

## **“Johnson Health Tech: Adaptive Indoor Rower for Wheelchair Users”**

### **402 - Excellence - 5- Adaptive Rower - Executive Summary**

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Exercise is essential for maintaining a healthy lifestyle; however, the majority of exercise equipment is inaccessible to individuals with lower extremity disabilities/injuries. In the U.S. alone, an estimated three million people require wheelchairs, and despite this large consumer base, the market for adaptive exercise equipment remains largely untapped. Rowing machines are especially beneficial to this demographic because combined cardio and strength training can help individuals in wheelchairs maintain and improve their upper-body strength. The British Columbia Institute of Technology designed an Adaptive Rowing Machine (AROW) that modifies a Concept2 industry rower by permanently replacing the machine’s original functionality with a wheelchair-accessible design. While this device successfully adapts a rowing machine for use by individuals in wheelchairs, fitness centers are unlikely to include the AROW machine in their floor plans because of limited space and the need to cater to the majority. This BME design project concentrated on creating a convertible device that extends the versatility of an adapted rowing machine and increases its marketability.

After researching competing designs and the biomechanical movements induced while rowing, multiple preliminary design options were created and evaluated according to several design criteria. Most importantly, the design must accommodate and stabilize a wide variety of users, provide a comparable upper-body workout between both sides of the rower, and allow easy access to the console and resistance adjustment mechanisms. After numerous iterations spanning three semesters, the final design consists of an antler-like structure and associated pulley, a stabilization frame, a resistance adjustment mechanism, and a console rotation mechanism. The antler-like structures hold the rowing handle in a central position that allows easy access from both the standard and adaptive sides of the rower, which are positioned 180° from each other. The metal stabilization frame secures individuals and wheelchairs of varying sizes by supplying a downward force that prevents translation and tipping. Based on the orientation of the stabilization frame, the console automatically rotates to face the side of the machine currently in use so that the workout metrics remain visible. The user may also alter the intensity of their workout by operating a user-friendly interface that adjusts and displays the resistance level. Throughout the project, each design component was iterated several times to improve the durability, functionality, and aesthetic appeal of the overall design.

The project recently received IRB approval to conduct EMG and usability testing. Data from EMG analysis revealed that the levels of muscle activation of the bicep, rear deltoid, and latissimus dorsi were comparable between the adaptive and standard sides for respective resistance levels. More extensive EMG testing is required to confirm these preliminary results. To gauge the usability of the device, 11 individuals using both sides of the machine and three individuals in wheelchairs using only the adaptive side of the machine filled out surveys based on their experience; this analysis is ongoing. Overall, this convertible design addresses all the design criteria and thereby permits users to pursue an active, healthy lifestyle using the adaptive rowing machine.