

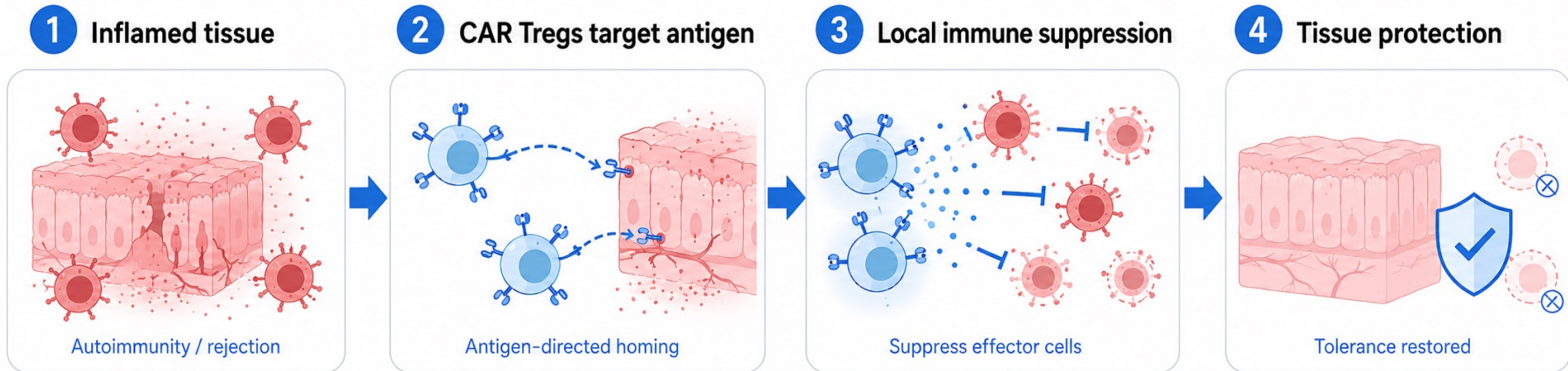
Efficient Nanoneedle Transfection Requires Caveolar Endocytosis

Ciro Chiappini
Centre for Craniofacial and Regenerative Biology - King's College London
CRS Meeting 2026 – Lisbon, Portugal

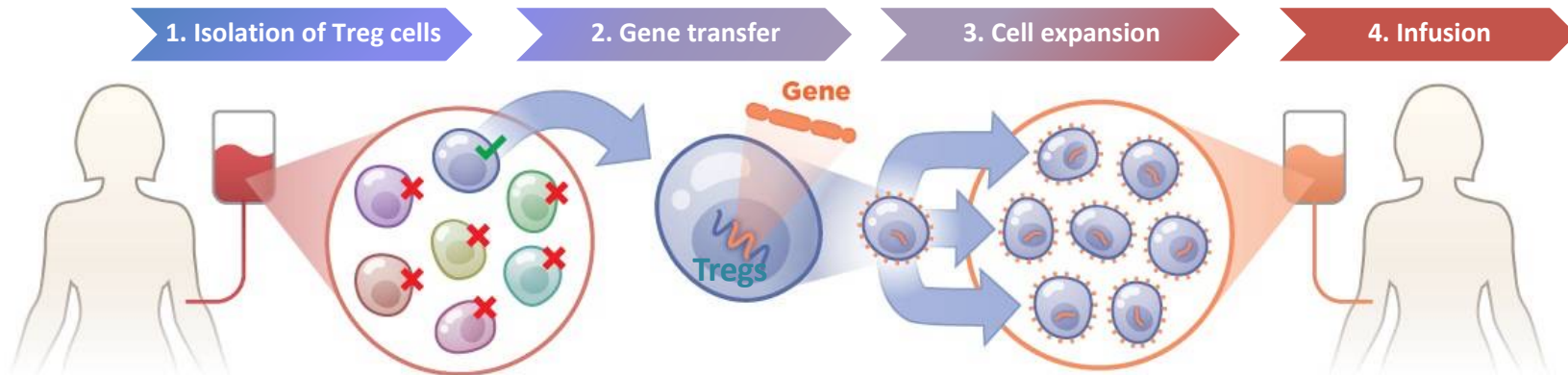


chiappinilab.com

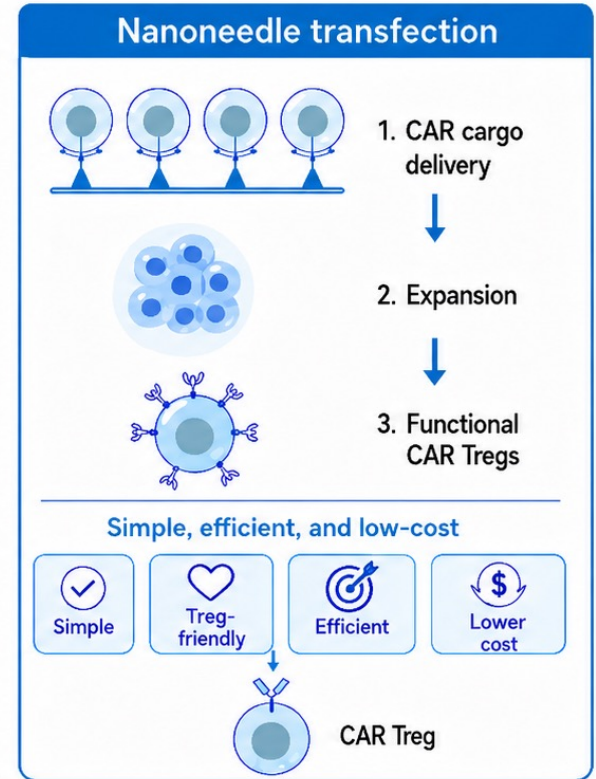
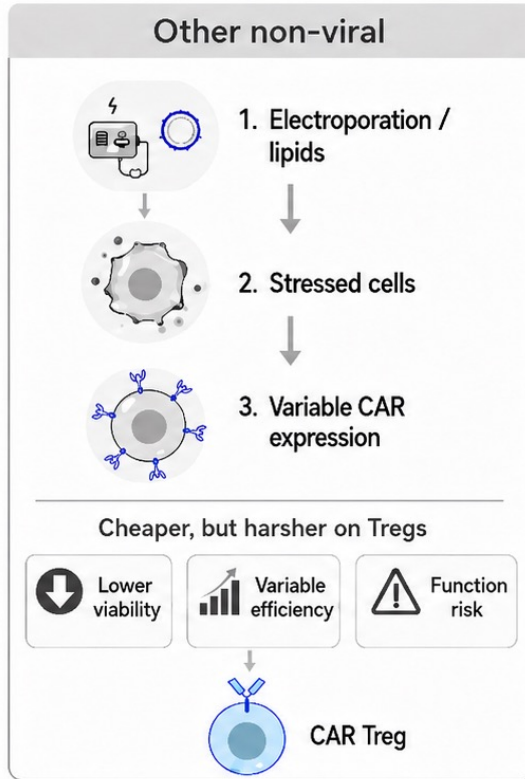
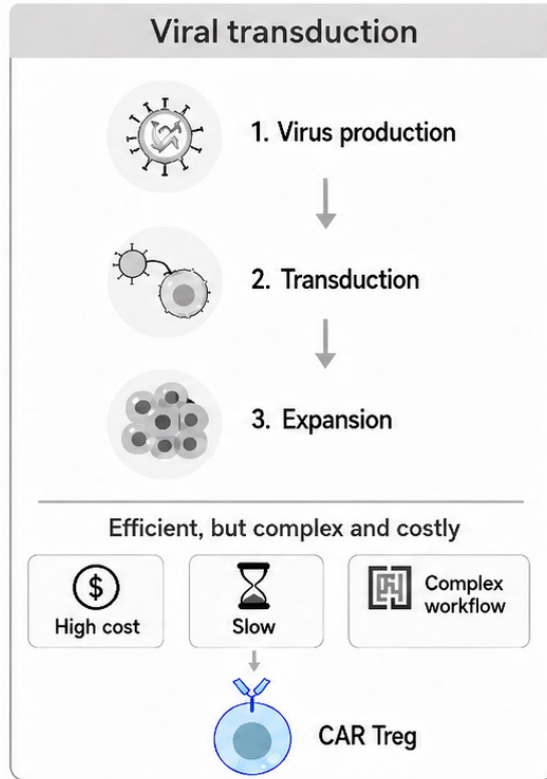
CAR TREG THERAPY



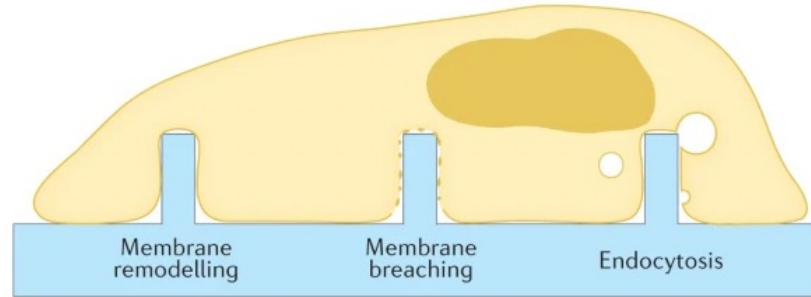
generated with ChatGPT



CAR TREGS NANOINJECTION

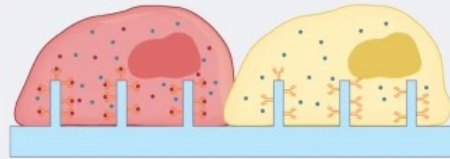


WHY USE NANONEEDLES?

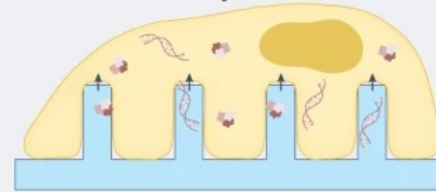


Gu et al. *Nat Nano* 2025
Kim et al. *ACS AM&I* 2024
Hansel et al. *ACS Nano* 2019
Chiappini et al. *Adv Mater* 2015

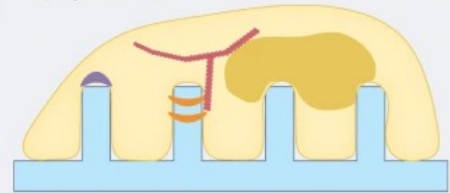
Biosensing



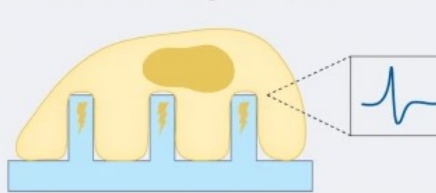
Intracellular delivery



Biophysical interactions



Electrical recording and stimulation



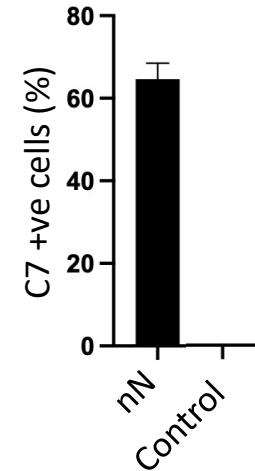
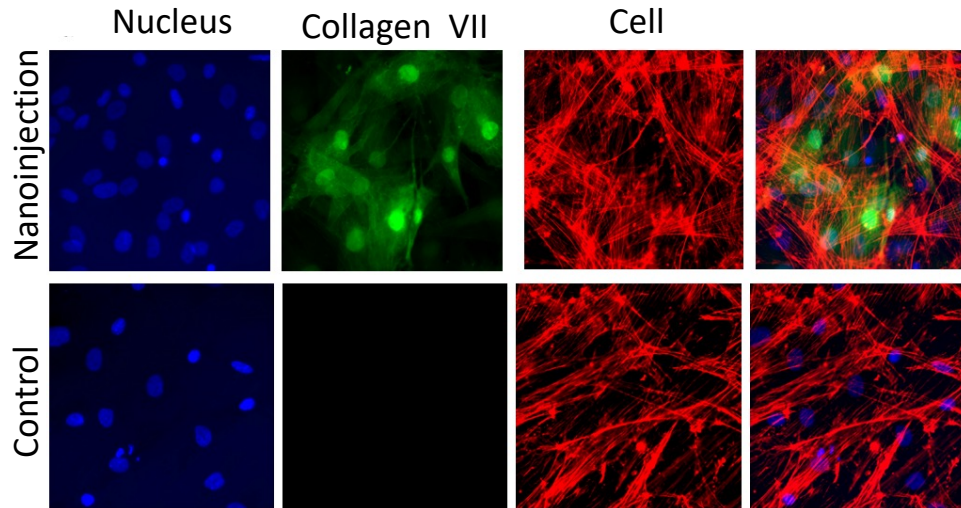
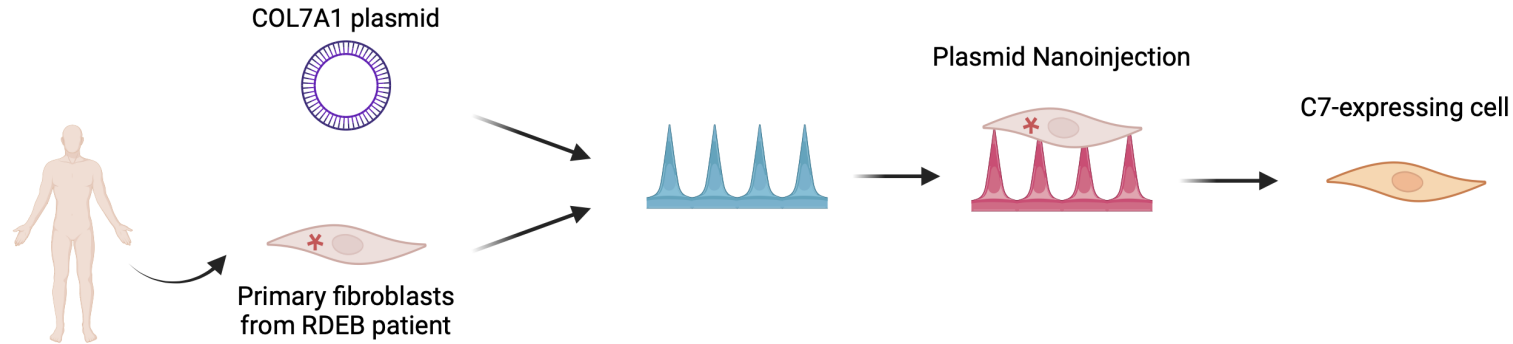
Sun et al. *ACS Nano* 2026
Hansel et al. *ACS Nano* 2019
Gopal et al. *Adv Mater* 2019
Chiappini et al. *ACS Nano* 2015

Sun et al. *Adv Sci* 2025
Mustfa et al. *Adv Mater* 2025
Wang et al. *ACS Nano* 2024
Maurizi et al. *Sci. Adv.* 2022
Chiappini et al. *Nat Prot* 2021
Chiappini et al. *Nat Mater* 2015

R. Elnathan, C. Chiappini et al. *Nat Rev Mater* (2022).

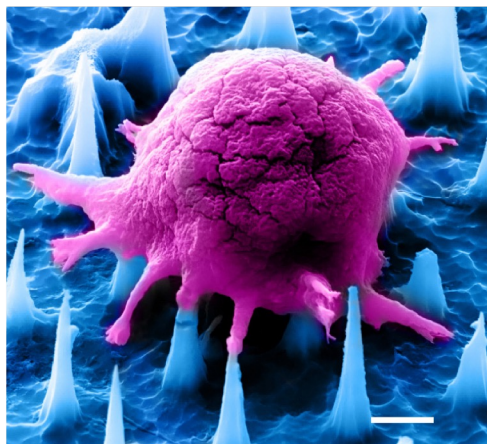


EFFICIENT TRANSFECTION BY NANOINJECTION

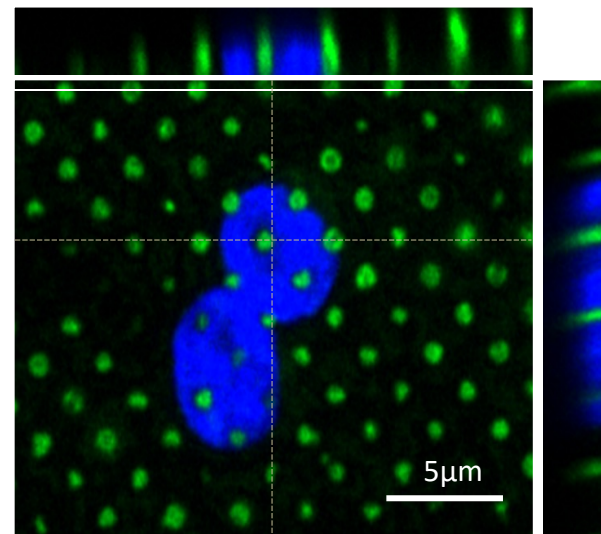
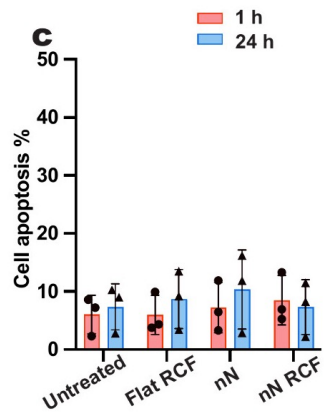
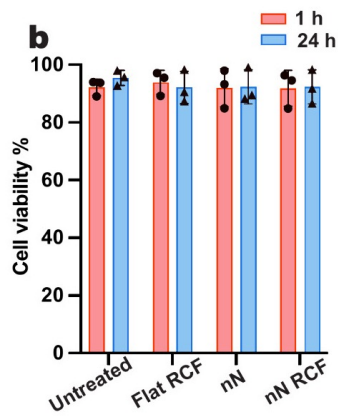
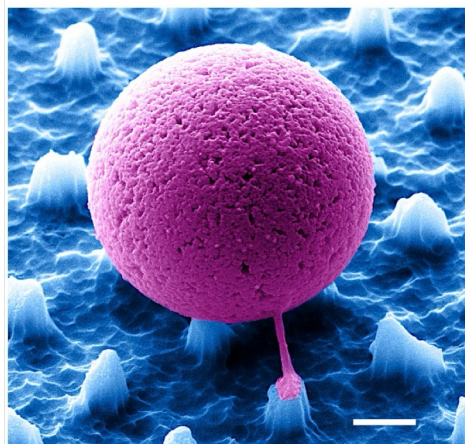


NANONEEDLE INTERFACING WITH PRIMARY HUMAN TREGS

1 hour



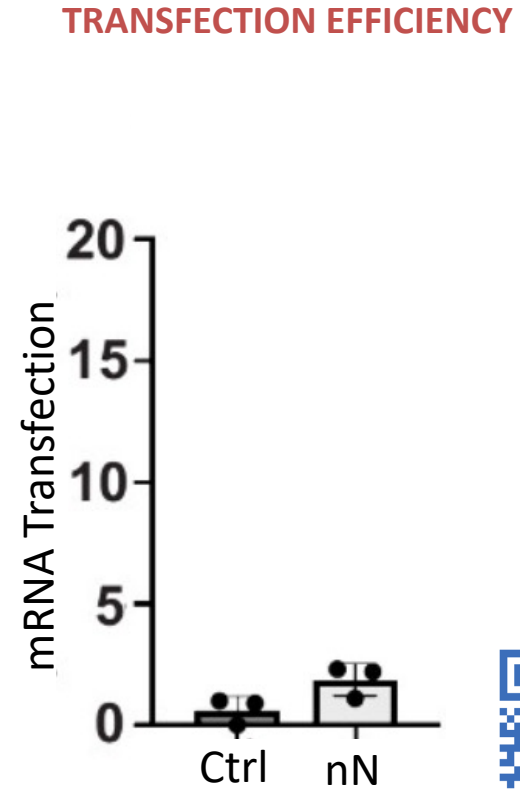
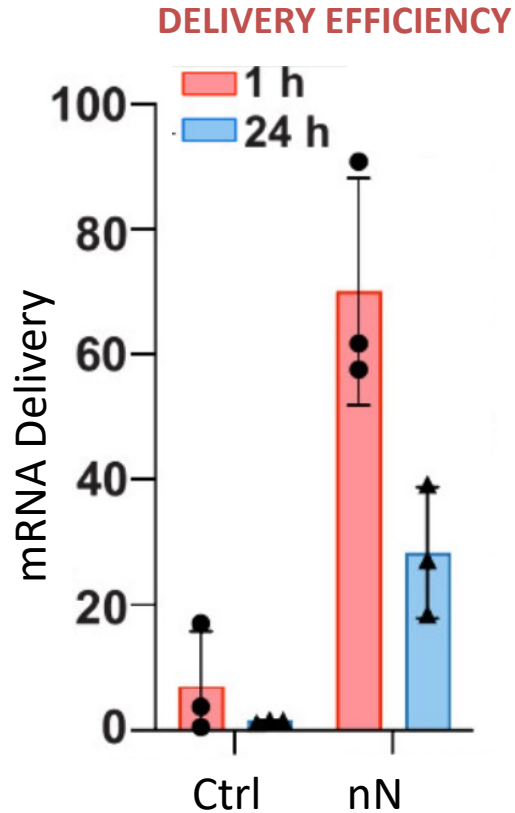
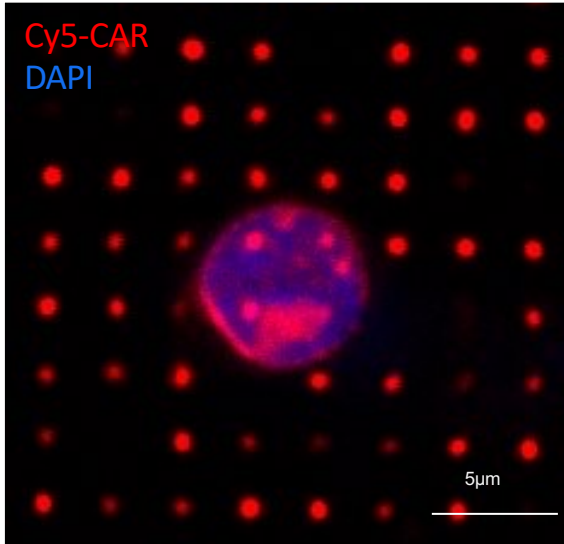
24 hours



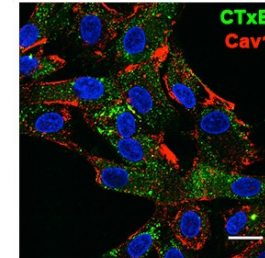
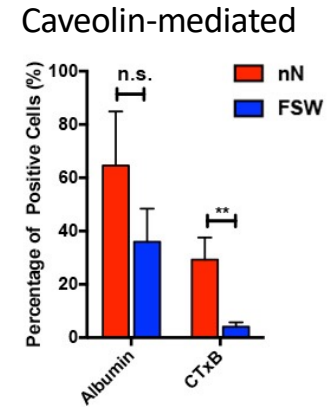
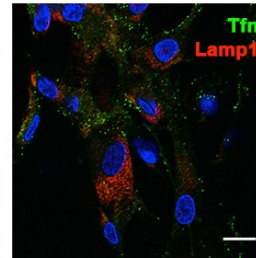
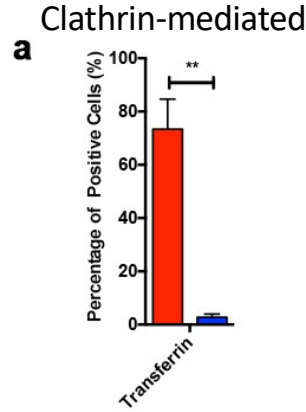
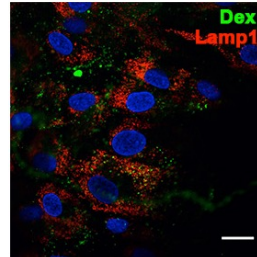
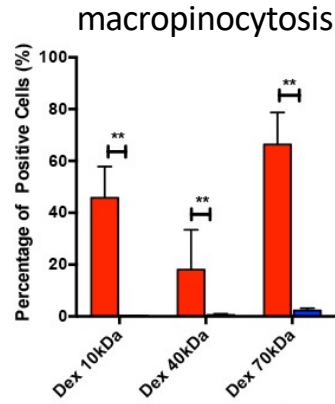
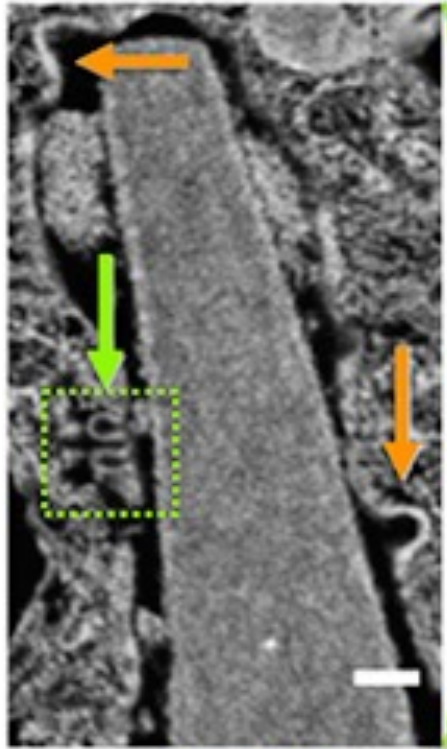
Tregs nucleus—Hoechst
Nanoneedle array—FTIC



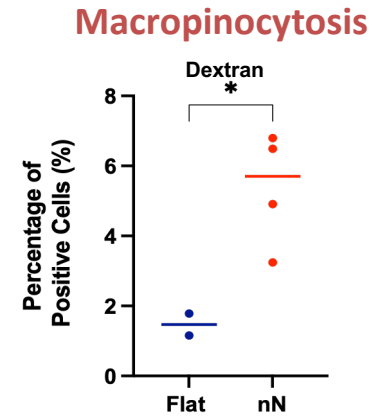
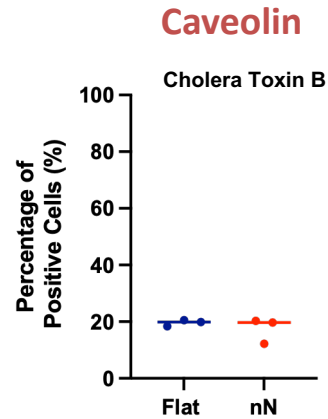
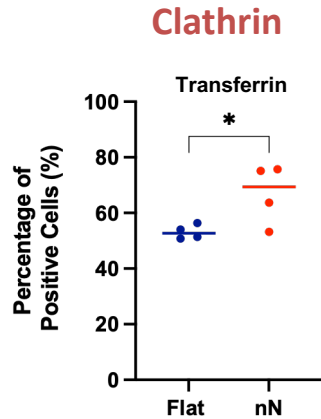
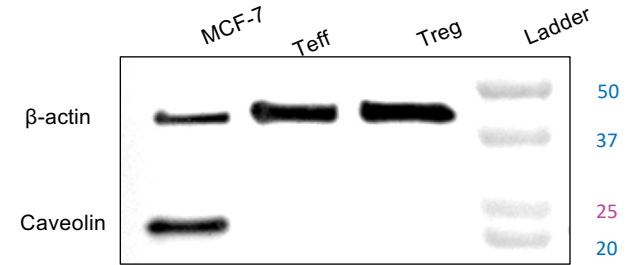
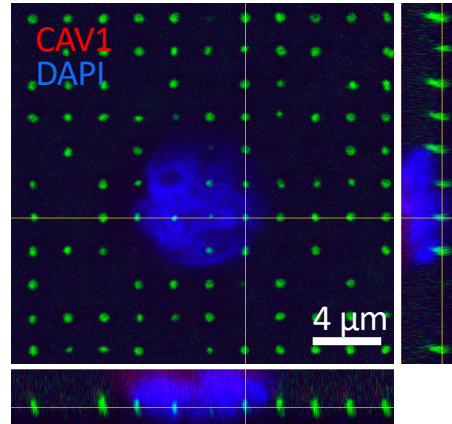
TREGS ARE RESISTANT TO NANOINJECTION



ENDOCYTOSIS REGULATES CELL ACCESS



TREGS LACK CAVEOLIN

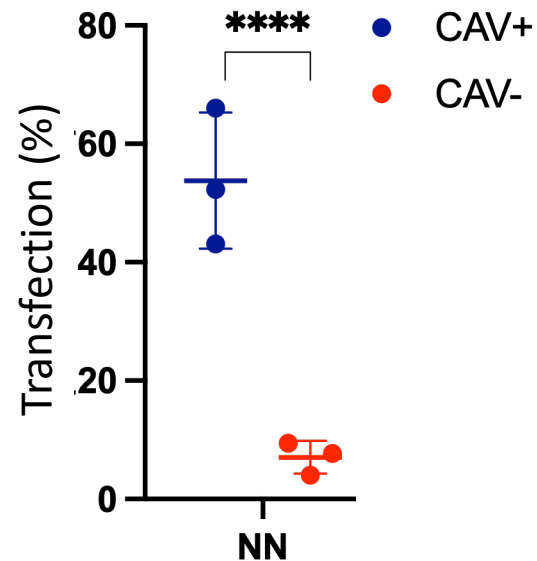
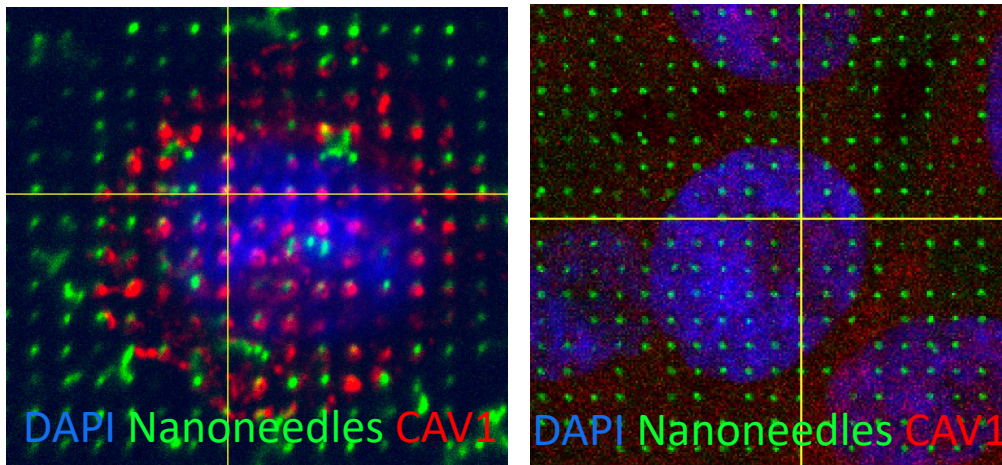


CAVEOLIN KNOCK OUT IMPAIRS TRANSFECTION

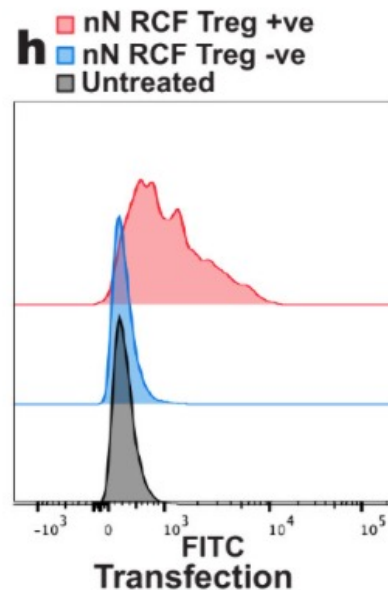
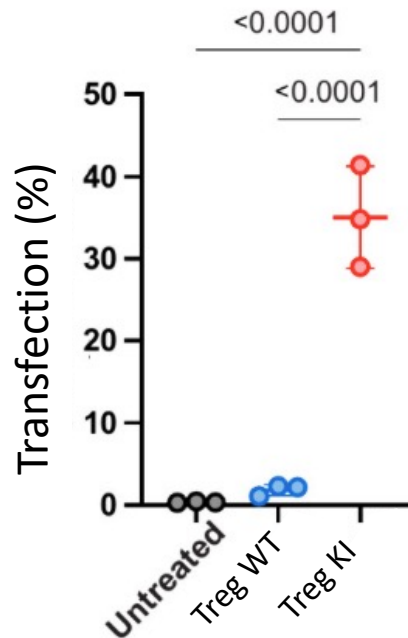
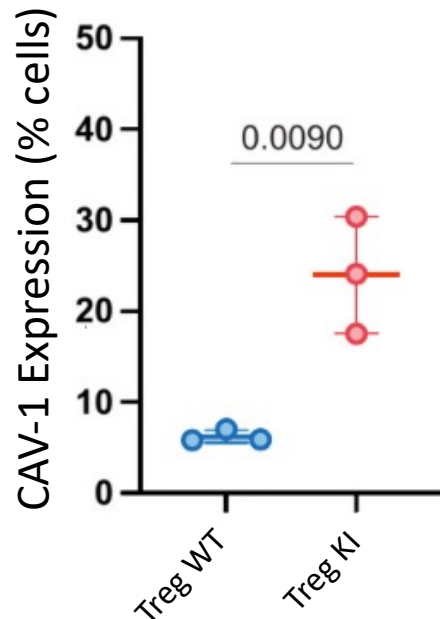
TRANSFECTION EFFICIENCY

MG63 WT

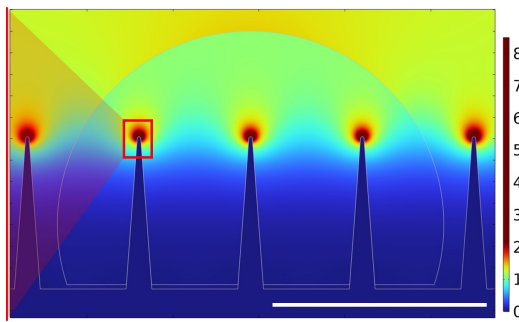
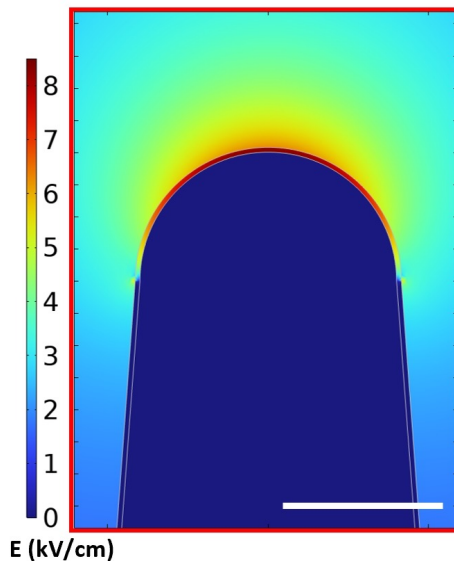
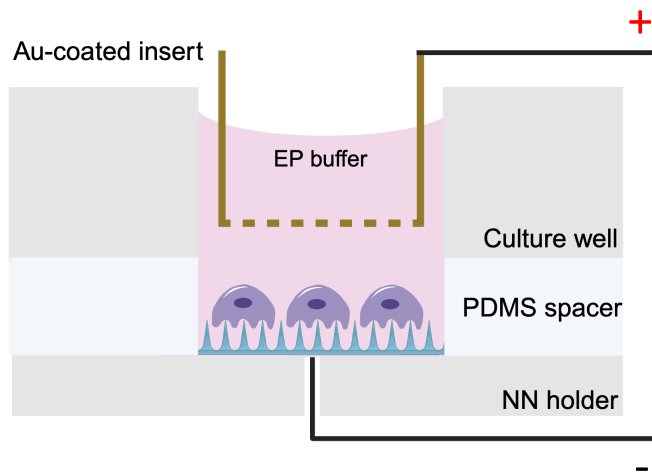
MG63 CAV1 KO



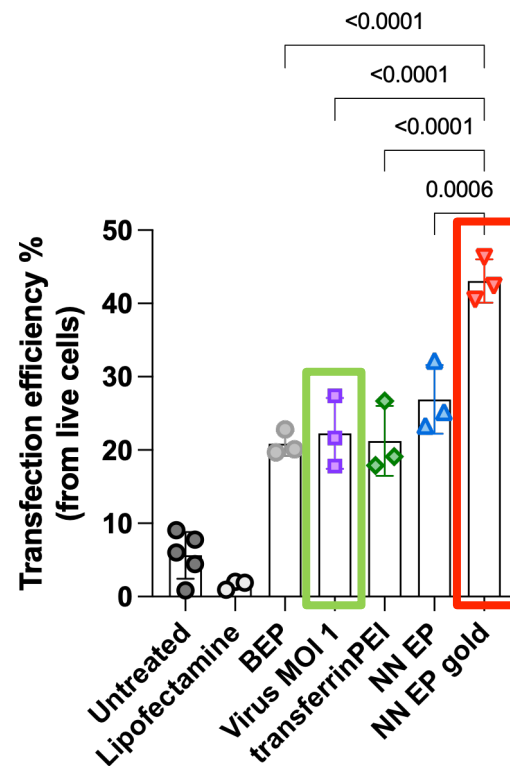
CAVEOLIN KNOCK IN SUPPORTS TRANSFECTION



T CELLS TRANSFECTION BY NANOELECTROPORATION



TRANSFECTION EFFICIENCY



ACKNOWLEDGEMENTS



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