Role of AI in Colorectal Surgery

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Conflict of interests: None

Topics to be covered

1. AI in surgical education and training of IBD surgeons (APMs)
2. AI in surgical research (LLMs)
3. AI in surgical risk prediction and decision support (Modelling surgical intervention)

Examples of ongoing OSRC projects

Article Contents

JOURNAL ARTICLE ACCEPTED MANUSCRIPT

Results of the Ninth Scientific Workshop of the European Crohn's and Colitis Organisation (ECCO): Artificial intelligence in IBD surgery: opportunities and limitations

FREE

Alaa El-Hussuna ✉, Gianluca Pellino, Alessandra Soriano, Kapil Sahnan, Aart Mookhoek, Pieter Sinonque, Mariangela Allocca, Dan Carter, Arzu Ensari, Marietta Iacucci, Uri Kopylov, Bram Verstockt, Daniel C Baumgart, Nurulamin M Noor, Urko M Marigorta, Daniele Noviello, Peter Bossuyt, Jan de Laffolie, Marco Daperno, Tim Raine, Isabelle Cleynen, Shaji Sebastian

Journal of Crohn's and Colitis, jjaf135, https://doi.org/10.1093/ecco-jcc/jjaf135

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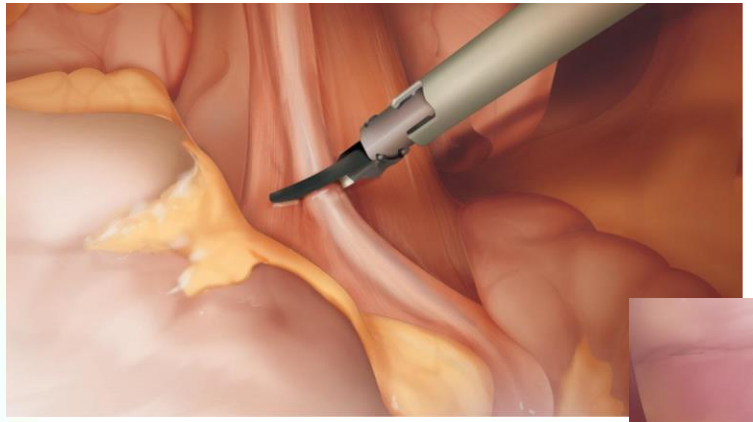
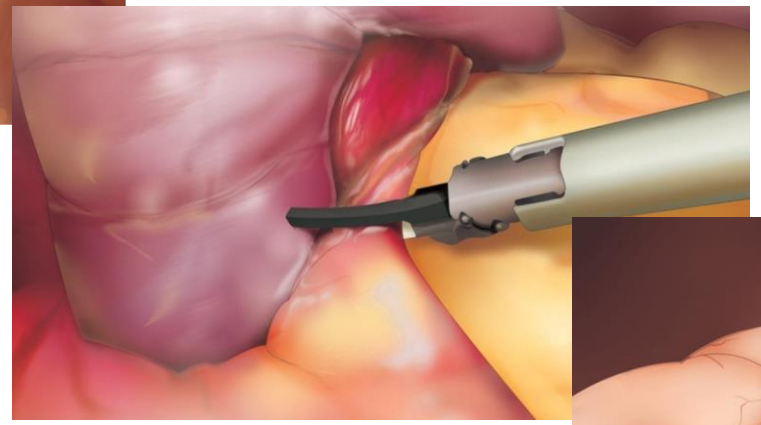
Role of AI in Surgical Training

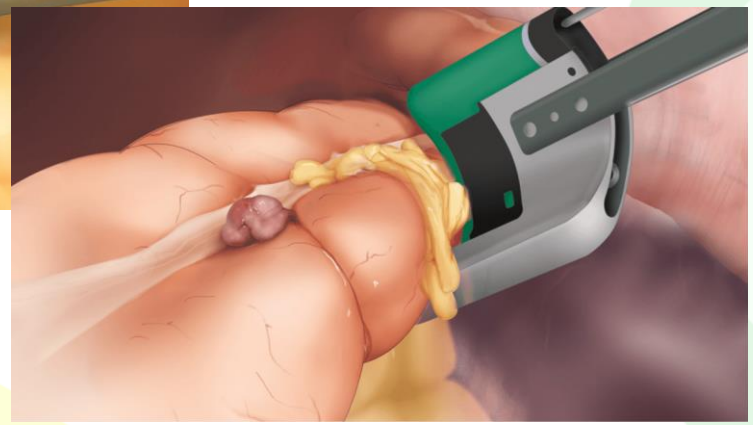
Automated Performance Metrics (APMs)

El-Hussuna et al. Results of the Ninth Scientific Workshop of the European Crohn's and Colitis Organisation (ECCO): Artificial intelligence in IBD surgery: opportunities and limitations. J Crohns Colitis. 2025

Identifying movements in laparoscopic surgery







- ❑ **Time** spent
- ❑ **Direction** of movement
- ❑ **Success** achieving the aim
- ❑ **Results** accomplished
- ❑ **Control of** bleeding
- ❑ **Cutting through** adherences

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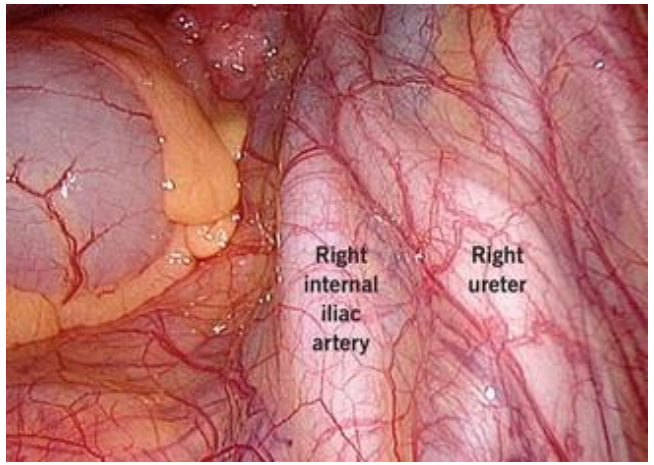
Pre-operative CT scan

3D Reconstruction



Laparoscopic video film

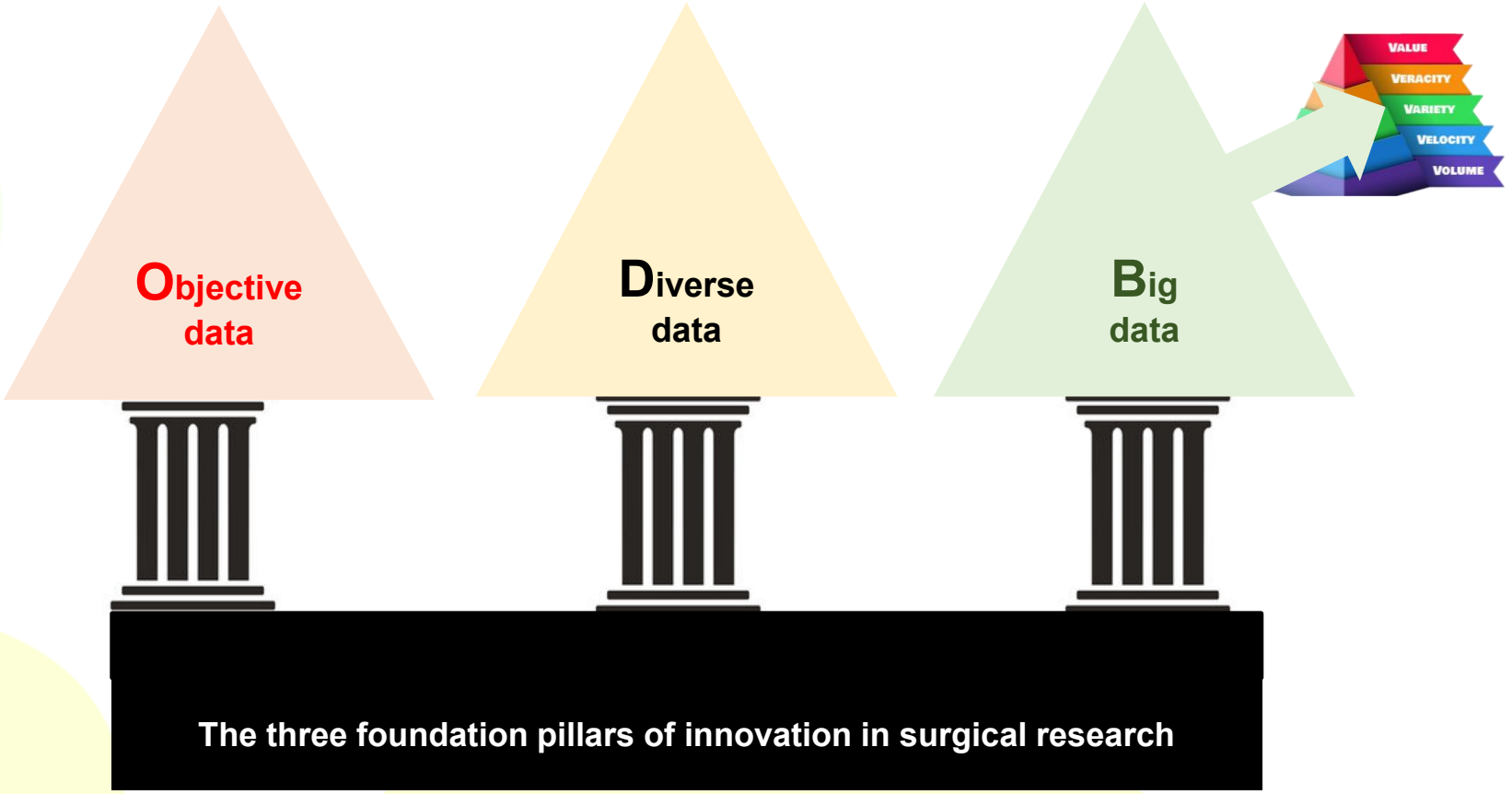
Computer vision

Garrow et al . Machine Learning for Surgical Phase Recognition: A Systematic Review. Annals of Surgery 2021

How APMs and analysis of surgical video films can contribute to surgery?

- ❑Improve **simulation** (Improve training)
- ❑Improve **surgeon's performance** (high volume can be achieved with low real operations)
- ❑Improve testing of **medical devices**
- ❑Develop a new **research tool** (more innovations)

Role of AI in Surgical Research



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World’s most valuable resource is no longer oil, but data?

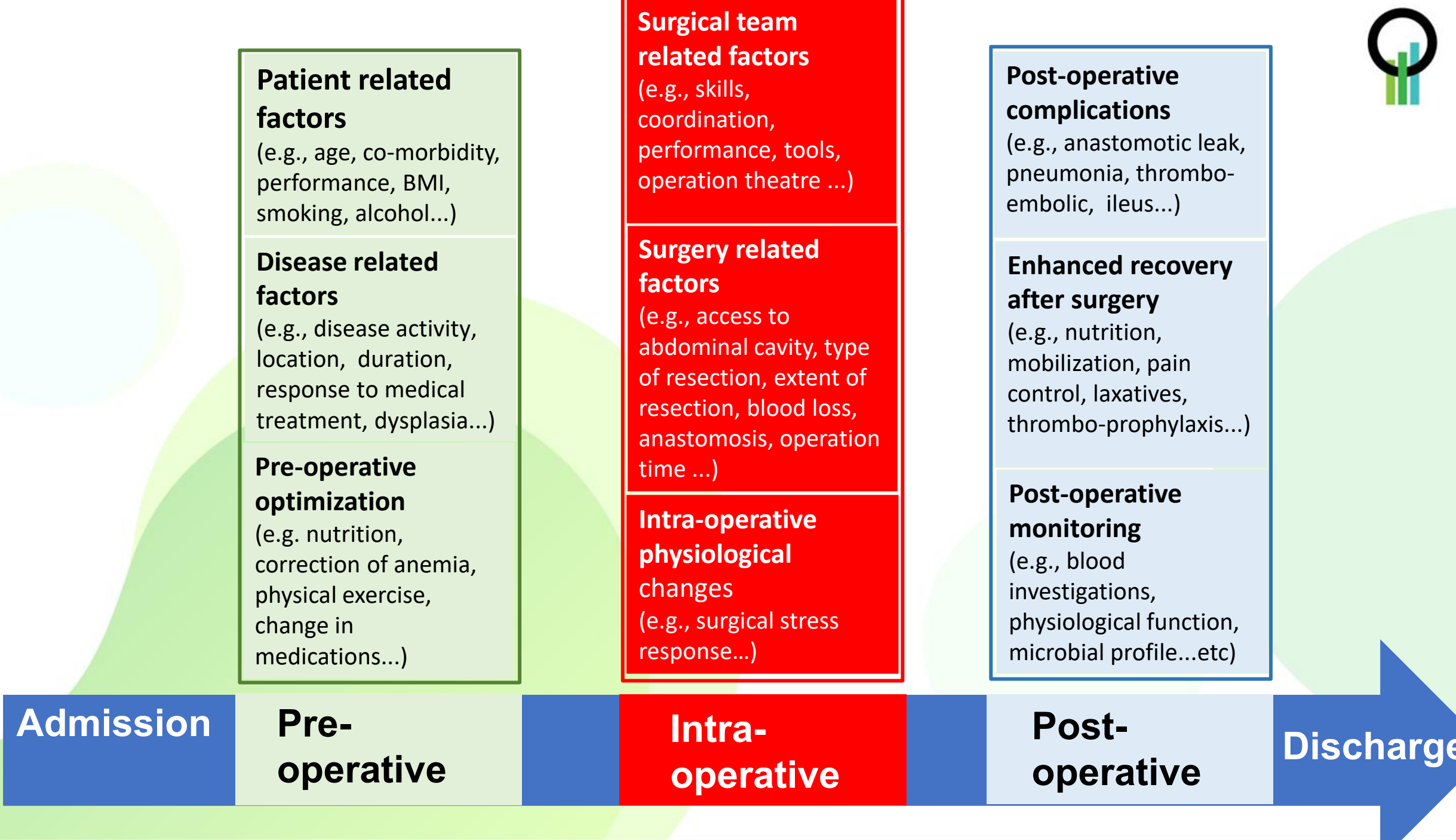
Reference: The Economist May 6th 2017

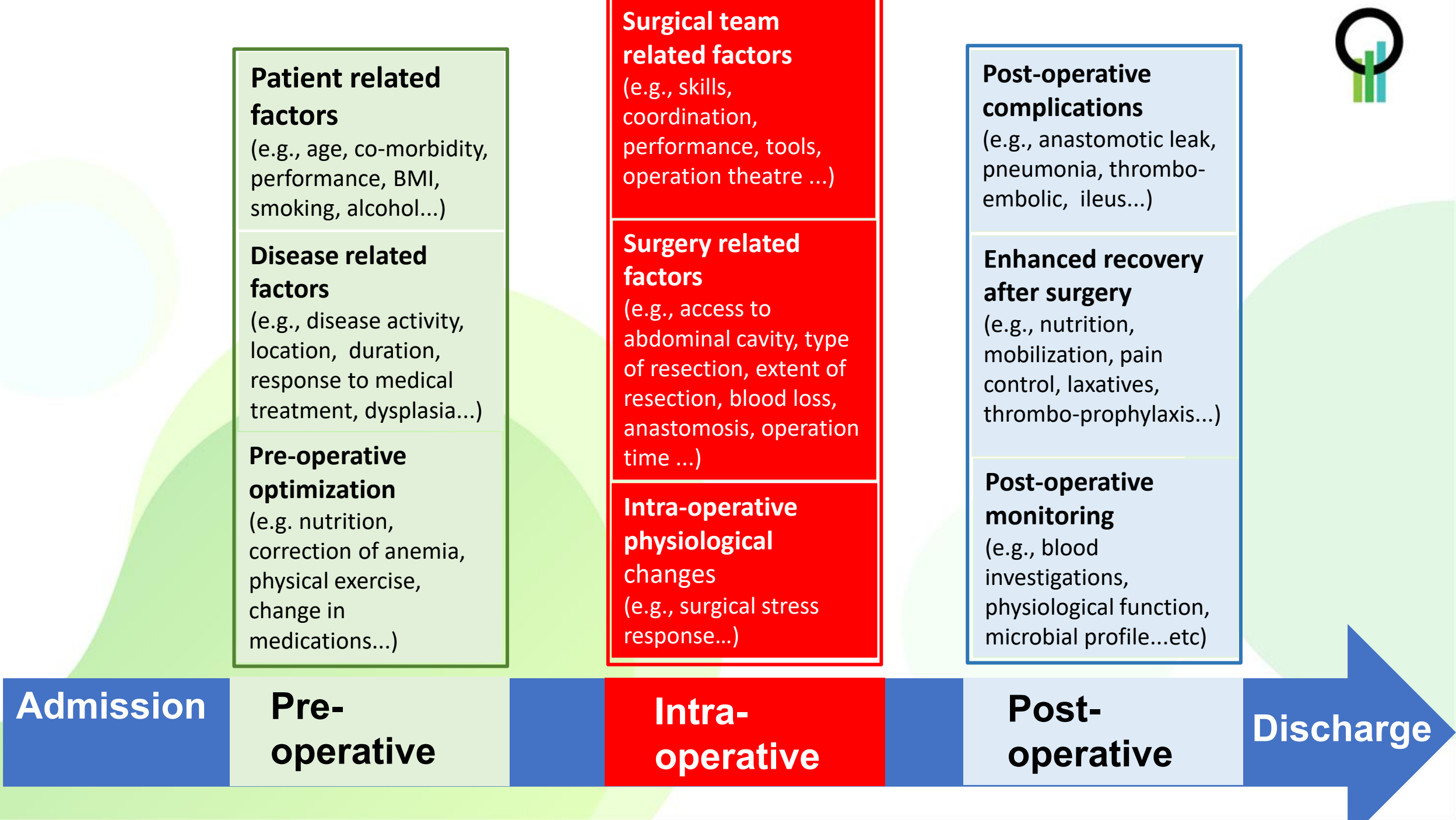
It is a question of developing skills in data management

Medicine will evolve from a clinical science supported by data to a **data science** supported by clinicians

The dawn of digital medicine: The pandemic is ushering in the next trillion-dollar industry
Economist Dec 2nd 2020

Role of AI in Surgical Modelling


Patient related factors
(e.g., age, co-morbidity, performance, BMI, smoking, alcohol...)
Disease related factors
(e.g., disease activity, location, duration, response to medical treatment, dysplasia...)
Pre-operative optimization
(e.g. nutrition, correction of anemia, physical exercise, change in medications...)
Surgical team related factors
(e.g., skills, coordination, performance, tools, operation theatre ...)
Surgery related factors
(e.g., access to abdominal cavity, type of resection, extent of resection, blood loss, anastomosis, operation time ...)
Intra-operative physiological changes
(e.g., surgical stress response...)
Post-operative complications
(e.g., anastomotic leak, pneumonia, thrombo-embolic, ileus...)
Enhanced recovery after surgery
(e.g., nutrition, mobilization, pain control, laxatives, thrombo-prophylaxis...)
Post-operative monitoring
(e.g., blood investigations, physiological function, microbial profile...etc)
Admission
Pre-operative
Intra-operative
Post-operative
Discharge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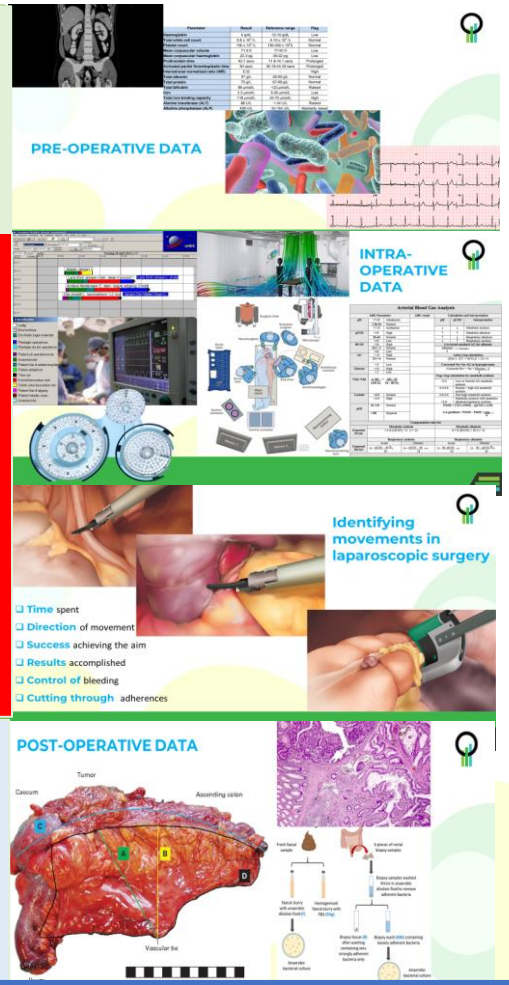
Pre-operative
Intra-operative
Post-operative
Discharge

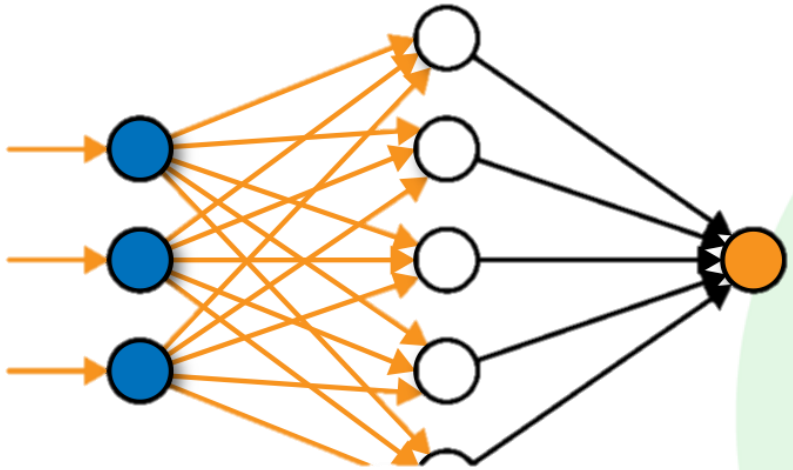
Where the data will come from?

Pre-operative

Intra-operative

Post-operative





EHRs

Objective

Objective
(e.g., blood investigation, microbiological profile...)

Patients' records
(e.g., age, co-morbidity, performance, BMI, smoking, alcohol...)

Objectives
(e.g., video film, OP theatre black box, anesthesia machine reading ...)

Patients' records
(e.g., surgical team names, details of operation, blood loss, operation time ...)

Objectives
(e.g., ECG, blood investigations, monitoring data...)

Patients' records
(e.g., Physicians notes, nurse notes, medications, complications, ERAS, QoL...)

Objectives
Outcome measures
(e.g., LoS, re-admission, cost registeration...etc)

Patients' records
(e.g., recovery, complications, QoL, disease recurrence/relapse, PROMs...)

(X1+X2+X3…Xn) * (Y1+Y2+Y3…Yn) * (Z1+Z2+Z3…Zn) = (T1~~+T2+T3…Tn~~)

(X1+~~X2+~~X3…Xn) * (Y1+Y2+~~Y3~~…Yn) * (Z1+Z2+~~Z3~~…Zn) = (T1+T2+T3…Tn)

(X1+X2+X3…Xn) * (Y1+Y2+Y3…Yn) * (Z1+Z2+Z3…Zn) = (T1+T2+T3…Tn)

(X1+X2+X3…Xn) * (Y1+Y2+Y3…Yn) * (Z1+Z2+Z3…Zn) = (T new)

Pre-operative factors | **Intra-operative factors** | **Post-operative factors** | **Outcomes**

Philosophy of marginal gains

"If you broke down everything that could impact on a cycling performance

and then

you improved every little thing by **1%**,

when you clump it all together,

you're going to get quite a **significant increase** in performance"

Dave Brailsford
British cycling coach and performance director

Courtesy of *Richard* Hooper

So, what if we build the model, what difference can the model make?

If we can build a model, surgical research will have a giant leap (precision)

So, what if we build the model, what difference can the model make?

We can tweak the model to achieve best performance

So, what if we build the model, what difference can the model make?

We can create and validate new outcomes

OpenSourceResearch

Implementing information technologies
in medical research

How OSRC works?

- **Identify** challenges in traditional research
- **Seek** solutions based on information technologies
- **Implement** information technologies in medical research

Examples of OSRC projects

Segmentation of blood vessels in CT scans

Analysis of surgical video films to extarct APMs

LLMs to facilitate clincal decision making

Modelling surgical intervention using big data

Reference:
OpenSourceResearch Collaboration website: www.osrc.network

Take-Home Messages

- AI improves surgical training
- AI improves understanding of human anatomy
- AI helps in surgical research and innovation

More about innovation in Surgery?

Website: https://osrc.network
Email: contact@osrc.netwrork
LinkedIn: https://www.linkedin.com/company/osrc
X: https://twitter.com/opsore