



BlueCross BlueShield
of Alabama

Name of Blue Advantage Policy:

Open and Thoracoscopic Approaches to Treat Atrial Fibrillation and Atrial Flutter (Maze and Related Procedures)

Policy #: 631

Latest Review Date: December 2024

Category: Cardiovascular

BACKGROUND:

Blue Advantage medical policy does not conflict with Local Coverage Determinations (LCDs), Local Medical Review Policies (LMRPs) or National Coverage Determinations (NCDs) or with coverage provisions in Medicare manuals, instructions or operational policy letters. In order to be covered by Blue Advantage the service shall be reasonable and necessary under Title XVIII of the Social Security Act, Section 1862(a)(1)(A). The service is considered reasonable and necessary if it is determined that the service is:

1. *Safe and effective;*
2. *Not experimental or investigational*;*
3. *Appropriate, including duration and frequency that is considered appropriate for the service, in terms of whether it is:*
 - *Furnished in accordance with accepted standards of medical practice for the diagnosis or treatment of the patient's condition or to improve the function of a malformed body member;*
 - *Furnished in a setting appropriate to the patient's medical needs and condition;*
 - *Ordered and furnished by qualified personnel;*
 - *One that meets, but does not exceed, the patient's medical need; and*
 - *At least as beneficial as an existing and available medically appropriate alternative.*

Routine costs of qualifying clinical trial services with dates of service on or after September 19, 2000, which meet the requirements of the Clinical Trials NCD are considered reasonable and necessary by Medicare. Providers should bill **Original Medicare for covered services that are related to **clinical trials** that meet Medicare requirements (Refer to Medicare National Coverage Determinations Manual, Chapter 1, Section 310 and Medicare Claims Processing Manual Chapter 32, Sections 69.0-69.11).*

POLICY:

Blue Advantage will treat **the maze or modified maze procedure**, performed on a non-beating heart during cardiopulmonary bypass with concomitant cardiac surgery, as a **covered benefit** for symptomatic, atrial fibrillation or atrial flutter. (CPT codes 33257 or 33259)

Blue Advantage will treat **stand-alone maze or modified maze procedures** (including open and minimally invasive) as a **covered benefit** in symptomatic patients who (33254, 33255, 33256, 33265, 33266)

- Have failed at least TWO class I or III antiarrhythmic medications and TWO endocardial ablations.

Blue Advantage will treat **the hybrid maze procedure** as a **covered benefit** as a stand-alone procedure in symptomatic patients who (CPT code 33999)

- Have failed at least TWO class I or III antiarrhythmic medications and a failed catheter-based therapy.

Blue Advantage will treat **stand-alone and hybrid (defined as a combined percutaneous and thoracoscopic approach) maze and modified maze ablation procedures** are considered as a **non-covered benefit** and as **investigational** in all other situations.

For an alternative approach for the treatment of atrial fibrillation, see medical policy #283 - Transcatheter Ablation of Arrhythmogenic Foci in the Pulmonary Veins as a Treatment of Atrial Fibrillation.

Blue Advantage does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Advantage administers benefits based on the members' contract and medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.

DESCRIPTION OF PROCEDURE OR SERVICE:

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 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 atrial fibrillation.

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. Surgical ablation, performed either by open surgical techniques or thoracoscopy, 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 that 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 surgical treatment of drug-resistant AF, with an approximately 90% success rate.

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 that are 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 (RF) 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 RF 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 that are 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 types of energy sources such as cryoablation and high-intensity ultrasound have also 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 a procedure that uses 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 doing a hybrid procedure is that a combination of both techniques may result in more 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, as directed by the electrophysiology study, on a separate day.

KEY POINTS:

The most recent literature review is through December 11, 2024.

Summary of Evidence

For individuals who have symptomatic, atrial fibrillation (AF) or flutter who are undergoing cardiac surgery with bypass who received a Cox maze procedure or 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 establish that the addition of a modified MAZE procedure results in a lower incidence of atrial arrhythmias following surgery, with minimal additional risks. Observational studies support the RCT findings. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have symptomatic, drug-resistant AF or flutter who have failed 2 or more endocardial ablations and are not undergoing cardiac surgery with bypass who receive minimally invasive or stand alone, off-pump 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. Several studies have reported high rates of maintaining sinus rhythm and less need for repeat ablations. Several single-arm case series of minimally invasive epicardial ablation have reported on patients who had failed catheter ablation (CA). These case series offer evidence that is more clinically relevant than studies of unselected patients because this population has fewer treatment options and is more likely to benefit from surgical procedures. The evidence is sufficient to determine that the technology results in an 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 hybrid thoracoscopic/endocardial ablation procedures, the evidence includes 4 RCTs, nonrandomized studies and an observational study. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. The studies suggest that hybrid ablation procedures are associated with high rates of freedom from AF and may be considered if conservative treatments have failed. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Practice Guidelines and Position Statements
Society of Thoracic Surgeons

In 2017, the Society of Thoracic Surgeons published guidelines for the surgical treatment of atrial fibrillation. Recommendations include the following (see Table 1).

Table 1: Guidelines on Surgical Treatment of Atrial Fibrillation

Recommendation	COR	LOE
Surgical ablation for AF is recommended at the time of concomitant mitral operations to restore sinus rhythm.	I	A
Surgical ablation for AF is recommended at the time of concomitant isolated aortic valve replacement, isolated CABG surgery, and aortic valve replacement plus CABG operations to restore sinus rhythm.	I	B
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 of both is reasonable as a primary stand-alone procedure to restore sinus rhythm.	IIa	B
Surgical ablation for symptomatic persistent or long-standing 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	IIa	B

AF: atrial fibrillation; CABG: coronary artery bypass graft; COR: class of recommendation; LOE: level of recommendation.

American Heart Association, American College of Cardiologists, and Heart Rhythm Society

The American Heart Association, American College of Cardiologists, and Heart Rhythm Society (2019) issued joint guidelines in collaboration with the Society of Thoracic Surgeons on the management of patients with AF. Recommendations on the use of surgical ablation to maintain sinus rhythm are provided in Table 2.

Table 2: Guidelines on the Management of Atrial Fibrillation

Recommendation	COR	LOE
“ AF catheter ablation may be reasonable in selected patients with symptomatic AF and HF with reduced left ventricular (LV) ejection fraction (HFrEF) to potentially lower mortality rate and reduce hospitalization for HF.”	IIb	B-R

AF: atrial fibrillation; COR: class of recommendation; LOE: level of evidence.

HRS, European Heart Rhythm Association, and European Cardiac Arrhythmia Society

A 2017 expert consensus statement was developed regarding catheter and surgical ablation of atrial fibrillation by the HRS, European Heart Rhythm Association, and European Cardiac Arrhythmia Society. The statement was endorsed by the American College of Cardiology, American Heart Association, Asia Pacific Heart Rhythm Society, and Society of Thoracic Surgeons.

The following recommendations were made regarding concomitant surgical ablation in patients undergoing cardiac surgery for other purposes and who have symptomatic AF: (see Table 3).

Table 3: Guidelines on Concomitant Surgical Ablation in Patients Undergoing Cardiac Surgery^a

Recommendation	COR	LOE
Paroxysmal: Surgical ablation is recommended for patients undergoing surgery for other indications	II	B-NR
Persistent: Surgical ablation is recommended for patients undergoing surgery for other indications	II	B-NR
Longstanding Persistent: Surgical ablation is recommended for patients undergoing surgery for other indications	II	NR

COR: class of recommendation; LOE: level of evidence; NR: nonrandomized

^a: For patients with symptomatic AF prior to initiation of antiarrhythmic therapy with Class I or III antiarrhythmic medication and indication for concomitant closed surgical ablation for AF, paroxysmal, persistent, and long-standing persistent (Class: IIa; LOE: B-NR).

The following recommendations were made regarding stand-alone surgical ablation in patients with symptomatic AF refractory or intolerant to at least one class 1 or 3 antiarrhythmic medication (see Table 4).

Table 4: Guidelines on Stand-Alone and Hybrid Surgical Ablation with Symptomatic AF Refractory

Recommendation ^a	COR	LOE
Paroxysmal:		
Stand-alone surgical ablation can be considered for patients who have not failed catheter ablation but prefer a surgical approach	Iib	B-NR
Stand-alone surgical ablation can be considered for patients who have failed one or more attempts at catheter ablation	Iib	B-NR
Persistent		
Stand-alone surgical ablation is reasonable for patients who have not failed catheter ablation but prefer a surgical approach	Iia	B-NR
Stand-alone surgical ablation is reasonable for patients who have failed one or more attempts at catheter ablation	Iia	B-NR
Longstanding		
Stand alone surgical ablation is reasonable for patients who have not failed catheter ablation but prefer a surgical approach	Iib	B-NR
Stand-alone surgical ablation is reasonable for patients who have failed one or more attempts at catheter ablation	Iib	B-NR

COR: class of recommendation; LOE: level of evidence

^a: The recommendations noted that "it might be reasonable to apply the indication for stand-alone surgical ablation described above to patients being considered for hybrid surgical AF ablation.

American Association for Thoracic Surgery

The American Association for Thoracic Surgery (2017) published guidelines on surgical ablation for AF. Recommendations on concomitant surgical ablation in patients with AF are provided in Table 5.

Table 5. Guidelines on Concomitant Surgical Ablation in Patients with AF

Recommendation	COR	LOE
“Addition of a concomitant surgical ablation procedure for AF does not increase the incidence of perioperative morbidity.”	IIa	A, B-R, B-NRa
“Addition of a concomitant surgical ablation procedure for AF does not change the incidence of perioperative stroke/TIA.”	IIa	A
“Addition of a concomitant surgical ablation procedure for AF does not change the incidence of late stroke/TIA, but subgroup analysis of nonrandomized controlled trials found a significant reduction in late stroke/TIA incidence.”	IIa	A, B-NR ^b
“A surgical procedure that includes concomitant surgical ablation for AF does improve HRQL.”	IIa	B-R
“Addition of concomitant surgical ablation for AF does improve AF-related symptoms, IIa C-LD and this improvement is greater than in patients without surgical ablation for AF.”	IIa	C-LD
“Addition of concomitant surgical ablation for AF does improve 30-day operative mortality.”	I	A
“Addition of a concomitant surgical ablation procedure for AF improves long-term survival.”	IIa	A, B-NR ^c

AF: atrial fibrillation; COR: class of recommendation; HRQL: health-related quality of life; LOE: level of evidence; NR: nonrandomized; R: randomized; TIA: transient ischemic attack a: “LOE A for deep sternal wound infection, pneumonia, reoperation for bleeding, and renal failure requiring dialysis; LOE B-R for intensive care unit length of stay and total hospital length of stay; and LOE B-NR for readmission less than 30 days and renal failure.” b: “LOE A for no change in incidence of late stroke/ TIA (up to 1 year of follow-up after surgery) and LOE BNR for reduction in incidence of late stroke/TIA (>1 year of follow-up after surgery).” c: “LOE A for no change in long-term survival (up to 1 year after surgery) and LOE B-NR for improvement in long-term survival (>1 year after surgery)

U.S. Preventive Services Task Force Recommendations

Not applicable.

KEY WORDS:

Maze procedure, hybrid maze procedure, mini-maze, mini maze, surgical ablation, hybrid, cardiac ablation, atrial fibrillation, minimally invasive technique, thorascopic, hybrid ablation,

mini-thoroscopic, modified MAZE, Cardioblate[®], Cardima Ablation System, Epicor[™], Isolator[™] Transpolar[™] Pen, Estech COBRA[®], Coolrail[™], Numeris[®], Epi-Sense[®], Cryocare[®] Cardiac Surgery System, SeedNet[™], SurgiFrost[®] XL, Isis[™] cryosurgical unit

APPROVED BY GOVERNING BODIES:

Several RFA systems used for cardiac tissue ablation have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process. They include:

- Epi-Sense Guided Coagulation System (Atricure);
- Medtronic DiamondTemp[™] System (Medtronic);
- Cobra Fusion Ablation System (AtriCure);
- The Medtronic Cardioblate[®] and Cardioblate Gemini[™] Systems (Medtronic);
- The Cardima Ablation System (Cardima);
- The Epicor[™] Medical Ablation System (Epicor Medical);
- The Isolator[™] Systems (AtriCure);
- The Estech COBRA[®] Cardiac Electrosurgical Unit (Endoscopic Technologies);
- The Coolrail[™] Linear Pen (AtriCure);
- The Numeris[®] Guided Coagulation System with VisiTrax[®] (nContact Surgical);
- The Epi-Sense[®] Guided Coagulation System with VisiTrax[®] (nContact Surgical)

A number of cryoablation systems which may be used on cardiac ablation procedures have also been cleared for marketing, including:

- The Cryocare[®] Cardiac Surgery System (Endocare);
- The SeedNet[™] System (Galil Medical);
- SurgiFrost[®] XL Surgical CryoAblation System (CryoCath Technologies; now Medtronic);
- The Isis[™] cryosurgical unit (Galil Medical);
- Artic Front Advance[™]) and Artic Front Advance Pro[™] and the Freezor Max[™] (Medtronic)

BENEFIT APPLICATION:

Coverage is subject to member's specific benefits. Group-specific policy will supersede this policy when applicable.

CURRENT CODING:

CPT Codes:

33254	Operative tissue ablation and reconstruction of atria, limited (e.g., modified MAZE procedure)
33255	Operative tissue ablation and reconstruction of atria, extensive (e.g., maze procedure); without cardiopulmonary bypass
33256	Operative tissue ablation and reconstruction of atria, extensive (e.g., maze procedure); with cardiopulmonary bypass
33257	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), limited (e.g., modified MAZE procedure) (List separately in addition to code for primary procedure.)
33258	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), extensive (e.g., maze procedure), without cardiopulmonary bypass (List separately in addition to code for primary procedure)
33259	Operative tissue ablation and reconstruction of atria, performed at the time of other cardiac procedure(s), extensive (e.g., maze procedure), with cardiopulmonary bypass (List separately in addition to code for primary procedure)
33265	Endoscopy, surgical; operative tissue ablation and reconstruction of atria, limited (e.g., modified MAZE procedure), without cardiopulmonary bypass
33266	Endoscopy, surgical; operative tissue ablation and reconstruction of atria, extensive (e.g., maze procedure), without cardiopulmonary bypass.
33999	Unlisted procedure, cardiac surgery

REFERENCES:

1. 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.
2. Ad N, Henry L, Hunt S, et al. The outcome of the Cox Maze procedure in patients with previous percutaneous catheter ablation to treat atrial fibrillation. *Ann Thorac Surg.* May 2011; 91(5):1371-1377; discussion 1377.
3. 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.

4. 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.
5. 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.
6. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Maze procedure for drug-resistant atrial fibrillation or flutter. *TEC Assessments.* 1994; Volume 9, Tab 19.
7. 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.* 2012 Jan 3; 125(1):23-30.
8. 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 results of the PRAGUE-12 randomized multicentre study. *Eur Heart J.* Nov 2012; 33(21):2644-2652.
9. 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.
10. 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.
11. Castella M, Pereda D, Mestres CA, et al. Thoracoscopic pulmonary vein isolation in patients with atrial fibrillation and failed percutaneous ablation. *J Thorac Cardiovasc Surg.* Sep 2010; 140(3):633-638.
12. Chernyavskiy A, Kareva Y, Pak I, et al. Quality of Life after Surgical Ablation of Persistent Atrial Fibrillation: A Prospective Evaluation. *Heart Lung Circ.* Apr 2016; 25(4):378-383.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.

18. 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)*. Nov-Dec 2013; 8(6):410-415.
19. 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.
20. 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 randomised control trials and propensity matched studies. *J Cardiothorac Surg*. Aug 13 2022; 17(1): 181.
21. Gaita F, Ebrille E, Scaglione M, et al. Very long-term results of surgical and transcatheter ablation of longstanding persistent atrial fibrillation. *Ann Thorac Surg*. Oct 2013; 96(4):1273-1278.
22. 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.
23. Genev IK, Tompkins LA, Khare MM, Farokhi F. Comparison of the efficacy and complication rates of the hybrid maze, complete cox-maze and catheter ablation in the treatment of atrial fibrillation. *J Atr Fibrillation*. 2017 Feb 28;9(5):1543.
24. 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.
25. 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 endocardial ablation of atrial fibrillation. *J Cardiovasc Electrophysiol*. Oct 2012; 23(10):1059-1066.
26. 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.
27. 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.
28. 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.
29. 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.
30. 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.
31. Han J, Wang H, Wang Z, et al. Comparison of CryoMaze With Cut-and-Sew Maze Concomitant With Mitral Valve Surgery: A Randomized Noninferiority Trial. *Semin Thorac Cardiovasc Surg*. Nov 24 2020.

32. 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.
33. Hindricks G, Potpara T, Dagres N, et al. 2020 ESC guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European association for cardio-thoracic surgery: The task force for the diagnosis and management of atrial fibrillation of the ESC developed with the special contribution of the EHRA to the ESC. *Eur Heart J.* 2021 Feb 1;42(5):373-498.
34. 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.
35. IOM (Institute of Medicine). 2011. *Clinical Practice Guidelines We Can Trust.* Washington, DC: The National Academies Press.
36. 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.
37. 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.
38. 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.* 2015 Oct; 48(4): 531-40.
39. 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.
40. Kim KC, Cho KR, Kim YJ, et al. Long-term results of the Cox-Maze III procedure for persistent atrial fibrillation associated with rheumatic mitral valve disease: 10-year experience. *Eur J Cardiothorac Surg.* Feb 2007; 31(2):261-266.
41. 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.
42. Krul SP, Driessen AH, Zwinderman AH, et al. Navigating the mini-maze: Systematic review of the first results and progress of minimally-invasive surgery in the treatment of atrial fibrillation. *Int J Cardiol.* 2013 Jun 5; 166(1): 132-40.
43. 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).
44. 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.* 2012; 7:71.

45. La Meir M, Gelsomino S, Luca F, et al. Minimal invasive surgery for atrial fibrillation: an updated review. *Europace*. Feb 2013; 15(2):170-182.
46. 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.
47. Lapenna E, De Bonis M, Giambuzzi I, et al. Long-term outcomes of stand alone maze IV for persistent or long standing persistent atrial fibrillation. *Ann Thorac Surg*. 2020 J;109(1):124-131.
48. 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.
49. 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.
50. 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.
51. 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).
52. 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.
53. 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*. Oct 03 2020.
54. MacGregor RM, Bakir NH, Pedamallu H, et al. Late results after stand-alone surgical ablation for atrial fibrillation. *J Thorac Cardiovasc Surg*. 2021 Apr 17;S0022-5223(21)00668-1.
55. 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.
56. Mhanna M, Beran A, Al-Abdoh 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.
57. 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.
58. 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.

59. Page P, C. C. S. Atrial Fibrillation Guidelines Committee. Canadian Cardiovascular Society atrial fibrillation guidelines 2010: surgical therapy. *Can J Cardiol.* Jan-Feb 2011; 27(1):67-73.
60. 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.
61. 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.
62. 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.
63. 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.
64. 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.
65. 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):724-730.
66. 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.
67. Schill MR, Sinn LA, Greenberg JW. A minimally invasive stand alone cox maze procedure is as effective as median sternotomy approach. *Innovations (phila).* May/Jun 2017;12 (3):186-91.
68. Si W, Yang S, Pan L, et al. Comparison of modified MAZE with minimally invasive monopolar ablation and traditional bipolar radiofrequency ablation in the treatment of atrial fibrillation. *J Cardiothorac Surg.* 2019 Nov 14;14(1):198.
69. 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.
70. 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.
71. 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.
72. Stulak JM, Suri RM, Burkhart HM, et al. Surgical ablation for atrial fibrillation for two decades: Are the results of new techniques equivalent to the Cox maze III procedure? *J Thorac Cardiovasc Surg.* May 2014; 147(5):1478- 1487.
73. 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.

74. Van Breugel HN, Nieman FH, Accord RE, et al. A prospective randomized multicenter comparison on healthrelated 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.
75. 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.
76. 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.
77. 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.
78. Wang J, Li Y, Shi J, et al. Minimally invasive surgical versus catheter ablation for the long-lasting persistent atrial fibrillation. *PLoS One*. 2011; 6(7):e22122.
79. 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.
80. 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.
81. 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.
82. 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.
83. 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.
84. 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*. 2012; 70(8):819-828.
85. 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.

POLICY HISTORY:

Adopted for Blue Advantage, January 2017

Available for comment February 6 through March 24, 2017

Medical Policy Group, May 2017

Available for comment May 15 through June 29, 2017

Medical Policy Group, July 2017

Medical Policy Group, June 2018

Medical Policy Group, May 2022

Medical Policy Group, June 2023

UM Committee, December 2023: Policy approved by UM Committee for use for Blue Advantage business.

Medical Policy Group, December 2024

UM Committee January 2025: Annual review of policy approved by UM Committee for use for Blue Advantage business.

This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member's plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield's administration of plan contracts.