



## EXPLORE

# SCIENTIFIC REVIEW OF CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI)

**Catheter associated urinary tract infections (CAUTI) are common in the hospital setting with consequential morbidity and mortality. The risk of bacterial adhesion and invasion of the urinary tract increases with use of an indwelling catheterization and may be reduced by adopting intermittent catheterization using hydrophilic single-use catheters.**

It is estimated that 40% of all nosocomial (hospital acquired) infections are urinary tract infections (UTI)<sup>1,2</sup> and that 80% of these are associated with the use of indwelling urethral catheters (CAUTI).<sup>1-4</sup> The cost of treating a single CAUTI has been reported to be around \$650<sup>5-7</sup>; however, the cumulative problem of antibiotic resistance, largely due to improper and over-administration of antibiotics, has led to many bacteria responding poorly or not at all to available UTI-treatment.<sup>8</sup> According to the NHS, the probability of clinical failure after treatment for symptomatic UTI is approximately 15% and that 40% of treatment failures are due to multidrug resistant UTI.<sup>9</sup> Along with the added treatment costs of \$2000-\$3000<sup>9,10</sup> per episode, these infections can lead to urosepsis and death.<sup>2,3</sup>

The healthy urinary tract has long been considered a sterile environment; however recent studies suggest a unique urinary microbiota.<sup>11,12</sup> Even so, the usual environment is greatly challenged by the presence of a catheter. Contamination may occur either through periurethral fecal or transient bacteria ascending along the tubing-exterior<sup>2</sup> or the tubing-interior following drainage bag colonization. It is estimated that 5% of bacteriuria incidents originate from bacteria being introduced at the time of catheter-insertion.<sup>4</sup> Bacteria that enter the urinary tract are normally annihilated by different host defense mechanisms such as normal urine flow which flushes out bacteria that have not attached to

the uroepithelium, an unfavorable environment (i.e low pH, high concentration of salts and urea), as well as different anti-adherence factors.<sup>13</sup> The presence of an indwelling catheter does, however, ensure that the bacteria have a surface to adhere to right from the start.<sup>4</sup> In addition, the catheter may damage the protective uroepithelial mucosa which facilitates bacterial adhesion to the cells of the urinary tract.<sup>2</sup>

Colonization of the urinary tract is facilitated by bacterial adhesins which recognize, and attach to, specific cell-surface and extracellular structures such as mannosylated proteins, glycoproteins and glycolipids on the uroepithelial cells or the catheter.<sup>4,14</sup> Many bacteria (including uropathogenic E.coli (UPEC), the most common infecting organism<sup>2,4</sup>) have small hair-like fimbriae on which adhesins are located. Once the bacteria have formed attachment, they start to replicate and produce an extrapolymeric substance (EPS) which protects and encapsulates the growing bacterial community.<sup>2-4,15</sup> The resulting biofilm is more resistant to host defense mechanisms and antimicrobials.<sup>2-4</sup> In addition to EPS, some bacteria (e.g. *P. mirabilis*) are effective in hydrolyzing urea, causing alkalization of the urine, precipitation of salts and formation of crystals in the urine. These salt crystals settle on the catheter surface causing encrustation.<sup>2</sup> A mature biofilm, with multiple bacterial species,<sup>4</sup> is typically formed between 1 day<sup>2</sup> to 2 weeks<sup>4</sup> after catheterization start, why even short term catheterization (defined as in place for less than 30 days<sup>4</sup>) may lead to persistent infection as well as encrustation and blockage of the catheter-tube.<sup>2</sup> In addition to forming biofilm, UPEC have the ability to invade<sup>2,13,14,16</sup> and replicate<sup>14</sup> inside bladder epithelial cells, creating intracellular bacterial communities (IBC). Replicated bacteria flux out of the host cell and are able to initiate new sites of infection.<sup>13,15,17</sup> IBC can persist within the bladder tissue even after antibiotic treatment<sup>13</sup> and is one cause of recurrent UTIs.<sup>17</sup>

In order to prevent CAUTIs, recommendations and guidelines have been put forth which include avoiding unnecessary indwelling catheterization, early removal when indwelling catheter is required, implementing different infection control programs and alternative means of catheterization.<sup>1,3,18</sup> Intermittent catheterization,<sup>1</sup> and hydrophilic-coated single-use catheters in particular,<sup>3</sup> has been shown to reduce the incidence of UTI.<sup>19-23</sup>

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