

Asthma is a chronic medical condition that affects approximately 1 in 12 children in the United States¹. It is a disease of airflow limitation caused by airway inflammation, the impact of which encompasses bronchoconstriction, airway hyperresponsiveness, and airway edema, leading to clinical symptoms such as recurrent coughing, wheezing, breathlessness, and chest tightness.² Asthma significantly affects the health and quality of life of children, resulting in increased medical costs from emergency department and urgent care center visits, as well as social costs such as an increase in missed school days and hindering participation in daily life activities^{3,4,5}.

As emphasized in the National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 3 (EPR-3) in 2007, the goal of asthma therapy is asthma control. Education for both patients and healthcare providers in recognizing symptoms and ensuring correct medication administration is central to preventing asthma symptoms and adverse outcomes². Long-term control medications alleviate the airway inflammation associated with asthma, which is primarily accomplished through the daily to twice-daily use of inhaled corticosteroids (ICSs). Other control medications, such as mast cell stabilizers (cromolyn sodium and nedocromil), immunomodulators (anti-IgE), leukotriene modifiers (LTRAs), LABAs, and methylxanthines, are added when control by ICS alone is insufficient².

However, managing medication administration and ensuring correct administration can be challenging for children, especially those with intellectual and developmental disabilities (IDD), including autism⁵. The rate of incorrect inhaler administration is already high in the general population, accounting for 30-90% of patients with incorrect use^{6,7,8,9}. This results in decreased efficacy of controller medication¹⁰. IDD, as defined by the American Association on Intellectual and Developmental Disabilities, involves significant and lifelong developmental deficits in learning, problem-solving, adaptive skills development, and independence¹¹. Individuals with IDD may encounter additional challenges in correctly administering inhalers and managing their chronic illness due to their cognitive and developmental deficits, leading to increased health service utilization^{12,13,14,15}.

Various studies have found that assistive electronic devices increase medication adherence in the pediatric population. For example, smart devices such as Turbu+, INCA, Digihaler, Respiro, Smart AeroChamber, and the Hailie, which track the duration of inhalation, frequency of usage, and/or spirometry data, have improved clinical outcomes such as medication adherence and lung functions¹⁶. Given the high rate of incorrect administration, there has also been an effort to create home assistive interventions that promote correct administration. CapMedic is among the first smart inhaler devices to provide step-by-step real-time feedback on inhaler technique, and it has shown to enhance correct medication administration in the pediatric population¹⁷.

Despite representing approximately 15.0% of the U.S. children, the pediatric IDD population is underrepresented in medical research surveillance data¹⁸, and there is a lack of published research on asthma and its treatment in people with intellectual disabilities, including autism¹⁹. There is a scarcity of empirical research that examines the specific challenges of medication adherence for asthma in individuals with IDD. Therefore, this study aims to investigate the impact of using smart inhalers in the LD/DD population to improve the rate of correct medication administration and lung function. This effort is aimed at promoting better asthma management and the prevention of exacerbations in the IDD population. We hypothesize that the use of CapMedic inhaler will improve inhaler administration technique in the IDD population as the primary outcome, and we anticipate that the use of CapMedic inhaler will improve lung function as a secondary outcome.

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² National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *J Allergy Clin Immunol*. 2007 Nov;120(5 Suppl):S94-138. doi: 10.1016/j.jaci.2007.09.043. Erratum in: *J Allergy Clin Immunol*. 2008 Jun;121(6):1330. PMID: 17983880.

³ Nurmagambetov T, Kuwahara R, Garbe P. The economic burden of asthma in the United States, 2008–2013. *Ann Am Thorac*

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