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ORIGINAL RESEARCH

Patient-Reported Outcomes and Patient-Reported Experience of Patients With Atrial Fibrillation in the IMPACT-AF Clinical Trial

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BACKGROUND: The IMPACT-AF (Integrated Management Program Advancing Community Treatment of Atrial Fibrillation) trial is a prospective, randomized, cluster design trial comparing atrial fibrillation management with a computerized clinical decision support system with usual care (control) in the primary care setting of Nova Scotia, Canada. The objective of this analysis was to assess and compare patient-reported health-related quality of life and patient-reported experience with atrial fibrillation care between clinical decision support and control groups.

METHODS AND RESULTS: Health-related quality of life was measured using the EuroQol 5-dimensional 5-level scale, whereas patient-reported experience was assessed using a self-administered satisfaction questionnaire, both assessed at baseline and 12 months. Health utilities were calculated using the Canadian EuroQol 5-dimensional 5-level value set. Descriptive statistics and generalized estimating equations were used to compare between groups. Among 1145 patients enrolled in the trial, 717 had complete EuroQol 5-dimensional 5-level data at baseline. The mean age of patients was 73.53 years, and 61.87% were men. Mean utilities at baseline were 0.809 (SD, 0.157) and 0.814 (SD, 0.157) for clinical decision support and control groups, respectively. At baseline, most patients in both groups reported being "very satisfied" with the care received for their atrial fibrillation. There were no statistically significant differences in utility scores or patient satisfaction between groups at 12 months.

CONCLUSIONS: Health-related quality of life of patients remained stable over 12 months, and there was no significant difference in patient satisfaction or utility scores between clinical decision support and control groups.

REGISTRATION INFORMATION: clinicaltrials.gov. Identifier: NCT01927367.

Key Words: atrial fibrillation ■ clinical trial ■ health utility ■ health-related quality of life ■ patient satisfaction

Atrial fibrillation (AF) is the most common arrhythmia, affecting approximately 200 000 Canadians.[1] It is associated with a broad range of symptoms, including palpitations, dyspnea, chest tightness, lethargy, sleeping difficulties, and psychosocial distress. Patients with AF are also at increased risk of major complications, such as heart failure, cognitive impairment, and stroke.[2]

Although management of AF typically aims to reduce symptoms and prevent AF-related complications,[3] patient-reported outcome measures (PROMs) and patient-reported experience measures have emerged as important measures of patient-centered care in treatment guidelines and the evaluation of clinical trials.[4,5] Health-related quality of life (HRQoL) is the most frequently evaluated PROM that relates to an individual's

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CLINICAL PERSPECTIVE

What Is New?

- Atrial fibrillation management aims to reduce symptoms and prevent atrial fibrillation–related complications.
- Patient-reported outcome measures and patient-reported experience measures are equally important gauges of patient-centered care, increasingly emphasized in treatment guidelines and important to assess when evaluating therapeutic interventions.
- The IMPACT-AF (Integrated Management Program Advancing Community Treatment of Atrial Fibrillation) trial, a prospective, randomized, cluster design trial, provided an opportunity to do so from the perspective of different patient care approaches.

What Are the Clinical Implications?

- Our study found that patients' health-related quality of life and satisfaction with their atrial fibrillation care remained stable over 12 months, whether or not their primary care provider received help and direction from a computerized decision support tool.

Nonstandard Abbreviations and Acronyms

CDS	clinical decision support
EQ-5D-5L	EuroQol 5-Dimension 5-level
GEE	generalized estimating equation
HRQoL	health-related quality of life
IMPACT-AF	Integrated Management Program Advancing Community Treatment of Atrial Fibrillation
PROM	patient-reported outcome measure

subjective evaluation of his/her health and well-being,[6] measuring the physical, psychological, emotional, and social impacts of a health condition and its treatments. For example, fear of complications associated with AF treatments, such as the risk of bleeding with oral anticoagulation therapy,[7] can isolate patients with AF from social activities and decrease their HRQoL.[8] Previous studies have reported that HRQoL is significantly impaired in patients with AF compared with the general population.[4,9] In contrast to PROMs, patient-reported experience measures do not look at the outcomes of care but rather the patient's experience with the process of care.[10] Black et al reported a positive correlation between experience and outcomes,[11] highlighting how PROMs and patient-reported experience measures are inherently linked as well their importance in providing superior quality of care.[10]

The objective of this analysis was to evaluate whether an electronic clinical decision support (CDS) system designed to assist both providers and patients with evidence-based management strategies for AF could improve HRQoL and patient satisfaction compared with usual care.

METHODS

Trial Design

The IMPACT-AF (Integrated Management Program Advancing Community Treatment of Atrial Fibrillation) trial was a prospective, randomized, unblinded, cluster-designed trial of a CDS system for the management of AF in primary care. The study methods and its main findings have been previously reported.[12,13] The data that support the findings of this study are available from the principal investigator (J. L. C.) on reasonable request.

Intervention

The CDS in the IMPACT-AF trial was a web-based software tool designed to support the management of patients with AF in primary care. It offered recommendations in regard to diagnostic assessment and treatment according to best practice and Canadian AF clinical guidelines.[14] As well, it allowed surveillance of patients with AF through a range of data sources, such as electronic laboratory results and patient-reported data, with proactive prompting for primary care providers to respond to critical alerts, trends, and situations. The CDS system also included web-based education and support tools for both providers and patients.

Participants

Primary care practices in the province of Nova Scotia, Canada, were randomized 1:1 to CDS (intervention) and usual care (control) groups. Within each practice, patients were recruited to participate. Inclusion criteria were as follows: aged ≥18 years, having electrocardiographically confirmed AF or documentation of past diagnosis or management of AF in their medical record, and ability to communicate in English and provide informed consent. The only exclusion criterion was having a poor likelihood of surviving 12 months after enrollment.

Data Collection

Clinical, laboratory, and treatment data relevant to the AF management of each participating patient were collected through electronic and/or paper medical record review by trained study abstractors at baseline (study entry) and 12 months. All patients were invited

to complete questionnaires (paper or electronic) at baseline and 12 months. Each questionnaire included variables on demographic characteristics, the EuroQol 5-Dimension 5-Level (EQ-5D-5L) scale, and satisfaction with AF care. The EQ-5D-5L is a widely used generic utility-based HRQoL instrument that examines 5 dimensions (namely, mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) with 5 levels of response representing no, slight, moderate, severe, and extreme problems for each dimension.[14] The combination of different health dimensions and levels of severity describes a total of 3125 health states. The raw response to the 5 questions of the EQ-5D-5L can be converted to a health utility index, which is anchored at 0 (representing a health state equivalent to being dead) and 1 (representing a health state equivalent to full or perfect health). Negative values are considered as a health state worse than death. The EQ-5D-5L also includes a visual analogue scale, in which participants were asked to rate their global health status on a scale of 0 (worst health you can imagine) to 100 (best health you can imagine). Satisfaction with care was assessed using 3 variables: satisfaction with care received from family physician, satisfaction with education received on AF, and satisfaction with support received on ways to manage AF. These variables were categorized according to 3 response options (not satisfied, satisfied, and very satisfied).

Statistical Analysis

The analysis followed the intention-to-treat principle. Descriptive statistics (percentage, mean, and SD) were used to summarize the sociodemographic and clinical characteristics of patients with complete baseline EQ-5D-5L data. The EQ-5D-5L was a prespecified secondary outcome of the IMPACT-AF trial; satisfaction with AF care was not prespecified, and all associated analyses are post hoc and exploratory.

Responses to the EQ-5D-5L dimension were evaluated according to each level of severity. Using the Paretian Classification of Health Change, the overall change in EQ-5D-5L levels between baseline and follow-up was calculated for intervention and control groups.[15] The Paretian Classification of Health Change enables a comparison of a participant's health state over time by classifying it as better (improvement in at least one EQ-5D-5L dimension and no worse on any other dimension), worse (a deterioration in at least one EQ-5D-5L dimension and no better on any other dimension), mixed (improvements and deteriorations in EQ-5D-5L dimensions), or unchanged.

The Canadian value set was used to convert EQ-5D-5L responses to utility scores.[16] Mean utility scores were compared between treatment arms at baseline and follow-up. Reviews indicate that minimally important differences in EQ-5D-5L range from 0.03 to 0.54, depending on the disease area.[17,18]

Generalized estimating equations (GEEs) were used to assess the intervention effect on HRQoL. A disutility score, calculated as 1–utility at follow-up, was entered as the dependent variable. Because most standard statistical methods (eg, γ and Poisson distributions) are only appropriate for right-skewed data, the transformation of utility scores to a disutility converts the data from left to right skewed.[19,20] Thus, the disutility allows for the skewed distribution of utility scores and predictions >1.[21] It represents a decrement in utility score from the maximum score of 1 for full health, with a higher disutility score indicating poorer HRQoL.

The GEE assumed an exchangeable correlation structure for patients within the same practice. Because GEE models require an accompanying distribution and link function, modified Park tests were used to test 3 distributions (γ, Gaussian, and Poisson).[22] Pearson correlation tests and modified Hosmer-Lemeshow tests were used to evaluate 3 link types (identity, square root, and log).[23,24] The regression model used a Poisson distribution and identity link.

The regression model included group assignment (CDS or control), location (rural or urban), and baseline utility score as explanatory variables. Baseline utility was included in the model because it is a potentially important predictor of follow-up HRQoL and thus likely to have an effect on the precision of estimates. Subgroup analyses were conducted according to prespecified subgroups of interest, including age (<75 or ≥75 years), sex (women or men), location (rural or urban), $CHADS_2$ (0 or ≥1), CHA_2DS_2-VAS_C (0 or ≥1), hypertension (yes or no), diabetes mellitus (yes or no), and antithrombotics (yes or no).[12,13] Additional nonprespecified subgroup analyses were conducted according to the lowest (0.760) and highest (0.911) quartiles of baseline utility scores. Regression results were reported as estimate of the effect (coefficient), 95% CI, and *P* value.

Given the amount of missing EQ-5D-5L data among patients, descriptive statistics and statistical tests were used to compare baseline sociodemographic and clinical characteristics between responders and nonresponders. *t* Tests were used to compare differences in means between groups, whereas χ^2 tests were used to compare proportions. Multiple imputation was conducted for the base case regression analysis to account for missing EQ-5D-5L data among patients. Multiple imputation was conducted at the response level, whereby missing responses to each EQ-5D-5L dimension were imputed individually and then used to calculate a utility score before pooling to imputed data sets.[25] Because the EQ-5D-5L dimensions are categorical data, ordered logit models, adjusted for age, sex, location, congestive heart failure, hypertension, diabetes mellitus, prior stroke, ischemic attack,

systemic embolism, vascular disease, $CHADS_2$ score, and CHA_2DS_2-VAS_c score, were used to create 10 imputed data sets that were analyzed using the PROC MIANALYZE procedure in SAS. Complete case regression was conducted as a sensitivity analysis.

For the post hoc analyses on patient satisfaction, descriptive statistics and χ^2 tests were used to compare the level of patient satisfaction between treatment arms at baseline and follow-up. GEE regression models were used to assess the intervention effect on each variable related to patient satisfaction separately. In each model, satisfaction at 12 months was the dependent variable. Group assignment (CDS or control), location (rural or urban), baseline utility score, and baseline satisfaction (not satisfied, satisfied, and very satisfied) were included as explanatory variables. The models used a multinomial distribution and cumulative logit link function. Similar to the HRQoL analyses, both complete case and multiple imputation analyses were conducted.

The IMPACT-AF trial was powered to detect a statistically significant absolute difference in relative risk reduction for the study's primary efficacy end point (a composite of unplanned cardiovascular hospitalizations and AF-related emergency department visits) and not to detect any clinically meaningful between-arm differences in patient-reported outcomes.[12] All analyses were conducted using SAS version 9.3 software (SAS Institute Inc). The trial was registered with ClinicalTrials.gov NCT01927367.

Ethical Approval

Ethical approval was provided by the Nova Scotia Health Authority Research Ethics Board. All participants provided written informed consent.

RESULTS

A total of 203 primary care providers were enrolled between June 2014 and December 2016. These providers recruited 1145 patients who consented to participate in the study, including 597 in the CDS arm and 548 in the control arm. Among these 1145 patients, 717 (62.6%) had complete EQ-5D-5L data at baseline, including 374 (62.6%) patients in the CDS arm and 343 (62.6%) patients in the control arm. Compared with nonresponders, patients with complete EQ-5D-5L data were more likely to have lower $CHADS_2$ scores (P=0.0244), no congestive heart failure (P=0.0017), and no vascular disease (P=0.0018). Additional detail is provided in Table S1.

Table 1 presents the baseline sociodemographic and clinical characteristics of patients who completed the EQ-5D-5L at baseline. Most patients were men, with a mean age of 72 years in both the CDS and control

Table 1. Baseline Sociodemographic and Clinical Characteristics of Patients With EQ-5D-5L Data

Characteristic	CDS Group (n=374)		Control Group (n=343)	
	No.	%	No.	%
Sociodemographic characteristics				
Age, y				
Mean (SD)	72.5 (9.4)		72.1 (9.4)	
Median (quartiles 1–3)	73.0 (66.0–79.0)		73.0 (67.0–79.0)	
Male sex	225	60.2	224	65.3
Rural location†	200	53.6	177	51.8
Marital status				
Married/common law	269	71.9	249	72.6
Separated/divorced	18	4.8	26	7.6
Single	24	6.4	13	3.8
Widowed	59	15.8	50	14.6
Not documented	4	1.0	5	1.5
Race/ethnicity				
White	329	88.0	308	89.8
Other/not documented*	45	12.0	35	10.2
Employment status				
Full-time employed	37	9.9	24	7.0
Homemaker	17	4.6	10	2.9
Part-time employed	12	3.2	22	6.4
Retired	285	76.2	265	77.3
Unemployed	2	0.5	6	1.8
Not documented	21	5.6	16	4.7
Highest level of completed education				
Some high school	89	23.8	64	18.7
Completed high school	66	17.7	86	25.1
College/trade school	87	23.3	92	26.8
University undergraduate	60	16.0	41	12.0
University postgraduate	45	12.0	41	12.0
Not documented	27	7.2	19	5.5
Annual household income, Canadian dollars				
<25 000	57	15.2	50	14.6
25 000–49 999	126	33.7	114	33.2
50 000–74 999	56	15.0	59	17.2
75 000–99 999	25	6.68	36	10.5
≥100 000	35	9.36	22	6.4
Prefer not to answer	48	12.83	40	11.7
Not documented	27	7.22	22	6.4
Clinical characteristics				
Stroke risk, mean (SD)				
$CHADS_2$	2.3 (1.4)		2.1 (1.4)	
CHA_2DS_2-VAS_c	3.9 (1.8)		3.7 (1.8)	

(*Continued*)

Table 1. Continued

Characteristic	CDS Group (n=374)		Control Group (n=343)	
	No.	%	No.	%
Congestive heart failure†‡	92	24.7	79	23.1
Hypertension†	296	79.4	258	75.4
Diabetes mellitus†	102	27.4	94	27.5
Prior stroke, transient ischemic attack, or systemic embolism§	72	19.3	53	15.5
Vascular disease†‡	118	31.6	119	34.8

CDS indicates clinical decision support; and EQ-5D-5L, EuroQol 5-Dimension 5-Level.

*The categories on the questionnaire for "other" included African Nova Scotian, First Nation, Asian, East Indian, other (please specify).

†Information missing for n=2.

‡Information missing for n=9 among control group.

§Excludes patients with incomplete EQ5D-5L data.

groups. Hypertension was the most common comorbidity in both groups, followed by vascular disease, diabetes mellitus, congestive heart failure, and prior stroke, transient ischemic attack, or systemic embolism.

Figure 1 presents the percentage of patients reporting "no problem" for each EQ-5D-5L dimension at baseline and follow-up. Most patients in the CDS and control groups reported no problems in the self-care (89.7% in the CDS versus 85.4% in the control group) and anxiety/depression (62.0% in the CDS versus 64.7% in the control group) dimensions. For patients with problems in the EQ-5D-5L dimensions, a large proportion reported moderate to extreme problems with mobility (31.0% in the CDS versus 29.7% in the control group), usual activities (28.3% in the CDS versus 25.4% in the control group), and pain/discomfort (26.2% in the CDS versus 23.0% in the control group) at baseline. Patients continued to experience problems with mobility and usual activities at 12 months.

Figure 2 displays the overall change in participants' health between baseline and follow-up according to the Paretian Classification of Health Change. In both CDS and control groups, the percentage of participants who did not experience a change in their overall health (24.9% in the CDS versus 25.0% in the control group) or who experienced an improvement in health (22.8% in the CDS versus 22.0% in the control group) were similar. A greater percentage of participants in the control group experienced worsened health (36.8%) compared with the CDS group (31.9%), whereas a greater percentage of participants in the CDS group experienced mixed changes in health (21.2%) than the control group (15.4%).

The mean utilities at baseline were 0.809 (SD, 0.157) for the CDS group and 0.814 (SD, 0.157) for the control group. At 12 months, the mean utilities were 0.804 (SD, 0.153) and 0.810 (SD, 0.157) for the CDS and control groups, respectively. There were no statistically significant differences between groups (CDS versus control) or time point (baseline versus follow-up). Baseline EuroQol visual analogue scale scores were 71.59 and 71.63 for the CDS and control groups, respectively. At 12 months, the visual analogue scale scores were 71.74 and 72.18 for the CDS and control groups, respectively.

Results of the regression analyses are summarized in Table 2. The regression models on disutility score at 12 months showed that there was no statistically significant impact of the CDS on HRQoL compared with the control group (with *P* values of 0.9902 and 0.4281 in the imputed regression analyses and complete case analyses, respectively). There was no statistically significant impact of the intervention on HRQoL across any of the subgroups examined (Figure 3).

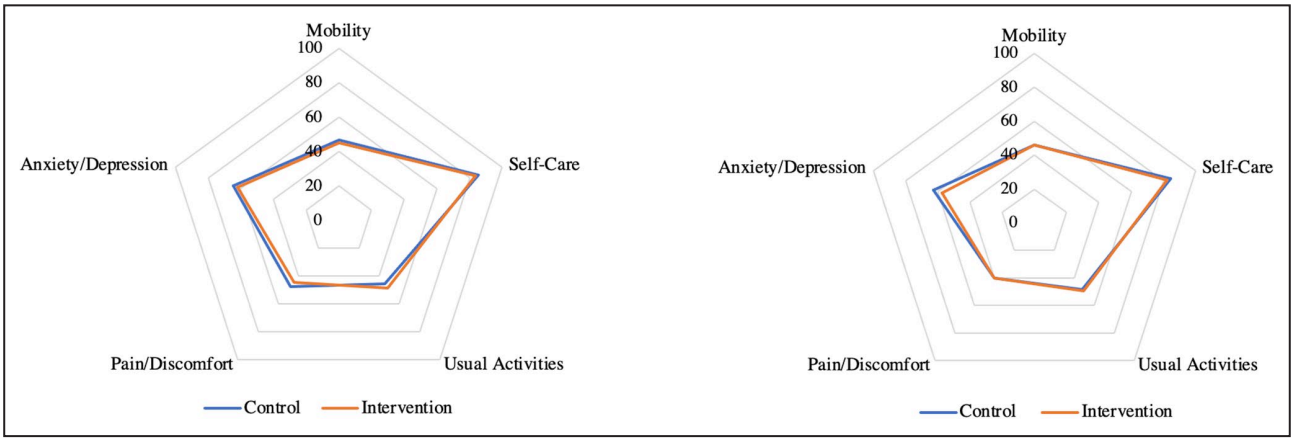

Figure 1. Percentage of patients reporting no problems for each EuroQol 5-dimensional 5-level dimension.
A, Baseline. **B**, Follow-up.

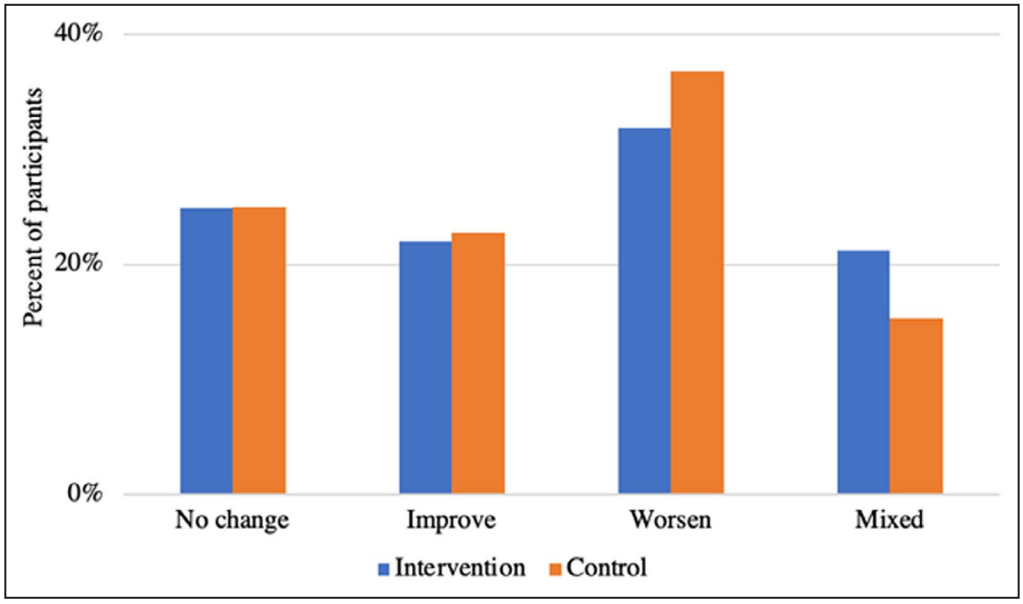

Figure 2. Pareto classification of health change from baseline to follow-up.

Figure 4A presents the percentage of patients satisfied with care received from their primary care provider for AF at baseline and 12 months according to CDS and control groups. Most patients reported being "very satisfied" at baseline, with a higher level of satisfaction among the CDS group (77% in the CDS versus 73% in control). At follow-up, the percentage of patients "very satisfied" with their care was 73% and 72% among CDS and control groups, respectively. There were no statistically significant differences in satisfaction with the primary care received between groups at baseline or follow-up.

Figure 4B presents the percentage of patients satisfied with the amount of education received for AF at baseline and 12 months according to CDS and control groups. At baseline, a greater percentage of patients in the CDS group reported being "very satisfied" compared with the control group (61% in the CDS versus 55% in control). Although 14% of patients in both groups reported being "not satisfied" at baseline, this percentage decreased to 11% in the CDS and remained at 14% in control at follow-up. There were no statistically significant differences in satisfaction with amount of education received for AF between groups at baseline or follow-up.

Figure 4C presents the percentage of patients satisfied with support received on ways to manage AF at baseline and 12 months. A greater proportion of patients in the CDS group reported being "not satisfied" compared with the control group at baseline (21% in the CDS versus 18% in control). This decreased at follow-up to 16% in the CDS group and increased to 20% in the control group. There were no statistically significant differences in satisfaction with support received on ways to manage AF between groups at baseline or follow-up.

Results of the regression analyses on satisfaction are summarized in Table 2. All regression models related to satisfaction showed that there was no statistically significant impact of the CDS on the following: (1) satisfaction with care received from family physician; (2) satisfaction with the amount of education received on AF; or (3) satisfaction with the support received on ways to manage AF. There were no significant differences between the multiple imputation and complete case regression models.

DISCUSSION

This analysis of patient-reported outcome and patient-reported experience data collected in the IMPACT-AF trial found no statistically significant differences in HRQoL or patient satisfaction at baseline or 12-month follow-up between the CDS and control groups. Patients experienced persistent problems with mobility, usual activities, and pain/discomfort over time. Most patients in both groups reported being "very satisfied" with the care received for their AF. Although a greater percentage of patients in the CDS group reported an improvement in satisfaction on the support received on ways to manage their AF, these findings were not statistically significant.

There are multiple factors that might explain non-significant improvement in HRQoL among the trial participants. These results must be interpreted within the context of the study's primary outcome measures, which

Table 2. Regression Models Examining Patient-Reported HRQoL and Patient-Reported Experience

	Regression Analysis With Imputed Data			Complete Case Regression Analysis		
Variable	Coefficient	95% CI	*P* Value	Coefficient	95% CI	*P* Value
Model 1: disutility score at 12 mo[*,†]						
Intercept	0.561	0.321 to 0.801	<0.0001	0.895	0.807 to 0.982	<0.0001
Group						
CDS	Reference			Reference		
Control	0.000	−0.052 to −0.053	0.9902	0.007	−0.011 to 0.025	0.4281
Baseline utility	−0.446	−0.704 to −0.188	0.0009	−0.851	−0.948 to −0.754	<0.0001
Location						
Urban	Reference			Reference		
Rural	0.014	0.014 to 0.023	0.5989	0.002	−0.015 to 0.019	0.8033
Model 2: patients satisfied with care received from family physician at 12 mo[‡]						
Intercept 1	−2.820	−4.005 to −1.635	<0.0001	−2.834	−4.159 to −1.509	<0.0001
Intercept 2	−0.577	−1.632 to 0.478	0.2805	−0.487	−1.747 to 0.773	0.4488
Group						
CDS	Reference			Reference		
Control	0.083	−0.289 to 0.454	0.6610	0.032	−0.372 to 0.436	0.8759
Baseline utility	−0.943	−2.184 to 0.299	0.1352	−1.141	−2.635 to 0.353	0.1345
Location						
Urban	Reference			Reference		
Rural	0.224	−0.177 to 0.625	0.2702	0.109	−0.310 to 0.529	0.6101
Baseline satisfaction with care						
Very satisfied	Reference			Reference		
Satisfied	0.796	0.287 to 1.305	0.0028	1.323	0.787 to 1.859	<0.0001
Not satisfied	0.865	−0.295 to 2.024	0.1412	2.092	0.629 to 3.554	0.0051
Model 3: patients satisfied with education received on AF at 12 mo[‡]						
Intercept 1	−1.494	−2.411 to −0.576	0.0015	−2.363	−3.493 to −1.234	<0.0001
Intercept 2	0.082	−0.808 to 0.971	0.8568	−0.355	−1.471 to 0.760	0.5325
Group						
CDS	Reference			Reference		
Control	0.088	−0.240 to 0.415	0.5980	0.020	−0.318 to 0.358	0.9078
Baseline utility	−0.773	−1.783 to 0.238	0.1337	−0.852	−2.068 to 0.365	0.1700
Location						
Urban	Reference			Reference		
Rural	−0.061	−0.405 to 0.283	0.7260	0.203	−0.147 to 0.552	0.2563
Baseline satisfaction with education						
Very satisfied	Reference			Reference		
Satisfied	0.737	0.310 to 1.164	0.0010	1.257	0.880 to 1.634	<0.0001
Not satisfied	1.461	0.899 to 2.023	<0.0001	2.605	2.009 to 3.202	<0.0001
Model 4: patients satisfied with support received on ways to manage AF at 12 mo[‡]						
Intercept 1	−1.982	−3.102 to −0.863	0.0008	−1.503	−2.642 to −0.364	0.0097
Intercept 2	−0.190	−1.254 to 0.874	0.7223	0.312	−0.836 to 1.460	0.5944
Group						
CDS	Reference			Reference		
Control	0.070	−0.262 to 0.401	0.6790	0.099	−0.211 to 0.409	0.5313
Baseline utility	−0.776	−1.910 to 0.358	0.1776	−1.414	−2.703 to −0.125	0.0316
Location						
Urban	Reference			Reference		

(*Continued*)

Table 2. Continued

Variable	Regression Analysis With Imputed Data			Complete Case Regression Analysis		
	Coefficient	95% CI	*P* Value	Coefficient	95% CI	*P* Value
Rural	0.168	−0.156 to 0.492	0.3074	−0.066	−0.374 to 0.243	0.6767
Baseline satisfaction with support						
Very satisfied	Reference			Reference		
Satisfied	0.726	0.345 to 1.108	0.0002	1.254	0.760 to 1.747	<0.0001
Not satisfied	1.368	0.871 to 1.864	<0.0001	2.544	2.109 to 2.979	<0.0001

AF indicates atrial fibrillation; CDS, clinical decision support; and HRQoL, health-related quality of life.
* Generalized estimating equation with Poisson distribution, identity link, and exchange correlation.
† The intraclass correlation coefficient for baseline utility was 0.008.
‡ Generalized estimating equation with multinomial distribution, cumulative logit link.

found that use of the CDS tool did not show superior efficacy (composite of unplanned cardiovascular hospitalizations and AF-related emergency department visits) or safety (major bleeding) compared with usual care.[13] If the CDS did not result in improved clinical outcomes, it is unsurprising that there was no noted improvement in HRQoL. The IMPACT-AF trial itself was conducted in the primary care setting. Although research into the effectiveness of interventions in the primary care setting is critical to inform evidence-based practice,[26] there are significant organizational barriers that can hinder the successful implementation of a pragmatic trial. These barriers relate to the complexity of data collection, design, and/or methodological issues that may be unrealistic for a primary care setting, as well as lack of time and the extra workload for healthcare providers involved in the trial. In the IMPACT-AF trial, it was noted that only 3 in 4 providers in the CDS arm completed their training on the use of the CDS tool.[13] It was also suspected that only a proportion of those trained providers used the tool regularly. This might partially explain why there was no statistically significant intervention effect on HRQoL at follow-up. Further research is required to determine if organizational barriers were the reason why the CDS was not successfully integrated into clinical practice and whether the intervention did have an effect on HRQoL among those providers and patients who did use the CDS.

The use of the EQ-5D-5L as the HRQoL outcome measure may have also contributed to the lack of observed intervention effect. The EQ-5D-5L is a generic utility-based HRQoL instrument that examines only 5 health dimensions. It is possible that a tool designed to empower patients and providers through education and decision support management would not have materially affected HRQoL relating to physical ailments, such as mobility and pain, which affect a large proportion of patients in the IMPACT-AF trial. Compared with other studies, patients in the IMPACT-AF trial reported low levels of anxiety. This could be attributed to the fact that most patients in both the CDS and control groups reported being already "very satisfied" with the support, care, and education they received for their AF at baseline. Because the CDS was designed as a clinical support tool, it is plausible the intervention could have a greater effect on metrics related to patient-reported experience measures, such as satisfaction with care, rather than PROMs. Exploratory analyses found no statistically significant effect of the intervention on patient-reported satisfaction. However, given the high level of satisfaction with care at baseline, there might have been little room for improvement among participants in this study.

Disease-specific instruments for AF are more responsive than generic instruments.[8] Yet, there are at least 34 different quality-of-life instruments that have been used in published AF studies to date, which suggests a lack of consensus on the optimal approach to measuring HRQoL among this patient population.[27] The EQ-5D-5L was selected for the IMPACT-AF trial because it is a widely used tool to measure HRQoL across disease areas. It will also be used to calculate quality-adjusted life years and inform a cost-effectiveness analysis of the trial. Nevertheless, further research is required to assess whether educational components of the intervention resonated with patients and improved their HRQoL in terms of providing a better understanding of AF and/or enhancing their psychological and emotional abilities to cope with it.

To date, most studies that have assessed HRQoL in AF have used non–utility-based generic instruments, in particular the SF-36.[28] This includes a 2002 Canadian study conducted by Dorian and colleagues, which administered the SF-36, symptom checklist, and AF Severity Scale to assess HRQoL in patients with symptomatic AF participating in the Canadian Trial of Atrial Fibrillation.[29] Across all domains of the SF-36, patients with AF reported substantially poorer quality of life than healthy controls, with scores of 24%, 23%, 16%, and 30% lower than healthy individuals on measures of physical and social functioning and mental and general health, respectively. When comparing mean utility scores from patients in the IMPACT-AF trial with Canadian population norms,[16] it was noted that patients with AF had a lower mean utility score compared with normative estimates from the same age

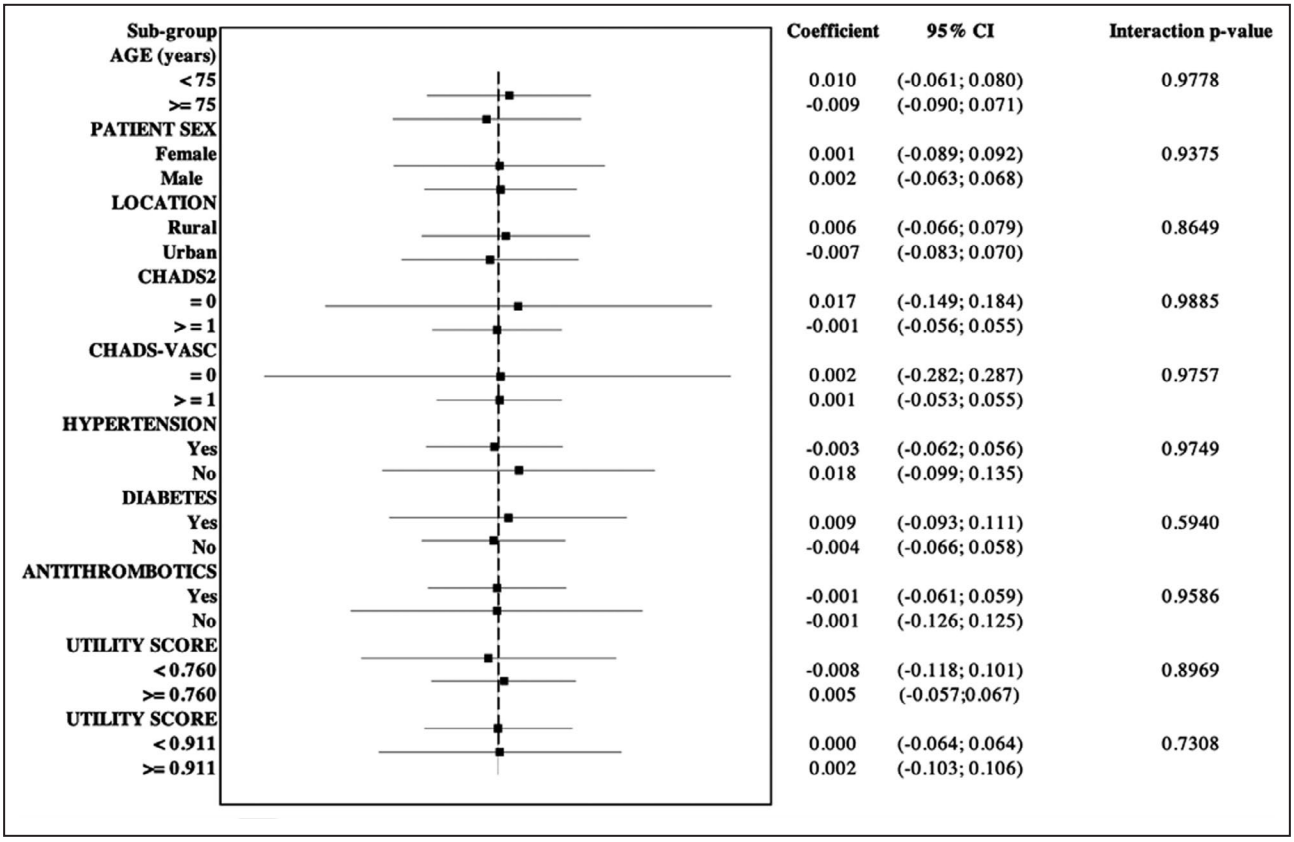

Figure 3. Subgroup analyses examining disutility score at 12 months.
The squares represent the point estimate, lines 95% confidence interval, and dotted lines coefficient of zero.

group (estimated at 0.867 for age group 64–74 years, according to the Canadian EQ-5D-5L Valuation Study). Although this is in line with published literature, which suggests that HRQoL is impaired in patients with AF compared with the general population,[4,9] the decrement in HRQoL among patients with AF in the IMPACT-AF trial compared with the general population is not as pronounced as in other studies evaluating HRQoL in AF.[29] This could be attributed to the fact that, compared with nonresponders, patients who provided baseline EQ-5D-5L data in this study were more likely to have lower $CHADS_2$ scores, no congestive heart failure, and no vascular disease. This suggests that patients in the IMPACT-AF trial were healthier and had a higher HRQoL than is typical for this population and thus had less room for improvement than anticipated when the trial was planned.

Although collecting HRQoL alongside a clinical trial provides a unique opportunity to gain additional insight into the effect of an intervention, there were several challenges in evaluating HRQoL during the IMPACT-AF trial. There was a high proportion of missing data

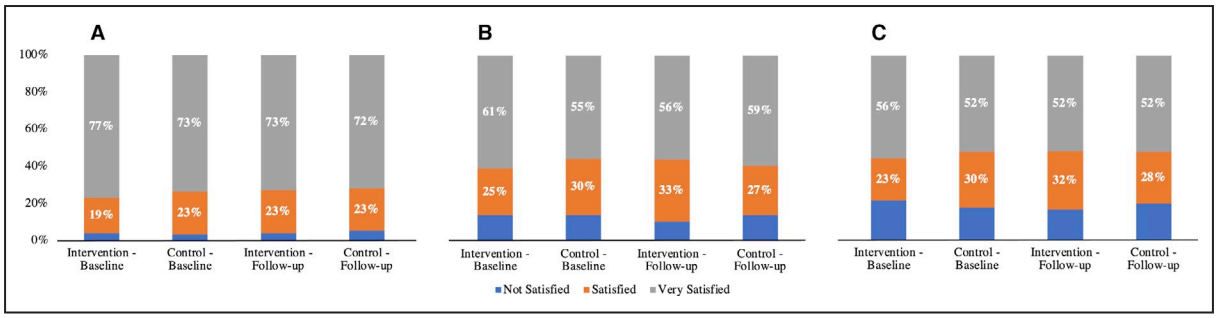

Figure 4. Percentage satisfied at baseline and 12 months.*
A, Care received from family physician for atrial fibrillation (AF). **B**, Amount of education received on AF. **C**, Support received on ways to manage AF. *Excludes missing values.

attributable to patients not completing the questionnaires at baseline and 12 months. Because the average age of respondents in our study was >72 years, we offered both paper and online versions of the questionnaires to improve response rates.[30] We noted similar response rates to other studies assessing EQ-5D-5L scores.[31,32] To deal with the missing utility data, we had to impute the values for each EQ-5D-5L dimension using multiple imputation. Overall, the complete-case regression conducted as a sensitivity analysis suggested the same conclusion as the multiple imputation analysis. Additional sensitivity analyses were conducted for the exploratory regression analyses on patient-reported satisfaction to account for the proportional odds assumption. By default, the PROC GENMOD procedure used to estimate the cumulative logit models in a GEE framework assumes proportional odds. Because a test of this assumption is not available in SAS, we collapsed the satisfaction variables into 2 levels ("very satisfied"/"satisfied" versus "not satisfied") and conducted a logistic regression. The results from this analysis suggested the same conclusions as those presented in Table 2.

Another challenge was that this was a cluster design trial in which there was an imbalance in baseline utility scores, with the control group having a higher mean utility score compared with the CDS group. An imbalance in mean baseline utility scores is not uncommon in trials, even with large sample sizes.[33] This can have implications for understanding the intervention effect on HRQoL because a patient's baseline utility score is likely to be strongly correlated with their utility score at follow-up.[33] To account for this imbalance, baseline utility was included as an explanatory variable in all regression analyses.[34]

CONCLUSIONS

The HRQoL of patients in the IMPACT-AF trial remained stable over the 12 months, and there was no significant difference between the CDS and the control groups in the IMPACT-AF trial. At baseline, most patients in both groups reported being "very satisfied" with the care received for their AF, and there were no statistically significant differences in the level of satisfaction between groups at follow-up.

ARTICLE INFORMATION

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Supplementary Material

Appendix
Table S1

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Supplemental Material

Appendix

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Table S1. Baseline sociodemographic and clinical characteristics of responders and non-responders for EQ-5D-5L.

	Responders				Non-Responders				p-value
	CDS group (n = 374)		Control group (n = 343)		CDS group (n = 223)		Control group (n = 205)		
	n	(%)	n	(%)	n	(%)	n	(%)	
Sociodemographic characteristics									
Age, years									
Mean (SD)	72.5 (9.4)		72.1 (9.4)		72.4 (11.2)		72.2 (10.7)		0.9805
Median (quartiles 1, 3)	73.0 (66.0, 79.0)		73.0 (67.0, 79.0)		74.0 (66.0, 80.0)		73.0 (65.0, 81.0)		
Male sex, n (%)	225	(60.2)	224	(65.3)	130	(58.3)	129	(62.9)	0.4775
Rural location, n (%)	200	(53.6)	177	(51.8)	115	(51.6)	122	(59.5)	0.2108
Clinical characteristics									
Stroke risk, mean (SD)									
$CHADS_2$	2.2 (1.4)		2.1 (1.4)		2.4 (1.5)		2.4 (1.3)		**0.0244**
CHA_2DS_2-VAS_c	3.9 (1.8)		3.7 (1.8)		4.0 (2.0)		4.0 (1.8)		0.0622
Medical conditions, n (%)									
Congestive heart failure**, ***	92	(24.7)	79	(23.1)	61	(27.4)	60	(29.3)	**0.0017**
Hypertension**	296	(79.4)	258	(75.4)	176	(78.9)	162	(79.0)	0.2063
Diabetes**	102	(27.4)	94	(27.5)	65	(29.1)	67	(32.7)	0.1425
Prior stroke, transient ischemic attack, or systemic embolism**	72	(19.3)	53	(15.5)	45	(20.2)	39	(19.0)	0.3528
Vascular disease**, ***	118	(31.6)	119	(34.8)	85	(38.1)	76	(37.1)	**0.0018**

TIA, transient ischemic attack; AF, atrial fibrillation; SD, standard deviation
* Excludes patients treated at AF clinics (n = 32)
** Information missing for n = 2 among CDS group
*** Information missing for n = 9 among control group