Quality in the Biomedical Sense

As a student in engineering, I have become increasingly aware of the importance of quality. Quality plays a role in motivating every person’s daily actions and routines from the mundane tasks of deciding what to eat for breakfast, to developing critical thinking skills to help solve some of the world’s problems. One such field where quality plays a defining role is in the field of biomedical engineering. Here, I’ve found that any intervention performed could mean benefits ranging from providing temporary relief to a single minor condition up to developing a cure to a life-threatening ailment for millions of people.

In the field of biomedical engineering, and perhaps in all engineering, quality seems to be determined in two stages. For the first stage, the engineer must be attentive and listen carefully to the situation at hand – specifically to the actual patient to make sure the true “voice of the customer” is understood as to the desired results. These objectives may be in the form of reduced pain, increased mobility, or greater independence to name a few. Once the objectives are clearly established, then root cause investigation can take place to solve the engineering problems toward them. Like brainstorming a breakthrough product for a business, these assessments make up the foundational step of determining the necessary standards of quality for the upcoming stage to reach maximum patient satisfaction.

This next stage of quality is defined in the overall execution of achieving the desired results. This is where the performance is critiqued based on the standards and corresponding procedures defined from the initial problems. I see this being analogous to an architect that must first listen carefully to the client and draw up a blueprint of the desired results, forming a “promise of quality.” The building must then be built and realize the promised outcomes of the vision, known as the “outcome quality.” Not unlike an architect planning for the unforeseen uses
and demands on a building, the biomedical engineer must design for a variety of stresses. The design must be robust to its environment, a key quality feature. To prepare solutions for such situations, engineers utilize their developed biomedical products and procedures in multiple experiments and virtual replications that simulate and test the proposed solutions under many possible conditions.

These stages of quality were made apparent to me in my engineering class, where my classmates and I performed a simulation project on the flow analysis of a one-degree inferior vena cava filter. To perform this, we first identified the critical scenarios this device would be applied to with the objectives the device would have to satisfy. In this case, the filter was designed to be a temporary solution to prevent blood clots that stem from a serious injury or medical condition from traveling through the vena cava and causing fatal pulmonary embolisms. The filter design was then replicated on 3D computer-aided design modeling software according to real-world specifications found on the filter’s official website and then imported to a separate 3D modeling and simulation program, where a blood vessel section with the appropriate walls and openings was designed to encase the filter. This compound model was then tested by running it through our blood flow simulation and analyzing it via a series of miniscule triangulated elements throughout the model that would accurately determine the blood flow velocities at any position with the filter at designated clot occlusion levels. It was imperative that the number of elements be as many as possible to best replicate the real-world situation of the blood flowing at any point through the vessel and around the filter.

Through what has been demonstrated, I found the field of biomedical engineering is certainly no stranger to quality as it plays a vital role in determining the highest standards of patient care and the most effective solutions to given health-related issues. These are formed
from the foundation of the given problem's assessment, where the biomedical engineers must listen to their patients and be their advocates through the process of science and engineering to achieve the desired results. They must then come through and leverage their engineering capabilities and practices to execute these procedures according to the established standards in real, operational outcomes. Ever since I exercised these capabilities with my classmates in our own project, I now have a better understanding and appreciation for the concept of quality in my field of engineering.