Designing, Prototyping and Testing of a Multi-Lumen Urinary Catheter with Sustained Unidirectional Biocide Flow

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Urinary catheter is a commonly used medical device employed to drain urine from the bladder into a collection bag to relieve urinary obstruction. It has some inherent problems, the most significant being urinary tract infections (UTIs), that account for 13,000 deaths annually in the U.S. alone. The common cause of such infections is biofilm formed by bacteria within the lining of catheters to protect themselves from antibiotics, disinfectants and dynamic environments. The novel catheter was designed and prototyped to prevent biofilm formation. The hypothesis was that the multi-lumen catheter, one-way valve and pumping mechanism allow sustained instillation of biocides into the catheter lumen without backflow into the bladder. The novel catheter had multiple channels, a mixing chamber at the insertion end and a one-way valve at the tip. To demonstrate competency of the design, biocide in the form of alkaline fluid, with pH of 11.5, was instilled into the catheter lumen. Acidic fluid with a pH of 6.5 was instilled into the bladder lumen. The pH of fluid in the collection bag and in bladder lumen was measured every 3 hours for 12 hours. Results showed that the pH maintained at 6-6.5 in bladder and 11.4-11.6 in the collection bag. It demonstrated multi-lumen catheter and the one-way valve functioned as hypothesized. These modifications in the catheter design could potentially lead to significant reduction of UTIs, sepsis and mortality and help save millions of healthcare dollars. Other catheters like triple-lumen catheters and PICC lines, where biofilm forms, can be similarly modified.

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