

Effect of a Self-management Support Intervention on Asthma Outcomes in Older Adults

The SAMBA Study Randomized Clinical Trial

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[+ Supplemental content](#)

IMPORTANCE Older adults with asthma have worse control and outcomes than younger adults. Interventions to address suboptimal self-management among older adults with asthma are typically not tailored to the specific needs of the patient.

OBJECTIVE To test the effect of a comprehensive, patient-tailored asthma self-management support intervention for older adults on clinical and self-management outcomes.

DESIGN, SETTING, AND PARTICIPANTS Three-arm randomized clinical trial conducted between February 2014 and December 2017 at primary care practices and personal residences in New York City. Adults 60 years and older with persistent, uncontrolled asthma were identified from electronic medical records at an academic medical center and a federally qualified health center. Of 1349 patients assessed for eligibility, 406 met eligibility criteria, consented to participate, and were randomized to 1 of 3 groups: home-based intervention, clinic-based intervention, or control (usual care). A total of 391 patients received the allocated treatment

INTERVENTIONS Screening for psychosocial, physical, cognitive, and environmental barriers to asthma control and self-management with actions to address identified barriers. The intervention was delivered in the home or primary care practices by asthma care coaches.

MAIN OUTCOMES AND MEASURES Primary outcomes were the Asthma Control Test, Mini Asthma Quality of Life Questionnaire, Medication Adherence Rating Scale, metered dose inhaler technique, and emergency department visits for asthma care. Primary analyses compared intervention (home or clinic based) with usual care.

RESULTS Of the 391 patients who received treatment, 58 (15.1%) were men, and the mean (SD) age was 67.8 (7.4) years. After accounting for baseline scores, scores on the asthma control test were better in the intervention groups vs the control group (difference-in-differences at 3 months, 1.2; 95% CI, 0.2-2.2; $P = .02$; 6 months, 1.0; 95% CI, 0.0-2.1; $P = .049$; 12 months, 0.6; 95% CI, -0.5 to 1.8; $P = .28$; and overall, $\chi^2 = 13.4$, with 4 degrees of freedom; $P = .01$). Emergency department visits were lower at 12 months for the intervention groups vs the control group (16 [6.2%] vs 17 [12.7%]; $P = .03$; adjusted odds ratio, 0.8; 95% CI, 0.6-0.99; $P = .03$). Statistically significant improvements were observed for the intervention vs control patients in quality of life (overall effect: $\chi^2 = 10.5$, with 4 degrees of freedom; $P = .01$), medication adherence (overall effect: $\chi^2 = 9.5$, with 4 degrees of freedom; $P = .049$), and inhaler technique (metered-dose inhaler technique, correctly completed steps at 12 months, median [range]: 75% [0%-100%] vs 58% [0%-100%]). No significant differences in outcomes were observed between patients receiving the intervention in home vs practice settings.

CONCLUSIONS AND RELEVANCE An intervention directed by patients' needs and barriers improved asthma outcomes and self-management behaviors among older adults.

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Asthma affects 7% of Americans older than 65 years¹ and causes more symptoms and hospitalizations in this age group than in younger patients with asthma.² While experts have called for interventions specifically targeting this population,³ few relevant studies have been reported.⁴⁻⁶

Older adults are prone to poor asthma outcomes owing in part to difficulties with self-management, like daily use of inhaled corticosteroids and proper inhaler technique.⁷⁻¹⁰ These difficulties arise because of varied psychosocial, cognitive, physical, and mental health issues.¹¹⁻¹³ Addressing such a broad range of barriers to self-management would be infeasible for any asthma intervention. Instead, published interventions have typically narrowed their scope, emphasizing generalized asthma education and skills training, with limited tailoring to the specific needs of the individual patient.^{4,5,14} Yet, a generalized asthma education approach can cognitively overload older patients, distracting them from the information they need most to improve self-care.

We created an asthma self-management support intervention for older adults that screens patients for self-management barriers and targets only the identified problems for support. We compared the effect of the intervention, Supporting Asthma Self-Management Behaviors in Older Adults (SAMBA), with usual care on self-management behaviors and outcomes. We also sought to determine whether delivery of the intervention in the home would have a greater benefit for patients who might have difficulty leaving home.

Methods

Patients and Settings

We conducted a pragmatic randomized clinical trial of SAMBA between February 1, 2014, and December 31, 2017 (Supplement 1). Adults older than 60 years with uncontrolled, moderate or severe persistent asthma were recruited from 3 adult primary care practices of the Mount Sinai Health System and 6 practices of the Institute for Family Health, a federally qualified health center, all in New York City. We excluded patients with other chronic pulmonary diseases or a smoking history greater than 15 pack-years, who required assistance with medication administration, or who did not speak English or Spanish. The study protocol was approved by the institutional review boards of all participating institutions.

Recruitment, Randomization, and Data Collection

Patients were identified by electronic health record query and screened by telephone for eligibility. Verbal informed consent was obtained in person, in English or Spanish, followed by baseline interview then randomization. Analysts and study investigators were blinded to participant assignment.

Patients were randomly assigned to usual care (control), the SAMBA intervention delivered at home, or SAMBA delivered in the primary care clinic. Randomization was in blocks of 6, stratified by site and asthma severity (severe vs moderate). Follow-up interviews were conducted by telephone at 3 and 6 months and in person at 12 months.

Key Points

Question Does a needs-tailored intervention improve outcomes for older adults with asthma?

Findings In this randomized clinical trial that included 391 adults, intervention patients had significantly better asthma control, quality of life, medication adherence, and inhaler technique than control patients. The proportion of intervention patients with an emergency department visit for asthma was 6% vs 12% in the control group, a significant difference.

Meaning Older adults with asthma can benefit from tailoring self-management support to the range of psychosocial, health, function, and cognitive barriers they have to asthma control.

Intervention

The SAMBA intervention has 3 core elements: (1) screening to identify barriers to asthma self-management and control, (2) targeted actions to address the barriers, and (3) reinforcement over time.¹⁵ The central feature of SAMBA is comprehensive screening for barriers to asthma control and self-management from among 21 domains of psychosocial, cognitive, physical and mental health, and environmental barriers. These barriers were identified by review of existing research, application of theory,^{16,17} qualitative research done in preparation for the trial,¹⁸ and input from the project's diverse stakeholder group, including patients.¹⁵ Specific actions are then taken to address the identified barriers. During follow-up encounters, the coaches assess asthma control, medication adherence, and inhaler technique, and check on progress with goals. An example of how the intervention works is provided in the Box, and additional examples and all intervention materials are available without charge online at SAMBAforAsthma.com.

The intervention was delivered by asthma care coaches (ACCs) who were high school- or college-educated employees of the organizations partnering on the study. The ACCs underwent a 2-day, classroom-based training addressing basic asthma pathophysiology and self-management support, motivational interviewing, communication strategies with low-literacy patients, and the SAMBA protocols. Demonstration of competency in delivering the intervention was required before the ACCs were allowed to work independently. All ACCs met monthly to review cases and hear lectures to support new skills and knowledge development.

The SAMBA design embraced the teach-to-goal concept,¹⁹ focusing only on topics the patient and ACC agreed required attention and reinforcement. The ACC and patient worked collaboratively, in English or Spanish, to set goals and priorities,²⁰ and ACCs used the teach-back technique to ensure understanding.²¹ The ACCs reinforced targeted learning by referring patients as needed to a low-literacy asthma educational booklet.²² Intervention duration was 12 months. The ACC recommended a schedule of in-person and telephone encounters but allowed for flexibility.

Primary Outcomes Measures

Asthma control and quality of life were measured with the Asthma Control Test (ACT, range 5-25)²³ and the Mini Asthma

Box. Example of the SAMBA Intervention**Screening**

During the initial encounter, the Asthma Care Coach (ACC) administers the screening assessment and identifies the following barriers to asthma control: poor inhaler technique, intermittent use of fluticasone propionate, and evidence of cockroach infestation in the home. Reasons for intermittent medication use identified through screening are patient's belief that asthma is an intermittent (vs chronic) disease and the cost of the medication.

Targeted Actions

Following screening during the initial and subsequent encounters, the ACC trains the patient on proper inhaler technique, provides brief asthma education focused exclusively on the chronic nature of asthma and the different roles and use of controller (eg, fluticasone) and rescue (albuterol) medications, advises the patient to discuss cost problems with her physician, and makes a referral for the New York City-sponsored pest remediation service available for residents of low-income households. The ACC faxes a summary of identified issues and actions to the patient's primary care physician.

Reinforcement

During subsequent encounters over 12 months, the ACC observes the patient's inhaler technique and corrects it if needed, reassesses medication adherence and the underlying contributing factors, and addresses new problems as they arise.

SAMBA indicates Supporting Asthma Self-Management Behaviors in Older Adults.

Quality of Life Questionnaire (mAQLQ, range 1-7).²⁴ Adherence to asthma controller medications (inhaled corticosteroids or leukotriene inhibitors) was measured by self-report using the Medication Adherence Rating Scale (MARS, range 0-5).²⁵ Data on these measures were collected at baseline, and 3, 6, and 12 months. Technique with metered-dose inhalers (MDI) was assessed on placebo devices using a validated checklist at baseline and 12 months.²⁶ Dry-powdered inhaler technique was assessed but not included in outcomes analysis because of low rates of use ($n = 108$). Hospital and emergency department visit data for the 12 months prior to and following study enrollment were obtained from the New York State Department of Health Statewide Planning and Research Cooperative System.²⁷ Events were attributed to asthma exacerbation if asthma was listed as the first diagnosis.

Secondary outcomes included use of an asthma action plan or peak flow meter, and exposures to or actions taken to avoid common asthma triggers.

Additional Measures

Baseline assessment included identification of cognitive impairment, defined as age and education adjusted score less than 21 on the Montreal Cognitive Assessment (range, 0-30),²⁸ severe physical impairment, defined as 20 points below the standard deviation of normal on the Patient-Reported Outcome Measurement Information System Short Form version 1.0—Physical Function 4a (standardized score range, 22.9-56.9),^{29,30} and moderate to severe depression, defined as a score of at least 65.8 on the 8-item Patient-Reported Outcomes Measurement

Information System short form measure (standardized score range, 38.2-81.3).^{29,31}

Data Analysis

We conducted intention-to-treat analyses of the combined SAMBA intervention (home or clinic based) vs usual care. In subgroup analyses, we compared outcomes between home-based and clinic-based arms.

ACT, mAQLQ, MARS, and inhaler technique scores were examined as continuous repeated measures using random and fixed effects hierarchical linear modeling, with study visit as a longitudinal level 1 factor and group (intervention or control) as a level 2 factor. For all models, preliminary analyses suggested the inclusion of age, education level, and marital status as time-invariant covariates as they were predictive of outcomes. Clinical site was included as a fixed effect. Nested models, with and without inclusion of treatment group effects, were fitted and compared using χ^2 analyses; covariate-adjusted means for each group and time point were estimated from the model. We report changes in mean scores between treatment arms as difference-in-differences. The study was not powered for formal assessment of noninferiority.

Because hospitalization rates were low, we only modeled emergency department visits. The outcome of having at least 1 asthma-related emergency department event was analyzed using a generalized linear model with a logit link function, adjusting for age, education level, marital status, and clinical site.

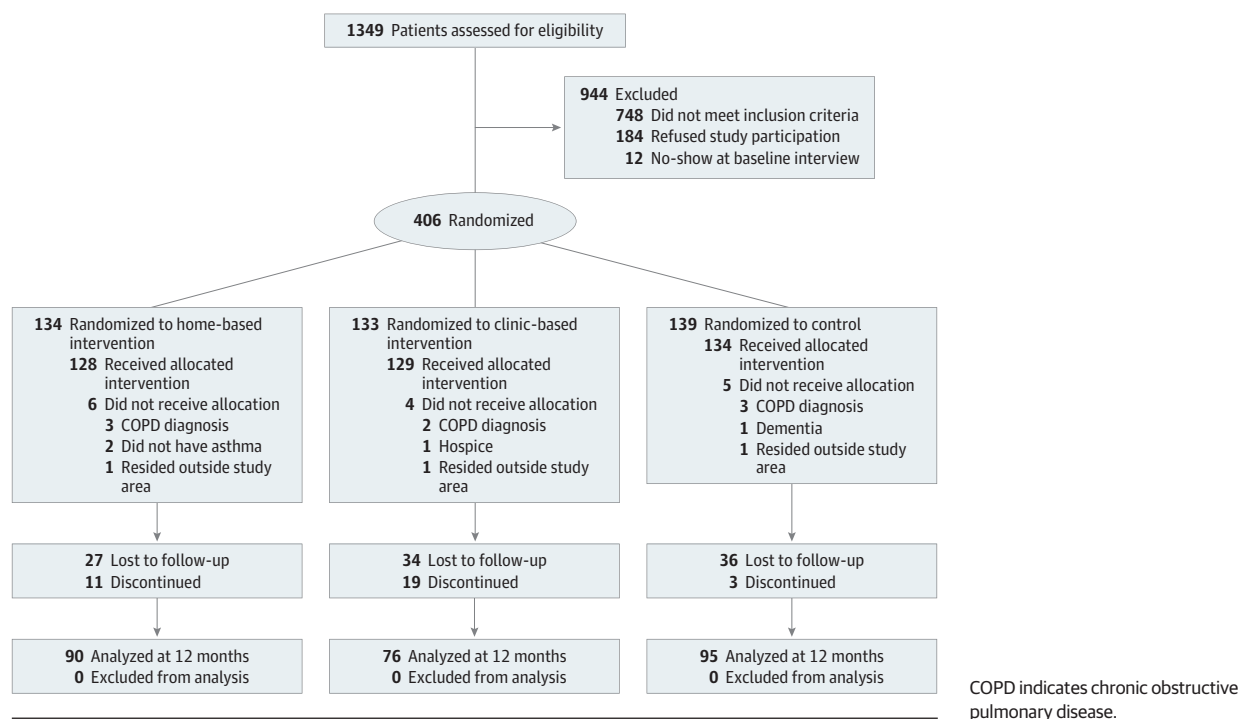
Effect sizes were calculated using estimates of variance components from the hierarchical linear modeling. We calculated the absolute risk reduction in poor asthma control and quality of life between intervention and control arms based on the minimal clinically important differences for these constructs (ACT, 3 points; AQLQ, 0.5 points).^{32,33} We then calculated the number needed to treat to achieve the minimal clinically important differences for one patient.

We conducted heterogeneity of treatment effects analyses to test the hypotheses that patients with depression or functional or cognitive impairment would benefit more from the home-based vs clinic-based intervention. Following the modeling strategy for home vs clinic analyses, we included interaction terms of treatment arm by impairment and set significance for the interaction terms at $P < .05$.

To handle missing data, we employed full information maximum likelihood estimation³⁴ and tested the sensitivity of the maximum likelihood estimation by repeating the main analyses of ACT and mAQLQ scores using multiple imputation (10 imputations per analysis).³⁵ We used the Chained Equation approach³⁶ to Multiple Imputation using Stata, version 15.1, to assemble the imputed data sets. Age, education, and marital status were included in the multiple imputation modeling to generate imputed values. The imputation process revealed very low standard error estimates (0.17 and 0.05) for ACT and mAQLQ, respectively, suggesting stable imputation results.

Study enrollment was planned for 150 individuals per arm (total, $n = 450$) based on differences between intervention and control of 0.7 for the Asthma Control Questionnaire (ACQ) and 0.5 for the mAQLQ, with 80% power.^{37,38} We replaced the ACQ

Figure. Study Enrollment Flowchart



with the ACT prior to study implementation. Sample size was adjusted for patient clustering by physicians³⁹ and an all-cause dropout rate of 15%.⁴⁰ Hierarchical linear modeling was performed using SPSS statistical software release 25.0 (IBM). All other analyses were conducted using SAS, version 9.4 (SAS Institute Inc).

Results

Of 1349 patients assessed for eligibility, 406 met eligibility criteria, consented to participate, and were randomized to intervention or usual care, and 391 received the allocated treatment (Figure). Retention at 12 months was 90 (70.3%), 76 (58.9%), and 95 (70.9%) for the home-based intervention, clinic-based intervention, and usual care arms, respectively ($P = .11$). Loss to follow-up was similar across study arms, but drop-out varied significantly: home-based arm, 11 (8.6%); clinic-based arm, 19 (14.7%); and usual care, 3 (2.2%) ($P = .001$). The most common reasons for drop-out were lack of interest (9 [27.3%]), other health concerns (7 [21.2%]), and time commitment (6 [18.1%]).

There were no significant differences between intervention and usual care patients by demographics, comorbidities (except prevalence of hypertension), and outcomes at baseline (Table 1). The mean (SD) patient age overall was 67.8 (7.4) years; 58 (15.1%) were men; 220 (56.3%) were Hispanic; and 144 (36.8%) had limited English proficiency.

Intervention and usual care patients had low average ACT scores (mean [SD], 14.6 [4.0]). Average mAQLQ scores were also low (mean [SD], 4.4 [1.1]), and 254 (64.9%) had poor quality

of life (mAQLQ, <4.7). Hospitalization and emergency department visit rates in the 12 months leading to study enrollment were low (hospitalizations for intervention vs usual care: 3 [2.2%] vs 3 [1.2%], $P = .42$; emergency department visits: 29 [10.5%] vs 13 [9.7%], $P = .86$). The mean (SD) MARS score was 3.7 (0.7), and 341 (87.3%) participants had low medication adherence. Poor MDI and dry-powdered inhaler technique were observed for 286 (73.2%) and 238 (60.9%) participants, respectively.

Primary Outcome Analyses

Intervention vs usual care patients had overall significantly greater improvements in asthma control, asthma-related quality of life, and medication adherence (eFigure in Supplement 2). For both ACT and mAQLQ scores, differences were statistically significant at months 3 and 6, but not at 12 months (Table 2). Medication adherence was greater at all 3 time points, and the proportion of correctly performed steps for the MDI technique increased by 15% (absolute increase, 95% CI, 7%-22%; $P < .001$) at 12 months. Fewer intervention patients had an asthma-related emergency department visit than controls (16 [6.2%] vs 17 [12.7%], $P = .03$; adjusted odds ratio, 0.8; 95% CI, 0.6-0.99, $P = .03$). Maximum likelihood estimation and multiple imputation models showed similar results and did not change the significance level of the intervention effect for any outcome.

Effect sizes at 12 months were 0.29 (95% CI, 0.07-0.50) for asthma control, 0.20 (95% CI, -0.01 to 0.41) for quality of life, 0.17 (95% CI, -0.04 to 0.38) for medication adherence, and 0.53 (95% CI, 0.31-0.75) for MDI technique (Table 3). The number needed to treat to achieve the minimal clinically important dif-

Table 1. Baseline Characteristics of Study Participants

	No. (%)					
			Intervention			
Characteristic	Total (n = 391)	Control (n = 134)	All (n = 257)	Home Based (n = 128)	Clinic Based (n = 129)	P Value ^a
Age, mean (SD)	67.8 (7.4)	68.4 (8.1)	67.3 (7.0)	68.1 (7.4)	66.5 (6.4)	.18
Age, y						
60-69	270 (69.1)	88 (65.7)	182 (70.8)	84 (65.6)	98 (76.0)	.10
70-79	83 (21.2)	27 (20.2)	56 (21.8)	32 (25.0)	24 (18.6)	
≥80	38 (9.7)	19 (14.2)	9 (7.4)	12 (9.4)	7 (5.4)	
Male sex	58 (15.1)	17 (12.7)	41 (16.0)	19 (14.8)	22 (17.1)	.39
Race/ethnicity						
White, non-Hispanic	29 (7.4)	6 (4.5)	23 (9.0)	12 (9.4)	11 (8.5)	.42
Black, non-Hispanic	119 (30.4)	43 (32.1)	76 (29.6)	37 (28.9)	39 (30.2)	
Hispanic	220 (56.3)	76 (56.7)	144 (56.0)	74 (57.8)	70 (54.3)	
Other	23 (5.9)	9 (6.7)	14 (5.5)	5 (3.9)	9 (7.0)	
Limited English proficiency	144 (36.8)	52 (38.8)	92 (35.8)	49 (38.3)	43 (33.3)	.83
Monthly household income <\$1350	262 (67.0)	86 (64.2)	176 (68.5)	87 (68.0)	89 (69.0)	.39
Married or partner	94 (24.0)	39 (29.1)	55 (21.4)	33 (25.8)	22 (17.1)	.09
Education						
<High school	163 (41.7)	63 (47.0)	100 (38.9)	50 (39.1)	50 (38.8)	.09
High school graduate	82 (21.0)	27 (20.2)	55 (21.4)	31 (24.2)	24 (18.6)	
Some college	84 (21.5)	31 (23.1)	53 (20.6)	25 (19.5)	28 (21.7)	
College graduate	62 (15.9)	13 (9.7)	49 (19.1)	22 (17.2)	27 (20.9)	
Physical impairment, severe	58 (14.8)	22 (16.4)	36 (14.0)	16 (12.5)	20 (15.5)	.52
Cognitive impairment	204 (52.2)	75 (56.0)	129 (50.2)	63 (49.2)	66 (51.2)	.28
Moderate-severe depression	32 (8.4)	10 (7.8)	22 (8.7)	12 (9.6)	10 (7.9)	.76
Comorbid medical conditions						
Diabetes mellitus	153 (39.1)	52 (38.8)	101 (39.3)	44 (34.4)	57 (44.2)	.92
High cholesterol	210 (53.7)	74 (55.2)	136 (52.9)	70 (54.7)	66 (51.2)	.66
Hypertension	283 (72.4)	106 (79.1)	177 (68.9)	88 (68.8)	89 (69.0)	.03
Main outcomes						
ACT score, mean (SD)	14.6 (4.0)	14.3 (4.0)	14.8 (3.9)	15.0 (3.8)	14.6 (4.0)	.25
mAQLQ score, mean (SD)	4.4 (1.1)	4.3 (1.1)	4.4 (1.2)	4.4 (1.2)	4.4 (1.2)	.78
Patients with ≥1 hospitalization prior 12 mo	6 (1.5)	3 (2.2)	4.4 (1.2)	0	3 (2.3)	.42 ^b
Patients with ≥1 ED visit prior 12 mo	40 (10.2)	13 (9.7)	27 (10.5)	17 (13.3)	10 (7.8)	.86 ^b
Medication Adherence Ratings scale score, mean (SD)	3.7 (0.7)	3.8 (0.7)	3.6 (0.7)	3.6 (0.7)	3.7 (0.6)	.11
MDI technique, ^c % correctly completed steps, median (range)	60 (0-100)	64 (9-100)	56 (0-100)	60 (0-100)	55 (0-100)	.10

Abbreviations: ACT, Asthma Control Test; ED, emergency department; mAQLQ, Mini Asthma Quality of Life Questionnaire; MDI, metered-dose inhaler.

^a Intervention vs control.

^b Fisher exact test.

^c n = 355.

ferences in asthma control and quality of life were 9 and 5, respectively, at 6 months, and 30 and 14 at 12 months. The number needed to treat to prevent 1 emergency department visit was 15.

Secondary Outcomes Analyses

At 12 months, intervention patients were more likely to report having a peak flow meter than usual care patients (95 [57.2%] vs 34 [35.8%], $P < .001$). There were no significant differences for having an asthma action plan (56 [33.7%] vs 25 [26.3%], $P = .21$), using a dehumidifier or air purifier (46 [27.7%] vs 24 [25.3%], $P = .67$), or reporting triggers in the home (mold: 29 [17.5%] vs 23 [24.2%], $P = .19$; cockroaches: 54 [32.5%] vs

35 [36.8%], $P = .48$; pets with fur or feathers: 50 [30.1%] vs 23 [24.2%], $P = .31$; tobacco smoke: 15 [9.6%] vs 16 [15.8%], $P = .14$).

Home-based vs Office-based Intervention

Outcomes improved within both treatment arms for all measures, but there were no significant differences in outcomes between home-based and clinic-based interventions at 3, 6, or 12 months (eTable 1 in Supplement 2), except greater improvement in quality of life for home-based SAMBA recipients at 6 months. The power to detect a statistically significant difference between the 2 arms at month 12 was 0.13 for the ACT and 0.31 for the mAQLQ.

Table 2. Primary Outcomes: Intervention vs Control Group

Characteristic	Intervention			Control			Intervention Effect (Adjusted)	
	Value, Mean (SD)	Δ (95% CI) ^a	P Value ^a	Value, Mean (SD)	Δ (95% CI) ^a	P Value ^a	DiD (95% CI)	P Value
Asthma Control Test score								
Baseline	14.8 (3.9)			14.3 (4.0)				
3 mo	16.2 (4.4)	1.4 (0.8 to 2.0)	<.001	14.6 (4.8)	0.4 (−0.5 to 1.2)	.58	1.2 (0.2 to 2.2)	.02
6 mo	16.2 (4.4)	1.4 (0.8 to 2.1)	<.001	14.6 (4.9)	0.4 (−0.5 to 1.2)	.37	1.0 (0.0 to 2.1)	.049
12 mo	17.1 (4.7)	2.2 (1.5 to 2.9)	<.001	16.1 (4.3)	1.5 (0.5 to 2.6)	<.001	0.6 (−0.5 to 1.8)	.28
Overall effect ^b							$\chi^2_4 = 13.4$	.01
Mini Asthma Quality of Life score								
Baseline	4.3 (1.2)			4.3 (1.1)				
3 mo	4.7 (1.2)	0.4 (0.2 to 0.5)	<.001	4.3 (1.3)	0.0 (−0.2 to 0.2)	.91	0.4 (0.1 to 0.6)	.007
6 mo	4.7 (1.3)	0.3 (0.1 to 0.5)	<.001	4.3 (1.3)	−0.1 (−0.3 to 0.2)	.62	0.4 (0.1 to 0.7)	.02
12 mo	4.8 (1.3)	0.5 (0.3 to 0.7)	<.001	4.6 (1.3)	0.3 (0.0 to 0.5)	.03	0.2 (−0.1 to 0.5)	.20
Overall effect ^b							$\chi^2_4 = 10.5$	.03
Medication Adherence Rating scale score								
Baseline	3.6 (0.7)			3.8 (0.7)				
3 mo	3.9 (0.6)	0.3 (0.2 to 0.4)	<.001	3.8 (0.7)	0.1 (0.0 to 0.3)	.50	0.2 (0.1 to 0.4)	.01
6 mo	3.9 (0.7)	0.3 (0.2 to 0.4)	<.001	3.8 (0.8)	0.0 (−0.1 to 0.2)	.69	0.2 (0.0 to 0.4)	.02
12 mo	3.9 (0.7)	0.3 (0.1 to 0.4)	<.001	3.8 (0.7)	0.1 (−0.1 to 0.2)	.70	0.3 (0.1 to 0.5)	.01
Overall effect ^b							$\chi^2_4 = 9.5$	.049
MDI technique, % correctly completed steps, median (range)								
Baseline	56 (0 to 100)			64 (9 to 100)				
12 mo	75 (0 to 100)	6 (−14 to 6)	.45	58 (0 to 100)	−16 (−1 to −31)	.04	15 (7 to 22)	.004
Patients with ≥ 1 emergency department visit, %								
Baseline	10.5			9.7				
12 mo	6.2	0.9 (0.7 to 1.0) ^c	.02	12.7	1.1 (0.9 to 1.3) ^c	.33	0.8 (0.6 to 0.99) ^c	.03

Abbreviations: DiD, difference-in-differences; MDI, metered-dose inhaler.

^b Effect over all time points.^a Change within study arm relative to baseline.^c Odds ratio.

Table 3. Intervention Effect Sizes

Characteristic	Effect Size (95% CI) ^a		
	3 mo	6 mo	12 mo
Control and quality of life			
Asthma Control Test	0.47 (0.25 to 0.68)	0.39 (0.17 to 0.60)	0.29 (0.07 to 0.50)
Mini Asthma Quality of Life Questionnaire	0.34 (0.13 to 0.55)	0.34 (0.13 to 0.55)	0.20 (−0.01 to 0.41)
Self-management			
Medication Adherence Rating scale	0.11 (−0.10 to 0.33)	0.17 (−0.04 to 0.38)	0.17 (−0.04 to 0.38)
Metered-dose inhaler technique	NA	NA	0.53 (0.31 to 0.75)

Abbreviation: NA, not applicable.

^a Cohen *d* effect size.

In heterogeneity of treatment effects analyses, there were no significant interactions of assignment to the home-based arm and physical impairment, cognitive impairment, or depression (eTable 2 in Supplement 2).

Process Measures

Screening for barriers to effective self-management was completed for 240 (93.2%) patients in the intervention (eTable 3 in Supplement 2), with rates ranging from 217 (84.6%) to 257 (100%) across sites ($P = .55$). The average

numbers of in-person and telephone encounters were 3.3 and 4.1, respectively.

Study Completers and Noncompleters

Among those who completed the study, there were no significant differences between intervention and control patients for any baseline measure.

Noncompleters of the study were less likely to be male than completers (9 [7.0%] vs 46 [17.5%], $P = .01$); have higher rates of cognitive impairment (81 [62.0%] vs 127 [48.8%], $P = .02$),

lower ACT scores (13.8 [3.8] vs 14.9 [4.0], $P = .01$) and mAQLQ scores (4.0 [1.0] vs 4.4 [1.2], $P = .002$); and were more likely to have a hospitalization for asthma in the prior 12 months (5 [4.0%] vs 2 [0.7%], $P = .02$).

Discussion

Compared with older adults receiving usual care, those randomized to the SAMBA asthma self-management support intervention had better asthma control and quality of life, improvements in medication adherence and MDI technique, and fewer asthma-related emergency department visits. These results demonstrate that identification of barriers to asthma self-management with targeted support is an effective method for improving proper asthma self-care, control, and quality of life among older adults.^{1,41}

Additional testing of the SAMBA intervention is needed to firmly establish evidence for its effectiveness given differences in retention between intervention and control arms and diminished treatment effects over time. Nonetheless, this study has a number of strengths that add to its value. This is the largest randomized trial of a self-management support intervention for older adults with asthma yet reported to our knowledge, and it targets a particularly vulnerable older population with very low incomes, low education, and high rates of comorbidity. Another core difference between this and previous studies is the broad scope of barriers to self-management addressed by the intervention and its avoidance of providing information that is not tailored to patients' needs. Previously reported interventions for older patients with asthma have narrower focus and use non-tailored asthma education.^{5,8} For example, Baptist et al⁸ randomized 70 patients with asthma (mean age, 73 years) in Ann Arbor, Michigan, to telephone and group education sessions that provided general asthma education combined with patient-driven self-management planning. The intervention improved asthma control and quality of life and reduced some use of urgent services at 12 months.⁸ Krieger and colleagues⁴² tested a home-based asthma self-management support intervention in Seattle, Washington, that included adults ages 18 to 65 years ($n = 366$). Community health workers provided patients with standardized asthma education and assessed their asthma knowledge, challenges controlling asthma, and asthma self-management practices and triggers. The intervention improved mAQLQ scores and reduced the number of days with asthma symptoms but did not reduce need for acute care.

Direct comparison of the SAMBA trial and earlier intervention studies is limited by their different populations, measures, and design (pragmatic vs efficacy trials). Whether the SAMBA intervention's reliance on an entirely patient-centered approach would result in a marginal benefit over models that mix general asthma education with patient-tailored self-management support must be determined empirically. However, taken together, these studies demonstrate that meaningful improvements in symptom control and quality of life can be achieved with older asthmatics through behavioral in-

terventions, and they provide an evidence-based menu of approaches toward this end.

This study demonstrates the value of patient centeredness and care coaching in supporting older adults with asthma and for ongoing efforts to engage patients in care delivery design and personalization. It also highlights the challenges of engaging vulnerable populations in self-management support, including modest retention rates⁴³ and reduced impact over time despite repeated encounters designed to sustain its effects. To support adoption and sustain impact, participating clinical sites and clinicians were free to deliver the intervention in the fashion that fit their workflow and practice culture and it is unclear how this strategy influenced the intervention's effects. Future iterations of the intervention will test strategies to improve long-term retention and impact, and may include repeated barrier screening, intentional matching of ACCs with patients, and targeted skills development with ACCs to enhance their ability to engage patients and affect behaviors.

The home-based and clinic-based interventions did not have significantly different outcome effects nor did the home-based intervention favor patients with physical or cognitive impairment or depression as hypothesized. This study was not powered to test noninferiority of the 2 intervention arms. Additionally, retention in the home-based arm was slightly lower than in the clinic-based arm. For these reasons, the question of which environment is better suited for asthma self-management support remains unanswered. The home and office environments each offer unique opportunities to advance the care and self-management of patients with chronic disease and warrant more research to determine when to provide support in each setting and for whom, as well as whether a blend of home-based and office-based self-management support would result in better outcomes.

Limitations

This study has limitations. First, the final sample was 80% of the planned recruitment, reducing the study's planned statistical power. Second, overall retention in the treatment arms was below 70%. However, analyses that address missing data do not alter any conclusions drawn from the data and there were no significant differences in baseline characteristics between intervention and control patients among those who completed the study. Third, generalizability of findings may be limited to inner city, predominantly older black and Hispanic patients with asthma, similar to those in this study. Additionally, the study included more women than men, which may reflect both higher prevalence of asthma in older women and higher rates of participation of women than men in asthma behavioral interventions.^{4,5,42,44} Fourth, research assistants conducting study interviews were not blinded to study arm assignment, which raises the possibility of biased documentation of self-reported outcomes. However, the lower emergency department rates among intervention patients, as determined by evaluation of administrative data, is consistent with outcomes of data collected by research assistants, suggesting that lack of blinding is an unlikely contributor to the favorable outcomes observed among intervention patients. Fifth, we observed improvements in some outcomes for patients in the con-

trol arm, suggesting that secular effects may have contributed to improvements for intervention patients as well. We are unaware of systematic efforts during the study to improve asthma outcomes in the participating practices.

Conclusions

Older adults receiving a patient-tailored self-management support intervention for asthma, whether in the home or clinic, achieved meaningful improvements in asthma control and quality of life, self-management behaviors, and reductions in

emergency department visits compared with patients in usual care. The SAMBA intervention is a promising model of self-management support and disease control for older adults with asthma, and possibly other chronic diseases, though because of lower retention of intervention patients and diminished intervention effects over time, the model should undergo additional refinement and testing before it is widely adopted. This study also demonstrates the challenge of retaining vulnerable patients in behavioral interventions and the need to improve understanding of facilitators and barriers to engagement and retention if interventions directed at social determinants of health and related factors are to succeed.

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