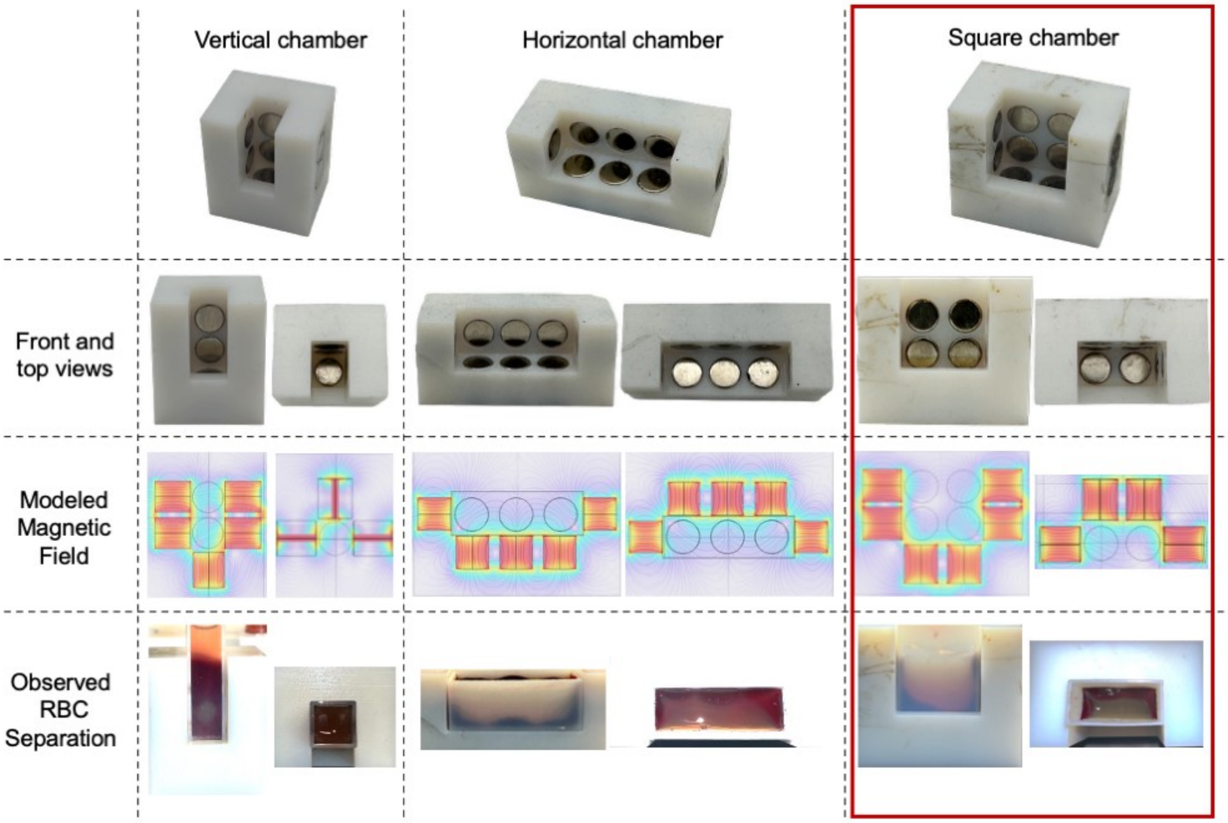
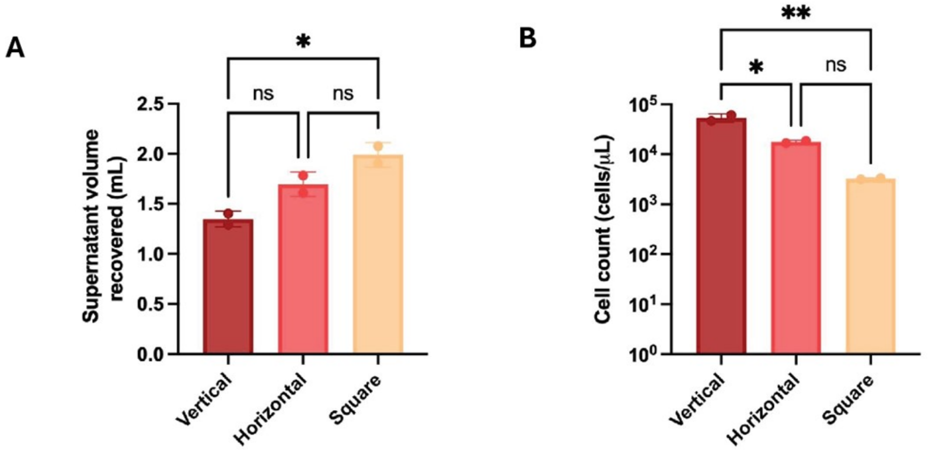
SUPPORTING INFORMATION

Supplementary Table 1. Current plasma separation devices for point-of-care applications. References indicated from main text.

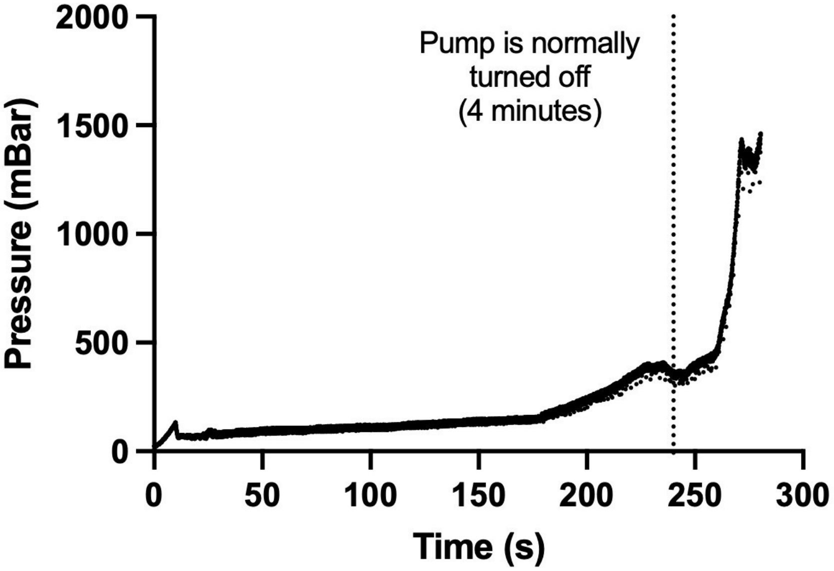
Study	**Automated**	**Large-volume processing** **(≥ 2 mL)**	**Minimal dilution**	**High plasma yield** **(≥ 75%)**
Liu et al. 2016 (36)	-	-	+	-
	Manual removal of plasma with micropipette	0.2 mL	No dilution	~70%
Liu et al. 2013 (37)	-	-	+	-
	Manual removal of plasma with micropipette	1.8 mL	No dilution	~34%
Su et al. 2020 (35)	-	-	+	+
	Manual removal of plasma with micropipette	0.4 mL	No dilution	~97%
Ayers/Victoriano et al. 2024 *(our previous work)* *(39)*	-	-	-	-
	Manual removal of plasma with syringe	0.05 mL	10x dilution	~40%
Victoriano et al. 2025 *(our work)*	+	+	+	+
	Automated removal of plasma with mini peristaltic pump	5 mL	1.1x dilution (Mixing with anti-RBC magnetic beads)	~75-80%



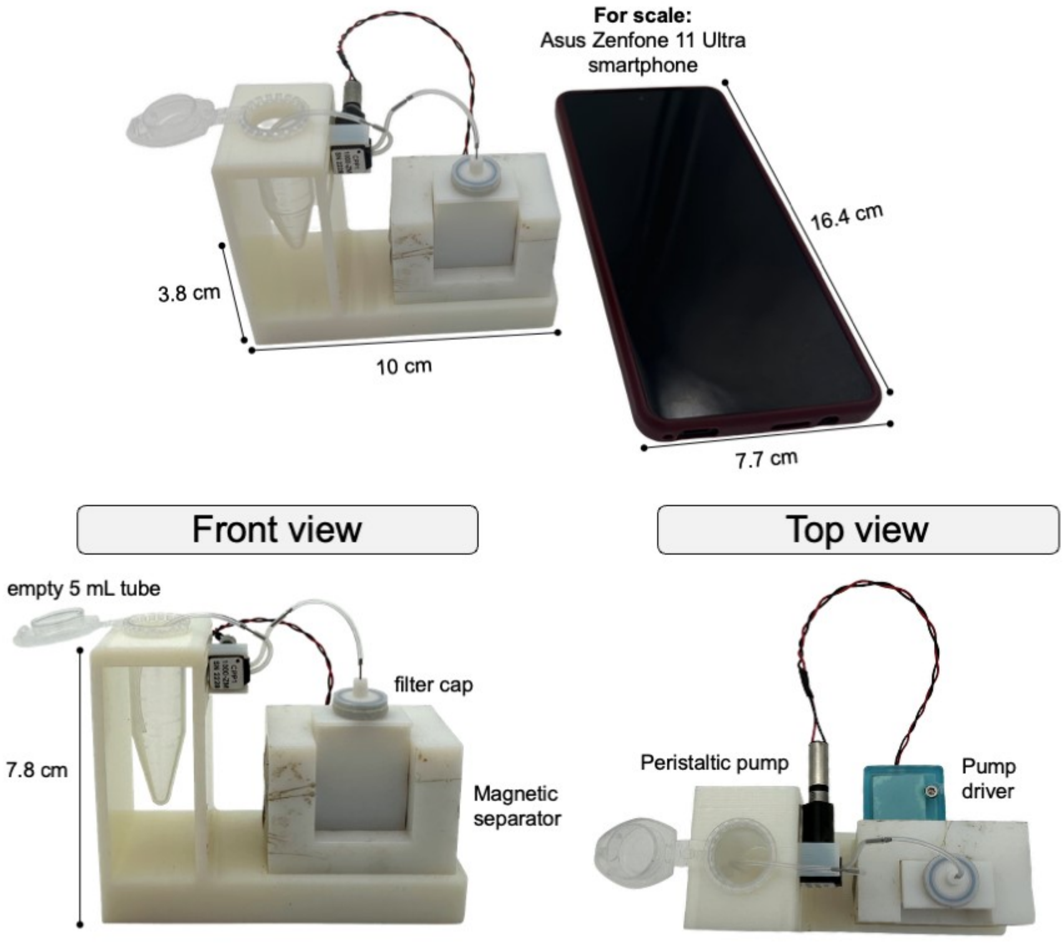
Supplementary Figure 1. Magnetic field simulations compared to observed RBC separation for three magnetic separator prototypes. Observed RBC separation correlated well spatially with magnetic field simulations across all prototypes. RBCs were drawn to areas of high magnetic field strength while RBC-depleted plasma accumulated in areas of low field strength.



Supplementary Figure 2. Quantitative analysis of RBC-depleted supernatant recovery and cell separation efficiency of magnetic separator prototypes. (A) Volume yield of each magnetic separator prototype after 5 minutes of magnetic separation. Prototype #3 yielded an average of 1.990 mL of supernatant, compared to 1.696 mL and 1.348 mL for Prototypes #1 and #2, respectively. **(B)** Cell separation efficiency across magnetic separator prototypes. Prototype #3 yielded the lowest cell concentration in RBC-depleted supernatant, with 3,233 remaining cells/μL, compared to 53,417 and 17,624 cells/μL for Prototypes #1 and #2, respectively. Error bars in all figures indicate mean ± standard deviation. ****$p<0.0001$, ***$p<0.001$, **$p<0.01$, *$p<0.05$



Supplementary Figure 3. Transmembrane pressure buildup during filtration. Transmembrane pressure was measured over time using a positive-pressure configuration at the operating flow rate. Pressure increased gradually during the initial phase of filtration, reaching ~340 mBar (~5 psi) at 4 minutes, corresponding to the standard operating endpoint. Beyond this point, pressure rose sharply to ~1400 mBar (~20 psi), consistent with progressive membrane fouling and eventual clogging due to red blood cell accumulation.



Supplementary Figure 4. **Additional views of the core components of PlasmaLIFT system.** Front and top views of PlasmaLIFT setup are shown, along with comparison to a smartphone (Asus Zenfone 11 Ultra) for scale.

Supplementary Materials and Methods

Projected Per-Sample Cost of Immunomagnetic RBC Depletion at Manufacturing Scale

To estimate the reagent cost of immunomagnetic red blood cell (RBC) depletion at manufacturing scale, we modeled a two-component system consisting of bulk carboxyl-functionalized magnetic beads covalently conjugated to anti-Glycophorin A (anti-CD235a) monoclonal antibody via EDC/NHS carbodiimide chemistry. All estimates apply to a 5 mL whole blood input volume. First, to estimate bead mass per sample, we estimate a working concentration of 10 mg/mL for 500 µL of bead suspension, consistent with published immunomagnetic cell depletion protocols[1], which yields an applied bead mass of ~5 mg per sample.

Next, we estimate cost of antibody conjugation. Carboxyl beads are activated with 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC) and N-hydroxysuccinimide (NHS), forming stable covalent amide bonds between bead surface carboxyl groups and primary amines on anti-GlyA antibody[2]. EDC and NHS are commodity reagents (~$0.01/reaction) and are not a meaningful cost driver. At a loading density of 30 µg antibody per mg beads and 50% saturation, the effective antibody requirement is ~75 µg per sample. Non-biotinylated anti-GlyA monoclonal antibody at OEM scale is estimated at $5-15/mg[3,6].

Using the EDC/NHS attachment chemistry, carboxyl magnetic beads are available from multiple suppliers at substantially lower list prices than premium IVD-grade formats. Advanced BioChemicals (Lawrenceville, GA) lists carboxyl magnetic beads at $745 per gram (20 mL at 50 mg/mL; Cat. #MBFB-04001)[4], which serves as the research-scale reference price. OEM bulk procurement contracts in the diagnostic reagent industry are typically subject to discounts of 10-90% relative to list price[3,5]; applying a 90% discount yields an estimated OEM cost of ~$75/g. At 5 mg per sample, the bead cost is approximately $0.38. The Anti-GlyA antibody is estimated to cost $10/mg at the OEM scale[3,6]. Table S1 estimates the total cost per sample at ~$1.19, although we note precise per-sample costs depend on titration optimization and supplier negotiation.

Supplementary Table 2. Estimated per-sample material cost for immunomagnetic RBC depletion using carboxyl bead/EDC-NHS chemistry at OEM scale (5 mL whole blood).

Component	Qty / 5 mL sample	Estimated cost
Carboxyl magnetic beads (~$75/g OEM est.)	5 mg	$0.38
Anti-GlyA mAb, unconjugated ($10/mg OEM est.)	~75 µg	$0.75
EDC/NHS crosslinker (amortized)	—	$0.01
Buffer / excipients (PBS, MES, BSA)	—	$0.05
Total per sample	—	~$1.19

References for Supporting Information

1. Majonis D, et al. Assessment of streptavidin bead binding capacity to improve quality of streptavidin-based enrichment studies. J Proteome Res. 2021;20(5):2695–2704. doi:10.1021/acs.jproteome.0c00956

2. Hermanson GT. Bioconjugate Techniques. 3rd ed. Academic Press; 2013.

3. Desai NR, et al. An approach to include the cost of consumables in biochemistry analyzer procurement on the reagent rental model alleviates hidden expenses. J Lab Physicians. 2024; PMC11536279.

4. Advanced BioChemicals. Carboxyl Magnetic Beads (Cat. #MBFB-04001). 20 mL at 50 mg/mL; list price $745.00/g. advancedbiochemicals.com (accessed 2026).

5. Vogler S, et al. Comparative price analysis of biological medicines: disparities generated by different pricing policies. Front Pharmacol. 2023;14:1256542. doi:10.3389/fphar.2023.125654