

What's New in MIS?

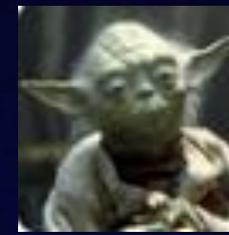
Matthew Albert MD, FACS, FASCRS

**Medical Director, Surgical Innovation,
Digestive Health and Surgery Institute**

AdventHealth, Orlando, FL



Disclosures



@tamisyoda

- Stryker
- Applied Medical
- Conmed
- Human Extensions
- LivsMed
- Proximie
- Astellas Pharmaceuticals
- Distal Motion
- Endo Quest



Whats new in MIS?

Surgical Robots

Single Port Robots

Endoluminal robots

Visualization

-Fluorophores

Instrumentation

Computer Technology

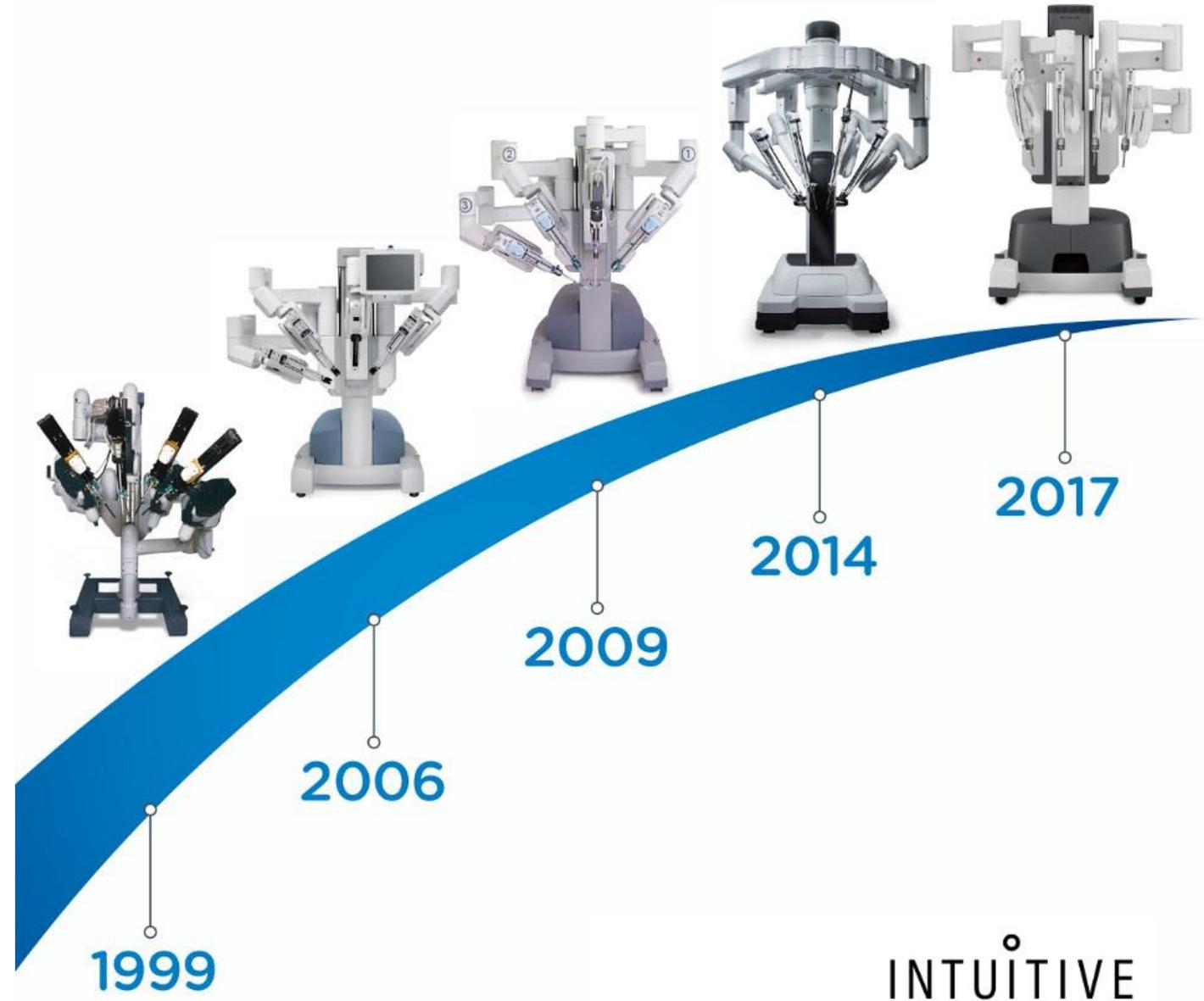


Surgical Robots: David vs Goliath



Intuitive Surgical

- Founded 1999
- Computer Vision



5 New Surgical Robots by 2025

Medtronic (Hugo)



CMR (Versius)



5 Surgical Robots by 2025

Distal Motion (Dexter)



Senhance

Avatera

Bitrack

Single Port Robots

Intuitive sp

-Not FDA approved for colorectal surgery





Single Port Robots

Titan Sport (Enos)

SURGICAL WORKSTATION



PATIENT CART



MULTI-ARTICULATED INSTRUMENTS



Single Port Robots

Virtual Incision (MIRA)



SinglePort Robots

Hominis (Memic Innovative Surgery Ltd.)

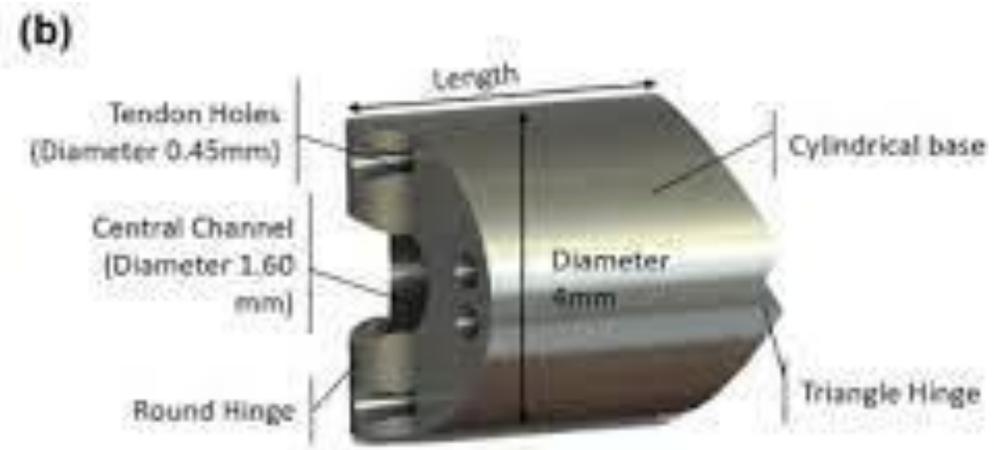
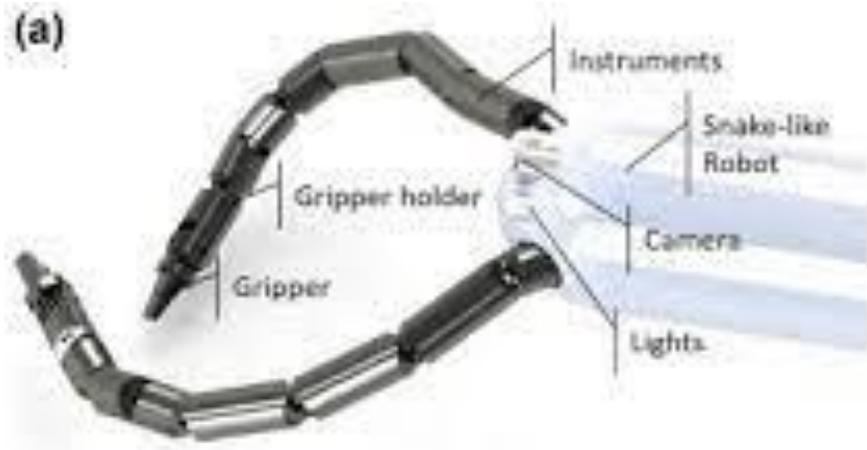
Vicarious

Endoluminal Robots

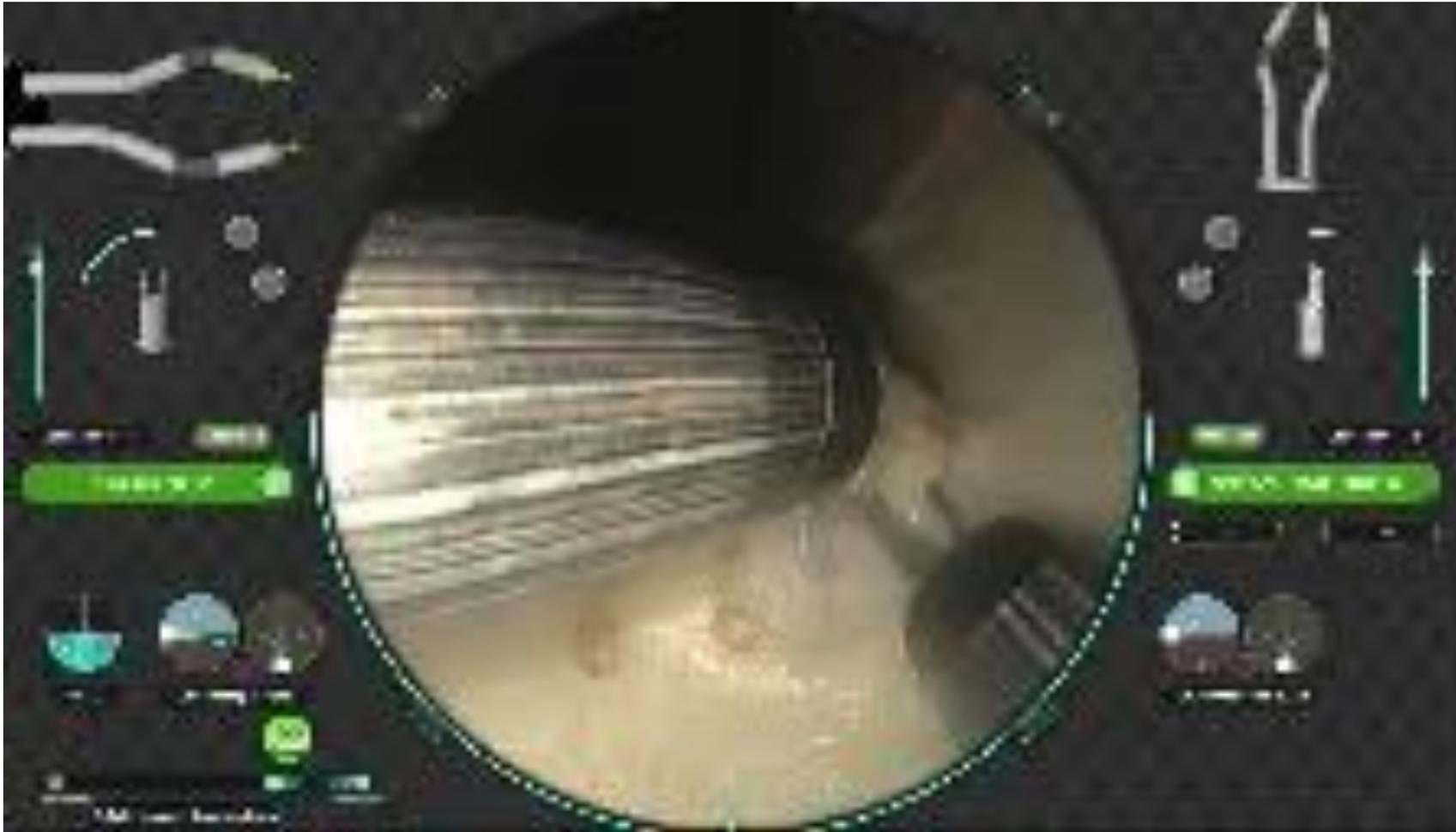
System	Image	Clinical application	Manipulation type (M)/robotic (R)	Endoscope (Guide tube) diameter/articulation DoF	Instrument diameter/articulation DoF	Approval	Technical advancement/limitation
K-FLEX (KAIST) (Image: Permission from KAIST)		GI surgery and NOTES	An endoscope (R)/two instruments (R)	17 mm/4	3.7 mm/2	No	Double-bending endoscope, payload enhanced instruments, and solo teleoperation/limited triangulation and large bending radius of endoscope
ColubrisMX ELS system (Colubris MX) (Image [156])		GI surgery	A guide tube (R)/a camera (R)/two instruments (R)	22 mm/2	6 mm/4	No	Articulating camera for angled view, triangulation using elbow joint, and solo teleoperation/large guide tube diameter
Roboflex Avicenna (ELMED) (Image © 2020 ELMED Medical Systems)		Renal stone removal	A ureteroscope (R)	Commercial ureteroscope	NA	CE	Compatible with various commercial ureteroscopes and integrated irrigation control/limited ureteroscope translation range and no robotic assistance for basketing
MONARCH (Auris Health) (Image © 2022 Auris Health, Inc.)		Lung biopsy and renal stone removal	A bronchoscope (R)/a sheath (R)	(Scope) 4.2 mm/2 (Sheath) 6.0 mm/2	NA	FDA	Integrated electromagnetic navigation guidance, enhanced scope steerability, and tension relaxation during withdrawal/risk of electromagnetic interference
ION (Intuitive) (Image © 2022 Intuitive Surgical)		Lung biopsy	A catheter (R)	(Catheter) 3.5 mm/1	NA	FDA	Optical fiber-based shape-sensing catheter/absence of direct camera vision during the use of biopsy needle
Sensi X (Hansen Medical) (Image [228])		Endovascular surgery	A catheter (R)/a sheath (R)	(Catheter) 8 F/2 (Sheath) NA/1	NA	FDA	Highly flexible catheter with small bending radius and tactile vibration/large size and relatively long setup time
Magellan (Hansen Medical) (Image [32])		Endovascular surgery	A catheter (R)/a sheath (R)/a guidewire (R)	(Catheter) 6 F/2 (Sheath) 9.5 F/1	NA	CE and FDA	Enhanced steerable active catheter and detection of excessive driving wire tension/lack of haptic feedback
R-One (RoboCath) (Image © 2018 Robocath, Inc.)		Endovascular surgery	A guide wire (R)/a balloon/stent catheter (R)	Commercial guide wires and catheters	NA	CE	Compatible with market leading guidewires and catheters/NA
Corpath (Corindus) (Image © 2022 Corindus, Inc.)		Endovascular surgery	A catheter (R)/a balloon/stent catheter (R)/a guidewire (R)	Commercial catheters	NA	FDA and CE	Manipulation of all interventional devices, procedural automation, and teletreatment/lack of catheter articulation and loss of tactile feedback

System	Image	Clinical application	Manipulation type (M)/robotic (R)	Endoscope (Guide tube) diameter/articulation DoF	Instrument diameter/articulation DoF	Approval	Technical advancement/limitation
COBRA (USGI Medical) (Image [120])		NOTES	A guide tube (M)/two instruments (M)	NA	NA	No	Shape-locking scope and triangulation/imprecise instrument control and impossibility of instrument change
R-Scope (Olympus) (Image [121])		GI surgery and NOTES	An endoscope (M)/two instruments (M)	14.3 mm/3	<2.8 mm/1	No	Instrument channels with vertical and horizontal motion/complex manipulation and poor instrument performance in retroflexion
DDES (Boston Scientific) (Image [123])		GI surgery and NOTES	An endoscope (M)/two instruments (M)	16 mm / 2	4 mm/2	No	Ergonomic instrument driving handles/impossibility of retroflexion and limited triangulation
EndoSamurai (Olympus) (Image [126])		GI surgery and NOTES	An endoscope (M)/two instruments (M)	15 mm/2	NA/2	No	Triangulation and driving handles with laparoscopic paradigm/difficulty in bending due to protruded arms and instrument motion delay
Anubiscope (Karl Storz/IRCAD) (Image [129])		GI surgery and NOTES	An endoscope (M)/two instruments (M)	18 mm/2	<4.3 mm/1	CE	Distal-end mechanism for triangulation and ergonomic instrument driving handles/limited instrument DoF
Micro Finger (Nagoya University) (Image [227])		GI surgery and NOTES	An endoscope (M)/two instruments (R)	Commercial endoscope	2.6 mm/2	No	The first prototype of a flexible surgical robot and thin instrument inserted through commercial endoscope channels/limited triangulation and force
ViaCath (Endo Via Medical) (Image [133])		GI surgery	An endoscope (M)/two instruments (R)	Commercial endoscope	4.75 mm/4	No	Enhanced instrument articulation with two distal bending segments/difficult insertion into the GI track and insufficient instrument force
EndoMASTER (EndoMaster) (Image [138])		GI surgery, NOTES, and Transoral head and neck	An endoscope (M)/two instruments (R)	12.6 mm/2 (Commercial endoscope)	<3.7 mm/4	No	Triangulation with an elbow joint and thin instrument inserted through commercial endoscope channels/retraction only with left arm, occlusion of instrument tip, and no service channel available during bimanual manipulation
FLEX (Medrobotics) (Image [141])		Transoral head and neck, GI surgery, and NOTES	An endoscope (R)/two instruments (M)	15 × 17 and 18 × 28 mm ² /2	3.5-4.0 mm/2	CE and FDA	Follow-the-leader mechanism for endoscope insertion, 3D HD vision, and laser instrument/limited endoscope bending angle, instrument torque, and grasping force
STRAS (Univ. Strasbourg) (Image [147])		GI surgery and NOTES	An endoscope (R)/two instruments (R)	16 mm/2	3.5 mm/1	No	End-tip mechanism for triangulation, solo teleoperation/limited instrument articulation DoF, and endoscope length
RAFE (Kyushu University) (Image [151])		GI surgery	An endoscope (R)/two instruments (R)	9.9 mm/2 (Commercial endoscope)	2.6 mm/2	No	Thin instrument inserted through commercial endoscope channel, solo teleoperation, and small radius of bending/limited triangulation and force
i2 snake robot (Imperial College London) (Image [191])		ENT surgery and GI surgery	An endoscope (R)/two instruments (R)	16 mm/6	3.8/5	No	Endoscope and instrument with high articulation DoFs, integration with industrial robot arm, and solo teleoperation/limited control accuracy and lack of axial rotation and translation of instrument
ROSE (Korea University) (Image [152])		GI surgery	An endoscope (M)/an instrument (R)	Commercial endoscope	16 mm/1	No	Master interface enabling simultaneous instrument control with endoscope/large robot arm, unsmooth roll motion, and protruding instrument during insertion
PETH (KAIST) (Image [154])		GI surgery	An endoscope (M)/an instrument (R)	Commercial endoscope	6 × 6 mm ² /2	No	Flexible transmission part without interference to endoscope bending/large robot arm, protruding robot arm during insertion, and assistant for instrument manipulation

I2 Snake



Endo Quest (formerly Colubris)



Computer tech/software

Content managers

Telementoring

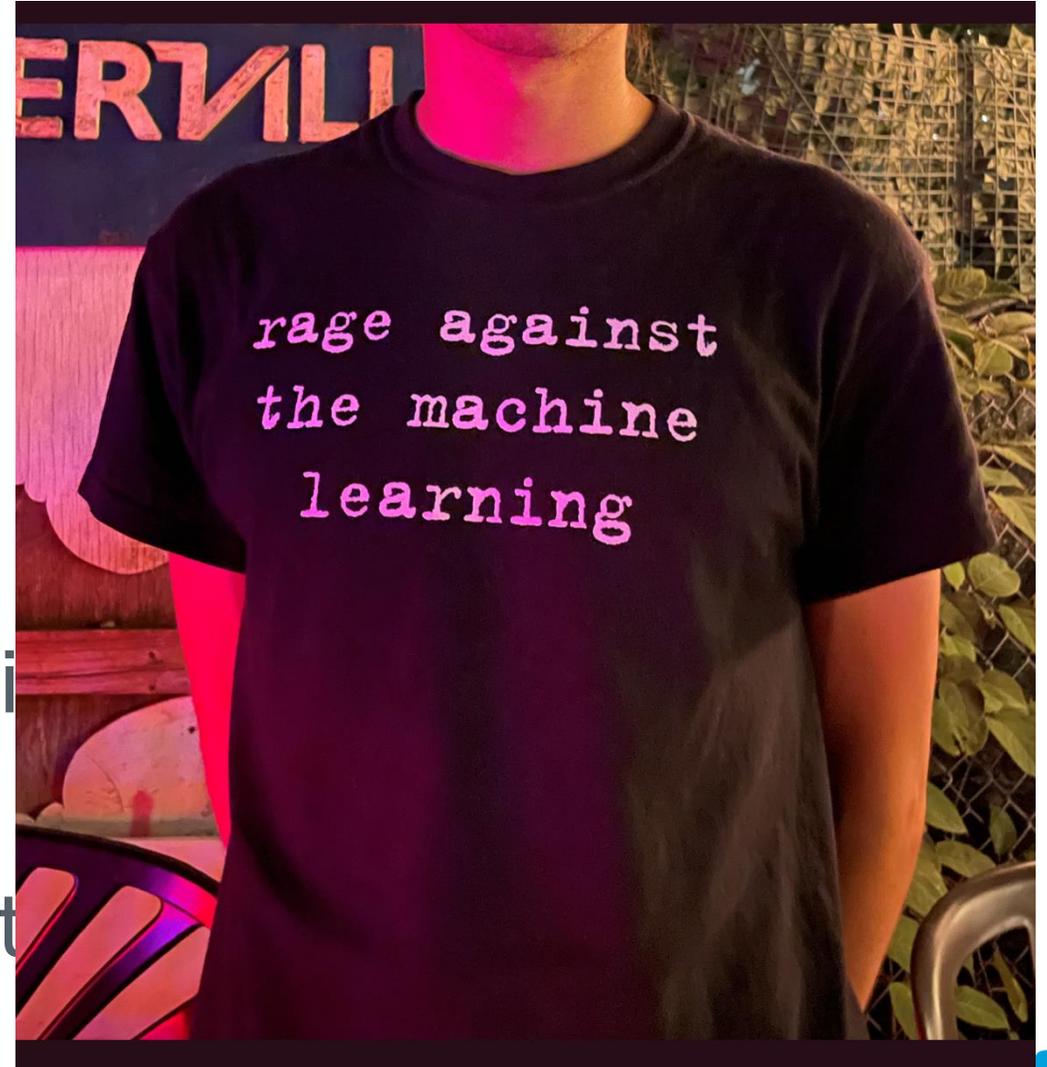
Augmented/virtual reality

Artificial Intelligence

Subjective assessment of technical skills

Navigation

Real time intraoperative support



SECURE ACCESS TO SURGICAL VIDEOS AND DATA, FROM ANYWHERE



The DS1 computer records as you operate.

All out-of-body frames are automatically anonymized by AI, using our proprietary RedactOR™ technology. Tag points-of-interest during the operation for postoperative review.



Videos are seamlessly uploaded to a surgeon's private library - without the need for USB drives, DVDs or encrypted hard drives - and are accessible from anywhere.



Review actual video of the operation in between cases.

Single-click annotation system allows for the easy addition of contextual information, or feedback.

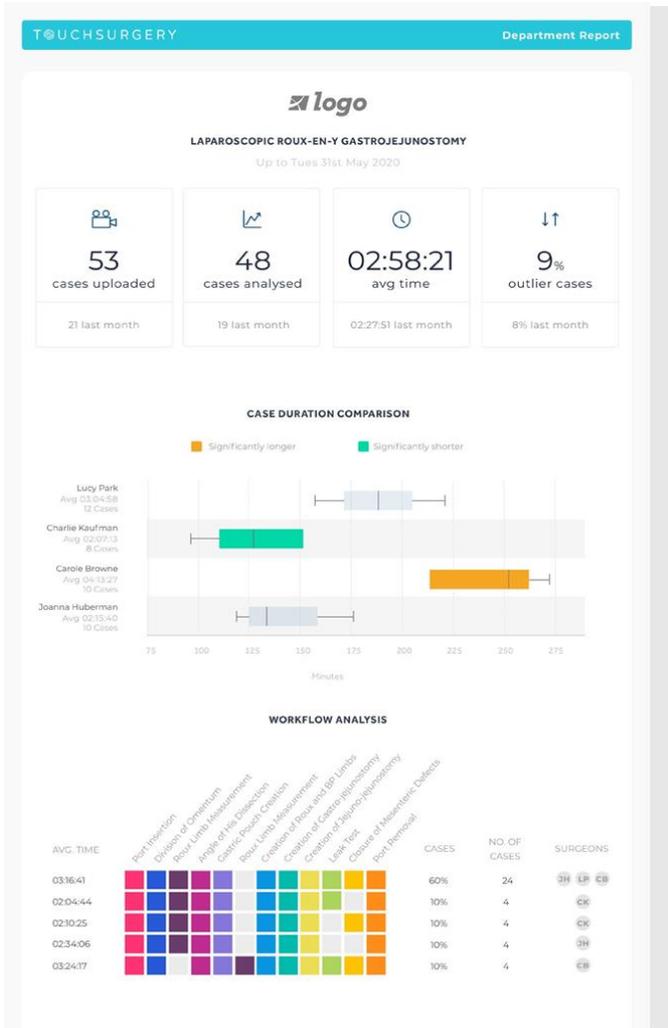
Share with permitted colleagues, enabling never before learning or decision-making.



Smart data unlocks easier navigation when reviewing the video and insights.

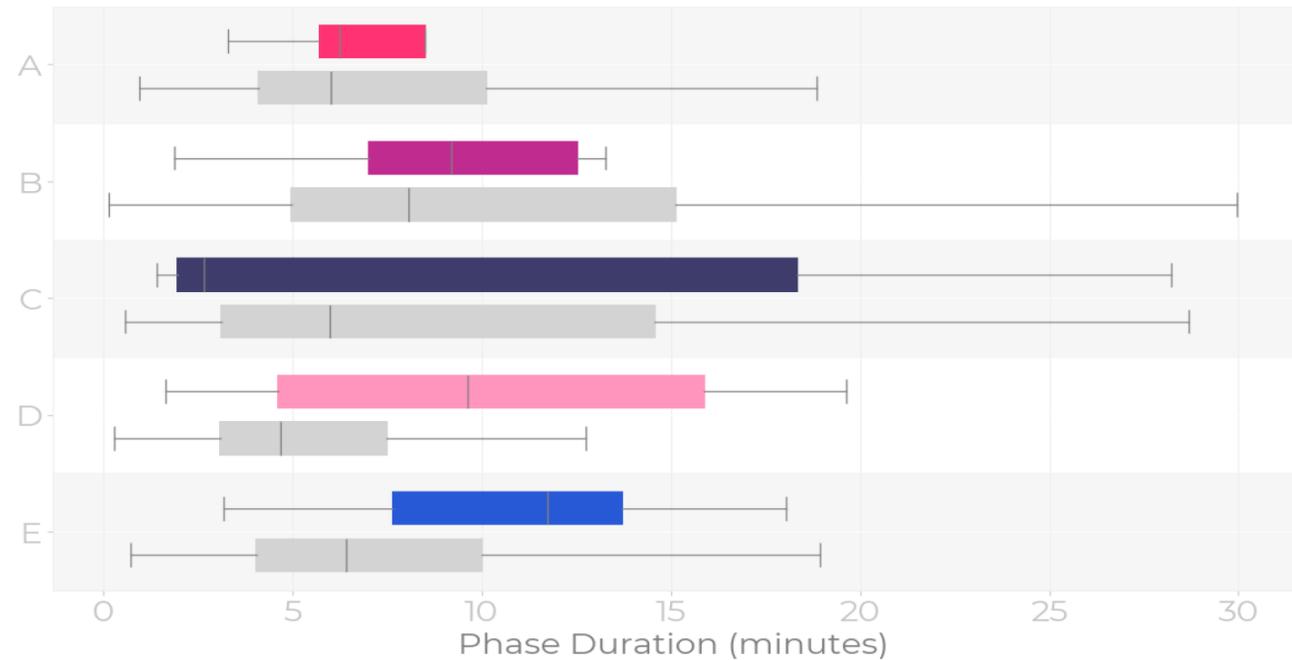
TOUCH SURGERY ENTERPRISE

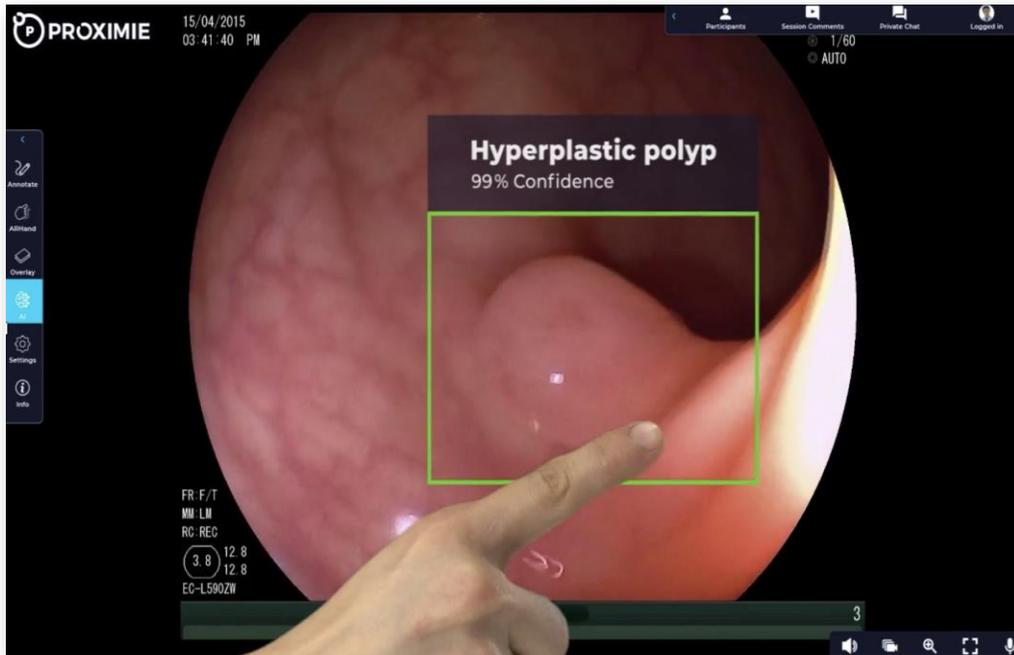
OBJECTIVE INTRAOPERATIVE DATA SET



PHASE DURATION COMPARISON

- A. Port Insertion & Gallbladder Exposure
- B. Dissection of Calot's Triangle
- C. Ligation and Division of Cystic Duct & Artery
- D. Gallbladder Dissection
- E. Specimen Removal & Closure
- Your Department Comparison

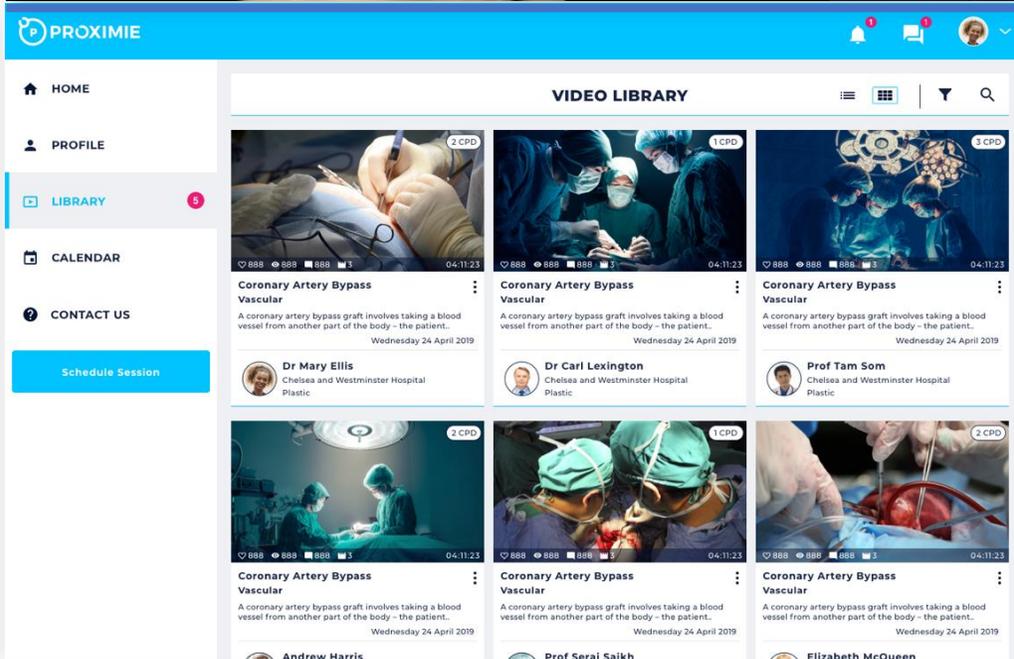




LIVE ENVIRONMENT

PROXIMIE IN ACTION

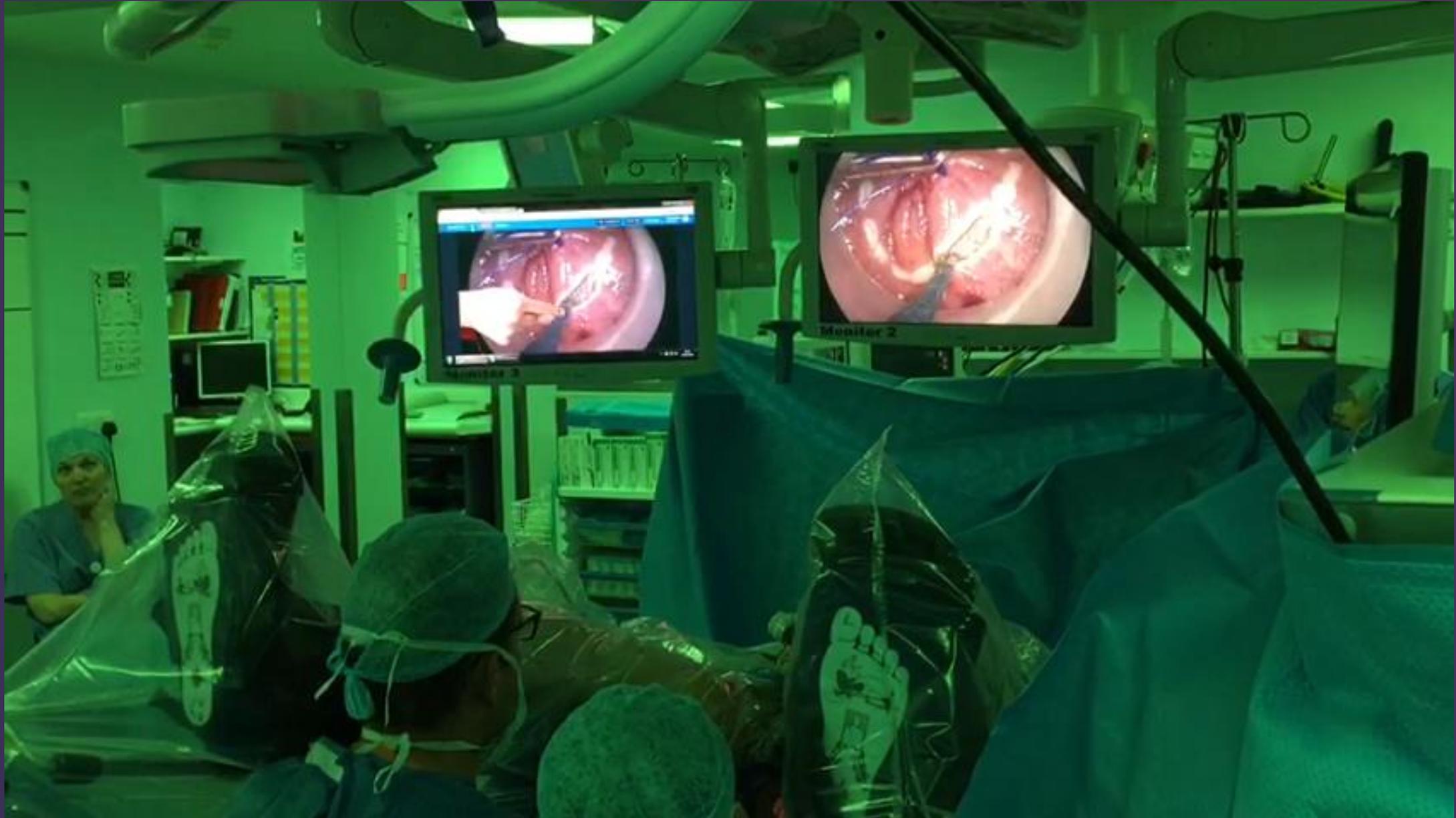
Proximie combines the best human expertise with advanced technologies (AR, AI, ML) to deliver unique insights to clinicians in real-time, before, during and after the procedure.



PROXIMIE LIBRARY

Colorectal Surgery – Remote Proctoring between Cardiff and Amsterdam

<https://app.aframe.com/links/c9140baf9daab31011bf5268952>



More....

Intuitive Hub

BrainLab

Stryker

Olympus

Storz

Sony

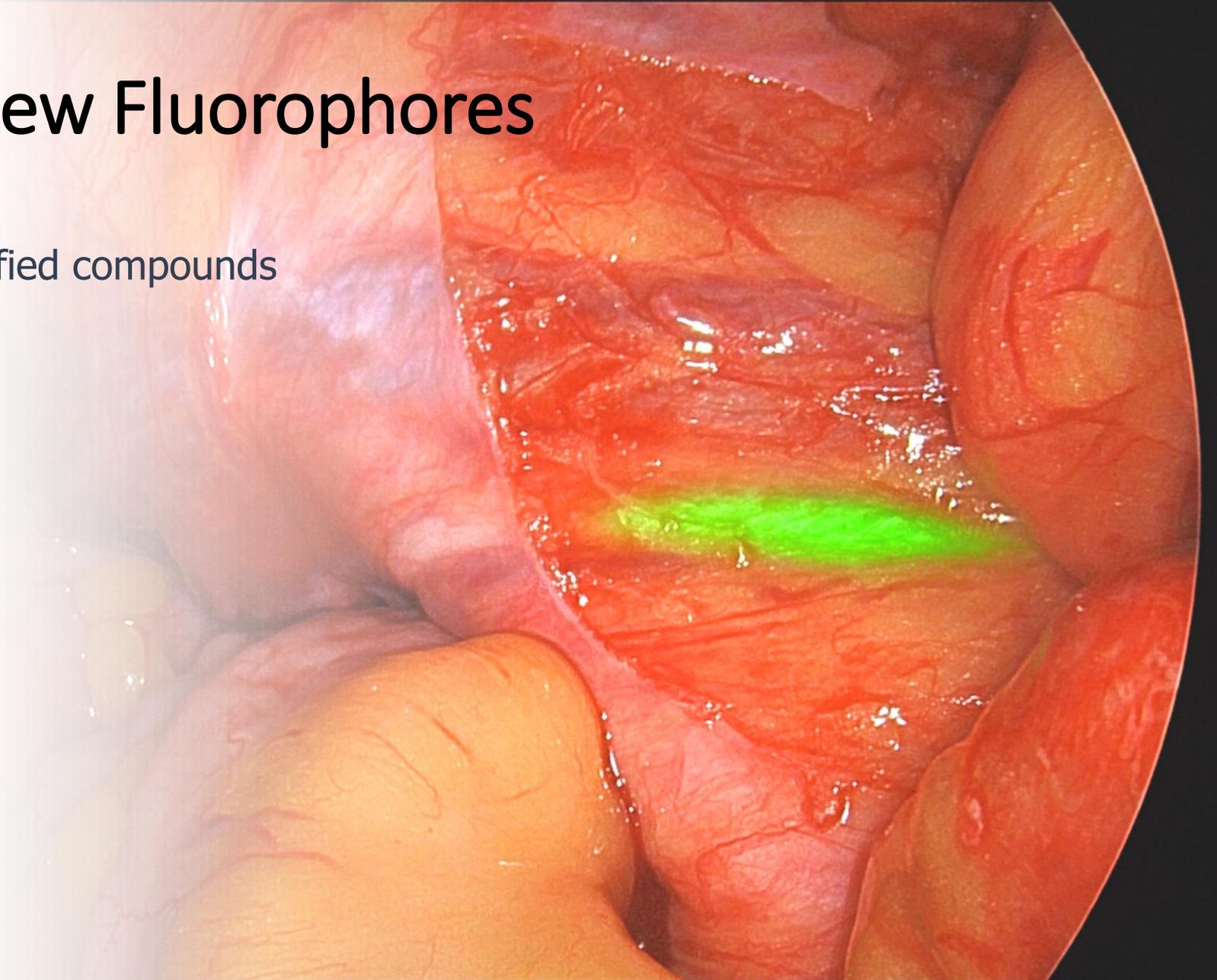
Theator

Visualization

- Enhanced Icg
- Quantification/Time-flow curves
- 3-D
- Scope holders, visual tracking

Visualization- New Fluorophores

- Indocyanine green modified compounds
- Intravenous dosing
- Metabolically inert
- Phase 3 trial



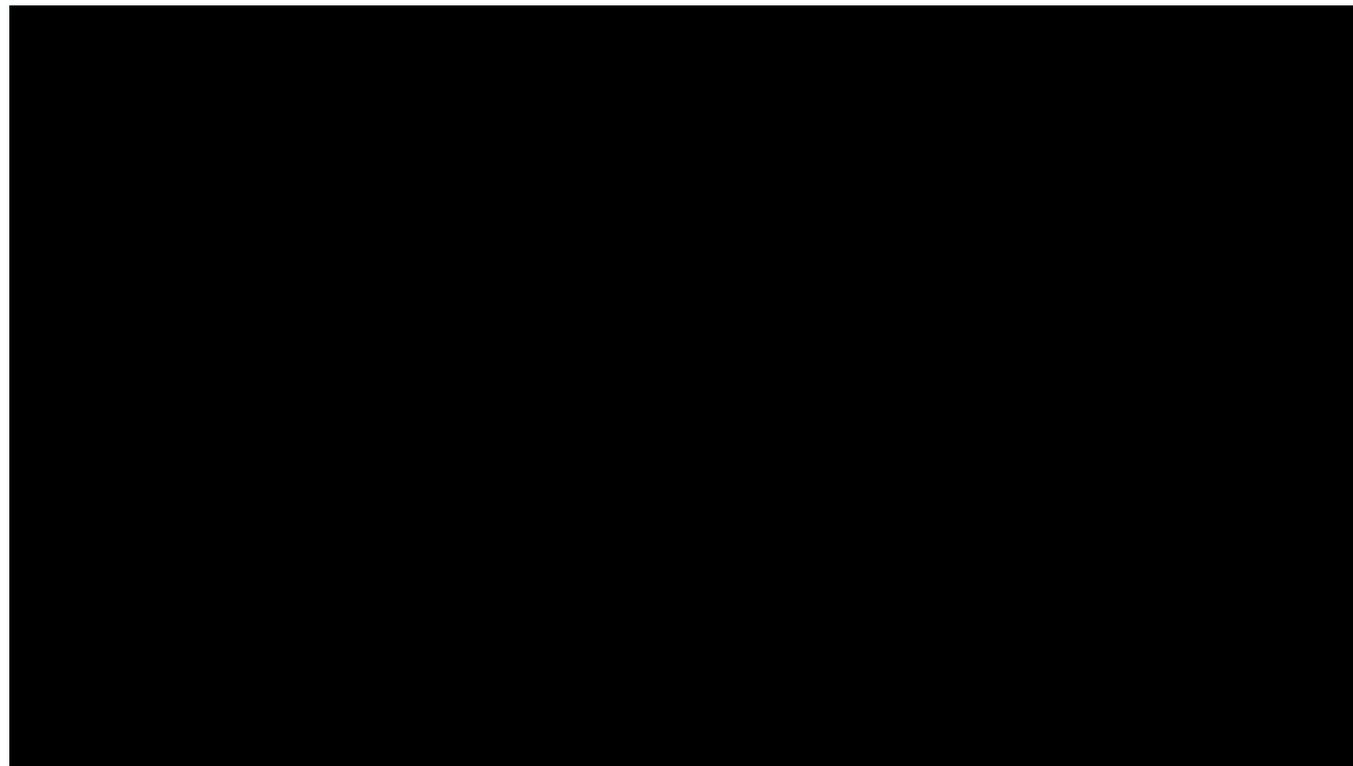
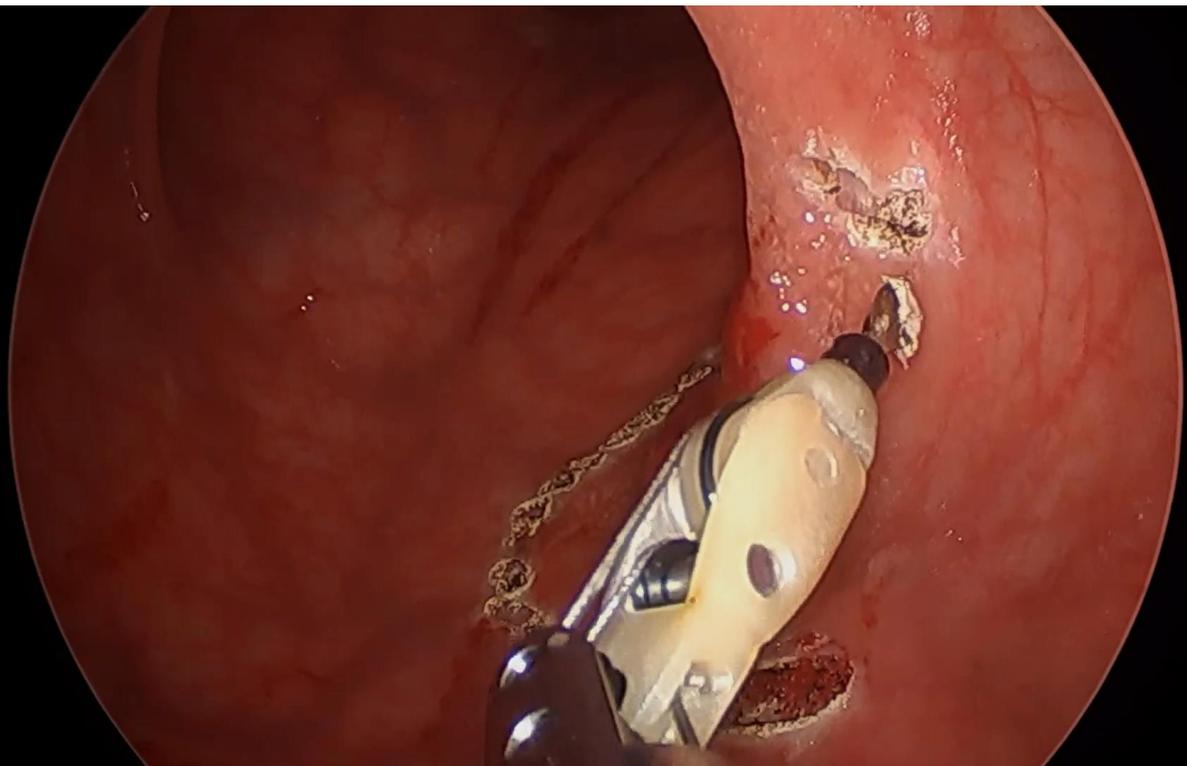
Instrumentation

Human Extensions

LivsMed



Artisential/LivsMed



Conclusions

Digitalization of operating room

Robotic MIS surgery (endoluminal surgery)

Artificial Intelligence (friend or foe)