Urinary tract infections (UTIs) result in 3.6 million office visits each year and greater than 100,000 hospital admissions in the United States annually[1]. In fact “Catheter-associated UTI (CAUTI) is the most common cause of nosocomial infections in the United States and is also considered the most common source of gram-negative septicemia in hospitals”[1]. Urinary tract infections result when bacteria enter the patient’s body from outside the catheter.

The product, antibacterial Foley catheter was designed based off the customer needs established by Dr. Jaffe. He had requested that the final product be antibacterial, easy to use, biocompatible, cost effective, and feasible manufacturability. To test the efficacy of our antibacterial Foley catheter against urinary tract infections, we designed a Foley Catheter that was able to eliminate bacteria with an antibacterial copper coating in conjunction with a dc stimulus of 500 μAmps. Samples of silicone coated with copper were tested in several mediums of growing E. Coli and S. Aureus. After some hours of incubation, inhibition zones were found around each sample. Further, upon testing the effect of the electrical current on bacteria, inhibition zones were found around each electrode.

As you can see in Figure 2 the portion of our catheter that is coated with the antibacterial copper is coated with our nano copper. The entire catheter is not coated. The electrical components are located outside the body. The current placed on the catheter through the use of a copper conductive strip. The copper conductive strip and the copper coating do not come in contact, so current does not travel through the entire length of the catheter.

Customer Needs

Customers needs established by our customer:

- Antibacterial
- Cost Effective
- Biocompatible
- Easy Operation
- Feasible Manufacturability

Design Concept

After evaluating our designs, we were able to determine which design fulfilled our customer needs. Our final design incorporates a small electrical current and antibacterial copper powder to eliminate the occurrence of CAUTI. The circuit is composed of a 9 volt battery, 15 k resistor, LED, and switch. The calculated current output is 600 microAmps. See Figure 1.

Test Results

Figure 2: Diagram demonstrating our design concept.

Figure 3: Testing the efficacy of Nanocopper on bacterial. The red circle encompasses the bacterial inhibition ‘killzone’ around our catheter material.

Figure 4: Apparatus for testing the efficacy of electrical stimulus on E. Coli. The petri dishes were place in an incubator for 24hrs at 37 C while being stimulated with about 600 microAm.

Figure 5: The results of testing the effects of an electrical stimulus on bacteria. Here we had one inhibition zone around the negative electrode. This indicated that the bacteria were polarized.

Figure 6: The results after reversing the polarity. Notice the large inhibition zones around each electrode.

References