Electronic Supplementary Material (ESI) for Lab on a Chip.

SUPPLEMENTARY FIGURES

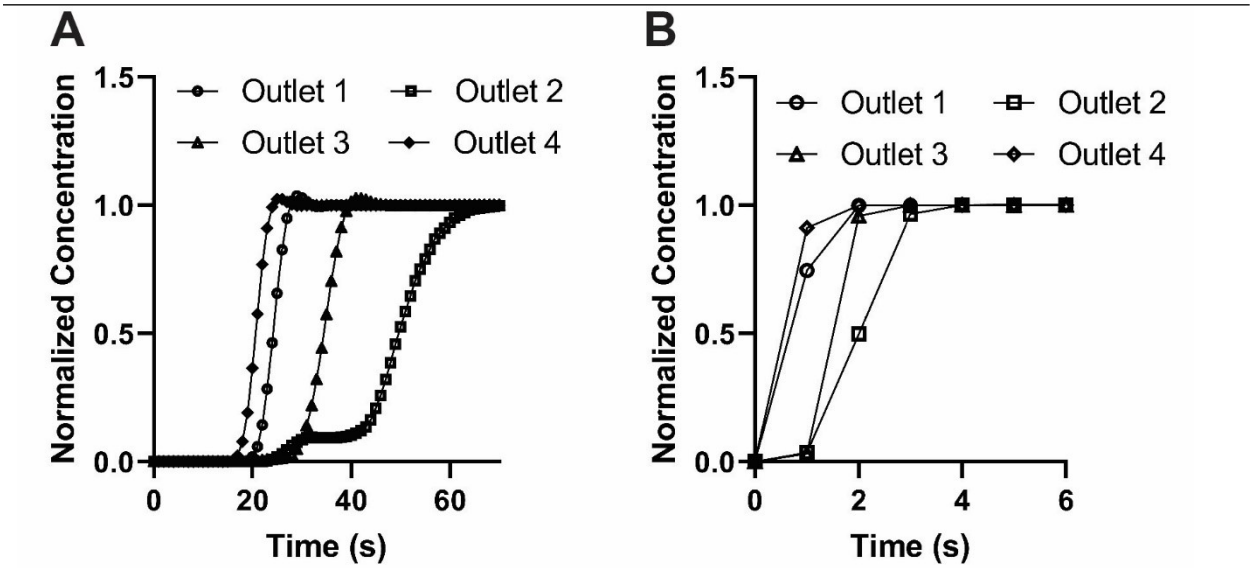

Figure S1: Transient profiles of concentration at the outlets of the gradient generator normalized to the steady state values at each outlet. (A) 0.83 µL/min (B) 20 µL/min.

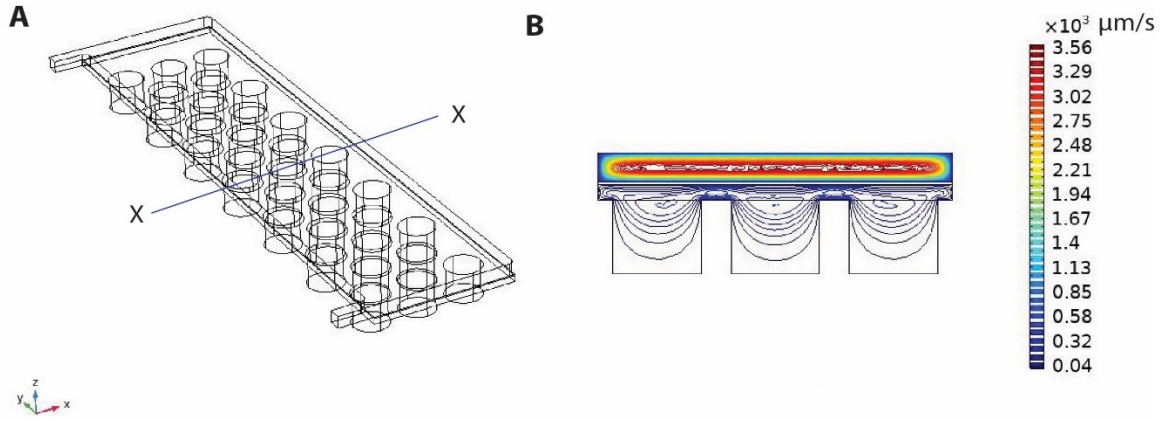

Figure S2: Estimation of velocities within the MPS micro-wells as predicted by finite element model made in COMSOL. Velocities are obtained via the solution of incompressible Navier-Stokes equation utilizing the *Laminar Flow* module. **(A)** Shows the 3D computational domain. The boundary conditions are set as mass flow rate at the two inlets ($\dot{m}_1 = 4.02 \times 10^{-8}\ kg/s$; $\dot{m}_2 = 1.54 \times 10^{-8}\ kg/s$) and outlets are set as pressure outlet boundaries, while no-slip condition is set for rest of the boundaries. The porous PET domain is modeled using Brinkman equation with Forchheimer correction. The porosity and permeability of the porous domain is set as 0.4 and 10^{-12} m^2, respectively. **(B)** Velocity profile for the cross-section X-X shows order difference in velocities in the media channel vs. the micro-well cell chamber.

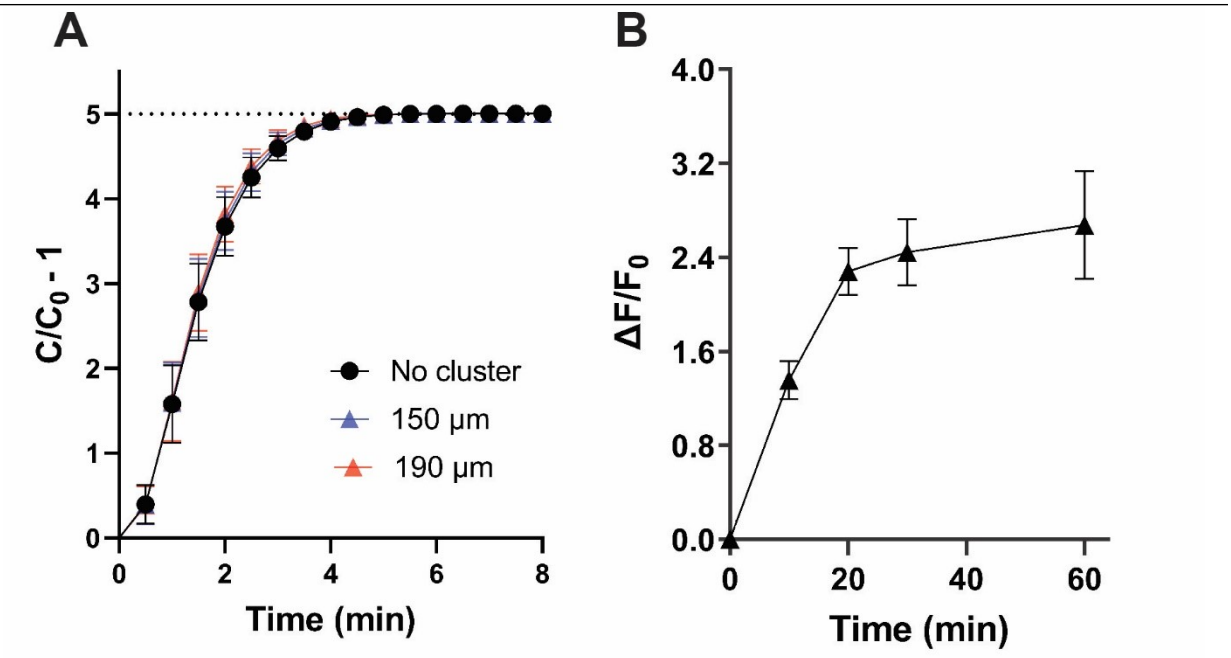

Figure S3: (A) Computational prediction of time required for the concentration within the micro-wells to reach the changes at the inlet concentration (C_0) at 0.83 µL/min. Each time point is a spatial average of all the micro-wells and error bars represent 95% confidence intervals. **(B)** Measurement of PEG-FITC Dextran uptake in clusters within the microwells at a flow rate of 0.83 µL/min. Traces represent mean and error bars represent SEM (n = 6).

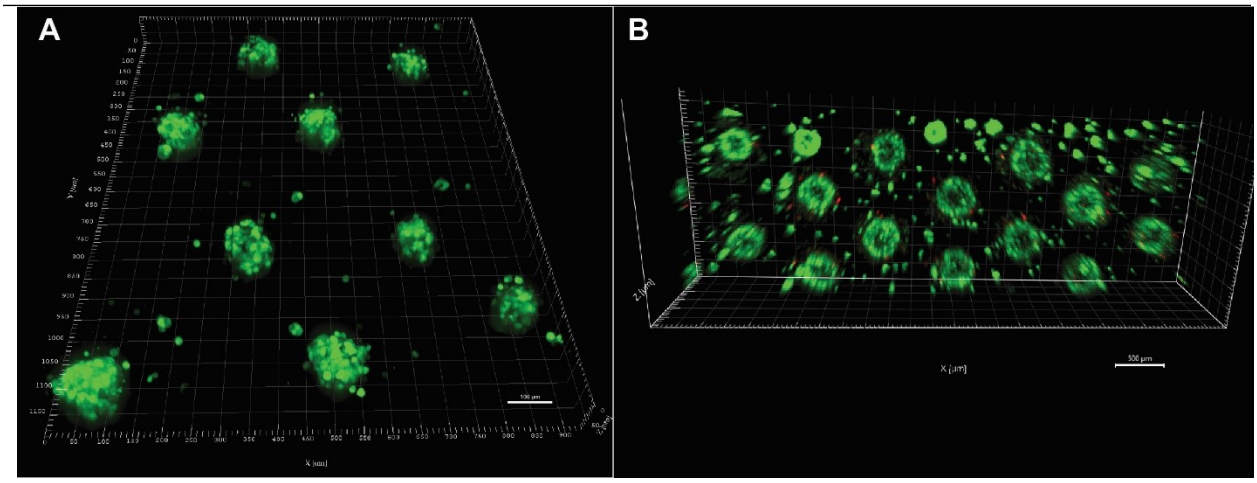

Figure S4: (A) Confocal z-stack images of the eBCs cultured for a week in the MPS. **(B)** Staining with cell membrane permeable live-cell Calcein Violet AM dye and red Ethidium Homodimer 1 dye shows no dead signal buried within the clusters. Slices were taken in a Perkin Elmer Opera Phenix microscope.

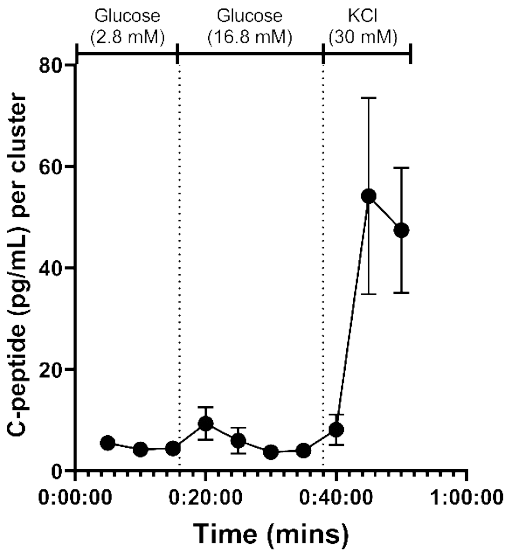

Figure S5: Representative GSIS traces of eBCs challenged with low glucose (2.8 mM), high glucose (16.8 mM), and KCl (30 mM). Trace is mean of n=3, and error bars represent SEM.

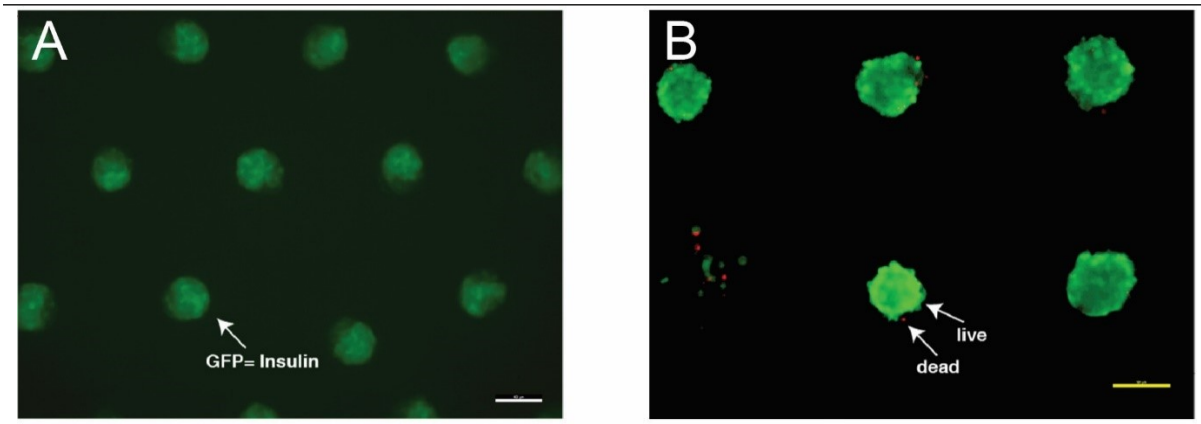

Figure S6: (A) Maintenance of INS expression in eBCs cultured in the MPS device for 3 weeks. **(B)** Propidium Iodide staining for dead cells along with expression of INS measured in eBCs cultured for 4 weeks provide proof of viability. Scales are 150 μm.