the indication of FADE: Focus on the problem (CAUTI); Data analysis (catheter use, CAUTI, CAUTI frequency, adherence to urinary catheter instructions, knowledge of nurses); Development of a plan to reduce CAUTI; Implementation of the plan and evaluation of results.	Obstruction of bladder emptying • Urine retention, diuresis 250 ml and more/hour • Urological and gynaecological operations • Significant haematuria • Doctor's indication • Unstable spine fracture • Decubitus of the 2nd and higher degree • Palliative care and terminal condition of the patient • Haemodynamic instability	• introduction of catheterization alternatives • introduction of the use of a scanner to detect residues • education of health professionals	
Underwood (2015), study	Implementation of the HOUDINI protocol (contains indications for catheterization and CAUTI prevention points), preceded by staff education. The protocol is used by nurses for daily reassessment of the indication for catheterization.	• **H** – hematuria • **O** – obstruction • **U** – urinary tract surgery • **D** – decubitus (pressure) ulcer (on the sacrum or perineum) in case of incontinence • **I** – input/output monitoring – haemodynamic instability or measurement of diuresis • **N** – "no code" – palliative or hospice care • **I** – impaired mobility due to unstable fracture (pelvis, spine, …)	• implementation or updating of standards • education of health professionals	At the same time, a standard catheterization and catheter care procedure was implemented.
Quinn (2015)	Protocol for nurses "Question the Foley criteria" – 8 indication criteria for bladder catheterization.	• Bladder lavage or applying medicaments in the bladder • Obstruction of urine outflow from the bladder • Permanent urinary drainage in patients with dg. Neurogenic bladder, hydronephrosis and chronic retention • Gynaecological or urological surgery • Doctor's indications in case of difficult catheterization • Simultaneous 3rd and 4th degree pressure ulcers and incontinence • Palliative care and terminal condition	• education of health professionals	The "Question the Foley criteria" protocol was implemented, and targeted education protocol use was carried out, physicians were supported, the responsible medical worker checked the acceptance of indications for catheterization on a daily basis and monitored CAUTI from microbiological results.

Annex *(continued)*

Author/year/ study type	Form of documentation	Indication	Other CAUTI preventive measures	Notes
Yatim et al. (2016), study	Implementation of the HOUDINI protocol (contains indications for catheterization and CAUTI prevention points)	• **H** – hematuria • **O** – obstruction • **U** – urinary tract surgery • **D** – decubitus (pressure) ulcer (on the sacrum or perineum) in case of incontinence • **I** – input/output monitoring – haemodynamic instability or measurement of diuresis • **N** – "no code" – palliative or hospice care • **I** – impaired mobility due to unstable fracture (pelvis, spine, …)	• education of health professionals	Targeted education of nurses before catheter insertion.
McCoy et al. (2016)	Implementation of a protocol with clear criteria for catheterization indications and options for nurses to remove the catheter	• Significant haematuria • Bladder lavage • Urinary tract surgery • Pressure ulcer/wound in sacrum or perineum and incontinence • Palliative care, terminal stage of the disease • Accurate measurement of fluid balance • Instability of the spine or pelvis	• education of health professionals • education of patients and relatives	Check-ups of aseptic techniques of catheterization and acceptance of gravitational inclination. The protocol was implemented in the electronic documentation system and available on the basis of the data from the beginning of catheterization.
Johnson et al. (2016)	Implementation of a protocol with clear criteria for catheterization indications and options for nurses to remove the catheter	• Immobility due to trauma, instability of the pelvis or spine • Monitoring of diuresis - haemodynamic instability, volume resuscitation, diuretic treatment • Healing of wounds on the sacrum and perineum in incontinent patients • Palliative care and terminal condition • Removal only due to a doctor's indication: • Disease, trauma to the urinary tract • Chronic retention • Difficult catheterization • Gynaecological and urological operations • Significant haematuria • Retention and urinary obstruction	• education of health professionals (catheterization, catheter care)	The nurse protocol includes criteria for nurses to reconsider the catheterization indication and remove the catheter, and indications when only a physician indicates removal.

Annex *(continued)*

Author/year/ study type	Form of documentation	Indication	Other CAUTI preventive measures	Notes
Zurmehly (2018), quasi-experimental study	Nurse-guided protocol for CAUTI reduction (in the electronic medical record = EMR) with clearly defined criteria for catheterization	• Accurate measurement of diuresis • Palliative care and terminal condition • Dealing with incontinence complications (dermatitis) • Neurogenic bladder • Acute urinary retention and obstruction • Significant haematuria • Long-term immobility	• education of health professionals	The protocol is set in the patient‘s documentation; a notification to reconsider the need for catheterization every 12 hours. Prior to the implementation of the protocol, online education of nurses.
Kim et al. (2017), prospective cohort study	The authors only state the implementation of indication monitoring; they do not present the method	• Acute urinary retention • Accurate measurement of diuresis • Palliative care and terminal condition • Perioperative period • Pressure ulcer/wound in the sacrum or perineum and incontinence • Long-term immobilization		The date of catheterization and continuous reassessment of the criteria for indication were documented.