Intermittent catheterization and LoFric

Using the evidence to guide clinical practice
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LoFric and science

Wellspect HealthCare is behind LoFric – the first hydrophilic catheter developed for intermittent catheterization. LoFric® has been used by patients requiring intermittent catheterization for over 30 years, and has been thoroughly documented since its introduction on the market. This comprehensive documentation summary includes research studies that show how LoFric works, for both short- and long-term use.

Wellspect HealthCare is a research driven company and scientific evidence is central to the development of our products. All products developed by Wellspect HealthCare undergo a process in which performance and safety are carefully evaluated. We also stay well-informed of the latest research, clinical recommendations and trends in clinical practice. This to ensure we optimize the design and use of our products and realize the benefits for the people who need them.

Why is documentation of urinary catheters so important?

As catheterization is often a lifelong therapy, catheters have to be suitable for long-term therapy. It is important to both protect the urinary tract and avoid infections. This is why a non-infecting and atraumatic technique is a basic principle for catheterization.¹ For someone who relies on catheterization five times a day and/or lack sensation and pain as a warning system, this can mean the difference between serious illness and staying healthy.

- Clinical documentation is an insurance of a catheter’s safety.
- Catheters must be suitable for lifelong therapy, it can take years before any complications become evident.
- Many users lack sensation, and therefore cannot rely on pain as a warning system.
Catheters and catheterization

Catheterization with a urinary catheter is necessary when there is urine left in the bladder that cannot be emptied through normal voiding, i.e. urinary retention. If not treated, urinary retention may cause infection, incontinence, nocturia and discomfort but also more severe complications such as renal failure and sepsicaemia. Hence catheterization is a life-saving therapy. Urinary retention can be caused by neurogenic bladder dysfunction; secondary to a lesion to the central and/or peripheral nervous system. Common diagnoses related to neurogenic bladder dysfunction are spinal cord injury, myelomeningocele (spina bifida), Multiple Sclerosis, Parkinson’s disease, diabetes and stroke. Non-neurogenic factors such as from benign prostatic hyperplasia can also cause urinary retention that necessitates catheterization.

The most common complication of all types of catheterizations is urinary tract infection (UTI). The bladder is generally considered a sterile environment but this has recently been challenged. The urinary microbiota seems linked to urinary health and the introduction of a catheter increases the risk of new bacterial contamination and an imbalance. However, it has been known for a long time that keeping the urine inside the body is far more dangerous than using a catheter to get it out.

Intermittent catheterization

Catheterization can either be done using an indwelling catheter or by practicing intermittent catheterization. Intermittent catheterization means ‘on demand’ emptying of the bladder using a catheter that is removed after each use. An indwelling catheter remains in the bladder with a balloon or other retention mechanism, and is either placed through the abdominal wall (suprapubic indwelling) or through the urethra (transurethral indwelling). While intermittent catheterization is a continence management method that allows normal bladder dynamics similar to normal voiding, an indwelling catheter involves more invasive placement and has a constant in and out flow leaving a static bladder. Complications are more frequently seen with the use of indwelling catheters, and include infections, bladder stones and catheter blockage. This is why intermittent catheterization is the first choice therapy today, both for short- and long-term. Suprapubic catheters are only recommended for short-term use and transurethral indwelling catheters should always be avoided and/or their use minimized. Apart from maintaining a good urinary tract health, successful intermittent catheterization means many advantages for the patient. These include improved self-confidence and self-esteem, improved quality of life with less incontinence/urgency, better sleep, making physical activities possible, ability to be sexually active, less pain and discomfort.
Long-term safety of intermittent catheterization

Single-use hydrophilic catheters were developed in the early eighties to address long-term complications of intermittent catheterization as seen when reusing plastic catheters with add-on lubrication. As reported by Wyndaele and Maes\(^{15}\) and Perrouin-Verbe et al.\(^{16}\) the majority of complications related to intermittent catheterization occur after long-term use as a result of damage to the urethral wall from repeated catheterizations. In contrast, long-term use of LoFric hydrophilic catheters is reported to prevent urethral trauma and complications.\(^{17,18}\)

LoFric documentation: Long-term safety


Health Care Utilization and Complications Rates among Users Of Hydrophilic-Coated Catheters. Observational study of catheter-associated complications in 288 long-term (mean of 10 years) LoFric users. The results suggest that LoFric use reduces the risk of complications associated with intermittent catheterization and that users may benefit from a change to LoFric.


Physical predictors of infection in patients treated with clean intermittent catheterization: 7-year study. Observational study in 155 LoFric users that provides long-term evidence that intermittent catheterization using LoFric reduces the risk for urethral complications, including UTI. For example, 65% of the patients were UTI-free and 39% had sterile urine after 7 years with LoFric.

Bakke et al. report the results of an observational study of Norwegian patients practicing intermittent catheterization with focus on complications. An initial sample of 302 patients who were previously evaluated 7 years ago were asked for participation. Questionnaires from 170 patients and urine samples from 150 patients were evaluated. Patients in the study had different background; 32% had higher spinal cord injury, 36% had lower spinal cord injury and 31% had bladder dysfunction of unknown etiology. The mean duration of intermittent catheterization was 8 years and 9 months and 91% used LoFric catheters. The results showed that 65% of the patients had no signs of clinical UTI, 35% had signs of clinical UTI (6% with pronounced symptoms and 29% with only minor signs of UTI). Bacteriuria was found in 61% of the urine samples. The dominating species were Escherichia coli for women and gram-positive cocci for men. The publication identifies three main predictive factors for UTIs. 1) Women have more infections, 2) a history of UTI and 3) high catheterization volume increase the risk. Frequency was also found to be predictive for bacteriuria where patients with a low catheterization frequency were less prone to have sterile urine. The study reports that sterile urine was seen in 31% of the patients not using antibiotics and in 54% of those who did.


Clean intermittent catheterization in spinal cord injury patients: long-term follow up of a hydrophilic low friction technique. Retrospective analysis that proposes that long term use of LoFric hydrophilic catheters reduces UTIs and prevents urethral trauma. For example, no new urethral trauma was identified during a 5-9 year follow up of 30 LoFric patients.

"It seems reasonable and is indicated by our study that the hydrophilic catheter regimen has a preventive effect on urethral traumatic complications and that it can facilitate the healing of minor epithelial damage..."\(^{18}\)
Urinary Tract Infection (UTI)

Effectiveness of hydrophilic coated catheters has been documented in the scientific literature and there is a general support that they reduce the risk of urological complications such as UTI and trauma (e.g. strictures, hematuria/bleeding). For example, there are five recent meta-analyses available comparing efficacy between hydrophilic-coated and non-hydrophilic catheters concluding that use of hydrophilic catheters can reduce the risk of UTI by 16-64% and the risk of hematuria by 43%. Summarizing the literature some publications confirm this conclusion, while others claim that more evidence is needed. Very few or none conclude the opposite. Comparing UTI incidences reported in the literature gives further support with figures between 40%-60% for single-use hydrophilic coated catheters as compared to figures around 70%-80% for non-coated catheters and/ or catheter reuse.

Studies investigating UTI incidence are compromised by the facts that different UTI definitions are used, different populations are studied (e.g. patients with spinal cord injury, Multiple Sclerosis, spina bifida, benign prostate hyperplasia) and different research perspectives are used (e.g. observational surveys, randomized controlled trials). To facilitate comparisons standardized definitions of UTI are proposed.

LoFric documentation: Reduced risk of UTI

Results of a prospective randomized control trial comparing hydrophilic to uncoated catheters in children with neurogenic bladder. Randomized controlled trial in 78 children with neurogenic bladder dysfunction comparing hydrophilic-coated to non-coated catheters. Results show lower occurrence of UTI among users of hydrophilic-coated catheters after 1 year, 9% vs. 52% (p < 0.003).

Rognoni C, Tarricone R. BMC Urology 2017;17:4
Intermittent catheterisation with hydrophilic and non-hydrophilic urinary catheters: systematic literature review and meta-analyses. Meta-analysis concluding that the risk of UTI is reduced with the use of hydrophilic-coated catheters as compared to non-coated catheters.

Clean intermittent catheterization revisited. Review of intermittent catheterization summarizing important features related to successful intermittent catheterization. It highlights the importance of infection prevention among catheter users and identifies hydrophilic-coated catheters as a cost-effective contributor. It acknowledges that hydrophilic catheters may vary in the quality of coatings and LoFric and the Urotonic™ Surface Technology are described.

Comparison of the microbiological milieu of patients randomized to either hydrophilic or conventional PVC catheters for clean intermittent catheterization. Randomized controlled trial in 50 patients with myelomeningocele. Urine bacteria flora were compared between 25 LoFric users and 25 users of non-coated plastic catheters. After a 1 year follow-up, the results showed a 40% reduction of the average number of potentially pathogenic bacteria in the LoFric group.

A cost-effectiveness analysis of long-term intermittent catheterisation with hydrophilic and uncoated catheters. Health economy evaluation concluding that hydrophilic coated catheters are cost-effective as they are associated with lower number of UTI events, higher life-expectancy and better quality of life as compared to non-coated catheters.
Hydrophilic catheter
Non-hydrophilic catheter

Graph based on results reported by Li et al. 2013

Incidence

UTI

Hematuria

50 %
46 %

72 %
55 %

0 %
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %

Hydrophilic catheter
Non-hydrophilic catheter


Intermittent catheterisation for long-term bladder management.

Meta-analysis of two randomized controlled trials with hydrophilic catheters, whereof one with LoFric. The results propose a 20% risk reduction for UTI with hydrophilic-coated compared to non-hydrophilic catheters. It is however concluded that there is a lack of well-designed trials.


Impact of hydrophilic catheters on urinary tract infections in people with spinal cord injury: systematic review and meta-analysis of randomized controlled trials.

Meta-analysis of 464 patients and five randomized controlled trials (RCT) with hydrophilic catheters, whereof three with LoFric. The results propose a 64% risk reduction for UTI with hydrophilic-coated compared to non-hydrophilic catheters.

This meta-analysis combines five randomized controlled trials to create stronger evidence. A meta-analysis follows strict rules on how to search, select, validate, weigh and summarize studies specified in the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-analyses) and by the Cochrane Collaboration. The studies selected for the meta-analysis were all comparing hydrophilic-coated catheters to uncoated plastic catheter in spinal cord injured patients. The following studies were included:

- Cardenas et al. 2011: SpeediCath vs. non-coated plastic catheter in 200 newly injured patients.
- Cardenas and Hoffman 2009: LoFric vs. non-coated plastic catheters in 45 patients with injury more than 6 months ago.
- De Ridder et al. 2005: SpeediCath vs. non-coated plastic catheters in 123 newly injured patients.
- Vapnek et al 2003: LoFric vs. reused non-coated plastic catheters in 63 patients, mainly spinal cord injury.
- Sutherland et al 1996: LoFric vs. non-coated plastic catheters in 33 patients, mainly spinal cord injury.

The publication combines the results from the studies and concludes that UTI incidence was 49.6% in patients using hydrophilic catheters and 72.0% for patients using non-hydrophilic. The results for hematuria (bleeding) were 45.7% (hydrophilic) and 55.0% (non-hydrophilic) but for this comparison only four studies could be used. The results are expressed as ‘odds ratio’ and/or ‘odds’ which is a sort of approximation for risk. The odds ratio for UTI and hematuria decreased for patients on hydrophilic catheters as follows:

- UTI: 0.36; 95% CI 24-54% (p<0.00001).
- Hematuria: 0.57; 95% CI 35-92% (p=0.001).

The figures above could be interpreted as using hydrophilic catheters, compared to non-hydrophilic ones, reduces the expected risk for UTI by 64% and hematuria by 43%.
1 year follow-up of 22 LoFric users and 23 users of non-coated plastic catheters, showing evidence of fewer antibiotic treated UTIs in patients using LoFric compared to non-coated catheters.

Vapnek JM, Maynard FM, Kim J. J Urol 2003;169:994-8. A prospective randomized trial of the LoFric hydrophilic coated catheter versus conventional plastic catheter for clean intermittent catheterization. 1 year study on 22 LoFric users and 26 users who reused non-coated plastic catheters. The results showed that the use of hydrophilic catheters are associated with less hematuria and decrease in the rate of UTI. The study suggests that patients with higher rate of UTI may benefit the most from hydrophilic catheters, and that the lower infection risk is a result of reduced urethral trauma.

Bakke A, Digranes A, Hoisaeter PA. Br J Urol 1997;79:85-90. Physical predictors of infection in patients treated with clean intermittent catheterization: 7-year study. Observational study in 1.55 LoFric users showing low complication rates associated with LoFric as compared to what is previously reported for non-coated plastic catheters. For example, 65% of the users were UTI-free and 39% had sterile urine after 7 years on LoFric.

Waller L, Jansson O, Norlen L, Sullivan L. J Urol 1995;153:345-8. Clean intermittent catheterization in spinal cord injury patients: long-term followup of a hydrophilic low friction technique. Retrospective analysis suggesting that long term use of LoFric hydrophilic catheters reduces UTIs and prevents urethral trauma. For example, no new urethral trauma was identified during a 5-9 year follow-up of 30 LoFric patients.

Bakke A, Vollset SE. J Urol 1993;149(3):527-31. Risk factors for bacteriuria and clinical urinary tract infection in patients treated with clean intermittent catheterization. Observational 13-month follow-up of 302 users of intermittent catheterization (95% used LoFric) identifying frequent low volume catheterization as a way to reduce the risk of UTI.

Bakke A, Vollset SE, Hoisaeter PA, Irgens LM. Scand J Urol Nephrol 1993;27(1):55-61. Physical complications in patients treated with clean intermittent catheterization. Observational 13-month follow-up of 302 users of intermittent catheterization (95% used LoFric) concluding fewer and less severe infections associated with LoFric use compared to non-coated plastic catheters with added lubricant. For example, patients using non-coated catheters had a 76% higher infection score.

Bakke A, Digranes A. Scand J Infect Dis 1991;23(5):577-82. Bacteriuria in patients treated with clean intermittent catheterization. Observational 13-month follow-up of 302 users of intermittent catheterization (95% used LoFric) concluding low frequency of UTI with hydrophilic catheters (LoFric). For example, 86% of patients showed no clinical signs of UTI during the study period. The study suggests that the use of antibiotics in patients using intermittent catheterization should be minimized and supports a frequency of more than 4 catheterizations per day to keep bladder volumes low and reduce the risk of UTI.

...hydrophilic catheter usage was associated with reduced numbers of treated UTIs as compared with standard non-hydrophilic catheters in persons with spinal cord injury...28

A lower infection score was found in the patients (mean score 2.1) using only low-friction catheters (LoFric) compared to those using plain PVC catheters (mean score 3.7) (p<0.05).46
Trauma

Intermittent catheterization has very few contraindications, but the scientific literature recommends lubrication of the catheter to avoid trauma. The background to this recommendation is the complications seen after long-term use. These complications are related to damage to the urethral wall from repeated catheterizations and the fact that urethral trauma as such is associated with an increase in UTI risk. Damage to the urethra is more likely to occur with an un-lubricated catheter, and findings reported in the literature support the use of hydrophilic catheter to reduce the risk of hematuria/urethral trauma. LoFric in particular seems to be able to reduce the risk of hematuria by 48%. The reported incidence of trauma varies depending on the evaluation method (e.g. self-reported bleeding, microscopic observations) and the study set-up, but the literature suggests general figures between 20-30% for patients practicing intermittent catheterization.

LoFric documentation: Reduced risk of trauma

Rognoni C, Tarricone R. BMC Urology 2017;17:4
Intermittent catheterisation with hydrophilic and non-hydrophilic urinary catheters: systematic literature review and meta-analyses.
Meta-analysis suggesting that the risk of hematuria may be different between brands of hydrophilic-coated catheters and that LoFric seems to lower the risk.

Clinical and economic evaluation of LoFric® catheters for the management of bladder dysfunctions.
Meta-analysis concluding that the risk of hematuria is 48% lower with the use of LoFric as compared to non-coated catheters.

Impact of hydrophilic catheters on urinary tract infections in people with spinal cord injury: systematic review and meta-analysis of randomized controlled trials.
Meta-analysis of 464 patients and five randomized controlled trials (RCT) with hydrophilic catheters, whereof three with LoFric. The results conclude a 43% risk reduction for hematuria with hydrophilic-coated compared to non-hydrophilic catheters.

Hydrophilic-coated catheters for intermittent catheterisation reduce urethral micro trauma: a prospective, randomised, participant-blinded, crossover study of three different types of catheters.
Cross-over study of LoFric and other hydrophilic/non-hydrophilic catheters in 40 healthy volunteers showing evidence of less microscopic hematuria and pain with LoFric. For example, frequency of hematuria was 40% for LoFric, 58% for SpeediCath and 67% for Incare Advance.
The LoFric catheter was associated with less microscopic hematuria...44

...use of a LoFric catheter for intermittent catheterization was associated with significantly lesser degree of urethral inflammatory response...5

"The LoFric catheter was associated with less microscopic hematuria...44"

"...use of a LoFric catheter for intermittent catheterization was associated with significantly lesser degree of urethral inflammatory response...5"

Vapnek JM, Maynard FM, Kim J. J Urol 2003;169:994-8

A prospective randomized trial of the LoFric hydrophilic coated catheter versus conventional plastic catheter for clean intermittent catheterization.

1 year study of 22 LoFric users and 26 users who reused non-coated plastic catheters. The results showed that the use of hydrophilic catheters are associated with less hematuria and decrease in the rate of UTI. For example, no hematuria was reported for the LoFric group while mild hematuria was reported for the control group.

This randomized controlled trial compared the use of LoFric to a non-coated plastic catheter for intermittent catheterization. The study included 62 patients, mainly with spinal cord injury, and the follow up period was 12 months. One patient was removed from analysis due to wrongful treatment and thirteen patients were lost during the follow up. Thus, 22 patients used LoFric for 12 months and 26 used non-coated plastic catheters for 12 months. In the hydrophilic-group, patients were given 120 catheters/month (4 per day) while in the PVC-group 30 catheters were given per month (1 per day) with the instructions to clean and reuse. The results showed twice as high hematuria score among the non-coated catheter users as compared to the hydrophilic-group where no significant hematuria was seen. Decrease in UTI rate in the hydrophilic-group was seen between baseline and follow up (0.44 to 0.14 monthly per patient). In the non-coated catheter group the UTI incidence remained more or less at the same level throughout the study (0.20 to 0.14 monthly per patient). The study reports of high patient satisfaction with LoFric catheters. The publication concludes that the use of hydrophilic catheters is associated with less hematuria and a decrease in the rate of UTI as compared to non-coated catheters. It proposes that patients with higher rate of UTI may benefit the most of hydrophilic catheters, and that the lower infection risk is a result of reduced urethral trauma.


Hydrophilic versus non-coated catheters for intermittent catheterization.

Review of hydrophilic coated catheters including primarily LoFric studies, concluding evidence on decreased urethral irritation.

Sutherland RS, Kogan BA, Baskin LS, Mevorach RA. J Urol 1996;156:2041-3

Clean intermittent catheterization in boys using the LoFric catheter.

2 months study of 16 LoFric-users and 14 users of non-coated plastic catheters showing evidence of less hematuria with LoFric. For example, 9 episodes of hematuria were detected in 6 subjects who used LoFric and 19 episodes were detected in 11 subjects in the control-group after 2 months of use. Furthermore, the study reports that the LoFric-group scored higher convenience and insertion comfort than the control-group and that 81% wished to continue with LoFric.

Vaidyanathan S, Soni BM, Dundas S, Krishnan KR. Paraplegia 1994;32(7):493-500

Urethral cytology in spinal cord injury patients performing intermittent catheterisation.

Study on 17 LoFric users, 14 users of a non-coated plastic catheter, and 11 users of an indwelling catheter. The results show evidence of LoFric causing less urethral inflammation and fewer numbers of bacteria than for those who use a non-coated plastic catheter or a urethral indwelling catheter. For example, a more than 10-fold increase in urethral inflammatory response was seen with non-coated catheters compared to LoFric.


Efficacy and safety of clean intermittent catheterization in adults.

40 months follow up study of 41 LoFric users presenting evidence on the low incidence of urethral complications associated with LoFric. For example, no cases of urethral trauma were observed during the study period and few patients had repeated UTIs (9.8%).
Friction

A recent review acknowledges that there are variations in the quality of coatings among hydrophilic catheters and proposes osmolality as one important factor to consider when comparing different hydrophilic catheters. It has been concluded that the outer layer of the hydrophilic coated catheter should possess the same osmolality as the urine and that high osmolality hydrophilic catheters are recommended to minimize risk of urethral trauma, catheter sticking and patient discomfort.

The LoFric catheter is characterized by the Urotonic™ Surface Technology. This means that the catheter has a surface layer isotonic to urine, i.e. the salt concentration of the catheter’s surface is in balance with the urine. Isotonic osmolality prevents removal of the hydrophilic coating from the surface. This is essential for keeping high lubricity and minimal friction between catheter and urethra during the entire catheterization process, including at withdrawal. According to peer-reviewed data, LoFric with the Urotonic Surface Technology, is the only available hydrophilic coated catheter that could demonstrate high osmolality (i.e. ~900 mOsm/kg) that corresponds to osmolality levels normally present in urine (i.e. 800-1200 mOsm/kg). This may be one contributing factor to the low complication rates associated with long-term LoFric use found in real-life evidence. A recent meta-analysis has identified a unique hematuria risk reduction of 48%, only applicable for the LoFric-brand.

LoFric documentation: Low friction

Design of a simulated urethra model for the quantitative assessment of urinary catheter lubricity.

In vitro study of LoFric and other hydrophilic catheters presenting evidence on low insertion/withdrawal friction.

The importance of osmolality for intermittent catheterization of the urethra.

Histology study in rabbit showing evidence of lower friction and less epithelial cell damage with the high osmolality LoFric catheter.

The importance of osmolality in hydrophilic urethral catheters: a crossover study.
Cross-over study of LoFric and another hydrophilic catheter in 14 users providing evidence that high osmolality of the hydrophilic coating results in less sticking and lower withdrawal friction. For example, 3 incidents of sticking were observed in 2 patients among LoFric users while 42 incidents of sticking were observed in 9 patients among users of another hydrophilic catheter.

This cross-over study investigates 14 male spinal cord injured patients who tested LoFric and another hydrophilic catheter (EasiCath) for ten days in a randomized order. Removal friction was measured, and although both had hydrophilic coating, LoFric with its high osmolality showed 55% lower removal friction (p<0.001). Events of catheter-sticking inside the urethra were different with 3 incidents in 2 patients among LoFric users compared to 42 incidents in 9 patients among users of the other hydrophilic catheter. An inverse correlation between osmolality measurements was reported. Osmolality measurement reported 900 and 950 mOsm/kg for LoFric and 15 and 80 mOsm/kg for the other hydrophilic catheter.
Patient preference

Patient compliance is a key factor for ensuring good clinical outcome. For this reason, non-compliance is related to a significant financial burden to the healthcare system and society with an estimated cost of about $100 billion each year in the US, affecting 30-50% of all patients, irrespective of diagnosis or setting. Several factors affect compliance, and shared decision-making between doctor and patient has been recommended as a way to improve initial compliance to a treatment or a therapy. Long-term compliance is dependent on whether the therapy fits into everyday life for the patient, and emphasis should be on finding treatment options that work well with life style and are easy to use.

For intermittent catheterization therapy, compliance is partly reached by a free and adapted choice of catheter as described in several publications. The greatest barriers for practicing intermittent catheterization are reported to be inconvenience related to preparations and access to bathrooms. Under such circumstances use of a convenient and neat catheter may improve compliance. It is however essential to fully understand patients’ catheter preferences to optimize compliance. Previous research has concluded that UTI risk reduction, ease of insertion and convenience are the most appreciated attributes for intermittent catheters among patients. There is also a general clinical recommendation to consider personal preference, comfort and ease of use in a patient’s catheter choice. Ease of use, comfort, and preference related to hydrophilic catheters have been documented by several authors. When a catheter choice is available, about 70-81% patients prefer hydrophilic catheters and 71% of patients prefer not to reuse non-coated plastic catheters.

Patient compliance is the cornerstone behind the LoFric-assortment of hydrophilic catheters. Wellspect HealthCare has extensively researched patient preferences and used the input as a driver in the product development of LoFric hydrophilic catheters.

LoFric documentation: Patient preference

Wilson M. Br J Nurs 2015;24(2):76-85
Clean intermittent self-catheterisation: working with patients.

Improving quality of life for men using intermittent self-catheterisation.

Clean Intermittent Catheterization Following Urethral Stricture Surgery Using a Low Friction Catheter Versus Conventional Plastic Catheter: A Prospective, Randomized Trial. 2 year follow-up of 31 LoFric users and 28 users of non-coated catheters. The results showed more satisfaction, increased comfort, and quality of life among LoFric users.

Patient experience with hydrophilic catheters used in clean intermittent catheterization. Evaluation of 100 hydrophilic catheter users showing good insertion and removal properties (85-90%) for LoFric.

A novel product for intermittent catheterisation: its impact on compliance with daily life-international multicentre study. 2-weeks study of 378 LoFric-users reporting high satisfaction rates. For example, LoFric was shown to improve patients' ability to comply with everyday life and 74% of patients previously using non-coated catheters wished to continue with LoFric.
Litherland AT, Schiotz HA. Br J Nurs 2007;16(5):284-7
Patient-perceived discomfort with two coated urinary catheters. Prospective study of 196 hydrophilic catheter users reporting low levels of discomfort with LoFric.

Coated catheters for intermittent catheterization: smooth or sticky? Evaluation of 61 hydrophilic catheter users presenting examples of minimized discomfort with LoFric.

Comparative study of the degree of patient satisfaction in intermittent catheterization with Lofric and polyvinyl chloride catheters. 2-months study of 35 LoFric users demonstrating evidence of higher satisfaction among LoFric-users compared to patients using non-coated catheters. For example, 83% of those who experienced withdrawal discomfort reported that this disappeared with LoFric and 86% found LoFric easy or very easy to learn and use. This prospective study involved 40 spina bifida patients who tried out LoFric for a 2-month period and reported satisfaction using a questionnaire. Patients represented both sexes and had previous experience of performing intermittent catheterization with a non-coated catheter. A total of 86% found LoFric easy to learn. Of the 51% who reported problems with their previous catheter, 72% found these to be resolved by LoFric use. The LoFric catheter was favored by 70% for its ability to reduce discomfort compared to the non-coated catheter. The study concluded that LoFric provided an increase in both comfort and patient satisfaction.

Evaluation of two coated catheters in intermittent self-catheterization. Cross-over study with 25 users testing LoFric and SpeediCath catheters for 1 week each. The results showed examples of good insertion and removal properties with LoFric. Approximately 90% of LoFric users found the catheter comfortable to insert and easy to remove.

(Comparison of 3 self lubrificated urethral catheters: prospective study on 27 patients). Prospective, randomized study in 27 users who evaluated LoFric and 2 other hydrophilic catheters. The results showed high satisfaction for LoFric with regard to catheter management, insertion/withdrawal properties and performance.

The LoFric catheter: new technology improves an old technique. Review of the overall benefits of using LoFric instead of non-coated catheters for intermittent catheterization.

Pachler J, Frimodt-Møller C. BJU International 1999;83:767-9
A comparison of prelubricated hydrophilic and non-hydrophilic polyvinyl chloride catheters for urethral catheterization. Cross-over study with 32 users who tested LoFric and a non-coated catheter for 3 weeks each. The results showed a trend toward easier management and preferences for the LoFric catheter.

Sutherland RS, Kogan BA, Baskin LS, Mevorach RA. J Urol 1996;156(6):2041-3
Clean intermittent catheterization in boys using the LoFric catheter. 2-months study of 16 LoFric users and 14 users of non-coated catheters showing evidence of less hematuria with LoFric. The study reports that the LoFric group scored higher convenience and insertion comfort than the control group and that 82% wished to continue with LoFric.

Patient satisfaction and the LoFric catheter for clean intermittent catheterization. 1-month study of 41 LoFric users showing evidence of high satisfaction. For example, 81% preferred LoFric and found it more convenient and favorable than their previous non-coated catheter and 88% found it easier to handle.

83% with previous withdrawal discomfort had it disappear with LoFric. 74
86% found LoFric easy or very easy to learn and use. 74

"...81% found the disposable catheter [LoFric] to be more convenient and 88% thought it was easier to handle..." 73

"...if given a choice most patients will prefer to use the pre-lubricated catheter [LoFric]..." 73
Dilatation and stricture treatment

A urethral stricture is an abnormal narrowing of the urethra and is often caused by trauma or inflammation. As catheterization is one cause of strictures, non-traumatic catheterization technique and catheter material are essential parts in preventing the occurrence of these complications. Common treatment methods for urethral strictures are urethrotomy and intermittent catheterization/dilatation.

Urethrotomy is an endoscopic surgical procedure that dilates the urethra, and it is performed in a medical center under local anesthesia. Intermittent catheterization/dilatation can be learned and performed at home. Recurrence rates for strictures are between 40-80%, but intermittent catheterization/dilatation has been reported to reduce recurrence. For example, Elhaj et al. report of lower stricture recurrence rates among patients who practiced intermittent catheterization (77.41% versus 19.35%). There is a significant impact on patients' quality of life when experiencing and treating strictures which is why it is important to use treatment alternatives that optimize comfort and reduce pain.

LoFric documentation: Stricture treatment


Bladder outflow problems in females. Study of 188 females with bladder outflow problems showing an example on LoFric use to successfully treat and prevent recurrent urethral strictures.

| Table based on results reported in Sallami et al. 2010 |
|---------------------------------|-----------------|-----------------|
| Mean questionnaire score* (standard deviation) and number of reported complications |
| **LoFric** (n = 31) | **Non-coated catheter** (n=28) |
| Troublesome catheterization | 3.46 (1.68) | 5.38 (1.36) |
| Convenience | 4.96 (1.20) | 5.82 (1.50) |
| Pain | 2.15 (1.18) | 7.78 (1.92)** |
| Comfort | 2.07 (1.12) | 5.89 (1.95)** |
| General satisfaction | 1.85 (0.55) | 7.05 (1.41)** |
| **Complications** |
| Prostatitis | 0 | 1 |
| Bleeding | 0 | 2 |
| Bacteriuria | 1 | 4 |
| Stricture recurrence | 2 | 7 |

*0 = most favorable, 5 = indifferent, 10 = unfavorable
**p-value <0.05


Clean Intermittent Catheterization Following Urethral Stricture Surgery Using a Low Friction Catheter Versus Conventional Plastic Catheter: A Prospective, Randomized Trial.

2 year follow-up on 31 LoFric users and 28 users of non-coated plastic catheters investigating prevention and/or treatment of recurrent strictures after endoscopic urethrotomy.

This randomized controlled study compared the use of LoFric or non-coated catheters for intermittent catheterization treatment of strictures after endoscopic urethrotomy. The study included 62 men, 41 treated for their first stricture and 21 with recurrent problems. All patients had an indwelling catheter placed after surgery and were taught intermittent catheterization 2 weeks later. The patients were followed for 2 years and each patient evaluated their catheter use with a questionnaire. Three patients from the control group failed to follow-up. There were no differences detected between the catheters with regard to convenience or in how troublesome the catheterization was. However, patients found the LoFric catheter to generate less pain (22.6% vs. 64.5% of patients), higher comfort, and better general satisfaction (71% versus 32.2%). The study concluded that the LoFric catheter decreases pain, and increases comfort and satisfaction compared to a non-coated catheter. For this reason, LoFric should be considered as a better option for prevention of urethral strictures from a quality of life aspect.
Intermittent self-dilatation after internal urethrotomy for primary urethral strictures: a case-control study.
Observational study of 55 users of hydrophilic catheters and 162 control patients followed during a 3-6 year period. Results showed evidence of the preventive effects of intermittent self-dilatation (ISD) on stricture recurrence. For example, stricture recurrence was 8% among those who practised ISD with hydrophilic catheters and 32% in the control. The median time to first recurrence was 2 years for the ISD group and 6 months for the control.

6-36 months study of 101 LoFric-users showing evidence that LoFric is a safe and effective way to prevent stricture recurrence long-term (>12 months).

Prevention of urethral stricture recurrence using clean intermittent self-catheterization. 1-4 year study of 31 LoFric users and 24 control patients that provides evidence for the use of LoFric to effectively reduce the frequency of recurrent urethral strictures. For example, 68% of patients not treated with intermittent catheterization experience recurrent strictures during the first year after urethrotomy compared to 19% in the LoFric-group.

Treatment of recurrent urethral stricture by internal urethrotomy and intermittent self-catheterization: a controlled study of a new therapy.
12 months follow-up of 23 patients practicing intermittent catheterization with LoFric (refers to abstract by Lawrence et al, 1991 and Zambon et al, 1990 on the use of LoFric) and 28 control patients. The study shows no recurrent strictures in patients who are actively practicing intermittent catheterization in order to prevent urethral strictures.

Treatment of recurrent urethral strictures using clean intermittent self-catheterisation. 6-months study of 65 patients with LoFric showing evidence of treating and preventing recurrent urethral strictures.

Treatment of urethral stricture disease by internal urethrotomy followed by intermittent ‘low-friction’ self-catheterization: preliminary communication. Preliminary results of Harriss et al. 1994 showing that postoperative urine flow-rates can be maintained if “low-friction” catheterization with LoFric is adopted.
Bladder instillation is used for local administration of drugs into the bladder. This is used for treatment of interstitial cystitis and cancer, for example. Drugs are being delivered by catheters and a hydrophilic-coated surface such as that of the LoFric catheters reduces the risk for trauma associated with instillation therapy.

**LoFric documentation: Instillation therapy**

*Dell JR, Parsons CL. J Reprod Med 2004;49(3 Suppl):243-52*

Multimodal therapy for interstitial cystitis. Review of treatment of interstitial cystitis including examples of the use of LoFric catheters for intravesical instillation.

*Saad A, Oakes G, Thompson AC, Hanbury DC, McNicholas TA, Bousted GB, Woodman AC. UroOncology 2002;2(1):23-26*

Delaying the Administration of Intravesical Chemotherapy Improves its Dwell Time. Study of 42 patients who had chemotherapy instilled in the bladder with LoFric.
For more information regarding Intermittent catheterization and LoFric, please visit wellspect.com or any of our local websites.
Cost-effectiveness

Today there is an increasing focus on costs due to restrictions in healthcare budgets and more people needing access to the healthcare systems. Costs are often highlighted, also when it comes to catheter choice in intermittent catheterization and there are increasing demands for data showing cost-effectiveness. Today there are several published per-reviewed cost-effectiveness analyses investigating value of hydrophilic coated catheters. The most recent ones conclude that hydrophilic coated catheters are cost-effective as they can reduce the number of UTI and other catheter-related complications and increase quality of life for the user. In addition, a recent review of intermittent catheterization acknowledges the fact that there may be increasing costs related to new improved catheters but that the therapy remains cost-effective.

Cost-effectiveness of hydrophilic coated catheter is strongly linked to available clinical evidence and long-term data. LoFric data, as described in previous sections, significantly contributes to the conclusion of cost-effectiveness of hydrophilic-coated catheters made in the publications above. This in combination with the unique LoFric long-term safety data described in previous sections, suggest that LoFric is a cost-effective choice for the healthcare system and for users of intermittent catheterization.

LoFric documentation: Cost-effectiveness

Healthcare Resource Consumption for Intermittent Urinary Catheterisation: Cost-Effectiveness of Hydrophilic Catheters and Budget Impact Analyses. Health economy evaluation concluding that hydrophilic-coated catheters for intermittent catheterization are cost-effective when considered over a lifetime. The hydrophilic-coated catheters seem to provide health benefits by reducing treatment-related complications at a reasonable additional cost.

Healthcare costs associated to hydrophilic coated and non-coated urinary catheters for intermittent use in the United States. Health economic evaluation comparing hydrophilic coated to non-coated catheters for intermittent catheterization. The results showed that life-long use of hydrophilic-coated instead of non-coated catheters avoids on average 18 complications and reduces healthcare cost by $10,184 per patient. This health economic evaluation uses a Markov model to estimate lifetime costs and catheter-related complications in a U.S. setting. By modelling a lifetime use of intermittent catheterization and starting at the age 40, substantial healthcare costs and complications were identified. However, the use of hydrophilic-coated instead of non-coated catheters avoided on average 18 complications per patient. This translated into a total cost saving for the healthcare system of $10,184 per patient. These results imply that the hydrophilic coated catheter was associated with both health benefits and substantial cost-savings compared to the non-coated catheter. For this reason, it is proposed that hydrophilic coated catheters should be the first and standard choice for those who are prescribed intermittent catheterization.
Clean intermittent catheterization revisited.
Review summarizing important features related to successful intermittent catheterization. It highlights the importance of infection prevention among catheter users and identifies hydrophilic-coated catheters as a cost-effective contributor. It acknowledges that hydrophilic catheters may vary in the quality of coatings and LoFric and the Urotonic™ Surface Technology are described.

A cost-effectiveness analysis of long-term intermittent catheterisation with hydrophilic and uncoated catheters. Health economy evaluation concluding that hydrophilic coated catheters are cost-effective as they are associated with lower number of UTI events, higher life-expectancy, and better quality of life as compared to non-coated catheters.

Intermittent self catheterisation with hydrophilic, gel reservoir, and non-coated catheters: a systematic review and cost effectiveness analysis. Cost-effectiveness and meta-analysis based on two randomized controlled trials with hydrophilic catheters, whereof one with LoFric. The results propose a 20% risk reduction for UTI with hydrophilic-coated compared to non-hydrophilic catheters but does not support cost-effectiveness due to the lack of evidence. The clinical recommendation is that patients should be offered a choice between hydrophilic and gel reservoir catheters.

The use of [hydrophilic-coated] HC catheters for intermittent catheterisation in SCI patients is highly cost effective. The outcome is consistent irrespective of whether UTI data are collected in hospital or community settings...
Environmental impact

At Wellspect HealthCare we take our environmental responsibility seriously. We continuously work to minimize the environmental impact related to our products. We ensure that proper materials are used and all applicable production requirements are followed. For the LoFric catheter, this means that we use a core catheter material with proven low environmental impact as compared to other common catheter materials without compromising quality and patient perception. In fact, the core material of LoFric has been proven to optimize catheter management and reduce discomfort.

LoFric documentation: Environmental impact of material


Evaluation of a new PVC-free catheter material for intermittent catheterization: a prospective, randomized, crossover study.

Study of 104 LoFric users who tested two types of LoFric with different core material for 1 week each. Results showed unchanged perception and safety as well as low perceived discomfort with both materials.

This randomized cross-over study compared two types of LoFric catheters with a core material made either by polyvinylchloride (PVC) or a PVC-free material. The study followed 104 male LoFric-users who had maintained urethral sensibility and who evaluated discomfort (e.g. pain, burning sensation, bleeding or other discomfort) associated with the catheterization procedure after one week’s use. Catheter material properties such as stiffness and flexibility were also evaluated along with general catheter management properties. Self-reported patient questionnaires were used and the results showed that among all patients 38% perceived discomfort during catheterization on a general basis. Patient preferences were different and varied between the two catheter types. For example, 10% experienced discomfort with both catheter types, 5% reported discomfort with the PVC-free and not with the PVC catheter and 19% reported discomfort with the PVC and not the PVC-free catheter (p=0.0066). Even though both catheter types were associated with low predefined discomfort rates and good management properties, the PVC-free material was reported as the better choice to optimize patient satisfaction and tolerability.


A multicenter, double-blind, randomized, parallel group study comparing Polyvinyl Chloride and Polyvinyl Chloride-Free Catheter Materials.

Study of 169 LoFric-users who tested two types of LoFric catheters with different core material for one month each. Results showed similar perception and safety for both materials.


Development and environmental improvements of plastics for hydrophilic catheters in medical care: an environmental evaluation.

Material life cycle assessment of LoFric and other hydrophilic catheters’ core materials. Results show minimized environmental impact for LoFric.
With more than 30 years on the market, LoFric has been used and documented in several ways. In addition to efficiently emptying the bladder, LoFric’s versatile use includes treatment and prevention of recurrent strictures, administration of chemotherapy by bladder instillation and resolution of rare complications. For example, Montagnino describes general use of LoFric to facilitate and prevent surgical procedures of the urethra and bladder. Intermittent catheterization with LoFric has also been shown to have and impact on renal recovery. For example, Halleberg Nyman et al. show faster return of normal bladder function after surgery and Petterson-Hammerstad et al describe improved renal function in favor of intermittent catheterization with LoFric as compared to indwelling catheterization.

### LoFric documentation: Other


Intermittent versus indwelling urinary catheterisation in hip surgery patients: a randomised controlled trial with cost-effectiveness analysis.

Study of 170 hip surgery patients showing evidence of faster return of normal bladder function after surgery when practicing intermittent catheterization with LoFric compared to using indwelling catheters.

This randomized controlled trial of 170 hip surgeries compared routine use of an indwelling catheter inserted in the morning of the day of the surgery to the use of intermittent catheterization when indicated after bladder scan measurements. Intermittent catheterization with LoFric was done if the patient was unable to void and if the bladder scan indicated more than 400ml of urine in the bladder. The study investigated post-surgery follow-up after 4 months, quality of life assessments using EQ-5D and SF-36 (SF-6D), and cost-effectiveness based on quality adjusted life years (QALYs). The results show no statistically significant difference in UTI rate between the groups although there were fewer events reported in the intermittent group. Use of intermittent catheterization was associated with faster return to normal voiding. Normal bladder function was defined as post-voiding residual volume of 150ml or less detected by bladder scan. No differences in cost-effectiveness could be concluded from the results. The authors noted that their infection rates were reduced compared to earlier studies; from 52% in 2011 to 11% in 2013 and that this was likely related to increased use of antibiotic prophylaxis (Cloxacillin) and increased awareness of basic hygiene.

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<tr>
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<th>Intermittent</th>
<th>Indwelling</th>
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<tr>
<td>Number of nosocomial UTIs</td>
<td>8 (9%)</td>
<td>10 (12%)</td>
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<td>Time to normal bladder function</td>
<td>24 [13.48] hours</td>
<td>48 [43.55]* hours</td>
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<td>Number of bladder scans</td>
<td>6 [4-9]</td>
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<tr>
<td>Total costs (SD)</td>
<td>€3642 (1605)</td>
<td>€3954 (1743)</td>
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*p-value < 0.05
SD = Standard Deviation
Renal function improves with time after injury and improvement is seen most clearly in the group that uses clean intermittent catheterization as a bladder emptying method.\(^\text{108}\)

"...the hydrophilic catheter should be a part of the urologist’s armamentarium whenever treating men with acute urinary retention."\(^\text{109}\)

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Impaired renal function in newly spinal cord injured patients improves in the chronic state-effect of clean intermittent catheterization? Observational 3-5 years follow-up of 169 spinal cord injured patients, using either LoFric intermittent catheters or indwelling catheters. The results showed better renal function improvement related to intermittent catheterization use.

**Mistry S, Goldfarb D, Roth DR. Urology 2007;70(1):25-7\(^\text{109}\)**

Use of hydrophilic-coated urethral catheters in management of acute urinary retention.

An example of LoFric use to treat acute urinary retention.

**Vaidyanathan S, Krishnan KR, Soni BM, Fraser MH. Spinal Cord 1996;34(12):745-7\(^\text{106}\)**

Unusual complications of intermittent self-catheterisation in spinal cord injury patients.

Case report on three rare events solved by LoFric use.


Clinical background of patients treated with clean intermittent catheterization in Norway.

Observational 13 month study of 302 users (95% LoFric) providing epidemiological data on the use of intermittent catheterization for persons with different disabilities.
## Summary of LoFric clinical evidence

× Publication/study of general importance
× × Publication/study of significant importance

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References


Knowledge, education and support

Do you need product information or therapeutic competence? We have comprehensive knowledge in all the areas associated with catheterization, dilatation and instillation and are willing to act as a resource, or to provide education.

When it comes to education and information we have a broad programme – both for healthcare personnel and for users. You may use our training staff, or training and information online, on DVD or in printed format. Furthermore, we can supply you with information on products, clinical studies, user guides, starter packs and much more. Contact us for all your needs, or visit us at www.lofric.com