The Smart Operating Room

Leveraging AI to
Improve Clinical Workflows

40th Annual FPC Seminar + Expo

Speaker intro

Alexandra-Laura Andrei

RA, NCARB, EDAC, Lean Practitioner

Florida / D.C.

Sr. Architect

Pediatric and Women's Health Practice

CANNONDESIGN

Outline

Setting the (OR) Stage: The History of Operating Rooms

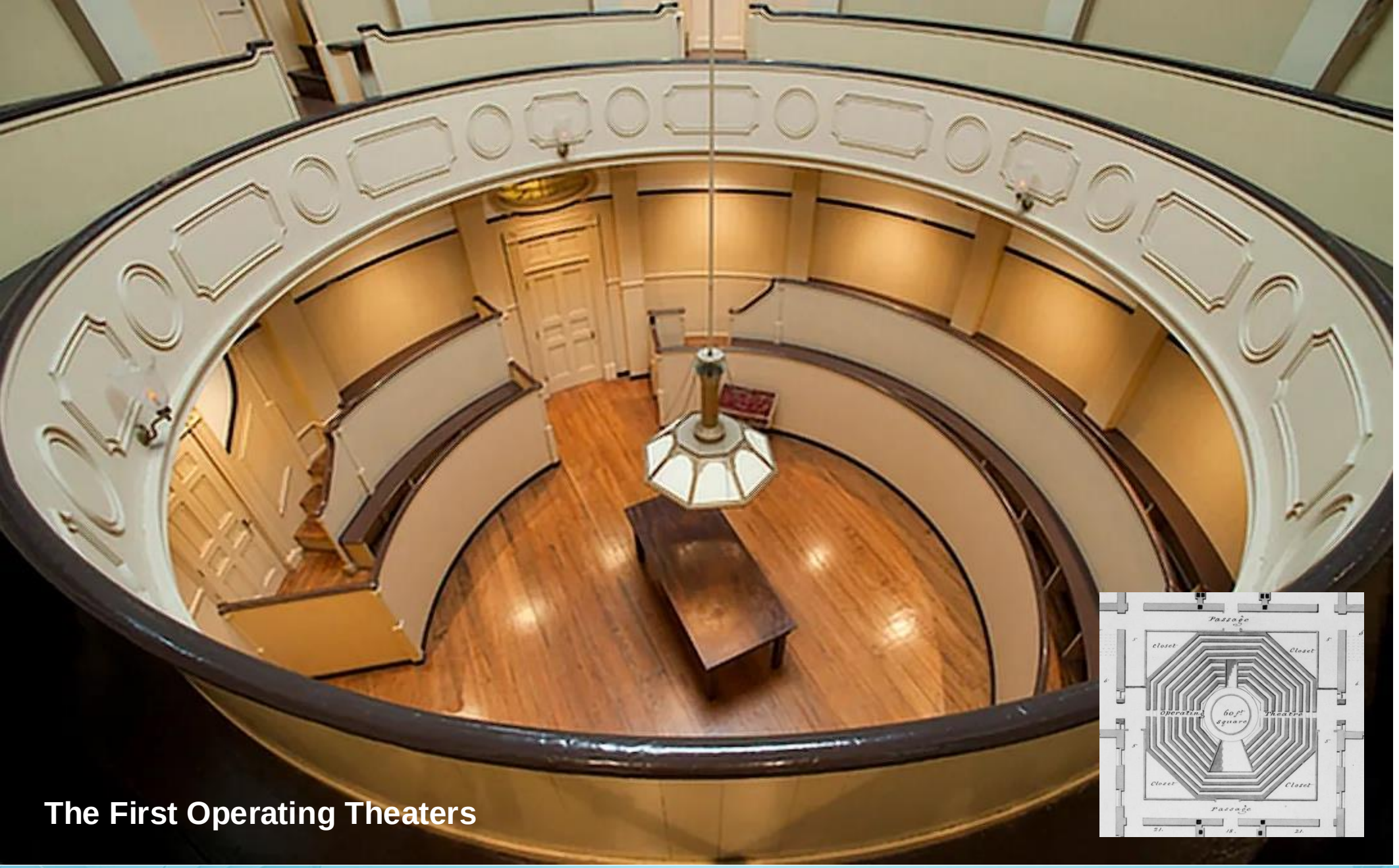
Today's Landscape: Opportunities Ripe for Change

Tomorrow's Potential: AI's Role in the O.R. of the Future

Setting the (OR) Stage

A Brief History of Operating Rooms by the Numbers

273
years ago

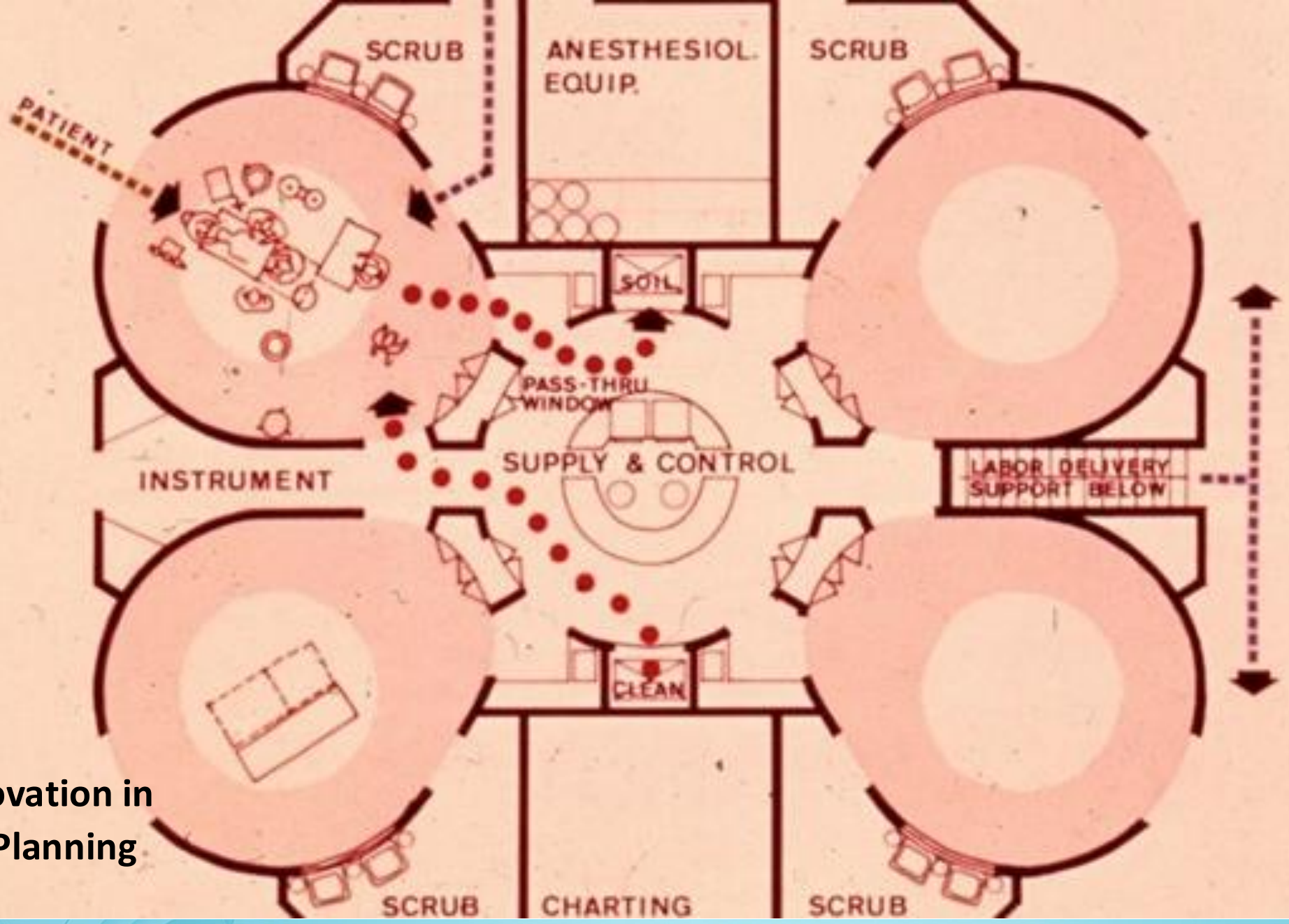


The First Operating Theaters

178
years ago

First Aseptic Operating Room

140
years ago



Innovation in OR Planning

58 years ago

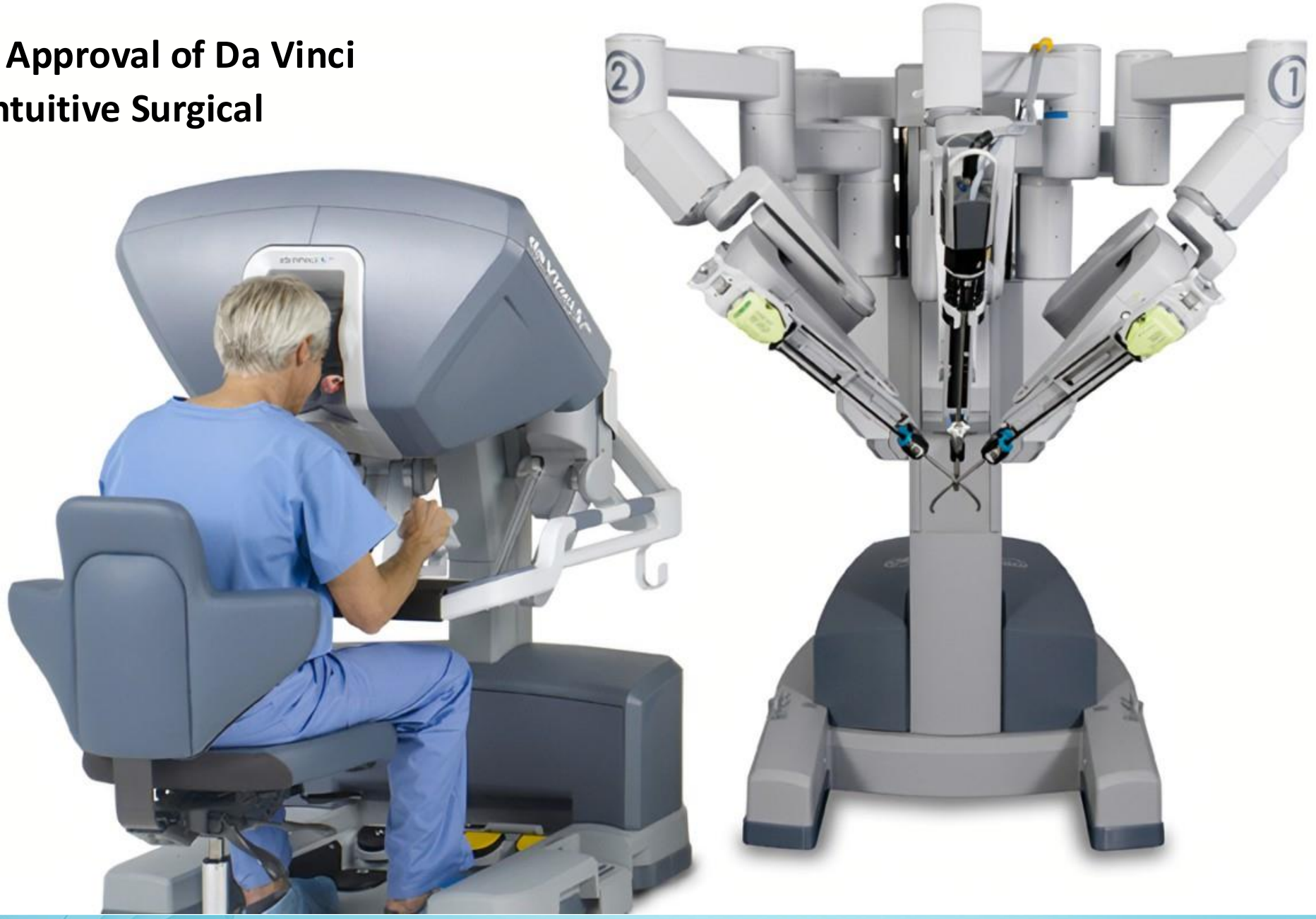
54
years ago

Hybrid IR

First Robotic Surgery

39
years ago

FDA Approval of Da Vinci by Intuitive Surgical



24 years ago

First Robotically
Assisted Telesurgery

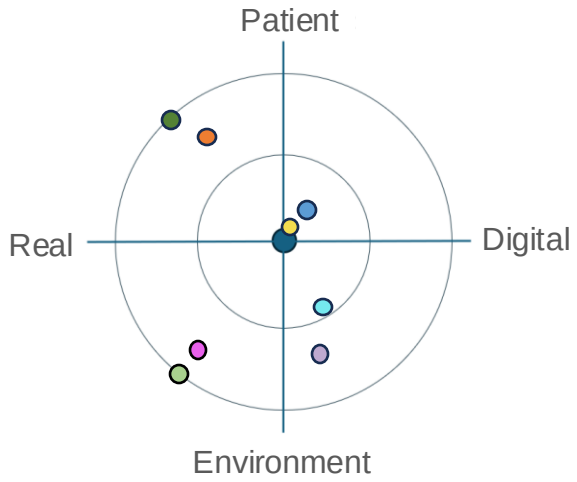
23
years ago

0
TODAY

Today’s Landscape

Opportunities
Ripe for Change

Patient Journey



Patient impact

Staff Management

Patient modellig

Surgical Decision making

Data Analytics

Diagnostics | Interdisciplinary Board | Admission | Preparation | Surgery | Recovery | Rehabilitation

Spatial Ressource Management

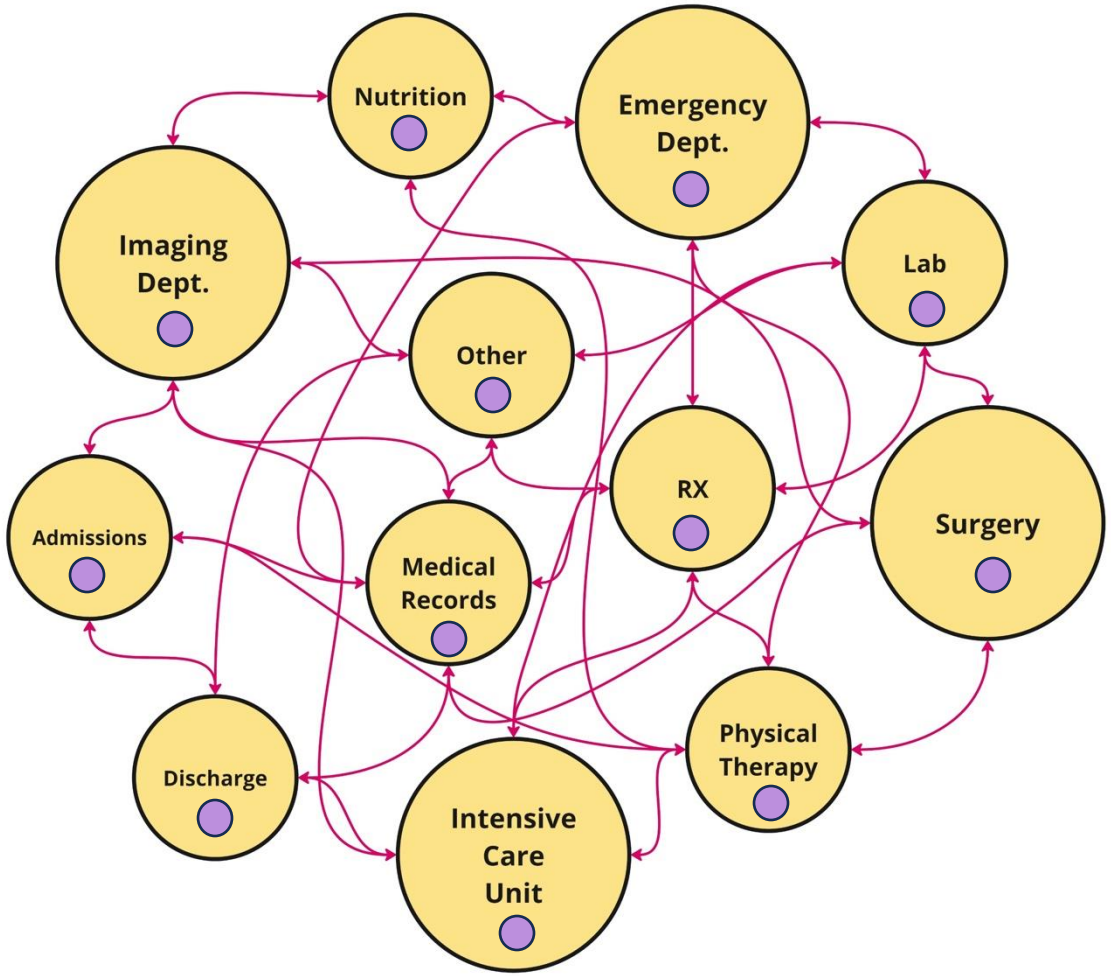
Supply Management

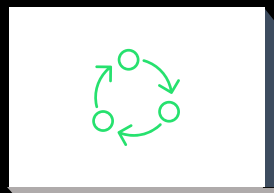
Sustainability Control

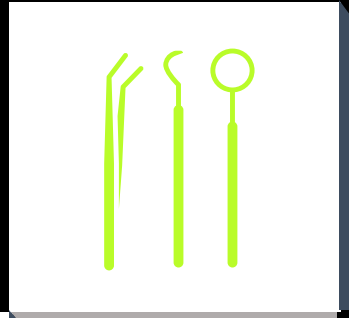
Device Management

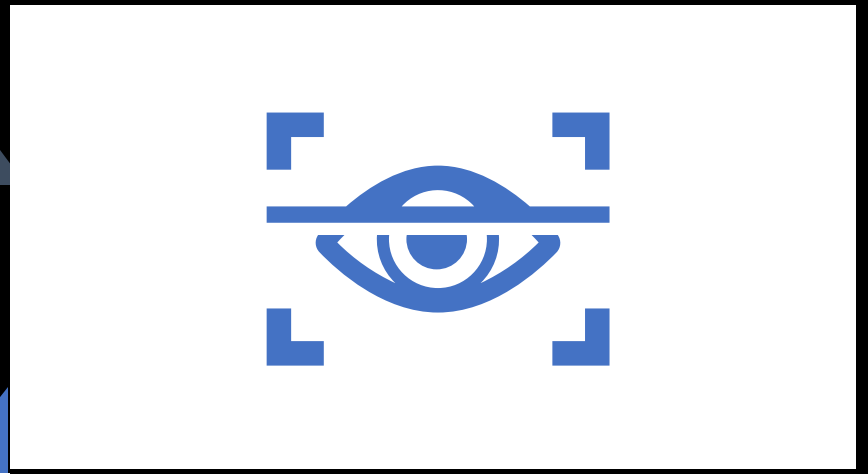
Today's communication challenges

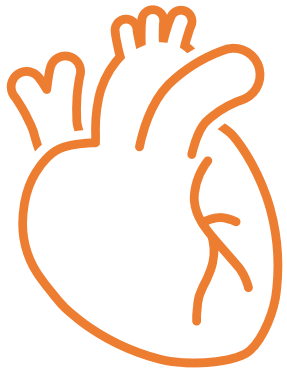
- Information silos
- One-way communications
- Communication with no traditional workforces
- Handoff communication
- Antiquated technology
- Medication error reporting
- Medication control
- Communication with family/home
- Technology integration
- Cultural language barriers
- Shift change

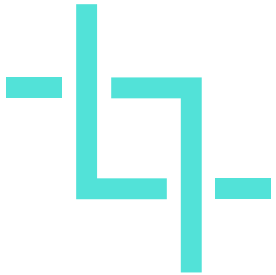


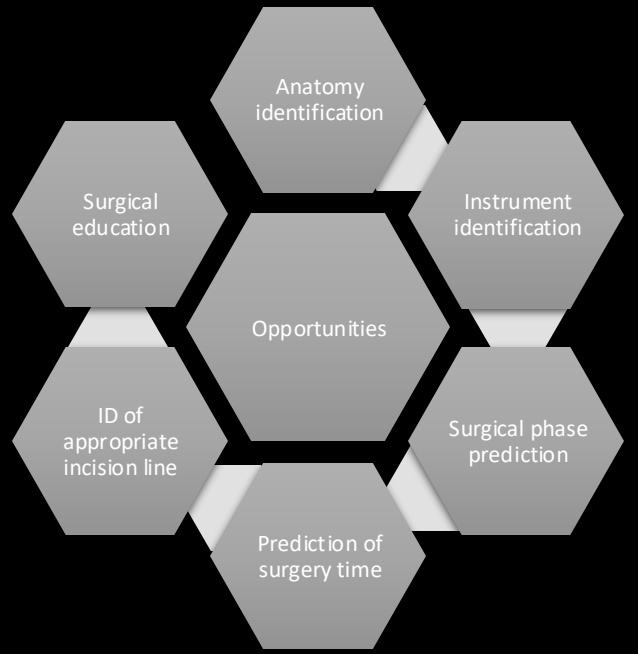






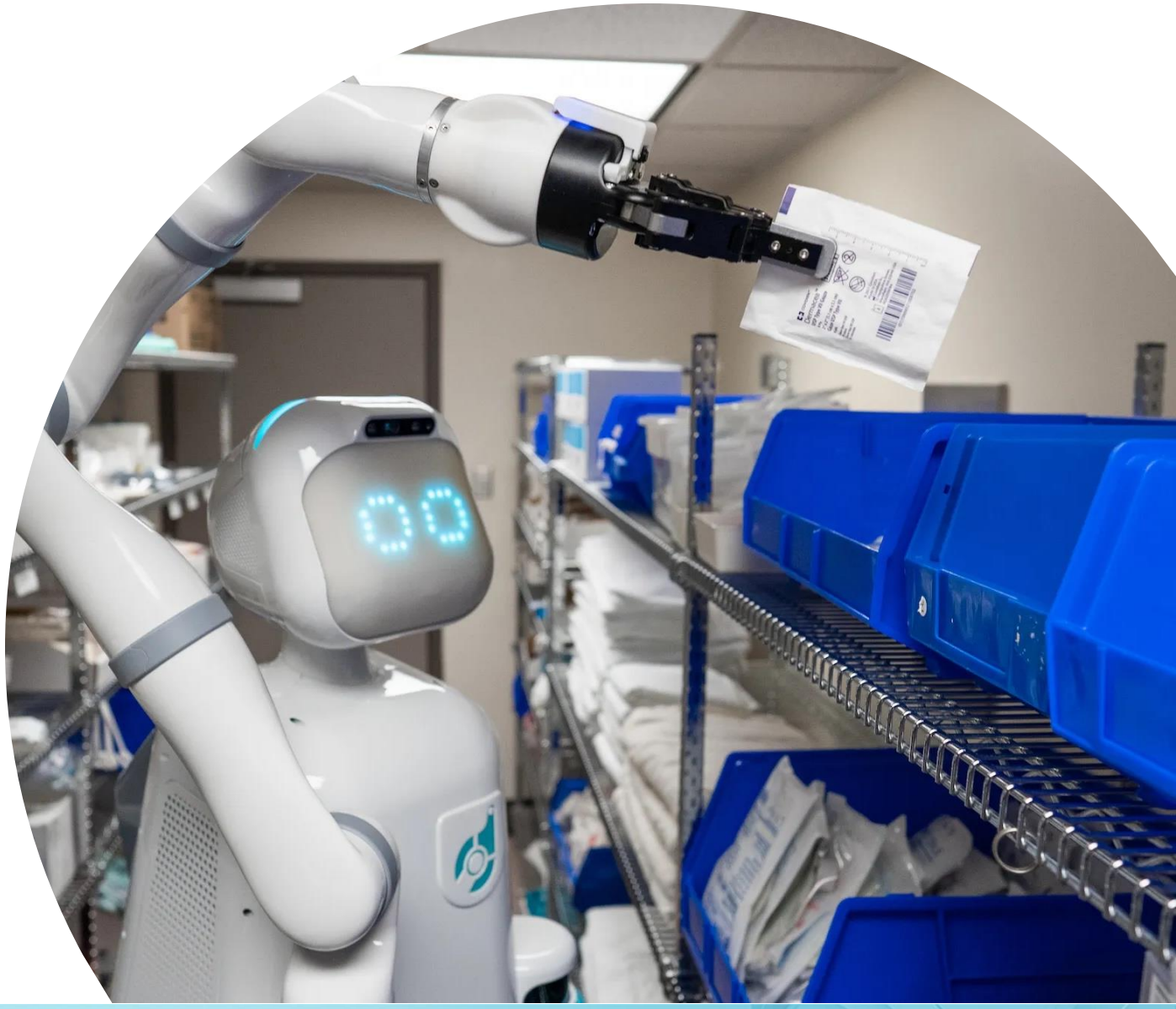





Anatomy identification
Surgical education
Instrument identification
Opportunities
ID of appropriate incision line
Surgical phase prediction
Prediction of surgery time

Question

Are you interested to implement a system that guarantees all necessary procedure instruments are always available in the OR?



Computer visioning can identify supplies inside the OR and predict levels of use depending on the procedure stage. Robots deliver supplies directly to the OR.

Question

Are you looking for a solution to completely eliminate retained surgical items in all procedures?

Real-time instrument identification can count instruments used in the OR and provide feedback.

Question

Save time by having AI develop a draft of your procedure narrative.

Use integrated audio and video recognition feeds during a procedure to develop a procedure summary narrative.

Question

Would you like to keep families informed during the procedure?

Video database correlation can identify procedure milestones from real-time video stream and generate automated messages to patient's family during or after a procedure.

Question

Do you want to implement a quality assurance system for procedure incisions?

Use a database to generate a training model that can help guide surgery or provide corrective course.

Question

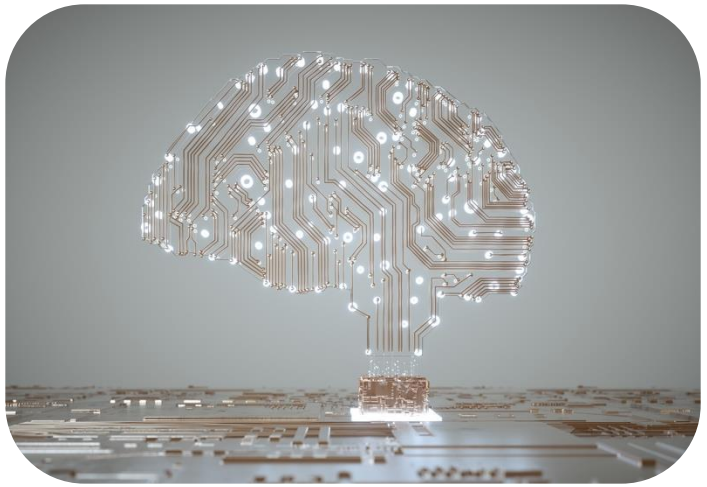
Would you benefit from a Real-time deep-learning model capable of detecting stress-induced movements during surgical procedures?

Use fatigue identifying software to make users aware of stressed-induced movements.

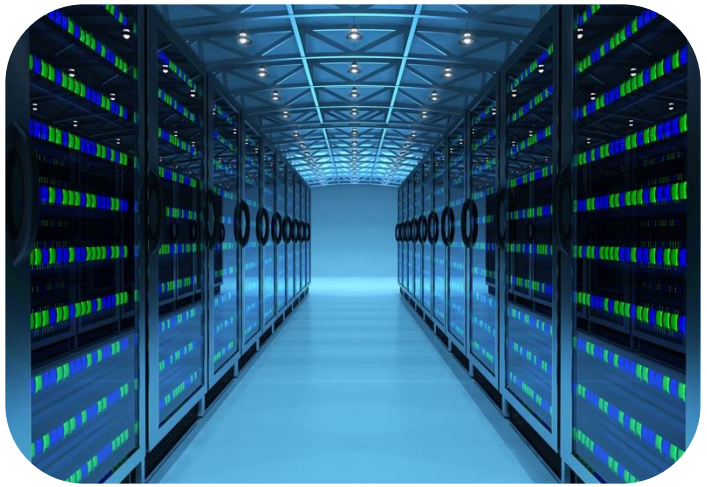
Tomorrow’s Potential

AI’s Role in the
O.R. of the Future

A.I.



The Good



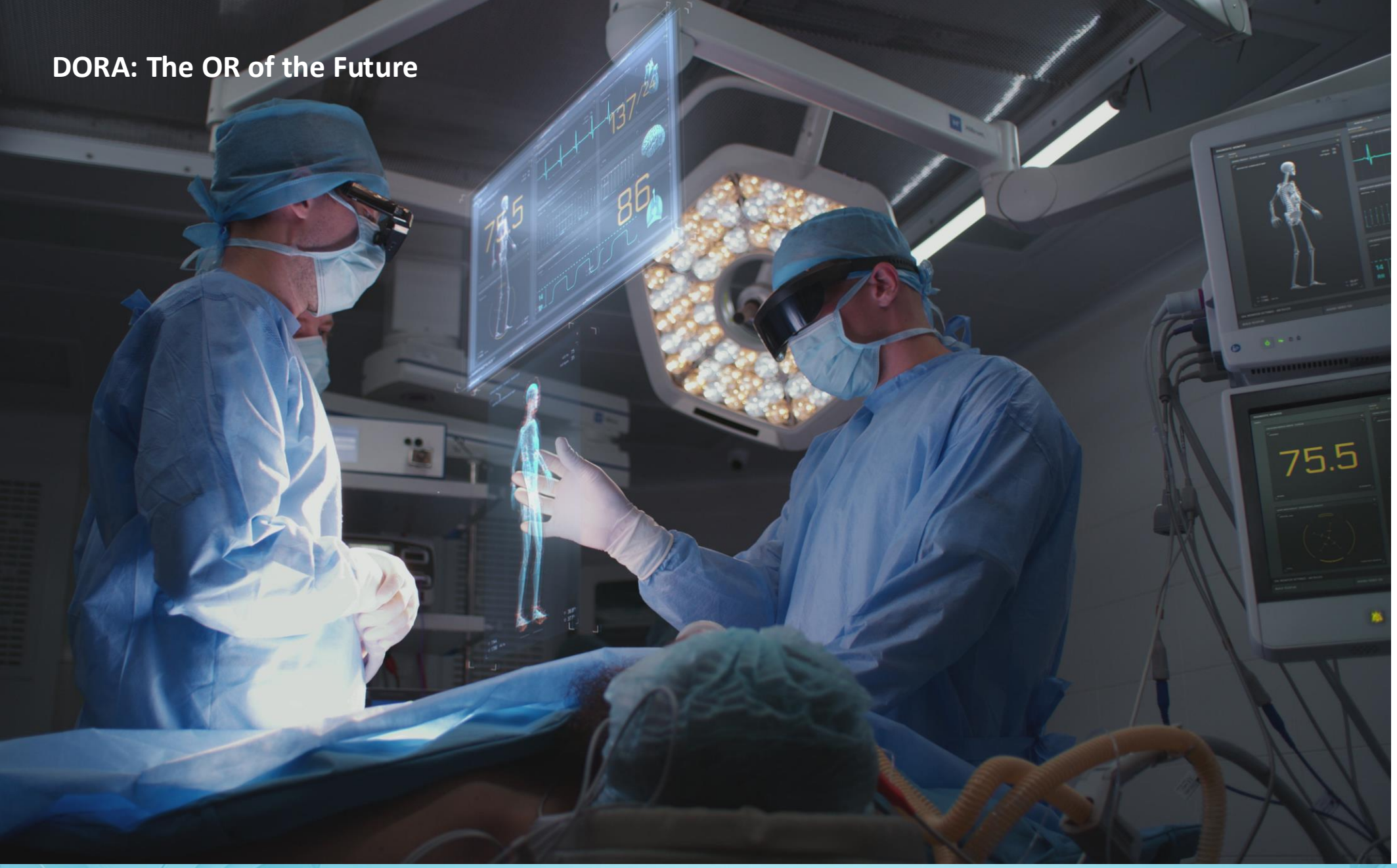
The Bad

The Ugly

AI Layers

- Machine Learning
- Deep Learning
- Natural Language Processing
- Convolutional Neural Networks
- Math Optimization models
- Computer visioning

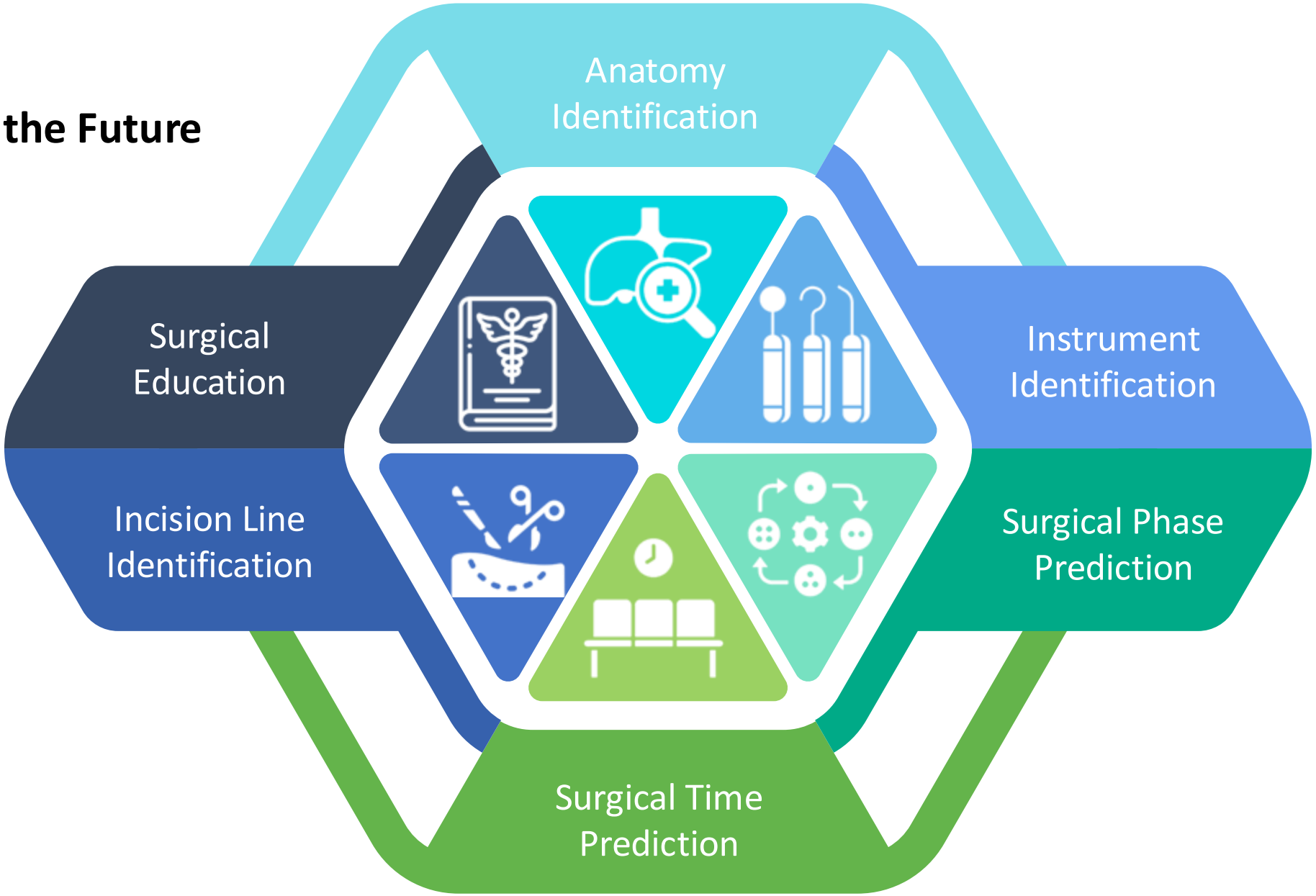
DORA: The OR of the Future



0
TODAY

+ 26
years

D.O.R.A.
The OR of the Future



Dr Lang, one of the cotton balls used in Phase 3 was not observed to be removed. Please check your procedure field.

Q: You can say ignore or review later
A: Review later!
Ok, I'll remind you later in sub-phase 4-e

Resource: [Minimization of occurrence of retained surgical items using machine learning and deep learning techniques: a review | BioData Mining | Full Text (biomedcentral.com)]

Dr. Smith, we have optimized your surgery instrument tray based on historical data for this procedure.

- Q: If you would prefer to have on standby the additional instruments you had in your instrument request form that SPD has on file, I can do that, this will not affect billing and instruments will be returned if not used. You can say: Yes or No.
- A: Yes!

Resource: Optimizing the surgical instrument tray to immediately increase efficiency and lower costs in the operating room - PubMed (nih.gov)

Dr. Joy you are in Phase 6 out of 7 of this procedure.

- Q: Would you like me to start the surgery dictation narrative for your review later? You can say: Yes or No
- A: Yes!

- Hey, DORA, summarize my procedure progresses for my review later!

Resource: Kaiser Permanente, doctor's visits automatic patient visit summary. https://www.denverpost.com/2024/08/26/kaiser-permanente-colorado-ai-recording/

Dr. Jane you are in your next phase of the surgery for little Tom, we sent a message to the family to let them know all is going according to plan.

- Q: Would you like me to send message or hold for the moment?
- A: Send Message!

- Hey, DORA, send a message to the family after each procedure phase is complete!

Resource: Advancements in Deep Learning for Minimally Invasive Surgery: A Journey through Surgical System Evolution https://doi.org/10.60087/jaigs.vol4.issue1.p120

Dr. Jones according you the surgery records the incision performed needs to be larger to access the left side of the tumor. Do you want me to help with that?

- Q: You can say: Project proposed incision on patient or show larger graphic on the screen. Which would you like?
- A: Project proposed incision on patient!

- Hey, DORA, show me a larger graphic of next Phase!

Resource: [Implementation of virtual reality in healthcare: a scoping review on the implementation process of virtual reality in various healthcare settings - PMC (nih.gov)]

Hello McClain, welcome to your first surgery. You are in Phase 1 of this procedure. I noticed that your movements are stress-induced, would you like me to make any adjustments to the operating environment?

- Q: You can say play my radio station, change the theme of the screens to biophilic scenes or switch to green lighting for better field of view. Which would you like?
- A: Play my radio station

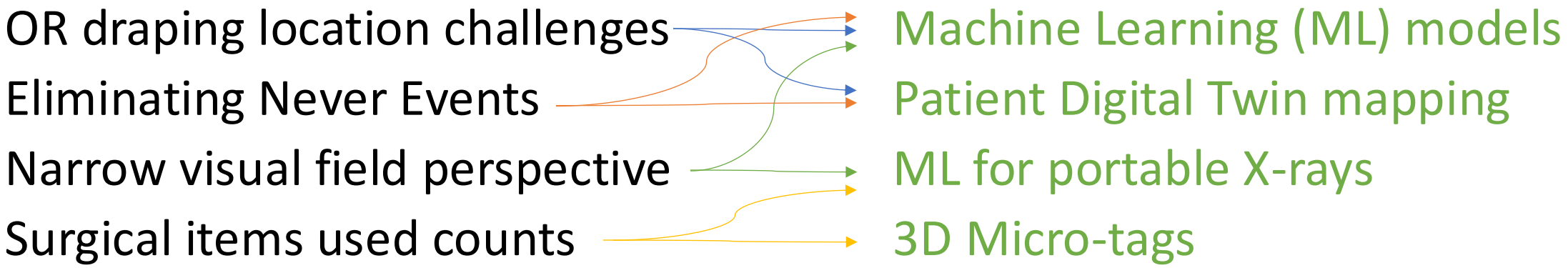
- Hey, DORA, play the patient's radio station!

Resource: [Listening to music reduces pain and anxiety for patients having surgery (nihr.ac.uk)]

Robots in Healthcare

Moxi delivering solutions at the point of care.

O.R. infrastructure challenges Response



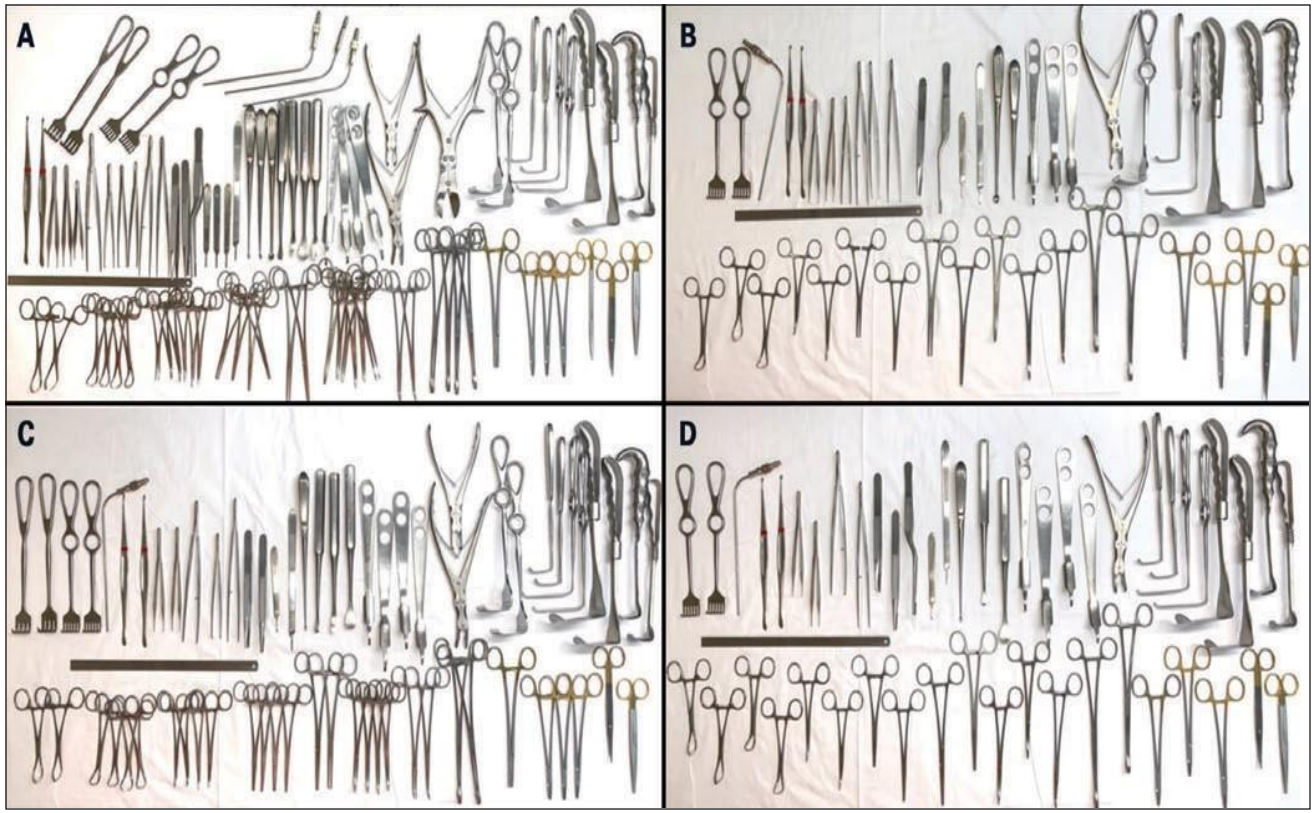
Surgery Tray optimization implementation

$$Q = m + z \times \sigma$$

m = the mean utilization of that instrument over the surgeries observed

z = the service level (number of standard deviations from the mean)

σ = the standard deviation of utilization



Resource: [Optimizing the surgical instrument tray to immediately increase efficiency and lower costs in the operating room - PubMed (nih.gov)]

Dictation and messaging applications

Here and now in your doctor's office

Here and now patient messaging (but also housekeeping, PACU teams…)

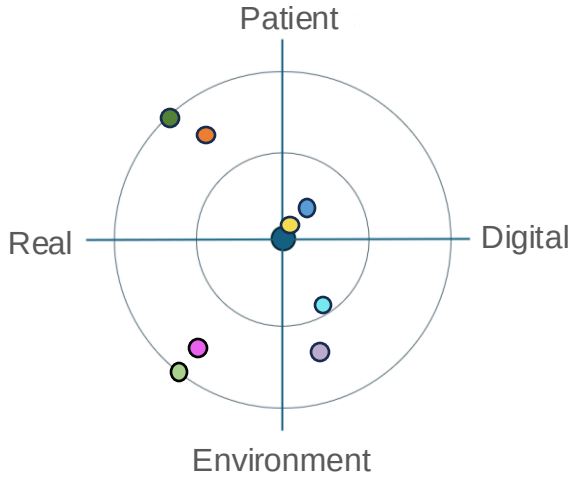
O.R. Augmented Reality

Philips technology for minimally invasive procedures in Europe

Azurion + Microsoft HoloLens 2


A
B
A
B

Improving the Journey



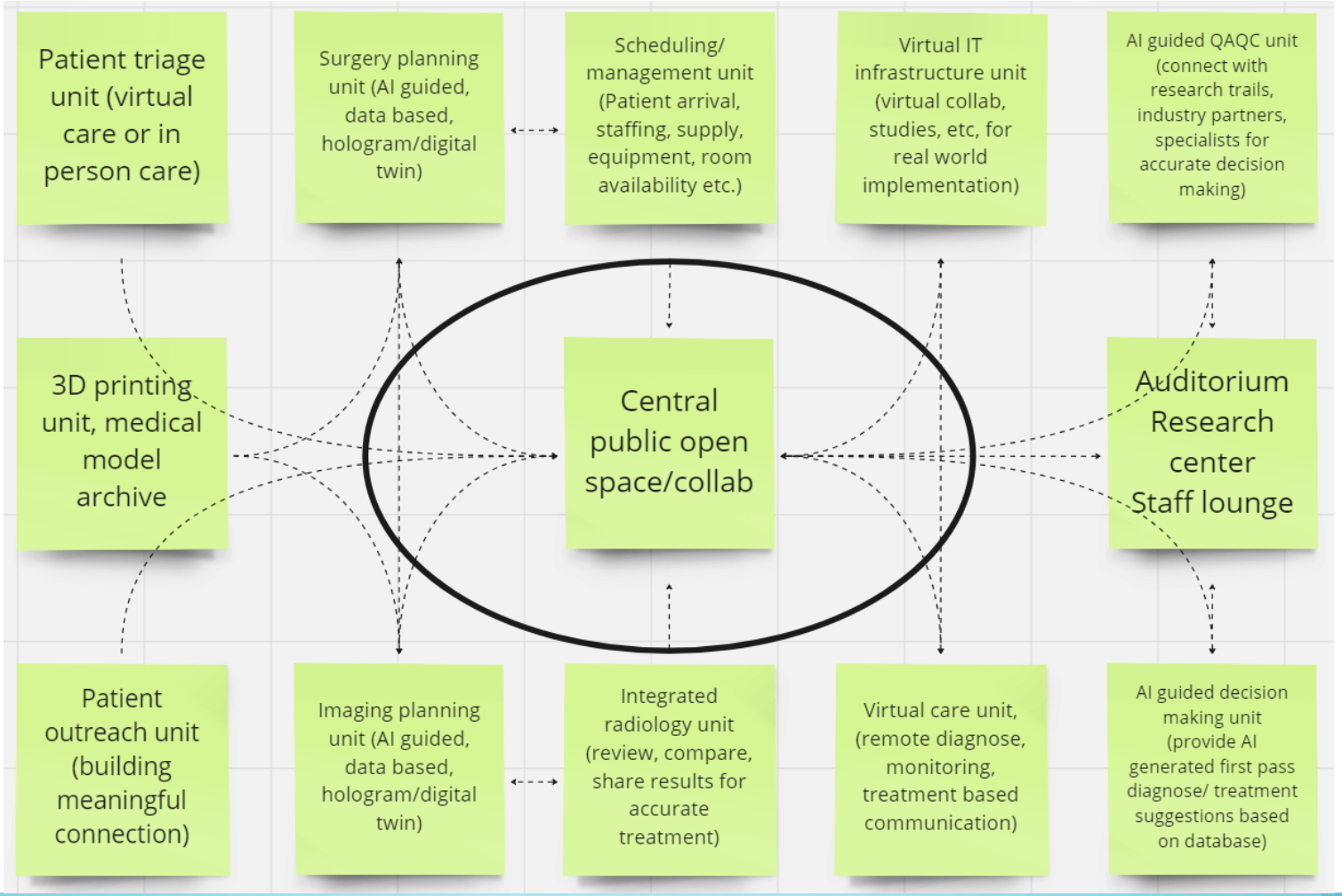
Patient impact

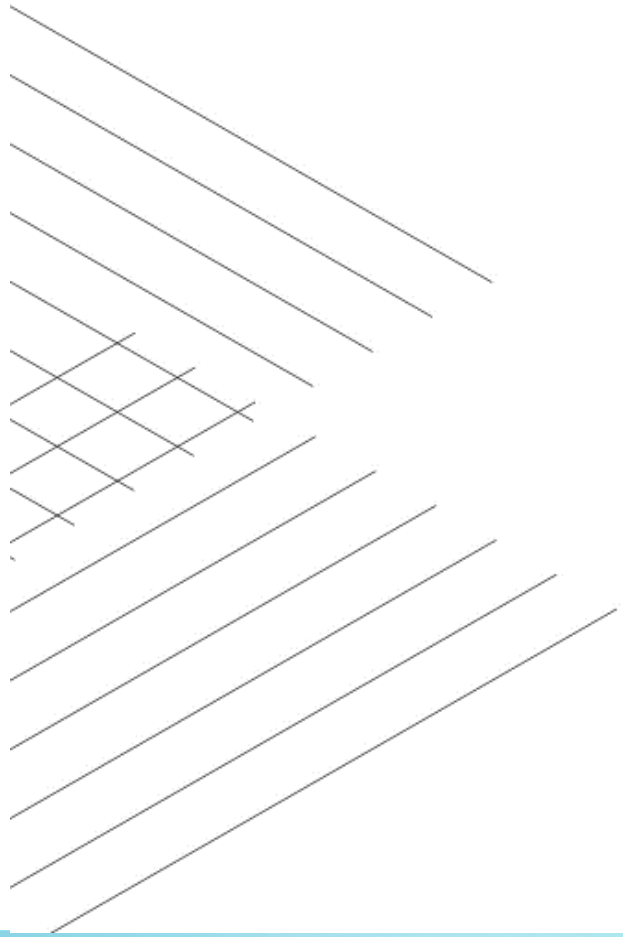
Patient modellig
Staff Management
Data Analytics
Surgical Decision making

Diagnostics | Interdisciplinary Board | Admission | Preparation | Surgery | Recovery | Rehabilitation

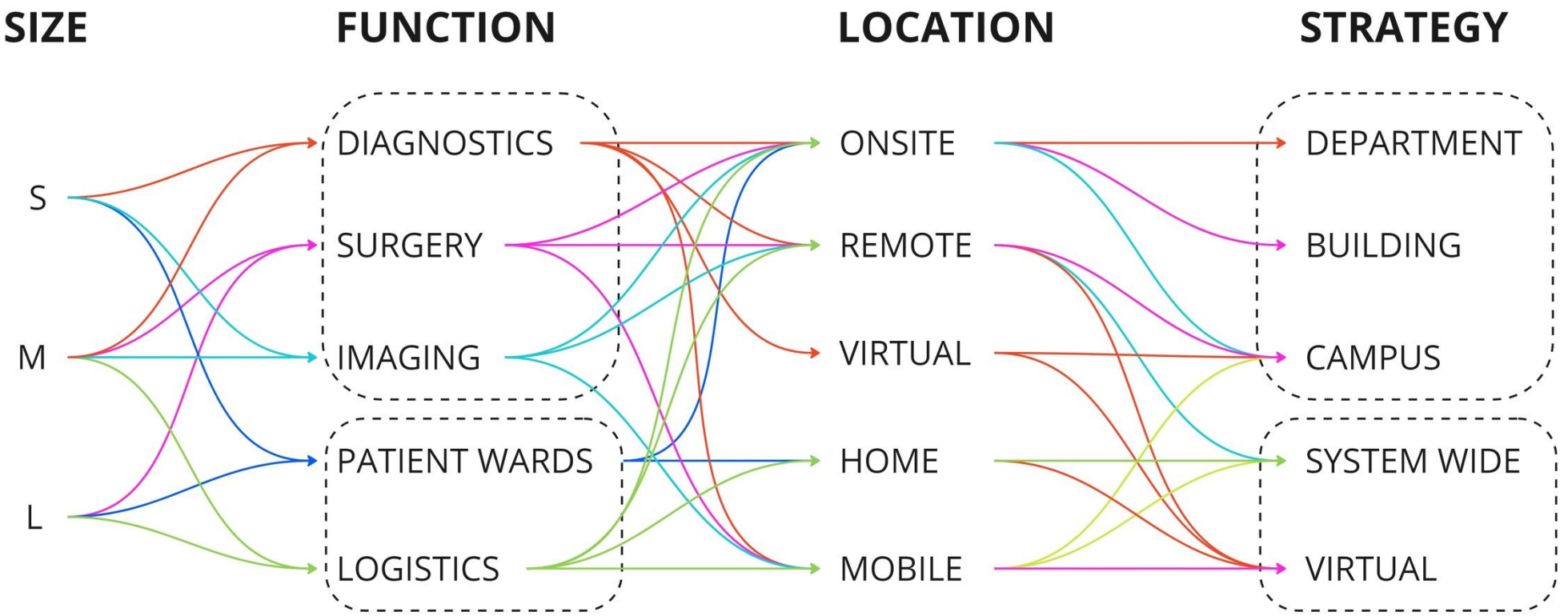
Supply Management
Device Management
Spatial Ressource Management
Sustainability Control

Tomorrow's Potential

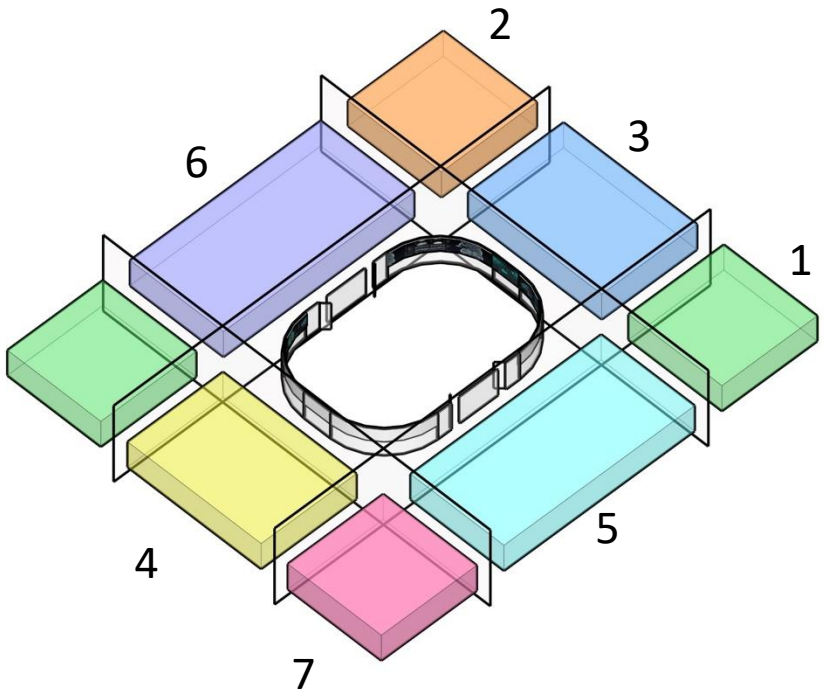




Central Command Suite Ecosystem



Interior ideas



1. Staff management
2. Surgical decision making
3. Patient modeling
4. Data analytics
5. Sustainability control
6. Spatial resource management
7. Supply management
8. Device management

Spatial Resource Management

Scan QR code for 360-degree tour

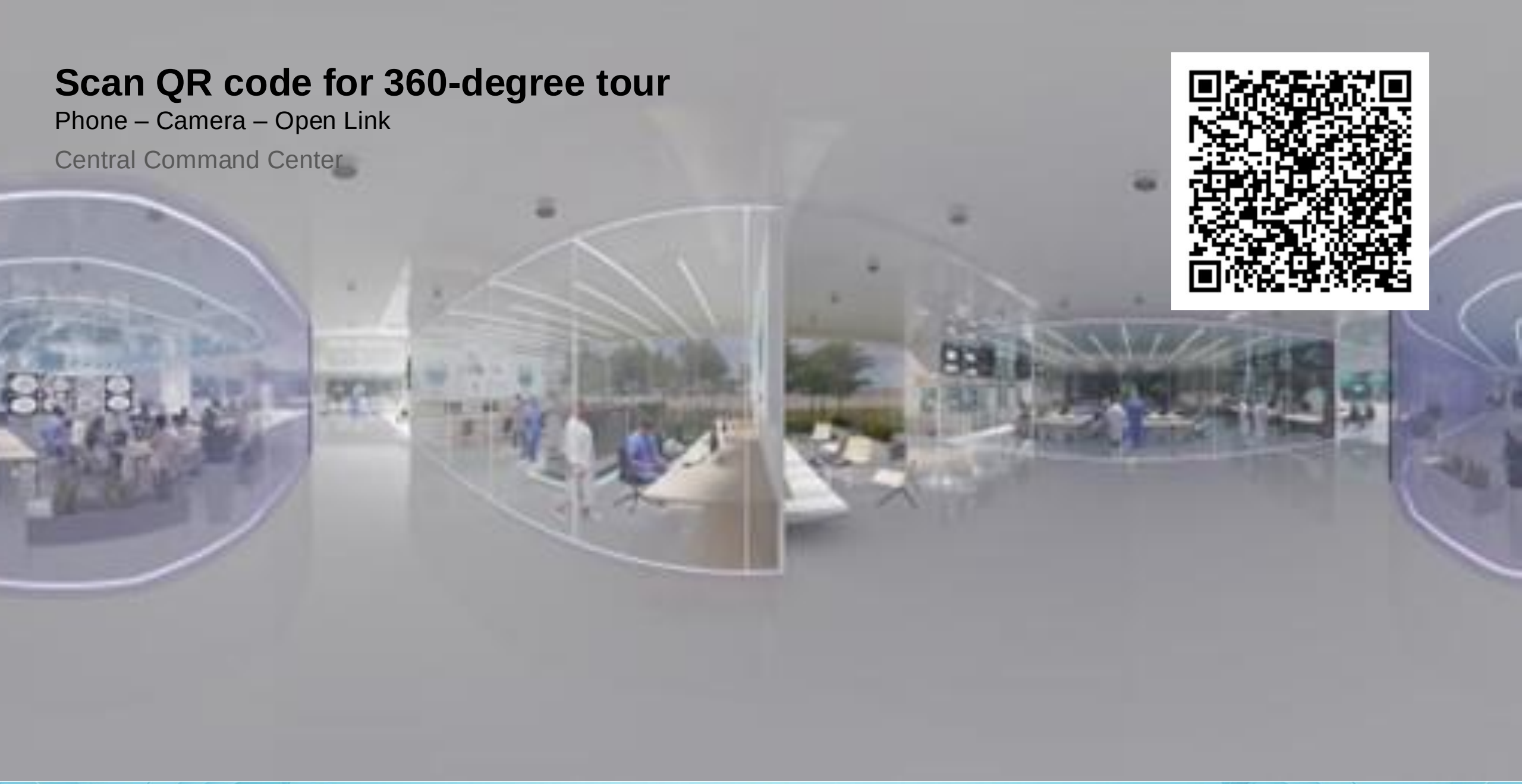
Phone – Camera – Open Link

Central Oval

Scan QR code for 360-degree tour

Phone – Camera – Open Link

Central Command Center



Layers of Implementation outside of the O.R.

Sandbox Phase

Implement AI Analytics

AI-based Health System Partnership

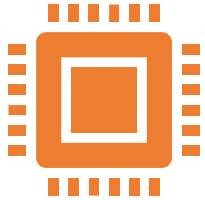
Key takeaways

Take the first steps towards implementation

Identify specific areas within your organization where AI technology can be effectively applied

Start with small-scale pilot projects

Consider integration capabilities, scalability, ongoing support, and cost



Consider allocating spaces for technology infrastructure hubs

New program pieces, such as Central Command Suite, to harness the power of AI for now and the future

AI Layers Resources

- Machine Learning: Comparative validation of machine learning algorithms for surgical workflow and skill analysis with the HeiChole benchmark - ScienceDirect
- Deep Learning: Minimization of occurrence of retained surgical items using machine learning and deep learning techniques: a review | BioData Mining | Full Text (biomedcentral.com)
- Natural Language Processing: LapTool-Net: A Contextual Detector of Surgical Tools in Laparoscopic Videos Based on Recurrent Convolutional Neural Networks
- Convolutional Neural Networks: Methods and datasets for segmentation of minimally invasive surgical instruments in endoscopic images and videos: A review of the state of the art - ScienceDirect
- Math Optimization models: Optimizing the surgical instrument tray to immediately increase efficiency and lower costs in the operating room - PubMed (nih.gov)
- Computer visioning: Computer vision (advisory.com)

Thank you!

Alexandra-Laura Andrei RA, NCARB, EDAC, Lean Practitioner

She/Her

E aandrei@cannondesign.com

T 703.350.4874

M 561.287.9595