

Anestézie Robotické operační techniky – co se (od nás) čeká ?

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Vojenská fakultní nemocnice Praha



6. října 2023
XXIX. Kongres ČSARIM

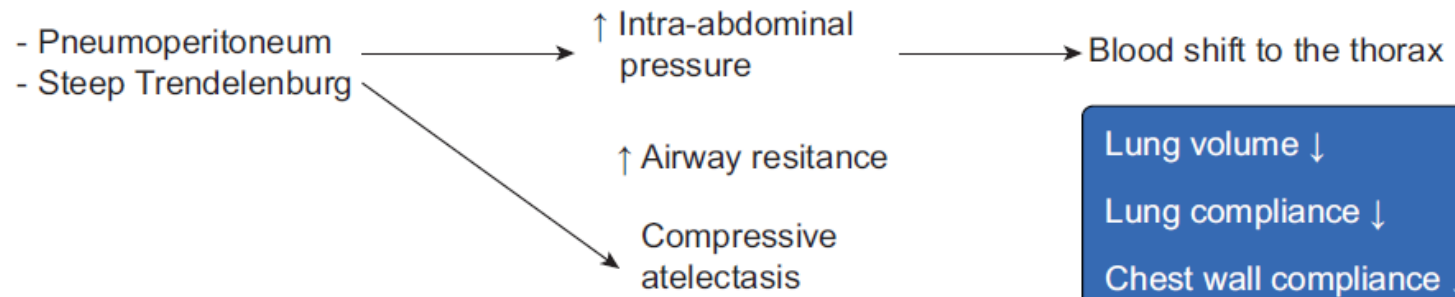
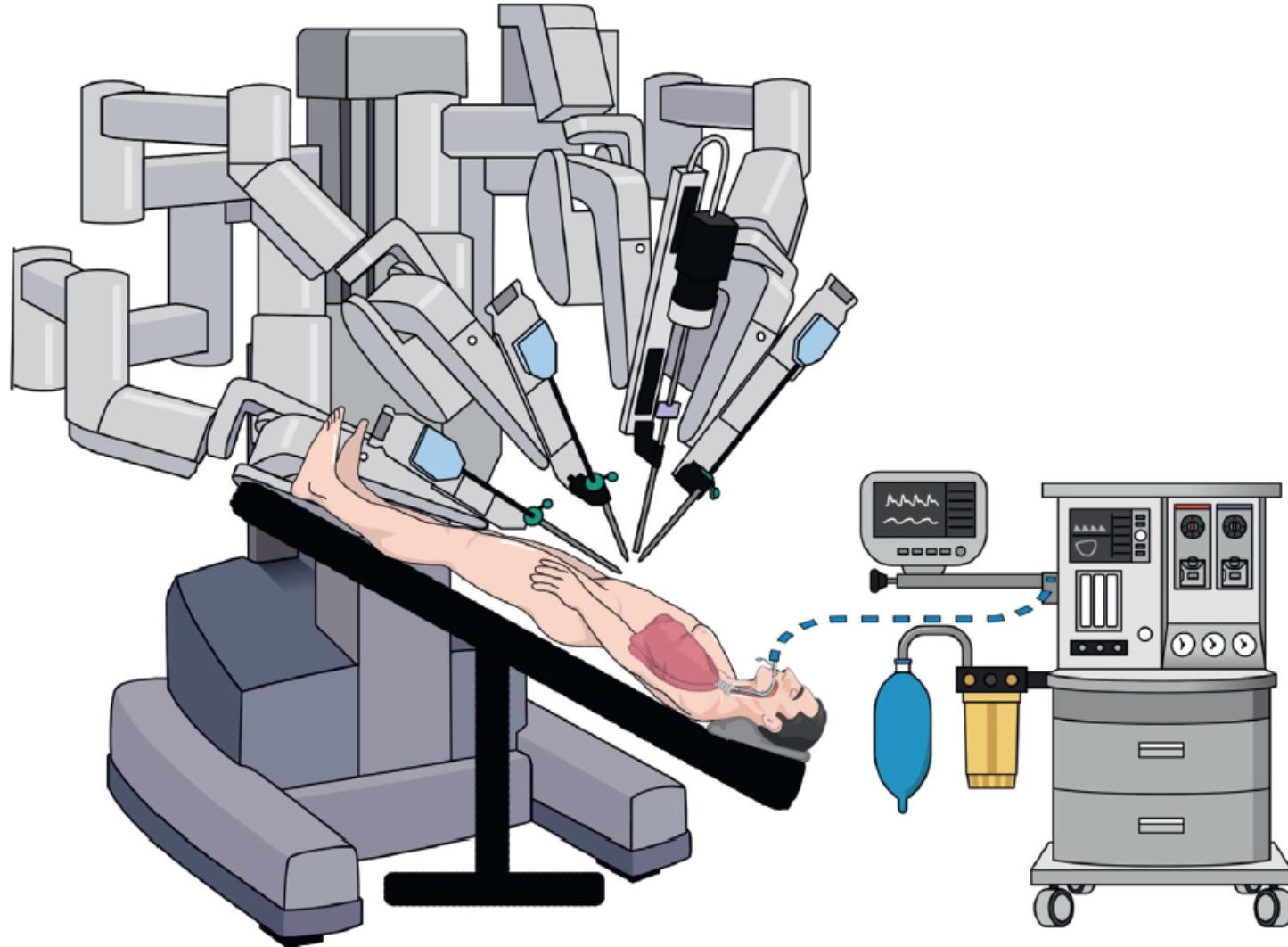


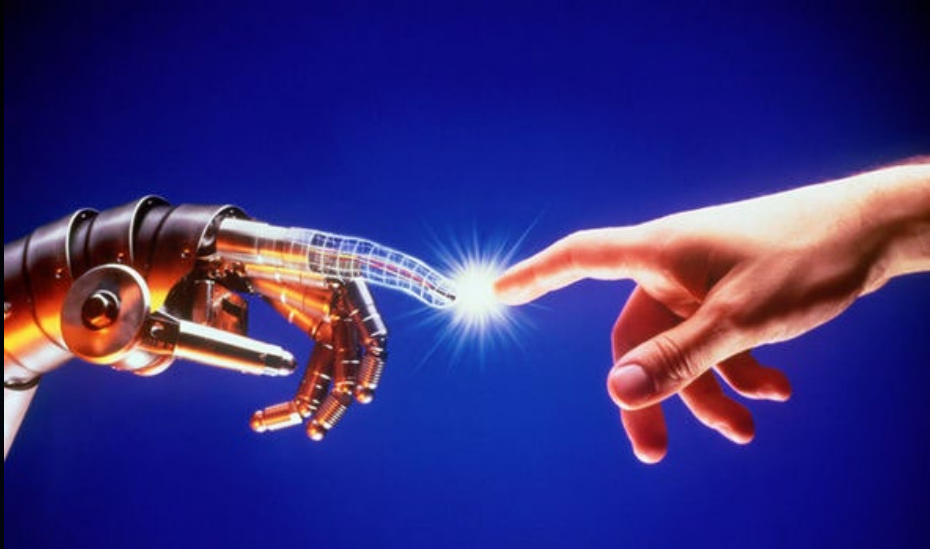


Da Vinci

- 1990
- Obory



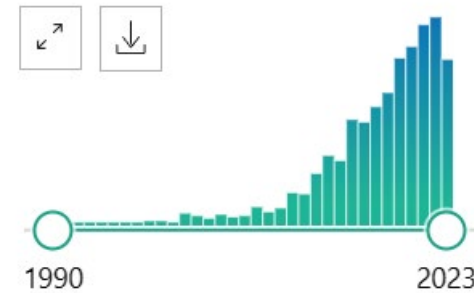




Jul 2000 : General laparoscopic procedures
 Mar 2001 : Non-cardiac thoracoscopic procedures
 May 2001 : Prostatectomy procedures
 Nov 2002 : Cardiotomy procedures
 Jul 2004 : Cardiac revascularization procedures
 Mar 2005 : Urologic surgical procedures
 Apr 2005 : Gynecologic surgical procedures
 Jun 2005 : Pediatric surgical procedures

Physiological effects of Trendelenburg position[17]

System	Changes
Cardiovascular system	Increase in systemic vascular resistance, mean arterial pressure, myocardial oxygen consumption Decrease in renal, portal and splanchnic flow
Respiratory system	Increase in ventilation-perfusion mismatch, peak airway pressure (P_{PEAK}) Decrease in functional residual capacity, vital capacity, compliance Pulmonary congestion and oedema Hypercarbia, respiratory acidosis
Central nervous system	Increase in intracranial pressure, cerebral blood flow, intraocular pressure
Endocrine	Catecholamine release Activation of renin-angiotensin system
Others	Gastro-oesophageal regurgitation Venous air embolism Neuropraxia Tracheal tube displacement Facial and airway oedema Visceral/Vascular injury



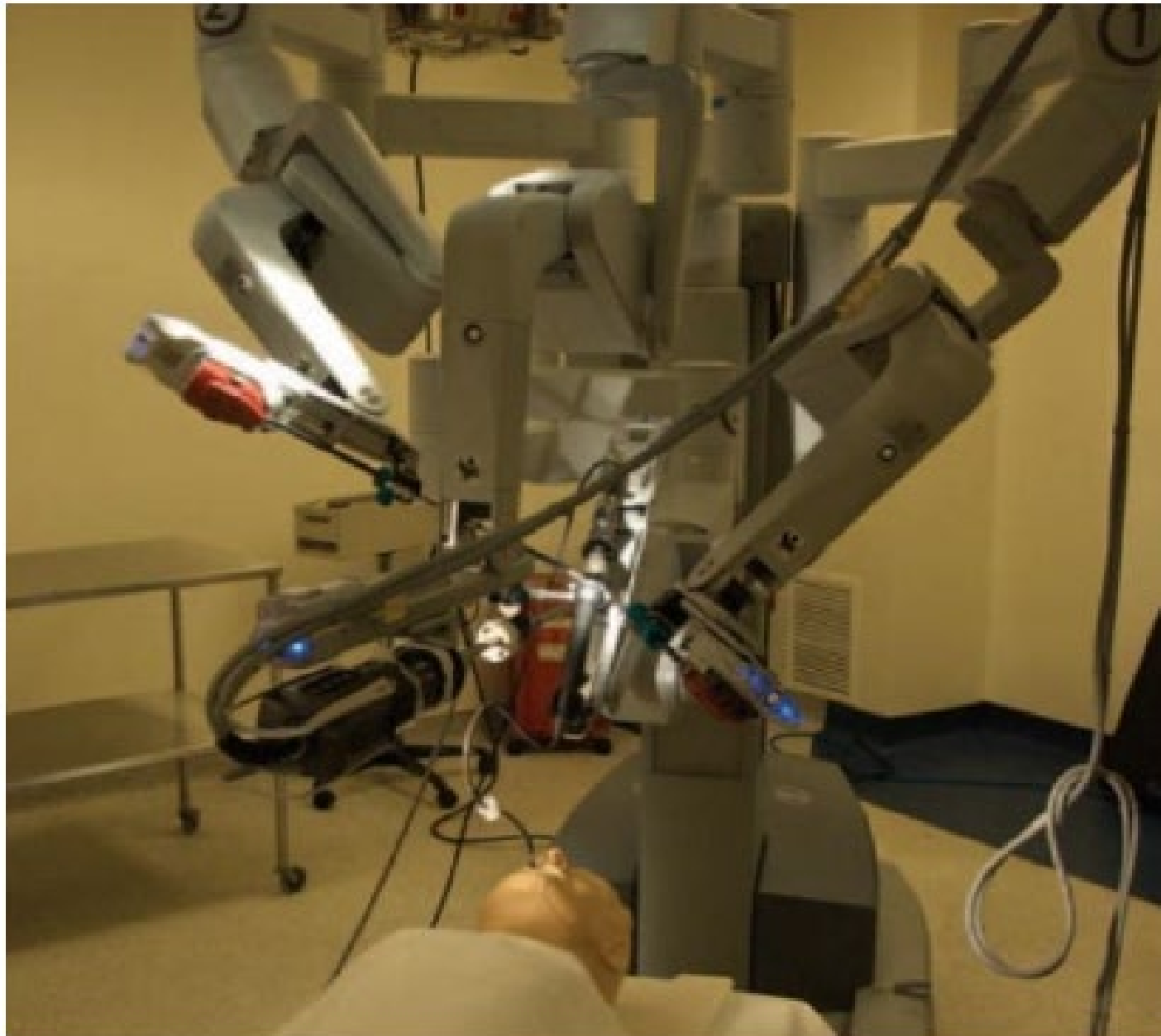
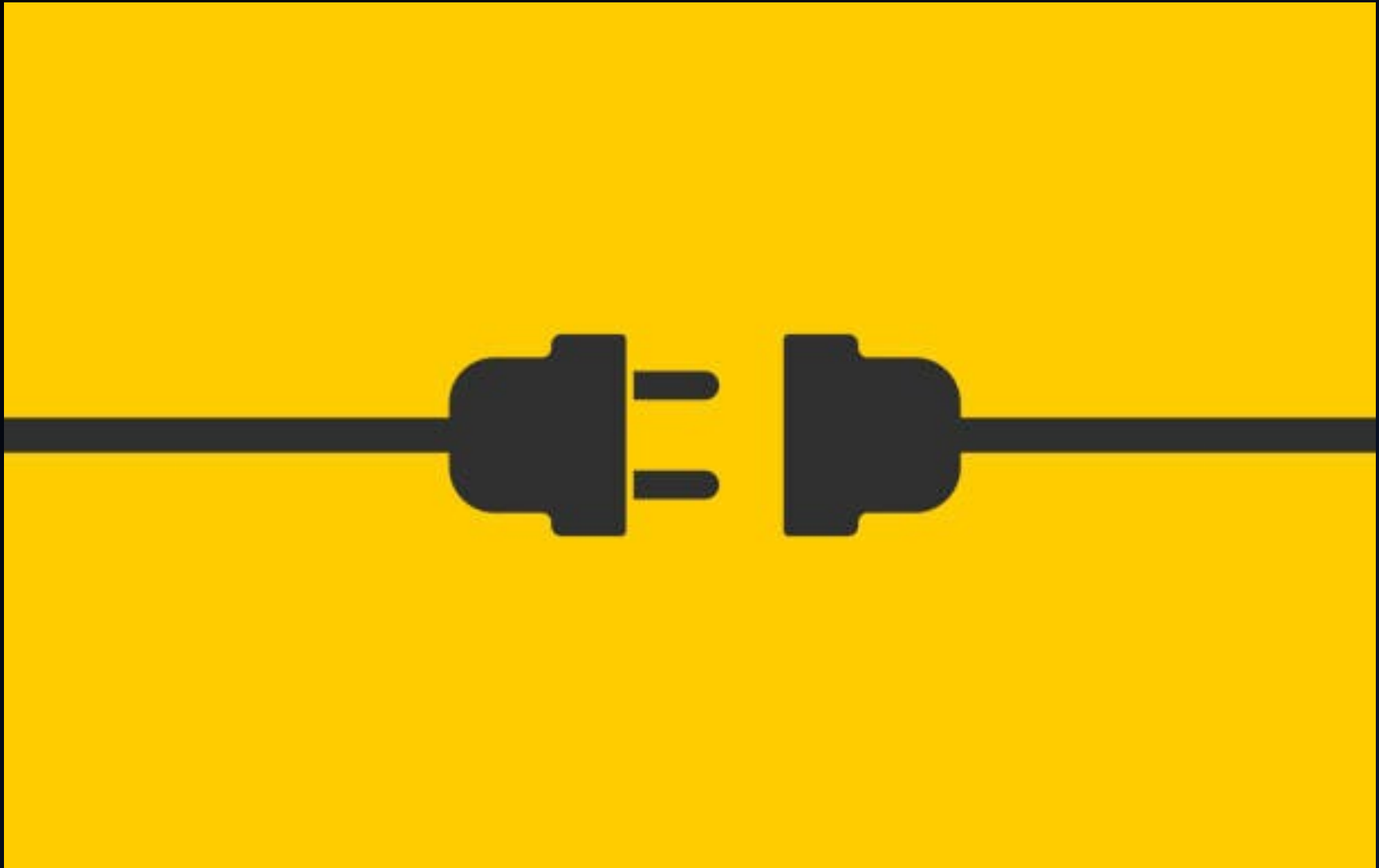
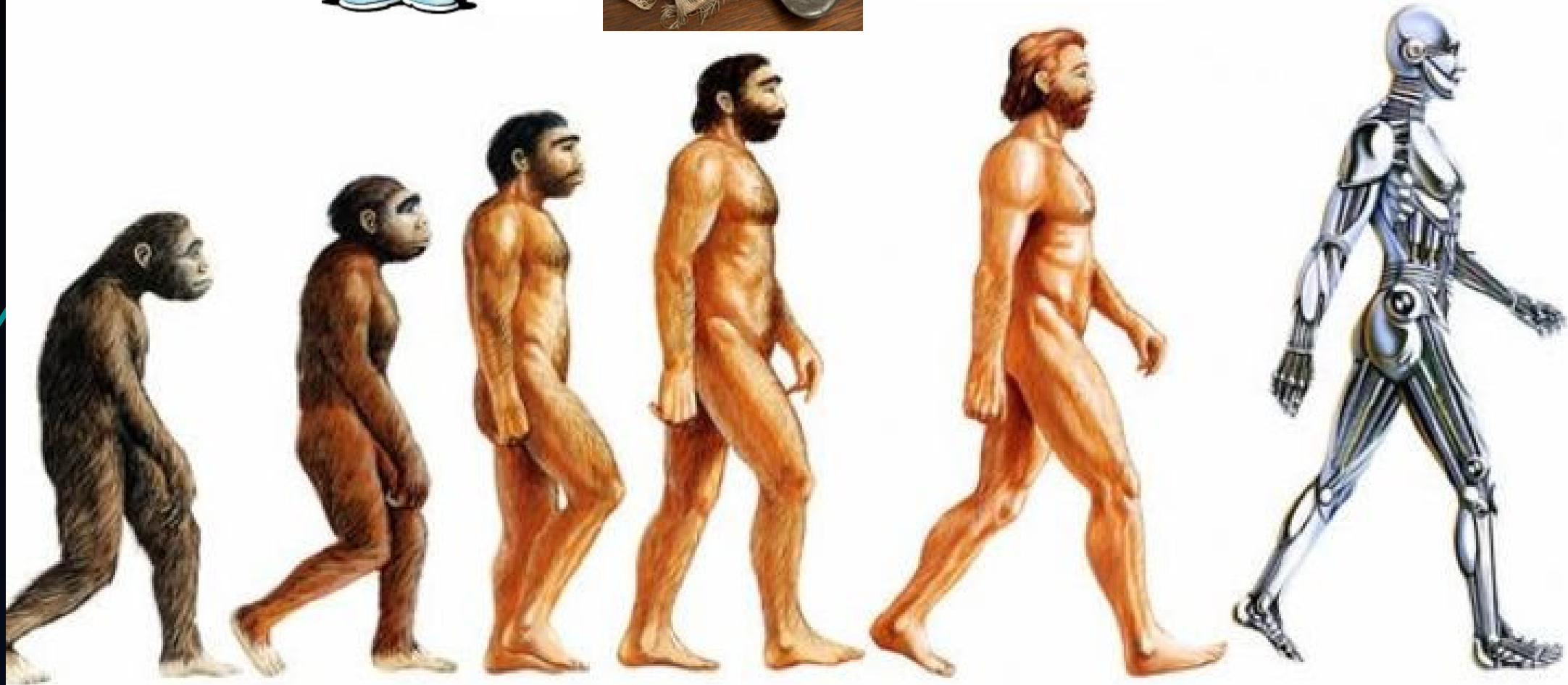
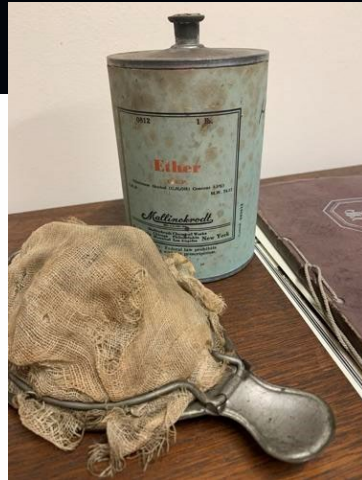


Figure 1: de Vinci intubation system







My & Roboti co nás čeká?

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Utopie

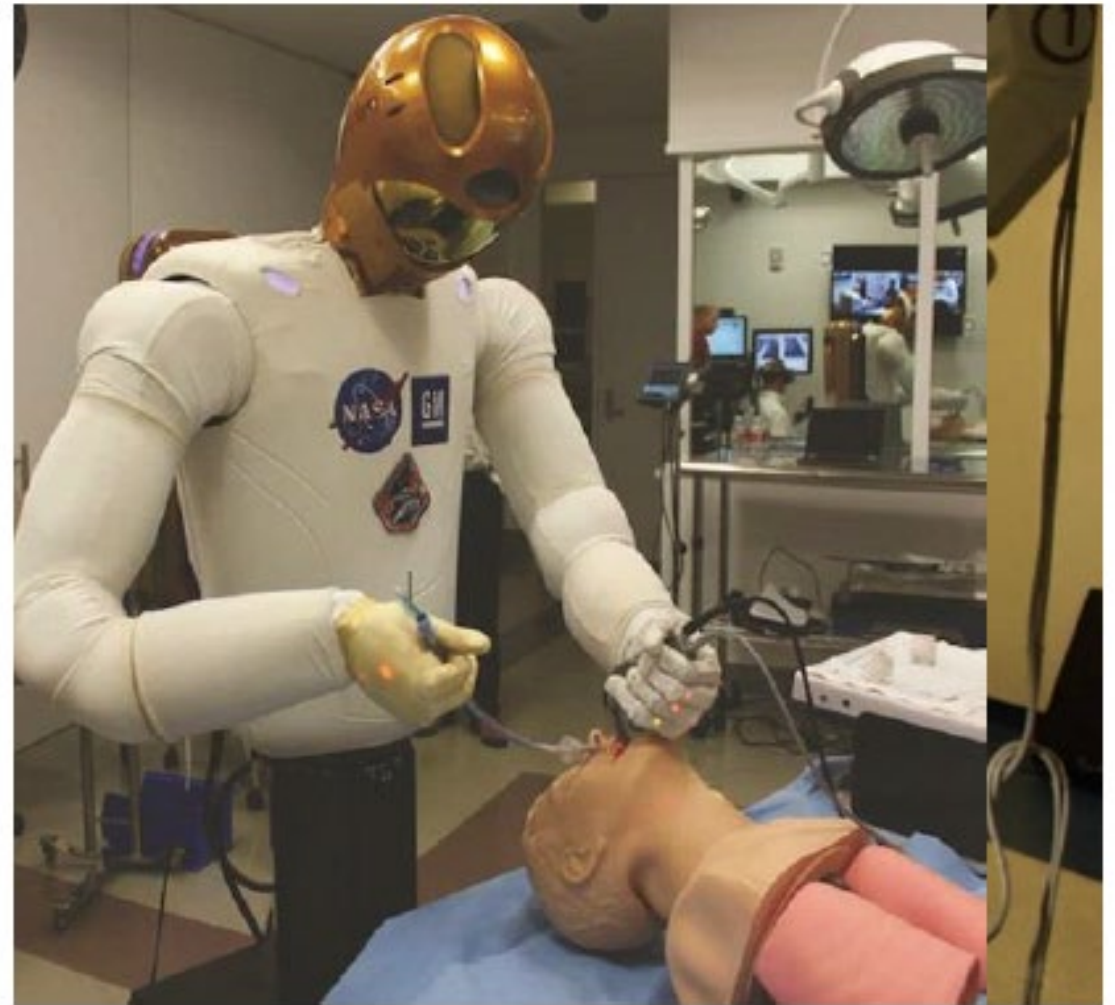
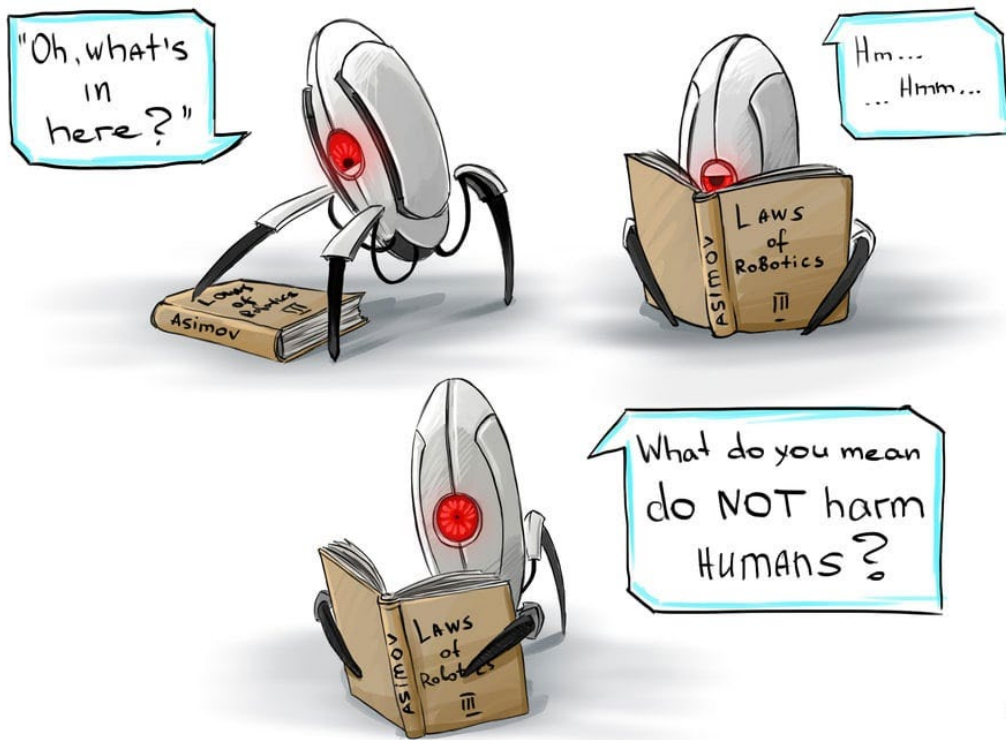
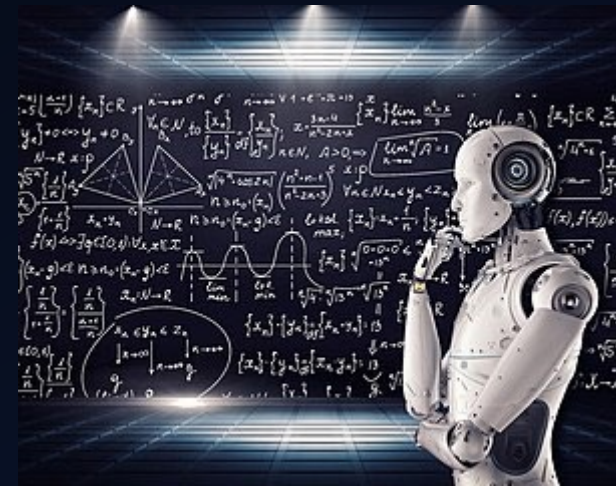


Figure 2: Robonaut 2

- Umělá inteligence + informatika + anesteziologie
= robotická anesteziologie

- Farmakologičtí roboti
- Mechaničtí
- Kognitivní



- TCI
- SISO
- MIMO

- Anestézie
- Sedace při vědomí







The diagram illustrates the 'Triad of Anaesthesia' as a central blue triangle. The triangle is surrounded by three light blue circles, each containing one of the three components: 'UNCONSCIOUSNESS' at the top, 'ANALGESIA' at the bottom left, and 'IMMOBILISATION' at the bottom right. The text is in a bold, sans-serif font.



UNCONSCIOUSNESS

**TRIAD OF
ANAESTHESIA**

ANALGESIA

IMMOBILISATION

Controller — analyzes the value of the controlled variable and adjust the actuator to attain the target value
Proportional-integral-derivative, rule-based, reinforcement learning, neural network, fuzzy logic



Variables of relevance
arterial pressure or heart rate or EEG




Actuator
Drug delivery mechanism

Better steadiness

Pharmacological Robot

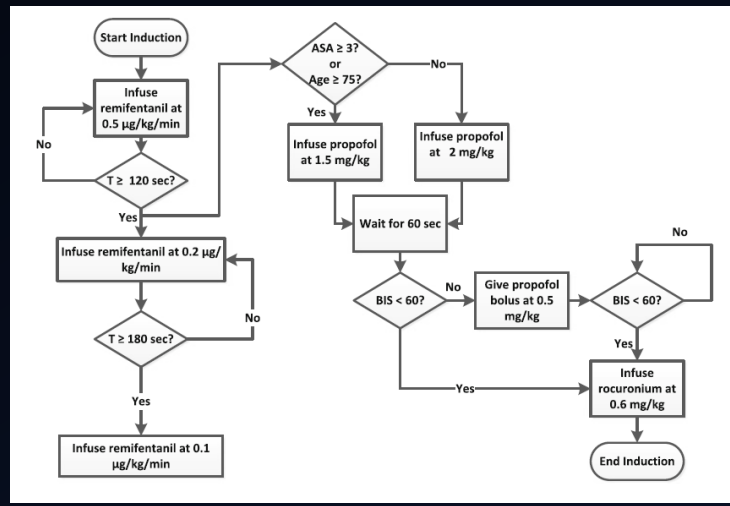
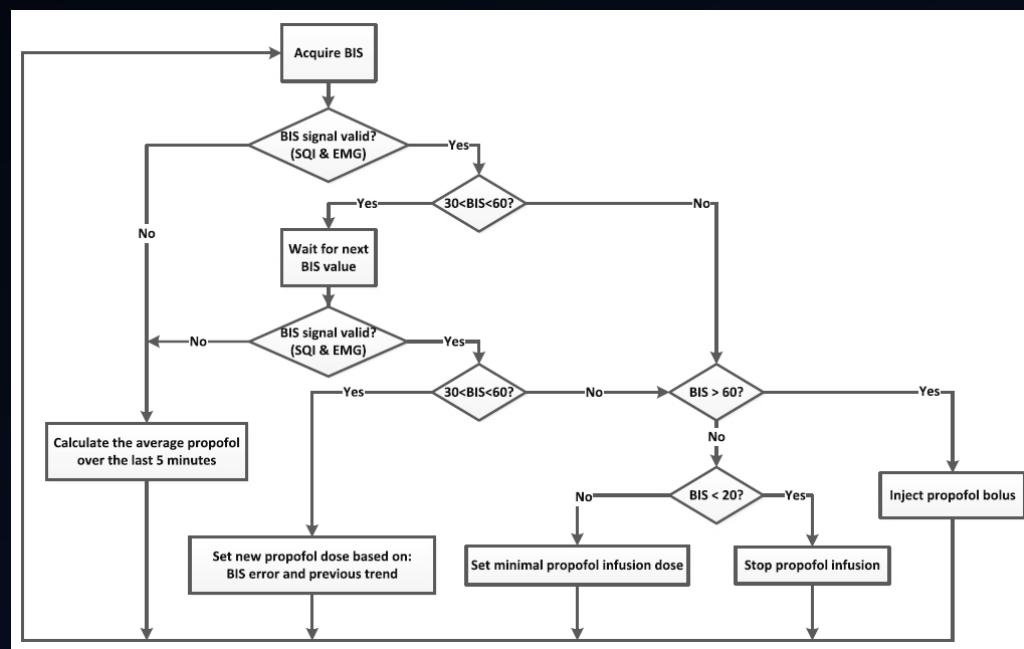
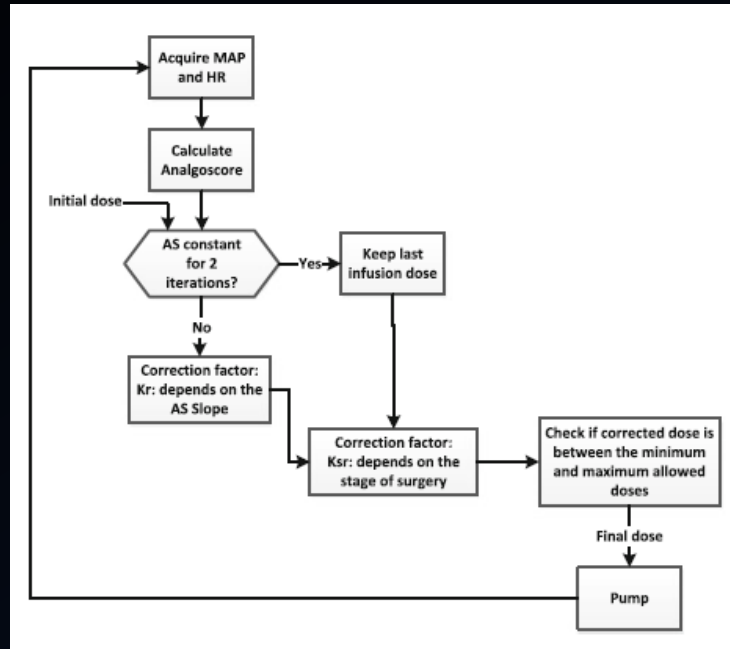
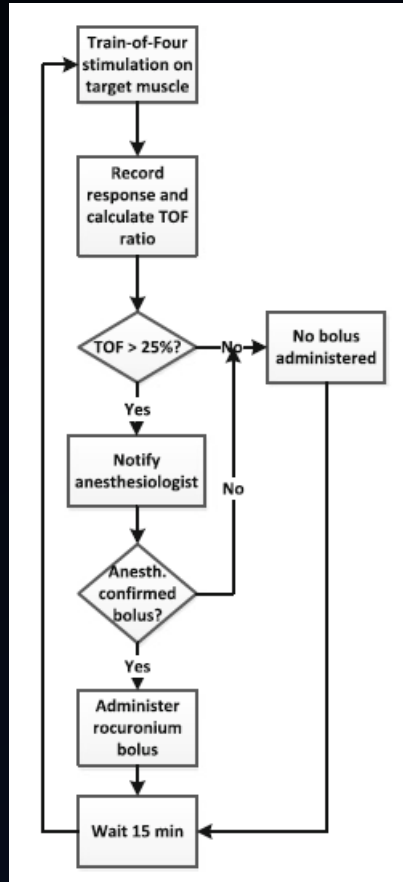
Less overshoot

Less undershoot



Patient

Mc Sleepy



The screenshot shows a multi-panel anesthesia workstation interface. The top panel displays the **Bispectral Index (BIS)** monitor with a color scale from 0 (black) to 100 (red), currently showing a value of 50. Below the scale are indicators for EMG (red bar) and SQT (96). The middle panel shows the **Analgoscure** monitor with a color scale from -9 (black) to 9 (black), currently showing 0. The bottom panel displays the **Neuromuscular Blockade** monitor with a bar graph showing Core TDF (20) and Peripheral TDF (75). Other panels include 'Induction' and 'Rescue Bolus' controls with various gauges and buttons.

A technical description of a novel pharmacological anesthesia robot

J Clin Monit Comput (2014) 28:27–34
DOI 10.1007/s10877-013-9451-8

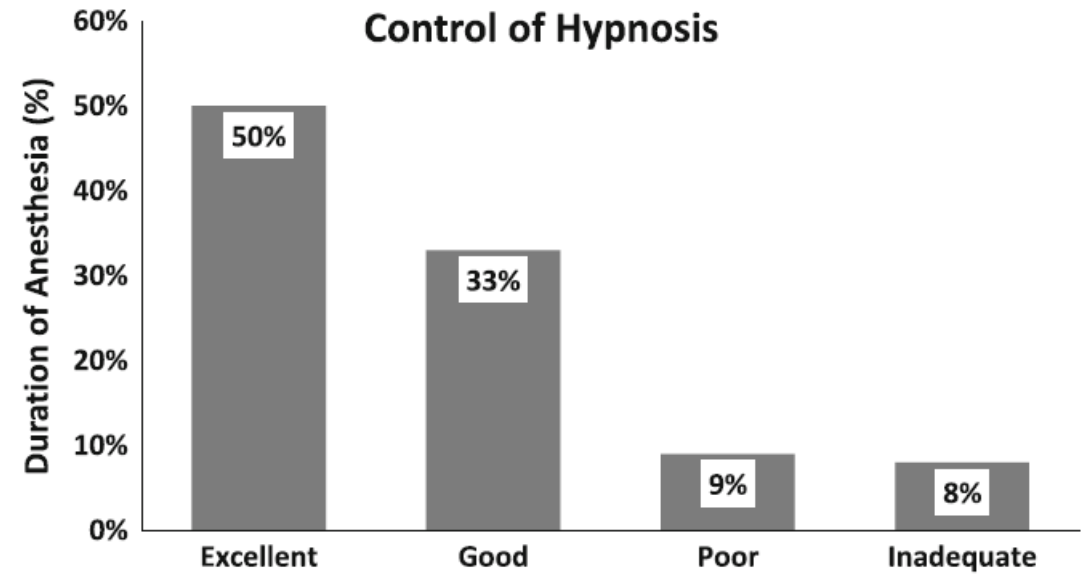
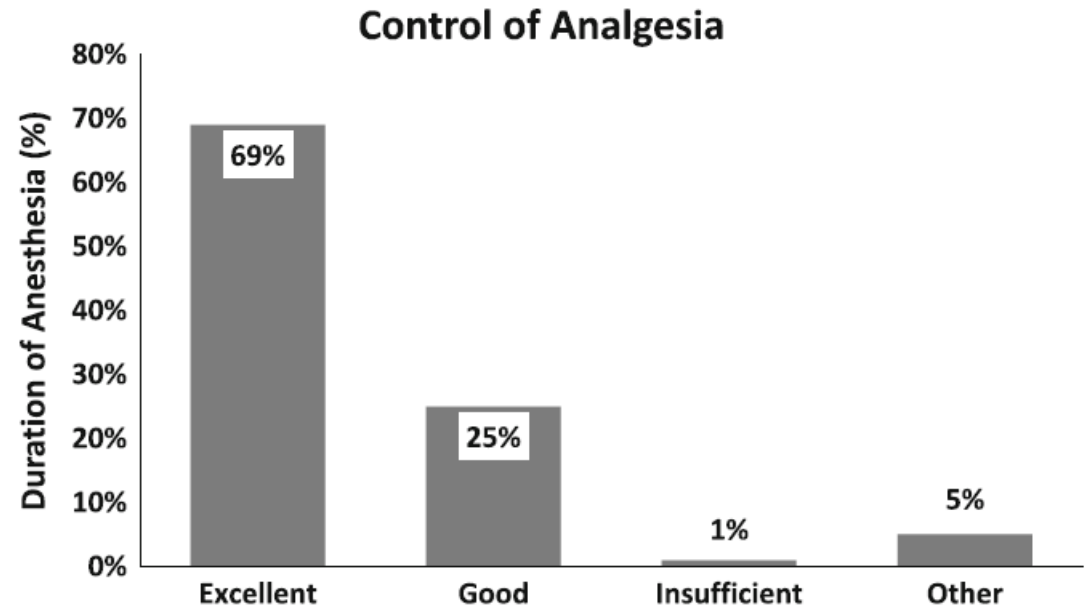


Fig. 7 Control of hypnosis




The SEDASYS[®] System is indicated for:

- Administration of 1% (10 mg/mL) propofol emulsion
- Minimal-to-moderate sedation
- ASA Physical Status I and II
- Patients undergoing esophagogastroduodenoscopy (EGD) procedures
- Patients 18 years of age or older

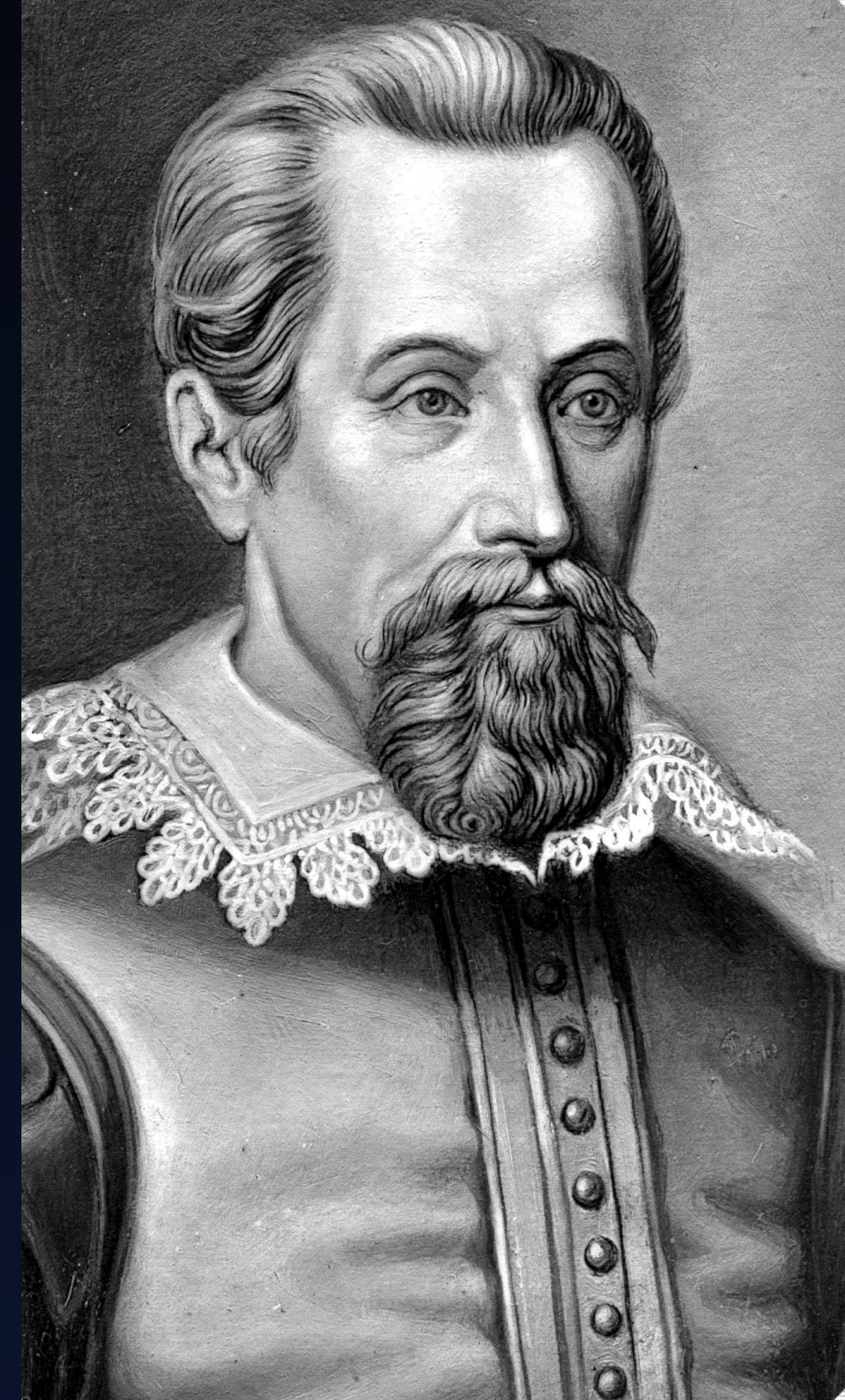
Review > Curr Opin Anaesthesiol. 2019 Aug;32(4):480-487.
doi: 10.1097/ACO.0000000000000761.

The rise, fall, and future direction of computer-assisted personalized sedation



- 
- GOAL directed fluid therapy
 - Vasopresory
 - Katecholaminy
 - Vasodilatancia
 - Protektivní ventilace

Keppler

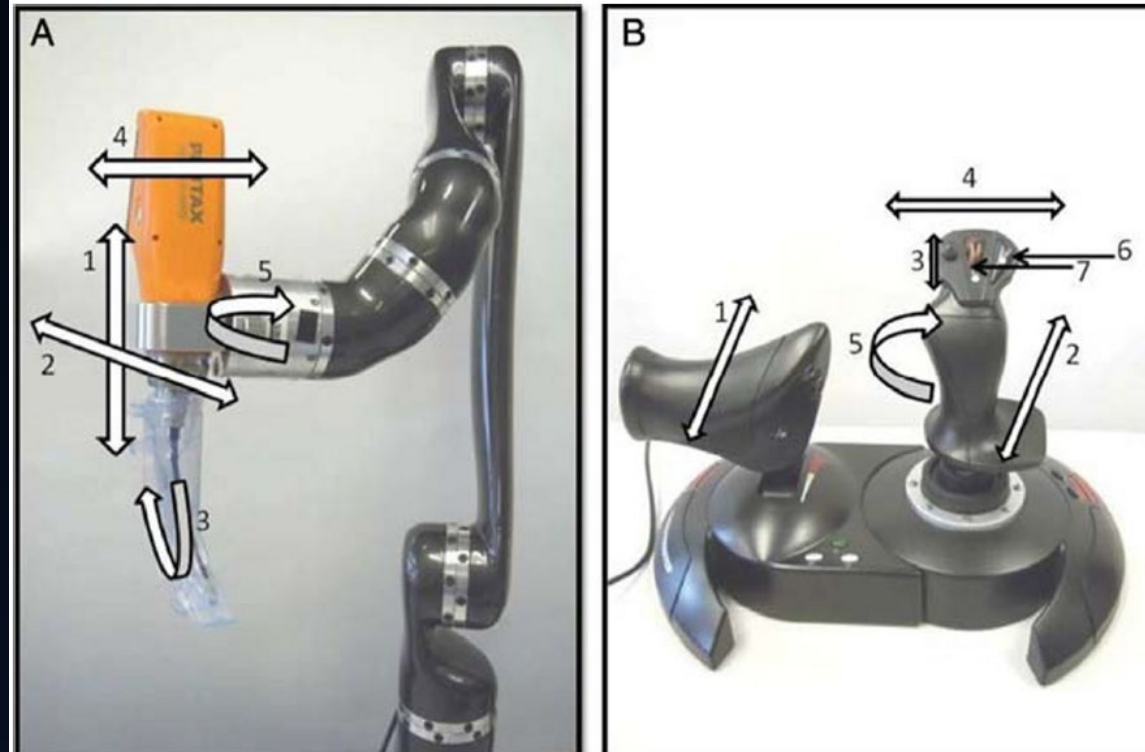
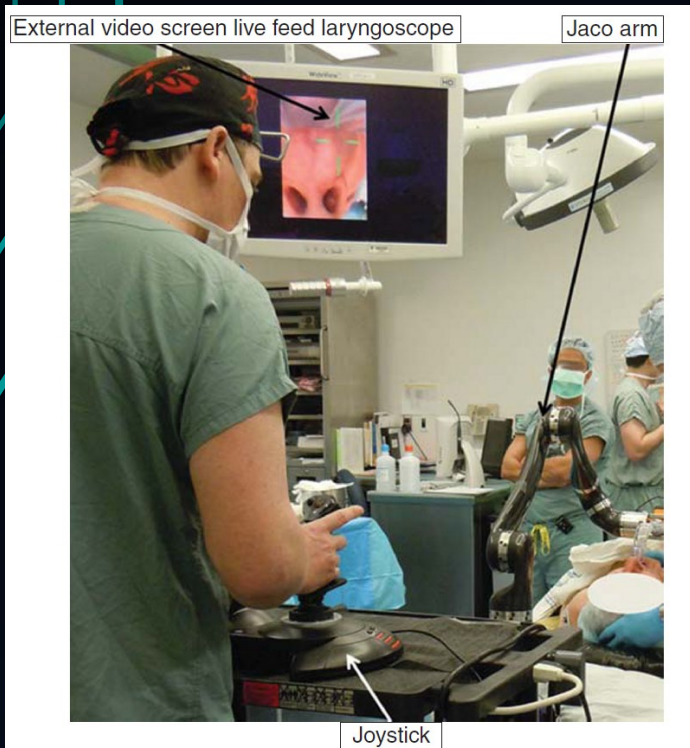


RESPIRATION AND THE AIRWAY

First robotic tracheal intubations in humans using the Kepler intubation system

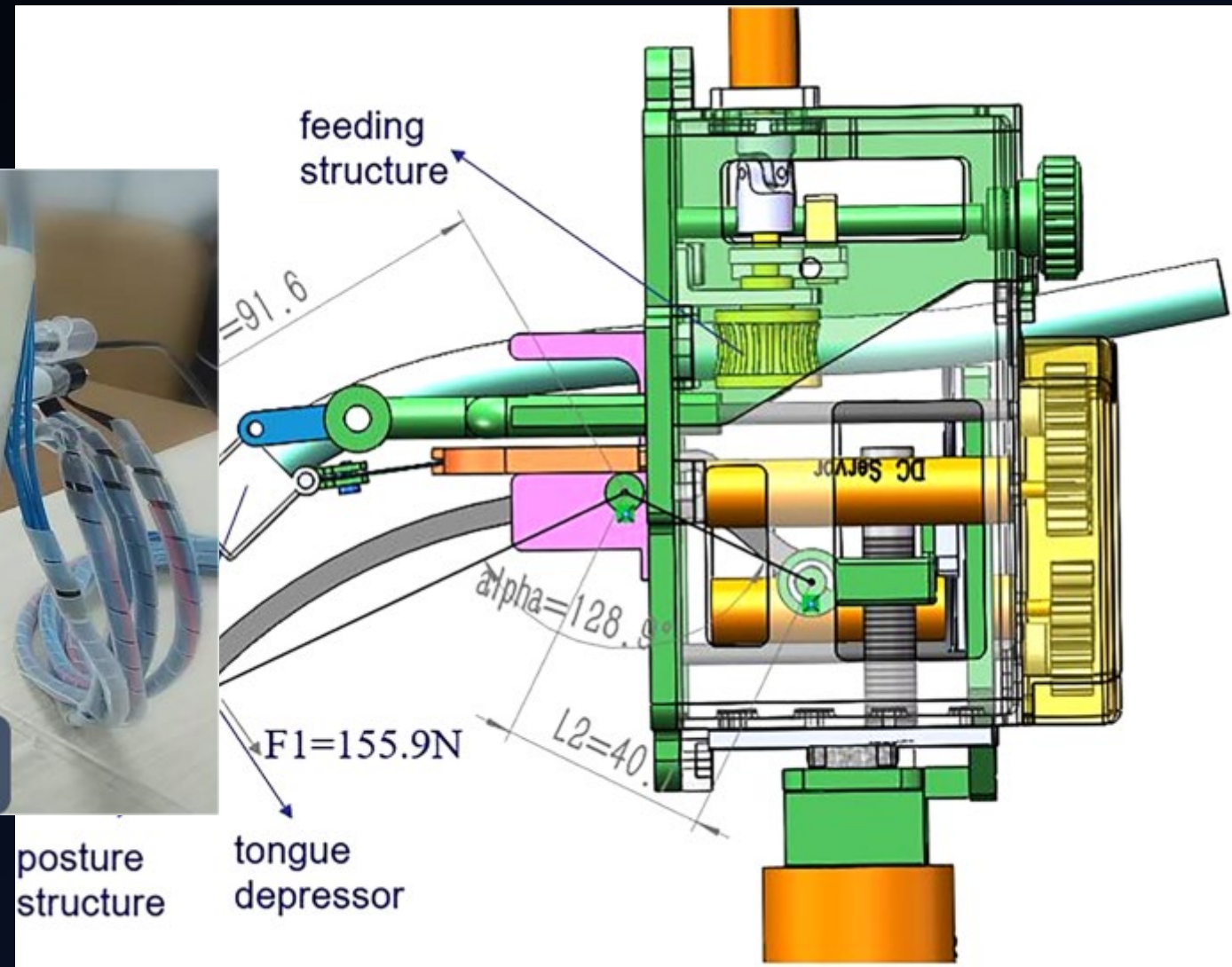
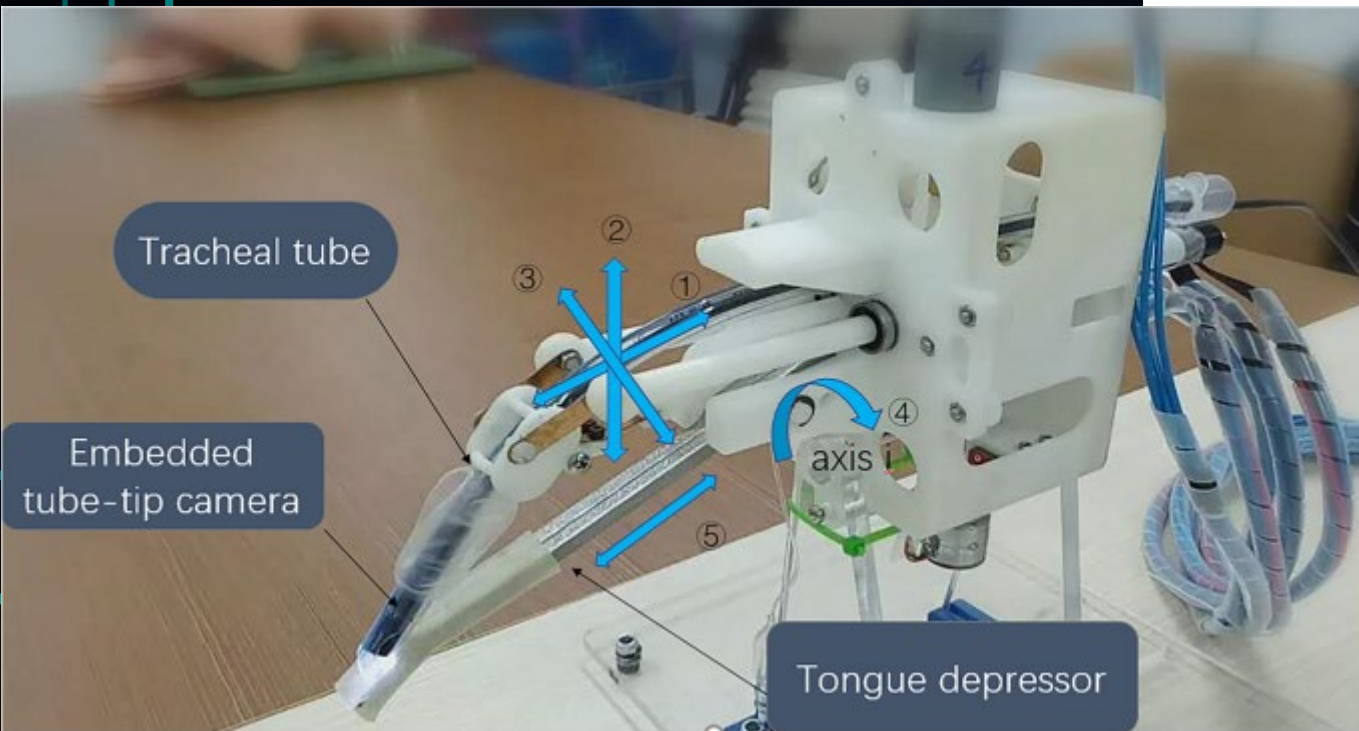
Editor's key points

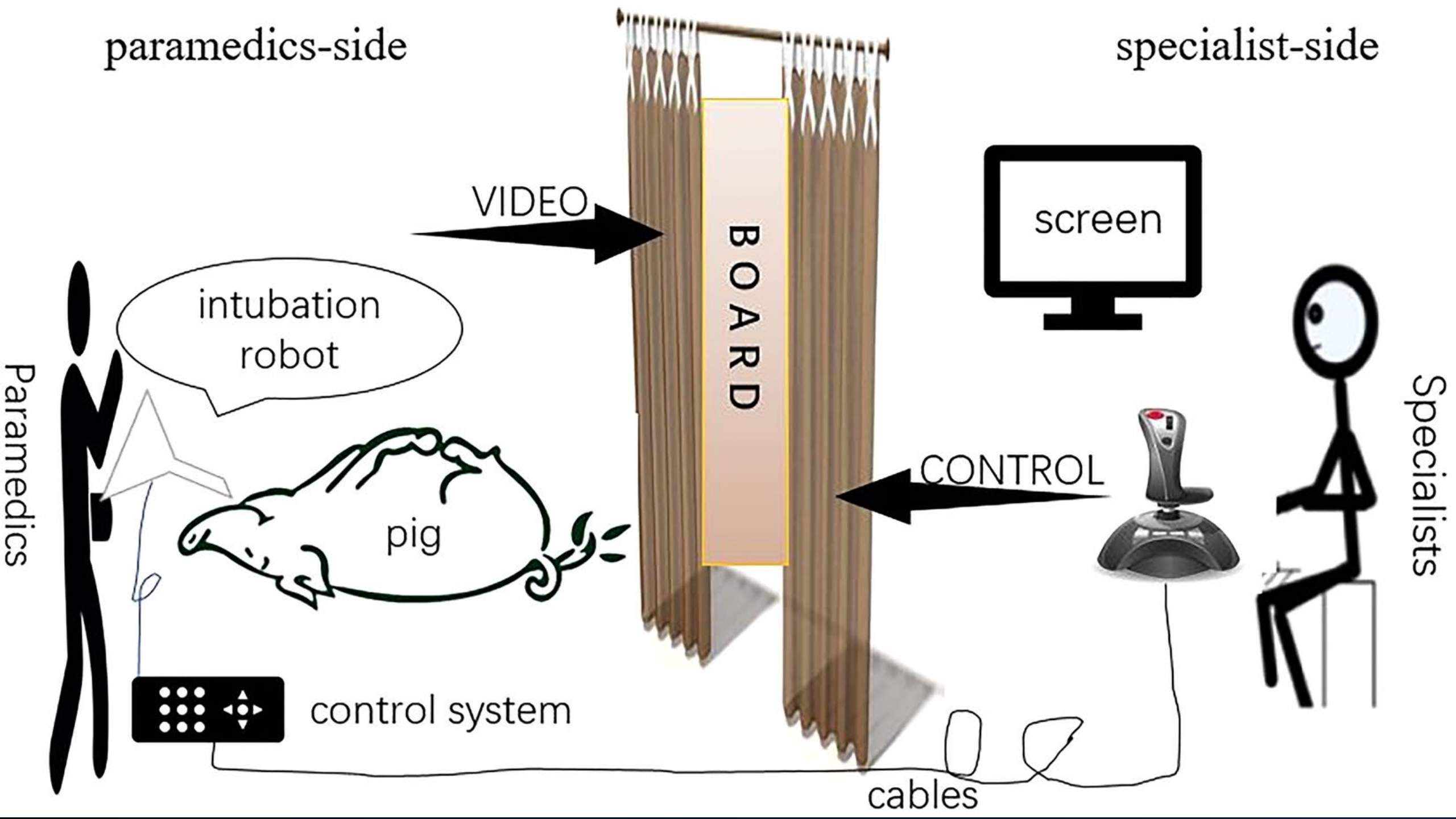
- The authors have developed a robotic system for tracheal intubation.
- This study is the first report of the use of this system in patients.
- This study shows that the system was successful in intubating 11 out of 12 patients.
- Further studies will be required to assess the safety, performance, and clinical usefulness of this system.



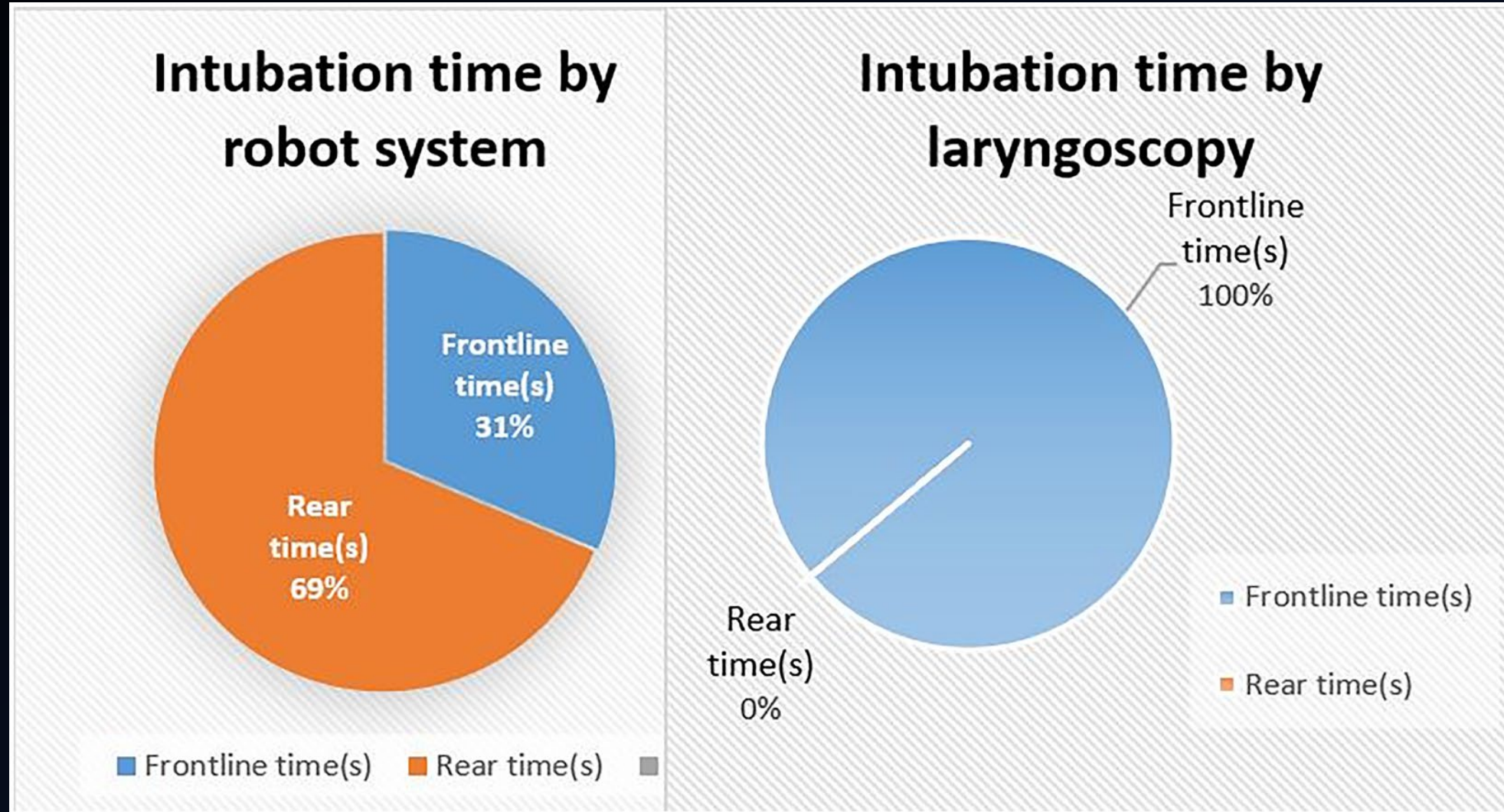
RRAISE

Remote Robot- Assisted Intubation System





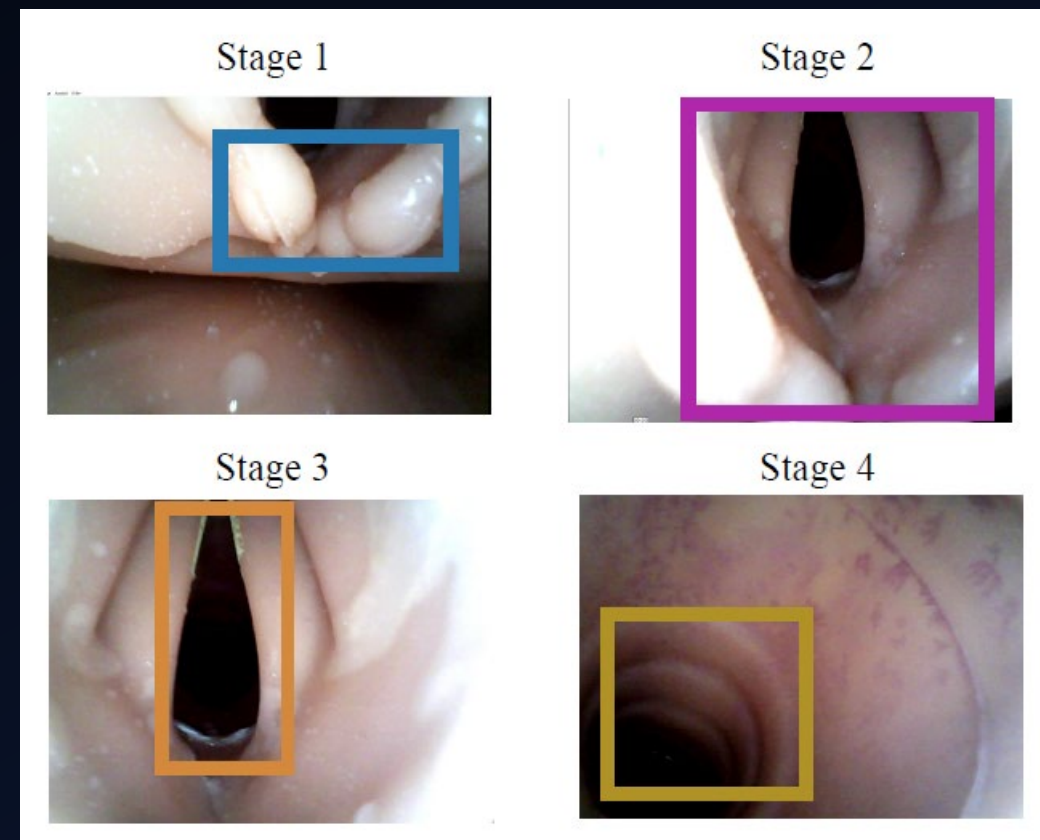
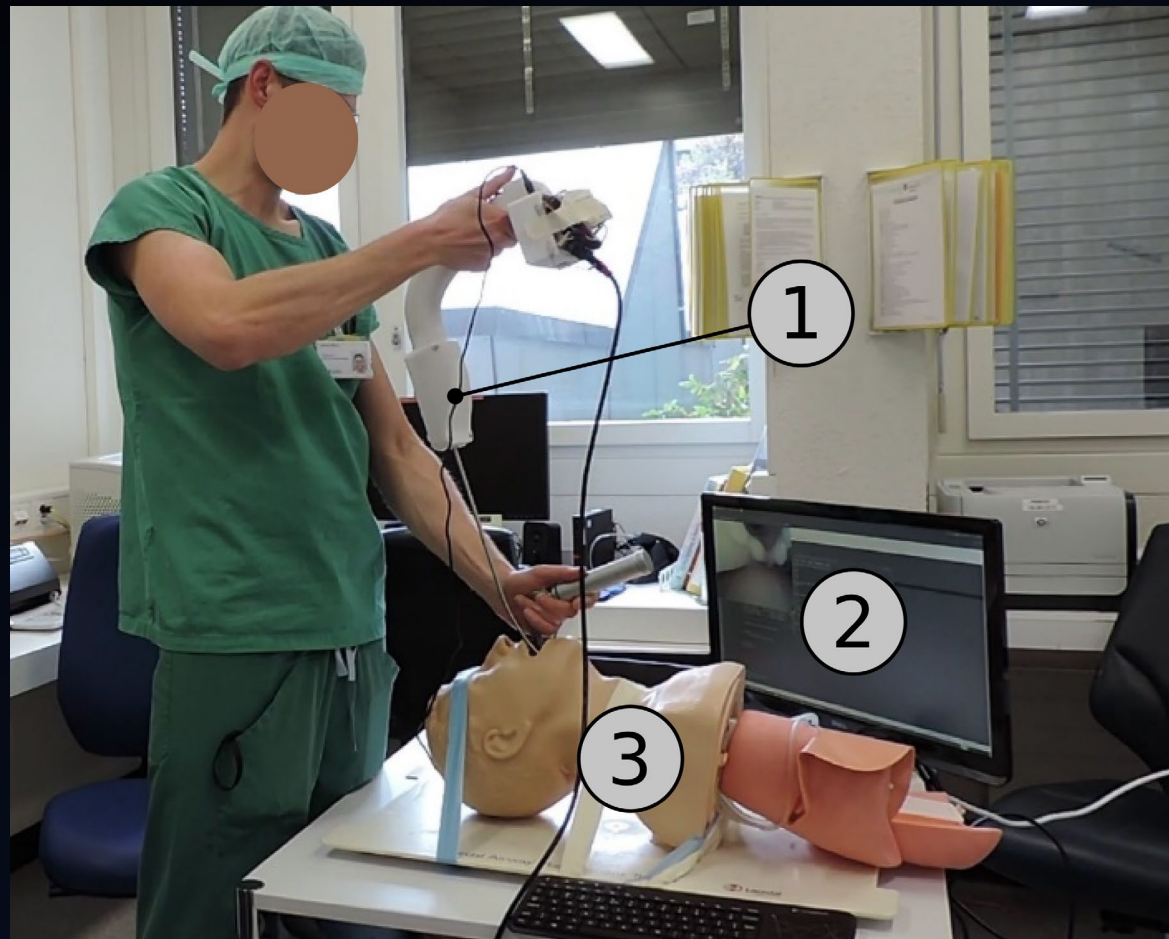
An original design of remote robot-assisted intubation system



REALITI: a Robotic Endoscope Automated via Laryngeal Imaging for Tracheal Intubation

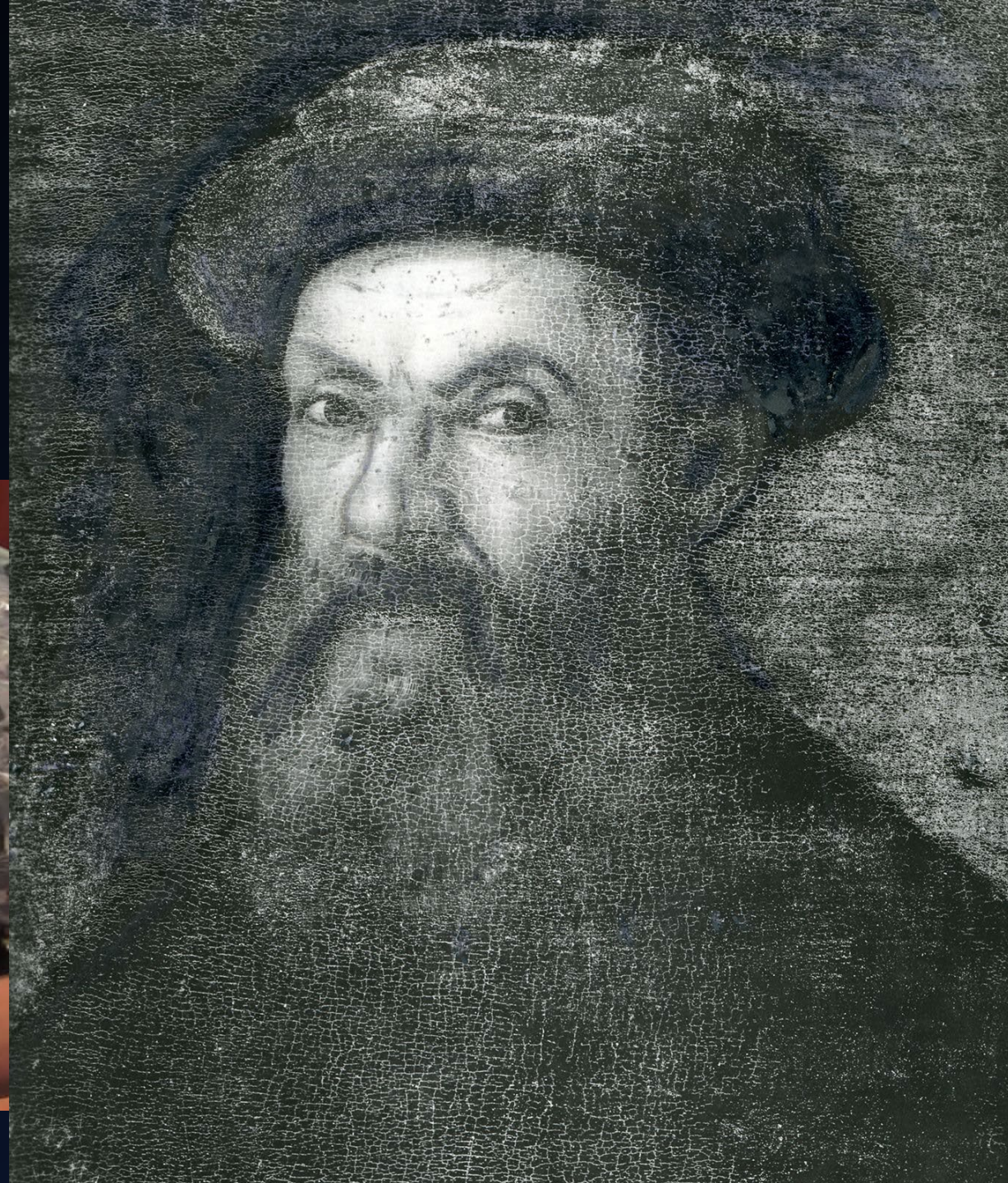
Quentin Boehler, David S. Gage, Phyllis Hofmann, Alexandra Gehring, Christophe Chautems, Donat R. Spahn, Peter Biro, and Bradley J. Nelson

Article in IEEE Transactions on Medical Robotics and Bionics · January 2020





Magellan



Anesth Analg. 2010 September ; 111(3): 813–816. doi:10.1213/ANE.0b013e3181e66386.

Robot-Assisted Regional Anesthesia: A Simulated Demonstration

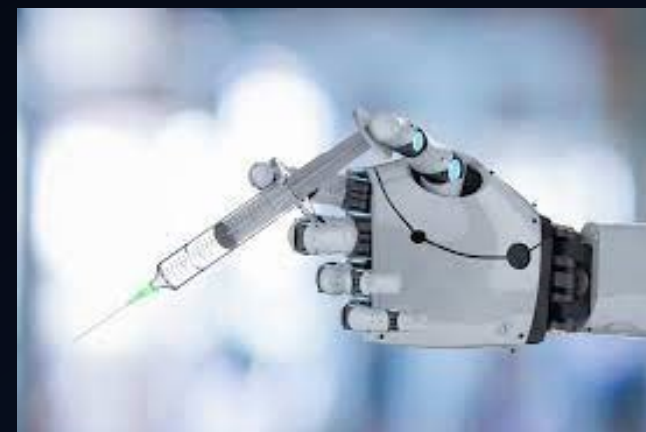
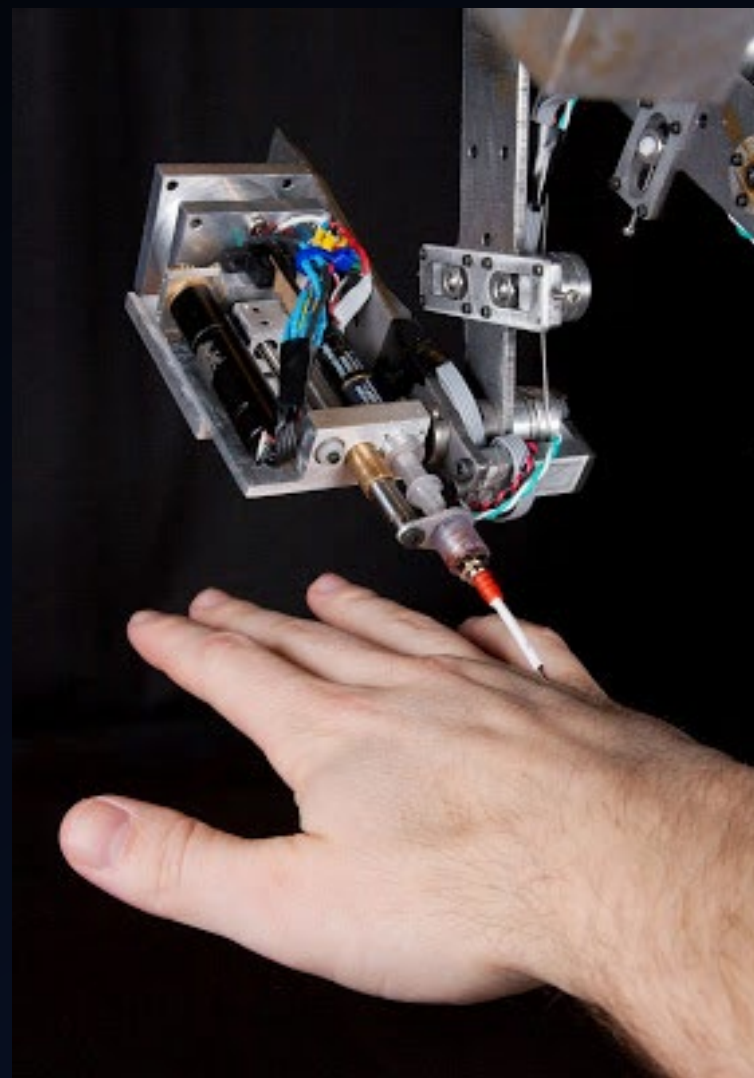
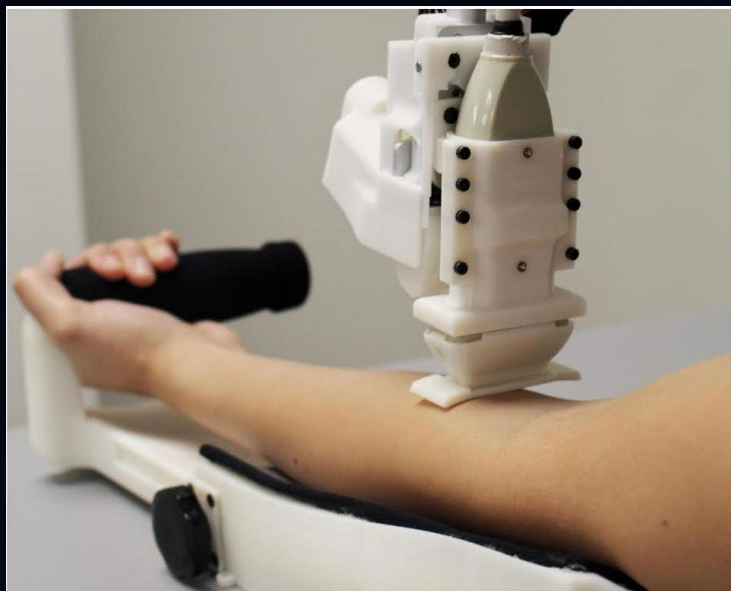
Anaesthesia 2021, 76 (Suppl. 1), 171-181

doi:10.1111/anae.15274

Review Article

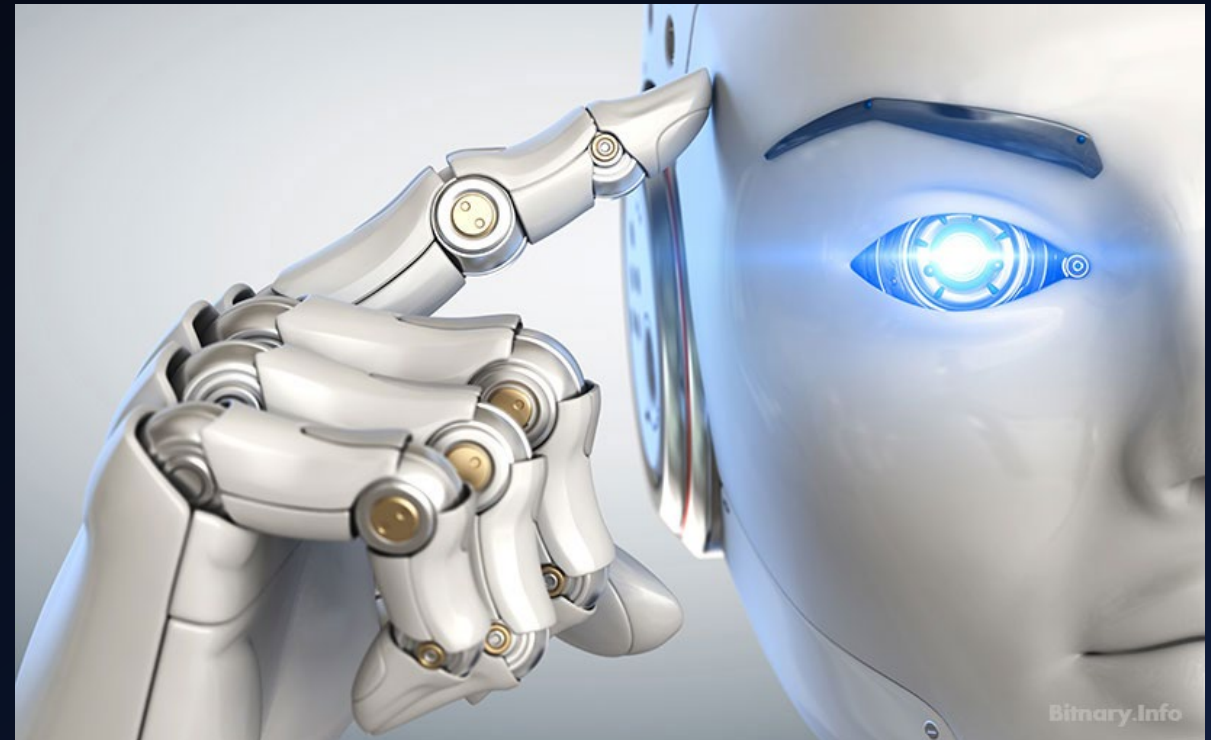
The use of artificial intelligence and robotics in regional anaesthesia

HaemoBot



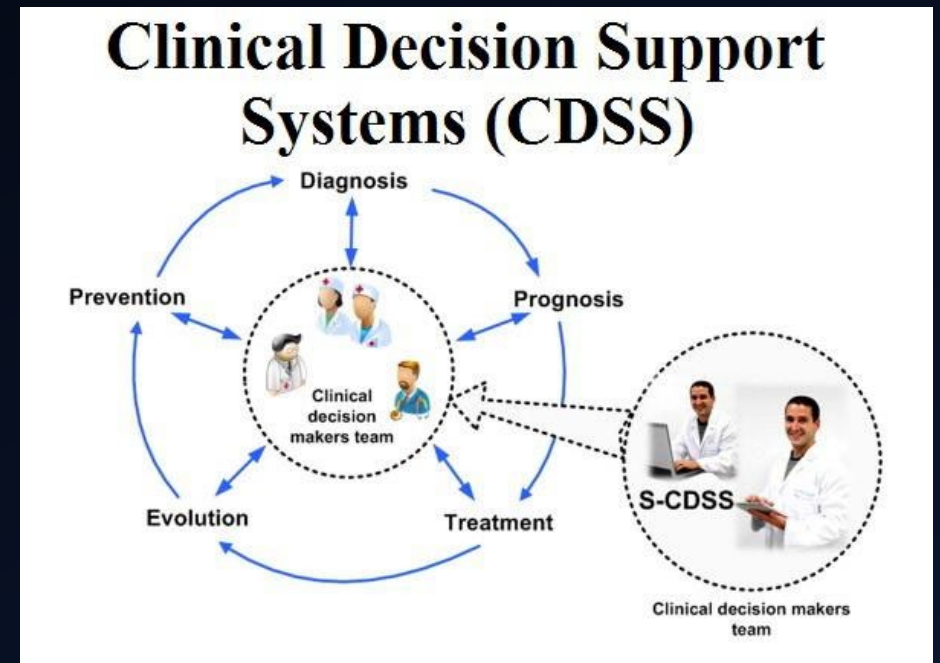
Clinical decision systems (CDS)

- Rule based expert systems
- Machine learning systems



- Časná detekce abnormálních hodnot
- Kontrola podané medikace
- Checklist

- ATB profylaxe, antiemetika
- Efektivita anestézie
- Účtování



- Roboti v A mají
 - posilovat anesteziologa technologicky, mentálně a fyzicky
 - umožnit chytré rozložení pracovní zátěže
- Cíl automatizace není nahradit, ale pomoci
- Kvalita, efektivita, bezpečnost

Technology, Computing, and Simulation

■ NARRATIVE REVIEW ARTICLE

Autonomous Systems in Anesthesia: Where Do We Stand in 2020? A Narrative Review

Cédric Zaouter, MSc, MD,* Alexandre Joosten, MD, PhD,† Joseph Rinehart, MD,‡
Michel M. R. F. Struys, MD, PhD, FRCA,§|| and Thomas M. Hemmerling, MSc, MD, DEAA¶

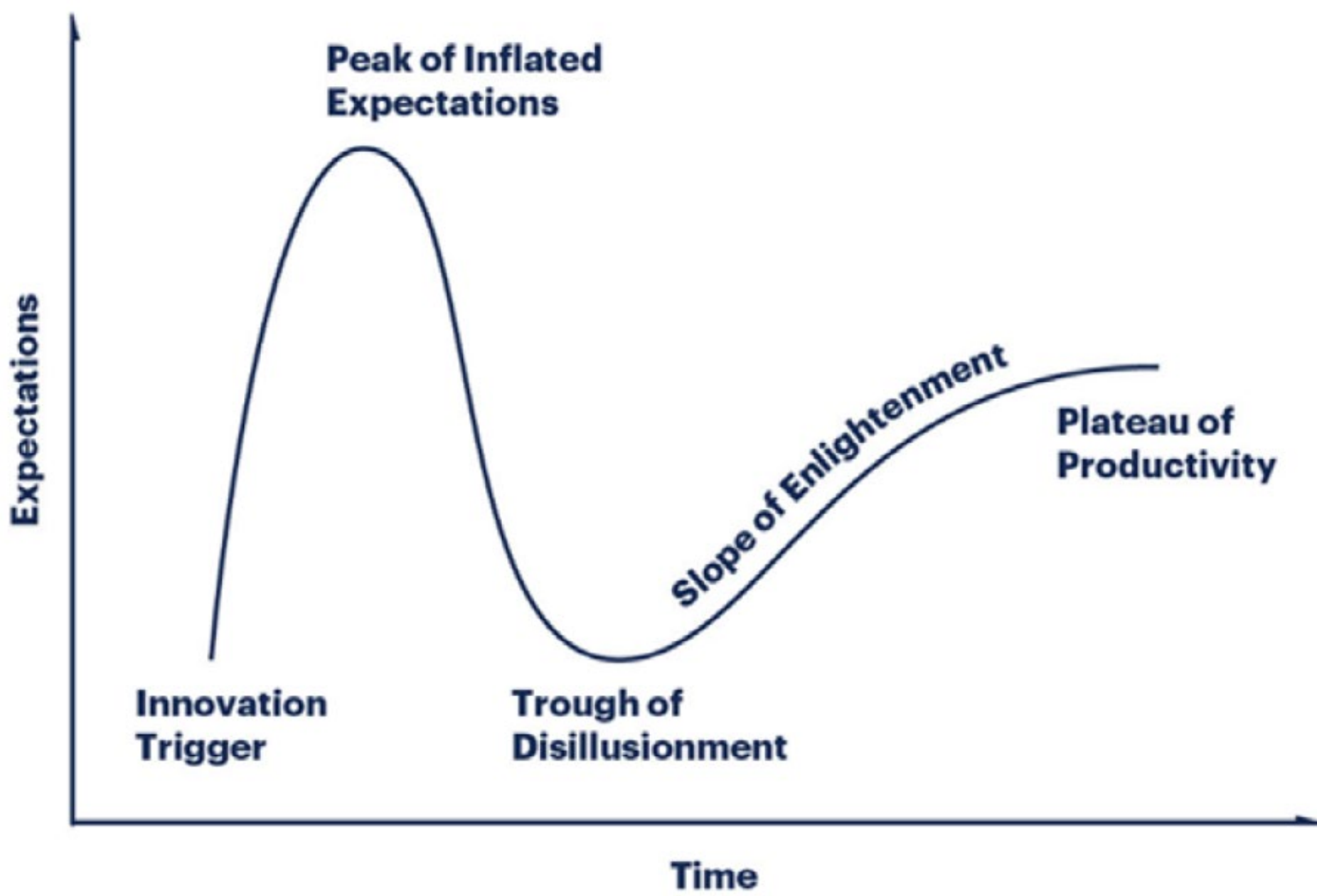
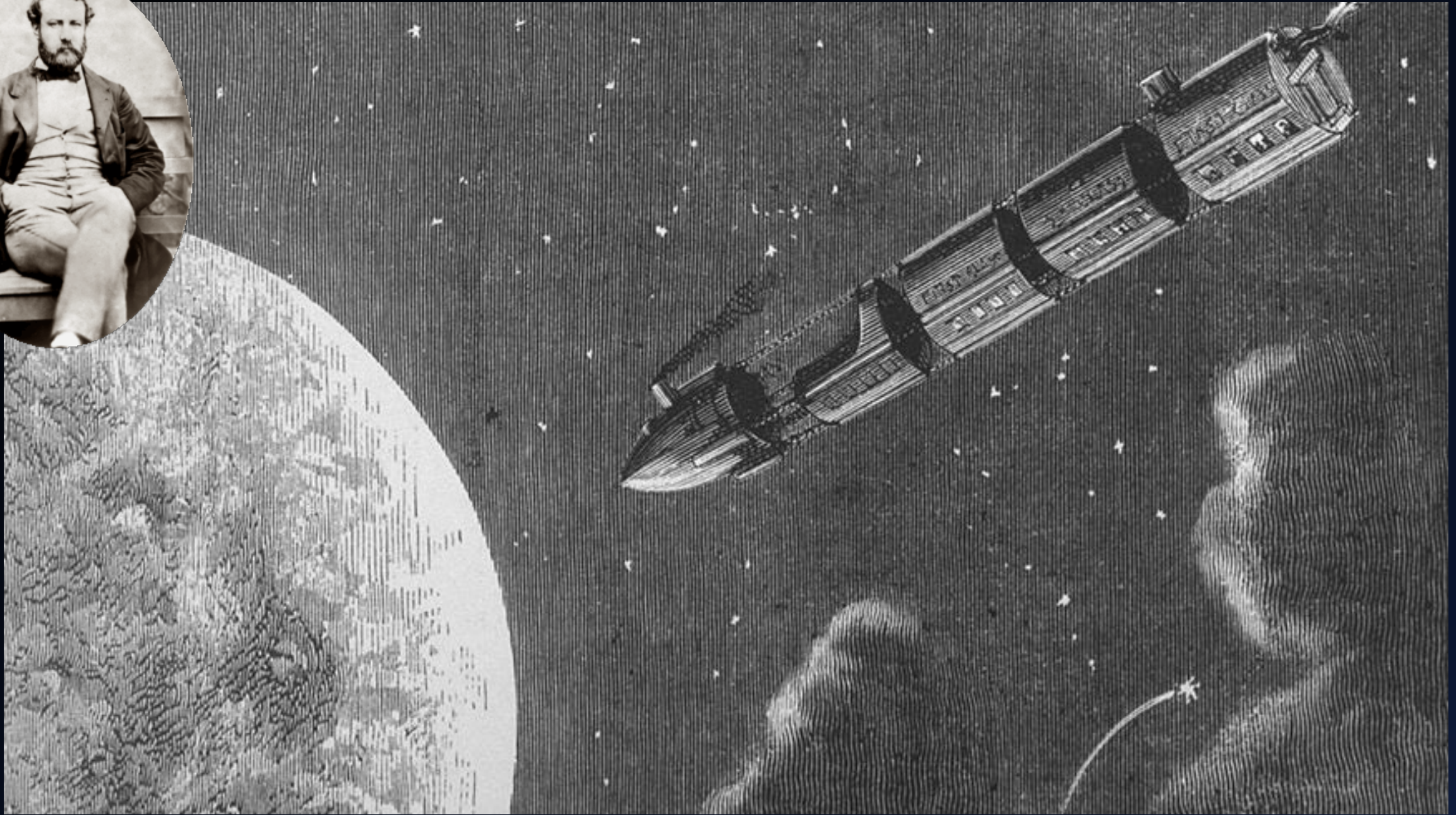


Figure. The Gartner Hype Cycle, a graphical representation of the maturity and adoption of technologies and applications.



BOJUJ ZA MÍR, PLŇ A PŘEKRAČUJ PLÁN

1971
Karel VLADIMÍR
1971

Mírný socialistický plán
Začínáme se vcelkem dobrou
časem na masbuřadách s. s. z.
ocelárna z. s. normovými doty
7.25 na 6.20 Kčs. 7.7. o 19.7.16.
Zhoršila tu
Konečně
vínem

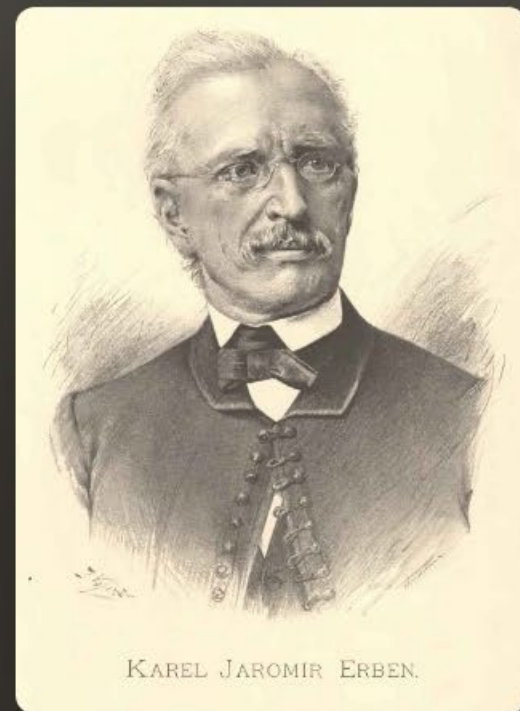
1971
pro Zeman
A. Dostál

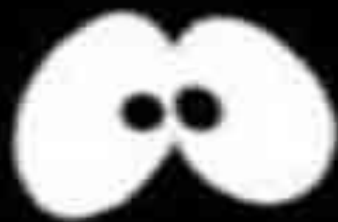




Však lépe v mylné naději
sníti, před sebou čirou
temnotu, nežli budoucnost
odhaliti, strašlivou poznati
jistotu!

Karel Jaromír Erben
český spisovatel





0. Robot nesmí ublížit lidstvu nebo svou nečinností dopustit, aby mu bylo ublíženo.

1. Robot nesmí ublížit člověku nebo svou nečinností dopustit, aby bylo člověku ublíženo.

2. Robot musí uposlechnout příkazů člověka, kromě případů, kdy jsou tyto příkazy v rozporu s prvním zákonem.

3. Robot musí chránit sám sebe před poškozením, kromě případů, kdy je tato ochrana v rozporu s prvním, nebo druhým zákonem.



UNIVARO

75

let
1948
2023

