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## *Leveraging digital health technology: Five ways to address barriers to inhaled medication adherence*

David Van Sickle, Justine Marcus and Meredith Barrett  
*Propeller Health*

Asthma and chronic obstructive pulmonary disease (COPD) place a heavy burden of cost, reduced quality of life and mortality on the global population. In the United States, these two diseases account for more than \$100 billion annually in direct as well as indirect healthcare costs and hundreds of thousands of emergency room visits, hospitalizations and missed days of work and school.<sup>1,3</sup>

Inhaled medications represent the key component of asthma and COPD management. When used appropriately, as many as 60% of asthma-related hospitalizations may be avoided with adequate adherence.<sup>4</sup>

Unfortunately, adherence has proven to be a difficult goal, with daily barriers such as cost, medication confusion, technique, motivation and forgetfulness contributing to an estimated 30-70% of patients who do not take their medications as prescribed.<sup>5,7</sup> Low adherence often results in poor control of the disease, leading to increased exacerbations and costs. An individual with uncontrolled asthma, for example, may require between \$3,000-4,000 more per year in healthcare than someone with controlled asthma.<sup>8,9</sup> The burden of poor adherence is untenable, especially with the aging population and the changing incentives of healthcare reform, such as readmission penalties.

While extensive research has investigated a range of adherence interventions, they have yielded a dearth of sustainable and scalable

tools to improve adherence, and clinical interventions have proven largely unsuccessful in the long term.<sup>10</sup>

Digital health technology, however, offers meaningful, supportive tools that lessen the burden of disease management and meet patients' appetites to integrate technology into their daily health monitoring. Of US adults, 85% own a cell phone and 53% own smartphones; of these smartphone users, 19% track their health using apps.<sup>11</sup> A survey conducted by Accenture found that 90% of patients want to self-manage their healthcare by leveraging technology, such as accessing their medical information and refilling prescriptions.<sup>12</sup>

### **Addressing barriers and promoting adherence**

For asthma and COPD, digital health offers an opportunity to address key barriers to adherence in five new ways:

1. Digital health can deliver more streamlined, personal strategies to help reduce the burden of disease management and adherence. Medication reminders via text messages, smartphone push notifications, inhaler ringtones and lights can reduce forgetfulness. Electronic monitoring of adherence, such as with the Propeller sensor,<sup>13-15</sup> makes recordkeeping wireless and effortless, eliminating tedious, manual paper or electronic diaries. While low tech, dose counters clarify when a patient needs a

prescription refill, and many disease management and pharmaceutical apps, such as Mango Health,<sup>16</sup> provide refill reminders to connect individuals with mail-order prescription services.

2. Digital health tools can motivate patients to improve adherence through monetary incentives, games and other behavioral strategies. New approaches allow users to earn points towards gift cards, video rentals or charitable donations. Digital tools have also moved adherence into a more socially-connected sphere. Patients join disease-specific social networks for mentoring, advice or to become accountable to peers, as in the network Omada Health has cultivated for diabetes.<sup>17</sup> Visual data dashboards can encourage more optimal self-management and also enable comparisons between users and their own historical trends, their community or national benchmarks, motivating through competition.

3. New digital tools can support and encourage appropriate inhaler technique, a long-chronicled obstacle to effective medication benefit and adherence. Devices such as the In-Check DIAL<sup>18</sup> directly identify technique errors by measuring airflow during simulated inhaler use. Sensors help providers diagnose technique issues by identifying abnormal medication use signals, such as excessive actuation frequency. Web-based video platforms such as Google Helpouts<sup>19</sup> support live,

in-home technique evaluation and personal coaching to correct problems.

4. Digital tools that electronically monitor adherence through sensors provide objective, real-time data that improve communication between patients and care teams about adherence. These conversations have proven difficult in the past.<sup>20</sup> For example, patient diaries have suffered from recall error, falsification and different expectations and interpretations of the disease. In contrast, objective data helps to identify barriers, such as forgetfulness, refill needs or misuse, and highlights potential issues with inhaler technique before they become problematic. Such information can enhance quality of care by supporting provider decision-making about management plans or medication changes. The data clarify the direct connection between non-adherence and poor outcomes, and motivate conversations around a patient's goals and quality of life.

5. Digital tools can merge various measures of asthma and COPD activity, risk and impairment with other health and personal data, producing a more holistic picture of patient health and well-being. Other sources of data collection tools include wireless spirometers, physical activity trackers, blood pressure cuffs and wireless scales.<sup>21</sup>

Never before has there been a confluence of technology-enabled therapeutics and tools that offer such promise for medication adherence. Patients appear eager to integrate these personal, convenient, objective and motivating tools into their daily self-management routines, and providers stand to benefit from the enhanced collaboration and communication that digital health will inspire.

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*David Van Sickle is CEO and co-founder, Propeller Health, 634 West Main Street, Suite 102, Madison, WI, 53703, Tel: +1 608 251-0470, david@propellerhealth.com. Website: www.propeller.com. Meredith Barrett is Vice President of Science & Research, Propeller Health. Justine Marcus is a Research Assistant at Harder + Company Community Research.*