

Robotics in General Surgery

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Objectives

- **Brief History of Robotics in General Surgery**
- **Robotic General Surgery Procedures**
- **Advantages/Disadvantages of Robotic General Surgery**
- **Role of Robotic Surgery in Bariatric Surgery**
- **Role of Robotic Surgery in Foregut Surgery**
- **Role of Robotic Surgery in Ventral Hernia Surgery**

History

- Multiple previous robotic devices created including Puma 560 (1985) for neurosurgical biopsies, AESOP (1993) for robotic assisted endoscopic surgeries, and ROBODOC for hip replacement surgery
- In 2000, the da Vinci Surgical System received FDA approval for minimally invasive surgery.
- Ohio State was one of the first robotic center worldwide (2000)
- First reports of robotic Heller myotomy (2001), Pancreatic resection (2001), and Four arm surgery (2004).

ROBODOC



Lanfranco AR¹, Castellanos AE, Desai JP, Meyers WC. Robotic Surgery: A Current Perspective. *Ann Surg.* 2004 Jan;239(1):14-21.

1999



Si System



Author: Cmglee (CC BY-SA 3.0)

2017

Xi System



(U.S. Air Force photo by
Kemberly Groue/Released)

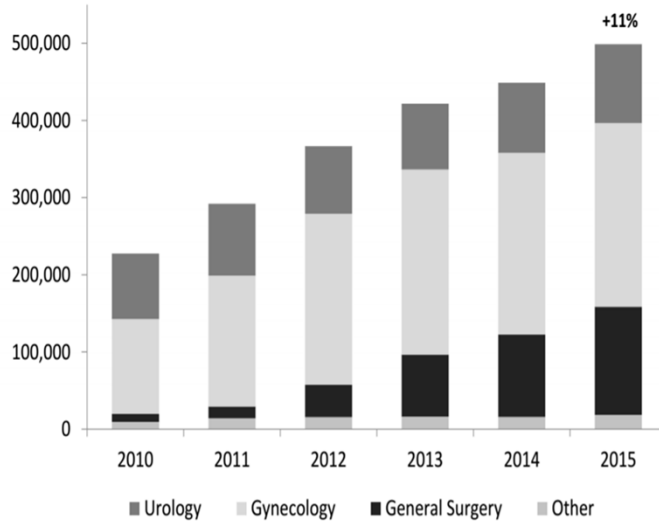


Author: Intuitive
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da Vinci Robot

- Initially developed for Cardiac Surgery use
- Ultimately expanded to other specialties with specific traction in Urology and Gynecology
- Over 3,100 systems worldwide

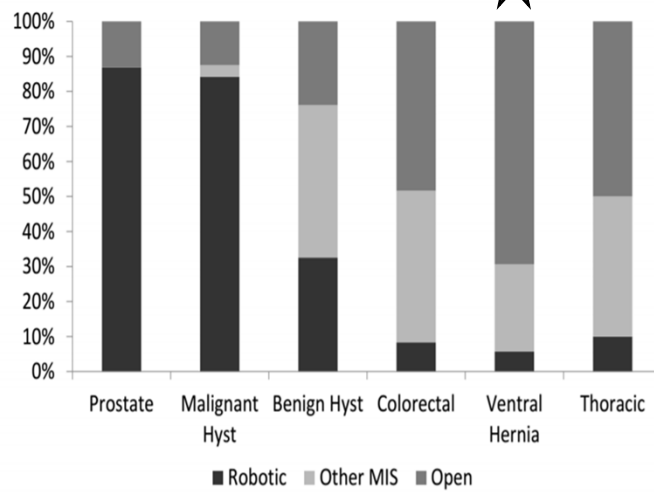
US Procedure Trend



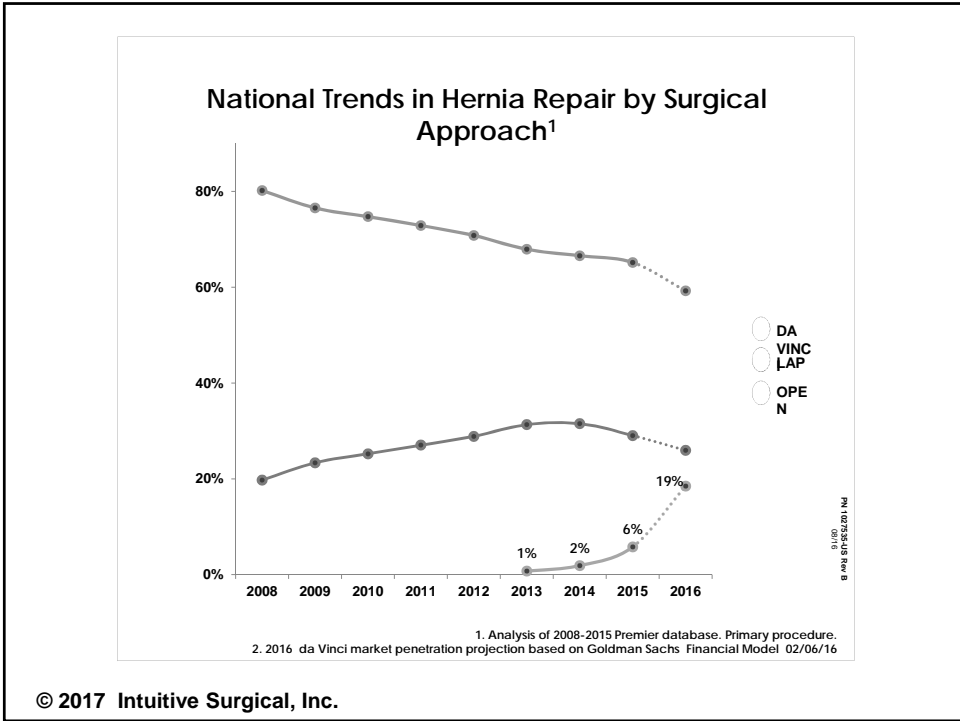
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Open Surgery Remains Common – U.S.

Yr: 2015




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Advantages

- **3 dimensional viewing**
- **Wrist articulation**
- **Increased ability to perform fine dissection**
- **Minimally invasive approach to previous open procedures**
- **Better ergonomics for surgeons**



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Disadvantages

- **Cost**
 - **Capital investment**
 - **Instruments – 10 use**
- **Longer Surgery Duration**
- **Learning Curve**
- **Patient advantage?**

Robotic General Surgery Procedures

FDA Approved procedures:

- **Bariatric procedures (sleeve, gastric bypass)**
- **Foregut Surgery: Nissen fundoplication, Heller Myotomy**
- **Gastrectomy (benign, malignant)**
- **Hernia repair**
- **Cholecystectomy**
- **Pancreatectomy (benign, malignant)**
- **Colectomy**
- **Rectal resection**

Bariatric Surgery

The Obesity Epidemic

- **78.6 million (34.9%) Americans are considered obese**
 - **More than doubled from 13.3% in 1960**
- **Obesity-related conditions affect nearly every organ system and are some of the leading causes of preventable deaths**

- www.cdc.gov

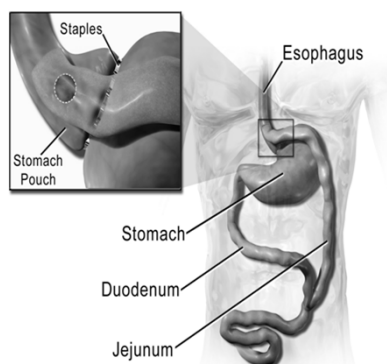
Estimate of Bariatric Surgery Numbers, 2011-2015

	2011	2012	2013	2014	2015
Total	158,000	173,000	179,000	193,000	196,000
RNY	36.7%	37.5%	34.2%	26.8%	23.1%
Band	35.4%	20.2%	14%	9.5%	5.7%
Sleeve	17.8%	33%	42.1%	51.7%	53.8%
BPD/DS	0.9%	1%	1%	0.4%	0.6%
Revisions	6%	6%	6%	11.5%	13.6%
Other	3.2%	2.3%	2.7%	0.1%	3.2%
Balloons					~700 cases
V-Bloc					18 cases

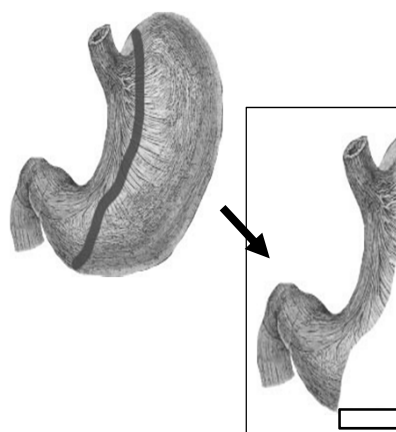
ASMBS total bariatric procedures numbers from 2011, 2012, 2013, 2014 and 2015 are based on the best estimation from available data (BOLD, ASC/MBSAQIP, National Inpatient Sample data and outpatient estimations).

asmbs.org

Robotic Bariatric Surgery



Roux-en-Y Gastric Bypass



Sleeve Gastrectomy

Images from https://en.wikipedia.org/wiki/Gastric_bypass_surgery

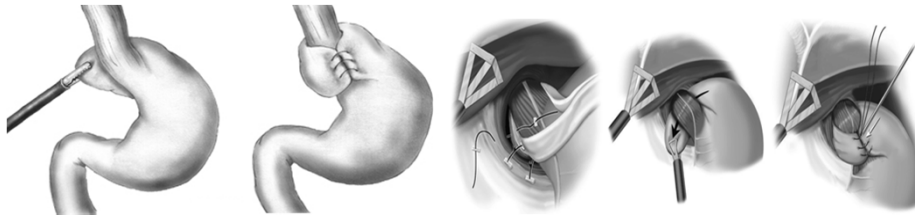
Robotic Bariatric Surgery

- **Advantages:**
 - **Studies have shown at least equal outcomes to laparoscopic surgery**
 - **May decrease gastrojejunostomy leak rate, stricture rate, length of stay**
- **Disadvantages:**
 - **Procedure length of time**
 - **Cost?**
- **More studies needed to determine if there is a true patient benefit**

Foregut Surgery

Robotic Foregut Surgery

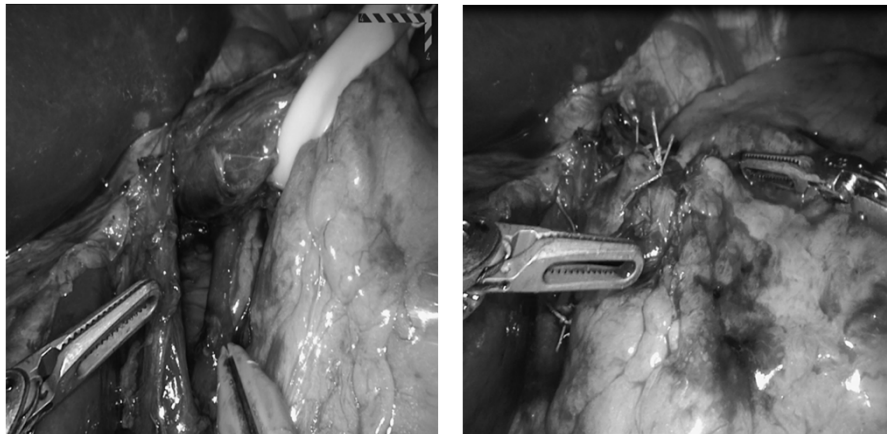
- Hiatal hernia repair with Nissen (360°) or Toupet (270°) fundoplication



- Paraesophageal hernia repair

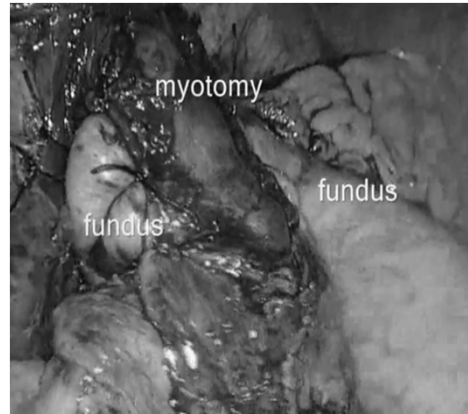
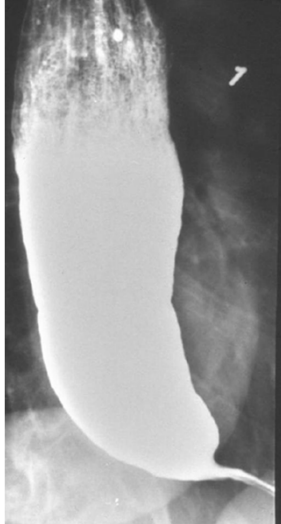
https://medlineplus.gov/ency/presentations/100181_5.htm

Robotic Foregut Surgery



Robotic Foregut Surgery

- Heller myotomy for achalasia



Author: Farnoosh Farrokhi, Michael F. Vaezi. - CC BY 2.0

Robotic Foregut Surgery

- Advantages of Robotic Foregut Surgery:
 - 3D Visualization
 - Magnification of Surgical Field
 - Very useful for redo operations where more precise movement are needed
 - Very useful for Heller myotomy for achalasia where precise division of muscle fibers is critical to prevent esophageal perforation

Ventral Hernia Repair

Advantages: Minimally Invasive Approach

- Minimally invasive hernia repairs are associated with shorter length of stay, fewer wound-related complications, improved postoperative pain profiles
- Limitations of Laparoscopic ventral hernia repair:
 - intraperitoneal mesh placement
 - difficult to re-approximate the midline
 - high cost of mesh and fixation devices
 - Bulging/Eventration of the mesh with larger defects
 - Technique not always equal to open

Robotic Pre-Peritoneal Ventral Hernia Repair – video



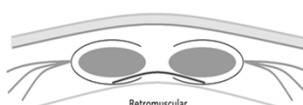
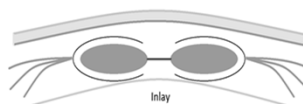
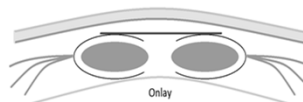
Advantages: Minimally Invasive Approach

- **Robotic ventral hernia repair may bridge the gap between open and laparoscopic repairs**
- **Robotic ventral hernia repair allows for larger defects to be repaired minimally invasively including myofascial releases:**
 - **Transversus abdominus release (TAR)**
 - **External oblique release**
 - **Bilateral postrectus sheath incision with retrorectus hernia repair**

Gonzalez, A., Escobar, E., Romero, R. et al. Surg Endosc (2016).

Advantages: Minimally Invasive Approach

- Retrorectus hernia repair: brings fascial edges to the midline to create a more functional abdominal wall



Advantages: Minimally Invasive Approach

- Recent study compared length of stay of robotic retrorectus ventral hernia repair (r-RVHR) to open retrorectus ventral hernia repair (o-RVHR)
- Evaluating value added to patients and the health system by assessing one component, length of stay

Carbonell AM, et. al. Ann Surg. 2017 Mar 27

Advantages: Minimally Invasive Approach



Robotic Retrorectus Ventral Hernia Repair – Video



Advantages: Minimally Invasive Approach

- **Utilizing data from the Americas Hernia Society Quality Collaborative (AHSQC), evaluated the largest collection of r-RVHR to date.**
- **Length of Stay (statistically significant):**
 - **r-RVHR – 2 days**
 - **o-RVHR – 3 days**
- **Despite the increased cost of robotic platform, cost savings was noted from decreased length of stay, mesh choice.**

Carbonell AM, et. al. Ann Surg. 2017 Mar 27

Current Status of Robotics in Hernia

- **Growing experience and increasing number of studies, however still very little data available**
 - **Literature primarily single surgeon experience**
 - **Largest study: Multicenter retrospective study**
 - **368 patients underwent robotic primary or incisional hernia repair by 5 surgeons**
 - **Reproducibly safe**
 - **Short term outcomes comparable to laparoscopic results**
- **Scrutiny over cost vs. benefit**

Gonzalez, A., Escobar, E., Romero, R. et al.
Surg Endosc (2016).

Robotics in General Surgery



References

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6. Gonzalez, A., Escobar, E., Romero, R. et al. Robotic-assisted ventral hernia repair: a multicenter evaluation of clinical outcomes. *Surg Endosc* (2016). doi:10.1007/s00464-016-511.8-0

Robotics in General Surgery

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Objectives

- **Role of Robotic Surgery in Inguinal Hernia Surgery**
- **Role of Robotic Surgery in Biliary Surgery**
- **Role of Robotic Surgery in Surgical Resident Education**

Inguinal Hernia Repair

Inguinal Hernia Repairs

- **Wide Variety of Repairs**
 - **Open Tissue Repairs**
 - **Open Mesh Repairs**
 - **Laparoscopic Mesh Repairs**
 - **Totally Extraperitoneal**
 - **Trans Abdominal Repairs**
 - **Robotic Mesh Repairs**

Advantages: MIS Inguinal Approaches

- **Both open and minimally invasive inguinal hernia repairs continue to be largely outpatient procedures.**
- **Minimally invasive inguinal hernia repairs are associated with:**
 - **Smaller incisions**
 - **Fewer wound-related complications and mesh infections**
 - **Improved postoperative pain profiles**
 - **Fewer complications related to chronic nerve issues**
 - **Bowel evaluation in emergent cases**

Limitations: MIS Inguinal Approaches

- **Limitations of Laparoscopic Inguinal hernia repair:**
 - **Steep learning curve**
 - **High cost of fixation devices**
 - **Difficulty managing larger defects**
 - **Technique not always equal to open**
 - **Previous Repairs may necessitate different approaches**

Robotic Bilateral Inguinal Hernia Repair

Advantages: Robotic Minimally Invasive Approach

- **Robotic inguinal hernia repair avoid costly fixation devices**
- **Robotic inguinal hernia repair may provide improved ergonomics to the surgeon during placement.**

Biliary Surgery

Laparoscopic Cholecystectomy

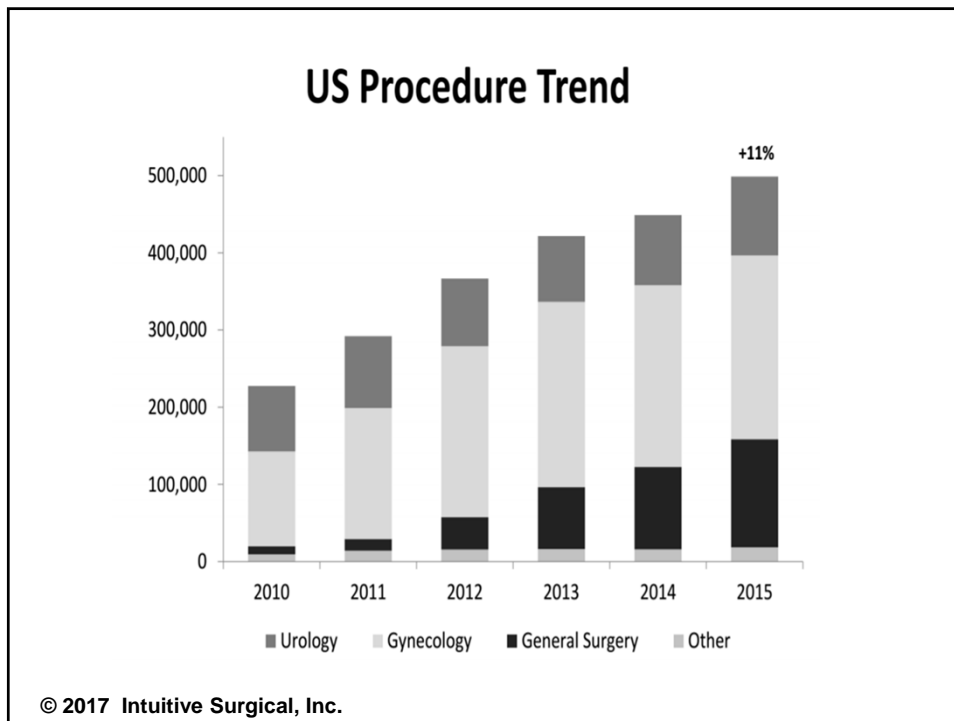
- **First performed in September of 1985.**
- **Popularized as Standard of Care**
- **Gave birth to the Laparoscopic Revolution of Surgery**
- **Continues to be one of the most common procedures performed in the United States**

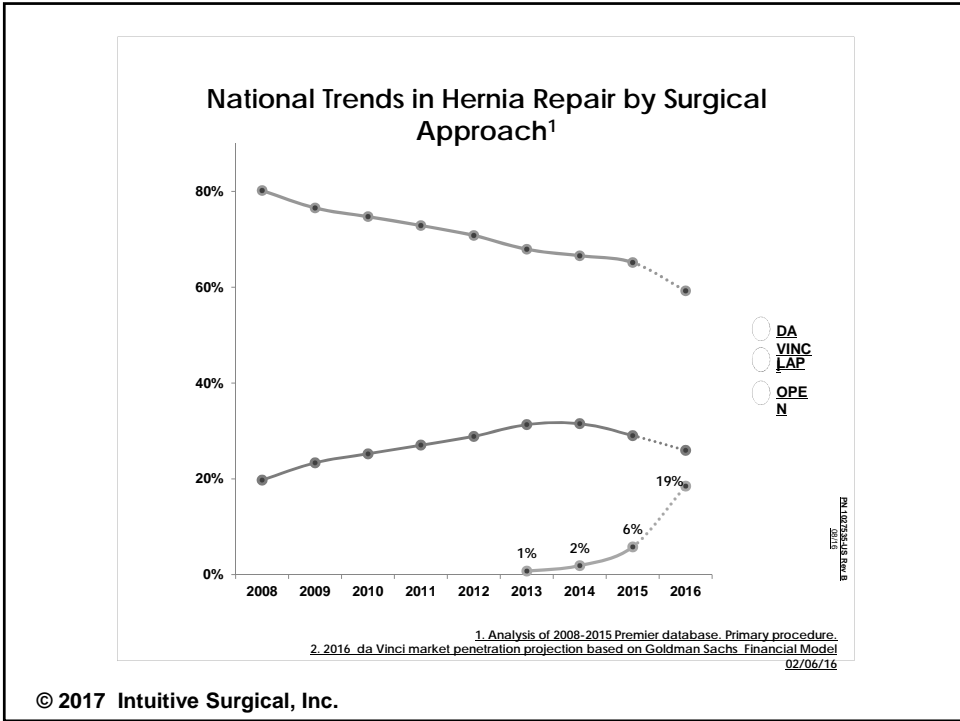
Minimally Invasive Advances in Biliary Surgery

- **Fluorescence imaging popularize for improved anatomic identification and prevention of complications**
- **Continues to push the boundaries of MIS surgeries including complex cancer resections and reconstructions**
- **Provides a stable platform for resident and fellow training**

Robotic Cholecystectomy with Fluorescence Imaging

Robotics in Resident and Fellowship Training





Robotic Training Requirements

- **Online surgical system course work**
- **Simulation modules with passing metrics**
- **Beside assisting cases**
- **Primary cases as the Console Surgeon**
- **Simulation modules with passing metrics**

Robotics in General Surgery

