2016

# Low Cost Sterilization

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BIOMEDICAL

# Low Cost Sterilization

CAPSTONE DESIGN EXPO 2016

## Clinical Need

In developing countries, there is a need for a low cost product that is sustainable while maintaining sterilization standards. Inadequate sterilization in developing countries has led to disease transmission, infection and even death. While autoclaves are the current gold standard for sterilization, they are often rendered useless after breaking, as the cost to repair and maintain them is incredibly high. Diluted bleach is an effective alternative for disinfection but leads to the destruction of surgical tools over time, does not destroy spores, and is unsustainable.

## Project Objective

The objective of this project was to develop a sterilizing product that lowered the bacteria survivability on medical tools before patient contact.

The project deliverables are:

1. Model
2. Prototype
3. Testing Results

## Design Requirements

| | |
|---|---|
| LOW COST | Cost efficient in comparison to current method |
| DURABILITY | The longer the product is effectual the more money is saved |
| EASE OF USE | Easy operation to facilitate appropriate use |
| DEPENDABILITY | The operator must be able to trust that the product is working correctly |

## Design

The product reduces the amount of living bacteria on flat, metal tools by using **Pulsed Electric Fields (PEFs)**. PEFs generate an electric field between two metallic plates, one being the unsterile tool. When the bacteria is exposed to PEF for a short time, the membrane polarizes, causing cell lysis.

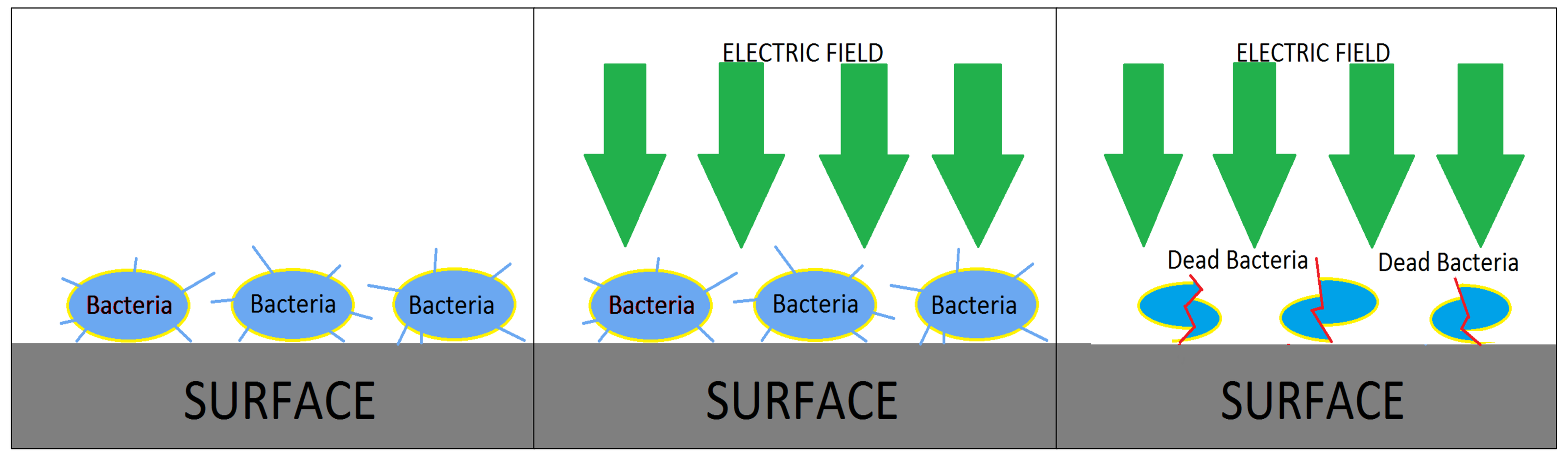


Figure 1: *Schematic of the electric field killing bacteria on the surface of a flat, metal tool*

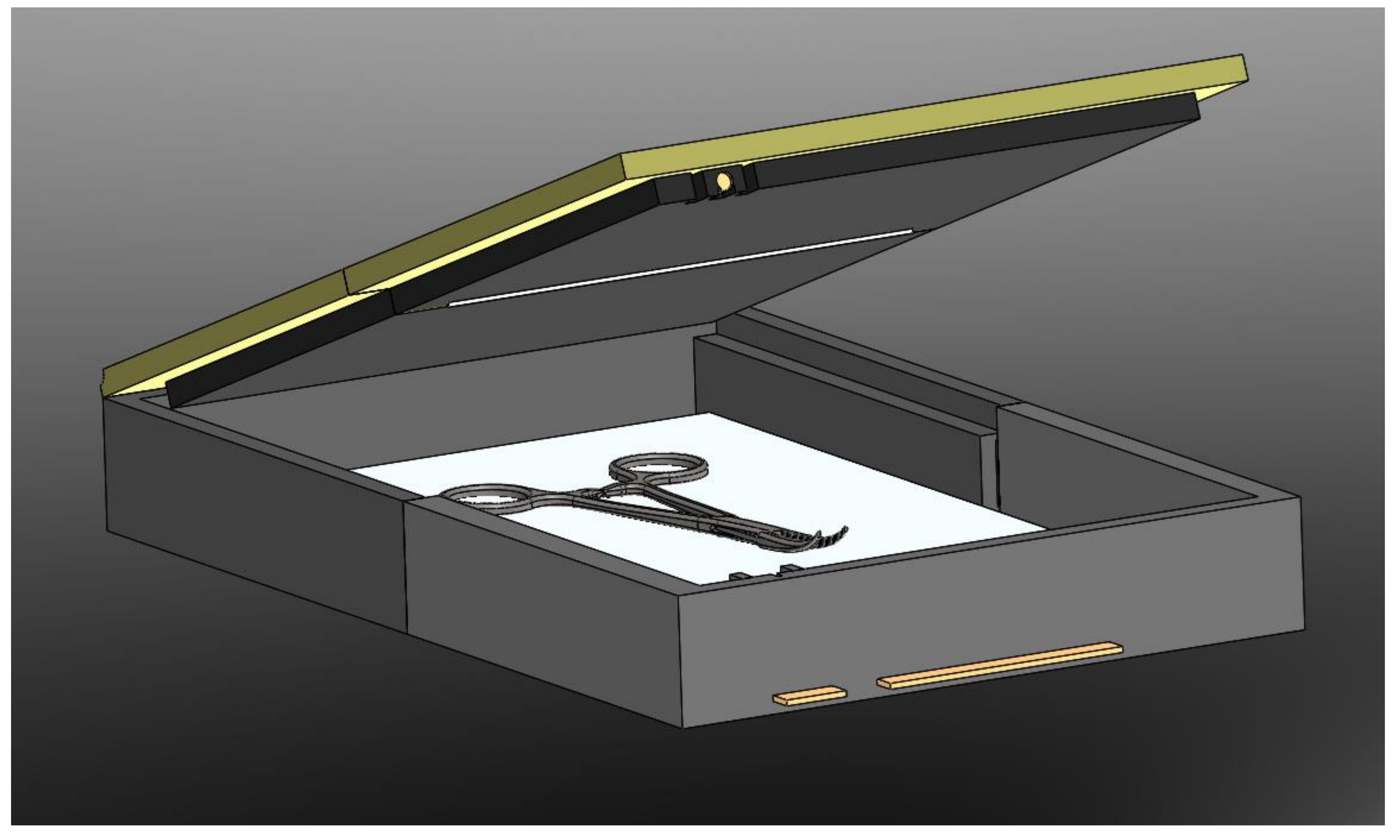

Figure 2: *SolidWorks model showing the prototype configuration with a flat, metal tool*

Soaking the tools in regular tap water creates a suitable environment for the prototype. The DC/AC treatment allows a variation of effects to occur as a result of the build up of a transmembrane-induced voltage on the bacterial membrane: current-based membrane degradation, electrically-induced dehydration, and a degree of time-dependent **electroporation**.

## Results

Power Difference

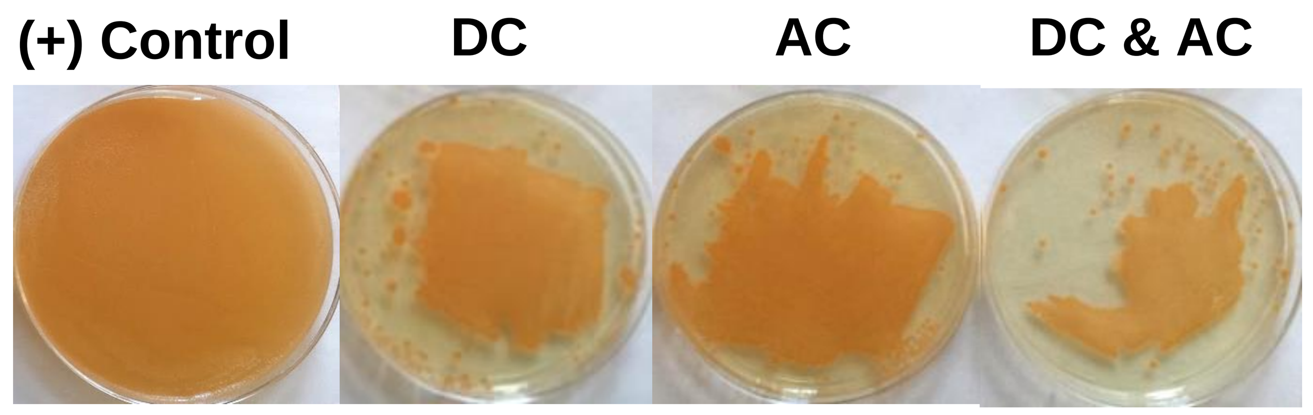


Figure 3: *Results from applying different types of voltage sources to bacteria through electric fields*

Plate Area Difference

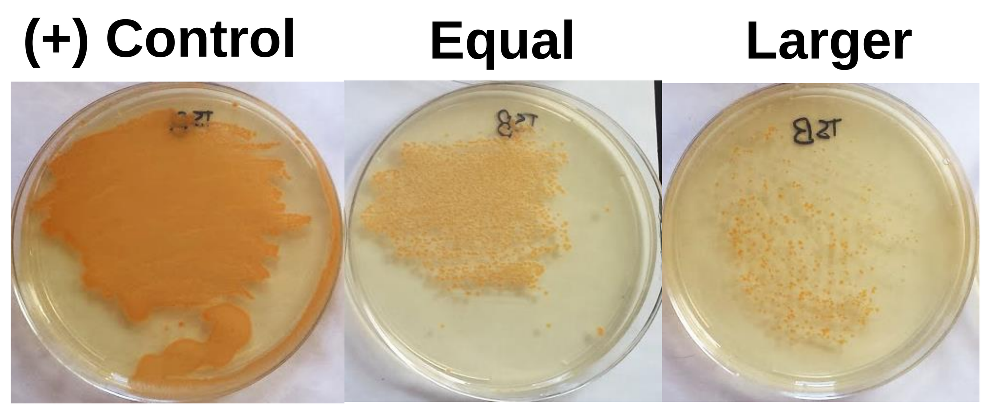


Figure 4: *Results from varying the size of the capacitor plate with respect to the size of the tool*

Time Difference

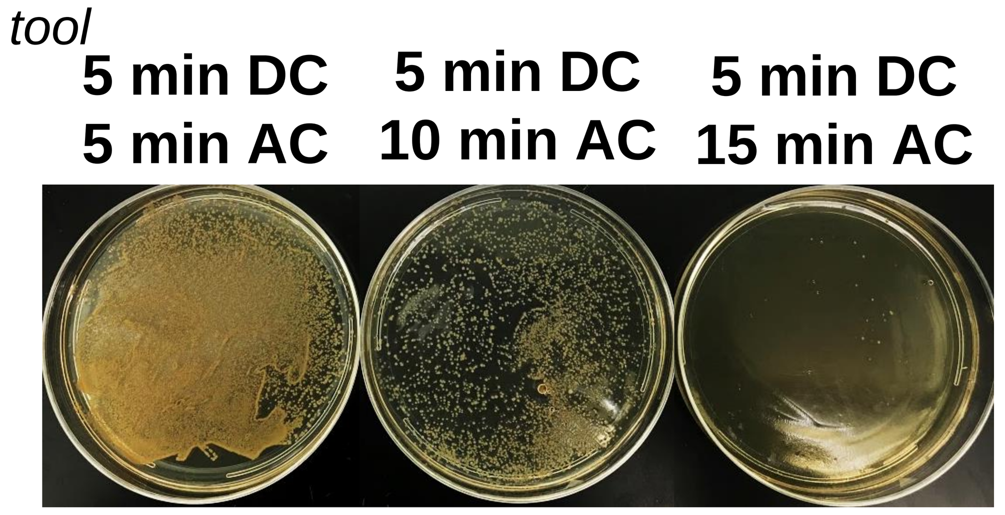


Figure 5: *Amount of bacteria remaining after applying DC/AC voltage for varying durations*

## Acknowledgements

**Dr. Daniel Conway**

*For mentorship and guidance throughout the project*

**VCU School of Engineering**

*For providing resources and support*

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Make it real