WHY *TREAT* AFIB SURGICALLY?

ACT against Afib

WHY *TREAT* AFIB SURGICALLY?

Even as the medical risks of atrial fibrillation (Afib) become more widely known and treatments are proven effective ...

only about

1/3

of Afib is treated during heart surgery.[1,2]

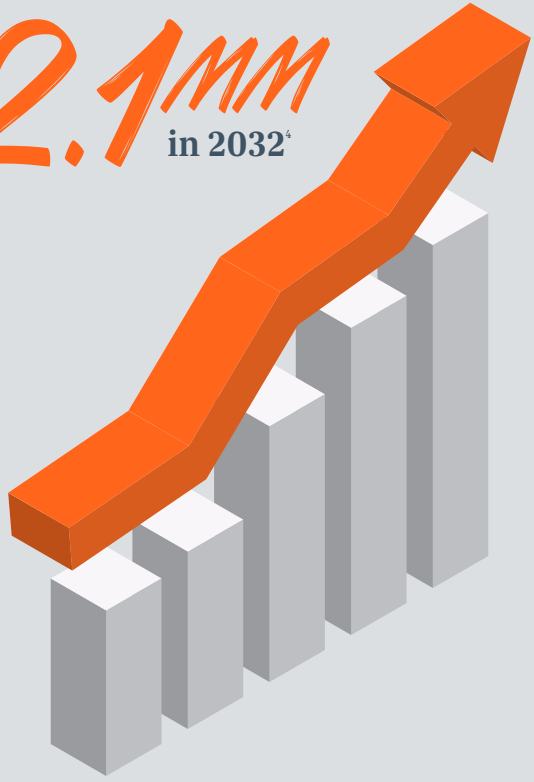
more than

33 MILLION

people currently suffer from Afib worldwide.[3]

In the U.S. alone, the prevalence of Afib is projected to increase from 5.2MM in 2010 to

12.1MM in 2032[4]



ACT against Afib

Afib is a Real Burden

Clinical Burden

Patients with Afib have:

5X increase in **stroke risk**[4]

5X increase in **heart failure (HF) development**[5]

46% greater risk of **death**[5,7]

MORE **cardiac complications**[6]

Patient Burden

Patients with Afib have:

- **Decrease** in general and mental health[8]
- **Decreased** cognitive function[9, 10, 11]
- Approximately 10 outpatient **hospital visits** and > 50 **physician encounters** per year on average[12]
- Heightened **anxiety** about medications[13]
- **Burnout** from frequent follow-up appointments[14]
- Up to a 47% **reduction** in quality of life[15-19]

Economic Burden

Afib patients cost **$8,700** more per year to treat[20]

564,000 ED visits per year[21]

470,000, or **~65%** of Afib patients presenting to the ED, are admitted each year[22]

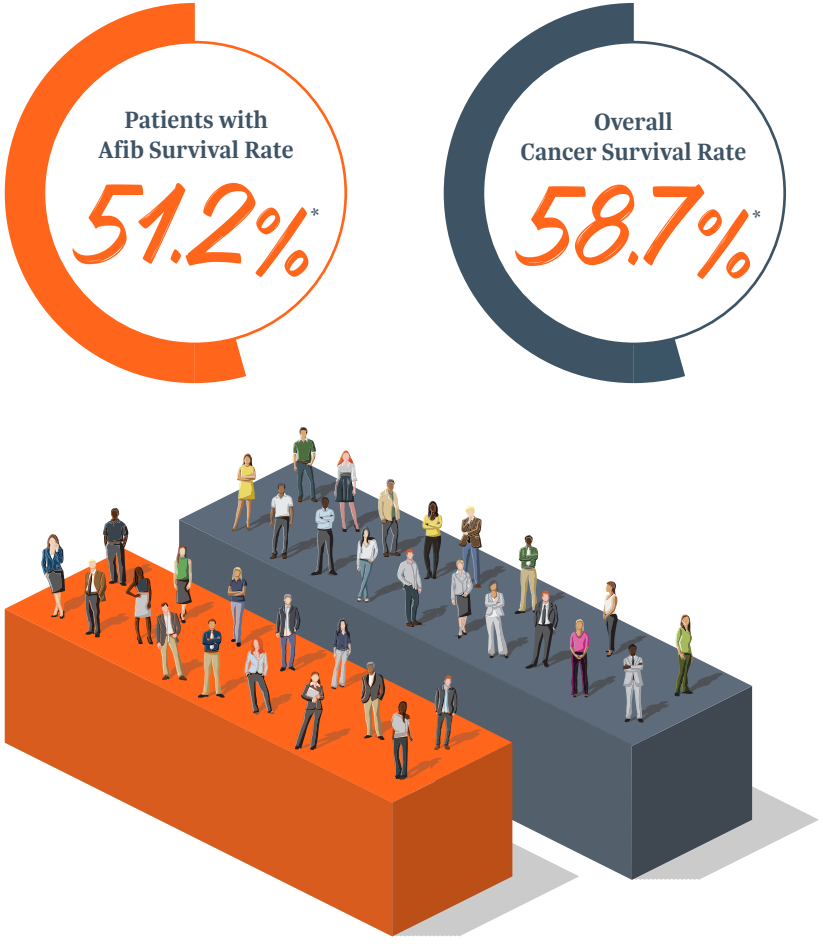
Afib costs the U.S. health system **$26 billion** per year[23]

ED: emergency department

Afib Burden is Real

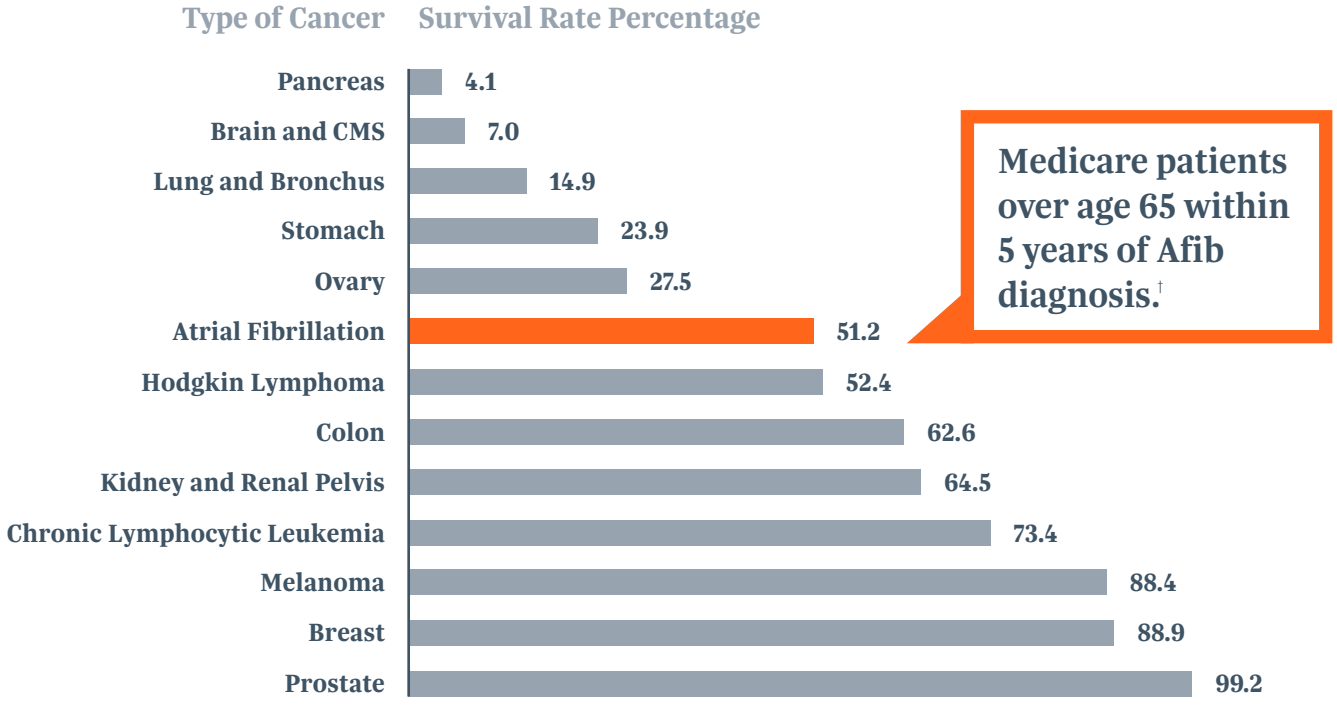
Patients Understand Cancer is Serious. So is the Burden of Afib.

Although patients with Afib have a 5-year lower survival rate than patients with many types of cancer, the Afib often goes untreated during heart surgeries — especially for AVR and CABG patients.



AVR: aortic valve repair/replacement
CABG: coronary artery bypass graft

"Most Feared" Cancer Survival Rates



Sources:

†Piccini, J.P. et al. (2014). Clinical course of atrial fibrillation in older adults: the importance of cardiovascular events beyond stroke. Eur Heart J, 35(4):250-6.

*Adapted from: Howlader, N. et al. SEER Cancer Statistics Review, 1975-2010. National Cancer Institute. Bethesda, MD, https://seer.cancer.gov/archive/csr/1975_2010/, based on November 2012 SEER data submission, posted to the SEER website, April 2013.

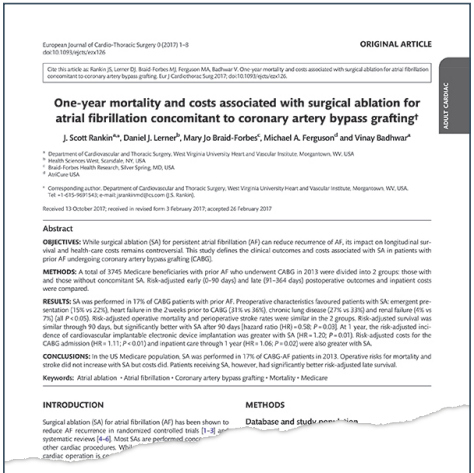
ACT against Afib

Help Patients Live Better. Longer.

Increasingly more data show that surgical ablation during heart surgery reduces mortality, risk of stroke, and other post-surgical complications. Concomitant surgical ablation to treat Afib isn't as risky as you might think.

Patients who undergo concomitant treatment may actually have reduced hospital LOS.[24] One year after CABG surgery with surgical ablation for Afib, survival improves by 42%.[25] Ten years after CABG surgery, Afib patients who receive concomitant treatment show a 20% improvement in life expectancy.[26] What's more, concomitant surgical ablation gives patients with non-paroxysmal Afib the highest chance at restoring NSR.[27-31] Patients with a surgically restored NSR show improvement in quality of life.[8]

42% Higher Survival at 1 Year



European Journal of Cardio-Thoracic Surgery 0 (2017) 1–8
doi:10.1093/ejcts/ezx126

ORIGINAL ARTICLE

ADULT CARDIAC

Cite this article as: Rankin JS, Lerner DJ, Braid-Forbes MJ, Ferguson MA, Badhwar V. One-year mortality and costs associated with surgical ablation for atrial fibrillation concomitant to coronary artery bypass grafting. Eur J Cardiothorac Surg 2017; doi:10.1093/ejcts/ezx126.

One-year mortality and costs associated with surgical ablation for atrial fibrillation concomitant to coronary artery bypass grafting†

J. Scott Rankin[a,*], Daniel J. Lerner[b], Mary Jo Braid-Forbes[c], Michael A. Ferguson[d] and Vinay Badhwar[a]

[a] Department of Cardiovascular and Thoracic Surgery, West Virginia University Heart and Vascular Institute, Morgantown, WV, USA
[b] Health Sciences West, Scandale, NY, USA
[c] Braid-Forbes Health Research, Silver Spring, MD, USA
[d] AtriCure USA

* Corresponding author. Department of Cardiovascular and Thoracic Surgery, West Virginia University Heart and Vascular Institute, Morgantown, WV, USA. Tel: +1-615-969?543; e-mail: jrankinmd@cs.com (J.S. Rankin).

Received 13 October 2017; received in revised form 3 February 2017; accepted 26 February 2017

Abstract

OBJECTIVES: While surgical ablation (SA) for persistent atrial fibrillation (AF) can reduce recurrence of AF, its impact on longitudinal survival and health-care costs remains controversial. This study defines the clinical outcomes and costs associated with SA in patients with prior AF undergoing coronary artery bypass grafting (CABG).

METHODS: A total of 3745 Medicare beneficiaries with prior AF who underwent CABG in 2013 were divided into 2 groups: those with and those without concomitant SA. Risk-adjusted early (0–90 days) and late (91–364 days) postoperative outcomes and inpatient costs were compared.

RESULTS: SA was performed in 17% of CABG patients with prior AF. Preoperative characteristics favoured patients with SA: emergent presentation (15% vs 22%), heart failure in the 2 weeks prior to CABG (31% vs 36%), chronic lung disease (27% vs 33%) and renal failure (4% vs 7%) (all $P < 0.05$). Risk-adjusted operative mortality and perioperative stroke rates were similar in the 2 groups. Risk-adjusted survival was similar through 90 days, but significantly better with SA after 90 days [hazard ratio (HR) = 0.58; $P = 0.03$]. At 1 year, the risk-adjusted incidence of cardiovascular implantable electronic device implantation was greater with SA (HR = 1.20; $P = 0.01$). Risk-adjusted costs for the CABG admission (HR = 1.11; $P < 0.01$) and inpatient care through 1 year (HR = 1.06; $P = 0.02$) were also greater with SA.

CONCLUSIONS: In the US Medicare population, SA was performed in 17% of CABG-AF patients in 2013. Operative risks for mortality and stroke did not increase with SA but costs did. Patients receiving SA, however, had significantly better risk-adjusted late survival.

Keywords: Atrial ablation • Atrial fibrillation • Coronary artery bypass grafting • Mortality • Medicare

INTRODUCTION

Surgical ablation (SA) for atrial fibrillation (AF) has been shown to reduce AF recurrence in randomized controlled trials [1–3] and systematic reviews [4–6]. Most SAs are performed concomitantly with other cardiac procedures. While cardiac operation is

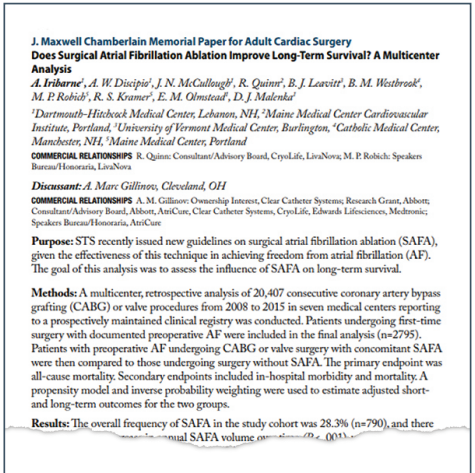
METHODS

Database and study population

"One-year mortality and costs associated with surgical ablation for atrial fibrillation concomitant to coronary artery bypass grafting"

N = 3,745
Risk-Adjusted Patients

31% Higher Survival at 5 Years



J. Maxwell Chamberlain Memorial Paper for Adult Cardiac Surgery

Does Surgical Atrial Fibrillation Ablation Improve Long-Term Survival? A Multicenter Analysis

A. Iribarne[1], A. W. Discipio[1], J. N. McCullough[1], R. Quinn[2], B. J. Leavitt[1], B. M. Westbrook[1], M. P. Robich[3], R. S. Kramer[3], E. M. Olmstead[3], D. J. Malenka[4]

[1]Dartmouth-Hitchcock Medical Center, Lebanon, NH, [2]Maine Medical Center Cardiovascular Institute, Portland, [3]University of Vermont Medical Center, Burlington, [4]Catholic Medical Center, Manchester, NH, [5]Maine Medical Center, Portland

COMMERCIAL RELATIONSHIPS R. Quinn: Consultant/Advisory Board, CryoLife, LivaNova; M. P. Robich: Speakers Bureau/Honoraria, LivaNova

Discussant: *A. Marc Gillinov, Cleveland, OH*

COMMERCIAL RELATIONSHIPS A. M. Gillinov: Ownership Interest, Clear Catheter Systems; Research Grant, Abbott; Consultant/Advisory Board, Abbott, AtriCure, Clear Catheter Systems, CryoLife, Edwards Lifesciences, Medtronic; Speakers Bureau/Honoraria, AtriCure

Purpose: STS recently issued new guidelines on surgical atrial fibrillation ablation (SAFA), given the effectiveness of this technique in achieving freedom from atrial fibrillation (AF). The goal of this analysis was to assess the influence of SAFA on long-term survival.

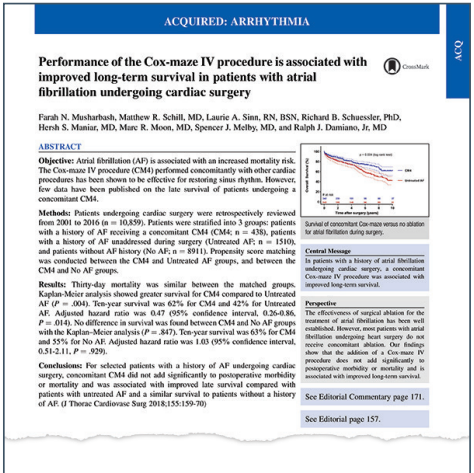
Methods: A multicenter, retrospective analysis of 20,407 consecutive coronary artery bypass grafting (CABG) or valve procedures from 2008 to 2015 in seven medical centers reporting to a prospectively maintained clinical registry was conducted. Patients undergoing first-time surgery with documented preoperative AF were included in the final analysis (n=2795). Patients with preoperative AF undergoing CABG or valve surgery with concomitant SAFA were then compared to those undergoing surgery without SAFA. The primary endpoint was all-cause mortality. Secondary endpoints included in-hospital morbidity and mortality. A propensity model and inverse probability weighting were used to estimate adjusted short- and long-term outcomes for the two groups.

Results: The overall frequency of SAFA in the study cohort was 28.3% (n=790), and there

"Does Surgical Atrial Fibrillation Ablation Improve Long-Term Survival? A Multicenter Analysis"

N = 20,407
Risk-Adjusted Patients

20% Higher Survival at 10 Years



ACQUIRED: ARRHYTHMIA

ACQ

Performance of the Cox-maze IV procedure is associated with improved long-term survival in patients with atrial fibrillation undergoing cardiac surgery

CrossMark

Farah N. Musharbash, Matthew R. Schill, MD, Laurie A. Sinn, RN, BSN, Richard B. Schuessler, PhD, Hersh S. Maniar, MD, Marc R. Moon, MD, Spencer J. Melby, MD, and Ralph J. Damiano, Jr, MD

ABSTRACT

Objective: Atrial fibrillation (AF) is associated with an increased mortality risk. The Cox-maze IV procedure (CM4) performed concomitantly with other cardiac procedures has been shown to be effective for restoring sinus rhythm. However, few data have been published on the late survival of patients undergoing a concomitant CM4.

Methods: Patients undergoing cardiac surgery were retrospectively reviewed from 2001 to 2016 (n = 10,859). Patients were stratified into 3 groups: patients with a history of AF receiving a concomitant CM4 (CM4; n = 438), patients with a history of AF unaddressed during surgery (Untreated AF; n = 1510), and patients without AF history (No AF; n = 8911). Propensity score matching was conducted between the CM4 and Untreated AF groups, and between the CM4 and No AF groups.

Results: Thirty-day mortality was similar between the matched groups. Kaplan-Meier analysis showed greater survival for CM4 compared to Untreated AF ($P = .004$). Ten-year survival was 62% for CM4 and 42% for Untreated AF. Adjusted hazard ratio was 0.47 (95% confidence interval, 0.26-0.86, $P = .014$). No difference in survival was found between CM4 and No AF groups with the Kaplan–Meier analysis ($P = .847$). Ten-year survival was 63% for CM4 and 55% for No AF. Adjusted hazard ratio was 1.03 (95% confidence interval, 0.51-2.11, $P = .929$).

Conclusions: For selected patients with a history of AF undergoing cardiac surgery, concomitant CM4 did not add significantly to postoperative morbidity or mortality and was associated with improved late survival compared with patients with untreated AF and a similar survival to patients without a history of AF. (J Thorac Cardiovasc Surg 2018;155:159-70)

Survival of concomitant Cox-maze versus no ablation for atrial fibrillation during surgery.

Central Message
In patients with a history of atrial fibrillation undergoing cardiac surgery, a concomitant Cox-maze IV procedure was associated with improved long-term survival.

Perspective
The effectiveness of surgical ablation for the treatment of atrial fibrillation has been well established. However, most patients with atrial fibrillation undergoing heart surgery do not receive concomitant ablation. Our findings show that the addition of a Cox-maze IV procedure does not add significantly to postoperative morbidity or mortality and is associated with improved long-term survival.

See Editorial Commentary page 171.

See Editorial page 157.

"Performance of the Cox-maze IV procedure is associated with improved long-term survival in patients with atrial fibrillation undergoing cardiac surgery"

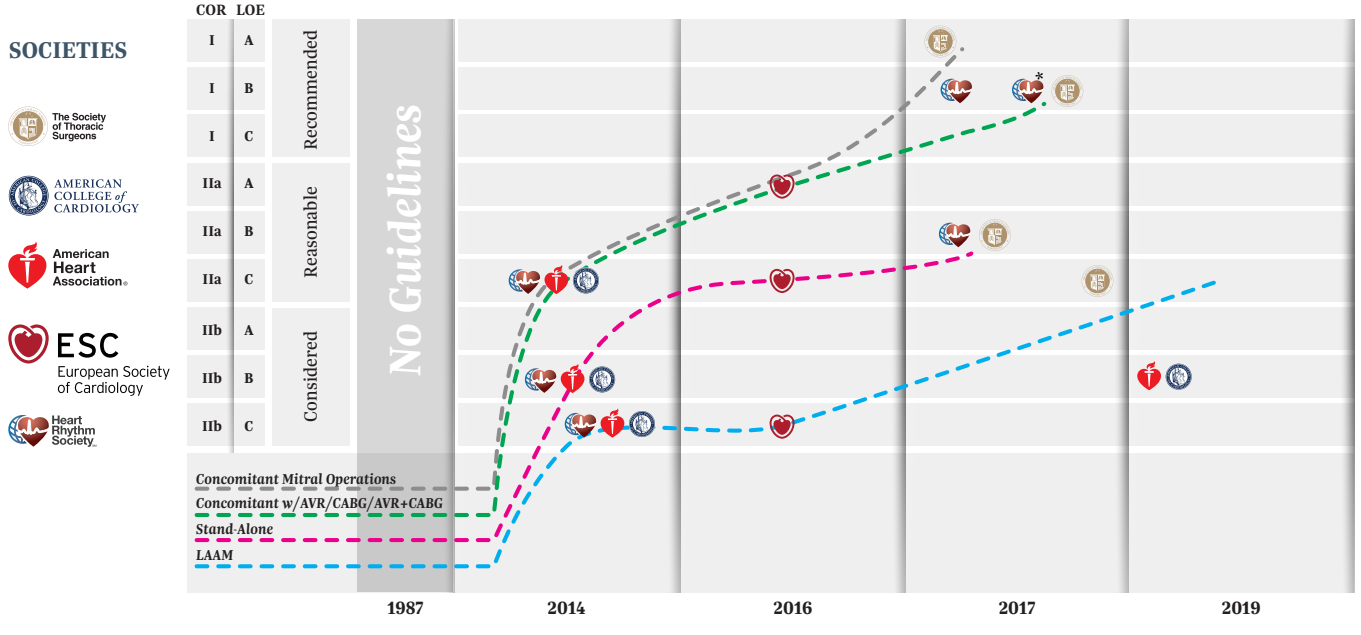
N = 10,859
Risk-Adjusted Patients

LOS: length of stay
NSR: normal sinus rhythm

ACT against Afib

Do Something

Concomitant Surgical Ablation has a Class I Recommendation



A wealth of data led the Surgical Thoracic and Heart Rhythm Societies to make a Class I recommendation that patients with Afib undergoing valve or coronary surgeries receive surgical Afib treatment.[32-37]

*AVR/CABG concomitant ablation Class I LDR for symptomatic persistent and long-standing persistent "refractory or intolerant to at least one Class I or III antiarrhythmic medication."

Cox Maze IV yields the highest efficacy for Afib treatment, but literature shows progressive efficacy for each additive lesion set of the Cox Maze IV.

Lesion Set Options

Reported Experiences: 1–5 year retro and prospective peer-reviewed publications both on and off AADs

Approach	Reported Experiences w/ Surgical Ablation	Ablation Duration
Pulmonary Vein Isolation (PVI)	PAF **~50–90%**[33,42,47]	*Note:* *+ = Time* +
	nPAF **~60%**[33,43]	
Box Set Lesion (Box)	nPAF **~55–70%**[44,48]	++
Left Atrial Lesion Set (LAL)	nPAF **~73–86%**[45,46,49]	+++
Bi-Atrial Lesion Set (Maze)	nPAF **~80–90%**[29-31]	++++

Endocardial PVI Outcomes (Lone Afib)	
PAF **~47–80%**	
47% – 1 ablation[38]	80% – 3 ablations[38]
74% – 2 ablations[38]	~70% – meta-analysis[39]
nPAF **~25–52%**	
25% – 1 ablation[41]	52% – multiple ablations[41]
43% – multiple ablations[40]	~50% – meta-analysis[39]

Reported Experiences: 1–5 year retro and prospective peer-reviewed publications both on and off AADs

LAL and Maze Lesion Sets Include LAAM

Left Atrial Appendage Management (LAAM)	Effectiveness of LAAM Modalities
LAAM is often part of surgical ablation procedures	Epicardial Clip Exclusion: 97% (93-100%)[58-68] Excision: 74% (45-100%) successful closure[69,70,72] Staple Ligation: 56% (0-71%) successful closure[69-71] Suture Ligation: 36% (23-49%) successful closure[69-72]

Individual results may vary. Please consult with your physician regarding your condition and appropriate medical treatment. The success of various procedures may be influenced by several factors, which may predict the outcome. Duration of pre-procedural Afib, type of Afib, lesion set performed, left atrial size, patient's age, atrial fibrillation wave <1.0mm, experience of the operator, left atrial reduction, and device used.

The success of various procedures may be influenced by several factors, which may predict the outcome, such as duration of pre-procedural Afib, type of Afib, lesion set performed, left atrial size, patient's age, atrial fibrillation wave <1.0mm, experience of the operator, left atrial reduction, and device used.

AADs: antiarrythmic drugs

ACT against Afib

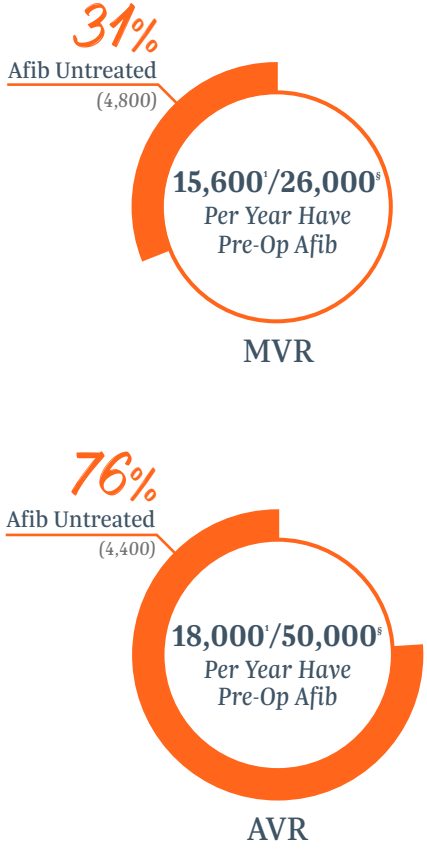
Afib is Surgically Undertreated and Underdiagnosed.

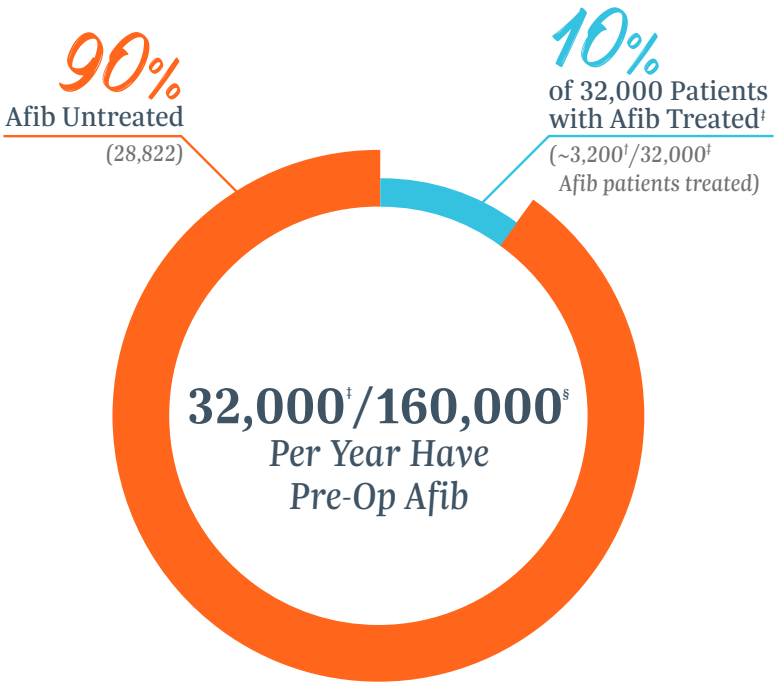
Based on STS data, almost half of patients with pre-operative Afib get surgical ablation (SA), with MVR patients getting the highest rate of concomitant SA and CABG patients the lowest.[1] However, more recent data show that patients are not screened for Afib when referred to CABG, resulting in notable underdiagnosis of Afib, and thus, undertreatment.[28]

Of the patients referred for CABG, **less than 10% with Afib get concomitant surgical ablation** (SA)[2,28] to restore NSR that could help them live longer and better.

MVR: mitral valve repair/replacement

Afib is Surgically Undertreated[1]





CABG Undertreated & Underdiagnosed

Recent data in more than 79,000 Medicare patients show prevalence of at least 20%, resulting in a treatment rate of <10%.[‡†]

Sources:

[1] Badhwar, V. et al. (2017). Surgical ablation of atrial fibrillation in the United States: trends and propensity matched outcomes. Ann of Thorac Surg, 104(2):493-500 Afib incidence pre-op by type of surgery. Reports incidence of Afib in MVR as 60% and AVR as 36%.

[§] McCarthy, P.M. et al. (2019). Prevalence of atrial fibrillation before cardiac surgery and factors associated with concomitant ablation. J Thorac Cardiovasc Surg, PII: S0022-5223(19) 31361-3, DOI: 10.1016/J.JTCVS.2019.06.062. Showed 20% prevalence of Afib in CABG based on CMS data showing admission for Afib 3 years prior to CABG.

[†] Braid-Forbes Health Research analysis of 2014 CMS SAF data: Annual Counts and Proportions of Atrial Fibrillation and Concomitant Surgical Atrial Ablation in US Cardiac Surgeries. Presented to AtriCure August 22, 2016. Showed 3,121 SA treatments during isolated CABG surgeries. Internal data on file.

[‡] Society of Thoracic Surgery Database.

ACT against Afib

Be Part of the Heart Failure Solution

"HF BEGETS AF, AF BEGETS HF"[51]

HF: heart failure
AF: atrial fibrillation

Recent research also points to a **relationship between Afib and heart failure**, in which Afib may be both a causal factor and a consequence of HF.[51,52] Studies show that the prevalence of Afib increases with the severity of heart failure,[53] and the development of Afib in HF patients is one of the leading causes of clinical deterioration.[54]

Restoration of NSR improved ejection fraction 8%–18%[55,56]

Restoration of NSR resulted in decreased mortality, improvement of LVEF, reduced left atrium dimensions, and might improve NYHA HF Class.[55,56]

LVEF: left ventricular ejection fraction
NYHA: New York Heart Association

Screen for Afib in CABG Patients

In a population of more than 79,000 patients, 20% of CABG patients had an admission for Afib within 3 years before the CABG, but the Afib diagnosis was often unknown during referral.[28]

Collaborate with the primary physician to discuss SA as part of the surgical plan.

Identify Patients with Afib:

- Include screening questions at referral in the surgical intake process, such as:
  - *Have you ever been told you have an irregular heart beat?*
  - *Have you ever had heart palpitations?*
  - *Have you ever taken blood thinners?*
  - *Have you ever taken medicines to manage your heart rate?*
- Review chart history for a past Afib diagnosis, Holter monitoring, cardioversion, or catheter ablation.

Did you Know?

Patients who are managed by a Nurse Navigator have:[57]

- Higher satisfaction
- Fewer readmissions and ED visits
- Improved outcomes
- Higher retention in the same system for other care needs
- Reduced length of stay in the ICU

- Contact primary physician, such as the General Cardiologist or Heart Failure Specialist, to ask about any history of Afib.
- Implement screening and a follow-up process for patients who present to the ED with Afib.
- Discuss concomitant surgical Afib treatment during the referral process.
- Consider active navigation of Afib patients with a Nurse Navigator to guide the patient through the referral, treatment, and follow-up management.

ICU: intensive care unit

Sources

[1] Badhwar, V. et al. (2017). Surgical ablation of atrial fibrillation in the United States: trends and propensity matched outcomes. Ann of Thorac Surg, 104(2):493-500.

[2] Braid-Forbes, M.J. Health Research, 2014 CMS SAF, August 2016. NIS for volume and Medicare to look back over 3 years and obtained diagnosis.

[3] Rahman, F., Kwan, G.F., & Benjamin, E.J. (2014). Global epidemiology of atrial fibrillation. Nat Rev Cardiol, 11(11):639-54.

[4] Colilla, S. et al. (2013). Estimates of current and future incidence and prevalence of atrial fibrillation in the U.S. adult population. Am J Cardiol, 112(8):1142-7.

[5] Odutayo, A. et al. (2016). Atrial fibrillation and risks of cardiovascular disease, renal disease, and death: systematic review and meta-analysis. BMJ; 354:i4482.

[6] Fukunaga, S. et al. (2008). Effect of surgery for atrial fibrillation associated with mitral valve disease. Ann of Thorac Surg, 86(4):1212-7.

[7] Boriani, G., & Proietti, M. (2017). Atrial fibrillation prevention: an appraisal of current evidence. Heart, 104(11):882-7.

[8] Forlani, S. et al. (2006). Conversion to Sinus Rhythm by Ablation Improves Quality of Life in Patients Submitted to Mitral Valve Surgery. Ann of Thorac Surg, 81(3):863-7.

[9] Zoni-Berisso, M., Lercari, F., Carazza, T., & Domenicucci, S. (2014). Epidemiology of atrial fibrillation: European perspective. Clin Epidemiol, 6:213-20.

[10] Zoni-Berisso, M. et al. (2013). Frequency, patient characteristics, treatment strategies, and resource usage of atrial fibrillation (from the Italian Survey of Atrial Fibrillation Management [ISAF] study). Am J Cardiol, 111(5):705-11.

[11] Ott, A. et al. (1997). Atrial fibrillation and dementia in a population-based study. The Rotterdam Study. Stroke, 28(2):316-21.

[12] Sullivan, E., Braithwaite, S., Dietz, K., & Hickey, C. (2010). Health services utilization and medical costs among Medicare atrial fibrillation patients. Avalere Health, 4(2):7.

[13] Wang, Y., Kong, M.C., Lee, L.H., Ng, H.J., & Ko, Y. (2014). Knowledge, satisfaction, and concerns regarding warfarin therapy and their association with warfarin adherence and anticoagulation control. Thromb Res, 133(4):550-4.

[14] Altiok, M., Yilmaz, M., & Rencüsogullari, I. (2015). Living with Atrial Fibrillation: An Analysis of Patients' Perspectives. Asian Nursing Research, 9(4):305-11.

[15] Nazli, C. et al. (2016). Impaired quality of life in patients with intermittent atrial fibrillation. Anatol J Cardiol, 16(4):250-5.

[16] Thrall, G., Lane, D., Carroll, D., & Lip, G.Y. (2006). Quality of life in patients with atrial fibrillation: a systematic review. Am J Med, 119(5):448.e1-19.

[17] Hagens, V.E. et al. (2004). Effect of rate or rhythm control on quality of life in persistent atrial fibrillation. Results from the Rate Control Versus Electrical Cardioversion (RACE) Study. J Am Coll Cardiol, 43(2):241-7.

[18] Hoegh, V. et al. (2016). Association between the diagnosis of atrial fibrillation and aspects of health status: a Danish cross-sectional study. Scand J Caring Sci, 30(3):507-17.

[19] Dorian, P. et al. (2000). The impairment of health-related quality of life in patients with intermittent atrial fibrillation: implications for the assessment of investigational therapy. J Am Coll Cardiol, 36(4):1303-9.

[20] Centers for Disease Control and Prevention. (2017). Atrial Fibrillation Fact Sheet. Accessed Dec 2018. Retrieved from https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_atrial_fibrillation.htm.

[21] McDonald, A.J., Pelletier, A.J., Ellinor, P.T., & Camargo Jr., C.A. (2008). Increasing US emergency department visit rates and subsequent hospital admissions for atrial fibrillation from 1993 to 2004. Ann Emerg Med, 51(1):58-65.

[22] Rozen, G. et al. (2018). Emergency Department Visits for Atrial Fibrillation in the United States: Trends in Admission Rates and Economic Burden From 2007 to 2014. J Am Heart Assoc, 7(15), PII:e009024.

[23] Kim, M.H., Johnston, S.S., Chu, B.C., Dalal, M.R., & Schulman, K.L. (2011). Estimation of total incremental health care costs in patients with atrial fibrillation in the United States. Circ Cardiovasc Qual Outcomes, 4(3):313-20.

[24] Iribarne, A. et al. (2019). Surgical Atrial Fibrillation Ablation Improves Long-Term Survival: A Multicenter Analysis. Ann of Thorac Surg, 107(1):135-42.

[25] Rankin, J.S., Lerner, D.J., Braid-Forbes, M.J., Ferguson, M.A., & Badhwar, V. (2017). One-year mortality and costs associated with surgical ablation for atrial fibrillation concomitant to coronary artery bypass grafting. Eur J Cardiothorac Surg, 52(3):471-7.

[26] Musharbash, F.N. et al. (2018). Performance of the Cox-maze IV procedure is associated with improved long-term survival in patients with atrial fibrillation undergoing cardiac surgery. J Thorac Cardiovasc Surg, 155(1):159-70.

[27] Philpott, J.M. et al. (2015). The ABLATE Trial: Safety and Efficacy of Cox Maze-IV Using a Bipolar Radiofrequency Ablation System. Ann of Thorac Surg, 100(5):1541-8.

[28] McCarthy, P.M. et al. (2019). Prevalence of Atrial Fibrillation before Cardiac Surgery and Factors Associated with Concomitant Ablation. J Thorac Cardiovasc Surg, PII: S0022-5223(19)31361-3, DOI: 10.1016/J.JTCVS.2019.06.062.

[29] Gaynor, S.L. et al. (2015). Surgical treatment of atrial fibrillation: predictors of late recurrence. J Thorac Cardiovasc Surg, 129(1):104-11.

[30] Weimar, T. et al. (2011). The Cox-maze IV procedure for lone atrial fibrillation: a single center experience in 100 consecutive patients. J Interv Card Electrophysiol. 31(1):47-54.

[31] Schill, M.R. et al. (2017). Late results of the Cox-maze IV procedure in patients undergoing coronary artery bypass grafting. J Thorac Cardiovasc Surg, 153(5):1087-94.

[32] January, C. T., et al. (2019). 2019 AHA/ACC/HRS Focused Update of the 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Circulation, CIR-0000000000000665.

[33] Badhwar, V. et al. (2017). The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation. Ann of Thorac Surg, 103(1):329-41.

[34] Calkins, H. et al. (2017). 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Europace, 20(1):e1-e10.

[35] January, C.T. et al. (2014). 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol, 64(21):e1-e76.

[36] Meier, B. et al. (2014). EHRA/EAPCI expert consensus statement on catheter-based left atrial appendage occlusion. Europace, 16(10):1397-416.

[37] Cox, J.L. et al. (1991). Successful surgical treatment of atrial fibrillation. Review and clinical update. JAMA, 266(14):1976-80.

[38] Ouyang, F. et al. (2010). Long-term results of catheter ablation in paroxysmal atrial fibrillation: lessons from a 5-year follow-up. Circulation, 122(23):2368-77.

[39] Kirchhof, P. et al. (2016). 2016 ESC guidelines for the management of atrial fibrillation developed in collaboration with EACTS: the Task Force for the management of atrial fibrillation of the European Society of Cardiology (ESC) developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC Endorsed by the European Stroke Organization (ESO). Europace, 18(11):1455-90.

[40] Tilz, R.R. et al. (2010). Catheter ablation of long-standing persistent atrial fibrillation: a lesson from circumferential pulmonary vein isolation. J Cardiovasc Electrophysiol, 21(10):1085-93. (Abstract-Only).

[41] Wynn, G.J. et al. (2016). Long-term outcomes after ablation of persistent atrial fibrillation: an observational study over 6 years. Open Heart, 3(2):e000394.

[42] Gillinov, A.M. et al. (2005). Surgical ablation of atrial fibrillation with bipolar radiofrequency as the primary modality. J Thorac Cardiovasc Surg, 129(6):1322-9.

[43] Gillinov, A.M. et al. (2015). Surgical ablation of atrial fibrillation during mitral-valve surgery. N Engl J Med, 372(15):1399-409.

[44] Voeller, R.K. et al. (2008). Isolating the entire posterior left atrium improves surgical outcomes after the Cox maze procedure. J Thorac Cardiovasc Surg, 135(4):870-7.

[45] Barnett, S.D., & Ad, N. (2006). Surgical ablation as treatment for the elimination of atrial fibrillation: a meta-analysis. J Thorac Cardiovasc Surg, 131(5):1029-35.

[46] Cox, J.L., & Ad, N. (2000). The importance of cryoablation of the coronary sinus during the Maze procedure. Semin Thorac Cardiovasc Surg, 12(1):20-4.

[47] Robertson, J.O. et al. (2013). Surgical Techniques Used for the Treatment of Atrial Fibrillation. Circ J, 77(8):1941-51.

[48] Gillinov, A.M. et al. (2006). Surgery for permanent atrial fibrillation: impact of patient factors and lesion set. Ann Thorac Surg, 82(2):502-14.

[49] Ad, N., Holmes, S.D., Lamont, D., & Shuman, D.J. (2017). Left-Sided Surgical Ablation for Patients With Atrial Fibrillation Who Are Undergoing Concomitant Cardiac Surgical Procedures. Ann Thorac Surg, 103(1):58-65.

[50] Gammie, J.S. et al. (2008). Atrial fibrillation correction surgery: lessons from the Society of Thoracic Surgeons National Cardiac Database. Ann Thorac Surg, 85(3):909-14.

[51] Maisel, W.H., & Stevenson, L.W. (2003). Atrial fibrillation in heart failure: epidemiology, pathophysiology, and rationale for therapy. Am J Cardiol, 91(6A):2D-8D.

[52] Efremidis, M., Pappas, L., Sideris, A., & Filippatos, G. (2008). Management of atrial fibrillation in patients with heart failure. J Card Fail, 14(3):232-7.

[53] Feinberg, W.M., Blackshear, J.L., Laupacis, A., Kronmal, R., & Hart, R.G. (1995). Prevalence, age distribution, and gender of patients with atrial fibrillation. Analysis and implications. Arch Intern Med, 155(5):469-73.

[54] Hunt, S.A. et al. (2005). ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). J Am Coll Cardiol, 46(6):1116-1143.

[55] Prabhu, S. et al. (2017). Catheter Ablation Versus Medical Rate Control in Atrial Fibrillation and Systolic Dysfunction: The CAMERA-MRI Study. J Am Coll Cardiol, 70(16):1949-61.

[56] Marrouche, N.F., Brachmann, J., & CASTLE-AF Steering Committee. (2009). Catheter ablation versus standard conventional treatment in patients with left ventricular dysfunction and atrial fibrillation (CASTLE-AF) - study design. Pacing Clin Electrophysiol, 32(8):987-94.

[57] Sources: Data approved for use by The Advisory Board. Research, articles, and case studies.

American Nursing Association. (2012, June). The Value of Nursing Care Coordination: Executive Summary. Accessed Jan 2019. Retrieved from https://www.nursingworld.org/~4afc1e/globalassets/practiceandpolicy/health-policy/20120601-executive-summary-the-value-of-nursing-care-coordination.pdf.

Health Catalyst. (2017). Data-Driven Approach to Improving Cardiovascular Care and Operations Leads to $75M in Improvements. Accessed Jan 2019. Retrieved from https://www.healthcatalyst.com/success_stories/cardiovascular-care-allina-health.

[58] Ailawadi, G. et al. (2011). Exclusion of the left atrial appendage with a novel device: early results of a multicenter trial. J Thorac Cardiovasc Surg, 142(5):1002-9.

[59] Caliskan, E. et al. (2017). Epicardial left atrial appendage AtriClip occlusion reduces the incidence of stroke in patients with atrial fibrillation undergoing cardiac surgery. Europace 20(7):e-105-e114. DOI: 10.1093/europace/eux211.

[60] van Laar, C. et al. (2018). Thoracoscopic Left Atrial Appendage Clipping: A Multicenter Cohort Analysis. JACC Clin Electrophysiol, 4(7):893-901.

[61] Ellis, C.R. et al. (2017). Angiographic Efficacy of the AtriClip Left Atrial Appendage Exclusion Device Placed by Minimally Invasive Thoracoscopic Approach, JACC Clin Electrophysiol, 3(12):1356-65.

[62] Kurfirst, V. et al. (2017). Epicardial clip occlusion of the left atrial appendage during cardiac surgery provides optimal surgical results and long-term stability. Interact Cardiovasc Thorac Surg, 25(1):37-40.

[63] Emmert, M.Y. et al. (2014). Safe, effective and durable epicardial left atrial appendage clip occlusion in patients with atrial fibrillation undergoing cardiac surgery: first long-term results from a prospective device trial. Eur J Cardiothorac Surg, 45(1):126-31.

[64] Ad, N. et al. (2015). New Approach to Exclude the Left Atrial Appendage During Minimally Invasive Cryothermic Surgical Ablation. Innovations (Phila), 10(5):323-7.

[65] Gerdisch, M. et al, AtriClip PRO•V Left Atrial Appendage Occlusion Study. AtriCure, Inc., Post Market Field Evaluation of the PRO•V Device, PM-US-0071A-1020-G.

[66] Mokracek, A. et al. (2015). Thoracoscopic Occlusion of the Left Atrial Appendage. Innovations (Phila), 10(3):179-82.

[67] Page, S. et al. (2019). Left Atrial Appendage Exclusion Using the AtriClip Device: A Case Series. Heart Lung Circ, 28(3):430-5.

[68] Beaver, T.M. et al. (2016). Thoracoscopic Ablation With Appendage Ligation Versus Medical Therapy for Stroke Prevention: A Proof-of-Concept Randomized Trial. Innovations (Phila), 11(2):99-105.

[69] Kandarian, A.S., Gillinov, A.M., Pettersson, G.B., Blackstone, E., & Klein, A.L. (2008). Success of surgical left atrial appendage closure: assessment by transesophageal echocardiography. J Am Coll Cardiol, 52(11):924-9.

[70] Cullen, M.W. et al. (2016). Left Atrial Appendage Patency at Cardioversion After Surgical Left Atrial Appendage Intervention. Ann Thorac Surg, 101:675-81.

[71] Healey, J.S. et al. (2005). Left Atrial Appendage Occlusion Study (LAAOS): results of a randomized controlled pilot study of left atrial appendage occlusion during coronary bypass surgery in patients at risk for stroke. Am Heart J, 150(2):288-93.

[72] Lee, R. et al. (2016). A randomized, prospective pilot comparison of 3 atrial appendage elimination techniques: Internal ligation, stapled excision, and surgical excision. J Thorac Cardiovasc Surg, 152(4):1075-80.

Ready to ACT against Afib?

To find out more about ACT and surgical treatment options for Afib, visit **ACTagainstAfib.com** or contact your AtriCure representative.

How are you treating the left atrial appendage?

To find out more about treating LAA,visit **AtriCure.com** or contact your AtriCure representative.

Individual results may vary. Please consult with your physician regarding your condition and appropriate medical treatment.

This material is intended to provide general information, including opinions and recommendations, contained herein for educational purposes only. Such information is not intended to be a substitute for professional medical advice, diagnosis or treatment. The material is not intended to direct clinical care in any specific circumstance. The judgment regarding a particular clinical procedure or treatment plan must be made by a qualified physician in light of the clinical data presented by the patient, the diagnostic and treatment options available.

ATRICURE, INC.

7555 Innovation Way
Mason, Ohio 45040
Customer Service: +1 (866) 349-2342
CustomerService@AtriCure.com
www.AtriCure.com

www.ACTagainstAfib.com

PE-US-1014A-0921-G

ACT against Afib