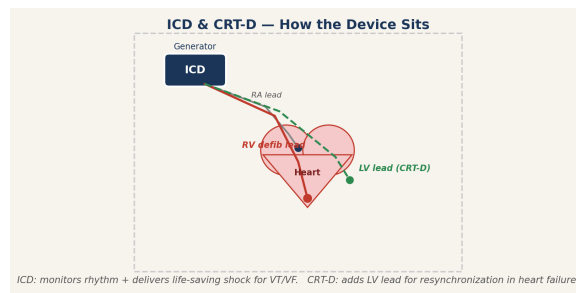


Understanding ICD and CRT-D

The implantable defibrillator and resynchronization device — what, when, and why

A small device under your collarbone, leads in your heart. It can shock you out of a deadly rhythm and (in CRT-D) help a weak heart beat in sync.



Online: <https://go.riasalimd.com/icd-crt-guide>

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Names & Terms You Will Hear

Term	Meaning
ICD (implantable cardioverter-defibrillator)	The core device. It watches your heart rhythm and delivers a shock to restore a normal rhythm when it sees VT or VF.
CRT-D (cardiac resynchronization therapy defibrillator)	An ICD plus a third lead in the left ventricle. The extra lead helps a weak, out-of-sync heart pump more evenly. Used when EF is 35% or lower and the QRS is wide.
CRT-P (cardiac resynchronization therapy pacemaker)	Same resync function as CRT-D, but no shock. Sometimes chosen for older or frail patients.
S-ICD (subcutaneous ICD)	An ICD whose lead runs under the skin near the breastbone — no leads inside the heart. Chosen when pacing is not needed.
Sudden cardiac death (SCD)	Death caused by a sudden dangerous heart rhythm — usually VT or VF. This is the event an ICD is designed to stop.
Primary prevention	An ICD placed before any VT/VF event. Given to patients at high risk — for example, EF of 35% or lower despite best medical therapy.
Secondary prevention	An ICD placed after a patient has already survived VT, VF, or fainting believed to be from arrhythmia.



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What Is ICD and CRT-D?

- An ICD is a small device — about the size of a wristwatch. It is placed under the skin below your collarbone (usually on the left). One or two thin wires (leads) run through a vein into your heart.
- The device watches your heart rhythm all the time. If it sees a dangerous fast rhythm (VT or VF), it can send rapid pacing (ATP) or a shock to restore a normal rhythm.
- A CRT-D is an ICD with a **third lead** in the left ventricle. This lead is placed through the coronary sinus vein. It lets the device pace both ventricles at once — helpful when the left side fires late (left bundle branch block, QRS 130 ms or wider).
- Most devices last 7-12 years. CRT-D batteries last 4-7 years because the extra LV pacing uses more power. When the battery runs low, you have a generator swap — a shorter, lower-risk procedure than the first implant.
- Most current devices are **MR-conditional**. This means MRI is safe under specific steps. Always tell the MRI staff and your cardiologist before any scan.
- Devices send data to a home monitor (CareLink, Latitude, or Merlin@Home). Alerts go to your cardiology team right away — often before you have symptoms.



A real ICD/CRT-D generator (Guidant Vitality AVT) shown next to a ruler for scale — about the size of a wristwatch. The header at top is where the leads connect before the device is placed under the collarbone. Image: Steven Rodriguez, Wikimedia Commons 2007 (CC BY 2.0).



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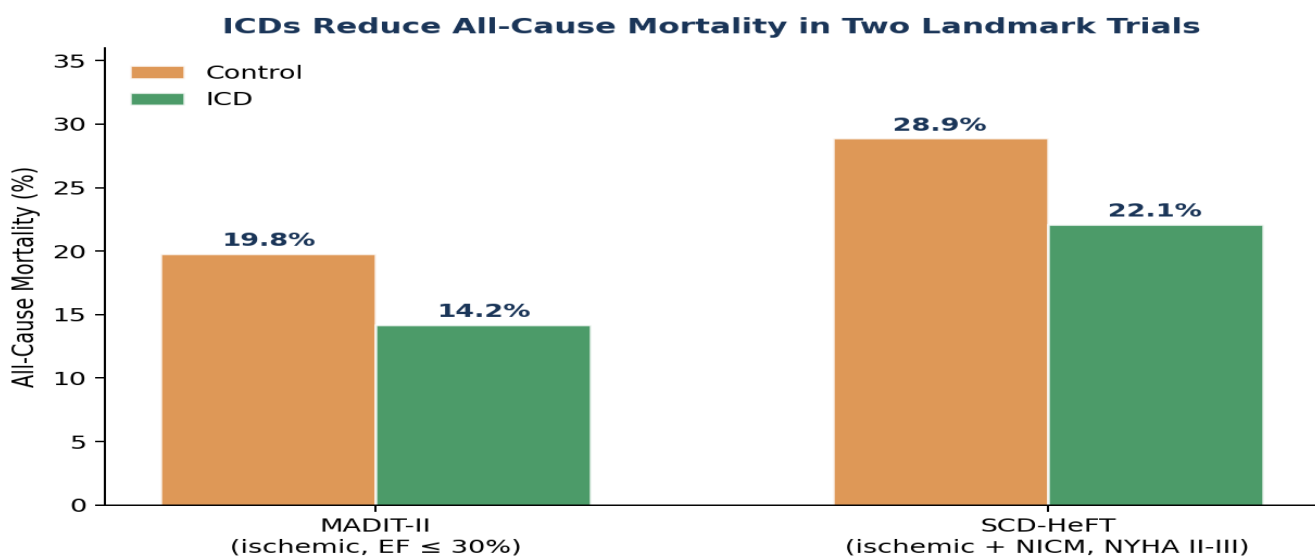
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Why It Matters

- **Sudden cardiac death (SCD)** from arrhythmia is a leading cause of death in many heart conditions. It is most common after a heart attack that weakens the muscle, in advanced heart failure, and in inherited arrhythmia syndromes.
- **MADIT-II (NEJM 2002)**: in ischemic cardiomyopathy with EF of 30% or lower, an ICD cut all-cause mortality by about 31% versus best medical care.
- **SCD-HeFT (NEJM 2005)**: in NYHA II-III heart failure (ischemic and nonischemic) with EF of 35% or lower, an ICD cut mortality by 23%. Amiodarone gave no benefit.
- **DANISH (NEJM 2016)**: in nonischemic cardiomyopathy, an ICD cut sudden cardiac death by ~50% but did not reduce overall mortality. Younger patients with high-risk features benefited most.
- **CRT-D in heart failure** (MADIT-CRT, RAFT, CARE-HF): lowers death and heart failure hospital stays in patients with EF of 35% or lower and wide QRS of 130 ms or more (especially LBBB). Up to one-third of patients see meaningful EF recovery.
- In selected high-risk patients, the device reduces a cause of death that medicines alone cannot easily prevent.



MADIT-II (Moss, NEJM 2002; n=1,232 ischemic CM, EF 30% or lower) and SCD-HeFT (Bardy, NEJM 2005; n=2,521 NYHA II-III HF, EF 35% or lower) both showed a large drop in mortality with ICD therapy compared to medicines alone. These two trials form the basis of current primary-prevention guidelines.



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Note on nonischemic cardiomyopathy. The DANISH trial (NEJM 2016) showed that in nonischemic CM with EF of 35% or lower, an ICD cut sudden cardiac death in half but did not lower overall mortality. Younger patients with high-risk features (genetic mutation, scar seen on MRI, prior brief runs of fast VT) got the most benefit. This means the ICD decision in nonischemic CM is more personal than it once was.



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Treatment Options

- **Before the procedure:** you will have an echo to check EF and heart structure. A 12-lead ECG checks QRS width. Some patients also need an EP study or cardiac MRI.
- **The procedure:** 1-3 hours in the cath lab or EP lab. You get sedation; general anesthesia is sometimes used. The doctor makes a small incision below the left collarbone. Leads are threaded through a vein into the heart. The generator is placed under the skin.
- **Recovery:** most patients stay one night for observation. Do not lift the arm on the implant side above shoulder height for 4-6 weeks. Most people return to desk work within a few days.
- **Driving:** wait 1 month after a primary-prevention implant. Wait 6 months after a secondary-prevention implant or after a shock. Rules for commercial drivers are stricter.
- **Follow-up visits:** device checks every 3-6 months in the first year, then every 6-12 months. A home transmitter sends data to your team between visits.
- **Keep taking your medicines:** beta-blockers, ACE inhibitors, ARBs, ARNI, MRAs, and SGLT2 inhibitors. The ICD does not replace medical therapy. Both work together.
- **When to get extra help:** if you receive several shocks in a short time (electrical storm), or if the device finds frequent VT, your doctor may adjust your medication or discuss VT ablation.



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Who Gets Which Device? (Simplified Indication Map)

EF	Substrate	QRS	Typical device
30% or lower	Ischemic CM, > 40 d post-MI	Any	ICD (primary prevention)
35% or lower	Ischemic CM, NYHA II-III	< 130 ms	ICD
35% or lower	Ischemic CM, NYHA II-III	130 ms or more, LBBB	CRT-D
35% or lower	Nonischemic CM, NYHA II-III	130 ms or more, LBBB	CRT-D
35% or lower	Nonischemic CM, no LBBB	Any	ICD (case-by-case per DANISH)
Any	Survived VT/VF or arrhythmic syncope	Any	ICD (secondary prevention)
35% or lower	Newly diagnosed; still optimizing GDMT	Any	WCD (LifeVest) bridge



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Unneeded Shocks — Why They Happen and How We Prevent Them

- **What 'unneeded' means:** the device shocks you for a rhythm that was not life-threatening. The most common causes are rapid AF, SVT, or lead noise that the device reads as VT or VF.
- **How common:** 5-10% of patients over a lifetime. Better software has made this far less common than it was in older devices.
- **Prevention by programming:** the device can wait for more beats before deciding it is VT. The rate cutoff for detection can be raised (e.g., 187 bpm instead of 150 bpm). Smart algorithms can also tell the difference between SVT and VT.
- **Prevention by medicine:** beta-blockers slow the heart rate in AF. Rate control or rhythm control of AF greatly cuts the risk of an unneeded shock.
- **Prevention by ablation:** in patients with frequent rapid AF, an AF ablation can lower the risk of unneeded shocks.
- **If you receive a shock:** call us. We will download the device and check the stored rhythm strip. This tells us if the shock was needed or not. We use that to decide the next step — reprogram, change medicine, do an ablation, or take no action.
- **Do not assume every shock was for a real arrhythmia.** Many patients have had one or two unneeded shocks over the life of their device. The device is tuned to be sensitive. Sometimes that means a false alarm.

Four Common Patient Scenarios

Post-MI ischemic CM, EF 30% or lower • Wait at least 40 days post-MI • At least 90 d post-revasc • On optimized GDMT • ICD recommended (Class I)	HFrEF + LBBB, QRS 150 ms or wider • EF 35% or lower, NYHA II-III • Strongest CRT-D indication • Up to 1/3 see EF recovery • Symptom + survival benefit	Nonischemic CM, EF 35% or lower, no LBBB • Individualize per DANISH • Cardiac MRI for substrate • Younger = stronger benefit • Reassess after GDMT	Survived VT/VF or arrhythmic syncope • ICD regardless of EF • Secondary prevention • Strongest evidence base • 6-month driving restriction
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Risks, Benefits, and Alternatives

Every choice has trade-offs. Use this table to start the shared decision conversation.

Option	Risks	Benefits	Alternatives
Primary-prevention ICD — ischemic CM, EF 30-35% or lower	Major procedural risks in 1-2%: collapsed lung, lead dislodgement, infection, or bleeding. Lifetime risk of an unneeded shock is 5-10%. Some body-image and lifestyle changes.	About 30% fewer deaths from any cause (MADIT-II / SCD-HeFT). Guards against the main cause of death in this group.	Optimize medical therapy first. Recheck EF after 3-6 months. If EF rises above 35%, you and your doctor may decide an ICD is no longer needed.
Primary-prevention ICD — nonischemic CM, EF 35% or lower	Same procedural risks. The DANISH trial showed no overall survival benefit — but sudden cardiac death was still cut in half.	Cuts sudden cardiac death by ~50%. The full mortality benefit is seen most in younger patients with high-risk features (genetic mutation, scar on MRI, prior runs of fast VT).	A wearable defibrillator (LifeVest) can protect you while medicines are being adjusted. Cardiac MRI helps assess risk.
Secondary-prevention ICD — survived VT, VF, or arrhythmic fainting	Same procedural risks. You must avoid driving for at least 6 months.	This is the strongest indication. An ICD is the standard of care regardless of EF. It clearly lowers mortality compared with medicines alone.	VT ablation may work alongside the device in some patients.



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Option	Risks	Benefits	Alternatives
CRT-D — HFrEF, EF 35% or lower, QRS 130 ms or wider (especially LBBB)	The LV lead is harder to place than a standard lead. About 1-3% of patients feel rhythmic hiccupping (phrenic nerve stimulation) — usually fixed by reprogramming. About 30% of patients do not respond.	Lowers death and heart failure hospital stays. About one-third of patients see meaningful EF recovery. The strongest benefit is in LBBB with QRS 150 ms or wider.	CRT-P (resync without a shock function) is an option for older or frail patients who do not want shock therapy.
Wearable defibrillator (LifeVest) as a bridge	Worn more than 23 hours a day. Alarms can sometimes be false. It is not a long-term fix.	Protects you during the 90-day wait after a procedure (revascularization) or while your medicines are being adjusted after a new diagnosis.	If ICD criteria are already met, go straight to implant. Close monitoring in the hospital is another option.
No device — medicines only	Higher risk of sudden cardiac death for patients who qualify for a device.	Avoids the procedure and lifestyle changes. A fair choice when life expectancy is limited by another serious illness.	Recheck over time. An ICD can still be placed later if things change.



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Common Misconceptions

Myth	Reality
If I have an ICD, I won't die.	An ICD guards against sudden death from VT or VF only. It does not stop heart attacks, heart failure, stroke, cancer, or other causes of death. It is a powerful but narrow protection.
The shock will be terrible and I won't survive it.	Most shocks last a fraction of a second. Patients describe it as a sudden kick in the chest or a startle. The shock fires because you were already in or near cardiac arrest. Most patients are glad it fired.
I shouldn't get an ICD because I might get unneeded shocks.	Unneeded shocks (usually from rapid AF or SVT) happen in 5-10% of patients. They are usually fixed with reprogramming, a medicine change, or rarely a lead revision. Modern devices have much better detection than older ones.
Once it's in, I can never turn it off.	Not true. The shock function can be turned off by a clinician at any time — including in hospice. This is ethical and legal. It does not hasten death. It only prevents an unwanted shock during natural dying.
I can't have an MRI with an ICD.	Most modern ICDs and CRT-Ds are MR-conditional. MRI is safe under specific steps. Tell the MRI center about your device. Your device team will adjust the settings before and after the scan.
ICDs and pacemakers are the same thing.	An ICD can also pace, but its key job is delivering a shock for deadly fast rhythms. A pacemaker treats slow rhythms. An ICD treats fast ones that can cause sudden death.
CRT just paces faster — it's no big deal.	CRT does not speed up the heart. It times the left and right ventricles to fire together when the electrical signal is delayed. The result is a more efficient squeeze — not a faster rate.



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Myth	Reality
If my EF improves, I should have the ICD removed.	Even when EF gets better, the scar or other risk factors often remain. Whether to turn off or remove the device is a personal decision. Talk with your electrophysiologist. Do not assume removal is automatic.



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Possible Complications

Knowing what can go wrong helps you spot problems early. Most complications are uncommon, especially with treatment.

Where / What	What Can Happen
Procedural — collapsed lung (pneumothorax)	Happens in 1-2% when the subclavian vein is used for the lead. Most cases are watched and resolve on their own. A chest tube is rarely needed.
Procedural — bleeding or bruising at the pocket	Light bruising is normal. A large bruise that needs draining happens in about 1-2% of cases. Risk is higher if you take blood thinners.
Procedural — pocket infection	Happens in about 1-2% of implants. May require removal of the device and IV antibiotics. Risk is higher with diabetes, dialysis, or a repeat procedure.
Lead dislodgement or fracture	About 1-3% of leads shift in the first month. Leads can also fail over time. A shifted or broken lead may need to be repositioned or replaced.
Unneeded shocks	5-10% lifetime risk. Usually caused by rapid AF or SVT that the device mistakes for VT. Better detection software has made this much less common.
CRT-D specific — phrenic nerve stimulation	In 1-3% of cases, the LV lead tickles the diaphragm and causes rhythmic hiccups. This is usually fixed by reprogramming the device.
Battery end-of-life / generator swap	Depending on the device, this is needed every 4-12 years. The swap is a shorter, lower-risk procedure than the first implant.
Device extraction (if needed)	Removing leads that have scarred in carries a 1-3% risk of a major complication, including death. It is reserved for infection, a broken lead, or an upgrade.



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Points to Know

If you remember nothing else, remember these key points.

- An ICD is a small device under your collarbone. It detects and treats deadly heart rhythms.
- Primary prevention means placing the device before any VT/VF episode. Secondary means placing it after you have already survived one.
- MADIT-II and SCD-HeFT showed a 25-30% drop in deaths in patients who qualify.
- CRT-D adds a third lead in the left ventricle for heart failure with wide QRS of 130 ms or more.
- The DANISH trial showed benefit in younger patients with nonischemic CM — not in all patients.
- Modern ICDs are MR-conditional. MRI is safe if you follow the right steps.
- Driving limit: 1 month for primary prevention; 6 months for secondary prevention or after a shock.
- Unneeded shocks happen in 5-10% of patients. Most are fixed by reprogramming.
- The shock function can be turned off at end of life. This is ethical and lawful.



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When to Call Us - and When to Call 911

If you are not sure, call. We would rather hear from you twice than miss a real problem.

- You received a shock — call us today. Call 911 if you have chest pain, trouble breathing, or feel another shock may be coming.
- Several shocks in 24 hours (electrical storm) — call 911 or go to the ER right away.
- Fever, redness, fluid, or pain at the device pocket — call us this week. This may be an infection.
- Chest twitching, rhythmic hiccupping, or a stimulation you can feel — call us this week. This may be a lead shift or phrenic nerve issue.
- Dizziness, lightheadedness, or near-fainting — call us this week. There may be a rhythm issue or device problem.
- Ongoing palpitations or new shortness of breath — call us this week.
- Planning travel, surgery, a dental visit, an MRI, or radiation therapy — call us first so we can prepare your device.
- Thinking about turning off the ICD as part of hospice or advance care planning — call us. We welcome this talk.

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End-of-life ICD decisions. We welcome this conversation at any stage. Turning off the shock function in hospice or serious illness is ethical, legal, and can be reversed. It does not hasten death. It only prevents an unwanted shock during natural dying. The pacing function can be left on or turned off based on your wishes. Please talk to us — this is part of good care planning.



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Trusted Resources

The links below are the trusted resources Dr. Ali used to write this guide and that he recommends you visit for more information. Each is a clickable link in the digital version and a Short.io tracked URL on the printed version.

- [AHA — Implantable Cardioverter Defibrillator \(ICD\)](#) - AHA patient page on ICDs.
- [Cleveland Clinic — Implantable Cardioverter Defibrillator \(ICD\)](#) - Cleveland Clinic overview of ICD types, procedure, and living with the device.
- [Mayo Clinic — Implantable Cardioverter Defibrillators \(ICDs\)](#) - Mayo overview of ICD indications, complications, and lifestyle.
- [Heart Rhythm Society — Patient Resources](#) - Patient resources from HRS, the leading EP/device society.
- [AHA — Cardiac Resynchronization Therapy \(CRT\)](#) - AHA overview of CRT and device-based therapies for heart failure.



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Sources Used to Build This Guide

Every recommendation in this guide is grounded in one or more of the studies, guidelines, or trusted resources below. Short links are tracked so Dr. Ali can see which references patients are reading; nothing personally identifying is captured.

- [MADIT-II — Prophylactic Implantation of a Defibrillator in Patients with Myocardial Infarction and Reduced EF \(Moss et al., NEJM 2002; PMID 11907286\) \[Clinical Trial\]](#)
Landmark primary-prevention ICD trial; established ~31% mortality reduction in ischemic cardiomyopathy with EF ≤ 30%. Foundation for current primary-prevention guidelines.
- [SCD-HeFT — Amiodarone or ICD for Congestive Heart Failure \(Bardy et al., NEJM 2005; PMID 15659722\) \[Clinical Trial\]](#)
Pivotal trial in 2,521 NYHA II-III HF patients (mixed ischemic + nonischemic, EF ≤ 35%); ICD cut all-cause mortality 23% vs placebo; amiodarone offered no benefit. Extended ICD indication to nonischemic CM.
- [DANISH — Defibrillator Implantation in Patients with Nonischemic Systolic Heart Failure \(Koeber et al., NEJM 2016; PMID 27571011\) \[Clinical Trial\]](#)
Nuanced the NICM primary-prevention picture: 1,116 patients with EF ≤ 35%; ICD reduced sudden cardiac death by 50% but did not reduce all-cause mortality; benefit concentrated in younger patients (<68 years).
- [MADIT-CRT — Cardiac Resynchronization Therapy for the Prevention of Heart Failure Events \(Moss et al., NEJM 2009; PMID 19723701\) \[Clinical Trial\]](#)
Established CRT-D benefit in mildly symptomatic HF (NYHA I-II) with EF ≤ 30% and QRS ≥ 130 ms; 34% reduction in death or HF events. Strongest benefit in LBBB.
- [2017 AHA/ACC/HRS Guideline for Management of Patients with Ventricular Arrhythmias and Prevention of SCD \(Al-Khatib et al., Circulation 2018\) \[Guideline\]](#)
Current US guideline defining Class I primary- and secondary-prevention ICD indications, EF and timing thresholds, secondary-prevention criteria, WCD use, and end-of-life device management.
- [2013 ACCF/AHA Guideline for the Management of Heart Failure \(Yancy et al., Circulation 2013\) \[Guideline\]](#)
Defines CRT eligibility criteria: EF ≤ 35%, NYHA II-IV, QRS ≥ 120 ms (Class I for ≥ 150 ms with LBBB), guideline-directed medical therapy in place.
- [AHA — Implantable Cardioverter Defibrillators \(ICDs\) Patient Page \[Clinical\]](#)
AHA patient-facing overview of ICDs, indications, and what to expect.
- [Cleveland Clinic — Implantable Cardioverter Defibrillator \(ICD\) \[Clinical\]](#)
Cleveland Clinic patient overview covering ICD types, procedure, recovery, and living with the device.
- [Mayo Clinic — Implantable Cardioverter Defibrillators \(ICDs\) \[Clinical\]](#)
Mayo patient overview of ICD indications, procedure, complications, and lifestyle considerations.



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Reviewer note: Reviewed against AHA, Cleveland Clinic, Mayo Clinic, and the 2017 AHA/ACC/HRS guideline. This guide adds more detail on primary vs. secondary prevention, the WCD bridge, CRT-D vs. CRT-P, inappropriate shocks, and end-of-life ICD decisions.

Disclaimer

This guide is for educational purposes only and does not replace medical advice from your physician. Recommendations may not apply to every patient. Always follow the specific instructions of Dr. Ali and your care team. In an emergency call 911 or go to the nearest emergency department.



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