MEDICAL POLICY

POLICY TITLE	**OPEN AND THORACOSCOPIC APPROACHES TO TREAT ATRIAL FIBRILLATION AND ATRIAL FLUTTER (MAZE AND RELATED PROCEDURES)**
POLICY NUMBER	**MP 2.083**

CLINICAL BENEFIT	☒ MINIMIZE SAFETY RISK OR CONCERN. ☒ MINIMIZE HARMFUL OR INEFFECTIVE INTERVENTIONS. ☐ ASSURE APPROPRIATE LEVEL OF CARE. ☐ ASSURE APPROPRIATE DURATION OF SERVICE FOR INTERVENTIONS. ☒ ASSURE THAT RECOMMENDED MEDICAL PREREQUISITES HAVE BEEN MET. ☐ ASSURE APPROPRIATE SITE OF TREATMENT OR SERVICE.
Effective Date:	**9/1/2024**

I. POLICY

The maze or modified maze procedures, performed on a non-beating heart during cardiopulmonary bypass with concomitant cardiac surgery may be considered **medically necessary** for treatment of symptomatic, atrial fibrillation or flutter.

The use of an open maze or modified maze procedure performed on a non–beating heart without structural heart disease during cardiopulmonary bypass without concomitant cardiac surgery may be considered **medically necessary** for treatment of symptomatic, atrial fibrillation or flutter when **EITHER** of the following are met:

- Atrial fibrillation is refractory to at least one class I/III antiarrhythmic drugs, **OR**;
- Atrial fibrillation is refractory to catheter-based therapy having had at least one unsuccessful catheter-based ablation

Hybrid ablation (defined as a combined percutaneous and thoracoscopic approach) and minimally invasive, off-pump maze procedures (i.e., modified maze procedures), including those done via mini-thoracotomy, may be considered **medically necessary** for the treatment of symptomatic persistent atrial fibrillation or flutter when **ALL** below are met:

- Atrial fibrillation is refractory to at least one class I/III antiarrhythmic drugs and/or catheter-based therapy, **AND**;
- Both the surgeon and electrophysiologist agree that the procedure is an appropriate treatment

All other indications are considered **investigationa**l, as there is insufficient evidence to support a general conclusion concerning the health outcomes or benefits associated with this procedure.

POLICY TITLE	OPEN AND THORACOSCOPIC APPROACHES TO TREAT ATRIAL FIBRILLATION AND ATRIAL FLUTTER (MAZE AND RELATED PROCEDURES)
POLICY NUMBER	MP 2.083

Policy Guidelines

Given the availability of less-invasive alternative approaches in the treatment of atrial fibrillation (AF) performing the maze procedure without concomitant cardiac surgery should rarely be needed.

Published studies on the maze procedure describe patients with drug-resistant AF and atrial flutter as having experienced their arrhythmias for an average of 7 or more years and having unsuccessful results with an average of 5 or more antiarrhythmic medications.

Cross-reference:

MP 1.127 Percutaneous Left-Atrial Appendage Closure Devices for Stroke Prevention in Atrial Fibrillation

II. PRODUCT VARIATIONS

TOP

This policy is only applicable to certain programs and products administered by Capital BlueCross and subject to benefit variations as discussed in Section VI. Please see additional information below.

FEP PPO - Refer to FEP Medical Policy Manual. The FEP Medical Policy manual can be found at:
https://www.fepblue.org/benefit-plans/medical-policies-and-utilization-management-guidelines/medical-policies.

III. DESCRIPTION/BACKGROUND

TOP

There are various surgical approaches to treat atrial fibrillation (AF) that work by interrupting abnormal electrical activity in the atria. Open surgical procedures, such as the Cox maze procedure were first developed for this purpose and are now generally performed in conjunction with valvular or coronary artery bypass graft surgery. Surgical techniques have evolved to include minimally invasive approaches that use epicardial radiofrequency ablation, a thoracoscopic or mediastinal approach, and hybrid catheter ablations/open procedures.

Atrial Fibrillation

Atrial Fibrillation (AF) is a supraventricular tachyarrhythmia characterized by disorganized atrial activation with ineffective atrial ejection. The underlying mechanism of AF involves the interplay between electrical triggering events that initiate AF and the myocardial substrate that permits propagation and maintenance of the aberrant electrical circuit. The most common focal trigger of AF appears to be located within the cardiac muscle that extends into the pulmonary veins. The atria are frequently abnormal in patients with AF and demonstrate enlargement or increased conduction time. Atrial flutter is a variant of AF.

Epidemiology
In the US, more than 3 to 6 million people have AF, and it has been estimated that more than 12 million people will have AF by 2030. Age, body mass index, height, hypertension, diabetes mellitus, obstructive sleep apnea, myocardial infarction, heart failure, hyperthyroidism, chronic kidney disease, smoking, moderate to heavy alcohol consumption, and genetic predisposition are all risk factors for AF. Age-adjusted AF incidence and prevalence is higher among men than women, although the lifetime risk is similar at 24% for men and 22% for women. AF incidence and prevalence appear lower in individuals who are Black compared to White, despite a higher burden of comorbidities. However, this difference is likely largely explained by differential detection of AF by race/ethnicity.

Treatment
The first-line treatment for AF usually includes medications to maintain sinus rhythm and/or control the ventricular rate. Antiarrhythmic medications are only partially effective; therefore, medical treatment is not sufficient for many patients. Percutaneous catheter ablation, using endocardial ablation, is an accepted second-line treatment for patients who are not adequately controlled on medications and may also be used as first-line treatment. Catheter ablation is successful in maintaining sinus rhythm for most patients, but long-term recurrences are common and increase over time. Performed either by open surgical techniques or thoracoscopy, surgical ablation is an alternative approach to percutaneous catheter ablation.

Open Surgical Techniques
The classic Cox maze III procedure is a complex surgical procedure for patients with AF. It involves sequential atriotomy incisions that interrupt the aberrant atrial conduction pathways in the heart. The procedure is also intended to preserve atrial pumping function. It is indicated for patients who do not respond to medical or other surgical antiarrhythmic therapies and is often performed in conjunction with correction of structural cardiac conditions such as valve repair or replacement. This procedure is considered the criterion standard for the surgical treatment of drug-resistant AF, with a success rate of approximately 90%.

The maze procedure entails making incisions in the heart that:

- direct an impulse from the sinoatrial node to the atrioventricular node;
- preserve activation of the entire atrium; and
- block re-entrant impulses responsible for AF or atrial flutter.

The classic Cox maze procedure is performed on a non-beating heart during cardiopulmonary bypass. Simplification of the maze procedure has evolved with the use of different ablation tools such as microwave, cryotherapy, ultrasound, and radiofrequency energy sources to create the atrial lesions instead of employing the incisional technique used in the classic maze procedure. The Cox maze IV procedure involves the use of radiofrequency energy or cryoablation to create transmural lesions analogous to the lesions created by the “cut-and-sew” maze.

Minimally Invasive (Thoracoscopic) Techniques
Less invasive, transthoracic, endoscopic, off-pump procedures to treat drug-resistant AF have been developed. The evolution of these procedures involves both different surgical approaches

and different lesion sets. Alternative surgical approaches include mini-thoracotomy and total thoracoscopy with video assistance. Open thoracotomy and mini-thoracotomy employ cardiopulmonary bypass and open-heart surgery, while thoracoscopic approaches are performed on the beating heart. Thoracoscopic approaches do not enter the heart and use epicardial ablation lesion sets, whereas the open approaches use either the classic “cut-and-sew” approach or endocardial ablation.

Lesion sets may vary independent of the surgical approach, with a tendency toward less extensive lesion sets targeted to areas most likely to be triggers of AF. The most limited lesion sets involve pulmonary vein isolation and exclusion of the left atrial appendage. More extensive lesion sets include linear ablations of the left and/or right atrium and ablation of ganglionic plexi. Some surgeons perform left atrial reduction in cases of left atrial enlargement.

The type of energy used for ablation also varies; radiofrequency energy Is most commonly applied. Other energy sources such as cryoablation and high-intensity ultrasound have been used. For our purposes, the variations on surgical procedures for AF will be combined under the heading of “modified maze” procedures.

Hybrid Techniques

“Hybrid” ablation refers to the use of both thoracoscopic and percutaneous approaches in the same patient. Ablation is performed on the outer surface of the heart (epicardial) via the thoracoscopic approach, and on the inner surface of the heart (endocardial) via the percutaneous approach. The rationale for a hybrid procedure is that a combination of both techniques may result in a complete ablation. Thoracoscopic epicardial ablation is limited by the inability to perform all possible ablation lines because the posterior portions of the heart are not accessible via thoracoscopy. Percutaneous, endoscopic ablation is limited by incomplete ablation lines that often require repeat procedures. By combining both procedures, a full set of ablation lines can be performed, and incomplete ablation lines can be minimized.

The hybrid approach first involves thoracoscopy with epicardial ablation. Following this procedure, an electrophysiologic study is performed percutaneously followed by endocardial ablation as directed by the results of electrophysiology. Most commonly, the electrophysiology study and endocardial ablation are done immediately after the thoracoscopy as part of a single procedure. However, some hybrid approaches perform the electrophysiology study and endocardial ablation on separate days, as directed by the electrophysiology study.

Regulatory Status

Several radiofrequency ablation systems have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process for cardiac tissue ablation (product code OCL). Table 1 provides a select list.

Table 1. Radiofrequency Ablation Approved by the Food and Drug Administration

Device	Manufacturer	510(k) Date
EPi-Sense Guided Coagulation System	Atricure	April 2021

Medtronic DiamondTemp™ System	Medtronic	Jan 2021
Cobra Fusion Ablation System	AtriCure	Feb 2019
Medtronic Cardioblate® System	Medtronic	Jan 2002
Cardima Ablation System	Cardima	Jan 2003
Epicor™ Medical Ablation System	Epicor Medical	Feb 2004
Isolator™ Transpolar™ Pen	AtriCure	Jun 2005
Estech COBRA® Cardiac Electrosurgical Unit	Endoscopic Technologies	Dec 2005
Coolrail™ Linear Pen	AtriCure	Mar 2008
Numeris® Guided Coagulation System with VisiTrax®	nContact Surgical	Feb 2009
EPi-Sense® Guided Coagulation System with VisiTrax®	nContact Surgical	Nov 2012

A number of cryoablation systems, which may be used during cardiac ablation procedures, have also been cleared for marketing, including those in Table 2.

Table 2. Cryoablation Systems Approved by the Food and Drug Administration

Device	Manufacturer	510(k) Date
Cryocare® Cardiac Surgery System	Endocare	Mar 2002
SeedNet™ System	Galil Medical	May 2005
SurgiFrost® XL Surgical CryoAblation System	CryoCath Technologies; now Medtronic	Jul 2006
Isis™ cryosurgical unit	Galil Medical	Mar 2007
Artic Front Advance™ and Arctic Front Advance Pro™ and the Freezer Max™ Cardiac Cryoablation Catheters	Medtronic	Jun 2020

Society Guidelines

The Society of Thoracic Surgeons 2017 clinical practice guideline for the surgical treatment of atrial fibrillation (AF):

Mitral Valve Operations and Concomitant Surgical Ablation:

- Surgical ablation for AF can be performed without additional risk of operative mortality or major morbidity and is recommended at the time of concomitant mitral operations to restore sinus rhythm. (Class I, Level A)

Aortic Valve and CABG Operations with Concomitant Ablation:

- Surgical ablation for AF can be performed without additional risk of operative mortality or major morbidity and is recommended at the time of concomitant isolated AVR, isolated CABG, and AVR plus CABG operations to restore sinus rhythm. (Class I, Level B nonrandomized)

Stand-Alone Surgical Ablation for AF:

- Surgical ablation for symptomatic AF in the absence of structural heart disease that is refractory to class I/III antiarrhythmic drugs or catheter-based therapy is reasonable as a primary stand-alone procedure to restore sinus rhythm (Class IIA, Level B)
- Surgical ablation for symptomatic persistent or longstanding persistent AF in the absence of structural heart disease is reasonable as a stand-alone procedure using the Cox-Maze III/IV lesion set compared with PVI alone. (Class IIA, Level B nonrandomized)
- Surgical ablation for symptomatic AF in the setting of left atrial enlargement (≥4.5 cm) or more than moderate mitral regurgitation by PVI alone is not recommended. (Class III no benefit, Level C expert opinion)

IV. RATIONALE

TOP

Summary of Evidence

For individuals who have symptomatic AF or flutter who are undergoing cardiac surgery with bypass who received a Cox maze or a modified maze procedure, the evidence includes several randomized controlled trials (RCTs) and nonrandomized comparative studies, along with systematic reviews of these studies. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. Several small RCTs have provided most of the direct evidence confirming the benefit of a modified maze procedure for patients with AF who are undergoing mitral valve surgery. These trials have established that the addition of a modified maze procedure results in a lower incidence of atrial arrhythmias following surgery, with minimal additional risks. Observational studies have supported these RCT findings. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive minimally invasive, off-pump thoracoscopic maze procedures, the evidence includes RCTs and observational studies, some of which identify control groups. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. Two RCTs reported significantly higher rates of freedom from AF at 1-year with surgical ablation but also reported significantly higher rates of serious adverse events. The remaining 2 RCTs found no significant differences between treatment groups in rates of freedom from AF and either did not assess or did not find significant differences in serious adverse events. The comparative observational studies consistently found significantly higher rates of freedom from atrial arrhythmias but lacked assessment of serious adverse events. The noncomparative studies generally only reported short-term outcomes and did not consistently report adverse events. Therefore, this evidence does not permit definitive conclusions about whether a specific approach is superior to the other. Factors, such as previous treatment, the probability of maintaining sinus rhythm, the risk of complications, contraindications to anticoagulation, and patient preference, may all affect the risk-benefit ratio for each procedure.

Additionally, the studies do not permit conclusions about harm due to heterogeneous measurement across studies, with mixed results. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome. However, The Society of Thoracic Surgeons 2017 clinical practice guidelines for the surgical treatment of atrial fibrillation (AF) supports this surgical treatment in certain circumstances.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive hybrid thoracoscopic and endocardial ablation procedures, the evidence includes 4 RCTs (sample sizes ranging from 41 to 153) , nonrandomized studies that compared a 'convergent' hybrid approach (i.e., epicardial approach combined with endocardial ablation) to catheter ablation (CA) , and 1 observational study that compared a thoracoscopic epicardial ablation with a percutaneous trans-septal procedure hybrid approach to CA. Pooled evidence from randomized and nonrandomized studies found an increased rate of AF-free survival and increased risk of periprocedural adverse events with hybrid procedures relative to standard ablation. Adverse events after the periprocedural period have not been reported. Multicenter RCTs are needed that assess both benefits and harms with at least 1-year of follow-up. At least 2 RCTs of hybrid procedures have been completed but not published (see table 20). The evidence is insufficient to determine that the technology results in an improvement in the net health outcome. However, The Society of Thoracic Surgeons 2017 clinical practice guidelines for the surgical treatment of atrial fibrillation (AF) supports this surgical treatment in certain circumstances.

V. DEFINITIONS

TOP

ATRIAL FLUTTER is a cardiac arrhythmia marked by rapid (about three hundred beats per minute) regular atrial beating, and, usually, a regular ventricular response.

ATRIOVENTRICULAR (AV) NODE is an area of specialized cardiac muscle that receives the cardiac impulse from the sinoatrial (SA) node and conducts it to the AV bundle and then to the Purkinje fibers and the walls of the ventricles. The AV node is located in the septal wall between the left and right atria.

ATRIUM is the upper chamber of each half of the heart. Atria is the plural of atrium.

MYOCARDIUM is the middle layer of the walls of the heart, composed of cardiac muscle.
SINOATRIAL (SA) NODE is a specialized group of cardiac muscle cells in the wall of the right atrium at the entrance to the superior vena cava. These cells depolarize spontaneously and rhythmically to initiate normal heartbeats.

SUPRAVENTRICULAR TACHYCARDIA (SVT) is any cardiac rhythm with a rate exceeding one hundred (100) beats per minute that originates above the branching part of the atrioventricular bundle, that is, in the sinus node, atria, or AV junction.

TACHYCARDIA is an abnormally rapid heart rate, greater than one hundred (100) beats per minute.

VI. BENEFIT VARIATIONS

TOP

The existence of this medical policy does not mean that this service is a covered benefit under the member's health benefit plan. Benefit determinations should be based in all cases on the applicable health benefit plan language. Medical policies do not constitute a description of benefits. A member's health benefit plan governs which services are covered, which are excluded, which are subject to benefit limits, and which require preauthorization. There are different benefit plan designs in each product administered by Capital Blue Cross. Members and providers should consult the member's health benefit plan for information or contact Capital Blue Cross for benefit information.

VII. DISCLAIMER

TOP

Capital BlueCross' medical policies are developed to assist in administering a member's benefits, do not constitute medical advice and are subject to change. Treating providers are solely responsible for medical advice and treatment of members. Members should discuss any medical policy related to their coverage or condition with their provider and consult their benefit information to determine if the service is covered. If there is a discrepancy between this medical policy and a member's benefit information, the benefit information will govern. If a provider or a member has a question concerning the application of this medical policy to a specific member's plan of benefits, please contact Capital BlueCross' Provider Services or Member Services. Capital BlueCross considers the information contained in this medical policy to be proprietary and it may only be disseminated as permitted by law.

VIII. CODING INFORMATION

TOP

Note: This list of codes may not be all-inclusive, and codes are subject to change at any time. The identification of a code in this section does not denote coverage as coverage is determined by the terms of member benefit information. In addition, not all covered services are eligible for separate reimbursement.

Covered when medically necessary:

Procedure Codes								
33254	33255	33256	33257	33258	33259	33265	33266	

ICD-10-CM Diagnosis Codes	Description
I48.0	Paroxysmal atrial fibrillation
I48.1	Persistent atrial fibrillation

ICD-10-CM Diagnosis Codes	Description
I48.11	Longstanding persistent atrial fibrillation
I48.19	Other persistent atrial fibrillation
I48.20	Chronic atrial fibrillation, unspecified
I48.21	Permanent atrial fibrillation
I48.3	Typical atrial flutter
I48.4	Atypical atrial flutter
I48.91	Unspecified atrial fibrillation
I48.92	Unspecified atrial flutter

IX. REFERENCES

TOP

1. *Huffman MD, Karmali KN, Berendsen MA, et al. Concomitant atrial fibrillation surgery for people undergoing cardiac surgery. Cochrane Database Syst Rev. Aug 22 2016(8):CD011814. PMID 27551927*
2. *Phan K, Xie A, Tian DH, et al. Systematic review and meta-analysis of surgical ablation for atrial fibrillation during mitral valve surgery. Ann Cardiothorac Surg. Jan 2014;3(1):3-14. PMID 24516793*
3. *Gillinov AM, Gelijns AC, Parides MK, et al. Surgical ablation of atrial fibrillation during mitral-valve surgery. N Engl J Med. Apr 9 2015;372(15):1399-1409. PMID 25853744*
4. *Budera P, Straka Z, Osmancik P, et al. Comparison of cardiac surgery with left atrial surgical ablation vs. cardiac surgery without atrial ablation in patients with coronary and/or valvular heart disease plus atrial fibrillation: final Procedures) results of the PRAGUE-12 randomized multicentre study. Eur Heart J. Nov 2012;33(21):2644-2652. PMID 22930458*
5. *Van Breugel HN, Nieman FH, Accord RE, et al. A prospective randomized multicenter comparison on health- related quality of life: the value of add-on arrhythmia surgery in patients with paroxysmal, permanent or persistent atrial fibrillation undergoing valvular and/or coronary bypass surgery. J Cardiovasc Electrophysiol. May 2010;21(5):511-520. PMID 19925605*
6. *Saint LL, Damiano RJ, Jr., Cuculich PS, et al. Incremental risk of the Cox-maze IV procedure for patients with atrial fibrillation undergoing mitral valve surgery. J Thorac Cardiovasc Surg. Nov 2013;146(5):1072-1077. PMID 23998785*
7. *Long-term results of the Cox-Maze III procedure for persistent atrial fibrillation associated with rheumatic mitral valve disease: 10-year 7. Kim KC, Cho KR, Kim YJ, et al. experience. Eur J Cardiothorac Surg. Feb 2007;31(2):261-266. PMID 17158057*
8. *Damiano RJ, Jr., Badhwar V, Acker MA, et al. The CURE-AF trial: a prospective, multicenter trial of irrigated radiofrequency ablation for the treatment of persistent atrial*

fibrillation during concomitant cardiac surgery. Heart Rhythm. Jan 2014;11(1):39-45. PMID 24184028

9. *Gaita F, Ebrille E, Scaglione M, et al. Very long-term results of surgical and transcatheter ablation of long- standing persistent atrial fibrillation. Ann Thorac Surg. Oct 2013;96(4):1273-1278. PMID 23915587*
10. *Watkins AC, Young CA, Ghoreishi M, et al. Prospective assessment of the CryoMaze procedure with continuous outpatient telemetry in 136 patients. Ann Thorac Surg. Apr 2014;97(4):1191-1198; discussion 1198. PMID 24582049*
11. *van Laar C, Kelder J, van Putte BP. The totally thoracoscopic maze procedure for the treatment of atrial fibrillation. Interact Cardiovasc Thorac Surg. Jan 2017;24(1):102-111. PMID 27664426*
12. *Phan K, Phan S, Thiagalingam A, et al. Thoracoscopic surgical ablation versus catheter ablation for atrial fibrillation. Eur J Cardiothorac Surg. Apr 2016;49(4):1044-1051. PMID 26003961*
13. *Boersma LV, Castella M, van Boven W, et al. Atrial fibrillation catheter ablation versus surgical ablation treatment (FAST): a 2-center randomized clinical trial. Circulation. Jan 3 2012;125(1):23-30. PMID 22082673*
14. *Pokushalov E, Romanov A, Elesin D, et al. Catheter versus surgical ablation of atrial fibrillation after a failed initial pulmonary vein isolation procedure: a randomized controlled trial. J Cardiovasc Electrophysiol. Dec 2013;24(12):1338-1343. PMID 24016147*
15. *Stulak JM, Dearani JA, Sundt TM, 3rd, et al. Ablation of atrial fibrillation: comparison of catheter-based techniques and the Cox-Maze III operation. Ann Thorac Surg. Jun 2011;91(6):1882-1888; discussion 1888-1889. PMID 21619987*
16. *Wang J, Li Y, Shi J, et al. Minimally invasive surgical versus catheter ablation for the long-lasting persistent atrial fibrillation. PLoS One. Jul 2011;6(7):e22122. PMID 21765943*
17. *Lawrance CP, Henn MC, Miller JR, et al. A minimally invasive Cox maze IV procedure is as effective as sternotomy while decreasing major morbidity and hospital stay. J Thorac Cardiovasc Surg. Sep 2014;148(3):955- 961; discussion 962-952. PMID 25048635*
18. *Massimiano PS, Yanagawa B, Henry L, et al. Minimally invasive fibrillating heart surgery: a safe and effective approach for mitral valve and surgical ablation for atrial fibrillation. Ann Thorac Surg. Aug 2013;96(2):520-527. PMID 23773732*
19. *Cui YQ, Li Y, Gao F, et al. Video-assisted minimally invasive surgery for lone atrial fibrillation: a clinical report of 81 cases. J Thorac Cardiovasc Surg. Feb 2010;139(2):326-332. PMID 19660413*
20. *Edgerton JR, Brinkman WT, Weaver T, et al. Pulmonary vein isolation and autonomic denervation for the management of paroxysmal atrial fibrillation by a minimally invasive surgical approach. J Thorac Cardiovasc Surg. Oct 2010;140(4):823-828. PMID 20299028*
21. *Han FT, Kasirajan V, Kowalski M, et al. Results of a minimally invasive surgical pulmonary vein isolation and ganglionic plexi ablation for atrial fibrillation: single-center*

experience with 12-month follow-up. Circ Arrhythm Electrophysiol. Aug 2009;2(4):370-377. PMID 19808492

22. *Pruitt JC, Lazzara RR, Ebra G. Minimally invasive surgical ablation of atrial fibrillation: the thoracoscopic box lesion approach. J Interv Card Electrophysiol. Dec 2007;20(3):83-87. PMID 18214660*
23. *Sirak J, Jones D, Sun B, et al. Toward a definitive, totally thoracoscopic procedure for atrial fibrillation. Ann Thorac Surg. Dec 2008;86(6):1960-1964. PMID 19022018*
24. *Speziale G, Bonifazi R, Nasso G, et al. Minimally invasive radiofrequency ablation of lone atrial fibrillation by monolateral right minithoracotomy: operative and early follow-up results. Ann Thorac Surg. Jul 2010;90(1):161- 167. PMID 20609767*
25. *Wudel JH, Chaudhuri P, Hiller JJ. Video-assisted epicardial ablation and left atrial appendage exclusion for atrial fibrillation: extended follow-up. Ann Thorac Surg. Jan 2008;85(1):34-38. PMID 18154774*
26. *Yilmaz A, Geuzebroek GS, Van Putte BP, et al. Completely thoracoscopic pulmonary vein isolation with ganglionic plexus ablation and left atrial appendage amputation for treatment of atrial fibrillation. Eur J Cardiothorac Surg. Sep 2010;38(3):356-360. PMID 20227287*
27. *Yilmaz A, Van Putte BP, Van Boven WJ. Completely thoracoscopic bilateral pulmonary vein isolation and left atrial appendage exclusion for atrial fibrillation. J Thorac Cardiovasc Surg. Aug 2008;136(2):521-522. PMID 18692667*
28. *Geuzebroek GS, Bentala M, Molhoek SG, et al. Totally thoracoscopic left atrial Maze: standardized, effective and safe. Interact Cardiovasc Thorac Surg. Mar 2016;22(3):259-264. PMID 26705300*
29. *Je HG, Shuman DJ, Ad N. A systematic review of minimally invasive surgical treatment for atrial fibrillation: a comparison of the Cox-Maze procedure, beating-heart epicardial ablation, and the hybrid procedure on safety and efficacy. Eur J Cardiothorac Surg. Oct 2015;48(4):531-540; discussion 540-531. PMID 25567961*
30. *La Meir M, Gelsomino S, Luca F, et al. Minimally invasive surgical treatment of lone atrial fibrillation: Early results of hybrid versus standard minimally invasive approach employing radiofrequency sources. Int J Cardiol. May 2 2012;167(4):1469-1475. PMID 22560495*
31. *Bisleri G, Rosati F, Bontempi L, et al. Hybrid approach for the treatment of long-standing persistent atrial fibrillation: electrophysiological findings and clinical results. Eur J Cardiothorac Surg. Nov 2013;44(5):919-923. PMID 23475587*
32. *Gehi AK, Mounsey JP, Pursell I, et al. Hybrid epicardial-endocardial ablation using a pericardioscopic technique for the treatment of atrial fibrillation. Heart Rhythm. Jan 2013;10(1):22-28. PMID 23064043*
33. *Gersak B, Pernat A, Robic B, et al. Low rate of atrial fibrillation recurrence verified by implantable loop recorder monitoring following a convergent epicardial and en dial docarablation of atrial fibrillation. J Cardiovasc Electrophysiol. Oct 2012;23(10):1059-1066. PMID 22587585*

34. *La Meir M, Gelsomino S, Lorusso R, et al. The hybrid approach for the surgical treatment of lone atrial fibrillation: one-year results employing a monopolar radiofrequency source. J Cardiothorac Surg. Jul 19 2012;7:71. PMID 22812613*
35. *Muneretto C, Bisleri G, Bontempi L, et al. Successful treatment of lone persistent atrial fibrillation by means of a hybrid thoracoscopic-transcatheter approach. Innovations (Phila). Jul-Aug 2012;7(4):254-258. PMID 23123991*
36. *Muneretto C, Bisleri G, Bontempi L, et al. Durable staged hybrid ablation with thoracoscopic and percutaneous approach for treatment of long-standing atrial fibrillation: a 30-month assessment with continuous monitoring. J Thorac Cardiovasc Surg. Dec 2012;144(6):1460-1465; discussion 1465. PMID 23062968*
37. *Pison L, La Meir M, van Opstal J, et al. Hybrid thoracoscopic surgical and transvenous catheter ablation of atrial fibrillation. J Am Coll Cardiol. Jul 3 2012;60(1):54-61. PMID 22742400*
38. *Zembala M, Filipiak K, Kowalski O, et al. Minimally invasive hybrid ablation procedure for the treatment of persistent atrial fibrillation: one year results. Kardiol Pol. Aug 2012;70(8):819-828. PMID 22933215*
39. *Gersak B, Zembala MO, Muller D, et al. European experience of the convergent atrial fibrillation procedure: multicenter outcomes in consecutive patients. J Thorac Cardiovasc Surg. Apr 2014;147(4):1411-1416. PMID 23988287*
40. *Civello KC, Smith CA, Boedefeld W. Combined endocardial and epicardial ablation for symptomatic atrial fibrillation: single center experience in 100+ consecutive patients. J Innovations Cardiac Rhythm Manage. 2013;August*
41. *Badhwar V, Rankin JS, Damiano RJ, Jr., et al. The Society of Thoracic Surgeons 2017 Clinical practice guidelines for the surgical treatment of atrial fibrillation. Ann Thorac Surg. Jan 2017;103(1):329-341. PMID 28007240*
42. *January CT, Wann LS, Calkins H, et al. 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. J Am Coll Cardiol. 2019 Jan 21. PMID: 30703431*
43. *Calkins H, Hindricks G, Cappato R, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Europace. 2018 Jan 1;20(1):e1-e160. PMID: 29016840*
44. *Ad N, Damiano RJ Jr, Badhwar V, et al. Expert consensus guidelines: Examining surgical ablation for atrial fibrillation. J Thorac Cardiovasc Surg. 2017 Jun;153(6):1330-1354.e1. PMID: 28390766*
45. *Zhang D, Shi J, Quan H, et al. Five-year results of a modified left atrial maze IV procedure in the treatment of atrial fibrillation: a randomized study. ANZ J Surg. Apr 2020; 90(4): 602-607. PMID 31742849*
46. *Castella M, Kotecha D, van Laar C, et al. Thoracoscopic vs. catheter ablation for atrial fibrillation: long-term follow-up of the FAST randomized trial. Europace. May 01 2019; 21(5): 746-753. PMID 30715255*

47. *Adiyaman A, Buist TJ, Beukema RJ, et al. Randomized Controlled Trial of Surgical Versus Catheter Ablation for Paroxysmal and Early Persistent Atrial Fibrillation. Circ Arrhythm Electrophysiol. Oct 2018; 11(10): e006182. PMID 30354411*
48. *Vos LM, Bentala M, Geuzebroek GS, et al. Long-term outcome after totally thoracoscopic ablation for atrial fibrillation. J Cardiovasc Electrophysiol. Jan 2020; 31(1): 40-45. PMID 31691391*
49. *Providência R, Barra S, Pinto C, Paiva L, Nascimento J. Surgery for Atrial Fibrillation: Selecting the Procedure for the Patient. J Atr Fibrillation. 2013;6(1):743. PMID 28496848*
50. *Harky A, Bithas C, Chan JSK, Snosi M, Pousios D, Muir AD. Surgical Treatment of Atrial Fibrillation: Cutting Through the Edges. Braz J Cardiovasc Surg. 2020 Jun 1;35(3):375-386. PMID 32549109*
51. *Badhwar V et al. The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation. Ann Thorac Surg 2017;103:329–41*
52. *Khoynezhad A, Ellenbogen K, Al-Atassi T, et al. Hybrid Atrial Fibrillation Ablation. Current Status and A Look Ahead. Circulation: Arrhythmia and Electrophysiology. 2017;10:e005263. Accessed August 31, 2022*
53. *Muneretto C, Bisleri G, Rosati F, et al. European prospective multicentre study of hybrid thoracoscopic and transcatheter ablation of persistent atrial fibrillation: the HISTORIC-AF trial. European Journal of Cardio-Thoracic Surgery, Volume 52, Issue 4, October 2017, Pages 740–745, Accessed August 31, 2022*
54. *Calkins H, Hindricks G, Cappato R, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Heart Rhythm. 2017;14(10):e275-e444. doi:10.1016/j.hrthm.2017.05.012*
55. *Ad N, Holmes S, Friehling T. Minimally Invasive Stand-Alone Cox Maze Procedure for Persistent and Longs-Standing Persisitent Atrial Fibrillation. Circulation: Arrhythmia and Electrophysiology. 2017.*
56. *Lee, R: Atrial fibrillation: Surgical ablation. UpToDate Online Journal [serial online]. Waltham, MA: UpToDate; updated April 2023. Literature review current through November 2023*
57. *Colilla S, Crow A, Petkun W, et al. Estimates of current and future incidence and prevalence of atrial fibrillation in the U.S. adult population. Am J Cardiol. Oct 15 2013; 112(8): 1142-7. PMID 23831166*
58. *Kornej J, Börschel CS, Benjamin EJ, et al. Epidemiology of Atrial Fibrillation in the 21st Century: Novel Methods and New Insights. Circ Res. Jun 19 2020; 127(1): 4-20. PMID 32716709*
59. *Heeringa J, van der Kuip DA, Hofman A, et al. Prevalence, incidence and lifetime risk of atrial fibrillation: the Rotterdam study. Eur Heart J. Apr 2006; 27(8): 949-53. PMID 16527828*
60. *Heckbert SR, Austin TR, Jensen PN, et al. Differences by Race/Ethnicity in the Prevalence of Clinically Detected and Monitor-Detected Atrial Fibrillation: MESA. Circ Arrhythm Electrophysiol. Jan 2020; 13(1): e007698. PMID 31934795*

61. *Reston JT, Shuhaiber JH. Meta-analysis of clinical outcomes of maze-related surgical procedures for medically refractory atrial fibrillation. Eur J Cardiothorac Surg. Nov 2005; 28(5): 724-30. PMID 16143540*
62. *Gerdisch M, Lehr E, Dunnington G, et al. Mid-term outcomes of concomitant Cox-Maze IV: Results from a multicenter prospective registry. J Card Surg. Oct 2022; 37(10): 3006-3013. PMID 35870185*
63. *McCarthy PM, Gerdisch M, Philpott J, et al. Three-year outcomes of the postapproval study of the AtriCure Bipolar Radiofrequency Ablation of Permanent Atrial Fibrillation Trial. J Thorac Cardiovasc Surg. Aug 2022; 164(2): 519-527.e4. PMID 33129501*
64. *Yi S, Liu X, Wang W, et al. Thoracoscopic surgical ablation or catheter ablation for patients with atrial fibrillation? A systematic review and meta-analysis of randomized controlled trials. Interact Cardiovasc Thorac Surg. Dec 07 2020; 31(6): 763-773. PMID 33166993*
65. *Castellá M, Kotecha D, van Laar C, et al. Thoracoscopic vs. catheter ablation for atrial fibrillation: long-term follow-up of the FAST randomized trial. Europace. May 01 2019; 21(5): 746-753. PMID 30715255*
66. *Haldar S, Khan HR, Boyalla V, et al. Catheter ablation vs. thoracoscopic surgical ablation in long-standing persistent atrial fibrillation: CASA-AF randomized controlled trial. Eur Heart J. Dec 14 2020; 41(47): 4471-4480. PMID 32860414*
67. *Kwon HJ, Choi JH, Kim HR, et al. Radiofrequency vs. Cryoballoon vs. Thoracoscopic Surgical Ablation for Atrial Fibrillation: A Single-Center Experience. Medicina (Kaunas). Sep 26 2021; 57(10). PMID 34684060*
68. *Mahapatra S, LaPar DJ, Kamath S, et al. Initial experience of sequential surgical epicardial-catheter endocardial ablation for persistent and long-standing persistent atrial fibrillation with long-term follow-up. Ann Thorac Surg. Jun 2011; 91(6): 1890-8. PMID 21619988*
69. *De Maat GE, Pozzoli A, Scholten MF, et al. Surgical minimally invasive pulmonary vein isolation for lone atrial fibrillation: midterm results of a multicenter study. Innovations (Phila). 2013; 8(6): 410-5. PMID 24356430*
70. *Harlaar N, Oudeman MA, Trines SA, et al. Long-term follow-up of thoracoscopic ablation in long-standing persistent atrial fibrillation. Interact Cardiovasc Thorac Surg. Jun 01 2022; 34(6): 990-998. PMID 34957518*
71. *MacGregor RM, Bakir NH, Pedamallu H, et al. Late results after stand-alone surgical ablation for atrial fibrillation. J Thorac Cardiovasc Surg. Nov 2022; 164(5): 1515-1528.e8. PMID 34045056*
72. *Mhanna M, Beran A, Al-Abdouh A, et al. Hybrid convergent ablation versus endocardial catheter ablation for atrial fibrillation: A systematic review and meta-analysis. J Arrhythm. Dec 2021; 37(6): 1459-1467. PMID 34887950*
73. *Eranki A, Wilson-Smith AR, Williams ML, et al. Hybrid convergent ablation versus endocardial catheter ablation for atrial fibrillation: a systematic review and meta-analysis of 14andomized control trials and propensity matched studies. J Cardiothorac Surg. Aug 13 2022; 17(1): 181. PMID 35964093*

74. *DeLurgio DB, Crossen KJ, Gill J, et al. Hybrid Convergent Procedure for the Treatment of Persistent and Long-Standing Persistent Atrial Fibrillation: Results of CONVERGE Clinical Trial. Circ Arrhythm Electrophysiol. Dec 2020; 13(12): e009288. PMID 33185144*
75. *Lee KN, Kim DY, Boo KY, et al. Combined epicardial and endocardial approach for redo radiofrequency catheter ablation in patients with persistent atrial fibrillation: a randomized clinical trial. Europace. Oct 13 2022; 24(9): 1412-1419. PMID 35640923*
76. *van der Heijden CAJ, Weberndörfer V, Vroomen M, et al. Hybrid Ablation Versus Repeated Catheter Ablation in Persistent Atrial Fibrillation: A Randomized Controlled Trial. JACC Clin Electrophysiol. Jan 10 2023. PMID 36752455*
77. *Jan M, Žižek D, Geršak ŽM, et al. Comparison of treatment outcomes between convergent procedure and catheter ablation for paroxysmal atrial fibrillation evaluated with implantable loop recorder monitoring. J Cardiovasc Electrophysiol. Aug 2018; 29(8): 1073-1080. PMID 29722468*
78. *DeLurgio DB, Blauth C, Halkos ME, et al. Hybrid epicardial-endocardial ablation for long-standing persistent atrial fibrillation: A subanalysis of the CONVERGE Trial. Heart Rhythm O2. Feb 2023; 4(2): 111-118. PMID 36873309*
79. *Kress DC, Erickson L, Choudhuri I, et al. Comparative Effectiveness of Hybrid Ablation Versus Endocardial Catheter Ablation Alone in Patients With Persistent Atrial Fibrillation. JACC Clin Electrophysiol. Apr 2017; 3(4): 341-349. PMID 29759446*
80. *Maclean E, Yap J, Saberwal B, et al. The convergent procedure versus catheter ablation alone in longstanding persistent atrial fibrillation: A single centre, propensity-matched cohort study. Int J Cardiol. Mar 15 2020; 303: 49-53. PMID 32063280*
81. *Mannakkara NN, Porter B, Child N, et al. Convergent ablation for persistent atrial fibrillation: outcomes from a single-centre real-world experience. Eur J Cardiothorac Surg. Dec 02 2022; 63(1). PMID 36346176*
82. *Kiankhooy A, Pierce C, Burk S, et al. Hybrid ablation of persistent and long-standing persistent atrial fibrillation with depressed ejection fraction: A single-center observational study. JTCVS Open. Dec 2022; 12: 137-146. PMID 36590727*
83. *Tonks R, Lantz G, Mahlow J, et al. Short and Intermediate Term Outcomes of the Convergent Procedure: Initial Experience in a Tertiary Referral Center. Ann Thorac Cardiovasc Surg. Feb 20 2020; 26(1): 13-21. PMID 31495813*
84. *Baudo M, Rosati F, Lapenna E, Di Bacco L, Benussi S. Surgical options for atrial fibrillation treatment during concomitant cardiac procedures. Annals of Cardiothoracic Surgery. 2024;13(2):135-145. doi:10.21037/acs-2023-afm-0208*
85. *Gao, Y., Luo, H., Yang, R. et al. Safety and efficacy of Cox-Maze procedure for atrial fibrillation during mitral valve surgery: a meta-analysis of randomized controlled trials. J Cardiothorac Surg 19, 140 (2024).*
86. *Kim MS, Kim HJ, Je HG, et al. Long-term results of atrial fibrillation surgery concomitant with mitral valve surgery: A propensity score-matched multicenter study. J Thorac Cardiovasc Surg. Published online January 16, 2024. PMID 38237763*

87. Blue Cross Blue Shield Association Medical Policy Reference Manual. 7.01.14, Open and Thoracoscopic Approaches to Treat Atrial Fibrillation and Atrial Flutter (Maze and Related Procedures). June 2023

X. POLICY HISTORY

TOP

MP 2.083	**07/20/2020 Minor Review.** Changed "Open Maze or modified maze procedure on a non-beating heart during cardiopulmonary bypass without concomitant cardiac surgery", "Hybrid ablation" and "Minimally invasive, off pump maze procedure" from investigational to medically necessary with criteria to align with The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines. Description, Background and Rationale updated. References added.
	09/27/2021 Consensus Review. No change to policy statement. References reviewed and updated.
	11/22/2022 Consensus Review. Clarification for INV statement but no change to coverage**.** References and background updated, and coding reviewed.
	12/14/2023 Consensus Review. No change to policy statement. Background and Rationale updated. References added.
	06/11/2024 Consensus Review. No change to policy statements. References reviewed and updated. Added ICD-10 diagnosis codes I48.91 and I48.92. No procedure code changes.

TOP