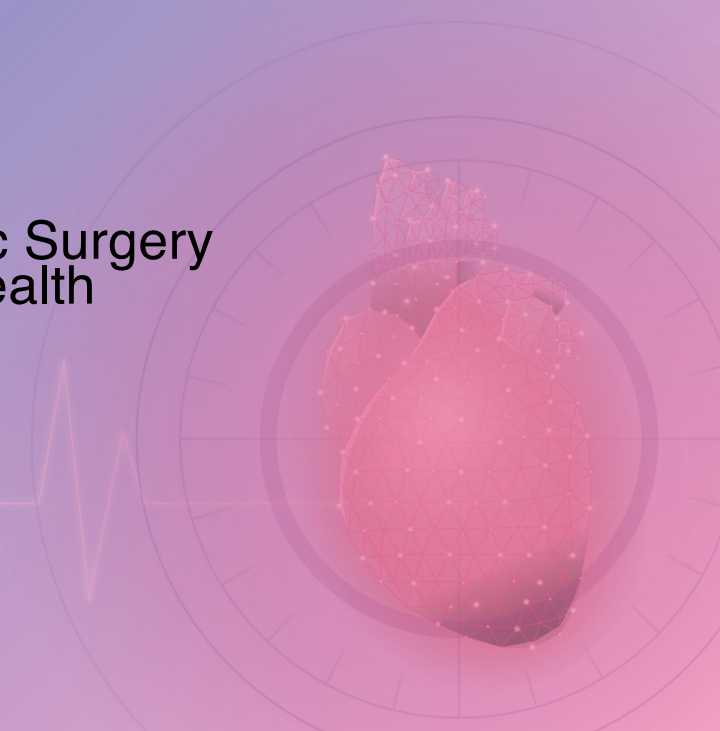# Building a Robotic Mitral Program

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DISCLOSURES

Consultant with:
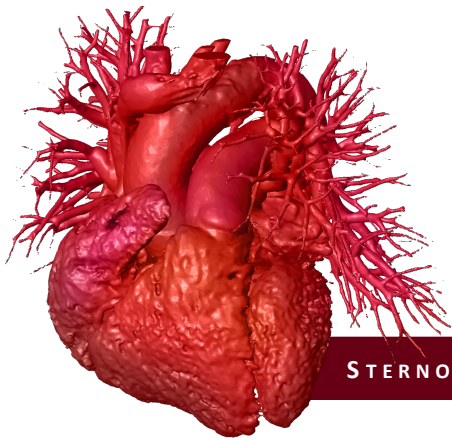
- Medtronic
- Abbott
- Corcym
- Johnson and Johnson

INTRODUCTION

❖ **Robot-assisted** mitral valve surgery has evolved as a method to intervene on mitral valve disease without a median sternotomy

❑ Provides **excellent visualization**

❑ Allows **precise** technical movements in a small space

❑ Avoid morbidity associated with sternotomy:
  ↓ Surgical invasiveness
  ↓ Post-operative pain
  ↓ Hospital length of stay
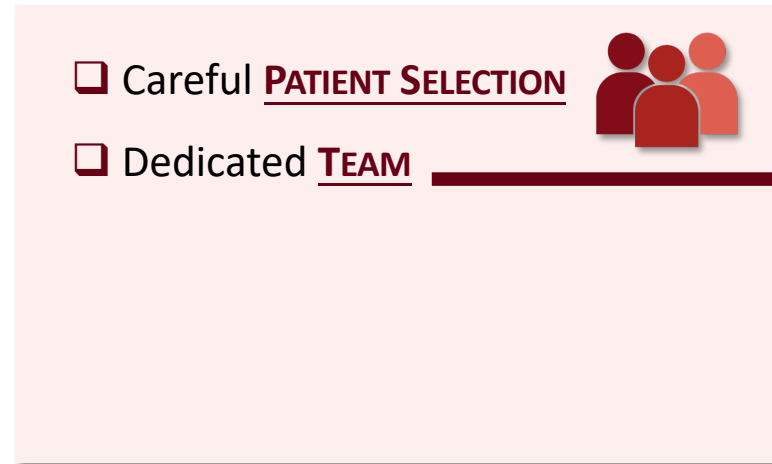
STERNOTOMY ＞ HEMI-STERNOTOMY ＞ MINI-THORACOTOMY ＞ VATS ＞ ROBOTIC

❖ **Establishing** a Robotic Mitral Valve Surgery Program

■ Fundamental factors for a **successful** robotic cardiac surgery program:

❑ Careful **PATIENT SELECTION**

❑ Dedicated **TEAM**

HEART TEAM APPROACH:

- CARDIOVASCULAR SURGEON
- INTERVENTIONAL CARDIOLOGIST
- NON-INVASIVE CARIOLOGIST HEART FAILURE EXPERT
- RADIOGRAPHERS (IMAGING EXPERTS)
- **PATIENT & FAMILY**
- ANESTHETISTS INTENSIVISTS
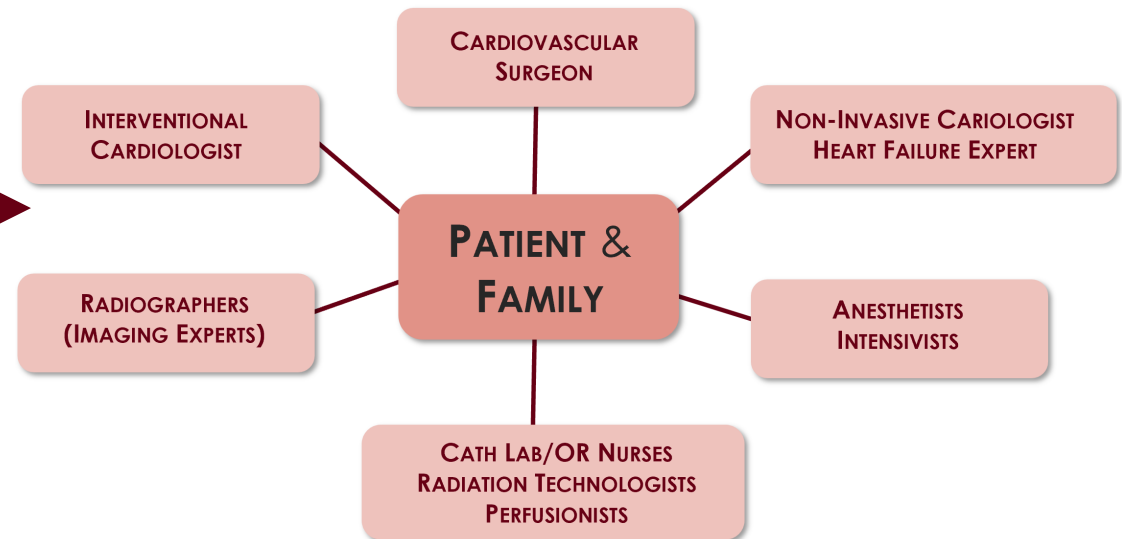- CATH LAB/OR NURSES RADIATION TECHNOLOGISTS PERFUSIONISTS

❖ **Establishing** a Robotic Mitral Valve Surgery Program

▪ Fundamental factors for a **successful** robotic cardiac surgery program:

❑ Careful PATIENT SELECTION

❑ Dedicated TEAM

❑ Institution SUPPORT

❑ Experience with SIMULATION team training *prior to live cases*

✓ Reinforce **non-technical** skills

✓ Delineate **specific tasks** for individual members of the team

✓ Team **debrief** after each case

▪ At our institution, we utilized the DaVinci system (**DaVinci Xi**, Intuitive Surgical Inc, Sunnyvale, CA, USA) for all of our mitral valve repair simulation and live cases

▪ This presentation focuses on the most important factors in the **successful implementation** of a robotic cardiac surgery program (rather than surgical techniques)

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INSTITUTION SUPPORT

> *Success of robotic cardiac surgery is a **TEAM** approach!*
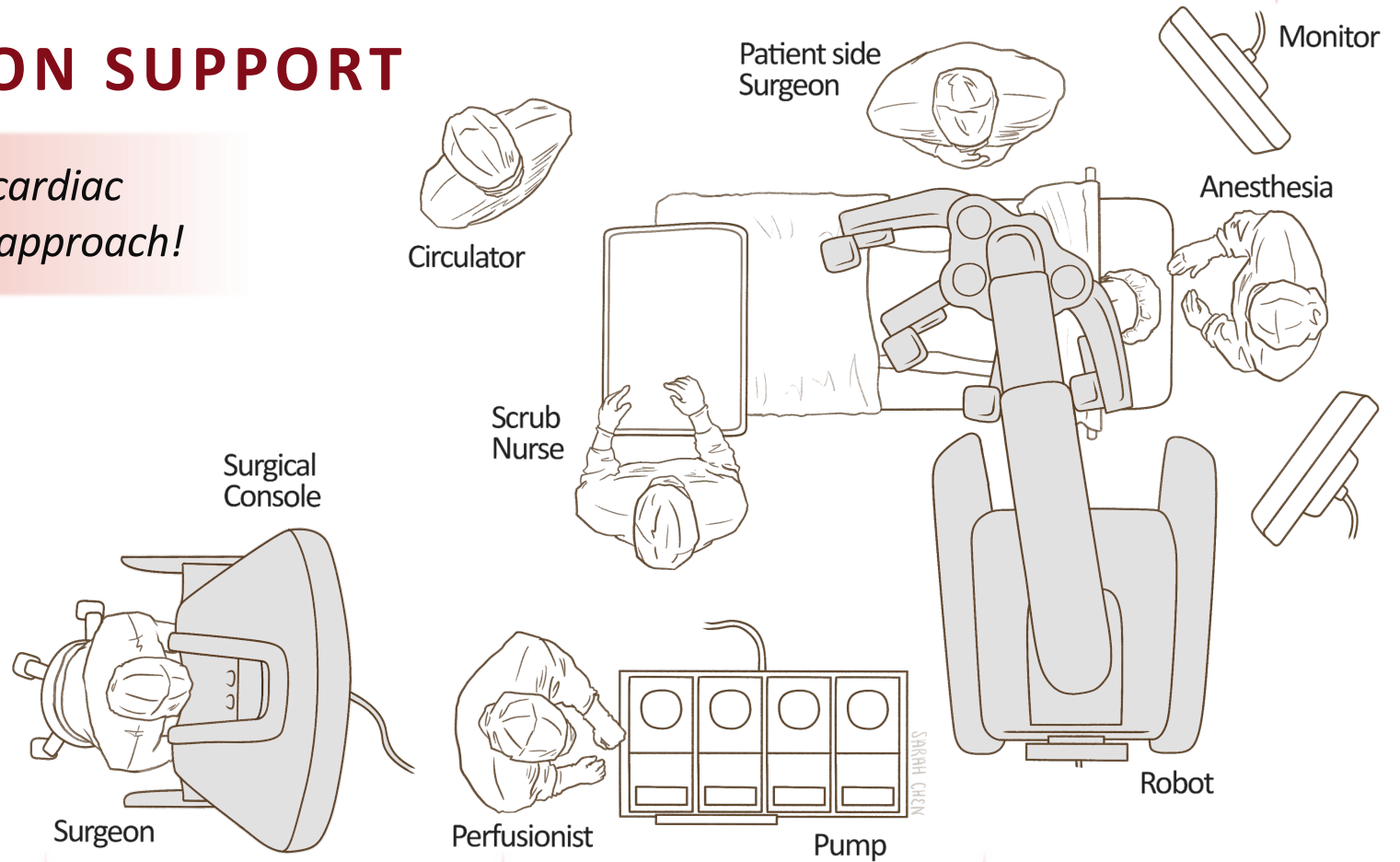
INSTITUTION SUPPORT

❖ Institutions interested in implementing a **Robotic** mitral valve surgery program should have prior experience with **Minimally Invasive** mitral valve procedures

❑ Prior to onset of a robotic mitral valve surgery program, crucial to have **institutional support** from:

✓ Hospital CEO	✓ Anesthesiologists	✓ Advanced practice providers
✓ Department chair	✓ Perfusionists	✓ Operating room nurses
✓ Administrative staff	✓ Surgical Trainees	✓ Ancillary OR staff
✓ Fellow surgeons	✓ Intensivists	

❑ Sufficient allocation of **robotic OR time** ensures skills repetition → mitigates the learning curve

❑ Appropriate infrastructure promotes individuals to contribute **ideas/feedback** to improve outcomes

❑ Valuable to contract an **independent surgical robotic training company** that works directly to:

  ✓ Oversee the implementation of a streamlined robotic mitral valve surgical program
  ✓ Facilitate training simulations

TRAINING

❖ **Robotic Module Training**

❑ The first step is for team members to be introduced to the robotic system and technology

➢ Representatives from DaVinci provided detailed education of the **robotic system** including:

  ✓ Docking
  ✓ Instrument exchange
  ✓ Key safety features

➢ Surgeons also completed:

  ✓ **Online** training modules
  ✓ Technical skills training on the robotic console **simulator**

❖ *DaVinci surgical systems/Intuitive only provide online modules and onsite training of equipment for cardiac surgery programs, and do not offer subsequent clinical training*

❖Team Training Simulation Platform

- **Mitral valve surgery** is one of the **most complex** cardiac surgery procedures due to nuanced anatomy/pathology of the mitral valve
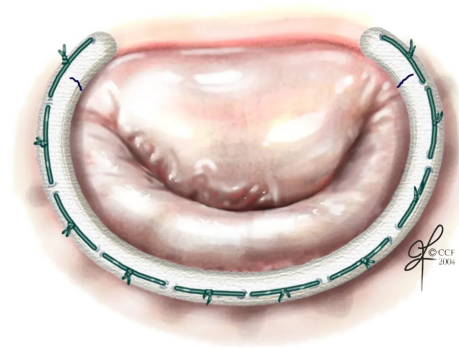

  - ✓ Given this complexity, **team training** is critical to ensure appropriate knowledge base
  - ✓ Surgeons should be proficient in open cardiac surgery and have expertise in the surgical management of mitral valve disease

- Safe and effective performance relies on teamwork:
  - ❑ Emphasize **non-technical skills**
    - ✓ e.g. communication + leadership
  - ❑ Training necessary increasing in response to the need for:
    - ✓ Educational efficiency
    - ✓ Clinical time pressures
    - ✓ Ethical imperative "not to practice on real patients"

- High fidelity patient **simulators** provide a realistic clinical environment with anatomic variations

- We utilized a thoracic cage model and **LifeLike BioTissue mitral valve model**, made of a polymer processing hydrogel technology that mimics the tissue characteristics of the mitral valve

- ❑ The mitral valve models may feature posterior leaflet prolapse and any of the biotissue chords can be torn or cut to simulate chordae tendinae repair
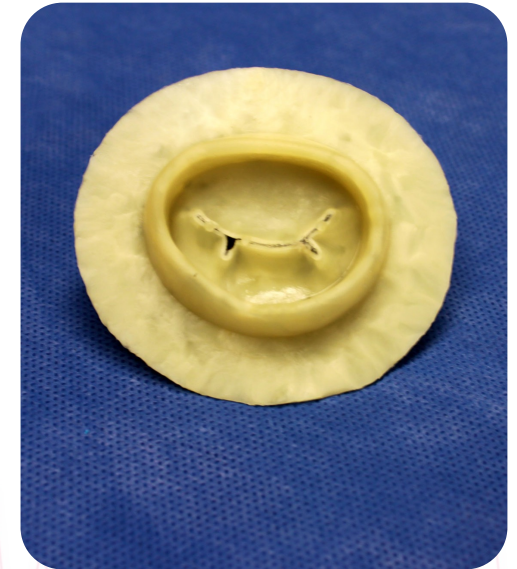
❖ Team Training Simulation Platform (con't)

▪ Mitral valve simulation model
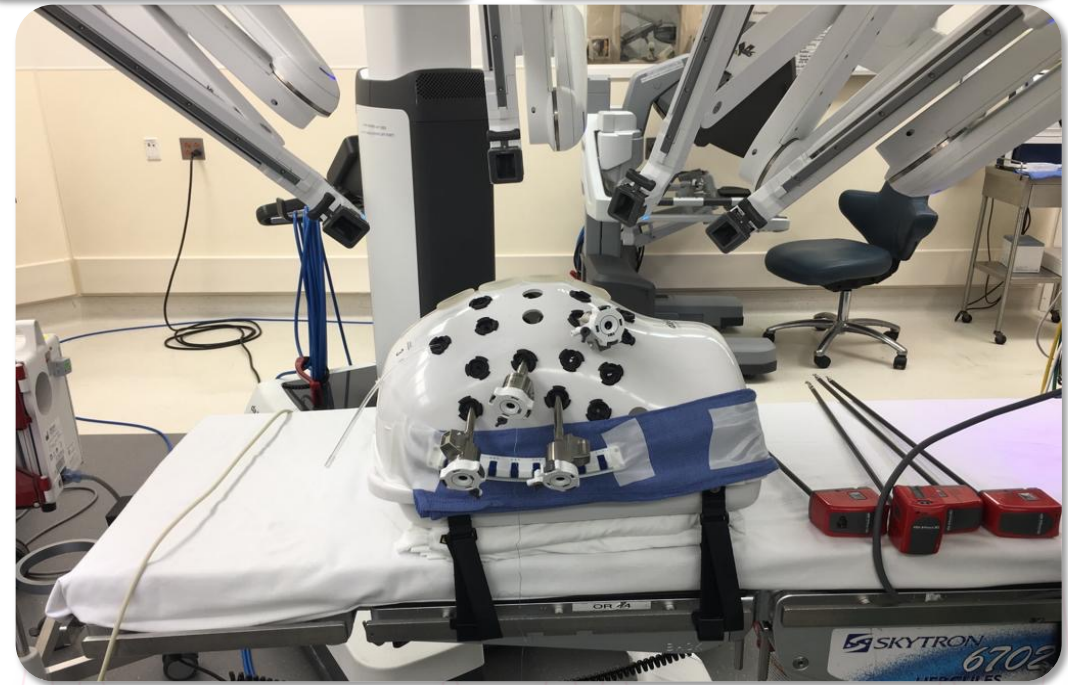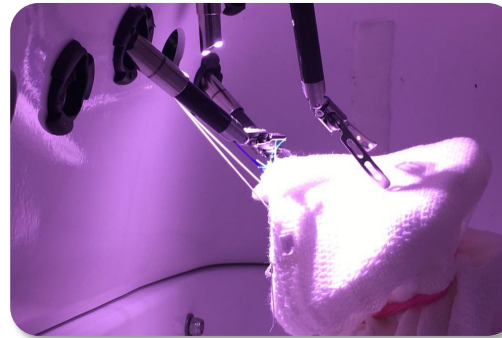
❖Team Training Simulation Platform (con't)

- 3 of our cardiac surgery advanced practice providers were designated as the robotic bedside assistant

  ➢ The involvement of dedicated advanced practice providers was extremely important for **consistency**

- The primary robotic cardiac surgeon at our institution has extensive experience in robotic cardiac surgery, specifically, in robotic mitral valve surgery

  ➢ For the other team members to be proficient and efficient in robotic mitral valve surgery, a **team training simulation platform** was developed

❖ Team Training Simulation Platform (con't)

➢ Team members present for simulation:

Cardiac Surgery
(attending, resident, PA)

Perfusion

Anesthesia

Cardiac OR Nursing

OR Equipment Specialists

❖ Team Training Simulation Platform (con't)

➢ All simulations sessions were performed in a **dedicated robotic OR**, with the DaVinci robot/robotic consoles, operating table, anesthesia equipment, transesophageal echocardiogram machine, cardiopulmonary bypass machine, and sterile instrument tables

❖ **Team Training Simulation Platform** (con't)

▪ A total of **33 simulation** sessions of mitral valve repair/valvuloplasty with neochords and annuloplasty with a semirigid band were performed

- ❑ Totaled **83 hours**

- ❑ For each session, documented times for:
  - ✓ Docking the robot
  - ✓ Valvuloplasty
  - ✓ Annuloplasty
  - ✓ Atriotomy closure

- ❑ The 3 designated advanced practice providers took turns as bedside assistant

- ❑ Reinforced communication required between bedside assistant and console surgeon

▪ Over course of training, **decreased**:
  - ✓ Docking time
  - ✓ **Annuloplasty**
  - ✓ **Valvuloplasty**
  - ✓ Atriotomy closure times

as team became more confident/comfortable

▪ Variability in simulation times due to:
  - ❑ 3 different advanced practice providers rotating through different steps of procedure
  - ❑ At times a cardiothoracic surgery resident rotating
  - ❑ May also be due to different experience levels, familiarity with the robot

❖ Overall, the structured team training simulation platform **steadily improved efficiency and flow of critical steps** of robot assisted mitral valve repair while **enhancing team dynamics**

Analysis of Key Procedural Steps (Valvuloplasty and Annuloplasty)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	11/5/20	11/7/20	11/8/20	11/8/20	11/8/20	11/8/20	11/8/20	11/21/20	11/21/20	11/21/20	11/22/20	11/22/20	11/22/20	11/22/20	12/13/20	12/13/20	12/13/20	2/6/21	2/6/21	2/6/21	4/11/21	4/11/21	4/11/21	6/6/21	6/6/21	6/6/21	7/11/21	7/11/21	8/1/21	8/1/21	8/8/21	8/8/21	9/13/21
Valvuloplasty	0:18	0:22	0:27	0:26	0:24	0:23	0:12	0:32	0:16	0:18	0:25	0:26	0:20	0:16	0:24	0:20	0:15	0:26	0:19	0:13	0:21	0:18	0:17	0:26	0:19	0:16	0:18	0:19	0:17	0:22	0:24	0:23	0:30
Annuloplasty	0:21				0:17	0:16	0:15	0:23	0:23	0:20	0:23	0:18	0:20	0:12	0:18	0:16	0:12	0:25	0:30	0:29	0:18	0:10	0:11	0:25	0:30	0:29	0:10	0:09	0:09	0:09	0:08	0:10	0:10

❖ Debriefing

➤ Following each simulation training day, a **team debriefing session** was conducted with all members from the simulation as well as the independent surgical robot company representative consultant

❑ Each team member was provided the opportunity to reflect on:

  ✓ **Positive** aspects of the day's simulation

  ✓ Room for **improvement**

❑ The consultant also reviewed and compared the durations of each critical procedure step and offered insight for improvement for the next simulation training session.

❑ Given the different level of progression of the advanced practice providers, the debriefing sessions allowed the surgeon to make necessary **adjustments** for patient safety and procedural efficiency

❑ The debriefing sessions were critically important and contributed to the steady **improvement in efficiency** and team dynamics throughout simulation training and carried over to the **live cases**

LIVE CASES

❖ The number of simulation cases <u>required prior to the first live case</u> is based on comparing duration of critical procedural steps to "best in class" benchmark times from 8 other high-volume institutions who have implemented successful robotic mitral valve surgery programs

   ✓ Can proceed to live case once team achieves procedural step times **at or better** than benchmark times on each critical procedure

   ✓ The independent surgical robot consultant was present for the first 10 live cases, with subsequent in-depth debriefing sessions

❖ Robotic cardiac surgery procedures are divided into <u>3 Levels</u>:

LEVEL 1: **Early** learning curve procedures using 3 robotic arms, e.g.
   ❑ Thoracic artery takedown
   ❑ Pericardial window
   ❑ Left ventricular lead placement

*At our institution, our robotic cardiac surgeon's extensive prior robotic cardiac experience allowed our program to begin with intracardiac advanced procedures during simulation as well as for live cases

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LEVEL 2: **Intermediate** procedures (based on surgeon's previous minimally invasive experience), e.g.
   ❑ Single vessel robotic minimally invasive direct coronary artery bypass (MIDCAB)
   ❑ Multi-vessel robotic MIDCAB
   ❑ Initiation of 4-robotic arm intracardiac procedures

▪ **LEVEL 3**: **Advanced** procedures, e.g.
   ❑ Arrest heart totally endoscopic coronary artery bypass graft (AH TECAB)
   ❑ **Mitral valve repair/replacement**
   ❑ Aortic valve replacement
   ❑ Concomitant valve repair/replacement
   ❑ Coronary artery bypass

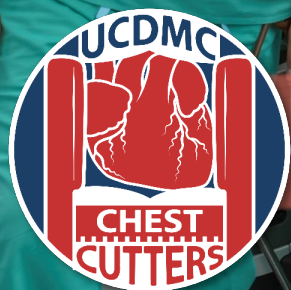❖ Example of live robot-assisted cardiac surgery

CONCLUSION

- ❖ Robotic cardiac surgery has drastically changed the clinical practice of cardiac surgery
  - ▪ Patients benefit from more rapid return to presurgical activities
  - ▪ While the learning curve for implementing a robotic mitral valve surgery program may initially be daunting, developing a structured team training simulation platform to train team members allows for a **more efficient and safer transition** to live cases
- ❖ Recommendations for establishing a robotic mitral valve program for a surgical team with *no prior robotic experience*:

  - ❑ **30-45** lives cases to achieve surgeon autonomy
  - ❑ Recommended at **least 2 cases** per month
  - ❑ Takes **~15-20 months** after completing simulated team training
  - ❑ Perform a minimum of **20 cases/year** to maintain proficiency
    - ❖ Must maintain a large enough referral base to maintain adequate case volume to support the program's experience, quality, and existence
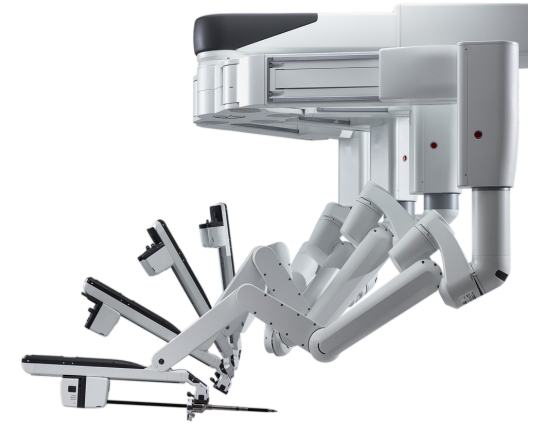
- ❖ As more cardiac surgeons gain experience with robotic cardiac surgery techniques, **the volume of robotic cases will increase** to meet patient demand and pave the way for the implementation of new programs

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THANK YOU