Cell Catcher: new method to extract and preserve live cells from urine

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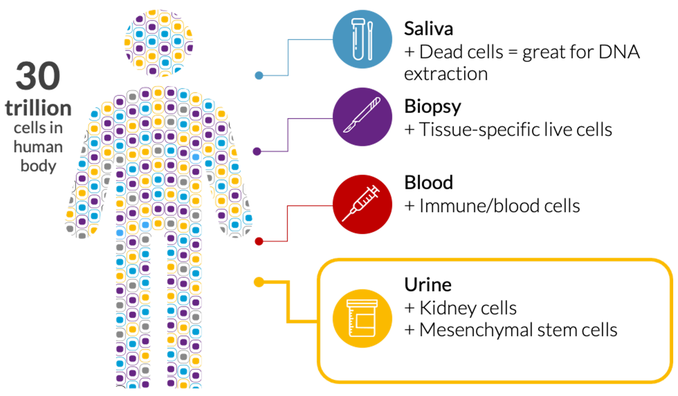
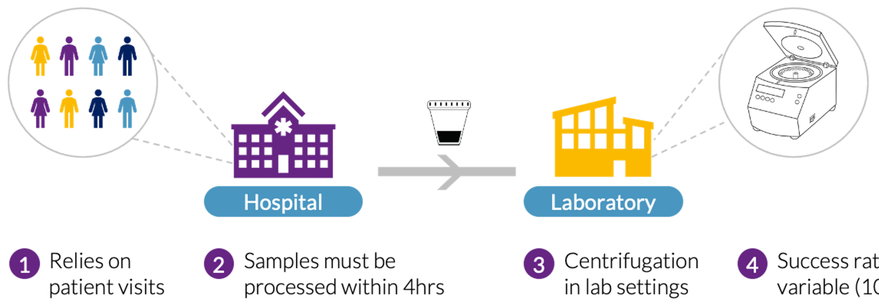
1 Background

Urine: a lesser known source of patient-specific cells



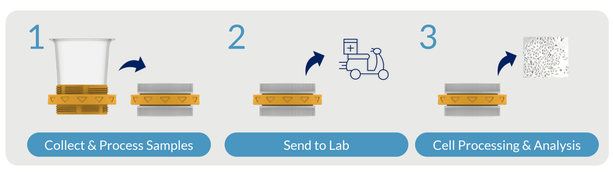
Current cell extraction protocol from urine samples: inconvenient and inconsistent



Optimising method of cell extraction from urine samples will improve cell yields impacting field of personalised medicine

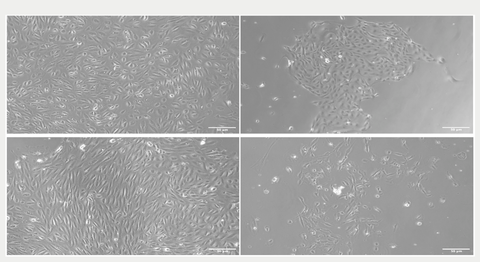
Study aims

Design and validate a point of care device that i) extends shelf life of samples, ii) fits into standard of care, and iii) standardises the method of extracting live cells from urine samples.



Results

4 Urine-derived cells heterogeneity



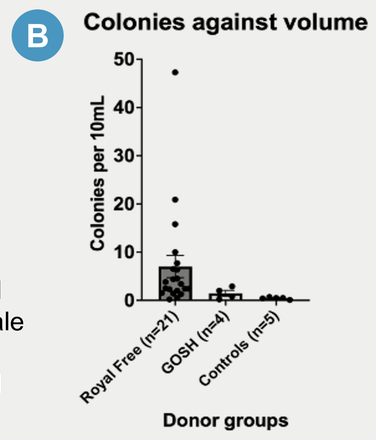


Figure 3. A. Representative images of different cell morphologies observed in urine derived cells. (Scale bar = 50µm.) **B. Variation in the number of colonies formed among patients with, or being predisposed to kidney disease** (n=30; error bar = ±SEM)

5 Conclusions and future directions

- **First study** to address methodological limitations of centrifugation to process urine samples to recover live cells.
- Demonstrated **increased efficiency** of the Cell Catcher to establish cultures from urine samples.
- Continuous work needed to improve device functionality and to release **mail-in kit**
- Further **cell characterisation studies needed** to determine the nature of morphological variation in urine-derived cells, potentially leading to **discovery of novel biomarkers in renal disease**

Results

2 *Feasibility study*: rationale behind the device

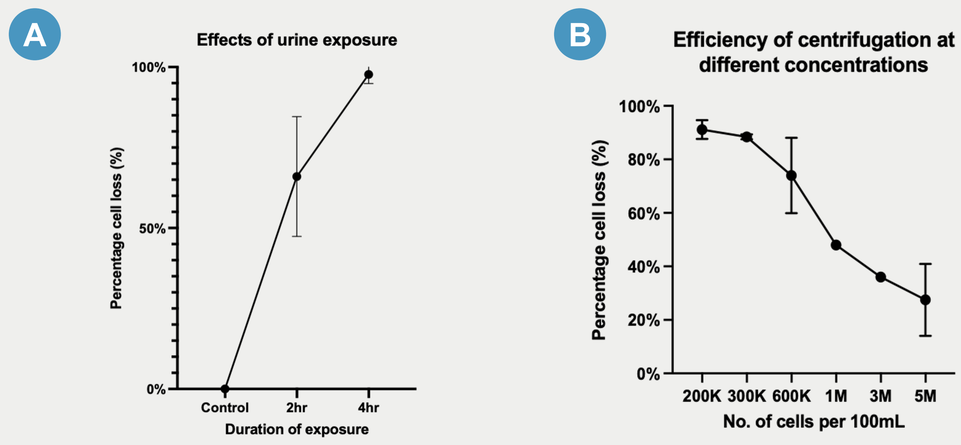


Figure 1. A. Effect of extended urine exposure on cell viability. IMCD3 cells were exposed to pooled human urine from 5 donors, for 2 and 4 hours. Around 65% cells were lost following 2hr exposure, and 90% were lost following 4hr exposure. (n=3, error bars= ±SEM) **B. Effect of centrifugation on cell recovery.** Different numbers of IMCD3 cells, suspended in PBS were centrifuged at 400g for 10min, to replicate conventional urine-processing protocol. Over 80% of cells are lost at low concentrations, compared to 25% at higher cell concentration. (n=3, error bars= ±SEM)

3 *Clinical validation*: Cell Catcher use improves success rate by 26.32 - 29.61%

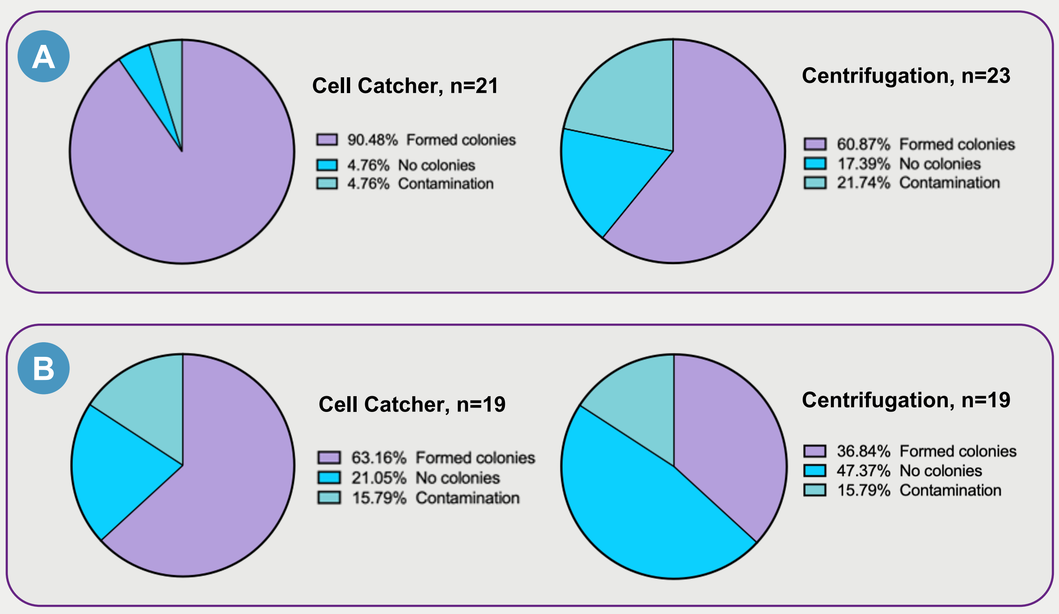
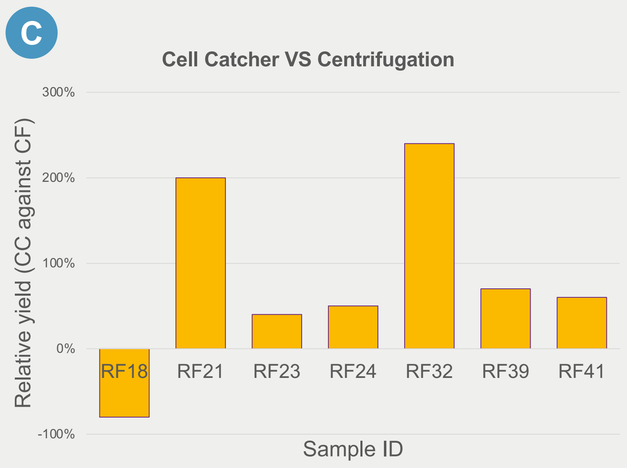


Figure 2. Cell Catcher clinic efficiency. A. Forty-four urine samples were collected from patients affected by genetic conditions (Renal tubulopathies (n=18), Bardet-Biedl Syndrome (n=15)) and controls (n=11). Twenty-one were processed in the Cell Catcher on site within 30mins of collection, while 23 samples were transported to the lab and centrifuged within 4 hours. **B.** Nineteen samples were collected from patients with renal tubulopathies. Each sample was split into two parts: half processed by the Cell Catcher, half centrifuged. Colonies were quantified 6 to 8 days post-collection using bright-field microscopy.



	CC	CF	Change
RF18	6	20	-70%
RF21	18	6	200%
RF22	2	0	n/a
RF23	20	14	43%
RF24	16	11	45%
RF30	2	0	n/a
RF31	1	0	n/a
RF32	10	3	233%
RF36	1	0	n/a
RF39	79	47	68%
RF40	7	0	n/a
RF41	142	88	61%

Figure 2. C. Split sample yield differences between Cell Catcher (CC) and Centrifugation (CF) fractions. Mean number of colonies in CC fraction was higher, compared to CF fraction (n=12, p-value=0.0098) On average, fraction of the sample processed in CC formed 80% more colonies, compared to CF (n=7).

References

Zhang Y *et al*. Urine Derived Cells are a Potential Source for Urological Tissue Reconstruction. J Urol. 2008;180(5):2226–33
Lazzeri E *et al*. Human Urine-Derived Renal Progenitors for Personalized Modelling of Genetic Kidney Disorders. J Am Soc Nephrol. 2015;1–14.
Bento G *et al*. Urine-derived stem cells: applications in regenerative and predictive medicine. Cells. 2020 Mar;9(3):573.

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