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

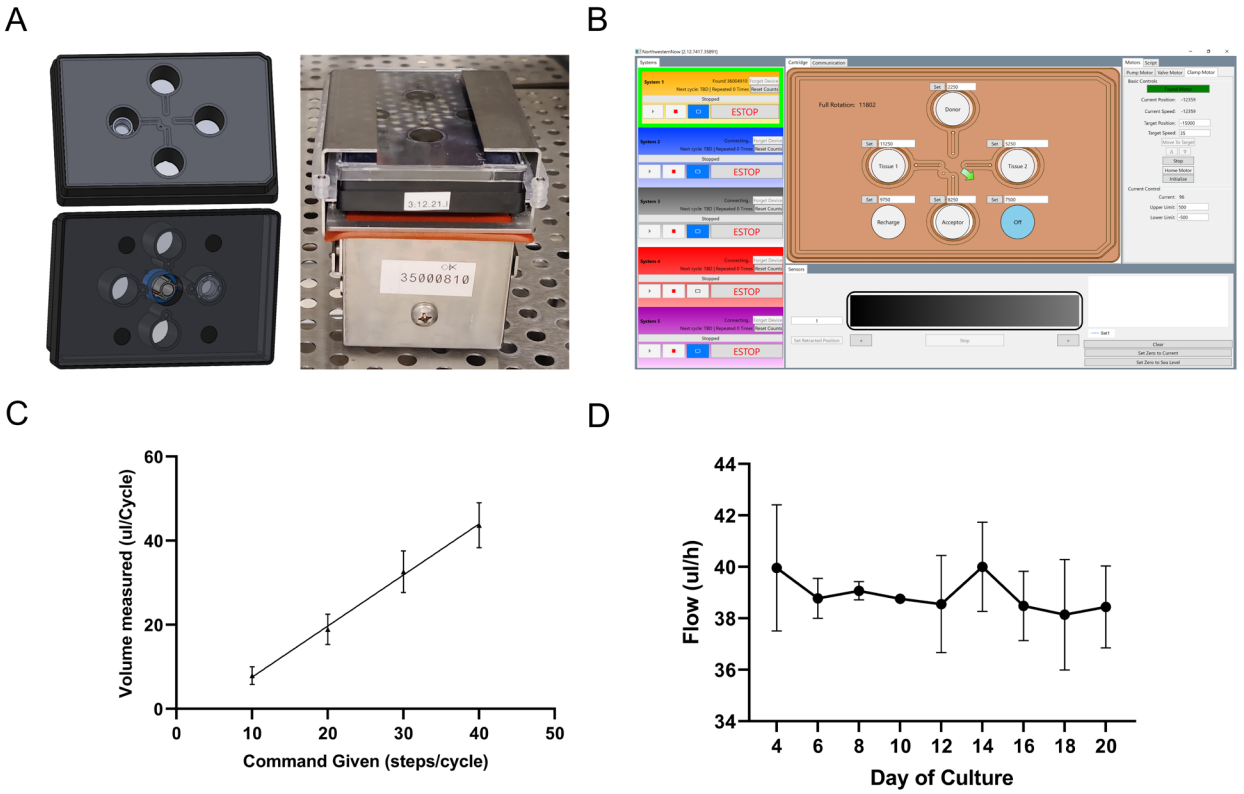

Fig. S1 2UP prototype. A. Basic design of the 2UP LATTICE culture plates (left) and engaged with the base station (right). B. Custom 2UP software gives the operator control over the different motors of the base station. This can be done manually or by writing executable scripts that describe each individual step. C. 2UP pump equation (n=21) D. Fluid flow during long term culture of 2UP platform.

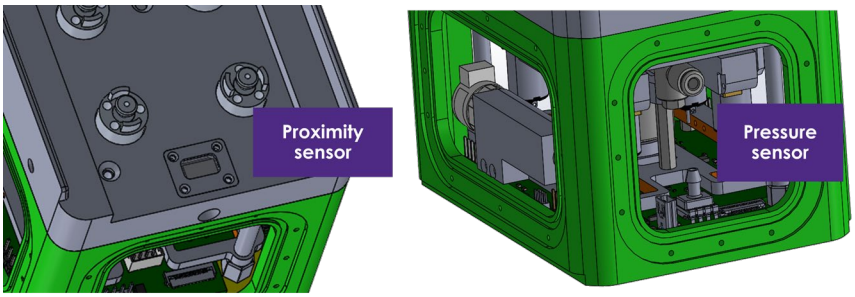

Fig. S2 Lattice sensors for automatic handling integration. A reflecting sensor can sense if the robotic arm correctly placed the 8up plate on the base station to confirm the “placed” state (left). An in-line pressure sensor is incorporated and can confirm if the plate is in the “ready” state or sense pressure losses when it is misaligned of malfunctions (right).

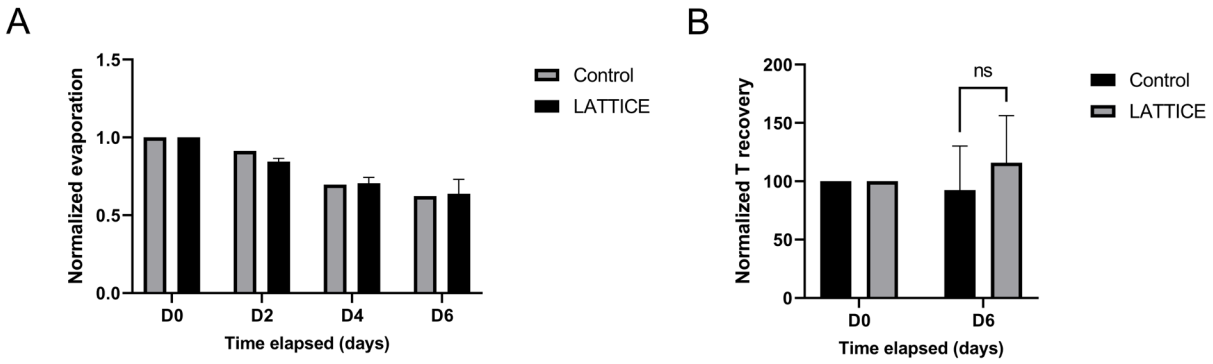

Fig. S3 LATTICE platform evaporation and hormone retention. (a) Evaporation rates normalized to day 0 show no difference between control (24 well plate) and a LATTICE 2UP plate. (b) After 6 days no significant differences were found when comparing testosterone recovery efficiencies.

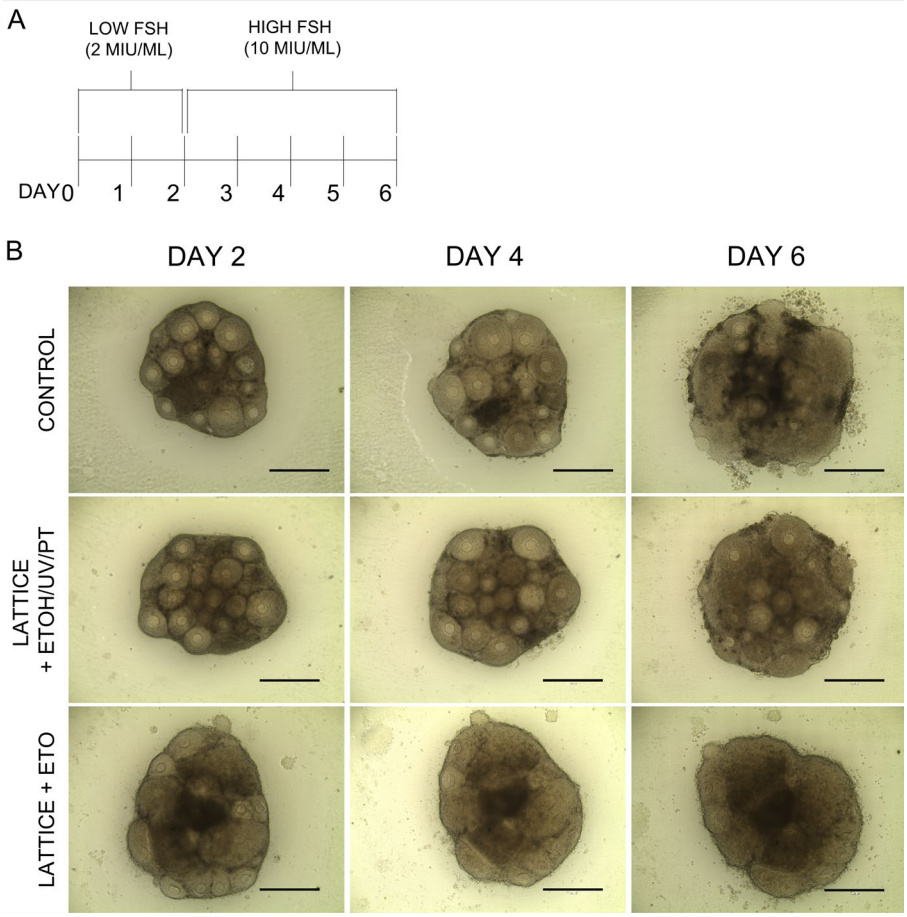

Fig. S4. Effects of sterilization methods on LATTICE culture plate. (a) Ovarian explants were subjected to a 6-day follicular phase with 2 days of low FSH (2 mIU) and 4 days of high FSH (10 mIU). (b) Follicle growth was seen over time in the control (24-well plate) and the 90% Ethanol (EtOH), ultraviolet (UV) and plasma treated (PT) LATTICE plate. Ethylene oxide (EtO) induced severe follicle deterioration over time. Scale bars = 500 µm.

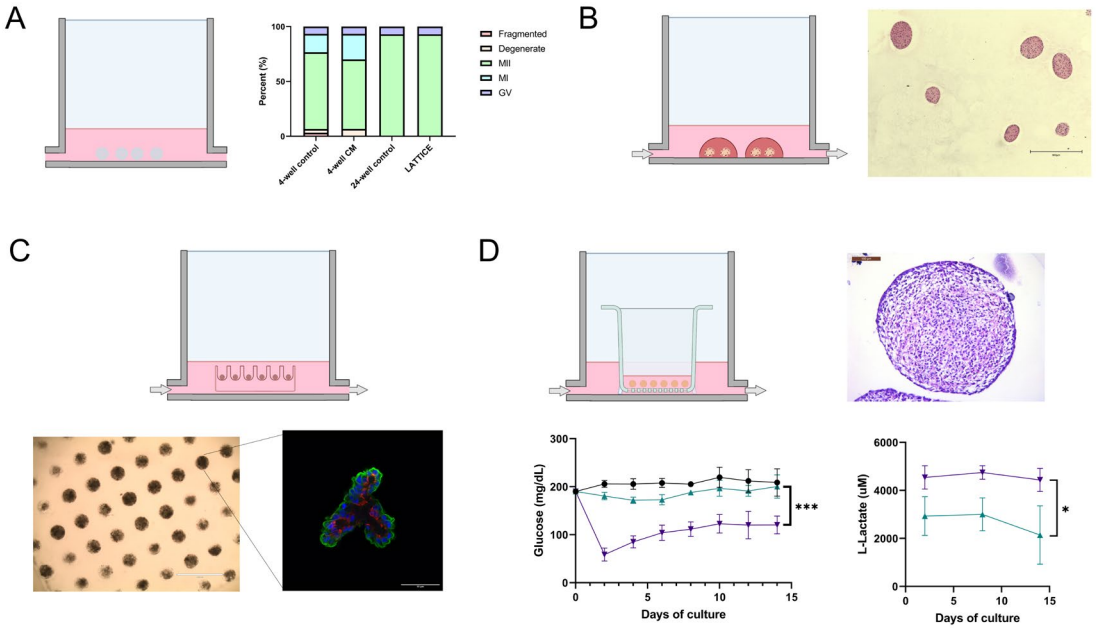

Fig. S5 Biocompatibility LATTICE with multiple culture modalities. A. Oocytes were cultured in standard in vitro maturation media that was incubated overnight in an incubator with or without black polystyrene pellets. Based on oocyte morphology the meiotic stage was scored as either germinal vesicle intact (GV), metaphase I (MI), metaphase II (MII), fragmented or degenerated. B. Pancreatic islets encapsulated in 1% alginate beads can be cultured directly in the culture well when adhering to the bottom of the well. When cultured in universal culture media, hematoxylin and eosin staining showed a healthy morphology with a homogenous distribution of the nuclei after 7 days (n=3, scale bar = 300 µm). C. Culture method for 3D cultures within 400-micron low adhesion agarose microwells of endometrial organoids. Immunofluorescence staining of Cytokeratin-18 (Green) and Vimentin (Red) shows epithelial and stromal organization respectively in endometrial organoids. Scale bars = 1000 µm and 50 µm, respectively. D. 30 fat spheroids were cultured in 2up Lattice wells and subjected to static (n=3) or dynamic conditions (n=3), glucose was measured every 2 days and L-lactate at day 2, 8 and 14 (*=P<0.05 and ***=P<0.001). Scale bar = 100 µm. Created with BioRender.com.

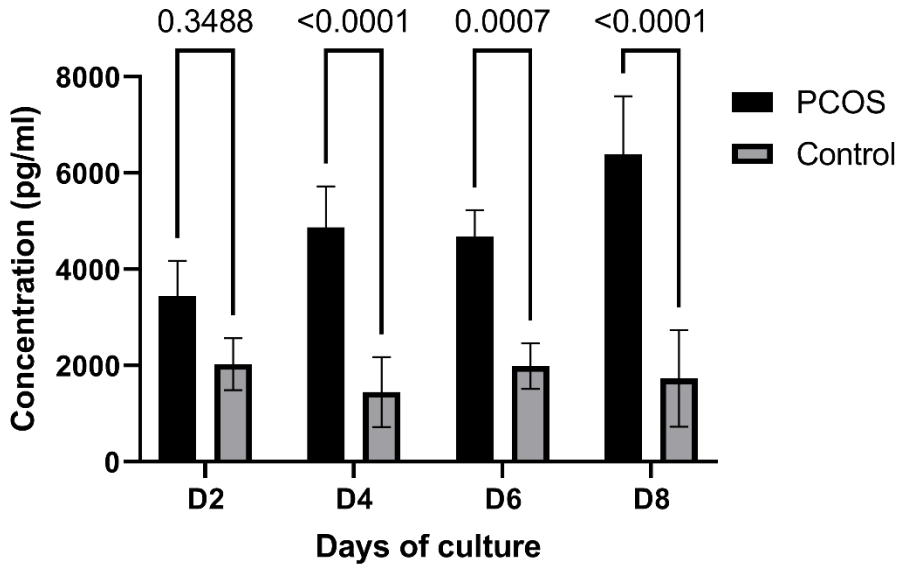

Fig. S6. Ovarian progesterone production in healthy and pathological hCG/FSH ratios (n=4). During the 8-day microfluidic culture a significantly higher production in the PCOS conditions takes place.

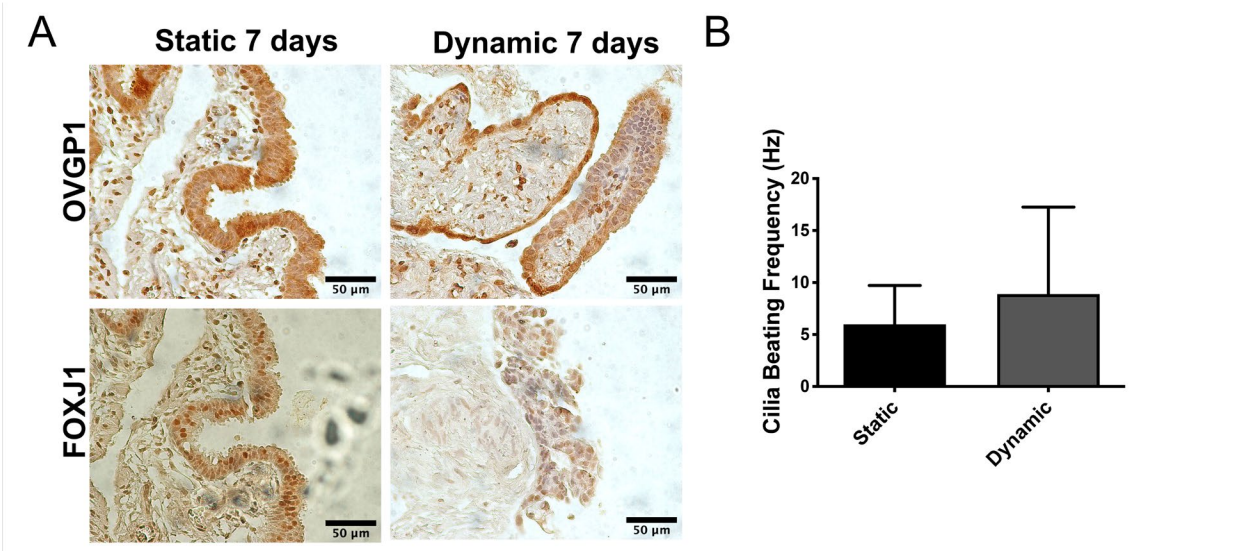

Fig. S7. hFTE tissues in dynamic vs static culture. A. IHC of human fallopian tube explants shows expression express OVGP1, FOXJ1 in the epithelium after 7 days of culture. Scale bars = 50 µm. B. No significant difference in cilia beating frequency was found between static and dynamic culture.

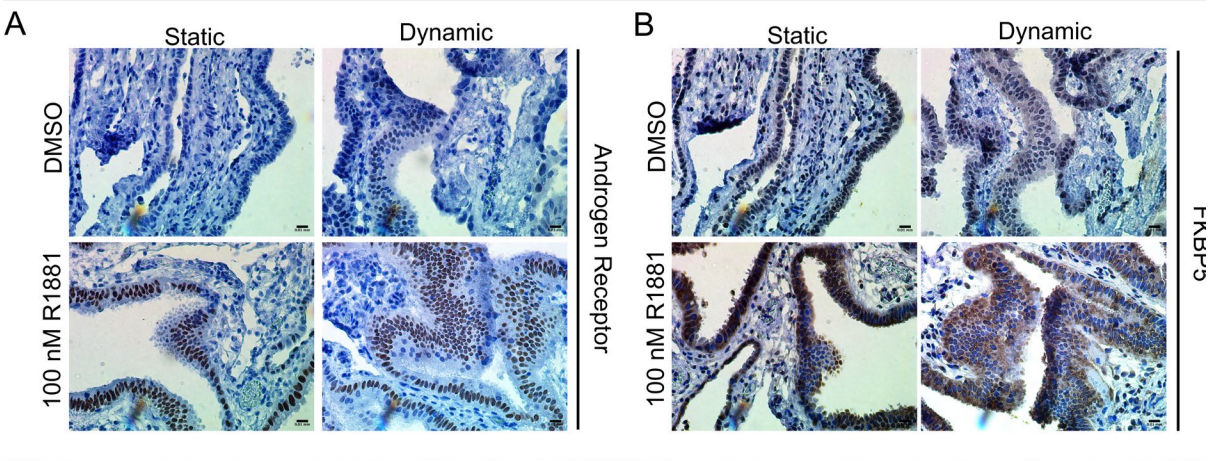

Fig. S8 hFTE cultures react physiologically to synthetic androgen receptor agonist. A. Immunohistochemistry demonstrated nuclear localization of AR and B. a downstream androgen target FKNP5. Both had highest expression in the epithelium of both static and dynamic cultures supplemented with R1881 while the vehicle control treated dynamic culture showed moderate nuclear AR expression. Scale bars = 10 µm.

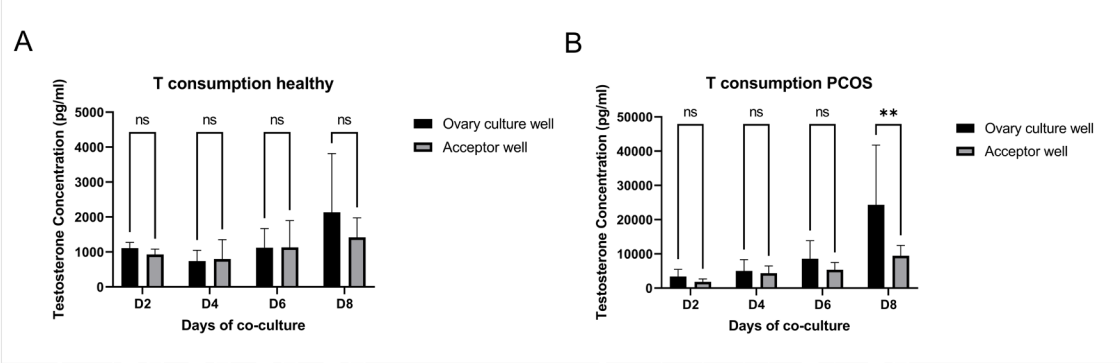

Fig. S9 Testosterone consumption by hFTE explants. Testosterone levels in media from the ovary culture well producing A. healthy and B. high hCG induced metabolites before and after passing through the hFTE culture well. Multiple unpaired t-test show no significant differences for all but one condition (**P<0.01).