The primary needs of this project were to develop a reproducible and standardized menstrual effluent (ME) purification pipeline to minimize variability between samples and improve consistency of results. Effectively isolate exosomes and remove contaminants, cellular debris, and non-target biomaterials from ME samples.

Several constraints influenced the design and development of this project such as required compliance with BSL-2 laboratory protocols and proper handling and storage of biological samples. Risks included non-sterile samples, contamination, and biological heterogeneity, all of which could interfere with biomarker isolation and reduce reproducibility. From a global impact perspective, the project aimed to create a low-barrier diagnostic pipeline that could improve accessibility in both clinical research and healthcare settings with limited resources. Manufacturability constraints included limited equipment availability in a shared laboratory environment and reliance on ultracentrifugation equipment, which may limit scalability. Quality control and marketability considerations required the pipeline to remain compatible with established downstream analytical techniques to support future clinical adoption.

The engineering standards that affected this design included the BSL-2 biosafety standards, downstream compatibility standards, and sample handling standards. It is possible for a standardized ME purification workflow for exosomal studies.

Ethical concerns include obtaining informed consent, protecting participant privacy, and responsibly handling sensitive reproductive health data. Societal concerns involve disparities in access to endometriosis diagnosis, as many individuals experience delayed diagnosis and reduced quality of life.

Although this was a single-person project, collaboration occurred through regular communication with the project mentor and through literature reviews incorporating differing scientific perspectives. All project tasks and subprojects were self-managed, requiring strong organization and initiative. Goals such as effective isolation and reproducibility remained priorities throughout the project, while constructive feedback from mentors helped improve methods and troubleshoot challenges. Motivating factors included understanding the relationship between exosomal cargo and endometriosis biomarkers, addressing the lack of standardization in ME research, and overcoming challenges such as contamination, non-specific bands, sample heterogeneity, and equipment limitations. One of the most innovative aspects of this project was optimizing purification methods to improve exosome purity and yield while maintaining scalability for future clinical research and commercialization potential.