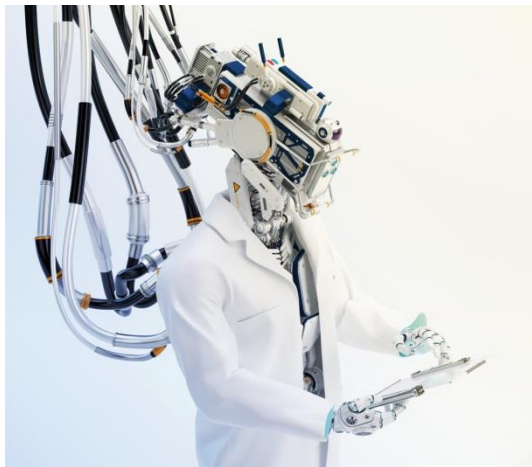


Surgical Robots: Capabilities & Promises

Roger Smith, PhD
Chief Technology Officer
roger.smith@flhosp.org





We teach your surgeon to use surgical robots.

Evolution of Perception

- Terrified of the robotic monster replacing their human surgeon
- Requesting robotic augmentation and extension of surgeon capabilities
- The future holds dozens of surgical robots, all of them unique in form and function.



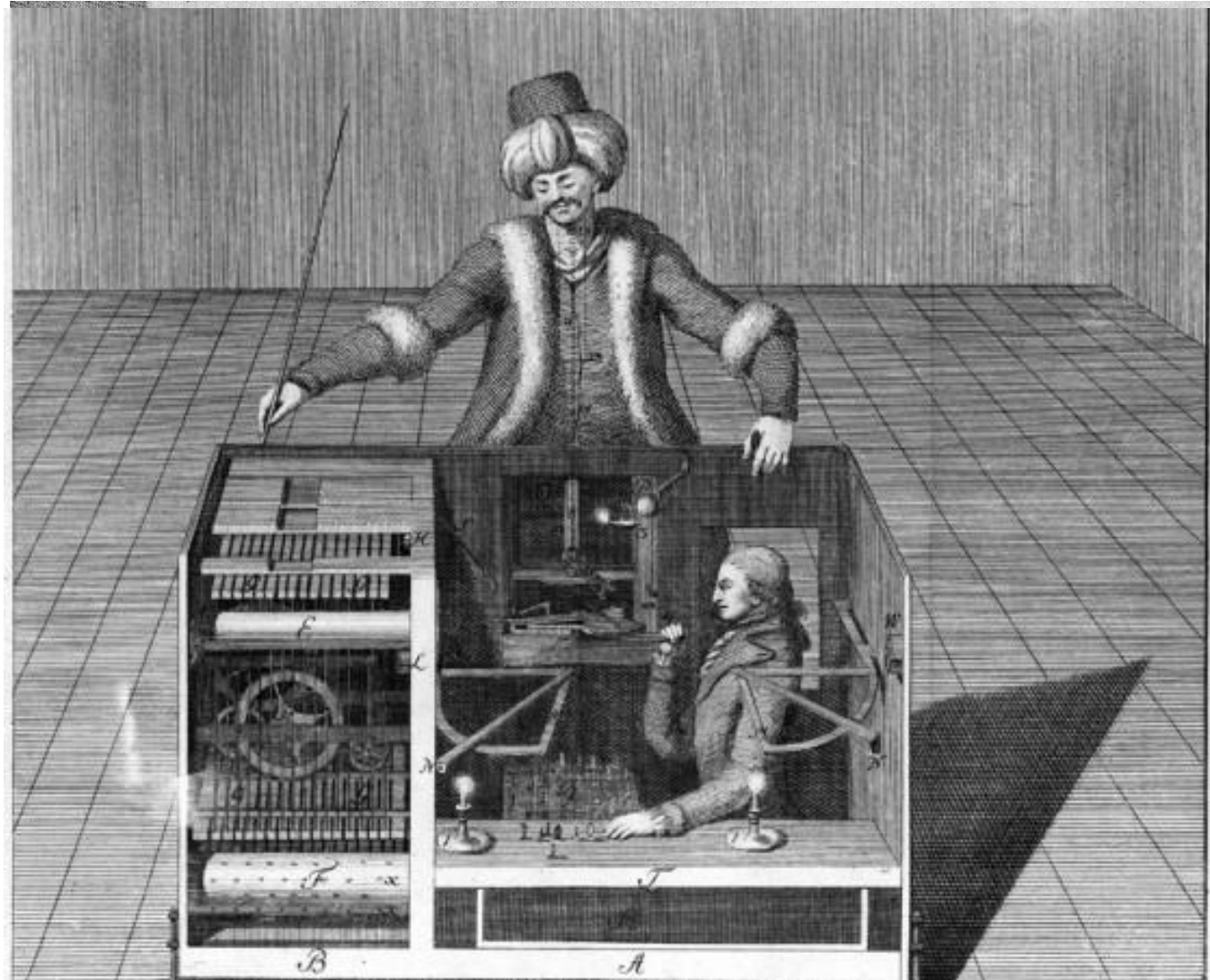
Linked  Robot-of-the-Day (#ROTD)

Why Robots?



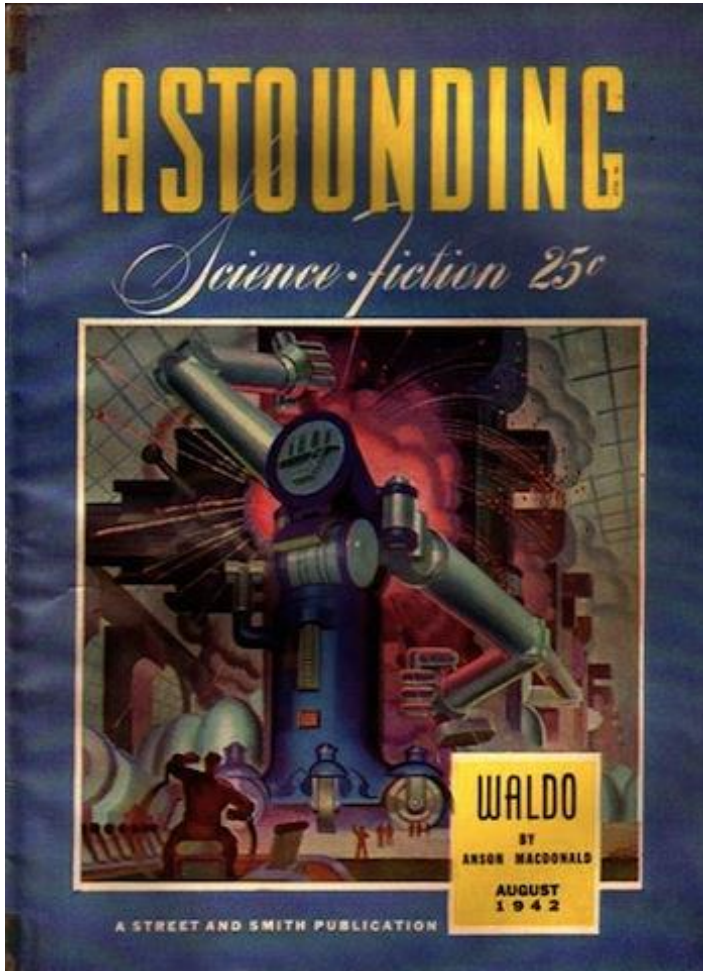
Mechanical Turk - robotic chess

1770

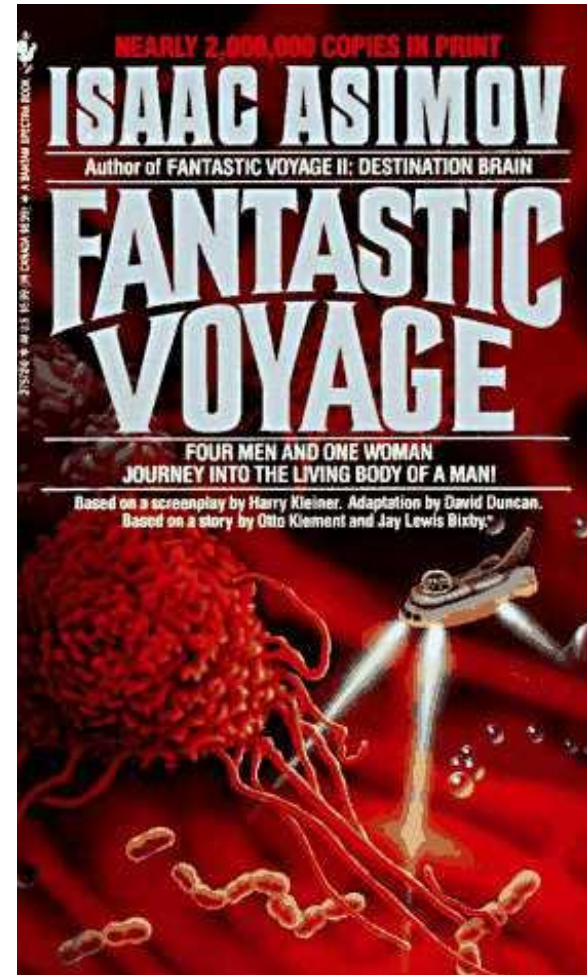


In Classic Science Fiction ...

1942



1988



In the Movies ...

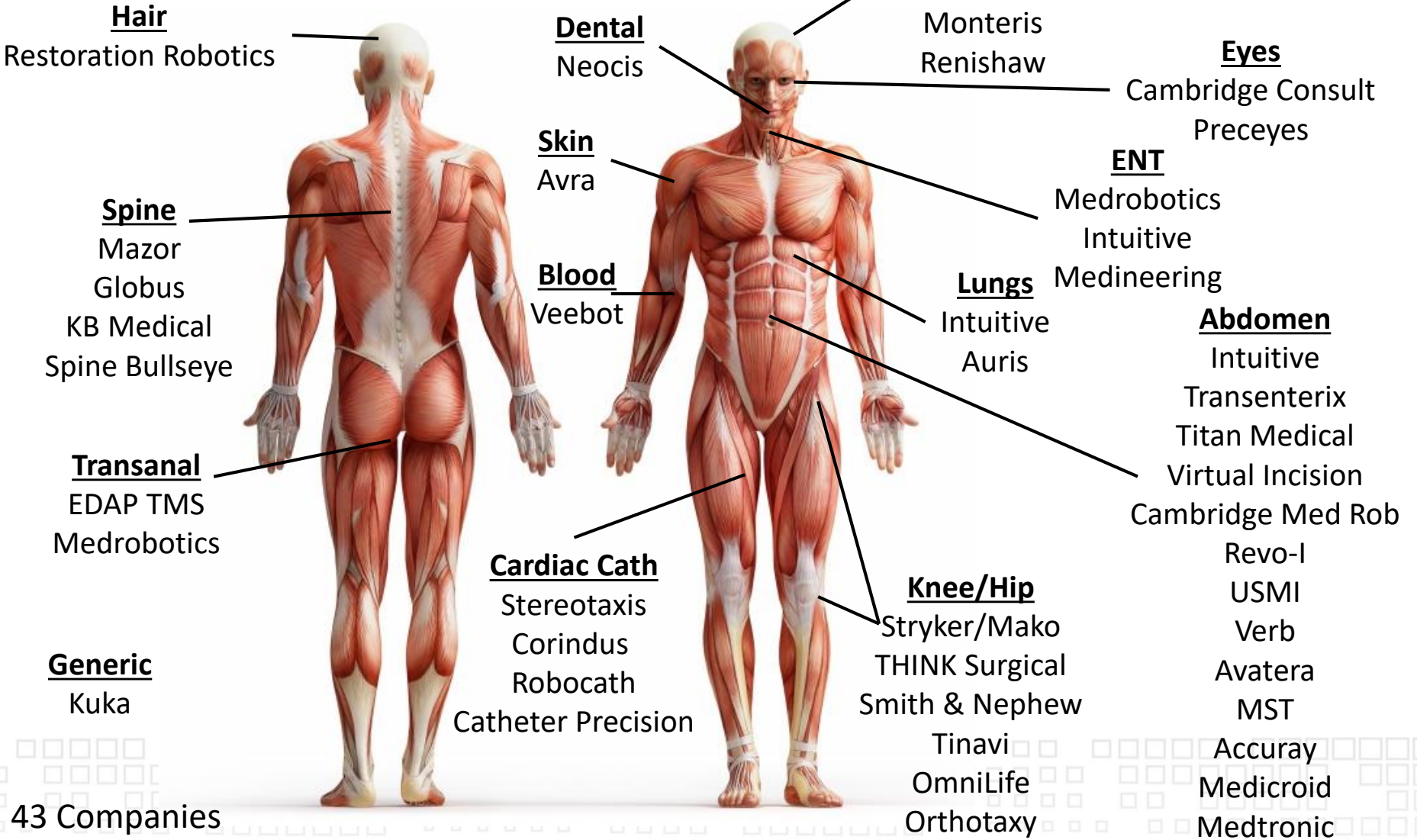


*Star Wars:
Empire Strikes Back
Return of the Jedi*



Prometheus

Surgical Robots



Robotic Motivations



PUMA 560 - needle brain biopsy



1985



AESOP - voice controlled lap camera



1994



ZEUS - two handed remote surgery



1998

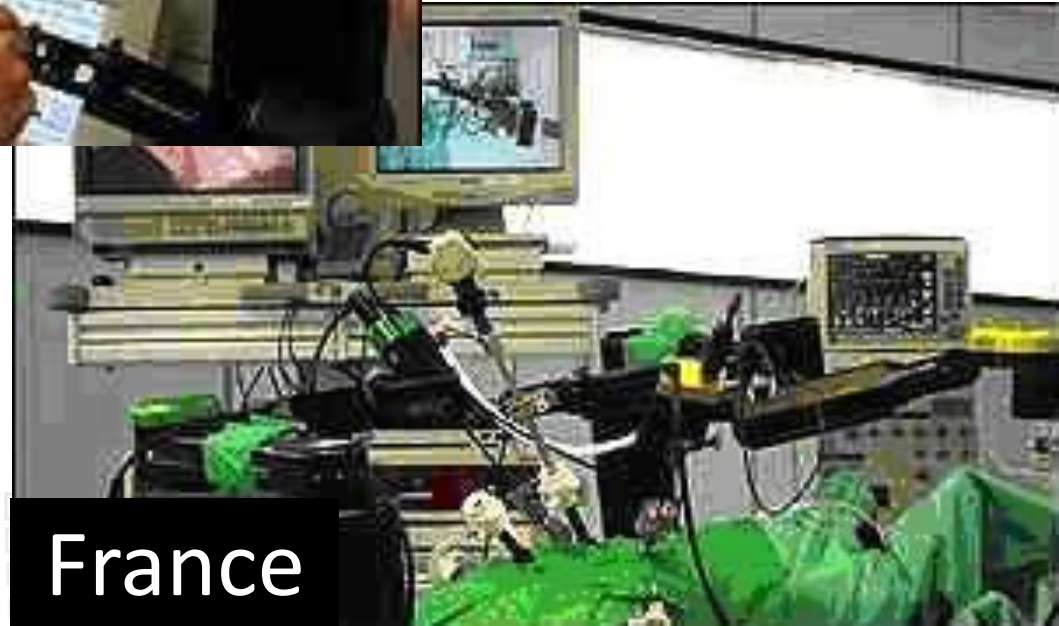


Operation Lindberg telesurgery



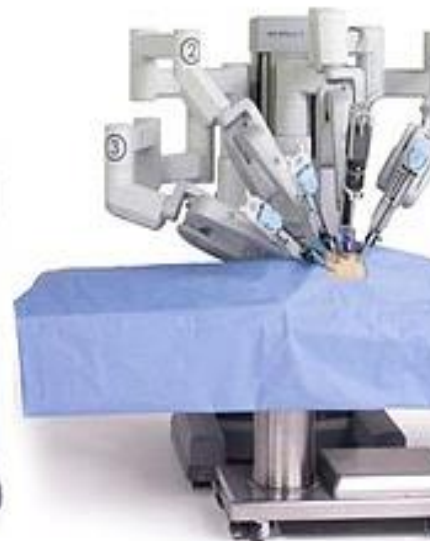
New York

2001

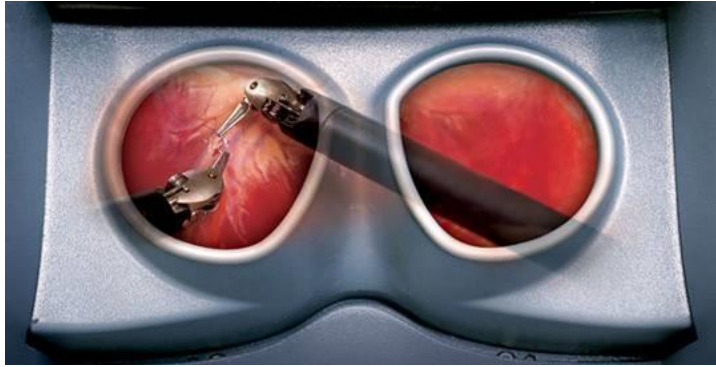


France

da Vinci - generations



Essential da Vinci Components



Stereo Vision



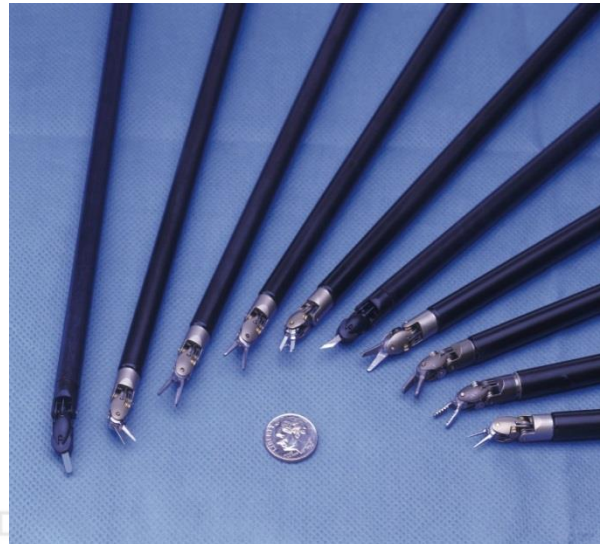
Stereo Mag Endoscope



7-DOF Instrument



Ergonomic Station



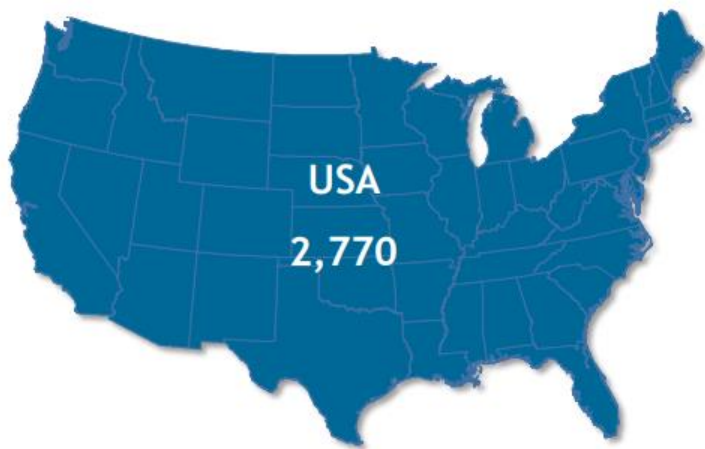
Diverse, Small Instruments



Fine Control

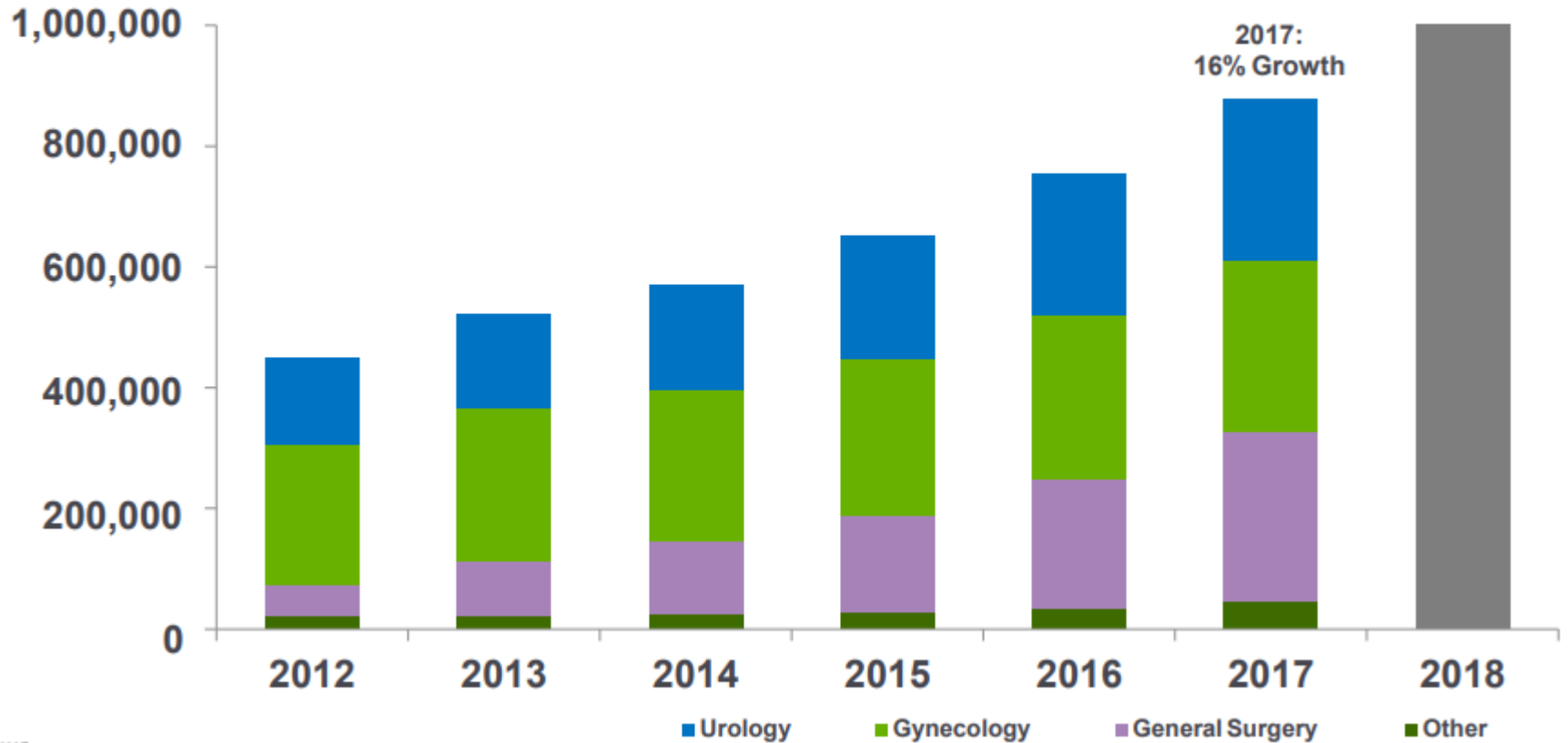
da Vinci System Installed Base

4,271 Worldwide as of September 30, 2017



Rest of World: 221

Worldwide Procedure Trend



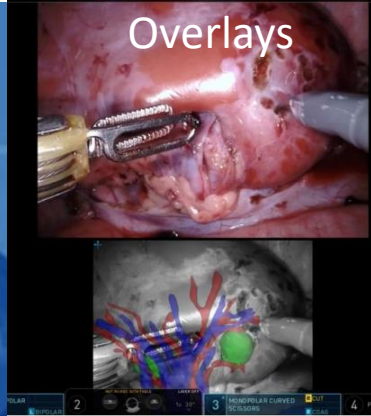
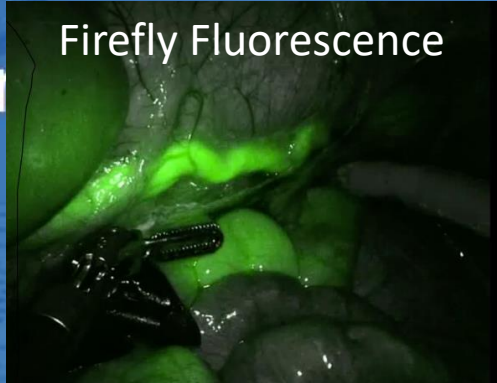


Figure 1: Patient Characteristics and Outcomes

	Open Surgery (n=20)	Robotic (n=29)	P value
Pre-operative Data			
Age (years)	50 (36.8-58.5)	55 (39-66.5)	0.392
Male	11 (55%)	15 (52%)	0.821
Myasthenia Gravis	11 (55%)	15 (52%)	0.821
Diabetes	3 (15%)	2 (7%)	0.387
Hypertension	4 (20%)	14 (48%)	0.07
Hyperlipidaemia	3 (15%)	13 (45%)	0.035
Ischaemic heart disease	1 (5%)	0	0.408
Operative Data			
Operative time (mins)	100 (77.5-107.8)	100 (86-162.3)	0.855
ICU stay (days)	1 (0-1)	0 (0-1)	0.001
Post-operative hospital stay (days)	5 (4-5)	2 (2-3)	0.007
Histopathology			
Thymoma	13 (65%)	12 (41%)	0.039
Thymic cyst	0	8	0.017
Benign thymic hyperplasia	2	5	0.692

INTUITIVE
SURGICAL®

Enhanced imaging

Intelligent systems

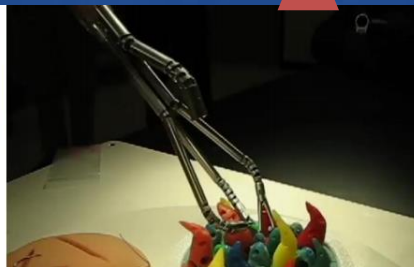
Less invasive approaches

Data analytics

Optimized learning

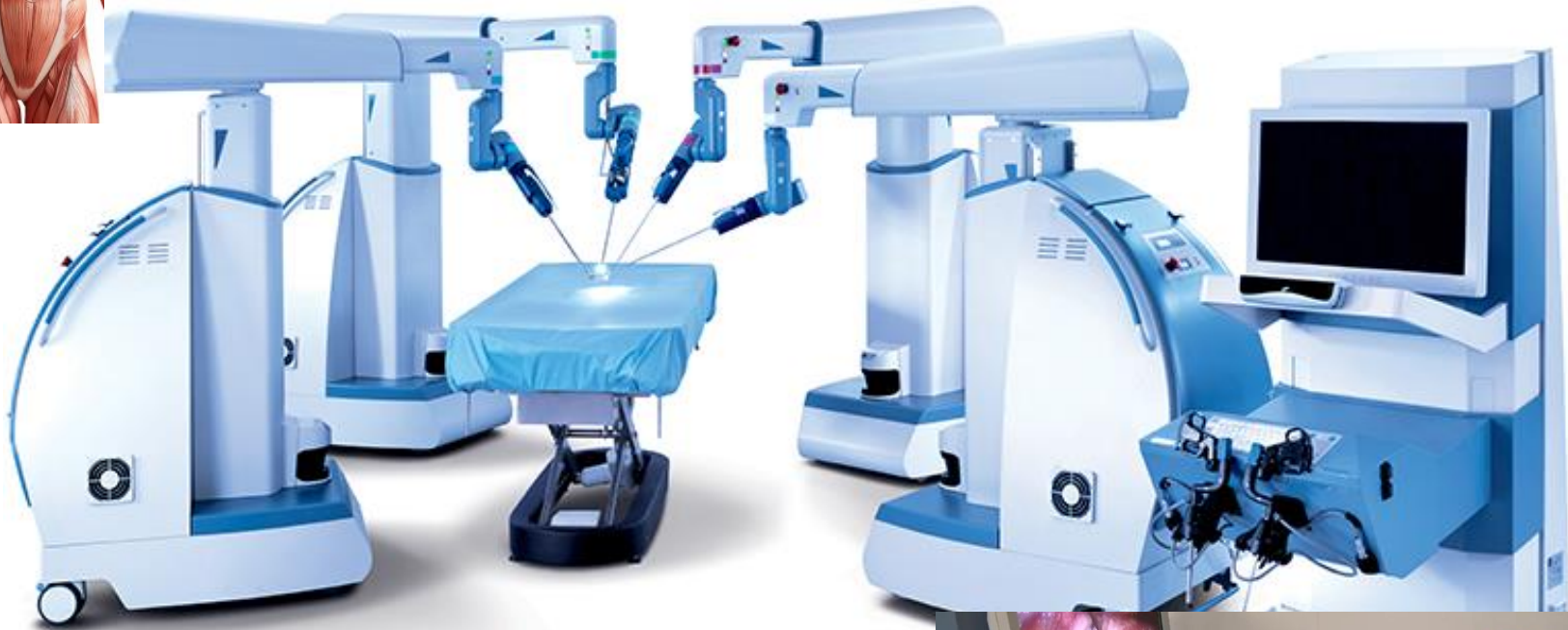


Da Vinci SP (Single Port)



Path to Expertise

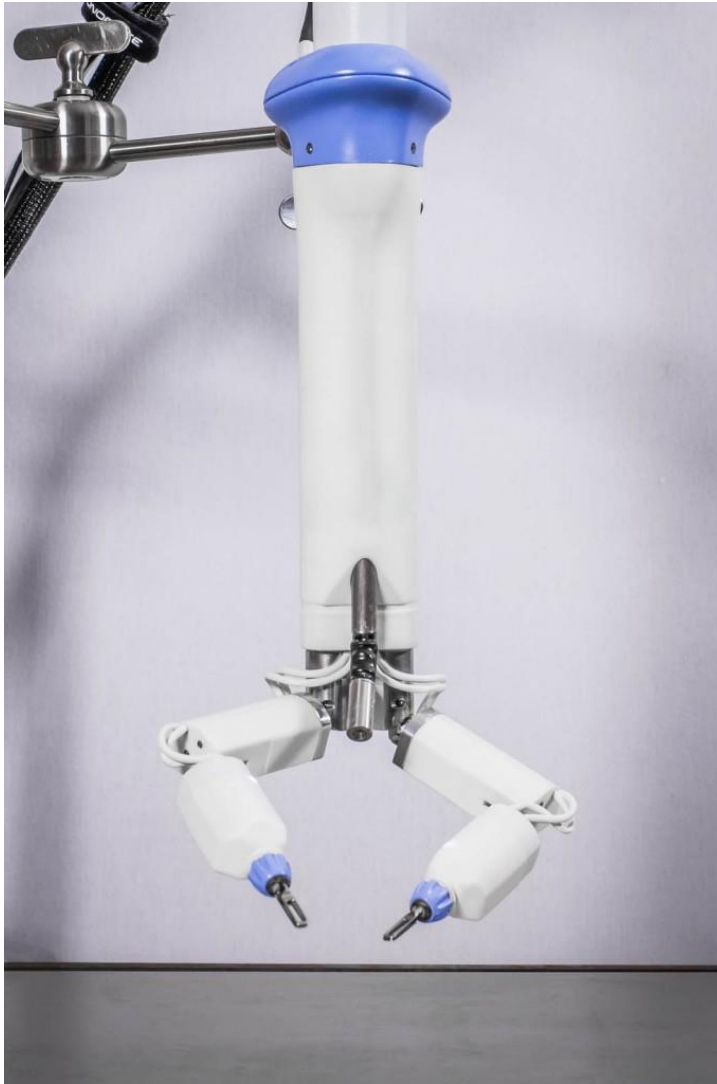
TransEnterix SenHance



2017



Virtual Incision



2017



2017

South Korean Ministry of Food and Drug Safety (MFDS):

“We expect the successful localization of surgical robots will significantly reduce financial burdens of patients who need endoscopic surgery through the import substitution effect...” (Aug 2017)



2009

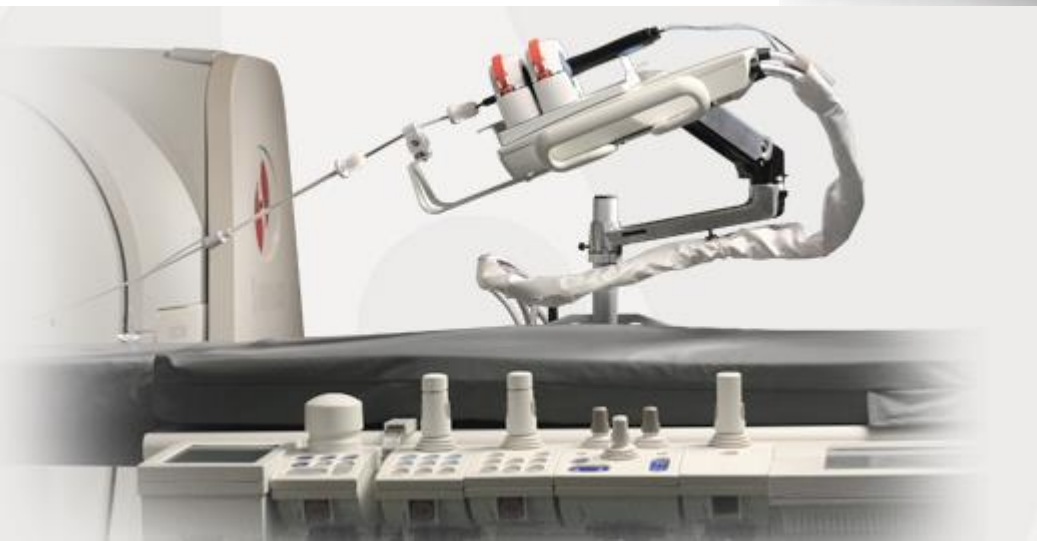
Mazor X/Renaissance



2011

Stereotaxis Niobe & V-Drive

2008



2015

Corindus Vascular Robot



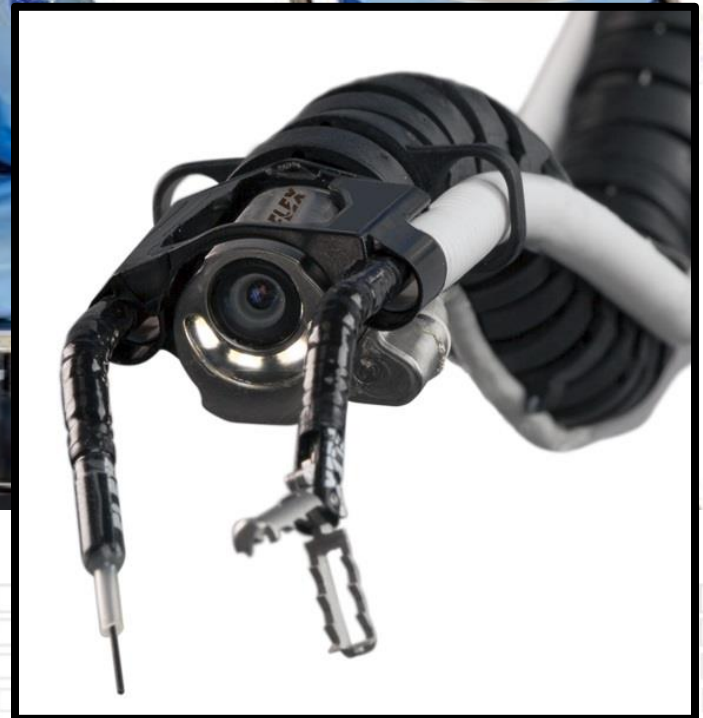
2017

ARTAS Hair Restoration



2011

Medrobotics Flex



2017

Titan Medical SPORT



Open 3D High Definition Visualization

Natural Multi-articulated Handle Control Interface

Camera Insertion Tube with Self-Cleaning Lens



Multi-articulated Instruments with Replaceable Tips

TSPORT™
SURGICAL SYSTEM



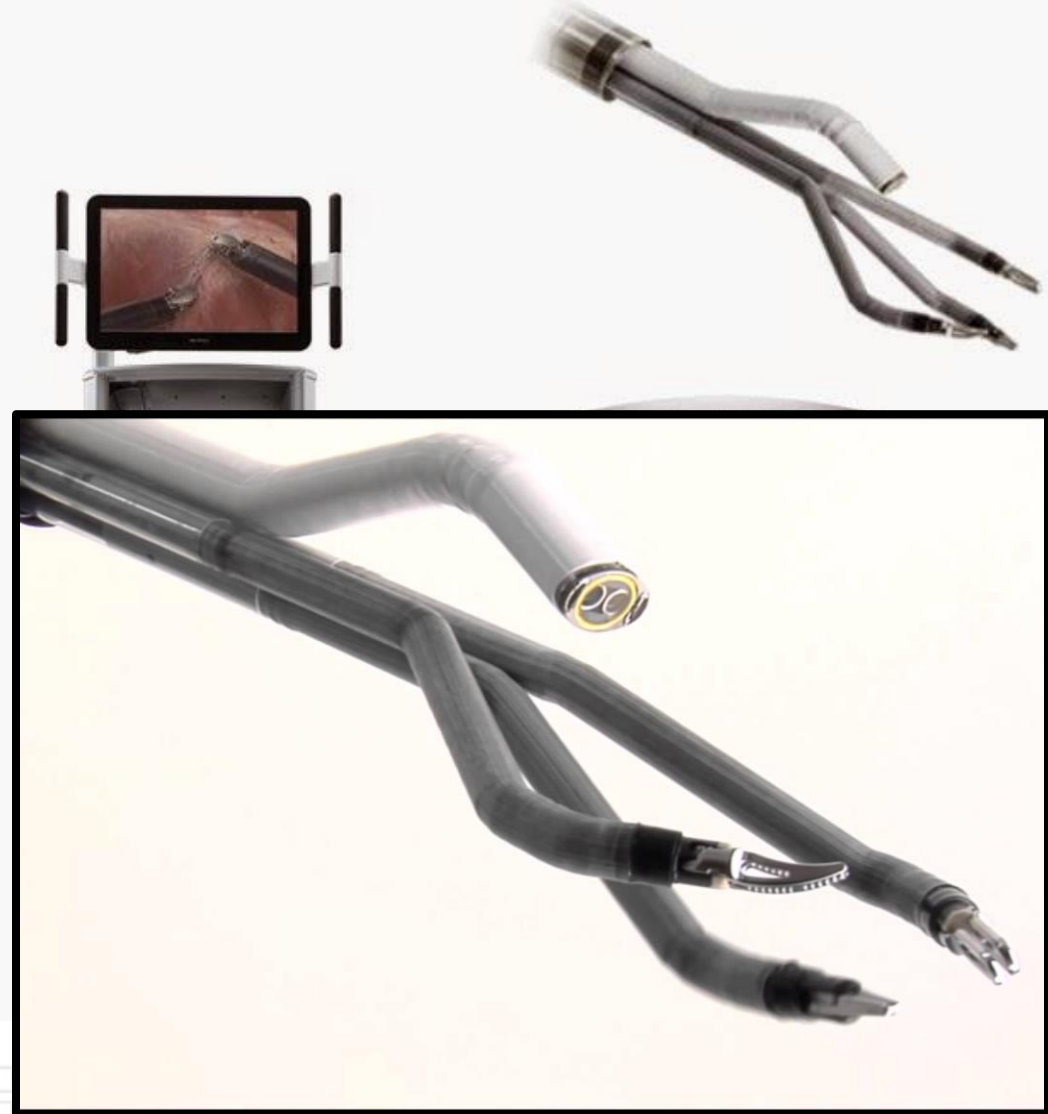
Single-Arm Mobile Patient Cart



2019

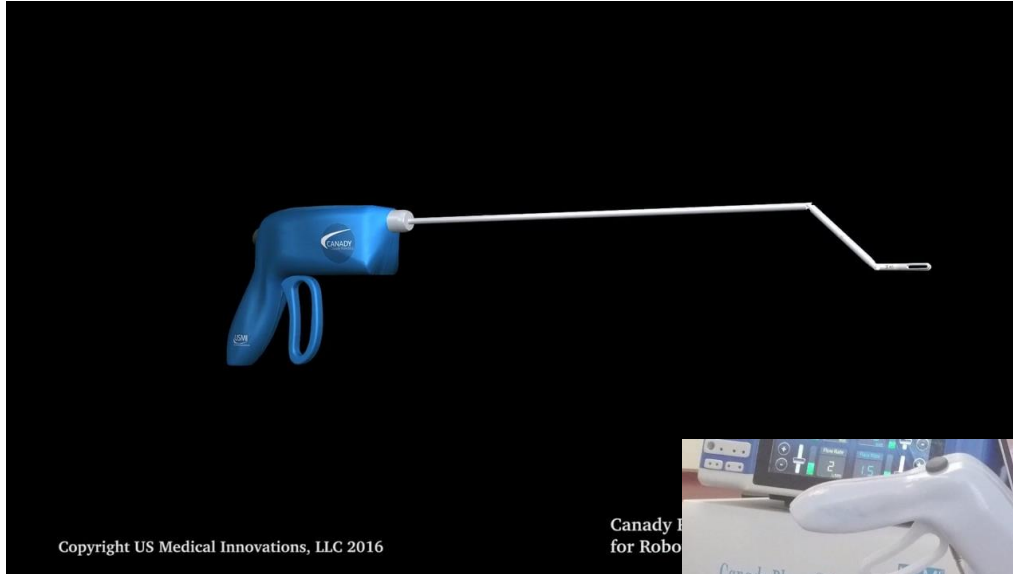


da Vinci SP (Single Port)



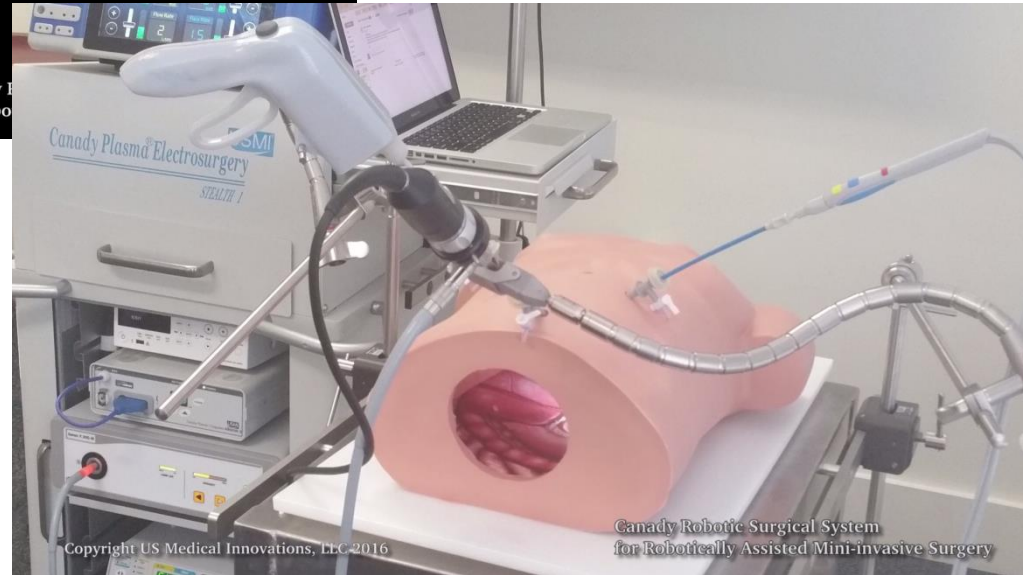
2017+

USMI Canady Surgical Robot



Copyright US Medical Innovations, LLC 2016

Canady
for Robo

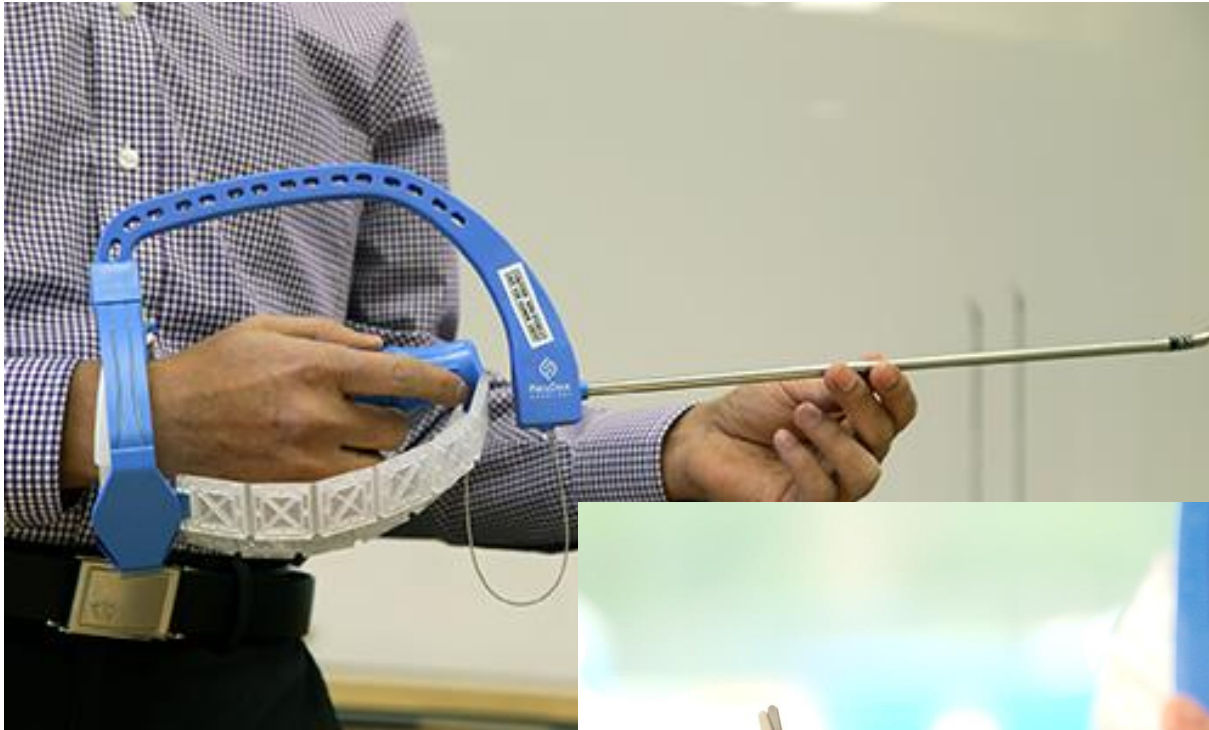


Copyright US Medical Innovations, LLC 2016

Canady Robotic Surgical System
for Robotically Assisted Mini-invasive Surgery

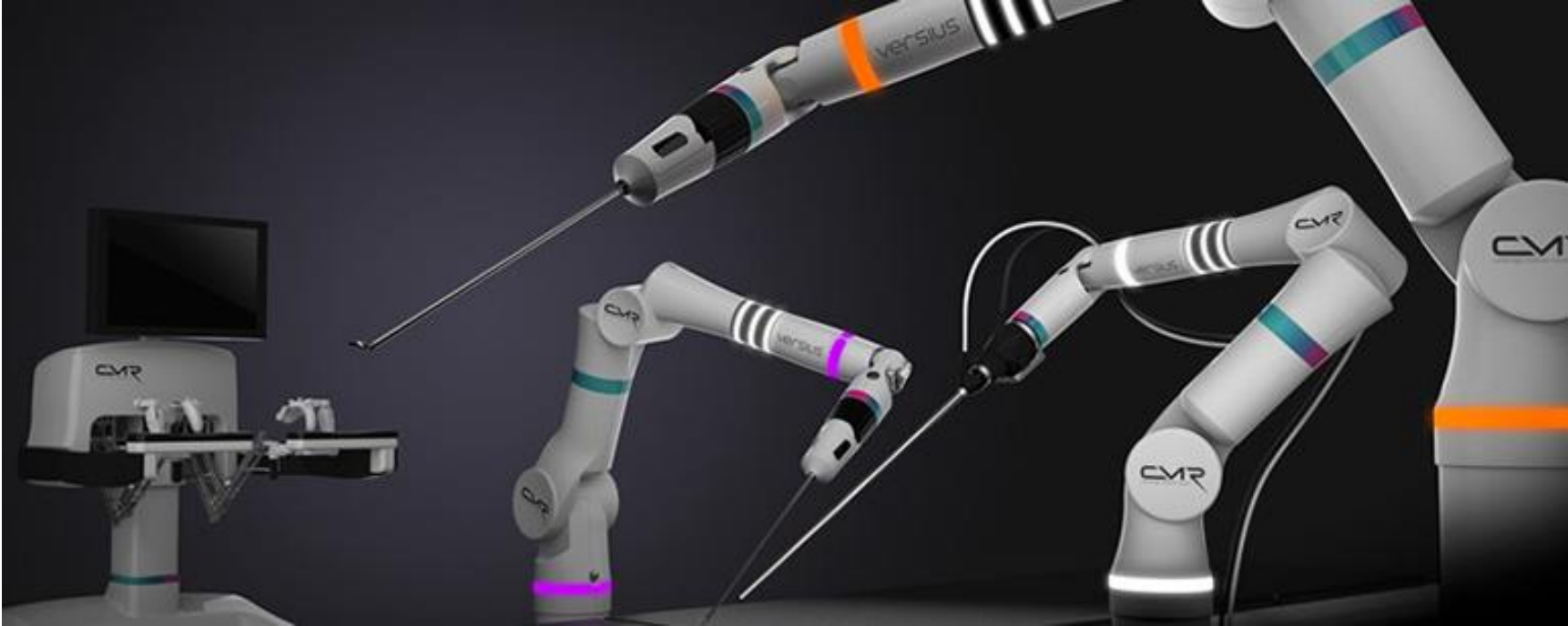
2019

FlexDex Endowristed Lap



2019

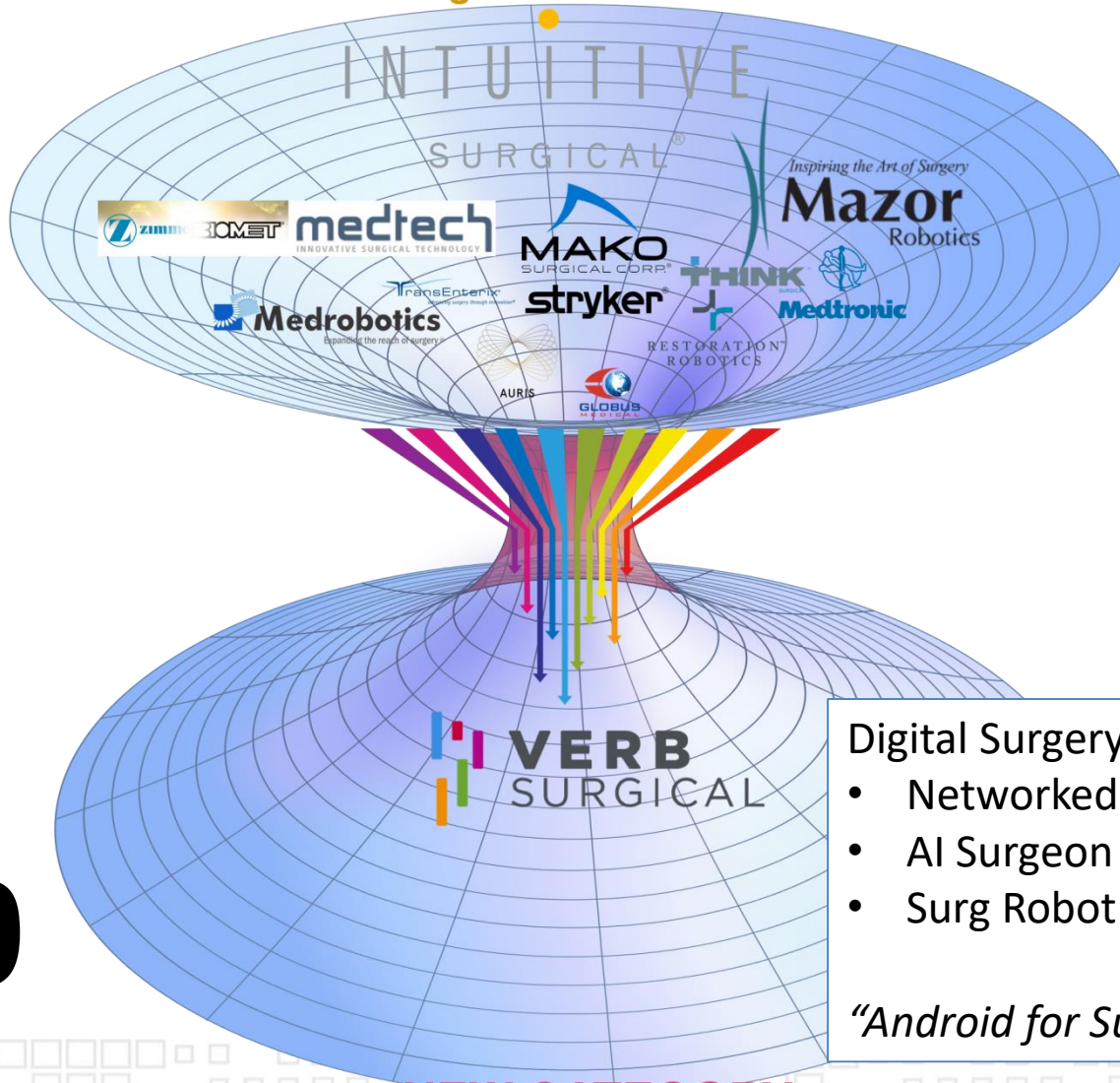
CMR Versius abdominal robot



2020

Verb Surgical

Surgical Robotics



2020

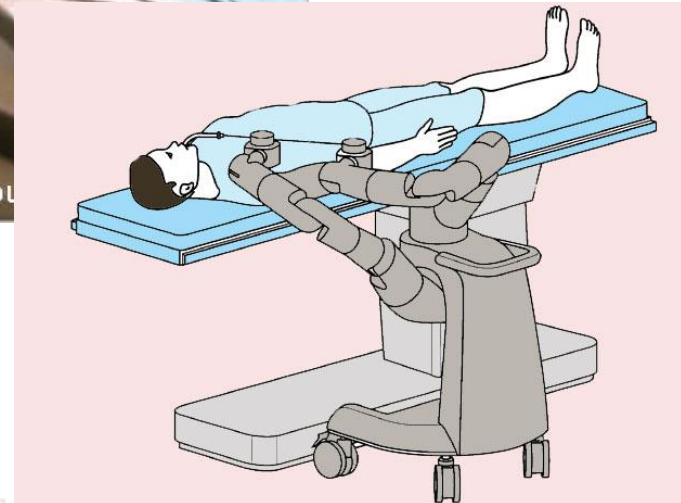
Digital Surgery:

- Networked Cloud Services
- AI Surgeon Assistance
- Surg Robot O/S Ecosystem

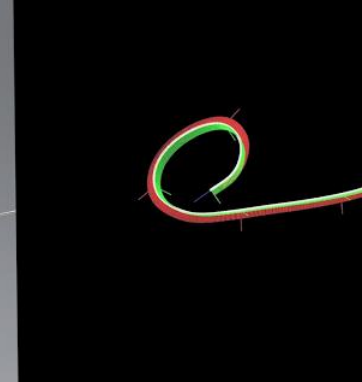
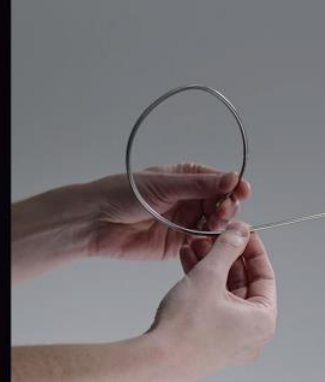
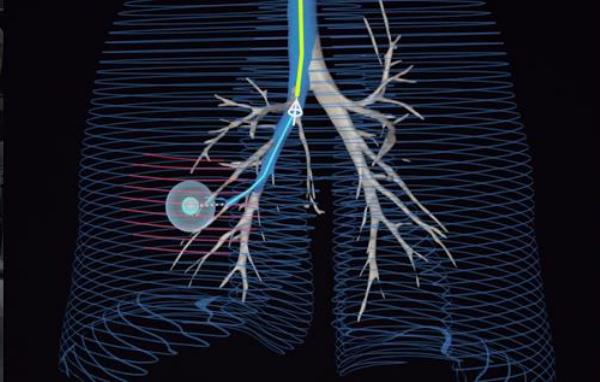
“Android for Surgical Robotics”

NEW CATEGORY

Auris Surgical Robotics



2020



2020

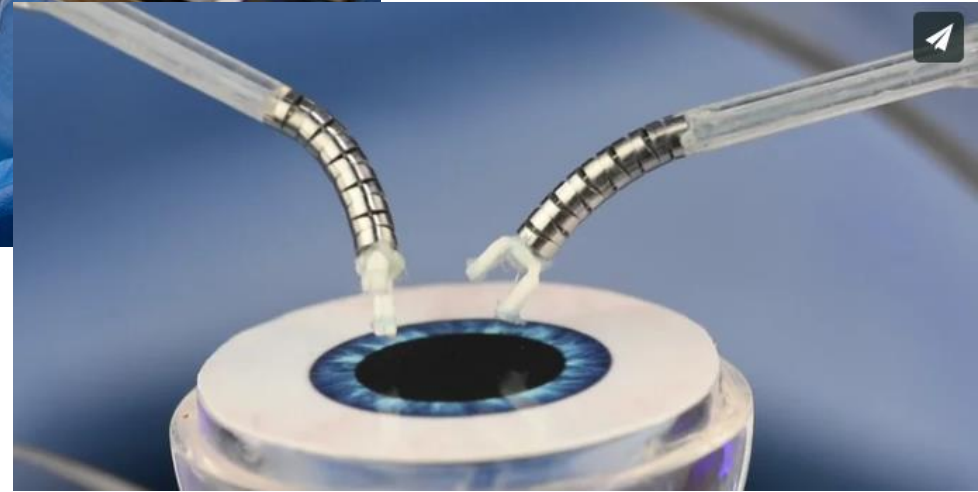
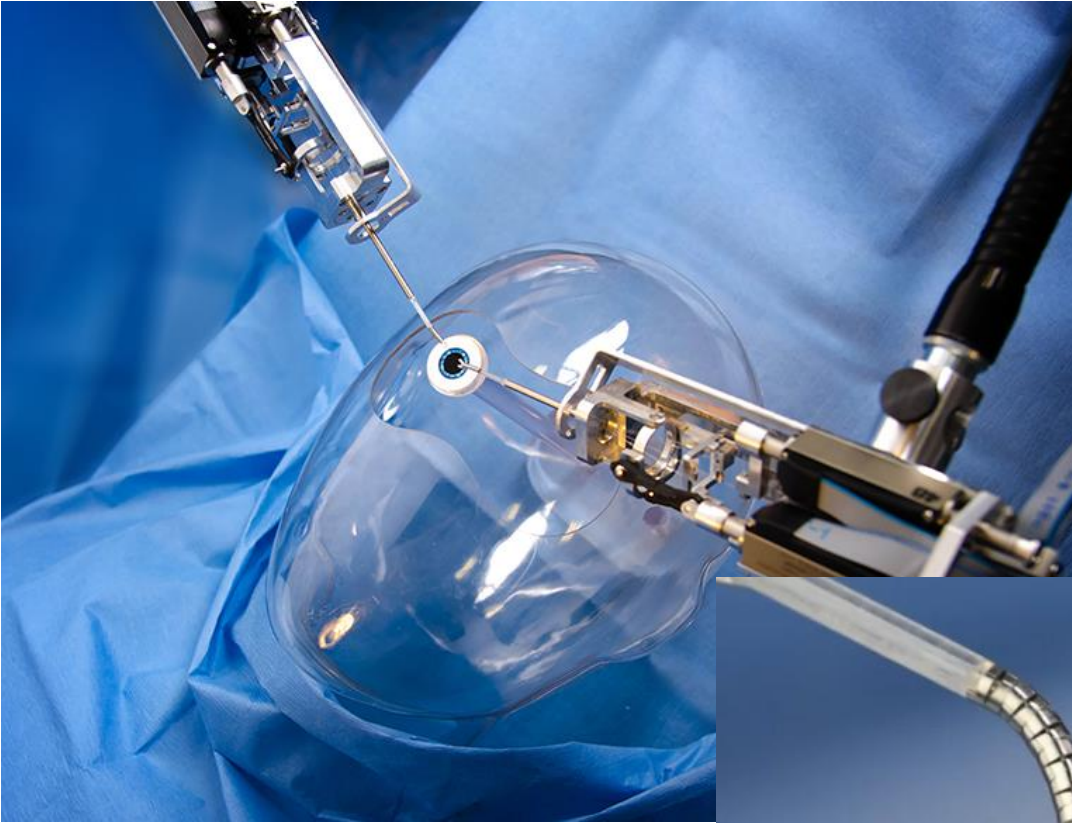


AVRA – Skin Ablation



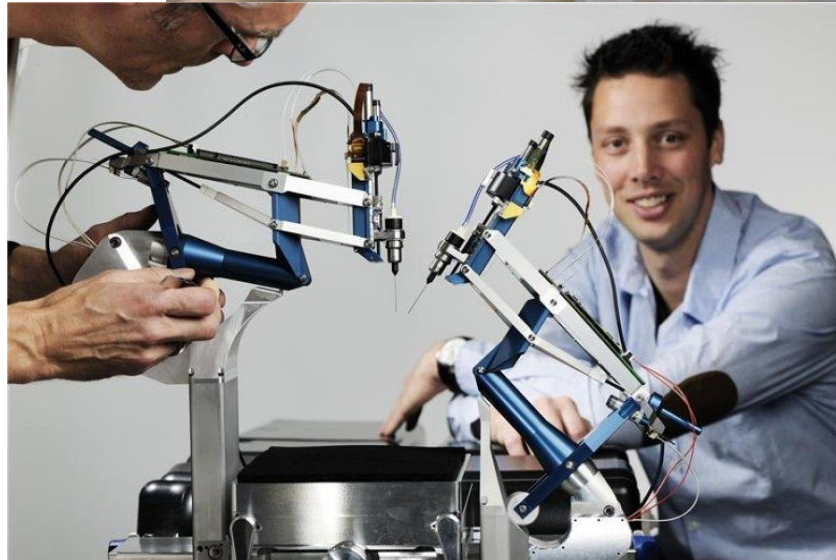
2020

Axis Cataract Eye Surgery



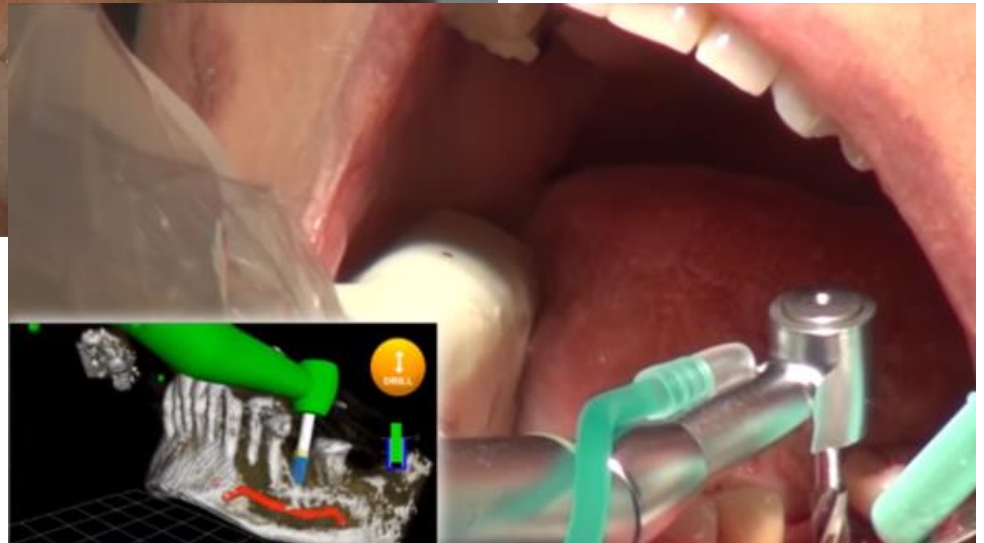
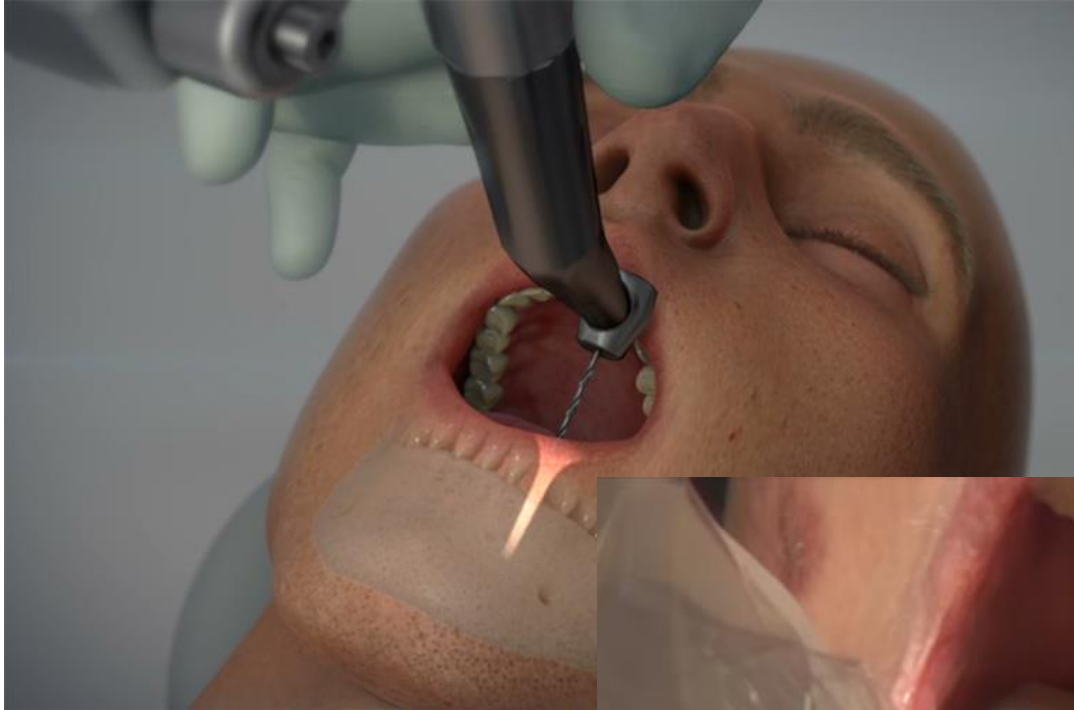
2018

R2D2 Retinal Eye Surgery



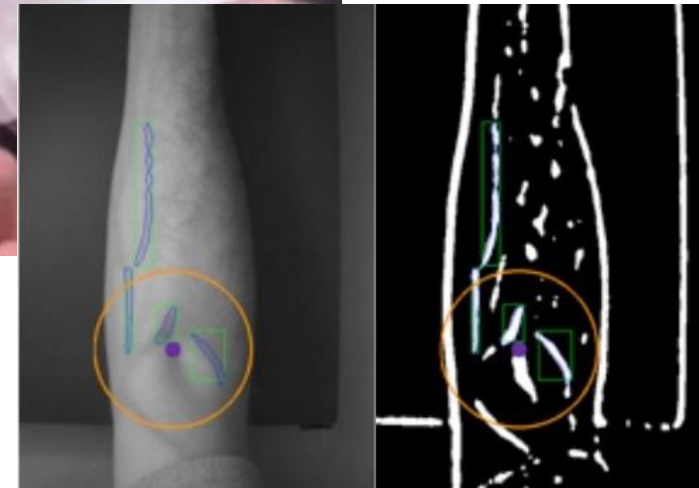
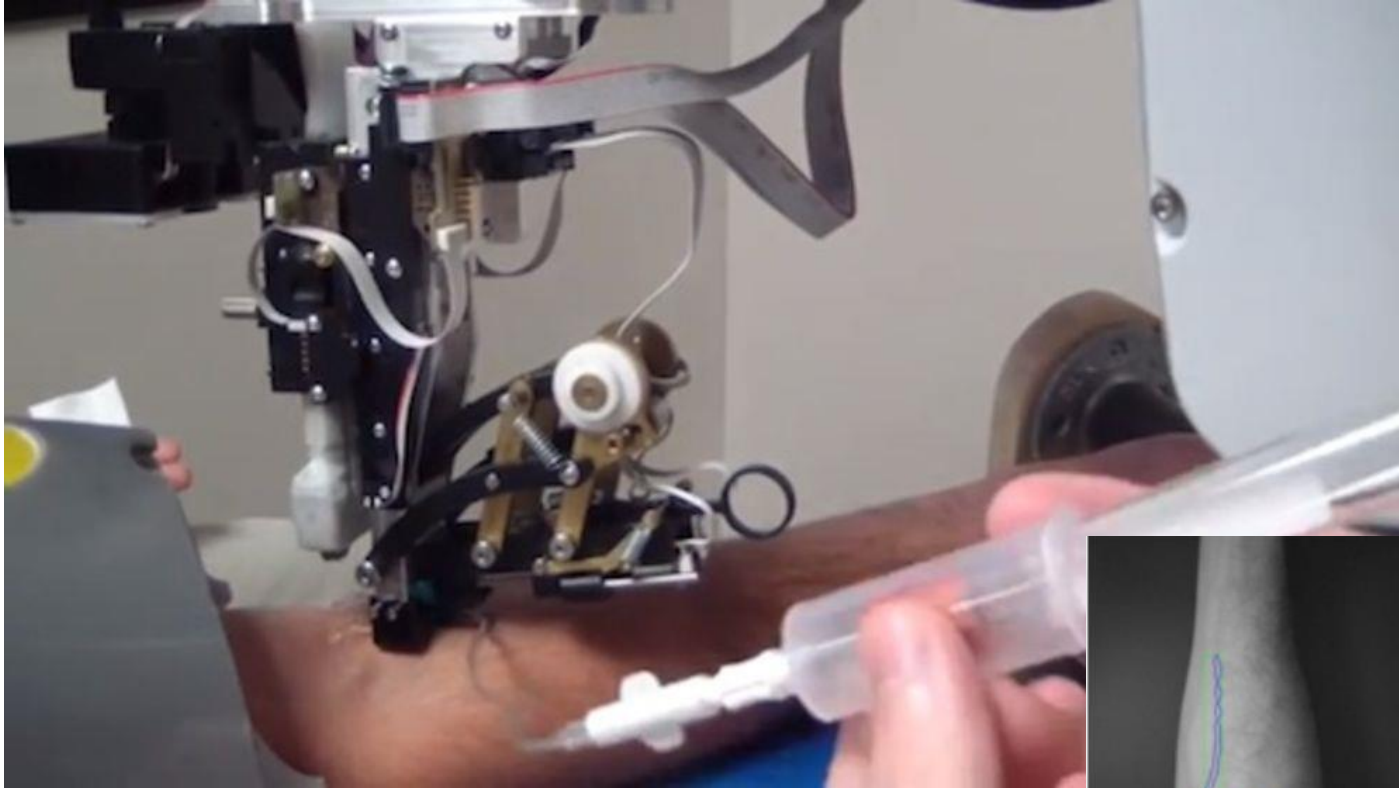
2016

Yomi Dental Implant Robot



2017

Veebot – blood draw



2018

AI Assistance
Verb, Intuitive

Action Transfer
*Intuitive,
TransEnterix,
Titan*

Planning & Guidance
Mazor, Globus

Independent Action
*Restoration,
Veebot, Accuray*

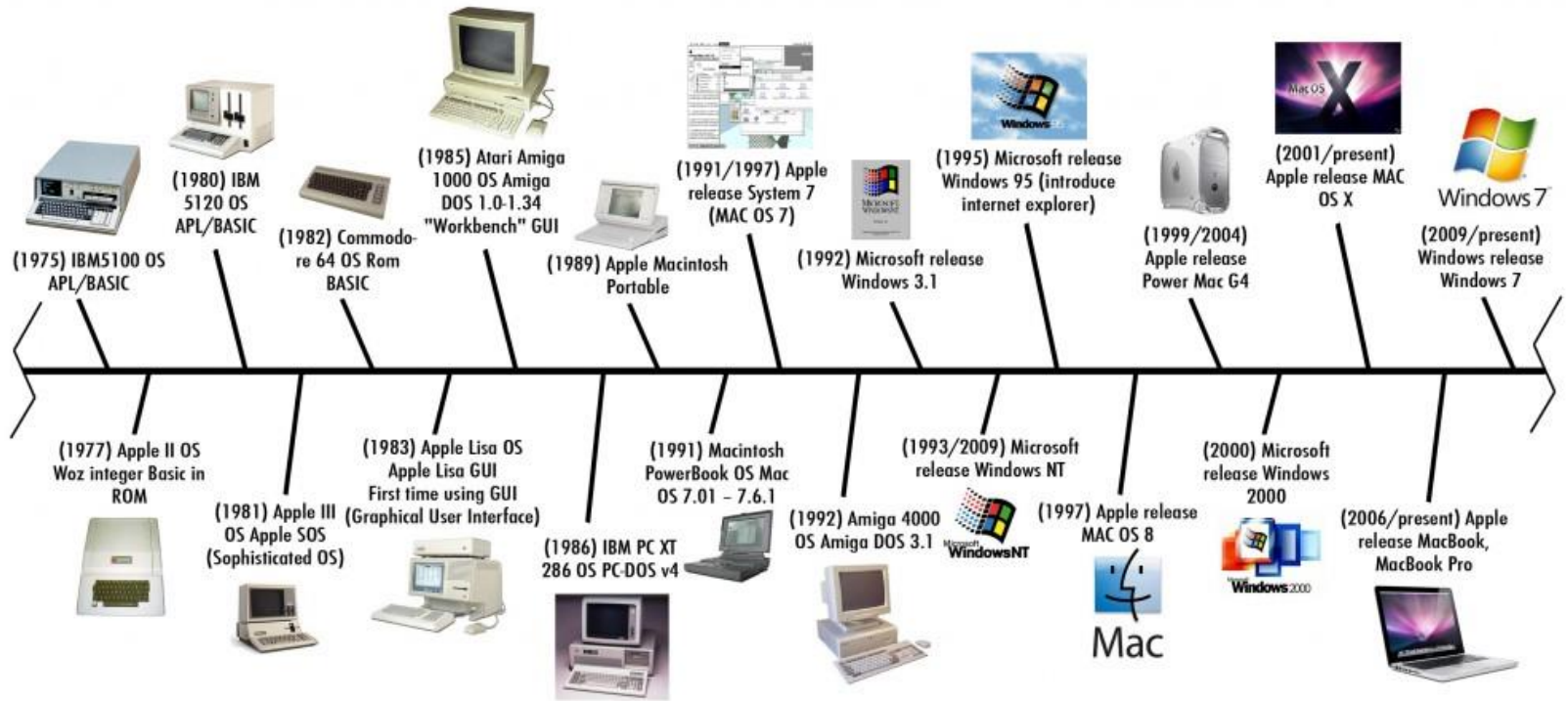
Steering Instrument
*Auris, Corindus,
Stereotaxis*

Planning & Control
Mako, Neocis

Adoption Challenges



Hospital Capacity for Robots?



Personal Computers ...Cellphones ...Automobile Companies

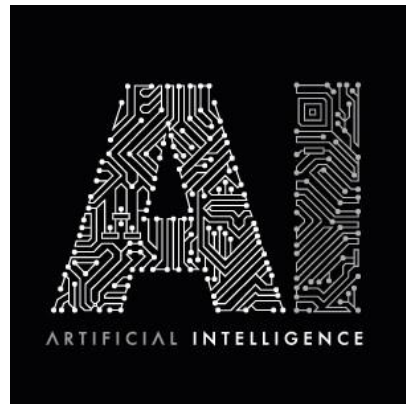
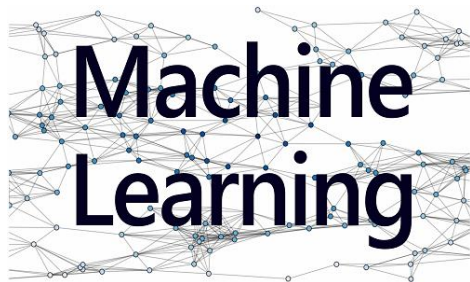
Hospital Capacity for Robots?



Answer = 3



Multi-finger
Instruments



Not just at the hospital

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Questions?