Formative Evaluation for Implementation of a Low Literacy Pictorial Asthma Action Plan Delivered via Telehealth Improves Asthma Control

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Abstract
Consistently uncontrolled asthma in children is an increasing concern in the United States. The use of asthma action plans with asthma education is inconsistent and may be improved with adaptations for low literacy. The objective of this study was formative evaluation for implementation of the New Mexico Pictorial Asthma Action Plan (NM PicAAP). Quality improvement processes guided NM PicAAP face validation and telehealth direct patient care implementation. The asthma control test was selected to measure asthma control. NM PicAAP was revised for face validity, and training curriculum on its use and telehealth implementation processes were developed. Seven youth received NM PicAAP via telehealth direct care, which increased overall asthma control scores over 1 month. NM PicAAP may be useful and effective for improving asthma care in children via telehealth. Additional testing is needed to assess applicability.

Keywords
adolescent health, asthma, telehealth, quality improvement

About 1 in 12 children in the United States and in New Mexico (NM) had asthma in 2016 1,2 Poorly controlled asthma is associated with increased risks for morbidity and mortality in children.3 In NM, 38% of children with current asthma were not controlled, and nearly 60% with current asthma had a reported asthma attack over the previous year.2 NM residents are more vulnerable to poor asthma outcomes because of several factors, including language barriers, low literacy, and limitations to health care access.4,5 The National Center for Education Statistics estimates that at least 16% of the population in NM lack basic literacy skills, with the proportion rising to as high as 33% in some rural counties.6 In addition, about 1 in 10 NM residents is an immigrant, with about 70% of Mexican origin, and about half have less than a high school diploma.7 This contributes to more than 34% of NM’s population speaking a language other than English.8 Much of the predominantly rural and frontier state is defined as a health care provider shortage area,9 and specialty pediatric care is almost entirely concentrated in the state’s largest metropolitan area. These compounding issues frequently limit access to rural asthma care.

National and international asthma guidelines include recommendations to provide asthma care instructions as written asthma action plans.10,11 However, usual care in childhood asthma is not always consistent with the guidelines.12 In NM, only 47% of caregivers for children with current asthma reported receiving an asthma action plan from a health care provider.8

Although written asthma action plans have been associated with reduced asthma-related morbidity in children,11 they use medical jargon that can be difficult to understand, especially for individuals with low literacy or who are English language learners.13 A systematic review suggested that relying on the use of formal written asthma action plans alone may not improve outcomes and that patient asthma education at diagnosis and at
future visits is more likely to lead to better asthma control. Alternatively, pictorial asthma action plans, which include less written language and more elements of asthma education, such as visual cues to prompt treatment decisions, have been well received by families. Their use may improve medication adherence and decrease reported symptoms and hospitalizations related to asthma in children, compared to standard asthma action plans.

Direct patient asthma care via telehealth increases rural access to asthma care management and also may improve asthma outcomes for children. Pictorial asthma action plans delivered via telehealth may bridge literacy, language, and access to care barriers in states similar to NM where there are many rural and frontier areas. Therefore, the study team developed a pictorial asthma action plan (New Mexico Pictorial Asthma Action Plan [NM PicAAP]) that includes a treatment plan for when asthma is controlled and actions to take for moderate and severe symptoms. The primary aims of this project were to evaluate face validity of NM PicAAP and then to assess the usefulness (utility and usability) and effectiveness of NM PicAAP, delivered via telehealth direct patient care, in a pediatric outpatient clinic serving low literacy and English learner populations.

Methods

Design

The project design incorporated improvement science methodology. The University of New Mexico Health Sciences Center Human Research Protections Office and the participating clinics approved the study protocol. No patient or clinic staff identifiable information was collected. This study was included as an initiative in a larger quality improvement project, Facilitating Rural Opportunities with New Technologies, Resources and Services (FRONTERAS [Health Resources and Services Administration Grant #H2ARH30307]), for which youth and parents provided written informed consent for telehealth care services. NM PicAAP used informed passive (opt-out) consenting.

NM PicAAP Development

NM PicAAP is a pictorial asthma action plan, adapted from a previous version with permission. It was developed collaboratively by the NM Department of Health Asthma Control Program (NMDOH ACP) and Envision NM from the University of New Mexico Health Sciences Center (UNM HSC) Division of Adolescent Medicine in the Department of Pediatrics. The plan includes an image of a child properly using a spacer (to effectively deliver medication to the lungs) and can be individualized using stickers that have pictorial images of triggers and common inhaler medications. NM PicAAP is an educational tool intended to be used interactively between the patient and health care provider as an adjunct to the NM sanctioned asthma action plan (AAP). The health care provider completes the NM AAP and then discusses NM PicAAP with the family, to translate the AAP medical orders into a plan that is individualized and understandable to youth and their caregivers. NM PicAAP fits within the core set of evidence-based measures as a strategy to promote improvement of asthma outcomes in the performance metric to increase value-based care set forth by the Centers for Disease Control and Prevention and included in the Centers for Medicare & Medicaid Services requirements. NM PicAAP is available for use on the NMDOH ACP web page and is also available with directions for use as supplemental materials (see supplemental materials, available with the article online).

Project Planning

The improvement science theoretical framework asserts that there is a fundamental relationship between improvement and change, with success requiring the will to improve, ideas for improvement, and skills to execute changes. Consistent with this framework, prework included recruitment of pediatric outpatient clinical sites with need (low literacy or English learner patient populations) and staff interested in improving asthma care; delivery of a brief overview of evidence to support use of NM PicAAP to improve asthma care to all clinical staff as a buy-in strategy; and development of the NM PicAAP clinical staff training curriculum.

Asthma Control Assessment

To assess asthma control and evaluate effectiveness, the study team selected the Asthma Control Test because it is available online, free to use, and cited by the Expert Panel Report-3 guidelines for assessing asthma control. Schatz et al evaluated the Asthma Control Test and reported internal consistency reliability ($\alpha = .85$ baseline, $\alpha = .79$ follow up), test and retest reliability ($\alpha = .77$), criterion validity ($P < .001$), discriminant validity ($P < .001$), and responsiveness to changes in asthma control ($P < .001$) and lung function (forced expiratory volume, $P < .001$) with balanced sensitivity (71%) and specificity (71%) for detecting uncontrolled asthma. Out of a total possible score of 25, scores $\leq 19$ indicate that asthma is not well controlled, and scores $\leq 15$ indicate that asthma is poorly controlled.


Context and Project Team

One urban outpatient pediatric clinic served as the physical environment for the in-person face validation evaluation phase and one rural outpatient school-based health center (SBHC) served as the physical environment for the telehealth implementation phase of the project. The sociocultural environment consisted of the project team, clinic staff, and the patient populations the clinics served. The project team included the Envision quality improvement project director (MKV) and a health educator trained as a quality improvement coach, along with 2 NMDOH ACP staff who participated throughout the project. All clinical staff were included in the initial project introduction, orientation, and training. The project team communicated via telephone or email throughout the project.

Intervention Development

The Model for Improvement framework guided the evaluation of the usefulness, defined as utility (ie, is it functional and beneficial?) and usability (ie, is it easy to use?), and the effectiveness of NM PicAAP. At various points during the project, the project team and clinical staff co-developed the intervention. Clinical staff provided qualitative feedback throughout the project by direct face-to-face communication, email, and phone calls on overall clinic and patient perceptions of NM PicAAP usefulness. A series of convergent iterative Plan-Do-Study-Act (PDSA) cycles targeted implementation strategies in both clinical sites to determine adoption, modification, or rejection of tests of change. Each cycle informed adaptations and new cycles according to feedback to ensure fit for purpose.

In-Person Face Validity Evaluation Phase

NM PicAAP development and face validity evaluation was conducted in person at a busy pediatric outpatient clinic in a NM urban setting from June to August 2018. Key stakeholders included the clinic medical director and charge nurse. The study team introduced NM PicAAP to the participating clinical staff, and elicited feedback for revisions and for strategies to limit clinic disruptions. Similarly, the team presented the training curriculum and refined based on staff feedback. The clinic staff used NM PicAAP for 3 months at the in-person clinic and provided feedback on content, usability, and utility. PDSAs assisted these processes and identified the steps and potential barriers to implementing NM PicAAP use as part of a patient asthma follow-up appointment for one medical provider in the clinic (Table 1).

Telehealth Implementation Phase

Telehealth implementation occurred at a busy high school SBHC geographically located in a rural health professional shortage area near the NM-Mexico border from February to June 2019. The SBHC is about 1 mile from the high school. Key stakeholders included the medical clinician and clinic coordinator.

In-person PDSA cycles with SBHC staff assisted with co-development of implementation processes and identifying potential barriers challenging the processes: (1) a process map to visually represent the project from start to finish (Figure 1); (2) a key driver diagram to identify primary drivers (factors that contribute directly to the aims), secondary drivers (components of primary drivers), and change ideas to test (Figure 2); (3) a work flowchart to define the sequence of steps in the clinic process, and to consider potential impacts on workflow (Figure 3); and (4) a series of iterative PDSA cycles (Table 1).

Following the PDSAs, the health educator delivered ongoing monthly telecoaching with SBHC clinical staff to revisit the established processes, adapt where needed, and provide guidance and support. During this time
period, a provider who specializes in asthma care located at the UNM HSC delivered NM PicAAP to patients located in the rural SBHC for 5 months, as an adjunct to the NM AAP, via telehealth direct patient care. SBHC clinical staff scheduled patients located at the SBHC for telehealth direct patient care visits with the asthma specialist located at the UNM HSC for an initial telehealth clinic visit (day 1) and 2 follow-up telehealth visits at day 7 and day 30. SBHC clinic staff triaged patients in person at the SBHC (measured height, weight, blood pressure, pulse, temperature), securely faxed anthropometry and vital sign measurements to the telehealth team at the UNM HSC, and telepresented patients for each clinic visit (logged into the secure virtual telehealth clinic meeting room and introduced the patient to the UNM HSC asthma specialist to start the individual telehealth direct patient care visit). The UNM HSC asthma care specialist administered the asthma control test during every telehealth direct patient care visit to assess asthma control and revisited NM PicAAP at telehealth direct patient care follow-up visits. A member of the project team conducted retrospective medical record reviews to collect the asthma control test scores to evaluate effectiveness.

**Analysis**

Descriptive analyses of asthma control test scores from the medical record reviews by visit number were conducted using Stata Statistical Software, release 15 (StataCorp LLC, College Station, Texas).27

**Results**

**In-Person Face Validity Phase**

Iterative PDSA cycles developed from clinic staff feedback aimed at face validity processes indicated a need for
alternative images in NM PicAAP. Clinical staff indicated that the emoji images originally included did not accurately represent asthma control and the mold image used to represent a trigger was confusing. Clinic staff also recommended the tool include additional prescribed inhaler images. The study team conducted an electronic Google search, identified alternative emoji, mold, and inhaler image options, and purchased user rights where needed.

Additional PDSA cycles emerged from more detail-specific processes and identified the need to format NM PicAAP to highlight daily medications as a treatment cornerstone, regardless of symptoms. Medical clinic staff confirmed face validity of the revised NM PicAAP. Clinic staff feedback also informed NM PicAAP teaching curriculum development and revisions to condense and simplify steps. Concurrently, collaborative implementation processes and iterative revisions from PDSA cycles guided strategies to limit work disruptions by integrating project work into the existing workflow and increase accessibility. These processes highlighted a need for additional NM PicAAP supplies placed in high-traffic clinic locations to increase accessibility to printed versions of NM PicAAP for clinic staff. Printing costs were identified as being potentially burdensome in terms of sustaining implementation of NM PicAAP in the future.

The medical clinic staff subjectively reported positive utility and usability feedback from their pediatric patients who received NM PicAAP. Compared to the standard written asthma action plan, use of NM PicAAP seemed to improve provider-to-patient communication, patient understanding of controller versus rescue inhalers, and engagement, without adding significant time to visits.

Telehealth Implementation Phase

Iterative PDSA cycles from collaborative processes aimed at implementation led to the clinic staff developing processes to identify, refer, schedule, and telepresent youth located at the SBHC for telehealth direct patient care visits with the asthma specialist located at the UNM HSC. These processes also helped organize the workload distribution among the rural SBHC clinic staff. SBHC clinic staff buy-in was slow early in the implementation phase. With high initial in-person project team guidance, clinic staff developed these processes with the SBHC provider taking the leadership role. Leveraging the momentum, monthly telecoaching built increased engagement under the SBHC provider’s continued leadership that eventually led to decreased need for guidance. The SBHC team became increasingly independent in navigating and refining the referral and telehealth processes.

Nine high school youth ages 10 to 17 years at the SBHC agreed and 7 provided written consent to receive telehealth direct care services and participate in NM PicAAP.
PicAAP, with a total of 13 telehealth visits completed. All 7 participated in the day 1 telehealth visit, 4 completed the follow-up telehealth visit at day 7, and 2 completed the telehealth follow-up visit at day 30. Telehealth visits overall lasted at least 30 minutes. Through use of NM PicAAP with youth during the telehealth visits, it was determined that, despite previous prescriptions ordered by their SBHC provider in person, none of the youth had a spacer and none had a second rescue inhaler to take to school. The study team contacted their pharmacies to assist families with obtaining spacers and second inhalers as their SBHC provider had ordered. Most youth confused the controller with the rescue inhaler, even though they had previously received in-person education on their inhalers at their SBHC. NM PicAAP highlighted an image of their controller inhaler in the daily medication section and an image of their rescue inhaler in the symptom treatment section with an image of a child correctly using a spacer, which helped youth understand how to differentiate between the inhalers and the appropriate way to use them.

Asthma Control Test scores ranged from 10 to 22 at the day 1 visit (average 16.6), from 17 to 23 at the day 7 visit (average 20.8), and from 20 to 24 at the day 30 visit (average 22; Figure 4). Overall, average scores for day 1

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**Figure 3.** Workflow chart.26
SBHC, school-based health center.
Key:
- Start and end points
- Activity or task
- Decision point

**Figure 4.** Asthma Control Test scores.
ACT, Asthma Control Test.
indicated that asthma was not well controlled, and day 7 and day 30 scores indicated asthma was controlled. Youth who received all 3 intended telehealth NM PicAAP direct patient care visits reported improved ability to participate in school physical education class running activities; previously they could not participate at all.

Discussion

During this formative project, the study team established the face validity of NM PicAAP in person, collaboratively developed and revised a training curriculum to promote use, and determined that it was useful and effective via telehealth in 1 rural pediatric SBHC. Overall, NM PicAAP was well received by clinic staff and pediatric patients with uncontrolled asthma. Key to project success were collaborative interactive working relationships with clinic staff who were highly motivated to address poorly controlled asthma in youth and, in particular, the medical provider who led the clinic team.

The team found that following a structured workflow algorithm and training curriculum that incorporated clinic staff input helped support adoption and ownership of the intervention during implementation. Similarly, Bian and colleagues incorporated structured, asthma-focused school nurse training into a school-based asthma telehealth program and found a statistically significant reduction in emergency room visits compared to standard school clinics.

Use of quality improvement methods during implementation was important to allow standardization of key aspects of delivery, such as use of the pictorial and traditional asthma action plans, while also adapting to site-specific challenges and strengths. Although promising initial results were found, inherent variabilities between and among other clinic staff, cultures, and patient populations could affect replication of the implementation processes that were used during this formative project on a larger scale, unless a similar quality improvement approach is used to routinely adapt the implementation at the clinic level.

After implementation via telehealth, NM PicAAP use increased asthma self-management engagement and control in the small subset of youth included in this project. These results are consistent with previous published studies that found that pictorial AAPs may be useful to increase asthma self-management in children without adding burden to clinic workflow time demands.

Limitations

Although this project was well received and had preliminary success in improving youth asthma outcomes, there are some aspects that could be improved. For example, development of an electronic version of NM PicAAP should be considered in the future to reduce the burden of printing costs and better facilitate use via telehealth.

Compared to a typical research study, the present study sample size to examine effectiveness was small. However, testing effectiveness with samples as small as 5 patients before scaling up an intervention is consistent with recommended quality improvement methods to reduce the risk of investing significant resources in interventions that have not been optimized through testing. Additional testing with more patients is required to confirm that use of NM PicAAP consistently improves asthma control.

This project also had high youth attrition. This is consistent with other telehealth programs, which often have high initial and low sustained engagement. In-person adolescent and asthma visits also reflect similar attrition; loss to follow-up is common and 66% typically do not receive even 1 follow-up asthma care visit within 30 days after an exacerbation. In the present project, it is possible that youth did not return for the 7- and 30-day appointments because asthma control improved, and they likely experienced fewer bothersome symptoms. Adolescents with asthma tend to underappreciate symptoms and deny having a chronic illness, and often view asthma as an episodic disease that does not require regular follow-up care. Transportation also may have contributed to attrition, given that the SBHC was not physically located at the high school. Youth education on asthma care and quality assurance monitoring to promote follow-up care should be considered in future pediatric asthma care projects.

Conclusions

Formative evaluation of implementation testing of NM PicAAP via telehealth indicated it may be useful for improving asthma care in a rural outpatient SBHC. NM PicAAP’s full applicability is yet to be determined, and larger scale testing may help determine NM PicAAP’s usefulness and effectiveness as a strategy to improve asthma outcomes in NM children.

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**Supplemental Material**

Supplemental material for this article is available online.

**References**


