**Introduction:** The goal of this study was to create a three dimensionally designed biomedical device with multiple functionalities and analyze its simulated heat transfer.

- The device would be fabricated through additive manufacturing; specifically electron beam melting (EBM).
- EBM has a feature size constraint of 1 mm (acceptable for this design) and is only capable of manufacturing titanium alloys [2]; a biocompatible metal commonly used in the medical implant market [1].
- Silicon IC chips are used as attached functional elements.

**Computational Methods:**

- The design was simulated to test its functionality in a way similar to that of a heat sink channel [3].
- It contains three separate domains (see figures 1 and 2)
  - A helix shaped titanium body with channels running through the center of each vessel
  - 16 silicon chip components that generate heat (each having the same power consumption)
  - Water running through each channel for cooling
- The water had a starting temperature of 283 K while the power dissipated from the silicon chips as well as normal inflow velocity of the water were modified to see how they affected the output temperatures.

**Results:**

- The volume temperature in figure 3 shows temperature highest at the bottommost located heat sources (silicon chips).
- The water in the channel as well as the titanium show an increase in temperature moving down the structure.
- In figure 5, there is a decreasing exponential relationship and in figure 6, a linear relationship.

**Conclusions:** It was determined from this simulation that:

- As flow rate increased, the output temperature was lower.
- The output temperature increased with increasing power from the system.

From these observations, we can conclude that the devise design and characteristics can be optimized through this COMSOL analysis.

**References:**