

In Vitro Clearance Performance of the Manual Single Lumen Alternating Micro-Batch (mSLAMB) - Potential Use in Austere Medical Environments

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Introduction

- Most blood-based renal replacement therapies (RRT) use a double lumen access catheter.
- A single lumen alternating micro-batch (SLAMB) has been developed; a variation of this single-lumen system is the manual SLAMB-HF (mSLAMB) kit.¹
- mSLAMB does not require electricity, a battery, or a pump. It uses syringes and gravity, making it potentially useful for medical situations in austere environments.

Purpose

- **To determine if the mSLAMB can achieve adequate small solute clearance.**

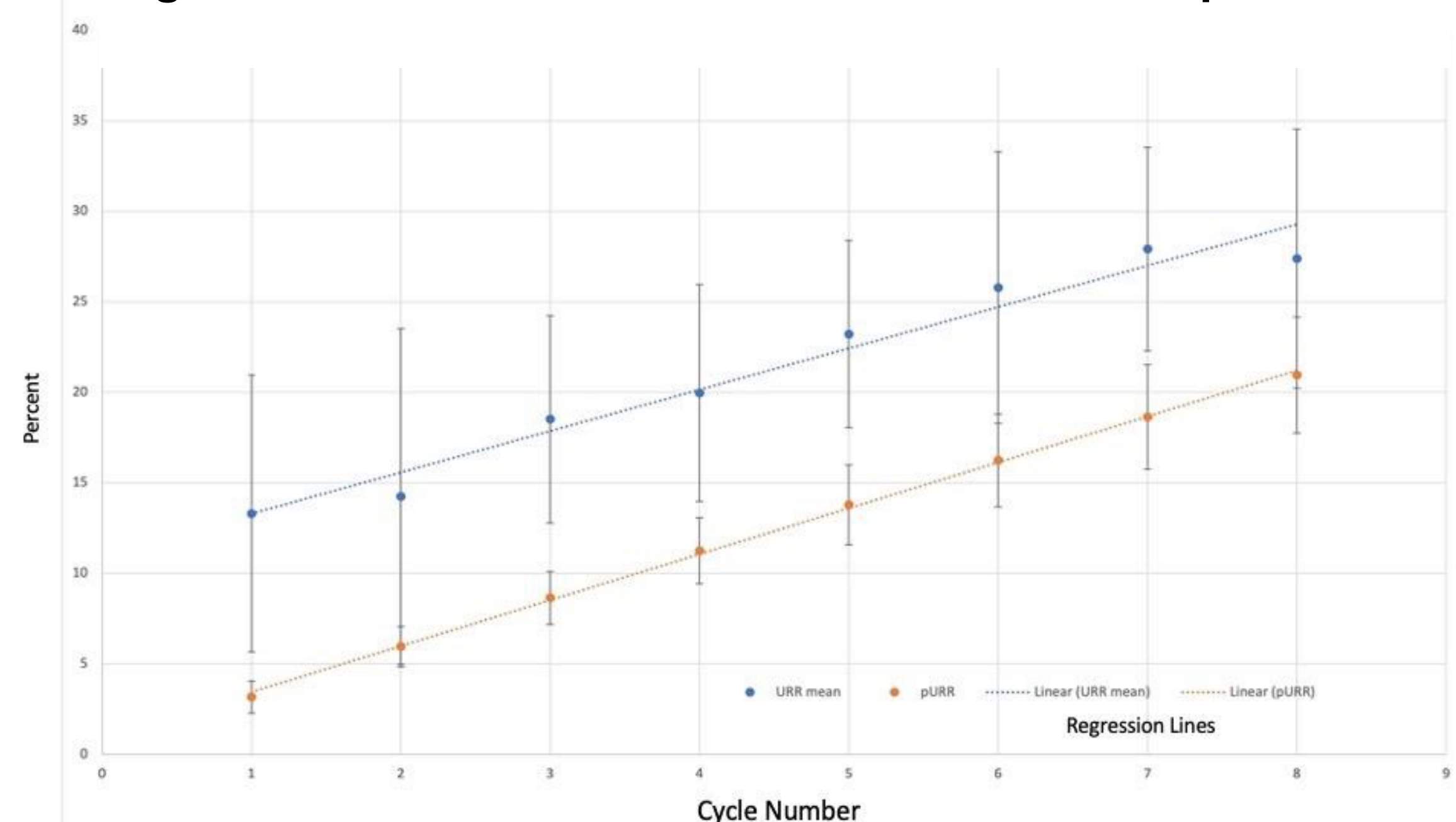
Methods

- *In vitro* clearance experiments were conducted with the mSLAMB.
- mSLAMB was connected to a 2-liter bag of a mixture of expired blood and 0.9% NaCl, which was spiked with urea to achieve a blood urea nitrogen (BUN) concentration of 50 - 120 mg/dL. Expired blood has a potassium level of 9.9-16.6 meq/L.
- Three sets of experiments were conducted, each with a different ratio of hemofiltration fluid to blood volume.
- The first set was hemofiltration series in a one-to-one ratio, with 100 cc of blood and 100 cc of hemofiltration fluid pulled. Our second and third sets of experiments had a one-to-two ratio and a one-to-three ratio, respectively.
- Three different dialyzers were also tested: Polyflux 6H, Rexeed 25S, and Nipro Cellentia 17H.
- Eight cycles were performed, and the urea and potassium concentrations were measured after each cycle.
- The data were normalized by percent removed.

Results

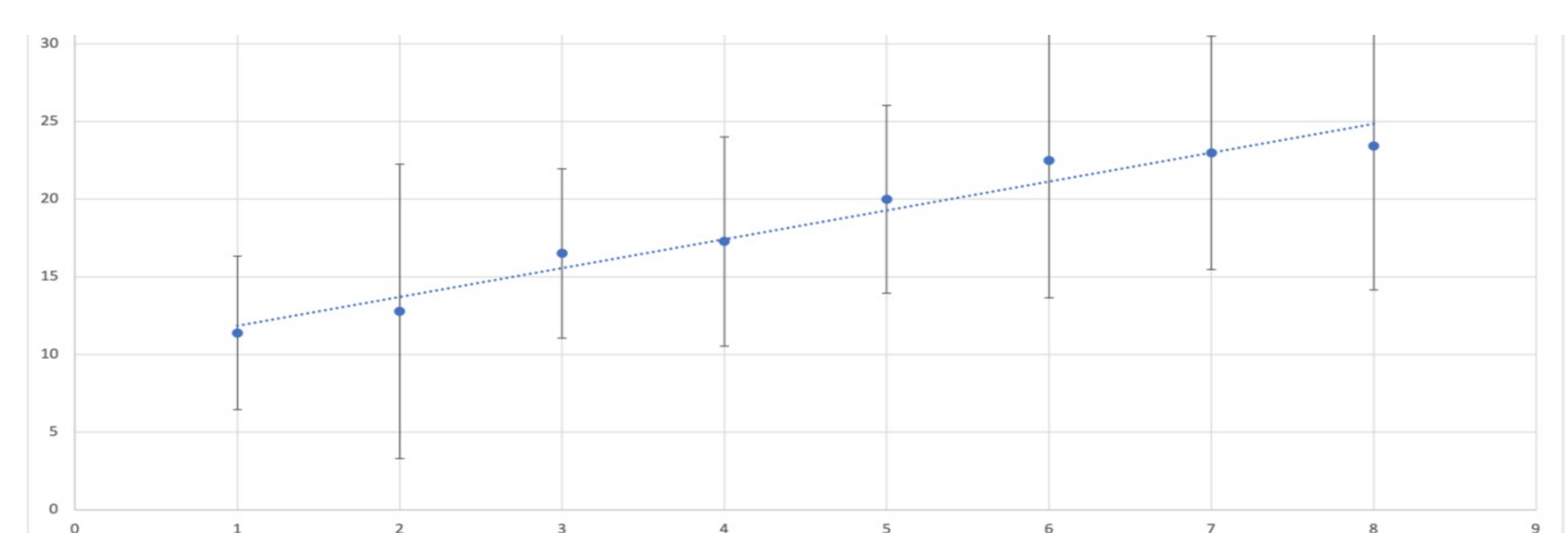
- The mean urea reduction ratio (URR) was $27.4 \pm 7.1\%$ after 8 cycles. The predicted URR was $20.9 \pm 3.2\%$.

Figure 1: Actual vs. Predicted URR Across All Experiments



- The mean percentage reduction of potassium was $23.4 \pm 9.3\%$.
- Mean cumulative URR after each cycle was : (1) $13.3 \pm 7.6\%$, (2) $14.3 \pm 9.3\%$, (3) $18.5 \pm 5.7\%$, (4) $20.0 \pm 6.0\%$, (5) $23.2 \pm 5.2\%$, (6) $25.8 \pm 7.5\%$, (7) $27.9 \pm 6.6\%$, (8) $27.4 \pm 7.1\%$.
- Mean potassium reduction for cycles 1-8 were: (1) $11.4 \pm 4.9\%$, (2) $12.8 \pm 9.5\%$, (3) $16.5 \pm 5.4\%$, (4) $17.2 \pm 6.7\%$, (5) $20.0 \pm 6.0\%$, (6) $22.5 \pm 8.8\%$, (7) $23.0 \pm 7.5\%$, (8) $23.4 \pm 9.3\%$.

Figure 2: Avg. % Reduction of Potassium Across All Experiments



- Clearance rates did not differ between the three different filters and membrane types.
- The largest reduction percentage for both urea and potassium occurred after the first cycle.

Conclusion

- The mSLAMB disposable system removes urea and potassium effectively.
- The efficiency of the mSLAMB was similar across three different sizes of dialysis filters and membrane type making it versatile.
- mSLAMB only requires manual syringe labor and gravity, allowing healthcare workers to offer dialysis in austere environments with limited resources. This creates a potential availability of dialysis services worldwide allowing medical professionals to treat people where they could not before.