

AHRQ Grant Final Progress Report

Title of Project: Feasibility of a clinician training program to improve patient-provider communication in the presence of health IT systems in the exam room

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Feasibility of a clinician training program to improve patient-provider communication in the presence of health IT systems in the exam room
Structured Abstract

Purpose: We extended the evidence-based Physician Asthma Care Education (PACE) program with EHR-specific communication/integration strategies. This study tests whether training providers with the extended program, EHR-PACE, would improve provider perception of their communication skills and asthma outcomes of their patients.

Scope: The rapid proliferation of computerized systems in exam rooms, such as electronic health records (EHR), has adverse consequences for patient-centered communication, yet few interventions have been evaluated to train physicians in effective practices.

Methods: A pilot randomized controlled trial was conducted to compare EHR-PACE to usual care. Participants were primary care physicians (n=18) and their adult patients with persistent asthma (n=126). Outcomes were assessed three times at baseline and 3- and 6-month post-intervention, using measures such as patient-reported perception of their provider's communication skills and provider-reported confidence in asthma counseling and in using EHRs during clinical encounters.

Results: Compared to the control group, physicians who completed the EHR-PACE program reported significant improvements at 3-month follow-up in their confidence with asthma counseling practices (Estimate 0.90 SE (0.4); $p < 0.05$) and with EHR-specific communication practices (Estimate 2.3 SE (0.8); $p < 0.01$). At 6-month follow-up, EHR-PACE physicians reported a significant decrease in perception that the computer interferes with the patient-provider relationship (Estimate -1.0 SE (0.3); $p < 0.01$). No significant changes were observed in patient asthma outcomes or their perception of their provider's communication and counseling skills.

Conclusion: More research is needed to fully evaluate EHR-PACE through a large-scale trial and more definitively assess its impact on patient health status.

Key Words: Electronic health records, PACE, provider training, provider-patient relationship, communication, asthma, clinical guidelines

Purpose

There is a pressing need for evidence and training on effective practices in using EHRs during clinical encounters in the context of direct patient care, while simultaneously attending to clinical treatment priorities. The goal of this pilot study was to create an intervention that promoted the seamless integration of health IT applications, particularly EHRs, in clinical settings by specifically training clinicians on best practices for utilizing such systems while maintaining patient-centered communication and enhancing therapeutic practice.

Specific aims included:

- Development of the EHR version of the evidence-based PACE program to be used as a training tool for clinicians on the effective use of EHRs at the point of care (EHR-PACE)
- Assessment of the feasibility of EHR-PACE on patients' perception of their provider's communication and care, and their asthma control and asthma-related quality of life

This study sought to address a current practice issue of the detrimental impact of EHR adoption on patient–clinician communication and subsequent patient health outcomes among individuals with asthma. If proven effective, EHR-PACE has potential for incorporation into a variety of CME and other training programs and venues, reaching a wide range of health care providers across specialties and practice settings who could benefit from such training.

Scope

Background and Context: This pilot study was in response to the AHRQ Program Announcement PA-14-001: *Improving Health Care Quality through Health Information Technology*. As noted in this announcement, newly implemented health IT applications such as EHRs are not always seamlessly integrated with existing clinical environments, resulting in inefficiencies and workarounds.¹ Moreover, health IT has had inconsistent impacts across different process measures and there is a need to understand whether and how health IT use leads to improved patient outcomes.

Most US clinics and hospitals have now been equipped with electronic health records (EHRs) as a result of a federal mandate and incentive programs through Meaningful Use.^{2,3} There are many benefits of EHRs such as improved access to data, hospital financial performance, and better care coordination.^{2,3} However, recent health IT evaluation studies have also revealed numerous unintended consequences due to rapid EHR implementation in complex healthcare settings.^{4,5} It has been reported that as a result of EHR adoption, professional dissatisfaction is on the rise, and nearly half of a clinician's time during a patient clinic visit is now being devoted to clerical work that is of limited value to the patient.^{6,7} Another highly prevalent adverse unintended consequence is the growing interference of EHR use on patient-centeredness, particularly on verbal and non-verbal communication between patients and providers during clinical encounters. Interpersonal communication, especially face-to-face communication, is central to patient-centered care and has a direct impact on care processes and health outcomes.^{8,9}

Several researchers have provided suggestions on how to mitigate these detrimental effects.^{4,10,11,12,13} Paid medical scribes, for example, are being increasingly utilized by hospitals and physician offices,¹⁴ but may not prove to be a viable option in low-resource settings. Some

recommendations based on ethnographic and observational data relate to repositioning of the computer in an exam room, sequencing of communications to ensure adequate eye contact and interactions, and explanations of how and why the clinician is attending to computerized information.^{11,12,13} However, two gaps remain that have direct implications for clinical practice: (1) whether these techniques are reaching clinicians to inform their everyday practice, and (2) whether such techniques are adequate to strengthen the provider–patient relationship to subsequently improve patient health outcomes. The risk is significant that resources are being allocated to incorporating EHRs into delivery systems without proper training for clinicians, which may in fact pose adverse consequences for rapport and health of patients.

For this pilot study, the evidence-based Physician Asthma Care Education (PACE) program was modified and expanded to train primary care clinicians on the effective use of EHRs at the point of care (EHR-PACE). PACE is a proven program for enhancing communication, therapeutic practice, and the ability of clinicians to foster effective self-management of asthma in their patients.^{15,16} The PACE program utilizes asthma as the case condition, a disease with exceedingly high healthcare burden and costs.^{15,16} It has demonstrated significant improvements in communication, symptom control, healthcare utilization, and costs of care.^{15,16} EHR-PACE is based on concepts and skills for strengthening communication and provider-patient relationships through behavior change principles that are highly applicable to patients with asthma and has specific application to EHR use in clinical practice.

Settings: Study participants were recruited from family practice and general internal medicine clinics within Integrated Health Associates (IHA), an independent practice group comprised of 297 clinicians in 41 practice locations that serve 359,000 active patients in Southeast Michigan. ClinSite is the research subsidiary of IHA and facilitates research activities through IHA, providing access to patient lists for research participation and working with researchers to recruit both patient and clinician participants.

Participants: Study participants included 18 primary care providers (PCPs) and 126 of their adult patients with asthma. AHRQ's priority populations were recruited into the study for both patients and primary care providers and included women, racial and ethnic minorities, and individuals with special health care needs, specifically asthma. See Table 1 for priority population enrollment.

Methods

Study Design: A two-group randomized controlled design was utilized for this pilot study with primary care physicians (PCPs) and their adult patients with asthma from multiple IHA practices throughout Southeast Michigan. All study procedures were approved by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board.

Recruitment & Follow-Up Methodology: Primary care providers were recruited through a convenience sample, and assessed for eligibility by a physician on the study team (HL). Primary care providers were eligible to participate in the study if they met the following criteria: 1) licensed and board certified in primary care or family medicine; 2) treated adults with asthma; 3) practiced at a clinic that had utilized an EHR system for at least one year; and 4) provided a roster of adult asthma patients for study eligibility assessment.

Personal contact by a local clinical practice leader has been identified as an important strategy for recruiting physicians.^{17,18,19} Potential physicians were approached by the physician on the study team via phone/email and provided basic study information using a physician recruitment script. During initial contact, prospective physicians did not need to make a decision to participate. The study coordinator later completed verbal consent or retrieved online consent from interested physicians. A common script was used to insure that all potential physician participants received the same information regarding the study and standardized responses were developed for frequently asked questions. Physicians were told that their participation in this two-year study involved the research team obtaining a list of their patients, completing 3 surveys, and being willing to participate in their study condition. Physicians were also told that every effort would be made to minimize physician or office staff burden.

Upon provider consent, patient lists of participating providers were obtained in order to recruit prospective participants and screen for eligibility. Patients were eligible to participate in the study if they met the following criteria: 1) treated by a participating provider, 2) 18 years of age or older; 3) diagnosed with asthma; 4) had at least one urgent medical care visit for asthma in the previous year; 5) did not have any other chronic disorders that present pulmonary complications; and 6) had access to a telephone. Research staff mailed recruitment packets to all eligible prospective subjects. The recruitment packet included a cover letter describing the study and that their physician was participating, that study participation was completely voluntary, and that the decision to participate would in no way influence the future care provided to the patient by the physician. The recruitment packet also included a summary of the research protocol and two copies of the consent form, describing the study and that participation would involve three surveys of 20–30 minutes each at baseline, and 3- and 6-months. Information made it clear that physicians were the subjects of the interventions and patients were providing information only.

PCPs and patient participants who met eligibility criteria and consented to participate in the study completed a baseline survey, and were subsequently randomly assigned to either the control group or the EHR-PACE intervention group. The control group consisted of usual care by PCPs. Patient participants followed their physicians into the same randomized group. The 3-month and 6-month follow-up survey was administered after the EHR-PACE intervention was completed. PCPs received \$40 for each survey completed, while patients received \$30 for each completion.

Figures 1 and 2 show the participation trajectory of PCPs and patient participants approached for the study. Recruitment spanned a period of 7 months (April 2016-October 2016). Of the 39 PCPs initially contacted, 15 provided no response, one did not meet eligibility criteria, five declined to participate prior to being screened, and 18 were screened and eligible for the study. All 18 eligible PCPs provided consent and completed the baseline and follow-up surveys, resulting in a 100% retention rate. Of the 1872 patient participants initially contacted, 844 were unreachable, 332 declined to participate, 569 did not meet eligibility criteria, and 1 individual did not complete the baseline questionnaire. There were 126 patient participants who were screened eligible, consented to participate in the study, and completed the baseline survey. At 6-month follow-up, 116 patient participants completed surveys (9 were unreachable after multiple attempts to contact and 1 participant dropped out of the study), resulting in a 92% retention rate.

Intervention: EHR-PACE is the electronic health record version of the Physician Asthma Care Education (PACE) program. The EHR component of PACE was developed by the research team at the University of Michigan School of Public Health as a way to teach clinicians techniques for improving their ability to communicate advice and deliver education to patients while simultaneously using an EHR system during clinical visits. EHR-PACE closely adapted PACE, presenting with a similar format and the same theoretical underpinnings.^{15,16} The EHR-PACE intervention utilized principles from the social cognitive theory as its social and behavioral theoretical foundation,^{20,21} creating an environment where clinicians can learn from other clinicians who have excellent treatment and counseling skills. The clinician can learn to self-regulate his/her own behavior through intervention activities to better achieve desired responses from the patients: more effective at-home management of the patient's condition, greater adherence to clinical recommendations, and greater satisfaction of care.

For development, a systematic literature review was conducted to ultimately distill 6–10 theoretically informed behavioral and communication techniques recommended for clinicians when interacting with patients in the presence of computerized systems during a clinical encounter. The systematic literature review results were distilled into “best practices” of EHR-accommodating communication strategies with supporting evidence that showed changes in meaningful patient-centered outcomes or demonstrated high satisfaction among patients for further review. An expert panel comprised of five individuals including physicians and behavioral scientists with expertise in patient–clinician communication practices convened to review, refine, and finalize the best practice communication techniques derived from the systematic literature review. A discussion was facilitated to inquire from experts their experience using the techniques derived from the literature, and others not noted in the literature that have proven effective in their own practice. After further review, the recommended EHR-accommodating communication practices were finalized and incorporated into the intervention.

EHR-PACE covered topics related to clinical aspects of asthma and its management, EHR-related communication/integration strategies, and patient education messages. The EHR-specific communication strategies were embedded into case studies, a video, strategy check-lists, and an interactive discussion to illustrate how they can be integrated into practice. EHR-PACE was delivered through an interactive, 1 ½ hour webinar facilitated by an asthma specialist and completed by nine PCPs who were randomly assigned to the intervention group of the pilot study. Participating physicians received 1.5 CME credits for completing the webinar.

Data Collection/Sources:

Physician Surveys: Physicians were offered the choice of completing their surveys by telephone, paper and pencil, or securely online using Qualtrics, a web-based survey system. Survey data was initially collected at baseline. Following randomization, data was also collected at 3- and 6-months post-intervention. For physicians who participated in the intervention, open-ended questions were later asked to ascertain accessibility and acceptability of EHR-PACE. Specific information regarding level of detail of the sessions, access to the program, and suggestions for improvement were also assessed. Follow up for survey completion was proactive.

Patient Surveys: Patients participated in three surveys either by phone, mail, or online using Qualtrics, which each lasted 20–30 minutes in duration. Baseline surveys were completed prior to physicians’ participation in the intervention. Follow-up surveys were conducted at 3- and 6-months following the physicians’ participation in the intervention. The Interviewing Center on site at the University of Michigan, School of Public Health was utilized to collect telephone data.

Measures: Self-reported recall data were collected from physician and patient participants at baseline (prior to randomization) and 3- and 6-months after the intervention. The primary outcomes of interest were patient reports of physician performance. Secondary outcomes included asthma control, patient satisfaction, asthma-related quality of life, and physician perception and confidence in their communication and counseling practices.

To assess changes in physician communication and counseling behavior, patients were asked to rate their physician’s performance of general communication skills (1, strongly disagree; 4, strongly agree) (3 items), asthma-specific counseling behaviors (1, never; 6, often) (16 items), EHR-specific communication practices (1, strongly disagree; 5, strongly agree) (15 items), and perception of EHR use in the exam room by the provider (1, strongly disagree; 5, strongly agree) (6 items). Items were summed to create a score for each factor.

Patients’ asthma control was measured using the sum of the 5-item validated Asthma Control Test (ACT).²² Responses ranged from 5 (poor control of asthma) to 25 (complete control of asthma). A score of 19 or above indicated good control. Asthma-related quality of life was measured using the mean of 15 items from the validated Mini Asthma Quality of Life Questionnaire (Mini-AQLQ).²³ Higher scores indicated a better quality of life. Patients’ satisfaction with their provider relationship was measured by how much patients agreed or disagreed (1-‘strongly disagree’ to 5-‘strongly agree’) with the following statement: “I am satisfied with the relationship I have with my provider.” Patients’ satisfaction with their care was measured by how much patients agreed or disagreed (1-‘strongly disagree’ to 4-‘strongly agree’) with the following statement: “I am very satisfied with the medical care I receive from my provider for my asthma.”

Providers were asked to rate their use of EHR communication practices using 7 items (1- never; 6- often). Items were summed, with higher scores indicating higher perception of skill with EHR-specific communication. Additional items also assessed perception of EHR use in the exam room (1-‘strongly disagree’ to 5-‘strongly agree’) (6-items). We also assessed physicians’ own perception of their asthma counseling practices (1-‘never’ to 5-‘always’) (6-items), and general communication practices (1-‘strongly disagree’ to 5-‘strongly agree’) (6-items). Items were summed, with higher scores indicating higher perception of skill.

Physician self-efficacy in communication practices with patients and asthma counseling behavior were measured by asking physicians to rate their confidence on a 6-point Likert scale (1- not at all confident; 6- extremely confident) in his or her ability to perform specific general communication (5 items), asthma counseling behaviors (2 items), and EHR-specific communication practices (7 items). Items were summed, with higher scores indicating higher levels of self-efficacy. Additional demographic (e.g. age, sex, race, marital status, income, health

insurance, employment), clinical and practice data were collected from both providers and patients.

Data Analysis: All analyses were conducted using SAS 9.4.²⁴ Descriptive and bivariate analyses were conducted to examine the baseline sample of both physicians and patients by randomization status. Mixed effect models compared the intervention effects for patients (EHR-PACE vs. control) on longitudinal outcomes at baseline and follow-up visits at both 3-months and 6-months post-intervention. Since the intervention is at the level of the physician, and patients were randomized to receive the treatments from the physician, the adjusted mixed effect model with random intercept was utilized to account for the clustering effect of the physician. Alpha values less than 0.05 were considered significant.

Limitations: This pilot study had a short follow-up period to assess the impact of physician training on therapeutic and EHR-specific communication/interaction practices on patient outcomes. A larger scale trial is necessary to assess the impact of EHR-PACE on patient health status and patient-centered outcomes. Our sample was derived from one large, integrated practice group in one region. The findings may not be generalizable to all settings, and a future larger scale trial may consider a heterogeneous sample of practice settings.

Results

Principal Findings and Outcomes:

Sample Characteristics

Characteristics of the patient participants are shown in the upper portion of Table 2. Their mean age was 46.8 (SD=14.1) years; 81% of them were female; 69% were White and 25% were African American. Forty-four percent of the sample reported an annual household income >\$60,000; 51% reported educational attainment of college or above; and 56% reported being married. Thirty-five percent had moderate-severe asthma; their mean ACT score was 17.1 (SD=4.8); mean asthma-related quality of life score was 4.7 (SD=1.2); and average time under the PCP's care was 57.1 (SD=42.6) months. Eighty-eight percent of these patient participants were satisfied with the care that they receive; 83% were satisfied with their relationship with the PCP. No significant differences were found at baseline between patient participants randomized into the treatment or the control group.

Eighty-three percent of the PCP participants were female (see lower portion of Table 2). On average, their mean years in practice was 14.4 (SD=6.1) years; 83% were part of a large group practice; and the mean number of asthma patients seen in their practice (reported by each clinic at the aggregated level) was 181.2 (SD=124.8). Sixty-four percent of the PCP participants reported an exam room structure with a laptop or computer on wheels; 29% had flexible exam room architecture (e.g., computer and/or computer screen can be readily repositioned to face the provider or the patient); and 7% did not have a flexible exam room. Twenty-eight percent of these PCPs reported being involved in prior EHR training efforts. No significant differences were found at baseline between PCPs randomized into the treatment or the control group.

Patient-Reported Results

Patient-reported results are summarized in Table 3. Analysis of patient-reported data revealed no significant differences at either the 3-month or the 6-month follow-up, across all study measures including asthma control, asthma-related quality of life, patient satisfaction, or perception of their PCP's general communication practices, EHR-specific communication practices, or asthma counseling practices.

Provider-Reported Results

Provider-reported results are summarized in Table 4. Compared to physicians in the control group, PCPs who completed the EHR-PACE program reported significant improvements in their confidence in asthma counseling practices at 6-month follow-up (Estimate 0.90 SE (0.4); $p < 0.05$).

Similarly, PCPs who completed the EHR-PACE program also showed significant improvements at 3-month follow-up in their confidence with EHR-specific communication practices (Estimate 2.3 SE (0.8); $p < 0.01$), including those who do not use a transcriptionist (Estimate 1.4 SE (0.6); $p < 0.04$). However, these improvements were not sustained at 6-month follow-up.

In examining specific behaviors, EHR-PACE physicians reported significant increased confidence at 3-month follow-up in their abilities to (1) ask the patient to elaborate on answers to questions prompted by the EHR (Estimate 0.7 SE (0.3); $p < 0.03$); (2) reposition the computer screen to allow the patient to see (Estimate 1.1 SE (0.4); $p < 0.01$); (3) share the screen with the patient to describe information that was interesting or helpful (Estimate 0.8 SE (0.3); $p < 0.02$); (4) use the computer as a resource to facilitate making shared decisions with patients (Estimate 1.3 SE (0.4); $p < 0.003$); (5) apply non-verbal communication skills while using the computer when the patient is talking (Estimate 1.2 SE (0.3); $p < 0.01$); and (6) tell the patient what they were doing when turning to the computer (Estimate 1.1 SE (0.4); $p < 0.02$). However, these improvements were not sustained at 6-month follow-up.

At 6-month follow-up, EHR-PACE physicians reported a significant decrease in perception that the computer interferes with the patient-provider relationship (Estimate -1.0 SE (0.3); $p < 0.01$); and increased confidence in keeping the conversation going while using the computer (Estimate 0.8 SE (0.3); $p < 0.03$). They also reported increased eye contact with the patient while using the computer (Estimate 0.8 SE (0.2); $p < 0.003$); and increased confidence in this behavior (Estimate 0.8 SE (0.4); $p < 0.05$).

Discussion: Increased computing demands as a result of adoption of EHRs continue to rapidly change how clinicians and patients interact during clinical visits. To our best knowledge, this is the first study that has used a randomized controlled trial design to evaluate the impact of training providers on how to work with an EHR system while simultaneously providing patient-centered care. We found that the EHR-PACE intervention, which equips providers with patient-centered communication techniques designed to enhance asthma management and EHR use, can significantly increase provider confidence, adoption of proper communication and interaction behaviors to better accommodate computer presence in the exam room, and provision of guideline recommended care, as well as decrease perceptions that the computer interferes with their interactions with patients.

This preliminary study did not show any significant differences in patient perception of their provider's communication and counseling practices, especially specific to EHR. The patient participants' baseline ratings of their provider's communication and counseling practices were very high, and in many cases, opposite of how providers rated themselves. More objective measurement of communication and counseling behaviors during the clinical encounter may provide more insight into how the EHR-PACE intervention translates to improved patient-centeredness. Our data also did not show any changes in asthma control and asthma-related quality of life, even though incremental positive changes were observed in asthma-specific outcomes over time. Given that this was a pilot study, more follow-up time may be needed for improved asthma counseling practices to transpire to show a significant, clinically meaningful impact on patient health status.

We found that PCPs who completed the EHR-PACE program showed significant improvements in their confidence with EHR-specific communication and integration practices at 3-month follow-up. Behavioral theory posits that when individuals have high confidence in performing particular behaviors, they are more likely to change their behavior and put forth greater and more persistent effort.²⁵ However, improvements were not sustained at 6-month follow-up, suggesting that future work should consider check-ins or mechanisms for positive reinforcement for implementing evidence-supported EHR-specific communication/integration practices with patients, thereby prompting their continued use.

We also found that EHR-PACE physicians reported a significant decrease in perception that the computer interferes with the patient-provider relationship—a change that sustained through 6-month follow-up. This finding directly addresses an issue reported in the health IT literature regarding provider concern for the disruption of EHR on their ability to focus on the patient, maintain eye contact, and establish trust and rapport.^{4,5,6,7}

Conclusions/Implications: EHR-PACE has important implications for clinical practice. Provider training initiatives, with specific emphasis on skills training in therapeutic practice coupled with EHR communication/integration practices, increases provider confidence and their perceived ability in maintaining patient-centered communications. Given the rapid proliferation of computerized systems in clinical settings, evidence-supported training initiatives that can increase the capacity of busy clinicians to manage increased computing demands while attending to patient needs has relevance to a wide range of practice settings and specialties. More research is needed to fully evaluate EHR-PACE and other training programs a like to definitely assess their impact on patient health status.

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Table 1. Priority population enrollment

Priority Population Enrollment Report

Study Title: Feasibility of a clinician training program to improve patient-provider communication in the presence of health IT systems in the exam room

Domestic/Foreign: Domestic

Racial Categories	Ethnic Categories				Total
	Not Hispanic or Latino		Hispanic or Latino		
	Female	Male	Female	Male	
American Indian/Alaska Native	0	0	0	0	0
Asian	0	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0	0
Black or African American	30	5	0	0	35
White	67	15	0	1	83
More Than One Race	5	2	0	0	7
Total	102	22	0	1	125

Note: Table only shows 125 patient participants due to one participant's refusal to provide racial/ethnic demographics.

Table 2. Baseline characteristics of patients and physicians by treatment group

Patients				
Factor	Total Sample (n=126) % (n)	Control (n=56) % (n)	EHR- PACE (n=70) % (n)	P- Value*
Age (mean, SD)	46.8 (14.1)	47.8 (15.0)	46.0 (13.4)	0.50
Sex (% female)	81 (102)	82 (46)	80 (56)	0.76
Education				0.73
Less than High School	2 (3)	2 (1)	3 (2)	
High School	13 (16)	13 (7)	13 (9)	
Vocational/Some College/Associates	34 (43)	39 (22)	30 (21)	
College or Above	51 (64)	46 (26)	54 (38)	
Annual Income				0.85
< \$20,000	21 (25)	20 (11)	22 (14)	
\$20,001-40,000	15 (17)	17 (9)	13 (8)	
\$40,001-60,000	20 (24)	22 (12)	19 (12)	
> \$60,000	44 (52)	41 (22)	47 (30)	
Marital Status (% Married)	56 (70)	50 (28)	60 (42)	0.26
Race/ethnicity				0.07
White	69 (86)	57 (32)	78 (54)	
African American	25 (31)	34 (19)	17 (12)	
Hispanic/Latino	1 (1)	2 (1)	0 (0)	
Multiracial	5 (7)	7 (4)	4 (3)	
Asthma severity				0.23
Intermittent	55 (67)	61 (34)	50 (33)	
Mild	10 (12)	11 (6)	9 (6)	
Moderate	16 (20)	9 (5)	23 (15)	
Severe	19 (23)	20 (11)	18 (12)	
Years with Asthma Diagnosis (mean (SD))	24.8 (15.5)	25.2 (15.7)	24.5 (15.4)	0.79
Time under physician care (mons) (mean, SD))	57.1 (42.6)	53.8 (48.9)	59.7 (37.2)	0.46
Asthma control (Mean (SD))	17.1 (4.8)	17.4 (4.9)	16.8 (4.7)	0.50
Asthma-related QOL (Mean (SD))	4.7 (1.2)	4.7 (1.2)	4.8 (1.2)	0.81
Satisfaction with care (% agree)	88 (104)	91 (48)	86 (56)	0.46
Satisfaction with physician relationship (% agree)	83 (104)	79 (44)	87 (60)	0.21

(cont. next page).

Physician and Practice Characteristics

Factor	(Total Sample) (n= 18) % (n)	Control (n=9) % (n)	EHR- PACE (n= 9) % (n)	P- Value ^{§*}
Sex (% female)	83 (15)	88.9 (8)	77.8 (7)	1.00
Years in Practice (Mean, (SD))	14.4 (6.1)	16.6 (7.1)	12.3 (4.4)	0.15
# of Adult Asthma Patients in Panel (Mean, (SD))	181.2 (124.8)	204.4 (146.0)	155.0 (98.9)	0.43
Practice Setting				0.21
Small Group Practice (2-5)	17 (3)	33 (3)	0 (0)	
Large Group Practice (>6)	83 (15)	67 (6)	100 (9)	
Involved in EHR Training Efforts (% yes)	28 (5)	44 (4)	11 (1)	0.29
Exam Room Structure				0.56
Laptop, computer on wheels	64 (9)	57 (4)	71 (5)	
Room flexible	29 (4)	43 (3)	14 (1)	
Room not flexible	7 (1)	0 (0)	14 (1)	

Table 3. Intervention effects on patient asthma-related outcomes, satisfaction, and their perception of their doctor's communication and care

Outcome	Baseline (n=126)	3 month Follow-up (n=123)	6 month Follow-up (n=116)	Changes in outcomes between 6 month follow-up and baseline (Mean (SD))		¹ EHR-PACE vs. Control at 3 months Estimate (SE)	P Value	¹ EHR-PACE vs. Control at 6 months Estimate (SE)	P Value
				Control	EHR-PACE				
Asthma control (Mean (SD))	17.1 (4.8)	17.6 (5.0)	17.8 (4.9)	0.8 (3.8)	0.8 (4.4)	-0.4 (0.9)	0.63	-0.4 (0.9)	0.63
Asthma-related QOL (Mean (SD))	4.7 (1.2)	4.8 (1.3)	5.0 (1.3)	0.2 (1.0)	0.3 (1.0)	0.1 (0.2)	0.66	0.1 (0.2)	0.77
Satisfaction with relationship (Mean (SD))	4.2 (0.9)	4.3 (0.9)	4.3 (0.8)	0.3 (0.9)	0.02 (0.8)	-0.1 (0.2)	0.64	-0.3 (0.2)	0.07
Satisfaction with care received (Mean (SD))	3.3 (0.7)	3.3 (0.7)	3.3 (0.7)	0.02 (0.6)	0.1 (0.7)	-0.1 (0.1)	0.57	0.004 (0.1)	0.97
Perception of physician use of Communication Practices (Mean (SD))	10.1 (1.8)	10.3 (1.6)	10.4 (1.6)	0.3 (2.0)	0.2 (1.4)	0.1 (0.3)	0.75	-0.1 (0.3)	0.70
Perception of physician use of asthma counseling practices (Mean (SD))	10.7 (4.3)	11.3 (3.9)	11.3 (4.3)	0.9 (3.7)	0.4 (2.8)	-0.7 (0.6)	0.21 [#]	-0.7 (0.6)	0.25 [#]
Perception of EHR Use in Exam Room (Mean (SD))	22.7 (5.1)	22.9 (5.0)	22.9 (5.0)	0.8 (4.0)	-0.5 (5.2)	-0.3 (1.1)	0.79	-1.0 (1.1)	0.38
Physician's communication while using EHR (Mean (SD))	53.3 (8.0)	54.6 (7.4)	55.1 (8.5)	2.9 (8.8)	0.8 (8.1)	-0.4 (1.4)	0.79	-1.9 (1.4)	0.19

1. Models adjusted for fixed effects of baseline outcome, age, gender, baseline asthma severity, random effect of physician - [#] Model did not converge

Table 4. Physician perception of their own care

Outcome	Baseline (n=18)	3 month Follow-up (n=18)	6 month Follow-up (n=18)	Changes in outcomes between 6 month follow-up and baseline (Mean (SD))		¹ EHR-PACE vs. Control at 3 months Estimate (SE)	P Value	¹ EHR-PACE vs. Control at 6 months Estimate (SE)	P Value
				Control	EHR-PACE				
Asthma Counseling Practices (Mean (SD))	19.8 (4.0)	21.6 (4.6)	21.0 (4.0)	0.6 (2.1)	1.8 (3.1)	0.4 (1.4)	0.79	0.6 (1.2)	0.62
Confidence in Asthma Counseling Practices (Mean (SD))	8.3 (1.4)	9.1 (1.3)	9.0 (1.2)	-0.1 (1.6)	1.4 (1.4)	0.8 (0.6)	0.19	0.9 (0.4)	0.05
Patient-centered Communication Practices (Mean (SD))	26.3 (3.0)	28.2 (3.1)	27.1 (2.8)	0.4 (2.7)	1.2 (1.8)	2.2 (1.1)	0.08	0.2 (1.0)	0.86
Confidence in Patient- centered Communication Practices (Mean (SD))	24.6 (3.0)	25.3 (2.6)	25.4 (2.4)	0.6 (2.4)	1.2 (1.3)	1.3 (0.8)	0.15	0.2 (0.6)	0.79
Perception of EHR communication (Mean (SD))	12.9 (5.1)	15.4 (4.4)	16.5 (5.2)	2.6 (2.7)	4.8 (5.8)	1.7 (1.3)	0.23	2.2 (1.7)	0.23
EHR communication (Mean (SD))	5.0 (1.6)	5.8 (1.2)	5.8 (1.4)	0.2 (0.8)	1.4 (1.7)	0.5 (0.4)	0.21	0.4 (0.6)	0.44
Confidence in EHR communication practices (Mean (SD))	3.9 (1.8)	5.3 (2.3)	5.5 (1.7)	0.3 (1.2)	2.9 (2.0)	2.3 (0.8)	0.01	1.1 (0.6)	0.10
EHR communication for those who don't use a transcriptionist (Mean (SD))	3.2 (1.0)	3.5 (0.8)	3.8 (0.5)	0.3 (0.5)	1.2 (1.1)	-0.2 (0.2)	0.46	-0.2 (0.4)	0.71
Confidence in EHR communication for those who don't use a transcriptionist (Mean (SD))	2.1 (1.6)	2.8 (1.4)	2.8 (1.1)	-0.3 (1.6)	2.0 (1.2)	1.4 (0.6)	0.04	0.3 (0.7)	0.74

1. Models adjusted for fixed effect of baseline outcome, physician's gender, examine room structure, years in practice

Figure 1. Provider trial trajectory

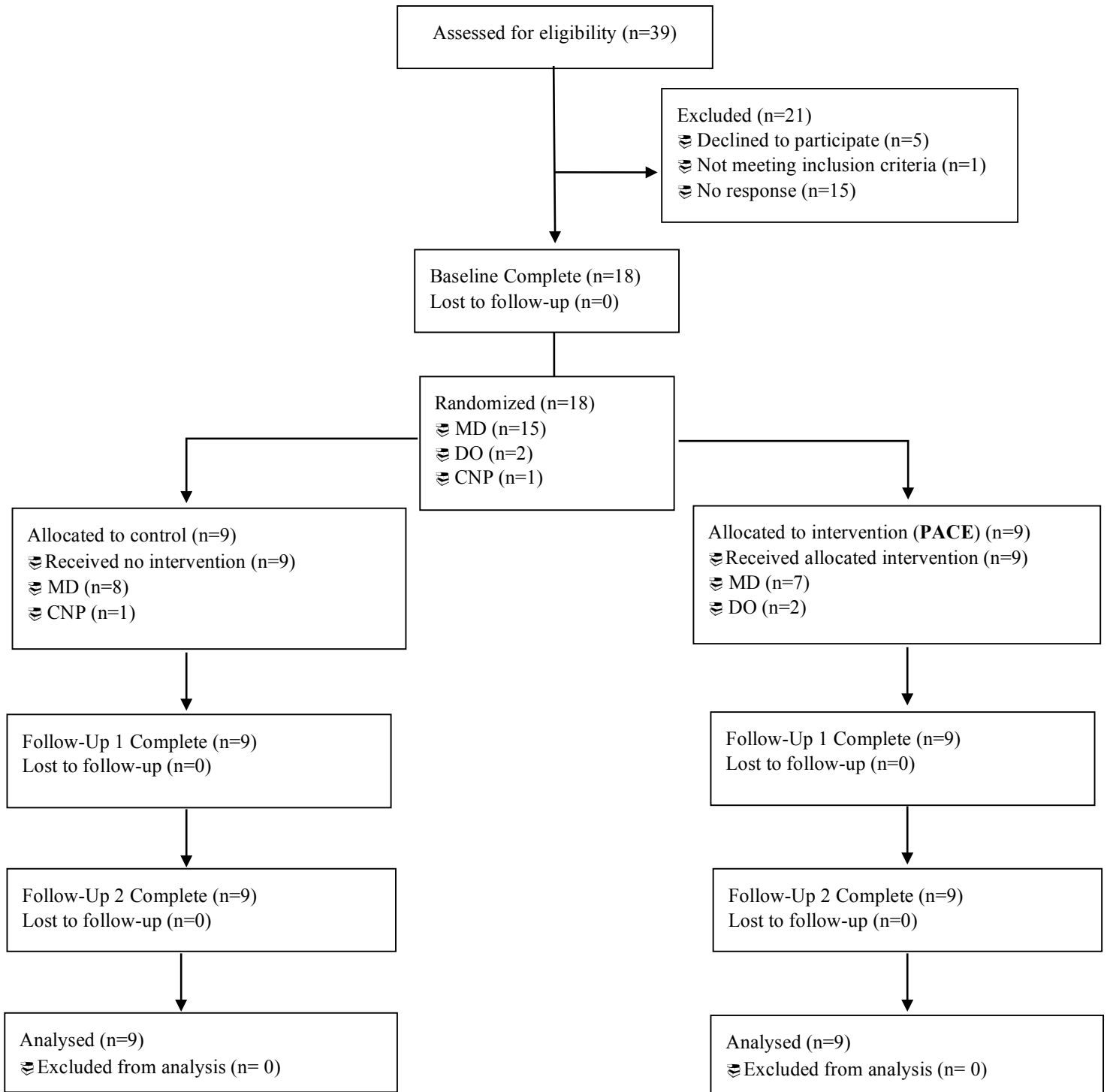


Figure 2. Patient trial trajectory

