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An automated pressure-swing absorption system to administer low oxygen therapy for persons with spinal cord injury

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Abstract:

Mild episodes of breathing low oxygen (02) (i.e., acute intermittent hypoxia, AIH) elicits rapid mechanisms of neural plasticity that enhance respiratory and non-respiratory motor function after spinal cord injury (SCI). Despite promising outcomes in humans and rodents with SCI, the translation potential of AIH as a clinical therapy remains dependent on a safer and more reliable air delivery system. The purpose of this study is to investigate the performance of a novel AIH delivery system to overcome inconsistencies in human AIH protocols using a hand-operated (manual) delivery system. Specifically, we characterized system performance of AIH delivery in terms of flow rate, 02 concentration, dose timing, and air temperature. Our data show that a novel 'automated' delivery system: i) produces reliable AIH with a goodness-of-fit at 98.1 % of 'ideal'; ii) eliminates dose timing errors via programmable solenoid switches; iii) reduces fluctuations in 02 to less than 0.01 %; and iv) delivers 62.7 % more air flow than the 'manual' delivery method. Automated physiological recordings, threshold detection, and visual feedback of the participant's blood 02 saturation, heart rate, and blood pressure ensures real-time user safety. In summary, the 'automated' system outperformed the 'manual' delivery method in terms of accuracy, reliability, and safety. The 'automated' system offers several design features that move the technology closer to a medically approved treatment for clinical and home use.

Keywords: hypoxia, oxygen, breathing, pressure swing adsorption, spinal cord injury, motor function, rehabilitation