

Project Design Specifications—Bioreactor Cassette

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Team: Ali Johnson, Kim Kamer, Elise Larson, Laura Zeitler

Client: Derek Hei, PhD – Technical Director, Waisman Clinical Biomanufacturing Facility

Advisor: Willis Tompkins , PhD

Function:

The bioreactor cassette will provide appropriate conditions to culture multiple samples (from different patients) of stem cells without exchanging media between samples. The cassette will be transparent and have an area of approximately 500 cm². It will facilitate confluent growth and adherence by encouraging appropriate fluid flow coverage. The perfusion interface will allow variable control of flow rate and volume of nutrient media supplied to each cassette, while maintaining physiological conditions within them. Both components will be sterilizable with gamma radiation or autoclaving, and composed of polymers not known to affect stem cell fate. The cassette and interface will be designed such that sterility can be maintained if iPS cells need to be removed from the bioreactor for microscopic viewing.

Client Requirements:

- Steam and gamma sterilizable
- Connects to bioreactor interface and allows variable media flow
- Gas-impermeable cell growth plates
- Optically transparent
- Monitor pH
- No extractables in contact with media

Design Requirements:

1) Physical and Operational Characteristics

a) *Performance requirements* – Must provide an appropriate cell growth environment with proficient perfusion of media.

b) *Safety* – Must not contain any chemicals or substances that will negatively influence the cell, cell growth or initiate differentiation.

c) *Accuracy and Reliability* – Must provide appropriate culture conditions that do not initiate differentiation

d) *Life in Service* – Prototype: sterilizable, withstands repeated use (10 times?) and fluid submersion. Keep in mind goal for mass-produced product: One-time use, up to 1 month

e) *Shelf Life* – Able to withstand a basic medical storage environment

f) *Operating Environment* – Must work properly at 37° C and in constant exposure to a liquid media.

g) *Ergonomics* – Should not interfere negatively with the users ability to monitor the cells.

h) *Size* – Cell growth area of at least 300 cm², fluid compartment depth of 2mm

i) *Weight* – Under 1 kg/cassette

| j) *Materials* – sterilizable, transparent, allow cell growth, not influence differentiation

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k) *Aesthetics* – Transparent cell plate

2) Production Characteristics

a) *Quantity* – One, but should be designed with the intent of mass production in the future.

| b) *Target Product Cost* – ~~\$400~~check against prototyping costs

3) Miscellaneous

a) *Standards and Specifications* – Uses USP Class VI Materials, adheres to Good Manufacturing Practice Guidelines and Good Tissue Practices

b) *Customer* – Medical Research Community

c) *Patient-related concerns* – Must not negatively influence the cells

d) *Competition* – There are currently different culture systems but none that allow for several different samples with no exchange of media.