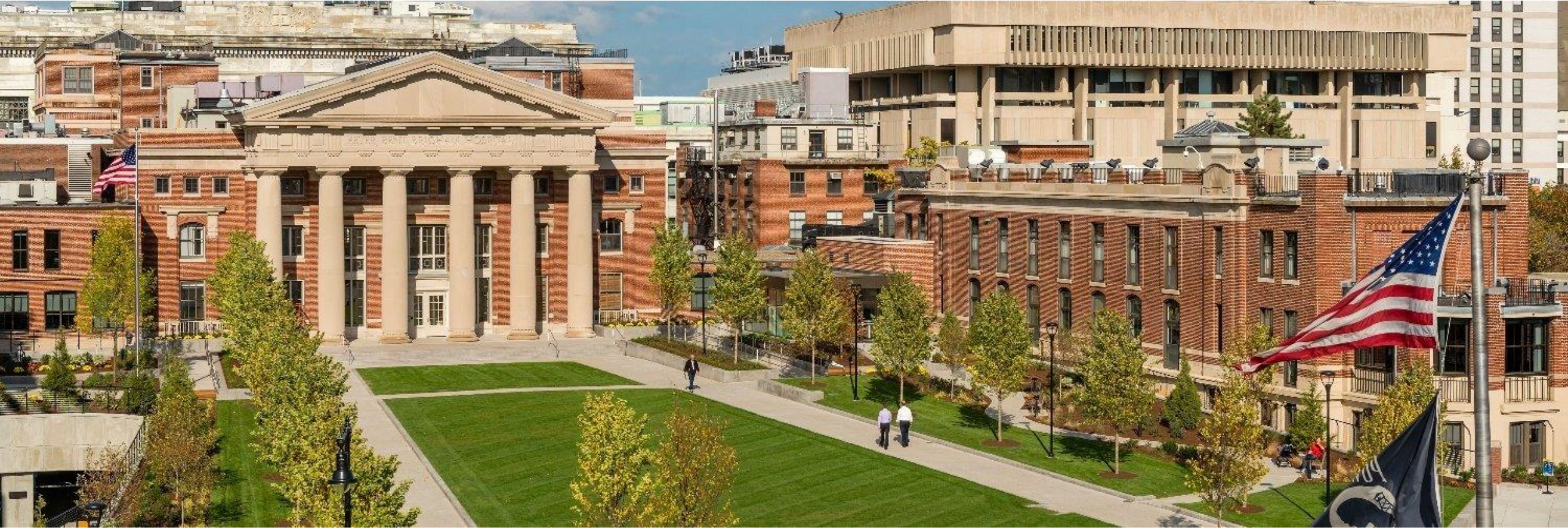

Next-Gen Robotics & Instruments: Emerging surgical tools that enhance precision, reduce invasiveness, and improve outcomes

Abdelrahman A. Nimeri, MD, FACS, FASMBS Dipl ABOM

Director, Bariatric Surgery Brigham & Women's Hospital

Secretary/Treasurer, IFSO

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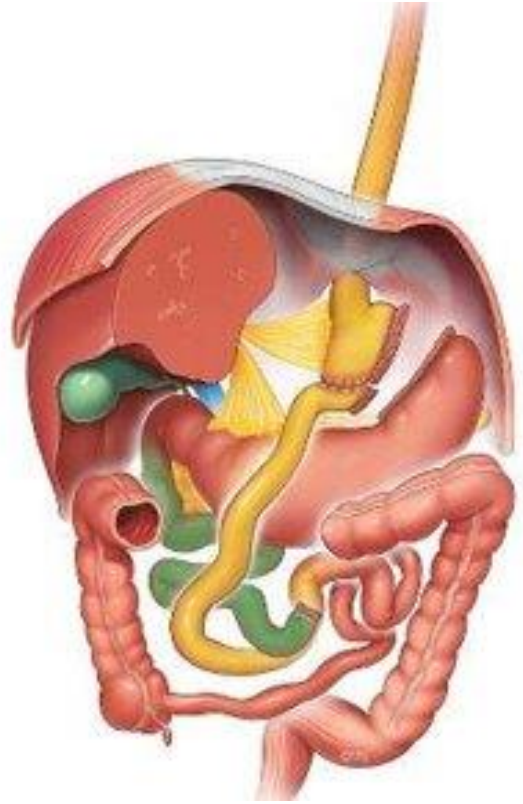
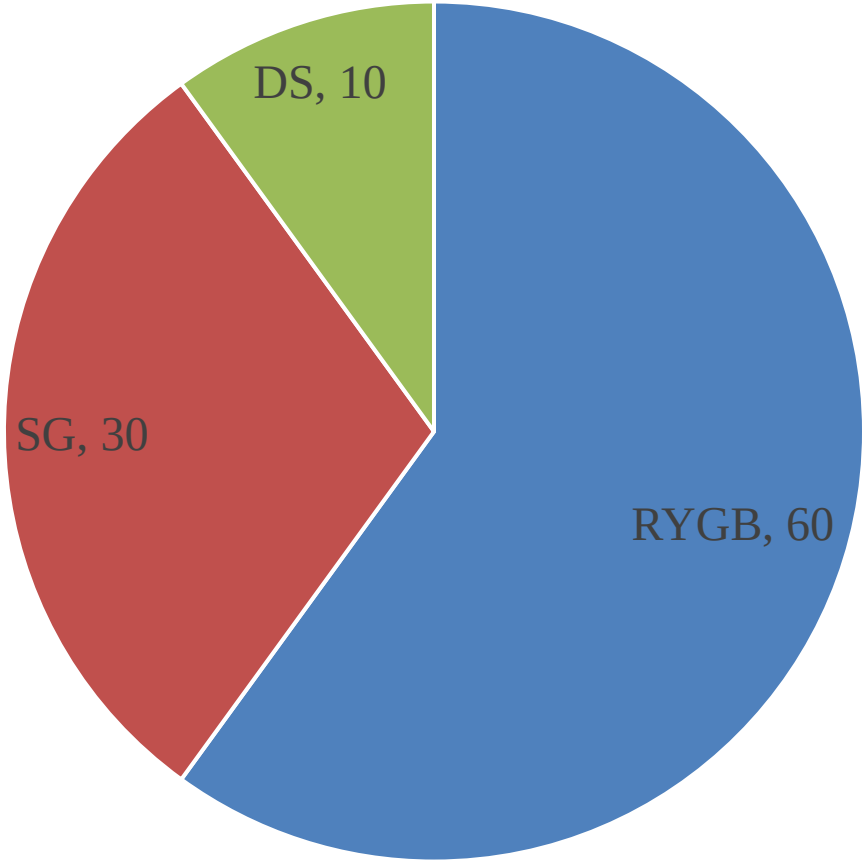
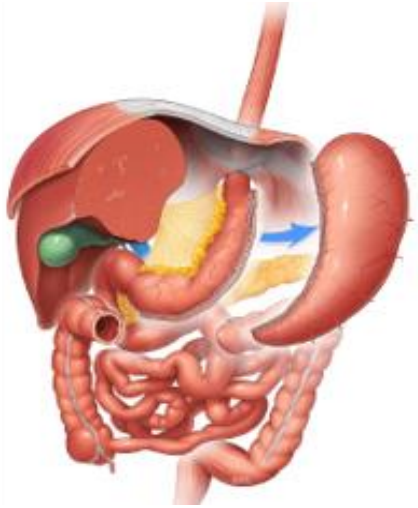
Speaker/Advisory board, Medtronic, Intuitive & Ethicon







Presentation outline

- ***Utilization of Robotic vs laparoscopic MBS.***
- ***Next generation of robotic instruments.***
- ***Machine learning and Artificial Intelligence.***

History of Metabolic/Bariatric Surgery

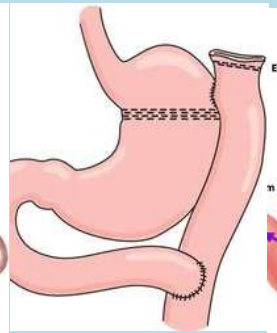
10% Mortality
50% Morbidity

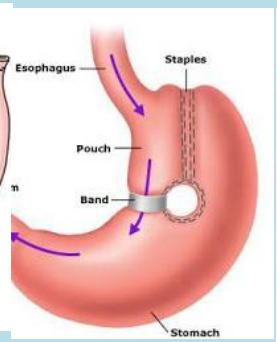
Safety, Serendipity, Innovation

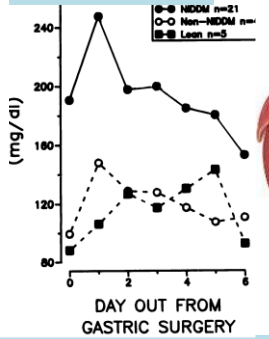
1954, A.J. Kremen
1956 JH Payne

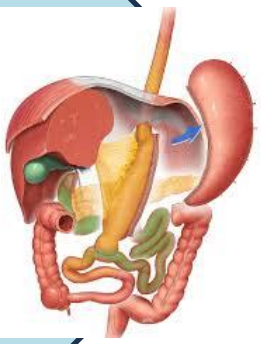
Robotic Bariatric Surgery
1998 Himpens

1954-1956 **1967** **1970s** **1976** **1988** **1994** **1995** **1998** **1998** **2000** **2007**









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Kremen, A.JAm. J. Surg. *118:141*, 1969

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Changes in Utilization of Bariatric Surgery in the United States From 1993 to 2016

Any complication

Mortality

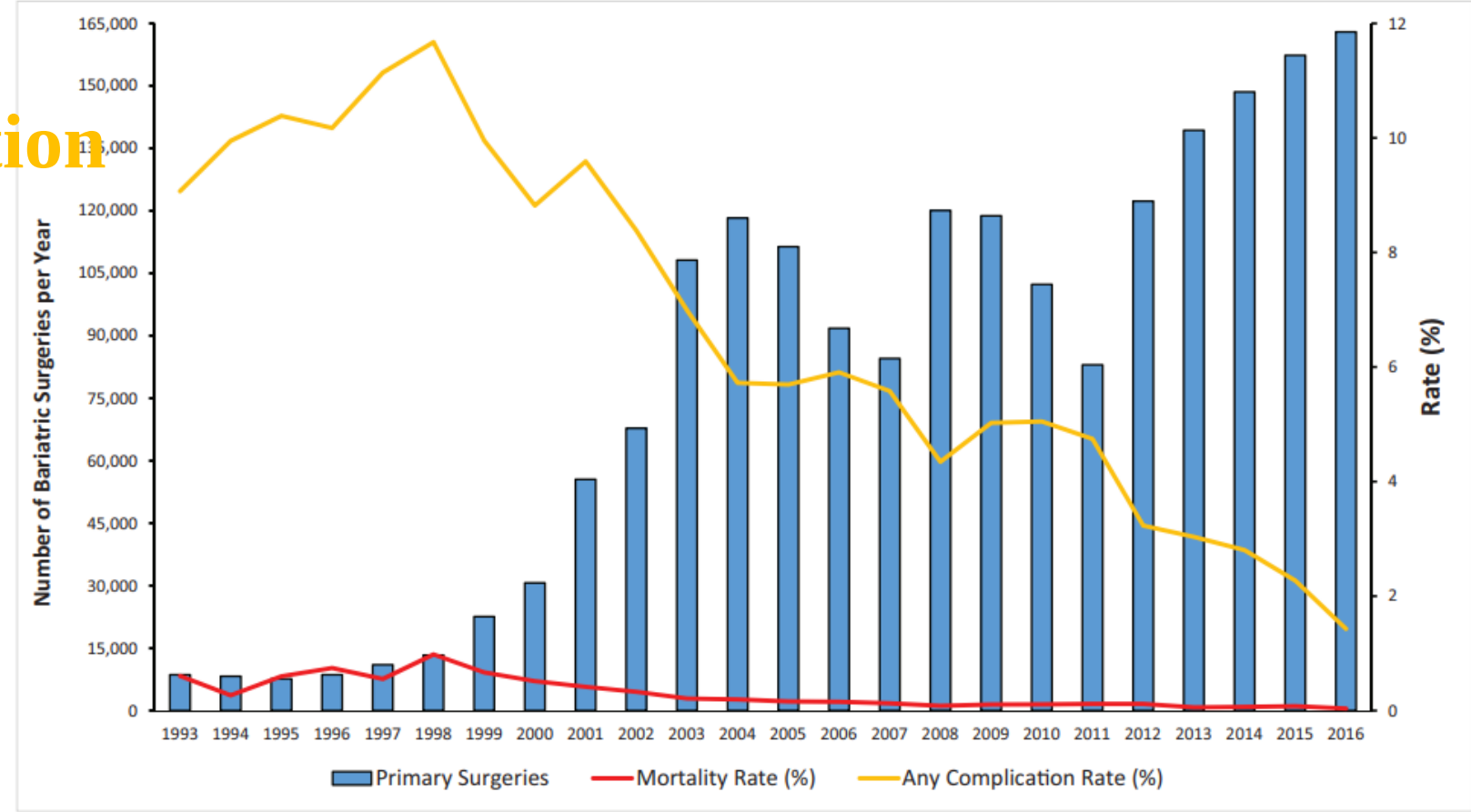
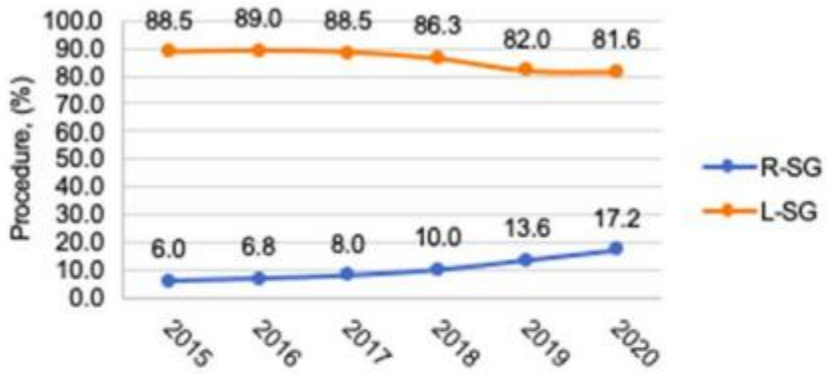
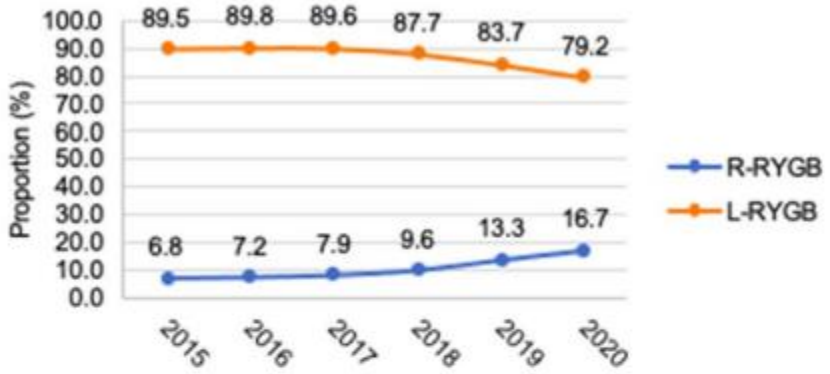


FIGURE 2. Number of inpatient primary bariatric surgery procedures and initial admission complication and mortality rates in the United States from 1993 to 2016.

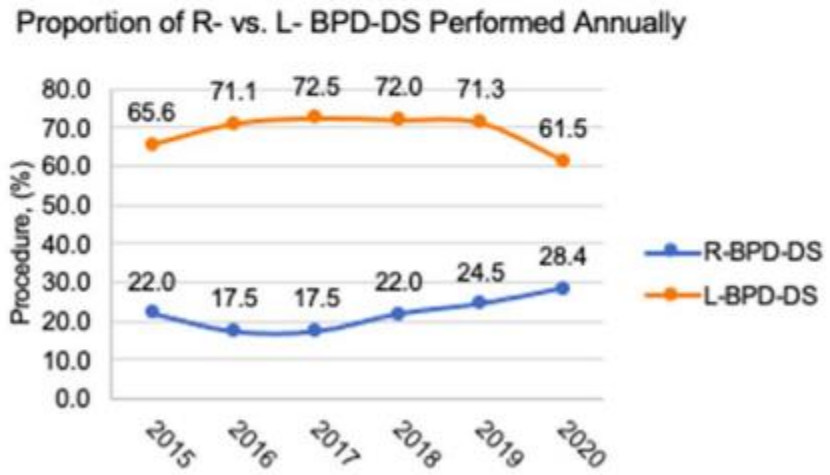
Robotic vs laparoscopic MBS 2015-2020



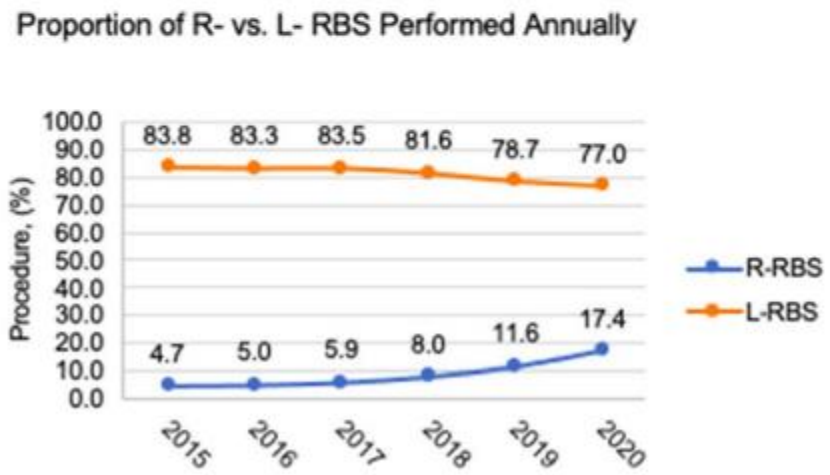
	2015	2016	2017	2018	2019	2020
R-SG (n)	5229	6918	8868	11393	15350	17063
L-SG (n)	76908	90263	98522	98747	92552	80864



	2015	2016	2017	2018	2019	2020
R-RYGB (n)	2554	2710	3023	3708	5372	6198
L-RYGB (n)	33661	33887	34445	33962	33781	29439



	2015	2016	2017	2018	2019	2020
R-BPD-DS (n)	221	205	272	447	506	393
L-BPD-DS (n)	659	832	1123	1465	1472	852

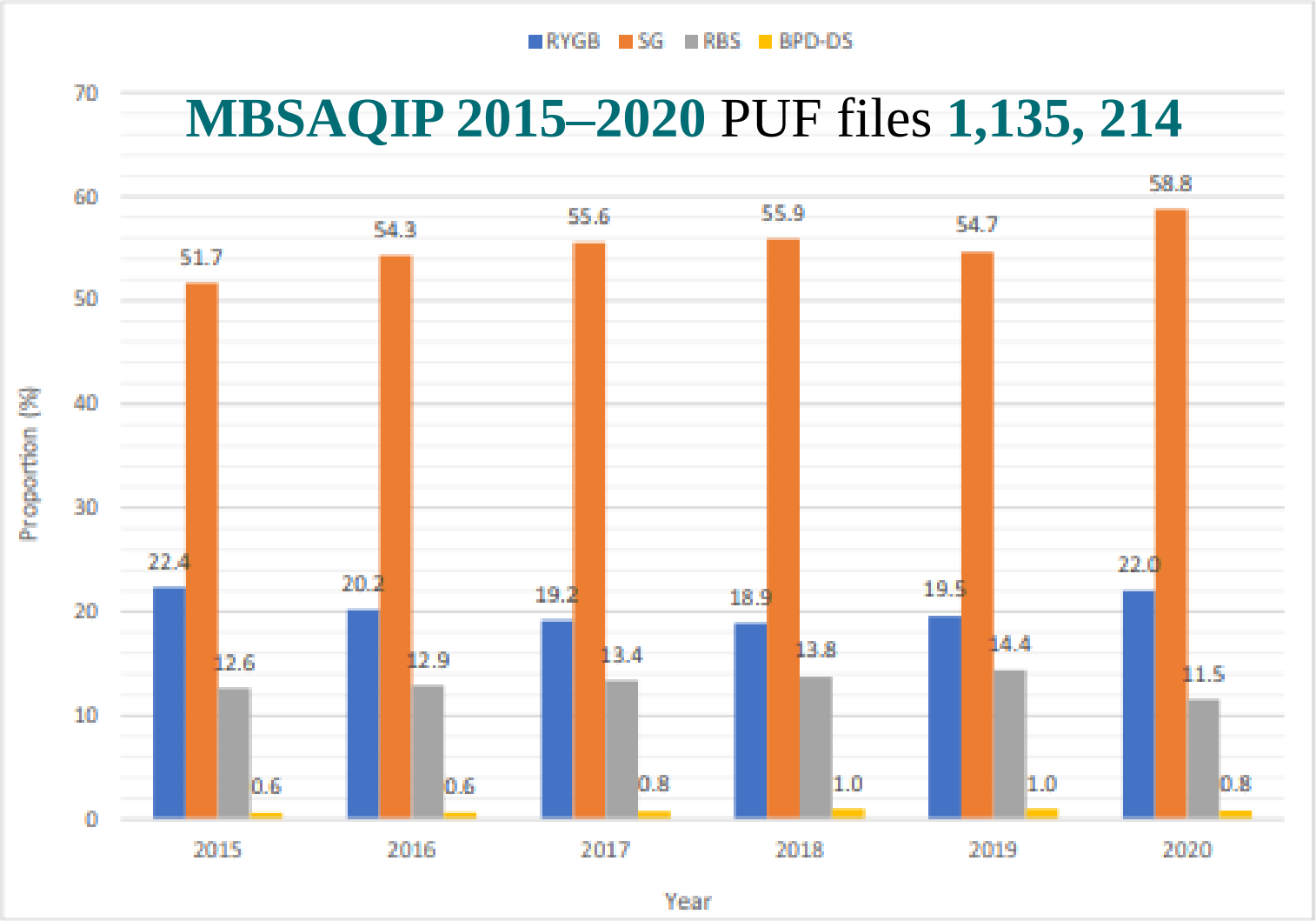


	2015	2016	2017	2018	2019	2020
R-RBS (n)	993	1199	1585	2257	3435	3386
L-RBS (n)	17737	20053	22364	23011	23330	14964

R-RYGB from (**6.8% to 16.7%**).
R-SG from (**6.0% to 17.2%**).
R-RBS from (**4.7% to 17.4%**).
R-BPD-DS from (**22.0% to 28.4%**).

W Bauerle et al Obes Surg. 2023; 33(2): 482–491.

Current Trends in the Utilization of a Robotic Approach in the Field of Bariatric Surgery



Key of Procedure Type: RYGB = Roux-en-Y Gastric Bypass, SG = Sleeve Gastrectomy, RBS = Revisional Bariatric Surgery, and BPD-DS = Biliopancreatic Diversion with Duodenal Switch

Robotic SG 17%
Robotic RYGB 16.7%
Robotic DS 28.4%
Robotic Revisional MBS 17.4%

Greatest increase was in **R-RBS & R-SG** (3.70-fold difference; slope 2.4% per year & 2.87-fold difference; slope 2.2% per year.

Conclusion: There is a nationwide **increase in the utilization** of a R-approach in MBS.

There are concerns related to the potential **increase in healthcare expenditures** related to robotics.

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Presentation outline

- *Utilization of Robotic vs laparoscopic MBS.*
- ***Next generation of robotic instruments.***
- *Machine learning and Artificial Intelligence.*

Robotic vs laparoscopy

- *3 D compared to 2D laparoscopy.*
- **Instrumentation better.**
- *Ergonomics for surgeon.*
- **High BMI patients [abdominal wall compliance issues].**

Single incision robotic surgery

Figure 3

Clashing of instruments.
Ergonomics.
Straight instruments.

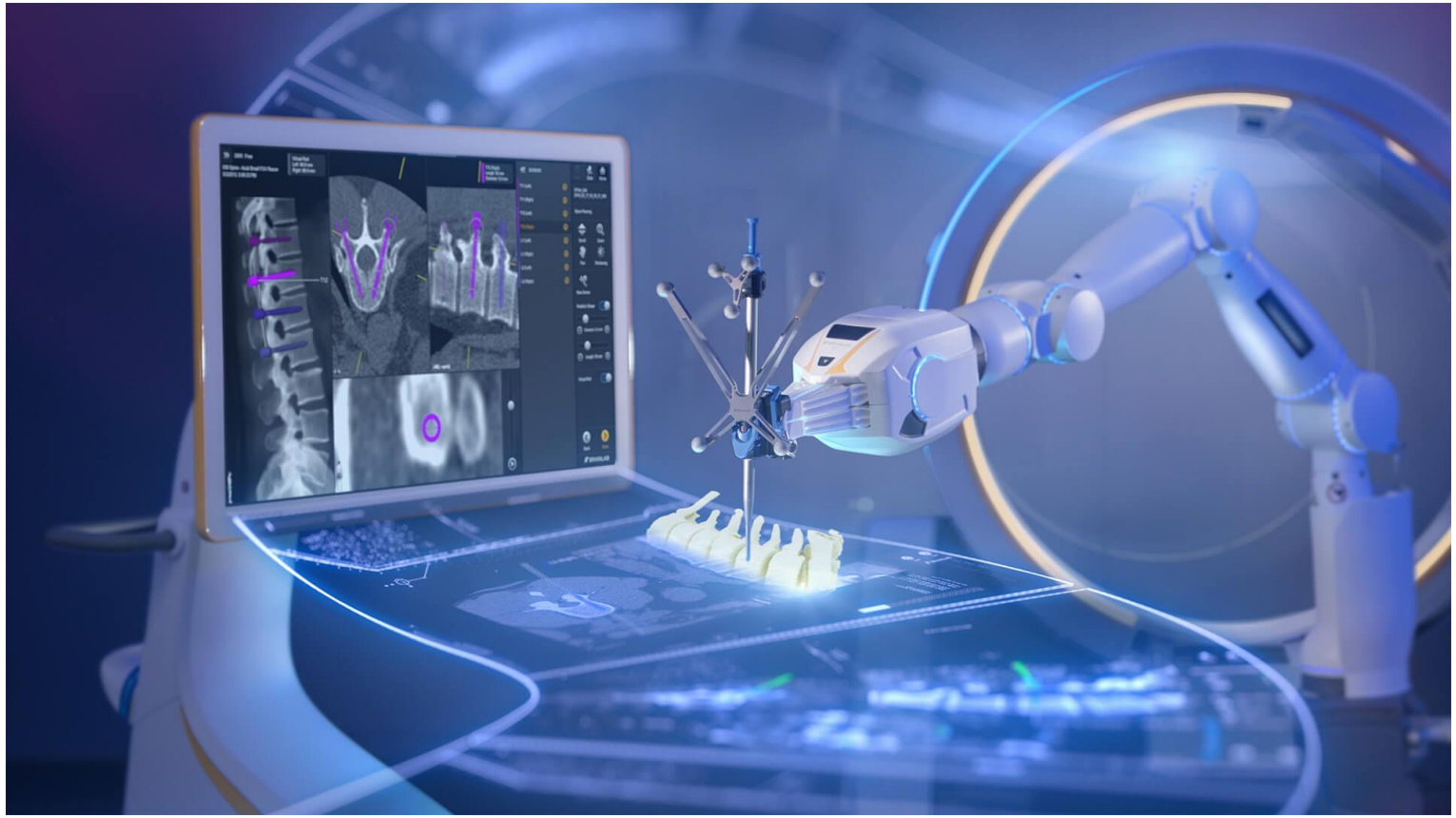
Learning curve for robotic distal gastrectomy is shorter compared to laparoscopic DG, but this may be due to prior experience in laparoscopic gastrectomy and ergonomic advantages of robotic distal gastrectomy

- ***3 D compared to 2D laparoscopy.***
- **Dexterity of fingers & steadiness.**
- ***Ergonomics for surgeon.***
- **Instruments are easier to use.**
- ***High BMI patients [abdominal wall compliance issues].***

Kai Siang Chan 1, Aung Myint J Gastro Surg 2023 Dec;27(12):2946-2982. **Establishing the Learning Curve of Laparoscopic and Robotic Distal Gastrectomy: a Systematic Review and Meta-Regression Analysis**

Robotic computer-integrated-surgery (CIS)

Utilizing associated technologies, and advent of imaging techniques like ultrasound (US), computed tomography (CT) & magnetic resonance imaging (MRI)



Biomedical Engineering Advances
Volume 6, November 2023, 100109

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The implementation of teleoperation, surgeons can now overcome geographical limitations and provide specialized healthcare remotely.

Swastika et al J Robot Surg 2024 Jan 17;18(1):28.

Telesurgery and Telementoring

ADVANCES IN SURGICAL TECHNIQUES

ANNALS OF SURGERY
Vol. 235, No. 4, 487–492

Transcontinental Robot-Assisted Remote Telesurgery: Feasibility and Potential Applications

Jacques Marescaux, MD, Joel Leroy, MD, Francesco Rubino, MD, Michelle Smith, MD, Michel Vix, MD, Michele Simone, MD, and Didier Mutter, MD

From the IRCAD-EITS (European Institute of Telesurgery), Louis Pasteur University, Strasbourg, France

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Presentation outline

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Robotic MBS and Artificial Intelligence

- **AI Is used Mainly in Diagnostic Specialties** radiology, pathology, and dermatology to recognize patterns, classify images, or detect objects by analyzing digital images or videos through a process called ***"computer vision."*** *****
- **Intraoperative Assistance: Guidance and Execution of Simple Tasks:** for example, during a colonoscopy, AI will be able to identify a potential polyp, tie a knot during laparoscopy or remind you to put a drain, remove a specimen or do a leak test.

*Ting Sim JZ et al Machine learning in medicine: What clinicians should know. Singapore Med J. 2023;64(2):91-97.

Robotic MBS and Artificial Intelligence

- **Based on its review of millions of surgical videos**, AI can anticipate the next 15 to 30 seconds of an operation and provide additional oversight during the surgery, in a laparoscopic cholecystectomy.**
- There's an international project to use AI to make laparoscopic cholecystectomies safer by placing an overlay on the surgeon's video screen during an operation to suggest where it is safer or less safe to operate.***

**Loftus TJ et al. AI enabled decision support. Ann Surg. March 23, 2023.

***ACS Bulletin Jim McCartney June 7, 2023

Intraoperative Application of Artificial Intelligence in Surgical Procedures

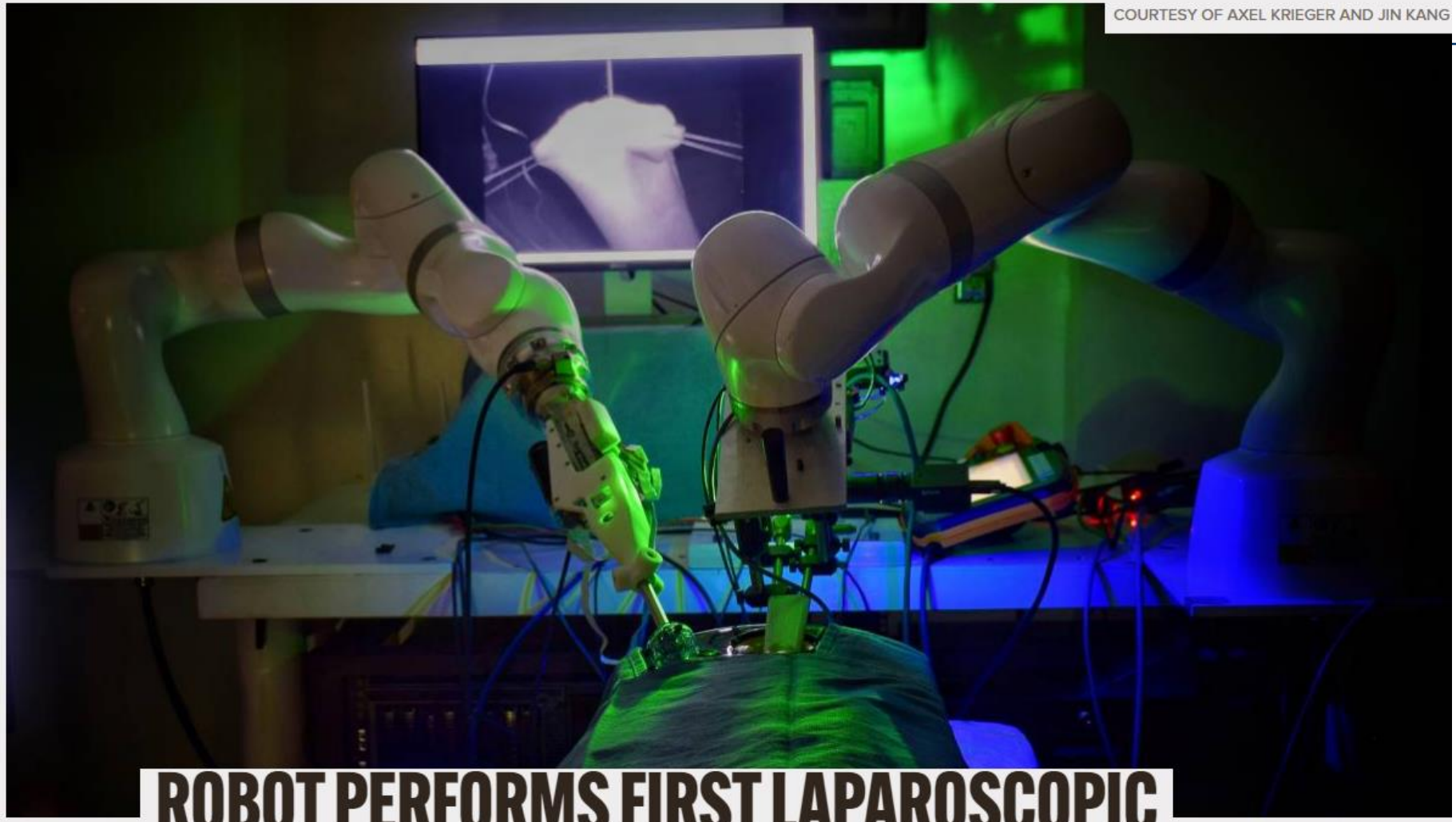
- **Augmented reality (AR) in robotic-assisted surgery (RAS) platforms.** A recent study by Checcucci et al. introduced a highly advanced artificial neural network model for predicting occurrences of bleeding during robotic prostatectomies. The programme analyses the footage captured by the endoscope at regular intervals of 3 s and provides a confidence rating below 100% may indicate a potential risk of bleeding.
- **A machine learning model** uses the information gathered during the surgical procedure to be linked to the patient's overall clinical results. In a recent study, Hung et al. examined a potential of algorithms in ***predicting surgical outcomes for*** Robot-Assisted Radical Prostatectomy **&** achieved a remarkable accuracy rate of 87.2% in predicting the duration of hospital stays & found correlation between the expected patient outcomes, specifically the duration of surgery and Foley catheter usage.

Checcucci Eet al. Development of Bleeding AI Detector (BLAIR) System for Robotic Radical Prostatectomy. *J. Clin. Med.* **2023**, *12*, 7355
Hung, A.J et al. Utilizing Machine Learning and Automated Performance Metrics to Evaluate Robot-Assisted Radical Prostatectomy Performance and Predict Outcomes. J. Endourol. 2018, 32, 438–444

ROBOTIC LAPAROSCOPIC SURGERY FOR INTESTINAL ANASTOMOSIS

HUB

JOHNS HOPKINS UNIVERSITY



ROBOT PERFORMS FIRST LAPAROSCOPIC SURGERY WITHOUT HUMAN HELP

Graham C. Johns Hopkins robot performs first laparoscopic surgery without human help.

In four experiments on pig tissues, the robot excelled at suturing two ends of intestine—one of the most intricate and delicate tasks in abdominal surgery

Who is accountable if an AI-guided patient case goes wrong?

SCIENCE ROBOTICSVOL. 7, NO. 62 26 Jan 2022 *Scientific American.* January 26, 2022. May 18, 2023.

Take home message

- *Most of MBS is done laparoscopically in the US [16-28%].*
- ***The value of robotic MBS compared to laparoscopic MBS is not clear based on the published literature.***
- ***Benefits of an assist port:*** *flattening of the initial learning curve of MBS, retraction, suctioning passing stuff & Airseal.*
- ***Why I do not use an assist port:*** *dependance on an experienced assist, difficulty in accessing the assist port & 1 less port during robotic surgery.*