Optimizing Operation of Sample Preparation Device For Blood-Borne Pathogen Diagnostics

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Introduction: Blood sample preparation is a prerequisite in diagnostic testing for blood-borne diseases such as Hepatitis C Virus. However, current methods are too complex and expensive to use in a widespread testing application. The lab has previously developed a point-of-care friendly device that utilizes microfiltration and RNA binding magnetic microparticles to process small volumes of blood to be converted into an RNA sample that is suitable for diagnostic testing. This work explores optimizations to the device in addition to a secondary device that was designed to increase throughput and optimize user operation and ease of use.

Methods: Fusion 360 was utilized to design the optimizations and the secondary device. The pieces were printed using a Stratasys 3D Printer. They were then chemically washed for 5 hours and dried in an oven.

Results: A sliding mechanism was designed for the upper magnet, replacing the need to flip the upper magnet to a position where it would not interact with the lower magnet. This allowed for a quicker transition between the operation of the upper and lower magnets, increasing efficiency for mixing the magnetic particles within the cartridge chambers. The filter module was redesigned with quick side-release buckles, removing the need to glue together the filter module. This enabled faster assembly time and limited assembly variability. Separately, a secondary device was created with parallelized cartridges, a movable lid, and external pieces with which to guide multiple magnets simultaneously. Multiple cartridges were able to be tested concurrently, allowing for increased throughput.

Figure A

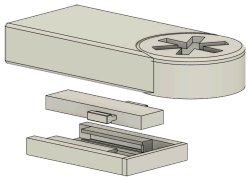

Figure B

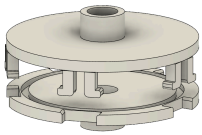

Figure C

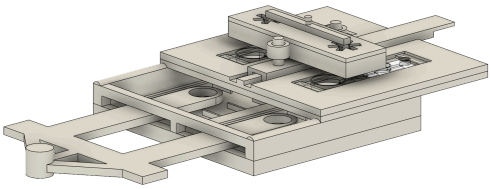

Figure A. Upper Magnet Sliding Mechanism. **Figure B.** Redesigned Filter Module **Figure C.** Secondary Parallelized Multicartridge Device

Conclusions: The redesigned filter module and the added sliding mechanism to the upper magnet reduced complexity of assembly and operation of the device. Future work includes expanding the number of cartridges in parallel, further increasing throughput, as well as integrating PCR instrumentation into the device to allow for an all-in-one sample preparation and detection device.

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