OVERCOMING LIMITATIONS OF ORGAN-ON-CHIP (OOC) TECHNOLOGIES TO ADVANCE THE CHARACTERIZATION AND MEDICAL MANAGEMENT OF CHEMICAL AND BIOLOGICAL (CB) THREATS

Design And Application Of An Adept Aerosol/vapor Lung-on-chip And Aerosol/vapor Delivery Systems

Dylan Fudge DTRA **Tyler Goralski** U.S. Army DEVCOM CBC **Priscilla Lee** U.S. Army DEVCOM CBC **Morgan Minyard** U.S. Army DEVCOM CBC

Organ-on-a-chip technology and other micro-physiological systems (MPS) were designed to recreate living tissues that mimic organ microenvironments through precise control of the cells, extracellular matrix, and other micro-environmental factors. While correcting many of the gaps present in traditional tissue culture with a more physiologically relevant model, these systems still suffer from limitations. The inability to accurately administer aerosols to the lung epithelial cells is a specific limitation to current lung-on-a-chip technology. Having the capability to perform testing and analysis on tissues through conventional routes of exposure specific to the organ is paramount in achieving a complete biologically relevant system. To close this gap, we combined 3D printing technology with microfluidic organ-chip engineering to build a customizable open-top lung-chip specific for the evaluation of aerosol and vapor toxicity and efficacy testing. 3D printing technology was additionally used to design an aerosol/vapor delivery chamber specific to the open-top lung-chips. This approach overall allowed for customizable, time and cost-effective parts to efficiently optimize a novel aerosol and vapor delivery system for lung tissue exposures. Overall, we designed, generated, and evaluated novel open-top lung-chips optimized designs in this study that will be used to expand our capabilities for elucidating novel mechanisms of action, informing potential targets for future development of diagnostics, therapeutics, and medical countermeasures.

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