

## REVIEW

# Reuse versus single-use catheters for intermittent catheterization: what is safe and preferred? Review of current status

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**Study design:** This is a narrative review summarizing prevalence and background of reusing catheters for intermittent catheterization. It also compares complications related to reuse versus single use.

**Objectives and setting:** The objective of the review is to highlight the on-going debate regarding whether reuse of catheters is as safe as single-use technique and investigate why reuse is common in some countries (for example, Australia, Canada and the United States).

**Methods:** The review is the result of systematic searches in several databases (for example, MEDLINE, EMBASE and CINAHL) using predefined key words and search strategy.

**Results:** The literature does not explicitly recommend reuse but instead proposes patient-oriented choice. Even so, the prevalence of reuse is ~50% in some regions. Both off-label reuse and reuse of catheters intended for multiple use occur. The former is not legally supported. There seems to be no consensus on how many times a catheter can be reused or how to clean it. Poor compliance and efficacy of cleaning techniques have been reported, increasing the risk for introducing bacterial contamination. The literature supports the use of single-use hydrophilic catheters to reduce the risk of urethral trauma and urinary tract infection with a reported incidence of the latter between 40 and 60%, as compared with 70–80% for reuse catheters. Further clinical studies are however needed to verify/reject a difference.

**Conclusion:** Complications associated with reuse need to be further investigated. Although awaiting evidence, it is recommended to use a confirmed safe, patient-preferred, noninfecting and nontraumatic technique for intermittent catheterization.

*Spinal Cord* (2014) **52**, 511–516; doi:10.1038/sc.2014.79; published online 27 May 2014

## INTRODUCTION

Reuse of urinary catheters among patients who practice intermittent catheterization is common, especially when financial reimbursement is not covered by the health-care system. Reuse is practiced in developing countries and also in Australia, Canada and the United States, whereas other countries reimburse and use single-use catheters. The reasons for this disparity could be searched within legal requirements, published guidelines and how to view costs. In addition, there is an on-going debate as to whether reuse is as safe as a single-use technique and also whether there is a difference in urinary tract infection (UTI) rate between clean and sterile techniques. The objectives of this narrative review are to summarize prevalence, regulatory background, views of published guidelines, cost implications and issues related to reusing catheters for intermittent catheterization. With this as a basis, comparisons between reported complications for reuse versus single-use catheters are highlighted. The overall purpose of the review is to summarize all relevant parts needed to make an informed decision on the best catheter choice for patients practicing intermittent catheterization. The review also points out gaps in evidence and includes recommendations for future research.

## MATERIALS AND METHODS

A literature search was performed in MEDLINE via PubMed in October 2013 using the keywords ‘intermittent catheter\*’ AND ‘reuse’ or ‘intermittent catheter\*’ AND ‘re-use’ that resulted in 18 publications. Similar searches were made in EMBASE, resulting in 14 publications, in Thomson Reuters Web of Knowledge, resulting in 11 publications, in EBSCO Discovery database covering, for example, CINAHL and full-text MEDLINE, resulting in 36 publications and in the Cochrane Library, resulting in one Cochrane review and three trials. All publication lists were screened for relevant citations, that is, publications referring to reuse of catheters used for intermittent catheterization and/or impact on clinical complications and outcomes because of different catheterization techniques. In addition, relevant publications found from cross-references have been added to the list of relevant citations. Selected citations are specified in the reference list.

## General assumptions

The following general assumptions have been made for the purpose of this review. First, the term ‘hydrophilic’ is used as a generic term for all different types of coated catheters with a smoothening surface even though it is recognized that different types are available, such as described by Nazarko<sup>1</sup> in 2012, for example, coated catheters activated with water or pre-packed with gel or fluid reservoir. Second, the lack of head-to-head comparisons between reuse

and single use of catheters with regard to UTI frequency and other complications has driven the review to also consider comparisons between hydrophilic and uncoated plastic catheters in general. It is assumed that potential differences found between single-use hydrophilic catheters and reused uncoated plastic catheters would be as great or greater as those found between single-use hydrophilic and single-use uncoated plastic catheters.

Third, this review has considered publications of all evidence levels and has with few exceptions been limited to clinical papers only. It has used an 'all-in' approach based on the limited number of appropriate publications investigating the specific research question. For this reason, a formal meta-analysis was not applicable.

Finally, more recently published reviews and citations have generally been chosen in favour of older ones, but it should be noted that, for some citations, reference is made both to review articles, including them, and to the single publication. In contrast, some articles published less recently have been excluded when they were included in review articles. To mitigate the risk of bias of individual studies, data from each study are only reported once.

## RESULTS

### Prevalence

Reuse of catheters for intermittent catheterization is common in different regions depending on the health-care system.<sup>2</sup> This review defines reuse as both off-label reuse, that is, reuse of devices intended for single use such as uncoated polyvinyl chloride (PVC), hydrophilic or gel catheters, and as reuse of devices labelled and intended for multiple use such as silicon, rubber (latex), glass or stainless steel catheters. Reasons for reuse of medical devices are mainly related to proposed cost and environmental savings, but reuse is also practiced because there is a lack of safety data on the incidence of cross-infection and device malfunction compared with single use.<sup>3</sup> Limitation of resources is also an important factor, especially for developing countries.<sup>4,5</sup> The prevalence of reuse is difficult to estimate and would reasonably differ between different regions. In the United States, the Centers for Medicare and Medicaid Services changed their policy in 2008 to reimbursing up to 200 catheters per month for patients practicing intermittent catheterization.<sup>6</sup> One could assume that this would more or less eliminate the need for reuse, but high rates of catheter reuse are still reported. For instance, in 2013, Bolinger and Engberg<sup>7</sup> reported 56% reused catheters, with a median of 20 times each, and referred high reuse rates to reimbursements of a more limited number of catheters per month by private insurers. Wilde *et al.*<sup>2</sup> reported 35% reuse in their sample studied in 2008–2009. Although the reuse frequency is lower in both reports<sup>2,7</sup> than in Sherbondy *et al.*,<sup>8</sup> who reported in 2002 that only 17% of catheters used were disposed of after a single use, substantial reuse rates could be expected for the United States, of ~40–50%. In Canada, Woodbury *et al.*<sup>9</sup> registered reuse in approximately half of the patients they studied for both uncoated (47%) and hydrophilic (46%) catheters, and it has been reported that cleaning catheters is the norm.<sup>2</sup> In Australia, reuse is common in the community setting and the reported prevalence would be at least 47–50%.<sup>10</sup> There seems to be no consensus for how many times a catheter should be reused. Getliffe *et al.*<sup>11</sup> described different set-ups in studies, with reuse varying from 24 h (5 times) to 7 days, whereas other authors present a reuse of catheters with a median of 20 times each<sup>7</sup> or an average reuse of 3 years.<sup>12</sup> The Medical Advisory Secretariat in Canada described in their report from 2006 an assumed use of one catheter per day, but found a use of one catheter per week was common in reality.<sup>13</sup> The latter is also described in the Australian community by Leek *et al.*<sup>10</sup> Practiced reuse is dominant in the community setting whereas single-use and sterile techniques are recommended in the hospital setting to avoid the risk of infection.<sup>14,15</sup>

### Regulatory background

Regulatory requirements for off-label reuse are generally the same as for original manufacturing. The US Food and Drug Administration (FDA) and the Australian Therapeutic Goods Administration (TGA) require the same quality, performance and safety on reused devices as for original single-use devices,<sup>3,16,17</sup> whereas the European Union has no uniform legislation.<sup>18</sup> For instance, it is illegal in France to reuse a single-use device. In Canada, there is no federal regulation of single-use reprocessing, and the Canadian Agency for Drugs and Technologies in Health (CADTH) acknowledges that there are variations across provincial policies where some regions ban the reuse of all single-use devices and others allow it as long as it is carried out by licensed third-party reproducers.<sup>19</sup> Although the regulatory background prohibits reprocessing and reuse of single-use devices, this is common practice among hospitals and academic centres, and it should be noted that parties involved in it are potential targets of litigation.<sup>19</sup>

As they are single-use devices, many catheters are neither intended nor approved for reuse. The single-use classification for hydrophilic catheters, for example, is supported by findings in the literature describing safety concerns related to sterilization and reuse.<sup>20,21</sup> Reuse may alter physical properties of the catheter material, and Kovindha *et al.*<sup>12</sup> showed electron microscopic findings such as encrustation and increased stiffness after reuse of silicone catheters, even though they were intended for reuse.<sup>12</sup>

In summary, off-label reuse is not supported by legal requirements in Europe or the United States, or in Australia or Canada where reuse is currently common. There are general safety concerns related to reuse because the physical properties of the catheter material change and there is a risk of introducing bacterial contamination because of suboptimal cleaning and resterilization.

### Guideline recommendations

Several published guidelines touch upon the reuse of catheters for intermittent catheterization. The European Association of Urology Nurses (EAUN) states in its guideline from 2013 that the gold standard in hospital and residential settings remains a new sterile catheter because of the risk of cross-infection.<sup>14</sup> The guideline mentions that reuse of catheters may be considered for the community setting but summarizes the concerns mentioned in the literature for efficacy and compliance with the cleansing techniques that are practiced. The National Institute for Health and Care Excellence (NICE) updated its clinical guideline for infection prevention and control in 2012 and recommended offering a choice of either single-use hydrophilic or gel reservoir catheters for intermittent catheterization or, in the case of uncoated catheter use, an appropriate lubricant from a single-use container to minimize urethral trauma and infection.<sup>22</sup> It further concludes that there is insufficient clinical evidence to recommend off-label reuse.<sup>22</sup>

Newman and Wilson<sup>23</sup> (United States) encouraged the use of a new catheter at every occasion of intermittent catheterization to prevent UTI and recommended considering a hydrophilic catheter to prevent UTI in the case of traumatic catheterization and a single-use/closed system to prevent UTI in the case of poor catheterization technique and catheter care. The Infectious Disease Society of America's (IDSA) guideline from 2009 concluded that the evidence is poor to moderate for recommending multiple-use catheters instead of sterile single-use catheters with regard to bacteriuria or UTI and that there are insufficient data for recommending a cleaning method for multiple-use catheters.<sup>24</sup> Howard<sup>6</sup> described the factors behind the switch in the US Medicare Policy, where the Centers for Medicare and Medicaid

Services of the Department of Health and Human Services eliminated mandatory reuse in intermittent catheterization in 2008. Factors mentioned are avoided risk owing to inadequate cleaning, improved patient care, enabled consumers' personal product choice and reduced risks for UTIs and thereby reduced health risks and costs.<sup>6</sup> In summary, international guidelines do not explicitly recommend multiple-use over single-use catheters but instead propose patient-oriented choice;<sup>14,21,22,25–28</sup> for example, some studies stress poor evidence level for reuse<sup>24</sup> and highlight issues related to reuse.<sup>6,14,23</sup>

### Costs

Kovindha *et al.*<sup>12</sup> acknowledged that disposable catheters are associated with less urethral trauma and infections and increased ease of use but that the high costs limit them to people in developed countries only. For patients in developing countries, reuse is often the only alternative and may be as safe as long as proper catheterization and cleaning techniques are applied to reduce infection.<sup>12,29</sup> Based on the findings from this review, the situation for developed countries differs depending on cost and reimbursement aspects, that is, some countries have chosen to reimburse single-use catheters (Europe and United States), whereas others are promoting reuse (Australia and Canada). In this context, it should be noted that cost comparisons for reuse and single use should not only consider the material costs for the catheters used but also costs related to add-on lubricants, sterilization methods, washing, complications, time spent and so on. For instance, a recent cost comparison between two catheterization techniques in the hospital setting found that the more expensive catheter was associated with a lower total cost for the hospital based on savings on additional lubricants used and nurse time spent.<sup>30</sup> Furthermore, if reuse is associated with an increased number of adverse events, material cost savings are likely to be neutralized.<sup>4</sup> It is also proposed that preference implications for costs and outcomes be acknowledged.<sup>26</sup> Bermingham *et al.*<sup>26</sup> showed that reuse of uncoated catheters was the most cost-effective option for intermittent catheterization but only in the case where less than four catheters a week are used. In the case of more frequent catheter use and/or of patient preference for single use, this may also be considered cost effective.<sup>26</sup>

### Cleaning and reesterilization

A sterile or reesterilized catheter should preferably be used to prevent infection,<sup>5</sup> and proper cleaning of reusable catheters is recognized to be important in preventing unnecessary introduction of bacteria into the bladder.<sup>31</sup> However, several procedural complications are associated with reuse of catheters, and the concerns for efficacy and compliance with cleansing techniques raised by Vahr *et al.*<sup>14</sup> are well grounded. For example, Sherbondy *et al.*<sup>8</sup> reported great variations in how cleaning is practiced at home by patients, from daily sterilization to sterilization for less than once a week, and poor compliance with cleansing instructions. Poor compliance was also described by Chan *et al.*<sup>32</sup> who concluded that the optimal cleansing technique remains to be established and that washing is not an absolute means to sanitize catheters. On the basis of an insufficiency of available disinfection methods, Bogaert *et al.*<sup>20</sup> recommended patients on intermittent catheterization to use a sterile-packed and not previously used catheter. Kovindha *et al.*<sup>12</sup> concluded that a shorter reuse time and proper cleansing and disinfection reduce the infection risk that is present for reuse. However, Hooton *et al.*<sup>24</sup> found that there are insufficient data for recommending a cleaning method for multiple-use catheters. For example, Lavallée *et al.*<sup>33</sup> proposed that catheters need to be rinsed under running, lukewarm tap water for at

least 30 s immediately after use, and then dried, to sufficiently reduce bacteria, whereas others suggested the use of an antiseptic solution,<sup>12</sup> microwaving in combination with antibacterial wash,<sup>32</sup> dishwashing soap and water,<sup>31</sup> alcohol immersion<sup>20</sup> or hydrogen peroxide, bleach or betadine in water.<sup>34</sup> Moy and Amsters<sup>15</sup> even proposed that the cleaning method may be irrelevant as long as the catheter and the catheterization technique are clean. The wide diversity of cleaning and reesterilization methods compromises the generalizability of results from studies involving reused catheters.

### UTI complications

Several review publications<sup>11,13,14,21,24,26,35–37</sup> in the literature conclude that there is a lack of evidence for a relation between catheter type, material and/or technique and frequency of UTI, and recently published studies on comparisons between reuse and single use indicate that there is no difference between the two alternatives but that these are compromised by being severely underpowered.<sup>10,38</sup> In contrast, several reviews and studies support the use of a single-use hydrophilic catheter to reduce the risk of UTI;<sup>9,14,21,35,39–43</sup> for example, a META analysis by Li *et al.*<sup>39</sup> concludes a risk reduction of 64% associated with use of hydrophilic coating. Whichever the case, a lack of evidence is not equal to assumed safe use, clearly indicating that complications related to reuse should be further investigated. Meanwhile, Wyndaele<sup>29,44</sup> summarized the essential basic principles for successful intermittent catheterization in his work from 2002 when concluding the need for good education of all involved, good patient compliance, use of a proper material and use of a noninfecting and nontraumatic technique adapted for the individual patient. Studies investigating UTI frequency are compromised by the facts that different UTI definitions are used (for example, antibiotic treated, self-reported, according to strict definition), different populations are studied (for example, spinal cord injuries, patients with multiple sclerosis, patients who practice intermittent catheterization) and different research perspectives are used (for example, retrospective study, observational surveys, randomized controlled trials). Although standardized definitions of UTI are proposed<sup>24,45</sup> and in many ways implemented, the UTI incidence reported in the literature is difficult to compare. UTI incidence for reuse could be expected to lie at ~70–80% based on observational studies described in the literature.<sup>2,7,9,12</sup> Reported UTI frequency for single-use populations is mainly viewed from the controlled environment that randomized controlled trials compose.<sup>39,40,42,43,46,47</sup> Table 1 summarizes literature describing reuse/single-use-related UTI and urethral trauma complications reported per country, study type, population and catheter type/technique.

In summary, UTI incidence for single-use hydrophilic catheters could be expected to lie at ~40–60% based on randomized controlled trials found in the literature. Compared with the observed UTI prevalence for reuse of ~70–80% in observational studies, there seems to be a difference, although this is difficult to estimate because of the many compromising factors mentioned above.

### Haematuria/urethral complications

Damage to the urethra is more likely to occur with an unlubricated catheter,<sup>48</sup> and findings reported in the literature support the use of a hydrophilic catheter to reduce the risk of microscopic haematuria/urethral trauma.<sup>14,21,39,41</sup> Guidelines also conclude that lubricants should be used to minimize pain and urethral trauma,<sup>5,14,22,23,25,31</sup> and it is recommended that single-use containers with lubricants be used to avoid contamination.<sup>22</sup> Trauma to the urothelium increases the risk of infection,<sup>31</sup> and catheter-related pain may decrease

**Table 1 Complications related to reuse/single-use catheters per country, study type, population and catheter type/technique**

Reference	Country	Study type	Population	Catheter type/technique	UTI rate	Urethral trauma
Wilde <i>et al.</i> <sup>2</sup>	USA	Observational	34 Patients using IC because of SCI or MS	35% Reuse; 65% plastic noncoated 24% latex 6% hydrophilic 6% silicone	77%	NA
Bolinger and Engberg <sup>7</sup>	USA	Observational survey	44 Home IC users (>2 months) because of different reasons (48% MS, 21% neuro-genic bladder)	56% reuse (~20 times)	77.2%	22.7% (bleeding)
Woodbury <i>et al.</i> <sup>9</sup>	Canada	Observational national survey	505 Patients using IC because of SCI	47% Reuse; 74% uncoated 15% hydrophilic 11% uncoated and hydrophilic	77%	—
Kovindha <i>et al.</i> <sup>12</sup>	Thailand	Observational, cross-sectional study	28 SCI injured men	100% reuse; silicon (~3-year reuse)	~79% <sup>a</sup>	11% (urethral bleeding)
Cardenas <i>et al./Li et al.</i> <sup>39,40</sup>	USA	RCT	200 Patients with new SCI	100% single-use; 50% hydrophilic 50% uncoated	41% Hydrophilic, 76% uncoated	23% Hydrophilic, 34% uncoated (microhaematuria)
Cardenas and Hoffman <sup>42</sup>	USA	RCT	45 SCI patients (injury ≥6 months ago)	100% Single use; 50% hydrophilic 50% uncoated	54% Hydrophilic, 61% uncoated	—
De Ridder <i>et al.</i> <sup>43</sup>	Europe	RCT	123 Patients with new SCI	100% Single-use assumed; 50% hydrophilic 50% uncoated	64% Hydrophilic, 82% uncoated	69% Hydrophilic, 54% uncoated (haematuria)
Kannankeril <i>et al.</i> <sup>50</sup>	USA	Observational (retrospective chart review)	159 Adult male IC users, mainly because of BPH	100% reuse; red rubber	40.3% <sup>b</sup>	—
Bakke <i>et al.</i> <sup>46</sup>	Norway	Observational	170 Long-term IC users, mainly because of SCI	99% single-use; 91% hydrophilic	35%	—
Vapnek <i>et al./Li et al.</i> <sup>39,47</sup>	USA	RCT	63 Patients on IC, mainly because of SCI	50% Reuse of uncoated 50% single-use hydrophilic	63% Single-use hydrophilic, 71% reuse of uncoated	27% Single-use hydrophilic, 35% reuse of uncoated (haematuria)

Abbreviations: BPH, benign prostatic hyperplasia; IC, intermittent catheterization; MS, multiple sclerosis; NA, not applicable; RCT, randomized controlled trial; SCI, spinal cord injury; UTI, urinary tract infection.

<sup>a</sup>During the most recent year, 21% of the patients did not show any signs of infections or urethral problems.

<sup>b</sup>Sample includes patients who performed IC occasionally, for example, once per month.

compliance to therapy. For instance, Wilde *et al.*<sup>2</sup> published figures on catheter-related pain reported by 38% patients where many did not use lubrication.

The reported incidence of microtrauma varies depending on the evaluation method (for example, self-reported bleeding, microscopic observation) and study set-up. See Table 1 for a summary of relevant evidence related to reuse/single-use catheters.

In summary, microtrauma can be expected to occur in 20–30% of the patients practicing intermittent catheterization, and it can be assumed that lower figures are related to hydrophilic coating or use of lubrication; for example, Li *et al.*<sup>39</sup> conclude that there is a 43% risk reduction of haematuria associated with use of hydrophilic coating.

### Patient preference

In reviewing the literature, it can be concluded that many authors argue for user choice in the product selection for intermittent catheterization. One product is unlikely to suit everyone, and intermittent catheterization users require products that meet their individual preferences and needs.<sup>2,14,21,22,25–28</sup> It is recommended that the catheter method be matched to patients' ability to maintain

cleanliness; for instance, if the patient has limited access to running water throughout the day, a single-use catheter may be more appropriate.<sup>21</sup> Bermingham *et al.*<sup>26</sup> among others conclude that the patients should be offered a choice between reuse and single-use and different catheter types. However, there is sometimes no choice for the patient. Chick *et al.*<sup>28</sup> observed that 83% of the patients who practiced reuse of a PVC catheter found it unacceptable but that 88% would continue to use it as this was the only method provided by the health-care system. Similar patterns were seen by Wilde *et al.*,<sup>2</sup> who concluded that many patients who were prescribed intermittent catheterization do not have complete medical insurance coverage or knowledge of different catheter options. Patients report that single-use catheters are more convenient<sup>49</sup> and make catheterization away from home easier,<sup>28</sup> and that it is inconvenient and unaesthetic to clean catheters away from home.<sup>24</sup> Bolinger and Engberg<sup>7</sup> show that the most significant barrier for practicing intermittent catheterization is access to public bathrooms and inadequate shelves or countertops for placing supplies in preparation for intermittent catheterization. This is confirmed by Wilde *et al.*<sup>2</sup> who described public bathrooms as being inaccessible and poorly designed and cleaned.<sup>2</sup> Patient choice is

highly individual but some studies conclude that patients prefer single-use hydrophilic catheters.<sup>26,41,43,47</sup> Bennet<sup>48</sup> proposed that a single-use and a mess-free catheter may contribute to good patient compliance. This is crucial to reducing risk factors for UTI, such as adequate catheterization frequency to maintain low bladder volumes and reduced distension.

## DISCUSSION

### Future research

As mentioned, a lack of evidence is not equal to assumed safe use, and thus complications related to reuse should be further investigated. The most clinically relevant and primary outcome measure should be the incidence of symptomatic UTI, as specified for instance in the NICE guideline.<sup>22</sup> Thus, for future randomized controlled trials investigating reuse versus single-use catheters, it is necessary to estimate an expected difference in UTI frequency. Li *et al.*<sup>39</sup> report 50% for hydrophilic catheters as compared with 72% for uncoated PVC catheters. Based on this review, a potentially greater difference may be expected for single-use versus reuse, that is, 40–60% for single-use hydrophilic catheters and 70–80% for reuse uncoated PVC catheters. The expected difference in UTI frequency will have a major impact on the required sample size and it is recommended to have a parallel group study with at least 132 patients/group and additional patients to cover for the dropout in order to test the difference level proposed by Li *et al.*<sup>39</sup> This number would enable detection of a 40% versus 60% calculated difference in UTI frequency with a power of 90%.

Furthermore, standardized symptomatic UTI definitions and a homogeneous population are recommended to best capture a potential treatment difference between single-use or reuse catheters. Worth mentioning is the intrinsic ethical and regulatory dilemma in comparing single-use catheters to reuse of catheters intended for single use, that is, off-label reuse is proposed from a cost-saving perspective putting the patient at potential risk why both ethical and regulatory clearance is necessary before such study commences.

Based on the high number of patients needed to investigate UTI frequency between single use and reuse and the ethical/regulatory challenges in doing so, it is recognized that smaller pilot studies may also be valuable in investigating, for instance, compliance to cleaning protocol, bacterial contamination, changed material properties associated with reuse and so on. Furthermore, if clinical efficacy could be proven with single use, further studies investigating effectiveness in general and cost effectiveness in particular should follow.

### Summary of evidence

Al though similar legal background and guideline recommendations prevail, the prevalence of reuse varies between regions and is very often driven by financial issues. For the United States, Canada and Australia, the prevalence of at least 50% seems to be a fair estimate. Both off-label reuse and reuse of catheters intended for multiple uses occur. The former is not legally supported. There seems to be no consensus on how many times a catheter should be reused and, although one catheter per day is recommended by some, it varies between 1 and 7 days and even up to longer periods of months and years.

Single-use catheters are more expensive than a reused catheter, but cost comparisons should not only consider the material costs for the catheters but also costs related to add-on lubricants, sterilization methods, washing, complication levels, time spent and patient preference. No uniform recommendation for cleaning procedures for reused catheters exists, and poor compliance and efficacy have

been reported, increasing the risk for introducing bacterial contamination when performing intermittent catheterization. Even though there are conflicting findings in the literature, there is support for using single-use hydrophilic catheters to reduce the risk of UTI and urethral trauma. The UTI incidence for single-use hydrophilic catheters can be expected to lie at ~40–60% based on randomized controlled trials reported in the literature. Compared with the observed UTI prevalence for reuse of ~70–80% found in observational studies, there seems to be a difference, although it is difficult to estimate owing to many compromising factors.

### Limitations

The findings in this review are limited by many compromising factors affecting the generalizability of the results. In particular, different ways of defining and measuring complications exists (for example, UTI, urethral trauma and so on), different populations are studied and different research perspectives are used. In addition, reuse of catheters is practiced in a number of ways, complicating the situation even further. For this reason, the comparative results from the review should be carefully considered if used as a basis for clinical decision making.

## CONCLUSIONS

Further clinical studies are needed to verify/reject safety differences between reuse/single-use catheters and, while awaiting more evidence, it is recommended to use a confirmed safe, noninfecting and nontraumatic technique for intermittent catheterization. It can be concluded that patients practicing intermittent catheterization prefer to have a choice and should be able to choose the catheters that best fit their needs and preference, regardless of whether it might be a more expensive choice. This may be expected to increase compliance to the therapy and ensure long-term success and cost effectiveness of intermittent catheterization.

### DATA ARCHIVING

There were no data to deposit.

### CONFLICT OF INTEREST

The study is sponsored by Wellspect HealthCare. Author discloses that she receives financial and material support as a manufacturer employee. No specific compensation is linked to the publication of this study.

### ACKNOWLEDGEMENTS

This study is sponsored by Wellspect HealthCare.

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