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A Patient Advocate to facilitate access and improve communication, care, and outcomes in adults with moderate or severe asthma: Rationale, design, and methods of a randomized controlled trial

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Abstract

Few interventions to improve asthma outcomes have targeted low-income minority adults. Even fewer have focused on the real-world practice where care is delivered. We adapted a patient navigator, here called a **Patient Advocate (PA)**, a term preferred by patients, to facilitate and maintain access to chronic care for adults with moderate or severe asthma and prevalent co-morbidities recruited from clinics serving low-income urban neighborhoods. We describe the planning, design, methodology (informed by patient and provider focus groups), baseline results, and challenges of an ongoing randomized controlled trial of 312 adults of a PA intervention implemented in a variety of practices.

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The PA coaches, models, and assists participants with preparations for a visit with the asthma clinician; attends the visit with permission of participant and provider; and confirms participants' understanding of what transpired at the visit. The PA facilitates scheduling, obtaining insurance coverage, overcoming patients' unique social and administrative barriers to carrying out medical advice and transfer of information between providers and patients. PA activities are individualized, take account of comorbidities, and are generalizable to other chronic diseases. PAs are recent college graduates interested in health-related careers, research experience, working with patients, and generally have the same race/ethnicity distribution as potential participants.

We test whether the PA intervention, compared to usual care, is associated with improved and sustained asthma control and other asthma outcomes (prednisone bursts, ED visits, hospitalizations, quality of life, FEV1) relative to baseline. Mediators and moderators of the PA-asthma outcome relationship are examined along with the intervention's cost-effectiveness.

Keywords

asthma; asthma control; asthma-related quality of life; inner-city asthma; patient advocate; health literacy

INTRODUCTION

Asthma affects 18.7 million US adults.¹ Despite efficacious medications and national guidelines for management,² asthma has a disproportionate impact on low income and minority adults, particularly African Americans and Puerto Ricans. In 2010, Blacks had more than 3 times the emergency department (ED) visits and 2 times the hospitalizations and death rate from asthma compared to whites.¹ Puerto Ricans were 3.4 times as likely to die from asthma compared to all Hispanic/Latino groups.³ Overall Hispanic/Latino adults are 60% more likely to be hospitalized for asthma than non-Hispanic whites.³ Compared to children, adults are more likely to die from asthma.¹ However, few interventions to improve asthma outcomes have targeted low-income minority adults;⁴⁻⁷ 65% of adults with asthma are women.^{1,8}

To reduce health outcome inequities the Institute of Medicine advocates addressing access to healthcare and patient-provider communication.⁹ This report found racial and ethnic inequities in health care at two levels: 1) the operation of the practice/health system where administrative tasks are completed; and 2) the individual patient-provider interaction.⁹ Asthma provides an excellent setting for addressing both levels. At the practice/health system level, features impeding asthma care in vulnerable patients may include general and urgent appointment availability, lack of evening hours; complicated insurance and health forms; and absence of policies that consider cultural or language differences between patients and staff.¹⁰⁻¹² At the patient-provider level, physicians have been found to underestimate asthma severity in black patients.¹³ Comorbidities including hypertension, diabetes, and obesity, frequent in low-income adults, increase the likelihood of adverse asthma-related outcomes and make access to care and patient-provider communication more complex. We describe a **Patient Advocate (PA)**, an intervention that addresses both levels.

The PA is based on the Patient Navigator, proposed by Harold P. Freeman, MD to overcome barriers to early diagnosis and treatment of cancer for patients living in poverty in Harlem.^{14–16} With input from patient and physician focus groups, we adapted the Patient Navigator as a PA, a term preferred by patients, to facilitate and maintain access to chronic care for adults with uncontrolled asthma and prevalent chronic morbidities recruited from clinics serving low-income urban neighborhoods.¹⁷ Our PA, designed to promote self-management of a chronic disease, compared to usual care, coaches, models, and assists with preparations for a visit with the asthma provider; attends the visit with permission of patient and provider; and confirms understanding of decisions and recommendations made at the visit. The PA facilitates scheduling, obtaining insurance coverage, overcoming patients' unique social and administrative barriers to carrying out medical advice, and exchange of information between providers and patients. PA activities are individualized and are generalizable to other chronic diseases.

We describe the planning, design, methodology, challenges, and baseline results of this ongoing randomized controlled trial ["Helping Asthma Patients 2" (HAP2)] of 312 adults, implemented in a variety of practices. HAP2 tests whether the PA intervention, compared to usual care, is associated with better and sustained asthma control and other asthma outcomes (prednisone bursts, ED visits, hospitalizations, quality of life, FEV1) relative to baseline. Mediators and moderators of the PA-asthma outcome relationship are examined along with cost-effectiveness.

METHODS

Adapting the Patient Navigator

Patient Navigators have been widely used to assist uninsured, minority, elderly, and low-income patients in a number of different settings, particularly in screening or facilitating induction of therapy for cancer,^{18,19} and for chronic diseases such as diabetes.²⁰ Patient Navigators have arranged transportation, scheduled appointments, ensured medical record availability, and provided social and financial support.²¹ They have been nurses,²² social workers,^{23,24} and community health workers.²⁵

To develop a feasible and acceptable PA intervention for asthmatic adults, we conducted four focus groups of patients and two of providers.¹⁷ Providers and patients thought a PA intervention to be feasible and potentially beneficial, particularly as a means of social support. Providers thought PAs could help with tasks for which providers are limited by time, understaffing, or other resources and could help with obtaining medications, transportation, insurance coverage, and medical information. Patients wanted an advocate (a term they preferred to "navigator"): "someone on your side." They reported being anxious about medical visits, forgetting to ask questions and obtain prescriptions, and forgetting what the doctor said after they left the visit. The focus groups revealed that patients experienced a variety of barriers in addition to limited literacy (e.g., transportation difficulties, caring for sick family members, inability to afford co-payments or to obtain insurance), suggesting resources to address these needs would be valuable.

Patients in the focus groups were asked to speculate on the training and background of a person who would make a good PA. The patients had participated in an earlier study in which research coordinators (RC), recent college graduates with an interest in healthcare careers and in working with patients but no formal healthcare training, had worked with them. These patients wanted someone like these RCs. Patients perceived these young people as good listeners, helpful and felt comfortable with them and observed they were also comfortable with clinical staff.^{17,26}

Piloting the patient advocate: HAP Study

Following the focus groups, a pilot study to test feasibility and acceptability of the PA intervention was conducted, the HAP (Helping Asthma Patients) Study: “A Patient Advocate & Literacy-Based Treatment of Asthma” (RC1 HL099612; Apter, PI).²⁷ In a prospective randomized trial, 100 adults with moderate or severe asthma were randomized to 16 weeks of the PA intervention or a minimal comparison intervention. Those in the PA arm worked with the non-health-professional recent college graduate, who prepared patients for a medical visit, attended the visit, and confirmed understanding. The PA facilitated scheduling, obtaining insurance coverage, and overcoming other barriers to carrying out medical advice. Adherence to inhaled steroids was electronically-monitored in both the intervention and the control group as the primary outcome.

Participants were mean age of 47 ± 14 years, 75% were female, 71% Black/African-American. The mean baseline FEV1 was $69\% \pm 18\%$ of predicted. Thirty-six percent of participants had experienced hospitalizations and 56% had ED visits for asthma in the year prior to enrollment. Sixty-four percent reported a household income of less than \$30,000 per year. Ninety-three participants completed all study visits; of 7 who did not complete, 3 had been assigned to a PA and 4 to the control group. Three withdrew because they were too busy with school/job; four were lost to follow-up. Of the 53 participants assigned the PA arm, 36 (68%) had at least one PA visit.

We called the comparison condition minimal intervention (MI) because these patients were monitored for adherence, an intervention in itself that required us to ensure patients had an inhaled steroid in order to place a monitor. Additionally, monitoring itself changes behavior. Also, when asking patients questions about knowledge of inhaled steroids, if incorrect answers were given, we provided correct answers, thus educating the participants. Similarly in testing use of inhalers, we taught the correct technique if it was incorrect.

PAs attended a total of 65 medical appointments with patients. One patient refused to have a PA accompaniment to one medical visit. One physician refused to have a PA participate in one, but not subsequent, patient visits. Of those randomized to the PA intervention, 91% rated the study experience positively and all reported they would recommend the study to a friend. Thus the PA intervention was feasible and acceptable.

However, the short observation time and the relatively small sample size did not allow definitive assessment of effectiveness.²⁷ Inhaled steroid adherence declined significantly in the control ($p=0.001$) but not significantly in the PA group ($p=0.30$). Both PA and MI groups demonstrated improved asthma control ($p=0.01$ in both) and quality of life ($p=0.001$,

p=0.004 respectively). Hospitalizations and ED visits for asthma during the study did not differ between groups. The observed changes over time tended to favor the PA group, but the study was underpowered to detect differences between groups.

These findings suggested potential effectiveness if a larger sample was studied, for longer duration, in more settings, and with a comparison to guideline-based usual care and the outcome of asthma control rather than comparing medication adherence. It was recognized that monitoring adherence was an intervention and would decrease the difference between the control and PA groups (i.e. the Hawthorne effect).²⁷

Hypothesis and Aims of HAP2 Study

The completed HAP pilot study, establishing feasibility and acceptability, led to the primary hypothesis of the ongoing HAP2 Study that a PA Intervention (PAI) is effective and would lead to improved asthma outcomes compared to guideline-based usual care. The PA of the HAP Study became the model for the HAP2 PA (Table 1). Like the HAP PA, the HAP2 PA is a recent college graduate interested in a healthcare career, who facilitates scheduling, obtaining insurance coverage, overcoming patients' unique social and administrative barriers to carrying out medical advice, and transfer of information between providers and patients.

HAP2 is a **randomized controlled trial** recruiting 300 adults with moderate or severe persistent asthma from clinics serving low-income, urban, primarily minority patients.

Specific Aim 1: (a) Assess whether 6 months of the PA Intervention (PAI) is associated with improved asthma control relative to baseline compared with **usual care (UC)** and (b) whether such a difference is sustained in the 6 months following the intervention's completion.

Specific Aim 2: (a) Assess whether the PAI improves other asthma outcomes (need for prednisone bursts, ED visits, hospitalizations, quality of life, FEV1) relative to baseline compared with UC at 6 months and (b) is sustained in the 6 months following the intervention's completion.

Secondary Aim 1: Evaluate whether improvement in self-efficacy, kept appointments, communication with providers, adherence, and navigating ability mediate the effect of the PAI on asthma control.

Secondary Aim 2: Assess whether baseline patient factors (e.g., educational attainment and health literacy, demographics, household income, depression, anxiety, social/community barriers) and provider factors (e.g. demographics, years in practice, primary versus specialty practice), moderate the effect of the PAI on the mediators and asthma control.

Specific Aim 3: (a) Measure the incremental direct costs of the PAI compared with UC from both payer and a modified societal perspective; and (b) determine the incremental cost-effectiveness of the PAI relative to UC for asthma control and other outcomes.

Exploratory Aim: Conduct post-study focus groups of providers to explore awareness of the intervention and their response to and assessment of the value of the PA.

This study was approved by the institutional review boards of the University of Pennsylvania and the Corporal Michael J. Crescenz Veterans Administration Medical Center. It is registered at [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT01972308) (NCT 01972308).

HAP2 design and methodological choices

The conceptual model is based on the multilevel framework of Canino et al.²⁸ This multi-level framework hypothesizes that the PAI will improve asthma management measured by patient-centered outcomes- specifically- asthma control, prednisone bursts, ED visits, and hospitalizations by addressing provider/clinician practices, the operation of the health system, patient and family context, and the social/environmental context of the patient and community in which they live. While preparing for a medical visit, it is hypothesized that the PA will improve communication between provider and patient by coaching and modeling ways to ask questions, obtain information and communicate lack of understanding of medical information to providers. We hypothesize as a secondary analysis that the PAI will improve outcomes by improving patient self-efficacy, appointment-keeping, patient satisfaction with communication with the provider, adherence with recommended and prescribed care, and navigating ability. The PAI-health outcome relationship may vary depending upon different levels of moderators like educational attainment, baseline health literacy, sociodemographics, comorbidities, community factors, presence of anxiety or depression, and clinician characteristics. Our model is grounded in Social Cognitive Theory that suggests that individuals will engage in a behavior like asthma self-management to the degree they believe that they are capable of carrying it out to achieve a desired result, e.g. improved asthma control.^{29–32} Social Cognitive Theory proposes that behavior and the environment (e.g. clinical practice, health system, social) interact continuously and these interactions should be taken into account.³³ We hypothesize that the individualized PAI will achieve this goal. Because implementation of a PAI requires additional resources (time and personnel), we also will estimate the incremental cost-effectiveness of the PAI relative to usual care to help ascertain whether the additional resources required for the intervention are partially or completely offset by other savings, such as a reduction in asthma hospitalizations and ED visits. **A randomized controlled trial design** was chosen because randomization reduces the likelihood of bias from both known and unknown confounders.³⁴ Randomization is particularly important in a study of health behavior where many complex influences are not well understood. If randomization is successful, confounders whether known or unknown will be equally distributed across comparison groups.

Along the multidimensional continuum of explanatory/efficacy to pragmatic/effectiveness designs, this study has strong pragmatic/effectiveness features.^{35–37} These include comparison of the PAI to the existing standard of care as practiced in both specialty and primary care. The study population enrolled is demographically diverse, with significant asthma morbidity and a range of co-morbidities and selected only on the basis of having moderate/severe asthma (patients with mild asthma do not require the resources of a PA intervention).³⁶ Smokers, often excluded in asthma efficacy trials, are included in this

study.³⁷ Randomization hopefully will equally distribute smoking behavior, other comorbidities, and relevant characteristics to PA or UC groups. Study sites include heterogeneous practice settings (primary care, specialty care; federally qualified health center, academic health center, Veterans Affairs Medical Center (VA)). We collect a broad range of patient-oriented outcomes: asthma control, ED visits, hospitalizations, prednisone requirements, quality of life.^{36,38,39} No special strategies are used to improve study protocol adherence and the protocol is individualized.³⁶ Thus, if cost-effective, the intervention will be able to be implemented in a variety of settings. The analysis is intention to treat.

Randomization by participant stratified by practice—The PAI is directed at the patient-PA interaction, so there is little opportunity for the providers to change their behavior with patients not randomized to PA. There was no evidence of contamination of study arms in HAP. Given that cluster randomization of clinics requires approximately 20 sites to obtain sufficient power to detect a 0.05 difference between groups, cluster randomization is not feasible with our resources for HAP2. We will convene post-study focus groups of providers to explore their awareness of the intervention and response to it. We also will obtain responses to a post-study question from all participants (PAI and UC) asking if providers changed behavior during the study.

Eligible consenting patient participants are randomized 1:1 to PAI or UC. Block randomization with block sizes ranging randomly between 4 and 6 consecutive participants within each site are employed to ensure that equal numbers of participants are assigned to each of the two groups and are balanced with respect to observed and unmeasured baseline factors.⁴⁰ Randomization is single-blind; the principal investigator and other investigators will be blinded to group assignment throughout the study and its analysis.

Asthmatic patients, at least 18 years of age, are recruited from clinics serving low-income neighborhoods—Most asthma studies involve children; adults are relatively understudied. The HAP and other previous studies established effective recruitment methods and relationships with a variety of clinical practices to recruit and retain adults with asthma with significant numbers of hospitalizations and ED visits and other health services requirements.^{26,27} HAP demonstrated that patients who find a PA most useful will enroll and maintain enrollment. Very busy, employed, highly educated persons, least likely to benefit from a PA, often choose not to participate and frequently do not enroll.

PA activities—PA activities are informed by focus groups¹⁷ and the completed HAP pilot study.²⁷ As in HAP, in HAP2 the PA facilitates and models administrative tasks to navigate the health system and practice, prepares for visits, carries out medical recommendations, and overcomes social and community barriers to accessing care. The PA coaches patients to articulate appointment goals, concerns, and lack of understanding of medical advice. PA activities surround 1) preparation for asthma medical visits, 2) medical visits attended by the PA, and 3) ensuring understanding, scheduling, and administrative tasks agreed upon by doctor and patient.

Research coordinators (RCs) act as PAs and data collectors (DCs), but play only one role (PA or DC) for any one participant—In our earlier focus groups,¹⁷

patient participants preferred PAs to be recent college graduates interested in health-related or education careers, research experience, further schooling, working with patients, and generally having the same race/ethnicity distribution as potential subjects. We considered other choices: lay health workers, social workers, and nurses; but no one background had been shown to be superior.⁴¹ Ultimately, we followed the recommendation of our focus group participants. End of study questions and comments to DCs and PAs in the HAP study, collected from their study blogs, confirmed that participants like working with PAs, frequently asking to continue working with them when the study ends. HAP PAs also were well-received by clinic personnel. Since PAs do not take part in medical decision-making, they do not need extensive medical background. PAs play a unique role whose activities are not performed by clinic health care providers or other participating clinic personnel (Table 1).

HAP2 RCs train for 3 weeks initially for their roles as PA and DC, using procedure manuals of recruitment, protocol, and data collection adopted from HAP. Training topics include asthma pathophysiology and education; asthma medications; spirometry; human subjects research; cultural competence; interpersonal skills; relating to medical providers; administrative tasks required of patients; procedures for reviewing medical records, screening, enrolling, obtaining consent, recognition of adverse and serious adverse events, and data collection procedures.⁴² Scripts in English and Spanish for recruiting phone calls, data collection, and encounters are provided to the RC trainee. At least two of the RCs are fluent in Spanish.

Specific training for the role of the PA also included training in the introduction and use of an asthma action plan, developing listening skills to allow uniform and standardized note-taking across patients during their medical appointments, learning ways to identify community resources in response to patients' questions, and becoming proficient at providing teach-back at a level of language and culture that would be appropriate to the patient.

After 3 weeks of this training which includes role-playing, the ability to obtain spirometry is tested by the principal investigator who is a physician. Then three data collection appointments and three patient advocate visits are observed and critiqued by the project manager. RCs are observed and later critiqued by the project manager at least quarterly for a PA and a DC visit. If a researcher believes a patient's asthma or health is unstable, the principal investigator and the patient's clinician are notified immediately.

Experiences during PA and DC visits are presented and discussed as part of each weekly team meeting. The project manager also checks data collection weekly and frequent QA reports are obtained by queries of the data set looking for missing or out of range values.

Comparison group is Usual Care (UC)—Both UC and intervention participants receive asthma care from their providers and practices which generally follow asthma guidelines.² The only research-related activity is data collection, which is collected quarterly (every 3 months). We do not provide medications to either group.

Choice of outcomes—The Primary outcome is asthma control^{43,44} which describes current symptoms, is patient-oriented, and the primary therapeutic goal emphasized by national and international guidelines for managing asthma^{2,45,46} and a recent Asthma Outcomes Workshop.⁴⁷ Pilot data from the HAP Study demonstrated overall improvement in asthma control. This and other asthma-related patient-oriented outcomes (i.e., prednisone bursts, ED visits, hospitalizations, ICU admissions, and quality of life) are described subsequently in the section entitled “Measures.”^{45,47}

In two prior intervention studies, the primary outcome was electronically-monitored adherence to inhaled steroids.^{26,27} In one, both intervention and comparison groups improved and the monitoring process was the same for both groups.²⁶ Monitoring had three elements that together had the potential to improve asthma outcomes: attention, monitoring feedback, and provision of inhaled steroids necessary for electronic monitoring. Thus, although adherence is an important measure of patient-provider communication,⁹ it is not an appropriate outcome to test the effectiveness of this pragmatic PAI, as monitored adherence is neither patient-oriented nor pragmatic. For this HAP2 study, therefore, we measure self-report of adherence, (although not as the primary outcome), which is correlated to monitored adherence⁴⁸ and more pragmatic although less precise.

Choice of mediators/moderators—Potential mediators, testing how the PAI might affect asthma outcomes, for example by improving adherence to medications or medical appointment-keeping, were identified from the literature and our preliminary HAP pilot test results.^{49–52} Their measurement characteristics are described in detail in the subsequent Measures section. Self-efficacy, a prominent construct in Social Cognitive Theory, is the conviction that one can successfully manage asthma.^{29,31,32} Specifically, we measure self-efficacy as 1) perceived confidence in filling out medical forms and 2) confidence in adherence to essential inhaled steroid regimens. Appointment-keeping and adherence to inhaled steroid regimens are measures of an effective working alliance between participant and provider facilitated by the PA. They are manifestations of effective self-management and we hypothesize should be associated with improved asthma outcomes.^{53–55} We also hypothesize that patient satisfaction with communication with providers should improve with the PAI. Finally, we have developed and validated a questionnaire, Navigating Ability⁵⁶ that measures the ability to access health care and to obtain diagnoses and treatment that is promoted by the PAI.

Moderators are baseline characteristics that interact with PAI to influence the level of outcomes.^{49,51} We test whether the relationship between PAI and outcome changes across levels of a moderator,^{49,51} including both patient (baseline health literacy, educational attainment,⁵⁷ comorbidities, smoking history, socio-demographics, community barriers,^{58,59} anxiety,^{60,61} depression^{60–62}) and provider characteristics (demographics, practice type, years in practice).

Duration of patient participation—Duration of patient participation for this pragmatic study is 12 months. For those in PAI, the intervention takes place in the first 6 months. Both groups are observed in the second 6 months without intervention. For both groups, the

number of visits per 12 months with the physicians who provide care to study participants are recorded.

Cost-effectiveness analysis—Implementation of a PAI will increase initial resource requirements (e.g., PA cost: potential initial increase in medications and potentially office visits and associated evaluation, management, and monitoring costs). However, initial increased resource utilization may be partially or completely offset by savings related to better asthma outcomes, such as reductions in asthma-related hospitalizations and ED visits. Even if a PAI is not cost-saving, based on analysis of direct medical costs, the intervention may be cost-effective if improvement in outcomes is achieved at reasonable increased costs and/or taking into account other non-medical and indirect benefits of improved asthma control, such as increased productivity and improved functional status and quality of life.

HAP2 Subjects

Inclusion criteria are designed to enroll a sample of adults with moderate/severe asthma with high risk of morbidity: 1) 18 years of age; 2) physician's diagnosis of asthma; 3) prescribed an inhaled-steroid-containing medication for asthma (ensuring the patient is believed to have moderate or severe reversible airways obstruction by their physician); 4) moderate or severe persistent asthma according to the NHLBI Guidelines;² 5) evidence of reversible airflow obstruction: (a) forced expiratory volume in 1 second (FEV1) < 80% predicted at the time of screening or within the 3 years prior to this screening, and (b) improvement with bronchodilator: either (i) an increase of 15% and 200ml in FEV1 with asthma treatment over the previous 3 years or (ii) after 4 puffs of albuterol by MDI (or 2.5 mg by nebulizer), an increase in FEV1 or FVC 12% and 200 ml in FEV1 within 30 minutes;^{2,63} and 6) at least one appointment scheduled with the asthma (primary or specialty care) provider from a participating practice during the first six months of participation.

Individuals are excluded for any of the following reasons: 1) Severe psychiatric or cognitive problems (e.g., obvious mania, schizophrenia, significant mental retardation) that preclude understanding and adhering with PA activities. Formal psychiatric evaluations are outside the scope of this project. However, RCs are trained to identify patients during screening who do not appear to be mentally competent to carry out study tasks. Individual cases are reviewed by the principal investigator. In our previous studies this has happened in 1% of screened subjects/study. Each clinical site has mental health facilities for referral of patients. 2) Unable to understand and provide informed consent; 3) Unable to communicate in English or Spanish; and 4) Participated in the previous HAP Study.

Patients with other comorbidities who meet the above inclusion criteria are not excluded. Indeed, patients with comorbidities may benefit most from a PA. Smoking likewise is not an exclusion criterion. We excluded smokers in earlier studies, but eliminated this exclusion because it excluded significant numbers of patients, particularly low-income patients, who might benefit from the intervention. Although this is a study of asthma patients, the PAI's assistance is not necessarily restricted to asthma. Thus, defining "pure" asthma with no overlap with COPD, even if it were possible, is unnecessary.

HAP2 Recruitment sites

Participating sites include primary care and asthma-specialty practices across a variety of settings: two family medicine, two general internal medicine, two pulmonary and one allergy outpatient practice in the University of Pennsylvania Health System; a pulmonary practice at the Corporal Michael J. Crescenz Veterans Administration Medical Center (which is affiliated with the University of Pennsylvania School of Medicine); the community-based primary care practice of the Woodland Avenue Health Clinic, a federally qualified health center; and the Episcopal Hospital Comprehensive Health Center, a primary care practice serving mainly Spanish-speaking patients. All sites have a large pool of patients with asthma and serve urban low income and minority patients from the surrounding communities. Having 10 sites, including both specialty and primary care practices, improves the generalizability of the results by asthma severity and patient demographics and ensures adequate enrollment. An orientation meeting prior to the beginning of recruitment was held at all sites. All sites have a co-investigator “champion” to facilitate communication with the practices and enrollment.

HAP2 Recruitment procedures

Research coordinators screen electronic or paper health records of participating practices for patients with upcoming appointments who have an asthma diagnosis and are prescribed an inhaled-steroid-containing medication. Data collectors (DCs) call or approach potential participants at the practice and request consent for further screening. IRB-approved consent is read and discussed in English or Spanish as appropriate to the potential participant to permit screening, with an opportunity for potential participants to ask questions. A second consent is obtained for enrollment. Seasonal variation is adjusted for by randomization and by recruiting through all seasons.

HAP2 Protocol

Data Collection Visits

Data Collection Visits generally occur at a private location in the practice of the participant’s asthma provider. Most providers are physicians but some are physician trainees (residents, fellows), or nurse practitioners. After explanation of the protocol, informed consent is obtained and baseline data collected by the DC (Table 2, Figure 1). Participants then are randomized 1:1 to either PAI or UC. As a pragmatic trial, there is no “run-in” prior to or following randomization and study enrollment, as this will select those most adherent.³⁶ Except for the test of reading comprehension, questionnaires are read to patients as they look on in English or Spanish as preferred by the participant. All questionnaires and all scripts have been translated into Spanish and back into English and independently reviewed by other native Spanish speakers and compared with English versions. Data collection (Table 2) occurs quarterly. All participants are reminded of data collection appointments with a phone call a few days prior to the visit.

At each visit the DC asks participants about any asthma symptoms and about urgent care obtained since the last visit, e.g., ED visits, hospitalizations, new or increased prednisone

prescriptions (“prednisone bursts”). From HAP experience, we estimate that both PA and UC participants will have three to five appointments with their asthma clinician during the observation period. PA, but not UC, activities surround these visits. Thus, we expect that randomization will result in approximately equal numbers of appointments with clinicians for both those randomized to PA or UC participants assigned to PA or UC.

HAP2 PA protocol

In HAP we found it was important for the patient to get to know the PA as much as possible before the medical visits. As in HAP, the HAP2 PA meets the PA-assigned participant after randomization at Data Collection Visit 1 (Figure 1). After introductions, the PA gives the participant some personal background (e.g., where the PA grew up, went to school, career goals) to begin to establish the PA-patient relationship and to motivate the patient to volunteer additional similar information. The PA gives the participant a notebook containing pages to enter medications; a calendar for appointments; and a page to enter contact information for physicians, pharmacies, and insurance. It contains a sample action plan that the PA encourages the patient to discuss with their asthma doctor. This notebook is used at subsequent meetings with the PA and as the patient otherwise desires. During the 6-month PAI period, the PA contacts the patient monthly to further solidify the PA-patient relationship if they do not meet otherwise. They may review clinician recommendations or converse about personal experiences or plans. The PA also meets the participant before, during, and after a visit to the asthma-treating clinician to model, facilitate, and empower patients to complete tasks related to asthma management.

A few days before each visit with the asthma clinician—By phone or in person, the PA assists the participant in creating/updating a medication list to share with the provider, if not already made. Patient and PA discuss any problems with obtaining, refilling, or taking medications. The participant reviews any questions she/he plans to address with the clinician, as this has been shown to improve communication and patient satisfaction with the visit.⁶⁴ The PA prompts the patient to prepare no more than 2 or 3 priorities to address at the medical visit (In HAP, we found preparing too many points to be frustrating to both the clinician who may have other issues to discuss as well as to the patient if such issues are not addressed). The PA inquires whether forms, referrals, or other documents are needed for the visit and helps the patient obtain and complete them if necessary.

The PA meets the patient in the waiting room when the patient comes for a visit—The PA asks the participant if there is an emergency plan if the patient experiences an asthma exacerbation and encourages the participant to discuss this at the visit if it is not adequately described by the patient. The PA helps the participant organize any needed materials, e.g. study results, medication lists, insurance information in the notebook. The PA uses the waiting time (which is sometimes considerable) to get to know more about the patient’s life and priorities and strengthen their relationship.

During the Medical Visit—If both the participant and clinician permit, the PA accompanies the participant during the visit as an observer. In general, the PA speaks only if invited by the participant. Patients provide written consent that allows PAs to take notes to

assist with the “teach back” (patient repeating provider recommendations in their own words).

In primary care practices, other health issues besides asthma may be discussed. The PA assists in organizing the visit to include all health issues and “teach back” to include all health recommendations.

Immediately after the Medical Visit—As needed, the PA facilitates scheduling follow-up appointments with the clinician and/or others as recommended and assists with the completion of any paperwork, e.g., insurance forms or other documents. The PA reviews instructions given to the participant at the appointment by asking the patient to “teach back,” that is, to teach the instructions as if the patient were the clinician. If the participant has questions for the clinician after reviewing these instructions, the PA and participant complete a report of items needing clarification for the clinician or staff. In previous studies, such reports have improved asthma outcomes and patient satisfaction.⁹ The PA and participant, as necessary, organize medical and administrative information. As needed, the PA will make use of a resource book of social services compiled by the team.

Between Visits—If there has been no contact with a participant for a month, the PA calls and checks how the patient is feeling, the patient’s general well-being, and whether the patient has sufficient medications. They review upcoming appointments. The PA asks whether there are new problems surrounding obtaining care or obtaining or taking medications, as well as determining whether the participant had interval ED visits or hospitalizations. The participant, with help as needed from the PA, notifies the clinician of problems judged significant by either PA or participant.

With patient consent, PAs and DCs keep a log of impressions and information given by patients that is shared only among team members and is de-identified. PA visits and the logs are discussed at weekly team meetings to solve problems patients have in self-managing asthma. (For example, sometimes a patient shares important information with the DC; this mechanism allows the DC to forward it to the PA. If the DC or team is concerned that information impacts on participants’ health, the PI is notified and, as she judges necessary, the medical provider may also be notified).

UC protocol

There are no meetings with a PA; PAs do not accompany participants or play a role in provider visits. DCs make phone calls as needed to schedule data collection visits.

Participant honorarium

All participants receive the same honorarium, regardless of randomization group. Potential participants receive \$10 for screening. Enrolled participants receive a total of \$170: \$25 for each of protocol proscribed data collection Visits 1–4 and \$70 for completing Visit 5. Public transportation tokens are provided for all data collection visits. No payment is given for PA visits or attending medical visits.

Participating providers

Participating providers are informed about the project in a conference at the start of recruitment and by email prior to enrolling patients. The protocol is described generally as a study comparing ways to improve asthma outcomes. Clinicians are asked to complete a brief questionnaire providing information about demographics, type of practice, years in practice, and on strategies used in accommodating patients with low literacy. Since current national guidelines for asthma² recommend visits for moderate/severe asthma at 1–6 month intervals if control is not optimal (i.e., symptoms or bronchodilator response), we ask if we may schedule all otherwise eligible participants for an appointment during study participation, if they had not been seen in the last 3 months and no appointment is scheduled. The HAP Study demonstrated that patients generally have upcoming clinician appointments and there is no difficulty ensuring participants have a medical visit for asthma scheduled during the first six months of participation.

Upon randomization to PAI, we send a letter/email to the patient's asthma provider informing them of the enrollment and briefly describe protocol activities prior to and after a visit. The letter asks permission, if the participant agrees, for the PA to accompany the participant to an appointment. We do not communicate with providers of UC participants. Thus, a provider will likely not know if a patient is enrolled in the UC arm.

Post-study focus groups of providers (Exploratory Aim)

Following completion of study data collection, we will convene three 2-hour focus groups of providers, with at least 3 providers whose patient had a PA and some providers who did not come in contact with a PA. Providers will be asked about their awareness of and response to PAs and how PAs might change practice procedures. Providers who cannot attend a focus group are offered an individual interview. Data will be collected by audio recording and note-takers.

Measures

Measures are classified as predictors (PAI or UC), outcomes, mediators, and moderators (Table 2). All questionnaires have validated Spanish versions.

Outcomes—The primary outcomes are obtained from all study participants, regardless of randomization group, at the same intervals by a research coordinator who is not the participant's PA. The primary outcome, asthma control, reflecting symptoms over the past week, is measured using the 7-item version of the Asthma Control Questionnaire (ACQ).^{43,44,65,66} The score is the mean of all responses (0=total control, 6=extremely uncontrolled). The minimally important clinical difference is 0.5. A score >1.5 is considered inadequate control.⁶⁶ Several other patient-oriented outcomes are evaluated. Asthma-related quality of life will be measured with the Mini-Asthma Quality of Life Questionnaire (AQLQ).^{67–69} This 15-item questionnaire has a 7-point response scale that provides a mean summary score. A 0.5-unit change is considered clinically meaningful.⁶⁷ The AQLQ has been shown to be a useful indicator of asthma-related quality of life in low-income adults.⁷⁰ Participants report hospitalizations including ICU admissions, ED visits, urgent medical visits (scheduled < 24 hours in advance), prednisone bursts (a new prescription for 3 days

of prednisone or an increase in an already-prescribed dose for an asthma exacerbation), and other medical visits. DCs will examine medical records for documentation. Spirometry is obtained using American Thoracic Society procedures for FEV1 and FVC.⁶³

Mediators—Mediators explain how the PAI could influence asthma control and other outcomes.⁴⁹ We measure self-efficacy, appointment keeping, adherence to inhaled steroid regimens, satisfaction with communication with providers and practices, and ability to navigate the clinical practice/health system. Self-efficacy is measured by response to “How confident are you filling out medical forms by yourself?”^{71,72}, a validated question that correlates with REALM, a standard test of literacy.⁷³ Subjects also complete our previously validated questionnaire of self-efficacy that asks about confidence to take prescribed inhaled steroids regularly.^{74,75} DCs observe and grade inhaler technique using a 7-point scale for metered dose inhalers and a 6-point scale for dry powder inhalers. The scales were derived from instructions in national guidelines.² Appointment-keeping is assessed by reviewing administrative records for appointments with the asthma provider. We measure adherence to inhaled steroids using the Inhaler Adherence Scale, a 6-item tool which we used previously in HAP.⁷⁶ The scale’s scores range from 0–6, with a lower score associated with better adherence.^{76,77,78} Patient satisfaction with patient-provider communication is measured with our previously used 13- item questionnaire.^{74,75} Each item has a 6-point response scale. The sum is used as the measure (alpha 0.74). We developed and validated a questionnaire, Navigating Ability, which focuses on specific tasks promoted in the PAI protocol.⁷⁸ The instrument was validated on 250 patients (Cronbach’s alpha=0.54), consistent with several concepts being measured by the instrument (i.e. multidimensional). We observed a trend towards a positive correlation of the overall score with numeracy (Spearman correlation=0.41, p-value<0.001), reading comprehension (0.44, p<0.001), and perception of benefits over risks of inhaled steroids (0.35, p<0.001).

Moderators—Moderators are baseline variables, gleaned from the literature, hypothesized to affect the PAI- outcomes relationships.⁴⁹ They include patient educational attainment (years of formal education completed), household income, other socio-demographics, and comorbidities (patient reported and verified in the medical record including hypertension, diabetes, obesity, cancer, smoking history, etc). Baseline health literacy is measured with the Asthma Numeracy Questionnaire (ANQ), a brief 4-item questionnaire of numerical concepts (arithmetic, percentage) we developed and validated.⁷⁹ Reading comprehension is tested using the Short Test of Functional Health Literacy in Adults (S-TOFHLA).⁸⁰ Community barriers are estimated by measuring report of exposure to community violence.⁵⁹ Depressive symptoms are measured by the Center for Epidemiologic Studies Depression Scale, a well-validated 20-item scale.⁸¹ Clinician characteristics include demographics, years in practice, type of medical practice (primary care vs. specialty; physician vs. nurse-practitioner; resident vs. attending, etc).

Costs—The cost of intervention administration will be measured by the resource-costing method.^{82–84} The primary resource used in the treatment intervention is PA time. Each contact, the type of contact, and the duration of the contact (including preparation, travel, waiting and follow-up time) is recorded by the PA on a case report form initiated at the time

of each contact. The cost of a contact per hour is based on PA wage and benefits plus a proportion of the fixed costs of training and of the facility.

The primary economic outcome of study will be the incremental cost-effectiveness of the intervention, comparing intervention and non-intervention group patients. Clinical effectiveness will be defined as described above. Medical resources such as office, ED, urgent medical visits and hospitalizations will be converted into costs based on allowed payer (i.e., insurance) costs, with total direct medical costs of treatment the sum of these components. The primary cost analysis will take a modified societal perspective, including all direct medical costs (defined as insurer 'allowable costs'), regardless of whether incurred by the payor (insurer reimbursements) or patient (i.e., deductibles, co-payments, coinsurance). The primary analyses will use service specific allowable medical costs from study enrollment through six-month follow-up of the last enrolled patient (expected to the end of the first quarter 2017). The primary analysis will be based on allowable costs for each patient by the person's payor for the intervention period plus six-month's post-intervention follow-up. Secondary analyses will be performed (1) confined to the intervention period; and (2) for extended follow-up for the duration of study follow-up (at least one year for each study participant and longer for most participants). For each time frame studied, secondary analyses will be performed for (1) Medicaid beneficiaries, using Medicaid allowable costs; and (2) using allowable costs for a representative private payor. Additional sensitivity analyses will include those of Medicare (restricted to Medicare beneficiaries, using Medicare allowable costs) and private payors (restricted to private payor beneficiaries, using private payor allowable costs). We also may develop a decision model to explore extension of potential incremental cost-effectiveness to various post-study timeframes, adjusting costs for inflation using the Consumer and Medical Price Indices, as appropriate, and discounting non-financial costs and benefits using a discount rate of 3%.⁸²⁻⁸⁴

Data management

REDCap (Research Electronic Data Capture), a secure web-based application for data entry and management, is being used for data entry and maintenance. REDCap (<https://projectredcap.org/>) employs electronic data capture using electronic case report forms, real-time data validation, integrity checks, and ensuring data quality⁸⁵ and allows data attribution and audit capabilities, data storage and backup, and export functions.⁸⁵

Analysis plan

The overarching statistical analysis approach is designed for a multi-site trial of parallel groups with longitudinal measurements. Planned measurements for each patient are to occur every three months for up to 4 follow-up measurements per patient. All patients will be analyzed according to the randomized group and included regardless of the number of follow-up measurements.

The analysis will begin with descriptive analyses of all variables, then compare PAI and UC groups for the adequacy of randomization, examining if baseline variables and potential moderators of the intervention are comparably distributed among patient groups. These baseline comparisons will be based on a global test of variables from a logistic regression

model with treatment assignment as the dependent variable. If imbalances are found at baseline, the relevant variables will be treated as confounders in the analyses.

The primary analysis will compare modeled changes in outcomes at 6 and 12 months between intervention groups. We will apply linear, logistic, and log linear mixed effects models to the outcomes of asthma control, need for prednisone bursts, ED visits, hospitalizations, quality of life, and FEV1. The models account for correlated longitudinal measurements and missing data, assuming that data are missing at random. Time effects will be modeled as continuous and time-treatment interactions will be included, such that the treatment-time interaction will be the intention-to-treat (ITT) effect on change since baseline. Models will be adjusted for study site and baseline characteristics found to be unbalanced after randomization. We will perform a sensitivity analysis of the missing at random assumption with a pattern mixture model.⁸⁶

Similar mixed effects models will be employed for assessment of mediation and moderation per Secondary Aims 1 and 2. The mediation analysis will use marginal structural models⁸⁷ and conduct sensitivity analyses to explore the potential impact of unmeasured confounders.⁸⁸ Moderators of the intervention will be examined with 3- and 2-way interactions among the treatment factor, potential moderator, and time in the mixed effects models in Aim 1.

Cost Effectiveness Analysis: The outcomes of different study arms will be combined with their respective costs (including both intervention costs, as well as costs of care) to provide a measure of incremental cost-effectiveness. The presumed effects will be improvements in patient outcomes, e.g. asthma control or avoided ED, hospitalization. Using the estimated mean cost and mean effect per patient by intervention group, an incremental cost-effectiveness ratio (ICER) will be constructed for each outcome for which the intervention is shown to have a significant effect. Incremental cost-effectiveness will be computed as the ratio of the difference in mean costs (incremental cost) to the difference in mean effects (incremental effect), and will represent the additional cost per additional improvement in patient outcome, of one intervention arm compared to another. We also will calculate the incremental cost per quality adjusted life year as estimated from the AQOL. We will estimate statistical error and construct confidence intervals using bootstrap procedures 168 for the incremental cost difference and the incremental cost-effectiveness ratio (ICER).

Statistical power

The study was designed to show a difference in mean change of asthma control between the PAI and usual care groups. The power analysis also takes into consideration the following factors: 1) 18% drop-out (estimated based on what was observed in a previous study in a similar population that used a related intervention of similar intensity);²⁶ 2) adjusted 2-sided significance level of 0.025; and 3) 80% power, based on the two-sample t-test with adjustments for 3 or 5 repeated measures per participant. We will adjust for clustering by patient by multiplying the estimated sample size under simple random sampling by a design effect that takes into account the patient intra-class correlation. We apply a conservative intra-class correlation of 0.30. With these factors, a study enrolling 300 adults (150 per intervention group) is powered to observe a standardized group effect of 0.29 and 0.32 in

mean change in asthma control across intervention groups at 6 months and 12 months, respectively. This clinically significant effect was detected in a study with a different focus⁸⁹ but did not achieve statistical significance.

Trial monitoring

An external Data Safety Monitoring Board reviews progress and data every six months and monitors adverse events and serious adverse events (unexpected ED visits and hospitalizations). Because patients have moderate or severe asthma, it is expected that ED visits and hospitalizations for these and patients' co-morbid conditions will occur.

RESULTS

We present baseline characteristics, challenges and solutions in recruitment, engagement, retention. As the trial is still in progress, investigators are blinded to study assignments and outcomes which are not presented.

Baseline characteristics of participants

We have enrolled 312 patient participants, accomplishing our target population size. Participants' baseline characteristics, described in Table 3, demonstrate a cohort of generally low-income and minority mostly female adults with marked morbidity from asthma and other coexisting diseases. For example, there is a high rate of self-reported ED visits (43%) and hospitalizations (29%) for asthma in the year before enrollment and hypertension, diabetes, and obesity among the study population. Thus, our recruitment goal to enroll patients at high risk for poor asthma outcomes who might potentially benefit from a PA was achieved.

To date five participants have died while enrolled, all for non-asthma causes. Four were female, four African American and one white, ages 41, 55, 70, 79, and 79. Four were assigned to UC. Their deaths were attributed to non-asthma causes: subdural hematoma, myocardial infarction, "natural causes," according to the participant's family.

Overcoming challenges of recruitment and retention

Recruitment was facilitated by use of the electronic health record (EHR) for those equipped clinics. From the EHR we screened patients for a diagnosis of asthma, prescription of an inhaled corticosteroid, and date and time of appointments. This allowed us to send patients letters of introduction. Knowing date and time of appointments permitted meeting patients at the time of an appointment. Thus, screening procedures allowed us to recruit participants without disturbing the clinical practices where they received care. Additionally we met briefly with providers at a faculty meeting, provided study updates, and most importantly had a "champion" from each clinic, a clinician co-investigator to facilitate communication between the research team and the practice.

Retention thus far has been excellent. No participant has dropped out. However, we are unable to contact 8/312 (3%) who are in various stages of the protocol, despite repeated efforts. Efforts to contact participants for either recruitment or data collection meetings with

the DC often require repeated phone calls at different times of the day and on weekends. We meet patients on weekends if it is most convenient for them. We find phones disconnected because funding for the participants' cellular plan runs out, particularly at the end of the month, in which case we try to contact participants again at the beginning of the subsequent month. We have "read-only" access to the medical record and scan the record for clinic appointments. If one is scheduled and data collection is needed, we will attempt to meet the patient at the appointment to accomplish data collection. We have maintained consistency with a participant's DC and PA whenever possible, facilitated by the fact that there has been little turnover of research coordinators. Keeping the research coordinators' job meaningful with opportunities for their participation in all activities of the research is essential. Team work is highly valued within the research team. As a result, the participant experience is pleasant; a sample of participants who finished the study unanimously indicated they would recommend the study to a friend and thought they benefitted.

Addressing challenges of engagement of patients and clinicians

Participants have been positive about the experience and reported enjoying working with research coordinators, whether they were acting as PAs or DCs. These research staff members were considered by the participants to be someone to talk to, whether they were collecting data or acting as PA. The questions asked by RCs while in the data collector role prompted participants to talk about their lives. Participants became familiar with RCs, facilitated by the fact that these staff members were relatively stable throughout the study period, allowing participants to work with the same RCs during their study participation. Thus the RCs filled a role that could not be filled by very busy clinic staff.

We were very careful not to burden clinics or interfere in any way with the care of patients as we recruited and accomplished our protocol and data collection. We presented our project briefly at faculty and staff meetings of participating clinics when enrollment began and we emailed providers when their patient was assigned to the PAI to let providers know a PA would ask to attend a clinic visit. We also emailed providers and their staff an update from time to time and sent cookies to the clinic. However, we found we were so careful not to interfere that some providers did not realize we were there or know what the PAs did. This became apparent in convening focus groups and interviews of providers who had patients assigned a PA. When questioned about their experience with a PA, several did not remember the appointment when the PA accompanied the participant. Nevertheless, among providers and particularly clinic support staff, RCs were recognized and welcomed, particularly when the clinic was running late, to engage patients or when instructions at the end of a visit were complicated to execute or the patient elderly. Patient-PA after-visit activities from a primary care visit could be particularly complex and lengthy as recommendations for a number of health problems including asthma may be made.

PAs also found barriers to engagement of patients and providers that were difficult to address. For example, some participants were homeless and lacked secure housing. Other participants reported the presence of environmental triggers of asthma in housing not easily modifiable such as tobacco smoke from household members, or the presence of pets, dust, or insect infestations. Some participants cared for sick loved ones that prevented participants

from attending to their own health and adherence to medical advice. Some participants found transportation to appointments provided by insurance for disabled patients unreliable.

DISCUSSION

While low-income minority adults have the worst outcomes and highest death rates from asthma, research to develop interventions to improve outcomes for this group is relatively limited.^{4–7} Interventions to address access to health care and patient-provider communication have been advocated to eliminate these health disparities.⁹ Research is needed to examine the feasibility, acceptability, adaptability, effectiveness, and sustainability of proposed interventions in different settings. Our project is innovative in studying adults with high asthma burden and high comorbidities and for proposing an intervention focused on the clinical setting. The selection of a recent college graduate as the PA is also novel, and may represent a cost-effective model compared to higher cost navigator models that employ clinically trained professionals such as RNs. The choice of PA, based upon patient preference, provided a unique addition to the care team, one that seemed to fill an important gap in busy clinics where providers are unable to spend substantial periods of time with patients for “teach back” or addressing social and administrative barriers. Further, the PA provided a welcomed ally for patients. Trusting relationships were formed in which patients shared intimate details about themselves, their families, and difficulties they faced accessing the healthcare system. We have demonstrated feasibility and acceptability in a number of practice settings where patients with the greatest morbidity and frequent comorbidities receive healthcare. PA activities easily can be generalized beyond asthma, as is demonstrated when PAs address health conditions other than asthma in primary care visits. Additionally, patients with smoking histories frequently are excluded from research, but these patients have significant primary and secondary exposure to tobacco.

Challenges and limitations in conducting “real-world” implementation research are common, especially surrounding feasibility and acceptability. We were so worried about acceptance of our intervention by practices and that our intervention would get in the way of patients and providers at the time of patient appointments that our research staff became invisible and were not noticed. In reality, participants and staff became more accepting of research personnel after it was clear they did not disrupt or interfere with clinical operations. When we held focus groups and interviews with providers to describe the PA role and reviewed what the PA did, providers acknowledged they were accomplishing important tasks such as ensuring proper inhaler technique not always covered by clinic staff. These experiences suggest that a PA role can evolve as an intervention individualized to patient, clinician, and practice needs and the relationship between clinicians and researchers grows over time. Thus, the PA role was feasible and acceptable.

Feasibility was enhanced by the individualization of the intervention. Each clinical site was a little different. In one site Spanish was primarily spoken. In another site there was no EHR that could be scanned for upcoming participant appointments. In primary care practice appointments and after-visit confirmation of understanding and appointments could be very complicated because in addition to asthma, other health conditions were discussed in a visit whose duration was shorter than that allowed for asthma specialists.

In summary, the PA intervention is feasible and acceptable to patients and providers, particularly for patients with severe or complex medical problems and limited socioeconomic resources, the very patients most likely to have a poor health outcome. Whether it is clinically effective and cost effective awaits assessment and analysis of the outcomes; so does data on sustainability. Success in these areas will require participation of another essential set of stakeholders: the health system/practice administrators.

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Abbreviations

ACQ	Asthma Control Questionnaire
ANQ	Asthma Numeracy Questionnaire
AQLQ	Mini-Asthma Quality of Life Questionnaire
DC	Data Collector
ED	Emergency Department
HAP	Helping Asthma Patients
HAP2	Helping Asthma Patients 2
MI	Minimal Intervention
PA	Patient Advocate
PAI	Patient Advocate Intervention
RC	Research Coordinator
S-TOFHLA	Short Test of Functional Health Literacy in Adults
UC	Usual Care

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Figure 1. HAP2 protocol

For participants assigned to the PA intervention, the PA accompanies the patient to medical visits for asthma in the first 6 months. Those in the UC arm do not work with a PA. Both groups are observed for the second 6 months. There are 5 visits with the Data Collector for all participants.

*Patient Advocate and Usual Care: Data collection every 3 months for 1 year.

**Baseline Data and Randomization

Table 1**Activities of the Patient Advocate in HAP2.**Before Medical Visit

- Before the first Medical Visit, the PA gives patient a binder to place any essential materials (e.g., medication list, insurance forms). This binder includes a form to record personal information including provider and pharmacy information, an asthma action plan form, a calendar and blank pages
- Before each Medical Visit
 - Call patient to remind him/her of appointment
 - Review medication list
 - Discuss any problems with obtaining, refilling, or taking medications
 - Assist patient with preparing a list of questions and/or asthma-related problems to address with the clinician
 - Ask patient if forms or other documents are needed for the visit and helps the patient obtain them if necessary
 - Ask patient if there is an emergency plan for an exacerbation and encourages the patient to discuss with clinician if it not well described by patient

During Medical Visit

- PA speaks only if invited by the participant
- Takes notes to assist with teach-back

After Medical Visit

- Facilitates scheduling follow-up appointments with the clinician and/or others as recommended
- Assists with completion of any paperwork
- Reviews instruction given to the participant at the appointment
- If the participant has questions for the clinician after review instructions, the PA and participant complete a report of items needing clarification for the clinician or staff

Between Visits

- Calls patient and checks how the patient is feeling, general well-being, and whether the patient has sufficient medications
- Review upcoming appointments
- Asks whether there are new problems surrounding obtaining care or obtaining or taking medications and whether there have been ED visits or hospitalizations

Table 2

Summary of Data Collection for Specific and Secondary Aims

Measure	Visit 1 Baseline Randomization	Visit 2 Week 12	Visit 3 Week 24	Visit 4 Week 36	Visit 5 Week 48
Mediators					
Self-efficacy	X	X	X	X	X
Appointment keeping	X	X	X	X	X
Adherence	X	X	X	X	X
Satisfaction with communication	X	X	X	X	X
Navigating ability	X	X	X	X	X
Moderators					
Educational attainment	X				
Baseline health literacy (ANQ, S-TOFHLA)	X				
Socio-demographics	X				
Comorbidities *	X				
Community factors (ECV)	X				
Affective State: Anxiety/Depression	X				
Clinician characteristics	X				
Participant Outcomes					
Asthma Control	X	X	X	X	X
Prednisone bursts, ED, hospitalizations	X	X	X	X	X
Asthma-Related Quality of Life (AQOL)	X	X	X	X	X
Spirometry (FEV1, FVC)	X	X	X	X	X

* Comorbidities include diabetes, hypertension, obesity, cancer, smoking history, and other conditions as reported by participant and verified in the medical record.

ANQ=Asthma Numeracy Questionnaire,⁷⁹ S-TOFHLA=Short Test of Functional Health Literacy in Adults,⁸⁰ ECV= Exposure to community violence,⁵⁹ AQOL⁶⁸

+Prednisone bursts are defined as a new prescription or an increase in dose of prednisone.

Table 3

Baseline characteristics of the 312 adults with moderate or severe asthma, expressed as frequency (percent) for discrete and mean ($\pm$ SD) for continuous variables.

Characteristic	Total N=312
Sociodemographics	
Age (years)	
Mean	51 $\pm$ 14
Range	19–93
Sex	
Female	216 (69%)
Race	
Black/African American	206 (66%)
White	75 (24%)
Other	7 (2%)
Declined to answer	24 (8%)
Ethnicity: Hispanic/Latino	25 (8%)
Household income	
< \$30,000/year	152 (49%)
\$30,000–\$49,999/year	42 (14%)
\$50,000 to \$99,999	44 (14%)
\$100,000 or more	29 (9%)
Declined to answer	45 (14%)
Educational attainment (highest level achieved)	
8 th grade or less	3 (1%)
Some high school	40 (13%)
High school graduate	97 (31%)
Some college or trade school	79 (25%)
College graduate	93 (30%)
Literacy	
S-TOFHLA	29 $\pm$ 11
Minimum, maximum	0,36
Asthma Numeracy (ANQ) (number of items correct)	2.05 $\pm$ 1.3
Asthma severity at baseline	
FEV1 (percent predicted)	68% $\pm$ 18%
Minimum, maximum	15%, 112%
# with 1 ED visit for asthma in past year	135 (43%)
# with 1 hospitalization for asthma in past year	91 (29%)
Asthma-related quality of life ⁶⁸	4 $\pm$ 1.5
Minimum, maximum	1.2, 7.0

Characteristic	Total N=312
Asthma control ⁴⁴	2.4 ± 1.2
Minimum, maximum	5.4, 0.0
Co-morbidities	
Hypertension	167 (54%)
Diabetes	65 (21%)
Body Mass Index (BMI)	33.9 ± 8.9
Ever smoked in the past	152 (49%)
Current smoker	52 (17%)

ANQ= Asthma Numeracy Questionnaire,⁷⁹ S-TOFHLA = Short Test of Functional Health Literacy in Adults,⁸⁰

* Note: A likelihood test of overall differences across all baseline factors between the two groups confirms success of randomization. (chisq= 34.4 df=31, p=0.31)