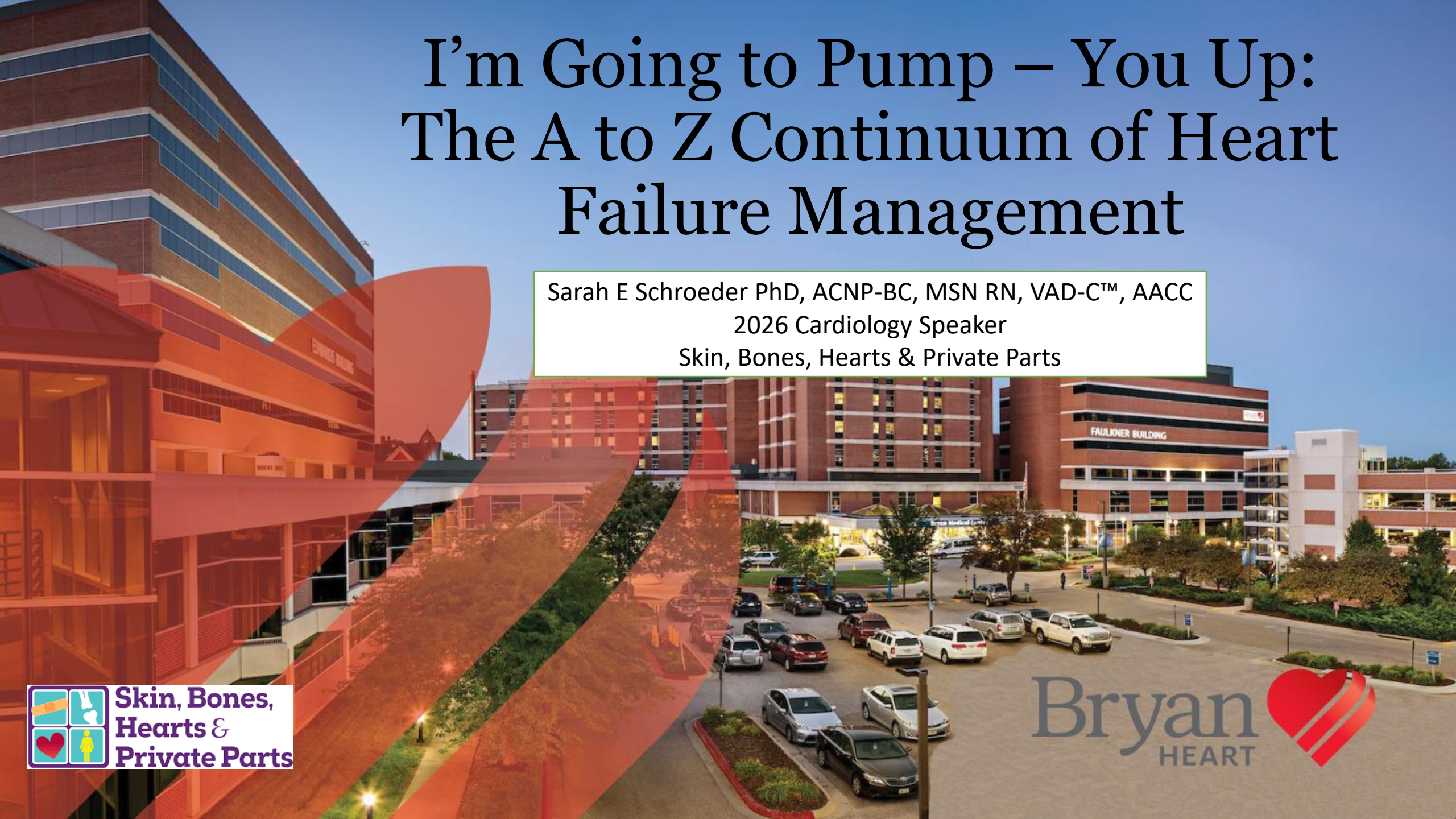
I'm Going to Pump – You Up: The A to Z Continuum of Heart Failure Management

Sarah E Schroeder PhD, ACNP-BC, MSN RN, VAD-C™, AACC
2026 Cardiology Speaker
Skin, Bones, Hearts & Private Parts



Disclosures

- Investigator-Driven Research Grant, Abbott Labs, 2023-2026
- VAD Coordinator Professional Development Grant, ICCAC, 2024-2026

I will occasionally discuss patient scenarios – any pictures directly of patients are displayed following consent and will be noted

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Bryan HEART

Objectives

- Heart Failure and Why it Matters
- Different Types of Heart Failure
- Heart Failure Symptomatology
- Evaluation Process for "HF" Symptoms
- HF Guideline Driven Medical Therapy – The Ins and Outs
- The Importance of Heart Failure Trajectory – The Pyramid Approach
- 90-Day Echocardiogram Re-evaluation
- Next Steps – DEVICES
  - Neuromodulation
  - Cardiomems
- Heart Pumps, Transplants, Palliative Medicine – The T in the Road Meets
- Final PEARLS on Important Heart Failure Need to Knows

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Heart Failure and Why it Matters



PREVALENT



EXPENSIVE

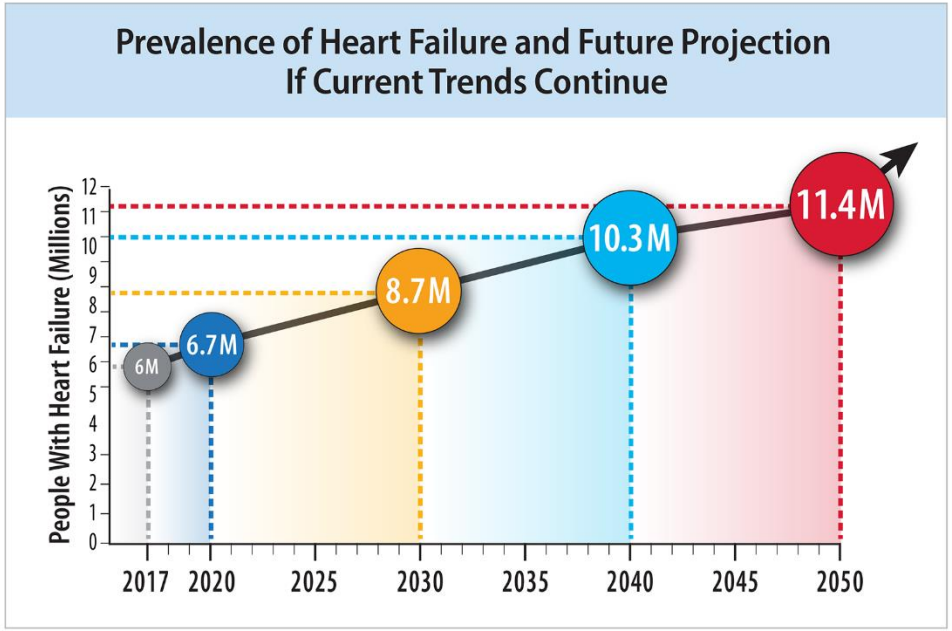


NO CURE

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Bryan HEART

Why Do We Care So Much?



HF = heart failure.

Data from Joynt Maddox KE, Elkind MSV, Aparicio HJ, Commodore-Mensah Y, de Ferranti SD, Dowd WN, et al. Forecasting the burden of cardiovascular disease and stroke in the United States through 2050-prevalence of risk factors and disease: A Presidential Advisory from the American Heart Association. *Circulation*. 2024 Jun 4.; Van Nuys KE, Xie Z, Tysinger B, Hlatky MA, Goldman DP. Innovation in heart failure treatment: life expectancy, disability, and health disparities. *JACC Heart Fail.* 2018; 6:401–9.; and Heidenreich PA, Albert NM, Allen LA, Bluemke DA, Butler J, Fonarow GC, et al. Forecasting the impact of heart failure in the United States: A policy statement from the American Heart Association. *Circ Heart Fail.* 2013; 6:606–19.

960,000
NEW CASES



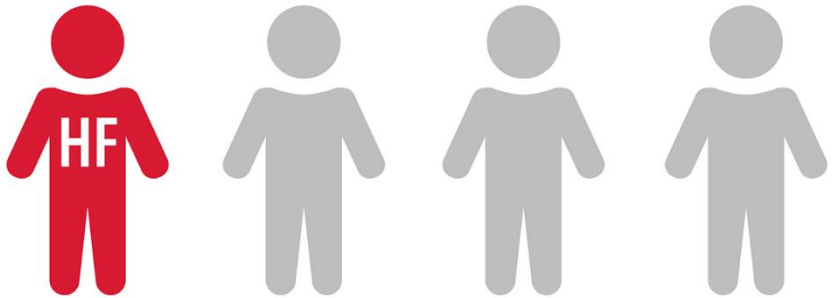
EVERY YEAR!

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J Card Fail. 2024; **31**, P 66-116

Lifetime Risk of Heart Failure



The lifetime risk of heart failure is 1 in 4 people.

HF=heart failure.

Data from Vasan RS, Enserro DM, Beiser AS, Xanthakis V. Lifetime risk of heart failure among participants in the Framingham Study. *J Am Coll Cardiol.* 2022; 79:250-63.

JCF Bozkurt et al DOI:10.1016/j.cardfail.2024.07.001

Over 11.4 million Americans are estimated to have HF by 2050, resulting in

$121 billion in direct medical costs attributed *solely* to HF

$22 billion indirect costs attributed *solely* to HF

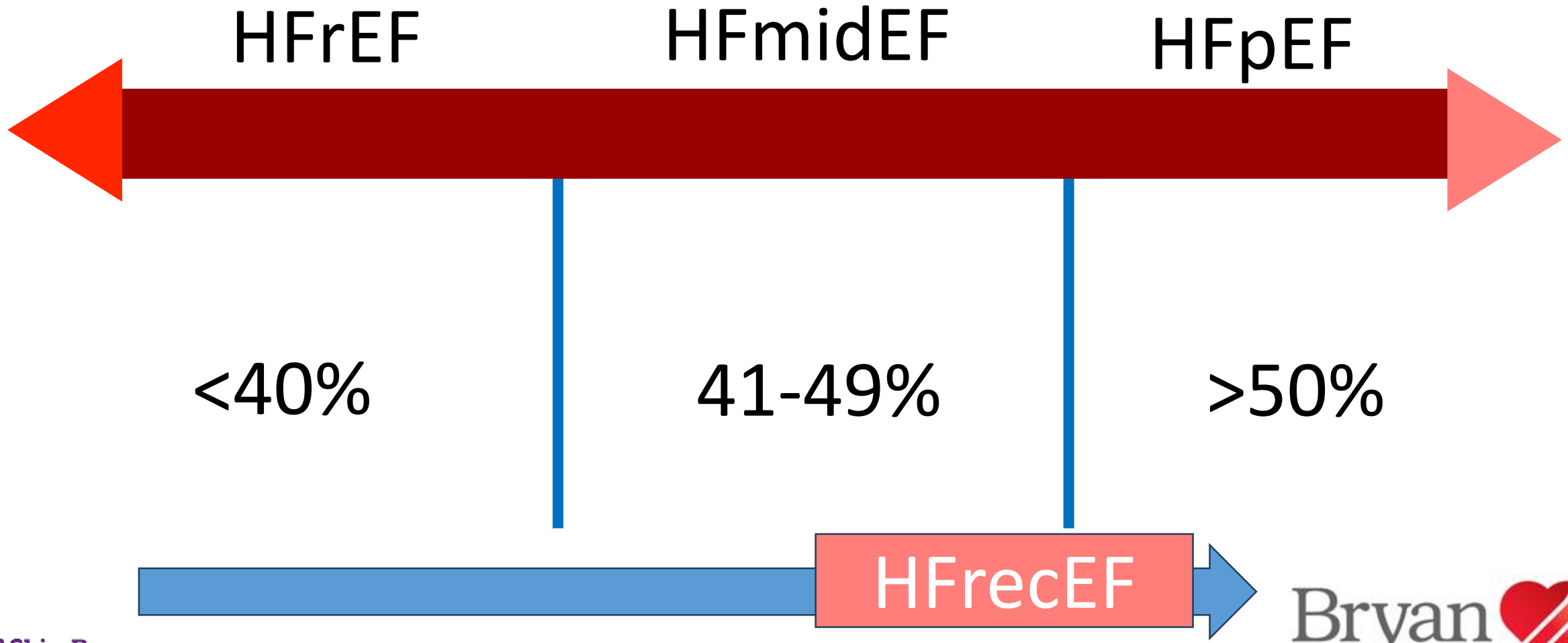


$142 billion total costs attributed *solely* to HF

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Different Types of Heart Failure



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The Initial Diagnosis







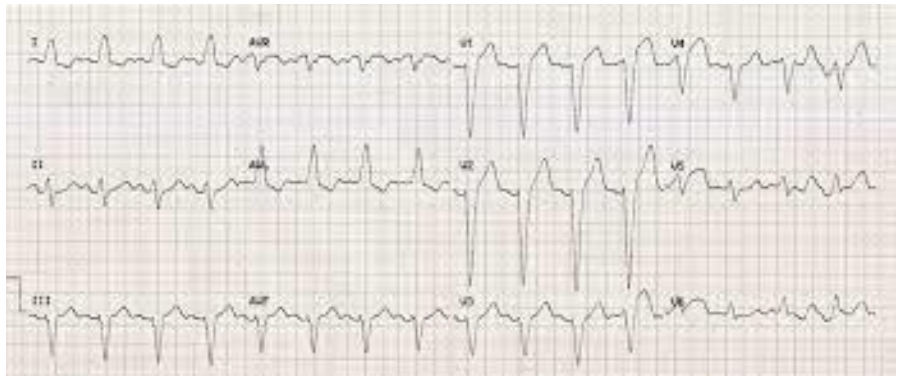




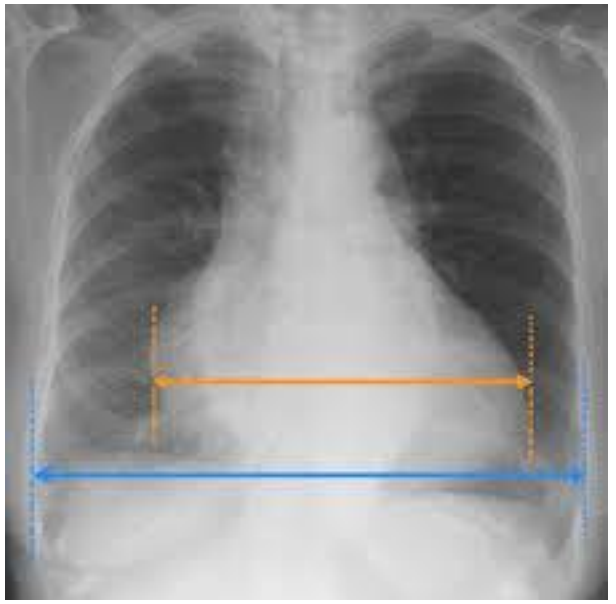


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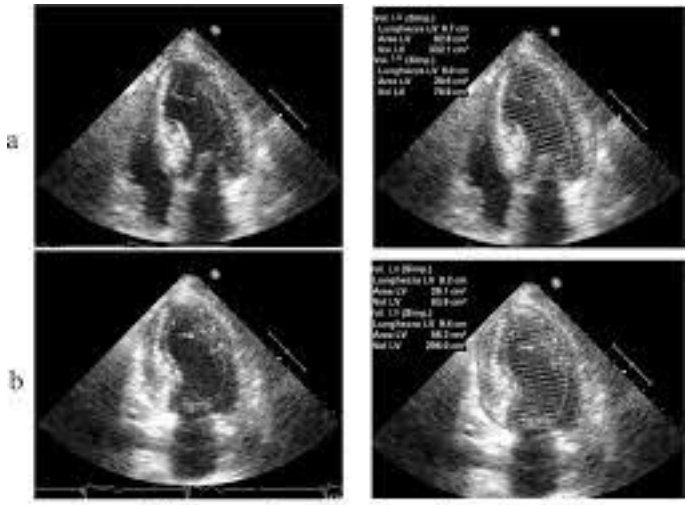
Atrial Fibrillation or Conduction Changes



Enlarged Heart



> 200



LVM assessed at 2D echocardiography = 237 g

Function of the Heart

Skin, Bones, Hearts & Private Parts

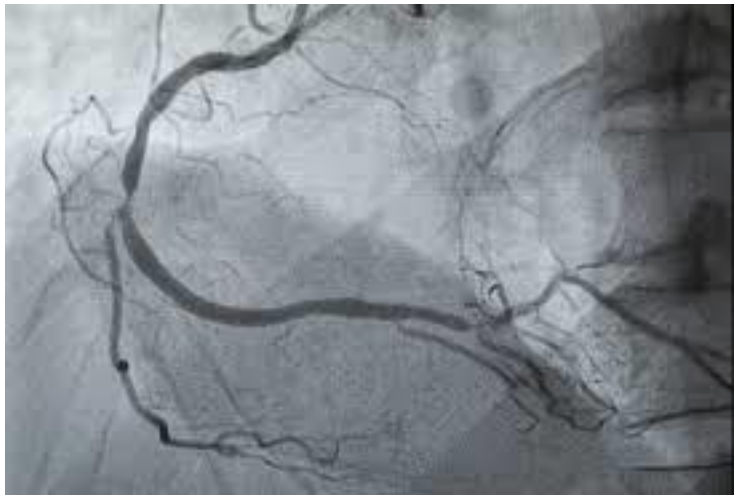
Bryan HEART

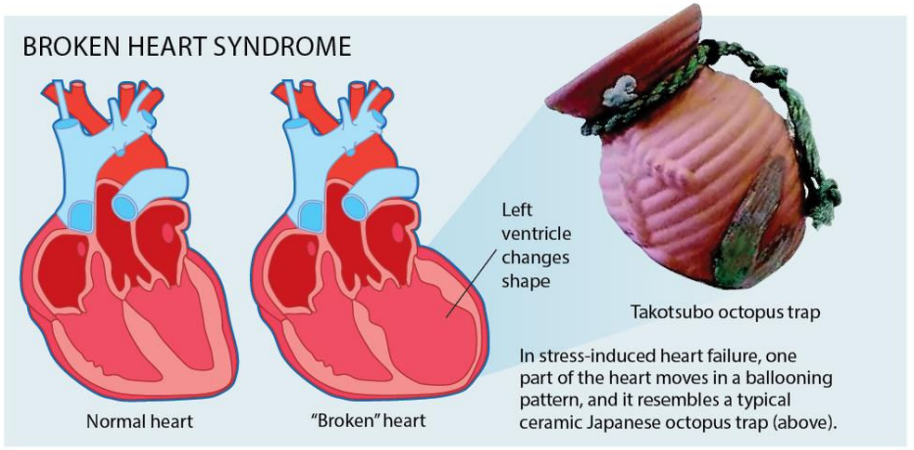
What are Typical Causes of Heart Dysfunction?

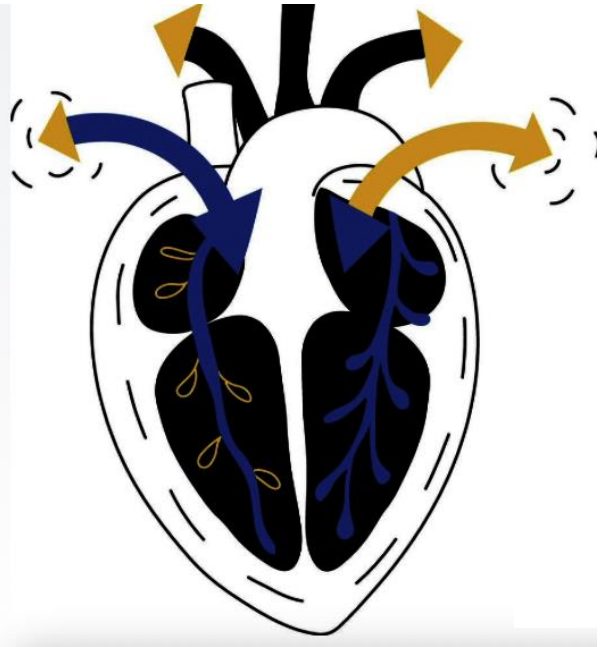


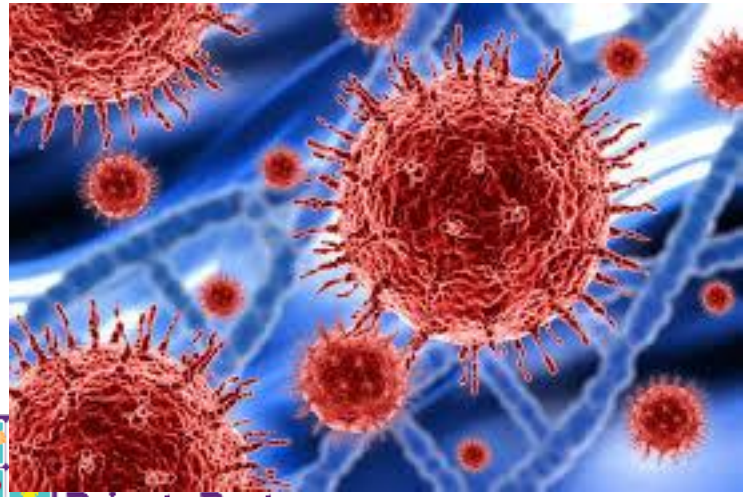
> 50









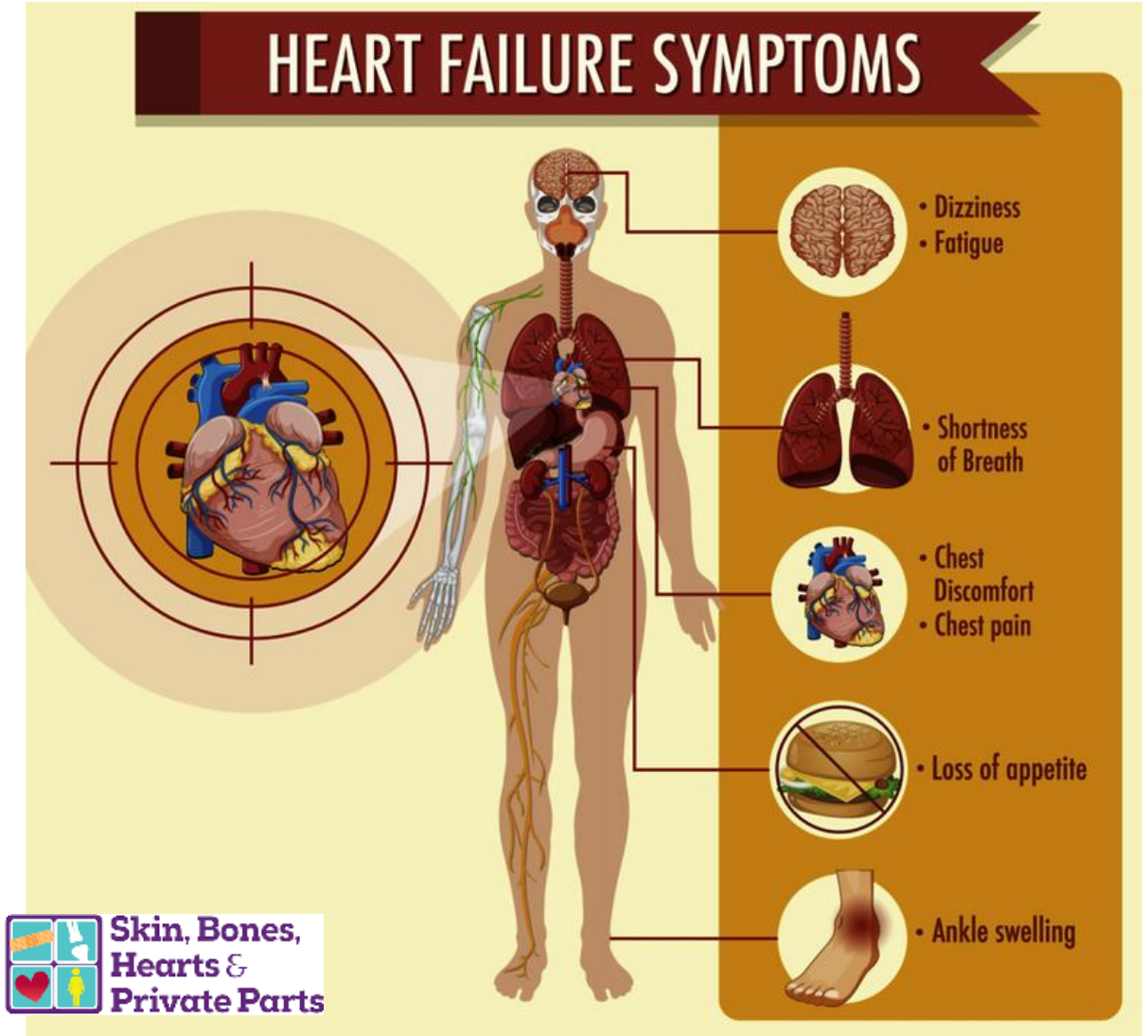




Private Parts

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What Kind of Symptoms are Present in those with Heart Dysfunction?



Low blood pressure, decreased output from the heart or increased diuretic use

Too much volume circulating backwards to the lungs

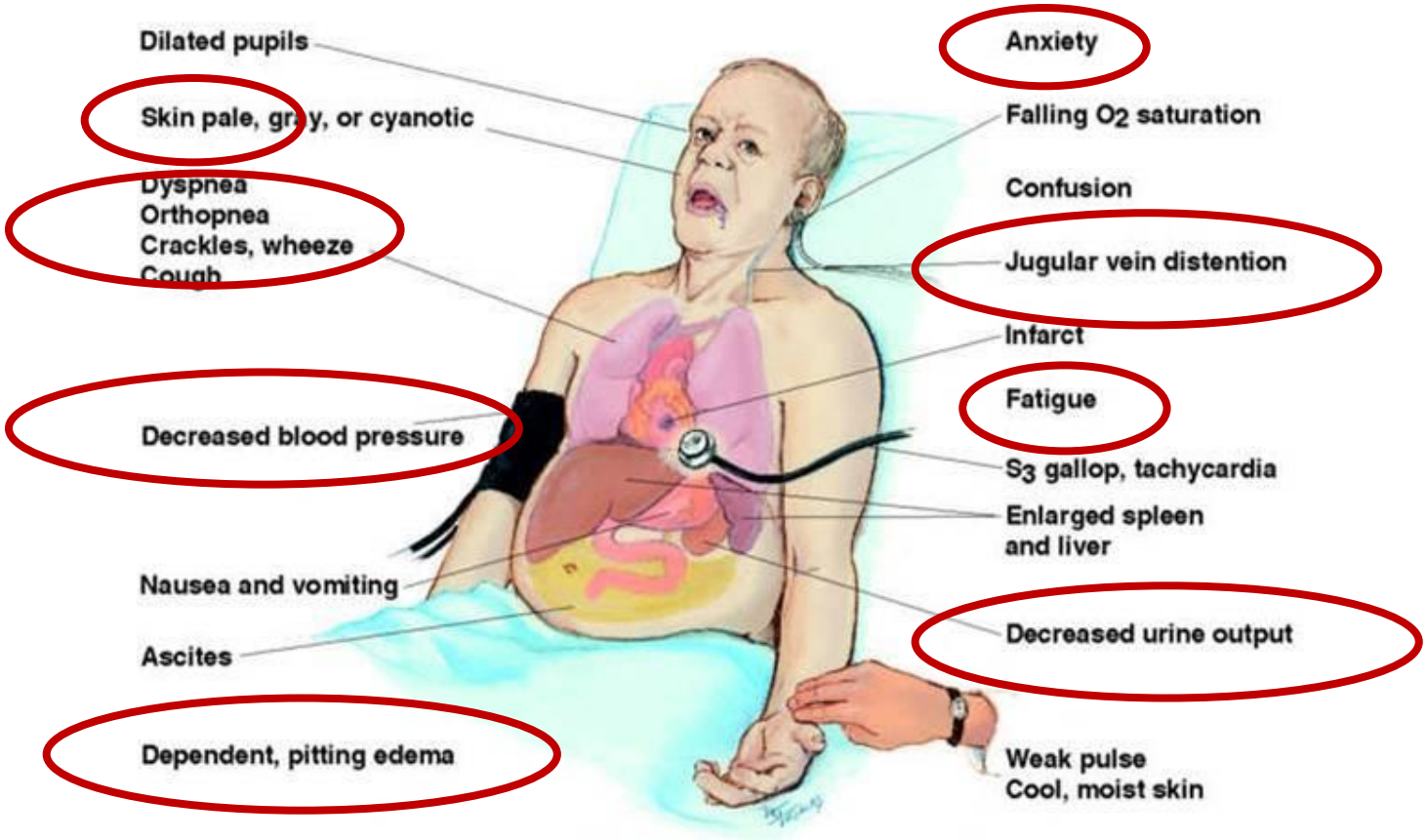
Heart is working too hard (possible blockage) or High Blood Pressure

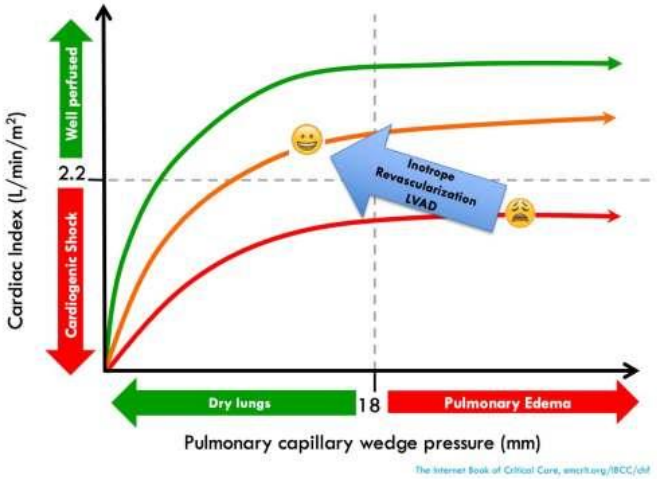
Not enough blood flow to the stomach for digestion

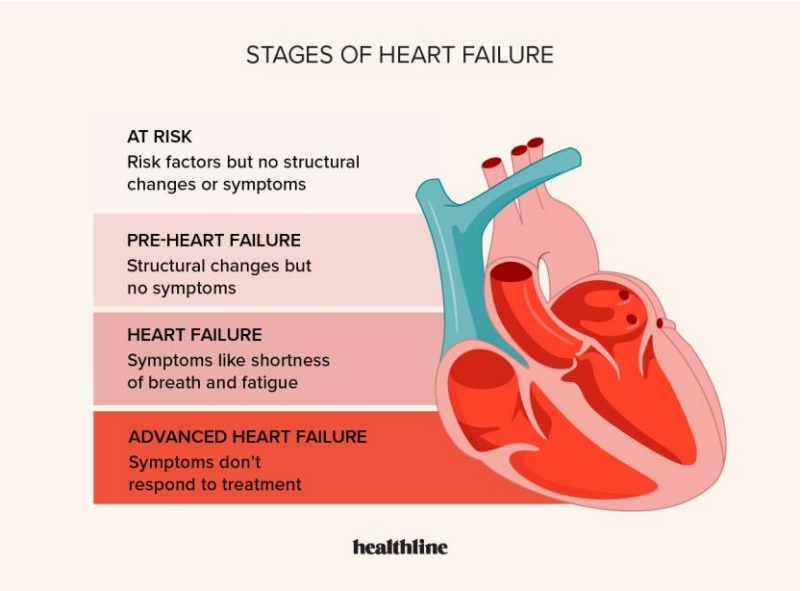
Too much salt/water and dysfunctional squeeze

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Heart Failure Symptomatology

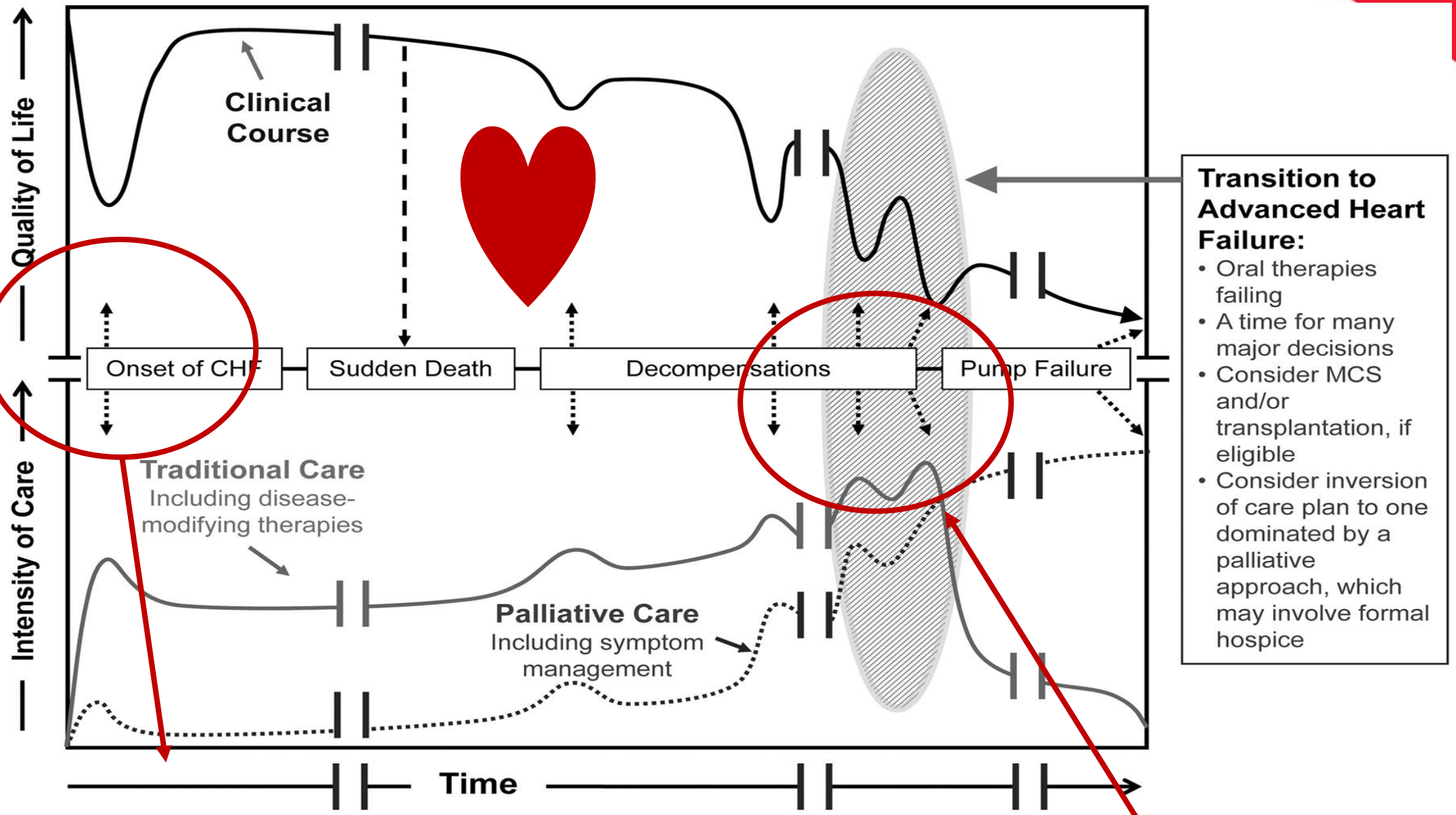






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Transition to Advanced Heart Failure:

- Oral therapies failing
- A time for many major decisions
- Consider MCS and/or transplantation, if eligible
- Consider inversion of care plan to one dominated by a palliative approach, which may involve formal hospice

10% 30-day mortality risk

Readmission here is too late (BIV failure)

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A Better Way to Understand





Dry

Warm

Wet

Warm





Dry

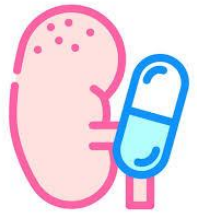
Cool

Wet



Cool





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What Symptoms Will We See?

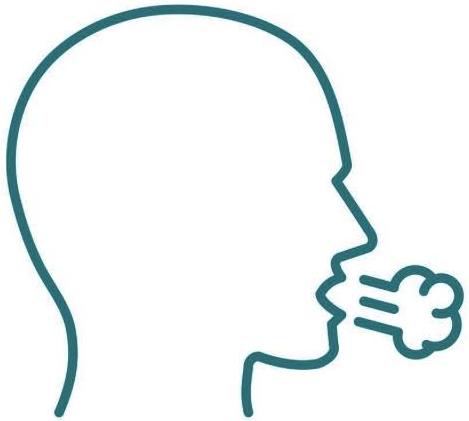


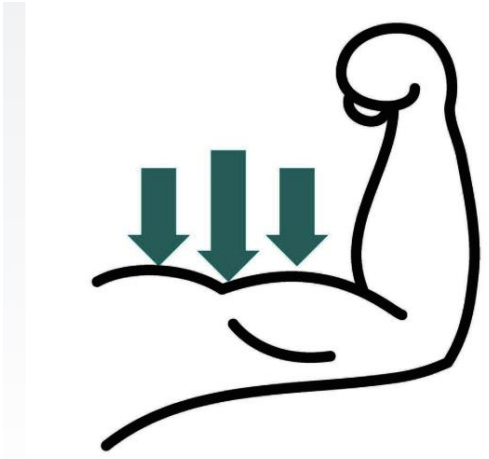








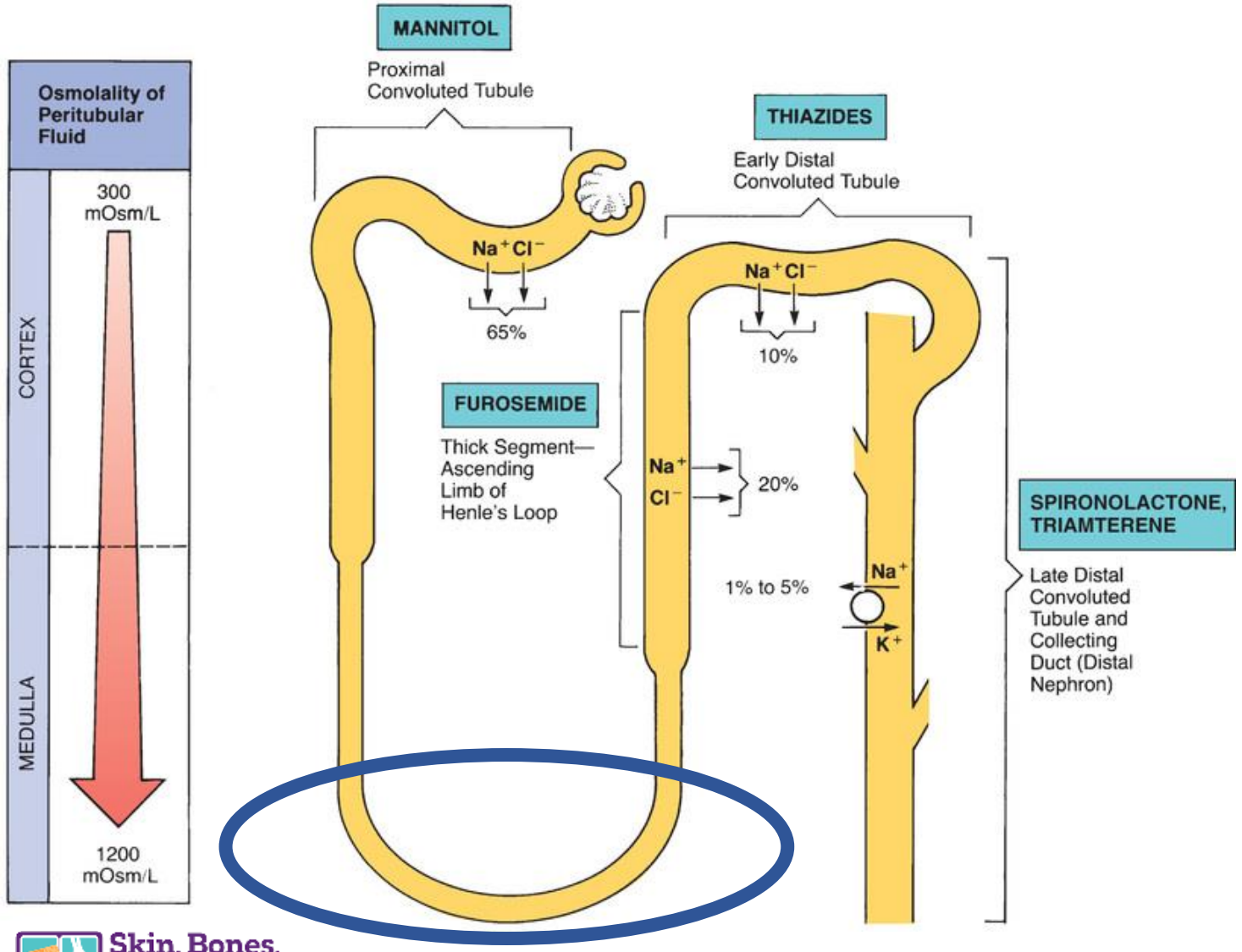




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IV Lasix = Liquid GOLD

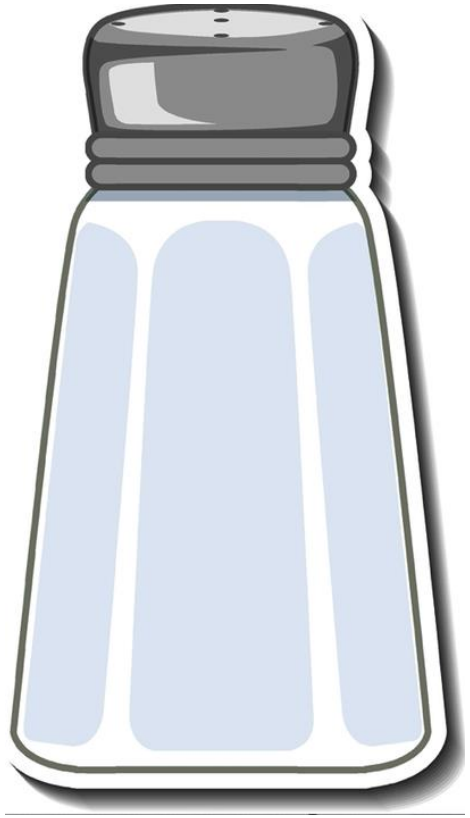




Skin, Bones, Hearts & Private Parts

Important Education

< 48 ounces of fluid



1500mg or less





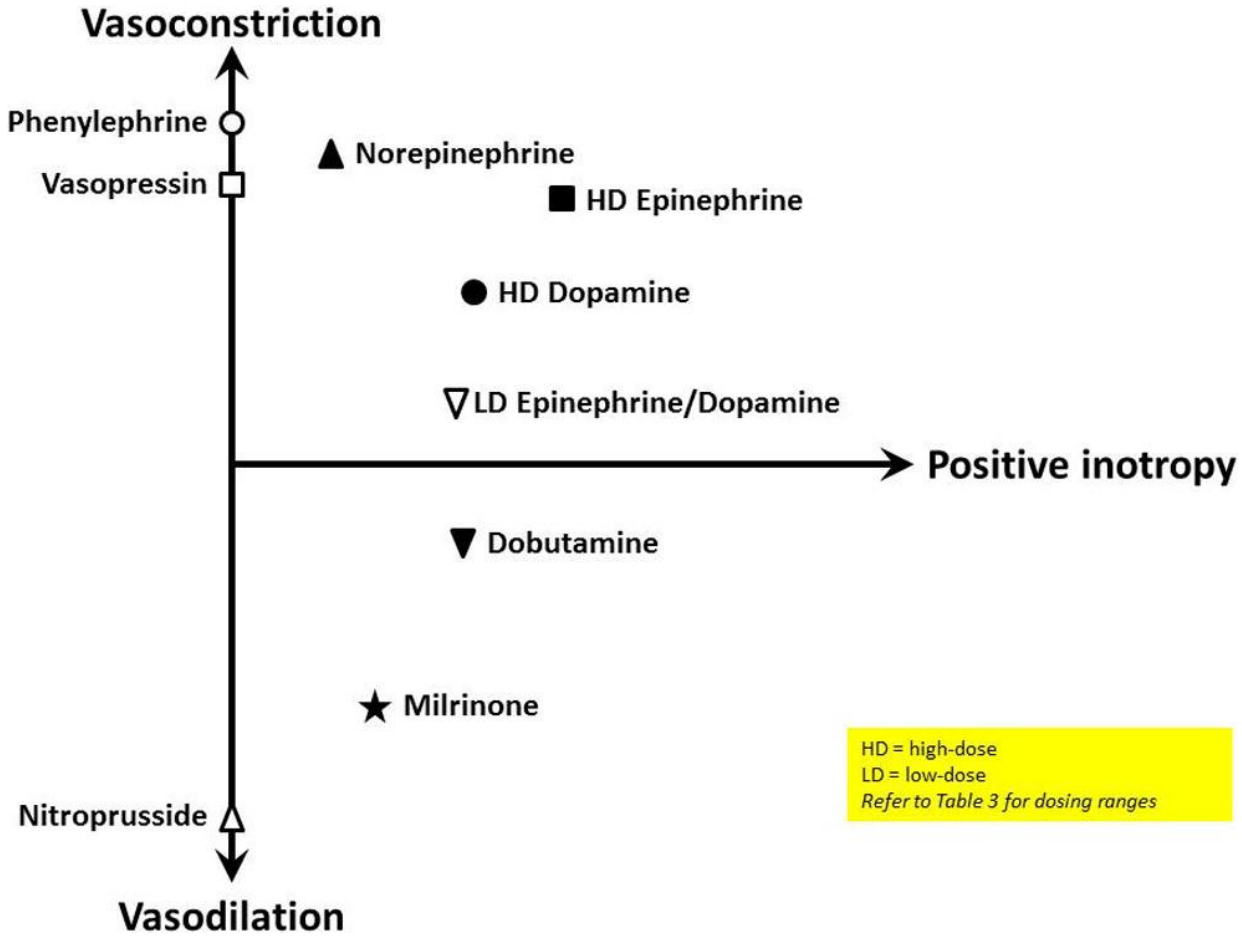
2# wt gain 1 day/3-5#s in 1 week

HF GDMT



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Use of Inotropes and Vasopressors = Fact or Fiction





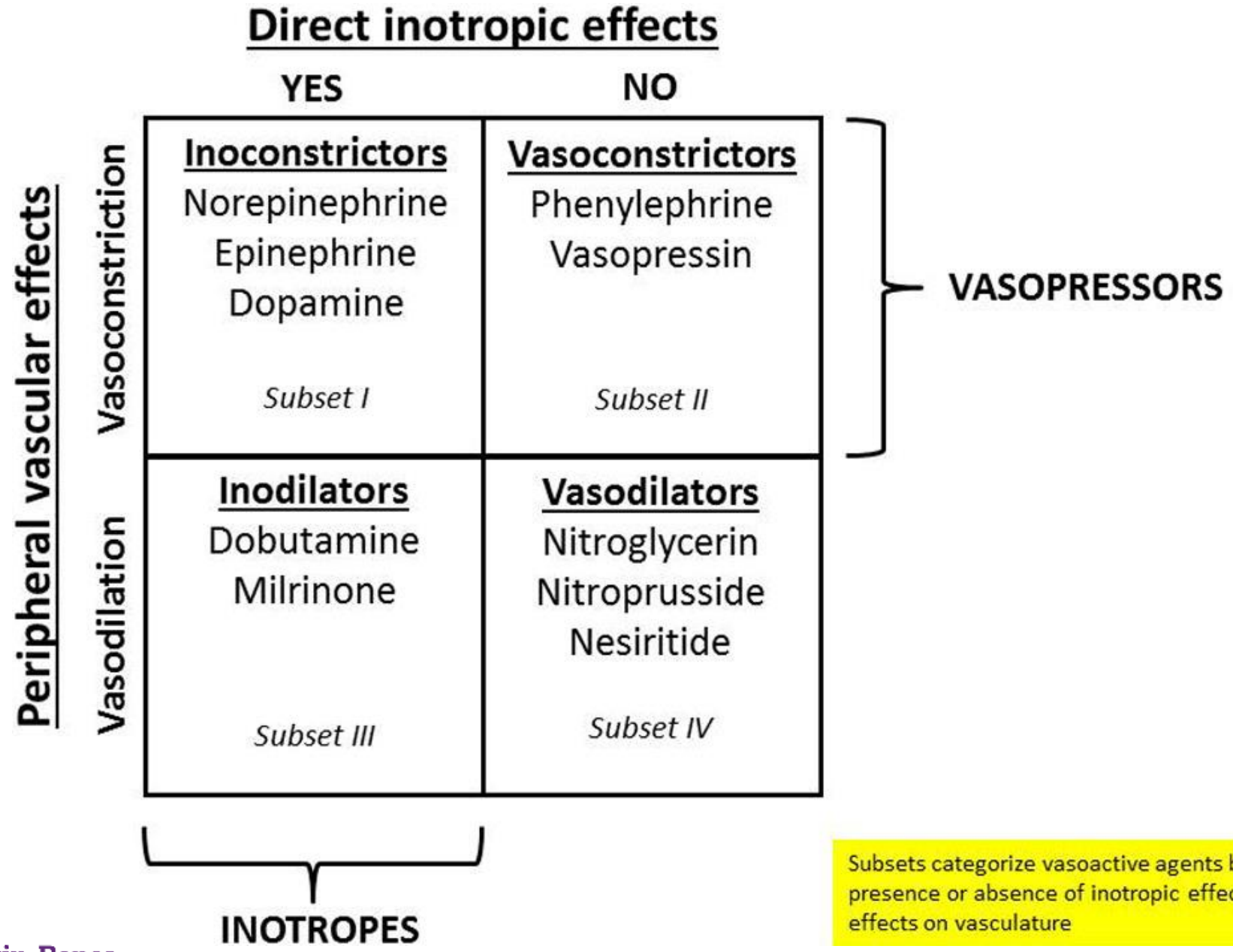
VASOCONSTRICTION

VASODILATION

INCREASED SQUEEZE

Skin, Bones, Hearts & Private Parts

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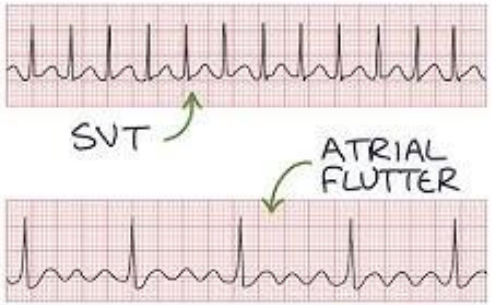
Subsets categorize vasoactive agents by presence or absence of inotropic effects and effects on vasculature

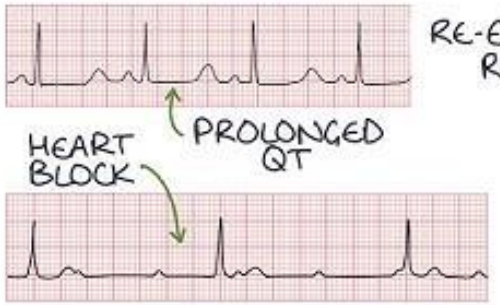
Skin, Bones, Hearts & Private Parts

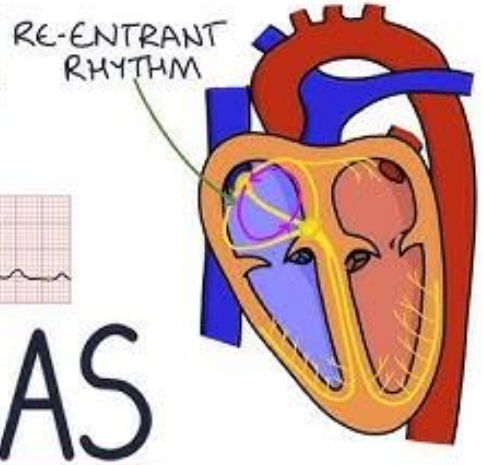
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Jentzer J, et al. 2014. Pharmacotherapy Update on the Use of Vasopressors and Inotropes in the Intensive Care Unit - Jacob C. Jentzer, James C. Coons, Christopher B. Link, Mark Schmidhofer, 2015

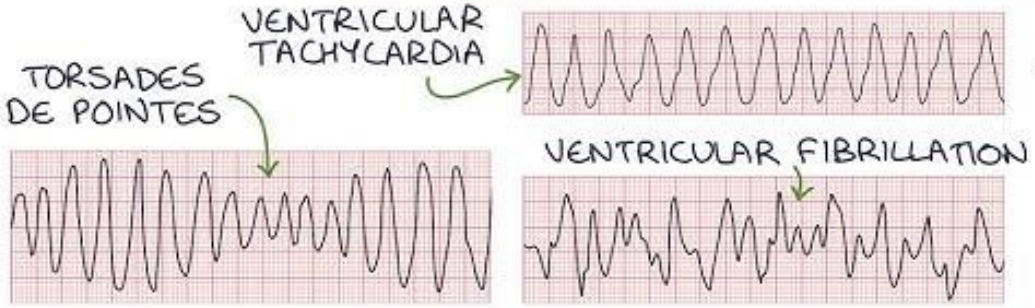








ARRHYTHMIAS







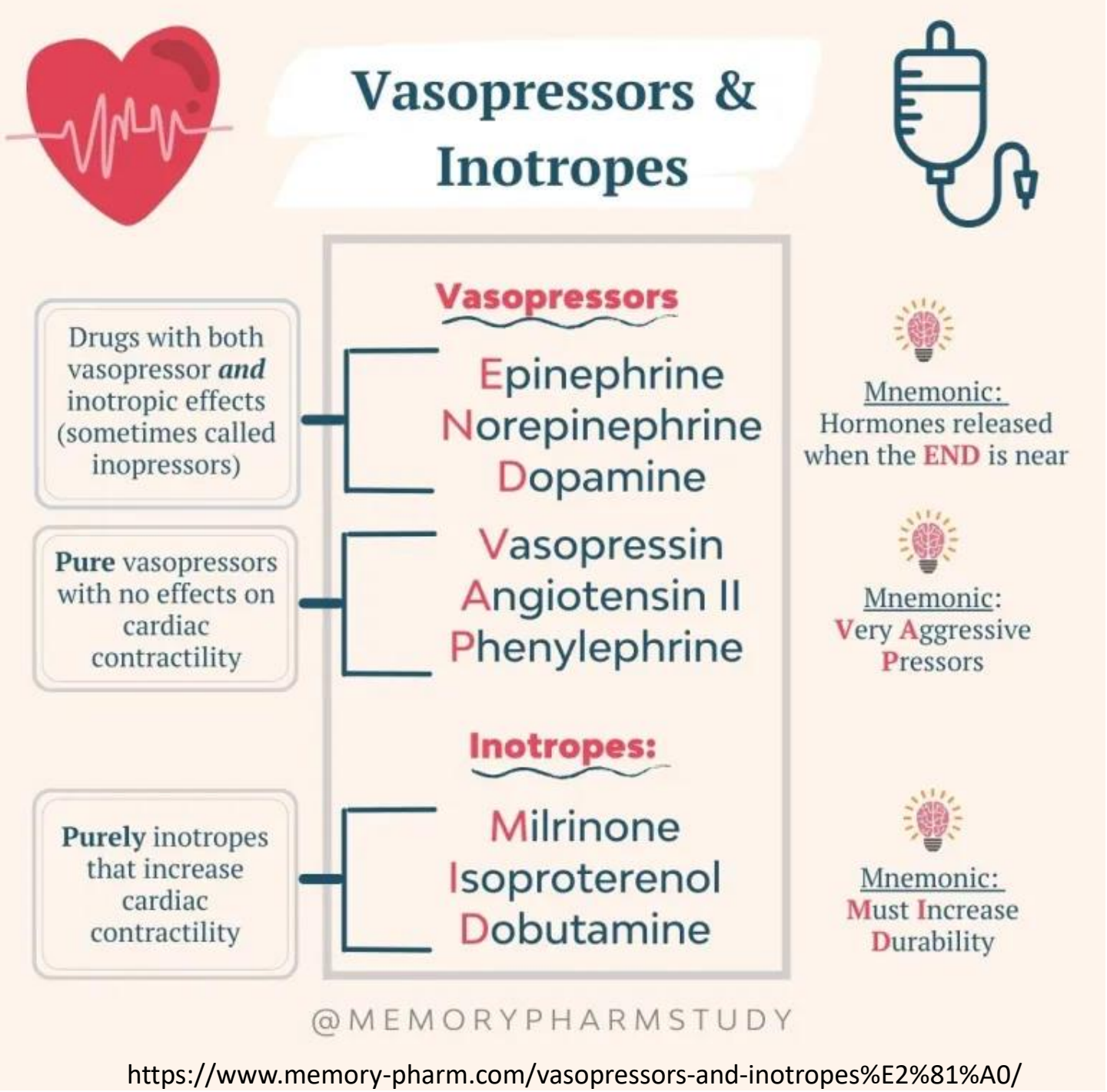






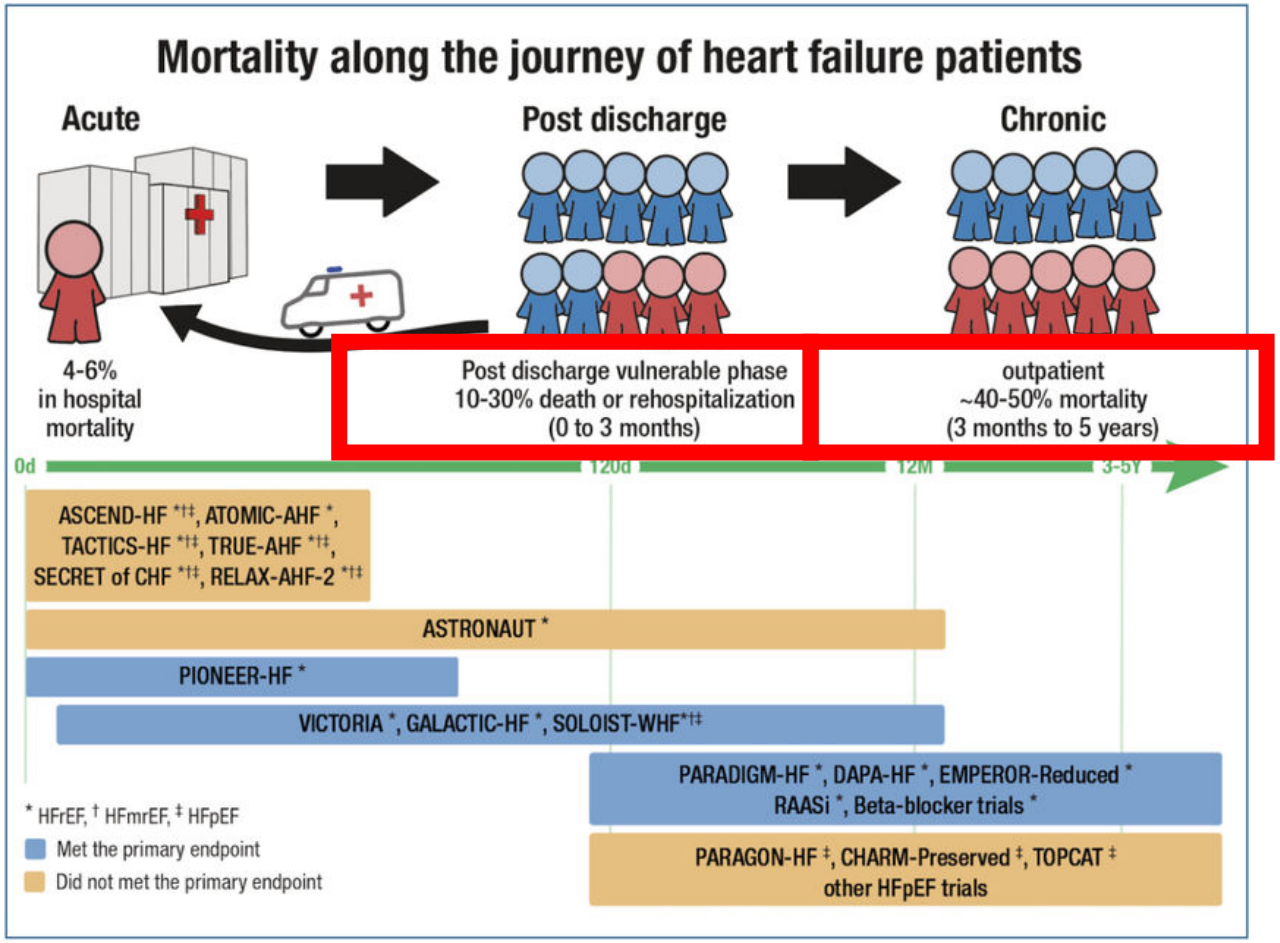
Skin, Bones, Hearts & Private Parts

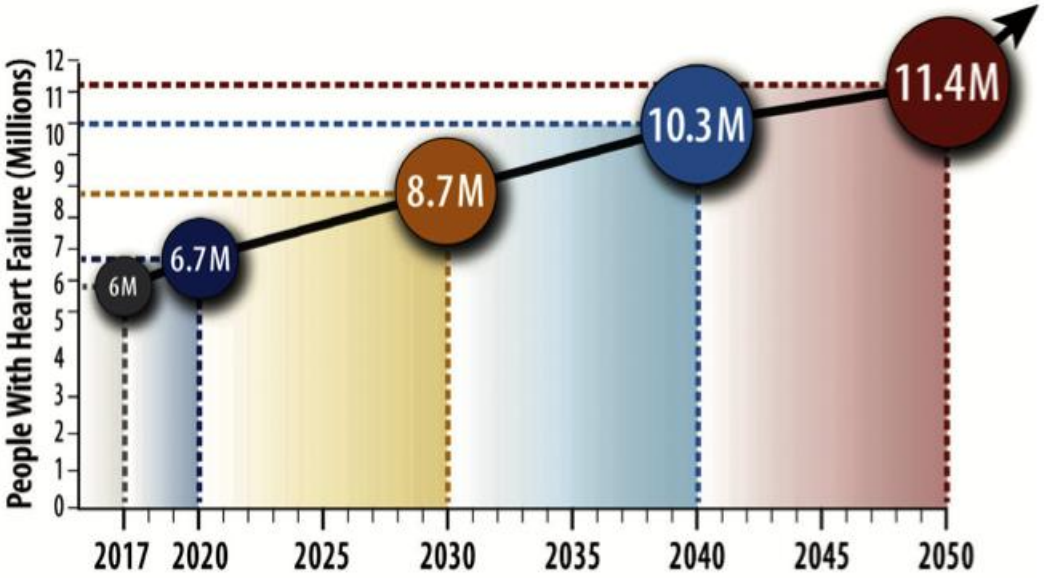
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https://www.memory-pharm.com/vasopressors-and-inotropes%E2%81%A0/

The Importance of Keeping Patients OUT of the Hospital





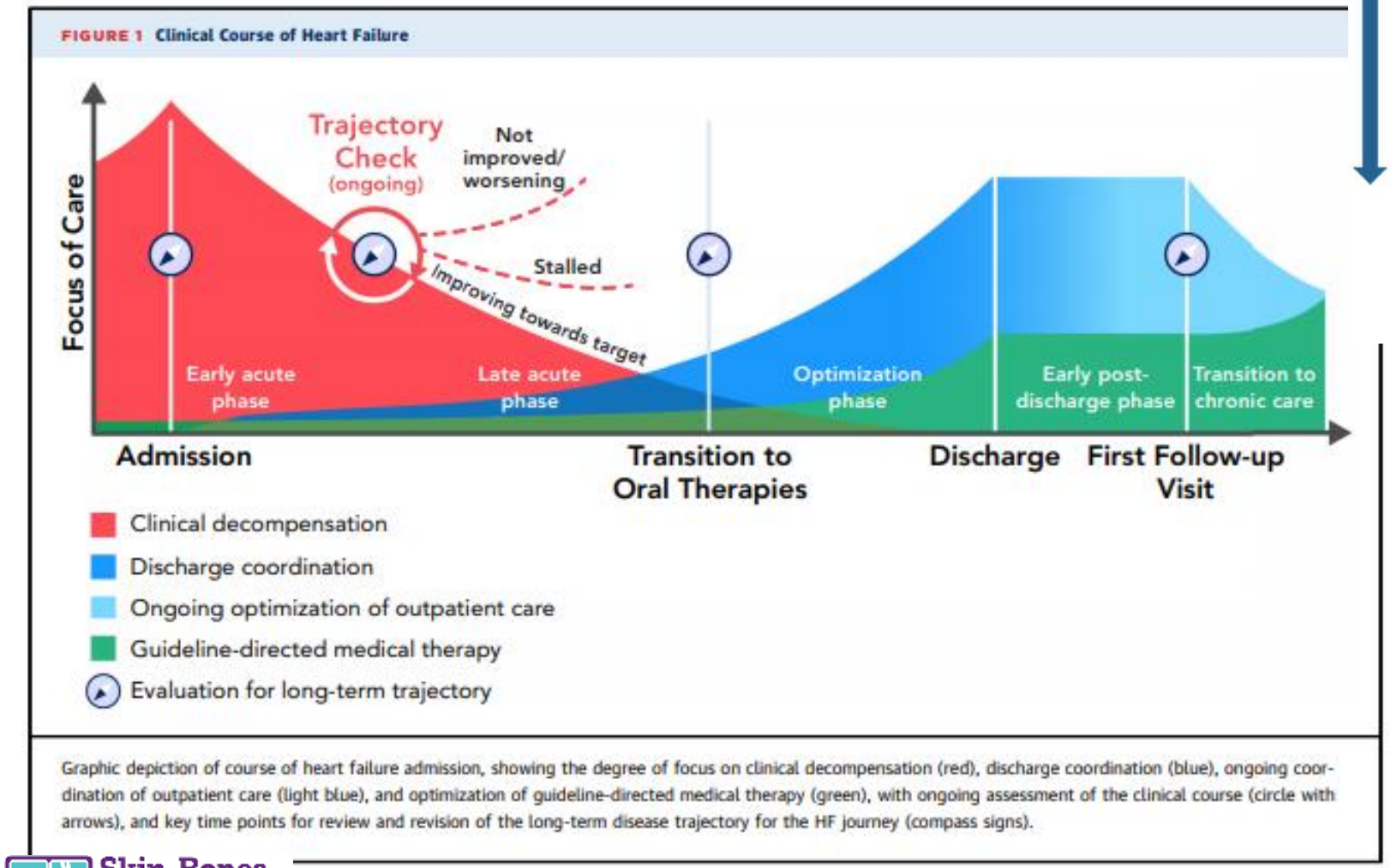


IMPROVE QUALITY OF LIFE

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Follow Up Appointments

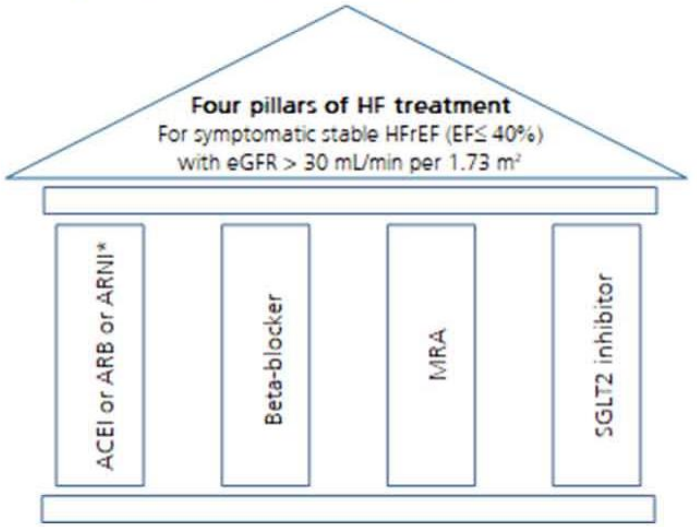


Graphic depiction of course of heart failure admission, showing the degree of focus on clinical decompensation (red), discharge coordination (blue), ongoing coordination of outpatient care (light blue), and optimization of guideline-directed medical therapy (green), with ongoing assessment of the clinical course (circle with arrows), and key time points for review and revision of the long-term disease trajectory for the HF journey (compass signs).

Initiate

Optimise

Reassess



Shaw et al Open Heart. 2021



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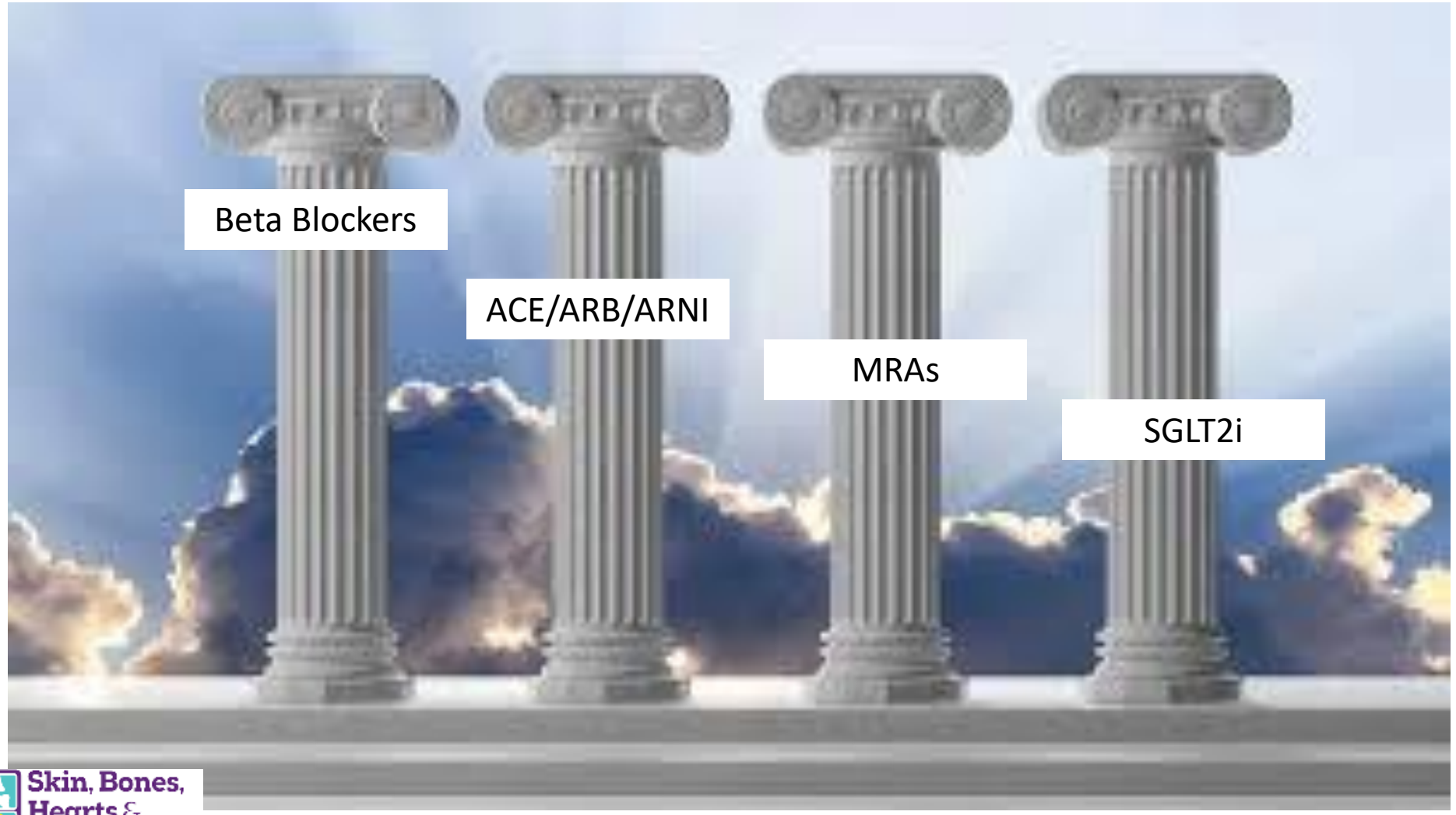
HF Guideline Driven Medical Therapy – The Ins and Outs



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Medications to Treat Heart Dysfunction



Skin, Bones, Hearts & Private Parts

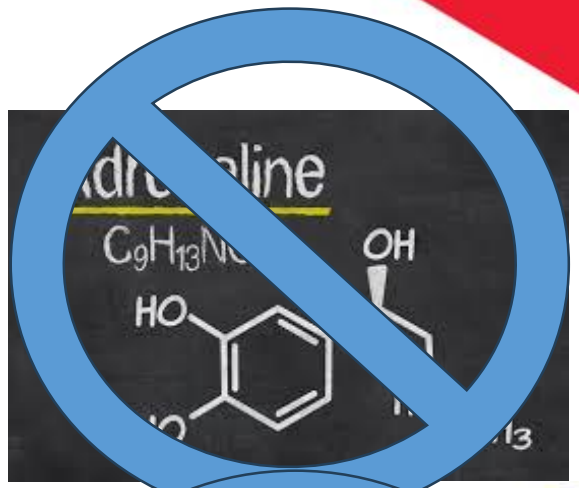
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Beta-Blockers

- Carvedilol (Coreg)
- Metoprolol Succinate (Toprol XL)
- Bisoprolol (Zebeta)











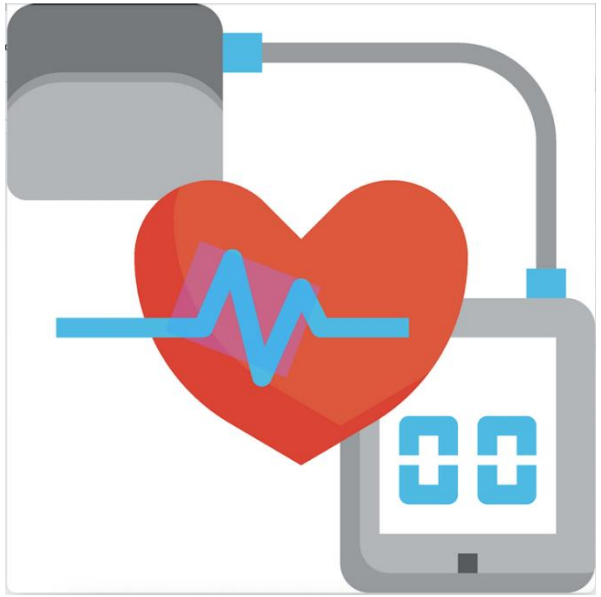
20-35 % decrease in mortality

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ACE/ARB/ARNI

- Lisino**pril**, Enala**pril**, Rami**pril**, Capto**pril**
- Los**artan**, Vals**artan**, Candesartan
- Entresto (Sacubitril/Vals**artan**)









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RAS inhibition		Neprilysin inhibition
Decreased vasoconstriction		Increased vasodilation
Reduced sodium and water retention	↓Na^+	Increased natriuresis/diuresis
Reduced hypertrophy and fibrosis		Reduced hypertrophy and fibrosis

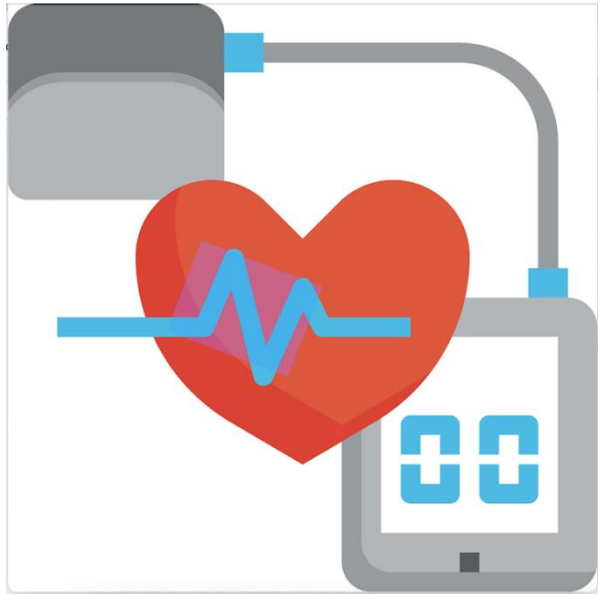
A Bit More About Entresto

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Mineralacorticoids (MRAs)

- Aldact**one** (Spironolactone)
- Eplerен**one** (Inspra)
- Finerен**one** (Kerendia)









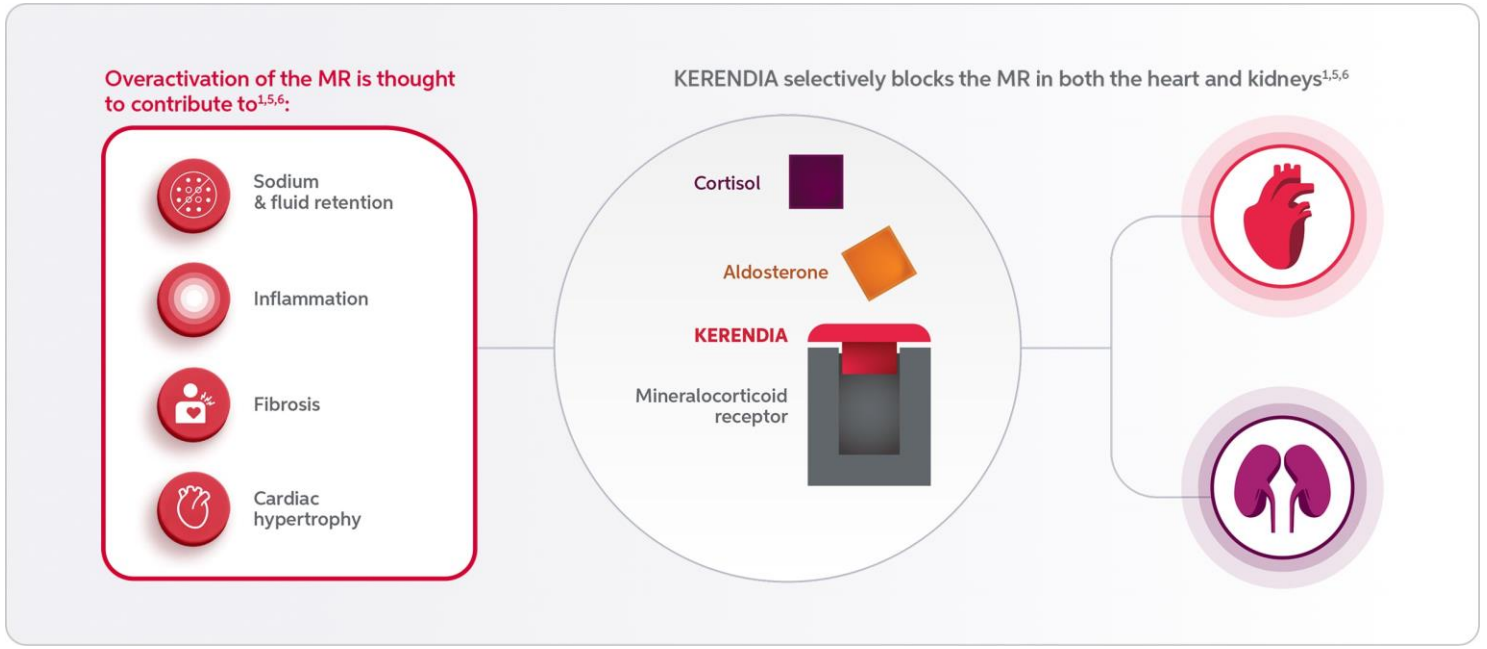


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Finerenone (need to mention as indicated for HFmildEF

- Decreases inflammation
- Cardiovascular and renal protective
- LVEF >/= 40%
- FINEARTS-HF trial
  - Decreased worsening HF
  - Decreased death
- Watch HIGH Potassium levels



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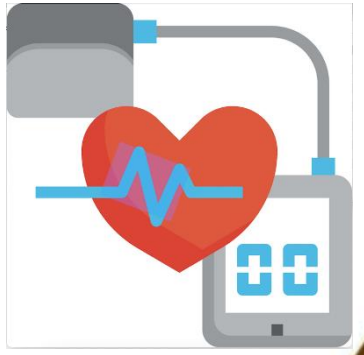
[Finerenone in Heart Failure with Mildly Reduced or Preserved Ejection Fraction | New England Journal of Medicine]

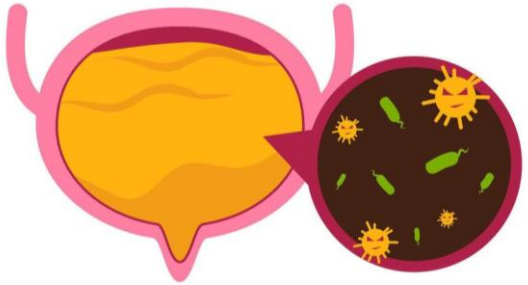
[Kerendia® (finerenone) Mechanism of Action | HCP]

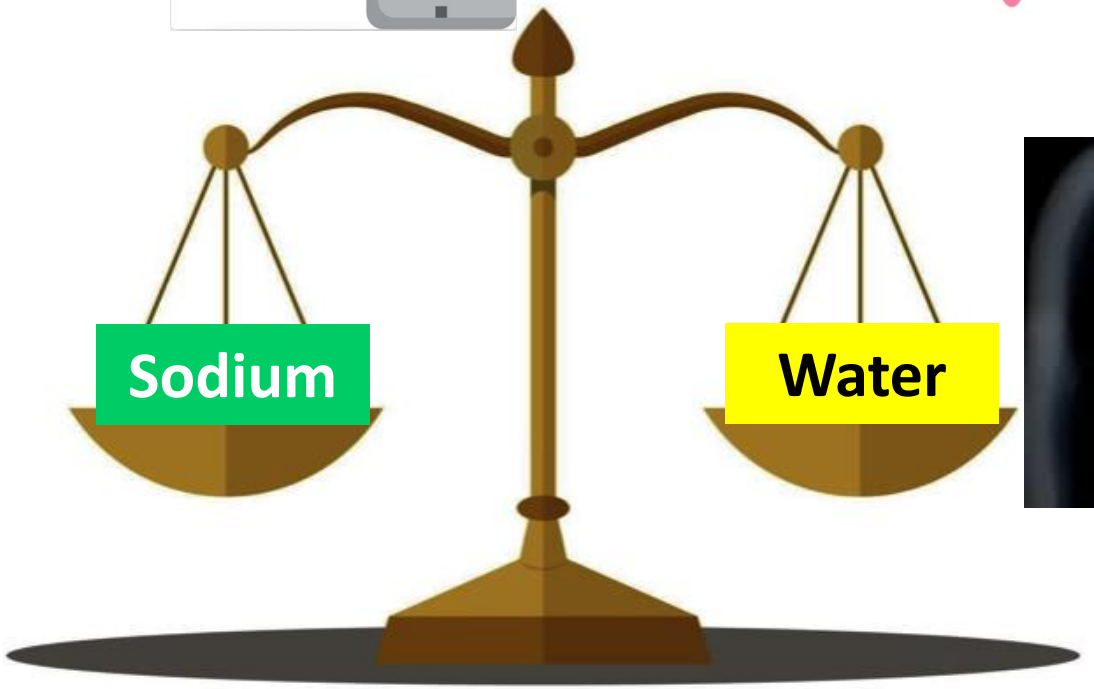
SGLT2-i (Sodium-Glucose Co-Transporter-2 Inhibitor)



- Empagli**flozin** (Jardiance)
- Dapagli**flozin** (Farxiga)
- Bexagli**flozin** (Brenzavvy)
- Canagli**flozin** (Invokana)





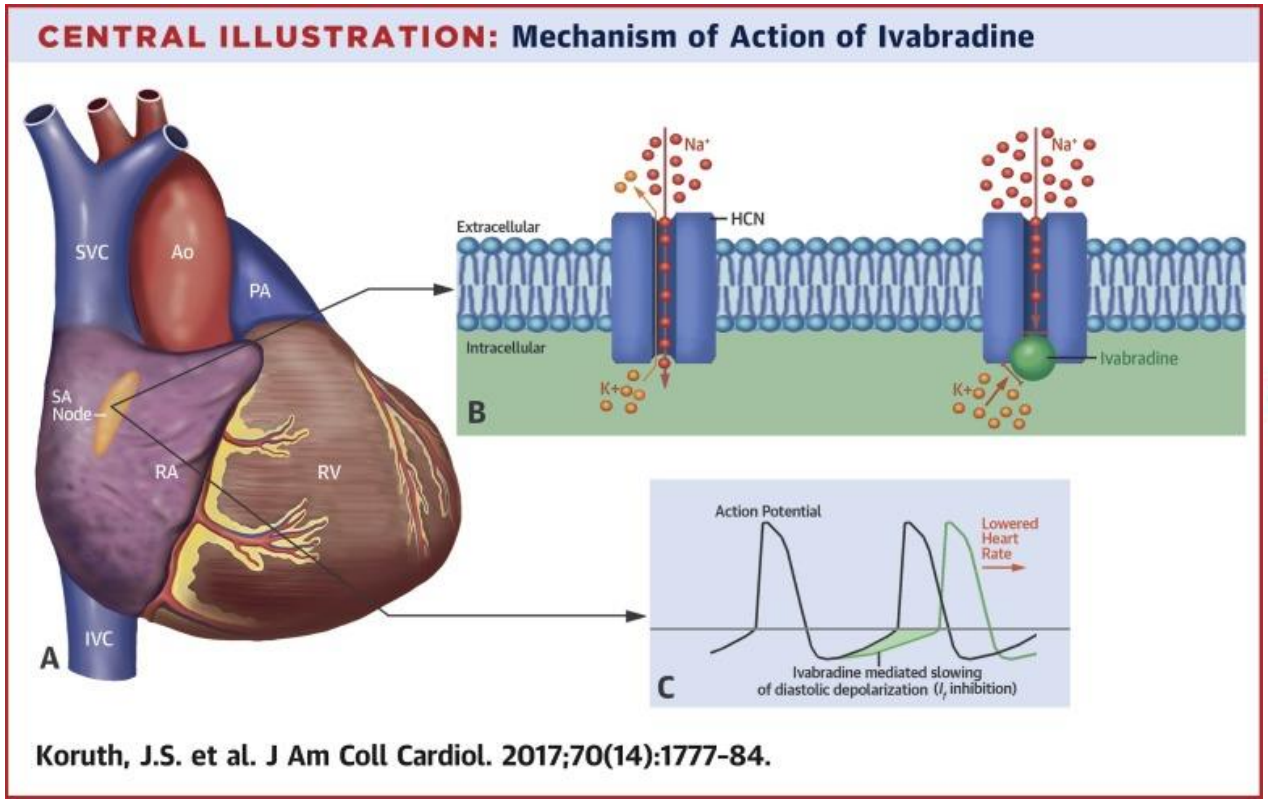




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Corlanor (Ivabradine)



Indication

Drug Showcase

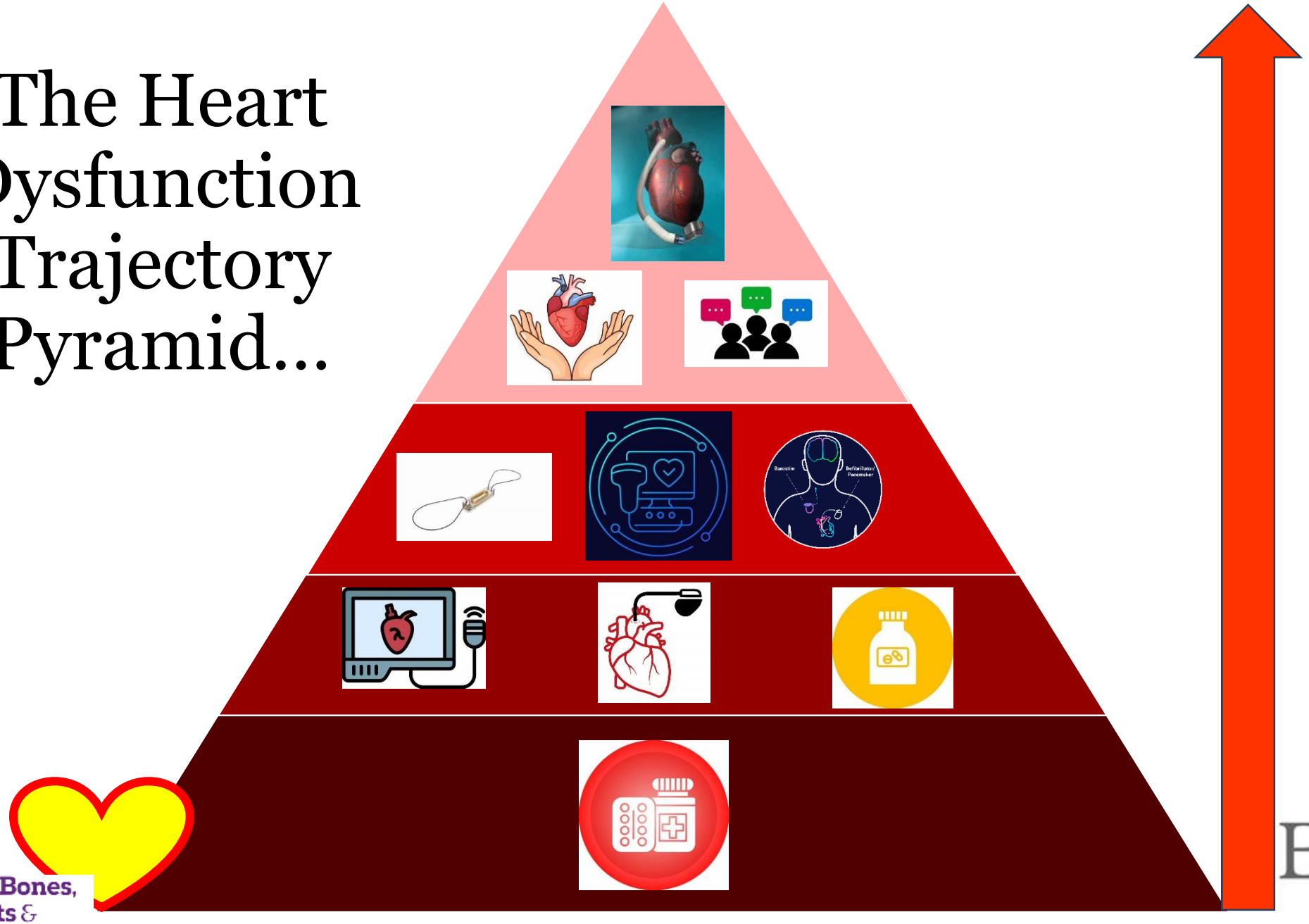
- **CORLANOR** (ivabradine) is a cyclic nucleotide-gated channel blocker indicated to reduce hospitalization for worsening heart failure in patients with stable, symptomatic chronic heart failure with left ventricular ejection fraction ≤ 35%, who are in sinus rhythm with resting heart rate ≥ 70 beats per minute and either are on maximally tolerated doses of beta-blockers or have a contraindication to beta-blocker use.

Renal & Urology News

Skin, Bones, Hearts & Private Parts

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The Heart Dysfunction Trajectory Pyramid…



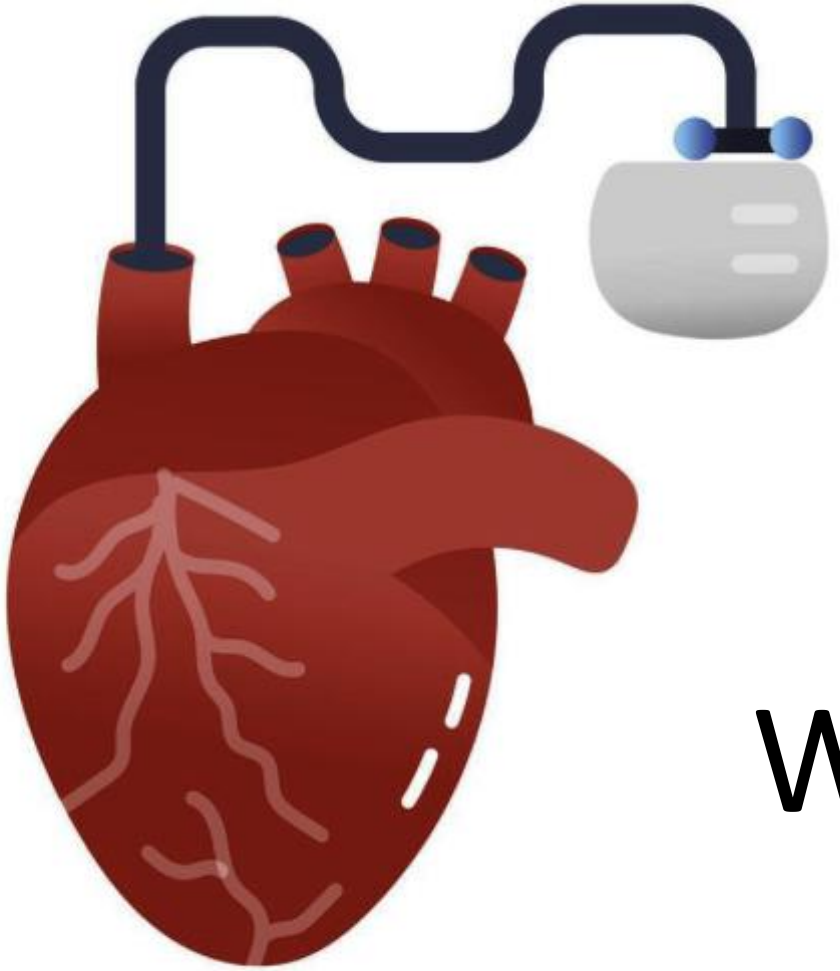
Skin, Bones, Hearts & Private Parts

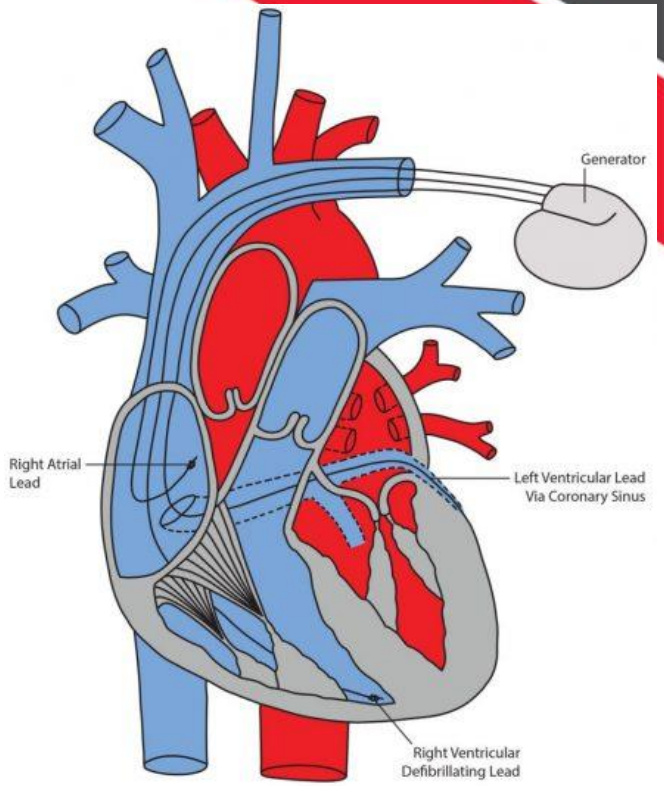
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90-Day Recheck









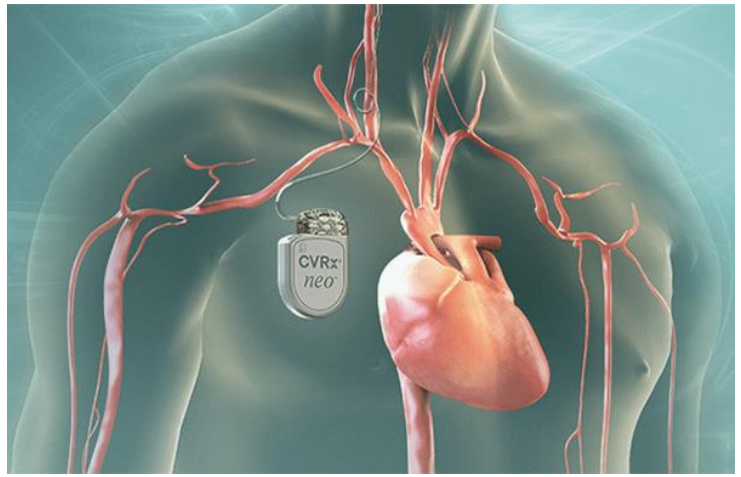
Wide QRS

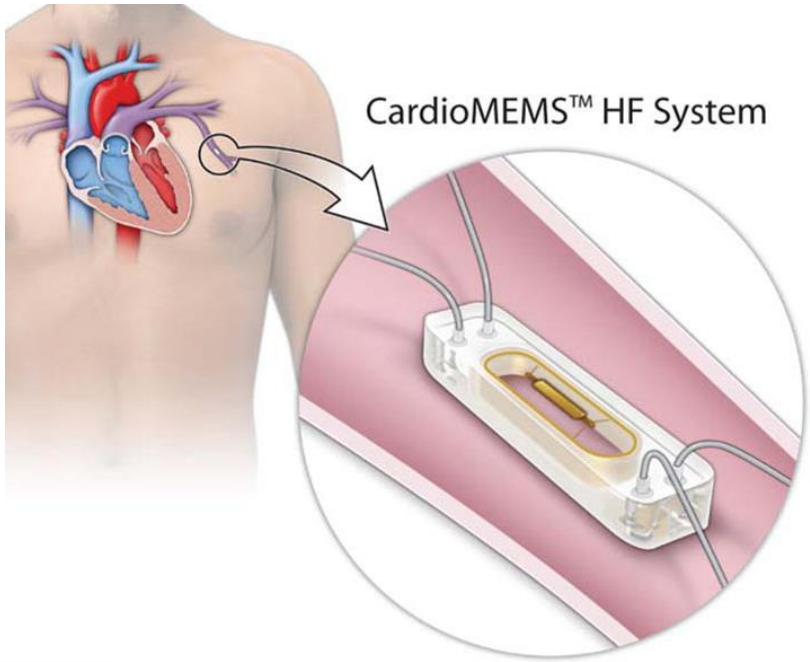
<35%

Skin, Bones, Hearts & Private Parts

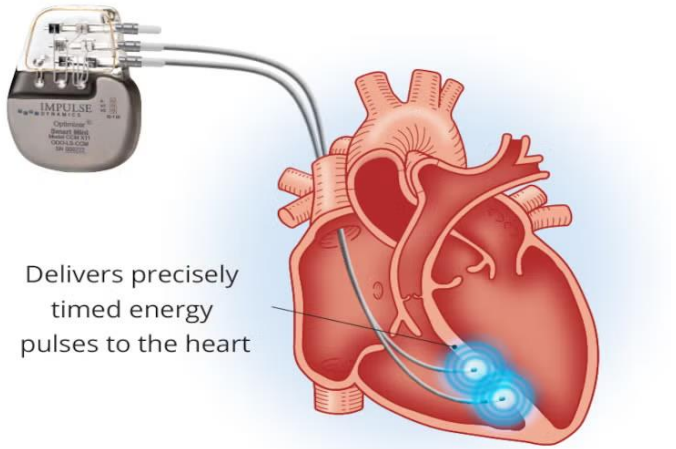
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Additional Tools in the Toolbox





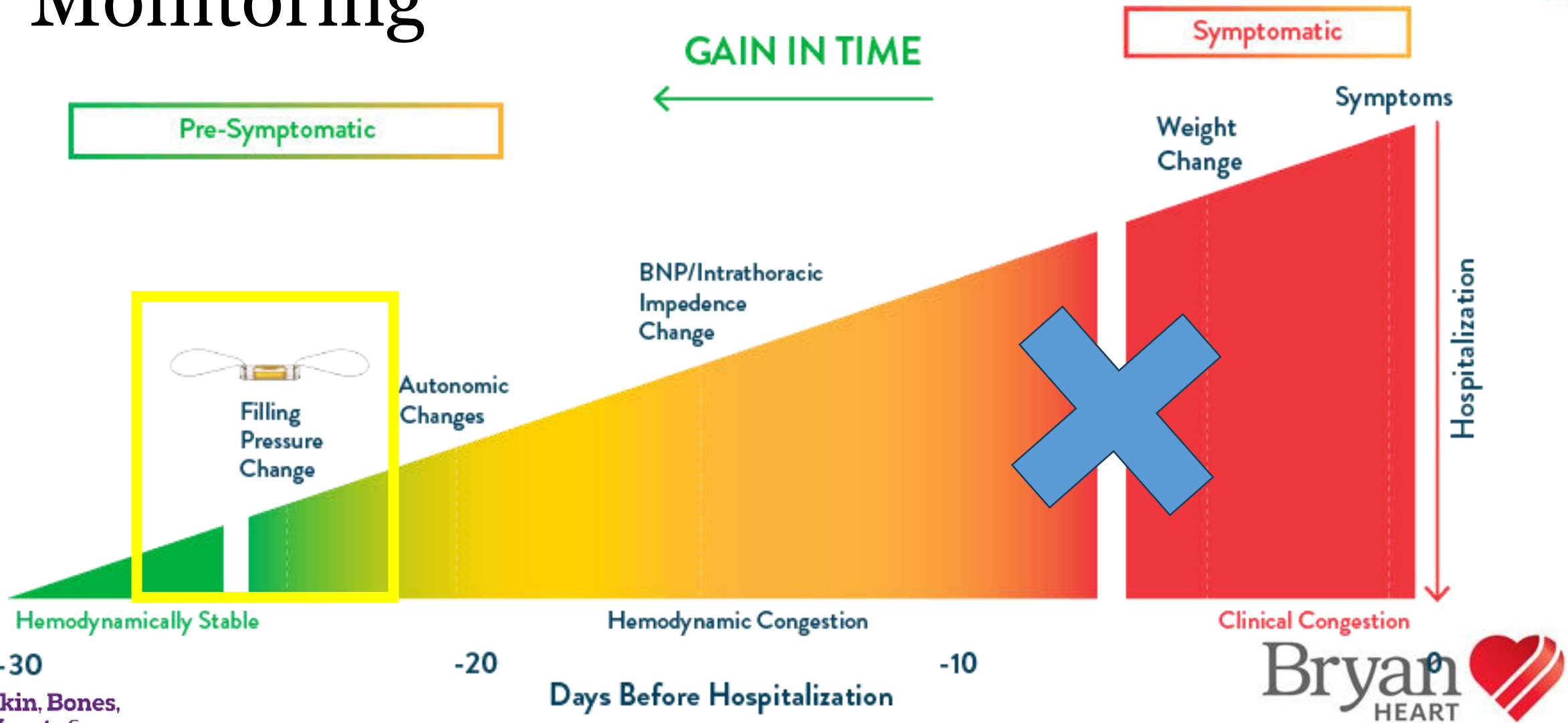




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Cardiomems Pulmonary Artery Monitoring



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https://www.cardiovascular.abbott/us/en/campaigns/always-there.html







PAd goal is set

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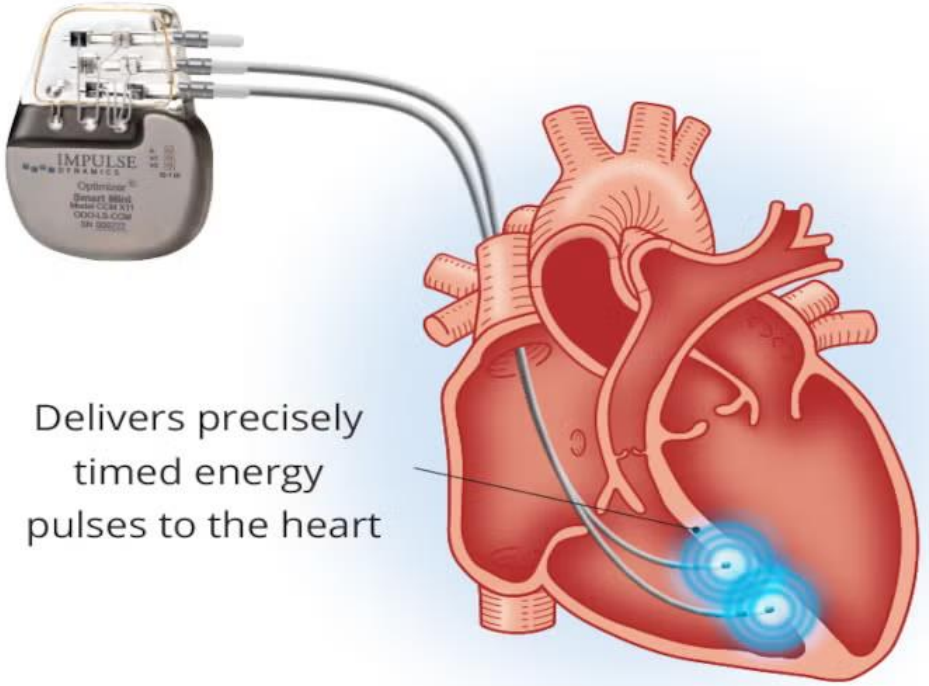
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Neuromodulation

Barostim



Optimizer CCM



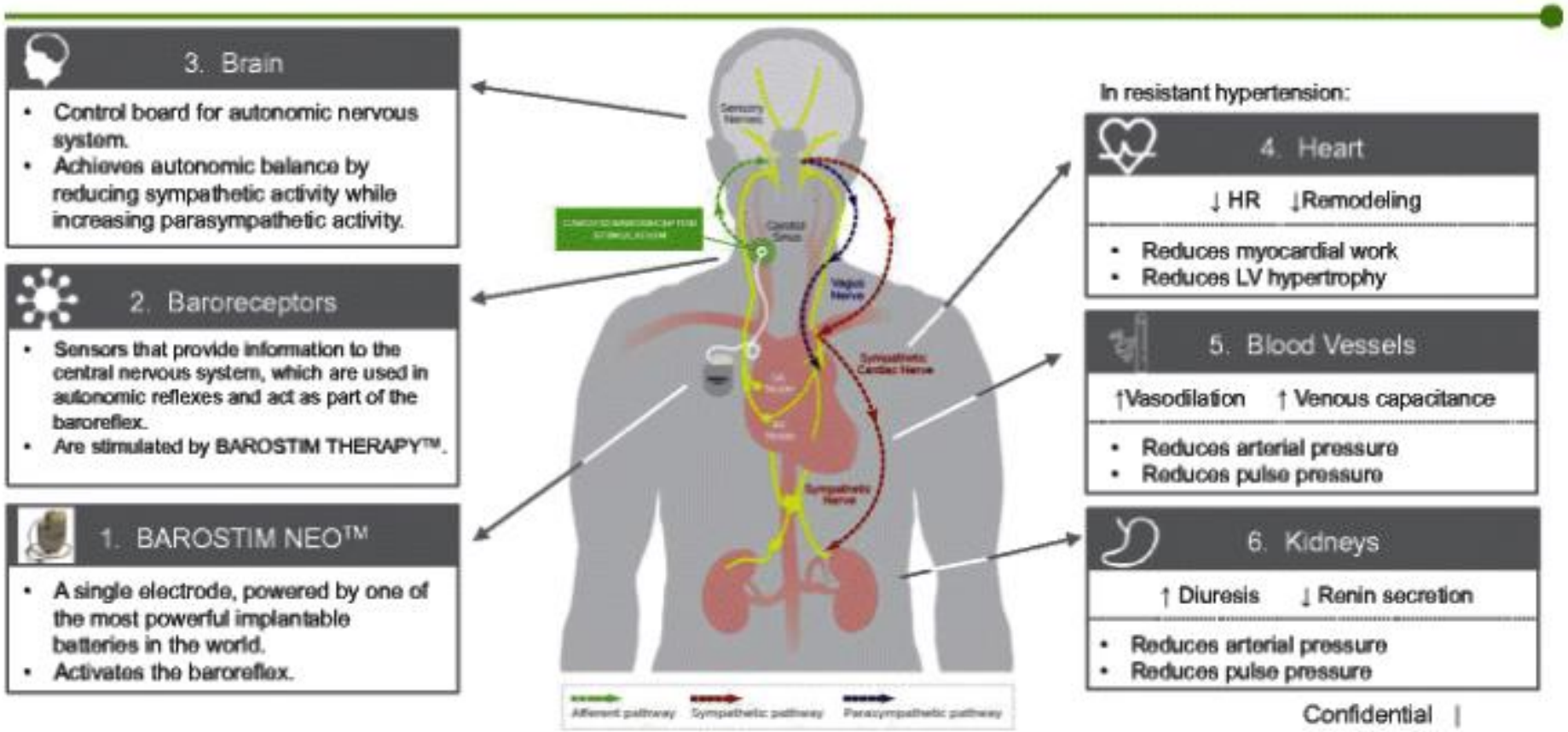
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https://www.barostim.com

https://www.medicaldevice-network.com/projects/impulse-dynamics-optimizer-smart-system/

Physiological Mechanism of Action

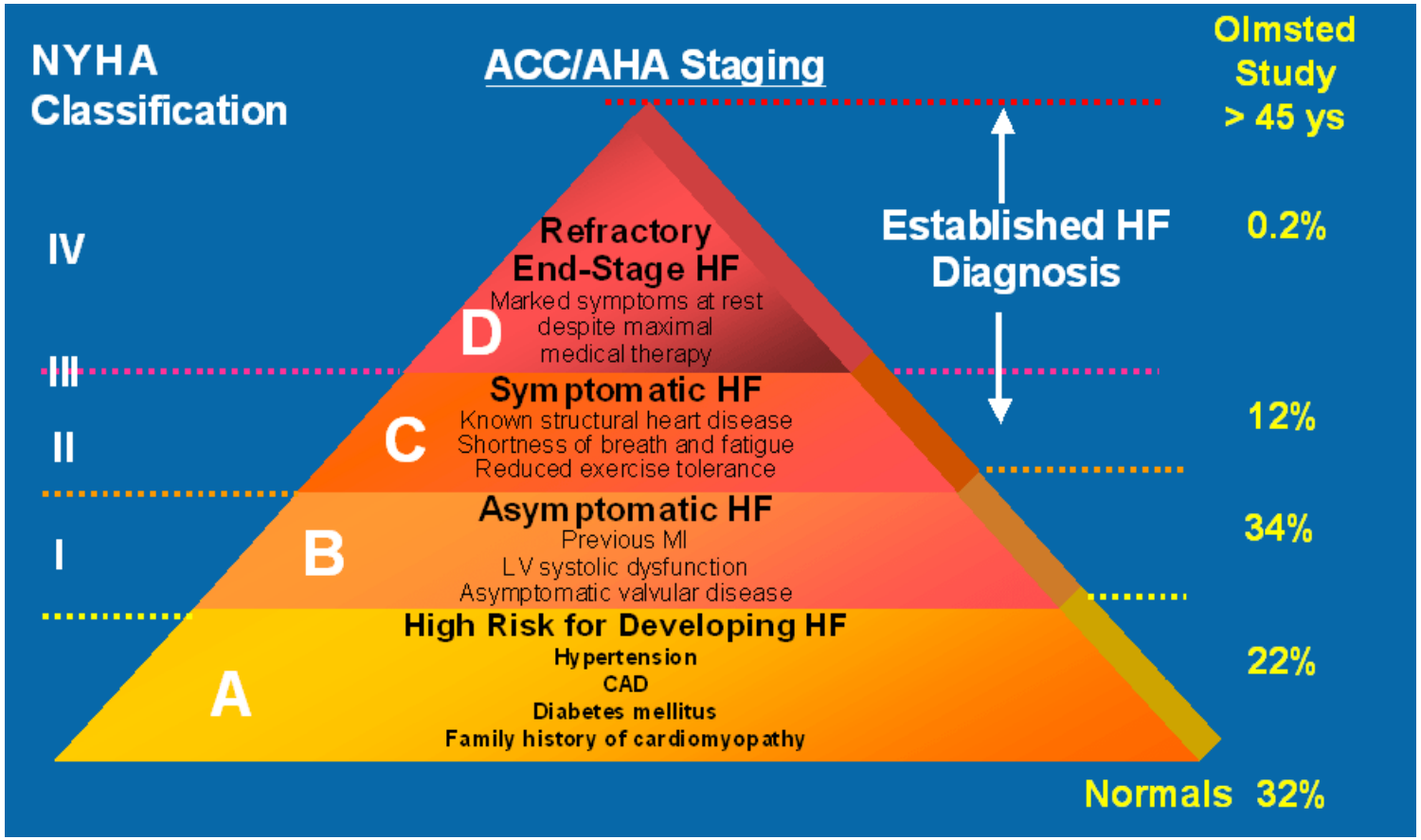


Carotid baroreceptor stimulation leads to physiological effects of the autonomic nervous system, with end-organ modulation on the heart, vasculature, and kidneys (courtesy of CVRx)

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Advancement to Advanced HF



I	Need for **inotropes**
N	**New** York Heart Association Class IV
E	Worsening **end-organ** dysfunction
E	**Ejection fraction** <20%
D	**Defibrillator** shocks for ventricular arrhythmias
H	Recurrent **HF** hospitalizations
E	**Escalating** diuretic dose
L	**Low blood pressure**
P	**Progressive** intolerance of GDMT

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Yancy et al. 2018. https://doi.org/10.1016/j.jacc.2017.11.025

Understanding Symptoms and Stages of Heart Failure (plus100years.com)

Heart Pumps, Transplants, Palliative Medicine – The T in the Road Meets



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LVAD technology has greatly improved



"It's not like the old days, is it?"







1998

HEARTMATE™ XVE LVAD
BTT 1998 | DT 2002
PULSATILE FLOW

First LVAD FDA approved for DT*

2008

HEARTMATE II™ LVAD
BTT 2008 | DT 2010
CONTINUOUS FLOW (AXIAL)

Over 26,000 patients implanted, with patients on therapy out to 5 and 10+ years[1]

2017

HEARTMATE 3™ LVAD
BTT 2017 | DT 2018 | PEDIATRIC 2020
CONTINUOUS FLOW (CENTRIFUGAL) with Full MagLev™ Flow Technology

Over 36,000 patients implanted, with patients on therapy out to 5+ years[1]

BTT = Bridge to Transplant
DT = Destination Therapy
*This product is no longer commercially available.
1. Abbott. Based on clinical and device tracking data as of August 31, 2024.

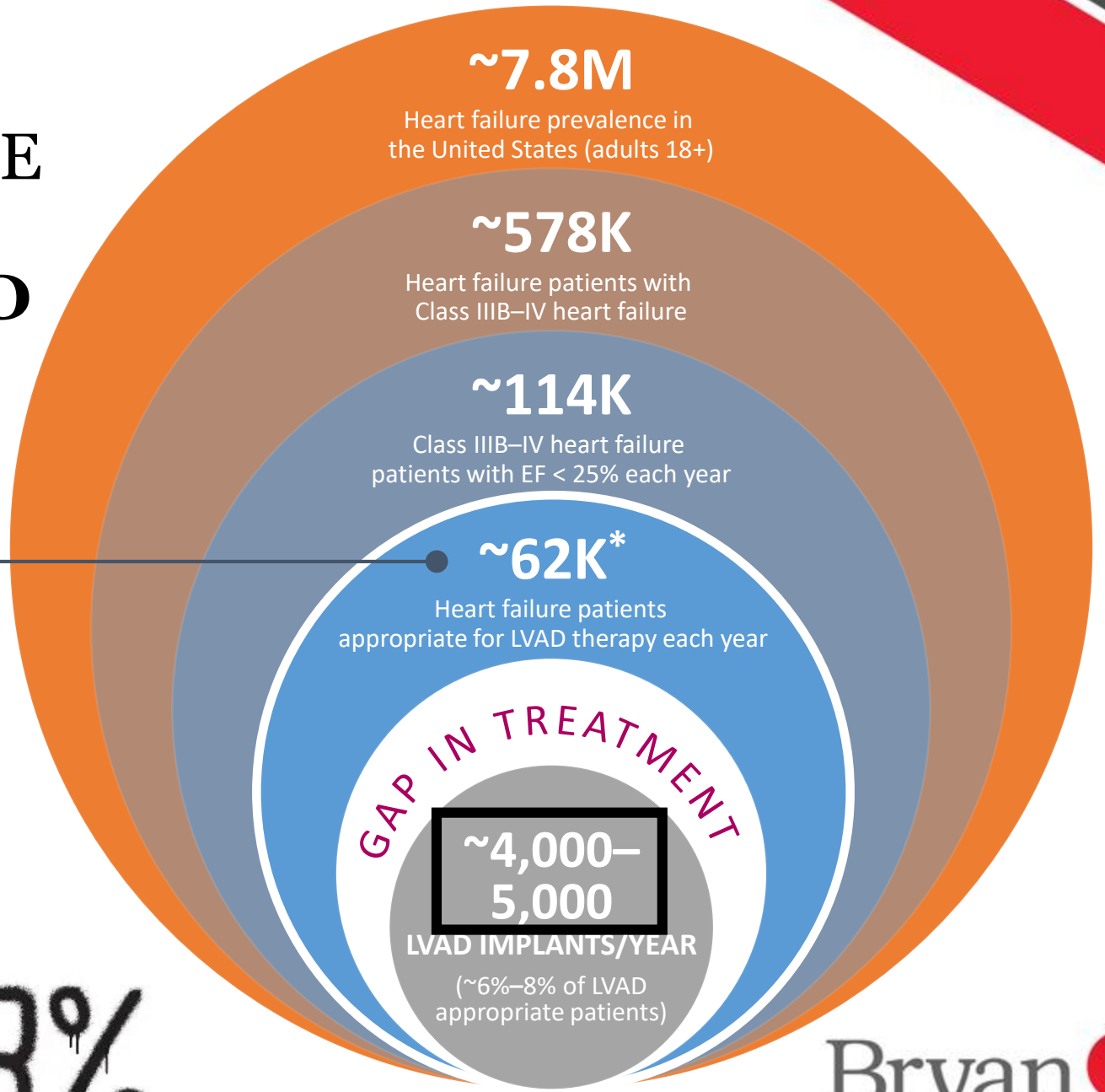
MAT-2000124 v6.0 | Item approved for U.S. use only.

4-Feb-25

HOW MANY HEART FAILURE PATIENTS IN THE U.S. ARE **APPROPRIATE CANDIDATES FOR LVAD THERAPY?**

AN ESTIMATED 62K PATIENTS ARE APPROPRIATE FOR LVAD THERAPY EACH YEAR[1]

Yet only ~6%–8% are receiving the benefits of LVAD therapy[1]



***46% of Class IIIB–IV heart failure with EF < 25% excluded** for the following clinical and non-clinical factors:

- End organ failure
- Anticoagulation intolerance
- Psychosocial risks
- Patient refusal
- Economic burden

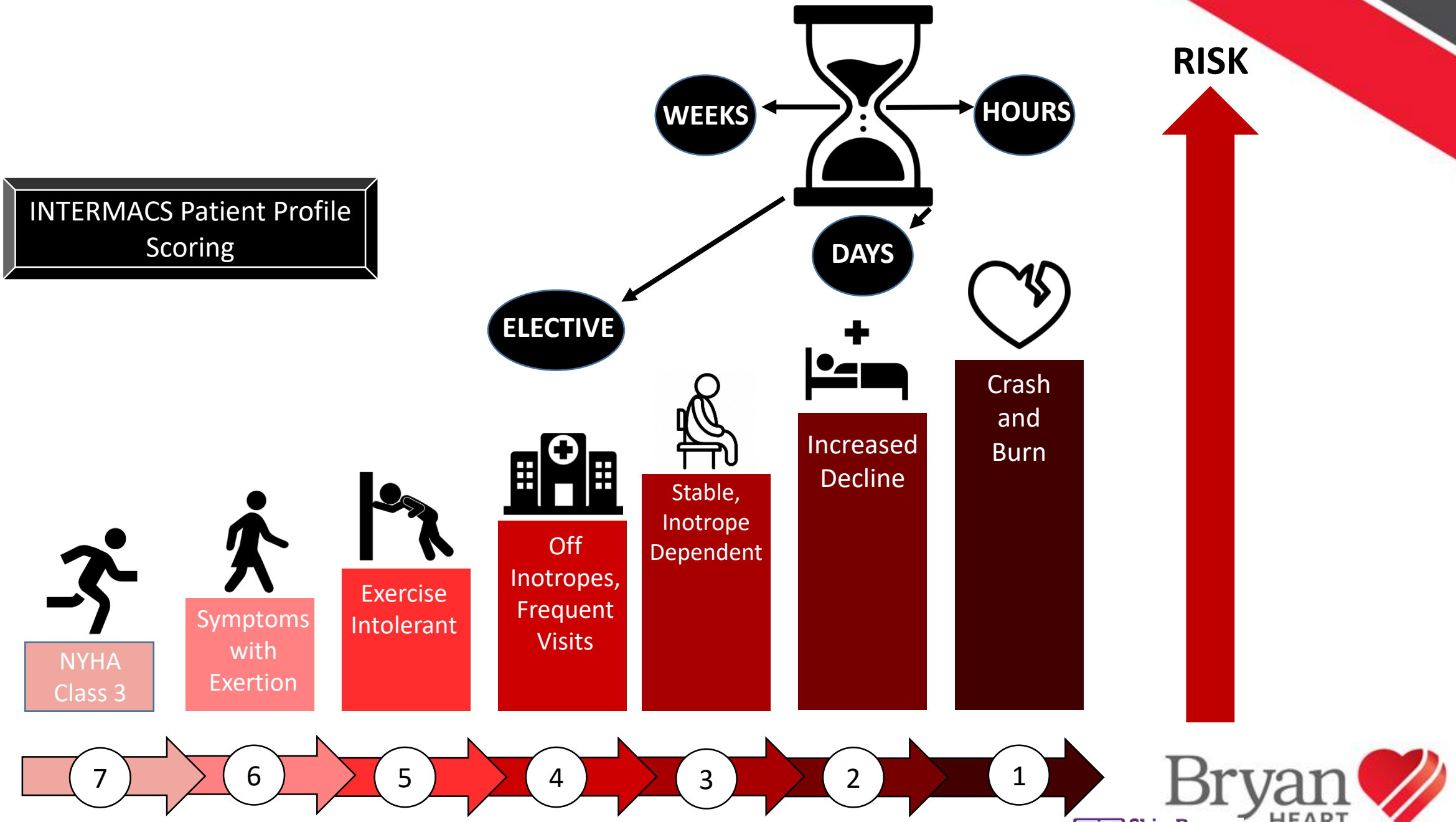
8%

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1. Abbott. Data on File. Abbott LVAD strategic market assessment report. May 2019.

INTERMACS Patient Profile Scoring



Schroeder, SE 2023. Adapted from Radley et al. 2018. doi: 10.3389/fimmu.2018.02651

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Survival







Medications Only:

25%

HeartMate II®:

73%

HeartMate 3® at 1-Year:

85%

HeartMate 3® at 5-Year:

58%

HeartMate 3® < 50 yrs of age at 5-Year:

72.6%

World Health Federation, 2022. https://world-heart-federation.org/resource/heart-failure-infographic/
Rose et el., 2001. *NEJM*, doi: 10.1056/NEJMoa01217
Park et al., 2012. *CIRC HEART FAIL*, doi: 10.1161/CIRCHEARTFAILURE.111.963991
Mehra et al., 2019. *NEJM*, doi: 10.1056/EJMoa1900486
Mehra et al., *NEJM*, doi: 10.1001/jama.2022.16197
Meyer et al. 2025. doi: 10.1016/j.athoracsur.2024.10.003

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Introduction to Cardiac Transplantation



Heart Transplantation in Man

Developmental Studies and Report of a Case

James D. Hardy, MD, Carlos M. Chavez, MD, Fred D. Kurrus, MD, William A. Neely, MD, Sudan Eraslan, MD, M. Don Turner, PhD, Leonard W. Fabian, MD, and Thaddeus D. Lebecki, MD, Jackson, Miss

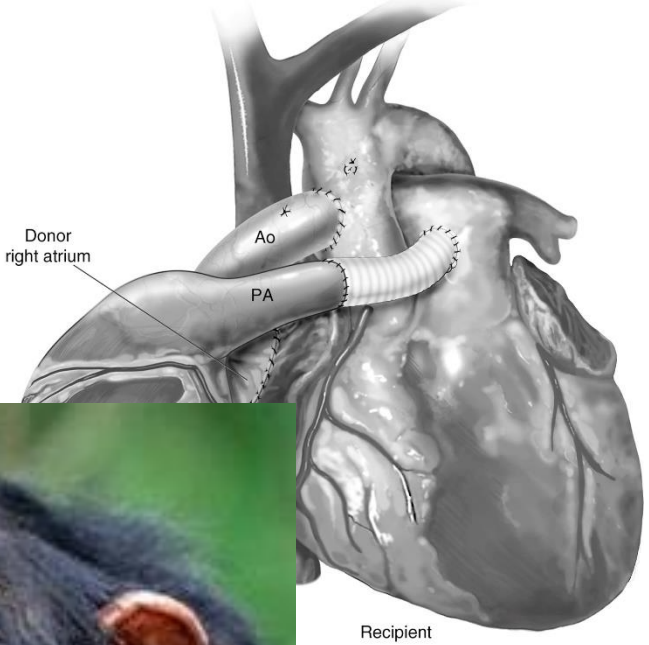
HEART TRANSPLANTATION has interested many investigators.[1-8] Studies of related problems were begun in our laboratory in 1956. Webb and his associates studied such factors as practical methods for homologous cardiac transplantation,[4] cardiopulmonary transplantation,[1,2] restoration of function of the refrigerated heart,[3] and cardiac metabolism as influenced by ischemia and refrigeration.[5] The operative mortality was high, but extended survival of some dogs with orthotopic homotransplants was achieved. Collateral studies were conducted by other members of the department.[6-8] Thus, in the spring of 1963, Webb and the senior author (J.D.H.) considered that the laboratory and clinical heart work justified a planned approach directed toward eventual heart transplantation in man. This objective, a natural outgrowth of transplantation research, was cleared with the administrative officials of the University Medical Center.

It remained for us to evaluate further the methods available for preservation of the heart during its transplantation. While resuscitation of the transplanted heart preserved with cold arrest could be achieved in most animals, it was essential that restoration of a good beat be assured for the first heart transplanted in man. Coronary artery perfusion had previously proved superior to ice slush during aortic valve surgery in animals[9] and in human beings and it was now re-examined. However, the coronary arteries of the dog were often too small and too variable to be perfused consistently with the equipment available, and ventricular ischemia and infarction occurred with some frequency.

Meanwhile, two operating teams had been established, one of which would obtain the heart from the donor and the other would prepare the recipient. One team continued heart transplantation in dogs (W.R.W.), but the other (J.D.H.) turned to a study of beef hearts and eventually to the use of the hearts of infant calves. It was found that the coronary arteries of even newborn calves were almost equal in size to those of the human adult, and that perfusion of both the right and left coronary arteries with cold oxygenated blood under gravity flow could routinely be achieved within three minutes from the time of excision of the organ. These small calves tolerated the supine position poorly, and ventricular fibrillation frequently occurred even before intrapericardial dissection had been initiated. Even so, the animals proved satisfactory for our purposes, in that coronary artery perfusion was regularly achieved without undue delay, following which the continuously perfused organ was transferred to an adjacent operating table and inserted into the new host who was supported with the pump oxygenator. The two operating teams were combined to complete this final insertion of the transplant. The extracorporeal circuit was primed with "sterile" but unmatched blood obtained from a slaughterhouse two hours previously, and the suture technique described by Lower and associates[9] was employed. In contrast to experience with heart transplantation in dogs, anastomotic bleeding rarely constituted a problem in calves, whose tissues were tough and held sutures without tearing. Digitalization was found helpful when used cautiously,[7] but on some occasions the digitalis produced heart block which often responded dramatically to the intravenous infusion of isoproterenol (Isuprel) hydrochloride.

Approximately 50 calves were used in the successful completion of 20 homotransplants.[10] Coronary artery perfusion was found to be satisfactory

From the departments of surgery, anesthesiology, and medicine, and the University Hospital of the University of Mississippi Medical Center.





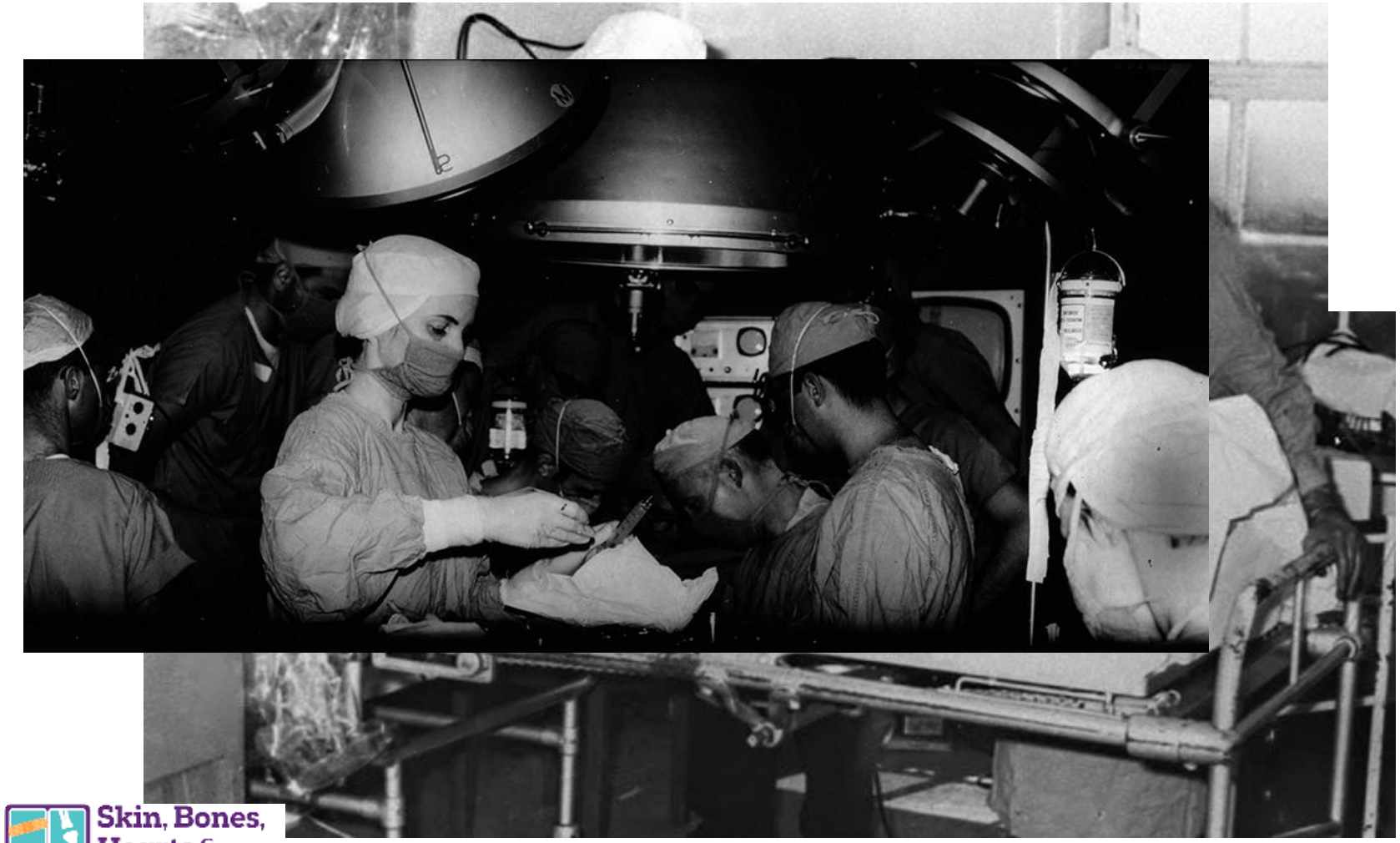
Cooper (2012). doi: 10.1080/08998280.2012.11928783

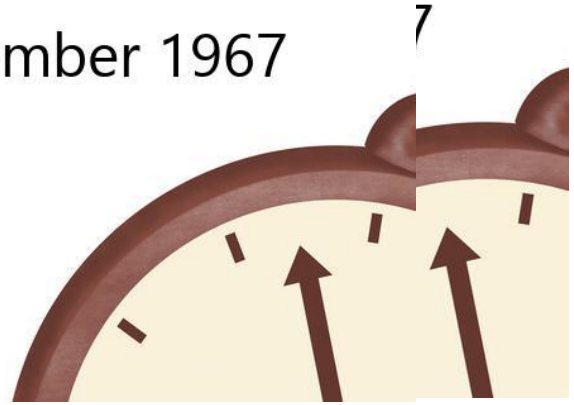
Fitzharris (2015). The Chimp & The Surgeon: A History of Heart Transplants • Dr. Lindsey Fitzharris (drlindseyfitzharris.com)

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Evolution of Cardiac Transplant

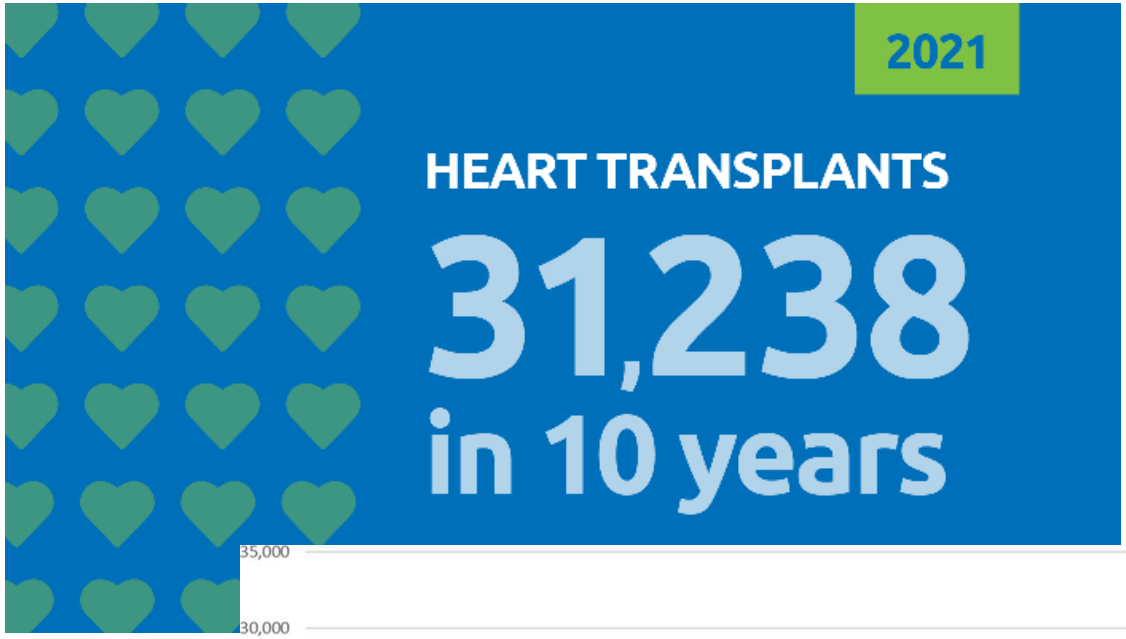


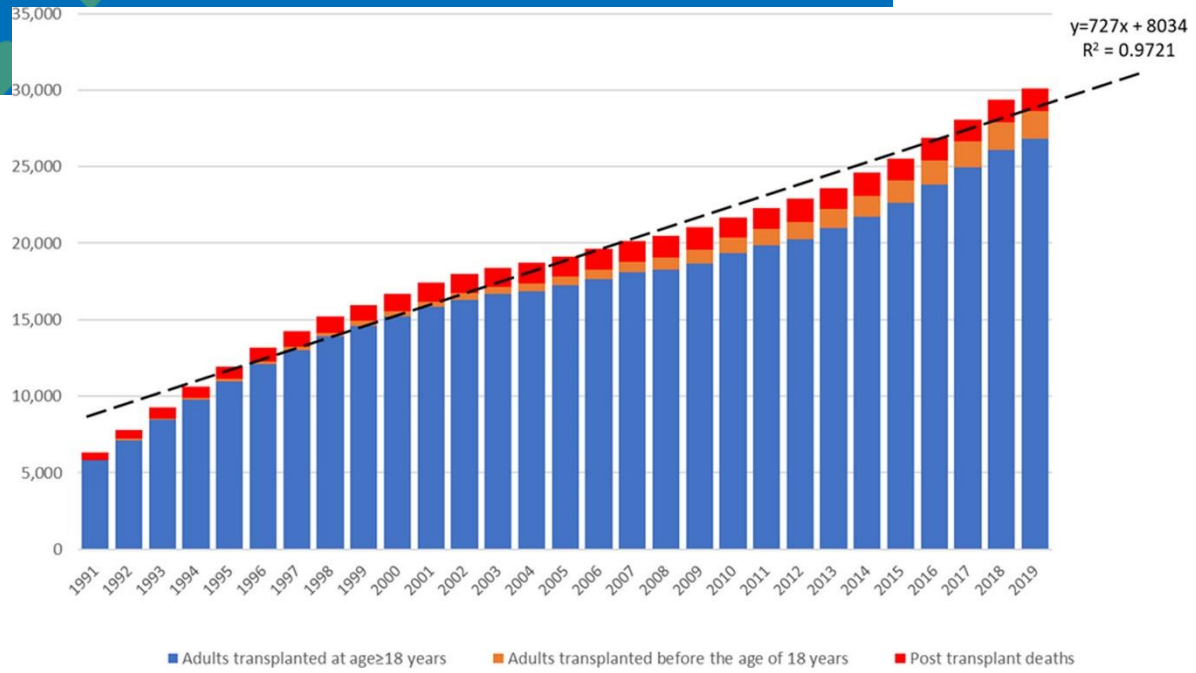


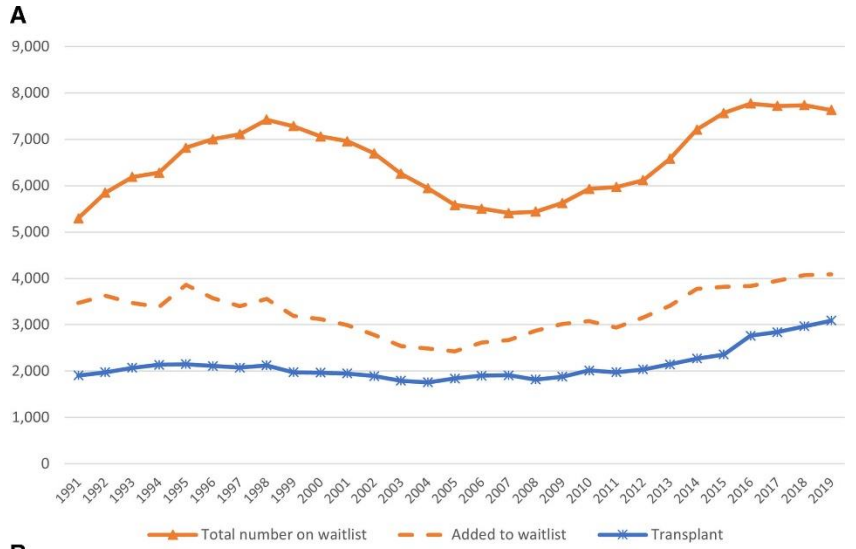


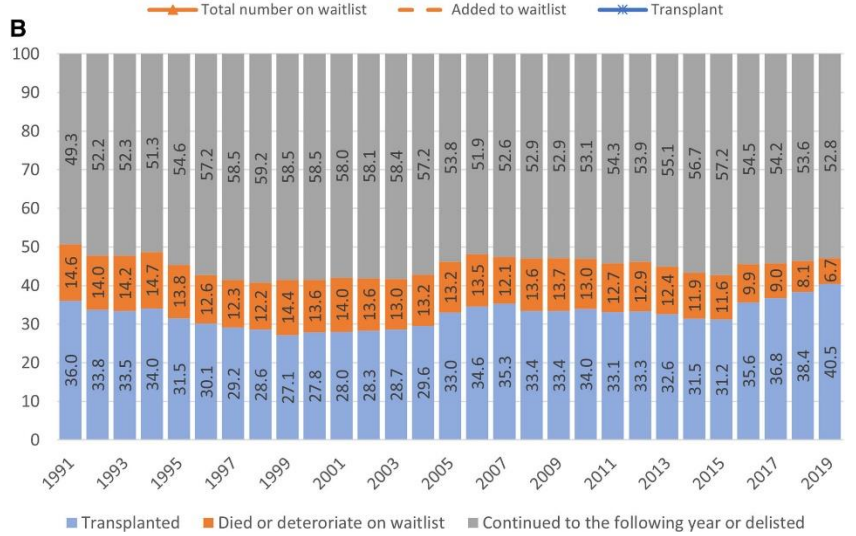
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Brink & Hassoulas, 2009. PMCID: PMC4200566
Stolf (2017). doi: 10.21470/1678-9741-2017-0508





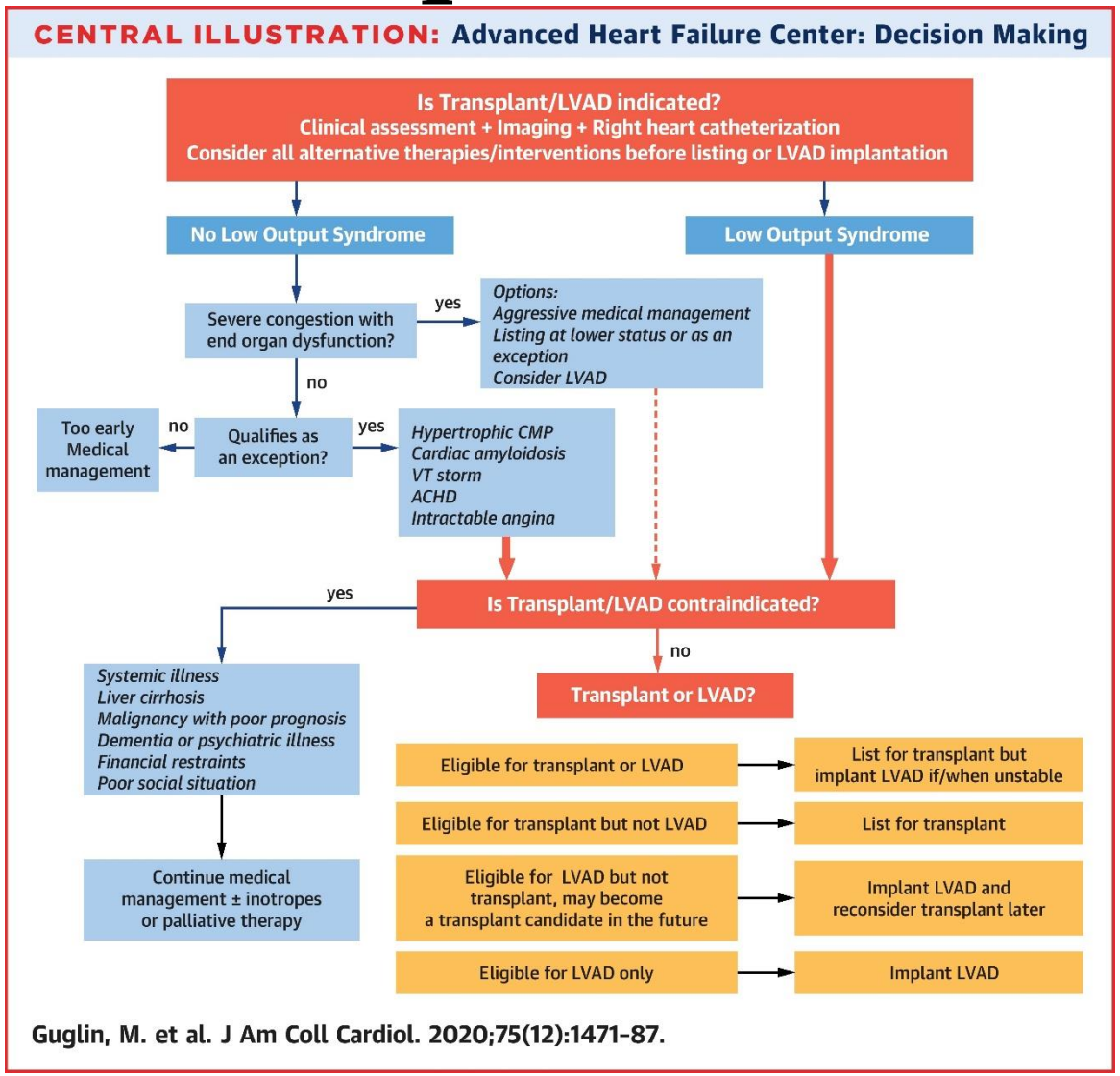




Unos.org. 2022. Heart transplant sets all-time record in 2021 - UNOS

Akintoye et al. 2021. Changing Demographics, Temporal Trends in Waitlist, and Posttransplant Outcomes After Heart Transplantation in the United States: Analysis of the UNOS Database 1991–2019 | Circulation: Heart Failure (ahajournals.org)

Transplant Criteria



Guglin, M. et al. J Am Coll Cardiol. 2020;75(12):1471-87.

Class I Indications for Cardiac Transplantation

- Cardiogenic shock requiring mechanical assistance.
- Refractory heart failure with continuous inotropic infusion.
- NYHA functional class 3 and 4 with a poor 12 month prognosis.
- Progressive symptoms with maximal therapy.
- Severe symptomatic hypertrophic or restrictive cardiomyopathy.
- Medically refractory angina with unsuitable anatomy for revascularization.
- Life-threatening ventricular arrhythmias despite aggressive medical and device interventions.
- Cardiac tumors with low likelihood of metastasis.
- Hypoplastic left heart and complex congenital heart disease.

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Guglin et al. 2020. https://doi.org/10.1016/j.jacc.2020.01.034
Zagul. 2019. https://www.slideserve.com/elina/introduction-1272769-powerpoint-ppt-presentation

Approximately 3,300 patients are currently on the U.S. heart transplant waiting list

Roughly 600 people die each year while waiting for a heart transplant in the U.S.



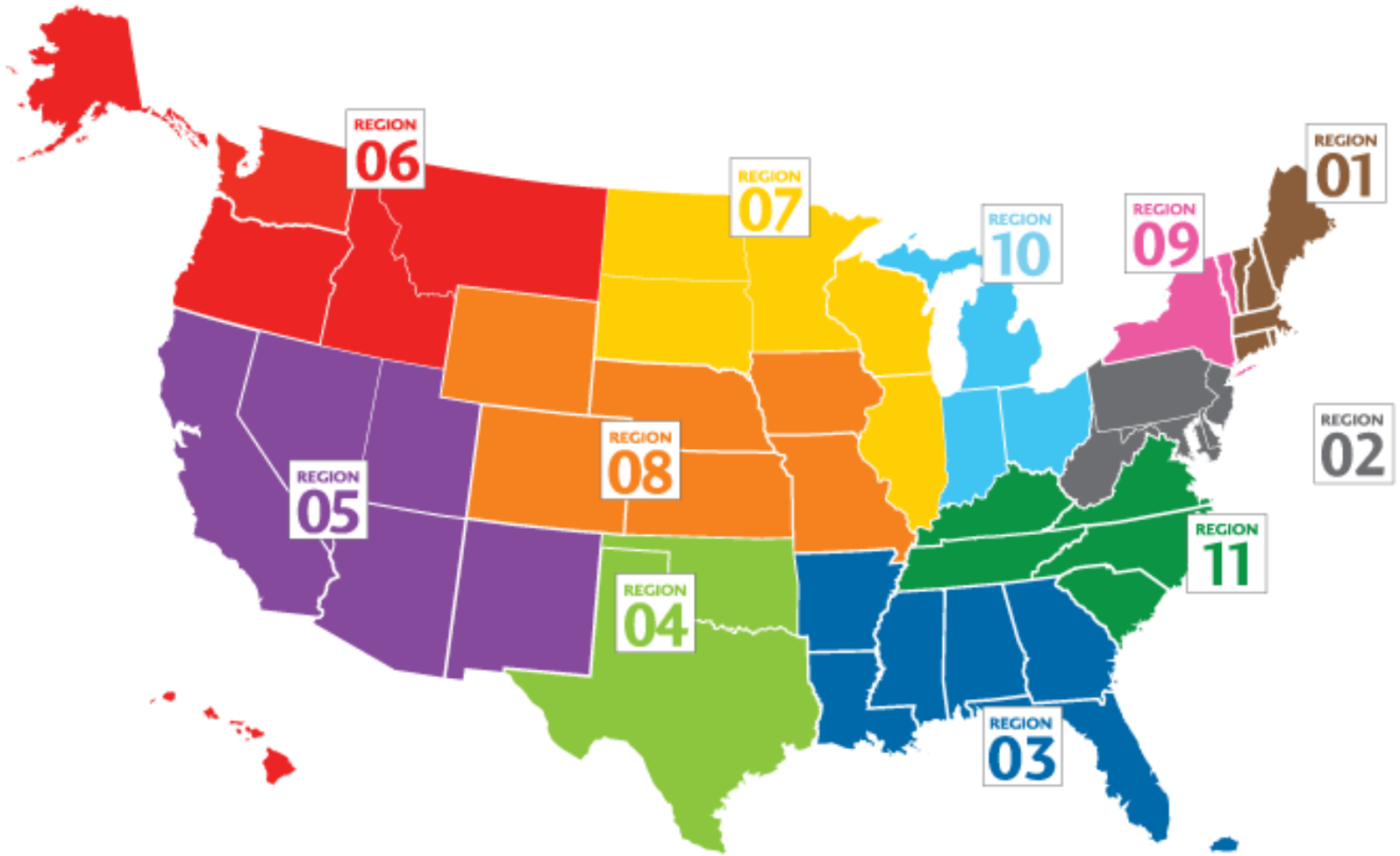
2006 Status	2018 Status	Indications
1A	1	ECMO[1] Non-dischargeable VAD[2] MVS with life threatening arrhythmia [2]
	2	Non-dischargeable LVAD[2] Percutaneous endovascular LVAD[2] IABP[2] VT/VF without MCS[2] MCS with mechanical failure[2] Dischargeable BiVAD/RVAD/TAH[2]
	3	Dischargeable LVAD[3] High Dose inotrope / multiple inotropes requiring monitoring[2] MCS with: • hemolysis[2] • pump thrombosis[2] • RV failure[2] • Infection[6] • mucosal bleeding[7] • aortic insufficiency[8] ECMO[4] Non-Dischargeable LVAD[5] Percutaneous Endovascular LVAD[5] IABP[5]
1B	4	Congenital heart disease[8] Hypertrophic cardiomyopathy[8] Restrictive cardiomyopathy[8] Dischargeable LVAD[8] Inotropes without monitoring[8] Intractable angina[8] Re-transplant[8]
	5	Multi -organ transplant[9]
2	6	All others[9]

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[Heart Transplant Waiting List Statistics | 2026 Edition]

[Donor Heart Allocation | IntechOpen]



Adult Heart Allocation Criteria for Medical Urgency Status

The Organ Procurement and Transplantation Network announced that a new, six-tier adult heart allocation system will be implemented this year.

Status 1
- VA ECMO
- Non-dischargeable, surgically implanted, non-endovascular biventricular support device
- MCSD with life-threatening ventricular arrhythmia

Status 2
- Non-dischargeable, surgically implanted, non-endovascular LVAD
- IABP
- V-tach / V-fib, mechanical support not required
- MCSD with device malfunction/mechanical failure
- TAH, BiVAD, RVAD, or VAD for single ventricle patients
- Percutaneous endovascular MCSD

Status 3
- Dischargeable LVAD for discretionary 30 days
- Multiple inotropes or single high-dose inotrope with continuous hemodynamic monitoring
- VA ECMO after 7 days; percutaneous endovascular circulatory support device or IABP after 14 days
- Non-dischargeable, surgically implanted, non-endovascular LVAD after 14 days
- MCSD with one of the following: device infection, hemolysis, pump thrombosis, right heart failure, mucosal bleeding, aortic insufficiency

Status 4
- Dischargeable LVAD without discretionary 30 days
- Inotropes without hemodynamic monitoring
- Retransplant
- Diagnosis of one of the following: congenital heart disease (CHD), ischemic heart disease with intractable angina, hypertrophic cardiomyopathy, restrictive cardiomyopathy, amyloidosis

Status 5
- On the waitlist for at least one other organ at the same hospital

Status 6
- All remaining active candidates

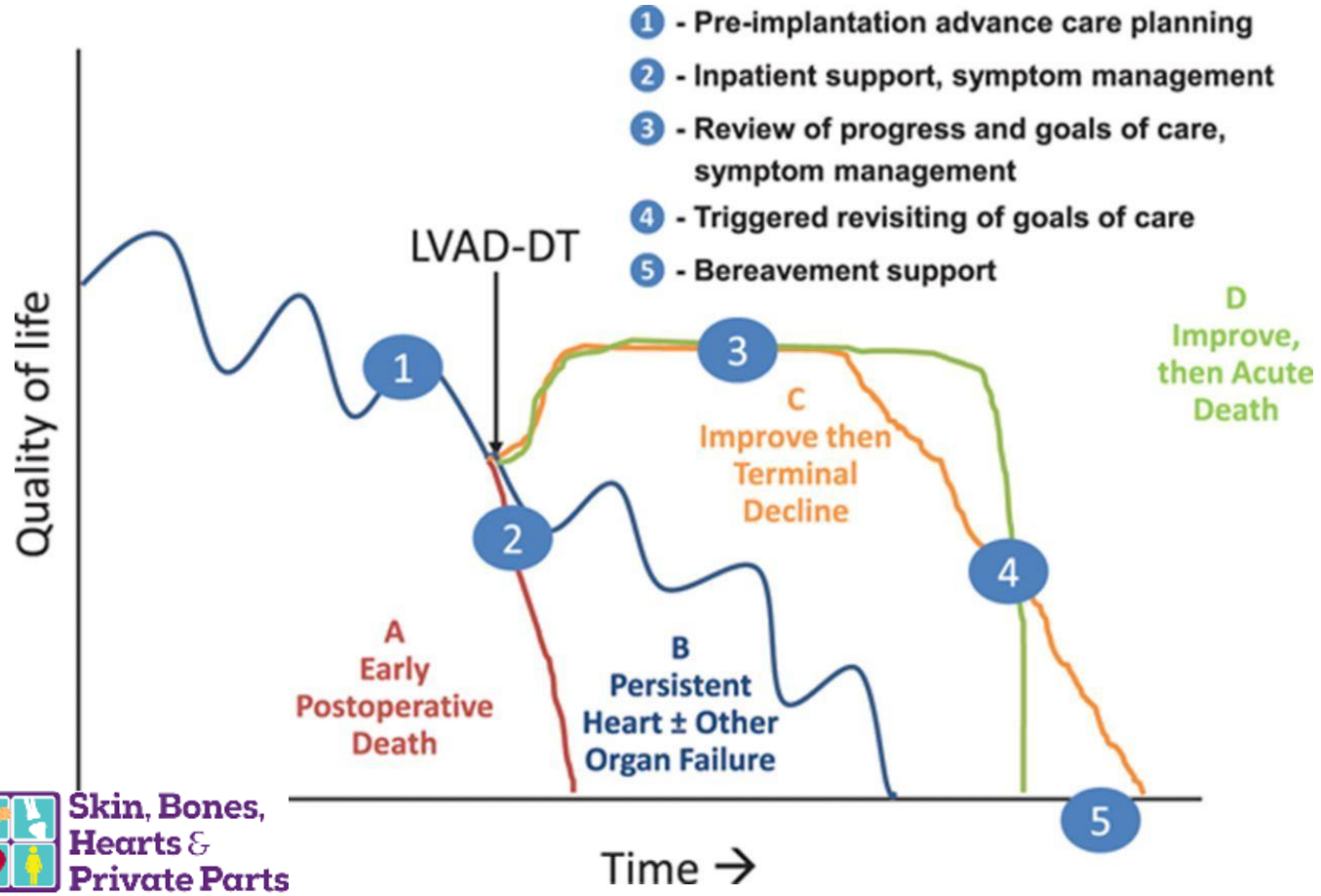
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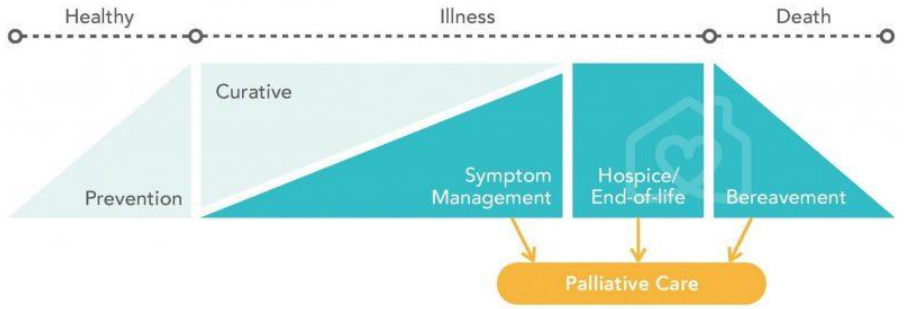
UNOS.org 2024. UNOS Regions | Organ Transplant Regional Resources

Waiting Games: Competition for Donor Hearts May Encourage Overtreatment (cardiovascularbusiness.com)

Introduction to Palliative Medicine for the Advanced HF Patient







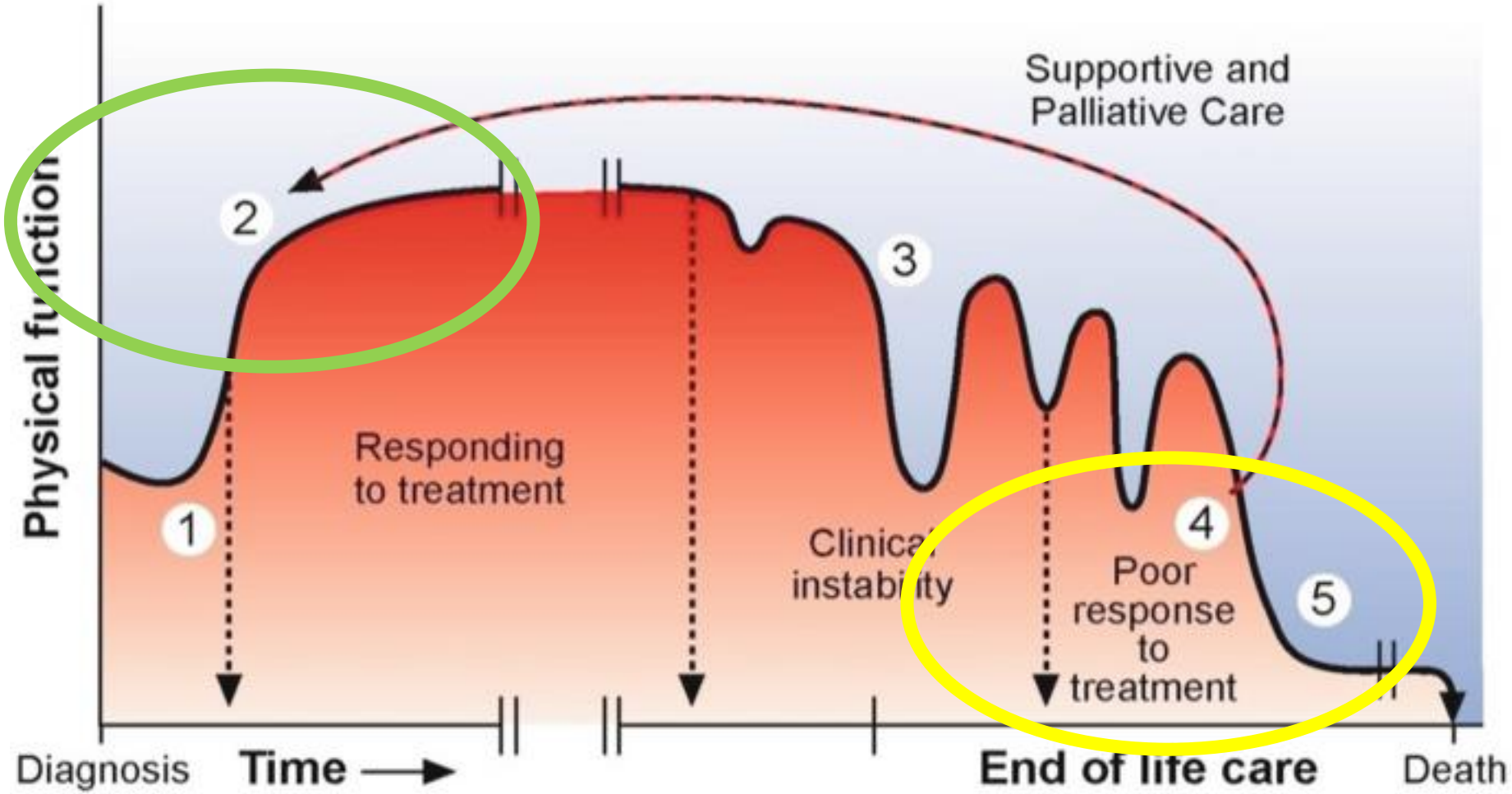
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Teuteberg & Maurer. 2016. https://doi.org/10.1161/CIRCHEARTFAILURE.116.003564

Thiviya. 2024. Palliative Care 101: A Complete Guide to End-of-Life Care - Homage

The typical course of heart failure



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Final PEARLS…

- Heart Failure is costly > KEEP THEM OUT OF THE HOSPITAL
- Heart Failure is Treatable
- "FAILURE" is scary to patients > dysfunction is a more realistic term
- LOTS of options > talk early
- Refer to your Heart Failure teams > Co-Management works great
- Not every can handle the full kitchen sink of HF GDMT (especially the young ones)
- DON'T forget to ask about family history, drugs and alcohol, and timing of symptoms

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Questions?



@sarsch79

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402-937-3595

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- Bayer (2026). Kerendia mechanism of action. Retrieved April 20, 2026, from Kerendia® (finerenone) Mechanism of Action | HCP
- Solomon S, et al. Finerenone in heart failure with mildly reduced or preserved ejection fraction. Retrieved April 20, 2026, from Finerenone in Heart Failure with Mildly Reduced or Preserved Ejection Fraction | New England Journal of Medicine
- Additional Sites Used:
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  - Heart Transplant Waiting List Statistics | 2026 Edition
  - Donor Heart Allocation | IntechOpen
  - Heart failure symptoms information infographic illustration Stock Vector Image & Art – Alamy
  - Acute decompensated heart failure (including cardiogenic shock) - EMCrit Project
  - Diuretics | Nurse Key
  - Manual Of Medicine on X: "Furosemide (Lasix) - Uses and Side Effects #medtwitter #foamed #foamrx https://t.co/OqgGxCs2SX" / X
  - In-hospital mortality is high after acute decompensation (left, 4–6%).... | Download Scientific Diagram
  - https://www.cardiovascular.abbott/us/en/campaigns/always-there.html
  - https://www.barostim.com
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