

Delivery of high-quality pediatric spirometry in rural communities: A novel use for telemedicine



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Clinical Implications

- Telemedicine allows for the expansion of specialty asthma services such as high-quality spirometry to children living in rural regions. Benefits include decreased travel burden for patients/families and improving translation of guidelines-based recommendations for spirometry monitoring among pediatric patients with asthma.

TO THE EDITOR:

Spirometry is an important component of pediatric asthma diagnosis and management. According to national asthma guidelines,¹ pulmonary function testing should be obtained at diagnosis and monitored for patients with asthma who are able to complete the maneuver. A major goal of asthma management is to maintain normal or near-normal pulmonary function; thus, long-term pulmonary function monitoring is required to align with guideline recommendations.

In rural US regions, pediatric asthma specialists are scarce, with 2% of pulmonologists and 7% of allergists practicing in rural regions.² Comparable to national statistics, pediatric pulmonologists and allergists in Arkansas are concentrated in urban regions of central and northwest Arkansas, with limited access to pediatric asthma specialists outside of these regions. Thus, pediatric patients are often required to travel long distances to tertiary health care centers to obtain spirometry or obtain spirometry testing at local primary care or adult health care facilities. Because of limited workforce and expense, these facilities are not typically staffed with highly skilled personnel to conduct pediatric spirometry. Travel to tertiary centers is expensive and time consuming for patients, and less experienced facilities have a higher proportion of test results that do not meet quality criteria for pediatric patients.^{3,4} Previous studies examining the quality of pediatric spirometry testing in the primary care setting reveal a rate of only 25% to 50% of acceptable spirometric tests based on American Thoracic Society/European Respiratory Society criteria.³⁻⁵ To address this significant health care need, we developed a novel telemedicine model that allows children in rural regions to obtain high-quality spirometry in their local community without the necessity of sending pediatric-trained registered respiratory therapists (RRTs) to remote areas or requiring patients to travel to a tertiary care center (Figure 1). This model is aligned with the American College of Allergy,



FIGURE 1. A hub and spoke telemedicine model was used to conduct asthma telemedicine clinics with high-quality remote pediatric spirometry. Asthma specialty providers and respiratory therapists were located at ACH in Little Rock. Patients were located at the ACH Jonesboro Clinic in Jonesboro and University of Arkansas for Medical Sciences Southwest Regional Center in Texarkana.

Asthma and Immunology's position paper supporting the use of telemedicine in allergy and immunology practice.⁶

The Arkansas Children's Hospital (ACH) asthma telemedicine program was initiated in February 2017. Rural pediatric asthma patients residing in Northeast or Southwest Arkansas who had previously been seen by a provider in an asthma specialty clinic at ACH were invited to attend an asthma follow-up visit via telemedicine. Patients remained in their local community, and a pediatric asthma specialist and RRT who were both located at ACH in Little Rock conducted the asthma visit remotely. In addition to the physician assessment, the visit included remote spirometry testing and asthma education. The rural originating sites were connected to ACH using telemedicine end points (Avizia CA300, Reston, Va, and Cisco EX60, San Jose, Calif) that allowed for real-time 2-way audiovisual communication between sites. For the spirometry maneuver, the RRT accessed and controlled the spirometry software (CompPAS, Morgan Scientific, Haverhill, Mass) at the originating (patient) site through remote desktop access (TeamViewer, TeamViewer US LLC, Largo, Fla). Before testing, the spirometer was calibrated by the telepresenter (trained nurse facilitator) under the RRT's supervision through real-time 2-way audiovisual communication. The telepresenter positioned the patient and assisted with the pneumotachograph (Pneumotrac, Vitalograph Inc, Lenexa, Kan). Using real-time 2-way audiovisual technology, the RRT communicated directly with the patient (Figure 2). The RRT demonstrated proper spirometry technique and coached the patient throughout the procedure. The telepresenter provided technical assistance as needed. Because of the rare risk of complications related to spirometry testing such as

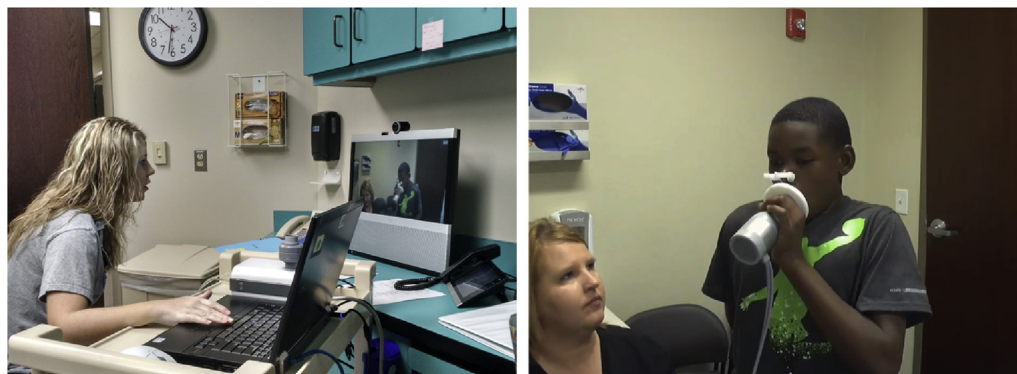


FIGURE 2. The respiratory therapist (left panel) located at Arkansas Children's used real-time 2-way audiovisual communication to demonstrate proper spirometry technique and coach the patient (right panel) at the originating (patient) site throughout the maneuver. A trained (nurse) telepresenter (right panel) provided local assistance as needed. A staff physician provided supervision at the originating site for any complications related to spirometry testing.

syncope, a medical doctor was present at the originating site to provide as-needed management.

A quality improvement protocol was established to track the quality and success of the telemedicine program, and it was deemed not to be human research by local Institutional Review Board. Between February 23, 2017, and October 19, 2017, a total of 50 spirometry tests were completed in 38 unique patients. The number of studies with full data was 38/50 (76%). In addition, 4 (8%) patients with incomplete data had an accurate FEV₁. Median age was 9.3 years (range, 5.1-17.8), 70% were non-Hispanic white, 14% black, and 16% Hispanic. Nine (18%) of baseline spirometries were followed by a post-bronchodilator study, and the albuterol was administered by the telepresenter. Eight (16%) patients were unable to complete spirometry because of age or other reasons. No complications were observed during or after the spirometric maneuvers. The mean (95% CI) forced vital capacity (FVC) was 112% (106%-120%) predicted, FEV₁ was 106% (101%-108%) predicted, FEV₁/FVC was 0.78 (0.77-0.82), forced expiratory flow at 25% to 75% was 85% (72%-98%) predicted, and exhalation time was 7.6 seconds (7.3-8 seconds).

Using a hub and spoke telemedicine model, rural pediatric patients successfully completed high-quality spirometry via telemedicine in their local community, while the RRT conducted the study and provided quality assurance from the tertiary care setting. Patients were able to complete the maneuver without complications, and 84% of tests were interpretable by a pediatric pulmonologist. This represents considerably better rate of spirometry tests meeting quality criteria compared with rates of 25% to 50% reported by others in the primary care setting³⁻⁵ and is similar to our in-house performance (80%). To improve both the utilization and quality of pediatric spirometry in primary care and regional centers, several solutions have been proposed by others including mentoring programs,⁷ online training, and distance learning.³ These programs have not been largely successful, and ongoing training/mentoring in a pediatric primary care or regional care setting may not be feasible or sustainable in all rural US regions because of cost constraints. Furthermore, inadequate frequency of spirometry testing as

recommended by national guidelines has been reported in the primary care setting especially among children with Medicaid insurance, with only 23% of children with Medicaid receiving spirometry as recommended by guidelines.⁸ To address these significant gaps in pediatric asthma care, additional solutions should be explored to extend the reach of pediatric asthma specialists particularly since compliance with guidelines-based spirometry recommendations as well as improved asthma outcomes have been reported when care is provided in the specialty setting.⁹ Similar to previous investigations,¹⁰ our findings also demonstrate the feasibility of using telemedicine to expand the reach of pediatric specialty health care services. This novel modality will bring care closer to home for children with pulmonary conditions that require spirometric monitoring, including pediatric asthma patients in rural and medically underserved regions. Furthermore, telemedicine will lessen the cost and travel burden for families and ensure that guidelines-based recommendations for long-term monitoring are translated to children in all communities.

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