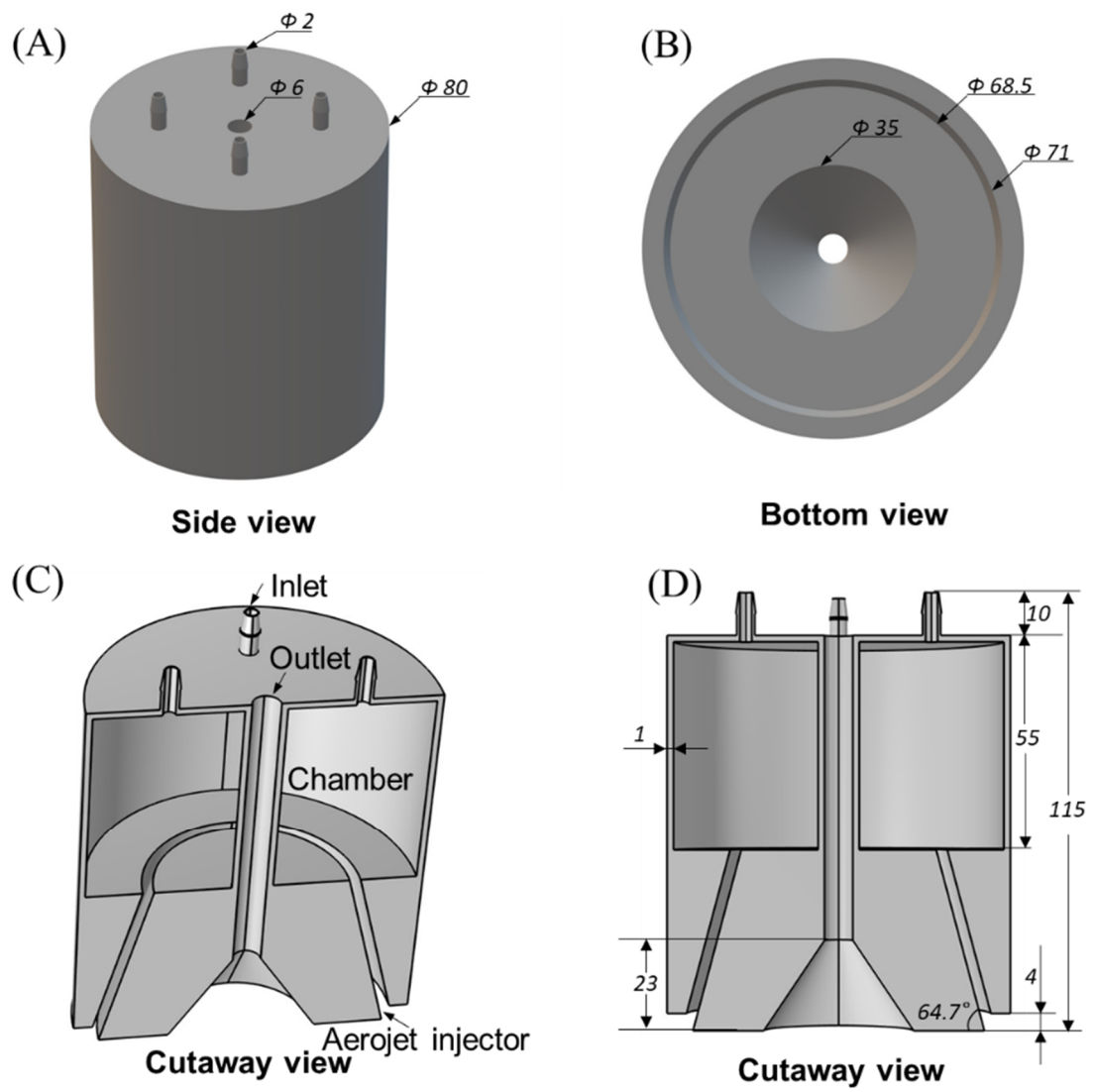
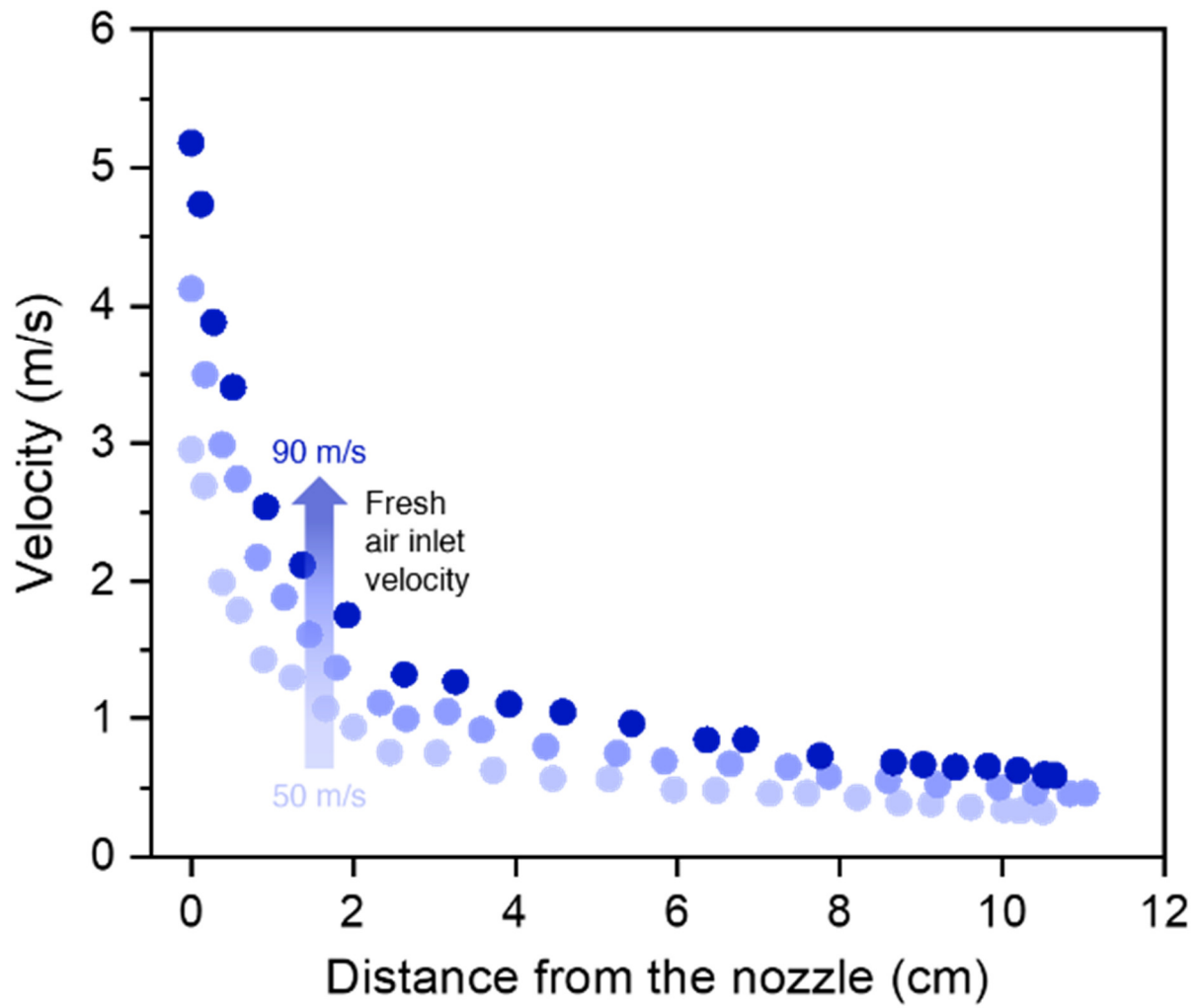


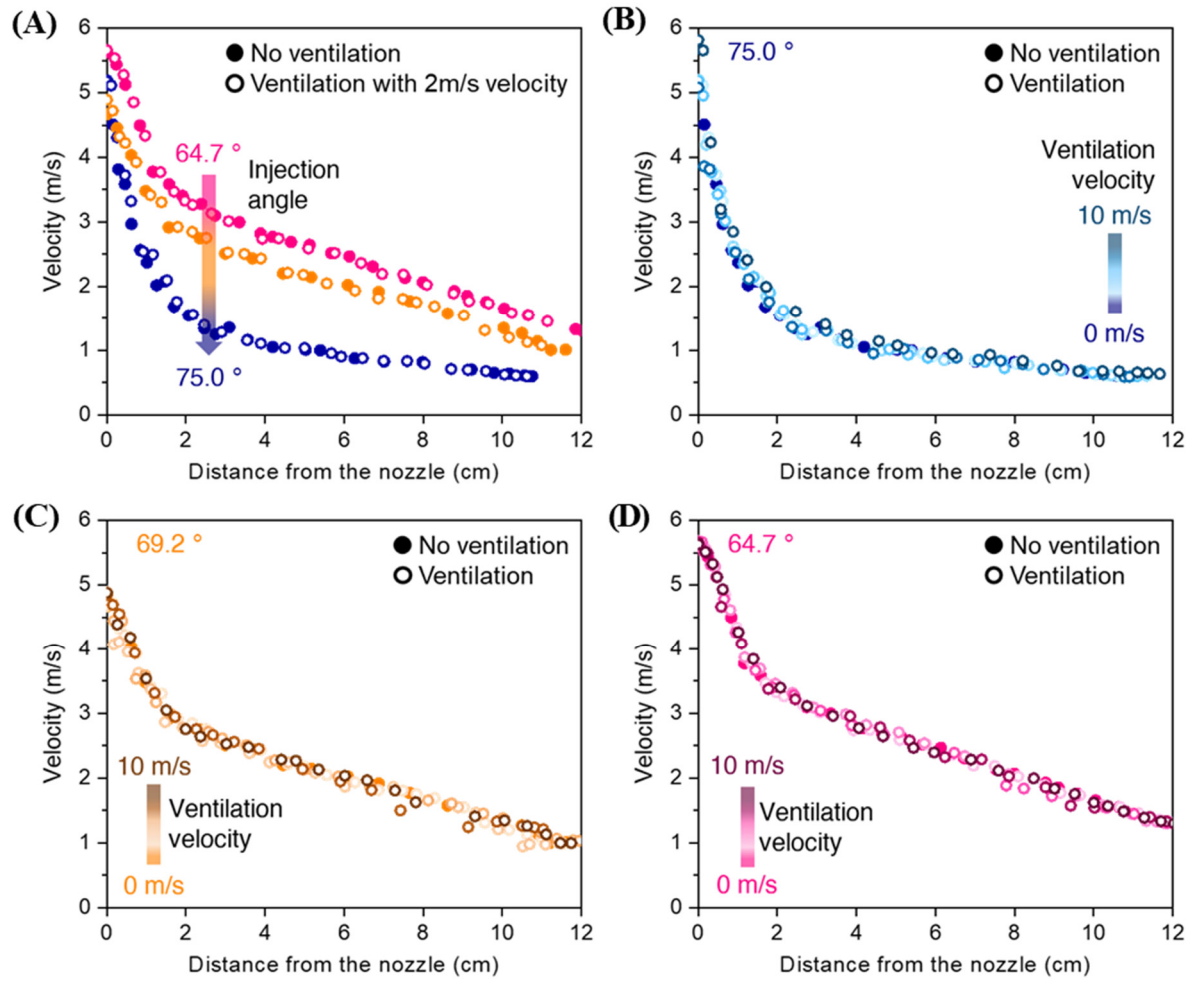
**Figure S1.** The convergence and mesh independence of study of COMSOL simulation.



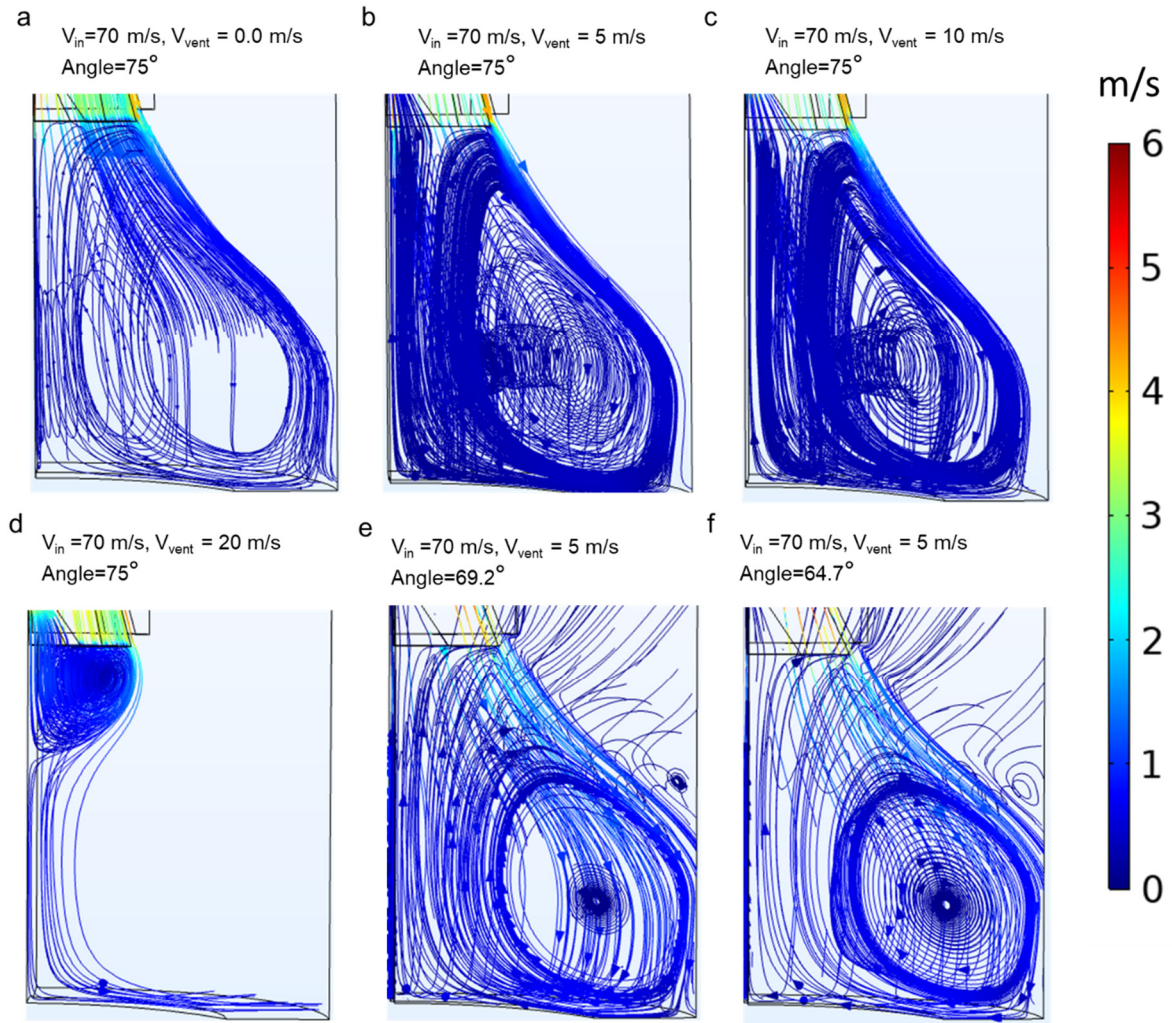
**Figure S2.** The detailed design and dimensions of the proposed device in COMSOL simulation.



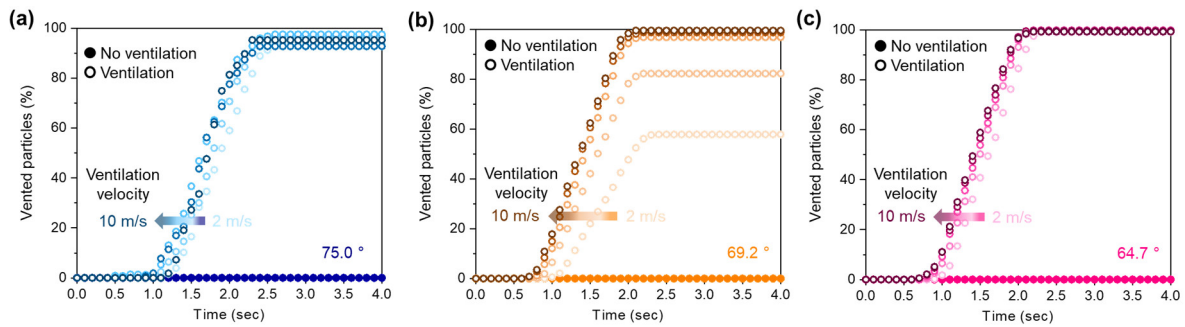
**Figure S3.** Velocity profiles of the air barrier at varied fresh-air inlet velocities (no ventilation applied).



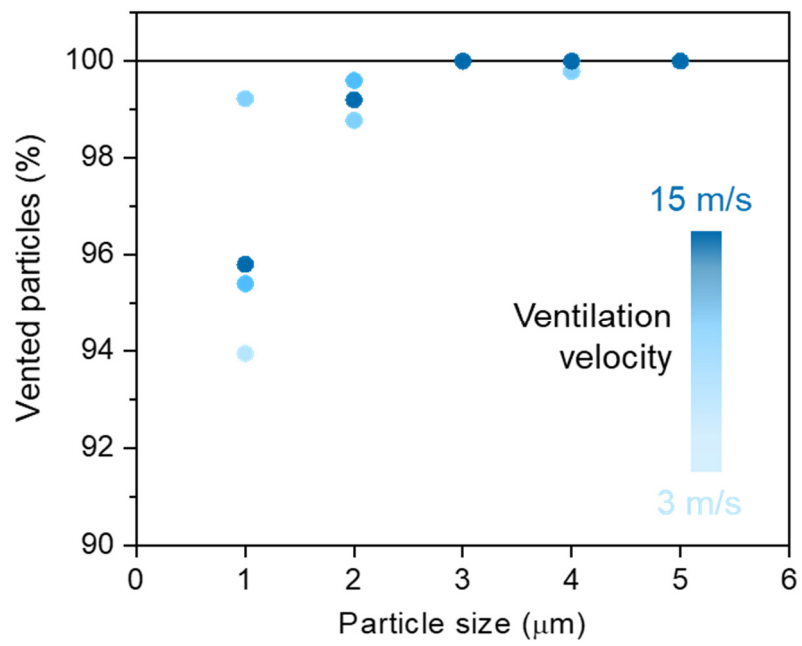
**Figure S4.** (A) The velocity of the air barrier as a function of distance from the nozzle with and without ventilation of 2 m/s. Velocity profiles of the air barrier with different ventilation velocities (0, 2, 4, 6, 8, 10 m/s) at (B) 75°, (C) 69.2°, and (D) 64.7°.



**Figure S5.** The streamline in the patient zone in the presence of the air barrier with varied ventilation velocities of (A) 0 m/s, (B) 5 m/s, (C) 10 m/s, and (D) 20 m/s and different injection angles of (E)  $69.2^\circ$ , (F)  $64.7^\circ$ .



**Figure S6.** Vented particles (%) with different ventilation velocities (0, 2, 4, 6, 8, 10 m/s) at (A)  $75^\circ$ , (B)  $69.2^\circ$ , and (C)  $64.7^\circ$ .



**Figure S7.** The vented particles (%) of microparticles in the range of 1  $\mu\text{m}$  to 5  $\mu\text{m}$  at different ventilation velocities (3, 7, 11, 15 m/s).

**Table S1.** The contaminant removal effectiveness at varied injection angles, injection velocities, and ventilation velocities.

Injection angle (°)	Injection velocity (m s <sup>-1</sup> )	Ventilation velocity (m s <sup>-1</sup> )	CRE
75.0	3.1	5	464
75.0	3.6		1569
75.0	4.1		766
75.0	5.1		4819
64.7	5.1	6	1310
69.2			1000
75.0			16300