

# O8

## DEPUTI: A NOVEL DEEP LEARNING MODEL PERFORMS AS WELL AS EXPERIENCED MICROSCOPISTS AT DETECTING MARKERS OF URINE INFECTION

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### Introduction:

The current routine tests used to diagnose urinary tract infections (UTI) are not fit for purpose (1). Urine microscopy is an informative diagnostic test by enumerating urinary cells, but is time-consuming and laborious. We developed DeepUTI, our novel deep learning pipeline, to automate urinary cell counts using microscope images, and compared its accuracy against an expert microscopist in the identification of urinary cells to detect UTI.

### Method:

Patients with UTI were recruited and urine samples with corresponding lower urinary tract symptom (LUTS) score were obtained. Freshly voided, unprocessed urine was used to generate brightfield microscope images at x200 magnification. Microscope Image Analyzer (2) was employed to build DeepUTI using a UNet and resnet50 architecture. An independent microscopist trained DeepUTI to identify white cells (WBC), epithelial cells (EPC), and red cells (RBC). An image dataset was used to compare DeepUTI predicted cell counts to manual cell counts performed by a second independent, blinded microscopist.

### Results:

346 urine samples produced 4152 images. The mean age was  $35 \pm 9$  years, with the majority being female (198/211, 98.5%). The average participant had a LUTS score 4 (IQR 0-7) with pain being the predominant symptom. The average time for DeepUTI to perform counts was  $0.25 \pm 0.04$  seconds per sample, ~160 faster than manual counts ( $39.8 \pm 26.1$  seconds). DeepUTI achieved a mean absolute error  $0.05 \pm 0.04$ . Predicted counts and manual counts were highly correlated for all cell types (WBC:  $r=0.97$ ,  $p<.005$ ; EPC:  $r=0.96$ ,  $p<.005$ ; RBC:  $r=0.96$ ,  $p<.005$ ).

### Conclusion:

DeepUTI can be used to correctly identify urinary cells from microscope images. Our findings suggest that a trained model can be leveraged in the outpatient setting with a simple brightfield microscope and camera set-up to automate urine microscopy. This would provide a rapid, cost-effective, and highly-accurate alternative diagnostic tool to identify urine infections.

### References:

1. Brubaker L, Chai TC, Horsley H, Khasriya R, Moreland RB, Wolfe AJ. Tarnished Gold-the "Standard" Urine Culture: Reassessing the characteristics of a criterion standard for detecting urinary microbes. *Frontiers in Urology*.;3:1206046.

2. Körber N. MIA is an open-source standalone deep learning application for microscopic image analysis. *Cell Reports Methods*. 2023 Jul 24;3(7).