

Appendices

Appendix 1: Average Surface Area of Human Pancreatic Beta Cells

In cells studied by both membrane-capacitance measurements and TIRF imaging, we found that the average human pancreatic beta cell had a basal capacitance of 15 ± 2 pF and an average footprint area of $410 \pm 40 \mu\text{m}^2$ ($n=6$ cells). Using a specific capacitance of $100 \mu\text{m}^2/\text{pF}$, we calculate that the footprint region accounts for roughly 27% of the cell's total surface area.

Appendix 2: Percentage of Vesicles Secreted That Are Fluorescent

In human pancreatic beta cells, the first depolarizing train of membrane-voltage steps stimulated an average increase in membrane capacitance of 0.51 ± 0.13 pF. Assuming a unitary capacitance value of 2 pF/vesicle, this capacitance change corresponds to secretion of 250 ± 60 vesicles, or 0.18 ± 0.06 vesicles/ μm^2 . Within the footprint, the average density of fluorescent vesicle secretion in the same cells during the first stimulus was 0.08 ± 0.03 fluorescent vesicles/ μm^2 . Thus, for the first stimulus, ~40% of total secretion was contributed by fluorescent vesicles. For the second stimulus, however, only ~25% of total secretion was contributed by fluorescent vesicles.